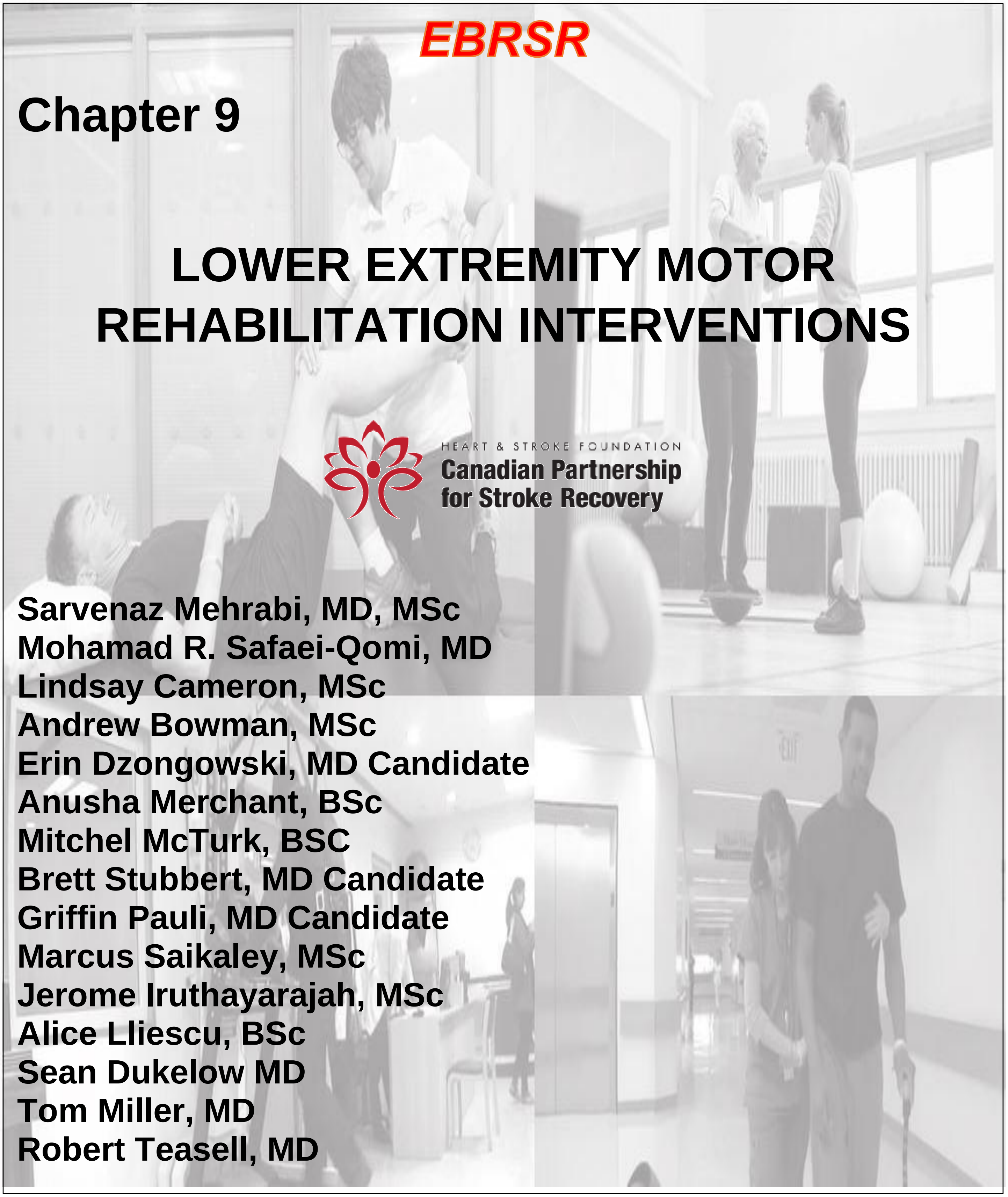

EBRSR

Chapter 9

LOWER EXTREMITY MOTOR REHABILITATION INTERVENTIONS

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Key Points (21st edition)

BCA may not be beneficial for improving functional ambulation, functional mobility, balance, and stroke severity after stroke when compared to conventional therapy.

BCA may be beneficial for improving gait, quality of life, and range of motion after stroke.

The literature is mixed regarding the effect of BCA on improvement of activities of daily living after stroke.

Early BCA may be beneficial for improving functional mobility and balance after stroke when compared to late BCA.

When comparing BCA and motor relearning programs, they may not have beneficial effect in motor function, functional ambulation, balance, spasticity, proprioception, activities of daily livings, and quality of life after stroke over each other.

Sit-to-stand training may be beneficial for improving gait and muscle strength, but not functional ambulation.

Sit-to-stand training with asymmetrical foot position may be beneficial for improving balance.

The Neater Uni-wheelchair may be beneficial for improving motor function and activities of daily living.

Encouraging self-propelling may not be beneficial for improving activities of daily living, quality of life, and spasticity after stroke when compared to discouraging self-propelling.

Trunk training may be beneficial for improving motor function, functional ambulation, balance, and quality of life after stroke.

The literature is mixed regarding the effect of trunk training on improvement of gait, functional mobility, range of motion, and proprioception after stroke.

Trunk training may not be beneficial for improving stroke severity, and spasticity of lower limb after stroke.

Task-specific training may be beneficial for improving gait and proprioception after stroke.

The literature is mixed regarding the effectiveness of task-specific training for improving balance, range of motion, muscle strength, stroke severity, and spasticity after stroke.

The literature regarding the effectiveness of task-specific training for improving motor function and functional ambulation after stroke is mixed and depends on the task components and modalities.

Task-specific training may not be beneficial for improving functional mobility, activities of daily living, and quality of life after stroke.

CIMT may be beneficial for improving muscle strength and spasticity following stroke.

CIMT may not be beneficial for improving motor function, functional ambulation, balance, and functional following stroke.

The literature is mixes regarding the effect of CIMT on gait and quality of life following stroke.

The literature is mixed regarding the effect of overground walking/gait training on improvement of motor function, functional ambulation, balance, activities of daily living, and quality of life.

Overground walking/gait training may not be beneficial for improving muscle strength following stroke.

Overground walking/gait training may be beneficial for improving gait following stroke when compared to conventional therapy but may not be beneficial when compared to different gait modalities.

Cycle ergometer training may be beneficial for improving motor function, functional mobility, gait, and muscle strength after stroke.

Cycle ergometer training may be beneficial for improving functional ambulation when compared to conventional treatment after stroke, but the literature is mixed regarding the effect of cycle ergometer training with different modalities and combination.

The literature is mixed regarding the effect of cycle ergometer training on balance improvement after stroke.

Cycle ergometer training may not be beneficial for improving activities of daily living, spasticity, and quality of life after stroke.

Treadmill training may not be beneficial in improving motor function, functional mobility, activities of daily living, range of motion, muscle strength, spasticity, stroke severity, proprioception, and quality of life after stroke.

The literature is mixed regarding treadmill training for improving gait and functional ambulation and the effect depends on the modality, duration, and combination to other interventions.

Bodyweight shift techniques may be beneficial for improving functional ambulation and gait after stroke.

Range of motion exercises may be beneficial for improving activities of daily living and range of motion after stroke.

Custom exercise programs, early rehabilitations trainings, and exercise trainings with higher intensity and duration may not be beneficial in improving activities of daily living, quality of life, muscle strength, spasticity, stroke severity, and muscle strength after stroke.

Balance focused exercise training may not be beneficial for improving motor function activities of daily living, spasticity, muscle strength, stroke severity, proprioception, and functional mobility after stroke.

Balance training with visual feedback may not be beneficial for improving functional ambulation, balance, and activities of daily living compared to balance training alone or conventional treatment.

The literature is mixed concerning the effect of balance focused exercise training in improving functional ambulation, gait, balance, and quality of life after stroke, and the effect varies by combination of balance training with other interventions.

Galvanic vestibular rehabilitation may not be beneficial for improving balance after stroke.

The literature is mixed concerning the effect of dynamic stretching in improving motor functions, balance, gait, range of motion, muscle strength, and spasticity after stroke.

Dynamic stretching may not be beneficial in improving quality of life, functional mobility, stroke severity, and activities of daily living after stroke.

Ankle-foot orthoses (chignon, dynamic, plantar stoop) may not be beneficial in post stroke lower extremity rehabilitation.

Hippotherapy may be beneficial for improving balance, quality of life, and activities of daily living, while the literature is mixed regarding hippotherapy for improving functional ambulation and gait following stroke.

Combining different types of biofeedback with rehabilitation training may not be beneficial in improving functional mobility, activities of daily living, range of motion, muscle strength, proprioception, and quality of life after stroke.

The literature is mixed regarding the effect of different types of biofeedback combined with rehabilitation trainings on improving motor function, functional ambulation, balance, gait, and spasticity after stroke, and the effect is widely dependent on the type of biofeedback and the type of training.

The literature is mixed regarding the effect of dual task training on functional ambulation, functional mobility, balance, and gait after stroke.

Dual task training may not be beneficial in improving motor function, muscle strength, activities of daily living, and quality of life.

The literature is mixed regarding mental practice combined with different types of physical therapy (task-specific training, conventional therapy, gait training) for improving functional ambulation, balance, gait, and muscle strength after stroke.

Motor imagery and mental practice may not be beneficial in improving motor function, functional mobility, activities of daily living, spasticity, and quality of life after stroke.

Motor imagery may be beneficial in improving proprioception after stroke.

Action observation with gait or treadmill training may be beneficial for improving functional ambulation, balance, and gait.

Mirror therapy may be helpful in improving motor function, balance, and activities of daily living compared to conventional treatment after stroke.

The literature is mixed regarding the effect of mirror therapy on functional ambulation and gait after.

Mirror therapy may not be beneficial for improving spasticity, proprioception, and quality of life after stroke.

The literature is mixed regarding the effects of aquatic therapy for improving motor function, functional ambulation, balance, gait, and spasticity after stroke.

Aquatic therapy may not be beneficial for improving functional mobility, muscle strength, and activities of daily living after stroke.

Aquatic therapy may be beneficial for improving proprioception.

The literature is mixed regarding strength and resistance training for motor function, functional ambulation, balance, gait, and quality of life after stroke.

Strength and resistance training may be helpful for improving muscle strength after stroke.

Strength and resistance training may not be beneficial for improving spasticity after stroke.

Rhythmic auditory stimulation combined with treadmill training or gait training may be helpful in improving functional ambulation and gait.

Respiratory muscle training and continuous positive airway pressure may not be beneficial in stroke management to improving any of the outcomes after stroke.

Home-based physiotherapy and exercise programs may not be beneficial in improving any of the post-stroke outcomes when compared to conventional rehabilitation.

Caregiver-mediated programs may be beneficial in improving motor function and balance, but not other outcomes after stroke.

Nursing-mediated programs may be beneficial in improving motor function, activities of daily living, stroke severity, and quality of life.

Home-based telerehabilitation programs may not be beneficial in improving any of the post-stroke outcomes when compared to conventional rehabilitation and treatments.

The literature is mixed with respect to the effect of virtual reality training on functional ambulation, balance, and gait.

Virtual reality training may not be beneficial in improving activities of daily living.

Virtual reality with treadmill training may be helpful in improving balance and functional ambulation.

End-effector assisted gait training may not be beneficial for improving motor function, functional ambulation, functional mobility, gait, balance, activities of daily living, spasticity, stroke severity, and muscle strength after stroke, when compared to conventional gait training.

End-effector assisted gait training combined with functional electrical stimulation or virtual reality may be beneficial in improving motor function, functional mobility, gait, balance, range of motion, and muscle strength after stroke, when compared to conventional gait trainings.

Exoskeleton systems may not be beneficial for improving motor function, functional ambulation, functional mobility, gait, balance, activities of daily living, spasticity, and muscle strength after stroke, when compared to conventional overground gait trainings.

The literature is mixed concerning the effect of functional electrical stimulation on improving motor function, functional ambulation, balance, gait, range of motion, muscle strength, and spasticity. The effect is varied by the type of intervention combined with functional electrical stimulation.

Functional electrical stimulation may not be beneficial for improving mobility and quality of life after stroke.

NMES may not be beneficial for improving motor function, functional ambulation, gait, activities of daily living, and quality of life after stroke.

The literature is mixed regarding the effect of NMES on improving mobility, balance, muscle strength, range of motion and spasticity after stroke.

TENS may be beneficial for improving balance and gait after stroke.

The literature is mixed concerning the effect of TENS on improving motor function, activities of daily living, range of motion, spasticity, proprioception, and muscle strength after stroke.

TENS may not be beneficial for improving functional ambulation, mobility, and quality of life after stroke.

Whole-body vibration may not be beneficial for improving motor function, mobility, balance, functional ambulation, gait, activities of daily living, spasticity, and quality of life after stroke.

The literature is mixed regarding the effect of whole-body vibration on improving muscle strength, and range of motion.

Electrical stimulation with mirror therapy may be beneficial for improving functional ambulation, balance, and muscle strength after stroke.

Photobiomodulation therapy may be beneficial for improving functional ambulation and balance after stroke.

Tactile and peroneal nerve stimulation may not be beneficial for improving functional ambulation after stroke.

The literature is mixed concerning the effects of remote ischemic conditioning on improving functional ambulation and muscle strength after stroke.

Remote ischemic conditioning may not be beneficial for improving activities of daily living after stroke.

Thermal stimulation may be beneficial for improving motor function, and muscle strength after stroke.

The literature is mixed concerning the effect of thermal stimulation on improving functional ambulation, activities of daily living, spasticity after stroke.

Thermal stimulation may not be beneficial for improving mobility and balance after stroke.

Cryotherapy may be beneficial for improving range of motion and spasticity after stroke.

Cryotherapy may not be beneficial for improving muscle strength, fait, and proprioception after stroke.

The literature is mixed concerning the effect extracorporeal shockwave therapy on improving motor function, balance, activities of daily living, and spasticity after stroke.

Extracorporeal shockwave therapy may not be beneficial for improving functional ambulation, range of motion after stroke.

Therapeutic ultrasound may not be beneficial for improving motor function, functional ambulation, activities of daily living, range of motion, muscle strength, and spasticity after stroke.

Repetitive peripheral magnetic stimulation may be beneficial for improving muscle strength after stroke.

Repetitive peripheral magnetic stimulation may not be beneficial for improving range of motion after stroke.

High frequency rTMS may be beneficial for improving balance after stroke.

High frequency rTMS may be beneficial for improving stroke severity after stroke.

The literature is mixed concerning the effect of high frequency rTMS on improving motor function, functional ambulation, activities of daily living, muscle strength after stroke.

Low frequency rTMS may be beneficial for improving gait, muscle strength, and stroke severity.

The literature is mixed concerning the effect of low frequency rTMS on improving motor function, functional ambulation, balance, activities of daily living after stroke.

The literature is mixed concerning the effect of TBS on improving balance after stroke.

Peripheral TBS may be beneficial for improving spasticity after stroke.

TBS may not be beneficial for improving motor function, functional ambulation, gait, and activities of daily living after stroke.

tDCS may not be beneficial in improving motor function, functional ambulation, mobility, gait, activities of daily living, muscle strength, spasticity, and stroke severity after stroke.

tDCS combined with other interventions may be beneficial for improving motor function and functional ambulation after stroke.

The beneficial effect of tDCS is varied by the modality and intensity. For detailed information, see table 41.

The use of antidepressants may be beneficial for improving motor function.

The literature is mixed regarding use of antidepressants for improving activities of daily living after stroke.

The use of antidepressants may not be helpful in improving functional ambulation, muscle strength, quality of life, and stroke severity after stroke.

Vasodilators may be beneficial for improving motor function after stroke, with no beneficial effect for improving other post-stroke outcomes.

Long-term edaravone may be beneficial for improving functional ambulation and muscle strength compared to short term use.

Edaravone may be beneficial for improving motor function, activities of daily living, and stroke severity compared to standard treatment.

Stimulants may not be beneficial for improving motor function, functional ambulation, functional mobility, activities of daily living, quality of life, and stroke severity after stroke.

Levodopa may be beneficial for improving stroke severity.

Levodopa and Ropinirole may not be beneficial for improving outcomes after stroke.

Nerve block agent intervention may not be beneficial for improving post-stroke outcomes, except for spasticity.

Botulinum Toxin A may be beneficial for improving motor function, spasticity, and quality of life.

The literature is mixed regarding the effect of botulinum Toxin A on activities of daily living and range of motion.

Botulinum Toxin A adjuvant to rehabilitation physical trainings or electrical stimulations may be beneficial for improving balance, functional ambulation, and gait.

Higher doses of Botulinum Toxin A may be beneficial for improving functional ambulation.

The literature is mixed regarding the modalities, location and intensity of treatment of Botulinum Toxin A for improving other lower extremity outcomes after stroke. For more details, please see table 48.

The literature is mixed regarding antispastic drug intervention for improving functional ambulation, and muscle strength after stroke.

antispastic drugs may not be beneficial for improving activities of daily living after stroke.

Some antispastic drugs (not Tizanidine) may be beneficial for improving spasticity. For more details about the types of drugs, please see table 49.

Cerebrolysin may not be beneficial for improving motor function.

4-aminopyridine may not be beneficial for improving functional ambulation.

Cutamesine may not be beneficial for improving functional ambulation, activities of daily living, and stroke severity after stroke.

Ganglioside GM1 may not be beneficial for improving motor function, and activities of daily living after stroke.

Neuronal cells may not be beneficial for improving motor function, stroke severity, and quality of life after stroke.

Mesenchymal stem cell injections may not be beneficial for improving motor function, functional ambulation, activities of daily living, and muscle strength after stroke.

Granulocyte-colony stimulating factor may not be beneficial for improving activities of daily living and stroke severity after stroke.

Anabolic steroids may be beneficial for improving muscle strength after stroke.

Supplements may be beneficial for improving motor function and functional ambulation after stroke. For more details, please see table 54.

Acupuncture may be beneficial for improving balance, and range of motion after stroke, however the effect varied by the different modalities, for more details see table 55.

The literature is mixed regarding the use of acupuncture for improving motor function, functional ambulation, muscle strength, and spasticity after stroke.

Acupuncture may not be helpful for improving gait, activities of daily living, and stroke severity, and quality of life after stroke.

Meridian acupressure may be beneficial for improving balance and activities of daily living.

Electroacupuncture may be beneficial for improving stroke severity after stroke.

The literature is mixed regarding the effect of electroacupuncture for improving motor after stroke.

Electroacupuncture may not be beneficial for improving functional mobility, functional ambulation, spasticity, activities of daily living, spasticity, quality of life, and muscle strength.

NeuroAid may not be beneficial for improving motor function, activities of daily living, and stroke severity.

Other herbal medications such as Dihuang Yinzi, Shaoyao, Gancao, Astragalus Membranaceus, and Tokishakuyakusan may be beneficial for improving motor function, functional mobility, spasticity and activities of daily living, for more details, please see table 57.

Methodology

Modified Sakett Scale

Level of evidence	Study design	Description
Level 1a	Randomized controlled trial (RCT)	More than 1 higher quality RCT (PEDro score ≥6).
Level 1b	RCT	1 higher quality RCT (PEDro score ≥6).
Level 2	RCT	Lower quality RCT (PEDro score <6).
	Prospective controlled trial (PCT)	PCT (not randomized).
	Cohort	Prospective longitudinal study using at least 2 similar groups with one exposed to a particular condition.
Level 3	Case Control	A retrospective study comparing conditions, including historical cohorts.
Level 4	Pre-Post	A prospective trial with a baseline measure, intervention, and a post-test using a single group of subjects.
	Post-test	A prospective post-test with two or more groups (intervention followed by post-test and no re-test or baseline measurement) using a single group of subjects
	Case Series	A retrospective study usually collecting variables from a chart review.
Level 5	Observational	Study using cross-sectional analysis to interpret relations. Expert opinion without explicit critical appraisal, or based on physiology, biomechanics or "first principles".
	Case Report	Pre-post or case series involving one subject.

1) PICO conclusion statements

This edition of Chapter 9: Lower extremity motor rehabilitation interventions, synthesizes study results from only randomized controlled trials (RCTs), all levels of evidence (LoE) and conclusion statements are now presented in the Population Intervention Comparator Outcome (PICO) format.

For example:

Population: Stroke survivors

Intervention **Comparator**

SPASTICITY			
LoE	Conclusion Statement	RCTs	References
1b	**Bilateral arm training** may not have a difference in efficacy when compared to **TENS** for improving spasticity.	1	Stinear et al. 2014

Outcome

New to these statements is also the use of colours where the levels of evidence are written.

Red statements like above, indicate that the majority of study results when grouped together show no significant differences between intervention and comparator groups.

Green statements indicate that the majority of study results when grouped together show a significant between group difference in favour of the intervention group.

For example:

Population: Stroke survivors

Intervention

MOTOR FUNCTION			
LoE	Conclusion Statement	RCTs	References
1a	**Bilateral arm training** may produce greater improvements in motor function than **conventional therapy**.	4	Meng et al. 2018; Lee et al. 2017; Stinear et al. 2008; Desrosiers et al. 2005

Outcome **Comparator**

Yellow statements indicate that the study results when grouped together are mixed or conflicting, some studies show benefit in favour of the intervention group, while others show no difference between groups.

For example:

Population: Stroke survivors

Outcome **Intervention**

DEXTERITY			
LoE	Conclusion Statement	RCTs	References
1a	There is conflicting evidence about the effect of **CIMT** to improve dexterity when compared to **conventional therapy or motor relearning programmes** during the acute/subacute phase poststroke.	4	Shah et al. 2016; Yoon et al. 2014; Boake et al. 2007; Ro et al. 2006

Comparator

2) Lower extremity rehabilitation outcome measures

Outcome measures were classified into the following broad categories:

Motor function: These outcome measures covered gross motor movements and a series of general impairment measures when using the upper extremities.

Activities of daily living: These outcome measures assessed performance and level of independence in various everyday tasks.

Spasticity: These outcome measures assessed changes in muscle tone, stiffness, and contractures.

Range of motion: These outcome measures assessed a patient's ability to freely move their upper extremity through flexion, abduction, and subluxation movements for instance, both passively and actively.

Proprioception: These outcome measures assessed sensory awareness about one's body and the location of limbs.

Stroke severity: These outcome measures assessed the severity of one's stroke through a global assessment of a multitude of deficits a stroke survivor may experience.

Muscle strength: These outcome measures assessed muscle power and strength during movements and tasks.

Functional ambulation: These outcomes measures assessed ambulatory abilities during distance-based or timed walking exercises commonly.

Balance: These outcome measures assessed postural stability, and both static and dynamic balance

Functional Mobility: These outcome measures assessed a person's ability to move around their environment, from one position or place to another, to complete everyday activities or tasks.

Gait: These outcome measures assessed various phases of the gait cycle.

Outcome measures that fit these categories are described in the next few pages.

Outcome Measures Definitions

The most common outcome measures are defined in each category and listed in descending order according to the frequency of use in the literature, which may change through time. The outcome measures used in the entire lower extremity rehabilitation RCTs are not limited to the following list.

Motor Function

Brunnstrom Recovery Stages (BRS): Is a measure of motor function and muscle spasticity in stroke survivors. The measure contains 35 functional movements which are done with the guidance of a clinician (e.g. should abduction, shoulder adduction, leg flexion/extension). These movements are evenly divided into 2 sections: upper extremity and lower extremity. Each movement is then rated on a 6-point scale (1=Flaccidity is present, and no movements of the limbs can be initiated, 2=Movement occurs haltingly and spasticity begins to develop, 3=Movement is almost impossible and spasticity is severe, 4=Movement starts to be regained and spasticity begins to decline, 5=More difficult movement combinations are possible as spasticity declines further. 6=Spasticity disappears, and individual joint movements become possible). This measure has been shown to have good reliability and concurrent validity (Naghdi et al., 2010; Safaz et al., 2009).

Chedoke McMaster Stroke Assessment Scale: Is a measure of motor impairment and consists of an impairment inventory as well as an activity inventory. The score for the impairment inventory ranges from a minimum of 6 to a maximum of 42, with a higher score corresponding to less impairment (Gowland et al., 1993). The maximum score for the activity inventory is 100, with a higher score corresponding to normal function (Gowland et al., 1993). The assessment has demonstrated excellent test-retest reliability, inter-rater reliability, internal consistency, and validity (Gowland et al., 1993).

Fugl-Meyer Assessment (FMA): Is an impairment measure used to assess locomotor function and control of the upper and lower extremities, including balance, sensation, and joint pain in patients poststroke. It consists of 155 items, with each item rated on a three-point ordinal scale. The maximum motor performance score is 66 points for the upper extremity section, 34 points for the lower extremity section, 14 points for the balance section, 24 points for sensation section, and 44 points each for passive joint motion and joint pain section, for a maximum of 266 points that can be attained. The upper extremity section consists of four categories (Shoulder/Elbow/Forearm, Wrist, Hand/Finger, and Coordination) and includes 23 different movements which evaluate 33 items. The items are scored on a 3-point rating scale: 0=unable to perform, 1=partial ability to perform and 2=near normal ability to perform. The measure is shown to have good reliability and construct validity (Nilsson et al., 2001; Okuyama et al., 2018; Sanford et al., 1993; Villán-Villán et al., 2018).

Lindmark Motor Assessment: Is an assessment of functional capacity, it investigates the domains of active selective movements (31 items), rapid movement (four items), mobility (eight items), balance (seven items), sensation (13 items), joint pain (nine items), and passive range of motion (26 items). The measure has both good intra-rater and inter-rater reliability within an acute stroke population (Kierkegaard & Tollbäck, 2005).

Lower Extremity Motor Coordination Test: The test consists of moving the lower extremity as fast as possible from one target to another for 20 seconds. The number of on target touches constitutes the score. The measure has good construct validity and test-retest reliability (Desrosiers et al., 2005).

Rivermead Motor Assessment (RMA): Is a multi-faced measure that assesses gross motor function, leg and trunk movements and arm movements in post-stroke patients. The arm movements section consists of 15 items ranging from specific isolated movements (e.g. protracting shoulder girdle in supine position) to complex tasks (e.g. placing a string around the head and tying a bow at the back). Patients perform all movements actively, and dichotomous scores indicate either success (score 1) or failure (score 0). The measure is shown to have good test-retest reliability, content validity, and construct validity (Dong et al., 2018; Van de Winckel et al., 2007).

Sodring Motor Evaluation Scale (SMES): Is a measure of motor function and activities in patients with stroke. It is comprised of 3 subscales that evaluate the motor function of the upper and lower limb, and gross motor function. The first 2 subscales assess simple voluntary movements, while the third evaluates functional tasks including trunk movements, balance, and gait. The scale is comprised of 32 different items scored using a 5-point scale. The measure is shown to have good concurrent and construct validity, as well as good inter-rater reliability (Gor-García-Fogeda et al., 2014).

Upright Motor Control Test (UMCT): Is a measure of the functional strength for the lower extremities in stroke patients. This measure consists of 8 tasks which mainly consist of flexion and extension of the lower extremities (e.g. hip flexion/extension, knee flexion/extension, and ankle flexion/extension). These tasks are then evaluated on a 3-point ordinal scale (0=cannot complete task, 2=completes task as well as the unaffected side). This measure has been shown to have good reliability and validity (Gelisanga & Gorgon, 2019; Lunar et al., 2017).

Functional Ambulation

10-Metre Walk Test: Is a measure used to assess walking speed, in which participants are asked to walk a distance of 10m in a straight line at maximum walking speed. The time taken to perform the task is recorded, and maximum walking speed is reported in m/s. The test is shown to have high interrater and intrarater reliability in stroke (Druzbicki et al., 2018).

Timed Up & Go Test (TUG): Is a measure of the ability of a stroke patient to perform sequential motor tasks. This measure consists of 1 functional task which involves the patient standing up from a chair, walking 3 metres, turning around and sitting back down again. This task is then evaluated on a scale from 1 to 5 (1=normal function, 5=severely abnormal function). This measure has been shown to have good reliability and validity (Shumway-Cook et al., 2000; Steffen et al., 2002).

6-Minute Walk Test: Is a measure of walking endurance, in which the distance walked by participants in a straight line within 6 minutes is reported. The test is proven to be valid and reliable in stroke (Fulk et al., 2008).

Gait Speed: Is a measure that is influenced by stride length and cadence and can be used to assess hemiparesis or motor recovery post-stroke. Often, an individual's "comfortable" gait speed, and/or "maximal" gait speed are recorded and used for assessment (Olney & Richards, 1996).

Functional Ambulation Category: Is a measure of functional mobility in which participants are ranked on their walking ability with categories ranging from zero, indicating the inability to walk or the requirement of two people assisting, to a 5, corresponding to the ability to walk anywhere independently. This measure has demonstrated excellent test-retest reliability, interrater reliability, and excellent concurrent validity in an acute stroke population (Mehrholz et al., 2007).

Stair Climb Test (SCT): Is a measure of the amount of dynamic balance a stroke patient possesses, as well as their overall aerobic capacity. This measure is scored by having the patient ascend 4-9 stairs while they are being timed by a trained professional. The lower the time, the better the patient's dynamic balance and aerobic capacity. This measure has been shown to have excellent inter-rater and test-retest reliability, as well as good validity (Almeida et al., 2010; Hesse et al., 2012).

Sit-to-Stand Test (STS): Is a measure of how effectively and efficiently a stroke patient can rise from a seated position into a stable, standing position. This measure consists of 3 areas: rising power, transfer time and gravitational sway, which are then evaluated on a balance-specific balance program run by a trained clinician. This measure has been shown to have good reliability and validity (Bohannon, 1995; Whitney et al., 2005).

2-Minute Walk Test: Is a measure of walking endurance in which participants are asked to walk at a comfortable pace between two defined points for two minutes. The walk is usually conducted along a straight path that is free of obstructions, and results are reported as a distance measure (in metres). The test is shown to have high inter- and intrarater reliability (Druzbicki et al., 2018; Hiengkaew et al., 2012).

Gait Distance: Is a measure of endurance and can be used to assess hemiparesis or motor recovery post-stroke. Distances are usually measured in a fixed amount of time. As an individual recovers after injury, the distance they can cover in a fixed time should increase (Tanaka et al., 2019).

Dual-Task Test: Is a measure of functional movement in which participants divide their attention between two tasks such as walking and talking or other cognitive tasks. This test may resemble community interactions and aid with participation (Plummer & Eskes, 2015).

Modified Emory Functional Ambulation Profile: Is a modified measure of functional ambulation that assessed the time required to walk during 5 challenges. The modified version allows for manual assistance. The modified measure has demonstrated excellent test/retest reliability, inter/intra-rater reliability, and concurrent validity in both subacute and chronic stroke populations (Baer & Wolf, 2001; Liaw et al., 2006; Wolf et al., 1999).

Functional Mobility

Rivermead Mobility Index (RMI): Is a self-reported measure of the ability of a stroke patient to complete functional tasks. This measure consists of 15 functional tasks (e.g. turning over in bed, stairs, walking outside) which are then rated on 2-point scale completed by the patient in the form of a questionnaire (0=cannot complete task, 1=can complete task). This measure has been shown to have good reliability and validity (Collen et al., 1991; Lennon & Johnson, 2000).

Stroke Rehabilitation Assessment of Movement (SRAM): Is a measure of how well a stroke patient can perform functional tasks. This measure consists of 30 functional tasks which are then subdivided 5 subsections: supine, sitting, standing, standing (while gripping a stable support), and standing plus walking activities. These tasks are then evaluated on a 4-point scale. 0=unable to complete task, 1a=able to perform only part of the activity independently with marked deviation from normal motor pattern, 1b=able to perform only part of the activity independently in a manner that is comparable to the unaffected side, 1c=able to perform the full movement but with marked deviation from the unaffected side, 2=able to perform the full movement with grossly normal motor movement but with assistance, 3=able to complete the activity independently with grossly normal motor movement. This measure ha been shown to have s good reliability and validity (Ahmed et al., 2003; Daley et al., 1999).

Modified Rivermead Mobility Index (MRMI): is an assessment of functional tasks, such as getting out of bed. This measure is derived from the Rivermead Mobility Index but consists of 8, instead of 15 items. Each item is rated on a 6-point scale, as opposed to the binary outcome recorded in the original Rivermead Mobility Index. This measure has shown high reliability, validity and sensitivity (Lennon & Johnson, 2000).

Short Physical Performance Battery (SPPB): Is a group of measures that combines gait speed, chair stand and balance tests. The scores for this measure range from 0-12, with 0 being the worst performance, and 12 corresponding to the best performance. The SPPB has been shown to have good predictive validity (Freire et al., 2012).

Elderly Mobility Scale: Is a measure of function designed for the assessment of frail elderly adults. This assessment has demonstrated high inter-rater reliability, good intra-rater reliability, and high concurrent validity (Linder et al., 2006; Nolan et al., 2008; Smith, 1994).

Clinical Outcome Variable Scale: Is a measure of functional mobility consisting of 13 mobility tasks, each scored on a 7-point scale. Overall scores range of a 13 at the lowest to 91 at the highest, with a higher score corresponding to better functioning (Salter et al., 2010).

De Morton Mobility Index: Is a measure of mobility that has demonstrated reliability and validity within a sub-acute stroke population (Braun et al., 2019). The raw score of 19 is converted to the final score out of 100, with a higher score indicating better mobility.

Life Space Assessment: Is a measure of mobility that assesses physical function, sociodemographic characteristics as well as psychological and cognitive aspects of daily functioning (Baker et al., 2003).

Balance

Berg Balance Scale: Is a 14-item scale that measures balance ability and control while sitting and standing. Each item is ranked on a 4-point scale for a total score of 56. The measure is shown to have high interrater, intrarater, and test-retest reliability (Blum & Korner-Bitensky, 2008; Conradsson et al., 2007).

Functional Reach Test: Is a measure of balance assessing the maximum distance a participant can reach forward while standing in a fixed position. The modified version assesses maximum reach while the participant is sitting. This measure has demonstrated excellent test-retest reliability, intrarater reliability, and high face validity within a stroke population (Katz-Leurer et al., 2009; Outermans et al., 2010).

Activities-Specific Balance Confidence Scale: Is a measure of an individual's confidence, in percent, in performing various ambulatory activities without losing balance. It is a self-reported assessment with 16-items that is proven to have high interrater and test-retest reliability in stroke (Ylva & Anette, 2012)

Trunk Impairment Scale (TIS): Is a measure of static and dynamic sitting balance as well as trunk coordination while a stroke patient is in a sitting position. This measure consists of 2 distinct subscales: static sitting balance and dynamic sitting balance. The static sitting balance subscale consists of 3 functional tasks (e.g. maintaining a sitting position, maintaining a sitting position with legs passively crossed and maintaining a sitting position with legs actively crossed). The dynamic sitting balance subscale consists of 1 functional task (e.g. rotating upper part of the trunk 6 times and then rotating the lower part of the trunk 6 times). These tasks are then graded on a 4-point ordinal scale (0=cannot complete task, 3=completes the task quickly and with ease). This measure has been shown to have good test-retest reliability and validity (Verheyden et al., 2004; Yu & Park, 2013).

Static Balance (SB): Is the ability of an object and/or person to maintain their stationary balance. This measure has been shown to have good reliability and validity (Geuze, 2003).

Postural Assessment Stroke Scale (PASS): Is a measure of how well a stroke patient balances in both static and dynamic positions. This measure consists of 12 functional tasks (e.g. sitting without support, standing without support, sit-to stand etc.). These tasks are then divided into 2 distinct subscales (maintaining a posture and changing a posture). The tasks are scored on a 4-point scale (0=cannot complete task, 3=completes task and can hold position for an extended period of time). This measure has been shown to have good inter-rater reliability and validity (Benaim et al., 1999; Chien et al., 2007).

Performance-Oriented Mobility Assessment (POMA) AKA Tinetti Balance Scale (TBS): Is a measure of how functionally mobile a stroke patient is. This test involves 9 different balancing tasks (e.g. standing balance, balance with eyes closed, sitting balance etc.). These tasks are measured using a 3-point scale (0=cannot complete task, 2=complete independence). This measure has been found to have good reliability and validity (Faber et al., 2006; Tinetti, 1986).

Postural Sway (PS): Is a measure of how well a stroke patient can maintain a state of balance during a dynamic posture and/or activity. This test consists of the patient standing on a force-plate and then gently swaying. The force plate analyzes the patient's level of control and the data from the force plate is read and interpreted by a trained healthcare professional. This measure has been shown to have good reliability and validity (Hughes et al., 1996; Lin et al., 2008).

The Falls Efficacy Scale – International (FES-I): Is a measure that assesses the concern of falling during everyday activities. This questionnaire consists of 16 activities and concern about falling is rated on a scale of one (not at all concerned) to four (very concerned). This measure has been shown to have good internal and test-retest reliability (Yardley et al., 2005).

Limit of Stability: Is an assessment of balance that measures the maximum distance the center of gravity can be displaced (Alfeeli et al., 2013). Reaction time, center of gravity movement velocity, directional control and excursion values are all recorded (Alfeeli et al. 2013).

Trunk Control Test (TCT): Is a measure that assesses the level of motor impairment a stroke patient has in the trunk/abdominal region. This measure consists of 4 functional tasks (e.g. roll to weak side, roll to strong side, balance on a sitting position at the edge of a bed, and sit up from lying down). For each task the patient receives points (0=cannot complete task, 12=completes task with some assistance, 25=completes task independently) for a maximum of 100 points. This measure has been shown to have good reliability and validity (Duarte et al., 2002; Franchignoni et al., 1997).

Rate of Falls (RoF): The number of falls that are recorded in a certain population. For example, stroke patients have a higher rate of falls than age matched healthy patients. This measure has been shown to have good reliability and validity (Nyberg & Gustafson, 1995).

Mini Balance Evaluation Systems Test: Is a shortened measure of balance, including assessments related to anticipatory postural adjustments, reactive postural control, sensory orientation, and dynamic gait. The maximum score is 28. This measure has demonstrated excellent test/retest reliability, inter/intra-rater reliability, and criterion validity within a chronic stroke population (Tsang et al., 2013).

Brunel Balance Assessment: Is a measure of functional balance. It is a 10-point hierarchial ordinal scale that is found to be a reliable and valid measure of balance issues post stroke (Karthikbabu et al., 2018; Tyson & DeSouza, 2004).

Romberg's Test of Balance: Is an assessment of balance that measures participants postural sway or stability. The test involves standing with your feet together while an observer notes any body movement and is conducted with both eyes open and closed (Lanska & Goetz, 2000).

Stabilometry Test (ST): Is a measure of the amount of postural equilibrium a stroke patient possesses. This measure is comprised of 2 distinct tests: unipedal (one foot) and bipedal (two feet). The evaluation begins once the patient steps onto a force plate and a trained clinician has them balance either on two feet or on one foot, and then the data is analyzed by said clinician. This measure has been shown to have good test-retest reliability and concurrent validity (Ageberg et al., 1998; Hsu et al., 2009).

Postural Control (PC): Is a measure of how well a stroke patient can maintain a state of balance during a static posture and/or activity. This test consists of the patient standing on a force-plate and then the force plate analyzes the patient's level of control. The data from the force plate is then read and interpreted by a trained healthcare professional. This measure has been shown to have good reliability and validity (Gill et al., 2001; Nichols et al., 1996).

Lateral Reach Test: Is a measure of medial-lateral postural stability that has demonstrated high inter-rater reliability within an elderly population (DeWaard et al., 2002).

Sensory Organization Test: The Sensory Organization Test (SOT) describes a component of Computerized Dynamic Posturography. The SOT evaluates the impact of visual, vestibular, and somatosensory inputs, as well as sensory reweighting, under conditions of sensory conflict. This test is performed using six sensory stimulation conditions, during which visual stimuli are changed and a rotation of the foot support platform, or movements of the visual surround. It is sometimes divided into static and dynamic evaluations (Benvenuti et al., 1999; Olchowik & Czwalik, 2020; Oliveira et al., 2011).

Modified Functional Reach Tests: Is a modified measure of balance in which the maximum distance an individual can reach forward is measured. This measure is adapted for individuals who are unable to stand so that assessments can be performed in a sitting position. This assessment has demonstrated excellent test-retest reliability and criterion validity in a stroke population (Katz-Leurer et al., 2009).

Overall Stability Test (OST): Is a measure of a stroke patient's static and dynamic balance. This test involves the patient standing on a force plate and moving slightly (anterior-posterior and medial-lateral) all while the force plate transmits information to a trained clinician. This measure has good test-retest reliability and validity (Goldbeck & Davies, 2000).

Burke Lateropulsion Scale: Is a measure of lateropulsion, or altered perception of body verticality, that may occur after a stroke. The scale consists of five items which assess the action or reaction of participants during supine, sitting, standing, transfers and walking positions. A therapist is required in scoring with a minimum score of 0 indicating no perceived lateropulsion, and a maximum score of 17. This scale has demonstrated excellent interrater and intrarater reliability in a stroke population (D'Aquila et al., 2004).

Four Square Step Test: Is a measure of dynamic balance that assesses a participant's ability to step over objects when approaching from the front, the side, and from the back. The best time of two trials is taken as the score (Whitney et al., 2007).

Gait

Cadence: Is a gait pattern that varies and is assessed through gait analysis (Brandstater et al., 1983). Gait parameters after a stroke are associated with functional performance and recovery.

Step Length: Is the distance between the heel print of one foot to the heel print of the second foot. The higher the distance, the better the score. This measure has been shown to have good reliability and validity (Kuo, 2001).

Step Time: Is the time between successive foot-floor contact for both feet. Participants are timed by a trained professional. The lower the time, the better the score. This measure has been shown to have good reliability and validity (Balasubramanian et al., 2009).

Stride Length: Is the distance between two successive placements of the same foot. One stride length is the equivalent of two step lengths. Unlike step lengths, stride lengths should be very similar for both the right and left leg. This measure has been shown to have good reliability and validity (Danion et al., 2003; Lewis et al., 2000).

Stride Time: Is the time that elapses between the first contact of two consecutive footsteps of the same foot. It is measured in milliseconds (ms). This measure has been shown to have good test-retest reliability and validity (Beauchet et al., 2011).

Stride Width: Is the distance between your heels when each heel is at its lowest point. Stroke patients typically have a wider stride length compared to non-stroke patients due to weaker overall balance. This measure has been shown to have good reliability and validity (Heitmann et al., 1989; Kawamura et al., 1991).

Double Limb Support Period: Is a measure of the time during which both feet are in contact with the ground during a gait cycle. Changes in this outcome may inform difficulty in balancing or in transferring body weight after stroke (Goldie et al., 2001).

Single Limb Support Time: Is a measure of the amount of time that passes during the swing phase of one extremity in a gait cycle. This measure involves a trained clinician attaching a wearable device to a stroke patient and having them walk on a treadmill. The device then sends the clinician information which can be analyzed. This measure has been shown to have good reliability and validity (Hanke & Rogers, 1992; Jenkins et al., 2009).

Support Duration: Is a measure of how long a stroke patient can support themselves while standing up. This measure consists of the patient standing up from a chair and continuing to stand for as long as possible while being timed by a trained clinician. This measure has been shown to have good reliability and validity (Plummer et al., 2007).

Stance Symmetry: Is the ability of a stroke patient to keep their centre of gravity in between their feet, instead of listing to one side or another. Most stroke patients list towards their unaffected side in order to compensate for a perceived lack of balance. This measure has been shown to have good reliability and validity (Rodriguez & Aruin, 2002).

Swing Symmetry: Is a measure of how synchronised a stroke patient's affected and unaffected sides are. The measure consists of 2 parts: a wearable device being attached to the stroke patient's unaffected side and the data from this device is then analyzed by a trained clinician. Additionally, the patient also undergoes a 3-5min walking test, which is administered by the clinician, who then records their observations. This measure has been shown to have good reliability and validity (Patterson et al., 2010).

Gait Cycle Time: Is the time it takes from the heel strike of one foot until the heel strike of the same foot before the next step. It allows for a quantifiable assessment of the ambulation pattern in participants with neurological impairments post-stroke (Nadeau et al., 2011).

Stance Phase: Is the part of the gait cycle where a patient's one foot makes contact with the ground. It comprises approximately 60% of the gait cycle. This measure has been shown to have good reliability and validity (Kozanek et al., 2009).

Dynamic Gait Index: Is a measure of balance and gait in which participant's ability to adapt while walking around various obstacles is assessed. The assessment is performed over a distance of 20 feet and equipment required includes a shoe box, two obstacles, and stairs. The maximum score is 24 points with a higher score indicating less impairment. This measure has demonstrated excellent test/retest reliability, interrater reliability, and validity (Jonsdottir & Cattaneo, 2007; Lin et al., 2010).

Symmetric Weight Bearing: Is a measure of how well a stroke patient keeps themselves centred, instead of tilting towards the unaffected side. This data is analyzed by having the stroke patient stand on a force plate and a trained clinician then interprets the results. This measure has been shown to have good reliability and construct validity (Cheng et al., 2001; Combs et al., 2012).

Step Test: Is a test that measures aerobic capacity. Participants step on and off a raised step in a quick but controlled manner for 3 minutes straight. The more steps completed, the higher the score. This measure has been shown to have good reliability and validity (Siconolfi et al., 1985).

Sway Area: Is a measure of the numerical amount a stroke patient's body deviates from a set point when they are standing still. Baseline (sample) points are laid down and then the patient-specific points are calculated once the test is complete. Stroke patients usually deviate from the sample points. This measure has been shown to have good reliability and validity (Wollseifen, 2011).

Sway in Centre of Pressure: Is a measure of the change in the centre of pressure over time in stroke patients. This deviation is measured through the use of force plates which help trained clinicians analyze movement in the anterior-posterior and medial-lateral directions. Stroke patients typically deviate more from their centre of pressure compared to age-matched non-stroke patients. This measure has been shown to have good reliability and validity (Matsuda et al., 2008; Riach & Starkes, 1994).

Sway Length: Measures the length of the path traversed by the sway pattern which is then measured in centimetres. This measure involves the patient walking on a treadmill while they are attached to a computer program. Their results are analyzed by a trained clinician. This measure has been shown to have good reliability and validity (Kincl et al., 2002).

Sway Velocity: Is the average horizontal area covered by the movement of the centre (anterior-posterior and medial-lateral directions) of force per second. This data is analyzed by a computer program which is in turn run by a trained clinician. This measure has been shown to have good reliability and validity (Cho et al., 2014).

Swing Power: Is the rate at which work is done in the swing phase (when the foot is NOT in contact with the ground) of the overall gait cycle. The patient has a wearable device attached to their affected side and the feedback is sent to a trained clinician for analysis. This measure has been shown to have good reliability and validity (Olney et al., 1991).

Functional Gait Assessment: Is a measure of balance and gait that consists of 10 items, each scored from 0 to 3 for a maximum score of 30. A higher score indicates less impairment during ambulation. This measure has demonstrated excellent test/retest reliability, inter/intra-rater reliability, and validity within a stroke population (Lin et al., 2010; Thieme et al., 2009).

Wisconsin Gait Scale: Is a measure that evaluates the gait parameters and walking abilities of a stroke patient. This measure consists of 14 functional areas of walking (e.g. use of hand-held gait aid, hip hitching, stance width etc.). These areas are then graded on a 3-point scale (0=cannot complete task, 2=no discernible gait troubles). This measure has been shown to have good reliability and validity (Pizzi et al., 2007; Turani et al., 2004).

Gait Assessment and Intervention Tool: Is a measure of gait that includes 31 items. This measure has demonstrated good intra/inter-rater reliability (Daly et al., 2009).

Activities of Daily Living

Barthel Index (BI): Is a measure of how well a stroke survivor can function independently and how well they can perform activities of daily living (ADL). The measure consists of a 10-item scale (e.g. feeding, grooming, dressing, bowel control). Possible total scores range from 0 to 100. This measure has been shown to have good reliability and validity in its full form (González et al., 2018; Park, 2018).

Functional Independence Measure (FIM): Is an 18-item outcome measure composed of both cognitive (5-items) and motor (13-items) subscales. Each item assesses the level of assistance required to complete an activity of daily living on a 7-point scale. The summation of all the item scores ranges from 18 to 126, with higher scores being indicative of greater functional independence. This measure has been shown to have excellent reliability and concurrent validity in its full form (Granger et al., 1998; Granger et al., 1993; Linacre et al., 1994) and within an acute stroke population (Hsueh et al., 2002).

Modified Barthel Index (MBI): Is a measure of how well a stroke survivor can function independently and how well they can perform activities of daily living (ADL). The measure consists of a 10-item scale (e.g. feeding, grooming, dressing, bowel control). Possible scores range from 0 to 20. This measure has been shown to have good reliability and validity in its full form (MacIsaac et al., 2017; Ohura et al., 2017).

Modified Rankin Scale (MRS): Is a measure of functional independence for stroke survivors. The measure contains 1 item. This item is an interview that lasts approximately 30-45 minutes and is done by a trained clinician. The clinician asks the patient questions about their overall health, their ease in carrying out ADLs (cooking, eating, dressing) and other factors about their life. At the end of the interview the patient is assessed on a 6-point scale (0=bedridden, needs assistance with basic ADLs, 5=functioning at the same level as prior to stroke). This measure has been shown to have good reliability and validity (Quinn et al., 2009; Wilson et al., 2002).

Motor Assessment Scale (MAS): Is a performance-based measure that assesses everyday motor function. The measure consists of 8 motor-function based tasks (e.g. supine lying, balanced sitting, walking). Each task is then measured on a 7-point scale (0=suboptimal motor performance, 6=optimal motor performance). This measure has been shown to have good reliability and concurrent validity (Simondson et al., 2003).

Nottingham Extended Activities of Daily Life (NEADL): Is a measure of a stroke survivor's independence with regards to their performance on various activities of daily living. The measure consists of 22 functional tasks (e.g. walking, cooking, cleaning, participation in active hobbies). These tasks are then further divided into 4 distinct subscales (mobility, kitchen, domestic, and leisure activities). In turn, each task is measured on a 5-point (0=not at all, 4=on my own with no difficulty). This measure has been shown to have good reliability and validity (das Nair et al., 2011; Sahin et al., 2008).

Frenchay Activities Index (FAI): Is a measure of activities that stroke survivors have participated in recently. The measure consists of 15 items that are in turn split up into 3 subscales (domestic chores, leisure/work and outdoor activities). These items include: preparing meals, washing clothes, light/heavy housework, social outings etc. Each task is then scored on a 4-point scale with 1 being the lowest score. This measure has been shown to have good reliability and concurrent validity in its full form (Schuling et al., 1993).

Modified Motor Assessment Scale: Is a measure of motor recovery. This measure includes eight items (supine to side lying, supine to sitting on bed, balanced sitting, sitting to standing, walking, upper extremity function, hand movements and advanced hand activities) which are rated on a scale of zero to six, with six being "most difficult". This measure has been shown to have good inter- and intrarater reliability (Loewen & Anderson, 1988).

Ability for Basic Movement Scale Revised: Is a measure of functional ability, it assesses five basic movements (turning over from the supine position, sitting up, remaining in sitting position, standing up, remaining in standing position). Each item is scored from: 1=prohibition from moving, 2=total dependence, 3=partial dependence, 4=supervision, 5=independence in a special environment, 6=complete independence. It has demonstrated validity within a stroke population (Kinoshita et al., 2017; Tanaka et al., 2010).

Lower Extremity Functional Scale: Is an assessment of lower extremity impairment. The measure includes 20 items that measure a person's ability to complete activities of daily living with a score range from 0 to 80. This outcome has demonstrated excellent test-retest reliability, and adequate to excellent validity (Verheijde et al., 2013).

Sunnaas Index: Is a measure of functional activity limitation. The measure consists of 12 items (eating, indoor mobility, toilet-management, transfer, dressing-undressing, grooming, cooking, bath/shower, housework, outdoor mobility, communication). Each item is scored from: 0=total dependence; 1=needs some help from others; 2=can manage alone; 3=complete independence (Claesson & Svensson, 2001).

Range of Motion

Active Range of Motion (AROM): Is a measure of the range of motion stroke survivors possess without receiving assistance. The measure consists of 20 functional movements for both the upper and lower extremity. The movements are evenly divided into 2 sections: upper extremity and lower extremity. These movements are then rated on a 4-point ordinal scale (0=cannot complete movement, 3=completes movement as well as the unaffected side). This measure has been shown to have good reliability and validity (Beebe & Lang, 2009; Dickstein et al., 1986).

Maximal Elbow Extension Angle During Reach (MEEAR): Is a measure of the amount of elbow extension undergone by a stroke survivor while they are reaching for an object. The measure consists of 1 functional movement which is when a patient reaches for an object and their rate of elbow extension is measured (the higher the rate of extension, the better the outcome). This measure has been shown to have good inter/intra reliability and concurrent validity (Cirstea et al., 2003; Murphy et al., 2011).

Passive Range of Motion (PROM): Is a measure of the range of motion stroke survivors possess while receiving assistance. The measure consists of 30 functional movements for both the upper and lower extremity. The movements are evenly divided into 2 sections: upper extremity and lower extremity. These movements are then rated on a 5-point ordinal scale (0=cannot complete movement, 4=completes movement as well as the unaffected side). This measure has been shown to have good test/retest reliability and validity (Lynch et al., 2005).

Muscle Strength

Motricity Index: Is a measure of muscle strength and motor impairment. It is based on weighted scores from the Medical Research Council Scale grades. This measure is composed of three measurements for upper extremity (shoulder abduction, elbow flexion and pinch grip) and three measurements for lower extremity (hip flexion, knee extension, ankle dorsiflexion). The total score ranges from 0-99 for both upper and lower extremity. This measure has been shown to have good reliability and validity (Collen et al., 1990; Fayazi et al., 2012).

Isokinetic Peak Torque (IPT): Is a measure of the work capacity of specific muscle groups of a stroke survivor. The measure consists of 1 functional task. The patient performs elbow flexion/extension while attached to a machine that measures force output. The process is then repeated for the leg. The output is then compared to healthy patients that are approximately the same age and build. This measure has been shown to have good test/retest reliability (Horvat et al., 1997).

Maximum Voluntary Isometric/eccentric Contraction (MVIC): Is a measure of strength and activation. Strength is measured using a strain gauge or dynamometer and the force that is exerted is converted to Newtons or kg by a computer. This measure has been shown to have good reliability (Meldrum et al., 2007; Meldrum et al., 2003).

Medical Research Council Scale (MRCS): Is a measure of overall muscle strength a stroke survivor possesses. The measure consists of 33 functional tasks (e.g. opening/shutting cupboards, screwing and unscrewing lids, lifting of light objects). Each task is then rated on a 4-point scale (0=cannot complete task, 3=completes task as well as the unaffected side). This measure has been shown to have good reliability and validity (Fasoli et al., 2004; Hsieh et al., 2011).

Manual Muscle Strength Test (MMST): Is a measure of how well a stroke survivor can complete various upper extremity movements while resistance is applied by a trained clinician. The measure consists of 3 functional tasks: muscle contraction, total range of motion and resistance to applied pressure. Patients are scored on a 12-point scale (0=no movement, T=trace/barely discernable movement, 10=movement carried out as well as the unaffected side). This measure has been shown to have good reliability and validity (Ada et al., 2006; Kristensen et al., 2017).

Spasticity

Modified Ashworth Scale (MAS): Is a measure of muscle spasticity for stroke survivors. The measure contains 20 functional movements which are done with the guidance of a trained clinician. These movements are evenly divided into 2 sections: upper extremity and lower extremity. Each movement is then rated on a 6-point scale (0=no increase in muscle tone, 1=barely discernible increase in muscle tone 1+=slight increase in muscle tone, 2=moderate increase in muscle tone 3=profound increase in muscle tone (movement of affected limb is difficult) 4=complete limb flexion/rigidity (nearly impossible to move affected limb)). This measure has been shown to have good reliability and validity (Blackburn et al., 2002; Mehrholz et al., 2005) (Merholz et al. 2005; Blackburn et al. 2002).

Ashworth Scale: Is a measure of spasticity and movements are scored based on five items (1. no increase in tone, 2. slight increase in tone giving a catch when the limb was moved in flexion or extension, 3. more marked increase in tone but limb easily flexed, 4. considerable increase in tone--passive movement difficult, 5. limb rigid in flexion or extension). This measure has been shown to have good within and between-rater variability (Lee et al., 1989) (Lee et al. 1989)

Composite Spasticity Index: Is a measure of spasticity and consists of three items assessing tendon jerk, resistance to passive flexion, and clonus. The total score is calculated by adding the individual scores from each item with a range of 0 to 16. A higher score is indicative of more severe spasticity (Chan, 1986) (Chan 1986).

Clonus Score: Is a measure of the clonus reflex. Clonus is rhythmic muscle contractions that occur involuntarily. This measure determines the duration of the clonus and could be measured in seconds or beats (Bayram et al., 2006; Boyraz et al., 2015) (Boyraz et al. 2015; Bayram et al. 2006)

Modified Tardieu Scale (MTS): Assesses spasticity through measuring the quality and angle of muscle movements in response to stretches of different velocities. The velocities of muscle movement are as slow as possible (V1), speed of the limb falling from gravity (V2), and when the joint is moved as fast as possible (V3). The quality and angle of muscle reactions are recorded during these velocities. The quality of muscle reactions are scored as: 0 (no resistance throughout the duration of the stretch), 1 (slight resistance), 2 (clear catch occurring at a precise angle, followed by a release), 3 (fatigable clonus), 4 (infatigable clonus), 5 (joint is immovable) (Li et al., 2014a) (Li et al. 2014b).

Spasm Frequency Scale (SFS): Is a measure of the amount of spasms experienced by stroke survivors in a day. The measure is only concerned with measuring the amount of spasms in a single day. The amount of spasms per day are rated based on a 5-point scale (0=No spasms, 1= One or fewer spasms per day, 2=Between 1 and 5 spasms per day, 3=Five to less than 10 spasms per day, 4=Ten or more spasms per day, or continuous contraction). This measure has been shown to have good reliability and validity (Santamato et al., 2013; Snow et al., 1990).

Proprioception

Joint Position Sense Test (JPST): Is a measure of how well stroke survivors can perceive the position of their joints in motion and standing still. The measure consists of 1 functional task repeated several times. This task involves the patient holding 2 different shaped objects that also weigh different from each other and then told to identify which one weighs more and which one has a stranger shape. The more times the patient (s) identifies which shape is heavier/unique, then the better the outcome. This measure has been shown to have good reliability and validity (Kattenstroth et al., 2013).

Kinesthetic Visual Imagery Questionnaire (KVIQ): Is the measure of the visual acuity and muscle movement that stroke survivors possess. The measure consists of 20 functional tasks (e.g. tying shoes, reading out loud, reaching for an object, peripheral vision testing). Each task is then measured on 3-point scale (0=cannot complete task, 2=completes task as well as the unaffected side). This measure has been shown to have good reliability and validity (Demanboro et al., 2018; Sallés et al., 2017).

Revised Nottingham Sensory Assessment (RNSA): Is a measure of somatosensory perception in stroke survivors. The measure consists of 1 functional task repeated with 11 different objects. The task involves patients identifying 11 different objects with their eyes closed. The higher the rate of objects identified leads to a better overall outcome. This measure is shown to have good reliability and validity (Boccuni et al., 2018; Gorst et al., 2019).

Stroke Severity

National Institutes of Health Stroke Scale (NIHSS): Is a measure of somatosensory function in stroke survivors during the acute phase of stroke. This measure contains 11 items and 2 of the 11 items are passive range of motion (PROM) assessments delivered by a clinician to the upper and lower extremity of the patient. The other 9 items are visual exams conducted by the clinician (e.g. gaze, facial palsy dysarthria, level of consciousness). Each item is then scored on a 3-point scale (0=normal, 2=minimal function/awareness). This measure has been shown to have good reliability and validity (Heldner et al., 2013; Weimar et al., 2004).

Stroke Impairment assessment set (SIAS): Is a measure of impairment including motor, sensory and motion. This measure involves rating participants on ten assessments, with the total score ranging from zero (total impairment) to 76 (normal function). This measure has been shown to have good inter-observer variation (Chino et al., 1994).

Canadian Neurological scale: Is a measure of neurologic status in acute stroke patients. This measure evaluates function such as level of consciousness, orientation, speech and motor functions or response. This measure has been shown to have good reliability and validity (Côté et al., 1989).

Clinical Neurological Deficit scale: Is a measure of stroke severity and is composed of eight items (level of consciousness, best gaze, facial palsy, language, shoulder/arm motor, hand motor, lower extremities motor, walking) (Fang et al., 2003).

Scandinavian Stroke Scale (SSS): Is a measure of somatosensory function in acute/subacute phase stroke patients. This measure consists of 10 functional tasks (e.g. speech, orientation in space, eye movement) which are rated on a 7-point (0=paralysis/no movement, 6=fully conscious/ as normal as unaffected side). This measure has been shown to have good reliability and validity (Askim et al., 2016; Christensen et al., 2005).

Hemispheric Stroke Scale (HSS): Is a predominantly neurologic examination for use after an acute hemispheric infarction (Adams et al., 1987). It assesses level of consciousness, language, cognitive function, motor function, and sensory outcomes post-stroke.

Quality of Life

Stroke Impact Scale (SIS): Is a patient-reported measure of multi-dimensional stroke outcomes. The measure consists of 59 functional tasks (e.g. dynamometer, reach and grab, walking, reading out loud, rating emotional regulation, word recall, number of tasks completed, and shoe tying). These tasks are then divided into 8 distinct subscales which include: strength, hand function, mobility, communication, emotion, memory, participation and activities of daily living (ADL). Each task is measured on a 5-point scale (1=an inability to complete the task, 5=not difficult at all). The measure has been shown to have good reliability and validity (Mulder & Nijland, 2016; Richardson et al., 2016).

SF36 (short form-36): Is a measure of health status. This measure consists of eight health concepts (physical functions, role limitations because of physical health, bodily pain, social functioning, general mental health, role limitations because of emotional problems, vitality and general health perceptions) and is composed of 36 questions. This measure has been shown to have good reliability and validity (Brazier et al., 1992; Ware & Sherbourne, 1992).

Stroke Specific Quality of Life: Is a measure of health-related quality of life with domains specific to stroke patients. This measure contains 12 domains that are commonly affected post-stroke (mobility, energy, upper extremity function, work/productivity, mood, self-care, social roles, family roles, vision, language, thinking, personality) and within the domains are 78 items. Each item is scored on a one to five scale, with higher scores corresponding to more normal function. This measure has been shown to have good reliability and validity (Williams et al., 1999).

EQ-5-D: Is a non-disease-specific measure of health-related quality of life. This measure consists of six domains which include mobility, self-care, main activity, social relationships, pain, mood and three levels within each domain. This measure has been shown to have good reliability and validity (Brooks, 1996; Group, 1990).

Nottingham Health Profile: Is a measure of any health-related problems. This measure consists of two parts. The first part covers six areas including, sleep, physical mobility, energy, pain, emotional reactions and social isolation. The second part focuses on areas of daily life that would be most impacted by health status including employment, social life, interests etc. Each section has a maximum score of 100. This measure has been shown to have good reliability and validity (Hunt et al., 1985).

Therapy Based Interventions

Neurodevelopmental Techniques and Motor Relearning

Adopted from: http://www.bobathconcept.eu/en/main-site/

There are several approaches considered to be neurodevelopmental techniques including the Bobath concept Approach (BCA). The Bobath concept is a comprehensive, problem-solving treatment approach that focuses on motor recovery (e.g. function, movement and tone) of an individual's affected side after a lesion in the central nervous system (Michielsen et al., 2019). Prior to its introduction in the 1950's, stroke rehabilitation largely assumed a compensatory approach towards the unaffected side for rehabilitation (Kollen et al., 2009). The Bobath concept like other neurodevelopmental techniques relies on the tenets of neuroplasticity, in that motor recovery of the affected side is possible through individualised treatment plans that focus on how tasks are completed, facilitation of movements through therapeutic handling, movement analysis, modification of the environment and appropriate use of verbal cues from therapists (Michielsen et al., 2019).

The motor relearning programme employs practice of task-specific activities to remediate specific motor skills needed to perform that task. Motor tasks are practiced in context relevant environments to enhance sensory input and modulate performance (Pandian et al., 2012).

A total of 14 RCTs were found that evaluated neurodevelopmental techniques for lower extremity motor rehabilitation. Four RCTs compared the Bobath concept to conventional therapy (Gelber et al., 1995; Kilinc et al., 2016; Wang et al., 2005; Yazici et al., 2021). One RCT compared early and late Bobath therapy (Tang et al., 2014). Two RCTs compared the Bobath concept with task specific-practice and task specific-practice alone (Brock et al., 2011; Mudie et al., 2002). Two RCTs compared motor relearning programmes to conventional or sham therapies (Bourbonnais et al., 2002; Chan et al., 2006b). Three RCTs compared motor relearning programmes to the Bobath concept approach (Langhammer & Stanghelle, 2000; Pollock et al., 2002; van Vliet et al., 2005). One RCT compared the Bobath concept to Proprioceptive Neuromuscular Facilitation (Krukowska et al., 2016). One RCT compared the Bobath concept with specific lower extremity soft tissue mobilization with conventional therapy (Covcic et al., 2022).

The methodological details and results of all 14 RCTs are presented in Table 1.

Table 1. RCTs Evaluating Neurodevelopmental Techniques for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Bobath Concept Approach vs Conventional Therapies		
Yazici et al. (2021) RCT (6) Nstart=41 Nend=39 TPS=Acute	E: Neurodevelopmental technique (BCA) C: Standard rehabilitation Duration: 60min/d, 5d/wk Bobath & 5d/wk Standard Rehabilitation	• Stroke Rehabilitation Assessment of Movement Scale - LE (-) • Trunk Impairment Scale (+exp) • Berg Balance Scale (+exp) • Barthel Index (+exp)
Kilinc et al. (2016) RCT (6) Nstart=22 Nend=19 TPS=Chronic	E: BCA C: Conventional techniques (strengthening, stretching, weight transfer, range of motion) Duration: 60min/d, 3d/wk, for 12wks	• Trunk Impairment Scale (-) • Stroke rehabilitation assessment of movement (-) • 10-Meter walking test (-) • Berg Balance Scale (-) • Functional Reach test (-) • Timed Up-and-Go test (-)
Wang et al. (2005) RCT (6) Nstart=44 Nend=44 TPS=Acute	E: BCA C: Orthopaedic approach (passive, assistive and progressive resistive exercise) Duration: 40min/d, 5d/wk for 4wks	**Patients with stroke spasticity:** • Stroke Impairment Assessment set ○ Lower extremity motor control (-) ○ Tone (+exp) • Motor Assessment Scale (+exp) • Berg Balance Scale (-) • Stroke Impact Scale (+exp) **Patients with relative recovery:** • Stroke Impairment Assessment set (-) • Motor Assessment Scale (+exp) • Berg Balance Scale (+exp) • Stroke Impact Scale (+exp)
Gelber et al. (1995) RCT (5) Nstart=20 Nend=20 TPS=Chronic	E: BCA C: Conventional techniques (passive range of motion, resistive exercises, functional tasks with affected side) Duration: 1hr/wk, 5d/wk, for 4wks	• Functional Independence Measure (-) • Stride Length (-) • Gait Speed (+exp)
Early vs Late Bobath Approaches		
Tang et al. (2014) RCT (6) Nstart=56 Nend=48	E: Contemporary BCA + early sitting, standing, and walking strategies with balance training C: Contemporary BCA	• Berg Balance Scale (+exp) • Stroke Rehabilitation Assessment of Movement-LE (+exp)

TPS=Acute	Duration: 50min/d, 5d/wk, for 8wks	
Bobath Concept Approach with Task-Specific Training vs Task-Specific Training		
Brock et al. (2011) RCT (7) Nstart=29 Nend=26 TPS=Chronic	E: BCA + Task specific practice C: Task specific practice Duration: 1h/session, 6sessions/wk, for 2wks	• Gait Velocity (+exp) • 6-Minute Walk Test (-) • Berg Balance Scale (-)
Mudie et al. (2002) RCT (4) Nstart=40 Nend=26 TPS=Acute and Subacute	E1: Task-specific training + Standard physiotherapy E2: BCA + Standard physiotherapy E3: Balance performance monitor feedback training + Standard physiotherapy C: Standard physiotherapy Duration: 30min/d, 7d/wk, for 2wks	<u>E1 v E2 v E3 v C:</u> • Barthel Index (-) ○ Mobility (-) • Weight distribution (-)
Motor Relearning Programmes vs Conventional Therapy or Sham		
Chan et al. (2006a) RCT (6) Nstart=66 Nend=52 TPS=Subacute	E: Motor relearning C: Conventional therapy Duration: 120min/d, 3d/wk for 6wks	• Berg Balance Scale (+exp) • Timed Up-and-Go Test (-) • Functional Independence Measure (+exp) • Lawton Assessment of Instrumental Activities of Daily Life (+exp) • Community Integration Questionnaire (+exp)
Bourbonnais et al. (2002) RCT (5) Nstart=26 Nend=25 TPS=Chronic	E1: Motor relearning with lower limb force-feedback E2: Motor relearning with upper limb force-feedback C: Untreated paretic limb of opposite treatment group Duration: 3d/wk, for 6wks	<u>E1 vs E2:</u> • 2-Minute Walk Test (+exp1) • Gait Velocity (+exp1) • Timed Up and Go Test (-) • Fugl-Meyer Assessment ○ Upper Limb (-) ○ Lower Limb (-) • Upper Extremity Performance Test for the Elderly (TEMPA) (-) • Box-and-Block Test (-) • Finger-to-Nose Test (-)
Motor Relearning vs Bobath Concept Approach		
Van Vliet et al. (2005) RCT (7) Nstart=120 Nend=99 TPS=Acute	E: BCA C: Motor relearning (Movement science based treatment) Duration: 23min/d, 5d/wk	• Rivermead Motor Assessment (-) • Motor Assessment Scale (-) • Ten Hole Peg Test (-) • 6-Minute Walk Test (-) • Modified Ashworth Scale (-) • Nottingham Sensory Assessment (-) • Barthel Index (-) • Extended Activities of Daily Living Scale (-)
Pollock et al. (2002) RCT (5) Nstart=28 Nend=21 TPS=Chronic	E: Motor relearning program C: BCA Duration 1hr/d, 4d/wk for 3wks	• Weight distribution ○ Sitting (-) ○ Standing (-) ○ Rising to stand (-) ○ Reaching (-)

Langhammer & Stanghelle (2000) RCT (6) Nstart=61 Nend=61 TPS=Acute	E: Motor relearning + Multidisciplinary treatment C: BCA + Multidisciplinary treatment Duration: 40min/d, 5d/wk during hospitalization	• Motor Assessment Scale (+exp) • Sodring Motor Evaluation Scale (-) • Barthel index (-) • Nottingham Health Profile (-)
Bobath Concept Approach vs Proprioceptive Neuromuscular facilitation		
Krukowska et al. (2016) RCT (4) Nstart=72 Nend=72 TPS=Subacute	E1: Neurodevelopmental BCA E2: PNF method (proprioceptive neuromuscular facilitation) Duration 6d/wk, for 6wks (35 sessions total)	• Gait Parameters ○ Total area of support (+exp1) ○ Center of Pressure pathway length (+exp1)
Bobath Concept Approach Combined with Other Therapies vs Bobath or Conventional Therapy		
Covcic et al. (2022) RCT (7) Nstart=40 Nend=40 TPS=Chronic	E: BCA with specific soft tissue mobilization of lower extremities muscles C: Standard BCA Duration: 45min, 5d/wk, for 5wks Bobath & 20min, 3d/wk, for 5wks soft tissue mobilization	• Berg Balance Scale (+exp) • Timed Up-and-Go test (-) • Active Range of Motion ○ Ankle dorsiflexion (+exp) ○ Knee flexion (+exp) ○ Knee extension (+exp)

Abbreviations and table notes: ANOVA=analysis of variance; ANCOVA=analysis of covariance; C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Neurodevelopmental Techniques

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Lowe extremity motor relearning with force feedback** may not have a difference in efficacy when compared to **upper extremity motor relearning with force feedback** for improving motor function.	1	Bourbonnais et al. 2002
1a	**Motor relearning programmes** may not have a difference in efficacy when compared to **BCA** for improving motor function.	2	Langhammer & Stanghelle 2000 ; Van Vilet et al. 2005

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**BCA with lower extremity soft tissue mobilization** may not have a difference in efficacy when compared	1	Covcic et al. 2022

	to **conventional therapy** for improving functional ambulation.		
1b	**BCA** may not have a difference in efficacy when compared to **conventional therapy** for improving functional ambulation.	2	Kilinc et al. 2016 ; Gelber et al. 1995
1b	The **BCA** may not have a difference in efficacy when compared to **motor relearning practice** for improving functional ambulation.	1	Van Vilet et al. 2005
1b	There is conflicting evidence about the effect of **BCA combined with task practice** when compared to **task practice alone** for improving functional ambulation.	1	Brock et al. 2011
1b	There is conflictinv evidence about the effect of **Lower extremity motor relearning with force feedback** when compared to **conventional therapy** for improving functional ambulation.	2	Chan et al. 2006; Bourbonnais et al. 2002

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1b	**Early BCA** may produce greater improvements in functional mobility when compared to **late BCA.**	1	Tang 2014
1a	**BCA** may not have a difference in efficacy when compared to **conventional therapy** for improving functional mobility.	2	Kilinc et al. 2016; Yazici et al. 2021

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	**Early BCA** may produce greater improvements in balance when compared to **late Bobath Approachs.**	1	Tang 2014
1b	**Motor Relearning Programs** may produce greater improvements in balance when compared to **Conventional Therapy**.	1	Chan et al. 2006
1b	There is conflicting evidence about the effect of **BCA combined with LE Muscles mobilization** when compared to **BCA alone** for improving balance.	1	Covcic et al. 2022
1a	**BCA** may not have a difference in efficacy when compared to **conventional therapy** for improving balance.	4	Kilinc et al. 2016; Mudie et al. 2002; Wang et al. 2005; Yazici et al. 2021
1b	**BCA combined with task-specific practice** may not have a difference in efficacy when compared to **task-specific practice alone** for improving balance.	1	Brock et al. 2011
1b	**BCA** may not have a difference in efficacy when compared to **task-specific practice** for improving balance.	1	Mudie et al. 2002

1b	**Motor relearning programmes** may not have a difference in efficacy when compared to the **BCA** for improving balance.	1	Pollock et al. 2002

GAIT			
LoE	Conclusion Statement	RCTs	References
2	**BCA** may produce greater improvements in gait than **conventional therapy**.	1	Gelber et al. 1995
2	**BCA** may produce greater improvements in gait than **proprioceptive neuromuscular facilitation.**	1	Krukowska et al. 2016

ACTIVITIES OF DAILY LIVING			
LoE	Conclusion Statement	RCTs	References
1b	**Motor relearning programmes** may produce greater improvements in activities of daily living than **conventional therapy**.	1	Chan et al. 2006
1a	There is conflicting evidence about the effect of the **BCA** to improve activities of daily living when compared to **conventional therapy**.	4	Wang et al. 2005; Mudie et al. 2002; Gelber et al. 1995; Yazici et al. 2021
1a	**Motor relearning programmes** may not have a difference in efficacy for improving activities of daily living when compared to the **BCA**.	2	Langhammer & Stanghelle 2000; Van Vliet et al. 2005
2	**BCA** may not have a difference in efficacy for improving activities of daily living when compared to **Task-specific Training.**	1	Mudie et al. 2002

RANGE OF MOTION			
LoE	Conclusion Statement	RCTs	References
1b	**BCA combined with LE Muscles mobilization** may produce greater improvements in range of motion when compared to **BCA alone.**	1	Covcic et al. 2022

PROPRIOCEPTION			
LoE	Conclusion Statement	RCTs	References
1a	**BCA** may not have a difference in efficacy when compared to **motor relearning practice** for improving proprioception.	2	Van Vilet et al. 2005; Langhammer & Stanghelle 2000

SPASTICITY			
LoE	Conclusion Statement	RCTs	References
1b	**BCA** may not have a difference in efficacy when compared to **motor relearning practice** for improving spasticity.	1	Van Vilet et al. 2005

Key Points

BCA may not be beneficial for improving functional ambulation, functional mobility, balance, and stroke severity after stroke when compared to conventional therapy.

BCA may be beneficial for improving gait, quality of life, and range of motion after stroke.

The literature is mixed regarding the effect of BCA on improvement of activities of daily livings after stroke.

Early BCA may be beneficial for improving functional mobility and balance after stroke when compared to late BCA.

When comparing BCA and motor relearning programs, they may not have beneficial effect in motor function, functional ambulation, balance, spasticity, proprioception, activities of daily livings, and quality of life after stroke over each other.

Sit to Stand Training

Adopted from: https://www.theptdc.com/how-to-assess-older-clients

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Standing from a seated position is considered the most frequently performed functional task and is necessary for mobility (Alexander et al., 2000). Sit-to-stand training is a targeted and specific intervention aimed at improving this particular movement, as well as at improving balance and muscle strength (Tung et al., 2010). Sit-to-stand training may improve outcomes through restoration of impairment, compensation for impairment, or substitution for impairment (Pollock et al., 2014).

Sit-to-stand training can be modified through providing an unstable support surface or through adjusting the positioning of the nonparetic limb to an asymmetric position, which can improve the weight-bearing rate of the paretic limb when compared to the symmetric foot position (Laufer et al., 2000).

15 RCTs were found evaluating sit-to-stand training for lower extremity motor rehabilitation. Three RCTs compared sit-to-stand training to conventional therapy (Kerr et al., 2017; Logan et al., 2022; Tung et al., 2010). One RCT compared sit-to-stand training with a swiss ball to a stool (Rasheeda & Sivakumar, 2017). One RCT compared unstable sit-to-stand support surface to stable sit-to-stand support surface (Mun et al., 2014). Two RCTs compared sit-to-stand training with asymmetrical foot position to sit-to-stand training with symmetrical foot position (Farqalit & Shahnawaz, 2013; Liu et al., 2016b). One RCT compared sit-to-stand training combined with auditory feedback to training with no feedback (Engardt et al., 1993). One RCT compared sit-to-stand training with visual feedback to sit-to-stand training on its own (Hyun et al., 2021). One RCT compared sit-to-stand training to conventional therapy (Britton et al., 2008). One RCT compared modified sit-to-stand training to conventional therapy (Suchetha et al., 2018). One RCT compared sit-to-stand training with postural feedback to conventional rehabilitation (Cheng et al., 2001). One RCT compared sit-to-stand training with transcutaneous electrical nerve stimulation to sit-to-stand training on its own (Jung et al., 2017a). One RCT compared intensive sit-to-stand training to

regular sit-to-stand training (de Sousa et al., 2019). One RCT compared lateral weight transference exercises in sitting and standing to conventional care (Howe et al., 2005).

The methodological details and results of all six RCTs are presented in Table 2.

Table 2. RCTs Evaluating Sit-to-Stand Training Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Sit-to-Stand Training vs Conventional Therapy		
Logan et al. (2022) RCT (2) Nstart=45 Nend=40 TPS=Acute	E: Sit-to-Stand training + Standing practice + Conventional therapy C: Conventional therapy Duration: 45min/d, 5-7d/wk, for 3wks	• Barthel Index (-)
Kerr et al. (2017) RCT (6) Nstart=61 Nend=59 TPS=Acute	E: Sit-to-Stand movements performed (Count by using a physical activity monitor) + Conventional therapy C: Conventional rehabilitation Duration: 2wks	• Modified Rivermead Mobility Index (-) • Five time Sit-to-stand (-)

Tung et al. (2010)
RCT (6)
Nstart=32
Nend=32
TPS=Chronic
	E: Sit-to-Stand training + Physical therapy
	C: Physical therapy
	Duration: 45min/d, 3d/wk, for 4wks
		• Static balance-weight distribution (-)
		• Limit of stability
		  ○ Max excursion Anterior (-)
		  ○ Affected side (-)
		  ○ Non-affected side (-)
		• Directional control
		  ○ Anterior (+exp)
		  ○ Affected side (-)
		  ○ Non-affected side (-)
		• Berg Balance Scale (-)
		• Sit-to-Stand time (+exp)
		• Muscle Strength
		  ○ Hip extensor affected side (+exp)
		  ○ Hip extensor non-affected side (-)
		  ○ Knee extensor affected/non-affected side (-)
		  ○ Plantar flexors affected/non-affected side (-)

Sit-to-Stand Training with Various Tools		
Rasheeda & Sivakumar (2017) RCT (7) Nstart=74 Nend=67 TPS=Acute	E: Sit-to-Stand Training (with Swiss ball) C: Sit-to-stand Training (with stool) Duration: 40min/d for 10 days	• 30-Second Sit-to-stand Test (-) • Weight Bearing (+exp) • Brunnstrom Recovery Stage (+exp)
Unstable Sit-to-Stand Support Surface vs Stable Sit-to-Stand Support Surface		
Mun et al. (2014) RCT (3) Nstart=30 Nend=30 TPS=Chronic	E: Unstable support surface sit-to-stand training C: Stable support surface sit-to-stand training Duration: 1hr/d, 4d/wk, for 8wks	• Step length (+exp) • Berg Balance Scale (-) • Timed Up-and-Go Test (-) • 10-Meter Walk Test (-) • 6-Minute Walk Test (-)

Sit-to-stand Training with Asymmetrical Foot Position vs Sit-to-stand Training with Symmetrical Foot Position		
Liu et al. (2016b) RCT (7) Nstart=50 Nend=50 TPS=Subacute	E: Sit-to-stand with asymmetrical foot positioning (paretic foot placed posterior) C: Sit-to-stand training with symmetrical foot position Duration: 30min/d, 5d/wk, for 4wks	• Berg Balance Scale (+exp) • Sit-to-stand (+exp) • Static balance (+exp) • Dynamic balance (+exp)
Farqalit et al. (2013) RCT (8) Nstart=40 Nend=40 TPS=Chronic	E: Sit-to-stand training with asymmetrical foot position + conventional care C: Sit-to-stand training with symmetrical foot position + conventional care Duration: 30min/d, 3d/wk, for 4wks	• Berg Balance Scale (+exp) • Timed Up-and-Go Test (+exp) • Sit-to-stand repetitions (+exp)
Sit-to-Stand training with Auditory Feedback		
Engardt et al. (1993) RCT (5) Nstart=42 Nend=40 TPS=Subacute	E: Continuous Auditory Feedback During Sit-to-Stand Training C: No Feedback During Sit-to-stand Training Duration: 15min/session, 3sessions/d, 5d/wk, 6wks	• Weight distribution (+exp) • Motor Assessment Scale (+exp) • Barthel Index (-) • Fugl-Meyer Assessment (+exp)
Sit-to-Stand training with Visual Feedback		
Hyun et al. (2021) RCT (5) Nstart=40 Nend=30 TPS=Subacute	E: Sit-to-stand training + visual feedback with Wii Balance Board + Standard physiotherapy C: Sit-to-stand Training + Standard physiotherapy Duration: 20min/d, 5d/wk, 6 wks sit-to-stand training & 30min/d, 5d/wk, 6wks physiotherapy	• Berg Balance Scale (+exp) • 10-Meter Walk Test (+exp) • Timed Up-and-Go test (+exp) • Stroke-Specific Quality of Life (+exp) • Manual muscle Strength test of the Lower Extremities (+exp) • Centre of Pressure (+exp)
Britton et al. (2008) RCT (5) Nstart=18 Nend=13 TPS=Subacute	E: Usual rehabilitation + Sit-to-Stand training + visual feedback C: Usual rehabilitation + Arm task training Duration: 30min/d, 5d/wk, 3wks	• Weight bearing -affected leg (+exp) • Timed Sit-to-stand test (-)
Modified Sit-to-Stand Training vs Conventional Therapy		
Suchetha et al. (2018) RCT (5) Nstart=30 Nend=28 TPS=Subacute	E: Modified sit-to-stand training with mental practice + conventional therapy C: Conventional Treatment Duration: 1h/d, 5d/wk, 2wks	• Berg Balance Scale (+exp) • Dynamic Gait Index (+exp)
Sit-to-Stand training combined with postural control biofeedback		
Cheng et al. (2001) RCT (5) Nstart=54 Nend=48 TPS=Subacute	E: Standing postural symmetry training with a visual and auditory biofeedback trainer + repetitive sit-to-stand training+ conventional rehabilitation C: Conventional rehabilitation Duration: 30min/d postural training & 20min/d sit-to-stand training, 5d/wk for 3wks	• Sit-to-stand performance (+exp) • Rate of falls (+exp)

Sit-to-Stand training combined with TENS vs Sit-to-Stand Training		
Jung et al. (2017) RCT (7) Nstart=41 Nend=40 TPS=Chronic	E: Sit-to-stand training + TENS + conventional therapy C: Sit-to-stand training + sham TENS + conventional therapy Duration: 15min/d, 5d/wk, 6wks sit-to-stand training & 30min/d, 5d/wk, 6wks TENS or sham 60min/d, 5d/wk, 6wks conventional physiotherapy	• Postural sway distance (cm) ○ Eyes open (+exp) ○ Eyes closed (+exp) • Muscle strength (kg) ○ Hip extensor (+exp) ○ Knee extensor (-) ○ Ankle plantar flexor (-) • CSS score (Spasticity) (+exp)
Intensive Sit-to-Stand Training vs Regular Sit-to-Stand Training		
DeSousa et al. (2019) RCT (8) Nstart=30 Nend=30 TPS=Chronic	E: Intensive Sit-To-Stand Training C: Usual Sit-to-Stand Training Duration: 2h/d, 5d/wk, 2wks usual sit-to-stand training; 3hr/d on weekdays + 2hr/d on weekends, 2wks intensive training.	• Global Impressions of sit-to-stand Change (+exp) • Mobility Scale for Acute Stroke Patients – sit-to-stand item (-) • Manual Muscle Test: ○ Lower Limb Extensor Strength (-) ○ Gross Lower Limb Extension Strength (+exp) • Goal Attainment Scale (-) • Change in ability to move from sitting to standing (+exp)
Lateral Weight Transference Exercises in Sitting and Standing VS Conventional Care		
Howe et al. (2005) RCT (7) Nstart=35 Nend=33 TPS=Acute	E: Lateral weight transference exercises in sitting and standing + Conventional care C: Conventional care Duration: 30min/d, 3d/wk for 4wks	• Lateral Reach Test (-) • Static Standing Balance (-) • Sit-to-Stand-to-Sit (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Sit-to-Stand Training

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Sit-to-stand training with Swiss ball** may produce greater improvements in motor function than **conventional sit-to-stand training.**	1	Rasheeda & Sivakumar, 2017
2	**Sit-to-stand training with auditory feedback** may produce greater improvements in motor function than **conventional sit-to-stand training**.	1	Engardt et al. 1993

FUNCTIONAL AMBULATION

LoE	Conclusion Statement	RCTs	References
1a	**Sit-to-stand training with asymmetrical foot position** may produce greater improvements in functional ambulation than **sit-to-stand training with symmetrical foot position.**	2	Liu et al. 2016; Fargalit et al. 2013
1a	**Sit-to-stand training** may produce greater improvements in functional ambulation when compared to **conventional therapy**.	2	Tung et al. 2010, Kerr et al. 2017
2	**Sit-to-stand training with visual feedback** may produce greater improvements in functional ambulation than **sit-to-stand training without feedback.**	1	Hyun et al. 2021
2	**Sit-to-stand training with visual feedback** may produce greater improvements in functional ambulation than **conventional therapy**	1	Britton et al. 2008
2	**Sit-to-stand training with postural control feedback** may produce greater improvement in functional ambulation than **conventional therapy.**	1	Cheng et al. 2001
2	**Unstable support surface sit-to-stand training** may not have a difference in efficacy when compared to **stable support sit-to-stand training** for improving functional ambulation.	1	Mun et al. 2014
1b	**Sit-to-stand training with various tools** may not have a difference in efficacy when compared to **conventional sit-to-stand training** for improving functional ambulation.	1	Rasheeda & Sivakumar, 2017
1b	**Lateral weight transference exercises in sitting and standing** may not have a differecnce in efficacy when compared to **conventional therapy** for improving functional ambulation.	1	Howe et al. 2005

BALANCE			
LoE	Conclusion Statement	RCTs	References
1a	**Sit-to-stand training with asymmetrical foot position** may produce greater improvements in balance than **sit-to-stand training with symmetrical foot position.**	2	Liu et al. 2016; Fargalit et al. 2013
1b	**Sit-to-stand training with transcutaneous electrical nerve stimulation** may produce greater improvements in balance than **sit-to-stand training alone.**	1	Jung et al. 2017
1b	**Lateral weight transference exercises in sitting and standing** may produce greater improvements in balance than **conventional therapy.**	1	Howe et al. 2005
2	**Sit-to-stand with Auditory Feedback** may produce greater improvements in balance than **sit-to-stand training with no feedback.**	1	Engardt et al. 1993

2	**Sit-to-stand training with Visual Feedback** may produce greater improvements in balance than **sit-to-stand training with no feedback**	1	Hyun et al. 2021
2	**Modified sit-to-stand training** may produce greater improvements in balance than **conventional therapy.**	1	Sucetha et al. 2018
2	**Sit-to-stand training with postural control feedback** may produce greater improvements in balance than **conventional therapy.**	1	Cheng et al. 2001
1b	**Sit-to-stand training** may not have a difference in efficacy when compared to **conventional therapy** for improving balance.	1	Tung et al. 2010
2	**Unstable support surface sit-to-stand training** may not have a difference in efficacy when compared to **stable support surface sit-to-stand training** for improving balance.	1	Mun et al. 2014

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Sit-to-stand training** may produce greater improvements in gait than **conventional therapy.**	1	Tung et al. 2010
1b	**Sit-to-stand training with various tools** may produce greater improvements in gait than **conventional sit-to-stand training.**	1	Rasheeda & Sivakumar, 2017
2	**Unstable support surface sit-to-stand training** may produce greater improvements in gait than **stable support surface sit-to-stand training.**	1	Mun et al. 2014
2	**Sit-to-stand training with visual feedback** may produce greater improvements in gait than **conventional therapy.**	1	Britton et al. 2008
2	**Modified sit-to-stand training** may produce greater improvements in gait than **conventional therapy.**	1	Sucetha et al. 2018

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Sit-to-stand training with transcutaneous electrical nerve stimulation** may produce greater improvements in muscle strength than **sit-to-stand training alone.**	1	Jung et al. 2017
2	**Sit-to-stand training with visual feedback** may produce greater improvements in muscle strength than **sit-to-stand training alone.**	1	Hyun et al. 2021
1b	There is conflicting evidence for the ability of **intensive sit-to-stand training** to improve muscle strength when compared to **regular sit-to-stand training.**	1	DeSousa et al. 2019

1b	**Sit-to-stand training** may not produce greater improvements in muscle strength than **conventional therapy.**	1	Tung et al. 2010

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence for the ability of **intensive sit-to-stand training** to improve functional mobility when compared to **regular sit-to-stand training.**	1	DeSousa et al. 2019
1b	**Sit-to-stand training** may not produce greater improvements in functional mobility than **conventional therapy.**	1	Kerr et al. 2017

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Sit-to-stand training with auditory feedback** may produce greater improvements in activities of daily living than **sit-to-stand training with no feedback.**	1	Engardt et al. 1993
1b	**Intensive sit-to-stand training** may not produce greater improvements in activites of daily living than **regular sit-to-stand training.**	1	DeSousa et al. 2019
2	**Sit-to-stand training** may not produce greater improvements in activities of daily living than **conventional rehabilitation.**	1	Logan et al. 2022

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Intensive sit-to-stand training** may produce greater improvements in quality of life than **regular sit-to-stand training.**	1	DeSousa et al. 2019
2	**Sit-to-stand training with visual feedback** may produce greater improvements in quality of life than **sit-to-stand training alone.**	1	Hyun et al. 2021

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Sit-to-stand training with transcutaneous electrical nerve stimulation** may produce greater improvements in spasticity than **sit-to-stand training alone.**	1	Jung et al. 2017

Key Points

Sit-to-stand training may be beneficial for improving gait and muscle strength, but not functional ambulation.

Sit-to-stand training with asymmetrical foot position may be beneficial for improving balance.

Wheelchair Use

Adopted from http://www.neater.co.uk/neater-uni-chair/

Following stroke, particularly when associated with hemiplegia, individuals often require use of a wheelchair. Wheelchairs are usually self-propelling, but can also be manually propelled (Blower, 1988). The Neater Uni-Chair is a wheelchair designed for those with hemiplegia and thus only requires one hand to propel and one foot to steer (Mandy et al., 2014). While patients view the temporary use of a wheelchair positively, there is a lack of consensus between clinicians about the benefits of wheelchair use in stroke rehabilitation, particularly in the acute phase (Ashburn & Lynch, 1988; Engstrom, 1995).

The main advantage for early use of wheelchairs is related to support for the hemiplegic sides and greater functional improvement and independence. The popular treatment regimen described by Bobath discourages early self-propulsion in a wheelchair because it is believed to cause poor posture and increased tone on the hemiplegic side, and may have an adverse impact on long-term recovery (Ashburn & Lynch, 1988; Bobath, 1990). These postulated negative impacts include increasing spasticity, encouraging one-sidedness, and reducing motivation to walk (Blower, 1988). While the use of wheelchairs following stroke is widespread, there is limited research evaluating them as an intervention.

Two RCTs were found evaluating wheelchairs as an assistive device for lower extremity motor rehabilitation. One RCT compared the Neater Uni-wheelchair attachment to a standard wheelchair (Mandy et al., 2015). One RCT compared encouraging self-propelling to discouraging self-propelling (Barrett et al., 2001).

The methodological details and results of the two RCTs are presented in Table 3.

Table 3. RCTs Evaluating Wheelchair Use for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Neater Uni-Wheelchair Attachment vs Standard Wheelchair		
Mandy et al. (2015) RCT (7) Nstart=4 Nend=4 TPS=Chronic	E: Neater Uni-wheelchair attachment C: Standard wheelchair Duration: 6h/d, 5d/wk, 6wks	• Motor Skills (+exp) • Activities of Daily Living (+exp) • Process Skills (-)
Encouraging vs Discouraging Self-Propulsion		
Barrett et al. (2001) RCT (7) Nstart=40 Nend=40 TPS=Chronic	E: Encouraged to self-propelusion C: Discouraged from self-propulsion Duration: 8 wks	• Barthel Index (-) • Nottingham Extended ADL Scale (-) • General Health Questionnaire (-) • Modified Ashworth Scale (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Wheelchair Use

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	The **Neater Uni-wheelchair attachment** may produce greater improvements in motor function than a **standard wheelchair.**	1	Mandy et al. 2015

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	The **Neater Uni-wheelchair attachment** may produce greater improvements in activities of daily living than a **standard wheelchair.**	1	Mandy et al. 2015
1b	**Encouraging self-propelling** may not have a difference in efficacy compared to **discouraging self-propelling** for improving activities of daily living.	1	Barrett et al. 2001

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Encouraging self-propelling** may not have a difference in efficacy compared to **discouraging self-propelling** for improving quality of life.	1	Barrett et al. 2001

SPASTICITY

LoE	Conclusion Statement	RCTs	References
1b	**Encouraging self-propelling** may not have a difference in efficacy compared to **discouraging self-propelling** for improving spasticity.	1	Barrett et al. 2001

Key Points

The Neater Uni-wheelchair may be beneficial for improving motor function and activities of daily living.
Encouraging self-propelling may not be beneficial for improving activities of daily living, quality of life, and spasticity after stroke when compared to discouraging self-propelling.

Trunk Training

Adopted from https://www.flintrehab.com/2016/core-exercises-for-stroke-patients/

Trunk impairment is common after stroke and is directly associated with balance and gait (Jijimol et al., 2013; Verheyden et al., 2006). Additionally, trunk control and balance while sitting are well known predictors in functional outcome and hospital stay after a stroke (Franchignoni et al., 1997; Verheyden et al., 2006).

Trunk training targets the trunk or "core muscles", which include those supporting the lumbo-pelvic-hip complex (Hibbs et al., 2008). An example of a specific trunk stabilization method is the abdominal drawing-in maneuver, which involves selectively activating the transversus abdominis (Hides et al., 2006). Core stability training typically involves a combination of multiple exercises that encourage deep muscle movement and selective pelvic exercises to produce a comprehensive core stabilization rehabilitation program (Haruyama et al., 2017).

37 RCTs were found evaluating trunk training for lower extremity motor rehabilitation. 10 RCTs compared trunk training to conventional therapy (Büyükavcı et al., 2016; Cabanas-Valdes et al., 2016; Chung et al., 2013; Dubey et al., 2018; Haruyama et al., 2017; Jung et al., 2014; Mahmood et al., 2022b; Park et al., 2019b; Saeys et al., 2012; Verheyden et al., 2009). Three RCTs compared different trunk training with physio equipment modalities (Cho et al., 2019; Choi et al., 2020; Choi et al., 2021b). Three RCTs compared trunk training with tilted platforms to trunk training with horizontal platforms (Fujino et al., 2016; Fukata et al., 2021; Sawa et al., 2022). Seven RCTs compared trunk training with varying surface modalities to conventional trunk training (Karthikbabu et al., 2018; Karthikbabu et al., 2022; Karthikbabu et al., 2011; Lee et al., 2020b; Lim et al., 2012; Sarwar et al., 2019; Tirupatamma et al., 2019). Three RCTs compared trunk training with robotics to trunk training alone or conventional therapy (Kim et al., 2022; Min et al., 2020; Moon & Kim, 2017). One RCT compared trunk training with dual task training to trunk training alone (Ahmed et al., 2021). One RCT compared trunk training to cognitive training (Van Criekinge et al., 2020). Two RCTs compared dynamic neuromuscular stabilization to conventional care (Lee et al., 2018b; Yoon et al., 2020). Four RCTs compared trunk training with visual or auditory feedback to conventional care (de Seze et al., 2001; Jung et al., 2017b; Shin, 2020; Shin & Song, 2016). One RCT compared trunk training with balance training and transcutaneous electrical nerve stimulation to treadmill training with placebo TENS. Two RCTs compared trunk

stabilization with different muscle activation exercises to each other or to conventional care (Lee et al., 2020a; Muckel & Mehrholz, 2014).
The methodological details and results of all 13 RCTs are presented in Table 4.

Table 4. RCTs Evaluating Trunk Training Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Trunk Training vs Conventional Therapy		
Mahmood et al. (2022) RCT (7) NStart=44 NEnd=71 TPS=Chronic	E: Core stabilization exercises + Conventional PT C: Conventional PT Duration: 40min/d, 5d/wk, 8wks conventional PT & 15min/d, 5d/wk, 8wks core stabilization exercises	• Trunk impairment scale (+exp) • Functional ambulation category (+exp) • Stroke specific quality of life (+exp) • Trunk range of motion ○ Flexion (+exp) ○ Extension (+exp) ○ Left and right-side flexion (-) ○ Left and right-side rotation (-)
Park et al. (2019) RCT (7) NStart=30 NEnd=29 TPS=Chronic	E: Land-based and aquatic trunk exercises + conventional physiotherapy C: Conventional physiotherapy Duration: E: 30min/d, 5d/wk, for 4wks land/aquatic trunk exercises + 30min/d, 5d/wk, 4wks conventional physiotherapy C: 60min/d, 5d/wk, 4wks conventional physiotherapy	• Korean Trunk Impairment Scale (+exp) • 5-item, 3-level Postural Assessment Scale for Stroke (+exp) • 7-item, 3-level Berg Balance Scale (+exp) • Functional reach test (+exp) • Modified Barthel index (+exp)
Dubey et al. (2018) RCT (5) NStart=34 NEnd=26 TPS=Chronic	E: Pelvic stability training C: Conventional physiotherapy Duration: 60min/d, 3d/wk, 6wks	• Fugl Meyer Assessment-Lower Extremity (+exp) • Muscle Strength ○ Isometric strength of hip extensors (+exp) ○ Isometric strength of flexors (+exp) ○ Isometric strength of abductors (+exp) ○ Isometric strength of adductors (+exp) • 10-Meter Walk Test (+exp) • Modified Barthel Index (-) • Trunk Impairment Scale (+exp)
Haruyama et al. (2017) RCT (6) Nstart=32 Nend=31 TPS=Subacute	E: Core stability training+ Conventional care C: Conventional care (physical therapy + Occupational therapy) Duration: E: (20min/d core stabilization exercises + 40mins conventional therapy)/d, 5d/wk, 4wks C: 60min/d conventional therapy, 5d/wk, 4wks	• Trunk Impairment Scale (+exp) ○ Static Sitting Balance (-) ○ Dynamic Sitting Balance (+exp) ○ Trunk Coordination (-) • Pelvic Active Range of Motion (+exp) • Balance Evaluation Systems Test Brief Version (+exp) • Functional Reach Test (-) • Timed Up-and-Go Test (+exp) • Functional Ambulation Categories (+exp)
Büyükavci et al. (2016) RCT (5)	E: Trunk training + conventional therapy	• Berg Balance Scale (+exp) • Rivermead Mobility Index (+exp)

Nstart=65 Nend=61 TPS=Subacute	C: Conventional therapy Duration: 120min/d, 7d/wk, 3wks trunk training & 120-180min/d, 5d/wk, 3wks conventional therapy	• Functional Independence Measure (+exp) • Brunnstrom Recovery Stage- LE(+exp) • Trunk Impairment Scale (-)
Cabanas-Valdes et al. (2016) RCT (7) Nstart=80 Nend=71 TPS=Acute	E: Core stability exercises + Conventional therapy C: Conventional therapy Duration: 15min core stability & 1hr Conventional therapy, 5sessions/wk for 5wks	• Brunel Balance Assessment (+exp) ○ Standing (+exp) ○ Stepping (+exp) ○ Sitting (-) • Spanish-Trunk Impairment Scale (+exp) ○ Dynamic sitting balance (+exp) ○ Coordination (+exp) • Berg Balance Scale (+exp) • Tinetti scale (+exp) ○ Gait (+exp) ○ Balance(+exp) • Spanish version of Postural Assessment Scale for Stroke (+exp) • Barthel Index (+exp) • Function in Sitting Test (+exp)
Jung et al. (2014) RCT (7) Nstart=18 Nend=17 TPS=Chronic	E: Weight-shift trunk training on unstable surface + conventional care C: Conventional exercise program Duration: 60min/d (30min weight shifting training/ conventional exercise program + 30 min conventional care), 5d/wk, 4wks	• Timed Up-and-Go Test (+exp) • Trunk Impairment Scale (+exp) ○ Static sitting balance (-) ○ Dynamic sitting balance (+exp) ○ Coordination (-) • Trunk repositions error (+exp)
Chung et al. (2013) RCT (5) Nstart=16 Nend=16 TPS=Chronic	E: Trunk training C: Conventional rehabilitation Duration: 30min/d, 3d/wk, 4wks	• Gait velocity (+exp) • Step length (-) • Stride length (-) • Cadence (-) • Timed Up-and-Go Test (-)
Saeys et al. (2012) RCT (7) Nstart=33 Nend=32 TPS=Subacute	E: Trunk training + Conventional rehabilitation C: Conventional therapy + upper limb exercises (sham) Duration: 30min/d, 4d/wk, 8wks	• Trunk Impairment Scale (+exp) ○ Static sitting balance (-) ○ Dynamic sitting balance (+exp) ○ Coordination (+exp) • Tinetti Scale(+exp) ○ Balance (+exp) ○ Gait (+exp) • Romberg (eye open/closed) (-) • Four Test Balance Scale (+exp) • Berg Balance Scale (+exp) • Dynamic Gait Index (+exp) • Functional Ambulation Categories (-) • Rivermead Motor Assessment Battery (+exp) ○ Gross function (+exp) ○ Leg and trunk (+exp) ○ Arm (-)
Verheyden et al. (2009) RCT (6) Nstart=33 Nend=28 TPS=Subacute	E: Trunk training + Conventional therapy C: Conventional therapy Duration: 30min/d, 4d/wk, 5wks	• Trunk Impairment Scale (-) ○ Dynamic balance (+exp) ○ Static balance (-) ○ Coordination (-)
Trunk Training with Physio Equipment		

Choi et al. (2021) RCT (8) Nstart=24 Nend=24 TPS=Chronic	E: Pelvic compression belt with trunk stabilization exercises + conventional physical exercise C: Trunk stabilization exercises + conventional physical exercise Duration: 60min/d, 5d/wk, 6wks physical exercise, 30min/d, 5d/wk, 6wks trunk stabilization	• Postural Assessment Scale for Stroke(+exp) • Berg Balance Scale(+exp) • Timed Up and Go test(+exp) • Center of pressure path length ○ open eyes (-) ○ close eyes (+exp) • Center of pressure path velocity ○ open eyes (+exp) ○ close eyes (+exp)
Choi et al. (2020) RCT (8) Nstart=36 Nend=36 TPS=Chronic	E1: Trunk stabilization exercise + Pelvic compression belt on paretic side + comprehensive rehabilitation therapy E2: Trunk stabilization exercise + Pelvic compression belt on non-paretic side + comprehensive rehabilitation therapy C: Trunk stabilization exercise + comprehensive rehabilitation therapy Duration: 30min/d, 5d/wk, 6wks Trunk stabilization therapy & 60min/d, 5d/wk, 6wks Neurodevelopmental therapy	<u>E1/E2 vs C</u> • Postural Assessment Scale for Stroke (+exp1, +exp2) • Timed Up-and-Go Test (+exp1, +exp2) • 10-Meter walk test (+exp1) • 6-Minute walking test (+exp1) • COL path length (+exp1) • COL path speed (+exp1, +exp2) • LOS changes (+exp1, +exp2) • Stance phase (+exp1) • Swing phase (+exp1) • Foot rotation change (+exp1, +exp2) <u>E1 Vs E2</u> • Postural Assessment Scale for Stroke (-) • Timed Up and Go Test (-) • 10-Meter walk test (+exp1) • 6-Minute walking test (+exp1) • COL path length (+exp1) • COL path speed (-) • LOS changes (-) • Stance phase (+exp1) • Swing phase (-) • Foot rotation change (-)
Cho et al. (2019) RCT (6) NStart=33 NEnd=33 TPS=Subacute	E1: Segmental mid-thoracic mobilization + NDT E2: Foam roller exercises + NDT Duration: 10min, 5x/wk, 4wk (mid thoracic spine mobilization or abdominal drawing in manuever) + 5 sessions neurodevelopmental program/wk, 4wks	• Dynamic balance-Limit of stability (-)
Trunk Training with Tilted Platforms vs Trunk Training with Horizontal Platforms		

Sawa et al. (2022) RCT Crossover (7) Nstart=33 Nend=33 TPS=Subacute	E: Lateral tilt trunk training with 10-degree wedge C: Lateral tilt trunk training without wedge Duration: 2min/d, 7d/wk for 2wks, 3d washout	• Functional independence measure (+exp) • Subjective Postural vertical ○ Eyes Closed-directional Errors (-) ○ Eyes Closed-variability Errors (+exp) ○ Eyes Open-directional Errors (-) ○ Eyes Open-variability Errors (+exp)
Fukata et al. (2021) RCT (8) Nstart=33 Nend=33 TPS=Acute	E: Tilted seat (10 degree diagonally backward and down) + Conventional care C: Horizonal seat trunk training + Conventional care Duration: 10-15min/session, 7 sessions, 8d trunk training & 60min/d physical therapy & 20-60min/d occupational therapy and speech Therapy, 8d	• Function in Sitting test (+exp) ○ Static (+exp) ○ Dynamic (+exp) ○ Scooting (+exp) ○ Reactive (+exp) • Subjective Postural vertical ○ Tilt Direction (+exp) ○ Variability (-) • Trunk Impairment scale (+exp) ○ Static (+exp) ○ Dynamic (-) ○ Coordination (-) • Trunk Control test (-) • Functional independence measure ○ Motor (-) ○ Cognitive (-) • Stroke Impairment assessment scale (-)
Fujino et al. (2016) RCT (6) Nstart=43 Nend=40 TPS=Acute	E: Trunk training on tilted platform + conventional therapy C: Trunk training on horizontal platform + conventional therapy Duration: 15min/d trunk training & 60min/d conventional therapy, 6d/wk, 3wks	• Stroke Impairment Assessment Set (-) • Trunk Control Test (+exp) • Trunk laterally tasks paretic side ○ Head orientation (-) ○ Body axis (-) • Trunk laterally task nonparetic side ○ Head orientation (+exp) ○ Body axis (+exp)
Trunk Exercise with Unstable Surface vs Trunk Exercise with Stable Surface or conventional therapy		
Karthikbabu et al. (2022) RCT (8) NStart=84 NEnd=81 TPS=Chronic	E1: Core stability training on stable surface E2: Core stability training on unstable surface C: Individualized physiotherapy Duration: 60min/d, 3d/wk, 6wks	• E1/E2 vs C; • Trunk impairment scale (+exp1, +exp2) • Trunk strength (+exp1, +exp2) • Weight-bearing asymmetry (+exp1, +exp2) • Activities-specific balance confidence scale (+exp1, +exp2) • E1 vs E2; • Trunk impairment scale (-) • Trunk strength (-) • Weight-bearing asymmetry (-) • Activities-specific balance confidence scale (-)
Lee et al. (2020) RCT (6) Nstart=38 Nfinal=35 TPS=Subacute	E: Trunk Exercise on Unstable Surfaces + conventional rehabilitation C: Upper limb range of motion exercises + conventional rehabilitation Duration: 30min/d, 2d/wk, 6wks	• Stroke Rehabilitation Assessment of Movement (-) • Trunk Impairment Scale (+exp) • Fugl-Meyer lower extremity motor scale (-) • Affected Plantar cutaneous sensation of the big toe (-) • 6-Meter walk test (+exp) • Sitting with foot support performance: ○ Static sway area (-) ○ Forward leaning (-) ○ Arm raising (-)

		• Sitting without foot support: ○ Static sway area (+exp) ○ Forward leaning (+exp) ○ Arm raising (+exp) • Standing balance: ○ Static sway area (-) ○ Forward leaning(+exp) ○ Arm raising (-)
Sarwar et al. (2019) RCT (5) Nstart=30 Nend=30 TPS=Chronic	E: Trunk exercise with unstable surface C: Trunk exercise with stable surface Duration: Not Reported	• Trunk Impairment Scale (+exp) • Timed Up-and-Go Test (-) • Berg Balance Scale (+exp)
Tirupatamma et al. (2019) RCT (3) Nstart=50 Nend=30 TPS=Not Reported	E: Trunk balance training on rocker board + conventional therapy C: Trunk balance training on plain surface + conventional therapy Duration: 45min/d, 6d/wk, 6wks	• Berg Balance Score (+exp) • Functional Reach Test (+exp) • 2-Minute Walk Test (+exp)
Karthikbabu et al. (2018) RCT (7) Nstart=108 Nend=86 TPS=Chronic	E1: Stable trunk training with plinth E2: Unstable trunk training with Swiss ball C: Standard physiotherapy Duration: 60min/d, 3d/wk, 6wks	<u>E1/ E2 vs C</u> • Trunk Impairment Scale (+exp1, +exp2) • Brunel Balance Assessment (+exp1, +exp2) • Tinetti scale (+exp1, +exp2) • 10-Metre Walk Test (+exp1, +exp2) • Stroke Impact Scale-16 (+exp1, +exp2) • Reintegration to Normal Living Index (+exp1, +exp2) <u>E1 vs E2</u> • Trunk Impairment Scale (-) • Brunel Balance Assessment (-) • Tinetti scale (-) • 10-Metre Walk Test (-) • Stroke Impact Scale-16 (-) • Reintegration to Normal Living Index (-)
Lim et al. (2012) RCT (4) Nstart=21 Nend=21 TPS=Chronic	E: Trunk training, enhanced (draw-in + bridge) C: Trunk training, standard (bridge) Duration: 35min/d, 4d/wk for 8wk	• Sway velocity (+exp) • Sway area (+exp) • Sway length (+exp)
Karthikbabu et al. (2011) RCT (8) Nstart=30 Nend=30 TPS=Acute	E: Trunk training on unstable surface (physio ball) + conventional care (acute physical therapy) C: Trunk training on stable surface (plinth) + conventional care (acute physical therapy) Duration: 1h/d, 4d/wk, 3wks	• Trunk impairment scale (+exp) ○ Static sitting balance (-) ○ Dynamic siting balance (+exp) ○ Coordination (+exp) • Brunel balance assessment (+exp) ○ Standing (-) ○ Stepping (+exp)
Trunk Training Combined with Robotics vs Conventional Therapy		
Kim et al. (2022) RCT (6) Nstart=40 Nend=40 TPS=Not Reported	E: Robot-assisted trunk control training + Conventional trunk stabilization exercise C: Conventional trunk stabilization exercise + stretching exercise Duration: 30 min/d, 5d/wk for 8 wks trunk stabilization exercise &	• Trunk Impairment Scale (+exp) • Berg Balance Scale (+exp) • Functional Reach Test (+exp) • Limit of Stability (+exp) • Centre of Pressure (+exp)

	15min/d, 5d/wk for 8 wks robot-assisted trunk control therapy/stretching exercise	
Min et al. (2020) RCT (7) Nstart=38 Nend=38 TPS=Chronic	E: Trunk stability robot training (3DBT-33) + conventional physical therapy C: Conventional Physical Therapy Duration: 30min/d, 5d/wk, 4wks conventional physical therapy; 30min/d robot training, 5d/wk, 4wks	• Functional Ambulation Categories (-) • Timed Up-and-Go test (-) • Berg Balance Scale (+exp) • Korean Modified Barthel Index (+exp) • Fugl-Meyer Assessment of Lower Extremity (+exp)
Moon et al. (2017) RCT (4) Nstart=30 Nend=24 TPS=Chronic	E: Spine stability exercise using the Spine Balance 3D system C: Spine stability exercise through the Bridge exercise without using an equipment Duration: 30min/d, 3d/wk, 7wks	• Trunk Muscle Strength Test (+exp) • Timed Up-and-Go (+exp) • 10-Meter walking test (+exp) • Walking speed (+exp) • Step length ○ Non-affected (+exp) ○ Affected (-) • Weight bearing symmetry ○ Non-affected and Affected (-) • Gait Distance (+exp)
Trunk Training Combined with Dual-Task Training vs Trunk Training		
Ahmed et al. (2021) RCT (8) Nstart=84 Nend=84 TPS=Chronic	E: High-intensity multiplanar trunk training + dual-task training + conventional rehabilitation C: Trunk training + conventional rehabilitation. Duration: 45min/d, 5d/wk for 3mo	• Trunk Impairment Scale (+exp) ○ Dynamic Control(+exp) ○ Coordination (+exp) • Timed-Up-And-Go (+exp) ○ Cognitive (+exp) • 10-Metre Walk Test (+exp) • Berg Balance Scale (+exp) • Stroke Impact Scale (+exp)
Trunk Training vs Cognitive Training		
Van Criekinge et al. (2020) RCT (7) Nstart=45 Nend=39 TPS=Subacute	E: Standard care + Trunk Training C: Standard care + Cognitive Training Duration: 120min/d standard care & 60min/d, 4d/wk, 4wks trunk training/cognitive training	• Tinetti Performance-Oriented Mobility Assessment (+exp) ○ Balance (-) ○ Gait (+exp) • Step time (-) • Step length (+exp) • Step width (+exp) • Stance (-) • Walking speed (+exp) • CoM displacements (Horizontal/ Vertical) (+exp); • Gait Deviation Index (-) • Trunk Impairment Scale (+exp) ○ Static SB (-) ○ Dynamic SB (+exp) ○ Coordination (+exp) • ROM for thorax: ○ Sagittal stance/Sagittal swing/ Transversal swing (+exp) ○ Frontal stance/Frontal swing/ Transversal stance (-) • ROM for pelvis: ○ Sagittal stance/Sagittal swing/Frontal swing (-)

		○ Frontal stance/Transversal stance/ Transversal swing (+exp)
Dynamic Neuromuscular Stabilization vs Conventional Core Exercises		
Yoon et al., 2020 RCT (5) Nstart=31 Nfinal=31 TPS=Subacute	E: Dynamic neuromuscular core-postural chain stabilization C: Neurodevelopmental treatment Duration: 30min/d, 3d/wk, 4wks	• Trunk impairment scale (-) • Berg balance scale (+exp) • Functional ambulation category (+exp) • Diaphragm movement (+exp) • Paretic Deep abdominal muscle thickness ○ TrA (+exp) ○ IO (+exp) ○ EO (-) • Non-paretic Deep abdominal muscle thickness ○ TrA (+exp) ○ IO (-) ○ EO (-)
Lee et al. (2018) RCT (5) Nstart=30 Nend=28 TPS=Chronic	E: Dynamic neuromuscular core stabilization (DNS) C: Conventional core stabilization exercises Duration: 30min/d, 5d/wk for 4wks DNS & 20 sessions conventional core stabilization	• Trunk impairment scale (-) • Berg Balance scale (-) • Falls Efficacy scale (-) • EMG (anticipatory postural adjustment time for EO, TrA/IO, and ES) during paretic/nonparetic shoulder flexion (+exp)
Trunk Training with Visual or Auditory Feedback vs Conventional Therapy		
Shin et al., (2020) RCT(7) Nstart=24 Nfinal=24 TPS=Chronic	E: Smartphone-based visual feedback trunk control training + Conventional rehabilitation C: Conventional Rehabilitation Duration: 50min/d, 5d/wk, 4wk Conventional Rehabilitation	• Trunk Impairment Scale (+exp) • Velocity (+exp) • Cadence (+exp) • Stride length (+exp) • Stride Time (+exp) • Step length (+exp) • Step width (+exp) • Step time (+exp) • Double Limb support (+exp)
Jung et al. (2017) RCT (6) Nstart=46 Nend=43 TPS=Chronic	E: Trunk stabilization exercises + audiovisual biofeedback (Pressure biofeedback unit) C: Trunk stabilization exercises Duration: 50min/d, 5d/wk,6wks	• Thickness of trunk muscles (+exp) ○ TrA-affected (+exp) ○ TrA-unaffected (+exp) ○ IO-affected (-) ○ IO-unaffected (-) ○ EO-affected (+con) ○ EO-unaffected (+con) ○ Symmetric ratio (-) • Static sitting balance ability (+exp) • Dynamic sitting balance ability (+exp)
Shin & Song (2016) RCT (6) Nstart=24 Nend=24 TPS=Chronic	E: Smartphone visual feedback for trunk control training + Conventional care C: Conventional care Duration: 80min/d conventional care + 20min/d Smartphone therapy, 5d/wk, 4wks	• Timed Up-and-Go (+exp) • Static balance ○ Eyes closed (+exp) ○ Eyes open (+exp) • Trunk Impairment scale (+exp) • Modified Functional reach test (+exp)
De Seze et al. (2001) RCT (6) Nstart=20 Nend=20 TPS=Subacute	E: Trunk postural control training with visual and auditory feedback + Conventional neurorehabilitation C: Conventional neurorehabilitation	• Motricity Index (-) • Ashworth scale (-) • Mini-mental status exam (-) • Upright Equilibrium Index (+exp) • Sitting Equilibrium Index (-) • Functional Ambulation Category (+exp) • Functional Independence Measure (-)

	Duration: 120min/d, 5d/wk for 3mo	• Trunk Control Test (+exp) • Bells Neglect Test (+exp)
Trunk Training with Balance Training and TENS vs Treadmill Training and Placebo TENS		
Lim et al. (2019) RCT(7) Nstart=37 Nfinal=30 TPS=Subacute	E: Multi-sensorimotor training (Stabilize-T and Reha bar exercises + TENS) + Conventional PT C: Treadmill training + placedo TENS + conventional PT Duration: 60min/d, 5d/wk for 8wks	• Balance (-) ○ Anterior-posterior (+exp) ○ Medial-lateral (-) • Proprioception (+exp)
Different Trunk Muscle Activation Exercises Compared to Each other		
Lee et al. (2020) RCT (7) Nstart=30 Nend=30 TPS=Chronic	E1: Trunk stabilization exercise with abdominal hallowing + Conventional rehabilitation program E2: Trunk stabilization exercise with bracing maneuver + Conventional rehabilitation program C: Conventional rehabilitation program Duration: 20min/d, 3d/wk, 6wks	E1/E2 vs C • Functional Reach Test (-) • Berg Balance Scale (-) • Timed Up and Go Test (+exp1) • 10-Meter walk test (-) • Abdominal muscles thickness ○ Affected side (-) ○ Non-affected side (-) E1 vs E2 • Functional Reach Test (-) • Berg Balance Scale (-) • Timed Up and Go Test (-) • 10-meter walk test (-) • Abdominal muscles thickness (-)
Muckel et al. (2014) RCT (7) Nstart=20 Nend=19 TPS=Subacute	E: External focus on trunk control C: Internal focus on trunk control Duration: 3 times	• Maximum distance in Lateral body weight shifting (+exp) • Anterior posterior deviation (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Trunk Training

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Trunk training** may produce greater improvements in motor function than **conventional therapy.**	3	Dubey et al. 2018; Büyükavci et al. 2016; Saeys et al. 2012
1b	**Trunk training with robotics** may produce greater improvements in motor function than **conventional therapy.**	1	Min et al. 2020
1b	**Trunk training on an unstable surface** may not produce greater improvements in motor function than **conventional therapy.**	1	Lee et al. 2020

FUNCTIONAL AMBULATION

LoE	Conclusion Statement	RCTs	References
1a	**Trunk training** may produce greater improvements in functional ambulation than **conventional therapy.**	6	Dubey et al. 2018; Hareuyama et al. 2017; Jung et al. 2014; Chung et al. 2013; Mahmood et al. 2012 Dean et al. 2007
1a	**Trunk training with visual or auditory feedback** may produce greater improvements in functional ambulation than **conventional therapy**	3	Shin et al. 2020; Shin & Song 2016; De Seze et al. 2001
1b	**Trunk training with physio equipment** may produce greater improvements in functional ambulation than **conventional therapy.**	1	Choi et al. 2021.
1b	**Trunk stabilization exercises with a pelvic compression belt on the paretic side** may produce greater improvements in functional ambulation than **trunk stabilization exercises alone.**	1	Choi et al. 2020
1b	**Trunk stabilization exercises with a pelvic compression belt on the paretic side** may produce greater improvements in functional ambulation than **trunk stabilization exercises with a pelvic compression belt on the non-paretic side.**	1	Choi et al. 2020
1b	**Trunk training on a stable surface** may produce greater improvements in functional ambulation than **conventional therapy.**	1	Karthikababu et al. 2018
1b	**Trunk training on an unstable surface** may produce greater improvements in functional ambulation than **conventional therapy.**	1	Lee et al. 2020; Karthikababu et al. 2018
1b	**Trunk training with dual task training** may produce greater improvements in functional ambulation than **trunk training alone.**	1	Ahmed et al. 2021
1b	**Trunk training** may produce greater improvements in functional ambulation than **cognitive training.**	1	VanCriekinge et al. 2020
2	**Dynamic neuromuscular stabilization training** may produce greater improvements in functional ambulation than **conventional therapy.**	1	Yoon et al. 2020
2	**Trunk training with robotics** may produce greater improvements in functional ambulation than **trunk training alone.**	1	Moon et al. 2017
1b	There is conflicting evidence on the effect of **trunk stabilization with abdominal hallowing** when compared to **conventional therapy** for improving functional ambulation.	1	Lee et al. 2020
1b	**Trunk stabilization with bracing** may not have a difference in efficacy for producing greater improvements in functional ambulation when compared to **conventional therapy.**	1	Lee et al. 2020
1b	**Trunk stabilization with abdominal hollowing** may not have a difference in efficacy for producing greater improvements in functional ambulation when compared to **trunk stabilization with bracing.**	1	Lee et al. 2020

1b	**Trunk stabilization exercises with a pelvic compression belt on the non-paretic side** may not have a difference in efficacy for producing greater improvements in functional ambulation when compared to **trunk stabilization exercises alone.**	1	Choi et al. 2020
1b	**Trunk training using robotics** may not have a difference in efficacy for producing greater improvements in functional ambulation when compared to **conventional therapy.**	1	Min et al. 2020
1b	**Trunk training on a stable surface** may not have a difference in efficacy for producing greater improvements in functional ambulation when compared to **trunk training on an unstable surface.**	3	Sarwar et al. 2019; Tirupatamma et al. 2019; Karthikbabu et al. 2018

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
2	**Trunk training** may produce greater improvements in functional mobility than **conventional therapy.**	1	Büyükavci et al. 2016
1b	**Trunk training on an unstable surface** may not have a difference in efficacy for producing greater improvements in functional mobility when compared to **conventional therapy.**	1	Lee et al. 2020

BALANCE

LoE	Conclusion Statement	RCTs	References
1a	**Trunk training with physio equipment** may produce greater improvements in balance than **conventional therapy**.	2	Choi et al. 2021; Cho et al. 2019
1a	**Trunk training on a tilted or unstable surface or with draw in bridge** may produce greater improvements in balance than **trunk training on a stable surface or conventional trunk training.**	3	Fujino et al. 2016; Lim et al. 2012; Karthikbabu et al. 2011
1a	**Trunk training on an unstable surface** may produce greater improvements in balance than **conventional therapy.**	3	Karthikbabu et al. 2022; Lee et al. 2020; Karthikbabu et al. 2018
1a	**Trunk training with visual or auditory feedback** may produce greater improvements in balance than **conventional therapy.**	4	Shin et al. 2020; Jung et al. 2017; Sin & Song 2016; De Seze et al. 2001
1b	**Trunk training with robotics** may produce greater improvements in balance than **trunk training alone.**	1	Kim et al. 2022
1b	**Trunk training with dual task training** may produce greater improvements in balance than **trunk training alone.**	1	Ahmed et al. 2021
1b	**Trunk stabilization exercise with a pelvic compression belt on the paretic side** may produce greater improvements in balance than **Trunk stabilization exercise alone.**	1	Choi et al. 2021

1b	**Trunk stabilization exercise with a pelvic compression belt on the non-paretic side** may produce greater improvements in balance than **Trunk stabilization exercise alone.**	1	Choi et al. 2021
1b	**Trunk training with robotics** may produce greater improvements in balance than **conventional therapy.**	1	Min et al. 2020
1b	**Trunk training** may produce greater improvements in balance than **cognitive training.**	1	Van Criekinge et al. 2020
1b	**Trunk training with balance training and transcutaneous electrical nerve stimulation** may produce greater improvements in balance than **treadmill training.**	1	Lim et al. 2019
1a	There is conflicting evidence about the effect of **trunk training** when compared to **conventional therapy** for improving balance.	9	Mahmood et al. 2022; Park et al. 2019; Dubey et al. 2018; Haruyama et al. 2017; Büyükavci et al. 2016; Cabanas-Valdes et al. 2016; Jung et al. 2014; Saeys et al. 2012; Verheyden 2009
1a	There is conflicting evidence about the effect of **trunk training on a tilted platform** when compared to **trunk training on a horizontal platform** for imporoving balance.	2	Fukata et al. 2021; Fujino et al. 2016
1b	There is conflicting evidence about the effect of **trunk training using robotics** when compared to **conventional therapy** for improving balance performance.	1	Min et al. 2020
1a	**Trunk training on a stable surface** may not have a difference in efficacy for producing greater improvement in balance than **trunk training on an unstable surface.**	6	Karthikbabu et al. 2022; Sarwar et al. 2019; Tirupatamma et al. 2019; Karthikbabu et al. 2019; Lim et al. 2012; Karthikbabu et al. 2011
1a	**Trunk muscle activation exercises** may not have a difference in efficacy for producing greater improvements in balance than **conventional therapy.**	2	Lee et al. 2020; Muckel et al. 2014
1b	**Trunk stabilization exercise with a pelvic compression belt on the paretic side** may not have a difference in efficacy for producing greater improvements in balance than **Trunk stabilization exercise with a pelvic compression belt on the non-paretic side.**	1	Choi et al. 2021
2	**Dynamic neuromuscular stabilization** may not have a difference in efficacy for producing greater improvements in balance than **conventional care.**	2	Yoon et al. 2020; Lee et al. 2018

GAIT

LoE	Conclusion Statement	RCTs	References

1b	**Trunk stabilization exercise with a pelvic compression belt on the paretic side** may produce greater improvements in gait than t**runk stabilization exercise alone.**	1	Choi et al. 2021
1b	**Trunk training on a stable surface** may produce greater improvements in gait than **conventional therapy.**	1	Karthikbabu et al. 2018
1b	**Trunk training on an unstable surface** may produce greater improvements in gait than **conventional therapy.**	1	Karthikbabu et al. 2018
1b	**Trunk training with visual or auditory feedback** may produce greater improvements in gait than **conventional therapy**.	1	Shin et al. 2020
1b	There is conflicting evidence about the effect of **trunk training** to improve gait when compared to **cognitive training**.	1	Van Criekinge et al. 2020
1b	There is conflicting evidence about the effect of **trunk stabilization exercises with a pelvic compression belt on the paretic side** to improve gait when compared to **trunk stabilization exercises with a pelvic compression belt on the non-paretic side.**	1	Choi et al. 2021
1b	**Trunk training** may not have a difference in efficacy for producing greater improvements in gait when compared to **conventional therapy.**	2	Chung et al. 2013; Saeys et al. 2012
1b	**Trunk stabilization exercises with a pelvic compression belt on the paretic side** may not have a difference in efficacy for producing greater improvements in gait than **Trunk stabilization exercise alone.**	1	Choi et al. 2021
1b	**Trunk training on a stable surface** may not have a difference in efficacy for producing greater improvements in gait than **trunk training on an unstable surface.**	1	Karthikbabu et al. 2022
1b	**Trunk training** may not have a difference in efficacy for producing greater improvements in gait than **cognitive training.**	1	Van Criekinge et al. 2020
2	**Trunk training with robotics** may not have a differeince in efficacy for producing greater improvements in gait than **trunk training alone.**	1	Moon et al. 2017

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Trunk training** may produce greater improvements in performance of activities of daily living when compared to **conventional therapy.**	4	Park et al. 2019 ;Dubey et al. 2018; Büyükavci et al. 2016; Cabanas-Valdes et al. 2016
1b	**Trunk training with robotics** may produce greater improvements in performance of activities of daily living when compared to **conventional therapy.**	1	Min et al. 2020

1b	**Trunk training on a stable surface** may produce greater improvements in performance of activities of daily living when compared to **conventional therapy.**	1	Karthikbabu et al. 2018
1b	**Trunk training on an unstable surface** may produce greater improvements in performance of activities of daily living when compared to **conventional therapy.**	1	Karthikbabu et al. 2018
1a	There is conflicting evidence about the efficacy of t**runk training with tilted platforms** to improve performance in activities of daily living when compared to **trunk training with horizontal platforms.**	2	Sawa et al. 2022; Fukata et al. 2021
1b	**Trunk training on a stable surface** may not produce greater improvements in performance of activities of daily living when compared to **trunk training on an unstable surface.**	1	Karthikbabu et al. 2018
1b	**Trunk training with visual or auditory feedback** may not produce greater improvements in performance of activities of daily living when compared to **conventional therapy.**	1	De Seze et al. 2001

RANGE OF MOTION

LoE	Conclusion Statement	RCTs	References
1a	**Trunk training** may produce greater improvements in the range of motion when compared to **conventional therapy.**	2	Mahmood et al. 2022; Haruyama et al. 2017
1b	There is conflicting evidence about the effect of **trunk training** to improve range of motion when compared to **cognitive training.**	1	Van Criekinge et al. 2020

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1b	**Trunk training on a stable surface** may produce greater improvements in muscle strength than **conventional therapy.**	1	Karthikbabu et al. 2022
1b	**Trunk training on an unstable surface** may produce greater improvements in muscle strength than **conventional therapy.**	1	Karthikbabu et al. 2022
1b	**Dynamic neuromuscular stabilization** may produce greater improvements in muscle strength than **conventional therapy.**	1	Lee et al. 2018
2	**Trunk training** may produce greater improvements in muscle strength than **conventional therapy.**	1	Dubey et al. 2018
2	**Trunk training with robotics** may produce greater improvements in muscle strength than **trunk training alone.**	1	Moon et al. 2017

1a	**Trunk training with visual or auditory feedback** may not produce greater improvements in muscle strength than **conventional therapy.**	2	Jung et al. 2001; Jung et al. 2017
1b	**Trunk training on a stable surface** may not produce greater improvements in muscle strength than **trunk training on an unstable surface.**	1	Karthikbabu et al. 2022
1b	**Trunk muscle activation exercises** may not produce greater improvements in muscle strength than **conventional therapy.**	1	Lee et al. 2020

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
1b	**Trunk training** may produce greater improvements in the quality of life when compared to **conventional therapy.**	1	Mahmood et al. 2022
1b	**Trunk training on a stable surface** may produce greater improvements in the quality of life when compared to **conventional therapy.**	1	Karthikbabu et al. 2018
1b	**Trunk training with dual task training** may produce greater improvements in quality of life when compared to **trunk training alone.**	1	Ahmed et al. 2021
1b	**Trunk training on an unstable surface** may produce greater improvements in the quality of life when compared to **conventional therapy.**	1	Karthikbabu et al. 2018
1b	**Trunk training on a stable surface** may not produce greater improvements in the quality of life when compared to **trunk training on an unstable surface.**	1	Karthikbabu et al. 2018

PROPRIOCEPTION

LoE	Conclusion Statement	RCTs	References
1b	**Trunk training with balance training and transcutaneous electrical nerve stimulation** may produce greater improvements in proprioception when compared to **treadmill training.**	1	Lim et al. 2019
1a	There is conflicting evidence about the effect of **trunk training with tilted platforms** to improve proprioception when compared to **trunk training with horizontal platforms.**	2	Sawa et al. 2022; Fukata et al. 2021

STROKE SEVERITY

LoE	Conclusion Statement	RCTs	References
1a	**Trunk training with tilted platforms** may not improve stroke severity when compared to **trunk training with horizontal platforms.**	2	Fukata et al. 2021; Fujino et al. 2016

SPASTICITY

LoE	Conclusion Statement	RCTs	References

1b	**Trunk training with visual or auditory feedback** may not improve spasticity when compared to **conventional therapy.**	1	De Seze et al. 2001

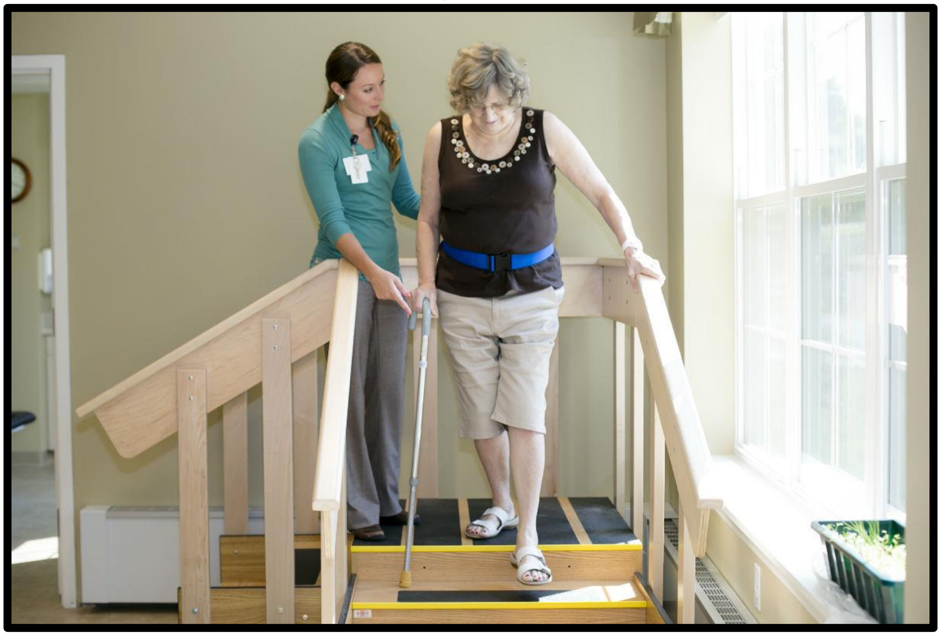
Key Points

Trunk training may be beneficial for improving motor function, functional ambulation, balance, and quality of life after stroke.

The literature is mixed regarding the effect of trunk training on improvement of gait, functional mobility, range of motion, and proprioception after stroke.

Trunk training may not be beneficial for improving stroke severity, and spasticity of lower limb after stroke.

Task-Specific Training



Adopted from: http://berkshireplace.com/programs-services/skilled-nursing-rehabilitation/

Task-specific training, also referred to as task-oriented, goal-directed, or functional task practice, involves therapy in which patients perform practical motor tasks that would be used in their everyday life, such as walking up the stairs. Tasks should be relevant, repetitive, and should be designed to progress towards performance of the whole task while being reinforced with feedback (Hubbard et al., 2009).

Task-specific circuit training is a tailored intervention program targeting balance, gait, strength, aerobic capacity, and range of movement. The training involves performing various exercises at different stations and is often performed in groups. In addition to lower limb recovery, benefits associated with circuit training include peer support and social interaction, as well as more efficient use of therapy staff.

46 RCTs were found evaluating task-specific training for lower extremity motor rehabilitation. Five RCTs compared task-specific training to conventional therapy or education (Ain et al., 2022; Arabzadeh et al., 2018; Ntsiea et al., 2015; Richards et al., 2004; Salbach et al., 2004). Two RCTs compared task-specific training with altered sensory input to conventional therapy (Kuberan et al., 2017; Park & Won, 2017). Two RCTs compared task-oriented reach training to sham training (Dean et al., 2007; Dean & Shepherd, 1997). Two RCTs compared task-specific training with treadmill training (Kwon et al., 2015; Sharma & Pandey, 2014). One RCT compared task-oriented resistance training to no treatment (Yang et al., 2006). Four RCTs compared task-oriented gait training to conventional training (Knox et al., 2018; Qurat Ul et al., 2018a; Qurat ul et al., 2018b; Richards et al., 1993). Five RCTs compared task specific circuit training to conventional or sham training (English et al., 2015; Indurkar & Iyer, 2013; Kim et al., 2016d; Martins et al., 2020; Sherrington et al., 2008). One RCT compared task-specific training to the use of orthoses (Kwakkel & Wagenaar, 2002). One RCT compared task-oriented leg training to body weight supported training (Brunelli et al., 2019). One RCT compared task-specific training in different discharge locations (Gjelsvik et al., 2014). One RCT compared task-oriented training to activity repetition (Ghous et al., 2017). Six RCTs compared task-specific training combined with other

therapies to task-specific therapy (Cha & Oh, 2016; Kim & Jang, 2021b; Kluding & Santos, 2008; Malik & Masood, 2021; Marin et al., 2013; Verma et al., 2011). One RCT compared lower body to upper body task-specific training (Dean et al., 2000). Two RCTs compared task-oriented training with tilt table to tilt table alone (Kim et al., 2015a; Kim et al., 2015b). Two RCTs compared high intensity task-specific training to low intensity (Outermans et al., 2010; Wellwood, 2004). Four RCTs compared task-specific circuit training, either individually or as a group, to conventional rehabilitation or group-based rehabilitation (Ali et al., 2020; Mudge et al., 2009; Renner et al., 2016; van de Port et al., 2012). One RCT compared task-specific training to proprioceptive neuromuscular facilitation (Anandan et al., 2020). Three RCTs combined task-oriented training with TENS (Hui-Chan et al., 2009; Ng & Hui-Chan, 2007; Ng et al., 2016). Lastly, two RCTs compared Bobath with task-specific training to task-specific training alone (Brock et al., 2011; Mudie et al., 2002).

The methodological details and results of all 46 RCTs are presented in in Table 5.

Table 5. RCTs Evaluating Task-Specific Training Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Task-Specific Training vs Conventional Therapy		
Ain et al. (2022) RCT (4) NStart=14 NEnd=12 TPS=Subacute	E: Task-specific training C: Conventional rehabilitation Duration: 12wks	• Timed-Up-and-Go Test (+exp) • Trunk Control Measurement Scale (-) • 6-Minute Walk Test (-) • Berg Balance Scale (+exp)
Arabzadeh et al. (2018) RCT (5) NStart=20 NEnd=20 TPS=Subacute	E: Task-oriented Exercises C: Conventional Physiotherapy Duration: 50min/session, for 4wks	• Berg Balance Scale (+exp) • Center of Pressure (COP) path length (+exp) • COP Confidence Ellipse Area (+exp) • Plantar Pressure Distribution (weight bearing) ○ Affected side (-) ○ Nonaffected Side (-)
Ntsiea et al. (2015) RCT (7) Nstart=80 Nend=80 TPS=Subacute	E: Workplace intervention program (functional exercises) + Usual rehabilitation therapy C: Usual rehabilitation therapy Duration: 3-6 months	• Rate of return to work (+exp) • Barthel index (+exp) • Modified Rivermead mobility index (+exp) • Montreal Cognitive Assessment (-) • Stroke specific quality of asklife scale (-)
Richards et al. (2004) RCT (6) Nstart=63 Nend=60 TPS=Subacute	E: Specialized task oriented locomotor training (includes using Tilt table, limb-load monitor, isokinetic device and treadmill training) + Conventional physiotherapy C: Conventional physiotherapy Duration: 60min/d, 5d/wk for 8wks	• Gait speed (-) • Fugl-Meyer Assessment ○ Leg (-) ○ Arm (-) • Timed Up and Go test (-) • Barthel Index (-) • Berg Balance Scale (-)
Salbach et al. (2004) RCT (8) Nstart=91 Nend=84	E: Task-oriented training C: Upper extremity activities (sham)	• 6-min Walk Test (+exp) • 5-m Walk (+exp) • Timed Up and Go (-)

TPS=Chronic	Duration: 60min/d, 3d/wk, for 6wks	• Berg Balance Scale (-)
Task oriented training with altered sensory input		
Kuberan et al. (2017) RCT (5) NStart=26 NEnd=26 TPS=Chronic	E: Task-oriented training + Altered sensory input C: Conventional physical therapy Duration: 45-60min/d, 5d/wk for 3wks	• Dynamic Gait Index (-) • Timed Up-and-Go Test (+exp) • Fall Efficacy Scale (+exp)
Park & Won. (2017) RCT (5) Nstart=28 Nend=26 TPS=Chronic	E: Task-Oriented Training + altered sensory input C: Conventional Physical Training Duration: Physical Therapy 5d/wk, 4wks + Task-oriented Training 1hr/d, 3d/wk, 4wks	• Berg Balance Scale (+exp) • Activities-Specific Balance Confidence Scale (-) • Limit of Stability (-)
Task Oriented sitting Reach Training vs Sham Training		
Dean et al. (2007) RCT (7) Nstart=12 Nend=9 TPS=Acute & Subacute	E: Sitting Reach Training + Regular physiotherapy C: Sham Training + Regular physiotherapy Duration: 30min/d, 5d/wk, 2wks	• Maximum Sitting Reach Distance (modified functional reach test in sitting) (+exp) • Reaching Time (+exp) • Peak vertical force through affected foot during reaching (+exp) • Peak vertical force through affected foot during standing up (+exp) • 10-Meter Walking Test (-)
Dean et al. (1997) RCT (7) Nstart=20 Nend=19 TPS=Chronic	E: Task- oriented reach training C: Sham training Duration: 30min/session, 10 sessions over 2wks	• Maximum distance reached ○ Ipsilateral (+exp) ○ Forward (+exp) ○ Across (+exp) • Peak Vertical Ground reaction forces ○ Ipsilateral (-) ○ Forward (+exp) ○ Across (+exp) • Hand movement time ○ Ipsilateral (+exp) ○ Forward (-) ○ Across (+exp) • 10-Meter Walk Test (-) • Cognitive task ○ Letter cancellation (+con) ○ Word puzzle (-) ○ Mathematics (-)
Task Specific Treadmill Training vs Standard Treadmill Training		
Kwon et al. (2015) RCT (5) Nstart=40 Nend=40 TPS=Chronic	E: Task-oriented treadmill training + conventional therapy C: Treadmill training + conventional therapy Duration: 30min/d, 5d/wk, 8wks conventional therapy, task-oriented treadmill training or conventional treadmill	• Timed Up-and-Go Test (+exp) • 6-Minute Walk Test (+exp) • Gait Parameters ○ Stride length (+exp) ○ Gait cycle (+exp) ○ Cadence (+exp) ○ Affected step length (+exp) ○ Average speed (+exp) ○ Affected single support (+exp) ○ Affected step (+exp) ○ Affected speed (+exp)
Task-Oriented Training vs Speed Dependent Treadmill Training		

Sharma et al. (2014) RCT (5) Nstart=30 Nend=30 TPS=Chronic	E: Task-oriented training (focused on LE function and gait) C: Speed-dependent treadmill training Duration: 30min/d, 3d/wk, 4wks	• Berg Balance Scale (-) • Rivermead Mobility Index (-)
Task Oriented Resistance Training vs No Treatment		
Yang et al. (2006) RCT (7) Nstart=48 Nend=48 TPS=Chronic	E: Task-oriented progressive resistance strength training C: No treatment Duration: 30min/d, 3d/wk for 4wks Task-oriented resistance training	• Muscle strength ○ Hip flexor (+exp) ○ Hip extensor (+exp) ○ Knee flexor (+exp) ○ Knee extensor (+exp) ○ Ankle dorsiflexor (+exp) ○ Ankle plantarflexor (+exp) • 10-m Walk Velocity (+exp) • Cadence (+exp) • Stride length (+exp) • 6-Minute Walk Test (+exp) • Step Test (+exp) • Timed Up-and-Go Test (+exp)
Task Oriented Gait Training vs Conventional Training		
Knox et al. (2018) RCT (7) NStart=144 NEnd=128 TPS=Subacute	E1: Task oriented circuit gait training E2: Strength training of lower extremities C: Educational session on stroke management Duration: E1/E2: 60min/d, 6d/12wk intervention sessions & C: 90min/d, 1d	E1/E2 vs C • Berg Balance Scale (+exp1) • 10m walk ○ Comfortable Gait Speed (+exp1) ○ Fast gait speed (+exp1) • Timed Up and Go test (+exp1) • 6-minute walk test (+exp1, +exp2) E1 vs E2 • Berg Balance Scale (+exp1) • 10-Meter Walk Test ○ Comfortable Gait Speed (+exp1) ○ Fast gait speed (+exp1) • Timed Up and Go test (+exp1) • 6-minute walk test (+exp1)
Qurat-Ul-ain et al., (2018) RCT (6) Nstart= 30 Nend = 30 TPS= Subacute and Chronic	E: Circuit gait training C: Traditional gait training Duration: 30-40min/d, 3-4d/wk for 6wks	• Berg Balance scale (+exp) • Fall Efficacy scale (+exp) • Stroke Specific QOL scale (+exp)
Qurat-ul-Ain et al. (2018) RCT (5) NStart=36 NEnd=30 TPS=Subacute and Chronic	E: Task specific Circuit Gait Training C: Conventional standard rehabilitation (Gait training) Duration: 40-50min/d, 4d/wk, for 6wks	• Timed Up-and-Go Test (+exp) • Cadence (+exp) • Step length (+exp) • Step width (+exp)
Richards et al. (1993) RCT (6) Nstart=27 Nend=27 TPS=Acute	E: Early, intensive, gait-oriented Task specific training (isokinetic device, treadmill, tilt table) + conventional hospital care	E vs C1 vs C2 • Gait velocity (-) • Fugl-Meyer Assessment ○ Balance (-) ○ Leg (-)

	C1: Early, intensive traditional PT approach + conventional hospital care C2: Conventional PT + conventional hospital care Duration: E/C1: 60min, 2sessions/d, 5d/wk, 5wks & C2: 60min/d, 5d/wk, 5wks	• Barthel Index (-)
Task Specific Circuit Training vs Conventional/Sham		
Martins et al. (2020) RCT (8) NStart=36 NEnd=28 TPS=Chronic	E: Task-specific circuit training (focused on UE and LE mobility) C: Training program including stretching, memory exercises and health education Duration: 60min/d, 3d/wk, for 12wks	• Energy Expenditure (-) • Human Activity Profile Adjusted Activity Score (-) • Upper Extremity Performance Test for the Elderly (-) • Walking Speed (-) • Grip Strength (-) • Knee Extensor Strength (-) • Six-Minute Walk Test (-) • Stroke Specific Quality of Life (+exp)
Kim et al. (2016d) RCT (7) Nstart=20 Nend=20 TPS=Subacute	E: Task-specific circuit training (focused on mobility and gait training) C: Conventional rehabilitation Duration: 1hr/d, 5d/wk for 4wk	• Fugl-Meyer Assessment (-) • Berg Balance Scale (-) • 6-Minute Walk Test (-) • Modified Barthel Index (-)
English et al. (2015) RCT (7) Nstart=283 Nend=261 TPS=Acute	E: Group Circuit class therapy C1: Usual care C2: Seven-day week usual therapy Duration: E: 3h/d, 5d/wk circuit class training; C: 5d/wk usual care C2: 7d/wk seven-day week therapy	E v C1 • 6min walk test (-) • Gait speed (-) • Functional Ambulatory category (-) • Wolf Motor Function test (-) • Stroke Impact Scale (-) • Length of Stay (-) • Australian Quality of Life Scale (-) E v C2 • 6min Walk test (-) • Gait speed (-) • Functional Ambulatory category (-) • Wolf Motor Function test (-) • Stroke Impact Scale (-) • Length of stay (-) • Australian Quality of Life Scale (-) C1 v C2 • 6min Walk test (-) • Gait speed (-) • Functional Ambulatory category (-) • Functional Independence measure (-) • Wolf Motor Function test (-) • Stroke Impact Scale (-) • Length of stay (-) • Australian Quality of Life scale (-)
Indurkar et al. (2013) RCT (4) Nstart=30 Nend=30	E: Task Oriented circuit LE strength training + physiotherapy	• 6-min Walk Test (+exp) • 5m Walk Test (+exp) • Berg Balance (+exp)

TPS=Chronic	C: Conventional physiotherapy Duration: 30min/d, 6dwk for 3wks circuit training & 60min physiotherapy	• Timed Up and Go (+exp)
Sherrington et al. (2008) RCT (7) Nstart=173 Nend=159 TPS=Not Reported	E: Task-Specific Circuit-Style group Exercise C: No treatment Duration: 1 hr/d, 2 d/wk for 5 wks	• Step Test (+exp) • Balance Scale ○ Semi-tandem Stance (-) ○ Tandem Stance (-) ○ Sit-to-Stand ○ Rate (+exp) ○ Minimum Height (-) • 6-Metre Gait Velocity (+exp) • 6-Minute Distance (+exp) • Knee extension (-) • Knee flexion (-)
Task-Specific Training vs Orthoses		
Kwakkel & Wagenaar (2002) RCT (5) Nstart=53 Nend=53 TPS=Acute	E1: Lower extremity task-specific rehabilitation E2: Upper extremity task-specific rehabilitation C: Immobilization of paretic LE and UE using inflatable pressure splint Duration: 30min/d, 5d/wk, for 20wks	E1 vs E2 • Walking Speed (+exp1) • Continuous Relative Phase Non-Paretic Leg (-) • Continuous Relative Phase Paretic Leg (-) • Standard Deviation of Continuous Relative Phase Leg (-) E1, E2 vs C • Walking Speed (+exp1) • Continuous Relative Phase Non-Paretic Leg (-) • Continuous Relative Phase Paretic Leg (-) • Standard Deviation of Continuous Relative Phase Leg (-)
Task Oriented Leg Training vs Body Weight Support Training		
Brunelli et al. (2019) RCT (6) Nstart=37 Nend=34 TPS=Acute	E: Conventional Physiotherapy + Body Weight Support training C: Conventional Physiotherapy + Task-oriented leg training Duration: 40-min PT + 40 min BWS or task specific trainings/d, 5d/wk, 4wks	• Functional Ambulation Classification (+exp) • Rivermead Mobility Index (-) • Barthel Index (-) • 6-minute walk test (-)
Activity Repetition Training vs Task Oriented Training		
Ghous et al. (2017) RCT (4) Nstart=32 Nend=27 TPS=Chronic	E: Activity Repetition (salat prayer) Training C: Task oriented training Duration: 60min/d, 4d/wk, for 6 wks	• Berg Balance Scale (+exp) • Motor assessment scale (+exp) • Time Up and Go Test (+exp)
Task-Specific Training Different Modalities		
Gjelsvik et al. (2014) RCT (7) Nstart=167 Nend=105 TPS=Acute	E1: early supported discharge to Day unit focussed on task-oriented training E2: early supported discharge to patients home focussed on task-oriented training C: Traditional treatment	E1 v E2 v C: • Postural Assessment Scale for Stroke (-) • Functional Ambulation categories (-) • Trunk Impairment Scale-modified Norwegian version (+exp2) • Timed Up-and-Go (-) • 5-meter timed walk (-)

	Duration: 5wks	• Self-reported Numerical Rating Scale ○ Walking (+exp1) ○ Balance (-) ○ ADL (+exp1, +exp2) ○ Physical activity (-) ○ Pain (-) ○ Tiredness (-) E1 v E2: • Postural Assessment Scale for Stroke (-) • Functional Ambulation categories (-) • Trunk Impairment Scale-modified Norwegian version (+exp2) • Timed Up-and-Go (-) • 5-meter timed walk (-) • Self-reported Numerical Rating Scale ○ Walking (-) ○ Balance (-) ○ ADL (-) ○ Physical activity (-) ○ Pain (-) ○ Tiredness (-)
Task Specific Training Combined with Other Therapies vs Task Specific Therapy		
Kim et al. (2021) RCT (5) Nstart=45 Nend=37 TPS=Chronic	E1: Task-specific training + cognitive sensorimotor exercise E2: Task-specific training + conventional physical therapy C: Conventional physical therapy Duration: 60min/d, 5d/wk for 8wks	E1 vs E2: • Proprioception error (+exp1) • Composite spasticity score (-) • Gastrocnemius muscle tone (-) • 10-Metre Walk Test (-) E1 vs C: • Proprioception error (+exp1, +exp2) • Composite spasticity score (+exp1, +exp2) • Gastrocnemius muscle tone (+exp1, +exp2) • 10-Metre Walk Test (+exp1, +exp2)
Malik et al. (2021) RCT (6) Nstart=52 Nend=43 TPS=Subacute	E: Task-oriented training + Virtual reality training C: Task-oriented training Duration: 40-45min/d, 3d/wk, for 8wks task-oriented training & 15-20min/d 3d/wk for 8wks virtual reality training	• Fugl-Meyer Assessment-Lower Extremity (+exp) • Berg Balance Test (+exp) • Timed Up and Go test (+exp) • Dynamic Gait Index (-)
Cha et al. (2016) RCT (6) Nstart=25 Nend=20 TPS=Chronic	E: Task-oriented training + mirror therapy C: Task oriented training Duration: 30min/d, 2 sessions/d, 5d/wk for 4wks	• Berg Balance scale (+exp) • Timed Up-and-Go test (+exp) • Balance index (+exp) • Dynamic limit of stability (+exp)
Marin et al. (2013) RCT (8) Nstart=20 Nend=20 TPS=Chronic	E: Task-Specific Training + Whole-Body Vibration Treatment (With an increase in frequency, sets, and time) C: Task-Specific Training + Sham Vibration Duration: 1-2d/wk, 12wks (17 total sessions WBV,	• Muscle thickness (-) • Berg Balance Scale (-) • Maximal isometric voluntary contraction of knee extensor (-)

	120min/session, 10 sessions/mo, for 3mo Task-specific sessions	
Verma et al. (2011) RCT (8) Nstart=30 Nend=30 TPS=Subacute	E: Task-oriented circuit class training + Motor imagery C: Standard rehabilitation (Bobath) Duration: 15min/d, 7d/wk, 2wks motor imagery, 25min/d, 7d/wk, 2wks task-oriented circuit class training, 40min/d, 7d/wk, 2wks standard rehabilitation	• Functional ambulation category (+exp) • Rivermead Visual gait assessment (+exp) • Step length asymmetry (-) • Cadence (+exp) • Stride length asymmetry (-) • 10-meter Walk test ○ Maximum speed (-) ○ Comfortable speed (+exp) • 6-Minute Walk test (+exp)
Kluding et al. (2008) RCT (5) Nstart=17 Nend=16 TPS=Chronic	E: Task-specific training + Ankle joint mobilizations C: Task-specific training Duration: 30min/d, 2d/wk for 4wk	• Passive ROM (+exp) • Active ROM (+exp) • Ankle Kinematics (-); -during sit-to-stand (-); during Gait (-) • Weight bearing symmetry; -during static standing (-); - during sit-to-stand (+con) • Sit-to-Stand time (+exp) • Rivermead mobility index (-)
Lower body vs Upper Body Task Specific Training		
Dean et al. (2000) RCT (5) Nstart=12 Nend=9 TPS=Chronic	E: Task-related lower body circuit training C: Task-related upper body circuit training Duration: 60min/d, 3d/wk for 4wks	• 10-meter Walk Test ○ With Assistive Device (-) ○ Without Assistive Device (+exp) • 6-minute Walk Test (+exp) • Step Test (+exp) • Timed Up and Go (-) • Sit-to-stand (+exp)
High Intensity Task-Specific Training vs Low Intensity Training or vs Conventional Therapy		
Outermans et al. (2010) RCT (7) Nstart=44 Nend=32 TPS=Acute	E: High-intensity task-oriented training + Usual therapy C: Low-intensity circuit physiotherapy + usual care Duration: 75min/d, 3d/wk, 4wks	• 10-Metre Walk Test (+exp) • 6-Minute Walk Test (+exp) • Berg Balance Scale (-) • Functional Reach Test (-)
Wellwood et al. (2004) RCT (7) Nstart=70 Nend=65 TPS=Chronic	E: Task-specific training, higher dosage C: Task-specific training, lower dosage Duration: 60-80min/d, 5d/wk for 4wk	• River Mobility Index (-) • Motricity Index (-) • Barthel Index (-) • Nottingham Extended ADL Index (-)
Task Oriented Training with Tilt Table vs Tilt Table Alone		
Kim et al. (2015) RCT (6) Nstart=39 Nend=39 TPS=Acute	E1: Tilt Table + Conventional therapy E2: Task-oriented training on tilt table + Conventional therapy C: Conventional therapy Duration: 50min/d, 5d/wk, 3wks	E2 vs E1/C • Barthel Index (+exp2) • National Institutes of Health Stroke Scale (+exp2) • Fugl Meyer Assessment (+exp2)

Kim et al. (2015)
RCT (5)
Nstart=37
Nend=30
TPS=Chronic
	E1: Tilt table one-leg standing training + Conventional rehabilitation
	E2: Tilt table progressive task-oriented training + Conventional rehabilitation
	C: Tilt table (Both legs strapped) + Conventional rehabilitation
	Duration: 30min/d, 5d/wk, 3wks routine therapy + 20min/d, 5d/wk, 3wks tilt table
		<u>E1 vs E2</u>
		
		• Lower extremity muscle strength
		  ○ Hip (-)
		  ○ Knee (+exp2)
		  ○ Ankle (+exp2)
		• Gait velocity (-)
		• Cadence (-)
		• Stride length (+exp2)
		• Gait symmetry ratio (+exp2)
		• Double support period (+exp2)
		
		<u>E1/E2 vs C</u>
		
		• Lower extremity muscle strength
		  ○ Hip (+exp1, +exp2)
		  ○ Knee (+exp1, +exp2)
		  ○ Ankle (+exp1, +exp2)
		• Gait velocity (+exp1, +exp2)
		• Cadence (+exp1, +exp2)
		• Stride length (+exp2)
		• Gait symmetry ratio (+exp1, +exp2)
		• Double support period (+exp1, +exp2)

Task-Specific Circuit Training vs Group Activities		
Mudge et al. (2009) RCT (7) Nstart=58 Nend=55 TPS=Chronic	E: Task-specific circuit training C: Social and educational classes Duration: 50-60min/d, 3d/wk, 4wks Circuit-training & 90min/d, 2d/wk, 4wks social and educational session	• 10m walk test (-) • 6-minute walk test (+exp) • Activities-Based Confidence Scale (-) • Rivermead Mobility Index (-) • Physical Activity and Disability Scale (-) • Usual walking performance (-)
Task-Specific Training vs Proprioceptive Neuromuscular Facilitation		
Anandan et al. (2020) RCT (4) Nstart=74 Nend=50 TPS=Chronic	E1: Task-specific training E2: Proprioceptive Neuromuscular Facilitation Duration: 60min/session, 10wks	• Modified Ashworth Scale (+exp1) • Action Research Arm Test (+exp1) • Berg Balance Scale (+exp1) • Dynamic Gait Index (+exp1)
Group Task-Oriented Circuit Training vs Conventional Training		
Ali et al., (2020) RCT (6) Nstart=22 Nfinal=22 TPS=Subacute	E: Group task specific training C: Individual task specific training Duration: 50min/d, 3d/wk for 6wk	• Berg Balance Scale (-) • Dynamic Gait Index (-) • Motor Assessment Scale (-) • Timed-Up-and-Go Test (-) • 10-Meter Walk Test (-) • Ashworth's Scale (-) • 6 Minute Walk Test (-) • Functional Reach Test (-)

Renner et al. (2016)
RCT (7)
Nstart=73
Nend=64
TPS=Subacute
	E: Group task-specific training + rehabilitation therapies
	C: Individual task-specific + rehabilitation therapies training
	Duration: 90min/d, 5d/wk, 6wks
		• Stroke Impact Scale (-)
		• Rivermead mobility index (-)
		• Falls Efficacy scale (-)
		• Hospital Anxiety and Depression scale
		  ○ Depression (-)
		  ○ Anxiety (+exp)
		• Fatigue Severity scale (-)
		• Motricity index (-)
		• Functional ambulation categories (-)
		• 6-minute walk test (-)

		• 10-meter walk (-) • Timed balance test (-) • Timed-up-and-go (-) • Chair stand-up test (-) • Modified stairs climb test (+exp) • Letter cancellation task (-)
Vandeport et al. (2012) RCT (7) Nstart=250 Nend=242 TPS=Subacute	E: Group Task-oriented circuit training in community C: Usual outpatient physiotherapy Duration: 90min/d, 2d/wk for 12wks - Circuit training	• Stroke impact scale (-) • Nottingham extended ADSISL (-) • Hospital Anxiety and Depression scale (-) • Falls Efficacy Test (-) • Rivermead mobility index (-) • Motricity index (-) • Functional ambulation category (-) • 6min Walk test (+exp) • 5m Walk test (+exp) • Timed balance test (-) • Timed Up and Go (-) • Modified Stairs test (-) • Letter cancellation test (-)
Task-related Training combined with TENS		
Ng et al. (2016) RCT (7) Nstart=76 Nend=69 TPS=Subacute	E: TENS + task-oriented balance training + conventional therapy C: C: Sham TENS+ task-oriented balance training + conventional therapy Duration: 60min/d, 2d/wk, 8wks. TENS + TOBT concurrent 150min/d conventional physiotherapy	• Berg Balance Scale (+exp) • 6-minute walk test (-) • Modified Rivermead Mobility Index (-) • Timed up and go test(+exp) • SF-36 (-)
Hui-Chan et al. (2009) RCT (7) Nstart=109 Nend=101 TPS=Chronic	E1: TENS E2: Placebo TENS + Task-related training E3: TENS + Task-related training C: No treatment Duration: 60min/d, 5d/wk, 4wks TENS ; 60min/d, 5d/wk, 4wks Placebo TENS; 60min/d, 5d/wk, 4wks Task-related training	<u>E1/E2/E3 v C:</u> • Composite spasticity scale (+exp1, +exp2, +exp3) • Maximum isometric contraction-Ankle (+exp2, +exp3) • 6min Walk test (+exp2, +exp3) • Timed Up and Go (+exp2, +exp3) <u>E3 v E1</u> • Composite spasticity scale (-) • Maximum isometric contraction-Ankle (+exp3) • Gait velocity (+exp3) • 6min Walk test (+exp3) • Timed Up and Go (+exp3) <u>E3 v E2</u> • Composite spasticity scale (-) • Maximum isometric contraction-Ankle (-) • Gait velocity (+exp3) • 6min Walk test (-) • Timed Up and Go (+exp3) <u>E1 v E2:</u> • Composite spasticity scale (-) • Maximum isometric contraction ○ Ankle Dorsiflexion (+exp1) ○ Ankle Plantarflexion (-)

		• Gait velocity (-) • 6min Walk test (-) • Timed Up and Go (-)
Ng & Hui-Chan (2007) RCT (6) Nstart=88 Nend=80 TPS= Chronic	E1: TENS E2: Placebo TENS + Task-related training E3: TENS + Task-related training C: No active treatment Duration: 60min/d, 5d/wk for 4wks	E1/E2/E3 v C • Composite Spasticity scale (+exp1, +exp2, +exp3) • Maximum isometric voluntary contradiction: peak torque-ankle (+exp1, +exp2, +exp3) • Gait velocity (+exp3) E3 v E1/E2 • Composite Spasticity scale (-) • Maximum isometric voluntary contradiction: peak torque-ankle (-) • Gait velocity (+exp3)
Task-Specific Training with Bobath Concept Approach vs Task-Specific Training		
Brock et al. (2011) RCT (7) Nstart=29 Nend=26 TPS=Chronic	E: BCA + Task specific practice C: Task specific practice Duration: 1h/session, 6sessions/wk, for 2wks	• Gait Velocity (+exp) • 6-Minute Walk Test (-) • Berg Balance Scale (-)
Mudie et al. (2002) RCT (4) Nstart=40 Nend=26 TPS=Acute and Subacute	E1: Task-specific training + Standard physiotherapy E2: BCA + Standard physiotherapy E3: Balance performance monitor feedback training + Standard physiotherapy C: Standard physiotherapy Duration: 30min/d, 7d/wk, for 2wks	E1 v E2 v E3 v C: • Barthel Index (-) ○ Mobility (-) • Weight distribution (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Task-Specific Training

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Task-specific training** may not have a difference in efficacy compared to **conventional therapy** for improving motor function.	1	Richards et al. 2004
1b	**Task-specific circuit training** may not have a difference in efficacy compared to **conventional or sham therapy** for improving motor function.	1	Kim et al. 2016
1b	**Task-oriented gait training** may not have a difference in efficacy compared to **conventional training** for improving motor function.	1	Richards 1993

1b	**Task-specific training with virtual reality** may produce greater improvements in motor function when compared to **task-specific training alone.**	1	Malik et al. 2021
1b	**Task-oriented training with tilt table** may produce greater improvements in motor function when compared to **tilt table alone.**	1	Kim et al. 2015
1b	**Task-oriented training with tilt table** may produce greater improvements in motor function when compared to **conventional therapy.**	1	Kim et al. 2015

FUNCTIONAL AMBULATION

LoE	Conclusion Statement	RCTs	References
2	**Task-specific training with altered sensory input** may produce greater improvements in functional ambulation when compared to **conventional therapy**.	1	Kuberan et al. 2017
2	**Task-specific training** may produce greater improvements in functional ambulation when compared to **orthoses**.	1	Kwakkel & Wagenaar 2002
2	**Task-specific treadmill training** may produce greater improvements in functional ambulation when compared to **treadmill training**.	1	Kwon et al. 2015
1b	**Task-specific circuit training** may produce greater improvements in functional ambulation when compared to **strength training of lower extremities**.	1	Knox et al. 2018
1b	**Task-oriented resistance training** may produce greater improvements in functional ambulation when compared to **no treatment**.	1	Yang et al. 2006
2	**Task-oriented training** may produce greater improvements in functional ambulation when compared to **activity repetition**.	1	Ghous et al. 2017
1a	**Task-oriented gait training** may produce greater improvements in functional ambulation when compared to **conventional training**.	3	Knox et al. 2018; Qurat-Ul-ain et al. 2018b; Richards 1993
2	**Task-specific training with cognitive sensorimotor** may produce greater improvements in functional ambulation when compared to **conventional physical therapy**.	1	Kim et al. 2021
2	**Task-specific training with physical therapy** may produce greater improvements in functional ambulation when compared to **conventional physical therapy**.	1	Kim et al. 2021
1b	**Task-specific training with virtual reality** may produce greater improvements in functional ambulation when compared to **task-specific training**.	1	Malik et al. 2021
1b	**Task-specific training with motor imagery** may produce greater improvements in functional	1	Verma et al. 2011

	ambulation when compared to **task-specific training**.		
1b	**Task-specific training with mirror therapy** may produce greater improvements in functional ambulation when compared to **task-specific training**.	1	Cha et al. 2016
2	**Task-specific training with ankle joint mobilization** may produce greater improvements in functional ambulation when compared to **task-specific training**.	1	Kluding et al. 2008
1b	**High intensity task-specific training** may produce greater improvements in functional ambulation when compared to **low intensity task-specific training**.	1	Outermans et al. 2010
2	**Task-oriented training with tilt table** may produce greater improvements in functional ambulation when compared to **tilt table**.	1	Kim et al. 2015b
1a	**Task-oriented training with TENS** may produce greater improvements in functional ambulation when compared to **TENS**.	2	Hui-Chan et al. 2009; Ng & Hui-Chan 2007
1a	**Task-oriented training with TENS** may produce greater improvements in functional ambulation when compared to **conventional or no treatment**.	2	Hui-Chan et al. 2009; Ng & Hui-Chan 2007
1a	There is conflicting evidence about the effect of **task-oriented reach training** for improving functional ambulation when compared to **sham training.**	2	Dean 1997; Dean et al. 2007
1a	There is conflicting evidence about the effect of **task-specific training** for improving functional ambulation when compared to **conventional training, education or no treatment.**	5	Salbach et al. 2004; Ain et al. 2022; Richards et al. 2004; Hui-Chan et al. 2009; Ng & Hui-Chan 2007
2	There is conflicting evidence about the effect of **lower body task-specific training** for improving functional ambulation when compared to **upper body.**	2	Dean et al. 2000; Kwakkel & Wagenaar et al. 2002
1a	There is conflicting evidence about the effect of **task-oriented training with TENS** for improving functional ambulation when compared to **task-oriented training** alone**.**	3	Hui-Chan et al. 2009; Ng & Hui-Chan 2007; Ng et al. 2016
1b	There is conflicting evidence about the effect of **task-specific training with Bobath** for improving functional ambulation when compared to **task-specific training.**	1	Brock et al. 2011
1a	**Task-specific circuit training** may not have a difference in efficacy compared to **sham or conventional therapy** for improving functional ambulation.	5	Martins et al. 2020; Kim et al. 2016; Sherrington et al. 2008; Indurkar et al. 2008; English et al. 2015
1b	**Task-oriented leg training** may not have a difference in efficacy compared to **body weight support training** for improving functional ambulation.	1	Brunelli et al. 2019

1b	**Task-specific training at a day unit** may not have a difference in efficacy compared to **task-specific training at home** for improving functional ambulation.	1	Gjelsvik et al. 2014
1b	**Task-specific training at a day unit** may not have a difference in efficacy compared to **traditional treatment** for improving functional ambulation.	1	Gjelsvik et al. 2014
1b	**Task-specific training at home** may not have a difference in efficacy compared to **traditional treatment** for improving functional ambulation.	1	Gjelsvik et al. 2014
2	**Task-specific training with cognitive sensorimotor** may not have a difference in efficacy compared to **task-specific training with conventional physical therapy** for improving functional ambulation.	1	Kim et al. 2021
2	**Task-oriented training with tilt table** may not have a difference in efficacy compared to **tilt table with one leg standing** for improving functional ambulation.	1	Kim et al. 2015b
1b	**Task-specific circuit training** may not have a difference in efficacy compared to **group activities** for improving functional ambulation.	1	Mudge et al. 2009
1a	**Group task-oriented circuit training** may not have a difference in efficacy compared to **conventional training** for improving functional ambulation.	3	Ali et al. 2020; Renner et al. 2016; Vandeport et al. 2012
1b	**Task-oriented training** may not have a difference in efficacy compared to **TENS** for improving functional ambulation.	1	Hui-Chan et al. 2009

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Task-specific training** may produce greater improvements in functional mobility when compared to **conventional, education or no treatment**.	1	Ntsiea et al. 2015
2	**Task-oriented training** may not have a difference in efficacy when compared to **speed dependent treadmill training** for improving functional mobility.	1	Sharma et al. 2014
1b	**Task-oriented leg training** may not have a difference in efficacy when compared to **body weight support training** for improving functional mobility.	1	Brunelli et al. 2019
2	**Task-specific training with ankle joint mobilization** may not have a difference in efficacy when compared to **task-specific training** for improving functional mobility.	1	Kluding et al. 2008
1b	**High intensity task-specific training** may not have a difference in efficacy when compared to **low intensity task-specific training** for improving functional mobility.	1	Wellwood et al. 2004

1b	**Task-specific circuit training** may not have a difference in efficacy when compared to **group activities** for improving functional mobility.	1	Mudge et al. 2009
1a	**Task-oriented training in a group** may not have a difference in efficacy when compared to **conventional training** for improving functional mobility.	2	Renner et al. 2016; Vandeport et al. 2012
1b	**Task-oriented training with TENS** may not have a difference in efficacy when compared to **task-oriented training** for improving functional mobility.	1	Ng et al. 2016

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	There is conflicting evidence about the effect of **task-specific training with altered sensory input** to improve balance when compared to **conventional therapy or education.**	2	Park & Won 2017; Kuberan et al. 2017
1b	**Task-oriented reach training** may produce greater improvements in balance than **sham training.**	1	Dean 1997
1b	There is conflicting evidence about the effect of **task-specific training** to improve balance when compared to **conventional therapy, education or no treatment.**	4	Ain et al. 2022; Arabzadeh et al. 2018; Salbach et al. 2004; Richards et al. 2004
1b	There is conflicting evidence about the effect of **task-specific circuit training** to improve balance when compared to **conventional or sham therapy.**	3	Kim et al. 2016; Sherrington et al. 2008; Indurkar et al. 2008
2	**Task-specific training** may not have a difference in efficacy compared to **orthoses** for improving balance.	1	Kwakkel & Wagenaar 2002
2	**Task-oriented training** may not have a difference in efficacy compared to **speed dependent treadmill training** for improving balance.	1	Sharma et al. 2014
1b	**Task-specific circuit training** may produce greater improvements in balance than **strength training of lower extremities.**	1	Knox et al. 2018
2	**Task-specific training** may produce greater improvements in balance than **activity repetition.**	1	Ghous et al. 2017
1a	**Task-oriented gait training** may produce greater improvements in balance than **conventional training.**	2	Knox et al. 2018; Qurat-Ul-ain et al. 2018a
1b	**Task-specific training at a day unit** may not have a difference in efficacy compared to **task-specific training at home** for improving balance.	1	Gjelsvik et al. 2014
1b	**Task-specific training at a day unit** may not have a difference in efficacy compared to **traditional treatment** for improving balance.	1	Gjelsvik et al. 2014
1b	There is conflicting evidence about the effect of **task-specific training at home** to improve balance when compared to **traditional treatment.**	1	Gjelsvik et al. 2014

1b	**Task-specific training with virtual reality** may produce greater improvements in balance than **task-specific training.**	1	Malik et al. 2021
1b	**Task-specific training with mirror therapy** may produce greater improvements in balance than **task-specific training.**	1	Cha et al. 2016
1b	**Task-specific training with whole body vibration** may not have a difference in efficacy compared to **task-specific training with sham vibration** for improving balance.	1	Marin et al. 2013
2	**Lower body task-specific training** may not have a difference in efficacy compared to **upper body task-specific training** for improving balance.	1	Kwakkel & Wagenaar 2002
1b	**High intensity task-specific training** may not have a difference in efficacy compared to **low intensity task-specific training** for improving balance.	1	Outermans et al. 2010
1b	**Task-specific circuit training** may not have a difference in efficacy compared to **group activities** for improving balance.	1	Mudge et al. 2009
2	**Task-specific training** may not have a difference in efficacy compared to **proprioceptive neuromuscular facilitation** for improving balance.	1	Anandan et al. 2020
1a	**Task-oriented training in a group** may not have a difference in efficacy compared to **conventional training** for improving balance.	3	Ali et al. 2020; Renner et al. 2016; Vandeport et al. 2012
1b	**Task-oriented training with TENS** may produce greater improvements in balance than **task-oriented training.**	1	Ng et al. 2016
1b	**Task-specific training with Bobath** may not have a difference in efficacy compared to **task-specific training** for improving balance.	2	Brock et al. 2011; Mudie et al. 2002

GAIT

LoE	Conclusion Statement	RCTs	References
2	**Task-specific training with altered sensory input** may not have a difference in efficacy for improving gait when compared to **conventional therapy or education.**	1	Kuberan et al. 2017
1b	**Task-oriented reach training** may produce greater improvements in gait than **sham training.**	1	Dean 1997
2	**Task-specific treadmill training** may produce greater improvements in gait than **treadmill training.**	1	Kwon et al. 2015
1b	**Task-oriented resistance training** may produce greater improvements in gait than **no treatment.**	1	Yang et al. 2006
1b	**Task-oriented gait training** may produce greater improvements in gait than **conventional training.**	1	Qurat-Ul-ain et al. 2018b

1b	**Task-specific training with virtual reality** may not have a difference in efficacy for improving gait when compared to **task-specific training.**	1	Malik et al. 2021
1b	There is conflicting evidence about the effect of **task-specific training with motor imagery** to improve gait when compared to **task-specific training**.	1	Verma et al. 2011
2	**Task-specific training with ankle joint mobilization** may not have a difference in efficacy for improving gait when compared to **task-specific training.**	1	Kluding et al. 2008
2	**Task-oriented training with tilt table** may produce greater improvements in gait than **tilt table with one leg standing.**	1	Kim et al. 2015b
2	**Task-oriented training with tilt table** may produce greater improvements in gait than **tilt table.**	1	Kim et al. 2015b
2	**Task-specific training** may produce greater improvements in gait than **proprioceptive neuromuscular facilitation.**	1	Anandan et al. 2020
1b	**Task-oriented training in a group** may not have a difference in efficacy for improving gait when compared to **conventional training.**	1	Ali et al. 2020

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1a	There is conflicting evidence about the effect of **task-specific training** to improve activities of daily living when compared to **conventional therapy, education or no treatment.**	2	Ntsiea et al. 2015; Richards et al. 2004
1a	**Task-specific circuit training** may not have a difference in efficacy when compared to **conventional or sham therapy** for improving performance on activities of daily living.	2	Martins et al. 2020; Kim et al. 2016
1b	**Task-oriented leg training** may not have a difference in efficacy when compared to **body weight support training** for improving performance on activities of daily living.	1	Brunelli et al. 2019
2	**Task-oriented training** may produce greater improvements in activities of daily living when compared to **activity repetition.**	1	Ghous et al. 2017
1b	**Task-oriented gait training** may not have a difference in efficacy when compared to **conventional training** for improving performance on activities of daily living.	1	Richards 1993
1b	**High intensity task-specific training** may not have a difference in efficacy when compared to **low intensity task-specific training** for improving performance on activities of daily living.	1	Wellwood et al. 2004

1b	**Task-oriented training with tilt table** may produce greater improvements in activities of daily living when compared to **tilt table.**	1	Kim et al. 2015
1b	**Task-oriented training with tilt table** may produce greater improvements in activities of daily living when compared to **conventional therapy.**	1	Kim et al. 2015
1b	**Task-specific circuit training** may not have a difference in efficacy when compared to **group activities** for improving performance on activities of daily living.	1	Mudge et al. 2009
1a	**Task-oriented training in a group** may not have a difference in efficacy when compared to **conventional training** for improving performance on activities of daily living.	2	Ali et al. 2020; Vandeport et al. 2012
2	**Task-specific training with Bobath** may not have a difference in efficacy when compared to **task-specific training** for improving performance on activities of daily living.	1	Mudie et al. 2022

RANGE OF MOTION

LoE	Conclusion Statement	RCTs	References
1b	**Task-specific training** may not have a difference in efficacy compared to **conventional therapy** for improving range of motion.	1	Sherrington et al. 2008
2	**Task-specific training with ankle joint mobilization** may produce greater improvements in range of motion when compared to **task-specific training.**	1	Kluding et al. 2008

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1a	**Task-specific training** may produce greater improvements in muscle strength when compared to **conventional therapy, education or no treatment.**	2	Ng &Hui-Chan 2007; Hui-Chan et al. 2009
1b	**Task-specific circuit training** may not have a difference in efficacy for improving muscle strength when compared to **conventional or sham training.**	1	Martins et al. 2020
1b	**Task-oriented resistance training** may produce greater improvements in muscle strength when compared to **no treatment.**	1	Yang et al. 2006
1b	**Task-specific training with whole body vibration** may not have a difference in efficacy for improving muscle strength when compared to **task-specific training with sham vibration.**	1	Marin et al. 2013
2	There is conflicting evidence about the effect of **task-oriented training with tilt table** to improve muscle strength when compared to **tilt table one leg standing**.	1	Kim et al. 2015b

1b	**High intensity task-specific training** may not have a difference in efficacy for improving muscle strength when compared to **low intensity task-specific training.**	1	Wellwood et al. 2004
2	**Task-oriented training with tilt table** may produce greater improvements in muscle strength when compared to **tilt table.**	1	Kim et al. 2015b
1a	**Task-oriented training in a group** may not have a difference in efficacy for improving muscle strength when compared to **conventional training.**	2	Renner et al. 2016; Vandeport et al. 2012
1a	There is conflicting evidence about the effect of **task-oriented training with TENS** to improve muscle strength when compared to **TENS**.	2	Hui-Chan et al. 2009; Ng & Hui-Chan 2007
1a	**Task-oriented training with TENS** may not have a difference in efficacy for improving muscle strength when compared to **task-oriented training.**	2	Hui-Chan et al. 2009; Ng & Hui-Chan 2007
1b	**Task-oriented training** may not have a difference in efficacy for improving muscle strength when compared to **TENS.**	1	Hui-Chan et al. 2009
1a	**Task-oriented training with TENS** may produce greater improvements in muscle strength when compared to **conventional therapy.**	2	Ng & Hui-Chan 2007; Hui-Chan et al. 2009

PROPRIOCEPTION

LoE	Conclusion Statement	RCTs	References
2	**Task-specific training with cognitive sensorimotor** may produce greater improvements in proprioception than **task-specific training with physical therapy.**	1	Kim et al. 2021
2	**Task-specific training with cognitive sensorimotor** may produce greater improvements in proprioception than **conventional physical therapy**.	1	Kim et al. 2021
2	**Task-specific training with physical therapy** may produce greater improvements in proprioception than **conventional physical therapy**.	1	Kim et al. 2021

STROKE SEVERITY

LoE	Conclusion Statement	RCTs	References
1b	**Task-specific training with tilt table** may not have a difference in efficacy for improving stroke severity when compared to **tilt tables.**	1	Kim et al. 2015
1b	**Task-oriented training with tilt table** may produce greater improvements in stroke severity when compared to **conventional therapy.**	1	Kim et al. 2015

SPASTICITY

LoE	Conclusion Statement	RCTs	References

1a	**Task-specific training** may produce greater improvements in spasticity when compared to **conventional therapy, education or no treatment.**	2	Hui-Chan et al. 2009; Ng &Hui-Chan 2007
2	**Task-specific training with cognitive sensorimotor** may not have a difference in efficacy for improving spasticity when compared to **task-specific training with physical therapy.**	1	Kim et al. 2021
2	**Task-specific training with cognitive sensorimotor** may produce greater improvements in spasticity when compared to **conventional therapy.**	1	Kim et al. 2021
2	**Task-specific training with physical therapy** may produce greater improvements in spasticity when compared to **conventional therapy.**	1	Kim et al. 2021
2	**Task-specific training** may produce greater improvements in spasticity when compared to **proprioceptive neuromuscular facilitation.**	1	Anandan et al. 2020
1b	**Task-oriented training in a group** may not have a difference in efficacy for improving spasticity when compared to **conventional training.**	1	Ali et al. 2020
1a	**Task-oriented training with TENS** may not have a difference in efficacy for improving spasticity when compared to **TENS.**	2	Hui-Chan et al. 2009; Ng &Hui-Chan 2007
1a	**Task-oriented training with TENS** may not have a difference in efficacy for improving spasticity when compared to **task-oriented training.**	2	Hui-Chan et al. 2009; Ng &Hui-Chan 2007
1b	**Task-oriented training** may not have a difference in efficacy for improving spasticity when compared to **TENS.**	1	Hui-Chan et al. 2009
1a	**Task-oriented training with TENS** may produce greater improvements in spasticity when compared to **conventional therapy.**	2	Hui-Chan et al. 2009; Ng &Hui-Chan 2007

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
1b	**Task-specific training** may not have a difference in efficacy for improving quality of life when compared to **conventional therapy, education or no treatment.**	1	Ntsiea et al. 2015
1a	**Task-specific circuit training** may not have a difference in efficacy for improving quality of life when compared to **conventional or sham therapy.**	2	Martins et al. 2020; English et al. 2015
1b	**Task-oriented gait training** may produce greater improvements in quality of life when compared to **conventional training.**	1	Qurat-Ul-ain et al. 2018a
1a	**Task-oriented training in a group** may not have a difference in efficacy for improving quality of life when compared to **conventional training.**	2	Renner et al. 2016; Vandeport et al. 2012

1b	**Task-oriented training with TENS** may not have a difference in efficacy for improving quality of life when compared to **task-oriented training.**	1	Ng et al. 2016

Key Points

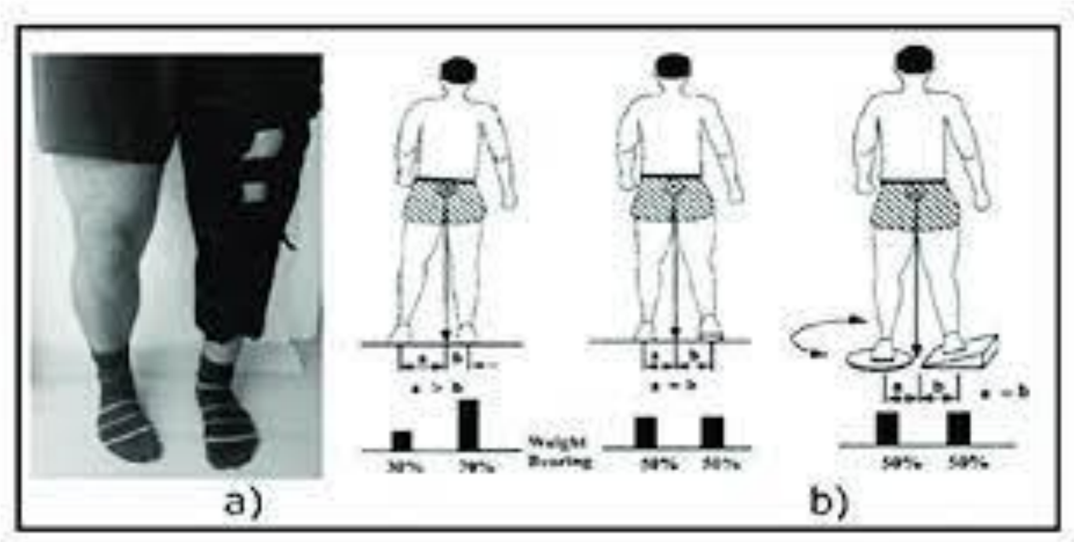
Task-specific training may be beneficial for improving gait and proprioception after stroke.

The literature is mixed regarding the effectiveness of task-specific training for improving balance, range of motion, muscle strength, stroke severity, and spasticity after stroke.

The literature regarding the effectiveness of task-specific training for improving motor function and functional ambulation after stroke is mixed and depends on the task components and modalities.

Task-specific training may not be beneficial for improving functional mobility, activities of daily living, and quality of life after stroke.

Constraint-Induced Movement Therapy (CIMT)



Adopted from: https://www.researchgate.net/figure/Constraint-method-of-the-nonparetic-lower-limb-a-Whole-leg-orthosis-b-addition-of-a_fig1_320587918

CIMT of the lower extremity (CIMT-LE) draws many aspects of CIMT of the upper extremity. As in CIMT for the upper extremity, CIMT-LE is designed to overcome the tendency among hemiparetic patients to avoid the use of their paretic limb, a process termed “learned non-use”. Despite similarities of protocols used in CIMT such as motor activity logs, supervised training and shaping, there are key differences implemented in CIMT for the LE. Unique to the protocols used during CIMT-LE, is the omission of restraint of the stronger limb. This is rationalized by the risk of falls and related injuries. In addition, both lower limbs are required to produce a natural gait cycle and restraint of one limb may hinder shaping interventions aimed at promoting gait and functional ambulation (dos Anjos et al., 2020).

Seven RCTs were found evaluating constraint-induced movement therapy for lower extremity motor rehabilitation. Three RCTs compared mCIMT to conventional therapy or neurodevelopmental techniques (Candan & Livanelioglu, 2017; Candan & Livanelioğlu, 2019; Zhu et al., 2016a). One RCT compared mCIMT to forced use therapy (Fuzaro et al., 2012). One RCT compared virtual reality with CIMT to virtual reality or conventional therapy alone (Choi et al., 2017a). One RCT compared CIMT with task-specific training to mCIMT with task-specific training (Abdullahi et al., 2021). One RCT compared CIMT with immobilization to mCIMT without immobilization (da Silva Filho & Andrade de Albuquerque, 2017).

The methodological details and results of all six RCTs are presented in Table 6.

Table 6. RCTs Evaluating CIMT Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) **Study Design (PEDro Score)** **Sample Size start** **Sample Size end** **Time post stroke category**	**Interventions** **Duration: Session length, frequency per week for total number of weeks**	**Outcome Measures** **Result (direction of effect)**
mCIMT vs Neurodevelopmental Therapy or Conventional Rehabilitation		
Candan et al. (2019) RCT (6) Nstart=33 Nend=30 TPS=Chronic	E: mCIMT + Neurodevelopmental therapy (NDT) C: NDT	• Motricity Index (+exp) • Stroke Specific Quality of Life (-) • Stroke Impact Scale (+exp) • Perceived recovery (+exp)

	Duration: 60min/d, 3d/wk, 4wks NDT & 120min/d, 5d/wk, 2wks NDT or mCIMT	
Candan et al. (2017) RCT (7) Nstart=33 Nend=30 TPS=Chronic	E: mCIMT on paretic LE C: NDT Duration: 120min/d, 5d/wk, 2wks	• Berg Balance Scale (+exp) • Postural Symmetry Ratio (+exp) • Step Length Ratio (+exp) • Cadence (+exp) • Walking velocity (+exp) • Functional Ambulation Classification (+exp)
Zhu et al. (2016) RCT (5) Nstart=22 Nend=22 TPS=Subacute	E: mCIMT + conventional rehabilitation C: Conventional Rehabilitation Duration: 120min/d, 5d/wk, 4wks mCIMT & 45min/d, 5d/wk, 4wks conventional therapy	• Centre of Mass (-) • Gait Velocity (-) • Normalized Velocity (+exp) • Step Width (-) • Normalized Step Width (+exp) • Step Length Affected Side (-) • Normalized Step Length Affected Side (-) • Step Length non-affected side (-) • Normalized Step Length non-affected side (+exp) • Paretic Swing time (-) • Non-paretic swing time (+exp)
mCIMT vs Forced Use Therapy		
Fuzaro et al. (2012) RCT (6) Nstart=72 Nend=37 TPS=Chronic	E: mCIMT C: Forced use therapy Duration: E: 23h/d immobilization of Non Paretic upper limb + 50min/d, 5d/wk exercise training for Paretic upper limb, 5d/wk; 4wk C: 23h/d immobilization by restraint wearing of Non Paretic upper limb, 5d/wk, 4wk	• Stroke Impact scale (+exp) • Berg Balance scale (-) • Fugl-Meyer assessment (+exp) • 10m Walk test (-) • Timed Up and Go (-)
CIMT with Task-Specific Training		
Abdullahi et al. (2021) RCT (9) NStart=58 NEnd=56 TPS=Chronic	E: CIMT + task specific training C: mCIMT + task specific training Duration: 3h/d, 5d/wk, for 4wks	• Fugl Meyer (-) • Berg Balance Scale (-) • Rivermead Mobility Index (-) • Modified Ashworth Scale (+exp) • Ten-Meter Walk Test (-) • Six-Minute Walk test (-) • Rate of perceived exertion (+exp)
VR Combined with CIMT vs VR or Conventional Training		

Choi et al. (2017)
RCT (7)
NStart=36
NEnd=36
TPS=Chronic
	E1: game-based CIMT + Traditional physical therapy
	E2: General game-based training + Traditional PT
	C: Traditional physical therapy
	Duration: 30min/d, 3d/wk, 4wks game training & 60min/d, 5d/wk, 4wks traditional PT
		<u>E1/E2 vs C</u>
		• Center of Pressure
		    ○ AP (+exp1)
		    ○ ML (+exp1)
		• Sway Mean Velocity (-)
		• Sway Area (+Exp1)
		• Symmetric Weight Bearing (+exp1, +exp2);
		• Functional Reach Test (-)
		• Modified Functional Reach Test (+exp1, +exp2);
		• Timed Up-and-go Test (-)
		
		<u>E1 vs E2</u>
		• Center Of Pressure

		○ AP (-) ○ ML (+exp1) • Sway Mean Velocity (-) • Sway Area (+exp1) • Symmetric Weight Bearing (+exp1) • Functional Reach Test (-) • Modified Functional Reach Test (-) • Timed Up-and-go Test (-)
CIMT With Immobilization vs Without Immobilization		
da Silva Filho et al. (2017) RCT (5) Nstart=26 Nend=26 TPS=Chronic	E: Constraint induced movement therapy (immobilization of non-paretic UL) C: Modified CIMT (without immobilization) Duration: 40min/d, 3d/wk for 4wks for movement training & 6h daily immobilization of non-paretic UL.	• Berg Balance scale (-) • Gait speed (+exp) • Timed Up and Go (+exp) • Going up and down stairs (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about CIMT

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**mCIMT** may not have a difference in efficacy compared to **forced use therapy** for improving motor function.	1	Fuzaro et al. 2012
1b	**CIMT with task-specific training** may not have a difference in efficacy compared to **mCIMT with task-specific training** for improving motor function.	1	Abdullahi et al. 2021

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **mCIMT** to improve performance of functional ambulation when compared to **conventional therapy or neurodevelopmental therapy.**	2	Candan et al. 2017; Zhu et al. 2016
1b	**CIMT with task-specific training** may not have a difference in efficacy for improving functional ambulation when compared to **mCIMT with task-specific training.**	1	Abdullahi et al. 2021
1b	**mCIMT** may not have a difference in efficacy for improving functional ambulation when compared to **forced use therapy.**	1	Fuzaro et al. 2012

1b	**CIMT with virtual reality** may not have a difference in efficacy for improving functional ambulation when compared to **virtual reality training alone.**	1	Choi et al. 2017
1b	**CIMT with virtual reality** may not have a difference in efficacy for improving functional ambulation when compared to **conventional therapy.**	1	Choi et al. 2017
2	**CIMT with immobilization** may produce greater improvements in functional ambulation than **mCIMT without immobilization.**	1	da Silva Filho et al. 2017

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **mCIMT** to improve performance of balance when compared to **conventional therapy or neurodevelopmental therapy.**	2	Candan et al. 2017; Zhu et al. 2016
1b	**mCIMT** may not have a difference in efficacy for improving balance when compared to **forced use therapy.**	1	Fuzaro et al. 2012
1b	**CIMT with task-specific training** may not have a difference in efficacy for improving balance when compared to **mCIMT with task-specific training.**	1	Abdullahi et al. 2021
1b	There is conflicting evidence about the effect of **mCIMT with virtual reality** to improve performance of balance when compared to **conventional therapy.**	1	Choi et al. 2017
1b	**mCIMT with virtual reality** may not have a difference in efficacy for improving balance when compared to **virtual reality alone.**	1	Choi et al. 2017
2	**CIMT with immobilization** may not have a difference in efficacy for improving balance when compared to **mCIMT without immobilization.**	1	da Silva Filho et al. 2017

GAIT

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **mCIMT** to improve performance of gait when compared to **conventional therapy or neurodevelopmental therapy.**	2	Candan et al. 2017; Zhu et al. 2016

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **mCIMT** to improve quality of life when compared to **conventional therapy.**	1	Candan & Livanelioglu 2019
1b	**mCIMT** may produce greater improvements in quality of life than **forced use therapy.**	1	Fuzaro et al. 2012

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**mCIMT** may produce greater improvements in muscle strength than **conventional therapy.**	1	Candan & Livanelioglu 2019

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**CIMT with task-specific training** may not have a difference in efficacy for improving functional mobility when compared to **mCIMT with task-specific training.**	1	Abdullahi et al. 2021

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**CIMT with task-specific training** may produce greater improvements in spasticity than **mCIMT without task-specific training.**	1	Abdullahi et al. 2021

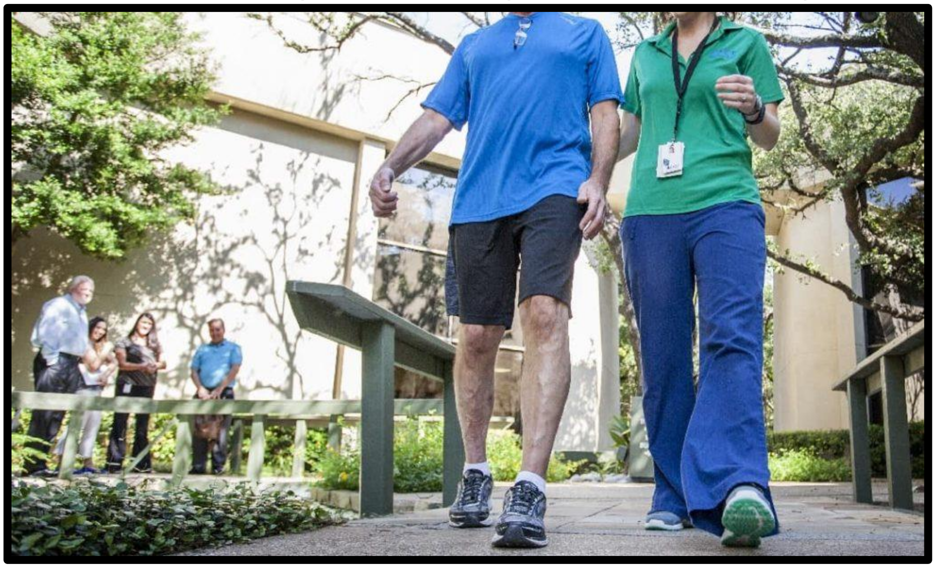
Key Points

CIMT may be beneficial for improving muscle strength and spasticity following stroke.

CIMT may not be beneficial for improving motor function, functional ambulation, balance, and functional following stroke.

The literature is mixed regarding the effect of CIMT on gait and quality of life following stroke.

Non-Technological Overground Walking and Gait Training



Adopted from: https://www.paterehab.com/about-abi/traumatic-brain-injury-tbi/

Gait training is one of the most common interventions provided following a stroke (Jette et al., 2005). Overground gait training includes walking and related exercises with or without cueing from a physical therapist but does not include use of technology aids such as those used to administer body weight support (States et al., 2009).

29 RCTs were found evaluating overground walking for lower extremity motor rehabilitation. Five RCTs compared overground walking to treadmill training (Bonnyaud et al., 2013a; Bonnyaud et al., 2013b; Combs-Miller et al., 2014; Gangopadhyay et al., 2021; Timmermans et al., 2021). Two RCTs compared overground walking with conventional care or massage (Gordon et al., 2013; Shen et al., 2015). Three RCTs compared community-based gait training to conventional care (Kim et al., 2014d; Lord et al., 2008; Park et al., 2011a). One RCT compared bent knee gait training to conventional care (Dalal et al., 2018). Six RCTs compared backward or sideways walking to standing or conventional care (Huang et al., 2021; Kale et al., 2019; Kim et al., 2017a; Rose et al., 2018; Sethy et al., 2021; Yang et al., 2005). One RCT compared gait training with motor imagery to conventional gait training (Sawant, 2020). Two RCTs compared overground walking with feedback to walking without feedback (Danks et al., 2016; Kim & Oh, 2020). One RCT compared gait training with postural support to gait training with conventional support (Dragin et al., 2014). One RCT compared gait training with insoles to gait training with conventional shoes (Sheikh et al., 2016). One RCT compared accurate adaptability to steady state walking (Clark et al., 2021). One RCT compared implicit motor learning while walking to explicit learning (Jie et al., 2021). Five RCTs compared stair or ramp training to flat surface gait training (Lee & Seo, 2014; Park et al., 2015b; Seo et al., 2014; Seo & Kim, 2015; Yoon-Hee et al., 2020).

The methodological details and results of all 29 RCTs are presented in Table 7.

Table 7. RCTs Evaluating Overground Walking Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Overground Walking vs Treadmill Training		
Gangopadhyay et al.(2021) RCT (7) Nstart=30 Nend=30 TPS=Subacute	E: Body weight supported treadmill training (BWST) + conventional rehabilitation C: Overground gait training + conventional rehabilitation Duration: 20min/d BWST/overground gait training & 40min/d conventional rehabilitation, 3d/wk for 4wks	• Timed Up-and-Go (+exp) • Gait Cadence (+exp) • 10-meter Walk test (+exp) • Berg Balance scale (+exp)
Timmermans et al. (2021) RCT (5) Nstart=40 Nend=30 TPS=Chronic	E1: Treadmill-based with augmented reality E2: Overground walking with physical obstacles Duration: 90min/d, 2d/wk for 5wks	E1 vs E2 • 10-Meter Walk test (-) ○ Context (+exp) ○ Context and Cognitive (-) ○ Cognitive (-) • Interactive walkway assessment ○ Obstacles (-) ○ Obstacles and cognitive (-) • Cognitive dual-task performance (-)
Combs-Miller et al. (2014) RCT (8) Nstart=20 Nend=20 TPS=Chronic	E: Body weight supported treadmill training C: Overground walking training Duration: 30min, 5d/wk for 2wk	• 10-Metre Walk Test comfortable walk subscale (+con) • 10-Metre Walk Test fast walk subscale (-) • 6-Minute Walk Test (-) • Step length (-) • Stance time symmetry (-) • Swing time symmetry (-) • ICF Measure of participation and activities (-) ○ Participation (-) ○ Activities (-)
Bonnyaud et al. (2013) RCT (4) Nstart=26 Nend=26 TPS=Chronic	E: Overground gait training C: Treadmill gait training Duration: 20min, single session	• Gait Speed (-) • Gait Cadence (-) • Single limb support phase ○ Paretic (-) ○ Non-paretic (-) • Step length ○ Paretic (-) ○ Non-paretic (-) • Peak hip flexion/extension (-) • Peak knee extension/flexion (-) • Peak ankle dorsi/plantar flexion (-) • Vertical ground reaction force ○ Total support phase-both sides (-) ○ Single support phase-both sides (-) • Peak propulsion-both sides (-) • Peak braking-both sides (-)
Bonnyaud et al. (2013) RCT (5) Nstart=60 Nend=60	E1: Overground gait training with ankle mass E2: Treadmill gait training with ankle mass	E1 vs C1 • Speed (-) • Cadence (-) • Step Length (Paretic/Non-paretic) (-)

TPS=Chronic	C1: Overground gait training without mass
	C2: Treadmill gait training without mass
	Duration: 20min/d, 1 session
		• Peak Hip Flexion (Paretic/Non-paretic) (-)
		• Peak Knee Flexion (Paretic/Non-paretic) (-)
		• Peak Ankle Dorsiflexion (Paretic/Non-paretic) (-)
		• Vertical GRF (Paretic/Non-paretic) (-)
		• Peak Propulsion (Paretic/Non-paretic) (-)
		• Peak Breaking (Paretic/Non-paretic) (-)
		E2 vs C2
		• Speed (-)
		• Cadence (-)
		• Step Length (Paretic/Non-paretic) (-)
		• Peak Hip Flexion (Paretic/Non-paretic) (-)
		• Peak Knee Flexion (Paretic/Non-paretic) (-)
		• Peak Ankle Dorsiflexion
		  • Paretic (-)
		  • Non-paretic (+con)
		• Vertical GRF (Paretic/Non-paretic) (-)
		• Peak Propulsion (Paretic/Non-paretic) (-)
		• Peak Breaking
		  • Paretic (-)
		  • Nonparetic (+con)

High Intensity Overground Walking vs Conventional Therapy		
Shen et al. (2015) RCT (6) Nstart=40 Nend=40 TPS=Subacute	E: Overground Walking (Intensified Walk Training) C: Conventional Therapy Duration: 40-60 min/d, 5-6 d/wk for 5 wks	• Fugl-Meyer Assessment (+exp) • Barthel Index (+exp) • 6-minute Walking Test (+exp)

Gordon et al. (2013)
RCT (7)
Nstart=128
Nend=116
TPS=Chronic
	E: Overground walking (aerobic, high intensity)
	C: Conventional therapy (Massage)
	Duration: 25min/d, 3d/wk, 12wks massage & 15-30min/d, 3d/wk, 12wks aerobic exercise
		• SF-36
		  ○ Physical health component (+exp)
		  ○ Mental component (-)
		• Barthel Index (-)
		• Older Americans Resources and Services Questionnaire (-)
		• 6 Minute Walk Test (+exp)
		• Resting heart rate (-)
		• Motricity index
		  ○ Affected (-)
		  ○ Unaffected (-)

Community-based gait training vs conventional training		
Kim et al. (2014d) RCT (6) Nstart=26 Nend=22 TPS=Chronic	E: Community walking training program + conventional care (physical and occupational therapy) C: Conventional care (physical and occupational therapy) Duration: E: 30min/d Community walking training program + 60min/d conventional care, 5d/wk, 4wks C: 60min/d conventional care, 5d/wk, 4wks	• 10-Metre Walk Test (+exp) • 6-min Walk Test (+exp) • Community walk test (+exp) • Stroke impact scale (+exp)
Park et al. (2011) RCT (7) Nstart=27 Nend=25 TPS=Chronic	E: Community-based ambulation training + conventional physical therapy C: Conventional physical therapy Duration: 1h/d, 7d/wk for 4wks - Functional training, 1h/d, 3d/wk	• 10-Metre Walk Test (+exp) • 6-Minute Walk Test (-) • Community Walk Test (+exp) • Walking ability questionnaire (+exp) • Activities-specific balance confidence scale (+exp)

	for 4wks - Community based ambulation training	
Lord et al. (2008) RCT (6) Nstart=36 Nend=30 TPS=Subacute	E: Functional gait activities in community environments C: Conventional care physiotherapy Duration: 2d/wk, 7wks	• 10m Walk test (-) • 6min Walk test (-) • Activities-specific Balance Confidence scale (-) • Subjective index of Physical and Social outcome (-)
Bent Knee (Prowling) Gait Training vs Conventional Therapy		
Dalal et al. (2018) RCT (8) Nstart=32 Nend=29 TPS=Not reported	• E: Bent Knee Gait training (prowling) with Proprioceptive Training + Conventional Care • C: Conventional Care • Duration: 15-20min Prowling and Proprioceptive training & 45-60min Conventional Physiotherapy - 6 sessions	• Knee hyperextension (+exp) • Ankle dorsiflexion (+exp) • Time taken (-) • Wisconsin Gait Scale (+exp)
Backward or Sideway Walking Training vs Standing Practice or Conventional Therapy		

Huang et al. (2021)
RCT (7)
Nstart=26
Nend=24
TPS=Chronic
	E: Lateral stair walking + traditional physiotherapy
	
	C: Traditional treatment
	
	Duration: E: 15min lateral stair climbing + 15min traditional treatment/d, 1d/wk, 12wks;
	C: 30min/d, 1d/wk, 12wks
		• Muscle strength
		  • Hip extensors (-)
		  • Hip flexors (-)
		  • Hip abductors (-)
		  • Knee extensors (-)
		  • Knee flexors (-)
		  • Ankle plantar flexors (+exp)
		  • Ankle dorsiflexors (-)
		• Postural assessment Stroke scale (+exp)
		• Fugl-Meyer assessment Lower extremity (-)
		• Barthel index (+exp)
		• Timed Up and Go (+exp)
		• Stance phase (-)
		• Swing phase (-)
		• Single support time (-)
		• Double support time (-)
		• Stride length (-)
		• Gait velocity (+exp)
		• Gait cadence (-)

Sethy et al. (2021) RCT (6) Nstart=56 Nend=56 TPS=Chronic	E: Backwards and sideways overground walking C: Conventional training Duration: 30min/d, 5d/wk, 6wks	• 10m Walk test (+exp) • 6min Walk test (+exp)
Kale et al. (2019) RCT (4) Nstart=30 Nend=30 TPS=Not Reported	E: Walking backwards + conventional forward walking C: Conventional forward walking Duration: Backward walk duration not specified + 20min/d conventional training, 3d/wk, 4wks	• Single limb support (+exp) • Double limb support (+exp) • Stride time (+exp) • Step time (+exp) • Cadence (+exp) • Speed (+exp) • Stride length (+exp) • Step length (+exp) • Step width (+exp)

Rose et al. (2018) RCT (5) Nstart=18 Nend=10 TPS=Acute	E: Backward Walking Training + Scheduled Therapy C: Standing Balance Training + Scheduled Therapy Duration: 30min/session for 8 sessions	• Five-Meter Walk Test (+exp) • 3-Meter Backward Walk Test (+exp) • Activities-Specific Balance Confidence Scale (+exp) • Berg Balance Scale (-) • Sensory Organization Test (-) • Function Independence Measure-Mobility (-)
Kim et al. (2017) RCT (6) Nstart=66 Nend=51 TPS=Chronic	E1: Lateral Walking Training + Conventional PT E2: Backward Walking Training + Conventional PT C: Conventional therapy Duration: 60min/d, 3d/wk, 3wks	E1 vs E2 • 10-m Walk Test (+exp1) • Gait velocity (+exp1) • Cadence (-) • Stride length affected side (+exp1) • Gait symmetry ratio (+exp1) • Double support period (+exp1) E1/E2 vs C • 10-m Walk Test (+exp1, +exp2) • Gait velocity (+exp1, +exp2) • Cadence (+exp1, +exp2) • Stride length affected side (+exp1) • Gait symmetry ratio (+exp1) • Double support period (+exp1)
Yang et al. (2005) RCT (6) Nstart=25 Nend=25 TPS=Chronic	• E: Backward Walking Training + Conventional Rehabilitation • C: Conventional Rehabilitation • Duration: 40min/d, 3d/wk for 3wks Conventional rehabilitation, 30min/d, 3d/wk for 3wks Backward walking training	• Gait Velocity (+exp) • Cadence (-) • Stride Length (+exp) • Gait Cycle (-) • Symmetry Index (+exp)
Stair or Ramp Training vs Flat Surface Gait Training		
Yoon-Hee et al. (2020) RCT (8) Nstart=20 Nend=20 TPS=Chronic	E1: 15cm Stair Height Training + Comprehensive rehabilitation E2: 10cm Stair Height Training + Comprehensive rehabilitation Duration: 30 min/d, 5d/wk, 6wks stair training + 30 min/d, 4d/wk , 6wks comprehensive rehabilitation	• Berg Balance Scale (-) • Timed Up-and-Go Test (-) • EMG Muscle Activity ○ Rectus femoris (+exp1) ○ Biceps femoris (+exp1) ○ Tibialis anterior (+exp1) ○ Gastrocnemius (-)
Park et al. (2015) RCT (5) Nstart=24 Nend=24 TPS=Chronic	E: Stair gait training C: Flat surface gait training Duration: 15min/d, 3d/wk for 8wk	• Rectus Femoris Strength (+exp) • Tibialis Anterior Strength (+exp) • Gastrocnemius Strength (-) • Timed Up & Go Test (-) • Step Length (-)
Seo & Kim (2015) RCT (4) Nstart=20 Nend=20 TPS=Chronic	E: Ramp gait training C: Flat surface gait training Duration: 1hr/d, 3d/wk for 4wk	• Berg Balance Scale (+exp) • Timed Up & Go Test (-) • Functional Reach Test (-)
Lee & Seo (2014) RCT (4) Nstart=40 Nend=40 TPS=Chronic	E: Stair gait training C: Flat surface gait training Duration: 1hr/d, 5d/wk for 4wk	• Weight bearing (+exp) • Limit of stability (+exp) • Romberg Test (+exp)
Seo et al. (2014) RCT (5) Nstart=30 Nend=28	E: Stair gait training C: Flat surface gait training Duration: 30min/d, 5d/wk for 10wk	• Romberg Test (+exp) • Limit of stability (-) • Weight bearing (-)

TPS=Chronic		
Gait Training with Motor Imagery vs Conventional Gait Training		
Sawant (2020) RCT (4) Nstart=82 Nend=82 TPS=Not Reported	E: Gait training + guided motor imagery + conventional exercises C: Gait training + conventional exercises Duration: E: 20min/d, 3d/wk, 4wks gait training + 10min/d, 3d/wk, 4wks motor imagery C: 30min/d, 3d/wk, 4wks gait training	• Functional Gait Assessment (+exp) • 10-Meter Walk Test (+exp)
Gait Training or Overground Walking with Feedback vs Without Feedback		
Kim et al. (2020) RCT (5) Nstart=30 Nend=24 TPS=Chronic	E: Visual performance feedback training during overground walking + conventional physical therapy C: Overground walking without feedback + conventional physical therapy Duration: 30min/d overground walking & 60min/d physical therapy, 3d/wk, 6wk	• Timed Up and Go test (+exp) • Step length (+exp) • Stride length (+exp) • Single support time on affected side (+exp) • Double support time (-) • Walking velocity (+exp) • Step length ratio (-) • Stride length ratio (+exp) • Single support time ratio (+exp)
Danks et al. (2016) RCT (4) Nstart=37 Nend=27 TPS=Chronic	E: E: Fast Walking training (FAST) + Step activity monitoring (SAM) program C: C: Fast Walking training (FAST) Duration: 30min/d, 3d/wk, 12wks	• Steps per Day (-) • Total Time Walking Per Day (-) • 10-Meter Walk Test • Self-Selected Speed (-) • Maximal Speed (-) • 6-Minute-Walk Test: Distance (+exp)
Gait Training with Postural Assistance Support vs Gait Training with Conventional Support		
Dragin et al. (2014) RCT (7) Nstart=22 Nend=22 TPS=Subacute	E: Gait training + postural assistance support (Walkaround device) + Conventional PT C: Gait training with conventional supports + Conventional PT Duration: 30min/d, 5d/wk, 4wks	• Barthel index (-) • Fugl-Meyer Score (-) • Berg Balance scale (-) • 10 m walk test (+exp)
Gait training with Insoles vs Gait training with Conventional Shoes		
Sheikh et al. (2016) RCT (7) Nstart=28 Nend=28 TPS=Chronic	E: Gait training + compelled weight-shift insole device C: Gait training with conventional insole Duration: 90min/d, 6d/wk, 6wks	• Weight bearing (+exp) • Gait velocity (-) • Stance symmetry ratio (-) • Swing symmetry ratio (-) • Overall symmetry ratio (-) • Step symmetry ratio (-)
Accurate Adaptability Walking vs Steady State Walking		
Clark et al. (2021) RCT (5) Nstart=38 Nend=36 TPS=Chronic	E1: Accurate adaptability walking E2: Steady state walking Duration: 30min/d, 3d/wk, 12wks	• 10-meter walk test (-) • Dynamic gait index (-) • Activities-Specific Balance Confidence Scale (-) • Satisfaction with mobility function and recovery (-) • Serial 7-Subtraction (-) • Fugl-Meyer assessment (+exp1)

Implicit vs Explicit Motor Learning with Walking		
Jie et al. (2021) RCT (7) Nstart=79 Nend=73 TPS=Chronic	E: Implicit motor learning + walking C: Explicit motor learning + walking Duration: 30min/session, 3d/wk, 3wk	• 10-metre walk test (-) • Modified Dynamic Gait Index (-) • Dual Task performance effect • Motor task (-) • Cognitive task (-) • Movement Specific Reinvestment Scale adapted for gait (-) • Stroke and Aphasia Quality of Life Scale (-) • Global Perceived Effect scale (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Overground Walking

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Overground walking** may produce greater improvements in motor function when compared to **conventional therapy.**	1	Shen et al. 2015
2	**Accurate adaptability walking** may produce greater improvements in motor function when compared to **steady state walking.**	1	Clark et al. 2021
1b	**Gait training with postural support** may not have a difference in efficacy in improving motor function when compared to **gait training with conventional support.**	1	Dragin et al. 2014
1b	**Lateral stair walking** may not have a difference in efficacy in improving motor function when compared to **conventional care.**	1	Huang et al. 2021

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Overground walking** may produce greater improvements in functional ambulation when compared to **conventional therapy or massage.**	2	Shen et al. 2015; Gordon et al. 2013
1a	**Backwards walking training** may produce greater improvements in functional ambulation when compared to **conventional training.**	4	Sethy et al. 2021; Kim et al. 2017; Kale et al. 2019; Yang et al. 2005
2	**Backwards walking training** may produce greater improvements in functional ambulation when compared to **standing balance training.**	1	Rose et al. 2019

1a	**Lateral stair walking training** may produce greater improvements in functional ambulation when compared to **conventional training.**	2	Kim et al. 2017; Huang et al. 2021
1b	**Lateral stair walking training** may produce greater improvements in functional ambulation when compared to **backward walking.**	1	Kim et al. 2017
2	**Overground gait training with motor imagery** may produce greater improvements in functional ambulation when compared to **conventional gait training.**	1	Sawant et al. 2020
1b	**Gait training with postural support** may produce greater improvements in functional ambulation when compared to **training with conventional support.**	1	Dragin et al. 2014
1a	There is conflicting evidence about the effect of **community-based gait training** to improve performance of functional ambulation when compared to **conventional training.**	3	Lord et al. 2008; Kim et al. 2014; Park et al. 2001
1a	**Overground gait training** may not have a difference in efficacy in improving functional ambulation when compared to **treadmill training.**	4	Gangopadhyay et al. 2021; Timmermans et al. 2021; Combs-Miller et al. 2014; Bonnyaud et al. 2013a
2	**Overground gait training with ankle mass** may not have a difference in efficacy in improving functional ambulation when compared to **overground gait training without ankle mass.**	1	Bonnyaud et al. 2013b
1b	**Bent knee gait training** may not have a difference in efficacy in improving functional ambulation when compared to **conventional therapy.**	1	Dalal et al. 2018
2	**Gait training with feedback** may not have a difference in efficacy in improving functional ambulation when compared to **gait training without feedback.**	2	Danks et al. 2016; Kim et al. 2020
1b	**Gait training with insole** may not have a difference in efficacy in improving functional ambulation when compared to **gait training with conventional shoes.**	1	Sheikh et al. 2016
2	**Accurate adaptability walking** may not have a difference in efficacy in improving functional ambulation when compared to **steady state walking.**	1	Clark et al. 2021
1b	**Implicit motor learning with walking** may not have a difference in efficacy in improving functional ambulation when compared to **explicit motor learning.**	1	Jie et al. 2021

2	**Stair or ramp training** may not have a difference in efficacy in improving functional ambulation when compared to **flat surface gait training.**	2	Park et al. 2015; Seo & Kim 2015
1b	**Short stair height training** may not have a difference in efficacy in improving functional ambulation when compared to **taller stair height training.**	1	Yoon-hee et al. 2020

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	**Overground gait training** may produce greater improvements in balance when compared to **treadmill training.**	1	Gangopadhyay et al. 2021
1b	**Lateral stair walking training** may produce greater improvements in balance when compared to **conventional training.**	1	Huang et al. 2021
1a	There is conflicting evidence about the effect of **community-based gait training** to improve performance of balance when compared to **conventional training.**	2	Park et al. 2011; Lord et al. 2008
2	There is conflicting evidence about the effect of **stair or ramp training** to improve performance of balance when compared to **flat surface gait training.**	3	Seo & Kim 2015; Lee & Seo 2014; Seo et al. 2014
2	**Backward walking training** may not have a difference in efficacy when compared to **standing balance training** for improving balance.	1	Rose et al. 2019
1b	**Gait training with postural support** may not have a difference in efficacy when compared to **training with conventional support** for improving balance.	1	Dragin et al. 2014
2	**Accurate adaptability walking** may not have a difference in efficacy when compared to **steady state walking** for improving balance.	1	Clark et al. 2021
1b	**Short stair height training** may not have a difference in efficacy when compared to **taller stair height training** for improving balance.	1	Yoon-Hee 2020

GAIT

LoE	Conclusion Statement	RCTs	References
1b	**Bent knee gait training** may produce greater improvements in gait when compared to **conventional therapy.**	1	Dalal et al. 2018
1b	**Backwards walking training** may produce greater improvements in gait when compared to **conventional rehabilitation.**	3	Kale et al. 2019; Kim et al. 2017; Yang et al. 2005
1b	**Lateral stair walking training** may produce greater improvements in gait when compared to **backward walking training.**	1	Kim et al. 2017

2	**Overground gait training with motor imagery** may produce greater improvements in gait when compared to **conventional gait training.**	1	Sawant et al. 2020
2	**Overground gait training with feedback** may produce greater improvements in gait when compared to **gait training without feedback.**	1	Kim et al. 2020
1b	**Overground gait training** may not have a difference in efficacy when compared to **treadmill training** for improving gait.	3	Bonnyaud et al. 2013a; Combs-Miller et al. 2014; Gangopadhyay et al. 2021
2	**Overground gait training with ankle mass** may not have a difference in efficacy when compared to **overground gait training without mass** for improving gait.	1	Bonnyaud et al. 2013b
1a	**Lateral stair walking training** may not have a difference in efficacy when compared to **conventional training** for improving gait.	2	Huang et al. 2021; Kim et al., 2017
1b	**Gait training with insoles** may not have a difference in efficacy when compared to **gait training with conventional shoes** for improving gait.	1	Sheikh et al. 2016
2	**Accurate adaptability walking** may not have a difference in efficacy when compared to **steady state walking** for improving gait.	1	Clark et al. 2021
1b	**Implicit motor learning with walking** may not have a difference in efficacy when compared to **explicit motor learning** for improving gait.	1	Jie et al. 2021
2	**Stair or ramp training** may not have a difference in efficacy when compared to **flat surface gait training** for improving gait.	1	Park et al. 2015

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1b	**Overground gait training** may produce greater improvements in performance on activities of daily living than **conventional therapy.**	1	Shen et al. 2015
1b	**Lateral stair walking training** may produce greater improvements in performance on activities of daily living than **conventional therapy.**	1	Huang et al. 2021
1b	**Overground gait training** may not have a difference in efficacy when compared to **massage** for improving performance on activities of daily living.	1	Gordon et al. 2013
1b	**Community-based gait training** may not have a difference in efficacy when compared to **conventional training** for improving performance on activities of daily living.	1	Lord et al. 2008
2	**Backward walking training** may not have a difference in efficacy when compared to **standing balance training** for improving performance on activities of daily living.	1	Rose et al. 2019

1b	**Gait training with postural support** may not have a difference in efficacy when compared to **training with conventional support** for improving performance on activities of daily living.	1	Dragin et al. 2014

RANGE OF MOTION

LoE	Conclusion Statement	RCTs	References
1b	**Bent knee gait training** may produce greater improvements in range of motion when compared to **conventional therapy.**	1	Dalal et al. 2018

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1b	**Overground gait training** may not have a difference in efficacy when compared to **massage therapy** for improving muscle strength.	1	Gordon et al. 2013
1b	**Lateral stair walking training** may not have a difference in efficacy when compared to **conventional training** for improving muscle strength.	1	Huang et al. 2021
2	There is conflicting evidence about the effect of **stair or ramp training** to improve muscle strength when compared to **flat surface gait training.**	1	Park et al. 2015

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
1b	**Community-based gait training** may produce greater improvements in quality of life when compared to **conventional training.**	1	Kim et al. 2014
1b	There is conflicting evidence about the effect of **overground gait training** to improve quality of life when compared to **massage.**	1	Gordon et al. 2013
1b	**Overground gait training** may not have a difference in efficacy when compared to **treadmill training** for improving quality of life.	1	Combs-Miller et al. 2014
1b	**Implicit motor learning with walking** may not have a difference in efficacy when compared to **explicit motor learning** for improving quality of life.	1	Jie et al. 2021

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
2	**Overground gait training** may not have a difference in efficacy when compared to **treadmill training** for improving functional mobility.	1	Timmermans et al. 2021

2	**Accurate adaptability walking** may not have a difference in efficacy when compared to **steady state walking** for improving functional mobility.	1	Clark et al. 2021
1b	**Implicit motor learning with walking** may not have a difference in efficacy when compared to **explicit motor learning** for improving functional mobility.	1	Jie et al. 2021

Key Points

The literature is mixed regarding the effect of overground walking/gait training on improvement of motor function, functional ambulation, balance, activities of daily living, and quality of life.

Overground walking/gait training may not be beneficial for improving muscle strength following stroke.

Overground walking/gait training may be beneficial for improving gait following stroke when compared to conventional therapy but may not be beneficial when compared to different gait modalities.

Cycle Ergometer Training

Adopted from: https://www.verywellfit.com/best-indoor-cycling-bikes-4160109

Use of a cycle ergometer for stationary cycling has been used as a safe form of exercise training in those with challenges in maintaining balance and independent gait (Brown et al., 1997). Cycling shares similar locomotor patterns with walking and is typically used for improving muscle strength, aerobic capacity, and to facilitate muscle control in the lower limbs (Kautz & Brown, 1998; Ozaki et al., 2015; Raasch & Zajac, 1999).

27 RCTs were found evaluating cycle ergometer training for lower extremity motor rehabilitation. Eleven RCTs compared cycle ergometer training to conventional therapy (Da Rosa Pinheiro et al., 2021; Jin et al., 2013; Jin et al., 2012; Karthiga, 2020; Katz-Leurer et al., 2003a; Katz-Leurer et al., 2006; Katz-Leurer & Shochina, 2007; Katz-Leurer et al., 2003b; Kim et al., 2015g; Letombe et al., 2010; Wang et al., 2016b). Three RCTs compared cycle ergometer exercise to sham or no treatment (Lund et al., 2018; Potempa et al., 1995; Sandberg et al., 2016). One RCT compared cycle ergometer training to stretching (Quaney et al., 2009). One RCT compared in-bed cycling to usual care (Sandberg et al., 2020). One RCT compared active cycling with education and coaching to active cycling and education with no coaching or passive mobilization therapy (Vanroy et al., 2017). One RCT compared early recumbent cycle ergometers to conventional physiotherapy (Wu et al., 2020a). One RCT compared cycle ergometer and treadmill training to conventional therapy (Toledano-Zarhi et al., 2011). One RCT compared cycle ergometer training to overground walking (Fujita et al., 2020). One RCT compared cycle ergometers to sliding machines (Song, 2015). Two RCTs compared progressive resistance training and cycling to sham cycling (Lee et al., 2010; Lee et al., 2008). One RCT compared interlimb coupling to conventional therapy (Arya et al., 2020). One RCT compared cycle ergometer with virtual reality to cycle ergometer (Lee, 2019b). One RCT compared EMG-triggered pedalling training to pedalling training (Lee, 2022). One RCT compared aerobic cycling training to cognitive training or aerobic exercise and cognitive training (Yeh et al., 2022).

The methodological details and results of all 27 RCTs are presented in Table 8.

Table 8. RCTs Evaluating Cycle Ergometer Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Cycle Ergometer Training vs Conventional Therapy		
da Rosa Pinheiro et al. (2021) RCT (6) Nstart=20 Nend =20 TPS=Acute	E: Conventional physiotherapy + aerobic cycle ergometer C: Conventional physiotherapy Duration: 40min/d, 5d/wk, for 1wk	• Lower limb strength ○ Hip flexor (+exp) ○ Knee extensor (+exp) ○ Ankle dorsiflexor (+exp) • 10-metre walk test (+exp) • Berg Balance Scale (+exp) • ICU-Mobility Scale (+exp) • Perme Score (+exp)
Wang et al. (2016) RCT (7) Nstart=42 Nend=34 TPS=Subacute	E: Aerobic training (cycle ergometer) C: Conventional rehabilitation Duration: 40min/d, 3d/wk for 6wks	• Functional Ambulation Category (+exp) • Fugl-Meyer Assessment (+exp) • Barthel Index (+exp)
Kim et al. (2015) RCT (8) Nstart=32 Nend=32 TPS=Chronic	E: Cycling exercise + Conventional rehabilitation C: Conventional rehabilitation Duration: 30min/d, 5d/wk for 6wks Cycling	• 10-Metre Walk Test (+exp) • Timed Up & Go Test (+exp) • Berg Balance Scale (+exp)
Karthiga et al. (2020) RCT (3) Nstart=20 Nend=20 TPS=Acute	E: Conventional physiotherapy + cycle ergometry training C: Conventional physiotherapy Duration: 1h/d, 15d physiotherapy; 30min/d, 15d cycle ergometry	• Fugl-Meyer Assessment (+exp) • Step Test (+exp) • Functional Ambulation Category (+exp)
Jin et al. (2013) RCT (4) Nstart=18b Nend=18 TPS=Chronic	E: Progressive aerobic cycling training C: Conventional therapy Duration: 40min/d, 5d/wk, for 12wks	• Muscle strength ○ Paretic knee extension (+exp) ○ Non paretic knee extension (+exp) • 6-minute walking distance (+exp) • Berg Balance Scale (-) • Modified Ashworth scale (-)
Jin et al. (2012) RCT (4) Nstart=133 Nend=133 TPS=Chronic	E: Aerobic training (cycle ergometer) C: Conventional rehabilitation Duration: 40min/d, 5d/wk for 8wks	• 6-minute walk distance (+exp) • Rivermead Mobility Index (-) • knee muscle strength (paretic/non-paretic) (+exp) • Berg balance Scale (-) • Modified Ashworth scale (-)
Letombe et al. (2010) RCT (3) Nstart=18 Nend=18 TPS=Acute	E: Aerobic training (cycle ergometer, treadmill, balance) C: Conventional rehabilitation Duration: 40-60min/d, 4d/wk for 4wks	• Barthel Index (+exp) • Katz ADL Scale (+exp)
Katz-leurer et al. (2007) RCT (5) Nstart=64 Nend=64 TPS=Acute	E; Leg cycle ergometer training C: Conventional rehabilitation Duration: 10-30min/d, 3-5d/wk, 8wks	• Walking Distance (-) • Stair Climbing (+exo) • Functional Independence Measure (-)

Katz-Leurer et al. (2006)
RCT (6)
Nstart=24
Nend=23
TPS=Not Reported
	E: Leg cycle ergometer + Conventional rehabilitation
	C: Conventional Rehabilitation
	
	Duration: 10-30min/d, 5d/wk for 3wks cycling
		• Postural Assessment Scale (+exp)
		  ○ Static (+exp)
		  ○ Dynamic (+exp)
		• Fugl-Meyer Assessment Lower Extremity (+exp)
		• Functional Independence Measure
		  ○ Total (-)
		  ○ Motor (+exp)

Katz-Leurer et al. (2003) RCT (5) Nstart=92 Nend=90 TPS=Acute	E: Aerobic Leg cycle ergometer + Conventional rehabilitation C: Conventional rehabilitation Duration: 10-20min/d, 5d/wk for 2wks then 30min/d, 3d/wk for 6wks Leg cycle	• Functional Independence Measure Total (-) • Stairs Climbing (+exp) • Walking Distance (+exp) • Walking Speed (-) • Frenchay Activities Index (-)
Katz-Leurer et al. (2003) RCT (6) Nstart=92 Nend=90 TPS=Acute	E: Aerobic training (cycle ergometer) C: Conventional therapy Duration: 10-30min/d, 3-5d/wk for 8wks	• Walking distance (-) • 10-m Walk Speed (-) • Stair climb (+exp) • Functional Independence Measure (-) • Mobility Score (+exp)
Cycle Ergometer Training vs Sham or No Treatment		
Lund et al., (2018) RCT (5) Nstart= 43 Nend = 43 TPS= Chronic	E1: Aerobic training on cycle ergometer E2: Resistance training of lower extremities C: Sham training of upper extremities Duration: 3sessions/wk for 12wks	E1 v E2 v C • Berg Balance Scale (-) • 6-minute walking test (-) • 10metre walk speed (-)

Sandberg et al. (2016)
RCT (7)
Nstart=56
Nend=56
TPS=Acute
	E: Aerobic exercise on ergometer cycle
	C: No treatment
	Duration: 60min/d, 2d/wk for 12wks
		• 6-minute walk test (+exp)
		• Maximum walking speed 10 meters (+exp)
		• Timed up and go (+exp)
		• Single leg stance
		  ○ Right eyes open (+exp)
		  ○ Left eyes open (+exp)
		  ○ Right eyes closed (+exp)
		  ○ Left eyes closed (-)
		• EQ-5D VAS (+exp)
		• SIS recovery (+exp)
		• EQ-5D index (-)
		• SIS participation (-)

Potempa et al. (1995)
RCT (5)
Nstart=42
Nend=42
TPS=Chronic
	E: Aerobic training (cycle ergometer)
	C: Sham exercise (passive range-of-motion)
	Duration: 30min/d, 3d/wk for 10wks
		• At Rest
		  ○ Fugl-Meyer index (-)
		  ○ Heart rate (-)
		  ○ Systolic pressure (-)
		  ○ Diastolic pressure (-)

Cycle Ergometer vs Stretching		

Quaney et al. (2009)
RCT (6)
Nstart=40
Nend=38
TPS=Chronic
	E: Aerobic Exercise (progressive resistive stationary bicycle training)
	C: Stretching Exercise at home
	Duration: 45min/d, 3d/wk for 8wks
		• Wisconsin Card Sorting Task (-)
		• Stroop task (-)
		• Trail-making (-)
		• Serial Reaction Timed Task
		  ○ Random (-)
		  ○ Repeated (+exp)
		• Fugl-Meyer sensorimotor test (-)
		• Berg Balance Scale (-)
		• Get Up and Go test (+exp)

In-Bed Cycling vs Usual Care		
Sandberg et al. (2020) RCT (6) Nstart=56	E: In- Bed cycling + Usual care C: Usual care	• 6-minute walk (-) • Modified Rankin Scale (-) • Barthel Index (-)

Nfinal=52 TPS=Acute	Duration: 20min/d, 5d/wk for 3wks bed cycling	
Active Cycling with Education and Coaching vs Active Cycling with Education or Passive Mobilization.0		
Vanroy et al. (2017) RCT (6) NStart=59 NEnd=53 TPS=Subacute	Phase I E: Active Cycling + Education C: Passive mobilization therapy Phase II E1: Active cycling + Coaching E2: Active cycling + non-Coaching Duration: E1 + E2: 30mins/d, 3d/wk, for 3 months Active Cycling interval (week 1-8) to continuous (week 9-12) E1: after initial phase 30mins/d, 3d/wk, for 9 months, Coached Active Cycling E2: after initial phase 30mins/d, 3d/wk, for 9 months, non-Coached Active Cycling	Phase I (E vs C) • Functional Ambulation Category (-) • 10-meter Walk Test (-) Phase II (E1 vs E2) • Functional Ambulation Category (-) • 10-meter Walk Test (-)
Early Recumbent Cycle Ergometer vs Conventional Therapy		
Wu et al. (2020) RCT (7) Nstart=31 Nend=31 TPS=Acute	E: Early Intensive Rehabilitation (Recumbent Cycle Ergometer Training) C: Conventional Physiotherapy Duration: 20 min/d, 5d/wk, for 2wks recumbent cycle ergometer training & 5d/wk, conventional physiotherapy	• Fugl-Meyer Assessment (+exp) • Berg Balance Scale (-) • Barthel Index (-) • 50m Walking (-) • Modified Rankin Scale (-)
Cycle Ergometer and Treadmill Training vs Conventional Therapy		
Toledano-Zarhi et al. (2011) RCT (6) Nstart=28 Nend=27 TPS=Acute	E: Aerobic training (treadmill and cycle ergometer) C: Conventional rehabilitation Duration: 35-55min/d, 3d/wk for 6wks	• 6min Walk test (-) • Stair Climb test (-) • Four Square step test (-)
Cycle Ergometer Training vs Overground Walking		
Fujita et al. (2020) RCT (8) Nstart=21 Nend=21 TPS=Chronic	E: Cycle ergometer C: Overground walking Duration: 10min/single session	• Ankle kinematics (-) • Knee kinematics ○ Knee flexion angle at toe-off (+exp) ○ Peak knee flexion angle during early swing phase (+exp) ○ Plantar flexion angle at peak knee flex (+con) ○ Plantar flexion velocity at toe-off (+exp) • Gait velocity (-) • Step length (-) • Stride length (-) • Cadence (-) • Single/double support (-)
Cycle Ergometer vs Sliding Machine		
Song et al. (2015) RCT (4) Nstart=40 Nend=40 TPS=Chronic	E1: Aerobic training (Ergometer bicycle training) E2: Aerobic training (sliding machine) Duration: 30min/d, 5d/wk for 8wks	• 10-Metre Walk Test (-) • Limit of Stability (+exp)
Progressive Resistance Training and Cycling vs Sham Progressive Resistance Training and Cycling		

Lee et al. (2010) RCT (5) Nstart=52 Nend=48 TPS=Chronic	E1: Progressive resistance training + Cycling E2: Progressive resistance training + Sham cycling E3: Sham progressive resistance training + Cycling E4: Sham progressive resistance training + Sham cycling Duration: 60min/d, 3d/wk for 10wks	<u>E1/E2 vs E3/E4</u> • Muscle strength – LE (+exp1, +exp2) • Muscle endurance (+exp1, +exp2) • Peak power (+exp1, +exp2) <u>E1 vs E2</u> • Muscle strength – LE (-) • Muscle endurance (-) • Peak power (-) <u>E3 vs E4</u> • Muscle strength – LE (+exp3) • Muscle endurance (+exp3) • Peak power (+exp3)

Lee et al. (2008)
RCT (5)
Nstart=52
Nend=48
TPS=Chronic
	E1: Aerobic cycling + progressive resistance training (PRT)
	E2: Aerobic cycling + sham PRT
	E3: Sham cycling + PRT
	C: Sham cycling + Sham PRT
	Duration: 60min/d, 3d/wk for 10wks
		<u>E2/E3 v C</u>
		• 6MWT
		  ○ Distance (-)
		  ○ Endurance-affected (+exp3)
		• 10MWT (-)
		• Stair climbing power (+exp3)
		• SF-36 (-)
		• Ewart self-efficacy
		  ○ Walking (+exp3)
		  ○ Stair climbing (+exp3)
		<u>E1 v C</u>
		• 6MWT
		  ○ Distance (-)
		  ○ Endurance-affected (+exp1)
		• 10MWT (-)
		• Stair climbing power (+exp1)
		• SF-36 (-)
		• Ewart self-efficacy (-)

Interlimb Coupling Training vs Conventional Therapy		
Arya et al. (2020) RCT (9) Nstart=50 Nend=47 TPS=Chronic	E: Interlimb coupling activities (rowing, bicycle ergometer, wall cycle and elliptical machine) C: Conventional rehabilitation Duration: 60min/d, 3d/wk for 8wks	• Fugl-Meyer Assessment-LE (+exp) • Rivermead Visual Gait Assessment (+exp) • Functional Ambulation Classification (+exp) • Modified Rankin Scale (-)
Cycle Ergometry with VR vs Cycle Ergometry		
Lee (2019) RCT (7) Nstart=42 Nend=42 TPS=Chronic	E: Speed-Interactive Pedaling Training + Virtual Reality C: Pedaling Training Duration: 40 min/d, 5d/wk, for 6wks	• Fugl-Meyer Assessment - LE (+exp) • Modified Functional Reach Test (+exp) • Gait Velocity (+exp) • Cadence (+exp) • Step Length (+exp) • Stride Length (+exp)
EMG-triggered Pedalling Training vs Pedalling Training		
Lee (2022) RCT (5) Nstart=44 Nend=41 TPS=Chronic	E: EMG-triggered Pedaling training C: Pedaling training Duration: 50min/d, 5d/wk for 4wks	• Fugl-Meyer Assessment (+exp) • Gait Velocity (+exp) • Cadence (-) • Stride time (-) • Affected sidestep time (+exp) • Unaffected sidestep time (-) • Affected single-limb support time (+exp) • Unaffected single-limb support time (-) • Double-limb support time (+exp)

		• Stride length (+exp) • Step length (+exp) • Gait symmetry on step length (-) • Gait symmetry on step time (+exp) • Berg balance scale (+exp) • Timed up and go (+exp) • Functional reach tests (+exp) • Modified Barthel Index (+exp)
Aerobic Cycling vs Aerobic Cycling with Cognitive Training		

Yeh et al. (2022)
RCT (6)
Nstart=56
Nend=56
TPS=Chronic
	E1: Aerobic cycling exercise training
	E2: Computerized cognitive training
	E3: Aerobic exercise + computerized cognitive training
	Duration: 60min/d, 3d/wk for 12wks
		E1 vs E2/E3
		• Montreal Cognitive Assessment (+exp3)
		• Wechsler Memory Scale
		  • Word List II (+exp3)
		  • Word List IA delayed (+exp2, +exp3)
		• Stroop colour-word test (-)
		• Timed Up & Go (-)
		• 6-Minute Walk Test (-)
		• Functional Independence Measure (-)
		• Lawton Instrumental Activities of Daily Living Scale (-)
		• Community Integration Questionnaire (-)
		• Stroke Impact Scale (-)
		
		E2 vs E3
		• Montreal Cognitive Assessment (+exp3)
		• Wechsler Memory Scale
		  ○ Word List II (+exp3)
		  ○ Word List IA delayed (-)
		• Stroop colour-word test (-)
		• Timed Up & Go (-)
		• 6-Minute Walk Test (-)
		• Functional Independence Measure (-)
		• Lawton Instrumental Activities of Daily Living Scale (-)
		• Community Integration Questionnaire (-)
		• Stroke Impact Scale (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Cycle Ergometer Training

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Cycle ergometer training** may produce greater improvements in motor function than **conventional therapy.**	3	Karthiga 2020; Wang et al. 2016; Katz-Leurer et al. 2006
2	**Cycle ergometer training** may not have a difference in efficacy compared to **sham training** for improving motor function.	1	Potempa et al. 1995

1b	**Cycle ergometer training** may not have a difference in efficacy compared to **stretching** for improving motor function.	1	Quaney et al. 2009
1b	**Early recumbent cycle ergometry** may produce greater improvements in motor function than **conventional therapy.**	1	Wu et al. 2020
1b	**Interlimb coupling training** may produce greater improvements in motor function than **conventional therapy.**	1	Arya et al. 2020
1b	**Cycle ergometry with virtual reality** may produce greater improvements in motor function than **cycle ergometry**.	1	Lee et al. 2019
2	**EMG-triggered pedalling training** may produce greater improvements in motor function than **pedalling training.**	1	Lee 2022

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Cycle ergometer training** may produce greater improvements in functional ambulation when compared to **conventional therapy.**	9	da Rosa Pinheiro 2021; Katz-Leurer 2007; Wang et al. 2016; Kim et al. 2015; Jin et al. 2013; Jin et al. 2012; Katz-Leurer et al. 2003a; Katz-Leurer et al. 2003b; Karthiga 2020
2	**Cycle ergometer training** may not have a difference in efficacy compared to **sham training** for improving functional ambulation.	1	Lund et al. 2018
2	**Cycle ergometer training** may not have a difference in efficacy compared to **lower extremity resistance training** for improving functional ambulation.	1	Lund et al. 2018
1b	**Cycle ergometer training** may produce greater improvements in functional ambulation when compared to **no treatment.**	1	Sandberg et al. 2016
1b	**Cycle ergometer training** may produce greater improvements in functional ambulation when compared to **stretching.**	1	Quaney et al. 2009
1b	**In-bed cycling** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	1	Sandberg et al. 2020
1b	**Active cycling with education and coaching** may not have a difference in efficacy compared to **active cycling without coaching** for improving functional ambulation.	1	Vanroy et al. 2017
1b	**Active cycling with education** may not have a difference in efficacy compared to **passive mobilization** for improving functional ambulation.	1	Vanroy et al. 2017
1b	**Early recumbent cycle ergometry** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	1	Wu et al. 2020

1b	**Cycle ergometer and treadmill training** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	1	Toledano-Zarhi et al. 2011
1b	**Cycle ergometer training** may not have a difference in efficacy compared to **overground walking** for improving functional ambulation.	1	Fujita et al. 2020
2	**Cycle ergometer training** may not have a difference in efficacy when compared to **sliding machine** for improving functional ambulation.	1	Song et al. 2015
2	There is conflicting evidence about the effect of **progressive resistance training and cycling** to improve functional ambulation when compared to **sham progressive resistance training and sham cycling**.	1	Lee et al. 2008
2	**Sham progressive resistance training and cycling** may not have a difference in efficacy when compared to **sham progressive resistance training and sham cycling** for improving functional ambulation.	1	Lee et al. 2008
2	There is conflicting evidence about the effect of **progressive resistance training and sham cycling** to improve functional ambulation when compared to **sham progressive resistance training and sham cycling**.	1	Lee et al. 2008
1b	**Interlimb coupling training** may produce greater improvements in functional ambulation than **conventional therapy.**	1	Arya et al. 2020
1b	**Cycle ergometry with virtual reality** may produce greater improvements in functional ambulation than **cycle ergometry.**	1	Lee 2019
2	**EMG-triggered pedalling training** may produce greater improvements in functional ambulation than **pedalling training.**	1	Lee 2022
1b	**Aerobic cycling with cognitive training** may not have a difference in efficacy when compared to **aerobic cycling** for improving functional ambulation.	1	Yeh et al. 2022
1b	**Aerobic cycling with cognitive training** may not have a difference in efficacy when compared to **cognitive training** for improving functional ambulation.	1	Yeh et al. 2022
1b	**Aerobic cycling** may not have a difference in efficacy when compared to **cognitive training** for improving functional ambulation.	1	Yeh et al. 2022

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1b	**Cycle ergometer training** may produce greater improvements in functional mobility than **conventional therapy.**	3	Jin et al. 2012; Katz-Leurer et al. 2003; da Rosa Pinheiro 2021

2	**Progressive resistance training and cycling** may not have a difference in efficacy when compared to **sham progressive resistance training and sham cycling** for improving functional mobility.	1	Lee et al. 2008

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **cycle ergometer** to improve balance when compared to **conventional therapy**.	6	da Rosa Pinheiro 2021; Kim et al. 2015; Jin et al. 2013; Jin et al. 2012; Katz-Leurer et al. 2006; Karthiga 2020
2	**Cycle ergometry** may not have a difference in efficacy when compared to **sham training** for improving balance.	1	Lund et al. 2018
2	**Cycle ergometry** may not have a difference in efficacy when compared to **lower extremity resistance training** for improving balance.	1	Lund et al. 2018
1b	**Cycle ergometer training** may produce greater improvements in balance than **no treatment.**	1	Sandberg et al. 2016
1b	**Cycle ergometry** may not have a difference in efficacy when compared to **stretching** for improving balance.	1	Quaney et al. 2009
1b	**Early recumbent cycle ergometry** may not have a difference in efficacy when compared to **conventional therapy** for improving balance.	1	Wu et al. 2020
1b	**Cycle ergometer and treadmill training** may not have a difference in efficacy when compared to **conventional therapy** for improving balance.	1	Toledano-Zarhi et al. 2011
2	**Cycle ergometer training** may produce greater improvements in balance than **sliding machine.**	1	Song et al. 2015
1b	**Cycle ergometry with virtual reality** may produce greater improvements in balance than **cycle ergometry**.	1	Lee 2019
2	**EMG-triggered pedalling training** may produce greater improvements in balance than **pedalling training**.	1	Lee 2022

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Interlimb coupling training** may produce greater improvements in gait than **conventional therapy.**	1	Arya et al. 2020
1b	**Cycle ergometer training** may not have a difference in efficacy when compared to **overground walking** for improving performance on gait.	1	Fujita 2020
1b	**Cycle ergometry with virtual reality** may produce greater improvements in gait than **cycle ergometry**.	1	Lee et al. 2019

2	There is conflicting evidence about the effect of **EMG-triggered pedalling training** to improve gait when compared to **pedalling training**.	1	Lee 2022

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Cycle ergometer** may not have a difference in efficacy when compared to **conventional therapy** for improving performance on activities of daily living.	6	Wang et al. 2016; Letombe et al. 2010; Katz-Leurer et al. 2006; Katz-Leurer et al. 2003a; Katz-Leurer et al. 2003b; Katz-Leurer et al. 2007
1b	**In-bed cycling** may not have a difference in efficacy when compared to **conventional therapy** for improving performance on activities of daily living.	1	Sandberg 2020
1b	**Early recumbent cycle ergometry** may not have a difference in efficacy when compared to **conventional therapy** for improving performance on activities of daily living.	1	Wu et al. 2020
1b	**Interlimb coupling training** may not have a difference in efficacy when compared to **conventional therapy** for improving performance on activities of daily living.	1	Arya et al. 2020
2	**EMG-triggered pedalling training** may produce greater improvements in activities of daily living than **pedalling training.**	1	Lee 2022
1b	**Aerobic cycling with cognitive training** may not have a difference in efficacy when compared to **aerobic training** for improving performance on activities of daily living.	1	Yeh et al. 2022
1b	**Aerobic cycling with cognitive training** may not have a difference in efficacy when compared to **cognitive training** for improving performance on activities of daily living.	1	Yeh et al. 2022
1b	**Aerobic cycling** may not have a difference in efficacy when compared to **cognitive training** for improving performance on activities of daily living.	1	Yeh et al. 2022

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Cycle ergometer training** may produce greater improvements in muscle strength than **conventional therapy.**	3	da Rosa Pinheiro 2021; Jin et al. 2013; Jin et al. 2012
2	**Progressive resistance training and cycling** may produce greater improvements in muscle strength than **sham progressive resistance training and sham cycling.**	1	Lee et al. 2010
2	**Progressive resistance training and cycling** may produce greater improvements in muscle strength	1	Lee et al. 2010

	than **sham progressive resistance training and cycling.**		
2	**Progressive resistance training and cycling** may not have a difference in efficacy compared to **progressive resistance training and sham cycling** for improving muscle strength.	1	Lee et al. 2010
2	**Progressive resistance training and sham cycling** may produce greater improvements in muscle strength than **sham progressive resistance training and cycling.**	1	Lee et al. 2010
2	**Sham progressive resistance training and cycling** may produce greater improvements in muscle strength than **sham progressive resistance training and sham cycling.**	1	Lee et al. 2010
2	**Progressive resistance training and sham cycling** may produce greater improvements in muscle strength than **sham progressive resistance training and sham cycling.**	1	Lee et al. 2010

SPASTICITY

LoE	Conclusion Statement	RCTs	References
2	**Cycle ergometer training** may not have a difference in efficacy compared to **conventional therapy** for improving spasticity.	2	Jin et al. 2013; Jin et al. 2012

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **cycle ergometer** to improve quality of life when compared to **no treatment**.	1	Sandberg et al. 2016
2	**Progressive resistance training and cycling** may not have a difference in efficacy when compared to **sham progressive resistance training and sham cycling** for improving quality of life.	1	Lee et al. 2008
2	**Sham progressive resistance training and cycling** may not have a difference in efficacy when compared to **sham progressive resistance training and sham cycling** for improving quality of life.	1	Lee et al. 2008
2	**Progressive resistance training and sham cycling** may not have a difference in efficacy when compared to **sham progressive resistance training and sham cycling** for improving quality of life.	1	Lee et al. 2008
1b	**Aerobic cycling with cognitive training** may not have a difference in efficacy when compared to **aerobic cycling** for improving quality of life.	1	Yeh et al. 2022
1b	**Aerobic cycling with cognitive training** may not have a difference in efficacy when compared to **cognitive training** for improving quality of life.	1	Yeh et al. 2022

1b	**Aerobic cycling** may not have a difference in efficacy when compared to **cognitive training** for improving quality of life.	1	Yeh et al. 2022

Key Points

Cycle ergometer training may be beneficial for improving motor function, functional mobility, gait, and muscle strength after stroke.

Cycle ergometer training may be beneficial for improving functional ambulation when compared to conventional treatment after stroke, but the literature is mixed regarding the effect of cycle ergometer training with different modalities and combination.

The literature is mixed regarding the effect of cycle ergometer training on balance improvement after stroke.

Cycle ergometer training may not be beneficial for improving activities of daily living, spasticity, and quality of life after stroke.

Treadmill Training

Adopted from: http://www.ptproductsonline.com/2016/01/accentuate-negative/

Treadmill walking is a common rehabilitation intervention used for patients with walking impairments after stroke. It has been shown to increase the total number of steps taken within a training session as compared to a conventional physiotherapy approach (Hesse et al., 2003). As such, treadmill training can be used to encourage intensive, repetitive, task-specific training, which is suggested to be an ideal form of gait training to optimize lower limb rehabilitation after stroke (French et al., 2016; Langhorne et al., 2009). Body weight support (BWS), provided through a harness above the treadmill, is an increasingly popular approach within rehabilitation programs that attempts to optimize locomotor-related sensory inputs to all neural regions involved in walking (Charalambous et al., 2013; Hassid et al., 1997; Langhorne et al., 2009).

Treadmill training can also be administered with support from Nordic poles or handrails, and training can be modified through adding additional load, applying a horizontal force, encouraging walking sideways, backwards, or through changing the treadmill surface to make it unstable or inclined. Additionally, speed of the treadmill can be changed to increase or decrease intensity.

98 RCTs were found evaluating treadmill training for lower extremity motor rehabilitation.

Five RCTs compared treadmill training to conventional therapy (Baer et al., 2018; Globas et al., 2012; Kuys et al., 2011; Laufer et al., 2001; Macko et al., 2005). Five RCTs compared treadmill training to overground training (Aguiar et al., 2020; Bonnyaud et al., 2013a; Bonnyaud et al., 2014b; Brauer et al., 2022; Langhammer & Stanghelle, 2010; Park et al., 2013). Twelve RCTs compared BWS treadmill training to conventional therapy (da Cunha et al., 2002; Eich et al., 2004;

Lura et al., 2019; Mackay-Lyons et al., 2013; Mustafaoglu et al., 2018; Nave et al., 2019; Ramakrishna et al., 2021; Sukonthamarn et al., 2019; Takao et al., 2015; Teixeira da Cunha Filho et al., 2001; Yang et al., 2010; Yen et al., 2008). 13 RCTs compared BWS treadmill training to overground walking (Ada et al., 2010; Combs-Miller et al., 2014; Dean et al., 2010; DePaul et al., 2015; Franceschini et al., 2009; Gama et al., 2017; Gangopadhyay et al., 2021; Hoyer et al., 2012; Kosak & Reding, 2000; Mao et al., 2015; Middleton et al., 2014; Nilsson et al., 2001; Suputtitada et al., 2004). Six RCTs compared BWS treadmill training to treadmill training (Barbeau & Visintin, 2003; Calabrò et al., 2020; Lee, 2015b; Srivastava et al., 2016; Ullah et al., 2017; Visintin et al., 1998). One RCT compared BWS treadmill training with mobility skills to BWS treadmill training (Graham et al., 2018). One RCT compared BWS treadmill training with upper extremity ergometry training to BWS treadmill training with resistance training (Sullivan et al., 2007). One RCT compared BWS treadmill training with facilitation technique to BWS treadmill training with mechanical assistance (Yagura et al., 2006). One RCT compared BWS treadmill training for different durations to a home-based exercise program (Duncan et al., 2011). Two RCTs compared treadmill training with Nordic poles to treadmill training (Kang et al., 2016; Shin et al., 2015). Six RCTs compared treadmill training with load to treadmill training without load or conventional therapy (de Lima Gomes et al., 2017; Kim & Yim, 2017; Park et al., 2014c; Ribeiro et al., 2017a; Ribeiro et al., 2020; Ribeiro et al., 2017b). Three RCTs compared treadmill training with an incline to treadmill training with a decline or treadmill training alone (Carda et al., 2013; Cheng et al., 2022; Gama et al., 2015). One RCT compared treadmill training with increased speed to treadmill training with increased incline (Alıpsatıcı et al., 2020). One RCT compared constraint induced movement with home exercise to treadmill training (Silva et al., 2017). One RCT compared treadmill training with foot drop stimulator to foot drop stimulator (Peishun et al., 2021). One RCT compared perturbation treadmill training to treadmill training (Esmaeili et al., 2020). One RCT compared turning treadmill training to treadmill training (Chen et al., 2014). One RCT compared treadmill training with mirror therapy to treadmill training (Broderick et al., 2019). One RCT compared treadmill training with taping to treadmill training (Kim & Kang, 2018). One RCT compared treadmill training with proprioceptive neuromuscular facilitation to treadmill training (Ribeiro et al., 2013). One RCT compared treadmill training with obstacles to treadmill training (Jeong & Koo, 2016). One RCT compared treadmill training on an unstable surface to treadmill training (Bang et al., 2014). One RCT compared treadmill training with handrails to treadmill training (Kang et al., 2015). One RCT compared treadmill training with horizontal force to treadmill training (Na et al., 2015). Three RCTs compared treadmill training with virtual reality to other training methods (Cho & Lee, 2013, 2014; Timmermans et al., 2021). One RCT compared treadmill training with a smartphone application to treadmill training alone (Lee et al., 2017b). One study compared treadmill training with visual deprivation to treadmill training (Kim & Kim, 2014). Five RCTs compared backward treadmill training to standard treadmill or conventional rehabilitation (Chang et al., 2021; Kim et al., 2014c; Kim et al., 2017b; Munari et al., 2020; Takami & Wakayama, 2010). Three RCTs compared treadmill training with overground training to home exercise or no treatment (Ada et al., 2003; Ada et al., 2013; Moore et al., 2010). Four RCTs compared high intensity treadmill training to low intensity treadmill training (Holleran et al., 2015; Ivey et al., 2015; Kuys et al., 2011; Munari et al., 2018). One RCT compared treadmill training and strength training (Kim et al., 2011a). Four RCTs compared speed dependent treadmill training to other treadmill training (Helm et al., 2019; Lau & Mak, 2011; Pohl et al., 2002; Sullivan et al., 2002). One RCT compared speed dependent treadmill training to task-oriented training (Sharma & Pandey, 2014). One RCT compared error augmentation treadmill training to treadmill training alone (Lewek et al., 2018). One RCT compared Treadmill training to stretching (Luft et al., 2008).

One RCT compared treadmill training with orthotic devices to treadmill training (In et al., 2017). One RCT compared an electromechanical gait trainer to body weight-supported treadmill training (Werner et al., 2002b). One RCT compared treadmill training with action observation to treadmill training (Bang et al., 2013).

The methodological details and results of all 98 RCTs are presented in Table 9.

Table 9. RCTs Evaluating Treadmill Training Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Treadmill Training vs Conventional Therapy		
Baer et al. (2018) RCT (7) Nstart=77 Nend=69 TPS=Subacute	E: Treadmill Training + normal gait re-education C: Normal gait re-education Duration: minimum of 1 session physiotherapy and 2 sessions gait training/wk for 8wks	• Rivermead Mobility Index (-) • Functional Ambulation Category (-) • 10-metre walk (-) • 6-minute walk (-) • Barthel Index (-) • Motor Assessment Scale (-) • Stroke Impact Scale (-) • Timed Up and Go (-)
Globas et al. (2012) RCT Crossover (6) Nstart=38 Nend=36 TPS=Chronic	E: High intensity Treadmill training C: Conventional therapy Duration: E: 30-50min, 3d/wk, for 13wks; C: 1h/d, 1-3d/wk, for 13wks	• 6-minute walk (+exp) • 10 metre walk test: ○ Maximum walking speed (+exp) ○ Comfortable walking speed (-) • Berg Balance Scale(+exp) • 5 chair rise (-) • SF-12: ○ Physical (-) ○ Mental (+exp) • Rivermead Mobility Index (+exp)
Kuys et al. (2011) RCT (8) Nstart=30 Nend=28 TPS=Subacute	E: High intensity treadmill training + usual physiotherapy C: Conventional rehabilitation Duration: 30min/d, 3d/wk for 6wks	• 6-Minute Walk Test (+exp) • 10-Metre Walk Test (+exp)
Macko et al. (2005) RCT (5) Nstart=61 Nend=45 TPS=Chronic	E: Treadmill training C: Conventional rehabilitation Duration: 40min/d, 3d/wk for 24wks	• 6-Minute Walk Test (+exp) • 30-ft Timed Walk (-) • Walking Impairment Questionnaire ○ Distance (+exp) ○ Speed (-) ○ Stair Climbing (-) • Rivermead Mobility Index (-)
Laufer et al. (2001) RCT (6) N_{start}=29 N_{end}=25 TPS=Subacute	E: Treadmill training + Conventional physical therapy C: Overground gait training + Conventional physical therapy Duration: 8-20min/d, 5d/wk for 3wks	• Functional Ambulation Category (+exp) • Standing Balance Test (-) • 10-Meter Walk Test (-) • Stride length (+exp) • Percentage of Swing (-) • Percentage of Paretic Single Stance Period (+exp) • Double Stance (-)
Treadmill Training vs Overground Training		

Brauer et al. (2022) RCT (8) Nstart=119 Nend=108 TPS=Acute	E: Treadmill training + Self-management education C: Conventional gait training Duration: 30min, 3d/wk, for 8wks Treadmill and Self-management & 5d/wk, for 8wks Conventional gait training	• 6-minute walk test (-) • 10-m walk test at preferred speed (-) • 10-m walk test at fast speed (-) • Hospital Anxiety and Depression Scale (-) • Self-Confidence Questionnaire (-) • Physical Activity Scale (-) • EuroQual-5D (-)

Aguiar et al. (2020)
RCT (7)
Nstart=22
Nend=18
TPS=Chronic
	E: Aerobic Treadmill Training (at 60-80% of heart rate reserve)
	C: Outdoor Overground Walking (below 40% of heart rate reserve)
	Duration: 40min, 3d/wk, for 12wks
		• Physical Activity Levels
		  • Energy Expenditure (-)
		  • Human Activity Profile (-)
		• Time Spent in Low-energy Expenditure Activities (-)
		• Stroke-Specific Quality of Life Scale (-)
		• Stroke Impact Scale (-)
		• 10-Meter Walk Speed Test (-)
		• Incremental Shuttle-Walk Test (-)
		• 6-Minute Walk Distance Test (-)
		• Patient Health Questionnaire 2 and 9 (-)

Bonnyaud et al. (2014) RCT (7) Nstart=56 Nend=56 TPS=Chronic	E: Treadmill training C: Overground gait training (on a 50-m-long corridor with turns) Duration: 20min single session	• Timed Up and Go (-)

Bonnyaud et al. (2013)
RCT (4)
Nstart=26
Nend=26
TPS=Chronic
	E: Overground gait training
	C: Treadmill gait training
	Duration: 20min, single session
		• Gait Speed (-)
		• Gait Cadence (-)
		• Single limb support phase (-)
		• Step length (-)
		• Vertical ground reaction force
		  ○ Total support phase-both sides (-)
		  ○ Single support phase-both sides (-)
		• Peak propulsion-both sides (-)
		• Peak braking-both sides (-)

Park et al. 2013 RCT (4) Nstart= 40 Nend=40 TPS=Chronic	E: Treadmill training C: Overground gait training Duration: 60min/d, 5d/wk, for 2wks	• 10-Metre Walk Test (-) • 6-Minute Walk Test (-) • Berg Balance Scale (-)
Langhammer & Stanghelle (2010) RCT (8) Nstart=39 Nend=34 TPS=Chronic	E1: Treadmill training + Rehabilitation program E2: Overground gait training + Rehabilitation program Duration: 30min/d, 5d/wk, treadmill or overground gait & 3hr & 50min/d, 5d/wk, rehabilitation program	• 6-minute walk test (+exp) • 10-meter walk test (+exp) • Stride length (+exp) • Step width (+exp) • Cadence (-)
BWS Treadmill Training vs Conventional Therapy		
Ramakrishna et al. (2021) RCT (5) Nstart=20 Nend=20 TPS=Acute	E: BWS treadmill training + conventional physiotherapy C: Conventional physiotherapy Duration: 30-45min/d, 3d/wk, for 4wks conventional PT & 30min/d, 3d/wk, for 4wks treadmill training	• 10-meter walk test (+exp)
Lura et al., 2019 RCT (5) Nstart=41 Nfinal=38	E: BWS treadmill training + regular physiotherapy C: Conventional gait training + regular physiotherapy	• Stride length (-) • Step width (-) • Step Asymmetry (-) • Gait Speed (+exp)

TPS=Acute	Duration: Not reported	• Functional Independence Measure (-)
Nave et al. (2019) RCT (6) Nstart=200 Nend=167 TPS=Acute	E: BWS treadmill training (Aerobic) + Standard care C: Standard care + Relaxation (sham) Duration: 50min/d, 5d/wk, for 4wks	• 10-Metre Walk Test (-) • Barthel Index (-) • 6-Minute Walk Test (+exp) • Rivermead Mobility Index (-) • Modified Rankin Scale (-) • Step length (-) • Cadence (-) • Medical Research Council Scale (-) • Resistance to passive movement (-) • Functional ambulation category (-) • EQ-5D (-) • Montreal Cognitive Assessment (-) • Trail Making Test (-)

Sukonthamarn et al. (2019)
RCT (8)
Nstart=31
Nend=29
TPS=Subacute
	E: Anti-gravity treadmill training + Conventional physiotherapy
	C: Conventional physiotherapy
	Duration: 2h 30min/d, 5d/wk, for 4wks
		• 6-Minute Walk Test (-)
		• Functional Ambulatory Category (-)
		• Path length from computerized balance test
		  ○ Eyes closed (+exp)
		  ○ Eyes open (-)
		• Maximum voluntary isometric contraction (-)

Mustafaoglu et al. (2018) RCT (7) Nstart=45 Nend=45 TPS=Chronic	E1: BWS treadmill training E2: BWS treadmill training + Conventional care C: Conventional training Duration: 45min/d, 2d/wk for 6wks BWS treadmill training & 45min/d, 5d/wk for 6wks Conventional training	<u>E1 vs E2</u> • Berg Balance Scale (+exp2) • Affected side single leg stance test (+exp2) • Non-affected side single leg stance test (+exp2) • Timed Up and Go Test (+exp2) • Falls Efficacy Scale-International (+exp2) • Rivermead Mobility Index (-) • Comfortable 10-m Walk Test (-) • Stair Climbing Test (+exp2) <u>E1/E2 vs C</u> • Berg Balance Scale (+exp2) • Affected side single leg stance test (+exp1, +exp2) • Non-affected side single leg stance test (+exp1, +exp2) • Timed Up and Go Test (+exp1, +exp2) • Falls Efficacy Scale-International (+exp2) • Rivermead Mobility Index (+exp2) • Comfortable 10-m Walk Test (+exp2) • Stair Climbing Test (+exp2)
Takao et al. (2015) RCT (4) Nstart=18 Nend=18 TPS=Chronic	E: Treadmill training + BWS C: Conventional rehabilitation Duration: 20min/d, 3d/wk for 4wks	• Gait speed (+exp) • Step length (-) • Cadence (-) • Timed Up and Go (-)

Mackay-Lyons et al. (2013)
RCT (8)
Nstart=50
Nend=45
TPS=Acute
	E: Bodyweight supported treadmill training
	C: Usual care
	Duration: 60min/d, 5d/wk for 6wks, then 60min/d, 3d/wk for 6wks
		• 6-minute walk test (+exp)
		• 10-m walk (-)
		• Berg Balance Scale (-)
		• Chedoke-McMaster Stages of Recovery
		  ○ Leg (-)
		  ○ Foot (+exp)

Yang et al. (2010) RCT (7) Nstart=18 Nend=18 TPS= Subacute & Chronic	E: Treadmill training + BWS C: Conventional rehabilitation Duration: 50min/d, 3d/wk for 4wks	• Fugl-Meyer Assessment (+exp)
Yen et al. (2008) RCT (7) Nstart=14 Nend=14 TPS=Chronic	E: Treadmill training with BWS + general physical therapy C: General physical therapy Duration: 50min/d, 2-5d/wk, for 4wks general physical therapy & 30 min/d, 3d/wk, for 4wks BWS	• Berg balance scale (-) • Motor Threshold (-) • Gait Speed (+exp) • Cadence (-) • Step length (+exp)
Eich et al. (2004) RCT (8) Nstart=50 Nend=50 TPS=Subacute	E: BWS Treadmill + Bobath physiotherapy C: Bobath physiotherapy Duration: 60min/d, 5d/wk for 6wks	• Rivermead Motor Assessment (-) • Walking Quality (-) • 10-m Walk Test (Max Speed) (+exp) • 6-m Walk Test (+exp) •
Da Cunha et al. (2002) RCT (4) Nstart=15 Nend=13 TPS=Acute	E: BWS treadmill training + Conventional rehabilitation C: Conventional rehabilitation Duration: 180min/d until discharge (about 3wks)	• Functional Ambulation Category (-) • 5-m Walk Test (-)
Teixeira da Cunha Filho et al. (2001) RCT (4) Nstart=15 Nend=12 TPS=Acute	E: Supported treadmill walking training + Regular rehabilitation C: Regular rehabilitation Duration: 180min/d, 5d/wk, for 2-3wks Regular rehabilitation, 20min/d, 5d/wk, for 2-3wks Treadmill training	• Functional Ambulatory Category (-) • Functional Independence Measure (locomotor) (-)
BWS Treadmill Training vs Overground Walking		
Gangopadhyay et al. (2021) RCT (7) Nstart=30 Nend=30 TPS=Subacute	E: BWS treadmill training+ conventional rehabilitation C: Overground gait training + conventional rehabilitation Duration: 20min/d BWST/overground gait training & 40min/d conventional rehabilitation, 3d/wk for 4wks	• Timed Up and Go (+exp) • Gait Cadence (+exp) • 10-meter Walk test (+exp) • Berg Balance scale (+exp)
Gama et al. (2017) RCT (6) Nstart=32 Nend=28 TPS=Chronic	E: Overground walking with BWS C: Treadmill training with BWS Duration: 45min/d, 3d/wk, for 6wks	• 10-Meter Walk Test (-) • 6-Minute Walk Test (-) • Functional Independence measure (-) • Fugl-Meyer Assessment Lower Extremity (-) • Step length (-) • Step length symmetry ratio (+exp) • Single limb support duration (-)
DePaul et al. (2015) RCT (8) Nstart=71 Nend=64 TPS=Chronic	E: Body-weight-supported Treadmill training C: Motor-learning-science-based Overground walking Duration: 60min/d, 3d/wk, for 5wks	• 5-m walk test (-) • 6-Minute Walk Test (-) • Functional Balance Test (-) • Activities-Specific Balance Confidence Scale (-) • Life Space Assessment (-) • Stroke Impact Scale (-)
Mao et al. (2015) RCT (5) Nstart=29 Nend=24	E: Body-weight-supported treadmill training C: Overground gait training	• Fugl-Meyer Assessment (-) • Brunel Balance Assessment (-) • Gait kinematic parameters: ○ Hip flexion (+exp) ○ Ankle dorsiflexion (-)

TPS=Subacute	Duration: 60min/d, 5d/wk for 3wks	○ Hip extension (+exp) ○ Knee extension (-) ○ Ankle plantar flexion (-) • Gait spatiotemporal parameters: ○ Cadence (+exp) ○ Stride length (-) ○ Stride time (-) ○ Step length (-) ○ Step time (-) ○ Gait speed (+exp)
Combs-Miller et al. (2014) RCT (8) Nstart=20 Nend=20 TPS=Chronic	E: Body weight-supported treadmill training C: Overground walking training Duration: 30min/d, 5d/wk for 2wks	• 10-Metre Walk Test comfortable walk subscale (+con) • 10-Metre Walk Test fast walk subscale (-) • 6-Minute Walk Test (-) • Step length (-) • Stance time symmetry (-) • Swing time symmetry (-)
Middleton et al. (2014) RCT (6) Nstart=50 Nend=38 TPS=Chronic	E: Treadmill training with body-weight support + customized PT exercises (Balance, Strength, ROM) C: Overground gait training + customized PT exercises (Balance, Strength, ROM) Duration: 1hr gait training (treadmill/overground walking) + 2hr other exercises, 5d/wk, for 2wks	• Step length differential (-) • 3m Walk test ○ Self-selected (-) ○ Fast walking speed (-) • 6min Walk test (-) • Berg Balance Scale (-) • Dynamic gait index (-) • Activities-specific Balance Confidence scale (-) • Single limb stance (-) • Timed Up & Go Test (-) • Fugl-Meyer Assessment-lower extremity (-) • Stroke Impact Scale (-)
Hoyer et al. (2012) RCT (7) Nstart=60 Nend=60 TPS=Subacute	E: Treadmill training + BWS + Conventional functional training C: Intensive gait training + conventional functional training Duration: 1h/d, 5d/wk for 4wks	• Functional Ambulation Category (-) • EU walking (-) • 10-Metre Walk Test (-) • 6-Minute Walk Test (-) • Functional Independence Measure ○ Shorter transfer (-) ○ Stairs (-)
Ada et al. (2010) RCT (8) Nstart=126 Nend=120 TPS=Acute	E: Treadmill training + BWS via overhead harness C: Overground gait training Duration: 30min/d, 5d/wk until independent walking or discharge	• Walking 15 meters independently (-)
Dean et al. (2010) RCT (8) Nstart=126 Nend=119 TPS=Acute	E: BWS treadmill training + Conventional rehabilitation C: Assisted overground walking + Conventional rehabilitation Duration: 30min/d, 5d/wk, until discharge or independent walking	• 10-metre Walk Test (-) • 6-min Walk Test (+exp) • Walking Perception (+exp) • Adelaide Activities Profile (-) • Number of Falls (-)
Franceschini et al. (2009) RCT (6) Nstart=102 Nend=85 TPS=Acute	E: Treadmill training with BWS + Conventional care C: Overground gait training + Conventional care Duration: 20min treadmill training & 40min conventional care, 5d/wk, for 4wks	• Motricity index (-) • Trunk Control test (-) • Barthel index (-) • Functional Ambulation category (-) • Ashworth scale (-) • Token test (-) • Albert test (-) • Proprioception of lower limb (-) • 10m Walk test (-) • 6-minute walk test (-)

		• Borg scale (-)
Suputtitada et al. (2004) RCT (5) Nstart=48 Nend=48 TPS=Chronic	E: Treadmill training + Partial BWS C: Overground gait training Duration: 25min/d, 5d/wk for 4wks	• 10-Meter Walk Test (-) • Berg Balance Scale (-)
Nilsson et al. (2001) RCT (7) Nstart=73 Nend=66 TPS=Acute	E: Treadmill training + BWS + Physical therapy C: Overground gait training + Physical therapy Duration: 30min/d, 5d/wk, during inpatient stay (3-19wks) Physical therapy 30min/d, 5d/wk during inpatient stay (3-19wks) Treadmill training/Overground training	• 10-Metre Walk Test (-) • Berg Balance Scale (-) • Functional Ambulation Categories (-) • Fugl-Meyer Assessment (-) • Functional Independence Measure (-)
Kosak & Reding (2000) RCT (4) Nstart=56 Nend=56 TPS=Subacute	E: Treadmill training with partial BWS + Conventional physical therapy C: Overground bracing-assisted gait training + Conventional physical therapy Duration: 45min/d, 5d/wk, for upto 6wks Conventional care, 45min/d, 5d/wk, for upto 6wks treadmill/overground training	• 2-min Walk Test (-) • Overground and Gait Endurance (-)
BWS Treadmill Training vs Treadmill Training		
Calabro et al. (2020) RCT (8) Nstart=50 Nend=50 TPS=Chronic	E: Treadmill training using lower body positive pressure support system (AlterG) C: Treadmill gait training Duration: 40min/d, 6d/wk for 4wks	• Functional Ambulatory Category (-) • Step time (+exp) • Stance/swing ratio (+exp) • Gait cadence (+exp) • Gait Quality Index (+exp)
Ullah et al. (2017) RCT (3) Nstart=50 Nend=50 TPS=Not Reported	E: Treadmill training with BWS C: Treadmill Training Duration: 15min/d, 4d/wk, for 6wks	• 10-Meter Walk Test (+exp) • Dynamic Gait Index (+exp) • Timed Get Up and Go Test (+exp)
Srivastava et al. (2016) RCT (6) Nstart=45 Nend=41 TPS=Chronic	E1: Treadmill training + BWS + conventional care E2: Treadmill training + conventional care C: Conventional gait training + conventional care Duration: 40min/d, 5d/wk for 4wks routine rehabilitation & 30min/d, 5d/wk for 4wks treadmill/Gait training	<u>E1 v E2 v C</u> • 10-Meter Walk Speed (-) • Walking Endurance (-) • Scandinavian Stroke Scale (-) • Functional Ambulation category (-)
Lee et al. (2015) RCT (6) Nstart=72 Nend=61 TPS=Subacute	E: High-speed treadmill training with partial BWS + conventional intervention C: Progressive treadmill training + conventional intervention	• Timed up and go test (+exp) • 10-m walk test (+exp) • 6-minute walk test (+exp) • Step length (+exp) • Step width (-) • Cadence (+exp)

	Duration: 60min/d, 3d/wk, for 5wks (20 sessions total)	
Barbeau & Visintin (2003) RCT (4) Nstart=100 Nend=79 TPS=Subacute	E: Treadmill training with BWS C: Treadmill training Duration: 60min/d, 4d/wk, for 6wks	• Overground Walking Speed (-) • Treadmill Walking Speed (-) • Overground Walking Endurance (-) • Treadmill Walking Endurance (-) • Berg Balance Scale (-) • Stroke Rehabilitation Assessment of Movement (-)
Visintin et al. (1998) RCT (5) Nstart=100 Nend=79 TPS=Subacute	E: Treadmill training with BWS C: Treadmill training Duration: 20min/d, 4d/wk, for 6wks	• Berg Balance Scale (+exp) • Stroke Rehabilitation Assessment of Movement (+exp) • 10-m walk test (+exp) • Walking endurance (+exp)
BWS Treadmill Training with Mobility Skills vs BWS Treadmill Training		
Graham et al. (2018) RCT (5) Nstart=39 Nend=29 TPS=Chronic	E: BWS treadmill training with challenging mobility skills C: BWS treadmill training without challenge Duration: 30min/d, 3d/wk, for 6wks	• 10-m walk ○ Comfortable walking speed (-) ○ Fast walk speed (-) • Six-minute walk distance (-) • Berg Balance Scale (-) • Activities Specific Balance Confidence scores (-)
BWS Treadmill Training with Cycle Ergometry or Resistive Training		
Sullivan et al. (2007) RCT (7) Nstart=80 Nend=71 TPS=Chronic	E1: BWS treadmill with upper extremity ergometry training E2: Resistive leg cycling with upper extremity ergometry training. E3: BWS treadmill with resistive leg cycling training. E4: BWS treadmill with lower extremity progressive resistive exercise. Duration: 60min/d, 4d/wk for 6wks	E1 vs E2: • Self-selected walking speed (+exp1) • Fast walking speed (+exp1) • 6-minute walk test (-) • Peak torque (-) E1 vs E3 vs E4 • Self-selected walking speed (-) • Fasting walking speed (-) • 6-minute walk test (-) • Composite torque (-)
BWS Treadmill Training with Facilitation Technique vs BWS Training with Mechanical Assistance		
Yagura et al. (2006) RCT (6) Nstart=49 Nend=47 TPS=Subacute	E: BWS treadmill training with facilitation technique + physical therapy C: BWS treadmill training with mechanical assistance + physical therapy Duration: 20min/d, 3d/wk, for 6wks BWSTT, 20min/d, 5d/wk, for 6wks PT	• Fugl-Meyer Assessment (-) • 10m Gait Speed (-) • Stride (-) • Cadence (-) • Functional Independence Measure (-)
BWS Treadmill Training for Different Durations vs Home Exercise		
Duncan et al. (2011) RCT (7) Nstart=408 Nend=362 TPS=Chronic	E1: Early Treadmill training with BWS (2mo post-stroke) E2: Late Treadmill training with BWS (6mo post-stroke) C: Home-based exercise program (2mo post-stroke) Duration: 90min/d, 3d/wk for 12-16wks	E1 vs C • 10 metre walk test (-) • 6-minute walk test (-) • Step Activity Monitor/ Number of steps per day (-) • Fugl-Meyer Assessment (-) • Berg Balance Scale (-) • Stroke Impact Scale (-)

		• Activities Specific Balance Confidence Scale (-) E2 vs C • 10 metre walk test (-) • 6-minute walk test (-) • Step Activity Monitor/ Number of steps per day (-) • Fugl-Meyer Assessment (-) • Berg Balance Scale (-) • Stroke Impact Scale (-) • Activities Specific Balance Confidence Scale (-)
Treadmill Training with Nordic Poles vs Treadmill Training		
Kang et al. (2016) RCT (4) Nstart=30 Nend=30 TPS=Chronic	E: Treadmill training + Nordic poles C: Treadmill training Duration: 30min/d, 5d/wk, for 6wks	• Berg Balance Scale (+exp) • Timed Up-and-Go (+exp) • Static standing balance (+exp) • 10-Metre Walk Test (-) • 6-Minute Walk Test (+exp) • Modified Barthel Index (+exp)
Shin et al. (2015) RCT (5) Nstart=20 Nend=20 TPS=Chronic	E: Treadmill training with arm swings using Nordic poles C: Treadmill training with arms fixed Duration: 30min/d, 3d/wk for 4wks	• 6-Minute Walk Test (+exp) • Dynamic Gait Index (+exp) • Timed Up & Go Test (-)
Treadmill Training with Load vs Treadmill Training without Load or Conventional Therapy		

Ribeiro et al. (2020)
RCT (8)
Nstart=38
Nend=36
TPS=Subacute
	E: Treadmill training with load (5% of body weight) on the nonparetic limb + home-based exercises
	C: Treadmill training without load + home-based exercises
	Duration: 30min/d, 9d/2wks, daily home exercises
		• Swing time symmetry ratio (-)
		• Paretic stance time (-)
		• Double-support time (-)
		• Foot Kinematics
		  ○ Static Ground Reaction Force (paretic limb/non-paretic) (-)
		  ○ Dynamic Ground Reaction Force (paretic limb/non-paretic) (-)

Kim & Yim (2017)
RCT (5)
Nstart=30
Nend=29
TPS=Chronic
	E: Power web hand exerciser + treadmill-based weight loading
	C: Conventional therapy
	Duration: E: 60min/d conventional care + 90min/d handgrip and treadmill training, 3d/wk, for 6wks
	C: 60min/d conventional care, 3d/wk, for 6wks
		• Montreal Cognitive Assessment-Korean version (+exp)
		• Trail making test
		  ○ A (-)
		  ○ B (-)
		• Stroop test
		  ○ Simple (-)
		  ○ Interference (-)
		• 10m Walk test (+exp)
		• Timed Up and Go (+exp)

de Lima Gomes et al. (2017) RCT (5) Nstart=13 Nend=13 TPS=Chronic	E: Treadmill gait training with load placement C: Conventional treatment Duration: 20min/d, 2d/wk, for 6wks	• Fugl-Meyer assessment (-) • Postural stroke scale (-) • 10-Metre Walk Test (-) • Number of steps (-) • Activity-specific balance confidence (-)
Ribeiro et al. (2017a) RCT (7) NStart=38 NEnd=36 TPS=Subacute	E: Treadmill training with load on the non-paretic ankle and home exercises C: Treadmill training without load and home exercises Duration: 30min/d, 9sessions/2wks	• Gait speed (-) • Symmetry ratio of swing time (-) • Range of motion-LE (-) • Step length (-)

Ribeiro et al. (2017b) RCT (5) Nstart=38 Nend=36 TPS=Subacute	E: Treadmill Training with Weight on Non-Paretic Lower Limb C: Treadmill Training Without Weight Duration: 30min/session, 9sessions/2wks, for 2wks	• Gait Distance (-) • Gait Speed (-)
Park et al. (2014c) RCT (4) Nstart=30 Nend=30 TPS=Chronic	E: Treadmill training + Incremental leg loading C: Treadmill training Duration: 30min/d, 5d/wk, for 8wks	• Centre of pressure (-) • Sway Length (-)
Treadmill Training with Incline vs Treadmill Training with Decline or Level Treadmill Training		
Cheng et al. (2022) RCT (8) Nstart=18 Nend=17 TPS=Chronic	E: Inclined treadmill training + overground walking C: Regular treadmill training + overground walking Duration: 30min treadmill, & 5min overground walking 2-3d/wk, for 4-6wks, total of 12 sessions.	• Gait velocity (-) • Cadence (+exp) • Stride length (-) • Stair climbing test (+exp) • Muscle strength-LE (-) • Dynamic spasticity index (+exp) • Muscle activities during gait cycle (+exp) • Ankle dorsiflexion at initial contact (+exp)
Gama et al. (2015) RCT (6) Nstart=28 Nend=28 TPS=Chronic	E: Partial BWS treadmill training at 10% of inclination C: Partial BWS treadmill gait training with no inclination Duration: 20min/d, 3d/wk, for 4wks	• Gait speed (+exp) • Stride length (-) • Fugl-Meyer Assessment (-) • Berg Balance Scale (-) • Cadence (-) • Symmetry ratio (-) • Double stance time (-) • Step length (+exp) • Stance time (-) • Swing time (-)
Carda et al. (2013) RCT (5) Nstart=38 Nend=38 TPS=Chronic	E: Treadmill training on incline + Physical therapy C: Treadmill training on decline + Physical therapy Duration: 45min PT + 30min treadmill/d, 5d/wk for 6wks	• 6-min Walk Test (+con) • 10m Walk Test (+con) • Timed Up and Go (-)
Treadmill Training with Increased Speed vs Treadmill Training with Increased Incline		
Alipsatici et al. (2020) RCT (5) Nstart=30 Nend=28 TPS=Chronic	E: Treadmill Training with Increased Speed + Conventional Treatment C: Treadmill Training with Increased Incline + Conventional Treatment Duration: 30min/d conventional exercise + 15min/d conventional stimulation + 30min/d treadmill, 3d/wk, for 8wks	• 6-M Walk Test (+exp) • 10-M Walk Test (+exp) • Stride Length (+exp) • Cadence (+exp) • Berg Balance Scale (-) • Beck Depression Inventory (-)
Constraint Induced Movement with Home Exercise vs Treadmill Training		

Silva et al. (2017) RCT (8) NStart=38 NEnd=36 TPS=Subacute	E: Constraint induced movement training on treadmill + home exercises C: Treadmill training Duration: 30min/d for 9d Treadmill training (constraint/ no constraint)	• Berg Balance Scale (-) • Timed Up and Go Test (-) • Turn Speed (-) • Stride Length (-) • Stride Time (-) • Stride Width (-) • Symmetry Ratio of Swing Time (-)
Treadmill Training with Foot Drop Stimulator vs Foot Drop Stimulator		
Peishun et al. (2021) RCT (4) Nstart=60 Nend=60 TPS=Subacute	E: Foot drop stimulator + treadmill training + Basic rehabilitation training C: Foot drop stimulator training + Basic rehabilitation training Duration: 30min/d, 5d/wk, for 3wks	• Hip flexion (+exp) • Knee flexion (+exp) • Ankle flexion (+exp) • EMG (+exp) • Pace (+exp) • Step length asymmetry (+exp) • Modified Ashworth Scale (+exp) • Functional Ambulation Classification (+exp)
Perturbation Treadmill Training vs Treadmill Training		
Esmaeili et al. (2020) RCT (6) Nstart=21 Nend=18 TPS=Chronic	E: Perturbation treadmill training group C: Non-perturbation treadmill training group Duration: 35-70min, 3d/wk, for 3wks	• Mini-BESTest (+exp) • 10m Walk test (-) • Knee extensors maximal strength (-) • Activities-specific Balance Confidence scale (-) • Reintegration to Normal Living Index (-)
Turning Treadmill Training vs Treadmill Training		

Chen et al. (2014)
RCT (7)
Nstart=32
Nend=30
TPS=Chronic
	E: Turning-based treadmill training + general exercise
	C: Regular treadmill training + general exercise
	Duration: 30min/d, 3d/wk for 4wks treadmill & 10min/d, 3d/wk for 4wks general exercise
		• Turning speed
		  ○ Affected side (+exp)
		  ○ Unaffected side (+exp)
		• Walking speed (+exp)
		• Stride length (-)
		• Cadence (-)
		• Temporal asymmetry ratio (+exp)
		• Spatial asymmetry ratio (-)

Treadmill Training with Mirror Therapy vs Treadmill Training		

Broderick et al. (2019)
RCT (6)
Nstart=30
Nend=23
TPS=Chronic
	E: Treadmill Training + Mirror Therapy
	C: Treadmill Training + Sham
	Duration: 30min, 3d/wk, for 4wks
		• 10-Meter Wak Test (-)
		• 6-Minute Walk Test (-)
		• Modified Ashworth Scale
		  ○ Hip (-)
		  ○ Knee (-)
		  ○ Ankle (+exp)
		• Fugl-Meyer Assessment (-)

Treadmill Training with Proprioceptive Neuromuscular Facilitation vs Treadmill Training		
Kim & Kang (2018) RCT (4) Nstart= 27 Nend = 27 TPS= Chronic	E: Treadmill training + Proprioceptive neuromuscular facilitation lower-leg taping (PNFLT) C: Sham taping + treadmill training Duration: 50min/d, 5d/wk, for 6wks	• 6-minute walk test (+exp) • 10-meter walking test (+exp) • Timed up and go test (+exp)
BWS Treadmill Training vs Proprioceptive Neuromuscular Facilitation		

Ribeiro et al. (2013) RCT (5) Nstart=25 Nend=23 TPS=Chronic	E: Treadmill training + BWS C: Proprioceptive neuromuscular facilitation training Duration: 30min/d, 3d/wk for 4wks	• Stroke Rehabilitation Assessment of Movement (-) • Functional Independence Measure (-) • Gait Speed (-) • Stride Length (-) • Double Support Time (-) • Symmetry Ratio (-) • Hip Extension/Flexion (-) • Knee Flexion (-) • Plantarflexion Push-Off (-) • Max Dorsiflexion (-) • Ankle dorsiflexion during the swing phase (+con)
Treadmill Training with Obstacles vs Treadmill Training		
Jeong et al. (2016) RCT (7) Nstart=30 Nend=29 TPS=Chronic	E: Treadmill walking training with obstacle-crossing C: Treadmill walking training Duration: 60 min/d, 5d/wk, for 4wks	• 10-Meter Walk Test (-) • 6-Minute Walk Test (+exp) • Berg Balance scale (+exp) • Timed Up-and-Go (-) • Activity-specific Balance Confidence (-)
Treadmill Training on Unstable Surface vs Treadmill Training		
Bang et al. (2014) RCT (5) Nstart=12 Nend=12 TPS=Chronic	E: Treadmill training + Unstable surface training C: Treadmill training Duration: 10min/d, 5d/wk, for 4wks Unstable Surface Training & 30min/d, 5d/wk Treadmill Training	• 6-Minute Walk Test (+exp) • Timed Up & Go Test (+exp) • 10-Meter Walk Test (-)
Treadmill Training with Handrails vs Treadmill Training		

Kang et al. (2015)
RCT (4)
Nstart=30
Nend=30
TPS=Chronic
	E1: Treadmill training + Front handrail
	E2: Treadmill training + Bilateral handrail
	C: Treadmill training (no handrail)
	Duration: 30min/d, 5d/wk for 8wks
		<u>E1 vs C</u>
		• Plantar Foot Pressure
		    ○ Heel-lateral (+exp1)
		<u>E2 vs C</u>
		• Plantar Foot Pressure
		    ○ Heel-lateral (+exp2)
		    ○ Heel-medial (+exp2)
		• Contact Area of Foot
		    ○ Rear Foot (+exp2)

Treadmill Training with Horizontal Force vs Treadmill Training		
Na et al. (2015) RCT (4) Nstart=24 Nend=24 TPS=Subacute	E: Treadmill training + Horizontal force C: Treadmill training Duration: 20min/d, 3d/wk for 8wks	• Constant gait speed (+exp) • Maximum gait speed (+exp) • Berg Balance Scale (+exp) • Timed Up & Go Test (+exp) • Cadence (+exp) • Step length (+exp) • Stride (+exp) • Functional Reach Test (-)
Treadmill Training with VR vs Other Training		

Timmermans et al. (2021)
RCT (5)
Nstart=40
Nend=30
TPS=Chronic
	E1: Treadmill-based C-Mill (using gait-dependent augmented reality)
	E2: Overground walking therapy (walking-adaptability exercises with physical obstacles)
	Duration: 90min/d, 2d/wk for 5wks
		<u>E1 v E2</u>
		• 10m Walk test (-)
		    ○ Context (+exp)
		    ○ Context and Cognitive (-)
		    ○ Cognitive (-)
		• Interactive walkway assessment
		    ○ Obstacles (-)

		○ Obstacles and cognitive (-) • Cognitive dual-task performance (-)
Cho et al. (2014) RCT (7) Nstart=32 Nend=30 TPS=Chronic	E: Treadmill training based real-world video recording + standard rehabilitation C: Treadmill training + Standard rehabilitation Duration: 30min/d, 3d/wk for 6wks treadmill trainings; 80min/d, 5d/wk, for 6wks standard rehabilitation program	• Berg Balance Scale (+exp) • Timed Up and Go test (+exp) • Postural sway velocity (-) • Gait speed (+exp) • Cadence (+exp) • Stride length (+exp) • Paretic side-step length (+exp) • Single time support (+exp) • Double time support (+exp)
Cho et al. (2013) RCT (7) Nstart=16 Nend=14 TPS=Chronic	E: Virtual walking training (VR) + standard rehabilitation program C: Treadmill gait training + standard rehabilitation Duration: 30min/d, 3d/wk for 6wks trainings; 80min/d, 5d/wk for 6wks standard rehabilitation program	• Berg Balance Scale (+exp) • Timed Up and Go test (+exp) • Gait velocity (+exp) • Gait cadence (+exp) • Step length (-) • Stride length (-) • Single limb support (-)
Treadmill Training with Smartphone Application vs Treadmill Training		
Lee et al. (2017) RCT (6) Nstart=36 Nend=34 TPS=Chronic	E: Treadmill training using Virtual Active, a smartphone application used for speed-interactive training C: Standard treadmill training Duration: 35min/d, 3d/wk, for 6wks	• Velocity (+exp) • Cadence (+exp) • Stride time (+exp) • Step time (+exp) • Double limb support (+exp) • Single limb support (+exp) • Stride length (+exp) • Step length (+exp) • Step width (-) • Gait symmetry (-)
Treadmill Training with Visual Deprivation vs Treadmill Training		
Kim et al. (2014) RCT (5) Nstart=24 Nend=24 TPS=Chronic	E: Treadmill training sideways with visual deprivation + Conventional Rehabilitation C: Treadmill training sideways + Conventional Rehabilitation Duration: 20min/d, 3d/wk for 6wks	• Gait speed (+exp) • Stance time (+exp) • Walking distance (-) • Step length (-) • Timed Up & Go (-) • Five Times Sit-to-Stand Test (-)
Backward Treadmill Training vs Standard Treadmill or Conventional Rehabilitation		
Chang et al. (2021) RCT (6) Nstart=16 Nend=16 TPS=Chronic	E: Walking backward on a treadmill + Physical therapy C: Conventional physical therapy Duration: 30 min PT, 30min treadmill, 3d/wk, for 4wks	• Berg Balance Scale (+exp) • Timed Up and Go (+exp) • 6-minute walk test (-) • 10-meter walk test (+exp)
Munari et al. (2020) RCT (8) Nstart=18 Nend=18 TPS=Chronic	E: Backward treadmill training + botulinum toxin type A therapy C: Standard forward treadmill training + botulinum toxin type A therapy	• 10-meter walking test (+exp1) • Modified Ashworth scale (-) • Step length (-) • Stride length (-) • Cadence (-) • Stabilometric assessment ○ Length CoP eyes open (+exp1)

	Duration: 40min/d, 3d/wk, for 4wks	○ Sway area eyes open (+exp1) ○ Length CoP eyes closed (+exp1) ○ Sway area eyes closed (+exp1)
Kim et al. (2017) RCT (7) Nstart=35 Nend=30 TPS=Chronic	E: Progressive Backward BWS Treadmill Training C: Treadmill training Duration: 30min/d, 5d/wk for 4wks	• Paretic step length (+exp) • Stride length paretic (+exp) • Single support (-) • Total double support (-) • Paretic step time (+exp) • Gait cycle (+exp) • Cadence (+exp) • Gait speed (-) • Dynamic gait index (+exp) • 6 min walk test (+exp)
Kim et al. (2014c) RCT (5) Nstart=36 Nend=36 TPS=Chronic	E1: BWS, backward and forward treadmill training E2: BWS, forward treadmill training E3: BWS, backward treadmill training Duration: 30min/d, 6d/wk for 3wks	E1 vs E2/E3 • Symmetry Index (-) • Step time (+exp1) • Step length (+exp1) • Stance phase (-) • Swing phase (-) • Single support (-)
Takami et al. (2010) RCT (4) Nstart=36 Nend=33 TPS=Acute	E1: Backward treadmill with partial BWS E2: Forward treadmill with partial BWS treadmill C: Conventional rehabilitation Duration: 40min, 6d/wk for 3wks	E1 vs C: • Berg Balance Scale (-) • Rivermead Mobility Index (+exp1) • 10-Metre Walk Test (+exp1) • Cadence (-) • Step length (+exp1) E2 vs C: • Berg Balance Scale (-) • Rivermead Mobility Index (+exp2) • 10-Metre Walk Test (-) • Cadence (-) • Step length (-) E1 vs E2: • Berg Balance Scale (-) • Rivermead Mobility Index (+exp1) • 10-Metre Walk Test (-) • Cadence (-) • Step length (-)
Treadmill Training with Overground Training vs Home Exercise/ no treatment		
Ada et al. (2013) RCT (9) Nstart=102 Nend=98 TPS=Chronic	E1: Long-term Treadmill and Overground Walking E2: Short-term Treadmill and Overground Walking C: No Intervention Duration: 30 min/d, 3d/wk, 8wks for short-term training and 16wks for long-term training	E1 vs C • 6-minute Walk Test (+exp1) • 10m Walk Test comfortable speed: ○ Speed (+exp1) ○ Step Length (-) ○ Cadence (+exp1) • 10m Walk Test fast speed: ○ Speed (+exp1) ○ Step Length (+exp1) ○ Cadence (-) • EuroQol EQ-5D (+exp1) • Adelaide Activities Profile (-) • Walking Self-Efficacy Scale (-) • Falls Rate (-) E2 vs C • 6-minute Walk Test (+exp2) • 10m Walk Test comfortable speed:

		○ Speed (-) ○ Step Length (-) ○ Cadence (-) • 10m Walk Test fast speed: ○ Speed (-) ○ Step Length (-) ○ Cadence (-) • EuroQol EQ-5D (-) • Adelaide Activities Profile (-) • Walking Self-Efficacy Scale (-) • Falls Rate (-) <u>E1 vs E2</u> • 6-minute Walk Test (+exp1) • 10m Walk Test comfortable speed: ○ Speed (-) ○ Step Length (-) ○ Cadence (-) • 10m Walk Test fast speed: ○ Speed (-) ○ Step Length (+exp1) ○ Cadence (-) • EuroQol EQ-5D (+exp1) • Adelaide Activities Profile (-) • Walking Self-Efficacy Scale (+exp1)
Moore et al. (2010) RCT crossover (5) Nstart=30 Nend=20 TPS=Chronic	E: Intensive locomotor training (BWS treadmill + overground walking) C: No training Duration: 2-5d/wk, for 4wks	• Fastest velocity (+exp) • Self-selected velocity (-) • 12-min walk test (-) • Peak treadmill speed (+exp) • Berg Balance Scale (-) • Timed Up and Go (-)
Ada et al. (2003) RCT (7) Nstart=29 Nend=27 TPS=Chronic	E: Treadmill training + overground gait training C: Placebo program of low-intensity home exercise program + Telerehabilitation Duration: 30min/d, 3d/wk, for 4wks Treadmill and overground walking, 3d/wk, for 4wks Placebo program	• 6-Minute Walk Test (+exp) • 10-Metre Walk Test (+exp) • Stroke-Adapted Sickness Impact Profile (-) • Step Length (+exp) • Step Width (-) • Cadence (-)
High vs Low Intensity Treadmill Training		
Munari et al., 2018 RCT (8) Nstart= 16 Nend = 15 TPS= Chronic	E: High intensity Aerobic treadmill training C: Low intensity Aerobic treadmill training Duration: 50-60min/d, 3d/wk, for 12wks	• 6-Minute Walk Test (+exp) • 10-Metre Walk Test (+exp) • Timed Up & Go (-) • Short Form-36 (-) • Stroke Impact Scale (-) • Gait analysis: ○ Stride length (+exp) ○ Step length non-paretic (+exp) ○ Step length paretic (+exp) ○ Cadence (+exp) ○ Symmetry ratio (+exp)
Holleran et al. (2015) RCT crossover (4) Nstart=14 Nend=12 TPS=Chronic	E: Aerobic training (treadmill, high intensity) C: Aerobic training (treadmill, low intensity) Duration: 45min/d, 3d/wk, for 4wks	• 6-Minute Walk Test (+exp) • Self Selected Velocity (-) • Fastest possible Velocity (-) • Peak Treadmill speed using modified graded treadmill (-)

	Washout: 4wk	
Ivey et al. (2015) RCT (4) Nstart=51 Nend=34 TPS=Chronic	E: High-intensity Aerobic treadmill training C: Low-intensity Aerobic treadmill training Duration: 30min/d - High-intensity, 50min/d - Low-intensity for 6mo	• 6-Minute walk distance (-) • 30-ft walk times (-)
Kuys et al. (2011) RCT (8) Nstart=30 Nend=28 TPS=Subacute	E: High intensity Treadmill training + Conventional care C: Conventional care Duration: 30min/d, 3d/wk, 6wks	• 6-minute Walk Test (+exp) • 10-metre Walk Test (+exp) • Walking Capacity (-)
Treadmill Training vs Strength Training		
Kim et al. (2011) RCT (5) Nstart=44 Nend=44 TPS=Chronic	E: Treadmill training C: Strength training Duration: 30min/d, 3d/wk for 6wks	• 10-Metre Walk Test (-) • Timed Up and Go Test (-) • Berg Balance Scale (-)
Fast Speed Treadmill Training with FES vs Self-selected or Fast Speed Treadmill Training		
Awad et al. (2016) RCT (6) Nstart=50 Nend=45 TPS=Chronic	E: Fast speed treadmill training + FES C1: Self-Selected Speed Treadmill Training C2: Fast Speed Treadmill Training Duration: 36 min (30min on treadmill + 6min overground walking)/session, 3d/wk, for 12wks	E vs C1/C2 • 6-Minute Walk Test (-) • Energy Cost at Comfortable Walking Speed (+exp) • Energy Cost at Fast Walking Speed (+exp)
Speed Dependent Treadmill Training vs Other Treadmill Training		
Helm et al. (2019) RCT (7) Nstart=32 Nend=32 TPS=Chronic	E: Variable speed treadmill training C: Constant speed treadmill training Duration: 15min/d, for 2d	• Step length asymmetry (-) • Limb phase asymmetry (-)
Lau & Mak (2011) RCT (6) Nstart=30 Nend=26 TPS=Acute	E: Speed Dependent Treadmill training + Conventional rehabilitation C: Steady speed treadmill training + conventional rehabilitation Duration: 30min treadmill training + 90min conventional therapy/session, 5d/wk, for 2wks	• Gait speed (+exp) • Stride length (+exp) • Cadence (-) • Berg Balance Score (-)
Pohl et al. (2002) RCT (6) Nstart=69 Nend=60 TPS=Subacute	E1: Structured speed-dependent treadmill training + Conventional therapy	E1 vs C: • 10-Metre Walk Test (+exp1) • Cadence (+exp1) • Stride length (+exp1)

	E2: Limited progressive treadmill training + Conventional therapy C: Conventional gait therapy + Conventional therapy Duration: 30min/d, 12d Limited progressive or Speed-dependent treadmill training, 45min/d, 8d Conventional therapy, 45min/d, 12d Gait training	• Functional Ambulation Category (+exp1) E2 vs C: • 10-Metre Walk Test (+exp2) • Cadence (+exp2) • Stride length (-) • Functional Ambulation Category (+exp2) E1 vs E2: • 10-Metre Walk Test (+exp1) • Cadence (+exp1) • Stride length (+exp1) • Functional Ambulation Category (+exp1)
Sullivan et al. (2002) RCT (5) Nstart=24 Nend=24 TPS=Chronic	E1: BWS treadmill training (slow speed) E2: BWS treadmill training (fast speed) E3: BWS treadmill training (variable speed) Duration: 20min/d, 3d/wk, for 4wks	E2 vs E1 + E3 • Self-Selected Overground 10-m Walking Speed (+exp2) E2 vs E1 vs E3 • Self-Selected Overground 10-m Walking Speed (-)
Speed-dependent Treadmill Training vs Task-oriented Training		
Sharma et al. (2014) RCT (5) Nstart=30 Nend=30 TPS=Chronic	E: Task-oriented training C: Speed-dependent treadmill training Duration: 30min/d, 3d/wk, 4wks	• Berg Balance Scale (-) • Rivermead Mobility Index (-)
Error Augmentation Treadmill Training vs Treadmill Training		
Lewek et al. (2018) RCT (4) Nstart=48 Nend=37 TPS=Chronic	E1: Error Augmentation treadmill training + Overground walking E2: Error Minimization treadmill training + Overground walking C: Conventional treadmill training + Overground walking Duration: 30-35min/session, for 18 sessions	E1/E2 vs C • Step length asymmetry (-) • Stance time asymmetry (-) • Step length (-) • Gait speed (-) E1 vs E2 • Step length asymmetry (-) • Stance time asymmetry (-) • Step length (-) • Gait speed (-)
Treadmill Training vs Stretching		
Luft et al. (2008) RCT (5) Nstart=113 Nend=71 TPS=Chronic	E: Progressive task-repetitive Aerobic treadmill exercise C: Stretching program Duration: 40min, 3d/wk for 24wks	• Peak effort treadmill walking velocity (+exp) • 6-minute walk test Overground (-) • 10-metre walk test Overground (-)
Treadmill Training with Orthotic Devices vs Treadmill Training		
In et al. (2017) RCT (7) Nstart=30 Nend=30 TPS=Chronic	E: Treadmill training + Thera-band C: Treadmill training Duration: 30min/d, 5d/wk, for 4wks	• Fugl-meyer Assessment (+exp) • Timed Up-and-Go (+exp) • 10-Metre Walk Test (+exp) • Performance-Oriented Mobility Assessment (+exp) ○ Balance (-) ○ Gait (+exp)

Electromechanical gait trainer vs Body weight-supported treadmill training		
Werner et al. (2002) RCT Crossover (7) Nstart=30 Nend=30 TPS=Subacute	E1: Electromechanical gait trainer therapy + Conventional rehabilitation E2: Body weight-supported treadmill training + Conventional rehabilitation Duration: 15-20min/d, 5d/wk for 6wks Interventions, 45min/d, 7d/wk, Conventional rehabilitation	• Functional Ambulation Category (+exp1) • Rivermead Motor Assessment (-) • 10-Metre Gait Velocity (-) • Modified Ashworth Score (-)
Treadmill Training with Action Observation vs Treadmill Training		
Bang et al. (2013) RCT (7) Nstart=30 Nend=30 TPS=Chronic	E: Action observational training + Treadmill training C: Sham action observational training + Treadmill training Duration: 40min/d, 5d/wk for 4wks	• Timed Up and Go test (+exp) • 10m Walk test (+exp) • 6min Walk test (+exp) • Max Knee Angle in Swing Phase (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Treadmill Training

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	There is conflicting evidence about the effect of **treadmill training with BWS** to improve motor function when compared to **conventional therapy.**	2	Mckay-Lyons et al. 2013; Yang et al. 2010
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **Bobath** for improving motor function.	1	Eich et al. 2004
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **overground walking** for improving motor function.	4	Gama et al. 2017; Middleton et al. 2014; Nilsson et al. 2001; Mao et al. 2015
1b	**Treadmill training with BWS and facilitation technique** may not have a difference in efficacy compared to **treadmill training with BWS and mechanical assistance** for improving motor function.	1	Yagura et al. 2006
1b	**Early treadmill training with BWS** may not have a difference in efficacy compared to **home-based exercise** for improving motor function.	1	Duncan et al. 2011
1b	**Late treadmill training with BWS** may not have a difference in efficacy compared to **home-based exercise** for improving motor function.	1	Duncan et al. 2011
2	**Treadmill training with load** may not have a difference in efficacy compared to **conventional**	1	de Lima Gomes et al. 2017

	therapy or treadmill training without load for improving motor function.		
1b	**Treadmill training on incline** may not have a difference in efficacy compared to **level treadmill training or treadmill training on decline** for improving motor function.	1	Gama et al. 2015
1b	**Treadmill training with mirror therapy** may not have a difference in efficacy compared to **treadmill training** for improving motor function.	1	Broderick et al. 2019
1b	**Electromechanical gait trainer** may not have a difference in efficacy compared to **body weight treadmill training** for improving motor function.	1	Werner et al. 2002
1b	**Treadmill training with orthotic devices** may produce greater improvements in motor function than **treadmill training.**	1	In et al. 2017

FUNCTIONAL AMBULATION

LoE	Conclusion Statement	RCTs	References
1a	**Treadmill training** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	6	Baer et al. 2018; Globas et al. 2012; Kuys et al. 2011; Macko et al. 2005; Laufer et al. 2001; Srivastava et al. 2016
2	**Backward treadmill training with BWS** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	1	Takami et al. 2010
2	**Backward treadmill training with BWS** may not have a difference in efficacy compared to **treadmill training with BWS** for improving functional ambulation.	1	Takami et al. 2010
1a	**Treadmill training** may not have a difference in efficacy compared to **overground walking** for improving functional ambulation.	5	Aguiar et al. 2020; Park et al. 2013; Bonnyaud et al. 2014; Langhammer & Stanghelle 2010; Bonnyaud et al. 2013
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	12	Ramakrishma et al. 2021; Lura et al. 2019; Mustafaoglu et al. 2018; Takao et al. 2015; Mackay-Lyons et al. 2013; Takami et al. 2010; Yen et al. 2008; Da Cunha et al. 2002; Teixeira da Cunha Filho et al. 2001; Nave et al. 2019; Srivastava et al. 2016; Sukonthamarn et al. 2019
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **intensive gait training** for improving functional ambulation.	1	Hoyer et al. 2013

1b	**Short-term treadmill training and overground walking** may not have a difference in efficacy compared to **no treatment** for improving functional ambulation.	1	Ada et al. 2013
1a	**Treadmill training with BWS** may not have a difference in efficacy compared to **overground walking** for improving functional ambulation.	12	Gangopadhyay et al. 2021; Gama et al. 2017; DePaul et al. 2015; Combs-Miller et al. 2014; Middleton et al. 2014; Ada et al. 2010; Franceschini et al. 2009; Suputtitada et al. 2004; Nilsson et al 2001; Kosak & Reding 2000; Deal et al. 2010; Mao et al. 2015
1b	There is conflicting evidence about the effect of **treadmill training with BWS** to improve functional ambulation when compared to **treadmill training.**	6	Calabro et al. 2022; Ullah et al. 2017; Srivastava et al. 2016; Lee et al. 2015; Barbeau & Visintin 2003; Visintin et al. 1998
2	**Treadmill training with BWS and mobility skills** may not have a difference in efficacy compared to **treadmill training with BWS** for improving functional ambulation.	1	Graham et al. 2018
2	**Treadmill training with BWS and overground walking** may not have a difference in efficacy compared to **no treatment** for improving functional ambulation.	1	Moore et al. 2010
1b	**Treadmill training with BWS and upper extremity ergometer training** may not have a difference in efficacy when compared to **treadmill training with BWS and resistive leg cycling** for improving functional ambulation.	1	Sullivan et al. 2007
1b	**Treadmill training with BWS and upper extremity ergometer training** may not have a difference in efficacy when compared to **resistive leg cycling with upper extremity ergometer training** for improving functional ambulation.	1	Sullivan et al. 2007
1b	**Treadmill training with BWS and upper extremity ergometer training** may not have a difference in efficacy when compared to **treadmill training with BWS and lower extremity progressive resistive exercise** for improving functional ambulation.	1	Sullivan et al. 2007
1b	**Treadmill training with BWS and facilitation technique** may not have a difference in efficacy when compared to **treadmill training with BWS and mechanical assistance** for improving functional ambulation.	1	Yagura et al. 2006
2	**Treadmill training with BWS on fast speed** may produce greater improvements in functional ambulation than **treadmill training with BWS on slow speed.**	1	Sullivan et al. 2002

2	**Treadmill training with BWS on fast speed** may produce greater improvements in functional ambulation than **treadmill training with BWS on variable speeds.**	1	Sullivan et al. 2002
2	**Treadmill training with BWS on slow speed** may produce greater improvements in functional ambulation than **treadmill training with BWS on variable speeds.**	1	Sullivan et al. 2002
1b	**Early treadmill training with BWS** may not have a difference in efficacy when compared to **home-based exercise** for improving functional ambulation.	1	Duncan et al. 2011
1b	**Late treadmill training with BWS** may not have a difference in efficacy when compared to **home-based exercise** for improving functional ambulation.	1	Duncan et al. 2011
1b	**Treadmill training with load** may not have a difference in efficacy when compared to **treadmill training without load or conventional therapy** for improving functional ambulation.	4	Kim & Yim 2017; de Lima Gomes et al. 2017; Ribeiro 2017a; Ribeiro 2017b
1b	**Treadmill training with incline** may not have a difference in efficacy when compared to **treadmill training with decline or level treadmill training** for improving functional ambulation.	3	Cheng et al. 2022; Gama et al. 2015; Carda et al. 2013
1b	**Treadmill training with education** may not have a difference in efficacy when compared to **conventional gait training** for improving functional ambulation.	1	Brauer et al. 2022
1b	**Constraint induced movement treadmill training with home exercise** may not have a difference in efficacy when compared to **treadmill training** for improving functional ambulation.	1	Silva et al. 2017
1b	**Perturbation treadmill training** may not have a difference in efficacy when compared to **treadmill training** for improving functional ambulation.	1	Esmaeili et al. 2020
1b	**Treadmill training with mirror therapy** may not have a difference in efficacy compared to **treadmill training** for improving functional ambulation.	1	Broderick et al. 2019
2	**Treadmill training with BWS** may not have a difference in efficacy compared to **proprioceptive neuromuscular facilitation** for improving functional ambulation.	1	Ribeiro et al. 2013
1b	**Treadmill training with obstacles** may not have a difference in efficacy compared to **treadmill training** for improving functional ambulation.	1	Jeong et al. 2016
2	**Treadmill training with visual deprivation** may not have a difference in efficacy compared to **treadmill training** for improving functional ambulation.	1	Kim et al. 2014
2	**Treadmill training** may not have a difference in efficacy compared to **strength training** for improving functional ambulation.	1	Kim et al. 2011

1b	**Fast speed treadmill training with FES** may not have a difference in efficacy compared to **self-selected or fast speed treadmill training** for improving functional ambulation.	1	Awad et al. 2016
2	**Error augmented treadmill training** may not have a difference in efficacy compared to **conventional training** for improving functional ambulation**.**	1	Lewek et al. 2018
2	**Error minimization treadmill training** may not have a difference in efficacy compared to **conventional training** for improving functional ambulation**.**	1	Lewek et al. 2018
2	**Error augmented treadmill training** may not have a difference in efficacy compared to **error minimization treadmill training** for improving functional ambulation**.**	1	Lewek et al. 2018
2	**Treadmill training** may not have a difference in efficacy compared to **stretching** for improving functional ambulation**.**	1	Luft et al. 2008
1b	There is conflicting evidence about the effect of **backward treadmill training** to improve functional ambulation when compared to **conventional therapy.**	1	Chang et al. 2021
1b	There is conflicting evidence about the effect of **long-term treadmill training and overground walking** to improve functional ambulation when compared to **short-term treadmill training and overground walking.**	1	Ada et al. 2013
1b	There is conflicting evidence about the effect of **long-term treadmill training and overground walking** to improve functional ambulation when compared to **no treatment.**	1	Ada et al. 2013
1b	There is conflicting evidence about the effect of **treadmill training with BWS and conventional care** to improve functional ambulation when compared to **treadmill training with BWS.**	1	Mustafaoglu et al. 2018
1b	There is conflicting evidence about the effect of **treadmill training with BWS and upper extremity ergometer training** to improve functional ambulation when compared to **resistive leg cycling with upper extremity ergometer training.**	1	Sullivan et al. 2007
2	There is conflicting evidence about the effect of **treadmill training with Nordic poles** to improve functional ambulation when compared to **treadmill training.**	2	Kang et al. 2016; Shin et al. 2015
1b	There is conflicting evidence about the effect of **backward treadmill training with BWS** to improve functional ambulation when compared to **treadmill training.**	1	Kim et al. 2017

1b	There is conflicting evidence about the effect of **high intensity treadmill training** to improve functional ambulation when compared to **low intensity treadmill training.**	4	Munari et al. 2018; Ivey et al. 2015; Holleran et al. 2015; Kuys et al. 2011
1b	There is conflicting evidence about the effect of an **electromechanical gait trainer** to improve functional ambulation when compared to **treadmill training with BWS.**	1	Werner et al. 2002
1b	**Treadmill training with BWS** may produce greater improvements in functional ambulation than **Bobath training.**	1	Eich et al. 2004
1b	**Treadmill training with body weight and conventional care** may produce greater improvements in functional ambulation than **conventional training.**	1	Mustafaoglu et al. 2018
2	**Treadmill training with BWS on fast speed** may produce greater improvements in functional ambulation than **treadmill training with BWS on slow and variable speeds.**	1	Sullivan et al. 2002
2	**Treadmill training with increased speed** may produce greater improvements in functional ambulation when compared to **treadmill training with increased incline.**	1	Alipsatici et al. 2020
2	**Treadmill training with a foot drop stimulator** may produce greater improvements in functional ambulation when compared to a **foot drop stimulator.**	1	Peishun et al. 2021
1b	**Botox with backward treadmill training** may produce greater improvements in functional ambulation when compared to **Botox with forward treadmill training.**	1	Munari et al. 2020
1b	**Turning treadmill training** may produce greater improvements in functional ambulation when compared to **treadmill training.**	1	Chen et al. 2014
2	**Treadmill training with PNF taping** may produce greater improvements in functional ambulation when compared to **treadmill training.**	1	Kim & Kang 2018
2	There is conflicting evidence about the effect of **treadmill training on an unstable surface** to improve functional ambulation when compared to **treadmill training.**	1	Bang et al. 2014
2	**Treadmill training with horizontal force** may produce greater improvements in functional ambulation when compared to **treadmill training.**	1	Na et al. 2015
2	**Treadmill training with virtual reality** may produce greater improvements in functional ambulation when compared to **overground walking.**	1	Timmermans et al. 2021
1a	**Treadmill training with virtual reality** may produce greater improvements in functional ambulation when compared to **treadmill training.**	2	Cho et al. 2014; Cho et al. 2013

1b	**Treadmill training with smartphone app** may produce greater improvements in functional ambulation when compared to **treadmill training.**	1	Lee et al. 2017
1b	**Treadmill training with overground training** may produce greater improvements in functional ambulation when compared to **home exercise.**	1	Ada et al. 2003
1b	**Variable speed treadmill training** may produce greater improvements in functional ambulation when compared to **constant speed treadmill training.**	1	Lau & Mak 2011
1b	**Speed dependent treadmill training** may produce greater improvements in functional ambulation when compared to **conventional therapy.**	1	Pohl et al. 2002
1b	**Limited progressive treadmill training** may produce greater improvements in functional ambulation when compared to **conventional therapy.**	1	Pohl et al. 2002
1b	**Speed dependent treadmill training** may produce greater improvements in functional ambulation when compared to **limited progressive treadmill training.**	1	Pohl et al. 2002
1b	**Treadmill training with orthotic devices** may produce greater improvements in functional ambulation when compared to **treadmill training.**	1	In et al. 2017
1b	**Treadmill training with action observation** may produce greater improvements in functional ambulation when compared to **treadmill training with sham action observation.**	1	Bang et al. 2013

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1b	**Treadmill training** may not have a difference in efficacy when compared to **conventional therapy** for improving functional mobility**.**	3	Baer et al. 2018; Globas et al. 2012; Macko et al. 2005
1b	**Treadmill training with BWS** may not have a difference in efficacy when compared to **conventional therapy** for improving functional mobility**.**	3	Mustafaoglu et al. 2018; Takami et al. 2010; Nave et al. 2019
1b	**Long-term treadmill training and overground walking** may not have a difference in efficacy compared to **no treatment** for improving functional mobility.	1	Ada et al. 2013
1b	**Short-term treadmill training and overground walking** may not have a difference in efficacy compared to **no treatment** for improving functional mobility.	1	Ada et al. 2013
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **overground walking** for improving functional mobility.	1	DePaul et al. 2015
1b	**Treadmill training with BWS and conventional care** may not have a difference in efficacy compared	1	Mustafaoglu et al. 2018

	to **treadmill training with BWS** for improving functional mobility.		
2	**Treadmill training with BWS** may not have a difference in efficacy compared to **proprioceptive neuromuscular facilitation** for improving functional mobility.	1	Ribeiro et al. 2013
2	**Treadmill training with virtual reality** may not have a difference in efficacy compared to **overground walking** for improving functional mobility.	1	Timmermans et al. 2021
2	**Speed dependent treadmill training** may not have a difference in efficacy compared to **task-oriented training** for improving functional mobility.	1	Sharma et al. 2014
2	There is conflicting evidence about the effect of **treadmill training with BWS** to improve functional mobility when compared to **treadmill training.**	2	Barbeau & Visintin 2003; Visintin et al. 1998
2	**Backward treadmill training with BWS** may produce greater improvements in functional mobility when compared to **conventional therapy.**	1	Takami et al. 2010
2	**Backward treadmill training with BWS** may produce greater improvements in functional mobility when compared to **treadmill training with BWS.**	1	Takami et al. 2010
1b	**Long-term treadmill training and overground walking** may produce greater improvements in functional mobility when compared to **short-term treadmill training and overground walking.**	1	Ada et al. 2013
1b	**Treadmill training with BWS and conventional care** may produce greater improvements in functional mobility when compared to **conventional training.**	1	Mustafaoglu et al. 2018

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **treadmill training** to improve functional mobility when compared to **conventional therapy.**	2	Globas et al. 2012; Laufer et al. 2001
2	**Backward treadmill training with BWS** may not have a difference in efficacy compared to **conventional therapy** for improving balance.	1	Takami et al. 2010
2	**Backward treadmill training with BWS** may not have a difference in efficacy compared to **treadmill training with BWS** for improving balance.	1	Takami et al. 2010
2	**Treadmill training** may not have a difference in efficacy compared to **overground walking** for improving balance.	1	Park et al. 2013
1a	**Treadmill training with BWS** may not have a difference in efficacy when compared to **conventional therapy** for improving balance.	5	Mustafaoglu et al. 2018; MacKay-Lyons et al. 2013; Takami et al. 2010; Yen et al. 2008; Sukonthamarn et al. 2019

1b	**Long-term treadmill training and overground walking** may not have a difference in efficacy when compared to **no treatment** for improving balance.	1	Ada et al. 2013
1b	**Short-term treadmill training and overground walking** may not have a difference in efficacy when compared to **no treatment** for improving balance.	1	Ada et al. 2013
1b	**Treadmill training with BWS** may not have a difference in efficacy when compared to **overground walking** for improving balance.	8	Gangopadhyay et al. 2021; DePaul et al. 2015; Middleton et al. 2014; Franceschini et al. 2009; Suputtitada et al. 2004; Nilsson et al. 2001; Mao et al. 2015; Dean et al. 2010
2	**Treadmill training with BWS and mobility skills** may not have a difference in efficacy compared to **treadmill training with BWS** for improving balance.	1	Graham et al. 2018
2	**Treadmill training with BWS and overground walking** may not have a difference in efficacy compared to **no treatment** for improving balance.	1	Moore et al. 2010
1b	**Early treadmill training with BWS** may not have a difference in efficacy compared to **home exercise** for improving balance.	1	Duncan et al. 2011
1b	**Late treadmill training with BWS** may not have a difference in efficacy compared to **home exercise** for improving balance.	1	Duncan et al. 2011
2	**Treadmill training with load** may not have a difference in efficacy compared to **treadmill training without load or conventional therapy** for improving balance.	2	de Lima Gomes et al. 2017; Park et al. 2014
1b	**Treadmill training with incline** may not have a difference in efficacy compared to **treadmill training with decline or level treadmill training** for improving balance.	1	Gama et al. 2015
2	**Treadmill training with increased speed** may not have a difference in efficacy compared to **treadmill training with increased incline** for improving balance**.**	1	Alipsatici et al. 2020
1b	**Constraint induced movement with home exercise** may not have a difference in efficacy compared to **treadmill training** for improving balance**.**	1	Silva et al. 2017
2	**Treadmill training** may not have a difference in efficacy compared to **strength training** for improving balance.	1	Kim et al. 2011
2	**Speed-dependent treadmill training** may not have a difference in efficacy compared to **task-oriented training** for improving balance.	1	Sharma et al. 2014
1b	**Variable speed treadmill training** may not have a difference in efficacy compared to **constant speed treadmill training** for improving balance.	1	Lau & Mak 2011

2	There is conflicting evidence about the effect of **treadmill training with BWS** to improve balance when compared to **treadmill training.**	2	Barbeau & Visintin 2003; Visintin et al. 1998
1b	There is conflicting evidence about the effect of **treadmill training with perturbation** to improve balance when compared to **treadmill training.**	1	Esmaeili et al. 2020
1b	There is conflicting evidence about the effect of **treadmill training with obstacles** to improve balance when compared to **treadmill training.**	1	Jeong et al. 2016
2	There is conflicting evidence about the effect of **treadmill training with horizontal force** to improve balance when compared to **treadmill training.**	1	Na et al. 2015
1a	There is conflicting evidence about the effect of **treadmill training with virtual reality** to improve balance when compared to **treadmill training.**	2	Cho et al. 2013; Cho et al. 2014
1b	**Backward treadmill training** may produce greater improvements in balance when compared to **conventional therapy.**	1	Chang et al. 2021
1b	**Treadmill training with BWS and conventional care** may produce greater improvements in balance when compared to **conventional training.**	1	Mustafaoglu et al. 2018
1b	**Treadmill training with BWS and conventional care** may produce greater improvements in balance when compared to **treadmill training with BWS.**	1	Mustafaoglu et al. 2018
2	**Treadmill training with Nordic poles** may produce greater improvements in balance when compared to **treadmill training**.	1	Kang et al. 2016
1b	**Botox with backward treadmill training** may produce greater improvements in balance than **Botox with forward treadmill training.**	1	Munari et al. 2020
1b	**Treadmill training with orthotic devices** may produce greater improvements in balance than **treadmill training.**	1	In et al. 2017

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Backward treadmill training with BWS** may not have a difference when compared to **treadmill training with BWS** for improving gait.	1	Takami et al. 2010
1b	**Treadmill training** may not have a difference when compared to **overground training** for improving gait.	2	Bonnyaud et al. 2013; Langhammer & Stangelle 2010
1b	**Treadmill training with BWS** may not have a difference when compared to **conventional therapy** for improving gait.	5	Lura et al. 2019; Takao et al. 2015; Nave et al. 2019; Takami et al. 2010; Yen et al. 2008;
1b	**Treadmill training with BWS** may not have a difference when compared to **overground walking** for improving gait.	5	Gangopadhyay et al. 2021; Gama et al. 2017; Combs-Miller et al. 2014; Middleton et al. 2014; Mao et al. 2015

1b	**Treadmill training with BWS and facilitation technique** may not have a difference when compared to t**readmill training with BWS and mechanical assistance** for improving gait.	1	Yagura et al. 2006
1a	**Treadmill training with load** may not have a difference in efficacy compared to **treadmill training without load or conventional therapy** for improving gait.	2	Ribeiro et al. 2019; Ribeiro et al 2017a
1a	**Treadmill training with incline** may not have a difference in efficacy compared to **treadmill training with decline or level treadmill training** for improving gait.	2	Cheng et al. 2022; Gama et al. 2015
1b	**Constraint induced movement with home exercise** may not have a difference in efficacy compared to **treadmill training** for improving gait.	1	Silva et al. 2017
1b	**Botox with backward treadmill training** may not have a difference in efficacy compared to **Botox with forwards treadmill training** for improving gait.	1	Munari et al. 2020
1b	**Turning treadmill training** may not have a difference in efficacy compared to **treadmill training** for improving gait.	1	Chen et al. 2014
2	**Treadmill training with BWS** may not have a difference when compared to **proprioceptive neuromuscular facilitation** for improving gait.	1	Ribeiro et al. 2013
2	**Backward and forward treadmill training** may not have a difference in efficacy compared to **backward treadmill training** for improving gait.	1	Kim et al. 2014
2	**Backward and forward treadmill training** may not have a difference in efficacy compared to **forward treadmill training** for improving gait.	1	Kim et al. 2014
1b	**Treadmill training with overground training** may not have a difference in efficacy compared to **home exercise** for improving gait.	1	Ada et al. 2003
1a	**Variable speed treadmill training** may not have a difference in efficacy compared to **constant speed treadmill training** for improving gait.	2	Helm et al. 2019; Lau & Mak 2011
2	**Error augmented treadmill training** may not have a difference in efficacy compared to **conventional training** for improving gait.	1	Lewek et al. 2018
2	**Error minimization treadmill training** may not have a difference in efficacy compared to **conventional training** for improving gait.	1	Lewek et al. 2018
2	**Error augmented treadmill training** may not have a difference in efficacy compared to **error minimization treadmill training** for improving gait.	1	Lewek et al. 2018
2	There is conflicting evidence about the effect of **treadmill training** to improve gait when compared to **conventional therapy.**	1	Laufer et al. 2001

2	There is conflicting evidence about the effect of **backward treadmill training with BWS** to improve gait when compared to **conventional therapy.**	1	Takami et al. 2010
1b	There is conflicting evidence about the effect of **treadmill training with virtual reality** to improve gait when compared to **treadmill training.**	2	Cho et al. 2014; Cho et al. 2013
2	There is conflicting evidence about the effect of **treadmill training with visual deprivation** to improve gait when compared to **treadmill training.**	1	Kim et al. 2014
1b	There is conflicting evidence about the effect of **limited progressive treadmill training** to improve gait when compared to **conventional therapy.**	1	Pohl et al. 2002
1b	**Treadmill training with BWS** may produce greater improvements in gait than **treadmill training.**	3	Calabro et al. 2022; Ullah et al. 2017; Lee et al. 2015
2	**Treadmill training with use of Nordic poles** may produce greater improvements in gait than **treadmill training.**	1	Shin et al. 2015
2	**Treadmill training with increased speed** may produce greater improvements in gait than **treadmill training with increased incline.**	1	Alipsatici et al. 2020
2	**Treadmill training with foot drop stimulator** may produce greater improvements in gait than **foot drop stimulator alone.**	1	Peishun et al. 2021
2	**Treadmill training with front handrails** may produce greater improvements in gait than **treadmill training.**	1	Kang et al. 2015
2	**Treadmill training with bilateral handrails** may produce greater improvements in gait than **treadmill training.**	1	Kang et al. 2015
2	**Treadmill training with horizontal force** may produce greater improvements in gait than **treadmill training.**	1	Na et al. 2015
1b	**Treadmill training with smartphone app** may produce greater improvements in gait than **treadmill training.**	1	Lee et al. 2017
1b	**Backward treadmill training with BWS** may produce greater improvements in gait than **treadmill training.**	1	Kim et al. 2017
1b	**High intensity treadmill training** may produce greater improvements in gait than **low intensity treadmill training.**	1	Munari et al. 2018
1b	**Speed dependent treadmill training** may produce greater improvements in gait than **conventional therapy.**	1	Pohl et al. 2002
1b	**Speed dependent treadmill training** may produce greater improvements in gait than **limited progressive treadmill training.**	1	Pohl et al. 2002

1b	**Treadmill training with action observation** may produce greater improvements in gait than **treadmill training with sham action observation.**	1	Bang et al. 2013

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Treadmill training** may not have a difference in efficacy compared to **conventional therapy** for improving activities of daily living.	1	Baer et al. 2018
1b	**Treadmill training** may not have a difference in efficacy compared to **overground walking** for improving performance on activities of daily living.	1	Aguiar et al. 2020
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **conventional therapy** for improving performance on activities of daily living.	3	Lura et al. 2019; Nave et al. 2019; Teixeira da Cunha Filho et al. 2001
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **intensive gait training** for improving performance on activities of daily living.	1	Hoyer et al. 2013
1b	**Long-term treadmill training and overground walking** may not have a difference in efficacy compared to **short-term treadmill training and overground walking** for improving performance on activities of daily living.	1	Ada et al. 2013
1b	**Long-term treadmill training and overground walking** may not have a difference in efficacy compared to **no treatment** for improving performance on activities of daily living.	1	Ada et al. 2013
1b	**Short-term treadmill training and overground walking** may not have a difference in efficacy compared to **no treatment** for improving performance on activities of daily living.	1	Ada et al. 2013
1b	**Treadmill training with BWS and facilitation technique** may not have a difference in efficacy compared to **treadmill training with BWS and mechanical assistance** for improving performance on activities of daily living.	1	Yagura et al. 2006
1a	**Treadmill training with BWS** may not have a difference in efficacy compared to **overground walking** for improving activities of daily living.	4	Gama et al. 2017; Franceschini et al. 2009; Nilsson et al. 2001; Dean et al. 2010
1b	**Treadmill training with education** may not have a difference in efficacy compared to **conventional gait training** for improving performance on activities of daily living.	1	Brauer et al. 2022
1b	**Perturbation treadmill training** may not have a difference in efficacy compared to **treadmill training** for improving performance on activities of daily living.	1	Esmaeili et al. 2020

2	**Treadmill training with BWS** may not have a difference in efficacy compared to **proprioceptive neuromuscular facilitation** for improving activities of daily living.	1	Ribeiro et al. 2013
2	**Treadmill training with Nordic poles** may produce greater improvements in activities of daily living than **treadmill training.**	1	Kang et al. 2016

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Treadmill training with load** may not have a difference in efficacy compared to **treadmill training without load or conventional therapy** for improving range of motion.	1	Ribeiro et al. 2017a

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Treadmill training with BWS** may not have a difference in efficacy compared to **conventional therapy** for improving muscle strength.	2	Sukonthamarn et al. 2019; Nave et al. 2019
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **overground walking** for improving muscle strength.	1	Franceschini et al. 2009
1b	**Treadmill training with BWS and upper extremity ergometer training** may not have a difference in efficacy compared to **resistive leg cycling with upper extremity ergometer training** for improving muscle strength.	1	Sullivan et al. 2007
1b	**Treadmill training with BWS and upper extremity ergometer training** may not have a difference in efficacy compared to **BWS treadmill training with resistive leg cycling** for improving muscle strength.	1	Sullivan et al. 2007
1b	**Treadmill training with BWS and upper extremity ergometer training** may not have a difference in efficacy compared to **BWS treadmill training with lower extremity progressive resistive exercise** for improving muscle strength.	1	Sullivan et al. 2007
1b	**Treadmill training with BWS and resistive leg cycling** may not have a difference in efficacy compared to **BWS treadmill training with lower extremity progressive resistive exercise** for improving muscle strength.	1	Sullivan et al. 2007
1b	**Treadmill training with incline** may not have a difference in efficacy compared to **treadmill training with decline or level treadmill training** for improving muscle strength.	1	Cheng et al. 2022
1b	**Perturbation treadmill training** may not have a difference in efficacy compared to **treadmill training** for improving muscle strength.	1	Esmaeili et al. 2020

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **conventional therapy** for improving spasticity.	1	Nave et al. 2019
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **overground walking** for improving spasticity.	1	Franceschini et al. 2009
1b	**Botox with backward treadmill training** may not have a difference in efficacy compared to **Botox with forwards treadmill training** for improving spasticity.	1	Munari et al. 2020
1b	**Electromechanical gait trainer** may not have a difference in efficacy compared to **treadmill training with BWS** for improving spasticity.	1	Werner et al. 2002
1b	**Treadmill training with incline** may produce greater improvements in spasticity than **level treadmill training or with decline.**	1	Cheng et al. 2022
2	**Treadmill training with foot drop stimulator** may produce greater improvements in spasticity than **foot drop stimulator alone.**	1	Peishun et al. 2021
1b	There is conflicting evidence about the effect of **treadmill training with mirror therapy** to improve spasticity when compared to **treadmill training.**	1	Broderick et al. 2019

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Treadmill training** may not have a difference in efficacy compared to **conventional therapy** for improving stroke severity.	1	Srivastava et al. 2016
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **conventional therapy** for improving stroke severity.	1	Srivastava et al. 2016
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **treadmill training** for improving stroke severity.	1	Srivastava et al. 2016

PROPRIOCEPTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **overground walking** for improving proprioception.	1	Franceschini et al. 2009

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**

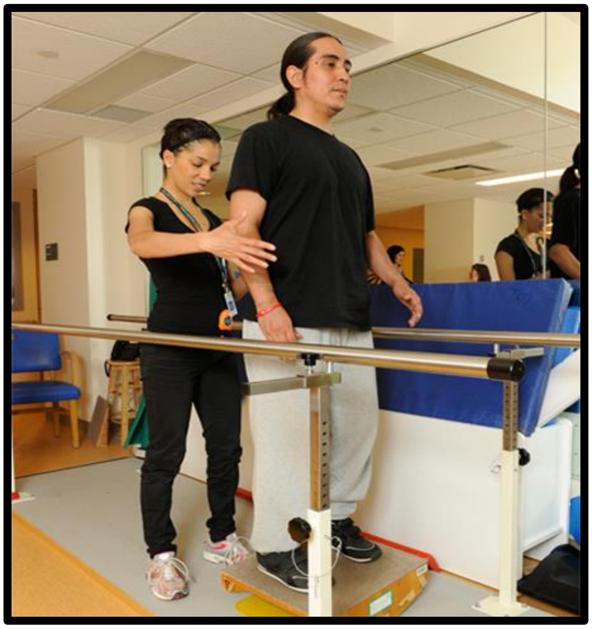
1b	**Treadmill training** may not have a difference in efficacy compared to **conventional therapy** for improving quality of life.	3	Baer et al. 2018; Macko et al. 2005; Globas et al. 2012
1b	**Treadmill training** may not have a difference in efficacy compared to **overground training** for improving quality of life.	1	Aguiar et al. 2020
1b	**Treadmill training with BWS** may not have a difference in efficacy compared to **conventional therapy** for improving quality of life.	1	Nave et al. 2019
1b	**Long-term treadmill training and overground walking** may produce greater improvements in quality of life than **short-term treadmill training and overground walking.**	1	Ada et al. 2013
1b	**Long-term treadmill training and overground walking** may produce greater improvements in quality of life than **no treatment.**	1	Ada et al. 2013
1b	**Short-term treadmill training and overground walking** may not have a difference in efficacy compared to **no treatment** for improving quality of life.	1	Ada et al. 2013
1a	**Treadmill training with BWS** may not have a difference in efficacy compared to **overground walking** for improving quality of life.	3	DePaul et al. 2015; Middleton et al. 2014; Dean et al. 2010
1b	**Early treadmill training with BWS** may not have a difference in efficacy compared to **home exercise** for improving quality of life.	1	Duncan et al. 2011
1b	**Late treadmill training with BWS** may not have a difference in efficacy compared to **home exercise** for improving quality of life.	1	Duncan et al. 2011
1b	**Treadmill training with education** may not have a difference in efficacy compared to **conventional gait training** for improving quality of life.	1	Brauer et al. 2022
1b	**Treadmill training with overground training** may not have a difference in efficacy compared to **home exercise** for improving quality of life.	1	Ada et al. 2003
1b	**High intensity treadmill training** may not have a difference in efficacy compared to **low intensity treadmill training** for improving quality of life.	1	Munari et al. 2018

Key Points

Treadmill training may not be beneficial in improving motor function, functional mobility, activities of daily living, range of motion, muscle strength, spasticity, stroke severity, proprioception, and quality of life after stroke.

The literature is mixed regarding treadmill training for improving gait and functional ambulation and the effect depends on the modality, duration, and combination to other interventions.

Physiotherapy and Exercise Programs



Adopted from: https://www.kliniknoridah.com/stroke-physiotherapy-treatment/

Exercise can be defined as planned physical activity that is structured and repetitive and is performed deliberately with the intention of improving physical fitness. Major factors of physical fitness are cardiovascular fitness, strength and power. After a stroke, individuals are impaired in all three of these attributes, to significant but varying degrees (Saunders et al., 2014). Physiotherapy and exercise are the primary method for regaining any of these deficits experienced after the injury. Although it is well known that physiotherapy and exercise are effective for rehabilitation, it is still not clear as to what type is most effective (Cho & Cha, 2016; Langhorne et al., 1996). Therefore, there is always an effort to identify when, where and how physiotherapy should be applied to maximize its benefit to the patient's recovery. Besides the more obvious physical benefits associated with exercise, psycho-social benefits also exist, and attempts are made to maximize these residual benefits as well (Saunders et al., 2014).

A total of 69 RCTs were found that looked at physiotherapy and exercise programs for lower extremity motor rehabilitation. One RCT compared body weight shift technique to conventional therapy (Krishna & Sangeetha, 2018). One RCT compared neurorestoration protocol physiotherapy to conventional physiotherapy (Rahayu et al., 2020). One RCT compared leisure-time physical activity to nonleisure physical activity (Ashizawa et al., 2021). One RCT compared self-regulation rehabilitation to conventional therapy (Liu & Chan, 2014). One RCT compared range of motion exercise to conventional therapy (Tseng et al., 2007). One RCT compared agility exercise to stretching (Marigold et al., 2005). One RCT compared the use of physio equipment to conventional therapy (Gul et al., 2021). One RCT compared cross-training to conventional physiotherapy (Park et al., 2021a). 16 RCTs compared early rehabilitation programs to conventional therapy or rehabilitation programs starting at different times post-stroke (Bai et al., 2012; Bernhardt et al., 2016; Bernhardt et al., 2015; Fang et al., 2003; Langhorne et al., 2017; Liu et al., 2021a; Pan, 2018; Rahayu et al., 2019; Wade et al., 1992; Wang et al., 2021a; Wu et al., 2020a; Wu et al., 2020b; Xu, 2022; Yelnik et al., 2017; Yen et al., 2020; Yu et al., 2020a). Two RCTs compared physical therapy to no treatment (Hoseinabadi et al., 2013; Werner & Kessler, 1996). One RCT compared occupational therapy to no treatment (Logan et al., 2004). Eight RCTs compared custom exercise programs to conventional therapy (Allen et al., 2009; Askim et al., 2018; Askim et al., 2010; Medina-Rincon et al., 2019; Sackley et al., 2015; Swank et al., 2020; Werner et al., 2002a; Xia et al., 2020). One RCT compared aerobic and resistance training to aerobic training (Marzolini et al., 2018). One RCT compared aerobic and resistance training to conventional care (Lee et al., 2015d). Two RCTs compared closed chain kinetic exercises to open chain kinetic exercise or standard rehabilitation (Krawczyk et al., 2014; Lee et al., 2013b). Two RCTs compared sling exercise therapy to conventional therapy (Liu et al., 2020; Lou et al., 2019). Two RCTs compared aerobic exercise with cognitive training to nonaerobic exercise with unstructured mental activities or sham (Koch et al., 2020; Yeh et al., 2019). One RCT compared virtual reality exercise programs to exercise program or conventional therapy (Cannell et al., 2018). One RCT compared a high-intensity functional exercise program to education (Holmgren et al., 2010). One RCT compared high repetitive weight bearing exercise to low repetitive weight bearing exercise (Agarwal et al., 2008). Nine RCTs compared higher intensity training to lower intensity training or conventional care (Boyne et al., 2016; Boyne et al., 2019; Gjellesvik et al., 2021; Hornby et al., 2019; Hornby et al., 2016; Langhammer et al., 2007; Langhammer et al., 2009; Reynolds et al., 2021; Sivenius et al., 1985). Four RCTs compared increased duration of exercise to conventional care/exercise (Glasgow Augmented Physiotherapy Study, 2004; Hesse et al., 2011; Klassen et al., 2020; Partridge et al., 2000). Two RCTs compared community-based physical activity to no intervention (Green et al., 2002; Marsden et al., 2010). Three RCTs compared community-based exercise program to other forms of care (Harrington et al., 2010; Olney et al., 2006; Stuart et al., 2019). Two RCTs compared community-based exercise programs to upper extremity exercise programs (Dean et al., 2012; Pang et al., 2005). One RCT compared motor training to conventional therapy (Pandian et al., 2014). One RCT compared a falls prevention program to usual care (Batchelor et al., 2012). One RCT compared skating exercises to treadmill training (Soh et al., 2020).

The methodological details and results of all 69 RCTs are presented in Table 10.

Table 10. RCTs Evaluating Physiotherapy-Based Interventions and Exercise Programs for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Body Weight Shift Technique vs Conventional Therapy		
Krishna et al. (2018) RCT (8) N_{Start}=30 N_{End}=30 TPS=Not reported	E: Body weight shift technique induced by shoe lift on unaffected side C: No shoe lift technique Duration: 2wks	• Fugl Meyer Assessment (-) • Weight Bearing on affected side (+exp) • 10-Meter Walk Test (+exp) • Berg Balance Scale (+exp) • Lower extremity functional performance (+exp)
Neurorestoration Protocol Physiotherapy vs Conventional Physiotherapy		
Rahayu et al. (2020) RCT (8) N_{start}=67 N_{end}=64 TPS=Acute	E: Neurorestoration protocol Physiotherapy C: Conventional Physiotherapy Duration: 60min/d, 7d/wk, for 1wk	• Brain-derived neurotropic factor (BDNF) biomarker (-) • Berg Balance Scale (+exp) • Barthel Index (+exp)
Leisure-time Physical Activity vs Nonleisure-time Physical Activity		

Ashizawa et al. (2021)
RCT (4)
N_{start}=45
N_{end}=33
TPS=Acute
	E: Nonleisure-time physical activity guidance (NLTPAG)
	
	C: Leisure-time physical activity guidance
	
	Duration: 20min/d, 2d/wk guidance program during hospitalization, 30-40min/d at-home activity for 3mo after discharge
		• Physical activity level (-)
		  ○ Low intensity (-)
		  ○ Moderate Intensity (-)
		• Sedentary Behavior Time (-)
		• 6-min walking distance (-)
		• 30s chair stand test (-)
		• Self-Efficacy for Physical Activity (-)

Self-regulation Rehabilitation vs Conventional Therapy		

Liu et al. (2014)
RCT (7)
N_{start}=46
N_{end}=44
TPS=Acute
	E: Self-regulation rehabilitation + physical therapy
	C: Conventional occupational + physical therapy
	Duration: 60min/d, 5d/wk, for 1wk intervention sessions & 60min/d physical therapy
		• Functional Independence Measure
		  ○ Motor (+exp)
		  ○ Cognitive (-)
		• Fugl-Meyer Assessment
		  ○ Lower extremity (-)
		  ○ Upper extremity (-)
		• Color Trails Test (-)

Range of Motion / mobilization Exercise vs Conventional Therapy		

Tseng et al. (2007)
RCT (6)
N_{start}=65
N_{end}=59
TPS=Chronic
	E1: Range of Motion exercise program by themselves
	
	E2: Range of Motion exercise program with physical help
	
	C: Usual care
	
	Duration: 20-40min/d, 6d/wk, for 4wks ROM exercise
		<u>E1/E2 vs C:</u>
		
		• Functional Independence (+exp1, +exp2)
		• Joint Angle-ROM (+exp1, +exp2)
		• Self-Reported Pain (+exp1, +exp2)
		• Geriatric Depression Scale – Short Form (+exp1, +exp2)
		
		<u>E1 vs E2:</u>
		
		• Functional Independence (-)
		• Joint Angle-ROM
		  ○ Hip -all directions (+exp2)
		  ○ Knee Flexion (+exp2)
		  ○ Knee Extension (-)
		  ○ Ankle Dorsal Flexion (-)
		  ○ Ankle Plantar Flexion/ Eversion/ Inversion (+exp2)
		• Self-Reported Pain (-)
		• Geriatric Depression Scale – Short Form (-)

Agility Exercise vs Stretching		
Marigold et al. (2005) RCT (6) N_{start}=61 N_{end}=48 TPS=Chronic	E: Agility exercises C: Stretching and weight-shifting Duration: 60min/d, 3d/wk for 10wks	• Step Reaction Time (+exp) • Berg Balance Scale (-) • Timed Up & Go Test (-) • Activity-Specific Balance Confidence (-)
Physio equipment vs Conventional Therapy		
Gul et al. (2021) RCT (3) N_{start}=40 N_{end}=40 TPS=Subacute	E: Swiss ball exercises + Conventional Treatment C: Conventional training Duration: 60mins/d, 4d/wk, for 3wks	• Berg Balance Scale (+exp) • Trunk Impairment Scale (+exp)
Cross-training vs Conventional Physiotherapy		

Park et al. (2021) RCT (6) N_{start}=60 N_{end}=52 TPS=Chronic	E1: Cross-training on affected side + conventional physiotherapy E2: Cross-training on unaffected side + conventional physiotherapy C: Conventional physiotherapy Duration: C: 60min/d, 5d/wk, for 4wks physiotherapy, E: 30min/d, 3d/wk cross training & 30-60min/d, 5d/wk physiotherapy, for 4wks	<u>E1 vs E2 vs C</u> • Timed Up & Go (-) • 10-Metre Walk Test (-) • Limit of Stability (-) ○ Paretic side (-) ○ Non-paretic side (-) ○ Forward (-) ○ Backward (-)
Early Rehabilitation Programs vs Conventional Therapy or Rehabilitation Programs Starting at Different Times Post-Stroke		
Xu (2022) RCT (4) N_{start}=160 N_{end}=160 TPS=Acute	E: Conventional stroke medication + Early rehabilitation exercise training (48-72h after stroke) C: Conventional stroke medication Duration: 30-45min/d, 4-6d/wk, for 4wks	• Fugl-Meyer score (+exp) • Barthel Index score (+exp)
Liu et al. (2021) RCT (5) N_{start}=90 N_{end}=88 TPS=Acute	E: Ultra early rehabilitation program (started within 72 hours of onset) C: Early rehabilitation program (started from 72 hours to 7 days after onset) Duration: 20-30min/d, 2-3sessions/d, 4-5d/wk, for 12wks	• National Institutes of Health Stroke Scale (+exp) • Modified Barthel Index (+exp) • Fugl-Meyer Assessment (+exp)
Wang et al. (2021) RCT (7) N_{start}=120 N_{end}=115 TPS=Acute	E: Early standard rehabilitation (24-48hr) post stroke C: Standard rehabilitation (72-96hr) post stroke Duration: 40min/d, 7d/wk, for 3mo	• Modified Rankin scale (+exp) • Fugl-Meyer assessment ○ Upper extremity (-) ○ Lower extremity (+exp)
Yen et al. (2020) RCT (8) N_{start}=60 N_{end}=60 TPS=Acute	E: Early Mobilization C: Standard Early Rehabilitation Duration: 30min/wk, 5d/wk till discharge	• FIM ○ Motor (+exp) ○ Self-care (+exp) ○ Transfers and locomotion (+exp) • PASS (-) • FAC (+exp)
Wu et al. (2020a) RCT (7) N_{start}=31 N_{end}=31 TPS=Acute	E: Early conventional PT + intensive strength exercises C: Conventional physiotherapy Duration: 20-30min/d, 5d/wk conventional PT & 30min/d, 5d/wk, for 2wks strength exercises	• Fugl-Meyer Assessment (+exp) • Functional Independence Measure - Ability to walk 50m (-) • Berg Balance Scale (-) • Barthel Index (-) • Modified Rankin Scale (-)
Wu et al. (2020b) RCT (7) N_{start}=31 N_{end}=31 TPS=Acute	E: Early and Intensive Physiotherapy C: Conventional Care	• Berg Balance Scale (-) • Barthel Index (-) • Fugl Meyer Assessment (+exp) • 50-Meter Walking (-) • Modified Rankin Scale (-)

	Duration: conventional 72hrs post CVA, early 24-48hrs, 30min/d, 5d/wk, for 4wks	
Yu et al. (2020) RCT (3) N_{start}=82 N_{end}=82 TPS=Acute	E: Early Interventional Rehabilitation (2-7 days Post Stroke) C: Late interventional Rehabilitation (3-4 wks Post Stroke) Duration: 45min/d, patient-dependant	• Fugl-Meyer Assessment (+exp) • Barthel Index (+exp) • Neurological deficit score (+exp)
Rahayu et al. (2019) RCT (6) N_{start}=40 N_{end}=40 TPS=Acute	E: Early mobilization training starting at 24h poststroke diagnosis C: Early mobilization training starting at 48h poststroke diagnosis Duration: 30-60min/d for 7d - 24h mobilization, 30-60min/d for 6d - 48h mobilization	• Berg Balance scale (+exp) • Barthel index (+exp)
Pan (2018) RCT (5) N_{start}=86 N_{end}=86 TPS=Acute	E: Early rehabilitation therapy + routine primary therapy C: Routine Primary Therapy Duration: 30 - 60 min/d, 2sessions/d, for 50 days	• Fugl-Meyer Assessment (+exp) • Neurologic Deficit Scale (+exp) • Barthel Index (+exp) • Clinical Efficacy (+exp) • Satisfaction (+exp)
Langhorne et al. (2017) RCT (8) N_{start}=2104 N_{end}=2083 TPS=Acute	E: Very early mobilization C: Conventional rehabilitation Duration: 3mo	• Modified Rankin Scale (+con) • 50 Meter Walking (-)
Yelnik et al. (2017) RCT (7) N_{start}=104 N_{end}=82 TPS=Acute	E: Early and intensive Physiotherapy C: Soft (passive) Physiotherapy Duration: 15 - 20min/d, 5d/wk Soft PT & 45min/d, 5d/wk Intensive PT for 3mo	• Fugl-Meyer Assessment (-) • Postural Assessment Scale for Stroke (-) • Days (no) to walk 10 m (-) • Modified Rankin Scale (-) • Functional Independence Measurement (-) • Stroke impact scale (-)
Bernhardt et al. (2016) RCT (6) N_{start}=2104 N_{end}=2083 TPS=Acute	E: Very early and frequent mobilization C: Conventional rehabilitation Duration: 10+min/session, 1+sessions/d, for 2wks early mobilization	• 50-Meter Walk Test (+exp) • Modified Rankin Scale (+exp)
Bernhardt et al. (2015) RCT (8) N_{start}=2104 N_{end}=2083 TPS=Acute	E: Early mobilization after stroke C: Conventional rehabilitation Duration: 14d or until discharge	• Mortality (-) • Adverse Effect (-) • Favourable Outcome (+con) • Modified Rankin Scale (-) • Walk 50m Unassisted (-)
Bai et al. (2012) RCT (5) N_{start}=364 N_{end}=345 TPS=Acute	E: Early 3-stage ADL-focused rehabilitation plan + Conventional Care C: Conventional care	• Fugl-Meyer Assessment (+exp) • Modified Barthel Index (+exp)

	Duration: First stage: 45min/d, 5d/wk, 1mo, Second stage: 2mo, Third stage: 3 mo; Total of 6mo	
Fang et al. (2003) RCT (6) N_{start}=156 N_{end}=128 TPS=Acute	E: Early physical therapy during hospitalization C: Conventional hospitalization care Duration: 45min/d, 5d/wk, for 4wks physical therapy	• Glasgow Coma Scale (-) • Mini-Mental State Examination (-) • Clinical Neurological Deficit Scale (-) • Fugl-Meyer Assessment (-) • Modified Barthel Index (+exp)
Wade et al. (1992) RCT crossover (6) N_{start}=94 N_{end}=89 TPS=Chronic	E: Early individualized physiotherapy program (education and exercise) C: Late individualized physiotherapy program (education and exercise) Duration: 1-11session/12wks	• 10 m walk time ○ At crossover time (+exp) ○ At the end of 2 phases (+con) • Rivermead motor assessment (-) • Barthel index (-) • Frenchay activities index (-) • Rivermead mobility index (-) • Nottingham extended activities of daily living index (-)
Physical Therapy vs No Treatment		
Hoseinabadi et al. (2013) RCT (4) N_{start}=31 N_{end}=31 TPS=Chronic	E: Practical Physical therapy C: No treatment Duration 60min/d, 3d/wk, for 4wks	• Berg Balance Scale (+exp) • Barthel Index (+exp) • Modified Ashworth Scale (+exp)
Werner et al. (1996) RCT (4) N_{start}=49 N_{end}=40 TPS=Chronic	E: Intensive outpatient rehabilitation program (physical + occupational therapy) C: No treatment Duration: 120min/d, 4d/wk, for 12wks	Functional Independence Measure (+exp) Jepsen hand function evaluation (-) Brunnstrom's motor rating (-) Timed evaluation of stair climbing (-) Walking speed (-) Sickness Index Profile (+exp)
Occupational Therapy vs No Treatment		
Logan et al. (2004) RCT (7) N_{start}=168 N_{end}=168 TPS=Chronic	E: Occupational Therapy + Leaflets for local transport C: Leaflets for local transport Duration: 7 sessions over 3mth	Nottingham Extended Activities of Daily Living (+exp) General Health Questionnaire-12 (-)
Custom Exercise Programs vs Conventional Therapy		
Swank et al. (2020) RCT (7) N_{start}=73 N_{end}=73 TPS=Acute	E: Patient Directed Activity Program (PDAP) + Conventional Care C: Conventional Care A Duration: 3h/d, 7d/wk for 1mo (on average) Usual care & 60min/d, 7d/wk Patient-directed Activity	• Steps/day (+exp) • Stroke Rehabilitation Assessment of Movement Measure (-) • Functional Independence measure (-) • Stroke Impact scale (+exp)
Xia et al. (2020) RCT (8) N_{start}=285 N_{end}=259 TPS=Acute	E: Customized Tiered Conventional Therapy C: Conventional rehabilitation Duration: 3wks	• Modified Barthel Index (+exp) • Fugl-Meyer Assessment (-) • Stroke-Specific Quality-of-life Scale (-)
Medina-Rincon et al. (2019) RCT (8) N_{start}=14 N_{end}=14 TPS=Subacute	E: Custom exercise program + Usual care C: Usual Care Duration: E: 45min/d, 5d/wk, 4wks Usual care + 15min/d, 5d/wk, for 4wks custom exercise	• Total Mini BESTest (+exp) ○ Anticipatory postural adjustments (+exp) ○ Postural responses (-) ○ Sensory orientation (+exp) • Balance during gait (+exp)

	C: 60 min/d, 5d/wk, for 4wks usual care	
Askim et al. (2018) RCT (6) N_{start}=380 N_{end}=329 TPS=Subacute	E: Individualized Regular Coaching (on physical activity and exercise) + Standard Physiotherapy C: Standard Physiotherapy Duration: 45min/wk standard physiotherapy; 1d/mo coaching to schedule 45-60min/wk exercise & 30min/d, 7d/wk physical activity as intervention, for 18mo	• Motor Assessment Scale (-) • Barthel Index (-) • Modified Rankin Scale (-) • Berg Balance scale-item 14 (-) • Timed Up and Go Test (+con) • Gait Speed (-) • 6-minute walk test (-) • Stroke Impact Scale (-) • MMSE (-) • Trailmaking A and B (-) • Hospital Anxiety and Depression Scale (-) • EQ-5D-5L (-) • Fatigue Severity Scale (-) • Caregiver Strain Index (-)
Sackley et al. (2015) RCT (7) N_{start}=1042 N_{end}=908 TPS=Chronic	E: Custom Occupational therapy + Caregiver training workshop C: Usual care alone Duration: 3mo program, frequency and duration of visits depended on patient and therapist	• Barthel index (-) • Rivermead Mobility index (-) • Geriatric depression scale-15 (-) • EuroQOL-5D-3L questionnaire (-)

Askim et al. (2010)
RCT (7)
N_{start}=62
N_{end}=59
TPS=Acute
	E: Intensive Motor Training + Home Exercise + Standard Treatment
	C: Standard Treatment
	Duration: 30min, 2x/d, 5d/wk, for 12wks, Standard Treatment & 30-50min/d, 1-3d/wk, for 12wks intensive Training & 2x/d, 6d/wk Home Exercise
		• Berg Balance Scale (-)
		• Barthel Index (-)
		• Motor Assessment Scale (-)
		• Step Test (-)
		• 5-meter Walk Test (-)
		• Stroke Impact Scale
		  ○ Recovery (-)
		  ○ Mobility (-)

Allen et al. (2009) RCT (7) N_{start}=380 N_{end}=319 TPS=Subacute	E: Individualized post-discharge care plan (Home visits, Education, Medication, Social Support, Regular telephone assessment) C: Usual post-discharge Care Duration: 6mo protocol for both groups. 1d/wk, for 4wks, then 1d/mo for 5mo periodic calls	• NIHSS (-) • Timed Up and Go Test (-) • Physical Performance Test (-) • Stroke-specific QOL scale (-) • Stroke Knowledge and Lifestyle Modification (+exp)
Werner et al. (2002) RCT (7) N_{start}=28 N_{end}=28 TPS=Subacute	E: Baseline conventional therapy + Treadmill training with partial BWS + Individual physical therapy C: Baseline conventional therapy + Treadmill training with partial BWS Duration: 3wks Baseline conventional therapy, 30min/d, 5d/wk, for 3wks BWS-treadmill, 40min/d, 5d/wk, for 3wks Individual physical therapy	• Functional Ambulation Category (+exp) • Rivermead Motor Assessment (-) • Gait Velocity (-)
Aerobic and Resistance Training vs Aerobic Training		

Marzolini et al. (2018) RCT (6) N_{start}=73 N_{end}=68 TPS=Chronic	E: Aerobic training (over ground walking) + Resistance training C: Aerobic Training Duration: 20-60mins/d, 5d/wk for 24wks	• 6-minute walking distance (-) • Stair climb (-) • Sit-to-stand (-) • Muscular strength • Knee extension affected side (-) • Knee extension nonaffected side (+exp)
Aerobic and Resistance Training vs Conventional Care		
Lee et al. (2015d) RCT (7) N_{start}=30 N_{end}=26 TPS=Chronic	E: Aerobic Training (fast walking and walking up-stairs) + Resistance Training C: Conventional care Duration: 60min/d, 3d/wk, 16wks	• 10-Metre Walk Test (+exp) • 6-Minute Walk Test (+exp) • Timed Up & Go Test (-) • 30-sec chair stand test (+exp) • Chair sit and reach (+exp) • Pulse wave velocity (+exp) • Augmentation index (+exp) • Grip strength (+exp) • Flexibility (+exp) • Functional Reach test (-)
Closed Chain Exercise vs Open Chain Exercise or Standard Rehabilitation		
Krawczyk et al. (2014) RCT (4) N_{start}=51 N_{end}=51 TPS=Subacute	E: Closed chain rehabilitation program C: Standard rehabilitation program Duration: 120 min/d, for 12wks	• Berg-Balance Scale (-) • Rivermead Motor Assessment-Trunk and LE (-) • Fugl-Meyer Assessment-LE (-) • Gait speed (-) • Cadence (-) • Stance phase (-) • Step length (-) • Step width (-) • Hip range of motion (-) • Range of pelvic tilt (-) • Gillette Gait Index (-) • Knee range of motion (-)
Lee et al. (2013) RCT (3) N_{start}=33 N_{end}=33 TPS=Chronic	E1: Closed Chain Kinetic exercise E2: Open Chain Kinetic exercise C: No Treatment Duration: 5d/wk, for 6wks	E1 v C • Muscle activity (+exp) • Sway velocity (+exp) E2 v C • Muscle activity ○ Rectus femoris (+exp) ○ Biceps femoris (+exp) ○ Gastrocnemius (-) ○ Tibialis anterior (-) • Sway velocity (-) E1 v E2 • Muscle activity ○ Rectus femoris (-) ○ Biceps femoris (-) ○ Gastrocnemius (+exp1) ○ Tibialis anterior (+exp1) • Sway velocity (+exp1)
Sling Exercise Therapy vs Conventional Therapy		
Liu et al. (2020) RCT (7) N_{start}=50 N_{end}=50 TPS=Subacute	E: Sling Exercise Therapy on Lower Limbs C: Conventional Therapy Duration: 30min/d, 5d/wk, for 4wks	• Berg Balance Scale (+exp) • Fugl-Meyer Assessment ○ Upper limb (+exp) ○ Lower limb (-) • Barthel index (-) • Short Form 36 (-) • General health (+exp) • Pain Visual Analogue Scale (VAS) (+exp)

Lou et al. (2019) RCT (6) N_{start}=56 N_{end}=56 TPS=Subacute	E: TheraSling Therapy with Neuromuscular Facilitation C: Conventional Care Duration: 45min/d, 6d/wk, for 6wks	• Functional Ambulation Category (+exp) • Barthel Index (+exp) • Fugl Meyer Assessment (+exp) • Berg Balance Scale (+exp) • 10-Meter Walk Test (+exp) • Step Length (+exp)
Aerobic Exercise with Cognitive Training vs Nonaerobic Exercise with Unstructured Mental Activities or Sham		
Koch et al. (2020) RCT (5) N_{start}=131 N_{end}=94 TPS=Subacute	E: Aerobic training (Stationary treadmill or bicycle ergometer) + resistance training + cognitive training C: Sham Combined aerobic and resistance training + Sham Cognitive training Duration: 80-100min/d, 3d/wk, 12wks	• Grooved Pegboard (-) • Stroop delis Kaplan Executive function test (-) • WAIS-IV Coding Digit Symbol Substitution Test (-) • Brief Visuospatial Memory Test-R (-) • Delayed Recall Digit Span Backwards (-) • Stroke Impact Scale (-) • Timed Up and Go Test (-) • 15 Meters Walk Speed (-) • 6-minute walk test (-) • 30-second chair stand repetition test (-) • Single repetition maximal leg (-)
Yeh et al. (2019) RCT (6) N_{start}=30 N_{end}=30 TPS=Chronic	E: Aerobic exercise (stationary bicycle training) + computerized cognitive training C: Nonaerobic exercise + unstructured mental activities Duration: 60min/d, 2-3d/wk, 12-18wks (36 sessions in total)	• 6-minute walk test (+exp) • Community Integration Questionnaire (-) • EuroQoL-5D questionnaire (-) • International Physical Activity Questionnaires (-) • Montreal Cognitive Assessment (+exp) • Wechsler Memory Scale-Third Edition ○ Spatial Span (+exp) • Verbal Pair (-)
Virtual Reality Exercise Program vs Customized Physiotherapy or Conventional Physiotherapy		
Cannell et al. (2018) RCT (8) N_{start}=81 N_{end}=73 TPS=Subacute	E: Customized Physiotherapy plan using interactive Motion Capture Rehabilitation (VR-based) C: Customized Physiotherapy plan Duration: Maximum of 1hr/d, 5d/wk, for 8wks or up to discharge (whichever comes first)	• Functional reach Test (-) • Lateral reach Test (-) • Sitting balance Test (-) • Modified Motor assessment scale (-) • Box and Block (-) • Step test (-) • Timed Up and Go (-) • Gait Velocity (-)
High-intensity Functional Exercise Program vs Education		
Holmgren et al. (2010) RCT (8) N_{start}=34 N_{end}=33 TPS=Subacute	E: High Intensity Functional Exercise (HIFE) program + education C: Education group Duration: Experimental - 45min/d 6d/wk, 5wks HIFE + 1h/wk, for 5wks Education Control - Education 1h/wk, for 5wks	• Berg Balance Scale (-) • Barthel Index (-) • Falls Efficacy Scale International (+exp) • Frenchay Activities Index (-)
High Repetitive Weight Bearing Exercises vs Low Repetitive Weight Bearing Exercises		
Agarwal et al. (2008) RCT (5) N_{start}=30	E1: Repetitive weight bearing exercises repeated 40 times.	<u>E1 v E2</u> • Cadence (+exp1)

N_{end}=30 TPS=Subacute	E2: Repetitive weight bearing exercises repeated 20 times. Duration: 1mo	• Step Length (+exp1) • Step Width (+exp1)
Higher Intensity Training vs Lower Intensity Training or Conventional Care		
Reynolds et al. (2021) RCT (7) N_{start}=20 N_{end}=19 TPS=Subacute	E: Progressive moderate-intensity cardiovascular training C: Low-intensity conventional exercise program Duration: 30min/d, 5d/wk, for 12wks	• VO2 peak (-) • 6-minute walk test (-) • 10-m walk test (-) • SF-36 (-) • Patient health questionnaire-9 (-)

Gjellesvik et al. (2021)
RCT (7)
N_{start}=70
N_{end}=64
TPS=Chronic
	E: High Intensity Interval Training (HIIT) + Conventional care
	C: Conventional care
	Duration: 35min/d, 3d/wk, for 8wks HIIT
		• 6 Minute Walk Test (+exp)
		• 10 Meter Walk Test (-)
		• Berg Balance Scale (+exp)
		• Timed Up & Go Test (-)
		• Hospital Anxiety and Depression Scale
		  ○ Anxiety (-)
		  ○ Depression (-)
		• Montreal Cognitive Assessment Test (-)
		• Trail Making Test
		  ○ Part A (-)
		  ○ Part B (+exp)
		• Stroke Impact Scale (-)
		• Functional Indep$_{end}$ence Measure (-)

Boyne et al. (2019) RCT crossover (5) N_{start}=16 N_{end}=16 TPS=Chronic	E1: High-Intensity Interval Training – Treadmill E2: High-Intensity Interval Training – Seated Stepper C: Moderate-intensity Continuous Exercise - Treadmill Duration: 20min Single session/Condition, ~ 1wk washout	<u>E1/E2 vs C</u> • Gait Speed (-) • Brain-derived neurotrophic factor (+exp1) • Active motor threshold response (+exp1) • VO2 peak (+exp1/2)
Hornby et al. (2019) RCT (8) N_{start}=97 N_{end}=90 TPS=Chronic	E1: High-intensity variable stepping training E2: High-intensity forward stepping training E3: Low-intensity variable stepping training C: N/A Duration: 1hr training sessions for 2mo (3–5 sessions/wk), with ≤40 minutes of stepping practice each session	• <u>E1/E2 v E3</u> • Self-selected speed (+exp1, +exp2) • Fastest-possible speed (+exp1, +exp2) • 6-minute walk test (+exp1, +exp2) • Step-length symmetry (-) • Paretic single-limb stance (+exp1, +exp 2) • Functional Gait Assessment (-) • 5-times sit-to-stand (-) • Activities-Specific Balance Confidence Scale (-) • Physical function/mobility score of Patient-Reported Outcomes Measurement Information System (-) • Peak treadmill speed (+exp1, +exp2) • Peak VO2 (-)

Hornby et al. (2016)
RCT (7)
N_{start}=33
N_{end}=32
TPS=Subacute
	E: High intensity (70-80% of heart rate reserve), variable stepping training on multiple surfaces (overground, treadmill, stair climbing etc)
	C: Conventional physical therapy care
		• 10-metre walk test
		  ○ Self-selected speed (+exp)
		  ○ Fastest speed (+exp)
		• 6-minute walk test (+exp)
		• Steps/day (-)
		• Single limb stance
		  ○ Self-selected speed (+exp)
		  ○ Fastest speed (+exp)

	Duration: 60min/d, 4-5d/wk, for 10wks for 40 sessions	• Step symmetry
		  ○ Self-selected speed (-)
		  ○ Fastest speed (-)
		• Berg Balance Scale (-)
		• 5 times sit to stand (-)
		• SF36 Physical (+exp)
		• Activities specific balance confidence (-)

Boyne et al. (2016) RCT crossover (8) N_{start}=18 N_{end}=16 TPS=Chronic	E1: High-Intensity Interval Training C: Moderate-intensity aerobic training Duration: 25min/d, 3d/wk, for 4wks	• Peak oxygen uptake (-) • Ventilatory threshold (+exp) • Metabolic cost of gait (-) • Fractional utilization (-) • Fastest treadmill speed (+exp) • 10-Meter Walk Test (-) • Six-Minute Walk Test (-)
Langhammer et al. (2009) RCT (8) N_{start}=75 N_{end}=63 TPS=Acute	E: Intensive exercise program C: Self-initiated exercise with No specific treatment Duration: 40-60min/d, 2-3d/wk, 48wks - (80hrs/12mo)	• Older Americans Resources and Service Procedures (-) • Motor Assessment scale (-) • 6min Walk test (-) • Berg Balance scale (-) • Timed Up and Go (-) • Grip strength (-) • Modified Ashworth scale (-) • Pulse rate (-)
Langhammer et al. (2007) RCT (8) N_{start}=75 N_{end}=63 TPS=Acute	E: Intensive functional exercise C: Motivation & exercise as needed Duration: 20hr/3mo, 4x (80h/12mo)	• Motor Assessment Scale (-) • Barthel Index (-) • Grip strength (-)
Sivenius et al. (1985) RCT (5) N_{start}=95 N_{end}=95 TPS=Acute	E: Intensive physiotherapy program C: Normal physiotherapy Duration: 30min/session, 2sessions/d	• ADL score (+exp) • Motor function (+exp)
Increased Duration of Exercise vs Conventional Care/Exercise		
Klassen et al., (2020) RCT (7) N_{start}=74 Nfinal=73 TPS=Acute	E1: Therapeutic exercise more than double the intensity of usual care. E2: Therapeutic exercise more than quadruple the intensity of usual care. C: Usual care physical therapy Duration: E1: 60min/d, 5d/wk, for 4wks E2: 120min/d, 5d/wk, for 4wks C: 60min/d, 5d/wk, for 4wks	E1/E2 vs C: • 6-minute walk test (+exp1, +exp2) • 5meter walk test (+exp2) • EQ-5D-5 L (+exp1, +exp2) • Berg Balance Scale (-) • Patient Health Questionnaire-9 (-) • Maximal Isometric Paretic Quadriceps (knee) strength (-)
Hesse et al. (2011) RCT (6) N_{start}=50 N_{end}=50 TPS=Subacute	E: Intermittent High-Intensity Physiotherapy C: Continuous Low-Intensity physiotherapy Duration: 30-45min/d, 4d/wk, 8wks for 3blocks/12month Intermittent PT & 30-45min/d, 2d/wk, 12month Continuous PT	• Rivermead Mobility index (-) • Rivermead motor assessment (-) • 10-m Walk (-) • Stair climbing velocity (-) • Timed Up and Go (-) • Modified Ashworth scale (-) • Rivermead Activities of Daily Living scale (-) • Fell seriously (+exp)

Glasgow Augmented Physiotherapy Study (GAPS) group (2004) RCT (7) N_{start}=70 N_{end}=68 TPS=Acute	E: Augmented conventional physiotherapy C: Conventional physiotherapy Duration: 30-40min/d, 5d/wk Conventional PT, 60-80min/d, 5d/wk Augmented PT	• Motricity Index (-) • Rivermead Mobility Index (-) • Barthel Index (-) • Length of Stay at Hospital (-) • 10-Metre Walking Speed (-)
Partridge et al. (2000) RCT (7) N_{start}=114 N_{end}=108 TPS=Not reported	E: Standard plus physiotherapy (longer duration) C: Standard physiotherapy Duration: 30min/d, for 6wks Standard physiotherapy, 60min/d, for 6wks Standard plus physiotherapy	• Profiles of Recovery (-) • Sit to Stand (-) • 5-Meter Timed Walk (-) • Functional Reach Test (-) • Recovery Locus of Control Scale (-)
Community-based Physical Activity vs No Intervention		
Marsden et al. (2010) RCT crossover (7) N_{start}=43 N_{end}=41 TPS=Chronic	E: Multidisciplinary group programme (combining physical activity, education, self-management principles) C: No treatment Duration: 150min/d, 1d/wk, for 7wks - 1wk washout	Stroke survivors: • Stroke Impact Scale (-) • Six Minute Walk Test (-) • Timed Up and Go (-) • Perceived overall recovery (-)
Green et al. (2002) RCT (8) N_{start}=170 N_{end}=161 TPS=Chronic	E: Community physiotherapy C: No intervention Duration: 13 wks	• Rivermead Mobility Index (+exp) • 10m walk speed (+exp) • Barthel Index (-) • Frenchay Activities Index (-) • Hospital Anxiety and Depression Scale (-) • General health questionnaire 28 (-) • Number of patients who had falls (-)
Community-based Exercise Program vs Other Care		

Stuart et al. (2019)
RCT (6)
N_{start}=76
N_{end}=48
TPS=Chronic
	E: Community-based progressive Adaptive Physical Activity exercise program with homework component
	C: Non-progressive seated exercise (sham)
	Duration: 60min/d, 3d/wk, for 24wks
		• Six-minute walk (-)
		• Berg Balance scale (-)
		• Short Physical Performance Battery (-)
		• 30-foot timed walk (-)
		• Stroke Impact Scale (-)
		  ○ Mobility (-)
		  ○ Total (-)

Harrington et al. (2010)
RCT (7)
N_{start}=243
N_{end}=228
TPS=Chronic
	E: Community-based exercise + Education
	C: Standard care
	Duration: 2hr/d, 2d/wk for 8wks
		• Subjective Index of Physical and Social Outcomes
		  ○ Physical (+exp)
		  ○ Social (-)
		• Frenchay Activities Index (-)
		• Rivermead mobility index (-)
		• Carer Strain index (-)
		• Functional reach test (-)
		• Timed Up and Go (-)
		• WHOQoL-Bref
		  ○ Physical (-)
		  ○ Psychological (-)
		  ○ Social (-)
		  ○ Environmental (-)
		• Hospital Anxiety and Depression scale (-)

Olney et al. (2006) RCT (7) N_{start}=74 N_{end}=66 TPS=Chronic	E: Supervised group exercise program C: Unsupervised (home-based) exercise program Duration: 90min/d, 3d/wk for 10wks	• 6-Minute Walk Test (-) • Human Activity Profile (-) • Short Form-36 ○ Mental (+exp) ○ Physical (-) • Physiological Cost Index (-) • Muscle Strength Sum (-)
Community-based Exercise Program vs Upper Extremity Exercise Program		
Dean et al. (2012) RCT (8) N_{start}=151 N_{end}=133 TPS=Chronic	E: Community-based mobility, balance, and fall prevention program C: Upper extremity and cognitive exercise program Duration: 45-60min weekly exercise & 45-60min, 3d/wk home exercise for 40wks	• 6min Walk test (+exp) • 10m Walk test ○ Comfort (-) ○ Fast (+exp) • Short form Physiological Profile Assessment (-) • Short form 12 ○ Physical (-) ○ Mental (-) • Timed Up and Go (-) • Step Test (-) • Physical activity-steps/d (-) • Adelaide Activities Profile ○ Domestic Chores (-) ○ Household Maintenance (-) ○ Service to Others (+exp) ○ Social Activities (+exp) • Choice stepping reaction time (+exp) • Affected knee strength (-) • Intact knee strength (+exp) • Maximal balance range (-) • Coordinated stability (-) • Single leg stance time (-) • Sit-to-stand (-)
Pang et al. (2005) RCT (8) N_{start}=63 N_{end}=60 TPS=Chronic	E: Community-based fitness and mobility exercises for lower limb C: Seated upper extremity exercises Duration: 60min/d, 3d/wk, for 19wks	• VO_2 max (+exp) • 6-Minute Walk Test (+exp) • Maximal Knee Contraction ○ Paretic Leg (+exp) ○ Nonparetic Leg (-) • Berg Balance Scale (-) • Physical Activity Scale for Individuals with Physical Disabilities (-) • Femoral Neck Bone Mineral Density ○ Paretic (+exp) ○ Nonparetic (-) • Respiratory Exchange Ratio (-)
Non-Paretic Side Training vs Conventional Therapy		
Pandian et al. (2014) RCT (7) N_{start}=39 N_{end}=37 TPS=Chronic	E: Motor training non-paretic side + conventional therapy C: Conventional therapy Duration: 60min/d, 3d/wk, for 8wks	• Berg Balance Scale (+exp) • Functional reach test (-) • Barthel index (+exp)
Falls Prevention Program vs Usual Care		
Batchelor et al. (2012) RCT (8) N_{start}=156	E: Usual Care + Falls prevention program (including individualized home exercise, implementation of	• Falls rate (-) • Falls Risk for Older People-Community setting (-) • Falls Efficacy Scale (-)

N_{end}=132 TPS=Subacute	falls and injury risk minimization strategies and education) C: Usual care Duration: 30-40min, 3-5d/wk, for 12mo home exercise	• Human Activity Profile (-) • Sit-to-Stand (-) • Step Test (-) • Functional Independence Measure (-)
Skating Exercise vs Treadmill Training		
Soh et al. (2020) RCT (5) N_{start}=45 N_{end}=36 TPS=Subacute & Chronic	E: Skating-like motion exercises C: Conventional treadmill exercise Duration: 30min/d, 3d/wk for 12wks	• EuroQoL-5D (+exp) • Dynamic Gait index (+exp) • Berg Balance scale (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Physiotherapy-Based Interventions and Exercise Programs

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Self-regulation rehabilitation** may not have a difference in efficacy when compared to **conventional therapy** for improving motor function.	1	Liu et al. 2014
2	**Physical therapy** may not have a difference in efficacy when compared to **no treatment** for improving motor function.	1	Werner et al. 1996
1a	**Custom exercise programs** may not have a difference in efficacy when compared to **conventional therapy** for improving motor function.	3	Xia et al. 2020; Allen et al. 2009; Werner et al. 2002
2	**Closed-chain exercises** may not have a difference in efficacy when compared to **open-chain exercises or standard rehabilitation** for improving motor function.	1	Krawczyk et al., 2014
1b	**Increased duration of exercise** may not have a difference in efficacy when compared to **conventional/exercise** for improving motor function.	1	Hesse et al. 2011
1b	There is conflicting evidence about the effect of **body weight shift technique** to improve motor function when compared to **conventional therapy.**	1	Krishna et al. 2018
1b	There is conflicting evidence about the effect of **early rehabilitation programs** to improve motor function when compared to **conventional therapy or rehabilitation programs of various times.**	11	Xu 2022; Liu et al. 2021; Wang et al. 2021; Wu et al. 2020a; Wu et al. 2020b; Yu et al. 2020; Pan 2018; Yelnik et al. 2017; Bai et al. 2012; Fang et al. 2003; Wade et al. 1992

1b	There is conflicting evidence about the effect of **sling exercise therapy** to improve motor function when compared to **conventional therapy.**	2	Liu et al. 2020; Lou et al. 2019
2	**Higher intensity training** may produce greater improvements in motor function when compared to **lower intensity training or conventional care.**	1	Sivenius et al. 1985

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Leisure-time physical activity** may not have a difference in efficacy when compared to **nonleisure-time physical activities** for improving functional ambulation.	1	Ashizawa et al. 2021
1b	**Agility exercise** may not have a difference in efficacy when compared to **stretching** for improving functional ambulation.	1	Marigold et al. 2005
1b	**Cross-training** may not have a difference in efficacy when compared to **conventional physiotherapy** for improving functional ambulation.	1	Park et al. 2021
1a	**Early rehabilitation programs** may not have a difference in efficacy when compared to **conventional therapy or rehabilitation programs of various times** for improving functional ambulation.	6	Wu et al. 2020b; Yen et al. 2020; Langhorne et al. 2017; Bernhardt et al. 2016; Bernhardt et al. 2015; Wade et al. 1992
2	**Physical therapy** may not have a difference in efficacy when compared to **no treatment** for improving functional ambulation.	1	Werner et al. 1996
1a	**Custom exercise programs** may not have a difference in efficacy when compared to **conventional therapy** for improving functional ambulation.	5	Swank et al. 2020; Askim et al. 2018; Askim et al. 2010; Allen et al. 2009; Werner et al. 2002
1b	**Aerobic and resistance training** may not have a difference in efficacy when compared to **aerobic training** for improving functional ambulation.	1	Mazolini et al. 2018
1a	**Higher intensity training** may not have a difference in efficacy when compared to **lower intensity training or conventional care** for improving functional ambulation.	9	Giellesvik et al. 2021; Reynolds et al. 2021; Klassen et al. 2020; Hornby et al. 2019; Boyne et al. 2019; Boyne et al. 2016; Hornby et al. 2016; Hesse et al. 2011; Langhammer et al. 2009
2	**Closed-chain exercise** may not have a difference in efficacy when compared to **open-chain exercise or standard rehabilitation** for improving functional ambulation.	1	Krawczyk et al. 2014

1b	**Aerobic exercise with cognitive training** may not have a difference in efficacy when compared to **nonaerobic exercise with unstructured mental activities or sham** for improving functional ambulation.	2	Koch et al. 2020; Yeh et al. 2019
1b	**Virtual reality exercise program** may not have a difference in efficacy when compared to **customized physiotherapy or conventional physiotherapy** for improving functional ambulation.	1	Cannell et al. 2017
1a	**Increased duration of exercise** may not have a difference in efficacy when compared to **conventional care/exercise** for improving functional ambulation.	4	Klassen et al. 2020; Hesse et al. 2011; Glasgow Group 2004; Patridge et al. 2000
1a	**Community-based physical activity** may not have a difference in efficacy when compared to **no intervention** for improving functional ambulation.	2	Marsden et al. 2010; Green et al. 2002
1a	**Community-based exercise programs** may not have a difference in efficacy when compared to **other care** for improving functional ambulation.	3	Stuart et al. 2019; Harrington et al. 2010; Olney et al. 2006
1b	**Falls prevention programs** may not have a difference in efficacy when compared to **usual care** for improving functional ambulation.	1	Batchelor et al. 2012
1a	There is conflicting evidence about the effect of **community-based exercise program** to improve functional ambulation when compared to **upper extremity exercise program.**	2	Dean et al. 2012; Pang et al. 2005
1b	**Body weight shift technique** may produce greater improvements in functional ambulation when compared to **conventional therapy.**	1	Krishna et al. 2018
1b	**Aerobic and resistance training** may produce greater improvements in functional ambulation when compared to **conventional care.**	1	Lee et al. 2015
2	**Sling exercise therapy** may produce greater improvements in functional ambulation when compared to **conventional therapy.**	1	Lou et al. 2019

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Leisure-time physical activity** may not have a difference in efficacy when compared to **nonleisure-time physical activity** for improving functional mobility.	1	Ashizawa et al. 2011
1a	**Early rehabilitation programs** may not have a difference in efficacy when compared to **conventional therapy or rehabilitation programs of various times** for improving functional mobility.	1	Yelnik et al. 2017; Wade et al. 1992

1a	**Custom exercise programs** may not have a difference in efficacy when compared to **conventional therapy** for improving functional mobility.	2	Swank et al. 2020; Sackey et al. 2015
1a	**Increased duration of exercise** may not have a difference in efficacy when compared to **conventional care/exercise** for improving functional mobility.	3	Hesse et al. 2011; Glasgow Group 2004; Patridge et al. 2000
1b	**Community-based physical activity** may produce greater improvements in functional mobility when compared to **no intervention.**	1	Green et al. 2002
1a	**Community-based exercise programs** may not have a difference in efficacy when compared to **other care** for improving functional mobility.	2	Stuart et al. 2019; Harrington et al. 2010

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	**Bodyweight shift techniques** may not have a difference in efficacy when compared to **conventional rehabilitation** for improving balance.	1	Krishna et al. 2018
1b	**Agility-focused exercise** may not have a difference in efficacy when compared **stretching** for improving balance.	1	Marigold et al., 2005
1b	**Cross training** may not have a difference in efficacy when compared to **conventional physiotherapy** for improving balance.	1	Park et al. 2021
1a	**Early rehabilitation programs** may not have a difference in efficacy when compared to **conventional therapy or rehabilitation programs of various times** for improving balance.	5	Yen et al. 2020; Wu et al. 2020a; Wu et al. 2020b; Rahayu et al. 2019; Yelnik et al. 2017
1a	**Custom exercise programs** may not have a difference in efficacy when compared to **conventional therapy** for improving balance.	4	Medina-Rincon et al. 2019; Askim et al. 2018; Askim et al. 2010; Allen et al. 2009
2	**Closed-chain exercise** may not have a difference in efficacy when compared to **open-chain exercise or standard rehabilitation** for improving balance.	1	Krawczyk et al. 2014
1b	**Virtual reality exercise program** may not have a difference in efficacy when compared to **customized physiotherapy or conventional physiotherapy** for improving balance.	1	Cannell et al. 2017
1a	**Increased duration of exercise** may not have a difference in efficacy when compared to **conventional care/exercise** for improving balance.	3	Klassen et al. 2020; Hesse et al. 2011; Patridge et al. 2000
1a	**Higher intensity training** may not have a difference in efficacy when compared to **lower intensity training or conventional care** for improving balance.	4	Gjellesvik et al. 2021; Hornby et al. 2019; Hornby et al. 2016; Langhammer et al. 2009

1b	**Community-based physical activity** may not have a difference in efficacy when compared to **no intervention** for improving balance.	1	Green et al. 2002
1a	**Community-based exercise program** may not have a difference in efficacy when compared to **other care** for improving balance.	2	Stuart et al. 2019; Harrington et al. 2010
1a	**Community-based exercise program** may not have a difference in efficacy when compared to **upper extremity exercise program** for improving balance.	2	Dean et al. 2012; Pang et al. 2005
1b	**Falls prevention program** may not have a difference in efficacy when compared to **usual care** for improving balance.	1	Batchelor et al. 2012
1b	There is conflicting evidence about the effect of **aerobic and resistance training** to improve balance when compared to **conventional care.**	1	Lee et al. 2015
1b	There is conflicting evidence about the effect of **high-intensity functional exercise program** to improve balance when compared to **education.**	1	Holmgren et al. 2010
1b	There is conflicting evidence about the effect of **non-paretic side motor training** to improve balance when compared to **conventional therapy.**	1	Pandian et al. 2014
1b	**Neurorestoration protocol physiotherapy** may produce greater improvements in balance when compared to **conventional therapy.**	1	Rahayu et al. 2020
2	**The use of physiotherapy equipment** may produce greater improvements in balance when compared to **conventional therapy.**	1	Gul et al. 2021
2	**Physical therapy** may produce greater improvements in balance when compared to **no treatment.**	1	Hoseinbadi et al. 2013
1b	**Sling exercise therapy** may produce greater improvements in balance when compared to **conventional therapy.**	2	Liu et al. 2020; Lou et al. 2019
2	**Skating exercises** may produce greater improvements in balance when compared to **treadmill training.**	1	Soh et al. 2020

GAIT

LoE	Conclusion Statement	RCTs	References
1b	**Body weight shift technique** may produce greater improvements in gait when compared to **conventional therapy.**	1	Krishna et al. 2018
1b	**Agility-focused exercise** may produce greater improvements in gait when compared to **stretching.**	1	Marigold et al., 2005
2	**Open chain kinetic exercise** may produce greater improvements in gait when compared to **no treatment.**	1	Lee et al. 2013

2	**Sling exercise therapy** may produce greater improvements in gait when compared to **conventional therapy.**	1	Lou et al. 2019
2	**High repetitive weight bearing exercises** may produce greater improvements in gait when compared to **low repetitive weight bearing exercises.**	1	Agarwal et al. 2008
2	**Closed chain exercise** may not have a difference in efficacy when compared to **open chain or standard rehabilitation** for improving gait.	1	Krawczyk et al., 2014; Lee et al. 2013
1a	**Higher intensity training** may not have a difference in efficacy when compared to **lower intensity training or conventional care** for improving gait.	2	Hornby et al. 2019; Hornby et al. 2016
2	**Skating exercises** may produce greater improvements in gait when compared to **treadmill training.**	1	Soh et al. 2020

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1b	**Neurorestoration protocol physiotherapy** may produce greater improvements in activities of daily living when compared to **conventional physiotherapy.**	1	Rahayu et al. 2020
1b	**Non-paretic side motor training** may produce greater improvements in performance on activities of daily living when compared to **conventional therapy.**	1	Pandian et al. 2014
2	**Range of motion exercise by themselves** may produce greater improvements in activities of daily living when compared to **conventional therapy.**	1	Tseng et al. 2007
2	**Range of motion exercise with physical help** may produce greater improvements in activities of daily living when compared to **conventional therapy.**	1	Tseng et al. 2007
2	**Physical therapy** may produce greater improvements in performance on activities of daily living when compared to **no treatment.**	2	Hoseinbadi et al. 2013; Werner et al. 1996
1b	**Occupational therapy** may produce greater improvements in performance on activities of daily living when compared to **no treatment.**	1	Logan et al. 2004
1b	There is conflicting evidence about the effect of **self-regulation rehabilitation** to improve activities of daily living when compared to **conventional therapy.**	1	Liu et al. 2014
1b	There is conflicting evidence about the effect of **sling exercise therapy** to improve activities of daily living when compared to **conventional therapy.**	2	Liu et al. 2020; Lou et al. 2019
2	**Leisure time physical activity** may not have a difference in efficacy when compared to **nonleisure time physical activity** for improving activities of daily living.	1	Ashizawa et al. 2021

2	**Range of motion with physical help** may not have a difference in efficacy when compared to **range of motion exercise by themselves** for improving performance on activities of daily living.	1	Tseng et al. 2007
1b	**Early rehabilitation programs** may not have a difference in efficacy when compared to **conventional therapy or rehabilitation programs of various times** for improving performance on activities of daily living.	16	Xu et al. 2022; Wang et al. 2021; Liu et al. 2021; Wu et al. 2020a; Wu et al. 2020b; Yu et al. 2020; Yen et al. 2020; Rahayu et al. 2019; Pan 2018; Yelnik et al. 2017; Langhorne et al. 2017; Bernhardt et al. 2016; Bernhardt et al. 2015; Bai et al. 2012; Fang et al. 2003; Wade et al. 1992
1a	**Custom exercise programs** may not have a difference in efficacy when compared to **conventional therapy** for improving performance on activities of daily living.	5	Swank et al. 2020; Xia et al. 2020; Askim et al. 2018; Sackey et al. 2015; Askim et al. 2010
1b	**Aerobic exercise with cognitive training** may not have a difference in efficacy when compared to **nonaerobic exercise with unstructured mental activities or sham** for improving performance on activities of daily living.	1	Yeh et al. 2019
1b	**Virtual reality exercise program** may not have a difference in efficacy when compared to **customized physiotherapy or conventional physiotherapy** for improving performance on activities of daily living.	1	Cannell et al. 2017
1b	**High intensity functional exercise program** may not have a difference in efficacy when compared to **education** for improving performance on activities of daily living.	1	Holmgren et al. 2010
1a	**Increased duration of exercise** may not have a difference in efficacy when compared to **conventional care/exercise** for improving performance on activities of daily living.	2	Hesse et al. 2011; Glasgow Group 2004
1b	**Higher intensity training** may not have a difference in efficacy when compared to **lower intensity training or conventional care** for improving performance on activities of daily living.	4	Gjellesvik et al. 2021; Langhammer et al. 2009; Langhammer et al. 2007; Sivenius et al. 1985
1b	**Community-based physical activity** may not have a difference in efficacy when compared to **no intervention** for improving performance on activities of daily living.	1	Green et al. 2002
1a	**Community-based exercise program** may not have a difference in efficacy when compared to **other care** for improving performance on activities of daily living.	2	Harrington et al. 2010; Olney et al. 2006
1a	**Community-based exercise program** may not have a difference in efficacy when compared to **upper extremity exercise program** for improving performance on activities of daily living.	2	Dean et al. 2012; Pang et al. 2005

1b	**Falls prevention program** may not have a difference in efficacy when compared to **usual care** for improving performance on activities of daily living.	1	Batchelor et al. 2012

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Range of motion exercise by themselves** may produce greater improvements in range of motion when compared to **conventional therapy.**	1	Tseng et al. 2007
1b	**Range of motion exercise with physical help** may produce greater improvements in range of motion when compared to **conventional therapy.**	1	Tseng et al. 2007
1b	The **range of motion exercise with physical help** may not have a difference in efficacy when compared to **range of motion exercise by themselves** for improving range of motion.	1	Tseng et al. 2007
2	The **open-chain exercises** may not have a difference in efficacy when compared to **closed-chain exercises** for improving range of motion.	1	Krawczyk et al. 2014

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Aerobic and resistance training** may not have a difference in efficacy when compared to **aerobic training** for improving muscle strength.	1	Marzolini et al. 2018
2	**Aerobic exercise with cognitive training** may not have a difference in efficacy when compared to **nonaerobic exercise with unstructured mental activities or sham** for improving muscle strength.	1	Koch et al. 2020
1a	**Increased duration of exercise** may not have a difference in efficacy when compared to **conventional care/exercise** for improving muscle strength.	2	Klassen et al. 2020; Glasgow Group 2004
1b	**Community-based exercise program** may not have a difference in efficacy when compared to **other care** for improving muscle strength.	1	Olney et al., 2006
1a	There is conflicting evidence about the effect of **community-based exercise program** to improve muscle strength when compared to **upper extremity exercise program.**	2	Dean et al. 2012; Pang et al. 2005

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Physical therapy** may produce greater improvements in spasticity when compared to **no treatment.**	1	Hoseinbadi et al. 2013

1b	**Increased duration of exercise** may not have a difference in efficacy when compared to **conventional care/exercise** for improving spasticity.	1	Hesse et al. 2011
1b	**Higher intensity training** may not have a difference in efficacy when compared to **lower intensity training or conventional care** for improving spasticity.	1	Langhammer et al. 2009

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Custom exercise programs** may not have a difference in efficacy when compared to **conventional therapy** for improving stroke severity.	1	Allen et al. 2009
1b	There is conflicting evidence about the effect of **early rehabilitation programs** to improve stroke severity when compared to **conventional therapy or rehabilitation programs of various times.**	5	Liu et al. 2021; Wu et al. 2020b; Yu et al. 2020; Pan 2018; Fang et al. 2003

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Early rehabilitation programs** may not have a difference in efficacy when compared to **conventional therapy or rehabilitation programs of various times** for improving quality of life.	1	Yelnik et al. 2017
1b	**Occupational therapy** may not have a difference in efficacy when compared to **no treatment** for improving quality of life.	1	Logan et al. 2004
1a	**Custom exercise programs** may not have a difference in efficacy when compared to **conventional therapy** for improving quality of life.	6	Xia et al. 2020; Swank et al. 2020; Askim et al. 2018; Sackey et al. 2015; Askim et al. 2010; Allen et al. 2009
1b	**Aerobic exercise with cognitive training** may not have a difference in efficacy when compared to **nonaerobic exercise with unstructured mental activities or sham** for improving quality of life.	2	Koch et al. 2020; Yeh et al. 2019
1a	**Higher intensity training** may not have a difference in efficacy when compared to **lower intensity training or conventional care** for improving quality of life.	4	Gjellesvik et al. 2021; Reynolds et al. 2021; Hornby et al. 2019; Hornby et al. 2016
1a	**Community-based physical activity** may not have a difference in efficacy when compared to **no intervention** for improving quality of life.	2	Marsden et al. 2010; Green et al. 2002
1a	**Community-based exercise programs** may not have a difference in efficacy when compared to **other care** for improving quality of life.	3	Stuart et al. 2019; Harrington et al. 2010; Olney et al. 2006
1b	**Community-based exercise programs** may not have a difference in efficacy when compared to	1	Dean et al. 2012

	upper extremity programs for improving quality of life.		
1b	There is conflicting evidence about the effect of **sling exercise therapy** to improve quality of life when compared to **conventional therapy.**	1	Liu et al. 2020
2	**Physical therapy** may produce greater improvements in quality of life when compared to **no treatment.**	1	Werner et al. 1996
1b	**Increased duration of exercise** may produce greater improvements in quality of life when compared to **conventional care/exercise.**	1	Klassen et al. 2020
2	**Skating exercises** may produce greater improvements in quality of life when compared to **treadmill training.**	1	Soh et al. 2020

Key Points

Bodyweight shift techniques may be beneficial for improving functional ambulation and gait after stroke.

Range of motion exercises may be beneficial for improving activities of daily living and range of motion after stroke.

Custom exercise programs, early rehabilitations trainings, and exercise trainings with higher intensity and duration may not be beneficial in improving activities of daily living, quality of life, muscle strength, spasticity, stroke severity, and muscle strength after stroke.

Balance Training

Adapted from: https://www.flintrehab.com/regaining-balance-after-stroke/

Balance impairment is a common early symptom after stroke and is strongly associated with future recovery. Likewise, balance problems are the strongest predictors for future falls and related injuries (Lubetzky-Vilnai & Kartin, 2010). Multiple interventions have aimed to improve balance in multi-faceted approaches. Many balance-focused rehabilitation strategies employ visual feedback to facilitate improvements in symmetrical weight bearing and posture. Recently, technological approaches have expanded the quantity and quality of real-time feedback on balance performance. Feedback driven interventions for balance training include bodyweight supported training, fixed, supportive and perturbation-based balance platforms and trunk training.

A total of 71 RCTs were found evaluating balance training interventions for lower extremity motor rehabilitation. Four RCTs were found evaluating balance training vs conventional therapy (Battesha et al., 2022; Gok et al., 2008; Pollock et al., 2002; Puckree & Naidoo, 2014). One RCT compared task specific balance training to upper limb exercise (Pang et al., 2018). One RCT compared balance training with posture changes to balance training (Jiang et al., 2021). Two RCTs compared wobble board training to conventional physiotherapy (Madhuranga et al., 2019; Onigbinde et al., 2009). One RCT compared balance-focused exercise programs to at-home exercises (Curuk & Aruin, 2022). Four RCTs compared SMART Balance Master training to conventional rehabilitation (Chen et al., 2002; Geiger et al., 2001; Rao et al., 2013; Walker et al., 2000). Four RCTs compared non-supportive balance training with feedback to conventional therapy or balance training (Brunelli et al., 2020; Komiya et al., 2021; Maciaszek, 2018; Zhang et al., 2020). Eleven RCTs compared balance training with visual feedback to conventional therapy or balance training (De Nunzio et al., 2014; Ghomashchi, 2016; James & A, 2017; Ko et al., 2015; Lee et al., 2013e; Noh et al., 2019; Ordahan et al., 2015; Sackley & Lincoln, 1997; Varoqui et al., 2011; Yavuzer et al., 2006a; Yoon et al., 2013). Three RCTs compared standing practice to conventional therapy or balance training (Allison & Dennett, 2007; Inoue et al., 2021; Wong et al., 1997). Eleven RCTs compared perturbation balance training with feedback to conventional therapy or balance training (An et al., 2021; Chayasit et al., 2022; Dusane & Bhatt, 2022; Goljar et al., 2010; Handelzalts et al., 2019; Jung et al., 2021; Mansfield et al., 2018; Schinkel-Ivy et al., 2019; Thijs et al., 2021; Yadav et al., 2018; Yadav et al., 2019). Three RCTs compared balance training with visual deprivation to balance training (Bonan et al., 2004; Narendra B et al., 2013; Yelnik et al., 2008). Two RCTs compared balance training with kinesthetic ability training device to conventional rehabilitation (Alptekin et al., 2008; Gok et al., 2008). One RCT compared balance training with full rest periods to balance training with short rest periods (Elsner et al., 2018). One RCT compared balance training with muscle vibration to conventional rehabilitation (Merkert et al., 2011). Four RCTs compared balance training with biofeedback to balance training (Eser et al., 2008; Hung et al., 2017; Kim & Shin, 2022; Lupo et al., 2018). Two RCTs compared vestibular training to conventional therapy (Ekvall Hansson et al., 2020; Tramontano et al., 2018). Three RCTs compared robotic balance training to conventional therapy (De Luca et al., 2020; Inoue et al., 2022; Kumar et al., 2020). One RCT compared trampoline balance training to stable surface balance training (Miklitsch et al., 2013). One RCT compared ankle-foot orthosis with balance training to ankle-foot orthosis with regular footwear (Farmani et al., 2016). One RCT compared balance training with TENS to balance training with conventional care (Jung et al., 2016). One RCT compared balance training with shoe lift to balance training (Sheikh & Hosseini, 2021). Three studies compared strength or resistance training with balance training to conventional therapy (Sekhar et al., 2013; Vahlberg et al., 2017a; Vahlberg et al., 2017b). One RCT compared structured balance awareness to health awareness program (Shaik et al., 2021). One RCT compared balance training with fresnel prism glasses to balance and walking training (Ha & Sung, 2020). One RCT compared sensory balance training to robot-assisted chair climbing (Gandolfi et al., 2019). One RCT compared external focus on a balance board to internal focus on a balance board (Kal et al., 2019). One RCT compared Balance training or no balance training to a healthy control population (Lisinski et al., 2012). One RCT compared sitting balance training with sensory input to sitting balance training alone (Ibrahimi et al., 2010).

The methodological details and results of all 66 RCTs are presented in Table 11.

Table 11. RCTs Evaluating Balance Training for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Balance-Focused Exercise Programs vs Conventional Rehabilitation		
Battesha et al. (2022) RCT (6) NStart=30 NEnd=30 TPS=Chronic	E: Conventional Physical Rehabilitation + Maze Control C: Conventional Physical Rehabilitation Duration: 50min/d, 3d/wk, for 8wks	• Clinical Test of Sensory Interaction of Balance (+exp) • Knee Proprioception ○ In 15 degrees (-) ○ In 30 degrees (-) ○ In 75 degrees (+exp) • Risk of Falling (+exp)
Puckree et al. (2014) RCT (5) Nstart=50 Nend=50 TPS=Chronic	E: Outpatient community-based Balance and Stability focused rehabilitation C: Regular physiotherapy Duration: 30min/d, 1d/2wks, for 24wks	• Postural assessment scale for stroke patients (+exp) • Berg balance scale (+exp)

Gok et al. (2008)
RCT (6)
Nstart=30
Nend=30
TPS=Chronic
	E: Balance training with kinaesthetic ability training device + conventional rehabilitation
	C: Conventional rehabilitation
	D: 2-3h/d, 5d/wk, 4 wks
		• Fugl-Meyer Assessment
		  ○ Lower extremity (-)
		  ○ Balance (+exp)
		• Kinesthetic Ability Trainer (+exp)
		  ○ Static balance (+exp)
		  ○ Dynamic balance (+exp)
		• Functional Independence Measure
		  ○ Motor (-)
		  ○ Locomotion (-)

Pollock et al. (2002) RCT (3) Nstart=28 Nend=16 TPS=Subacute	E: Independent balance practice + conventional therapy C: Conventional therapy Duration: 5d/wk, 4wks	• Weight Distribution (-) • Balance (-)
Task Specific Balance Training vs Upper Limb Exercise		

Pang et al. (2018)
RCT (8)
NStart=84
NEnd=78
TPS=Chronic
	E1: Dual-task balance/mobility
	E2: Single-task balance/mobility
	C: Upper limb exercise
	Duration: 60min/d, 3d/wk, for 8wks
		E1 vs E2/C
		• Percent dual-task effect(%DTE) in walking time
		  ○ When forward walking + verbal fluency (+exp1)
		  ○ When forward walking + serial-3-subtractions (+exp1)
		  ○ When TUG + verbal fluency (+exp1)
		  ○ When TUG + serial-3-subtractions (-)
		• %DTE in correct response rate- all tasks (-)
		• Activities-specific balance confidence scale (-)
		• Frenchay Activities Index (-)
		• Stroke-specific Quality of Life Scale (-)
		E2 v C:
		• DTE%-all tasks (-)
		• DTE% in correct response rate-all tasks (-)
		• Activities-specific Balance Confidence Scale (-)
		• Frenchay Activities Index (-)
		• Stroke-specific Quality of Life Scale (-)

Balance Training with Posture Changes vs Balance Training		
Jiang et al. (2021) RCT (9) NStart=60 NEnd=57 TPS=Chronic	E1: Shoulder elevation posture change + balance training + Conventional training E2: Back posture change + balance training + Conventional training C: Conventional training + Balance training Duration: 30min/d, 5d/wk for 4wks	E1 vs C • EMG Test (+exp1) • Fugl-Meyer assessment (+exp1) • 10m Walk (+exp1) • Barthel index (-) E2 vs C • EMG Test (+exp2) • Fugl-Meyer assessment (-) • 10m Walk (-) • Barthel index (-) E1 vs E2 • EMG Test (+exp1) • Fugl-Meyer assessment (+exp1) • 10m Walk (+exp1) Barthel index (-)
Wobble Board Training vs Conventional Physiotherapy		

Madhuranga et al. (2019) RCT (6) NStart=30 NEnd=29 TPS=Chronic	E: Wobble board training + Conventional physiotherapy C: Conventional physiotherapy Duration: 50min/d, 2d/wk, for 6wks	• Four-Square Step Test (+exp) • Berg balance scale (+exp)
Onigbinde et al. (2009) RCT (4) Nstart=17 Nend=17 TPS= Not Reported	E: Wobble Board exercises + Conventional Therapy C: Conventional Therapy Duration: 6wks	• Static Balance ○ Eyes open (-) ○ Eyes closed (+exp) • Foursquare step test (+exp)
Balance-Focused Exercise Programs vs At-home Exercises		
Curuk & Aruin (2022) RCT crossover (6) NStart=6 NEnd=6 TPS=Chronic	E: Anticipatory postural adjustment and postural control exercises C: At-home self-guided general mobility exercise program Duration: 20-30 min, 5 sessions over 2wks, 1wk washout	• Activity-specific Balance Confidence Scale (-) • Mini-Balance Evaluation Systems test (-) • Postural adjustments Muscle onsets (+exp) • COP displacements (+exp)
Balance Training Using SMART Balance Master vs Conventional Rehabilitation		
Rao et al. (2013) RCT (5) Nstart=28 Nend=28 TPS=Acute	E: Balance training + postural control visual biofeedback (SMART Balance master) C: Conventional PT + balance training Duration: 60min/d, 5d/wk, 2wks + 30min/d, 1d/wk, 2wks conventional PT & 3session balance training/balance training with visual biofeedback with BWS	• Functional Independence Measure (-) • Fugl-Meyer Balance scores (-) • Fugl-Meyer lower extremity assessment (-)
Chen et al. (2002) RCT (4) Nstart=41 Nend=38 TPS=Subacute	E: Balance training + postural control visual biofeedback (SMART Balance master) C: Conventional rehabilitation Duration: Not Specified	• Dynamic balance (+exp) • Static balance (-) • Functional Independence Measure (-)
Geiger et al. (2001) RCT (5) Nstart=13 Nend=13 TPS=Subacute	E: Physical therapy + visual biofeedback (SMART Balance master forceplate) C: Physical therapy Duration: 50min/d, 2-3d/wk for 4wks	• Berg Balance Scale (-) • Timed Up & Go Test (-)
Walker et al. (2000) RCT (4) Nstart=54 Nend=46 TPS=Subacute	E1: Balance training + Visual feedback E2: Balance training + Verbal and tactile cues C: Conventional rehabilitation Duration: 30min/d, 5d/wk for 3-8wks Balance training, 120min/d, 5d/wk Conventional rehabilitation	<u>E1/E2 vs C</u> • Postural sway (-) • Berg Balance Scale (-) • Timed Up & Go Test (-) • 10-m Walk Test (-) <u>E1 vs E2</u> • Postural sway (-) • Berg Balance Scale (-) • Timed Up & Go Test (-) • 10-m Walk Test (-)
Non-Supportive Balance Trainers with Feedback vs Conventional Therapy or Balance Training		

Komiya et al. (2021) RCT (6) NStart=30 NEnd=27 TPS=Chronic	E: Balance exercises + Real-time position feedback system+ standard physical therapy C: Balance exercise using polyurethane mat + standard physical therapy Duration: 2min/d, 2d/wk for 6wks balance exercise & 2d/wk for 6wks physical therapy	• Isometric Muscle Strength Knee extension (-) • Short Physical Performance Battery (-) • Timed Up and Go Test (+exp) • Centre of Pressure trajectory length (-) • Modified Gait Efficacy Scale (+exp) • Falls Efficacy (-)
Brunelli et al. (2020) RCT (5) Nstart=32 Nend=24 TPS=Acute	E: Computerized balance training + conventional physiotherapy C: Conventional physiotherapy Duration: 80min/d, 5d/wk for 4wks	• Berg Balance Scale (+exp) • Tinetti Balance Scale (+exp) • Two minute walk test (+exp) • Barthel Index (-)
Zhang et al., (2020) RCT(5) Nstart=40 Nfinal=40 TPS= Subacute	E: Conventional balance training + visual balance training with Pro-kin system + Game training C: Conventional balance training Duration: 20min/d, 5d/wk for 3wks	• Berg Balance Scale (+exp) • Timed Up & Go Test (+exp) • Functional Ambulation Classification (+exp) • Barthel Index (+exp) • Pro-kin system parameters ○ Perimeter EO (+exp) ○ Ellipse area EO (+exp) ○ Perimeter EC (+exp) ○ Ellipse area EC (+exp)
Maciaszek. (2018) RCT (4) Nstart=20 Nend=20 TPS=Subacute	E: Posturographic platform biofeedback training C: Standard hospital treatment Duration: 15d	• One-leg standing test (+exp) • Timed Up & Go Test (+exp)
Balance Training with Visual Biofeedback vs Conventional Therapy or Balance Training		
Noh et al. (2019) RCT (8) NStart=24 NEnd=24 TPS=Subcute	E: 3D balance training using visual feedback + Conventional therapy C: Conventional therapy Duration: 30min/d conventional therapy & 30min/d space balance training, 5d/wk, for 4wks	• Berg Balance Scale (+exp) • Gait speed (+exp) • Cadence (+exp) • Step length (+exp) • Double-limb support period (+exp) • Activity-specific balance confidence (+exp)
James et al. (2017) RCT (6) Nstart=10 Nend=10 TPS=Acute	E: Gaming Assisted Visual feedback for balance training + Conventional therapy C: Balance training exercises + Conventional therapy Duration: 60min/d, 2sessions/d, 4d (8 sessions total)	• Berg Balance Scale (+exp) • AP-Postural sway (-) • Lat-Postural Sway (+exp) • Stance symmetry (+exp) • Active ankle ROM dorsiflexion (-) • Active ankle ROM plantarflexion (+exp) • Lateral reach test (-)
Ghomashchi (2016) RCT (3) Nstart=31 Nend=31 TPS=Chronic	E: Balance training using Biodex stability system + visual biofeedback C: Balance training Duration: 1hr/d, 3d/wk for 4wks	• Postural balance (-) • Centre of pressure (-)
Ordahan et al. (2015) RCT (4) Nstart=50 Nend=50	E: Balance training + postural control visual biofeedback + conventional rehabilitation C: Conventional rehabilitation	• Berg Balance Scale (+exp) • Timed Up & Go Test (+exp) • Functional Independence Measure (-)

TPS=Subacute	Duration: 20min/d, 5d/wk for 6wks Balance Training & 30min/d, 5d/wk, for 6wks Conventional Program	
Ko et al. (2015) RCT (4) Nstart=52 Nend=40 TPS=Acute	E: Space balance 3D training using visual feedback program + Conventional rehabilitation C: Conventional rehabilitation Duration: 30min/d, 5d/wk for 3wks	• Berg Balance Scale (-) • Timed Up & Go Test (-) • Postural Assessment Scale for Stroke (-)
De Nunzio et al. (2014) RCT (7) Nstart=37 Nend=37 TPS=Acute	E: Balance Platform Training with Audio-visual Feedback + Rehabilitation program C: Rehabilitation program + postural training with physiotherapy Duration: 60min, 6d/wk, for 2wks rehabilitation program & 30min of postural training	• Standing Balance Score (-) • Berg Balance Score (-) • Performance-Oriented Mobility Assessment (-) • Fullerton's Advanced Balance Scale (-) • Functional Independence Measure (-) • Centre of Pressure (-)
Lee et al. (2013e) RCT (4) Nstart=22 Nend=22 TPS=Chronic	E: Balance training + postural control visual biofeedback C: Conventional physiotherapy Duration: 60min/d, 5d/wk for 4wks	• Static balance (+exp) • Dynamic balance (+exp)
Yoon et al. (2013) RCT (2) Nstart=24 Nend=24 TPS=Chronic	E1: Balance training + self-controlled postural control visual biofeedback E2: Balance training + no control over postural control visual biofeedback C: Balance training Duration: 2d	<u>E1/E2 vs C:</u> • Postural sway:(+exp1, +exp2) <u>E1 vs E2:</u> • Postural Sway (+exp1)

Varoqui et al. (2011)
RCT (6)
Nstart=24
Nend=23
TPS=Subacute
	E1: Balance training + postural control visual biofeedback from unaffected side + physiotherapy
	E2: Balance training + postural control visual biofeedback from affected side +physiotherapy
	C: Stand-up task + physiotherapy
	Duration: 10min/session, 8session/28d
		<u>E1/E2 vs C</u>
		• Postural Assessment Scale for Stroke (-)
		• Berg Balance Scale (-)
		• modified Ashworth scale (-)
		• Motor weakness (-)
		• Functional Ambulation Category (-)
		• Functional Independence Measure
		    ○ Motor (+exp1, +exp2)
		    ○ Cognitive (-)

Yavuzer et al. (2006)
RCT (6)
Nstart=50
Nend=41
TPS=Chronic
	E: Force platform biofeedback balance training + Conventional rehabilitation
	C: Conventional rehabilitation
	Duration: 2-5hr/d, 5d/wk, for 8wks Conventional rehabilitation & 15min/d, 5d/wk for 3wks Balance training
		• Walking Velocity (-)
		• Cadence (-)
		• Step length (-)
		• Single-Support Time (-)
		• Step Length Asymmetry (-)
		• Single-support Time Asymmetry (-)
		• Pelvic Tilt (-)
		• Pelvis Obliquity (+exp)
		• Pelvic rotation (-)
		• Sagittal Plane Total Excursion
		    ○ Knee (-)
		    ○ Hip (-)

		○ Ankle (-) • Peak Hip Extensor Moment (-) • Peak Hip Abductor Moment (-) • Peak Knee Extensor Moment (-) • Peak Ankle Plantar Flexor Moment (-) • Vertical Ground Reaction Force (+exp)
Sackley & Lincoln (1997) RCT (6) Nstart=26 Nend=24 TPS=Subacute	E: Visual feedback + Nottingham Balance Platform training + physical therapy C: Sham visual feedback + Nottingham Balance Platform training + physical therapy Duration: 60min/d, 3d/wk, for 4wks	• Balance co-efficient (+exp) • Rivermead Motor assessment (+exp) ○ Leg and trunk (-) ○ Gross function (+exp) • Nottingham 10-point Activities of Daily Life scale (+exp) • Stance symmetry (+exp) • Sway (+exp)
Standing Practice vs Conventional Therapy		
Inoue et al. (2021) RCT (8) Nstart=52 Nend=52 TPS=Chronic	E: Standing exercise with weight shifting to the nonparetic side (on an inclined surface that was elevated 5 degrees to the nonparetic side) + Conventional physiotherapy C: Standing exercise with weight shifting to the nonparetic side (on a flat surface) + Conventional physiotherapy 30 exercises sessions/d for 5d interventions & 60min/session conventional physiotherapy	• Berg Balance Scale (-) • Posturographic examination ○ Static standing (-) ○ Maximum lateral weight shifting to nonparetic side (-) ○ Maximum lateral weight shifting to paretic side (-) • Stroke Impairment Assessment Set (-) • Trunk Control Test (-) • Trunk Impairment Scale (-) • Functional Ambulation Category (+exp) • Functional Independence Measure motor items (-)
Allison et al. (2007) RCT (8) Nstart=17Nend=14 TPS=Acute	E: Standing practice + Conventional therapy C: Conventional therapy Duration: 45min/d, 5d/wk for 2-4wks	• Berg Balance Scale (-) • Rivermead Motor Assessment (-) • Trunk Control Test (-)
Wong et al. (1997) RCT (5) Nstart=60 Nend=60 TPS=Acute	E: Standing practice + Force platform biofeedback C: Standing training table Duration: 60min/d, 5d/wk, for 3-4wks	• Postural symmetry (+exp)
Perturbation Balance Trainers with Feedback vs Conventional Therapy or Balance Training		
An et al. (2021) RCT (8) Nstart=30 Nend=30 TPS=Subacute	E: Whole-Body Tilting Postural Training (Visual feedback monitor + Trunk sensor + 8-direction body tilt + Spine balance 3D) C: General Postural Training Duration: 30min/session, 2sessions/d, 5d/wk, for 3wks	• Burke Lateropulsion Scale (+exp) • Postural Assessment Scale for Stroke (+exp) • Berg Balance Scale (+exp) • Korea-Modified Barthel Index (+exp) • Fugl-Meyer Assessment (+exp)
Jung et al. (2021) RCT (7) Nstart=24 Nend=24 TPS=Subacute	E: Space Balance 3D system for active trunk training + conventional physical and occupational therapy C: General trunk training + Conventional physical and occupational physiotherapy	• Trunk Impairment Scale (+exp) • Trunk Flexion muscle strength (+exp) • Trunk Extension muscle strength (+exp) • Static balance (+exp) • Brunel Balance Assessment (+exp)

	Duration: 30min/d, 5d/wk, for 3wks	
Thijs et al. (2021) RCT (8) Nstart=30 Nend=29 TPS=Chronic	E: Technology-supported sitting balance therapy + conventional therapy C: Conventional therapy Duration: 30-120min/d, 3d/wk, for 4wks usual care & 50min/d, 3-4d/wk, for 4wks (12 in total) sitting balance therapy	• Trunk Impairment Scale (+exp) • Modified Functional Reaching Test (-) • Functional Ambulation Categories (-) • 10 Metre Walk Test ○ Max speed (+exp) ○ Comfortable speed (-) • Two Minute Walk Test (-) • Fugl-Meyer Assessment of Lower Extremity (-) • Berg Balance Scale (+exp) • Functional Independence Measure (-) • Modified Barthel Index (-) • Trunk and leg strengths (-) • Modified Ashworth Scale (-)
Perturbation Balance Trainers vs Conventional Therapy or Balance Training		
Dusane & Bhatt (2022) RCT (5) Nstart=49 Nend=45 TPS=Chronic	E: Slip adaptation training on an overground perturbation system (8 unexpected overground, nonparetic-side gait-slips + 2 paretic-side slips) C: Slip adaptation training an overground perturbation system (2 paretic-side slips) Duration: single time	• Fall rate on exposure to slip (-) • Post slip centre of mass stability (-) • Post-slip stride length (-) • Backward loss of balance (-) • Slipping kinematics ○ Peak heel displacement (-) ○ Peak heel velocity (-)
Chayasit et al. (2022) RCT (5) Nstart=34 Nend=33 TPS=Chronic	E: Voluntary-induced stepping response (VSR) C: DynSTABLE perturbation training (DST) Duration: 60min, single session training	• Step length (-) • Step width (-) • COM position at the 1st stepping foot touchdown (+con)
Schinkel-Ivy et al. (2019) RCT (6) NStart=43 NEnd=16 TPS=Chronic	E: Perturbation-Based Balance Training C: Conventional care Duration: 60min/d, 2d/wk, for 6wks	• Reactive Stepping (-) • Frequency of extra steps (-) • Frequency of lateral steps (-) • Frequency of stepping with more affected limb (-) • Frequency of foot collisions (-) • Step Timing (-) • Foot-off time (-) • Swing time (-)
Handelzalts et al. (2019) RCT (6) Nstart=34 Nfinal=32 TPS=Subacute	E: Perturbation-based balance training + conventional care C: Weight shifting + Gait training without perturbation + conventional care Duration: 12 sessions, 30min/d, for 2.5wks	• Multistep threshold • Forward (+exp) • Backward (+exp) • Toward the paretic side (-) • Toward the non-paretic side (-) • Fall threshold (-) • Fugl-Meyer assessment Lower Extremity (-) • Berg balance scale (-) • 10m Walk test (-) • 6min Walk test (-) • Activity-specific Balance Confidence scale (-)
Yadav et al. (2019) RCT (4) Nstart=133 Nend=110	E1: Haemorrhagic Stroke Erigo Robotic Tilt Table E2: Ischemic Stroke Erigo Robotic Tilt Table	<u>E1 vs C1</u> • Manual Muscle Testing (-) • Modified Ashworth Scale (+exp)

TPS=Acute	C1: Haemorrhagic Stroke Conventional Care C2: Ischemic Stroke Conventional Care Duration: 50-60min, 6d/wk, 30d	• NIHSS (+exp) E2 vs C2 • Manual Muscle Testing (-) • Modified Ashworth Scale (-) • NIHSS (-)
Mansfield et al. (2018) RCT (8) Nstart=88 Nend =83 TPS=Chronic	E: Perturbation-based balance training C: Traditional balance training Duration: 60min/d, 2d/wk, for 6wks	• Fall rates (after 1 year) (-) • Berg balance scale (-) • Mini-Balance Evaluation Systems test (-) • Anticipatory balance control (-) • Reactive balance control (+exp) • Sensory orientation (+con) • Gait (-) • Timed Up & Go (-) • Activities-specific Balance Confidence (-) • Physical Activity Scale for Individuals with Physical Disabilities (-) • Subjective Index of Physical and Social Outcome (-)
Yadav et al. (2018) RCT (4) Nstart=30 Nend=30 TPS=Acute	E: Robotic Tilt table + Upper extremity exercises C: Conventional therapy Duration: 50-60min/d, 6d/wk, for 4wks	• SF-36 Quality of life (+exp) • Medical Research council Muscle scale (+exp)
Goljar et al. (2010) RCT (6) Nstart=44 Nend=39 TPS=Subacute	E: Balance trainer mechanical device + Conventional care C: Conventional balance training + Conventional care Duration: 45min/d, 5d/wk for 4wks	• Berg Balance Scale (-) • Timed Up and Go Test (-) • 10-metre walk test (-) • Single limb standing duration (-)
Balance Training with Visual Deprivation vs Balance Training with Visual Cues		

Narendra et al. (2013)
RCT (5)
Nstart=30
Nend=30
TPS=Not Reported
	E: Balance exercises with blindfold
	C: Balance exercises with free vision
	Duration: 45-60min/d, 5d/wk for 6wks
		• Berg Balance scale (+exp)
		• Stroke specific Quality of Life scale (-)
		  ○ Family role (-)
		  ○ Mobility (-)
		  ○ Self-care (-)
		  ○ Upper extremity
		  ○ Function/productivity (-)
		• Rivermead mobility index (-)

Yelnik et al. (2008) RCT (7) Nstart=68 Nend=67 TPS=Chronic	E: Balance training + Visual deprivation C: Conventional rehabilitation Duration: 45min/d, 5d/wk for 4wks	• Functional Independence Measure (+exp) • Berg Balance Scale (-) • Double stance phase (-) • 10-Meter Walk Test (-) • Timed stair climbing Test (-)
Bonan et al. (2004) RCT (7) Nstart=20 Nend=20 TPS=Chronic	E: Vision deprived balance rehabilitation C: Balance rehabilitation Duration: 60min/d, 5d/wk, for 4wks	• Sensory Organization Test (+exp) • Self-Assessed VAS – ease of gait (-) • Timed Stair Climbing (-) • Gait Velocity (-) • Nottingham Health Profile (-)
Balance Training with Kinesthetic Ability Training Device vs Conventional Rehabilitation		

Alptekin et al. (2008)
RCT (6)
Nstart=30
	E: Balance Training with a kinaesthetic ability training (KAT)	• Balance Index
		  ○ Static (+exp)
		  ○ Dynamic (+exp)

Nend=30 TPS=Chronic	device (postural control visual biofeedback) C: Conventional rehabilitation Duration: 20min/d, 5d/wk, for 4wks balance KAT training & 3-4hr/d, 5d/wk, for 4wks conventional rehabilitation	• Fugl-Meyer Assessment ○ Lower Extremity (-) ○ Balance (+exp) ○ Instrument (-) • Functional Independence Measure ○ Total Motor (-) ○ Locomotor (-)
Gok et al. (2008) RCT (6) Nstart=30 Nend=30 TPS=Chronic	E: Balance training with kinesthetic ability training device + conventional rehabilitation C: Conventional rehabilitation Duration: 2-3h/d, 5d/wk, for 4wks	• Fugl-Meyer Assessment ○ Lower extremity (-) ○ Balance (+exp) • Kinesthetic Ability Trainer ○ Static balance (+exp) ○ Dynamic balance (+exp) • Functional Independence Measure ○ Motor (-) ○ Locomotion (-)
Balance Training with Full Rest Periods vs Balance Training with Short Rest Periods		
Elsner et al. (2018) RCT (8) Nstart=20 Nend=20 TPS=Subacute	E: Full rest during Balance training C: Short rest during Balance training Duration: 2min/exercise for 7 exercises with either a 4-min rest or 1-min rest between exercises.	• One-leg standing time (-) • Tandem standing time (-)
Balance Training with Muscle Vibration vs Conventional Rehabilitation		
Merkert et al. (2011) RCT (3) Nstart=66 Nend=48 TPS =Acute	E: Vibrosphere (balance training + whole body vibration) + conventional geriatric rehabilitation. C: Conventional geriatric rehabilitation. Duration: 15 sessions of Vibrosphere training	• Berg Balance scale (-) • Functional test of Lower trunk stability (-) • Tinetti Gait test (-) • Timed Up and Go (-) • Mini-mental State examination (-) • Barthel index (-) ○ Transfer (+exp) ○ Dressing (+exp) ○ Feeding (+exp) ○ Walking (-) ○ Climbing stairs (-)
Balance Training with Biofeedback vs Balance Training		
Kim et al. (2022) RCT crossover (6) Nstart=24 Nend=24 TPS=Chronic	E1: Pressure sensor-based vibrotactile biofeedback E2: Visual biofeedback providing posture information C: Standing without biofeedback Duration: 3 sets of 30sec with 3min rest between sets/1d - 24h washout	E1 vs E2 • Sway Length (+exp1) • Sway Velocity (+exp1) • Weight-Distribution Symmetric Index (+exp1) E1/E2 vs C • Sway Length (+exp1, +exp2) • Sway Velocity (+exp1, +exp2) • Weight-Distribution Symmetric Index (+exp1, +exp2)
Lupo et al. (2018) RCT (7) Nstart=15 Nend=15 TPS=Subacute	E: Biofeedback Balance training (RIABLO training) C: Conventional balance training Duration: 20min/d, 3d/wk, 10 sessions total	• Berg Balance scale (+exp) • Rivermead mobility index (-) • Modified Barthel index (-) • NIH Stroke scale (+exp) • Canadian Neurological scale (-) • Centre of pressure (+exp)

Hung et al. (2017) RCT (7) Nstart=43 Nend=37 TPS=Chronic	E1: Wii Fit balance training E2: Tetrax biofeedback balance training C: Conventional weight-shifting training Duration: 30min/d, 2d/wk for 12wks	<u>E1/E2 vs C</u> • Berg Balance Scale (-) <u>E1 vs E2</u> • Berg Balance Scale (-)
Eser et al. (2008) RCT (5) Nstart=50 Nend=41 TPS=Chronic	E: Balance training + force platform biofeedback + Conventional rehabilitation C: Conventional rehabilitation Duration: 15min/d, 5d/wk, for 3wks Balance training & 5h/d, 5d/wk, for 8wks conventional care	• Brunnstrom Recovery Stage (-) • Rivermead Mobility Index (-) • Functional Independence Measure (-)
Vestibular Training vs Conventional Therapy		
Ekvall Hansson et al. (2020) RCT (7) Nstart=32 Nend=22 TPS=Chronic	E: Vestibular rehabilitation + Conventional therapy C: Conventional therapy Duration: 2sessions/wk, for 3mo	• Activity-specific Balance Confidence scale (-) • Berg Balance scale (-) • Functional Gait assessment (-) • EuroQOL-5D ○ Index (-) ○ Visual analog scale (-)
Tramontano et al. (2018) RCT (6) Nstart=25 Nend=25 TPS=Subacute	E: Standard physiotherapy + Vestibular rehabilitation (Gaze stability and postural control) C: Standard physiotherapy + balance (trunk stabilization) Duration: 2d/wk, for 4wks standard physiotherapy & 20min/d, 3d/wk, for 4wks rehabilitation sessions	• Functional Ambulation Classification (-) • Tinetti scale (+exp) ○ Balance (-) ○ Gait (+exp) • Berg Balance Scale (-) • Modified Barthel Index (-) • 10-Meter Walk Test (+exp) • Rivermead Motricity Index (-) • Stride frequency (-) • Stride length (+exp) • Coefficient of attenuation of acceleration between pelvis and head (-) • Improved harmonic ratio (-)
Robotic Balance Training vs Conventional Therapy		
Inoue et al. (2022) RCT (7) Nstart=60 Nend=57 TPS=Subacute	E1: Robotic balance training + conventional rehabilitation E2: Intensive balance training + conventional rehabilitation C: Conventional training Duration: E1/E2: 120-180min/d, 6d/wk, for 2wks conventional care + 18min/d, 6d/wk, for 2wks & C: 120-180min/d, 6d/wk, for 2wks conventional	<u>E1/E2 v C</u> • Mini-BEST (+exp1, +exp2) • Muscle strength (-) • Stroke Impairment Assessment set (-) • Maximum COP movement (-) • Functional Independence measure (-) • Functional Ambulation category (-) • Timed Up and Go (+exp1) • Falls efficacy scale-international (-) <u>E1 v E2</u> • Mini-BEST (+exp1) • Muscle strength (-) • Stroke Impairment Assessment set (-) • Maximum COP movement (-) • Functional Independence measure (-) • Functional Ambulation category (-) • Timed Up and Go (-)

		• Falls efficacy scale-international (-)
De Luca et al. (2020) RCT (6) Nstart=30 Nend=28 TPS=Chronic	E: Robot-assisted balance exercises C: Conventional care Duration: 45min, 3d/wk, for 5wks	• Berg Balance Scale (-) • Trunk Impairment Scale (-) • Mini-Balance Evaluation Test (-) • Static Balance Test (-) • Dynamic Balance test on unstable platform o Sway area (+exp) o Sway path (-) o Trunk total movement (+exp) o Variability-trunk (+exp) • Reactive Balance Test-changes of trunk oscillatory (-) • Proprioceptive control test (Reaching in standing position) o Number of targets (+exp) o Variability-trunk (+exp) o Normalized range mediolateral trunk (-) o Normalized range anteroposterior trunk (-) • Proprioceptive control test (Reaching in Sitting position) o Number of targets (+exp) o Variability-trunk (+exp) o Normalized range mediolateral trunk (+exp) o Normalized range anteroposterior trunk (+exp) • Sit to stand (-)
Kumar et al. (2020) RCT (4) Nstart=133 Nend=110 TPS=Acute	E: Robotic tilt table (Erigo) therapy C: Conventional physiotherapy Duration: 50-60min/d, 6d/wk, 30d	• SF-36 (+exp) • Manual Muscle Testing (+exp)
Trampoline Balance Training vs Stable Surface Balance Training		
Miklitsch et al. (2013) RCT (8) Nstart=40 Nend=40 TPS=Chronic	E: Predefined mini-trampoline balance training + individualized physiotherapy C: Balance training on stable surface + individualized physiotherapy Duration: 30min/session, 10sessions/3wks	• Berg Balance Scale (+exp) • Timed Up and Go test (-) • 6-minute walk test (-) • Barthel Index (-)
Ankle-Foot orthosis + Balance Training Shoes vs Ankle-Foot Orthosis + Regular Shoes		
Farmani et al. (2016) RCT (4) Nstart=30 Nend=30 TPS=Chronic	E: Solid Ankle-foot orthosis, then Rocker shoes C: Solid Ankle-foot orthosis, then Regular shoes Duration: Not reported	• Timed Up and Go (+exp) • Timed Up Stairs test (-) • Timed Downstairs test (-) • 10MWT at preferred speed (+exp) • Oxygen uptake (+exp)
Balance Training + TENS vs Balance Training + Conventional Care		
Jung et al. (2016) RCT (7) Nstart=61 Nend=60 TPS=Subacute	E1: Weight-shifting exercise + TENS + Conventional care E2: Weight-shifting training + Placebo TENS + Conventional care C: Conventional care	E1 vs C • Muscle Activity o External Oblique (+exp1) o External Spinae (+exp1) • Maximum Reaching Distance (+exp1) • Trunk Impairment Scale (+exp1)

	Duration: 30min/d, 5d/wk, for 6wks intervention sessions + 60min/d, 5d/wk, for 6wks conventional care	○ Dynamic Sitting balance (+exp1) ○ Coordination (+exp1) ○ Static Sitting Balance (-) E2 vs C • Muscle Activity ○ External Oblique (+exp2) ○ External Spinae (-) • Maximum Reaching Distance (+exp2) • Trunk Impairment Scale (+exp2) ○ Dynamic Sitting Balance (+exp2) ○ Coordination (+exp2) ○ Static Sitting Balance (-) E1 vs E2 • Muscle Activity ○ External Oblique (+exp1) ○ External Spinae (-) • Maximum Reaching Distance (+exp1) • Trunk Impairment Scale (+exp1) ○ Dynamic Sitting Balance (-) ○ Coordination (+exp1) ○ Static Sitting Balance (-)
Balance Training with Shoe Lift vs Balance Training		
Sheikh & Hosseini. (2021) RCT (8) Nstart=36 Nend=36 TPS=Chronic	E: Balance training with shoe lift under nonaffected leg C: Balance training alone Duration: 60min/d, 5d/wk, for 6wks balance training & 6wks wearing shoe lift for all daily activities	• Weight-bearing asymmetry (+exp) • RMS of AP COP asymmetry index (+exp) • RMS of ML COP asymmetry index (-) • Berg Balance Scale (-) • Activities-specific Balance Confidence Scale (-)
Strength or Resistance Training with Balance Training vs Conventional Therapy		
Vahlberg et al. (2017a) RCT (7) Nstart=43 Nend=43 TPS=Chronic	E: Progressive resistance + balance training and motivational session C: Usual activity Duration: 75min/d, 2d/wk, for 12wks	• Bergs Balance Scale (-) • Body Mass Index (-) • Fat-free Mass Index (-) • Fat Mass Index (-) • Fat-mass Percent (+exp) • Physical Activity Scale for the Elderly (-) • Six-minute Walking (+exp) • Short Physical Performance Test (-) • Chair Rise 5times (-) • Plasma Albumin (-) • Plasma Total Cholesterol (-) • Plasma HDL And LDL Cholesterol (-) • Serum IGF-1 (+exp) • Plasma CRP (-)
Vahlberg et al. (2017b) RCT (8) Nstart=67 Nend=57 TPS=Chronic	E: Progressive resistance + balance training and motivational session C: Usual activity Duration: 75min/d, 2d/wk, for 12wks	• Berg Balance Scale (+exp) • Short Physical Performance Battery (-) • Six-Minute Walk Test (+exp) • 10 Meter Walk Test (+exp) • Euro-QoL-5D (-) • Fall-Related Self-Efficacy Scale (-) • Geriatric Depression Scale (-) • Physical Activity Scale for the Elderly (-)

Sekhar et al. (2013)
RCT (5)
Nstart=40
Nend=40
TPS=Not Reported
	E: Isokinetic strength training + balance exercises
	C: Conventional physiotherapy
	Duration: 6wks
		• Isokinetic peak torque
		  ○ 30° (+exp)
		  ○ 60° (+exp)
		  ○ 90° (+exp)
		• Berg balance scale (+exp)

Structured Balance Awareness vs Health Awareness Program		
Shaik et al. (2021) RCT (5) Nstart=97 Nend=82 TPS=Chronic	E: Structured Balance awareness program + Balance training C: Health awareness program + Balance training Duration: 30min/d, 5d/wk for 8wks Specific interventions & 30min/d, 5d/wk for 8wks - Balance training	• Activities-specific Balance Confidence scale (+exp) • Berg Balance scale (+exp) • Falls-efficacy scale-International (+exp)
Balance Training with Fresnel Prism Glasses vs Balance and Walking Training		

Ha & Sung (2020)
RCT (4)
Nstart=23
Nend=17
TPS=Chronic
	E: Balance training + walking training + Fresnel prism glasses
	C: Balance training + walking training
	Duration: 30min/d, 5d/wk, for 4wks
		• Motor-free visual perception test (-)
		• Berg Balance Scale (+exp)
		• Functional reach test (+exp)
		• Gait
		  ○ Step count (+exp)
		  ○ Ambulation time (+exp)
		  ○ Velocity (+exp)
		  ○ Cadence (-)
		  ○ Step time (-)
		  ○ Cycle time (-)
		  ○ Swing time (-)
		  ○ Stance time (-)
		  ○ Double support time (+exp)
		  ○ Step length (+exp)
		  ○ Stride length (+exp)
		  ○ Single support of cycle (-)
		  ○ Double support of cycle (+exp)

Sensory Balance Training vs Robot-assisted Stair Climbing		

Gandolfi et al. (2019)
RCT (8)
Nstart=32
Nend=28
TPS=Chronic
	E: Robot-assisted stair climbing training (G-EO System)
	C: Sensory integration balance training
	Duration: 50min/session, 2d/wk, for 5wks
		• Berg Balance Scale (-)
		• 10-metre Walk test (-)
		• 6min Walk test (+exp)
		• Dynamic gait index (-)
		• Stair climbing test
		  ○ Up (-)
		  ○ Down (-)
		• Timed Up and Go (-)
		• Postural sway (-)
		• Centre of Pressure perimeter
		  ○ Open eyes-stable surface (-)
		  ○ Closed eyes-stable surface (+exp)
		  ○ dome-stable surface (-)
		  ○ Open eyes-compliant surface (-)
		  ○ Closed eyes-compliant surface (+exp)
		  ○ Dome-compliant surface (+exp)
		• Centre of Pressure sway area
		  ○ Open eyes-stable surface (-)
		  ○ Closed eyes-stable surface (-)
		  ○ dome-stable surface (-)
		  ○ Open eyes-compliant surface (+exp)
		  ○ Closed eyes-compliant surface (-)

		○ Dome-compliant surface (+exp)
Sitting Balance Training with Sensory Input vs Sitting Balance		
Ibrahimi et al. (2010) RCT (4) Nstart=30 Nend=30 TPS=Subacute	E: Sitting balance training under varied sensory input C: Sitting balance training without sensory input Duration: 20-30min/d, 5d/wk, for 2wks	• Berg Balance Scale (+exp) • Stroke Specific Quality of Life Questionnaire (+exp) • Motor Assessment Scale ○ Sitting (+exp) ○ Sit to Stand (+exp)
External vs Internal focus on Balance Board		
Kal et al. (2019) RCT (8) Nstart=63 Nend=51 TPS=Acute	E1: External focus on balance board task E2: Internal focus on balance board task Duration: 3d/wk, for 3wks	• Threshold stiffness (-) • Single-task sway (+exp1) • Dual-task sway (-) • Single task Timed Up and Go Test (-) • Dual-task Timed Up and Go Test (-) • Utrecht Scale for Evaluation of Rehabilitation, Mobility (-)
Balance Training vs No Training		
Lisinski et al. (2012) RCT (6) Nstart=26 Nend=26 TPS=Chronic	E1: Balance training on Metitur Good Balance Platform E2: No balance training C: Healthy controls (able-bodied) Duration: 20-day balance training	E1 vs C • Weight Symmetry (+exp1) • Centre of Feet Pressure Sway Velocity ○ Medio-lateral Direction (+exp1) ○ Anterior-posterior Direction Eyes Open and Closed (-) ○ Anterior-posterior Tandem Position (+exp1) E2 vs C • Weight symmetry (-) • Centre of Feet Pressure Sway Velocity ○ Medio-lateral Direction (+exp2) ○ Anterior-posterior Direction Eyes Open and Closed (-) ○ Anterior-posterior Tandem Position (+exp2)
Vestibular rehabilitation vs Convectional treatment		
Balci et al. (2013) RCT (6) N_{start}=25 N_{end}=25 TPS=Acute	E1: Vestibular rehabilitation (consisted of eye-head coordination exercises, balance and ambulation exercises) E2: Visual feedback: Posturography Training C: Usual Home Exercise Duration: 10min, 2-3sessions/d (20-30min/d), for 6wks vestibular rehabilitation and & 25-30min, 3d/wk, for 6wks visual feedback training & 20-30min/d, for 6wks usual home exercise	E2 vs E1 vs C • Berg Balance scale (-) • Timed Up and Go test (-) • Dizziness Handicap Inventory (-) • Dynamic Gait Index (-) • Centre of gravity (-)
Dai et al. (2013) RCT (6) N_{start}=55 N_{end}=48 TPS=Subacute	E: Vestibular rehabilitation + Conventional rehabilitation C: Conventional rehabilitation Duration: 30min/d, 5d/wk for 2wks VR supervised by a nurse,	• Functional Independence measure (-) • Postural Assessment scale for Stroke (-) • Number of falls (-) • Behavioral Inattention Test Conventional (-)

	then 30min/d, 5d/wk for 2wks at-home VR supervised by a care giver & 2hr/d, 5d/wk for 4wks conventional rehabilitation	

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Balance Training

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Shoulder elevation posture change with balance training** may produce greater improvements in motor function when compared to **back posture change with balance training.**	1	Jiang et al. 2021
1a	There is conflicting evidence about the effect of **balance training with visual biofeedback** when compared to **conventional therapy or balance training** for improving motor function.	2	Varoqui et al. 2011; Sackley & Lincoln 1997
1a	There is conflicting evidence about the effect of **perturbation balance training with feedback** when compared to **conventional therapy or balance training** for improving motor function.	2	An et al. 2021; Thijs et al. 2021
1b	There is conflicting evidence about the effect of **balance-focused exercise programs** when compared to **conventional therapy** for improving motor function.	1	Gok et al. 2008
1b	There is conflicting evidence about the effect of **balance training with posture changes** when compared to **conventional therapy** for improving motor function.	1	Jiang et al. 2021
1a	**Balance training with a kinesthetic ability training device** may not produce greater improvements in motor function when compared to **conventional therapy.**	2	Alptekin et al. 2008; Gok et al. 2008
1b	**Perturbation balance training** may not have a difference in efficacy when compared to **conventional therapy or balance training** for producing greater improvements in motor function.	1	Handelzalts et al. 2019
1b	**Standing practice** may not produce greater improvements in motor fuction when compared to **conventional therapy.**	1	Allison et al. 2007
2	**SMART Balance Trainers with feedback** does not have a difference in efficacy when compared to **conventional therapy** for improving motor function.	1	Rao et al. 2013

2	**Balance training with biofeedback** may not produce greater improvements in motor function when compared to **balance training alone.**	1	Eser et al. 2008

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Strength or resistance training with balance training** may produce greater improvements in functional ambulation when compared to **conventional therapy.**	2	Vahlberg et al. 2017a; Vahlberg et al. 2017b
1b	**Shoulder elevation posture change with balance training** may produce greater improvements in functional ambulation when compared to **back posture change with balance training.**	1	Jiang et al. 2021
1b	**Balance exercise with biofeedback** may produce greater improvements in functional ambulation when compared to **balance exercise alone.**	1	Komiya et al. 2021
1b	**Standing practice** may produce greater improvements in functional ambulation when compared to **conventional therapy.**	1	Inoue et al. 2021
2	**Non-supportive balance trainers with biofeedback** may produce greater improvements in functional ambulation when compared to **conventional therapy or balance training.**	3	Brunelli et al. 2020; Zhang et al. 2020; Maciaszek 2018
2	**Balance training with fresnel prism glasses** may produce greater improvements in functional ambulation when compared to **balance and walking training.**	1	Ha & Sung 2020
1b	There is conflicting evidence about the effect of **balance training with postural changes** when compared to **conventional therapy** for improving functional ambulation	1	Jiang et al. 2021
1b	There is conflicting evidence about the effect of **vestibular training** when compared to **conventional therapy** for improving functional ambulation.	1	Tramontano et al. 2018
2	There is conflicting evidence about the effect of **Ankle-foot orthosis with balance training shoes** when compared to **ankle-foot orthosis with regular shoes** for improving functional ambulation.	1	Farmani et al. 2016
1a	**Balance training with visual biofeedback** may not produce greater improvements in functional ambulation when compared to **conventional therapy or balance training alone.**	5	Noh et al. 2019; Ko et al. 2015; Ordahan et al. 2015; Varoqui et al. 2011; Yavuzer et al .2006
1a	**Perturbation balance trainers** may not produce greater improvements in functional ambulation when compared to **conventional therapy or balance training.**	3	Handelzalts et al. 2019; Mansfield et al. 2018; Goljar et al. 2010
1a	**Balance training with visual deprivation** may not produce greater improvements in functional	2	Yelnik et al. 2018; Bonan et al. 2004

	ambulation when compared to **balance training alone.**		
1a	**Robotic balance training** may not produce greater improvements in functional ambulation when compared to **conventional therapy or balance training alone.**	2	Inoue et al. 2022; De Luca et al. 2020
1b	**Perturbation balance trainers with biofeedback** may not produce greater improvements in functional ambulation when compared to **conventional therapy or balance training.**	1	Thijs et al. 2021
1b	**Trampoline balance training** may not produce greater improvements in functional ambulation when compared to **stable surface balance training.**	1	Miklitsch et al. 2013
1b	**Sensory balance training** may not produce greater improvements in functional ambulation when compared to **robot-assisted stair climbing**.	1	Gandolfi et al. 2019
1b	**External focus on a balance board** may not produce greater improvements in functional ambulation when compared to **internal focus on a balance board.**	1	Kal et al. 2019
2	**Balance training using the SMART balance master** may not produce greater improvements in functional ambulation when compared to **conventional therapy.**	2	Geiger et al. 2001; Walker et al. 2000
2	**Balance training with muscle vibration** may not produce greater improvements in functional ambulation when compared to **conventional therapy.**	1	Merkert et al. 2011

GAIT

LoE	Conclusion Statement	RCTs	References
1b	**Arial Balance training with shoe lift** may produce greater improvements in gait when compared to **balance training alone.**	1	Sheikh & Hosseini 2021
2	**Standing practice with biofeedback** may produce greater improvements in gait when compared to **standing practice alone.**	1	Wong et al. 1997
1a	There is conflicting evidence about the effect of **balance training with visual biofeedback** when compared to **conventional therapy or balance training** for improving gait.	4	Noh et al. 2019; James et al. 2017; Yavuzer et al. 2006; Sackley & Lincoln 1997
1a	**Perturbation balance trainers** may not produce greater improvements in gait when compared to **conventional therapy or balance training.**	4	Chayasit et al. 2022; Dusanne & Bhatt 2022; Schinkel-Ivy et al. 2019; Mansfield et al. 2018
1a	**Vestibular training** may not produce greater improvements in gait when compared to **conventional therapy.**	2	Ekvall Hansson et al. 2020; Tramontano et al. 2018.

1b	**Sensory balance training** may not produce greater improvements in gait when compared to **robot-assisted stair climbing.**	1	Gandolfi et al. 2019
1b	**Balanced training with visual deprivation** may not have a difference in efficacy when compared to **balance training alone** for improving gait.	1	Yelnik et al., 2008
2	**Balance training with fresnel prism glasses** may not produce greater improvements in gait when compared to **balance and walking training.**	1	Ha & Sung 2020

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Balanced-focused exercise** may have a difference in efficacy when compared to **conventional rehabilitation** for improving balance.	3	Battesha et al. 2022; Pucktree et al. 2014; Gok et al. 2008; Pollock et al. 2002
1a	**Balance training with biofeedback** may produce greater improvements in balance when compared to **balance training alone.**	3	Kim et al. 2022; Lupo et al. 2018; Hung et al. 2017
1a	**Perturbation balance trainers with feedback** may produce greater improvements in balance when compared to **conventional therapy or balance training alone.**	3	An et al. 2021; Jung et al. 2021; Thijs et al. 2021
1a	**Balance training with kinesthetic ability training devices** may produce greater improvements in balance when compared to **conventional therapy.**	2	Alptekin et al. 2008; Gok et al. 2008
1b	**Wobble board training** may produce greater improvements in balance when compared to **conventional therapy.**	2	Madhuranga et al. 2019; Oniqbinde et al. 2009
1b	**Balance training with transcutaneous electrical nerve stimulation** may produce greater improvements in balance when compared to **balance training alone or conventional therapy.**	1	Jung et al. 2016
1b	**Trampoline balance training** may produce greater improvements in balance when compared to **stable surface balance training.**	1	Miklitsch et al. 2013
2	**Structured balance awareness** may produce greater improvements in balance when comapred to **health awareness programs.**	1	Shaik et al. 2021
2	**Non-supportive balance trainers with feedback** may produce greater improvements in balance when compared to **conventional therapy or balance training.**	3	Brunelli et al. 2020; Zhang et al. 2020; Maciaszek 2018
2	**Balance training with fresnel prism glasses** may produce greater improvements in balance when compared to **balance and walking training.**	1	Ha & Sung 2020
2	**Sitting balance training with sensory input** may produce greater improvements in balance when comapred to **sitting balance training.**	1	Ibrahimi et al. 2010

1a	There is conflicting evidence about the effect of **strength or resistance training with balance training** when compared to **conventional therapy** for producing greater improvements in balance.	3	Vahlberg et al. 2017a; Vahlberg et al. 2017b; Sekhar et al. 2013
1a	There is conflicting evidence about the effect of **balance training with visual deprivation** when compared to **balance training alone** for producing greater improvements in balance.	3	Narendra et al. 2013; Yelnik et al. 2008; Bonan et al. 2004
1b	There is conflicting evidence about the effect of **balance-focused exercise programs** when compared to **at-home exercises** for producing greater improvements in balance.	1	Curuk & Aruin 2022
1a	**Perturbation balance trainers** may not produce greater improvements in balance when compared to **conventional therapy or balance training.**	5	Chayasit et al. 2022; Dusane & Bhatt 2022; Handelzalts et al. 2019; Mansfield et al. 2018; Goljar et al. 2010
1a	**Robotic balance training** may not produce greater improvements in balance when compared to **intensive balance therapy or conventional therapy.**	2	Inoue et al. 2022; De Luca et al. 2020
1a	**Standing practice** may not produce greater improvements in balance when compared to **conventional therapy.**	2	Inoue et al. 2021; Allison et al. 2007
1a	**Vestibular training** may not produce greater improvements in balance when compared to **conventional therapy.**	2	Ekvall Hansson et al. 2020; Tramontano et al. 2018
1a	**Balance training with visual biofeedback** may not produce greater improvements in balance when compared to **conventional therapy or balance training alone.**	10	Noh et al. 2019; James et al. 2017; Ghomashchi 2016; Ko et al. 2015; Ordahan et al. 2015; De Nunzio et al. 2014; Lee et al. 2013; Yoon et al. 2013; Varoqui et al. 2011; Sackley & Lincoln 1997
1b	**Balance exercise with feedback** may not produce greater improvements in balance when compared to **balance exercise alone.**	1	Komiya et al. 2021
1b	**Arial balance training with shoe lift** may not produce greater improvements in balance when compared to **balance training alone.**	1	Sheikh & Hosseini 2021
1b	**Sensory balance training** may not produce greater improvements in balance when compared to **robot-assisted stair climbing.**	1	Gandolfi et al. 2019
1b	**External focus on a balance board** may not produce greater improvements in balance when compared to **internal focus on a balance board.**	1	Kal et al. 2019
1b	**Balance training with full rest periods** may not produce greater improvements in balance when compared to **balance training with short rest periods.**	1	Elsner et al. 2018.

1b	**Dual-task specific balance training** may not produce greater improvements in balance when compared to **single-task specific balance training or upper limb exercises.**	1	Pang et al. 2018
2	**Balance training with muscle vibration** may not produce greater improvements in balance when compare to **conventional therapy.**	1	Merkert et al. 2011
2	**SMART Balance Trainers with feedback** may not have a difference in efficacy when compared to **conventional therapy** for improving balance.	3	Chen et al. 2002; Geiger et al. 2001; Walker et al. 2000
1a	**Galvanic vestibular rehabilitation** may not have a difference in efficacy compared **conventional rehabilitation** for improving balance.	2	Balci et al., 2013; Dai et al., 2013

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Balance exercise with feedback** may improve performance of activities of daily living when compared to **balance exercise alone.**	1	Komiya et al. 2021
1b	**Balance training with visual deprivation** may improve performance of activities of daily living when compared to **balance training alone.**	1	Yelnik et al. 2008
2	**Sitting balance training with sensory input** may not improve performance of activities of daily living when compared to **sitting balance training alone.**	1	Ibrahimi et al. 2010
1a	There is conflicting evidence about the effect of **perturbation-based balance training with feedback** when compared to **balance training or conventional therapy** for improving performance on activities of daily living.	2	An et al. 2021; Thijs et al. 2021
2	There is conflicting evidence about the effect of **non-supportive balance trainers with feedback** when compared to **conventional therapy or balance training** for improving performance of activities of daily living.	2	Brunelli et al. 2020; Zhang et al. 2020
1a	**Strength or resistance training with balance training** may not improve performance of activities of daily living when compared to **conventional therapy.**	2	Vahlberg et al. 2017a; Vahlberg et al. 2017b
1a	**Balance training with visual biofeedback** may not have a difference in efficacy when compared to **conventional therapy or balance training** for improving performance on activities of daily living.	4	Ordahan et al. 2015; De Nunzio et al. 2014; Varoqui et al. 2011; Sackley & Lincoln 1997
1a	**Balance training with a kinesthetic ability training device** may not improve performance of activities of daily living when compared to **conventional rehabilitation.**	2	Alptekin et al. 2008; Gok et al. 2008
1b	**Robotic balance training** may not improve performance of activities of daily living when	1	Inoue et al. 2022

	compared to **intensive balance training or conventional therapy**		
1b	**Standing practice** may not improve performance of activities of daily living when compared to **conventional therapy.**	1	Inoue et al. 2021
1b	**Balance training with posture changes** may not improve performance of activities of daily living when compared to **conventional therapy.**	1	Jiang et al. 2021
1b	**Balance training with biofeedback** may not improve performance of activities of daily living when compared to **balance training alone.**	2	Lupo et al. 2018; Eser et al. 2008
1b	**Perturbation balance trainers** may not improve performance of activities of daily living when compared to **conventional therapy or balance training.**	1	Mansfield et al. 2018
1b	**Dual-task specific balance training** may not improve performance of activities of daily living when compared to **single-task specific balance training or upper limb exercise.**	1	Pang et al. 2018
1b	**Vestibular training** may not improve performance of activities of daily living when compared to **conventional therapy.**	1	Tramontano et al. 2018
1b	**Trampoline balance training** may not improve performance of activities of daily living when compared to **stable surface balance training.**	1	Miklitsch et al. 2013
1b	**Balance-focused exercise programs** may not improve performance of activities of daily living when compared to **conventional therapy.**	1	Gok et al. 2008
2	**SMART Balance Trainers with feedback** does not have a difference in efficacy when compared to **conventional therapy** for improving performance on activities of daily living.	2	Rao et al. 2013; Chen et al. 2002
2	**Balance training with muscle vibration** may not improve performance of activities of daily living when compared to **conventional therapy**	1	Merkert et al. 2011

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	There is conflicting evidence about the effect of **perturbation-based balance trainers** when compared to **conventional therapy or balance training** for improving spasticity.	1	Yadav et al. 2019
1b	**Perturbation balance trainers with feedback** may not produce greater improvements in spasticity when compared to **conventional therapy or balance training.**	1	Thijs et al. 2021
1b	**Training with visual biofeedback** may not produce greater improvements in spasticity when compared to **conventional therapy.**	1	Varoqui et al. 2011

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Strength or resistance training with balance training** may produce greater improvements in muscle strength when compared to **conventional therapy.**	1	Sekhar et al. 2013
2	There is conflicting evidence about the effect of **perturbation-based balance trainers** when compared to **balance training or conventional therapy** for improving muscle strength.	1	Yadav et al. 2019; Yadav et al. 2018
1a	**Perturbation balance trainers with feedback** may not produce greater improvements in muscle strength when compared to **conventional therapy or balance exercise.**	2	Jung et al. 2021; Thijs et al. 2021
1b	**Balance exercise with feedback** may not produce greater improvements in muscle strength when compared to **balance exercise alone.**	1	Komiya et al. 2021
1b	**Robotic balance training** may not produce greater improvements in muscle strength when compared to **conventional therapy.**	2	Inoue et al. 2022; Kumar et al. 2020

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **perturbation-based balance training** when compared to **balance training or conventional therapy** for improving stroke severity.	1	Yadav et al. 2019
1b	There is conflicting evidence about the effect of **balance training with biofeedback** when compared to **balance training alone** for improving stroke severity.	1	Lupo et al. 2018
1b	**Robotic balance training** may not produce greater improvements in stroke severity when compared to **conventional therapy.**	1	Inoue et al. 2022
1b	**Standing practice** may not produce greater improvements in stroke severity when compared to **conventional therapy.**	1	Inoue et al. 2021

PROPRIOCEPTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **robotic balance training** when compared to **conventional therapy** for improving proprioception.	1	De Luca et al. 2020
1b	**Balance-focused exercise programs** may not produce greater improvements in proprioception when compared to **conventional therapy**	1	Battesha et al. 2022

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Dual-task balance training** may produce greater improvements in functional mobility when compared to **single-task balance training or upper limb exercise.**	1	Pang et al. 2018
1a	**Strength or resistance training with balance training** may not produce greater improvements in functional mobility when compared to **conventional therapy.**	2	Vahlberg et al. 2017a; Vahlberg et al. 2017b
1b	**Balance exercise with feedback** may not produce greater improvements in functional mobility when compared to **balance exercise.**	1	Komiya et al. 2021
1b	**Balance training with biofeedback** may not produce greater improvements in functional mobility when compared to **balance training alone.**	2	Lupo et al. 2018; Eser et al. 2008
1b	**Single-task balance training** may not produce greater improvements in functional mobility when compared to **upper limb exercise.**	1	Pang et al. 2018
1b	**Vestibular training** may not produce greater improvements in functional mobility when compared to **conventional therapy.**	1	Tramontano et al. 2018
2	**Balance training with visual deprivation** may not produce greater improvements in functional mobility when compared to **balance training alone.**	1	Narendra et al. 2013

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Perturbation balance trainers** may produce greater improvements in quality of life when compared to **conventional therapy or balance training alone.**	1	Yadav et al. 2018
2	**Robotic balance training** may produce greater improvements in quality of life when compared to **conventional therapy.**	1	Kumar et al. 2020
2	**Sitting balance training with sensory input** may produce greater improvements in quality of life when comapred to **sitting balance training alone.**	1	Ibrahimi et al. 2010
1b	**External focus on a balance board** may not produce greater improvements in quality of life when compared to **internal focus on a balance board.**	1	Kal et a. 2019
1b	**Dual-task specific balance training** may not produce greater improvements in quality of life when compared to **single-task specific balance training or upper limb exercise.**	1	Pang et al. 2018
1b	**Balance training with visual deprivation** may not produce greater improvements in quality of life when compared to **balance training alone.**	2	Narendra et al. 2013; Bonan et al. 2004

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **training with visual biofeedback** when compared to **conventional therapy or balance training** for improving range of motion.	1	James et al. 2017

Key points

Balance focused exercise training may not be beneficial for improving motor function activities of daily living, spasticity, muscle strength, stroke severity, proprioception, and functional mobility after stroke.

Balance training with visual feedback may not be beneficial for improving functional ambulation, balance, and activities of daily living compared to balance training alone or conventional treatment.

The literature is mixed concerning the effect of balance focused exercise training in improving functional ambulation, gait, balance, and quality of life after stroke, and the effect varies by combination of balance training with other interventions.

Galvanic vestibular rehabilitation may not be beneficial for improving balance after stroke.

Dynamic Stretching (Pilates, Tai Chi, Yoga)

Adopted from: https://www.medicalnewstoday.com/articles/318160.php

Stretching exercise performed during dynamic activities such as pilates, yoga, and tai chi or during proprioceptive neuromuscular facilitation aims to reduce hypertonicity post-stroke. Prevention of hypertonicity may reduce the risk for development of contracture while improving the range of motion of the joint and stability of the whole-body. Most stretching activities are of relatively low physical impact and low cost. From a fitness standpoint, they focus on flexibility, balance, coordination and muscle endurance (Donahoe-Fillmore & Grant, 2019). Given these attributes, dynamic stretching could provide an alternative therapy to improve lower extremity rehabilitation. In addition, these practices have non-physical benefits. It has been reported that yoga can increase mental health outcomes and contribute to a higher overall quality of life (Büssing et al., 2012). Stretching activities are also benefiting from the addition of technology as evidenced by the use of VR and ankle stretching robotics.

A total of 33 RCTs were found evaluating stretching and mobilization interventions for lower extremity motor rehabilitation. Two RCTs were found evaluating functional stretching or mobilization programs compared to conventional or no therapy (Ghasemi et al., 2018; Pradines et al., 2019). Two RCTs compared mobilization to conventional therapy or placebo (An & Jo, 2017; Kim & Lee, 2018b). Two RCTs compared very early mobilization with standard care (Bernhardt et al., 2008; Cumming et al., 2011). Two RCTs compared mobilization with or without stretching to conventional mobilization or stretching (Cho & Park, 2020; Park et al., 2020b). One RCT compared mobilization with movement to static muscle stretching (Park et al., 2019a). One RCT compared mobilization with an incline board to conventional mobilization (Park et al., 2018). Nine RCTs compared dynamic stretching programs to conventional or no therapy (Au-Yeung et al., 2009; Chan & Tsang, 2017, 2018; Immink et al., 2014; Kim et al., 2015d; Lim et al., 2016; Schmid et al., 2012b; Song et al., 2021b; Zhao et al., 2022b). One RCT compared Dynamic stretching to SilverSneaker exercises or conventional therapy (Taylor-Piliae et al., 2014). Two RCTs compared body weight supported tai chi to conventional care (Huang et al., 2019; Yu et al., 2020b). One RCT compared early and late proprioceptive neuromuscular facilitation (Morreale et al., 2016). One RCT compared Baduanjin training with conventional exercise (Yuen et al., 2021). One RCT compared proprioceptive neuromuscular facilitation and custom exercises with custom exercises alone (Stern et al., 1970). One RCT compared proprioceptive neuromuscular facilitation with virtual reality to virtual reality of PNF alone (dos Santos et al., 2019). One RCT compared proprioceptive neuromuscular facilitation and functional electrical stimulation with proprioceptive neuromuscular facilitation (Shim et al., 2020). One RCT compared stretching in a supine position with stretching in a seated position (Fleuren et al., 2006). Two RCTs compared an ankle stretching robotic device to ankle stretching with a board (Yoo et al., 2019; Yoo et al., 2018). One RCT compared isotonic muscle stretching to healthy controls (Maynard et al., 2005). One RCT compared ankle range of motion training with no treatment (Rydwik et al., 2006).

The methodological details and results of all 33 RCTs are presented in Table 12.

Table 12. RCTs Evaluating Stretching or Mobilization Exercises for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Functional Stretching vs Conventional Therapy		
Pradines et al. (2019) RCT (6) Nstart=23 Nend=23 TPS=Chronic	E: Guided Self-rehabilitation Stretching Program C: Conventional Care Duration:10-3d/wk, 52 wks conventional PT 24.7min/d, 7d/wk, 52wks self-stretch	• Muscle architecture ○ Fascicle length in soleus muscle (+exp) ○ Soleus thickness (+exp) ○ Medial gastrocnemius thickness (+exp) • Tardieu scale-passive extensibility ○ Soleus (+exp) ○ Gastrocnemius (+exp) ○ Gluteus maximus (-) ○ Rectus femoris (+exp) • 10m Walk test (+exp)
Ghasemi et al. (2018) RCT (6) Nstart=30 Nend=28 TPS=Chronic	E: Functional stretch training C: Conventional physiotherapy Duration: 5min/d, 3d/wk, 4wks	• Modified Ashworth Scale (-) • Ankle Range of Motion (-) • Ten Meter Walk Test (-) • Timed Up-and Go (-)
Mobilization vs Conventional Therapy or Placebo		
Kim & Lee (2018) RCT (5) Nstart=33 Nend=30 TPS=Chronic	E: Weight-bearing-based mobilization with movement + physical therapy C: Weight-bearing with placebo mobilization with movement + physical therapy Duration: 5d/wk, for 4wks	• Ankle ROM (+exp) • Postural sway (+exp) • Static balance (+exp) • Timed Up and Go (+exp) • Dynamic Gait index (+exp)
An et al. (2017) RCT (6) Nstart=26 Nend=26 TPS=Chronic	E: Talocrural Mobilization with Movement (MWM) + Conventional Physiotherapy C: Conventional Physiotherapy Duration: 30min, 3d/wk, 5wks PT & 30min, 3d/wk, 5wks MWM	• Limit of Stability ○ Forward (+exp) ○ Backward (-) ○ Paretic (-) ○ Forward-paretic (+exp) • Ankle Strength ○ Plantarflexor (+exp) ○ Dorsiflexor (-) • Dorsiflexion-PROM (+exp) • Gait Cycle ○ Swing Phase (-) ○ Single Limb Support Phase (-)

		○ Double Limb Support Phase (-)
Early and Intense Mobilization vs Standard Care		
Cumming et al. (2011) RCT (8) Nstart=71 Nend=60 TPS=Acute	E: Very early and intense mobilization C: Standard stroke unit care with standard mobilization dose Duration: 14d or until discharge (whichever sooner)	• Barthel index (-) • Rivermead motor assessment (-)
Bernhardt et al. (2008) RCT (8) Nstart=71 Nend=65 TPS=Acute	E: Very early mobilization + Standard care C: Standard care Duration: 2sessions/d, 6d/wk for 2wks	• Scandinavian Stroke Scale (-) • Borg Perceived Exertion scale (-) • Mortality at 3mo (-)
Active Stretching vs Joint Mobilization		
Cho et al. (2020) RCT (6) Nstart=45 Nend=45 TPS=Chronic	E1: Joint mobilization E2: Active Stretching E3: Joint mobilization + active stretching Duration: 15min/d, 3d/wk, 6wks	E1 vs E3 • Cadence (+exp3) • Gait speed (+exp3) • Stride length (+exp3) • Passive ankle dorsiflexion ROM ○ Seated position (+exp3) ○ Supine position (-) E2 vs E3 • Cadence (-) • Gait speed (-) • Stride length (-) • Passive ankle dorsiflexion ROM ○ Seated position (+exp3) ○ Supine position (-)
Mobilization With Movement vs Muscle Stretching		
Park et al. (2020) RCT (7) Nstart=38 Nend=38 TPS=Chronic	E: Self-ankle mobilization with movement + Conventional physiotherapy (CT) C: Calf muscle stretching + Conventional physiotherapy (CT) Duration: 30min/d - Conventional care, 3d/wk for 4wks - Self ankle mobilization or Calf muscle stretching	• Ankle dorsiflexion passive range of motion (+exp) • Gait speed (+exp) • Cadence (+exp) • Stride length ○ Affected side (+exp) ○ Unaffected side (+exp) • Fall risk test (+exp)
Park et al. (2019) RCT (7) Nstart=20 Nend=20 TPS=Chronic	E: Mobilization with movement (MWM) + Conventional rehabilitation (CR) C: Static muscle stretching (SMS) + Conventional rehabilitation (CR) Duration: 30 min/d, 3d/wk, 4 wks (MWM & SMS) 30 min per session CT	• Dorsiflexion passive range of motion (-) • Static balance ability (+exp) • Berg Balance Scale (+exp) • Gait speed (-) • Cadence (+exp)
Mobilization With vs Without Incline Board		

Park et al. (2018) RCT (6) Nstart=28 Nend=28 TPS=Chronic	E1: Self-ankle mobilization + standard rehabilitation E2: Self-ankle mobilization with 10-degree inclined board + standard rehabilitation Duration: 30min/d standard rehabilitation & ~7min/d ankle exercises, 3d/wk, for 4wks	<u>E1 vs E2</u> • Ankle Passive ROM (+exp2) • Static Balance Ability (+exp2) • Berg Balance Scale (-) • Gait Speed (+exp2) • Cadence (+exp2) • Step Length ○ Affected side (+exp2) ○ Unaffected side (+exp2) • Modified Barthel Index-Korean (-)
Dynamic Stretching (Tai Chi, Yoga, Pilates) vs Conventional or No Therapy		
Zhao et al. (2022) RCT (8) Nstart=160 Nend=134 TPS=Subacute	E: Sitting Tai Chi program with home program C: Attention control (hospital-recommended upper limb movements) Duration: 40min/d, 3d/wk, 12wks	• Wolf-Motor Function Test (+exp) • Berg balance scale (+exp) • Trunk Impairment scale (+exp) • Shoulder Range of Motion (-) • Shoulder Pain (-) • Modified Barthel Index (+exp) • Stroke Specific Quality of Life (+exp)
Song et al. (2021) RCT (7) Nstart=34 Nend=29 TPS=Chronic	E: Tai Chi-based stroke rehabilitation program C: Stroke symptom management program Duration: 50min/d, 2d/wk, 24wks	• Montreal Cognitive Assessment (+exp) • Mini Mental State Examination (+exp) • knee flexion peak torque (+exp) • knee extension peak torque (-) • Berg Balance Scale (-) • Trunk Impairment Scale (-) • Functional Ambulation Category (+exp) • Modified Rankin Scale (-) • Modified Barthel Index (+exp) • Stroke-Specific Quality of Life (-) • Stroke Symptom Cluster Scale (-)
Chan & Tsang (2018) RCT (7) Nstart=47 Nend=42 TPS=Chronic	E1: Tai Chi E2: Conventional exercise C: No Treatment Duration: 1h/d, 2d/wk, for 12wks	<u>E1 vs E2 vs C</u> • Stroop Test (-) • Turn speed (-) • Dual task test (-)
Chan & Tsang (2017) RCT (6) Nstart=26 Nend=18 TPS=Chronic	E1: Tai Chi exercise group E2: Conventional exercises C: No treatment Duration: 1hr/session, 2d/wk for 12wks	<u>E1/E2 vs C</u> • Auditory stroop test (-) • Anteroposterior sway COP (-) • Mediolateral sway COP (-) • Sway velocity (-) <u>E2 vs E1</u> • Auditory stroop test (-) • Anteroposterior sway COP (-) • Mediolateral sway COP (-) • Sway velocity (-)
Lim et al. (2016) RCT (5) Nstart=19 Nend=19 TPS=Chronic	E: Pilates C: No therapy Duration: 60min/d, 3d/wk for 8wks	• Centre of pressure sway (+exp) • Centre of pressure velocity (+exp)
Kim et al. (2015d) RCT (5) Nstart=22 Nend=22 TPS=Chronic	E: Therapeutic Tai Chi + General PT C: General PT Duration: 60min/d, 2d/wk, 6wks Therapeutic Tai Chi & 60min/d, 10sessions/wk, 6wks General PT	• Static balance ○ Sway length (+exp) ○ Sway velocity (+exp) • Timed Up & Go Test (+exp) • Functional Reach Test (+exp) • 10-m Walking Test (+exp) • Dynamic Gait Index (+exp) • SF36 (+exp)

Immink et al. (2014)
RCT (6)
Nstart=25
Nend=22
TPS=Chronic
	E: Yoga (yoga asana and pranayama practices and Satyananda Yoga Nidra meditation)
	C: No treatment
	Duration: 90min/d, 1d/wk, 10 weeks in person group yoga, 35-45min/d, 6d/wk, 10wks home yoga
		• Motor assessment scale (-)
		• Berg balance scale (-)
		• 2-minute walk test
		  ○ Distance (-)
		  ○ Comfort speed (-)
		• Geriatric Depression Scalen (-)
		• State Anxiety Inventory (-)
		• Trait Anxiety Inventory (-)
		• Stroke Impact Scale (-)

Schmid et al. (2012a) RCT (6) Nstart=47 Nend=39 TPS=Chronic	E1: Group yoga E2: Group yoga + at-home yoga C: No therapy Duration: 60min/d, 2d/wk, 8wks	<u>E1 vs E2 vs C:</u> • Berg Balance Scale (-) • Activities-specific Balance Confidence Scale (-) • Stroke-Specific QoL scale (-)

Au-Yeung et al. (2009)
RCT (6)
Nstart=136
Nend=114
TPS=Chronic
	E: Tai Chi
	C: Conventional exercises
	Duration: 4hr (1hr group practice+ 3hr self-practice)/session, 1d/wk, 12wks
		• Limit of Stability Test (-)
		• Limit of Stability Test-Excursion (+exp)
		• Sensory Organization Test- Sensory ratio
		  ○ Somatosensory (-)
		  ○ Visual (-)
		  ○ Vestibular (+exp)
		• Timed Up & Go Test (-)

Dynamic Stretching vs SilverSneaker exercises vs Usual care		

Taylor-Piliae et al. (2014)
RCT (8)
Nstart=145
Nend=131
TPS=Chronic
	E1: Tai Chi
	E2: SilverSneakers exercises
	C: Usual care
	Duration: 60min/d, 3d/wk, 12wks Tai Chi/Silver Sneakers Exercise
		<u>E1/E2 v C</u>
		• Short Physical Performance Battery (-)
		  ○ Balance (-)
		  ○ Strength (-)
		  ○ Gait (-)
		• Fall rates (+exp1)
		• 2-minute step test (+exp1, +exp2)
		• SF-36 (-)
		• Pittsburgh Sleep Quality Index (-)
		<u>E1 v E2</u>
		• Short Physical Performance Battery (-)
		  ○ Balance (-)
		  ○ Strength (-)
		  ○ Gait (-)
		• Fall rates (-)
		• 2-minute step test (-)
		• SF-36 (-)
		• Pittsburgh Sleep Quality Index (-)

Body Weight Supported Dynamic Stretching vs Conventional Therapy		
Yu et al. (2020) RCT (8) Nstart=74 Nend=71 TPS=Chronic	E: Body weight supported Tai Chi + conventional rehabilitation C: Conventional rehabilitation Duration: 40min/d, 3d/wk, for 12wks	• Limit of Stability (-) • Gait cycle time (+exp) • Step velocity (-) • Step length (+exp) • Single support time (-) • Double support time (-) • Hip swing range (+exp) • Knee swing range (-) • Ankle range (-) • Berg Balance Scale (+exp) • Fugl-Meyer Assessment (+exp)
Huang et al. (2019) RCT (8)	E: Body Weight Supported Tai Chi	• Dynamic balance (-)

Nstart=28 Nend=25 TPS=Chronic	C: Conventional Care Duration: 40min/d, 3d/wk, 12wks	• Modified Clinical Test of Sensory Integration of Balance (Sway index of centre of gravity) ○ Firm surface (eye open/eye close) (+exp) ○ Foam surface (eye open) (+exp) ○ Foam surface (eye close) (-) • Fall risk index (+exp) • Fugl-Meyer Assessment (+exp)
Early vs late Proprioceptive Neuromuscular Facilitation (PNF)		
Morreale et al. (2016) RCT (7) Nstart=340 Nend=293 TPS=Acute	E1: Early (<24hrs post-admission) Proprioceptive Neuromuscular Facilitation E2: Early (<24hrs post-admission) Cognitive Therapeutic Exercises C1: Delayed (4 days post-admission) Proprioceptive Neuromuscular Facilitation C2: Delayed (4 days post-admission) Cognitive Therapeutic Exercises Duration: 12mos (2.15hrs/d inpatient, 1.3hrs, 5d/wk outpatient) 60min/d, 4d, then 135min/d, 55d, then 90min/d, 5d/wk, 38wks	E1 vs C1 • Modified Rankin Scale (-) • Barthel Index (-) • 6-Minute Walk Test (+exp1) • Motricity Index (+exp1) E2 vs C2 • Modified Rankin Scale (-) • Barthel Index (-) • 6-Minute Walk Test (+exp2) • Motricity Index (+exp2)
Baduanjin Training vs Conventional Exercise		
Yuen et al. (2021) RCT (7) Nstart=58 Nend=50 TPS=Chronic	E: Baduanjin training C: Conventional exercise training Duration: 50min/d, 3d/wk, 16wks	• Mini-Balance Evaluation Systems Test (+exp) • Limit of Stability Test (-) • Sensory Organization Test (+exp) • Five Times Sit to Stand (+exp) • Timed Up & Go (+exp) • Fall Efficacy Scale (-) • Modified Barthel Index (-) • Stroke-Specific Quality of Life (-)
Proprioceptive Neuromuscular Facilitation (PNF) vs Conventional Therapy		
Asghar et al. (2021) RCT (6) Nstart=60 Nend=60 TPS=Chronic	E: Proprioceptive Neuromuscular Facilitation (PNF) + Conventional Physical Therapy C: Conventional Physical Therapy Duration: 50min/d, 3d/wk, 6wks (40min PT + 10min PNF for intervention/ 50 min PT for control)	• Berg Balance Scale (+exp)
Proprioceptive Neuromuscular Facilitation (PNF) with Custom Exercises vs Custom Exercises Alone		
Stern et al. (1970) RCT (3) Nstart=62 Nend=62 TPS=Not Reported	E: Proprioceptive neuromuscular facilitation (PNF) program + custom exercises C: Custom exercises Duration: 75min/d, 5d/wk custom exercises & 40min/d, 5d/wk PNF	• Motility Index (-) • Kenny Self-Care Evaluation (-) • Leg muscle Strength (-)
Proprioceptive Neuromuscular Facilitation (PNF) with VR vs PNF or VR Alone		
Dos Santos Junior et al. (2019) RCT (6) Nstart=48	E1: Virtual Reality	E1 v E2 v C • Fugl-Meyer Assessment (-) ○ passive motion and pain (-)

Nend=40 TPS=Chronic	E2: Virtual Reality + Proprioceptive Neuromuscular Facilitation C: Proprioceptive Neuromuscular Facilitation Duration: 50min/d, 2d/wk, 8wks	○ sensory function (-) ○ upper limb motor function (-) ○ lower limb motor function (-) ○ balance (-)
Proprioceptive Neuromuscular Facilitation (PNF) with Electrical Stimulation vs PNF Alone		
Shim et al., 2020 RCT (4) Nstart=40 Nfinal=33 TPS= Chronic	E: Proprioceptive neuromuscular facilitation (PNF) trunk pattern + EMG-triggered FES C: proprioceptive neuromuscular facilitation (PNF) trunk pattern Duration: 30min/d, 5d/wk, 4wks	• Trunk impairment scale (-) • Berg balance scale (-) • Dynamic gait index (-)
Technology-Assisted Ankle Stretcher vs Stretching Board		
Yoo et al. (2019) RCT (4) Nstart=16 Nend=16 TPS=Chronic	E: Ankle stretching with Motorized Ankle Stretcher C: Ankle stretching with stretching board Duration: 40min/d, 2d/wk, 4wks	• Sensory Organization Test Condition 1 ○ Anterior posterior COP RMS (-) ○ Anterior posterior COP range (+exp) ○ COP area (-) • Sensory Organizational Test Condition 4 ○ Anterior posterior COP RMS (+exp) ○ Anterior posterior COP range(+exp) ○ COP area (+exp)
Yoo et al. (2018) RCT (4) Nstart=16 Nend=16 TPS=Chronic	E: Robotic ankle stretching exercises C: Conventional stretching board Duration: 30min/d, 2d/wk, for 3.5wks (7 sessions total)	• Ankle ROM (+exp) • Sensory organization test (+exp) • Walking speed (-) • Cadence (-) • Step Length affected (-) • Step Length unaffected (+exp)
Isotonic and Isokinetic Stretch		
Maynard et al. (2005) RCT (6) Nstart=87 Nend=87 TPS=Chronic	E1: Isotonic muscle stretch with weight bearing E2: Isotonic stretch without weight bearing E3: Isokinetic stretch C1: Healthy isotonic muscle stretch with weight bearing C2: Healthy isotonic stretch without weight bearing C3: Healthy isokinetic stretch Duration: 20min/d, 1d	E1/E2/E3 vs C1/C2/C3: • Kinematic Gait Parameters (-) • Kinetic Gait Parameters (-) • Spatio-Temporal Gait Parameters ○ Duration of Stance (-) ○ Duration of Swing (-) ○ Walking Speed (-)
Ankle Range of Motion Training vs No Treatment		
Rydwik et al. (2006) RCT (5) Nstart=18 Nend=16 TPS=Chronic	E: Stimulo-based ankle range of motion training C: No treatment Duration: 30min/d, 3d/wk, for 6wks	• Short Form-36 (-) • Functional Independence Measure (-) • Instrumental Activity Measure- Swedish (-) • 6-min Walk Test (-) • 10-m Walk Speed (-) • Timed Up and Go (-) • Romberg’s Test ○ Semi-Tandem Stance (-) ○ Tandem Stance (-) • Muscle Strength-LE ○ Dorsal Extension (-) ○ Plantar Extension (-) • Modified Ashworth Scale (-)
Stretching in a Supine Position vs Stretching in a Seated Position		

Fleuren et al. (2006) RCT Crossover (6) Nstart=20 Nend=19 TPS=Chronic	E: Strech flex activity in supine position C: Stretch flex activity in sitting position Duration: 3 tests done per position	• Pendulum test (+exp) • Ashworth Scale ○ Extensors (+exp) ○ Flexors (+con) • Muscle Activation by EMG (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Dynamic Stretching

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Body weight supported dynamic stretching** may produce greater improvements in motor function than **conventional rehabilitation**	2	Yu et al. 2020; Huang et al. 2019
1b	**Proprioceptive neuromuscular facilitation and VR** may not have a difference in efficacy in improving motor function when compared to **Proprioceptive neuromuscular facilitation or VR alone.**	1	Do Santos Junior et al. 2019
1b	**Very early mobilization** may not produce greater improvements in motor function when compared to **standard care.**	1	Cumming et al. 2011
2	**Proprioceptive neuromuscular facilitation with custom exercises** may not produce greater improvements in motor function when compared to **custom exercises alone.**	1	Stern et al. 1970

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Baduanjin training** may produce greater improvements in functional ambulation when compared to **conventional exercises.**	1	Yuen et al. 2021
1b	**Joint mobilization with active stretching** may produce greater improvements in functional ambulation when compared to **joint mobilization alone.**	1	Cho et al. 2020
1b	**Self-ankle mobilization with movement** may produce greater improvements in functional ambulation when compared to **calf muscle stretching.**	1	Park et al. 2020
1b	**Mobilization with an incline board** may produce greater improvements in functional ambulation when compared to **mobilization alone.**	1	Park et al. 2018

1b	**Early cognitive therapeutic exercises** may produce greater improvements in functional ambulation when compared to **delayed cognitive therapeutic exercises.**	1	Morreale et al. 2016
1b	**Early proprioceptive neuromuscular facilitation** may produce greater improvements in functional ambulation when compared to **delayed proprioceptive neuromuscular facilitation.**	1	Morreale et al. 2016
2	**Mobilization** may produce greater improvements in functional ambulation when compared to **conventional therapy.**	1	Kim & Lee. 2018
1a	There is conflicting evidence about the effect of **dynamic stretching** when compared to **conventional therapy** for improving functional ambulation.	5	Song et al. 2021; Chan & Tsang. 2018; Kim et al. 2015; Immink et al. 2014; Au-Yeung et al. 2009
1a	**Dynamic stretching** may not produce greater improvements in functional ambulation when compared to **conventional rehabilitation.**	2	Pradines et al. 2019; Ghasemi et al. 2018
1b	**Joint mobilization with active stretching** may not produce greater improvements in functional ambulation when compared to **active stretching alone.**	1	Cho et al. 2020
1b	**Body weight supported dynamic stretching** may not produce greater improvements in functional ambulation when compared to **conventional therapy.**	1	Yu et al. 2020
1b	**Mobilization with movement** may not produce greater improvements in functional ambulation when compared to **static muscle stretching.**	1	Park et al. 2019
1b	**Technology-assisted ankle stretching** may not produce greater improvements in functional ambulation when compared to **stretching board-assisted ankle stretching.**	1	Yoo et al. 2018
1b	**Isokinetic muscle stretching** may not produce greater improvements in functional ambulation of a stroke patient population when compared to **healthy controls.**	1	Maynard et al. 2005
2	**Ankle range of motion training** may not produce greater improvements in functional ambulation when compared to **no treatment.**	1	Rydwik et al. 2006

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	**Proprioceptive neuromuscular facilitation** may produce greater improvements in balance when compared to **conventional therapy.**	1	Asghar et al. 2021
1b	**Self-ankle mobilization with movement** may produce greater improvements in balance when compared to **calf muscle stretching.**	1	Park et al. 2020

1b	**Mobilization with movement** may produce greater improvements in balance when compared to **static muscle stretching.**	1	Park et al. 2019
1b	**Mobilization** may produce greater improvements in balance when compared to **conventional therapy.**	2	Kim & Lee 2018; An et al. 2017
2	**Technology-assisted ankle stretching** may produce greater improvements in balance when compared to **stretching with a stretching board.**	2	Yoo et al. 2018; Yoo et al. 2018
1a	There is conflicting evidence about the effect of **dynamic stretching** when compared to **conventional therapy** for improving balance.	9	Zhao et al. 2022; Song et al. 2021; Chan & Tseng 2017; Lim et al. 2016; Kim et al. 2015; Immink et al. 2014; Schmid et al. 2012; Au-Yeung et al. 2009
1a	There is conflicting evidence about the effect of **body eght supported dynamic stretching** when compared to **conventional therapy** for improving balance.	2	Yu et al. 2020; Huang et al. 2019
1b	There is conflicting evidence about the effect of **Baduanjin training** when compared to **conventional therapy** for improving balance.	1	Yuen et al. 2021
1b	There is conflicting evidence about the effect of **mobilization with an incline board** when compared to **mobilization alone** for improving balance.	1	Park et al. 2018
1b	**SilverSneaker exercises** may not produce greater improvements in balance when compared to **dynamic stretching or usual care.**	1	Taylor-Piliae et al. 2014
2	**Proprioceptive neuromuscular facilitation with functional electrical stimulation** may not produce greater improvements in balance when compared to **proprioceptive neuromuscular facilitation alone.**	1	Shim et al. 2020
2	**Ankle range of motion training** may not produce greater improvements in balance when compared to **no treatment.**	1	Rydwik et al. 2006

GAIT

LoE	Conclusion Statement	RCTs	References
1b	**Joint mobilization with active stretching** may produce greater improvements in gait when compared to **joint mobilization alone.**	1	Cho et al. 2020
1b	**Self-ankle mobilization with movement** may produce greater improvements in gait when compared to **calf muscle stretching.**	1	Park et al. 2020
1b	**Mobilization with movement** may produce greater improvements in gait when compared to **static muscle stretching.**	1	Park et al. 2019
1b	**Mobilization with an incline board** may produce greater improvements in gait when compared to **mobilization alone.**	1	Park et al. 2018

1b	**Dynamic stretching** may produce greater improvements in gait than **conventional rehabilitation**	1	Kim et al., 2015
1b	There is conflicting evidence about the effect of **body weight supported dynamic stretching** when compared to **conventional therapy** for improving gait.	1	Yu et al. 2020
1b	**Joint mobilization with active stretching** may not produce greater improvements in gait when compared to **active stretching alone.**	1	Cho et al. 2020
1b	**Mobilization** may not produce greater improvements in gait when compared to **conventional therapy.**	2	Kim & Lee 2018; An et al. 2017
1b	**Isotonic muscle stretching** may not produce greater improvements in a stroke patient population when compared to **healthy controls.**	1	Maynard et al. 2005
2	**Proprioceptive neuromuscular facilitation with functional electrical stimulation** may not produce greater improvements in gait when compared to **proprioceptive neuromuscular facilitation alone.**	1	Shim et al. 2020
2	**Motorized ankle stretching** may not have a difference in efficacy when compared to **ankle stretching boards** for improving gait.	1	Yoo et al. 2018

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1a	**Dynamic stretching** may not have a greater impact on the performance of activities of daily living when compared to **conventional therapy.**	3	Zhao et al. 2022; Song et al. 2021; immink et al. 2014
1b	**Baduanjin training** may not have a greater impact on the performance of activities of daily living when compared to **conventional therapy.**	1	Yuen et al. 2021
1b	**Mobilization with an incline board** may not have a difference in efficacy for improving performance on activities of daily living when compared to **mobilization alone**.	1	Park et al. 2018
1b	**Early proprioceptive neuromuscular facilitation** may not have a difference in efficacy when compared to **delayed proprioceptive neuromuscular facilitation for** producing greater improvements in performance on activities of daily living.	1	Morreale et al. 2016
1b	**Very early mobilization** may not have a greater impact on the performance of activities of daily living when compared to **standard care.**	1	Cumming et al. 2011
2	**Ankle range of motion training** may not have a greater impact on the performance of activities of daily living when compared to **no treatment.**	1	Rydwik et al. 2006
2	**Proprioceptive neuromuscular facilitation with custom exercises** may not have a greater impact on	1	Stern et al. 1970

	the performance of activities of daily living when compared to **custom exercises alone.**		

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Self-ankle mobilization with movement** may produce greater improvements in range of motion when compared to **calf muscle stretching.**	1	Park et al. 2020
1b	**Mobilization** may produce greater improvements in range of motion when compared to **conventional therapy.**	2	Kim & Lee 2018; An et al. 2017
1b	**Mobilization with an incline board** may produce greater improvements in range of motion when compared to **mobilization alone.**	1	Park et al. 2018
2	**Technology-assisted ankle stretching** may produce greater improvements in range of motion when compared to **stretching with a stretching board.**	1	Yoo et al. 2018
1b	There is conflicting evidence about the effect of **joint mobilization with active stretching** when compared to **joint mobilization or active stretching** for improving range of motion.	1	Cho et al. 2020
1b	**Dynamic stretching** may not produce greater improvements in range of motion when compared to **conventional therapy.**	1	Zhao et al. 2022
1b	**Body weight supported dynamic stretching** may not produce greater improvement in range of motion when compared to **conventional therapy.**	1	Yu et al. 2020
1b	**Mobilization with movement** may not produce greater improvements in range of motion when compared to **static muscle stretching.**	1	Park et al. 2019
1b	**Functional stretching** may not produce greater improvements in range of motion when compared to **conventional therapy.**	1	Ghasemi et al. 2018

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Functional stretching** may produce greater improvements in muscle strength when compared to **conventional therapy.**	1	Pradines et al. 2019
1b	**Early proprioceptive neuromuscular facilitation** may produce greater improvements in muscle strength when compared to **delayed proprioceptive neuromuscular facilitation.**	1	Morreale et al. 2016
1b	**Early cognitive therapeutic exercises** may produce greater improvements in muscle strength when	1	Morreale et al. 2016

	compared to **delayed cognitive therapeutic exercises.**		
1b	There is conflicting evidence about the effect of **dynamic stretching** when compared to **conventional therapy** for improving muscle strength.	1	Song et al. 2021
1b	There is conflicting evidence about the effect of **dynamic stretching programs** for improving muscle strength when compared to **conventional therapy**.	1	An et al. 2017
2	**Ankle range of motion training** may not produce greater improvements in muscle strength when compared to **no treatment.**	1	Rydwik et al. 2006
2	**Proprioceptive neuromuscular facilitation with custom exercises** may not produce greater improvements in muscle strength when compared to **custom exercises alone.**	1	Stern et al. 1970

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Stretching in a supine position** may produce greater improvements in spasticity when compared to **stretching in a supine position.**	1	Fleuren et al. 2006
1b	There is conflicting evidence about the effect of **functional stretching** when compared to **conventional therapy** for improving spasticity.	2	Pradines et al. 2019; Ghasemi et al. 2018
1b	**Dynamic stretching** may not produce greater improvements in spasticity when compared to **conventional therapy.**	1	Song et al. 2021
2	**Ankle range of motion training** may not produce greater improvements in spasticity when compared to **no treatment.**	1	Rydwik et al. 2006

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Early proprioceptive neuromuscular facilitation** may not have a difference in efficacy when compared to **late proprioceptive neuromuscular facilitation** for producing greater improvements stroke severity.	1	Morreale et al. 2016
1b	**Very early mobilization** may not produce greater improvements in stroke severity when compared to **standard care.**	1	Bernhardt et al. 2008

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Dynamic stretching** may not produce greater improvements in functional mobility when compared to **conventional therapy.**	1	Chan & Tsang et al. 2018

1b	**SilverSneaker exercises** may not produce greater improvements in functional mobility when compared to **dynamic stretching or usual care.**	1	Taylor-Piliae et al. 2014

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Dynamic stretching** may not produce greater improvements in quality of life when compared to **conventional therapy.**	5	Zhao et al. 2022; Song et al. 2021; Kim et al. 2015; Immink et al. 2014; Schmid et al. 2012
1b	**Baduanjin training** may not produce greater improvements in quality of life when compared to **conventional therapy.**	1	Yuen et al. 2021
1b	**SilverSneaker exercises** may not produce greater improvements in quality of life when compared to **dynamic stretching or usual care.**	1	Taylor-Piliae et al. 2014
2	**Ankle range of motion training** may not produce greater improvements in quality of life when compared to **no treatment.**	1	Rydwik et al. 2006

Key points

The literature is mixed concerning the effect of dynamic stretching in improving motor functions, balance, gait, range of motion, muscle strength, and spasticity after stroke.

Dynamic stretching may not be beneficial in improving quality of life, functional mobility, stroke severity, and activities of daily living after stroke.

Orthotics

Adopted from: http://www.acor.com/orthotic-devices.php

Orthotics are defined as medical devices used to improve the function and mobility of the body. Commonly used orthotics used in post-stroke rehabilitation of the lower extremity include ankle foot orthoses and shoe lifts. Shoe lifts or wedges alter biomechanical positioning by compelling a weight shift to the paretic side and consequently redistribute weight more symmetrically. This has the potential to improve the ability for functional ambulation and quality gait cycles. Ankle-foot orthotics (also known as foot-drop splints) aim to stabilize the foot and ankle and during weight-bearing and lift the toes while stepping, in effect reducing foot drop (Tyson & Kent, 2013). Other assistive devices including taping and canes are also reviewed below.

A total of 70 RCTs were found evaluating orthotic devices for lower extremity motor rehabilitation. 13 RCTs compared ankle taping to placebo or no tape (Bae & Park, 2022; Chen et al., 2019b; Cho et al., 2020; Choi & Lim, 2020; In et al., 2021b; Kim & Kang, 2018; Kurul et al., 2021; Maguire et al., 2010; Mehraein et al., 2021; Park et al., 2020c; Sheng et al., 2019; Shin et al., 2019; Wang et al., 2022). Two RCTs compared taping with electrical stimulation to taping or electrical stimulation alone (Bae & Park, 2022; In et al., 2021a). One RCT compared a new body orthosis to no orthosis (Thijssen et al., 2007). Seven RCTs compared shoe insole orthotics during walking to sham insole, no insole, overground walking, or conventional therapy (Eckhardt et al., 2011; Ferreira et al., 2018; Ferreira et al., 2017; Fortes et al., 2020; Liao et al., 2018; Liu et al., 2021b; Sungkarat et al., 2011). Two RCTs compared weight shift using a shoe insert to conventional therapy (Aruin et al., 2012; Sheikh et al., 2016). Nine RCTs compared ankle-foot orthosis with no orthosis, sham ankle-foot orthosis, or conventional therapy (Chen et al., 2010; de Wit et al., 2004; Erel et al., 2011; Karpe et al., 2019; Lee et al., 2014c; Pomeroy et al., 2016; Simons et al., 2009; Yeung et al., 2018; Zissimopoulos et al., 2015). One RCT compared the use of ankle-foot orthosis with botulinum toxin to botulinum toxin alone (Farina et al., 2008). One RCT compared taping with botulinum toxin to botulinum toxin alone (Reiter et al., 1998). Four RCTs compared early use of ankle-foot orthosis to late use of ankle-foot orthosis (Nikamp et al., 2019a; Nikamp et al., 2017; Nikamp et al., 2019b; Nikamp et al., 2018). 14 RCTs compared various ankle-foot orthosis modalities to standard ankle-foot orthosis or no ankle-foot orthosis (Chen et al., 2010; Chen et al., 2022; Daryabor et al., 2021; de Sèze et al., 2011; Do et al., 2014; Forghany et al., 2010; Karakkattil et al., 2020; Katsuhira et al., 2018; Rao et al., 2014; Tyson & Rogerson, 2009; Tyson et al., 2018; Yamamoto et al., 2018; Zollo et al., 2015). One RCT compared a bivalve cast or pressure-relieving ankle-foot orthosis to physical therapy (DeMeyer et al., 2015). One RCT compared use of a toe spreader to conventional care (Chiong et al., 2013). Three RCTs compared various cane modalities to each other (Avelino et al., 2021; Huang et al., 2022; Jeong et al., 2015). One RCT compared neuromuscular electrical stimulation to the use of an ankle-foot orthosis (Morone et al., 2012a). One RCT compared ankle-foot orthosis with balance training shoes to ankle-foot orthosis with regular shoes (Farmani et al., 2016). One RCT compared the use of a night splint to standing on a tilt table (Robinson et al., 2008). One RCT compared the use of an arm sling to standing on a tilt table (Yavuzer & Ergin, 2002). One RCT compared the use of an arm sling with a walk aid to no support while walking with a walk aid (Jeong et al., 2017). Two RCTs compared wearable assistive walking devices to conventional care or no therapy (Lee et al., 2017d; Pomeroy et al., 2001). One RCT compared a standing frame assistive device to conventional care (Bagley et al., 2005). Two RCTs compared treadmill training with orthotic devices to treadmill training alone (An et al., 2020; In et al., 2017). One RCT compared the use of orthotic devices with either visual biofeedback or sham feedback (Tamburella et al., 2017). One RCT compared the use of a Regent suit to conventional therapy (Iuppariello et al., 2018). One RCT compared various forms of knee immobilizer braces to each other (Talu & Bazancir, 2017).

The methodological details and results of all 70 RCTs are presented in Table 13.

Table 13. RCTs Evaluating Orthotic Devices for Upper Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Wang et al. (2022) RCT (8) Nstart=21 Nend=19 TPS=Chronic	E: Non-elastic taping + Exercise training (progressive resistance exercise, balance training and treadmill training) C: Sham taping + exercise training Duration: 50min/d, 2d/wk, for 6wks	• Velocity (-) • Double support time (+exp) • Spatial/temporal symmetry index (-) • Berg Balance Scale (-) • 6-min walk test (-) • Fall Efficacy Scale International (-)
In et al. (2021) RCT (7) Nstart=40 Nend=40 TPS=Chronic	E: Posterior pelvic tilt taping + functional movements (sitting-to-standing + indoor walking + stair walking training) C: Functional movements (sitting-to-standing + indoor walking + stair walking training) Duration: 30min/d, 5d/wk, 6wks	• Pelvic inclination (+exp) • Isometric muscle strength (+exp) • 10-metre walk test (+exp)
Kurul et al. (2021) RCT (5) Nstart=68 Nend=61 TPS=Chronic	E: Kinesio taping + conventional therapy C: Conventional therapy Duration: 60min/d, 5d/wk, 2wks	• Balance Evaluation Systems Test (+exp) • Functional Reach Test (+exp) • Timed Up and Go Test (-) • Tetrax Balance System (postural stability & static balance) (-) • Barthel Index (-)
Mehraein et al. (2021) RCT (6)	E: Inhibitory kinesiology taping C: No treatment	• Modified Ashworth Scale (-)

Nstart=30 Nend=30 TPS=Chronic	Duration: 48hr	
Cho et al. (2020) RCT (8) Nstart=28 Nend=28 TPS=Chronic	E: Trunk rehabilitation + Kinesio taping C: Trunk rehabilitation + Placebo taping Duration: 18hr/d, 7d/wk, 8wks Taping & 60min/d, 3d/wk, 8wks Trunk rehabilitation	• Dynamic center of pressure (-) • Limit of Stability- total area (-) • Static sway area (-) • Static sway length (-)
Choi et al. (2020) RCT (8) Nstart=30 Nend=30 TPS=Chronic	E: Non-elastic sports tape C: Placebo tape Duration: One session	• Static balance (+exp) • Dynamic balance (+exp) • Gait velocity (+exp) • Cadence (+exp) • Step Length ○ Paretic (+exp) ○ Non-paretic (+exp) • Stride length ○ Paretic (+exp) ○ Non-paretic (+exp)
Park et al. (2020) RCT crossover (8) Nstart=20 Nend=20 TPS=Chronic	E1: Tibialis anterior taping E2: Calf taping C: No intervention Duration: Not reported	<u>E1 vs E2 vs C</u> • COP excursion ○ Paretic side area (-) ○ Nonparetic side area (-) ○ Forward area (+exp2) ○ Backward area (+exp1)
Chen et al., (2019) RCT (8) Nstart=28 Nfinal=28 TPS=Chronic	E: Kinesiotaping with outpatient rehabilitation C: Sham taping with outpatient rehabilitation Duration: 50min, 2-3d/wk outpatient rehabilitation	• Berg Balance Scale (+exp) • 6-minute walk test (+exp) • Falls Efficacy Scale (-) • Walking speed (-)
Shin et al. (2019) RCT crossover (8) Nstart=15 Nend=15 TPS=Chronic	E: Ankle Eversion Taping C1: Placebo Taping C2: No taping Duration: single session - 10min washout period	<u>E vs C1</u> • Gait Velocity (+exp) • Step Length (+exp) • Stride Length (+exp) • Cadence (+exp) <u>E vs C2</u> • Gait Velocity (+exp) • Step Length (+exp) • Stride Length (+exp) • Cadence (+exp)
Sheng et al. (2019) RCT (6) Nstart=60 Nend=61 TPS=Chronic	E: Routine rehabilitation + kinesio taping C: Routine rehabilitation Duration: Not Specified	• 10-MeterWalking Test (+exp) • Timed Up and Go Test (+exp) • Stride length(+exp) • Stance phase(+exp) • Swing phase(+exp) • Foot rotation (+exp)
Kim & Kang. (2018) RCT (4) Nstart= 27 Nend = 27 TPS= Chronic	E: Treadmill training + Proprioceptive neuromuscular facilitation lower-leg taping (PNFLT) C: Sham taping + treadmill training	• 6-minute walk test (+exp) • 10-metre walking test (+exp) · Timed up and go test (+exp)

	Duration: 50min/d, 5d/wk, 6wks	
Maguire et al. (2010) RCT crossover (3) Nstart=13 Nend=13 TPS=Subacute	E1: Walking with hip abductor taping E2: Walking with TheraTogs E3: Walking with cane at normal height Duration: Until six gait cycles with clear datasets were collected	E1 vs E3 • Gait Speed (-) E2 vs E3 • Gait Speed (-)
Taping With Electrical Stimulation vs Electrical Stimulation or Taping Alone or No Taping		
Bae et al. (2022) RCT crossover (8) Nstart=18 Nend=18 TPS=Chronic	E1: Ankle Kinesio taping E2: Lower-leg KT using the concept of Proprioceptive neuromuscular facilitation Kinesio taping (PNF-KT) C: No Taping Duration: 10min familiarization on treadmill + 10min rest+ Start three conditions with 5min washout in between.	E1/E2 vs C; • Ankle Dorsiflexion-Range of Motion (+exp1, +exp2) • Gait Velocity (+exp1, +exp2) • Cadence (+exp1, +exp2) • Step Length (+exp1, +exp2) E1 vs E2: • Ankle Dorsiflexion-Range of Motion (+exp2) • Gait Velocity (+exp2) • Cadence (+exp2) • Step Length (+exp2)
In et al. (2021) RCT crossover (7) Nstart=50 Nend=46 TPS=Chronic	E: TENS + Taping + Exercise C: TENS + Exercise Duration: 30min/d, 5d/wk, for 6wks (30 sessions total TENS) +/- tape during session & 30min/5d/wk, for 6wks exercise	• Composite spasticity score (+exp) • Muscle Strength o Knee extensor (+exp) o Ankle plantar flexor (+exp) • 10m walk test (+exp)
New Body Orthosis vs No Orthosis		
Thijssen et al. (2007) RCT Crossover (4) Nstart=27 Nend=27 TPS=Chronic	E: New body orthosis C: No orthosis Duration: 3wks	• 6m Walk Test Speed (+exp) • Cadence (-) • Step Length o Affected Side (+exp) o Unaffected Side (+exp) • Swing Phase o Affected (+exp) o Unaffected (+exp) • Stance Phase o Affected (+exp) o Unaffected (+exp) • Double-Support (+exp)
Shoe Insole Orthotics During Walking vs Overground Walking or Conventional Therapy or Sham		
Liu et al. (2021) RCT crossover (7) Nstart=32 Nend=32 TPS=Chronic	E: Orthopaedic insoles C: Standard insoles (flat pad) sham Duration: Single session, 1 day wash out	E v C • Berg balance scale (+exp) • Functional reach test (+exp) • Timed-Up- and-go (+exp) • Computerized Posturography o Static anterioposterior (-) o Static mediolateral (+exp) o Static velocity (-) o Dynamic anterioposterior (-) o Dynamic mediolateral (-) o Dynamic velocity (-)

Fortes et al. (2020) RCT (6) Nstart=42 Nend=42 TPS=Chronic	E: Shoe orthotic (shoe lift) 1.5cm C: Overground walking Duration: single session	• Ten Meter Walk Test (+exp) • Timed Up-and-Go (+exp)
Ferreira et al. (2018) RCT (7) Nstart=24 Nend=20 TPS=Chronic	E: Posture corrective insoles C: Placebo insoles without corrective feature Duration: Variable for 3mo	• Pelvic kinematics ○ Anterior Pelvic Tilt (-) ○ Posterior Pelvic Tilt (-) ○ ROM pelvic tilt (-) ○ Pelvic Obliquity Up (-) ○ Pelvic Obliquity Down (-) ○ ROM Obliquity (-) ○ Internal rotation (-) ○ External Rotation (-) ○ Int/ Ext Rotation ROM (-) • Hip kinematics ○ Flexion (-) ○ Extension (-) ○ Flex/Ext ROM (-) ○ Adduction (-) ○ Abduction (-) ○ Add/ Abd ROM (-) ○ Internal Rotation (-) ○ External Rotation (-) ○ Int/Ext hip ROM (-) • Knee kinematics ○ Flexion (+exp) ○ Extension (-) ○ Flex/Ext ROM (+exp) ○ Varus (-) ○ Vagus (-) ○ ROM (-) • Ankle kinematics ○ Dorsiflexion (+exp) ○ Plantarflexion (-) ○ Dorsi/ plantar ROM (+exp) ○ Foot pronation (-) ○ Foot supination (-) • Stance phase (-) • Swing phase (-) • Double support time (-) • Step length (-) • Step width (-) • Gait velocity (-) • Gait cadence (-)
Liao et al. (2018) RCT (8) Nstart=56 Nend=51 TPS=Chronic	E1: Routine rehabilitation + Balance training + Visual biofeedback E2: Routine rehabilitation program + lateral wedge insole C: Routine rehabilitation program Duration: 20min/d, 3d/wk, 6wks balance training & 6 wks usual standing and walking with the show insole	<u>E1/E2 vs C</u> • Balance computerized adaptive test (+exp1, +exp2) • Timed up and go (TUG) (+exp1, +exp2) <u>E1 vs E2</u> • Balance computerized adaptive test (-) • Timed up and go (TUG) (-)
Ferreira et al. (2017) RCT (6) Nstart= 24	E: Insoles + Conventional physiotherapy C: Conventional physiotherapy	• Oscillation in Center of Pressure (-) • Anteroposterior Range of Movement (-) • Mediolateral Range of Movement

Nend = 20 TPS= Chronic	Duration: 12wks	○ Eye open (+exp) ○ Eye closed (-) • Trace Length of Oscillation (-) • Sway Velocity (-) • Equivalent Area (-)
Sungkarat (2011) RCT (7) Nstart=40 Nend=35 TPS=Subacute	E: Gait training with Insole Shoe Wedge and Sensors + Auditory feedback + Conventional rehabilitation C: Conventional gait training + Conventional rehabilitation Duration: 30min/d, 5d/wk for 3wks - Conventional rehabilitation, 30min/d, 5d/wk for 3wks - Gait training	• Gait speed (+exp) • Step length asymmetry ratio (+exp) • Single support time asymmetry ratio (+exp) • Berg balance scale (+exp) • Timed up and go (+exp) • Loading on paretic leg during stance (+exp)
Eckhardt et al. (2011) RCT (5) Nstart=19 Nend=19 TPS=Subacute	E: High orthopedic shoe C: Regular shoes without high orthosis Duration: 2wks	• Without dual-task ○ Timed Up and Go (+exp) ○ Step length affected/unaffected leg (+exp) ○ stance duration affected/unaffected leg (+exp) ○ Cadence (+exp) ○ Walking speed (+exp) ○ Clearance (-) ○ Step width (+exp) ○ Knee extension (-) • With dual-task ○ Timed Up and Go (+exp) ○ Step length affected/unaffected leg (+exp) ○ stance duration affected/unaffected leg (+exp) ○ Cadence (+exp) ○ Walking speed (+exp) ○ Clearance (-) ○ Step width (-) ○ Knee extension (-)
Weight-Shift Therapy Using Shoe Insert vs Conventional Treatment		
Sheikh et al. (2016) RCT (7) Nstart=28 Nend=28 TPS=Chronic	E: Gait training + compelled weight-shift insole device C: Gait training with conventional insole Duration: 90min/d, 6d/wk, 6wks	• Weight bearing (+exp) • Gait velocity (-) • Stance symmetry ratio (-) • Swing symmetry ratio (-) • Overall symmetry ratio (-) • Step symmetry ratio (-)
Aruin et al. (2012) RCT (4) Nstart=18 Nend=18 TPS=Chronic	E: Compelled Body Weight Shift (CBWS) + Physical Therapy C: Physical Therapy Duration: 60 min, 1d/wk, 6wks Physiotherapy, wearing weighted shoes for ADL, 6wks	• Symmetric Weight Bearing (-) • Gait Velocity (-) • Berg Balance Scale (-) • Fugl-Meyer Assessment (-)
Ankle-Foot Orthosis vs No Ankle-Foot Orthosis or Sham Ankle-Foot Orthosis		
Yeung et al. (2018) RCT (5) Nstart=19 Nend =15	E: Robot-assisted ankle-foot-orthosis (AFO) with dorsiflexion assistance	• Functional Ambulation Categories (+exp) • Fugl-Meyer Assessment (+exp) • Modified Ashworth Scale (-) • Berg Balance Scale (-)

TPS=Chronic	C: Sham Ankle foot orthosis (AFO) with torque impedance Duration: 30min/d, 2-4d/wk, 5wks (20 session total)	• 10-Meter Walk Test (+exp) • Six-Minute Walk Test (-) • Walking Speed (+exp) • Step Length (-) • Stance Time (-) • Swing Time (-)
Pomeroy et al. (2016) RCT (7) Nstart=105 Nend=91 TPS=Acute	E: Ankle-foot orthosis (SWIFT cast) + Conventional therapy C: Conventional therapy Duration: 6wks wearing cast during daytime and physiotherapy	• Walking speed (-) • Functional Ambulation category (-) • Modified Rivermead mobility index (-) • Gait symmetry (-) • Ratio of stance time (-) • Ratio of step lengths (-) • Ratio peak angular velocities (-)
Zissimopoulos et al. (2015) RCT crossover (6) Nstart=15 Nend=13 TPS=Chronic	E: Ankle Foot Orthoses (participants own, non-rigid articulated, dorsiflexion, plantar flexion, posterior leaf spring types) C: No Orthotic Duration: 1 session per treatment	• Mid-swing Plantar Flexion (+exp) • Hip hiking (-) • Circumduction (-) • Coronal Plane Hip Range of Motion (-) • Mediolateral Foot-Placement Ability (-)
Lee et al. (2014) RCT (5) Nstart=25 Nend=25 TPS=Chronic	E: Ankle Foot Orthosis (Joint type) + Balance Training C: No Orthotic + Balance Training Duration: 40min/d, 5d/wk, 6wks	• Static Balance Index ○ Normal open (+exp) ○ Normal close (-) ○ Pillow open (-) ○ Pillow close (-) • Paretic Tibialis Anterior Muscle Activity (+exp) • Paretic Medial Gastrocnemius Muscle Activity (-)
Erel et al. (2011) RCT (6) Nstart=32 Nend=28 TPS=Chronic	E: Dynamic Ankle-foot orthosis C: Conventional care Duration: 3mo	• Functional Reach test (-) • Timed Up and Go (-) • Timed Up Stairs (+exp) • Timed Downstairs (-) • Walking velocity (+exp) • Physiological Cost index (+exp)
Chen et al. (2010) RCT crossover (3) Nstart=14 Nend=14 TPS=Chronic	E1: Posterior ankle-foot orthosis E2: Anterior ankle-foot orthosis C: No orthosis Duration: 5min/session - 5min washout	E1 vs E2 vs C • Walking Speed (-) • Step Length (-) • Cycle Times (-)
Karpe et al. (2019) RCT (3) Nstart=32 Nend=28 TPS=Not Reported	E: Modified Dynamic Ankle Foot Orthosis (including functional electrical stimulation) + Conventional physiotherapy C: Conventional physiotherapy Duration: 3d/wk, 4wks	• 10-metre Walk (+exp)
Simons et al. (2009) RCT crossover (5) Nstart=23 Nend=20 TPS=Chronic	E: Wearing Ankle-foot orthosis C: Tested Without wearing Ankle-foot orthosis Duration: One session; 1wk washout	• Static weight bearing (-) • Dynamic weight bearing (-) • Dynamic balance contribution (-) • Berg Balance scale (+exp) • Timed Up and Go (+exp) • 10m Walk test (+exp) • Functional Ambulation category (+exp) • Timed Balance test (-)
de Wit et al. (2004) RCT crossover (6)	E: Walking with non-articulated plastic ankle-foot orthosis	• Timed Up-and-Go (+exp) • Stair Climb (+exp)

Nstart=20 Nend=20 TPS=Chronic	C: Walking without non-articulated plastic ankle-foot orthosis Duration: 6mo wearing AFO	• Walking speed (+exp)
Ankle-Foot Orthosis with Botulinum Toxin vs Botulinum Toxin		
Farina et al. (2008) RCT (5) Nstart=13 Nend=13 TPS=Chronic	E: Botulinum toxin A (190-320U) + AFO C: Botulinum toxin A (190-320U) Duration: 4mo	• Modified Ashworth Scale (+exp) • 10-Metre Walk Test (-) • Baropodometric footprint changes (+exp) • Baropodometric changes in time of full load (+exp)
Taping with Botulinum Toxin vs Botulinum Toxin		
Reiter et al. (1998) RCT (5) Nstart=18 Nend=18 TPS=Chronic	E: Botulinum toxin A (100U) injection into tibialis posterior + ankle-foot adhesive taping C: EMG-guided Botulinum toxin A (190-320U) injection into several calf muscles Duration: Single injection session & 1d/wk, 3wks ankle-foot taping	• Ankle passive ROM ○ Dorsiflexion (+exp) ○ Eversion (-) • Ankle Rest Position ○ Foot extension (-) ○ Foot inversion (-) • Modified Ashworth scale (-) • 10 m walk test (-) • Step length (-)
Early vs Late Ankle Foot Orthosis		
Nikamp et al. (2019) RCT (6) Nstart=33 Nend=27 TPS= Subacute	E1: Provided with ankle-foot orthosis early in the study (wk1) E2: Delayed use of ankle-foot orthosis (wk9) Duration: 52wks	• Number of falls wk1-8 (-) • Number of falls wk9-52 (-)
Nikamp et al. (2019) RCT (4) Nstart=33 Nend=26 TPS=Subacute	E: Early use of ankle-foot orthosis + conventional physical therapy C: Delayed ankle-foot orthosis + conventional physical therapy Duration: after 26 wks of follow up	• Tibialis anterior muscle activity (-) • Walking speed (-)
Nikamp et al. (2018) RCT (5) Nstart=33 Nend=26 TPS=Subacute	E: Ankle-foot orthoses Early (Week 1 start) + Usual Care C: Ankle-foot orthoses Delayed (Week 9 start) + Usual Care Duration: 26wks follow up after early Ankle-foot orthosis, 18wks - Late Ankle-foot orthosis	• Kinematics ○ Pelvic (-) ○ Hip (-) ○ Knee (-) ○ Ankle (-) • Walking speed (+exp)
Nikamp et al. (2017) RCT (7) Nstart=33 Nend=26 TPS=Subacute	E: Early use of ankle-foot orthosis + conventional physical therapy C: Delayed ankle-foot orthosis + conventional physical therapy Duration: E: wk1-wk11, C: wk9-wk11	• Berg balance scale (+exp1) • Functional ambulation categories (-) • Rivermead mobility index (-) • 10-meter walk test (-) • 6-minute walk test (-) • Barthel index (+exp1) • Timed up and go test (-) • Stair test (-)
A Comparison of Orthoses		
Daryabor et al. (2021) RCT (4)	E1: Ankle-foot orthosis with mechanical plantar flexion stops	E2 vs E3 • Gait cycle phase/time (-) • Step length/time/width (-)

Nstart=20 Nend=10 TPS=Chronic	(AFO-PlfS) with Rocker shoe (RSh) E2: AFO-PlfS with Standard shoe (SSh) E3: SSh only C1: Ankle-foot orthosis with plantar flexion resistive movement (AFO-PlfR) with RSh C2: AFO-plfR C3: SSh only Duration: 2wk adaptation	• Active range of motion (-) <u>C2 vs C3</u> • Gait cycle phase/time (+con2) • Step length/time/width (+con2) • Active range of motion (-) <u>E2 vs C2</u> • Gait cycle phase/time (-) • Step length/time/width (-) • Active range of motion (-) <u>E1 vs E2</u> • Ankle kinematics (+exp1) • Peak power output (+exp1) <u>C1 vs C2</u> • Ankle kinematics (+con1) • Peak power output (+con1) <u>E1 vs C1</u> • Ankle kinematics (-) • Peak power output (+exp1)
Karakkattil et al. (2020) RCT crossover (5) Nstart=21 Nend=20 TPS=Subacute	E: Custom double-adjustable ankle foot orthotic C: Standard ankle foot orthotic Duration: 1wk- 10min washout	• 6 Minute walk test (-) • Gait symmetry (-) • Gait velocity (-)

Katsuhira et al. (2018)
RCT (4)
Nstart=28
Nend=27
TPS=Chronic
	E: Level walking with ankle-foot orthosis + trunk orthosis with joints providing a resistive force (TORF)
	C: Level walking with ankle-foot orthosis + lumbosacral orthosis (corset)
	Duration: Not Reported
		• Ankle ROM (+exp)
		• Spatiotemporal parameter
		    ○ Walking speed (+exp)
		    ○ Step time (+exp)
		    ○ Steps/min (+exp)
		• Ground reaction force (-)
		• Ankle peak plantar flexion and dorsiflexion (+exp)
		• Peak knee abduction (-)
		• Peak hip extension (-)
		• Pelvic backward tilt angle (-)

Tyson et al. (2018) RCT (6) Nstart=139 Nend=125 TPS=Chronic	E: Bespoke ankle-foot orthoses C: Off-the-shelf ankle-foot orthosis Duration: 12wks	• Walking Handicap Scale (-) • Falls Efficacy Scale (-) • 5-m walk test (-) • Step length (-)
Yamamoto et al. (2018) RCT (7) Nstart=42 Nend=40 TPS=Subacute	E: Ankle foot Orthosis with Plantar Stop C: Ankle Foot Orthosis with Plantar Flexion Resistance Duration: 60min/d, 7d/wk, 2wks of physiotherapy while wearing device	• Ground Reaction Forces (-) • Center of Pressure (-) • Ankle Joint Angle (-) • Ankle Joint Moment and Power (-) • Knee Joint Angle (-) • Knee Joint Moment (-) • Hip Joint Angle (-) • Hip Joint Moment (-) • Gait Speed (-) • Cycle time (-) • Loading Response Time (-) • Single-Stance Time (-) • Swing time (-)

Zollo et al. (2015)
RCT crossover (4)
Nstart=10
Nend=10
TPS=Chronic
	E1: Solid Ankle Foot Orthosis
	E2: Dynamic Ankle Foot Orthosis
	C: No Ankle Foot Orthosis
		<u>E1 Vs C</u>
		• Spatiotemporal Gait Analysis (-)
		• Kinematic Data
		    ○ Ankle (-)
		    ○ Knee (-)
		    ○ Hip (-)

	Duration: 5 walking trials/condition, no washout period	<u>E2 Vs C</u>
		• Spatiotemporal Gait Analysis (-)
		• Kinematic Data
		  ○ Ankle (-)
		  ○ Knee (-)
		  ○ Hip (-)
		
		<u>E1 Vs E2</u>
		• Spatiotemporal Gait Analysis (-)
		• Kinematic Data
		  ○ Ankle (-)
		  ○ Knee (-)
		  ○ Hip (-)

Do et al. (2014) RCT crossover (6) Nstart=17 Nend=17 TPS=Chronic	E1: Plastic ankle foot orthosis made with polypropylene E2: Hybrid ankle foot orthosis made with polypropylene covered with canvas fabric C: Barefoot Duration: 3h/d, for 2wks – 5min washout	<u>E1 vs E2</u> • Walking velocity (-) • Cadence (-) • Stride length (-) • Step length (-) <u>E1/E2 vs C</u> • Walking velocity (+exp1, +exp2) • Cadence (-) • Stride and step length (-)
Rao et al. (2014) RCT Crossover (5) Nstart=30 Nend=30 TPS=Acute	E1: Using an off-the-shelf carbon ankle-foot orthosis (C-AFO) E2: Using a custom plastic ankle-foot orthosis (P-AFO) C: No ankle-foot orthosis Duration: 60min/d, 2-3d/wk, 12wks	<u>E1 vs C</u> • Gait velocity (+exp1) • Cadence (+exp1) • Stride Length (+exp1) • Step Length (+exp1) <u>E1 vs E2</u> • Gait velocity (-) • Cadence (-) • Stride Length (-) • Step Length (-) <u>E2 vs C</u> • Gait velocity (+exp2) • Cadence (+exp2) • Stride Length (+exp2) • Step Length (+exp2)

de Seze et al. (2011)
RCT (6)
Nstart=28
Nend=26
TPS=Subacute
	E: Chignon Ankle-Foot Orthosis
	C: Standard Ankle-Foot Orthosis
	Duration: Not Reported
		• 10m Walking test
		  ○ Time with orthosis (-)
		  ○ Time without orthosis (-)
		  ○ Mean time difference (+exp)
		  ○ Gain ratio (+exp)
		• Modified Ashworth scale (-)
		• Motricity index (-)
		• Functional ambulation category (-)
		• Postural assessment structural scale (-)
		• Functional Independence measure (-)
		• Visual analog scale for pain tolerance (-)

Forghany et al. (2010) RCT crossover (4) Nstart=8 Nend=8 TPS=Not Reported	E1: 5-degree lateral wedge orthotic in both shoes E2: 8.5-degree lateral wedge orthotic in both shoes C: Overground walking with no wedge Duration: Single session, no washout period	<u>E1 vs C</u> • Walking speed (-) • Ankle plane of motion (+exp_1) • Lower leg muscle strength (-) <u>E2 vs C</u> • Walking speed (-) • Ankle plane of motion (+exp_2) • Lower leg muscle strength (+exp_2) <u>E1 vs E2</u> • Walking speed (-) • Ankle plane of motion (+exp_2)
Tyson & Rogerson. (2009)	E1: Walking cane;	<u>E1/E2/E3/E4 vs C:</u>

RCT (7) Nstart=20 Nend=20 TPS=Subacute	E2: Ankle-foot orthosis; E3: Slider shoe; E4: Walking cane + Ankle-foot orthosis + Slider shoes C: Walking with no device Duration: One day	• Functional Ambulatory category (+exp1, +exp2, +exp3, +exp4) • 5m Walk test ○ Walking speed (-) ○ Affected sidestep length (-)
Anterior vs Posterior Ankle-Foot Orthosis		
Chen et al. (2022) RCT crossover (7) Nstart=20 Nend =20 TPS=Chronic	E1: Anterior ankle foot orthosis E2: Posterior ankle foot orthosis Duration: 360min/d, 7d/wk, 4wks - 1 wk washout period	• Passive range of motion Ankle (-) • Modified Ashworth Scale-Gastrocnemius (-) • Walking velocity (+exp) • Stretch Reflex Root mean square of gastrocnemius (+exp) • Walking root mean square of gastrocnemius (+exp)
Chen et al. (2010) RCT crossover (3) Nstart=14 Nend=14 TPS=Chronic	E1: Posterior Ankle-Foot Orthosis E2: Anterior Ankle-Foot Orthosis C: No Ankle-Foot Orthosis Duration: single session - 5min washout	E1 vs E2 • Sagittal Plane ○ Initial Contact (+exp1) ○ Stance Phase (+exp1) ○ Swing Phase (+exp1) • Coronal Plane ○ Initial Contact (-) ○ Stance Phase (-) ○ Swing Phase (-) • Transverse Plane ○ Initial Contact (-) ○ Stance Phase (-) ○ Swing Phase (-) E1/E2 vs C • Sagittal Plane ○ Initial Contact (+exp1 ○ Stance Phase (+exp1) ○ Swing Phase (+exp1) • Coronal Plane ○ Initial Contact (-) ○ Stance Phase (+exp2) ○ Swing Phase (+exp1/+exp2) • Transverse Plane ○ Initial Contact (+exp1/+exp2) ○ Stance Phase (-) ○ Swing Phase (-)
Bivalve Cast vs Pressure-Relieving Ankle-Foot Orthosis vs Conventional Care		
DeMeyer et al. (2015) RCT (7) Nstart=46 Nend=45 TPS=Acute	E1: Bivalve Cast + Physical Therapy E2: Pressure-relieving Ankle-foot Orthosis + Physical Therapy C: Physical Therapy Duration: 60-90min/d, 5-7 d/wk, physical therapy & 480-720min/d, 5-7 d/wk bivalve cast and pressure-relieving ankle-foot orthosis (nighttime)	E1 vs C • Modified Ashworth Scale (-) • Ankle Range of Motion (-) • Functional Independence Measure ○ Transfer (-) ○ Walking (-) E2 vs C • Modified Ashworth Scale (-) • Ankle Range of Motion (-) • Functional Independence Measure ○ Transfer (-) ○ Walking (-)
Toe Spreader vs Conventional Care		

Chiong et al. (2013) RCT (8) Nstart=9 Nend=8 TPS=Chronic	E: Stretching exercise + wearing toe spreader C: No Orthotic (conventional care) Duration: Daily stretching exercise & wearing spreader over 6mo	• 10-metre Walking Test (-) • 6-metre walking distance (-) • Fugl-Meyer Assessment - Lower extremity (-) • Barthel Index (-) • Stroke Impact Scale (-) ○ Mobility (-) ○ Activities of Daily Living (-) ○ Social participation (-) ○ Total recovery (-)
Comparing Types of Canes		
Huang et al. (2022) RCT (6) Nstart=40 Nend=34 TPS=Chronic	E: Ambulation therapy with laser cane + Conventional therapy C: Ambulation therapy with cane + Conventional therapy Duration: 30min/d, 2d/wk, for 4wks	• 10-m Walk Test (-) • Stride length (+exp) • Cadence (-) • Stance phase (-) • Swing phase (-) • Temporal swing symmetry (+exp) • Temporal stance symmetry (-) • Overall gait symmetry deviation (-) • Heel-strike angle (-) • Toe-off angle (-) • Gait speed (-) • Berg Balance Scale (-) • Timed Up and Go Test (-) • Barthel index (-)
Avelino et al. (2021) RCT (8) Nstart=50 Nend=45 TPS=Chronic	E: Provision of a single-point cane C: Stretching exercises Duration: 1mo	• 10-m Walk Test (-) • Step length (-) • Cadence (-) • Six-minute Walk test (-) • Modified Gait-Efficacy Scale (-) • Stroke Impact Scale (-)
Jeong et al. (2015) RCT crossover (7) Nstart=30 Nend=30 TPS=Chronic	E1: Single-point cane E2: Quad cane E3: Hemi-walker Duration: same amount of time for 3 days – 1d washout	E1 vs E2 • 10m Walk test (+exp1) • Heart rate (-) • 6min Walk test (+exp1) • Energy cost (+exp1) • Energy expenditure (+exp1) E1 vs E3 • 10m Walk test (+exp1) • Heart rate (-) • 6min Walk test (+exp1) • Energy cost (+exp1) • Energy expenditure (+exp1)
NMES vs Ankle-Foot Orthosis		
Morone et al. (2012) RCT (5) Nstart=20 Nend=20 TPS=Acute	E: NMES (Walkaide) + walking training + conventional therapy C: Walking training + ankle-foot-orthosis + conventional therapy Duration: 40min/d, 5d/wk, 4wks Walking training with NMES or AFO & 40min/d, 5d/wk, 4wks conventional therapy	• 10-Metre Walk Test (+exp) • Functional Ambulation Classification (+exp) • Barthel Index (-) • Rivermead Mobility Index (-) • Medical Research Council Scale (-) • Canadian Neurological Scale (-) • Ashworth Scale (-) • Manual Muscle Test (-)
Ankle-Foot Orthosis + Balance Training Shoes vs Ankle-Foot Orthosis + Regular Shoes		

Farmani et al. (2016) RCT (4) Nstart=30 Nend=30 TPS=Chronic	E: Solid Ankle-foot orthosis, then Rocker shoes C: Solid Ankle-foot orthosis, then Regular shoes Duration: Not reported	• Timed Up-and-Go (+exp) • Timed Up Stairs test (-) • Timed Downstairs test (-) • 10-Meter Walk Test at preferred speed (+exp) • Oxygen uptake (+exp)
Night Splint vs Standing on a Tilt Table		
Robinson et al. (2008) RCT (8) Nstart=30 Nend=24 TPS=Acute	E1: Nighttime splint wearing + Inpatient rehabilitation E2: Standing on a tilt table + Inpatient rehabilitation Duration: 30min/d, 5d/wk, 4wks tilt table; 7d/wk, 4wks Nighttime splint; 5d/wk, 4wks Inpatient rehabilitation	• Maximum passive dorsiflexion (-) • Motor Assessment Scale (-)
Arm Sling vs No Therapy		
Jeong et al. (2017) RCT (6) Nstart=57 Nend=57 TPS=Chronic	E: Arm multi-support sling while waking with walk aid C: No support while walking with walk aid Duration: 12min, 1session/d, 1d -1hr washout period.	<u>E vs C for Those with a Single Cane</u> • Energy Cost (+Exp) • Energy Expenditure (+Exp) • 6-minute Walking Test (+Exp) • 10-meter Walk Test (-) <u>E vs C for Those with a Quad Cane Walk Aid</u> • Energy Cost (-) • Energy Expenditure (-) • 6-minute Walking Test (-) • 10-meter Walk Test (-)

Yavuzer & Ergin (2002)
RCT Crossover (3)
Nstart=31
Nend=31
TPS=Subacute
	E: Arm sling
	C: No treatment
	Duration: Single session
		• Gait Parameters
		  ○ Walking Velocity (+exp)
		  ○ % of Stance Phase Paretic Side (+exp)
		  ○ Step Time (-)
		  ○ Step Length (-)
		  ○ Double Support Time (+exp)
		• Pelvic Excursion
		  ○ Sagittal Plane (+exp)
		  ○ Coronal Plane (+exp)
		  ○ Transverse Plane (+exp)
		• Hip Excursion (-)
		• Knee Excursion (-)
		• Ankle Excursion (-)
		• Peak Vertical Force (+exp)

Wearable Devices vs Conventional Care or No Therapy		
Lee et al. (2017) RCT (6) Nstart=23 Nend=23 TPS=Chronic	E: Wearable tubing assistive walking device (WTAWD) C1: Conventional elastic band orthosis C2: Walking barefoot (no orthosis) Duration: One session	<u>E vs C1/C2</u> • Gait speed (+exp) • Cadence (+exp) • Step Length (+exp) • Stride Length (+exp) • Swing Time (-) <u>C1 vs C2</u> • Gait Speed (+exp)

		• Cadence (+exp) • Step Length (+exp) • Stride Length (+exp) • Swing Time (-)
Pomeroy et al. (2001) RCT (7) Nstart=24 Nend=22 TPS=Chronic	E: Wearing weighted garments on the paretic side C: No treatment Duration: 7d/wk, for 6wks	• Berg Balance Scale (-) • Step Length Symmetry Index (-) • Single Support Time (-) • Double Support Time (-) • Support Base Width (-) • Velocity (-) • Cadence (-)
Standing Frame Assistive Device		
Bagley et al. (2005) RCT (8) Nstart=140 Nend=112 TPS=Acute	E: Oswestry standing frame treatment C: Usual treatment Duration: 1sessions/d, 14d	• Rivermead Mobility Index (-) • Barthel Index (-) • Hospital Anxiety and Depression Score (-) • Nottingham Extended ADL Scale (-) • Rivermead Motor Assessment (-) • Motor Assessment Scale (-) • Trunk Control Test (-)
Treadmill Training with Orthotic Devices Vs Treadmill Training Alone		

An et al. (2020)
RCT (5)
Nstart=36
Nend=36
TPS=Chronic
	E: Treadmill training using insole on less affected side
	C: Treadmill training
	Duration: 30min/d, 5d/wk, for 4wks
		• Functional Gait Assessment (+exp)
		• Figure-of-Eight Walk Test
		  ○ Step (+exp)
		  ○ Time (+exp)
		• 6-Minute Walk Test (+exp)
		• 10-m Walk Test (+exp)
		• Gait Cadence (+exp)
		• Stride Length/ Heigh Ratio (+exp)
		• Stride Length (+exp)
		• Stance Phase Duration (-)
		• Swing Phase Duration (-)
		• Double Support Duration (+exp)
		• Single Support Duration (+exp)

In et al. (2017) RCT (7) Nstart=30 Nend=30 TPS=Chronic	E: Treadmill training + Thera-band C: Treadmill training Duration: 30min/d, 5d/wk, 4wks	• Fugl-meyer Assessment (+exp) • Timed Up-and-Go (+exp) • 10-Metre Walk Test (+exp) • Performance-oriented mobility assessment (+exp) • Balance (-) • Gait (+exp)
Visual Biofeedback with Orthotic Devices vs Sham Feedback		
Tamburella et al. (2017) RCT (7) Nstart=10 Nend=10 TPS=Subacute	E: Ankle treatment + biomechanical visual biofeedback (using an active sensorized AFO) C: Ankle treatment + an inactive sensorized AFO (sham) Duration: 60min/d, 5d/wk, 6wks	• Active/passive ankle ROM (-) • Modified Ashworth Scale (+exp) • Coactivation index (+exp) • Active joint speed (+exp) • Passive joint speed (-)
Regent Suit vs Conventional Therapy		
Iuppariello et al. (2018) RCT (4)	E: Rehabilitation training + regent suit	E vs C1

Nstart= 60 Nend = 60 TPS= Chronic	C1: Rehabilitation training C2: Healthy controls Duration: 40min/d, 5d/wk for 8wks	• National Institute of Health Stroke Scale (+exp) • Barthel Index (+exp) • Functional Independent Measure (+exp) • Berg Balance Scale (+exp) • EMG patterns: • SL NAS (+exp) • SL AS (+exp) • TA NAS (-) • TA AS (+exp) • ST NAS (+exp) • ST AS (+exp) • VL NAS (+exp) • VL AS (+exp) E vs C2 • EMG patterns (-)
Knee Immobilizer Brace with Foot Orthosis or Rigid Taping vs Knee Immobilizer Brace		
Talu & Bazancir. (2017) RCT (5) Nstart=20 Nend=20 TPS=Acute	E1: Knee immobilizer brace E2: Knee immobilizer brace + Foot lifter orthosis E3: Knee immobilizer brace + Rigid taping Duration: Single application of each intervention	E1 vs E2 • Total Balance Score (+exp2) E1 vs E3 • Total Balance Score (-) E2 vs E3 • Total Balance Score (+exp2)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Orthotics

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Treadmill training with orthotic devices** may produce a greater improvement in motor function when compared to **treadmill training alone.**	1	In et al. 2017
2	**An ankle-foot orthosis** may produce a greater improvement in motor function when compared to **conentional tcare.**	1	Yeung et al. 2018
1b	**A toe spreader orthosis** may not produce a greater improvement in motor function when compared to **conventional care.**	1	Chiong et al. 2013
1b	**A standing frame assistive device** may not produce a greater improvement in motor function when compared to **conventional care.**	1	Bagley et al. 2005
2	**Shoe insert orthotics** may not have a difference in efficacy when compared to **conventional therapy** for improving motor function.	1	Aruin et al. 2012

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**

1a	**Taping** may produce greater improvements in functional ambulation when compared to **no tape or conventional therapy.**	10	Bae et al. 2022; Wang et al. 2022; In et al. 2021; Kurul et al. 2021; Choi et al. 2020; Chen et al. 2019; Sheng et al. 2019; Shin et al. 2019; Kim & Kang 2018; Maguire et al. 2010
1a	**Taping with electrical stimulation** may produce greater improvements in functional ambulation when compared to **electrical stimulation or taping alone.**	2	Bae et al. 2022; In et al. 2021
1a	**Shoe insole orthotics during walking** may produce greater improvements in functional ambulation when compared to **sham insole, no insole, overground walking, or conventional therapy.**	6	Liu et al. 2021; Fortes et al. 2020; Ferreira et al. 2018; Liao et al. 2018; Eckhardt et al. 2011; Sungkarat et al. 2011
1a	**An ankle-foot orthosis** may produce greater improvements in functional ambulation when compared to **sham ankle-foot orthosis or conventional therapy.**	7	Karpe et al. 2019; Yeung et al. 2018; Pomeroy et al 2016; Erel et al. 2011; Chen et al. 2010; SImons et al. 2009; De Wit et al. 2004
1b	**An anterior ankle-foot orthosis** may produce greater improvements in functional ambulation when compared to **a posterior ankle-foot orthosis.**	1	Chen et al. 2022
1b	**Treadmill training with orthotic devices** may produce greater improvements in functional ambulation when compared to **treadmill training alone.**	2	An et al. 2020; In et al. 2017
1b	**A wearable tubing assistive device** may produce greater improvements in functional ambulation when compared to **a conventional elastic band orthosis or no therapy.**	1	Lee et al. 2017
1b	**A single-point cane** may produce greater improvements in functional ambulation when compared to a **quad cane or hemi-walker.**	1	Jeong et al. 2015
1b	**A plastic or hybrid ankle-foot orthosis** may produce greater improvements in functional ambulation when compared to **barefoot.**	1	Do et al. 2014
2	**Level walking with an ankle-foot orthosis and trunk orthosis** may produce greater improvements in functional ambulation when compared to **level walking with an ankle-foot orthosis and lumbosacral orthosis.**	1	Katsuhira et al. 2018
2	**Neuromuscular electrical stimulation** may produce greater improvements in functional ambulation when compared to **an ankle-foot orthosis.**	1	Morone et al. 2012
2	**A carbon or custom plastic ankle-foot orthosis** may produce greater improvements in functional ambulation when compared to **no ankle-foot orthosis.**	1	Rao et al. 2014

2	**New body orthosis** may produce greater improvements in functional ambulation when compared to **no orthosis.**	1	Thijssen et al. 2007
2	**An arm sling** may produce greater improvements in functional ambulation when compared to **standing on a tilt table.**	1	Yavuzer & Ergin 2002
1b	There is conflicting evidence about the effect of **a walking cane, ankle-foot orthosis, and/or slider shoes** when compared to **walking with no device** for improving functional ambulation.	1	Tyson & Rogerson 2009
2	There is conflicting evidence about the effect of **an ankle-foot orthosis with balance training shoes** when compared to **an ankle-foot orthosis with regular shoes** for improving functional ambulation.	1	Farmani et al. 2016
1b	**Ambulation therapy with a laser cane** may not produce greater improvements in functional ambulation when compared to **a regular cane.**	1	Huang et al. 2022
1b	**A single-point cane** may not produce greater improvements in functional ambulation when compared to **stretching exercises.**	1	Avelino et al. 2021
1b	**Early use of ankle-foot orthosis** may not produce greater improvements in functional ambulation when compared to **late use of ankle-foot orthosis.**	3	Nikamp et al. 2019; Nikamp et al. 2018; Nikamp et al. 2017
1b	**Balance training with visual biofeedback** may not produce greater improvements in functional ambulation when compared to **a lateral wedge insole.**	1	Liao et al. 2018
1b	**A bespoke ankle-foot orthosis** may not produce greater improvements in functional ambulation when compared to **an off-the-shelf ankle-foot orthosis.**	1	Tyson et al. 2018
1b	**Ankle-foot orthosis with plantar stop** may not produce greater improvements in functional ambulation when compared to **an ankle-foot orthosis with plantar flexion resistance.**	1	Yamamoto et al. 2018
1b	**An arm sling with walk aid** may not produce greater improvements in functional ambulation when compared to **no support while walking with a walk aid.**	1	Jeong et al. 2017
1b	**Weight shift using a shoe insert** may not produce greater improvements in functional ambulation when compared to **conventional therapy.**	2	Sheikh et al. 2016; Aruin et al. 2012
1b	**Plastic ankle-foot orthosis made with polypropylene** may not produce greater improvements in functional ambulation when compared to **a hybrid ankle-foot orthosis made with polypropylene.**	1	Do et al. 2014
1b	**Toe spreader orthotics** may not produce greater improvements in functional ambulation when compared to **conventional care.**	1	Chiong et al. 2013

1b	**Chignon ankle-foot orthosis** may not produce greater improvements in functional ambulation when compared to **a standard ankle-foot orthosis**	1	De Seze et al. 2011
1b	**Wearing weight garments on the paretic side** may not produce greater improvements in functional ambulation when compared to **conventional care.**	1	Pomeroy et al. 2001
2	**Custom double-adjustable ankle-foot orthosis** may not produce greater improvements in functional ambulation when compared to **a standard ankle-foot orthosis.**	1	Karakkattil et al. 2020
2	**A carbon ankle-foot orthosis** may not produce greater improvements in functional ambulation when compared to **a custom plastic ankle-foot orthosis.**	1	Rao et al. 2014
2	**An ankle-foot orthosis with botulinum toxin treatment** may not produce greater improvements in functional ambulation when compared to **botulinum toxin alone.**	1	Farina et al. 2008
2	**A 5-degree wedge orthosis** may not produce greater improvements in functional ambulation when compared to **an 8.5 degree wedge orthosis or overground walking.**	1	Forghany et al. 2010
2	**Taping with botulinum toxin treatment** may not produce greater improvements in functional ambulation when compared to **botulinum toxin alone.**	1	Reiter et al. 1998

BALANCE

LoE	Conclusion Statement	RCTs	References
2	**A regent suit** may produce greater improvements in balance when compared to **conventional therapy.**	1	Iuppariello et al. 2018
2	**A knee immobilizer brace with foot lifter orthosis** may produce greater improvements in balance when compared to **a knee immobilizer brace alone or with rigid taping.**	1	Talu & Bazancir et al. 2017
2	**An arm sling** may produce greater improvements in balance when compared to **standing on a tilt table.**	1	Yavuzer & Ergin et al. 2002
1a	There is conflicting evidence about the effect of **shoe insole orthotics during walking** when compared to **a shame insole, overground walking, or conventional therapy.**	4	Liu et al. 2021; Liao et al. 2018; Ferreira et al. 2017; Sungkarat et al. 2011
1b	There is conflicting evidence about the effect **of shoe insert** orthotics to improve balance when compared to **conventional therapy or overground walking training.**	2	Fortes et al. 2020; Aruin et al. 2012
1b	There is conflicting evidence about the effect of **treadmill training with orthotic devices** when compared to **treadmill training alone** for improving balance.	1	In et al. 2017

1a	**Taping** may not produce greater improvements in balance when compared to **conventional therapy.**	6	Wang et al. 2022; Kurul et al. 2021; Cho et al. 2020; Choi et al. 2020; Park et al. 2020; Chen et al. 2019
1a	**Early ankle-foot orthosis use** may not produce greater improvements in balance when compared to **late ankle-foot orthosis use.**	2	Nikamp et al. 2019; Nikamp et al. 2017
1a.	**Ankle-foot orthoses (chignon, dynamic, plantar stop**) may not have a difference in efficacy when compared to **ankle foot orthotics (standard, rigid, anterior) or no orthotics** for improving balance.	4	Yamamoto et al. 2018; Lee et al. 2014; de Seze et al. 2011; de Wit et al. 2004
1b	**Ambulation therapy with a laser cane** may not produce greater improvements in balance when compared to **a regular cane.**	1	Huang et al. 2022
1b	**Balance training with visual biofeedback** may not produce greater improvements in balance when compared to **a lateral wedge insole.**	1	Liao et al. 2018
1b	**A bespoke ankle-foot orthosis** may not produce greater improvements in balance when compared to **an off-the-shelf ankle-foot orthosis.**	1	Tyson et al. 2018
1b	**An ankle-foot orthosis with plantar stop** may not produce greater improvements in balance when compared to **an ankle-foot orthosis with plantar flexion resistance.**	1	Yamamoto et al. 2018
1b	**An ankle-foot orthosis** may not produce greater improvements in balance when compared to **a sham ankle-foot orthosis or conventional therapy.**	4	Yeung et al. 2018; Lee et al. 2014; Erel et al. 2011; Simons et al. 2009
1b	**Toe-spreader orthotics** may not have a difference in efficacy when compared to **no orthotics** for improving balance.	1	Chiong et al. 2013
1b	**A chignon ankle-foot orthosis** may not produce greater improvements in balance when compared to **a standard ankle-foot orthosis.**	1	De Seze et al. 2011
1b	**A standing frame assistive device** may not produce greater improvements in balance when compared to **conventional care.**	1	Bagley et al. 2005
1b	**Wearing weight garments on the paretic side** may not produce greater improvements in balance when compared to **conventional care.**	1	Pomeroy et al. 2001
2	**Weight shift using a shoe insert** may not produce greater improvements in balance when compared to **conventional therapy.**	1	Aruin et al. 2012

GAIT

LoE	Conclusion Statement	RCTs	References
1a	**Ankle taping** may produce greater improvements in gait when compared to **no tape or conventional care**.	7	Bae et al. 2022; Wang et al. 2022; In et al. 2021; Mehraein et al. 2021; Choi et al. 2020;

			Sheng et al. 2019; Shin et al. 2019
1b	**Ankle taping with electrical stimulation** may produce greater improvements in gait when compared to **ankle taping or electrical stimulation alone.**	1	Bae et al. 2022
1b	**Treadmill training with orthotic devices** may produce greater improvements in gait when compared to **treadmill training alone.**	2	An et al. 2020; In et al. 2017
1b	**A wearable tubing assistive walking device** may produce greater improvements in gait when compared to **a conventional elastic band orthosis or no therapy.**	1	Lee et al. 2017
2	**An ankle-foot orthosis with plantar flexion resistance** may produce greater improvements in gait when compared to **a standard shoe.**	1	Daryabor et al. 2021
2	**Level walking with an ankle-foot orthosis and trunk orthosis** may produce greater improvements in gait when compared to **level walking with an ankle-foot orthosis and lumbosacral orthosis.**	1	Katsuhira et al. 2018
2	**A carbon or custom plastic ankle-foot orthosis** may produce greater improvements in gait when compared to **no ankle-foot orthosis.**	1	Rao et al. 2014
2	**A new body orthosis** may produce greater improvements in gait when compared to **no orthosis**.	1	Thijssen et al. 2007
2	There is conflicting evidence about the effect of **an arm sling** when compared to **standing on a tilt table** for improving gait.	1	Yavuzer & Ergin 2002
1a	**Shoe insole orthotics during walking** may not produce greater improvements in gait when compared to **sham or no insole, overgroundst walking, or conventional therapy.**	4	Ferreira et al. 2018; Ferreira et al. 2017; Eckhardt et al. 2011; Sungkarat et al. 2011
1a	**An ankle-foot orthosis** may not produce greater improvements in gait when compared to **sham or no orthosis, or conventional therapy.**	4	Yeung et al. 2018; Pomeroy et al. 2016; Zissimopoulos et al. 2015; Chen et al. 2010
1b	**Ambulation therapy with a laser cane** may not produce greater improvements in gait when compared to **a regular cane.**	1	Huang et al. 2022
1b	**A single-point cane** may not produce greater improvements in gait when compared to **stretching exercises.**	1	Avelino et al. 2021
1b	**A bespoke ankle-foot orthosis** may not produce greater improvements in gait when compared to **an off-the-shelf ankle-foot orthosis.**	1	Tyson et al. 2018
1b	**An ankle-foot orthosis with plantar stop** may not produce greater improvements in gait when compared to **an ankle-foot-orthosis with plantar flexion resistance or a standard shoe.**	2	Daryabor et al. 2021Yamamoto et al. 2018

1b	**A weight shifting shoe insert** may not have a difference in efficacy when compared to **conventional therapy** for improving gait.	2	Wheikh et al. 2016; Aruin et al. 2012
1b	**A plastic ankle-foot orthosis made with polypropylene** may not produce greater improvements in gait when compared to **a hybrid ankle-foot-orthosis made with polypropylene or barefoot.**	1	Do et al. 2014
1b	**Wearing weight garments on the paretic side** may not produce greater improvements in gait when compared to **conventional care.**	1	Pomeroy et al. 2001
2	**A custom double-adjustable ankle-foot orthosis** may not produce greater improvements in gait when compared to **a standard ankle-foot orthosis.**	1	Karakkattil et al. 2020
2	**A solid ankle-foot orthosis** may not produce greater improvements in gait when compared to **a dynamic ankle-foot orthosis or no orthosis.**	1	Zollo et al. 2015
2	**A carbon ankle-foot orthosis** may not produce greater improvements in gait when compared to **a custom plastic ankle-foot orthosis.**	1	Rao et al. 2014
2	**An anterior ankle-foot orthosis** may not produce greater improvements in gait when compared to **a posterior or no ankle-foot orthosis.**	1	Chen et al. 2010
2	**Ankle taping with botulinum toxin** may not produce greater improvements in gait when compared to **botulinum toxin alone.**	1	Reiter et al. 1998

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1b	**Early use of ankle-foot orthosis** may have a difference in efficacy for improving performance on activities of daily living when compared to **late use of ankle-foot orthosis.**	1	Nikamp et al. 2017
2	**A regent suit** may have a difference in efficacy for improving performance on activities of daily living when compared to **conventional therapy.**	1	Iuppariello et al. 2018
1b	**Ambulation therapy with a laser cane** may not have a difference in efficacy for improving performance on activities of daily living when compared to **a regular cane**	1	Huang et al. 2022
1b	**A single-point cane** may not have a difference in efficacy for improving performance on activities of daily living when compared to **stretching exercises.**	1	Avelino et al. 2021
1b	**Night splinting** may not have a difference in efficacy for improving performance on activities of daily living when compared to **standing on a tilt table.**	1	Robinson et al. 2018
1b	**Chignon ankle-foot orthotics** may not have a difference in efficacy when compared to **standard**	1	De Seze et al. 2011

	ankle-foot orthotics for improving performance on activities of daily living.		
1b	**Bivalve casts or pressure relieving ankle-foot orthosis** may not have a difference in efficacy when compared to **conventional therapy** for improving performance on activities of daily living.	1	DeMeyer et al. 2015
1b	**A standing frame assistive device** may not have a difference in efficacy for improving performance on activities of daily living when compared to **conventional care.**	1	Bagley et al. 2005
2	**Ankle taping** may not have a difference in efficacy for improving performance on activities of daily living when compared to **placebo, no tape, or conventional therapy.**	1	Kurul et al. 2021
2	**Neuromuscular electrical stimulation** may not have a difference in efficacy for improving performance on activities of daily living when compared to **an ankle-foot orthosis.**	1	Morone et al. 2012

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Taping with electrical stimulation** may produce greater improvements in range of motion when compared to **electrical stimulation or taping alone.**	1	Bae et al. 2022
1b.	**Shoe insert orthotics** may produce greater improvements in range of motion when compared **to overground walking**	1	Forghany et al. 2012
2	There is conflicting evidence on the effect of **ankle taping with botulinum toxin** when compared to **botulinum toxin alone** for improving range of motion.	1	Reiter et al. 1998
1a	**Shoe insole orthotics during walking** may not produce greater improvements in range of motion when compared to **sham or no insole, overground walking, or conventional therapy.**	2	Ferreira et al. 2018; Ferreira et al. 2017
1b	**Anterior ankle-foot orthotics** may not produce greater improvements in range of motion when compared to **posterior ankle-foot orthotics.**	1	Chen et al. 2022
1b	**An ankle-foot orthosis with plantar stop** may not produce greater improvements in range of motion when compared to **an ankle-foot orthosis with plantar flexion resistance.**	1	Yamamoto et al. 2018
1b	**Visual biofeedback with orthotic devices** may not produce greater improvements in range of motion when compared to **sham feedback.**	1	Tamburella et al. 2017
1b	**Bivalve casts or pressure-relieving ankle-foot orthosis** may not have a difference in efficacy when compared to **conventional therapy** for improving range of motion.	1	DeMeyer et al. 2015

1b	**An ankle-foot orthosis** may not produce greater improvements in range of motion when compared to **sham or no ankle-foot orthosis, or conventional care.**	1	Zissimopoulos et al. 2015
1b	**A night splint** may not produce greater improvements in range of motion when compared to **standing on a tilt table.**	1	Robinson et al. 2008
2	**An ankle-foot orthosis with plantar stop** may not produce greater improvements in range of motion when compared to **an ankle-foot orthosis with plantar flexion resistance or standard shoe.**	1	Daryabor et al. 2021
2	**Level walking with an ankle-foot orthosis and trunk orthosis** may not produce greater improvements in range of motion when compared to **level walking with an ankle-foot orthosis and lumbosachral orthosis.**	1	Katsuhira et al. 2018

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Ankle taping with electrical stimulation** may produce greater improvements in spasticity when compared to **electrical stimulation or taping alone.**	1	In et al. 2021
1b	**Visual biofeedback with orthotic devices** may produce greater improvements in spasticity when compared to **sham feedback.**	1	Tamburella et al. 2017
2	**An ankle-foot orthosis with botulinum toxin** may produce greater improvements in spasticity when compared to **botulinum toxin alone.**	1	Farina et al. 2008
1b	**Anterior ankle-foot orthotics** may not produce greater improvements in spasticity when compared to **posterior ankle-foot orthotics.**	1	Chen et al. 2022
1b	**Bivalve casts and pressure-relieving ankle-foot orthosis** may not have a difference in efficacy when compared to **conventional therapy** for improving spasticity.	1	DeMeyer et al. 2015
1b	**Chignon ankle-foot orthotics** may not have a difference in efficacy when compared to **standard ankle-foot orthotics** for improving spasticity.	1	De Seze et al. 2011
1b.	**Toe-spreader orthotics** may not have a difference in efficacy when compared to **no orthotics** for improving spasticity	1	Chiong et al. 2013
2	**An ankle-foot orthosis** may not produce greater improvements in spasticity when compared to **sham or no ankle-foot orthosis or conventional therapy**.	1	Yeung et al. 2018
2	**Neuromuscular electrical stimulation** may not produce greater improvements in spasticity when compared to **an ankle-foot orthosis.**	1	Morone et al. 2012

2	**Ankle taping with botulinum toxin** may not produce greater improvements in spasticity when compared to **botulinum toxin alone.**	1	Reiter et al. 1998

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1b	**Ankle taping with electrical stimulation** may produce greater improvements in muscle strength when compared to **electrical stimulation or taping alone.**	1	In et al. 2021
2	**A 5-degree and 8.5-degree wedge orthosis** may produce greater improvements in muscle strength when compared to **overground walking.**	1	Forghany et al. 2010
1b	**A chignon ankle-foot orthosis** may not produce greater improvements in muscle strength when compared to **a standard ankle-foot orthosis.**	1	De Seze et al. 2011
2	**Neuromuscular electrical stimulation** may not produce greater improvements in muscle strength when compared to **an ankle-foot orthosis.**	1	Morone et al. 2012

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1b	**Early ankle-foot orthosis use** may not produce greater improvements in functional mobility when compared to **late ankle-foot orthosis use.**	1	Nikamp et al. 2017
1b	**An ankle-foot orthosis** may not produce greater improvements in functional mobility when compared to **a sham or no ankle-foot orhtosis, or conventional therapy.**	1	Pomeroy et al. 2016
1b	**A standing frame assistive device** may not produce greater improvements in functional mobility when compared to **conventional care.**	1	Bagley et al. 2005

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
1b	**A single-point cane** may not produce greater improvements in the quality of life when compared to **stretching exercises.**	1	Avelino et al. 2021
1b	**A toe spreader orthosis** may not produce greater improvements in the quality of life when compared to **conventional care.**	1	Chiong et al. 2013

STROKE SEVERITY

LoE	Conclusion Statement	RCTs	References

2	**A regent suit** may produce greater improvements in stroke severity when compared to **conventional care.**	1	Iuppariello et al. 2018

Key Points

Ankle-foot orthoses (chignon, dynamic, plantar stoop) may not be beneficial in post stroke lower extremity rehabilitation.

Hippotherapy

Adopted from: https://strokerecoveryfoundation.org

Hippotherapy utilizes the natural gait and rhythmic, repetitive movements of a horse to provide motor and sensory input, such inputs are similar to the movement pattern of the pelvis when a person is walking (Cunningham, 2009; Koca & Ataseven, 2015). As a result, hippotherapy has garnered attention as a rehabilitative method for lower limb stroke recovery.

Six RCTs were found evaluating hippotherapy for lower extremity motor rehabilitation. Three RCTs compared hippotherapy to conventional therapy (Kim & Lee, 2015; Lee & Kim, 2015; Sung et al., 2013). One RCT compared hippotherapy to trunk training (Baek & Kim, 2014). One RCT compared hippotherapy to treadmill training (Lee et al., 2014a). One RCT compared hippotherapy or music and rhythm-based therapy to no treatment (Bunketorp-Kall et al., 2017).

The methodological details and results of all six RCTs are presented in Table 14.

Table 14. RCTs Evaluating Hippotherapy Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) **Study Design (PEDro Score)** **Sample Size start** **Sample Size end** **Time post stroke category**	**Interventions** **Duration: Session length, frequency per week for total number of weeks**	**Outcome Measures** **Result (direction of effect)**
Hippotherapy vs Conventional Therapy or No Treatment		
Kim & Lee (2015) RCT (4) Nstart=20 Nend=20 TPS=Chronic	E: Hippotherapy C: No Treatment Duration: 30min/d, 5d/wk for 6wks	• 10-Meter Walk Test (+exp) • Berg Balance Scale (+exp) • Modified Barthel Index (+exp)
Lee & Kim (2015) RCT (6) Nstart=30 Nend=30 TPS=Chronic	E: Hippotherapy C: Conventional therapy Duration: 30min/d, 5d/wk for 6wk	• Berg Balance Scale (+exp) • Timed Up & Go Test (+exp)

Sung et al. (2013) RCT (4) Nstart=20 Nend=20 TPS=Chronic	E: Hippotherapy stimulator + conventional rehabilitation C: Conventional rehabilitation Duration: 60min/d, 5d/wk for 4wk	• Surface EMG during sit to stand (+exp) • Step length (-) • Stance phase (-) • Swing phase (-) • Single support (+exp) • Load response (+exp) • Pre-swing (+exp) • Cadence (-) • Total double support (+exp)
Hippotherapy or Rhythm and Music-Based Therapy vs No Treatment		
Bunketorp-Käll et al. (2017) RCT (8) Nstart=123 Nend=117 TPS=Chronic	E1: Rhythm- and Music-based therapy E2: Horse-riding therapy C: No treatment Duration: 2d/wk, for 12wks	E1/E2 vs C: • Stroke Impact Scale (+exp1, +exp2) • Timed Up and Go Test (+exp 2) • Berg Balance Scale (+exp 2) • Bäckstrand, Dahlberg and Liljenäs Balance Scale (+exp1, +exp2) • Grip Strength o Right Hand Final (-) o Right Hand Mean (-) o Right Hand Max (+exp1) o Left Hand Final (+exp1) o Left Hand Mean (-) o Left Hand Max (-) • Barrow Neurological Institute Screen (+exp1) • Letter Number Sequencing (+exp1)
Hippotherapy vs Trunk Training Therapy		
Baek et al. (2014) RCT (3) Nstart=30 Nend=30 TPS=Not Reported	E: Hippotherapy + Central nervous system development therapy C: Trunk training + Central nervous system development therapy Duration: 1h/d, 3d/wk for 8wks	• Static Balance (+exp) • Muscle Thickness (-)
Hippotherapy vs Treadmill Training		
Lee et al. (2014a) RCT (4) Nstart=30 Nend=30 TPS=Not Reported	E: Hippotherapy C: Treadmill training Duration: 30min/d, 3d/wk for 8wks	• Step length asymmetry ratio (+exp) • Berg Balance Scale (-) • Gait speed (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Hippotherapy

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **hippotherapy** to improve functional ambulation when compared to **conventional therapy or no treatment.**	3	Bunketorp-Kall et al. 2017; Kim & Lee 2015; Lee & Kim 2015
2	**Hippotherapy** may produce greater improvements in functional ambulation compared to **treadmill training.**	1	Lee et al. 2014

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Hippotherapy** may produce greater improvements in balance compared to **conventional therapy or no treatment.**	3	Bunketorp-Kall et al. 2017; Kim & Lee 2015; Lee & Kim et al. 2015
2	**Hippotherapy** may produce greater improvements in balance compared to **trunk training.**	1	Baek et al. 2014
2	**Hippotherapy** may not have a difference in efficacy compared to **treadmill training** for improving balance.	1	Lee et al. 2014

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	There is conflicting evidence about the effect of **hippotherapy** to improve gait when compared to **conventional therapy or no treatment.**	1	Sung et al. 2013
2	**Hippotherapy** may produce greater improvements in gait than **treadmill training.**	1	Lee et al. 2014

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Hippotherapy** may produce greater improvements in activities of daily living compared to **conventional therapy or no treatment.**	1	Kim & Lee 2015

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Hippotherapy** may produce greater improvements in quality of life compared to **conventional therapy or no treatment.**	1	Kim & Lee 2015

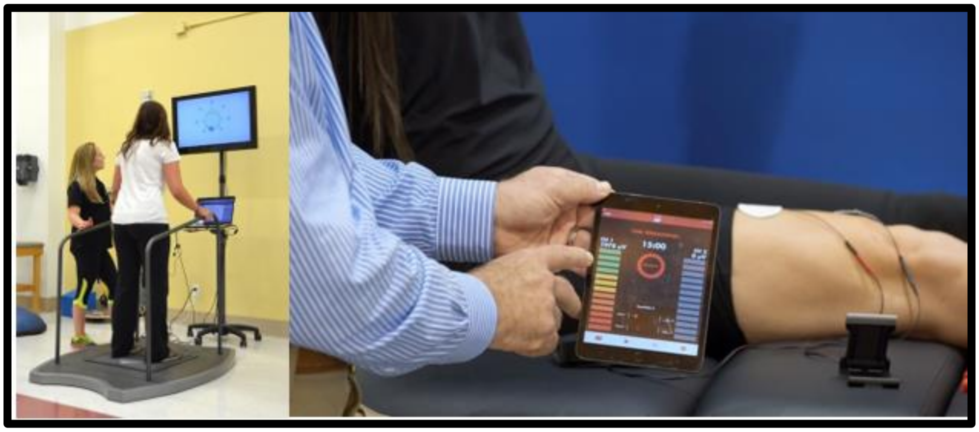
MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**

2	**Hippotherapy** may not have a difference in efficacy compared to **trunk training therapy** for improving muscle strength.	1	Baek et al. 2014

Key Points

Hippotherapy may be beneficial for improving balance, quality of life, and activities of daily living, while the literature is mixed regarding hippotherapy for improving functional ambulation and gait following stroke.

Biofeedback



Adopted from: http://aim2walk.ca/stabilometric-platform/ ; https://mikereinold.com/why-you-should-be-using-biofeedback-in-rehabilitation/

Table 15. Classification of Biofeedback used for stroke rehabilitation (Giggins et al., 2013)

Biofeedback category	Subcategories	Examples
Biomechanical	Movement Postural Control Force	• Inertial sensors • Force plates • Electrogoimeters • Pressure biofeedback units • Camera based systems • Physiotherapist comments
Physiological	Neuromuscular system	• EMG biofeedback • Real time ultrasound imagining biofeedback
	Cardiovascular system	• Heart rate biofeedback • Heart rate variability biofeedback
	Respiratory system	• Breathing electrodes and sensors that convert breathing to auditory and visual signals

Biofeedback is a longstanding technique used within rehabilitation that involves providing real-time biological information to patients as a form of augmented or extrinsic feedback during rehabilitation (Giggins et al. 2013). Feedback provided is extrinsic as opposed to intrinsic because additional information is provided beyond self-generated information from intrinsic sensory receptors (Giggins et al. 2013). Providing additional and detailed feedback to patients during rehabilitation may produce a positive impact on their learning and performance through improving accuracy during functional tasks and increasing engagement during rehabilitation (Giggins et al., 2013; Johnson et al., 2013).

There are two strategies through which biofeedback is relayed to the user. The first option is through direct feedback, in which a physiological measurement such as heart rate is displayed (Giggins et al. 2013). The second way is through transformed feedback, in which measurements are used to inform and produce an auditory, visual, or tactile feedback signal (Giggins et al. 2013).

Biofeedback can be classified most broadly into biomechanical or physiological categories (Table 15). Biomechanical feedback can be further broken down based on measurements of movement, postural control, and force (Giggins et al. 2013). Physiological feedback can be broken down based on measurements of the neuromuscular, cardiovascular, and respiratory systems (Giggins et al. 2013).

Electromyography (EMG) biofeedback therapy uses surface electrodes to detect changes in skeletal muscle activity, which is then transformed to a visual or auditory feedback signal (Giggins et al 2013). It is used to increase activity within a paretic muscle or can be used to reduce tone in a spastic muscle (Giggins et al. 2013).

A total of 58 RCTs were found evaluating feedback for lower extremity motor rehabilitation.

Three RCTs compared gait training with visual feedback to gait training alone or conventional therapy (Byl et al., 2015; Kim & Oh, 2020; Pignolo et al., 2020). Five RCTs compared treadmill training with visual biofeedback to treadmill training alone (Brasileiro et al., 2015; Druzbicki et al., 2015; Drużbicki et al., 2016a; Druzbicki et al., 2018; Drużbicki et al., 2016b). Four RCTs compared gait training with activity feedback to gait training alone or conventional therapy (Danks et al., 2016; Dorsch et al., 2015; Mansfield et al., 2015; Phonthee et al., 2020). Three RCTs compared gait training with postural control visual feedback to gait training alone or EMG biofeedback (Balci et al., 2013; Khallaf et al., 2014; Mandel et al., 1990). Five RCTs compared trunk training with visual biofeedback to conventional therapy (Chae et al., 2011; Chung et al., 2014; Jung et al., 2017b; Shin, 2020; Shin & Song, 2016). Ten RCTs compared rehabilitation with EMG biofeedback to conventional therapy (Bradley et al., 1998; Burnside et al., 1982; Cozean et al., 1988; Dost Surucu & Tezen, 2021; Gamez et al., 2019; Intiso et al., 1994; Jonsdottir et al., 2010; Mulder et al., 1986; Tsaih et al., 2018; Xu et al., 2015). One RCT compared training with the Lokomat to galvanic vestibular stimulation or physiotherapy with visual feedback (Krewer et al., 2013). One RCT compared balance training with computer-based visual feedback to mirror feedback (Yang et al., 2015). One RCT compared cycling training with biofeedback to conventional rehabilitation (Yang et al., 2014). Eight RCTs compared overground gait training with auditory feedback to gait training alone (Aruin et al., 2003; Cha et al., 2018; Choi et al., 2019; Dobkin et al., 2010; Jung et al., 2015; Jung et al., 2020a; Ki et al., 2015; Sungkarat et al., 2011). One RCT compared verbal feedback during walking to tactile feedback during walking (Ploughman et al., 2018). Three RCTs investigated biofeedback combined with sit-to-stand training (Cheng et al., 2001; Engardt & Knutsson, 1994; Hyun et al., 2021). Five RCTs compared balance training with biofeedback to balance training alone or conventional therapy (Elshinnawy et al., 2021; Hung et al., 2016; Liao et al., 2018; Lupo et al., 2018; Maciaszek et al., 2014). Two RCTs compared target or reach visual feedback training to conventional rehabilitation (Khumsapsiri et al., 2018; Pak & Lee, 2020). One RCT compared strength training with visual feedback to physical therapy (Cho et al., 2021). One RCT compared perceptual feedback to conventional treatment (Morioka & Yagi, 2003). Two RCTs compared robot-assisted gait training with biofeedback to no biofeedback or conventional biofeedback (Maggio et al., 2021; Tamburella et al., 2019). One RCT compared visual biofeedback with orthotic devices to sham feedback (Tamburella et al., 2017). One RCT compared neurofeedback to sham feedback (Lee et al., 2015b).

The methodological details and results of all 58 RCTs are presented in Table 16.

Table 16. RCTs Evaluating Biofeedback Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Gait Training with Visual Feedback vs Gait Training or Conventional Therapy		
Kim et al. (2020) RCT (5) Nstart=30 Nend=24 TPS=Chronic	E: Visual performance feedback training during overground walking + conventional physical therapy C: Overground walking without feedback + conventional physical therapy Duration: 30min/d overground walking & 60min/d physical therapy, 3d/wk, 6wk	• Timed Up and Go test (+exp) • Step length (+exp) • Stride length (+exp) • Single support time on affected side (+exp) • Double support time (-) • Walking velocity (+exp) • Step length ratio (-) • Stride length ratio (+exp) • Single support time ratio (+exp)
Pignolo et al. (2020) RCT (7) Nstart=66 Nend=63 TPS=Subacute	E1: Gait training sessions using the computerized body-weight-support system with real-time interactive visual feedback E2: Gait training sessions using the computerized body-weight-support system without visual feedback C: Neuromotor conventional treatment Duration: 2hr, 5d/wk, 6wks conventional therapy in control group & 60min gait training + 60min conventional therapy, 5d/wk, 6wks for intervention groups	E1 vs E2/C • Tinetti balance scales (+exp1) • Functional Independence Measures (+exp1) • Trunk Control Test (-) • Motricity Index (-) • Fugl-Meyer Lower Extremities scale test (-) • Static gait balance (+exp1)
Byl et al. (2015) RCT (4) Nstart=24 Nend=23 TPS=Chronic	E: Gait training enhanced with visual kinematic biofeedback C: Gait training Duration: 90min, 12sessions over 6-8wk	• 10-Metre Walk Test (-) • Step length (-) • 6-Minute walk test (-) • Dynamic Gait Index (-) • Tinetti Gait Scale (-) • Timed Up and Go Test (-) • Five times Sit-to-Stand test (-) • Berg Balance Scale (-) • Strength LE (-) • Range of motion (-)
Treadmill Training with Visual Biofeedback vs Treadmill Training		
Druzbicki et al. (2018) RCT (7) Nstart=30 Nend=30 TPS=Acute	E: Body weight support treadmill training + visual biofeedback C: Body weight support treadmill training Duration: 30min/d, 5d/wk for 3wks	• Stance phase ○ Paretic (-) ○ Non paretic (-) • Symmetry Index ○ Stance Phase (-) ○ Swing Phase (-) ○ Step Length (+exp) • Swing phase ○ Paretic (-) ○ Non paretic (-) • Cadence (-) • Gait speed (-) • Step length

		○ Paretic (-) ○ Non paretic (-) • 10-metre walk test (+exp) • 2-minute walk test (+exp) • Timed Up and Go (-)
Druzbicki et al. (2016a) RCT (8) Nstart=30 Nend=30 TPS=Chronic	E: Treadmill training + visual biofeedback + physiotherapy exercises C: Treadmill training + physiotherapy exercises Duration: 90min/d, 5d/wk for 2wk	• Step length ○ Paretic side (-) ○ Non paretic side (-) • Stance phase ○ Paretic side (-) ○ Non paretic side (-) • Swing phase ○ Paretic side (-) ○ Non paretic side (-) • Range of motion Hip ○ Paretic side (-) ○ Non paretic side (-) • Range of motion Knee ○ Paretic side (-) ○ Non paretic side (-)
Druzbicki et al. (2016b) RCT (7) Nstart=46 Nend=46 TPS=Chronic	E: Treadmill training with Gait Trainer 2 Biodex biofeedback (30-45min/d) + Conventional individual exercises C: Treadmill training without biofeedback + Conventional individual exercises Duration: 70min/d (30-45min/d treadmill training + individual exercises), 5d/wk, 12d	• Static balance (-) • Timed Up and Go (-) • Center of Pressure Length ○ Eyes Open (-) ○ Eyes Closed (-) • Sway Area ○ Eyes Open (-) ○ Eyes Closed (-) • Center of Pressure in Mediolateral Range Scalar with ○ Eyes Open (-) ○ Eyes Closed (-) • Center of Pressure in Anterioposterior Range Scalar with ○ Eyes Open (-) ○ Eyes Closed (-) • Symmetry ratio of lower limb load (-)
Brasileiro et al. (2015) RCT (6) Nstart=30 Nend=30 TPS=Chronic	E1: Partial body-weight support treadmill training + Visual biofeedback E2: Partial body-weight support treadmill training + Auditory biofeedback C: Partial body-weight support treadmill training Duration: 20min/1session	<u>E1/E2 vs C</u> • Speed (-) • Stride length (-) • Cadence (-) • Stance time (-) • Symmetry ratio (-) • Max hip extension during stance (-) • Max hip flexion during swing (-) • Hip range of motion (-) • Knee angle at initial contact (-) • Max knee flexion during swing (-) • Knee range of motion (-) • Ankle angle at initial contact (-) • Ankle angle at toe-off (-) • Ankle range of motion (-)
Druzbicki et al. (2015) RCT (7) Nstart=50 Nend=50 TPS=Chronic	E: Treadmill training + visual biofeedback + basic physiotherapy C: Treadmill training + basic physiotherapy	• 10-Metre Walk Test (-) • 2-Minute Walk Test (-) • Timed Up & Go Test (-) • Cadence (-) • Gait velocity (-) • Swing phase ○ Paretic (-)

	Duration: 150min/d, 5d/wk, 2wks	○ Non paretic (+exp) • Stance phase ○ Paretic (-) ○ Non paretic (+exp) • Length of gait cycle ○ Paretic (-) ○ Non paretic (+exp) • Barthel Index (-)
Gait Training with Activity Feedback vs Gait Training or Conventional Therapy		
Phonthee et al. (2020) RCT (7) Nstart=39 Nend=36 TPS=Chronic	E: Stepping Training with External Feedback C: Stepping Training Alone Duration: 40min, 5d/wk, 4wks	• Lower limb support period (+exp) • Single limb support period (affected) (+exp) • Timed Up and Go Test (+exp) • 10-Meter Walk Test (-) • 6-Minute Walk Test (-) • Step length (affected/non-affected) (-) • Step length symmetry (-)
Danks et al. (2016) RCT (4) Nstart=37 Nend=27 TPS=Chronic	E: Fast Walking training (FAST) + Step activity monitoring (SAM) program C: Fast Walking training (FAST) Duration: 30min/d, 3d/wk, 12wks	• Steps per Day (-) • Total Time Walking Per Day (-) • 10-Meter Walk Test ○ Self-selected speed (-) ○ Maximal speed (-) • 6-Minute-Walk Test: Distance (+exp)
Dorsch et al. (2015) RCT (6) Nstart=151 Nend=125 TPS=Acute	E1: Gait training with Augmented Accelerometer feedback (speed and activity) C: Gait training with Accelerometer feedback on speed only Duration: variable duration, received feedback 3d/wk	• 15m Walking speed (-) • 3-minute walking distance (-) • Functional Ambulatory category (-) • Stroke Impact Scale-16 (-)
Mansfield et al. (2015) RCT (8) Nstart=60 Nend=57 TPS=Acute	E: Accelerometer-based feedback + Walking training C: Walking training without feedback Duration: 60min/d, 5d/wk	• Total walking duration (-) • Total number of steps (-) • Cadence (+exp) • Longest bout duration (-) • Number of long walking bouts (-) • Gait data ○ Walking speed (+exp) ○ Step length symmetry (-) ○ Swing time symmetry (-) ○ Step length variability (-) ○ Step time variability (+exp) ○ Step width variability (-) • Stroke self-efficacy (-)
Gait Training with Postural Control Visual Feedback vs Gait Training or EMG Biofeedback		
Khallaf et al. (2014) RCT (5) Nstart=16 Nend=16 TPS=Chronic	E: Gait training with postural control visual feedback on monitor + task specific exercises C: Gait training + physiotherapy Duration: 90min/d, 5d/wk, 8wks Exercises Treatment Group & 50min/d, 5d/wk, 8wks Exercises Control Group	• Foot placement/contact during walking (+exp)
Balci et al. (2013) RCT (6) Nstart=25 Nend=25	E1: Vestibular rehabilitation (consisted of eye-head coordination exercises, balance and ambulation exercises)	<u>E2 vs E1 vs C</u> • Berg Balance scale (-) • Timed Up and Go test (-)

TPS=Acute	E2: Visual feedback: Posturography Training C: Usual Home Exercise Duration: 10min, 2-3sessions/d (20-30min/d), 6wks vestibular rehabilitation & 25-30min, 3d/wk, 6wks visual feedback training & 20-30min/d, 6wks usual home exercise	• Dizziness Handicap inventory (-) • Dynamic gait index (-) • Center of Gravity ○ Sway Velocity (-) ○ Limit of Stability (-)
Mandel et al. (1990) RCT (3) Nstart=37 Nend=37 TPS=Chronic	E1: Electromyographic with novel biofeedback E2: Electromyographic with novel biofeedback for 6wks, then rhythmic positional novel biofeedback for last 6wks C: No treatment Duration: 12wks	E2 vs C • Gait speed (+exp2) E1 vs E2/C • Passive plantar flexor torque (-) • Borg RPE (-)
Trunk Training with Visual Biofeedback vs Conventional Therapy		
Shin et al. (2020) RCT(7) Nstart=24 Nfinal=24 TPS=Chronic	E: Smartphone-based visual feedback trunk control training + Conventional rehabilitation C: Conventional Rehabilitation Duration: 50min/d, 5d/wk, 4wk Conventional Rehabilitation	• Trunk Impairment Scale (+exp) • Velocity (+exp) • Cadence (+exp) • Stride length (+exp) • Stride Time (+exp) • Step length (+exp) • Step width (+exp) • Step time (+exp) • Double Limb support (+exp)
Jung et al. (2017) RCT (6) Nstart=46 Nend=43 TPS=Chronic	E: Trunk stabilization exercises + audiovisual biofeedback (Pressure biofeedback unit) C: Trunk stabilization exercises Duration: 50min/d, 5d/wk,6wks	• Thickness of trunk muscles ○ TrA-affected (+exp) ○ TrA-unaffected (+exp) ○ IO-affected (-) ○ IO-unaffected (-) ○ EO-affected (+con) ○ EO-unaffected (+con) • Symmetric ratio (-) • Static sitting balance ability (+exp) • Dynamic sitting balance ability (+exp)
Shin & Song (2016) RCT (6) Nstart=24 Nend=24 TPS=Chronic	E: Smartphone visual feedback for trunk control training + Conventional care C: Conventional care Duration: 80min/d conventional care + 20min/d Smartphone therapy, 5d/wk, 4wks	• Timed Up and Go (+exp) • Static balance ○ Eyes closed (+exp) ○ Eyes open (+exp) • Trunk Impairment scale (+exp) • Modified Functional reach test (+exp)
Chung et al. (2014) RCT (4) Nstart=26 Nend=19 TPS=Chronic	E: Core stability exercises + real time feedback + conventional physical therapy C: Core stability exercises + conventional physical therapy Duration: 30min/session, 3d/wk for 6wks	• Timed Up and Go test (+exp) • Gait velocity (+exp) • Gait cadence (-) • Affected side ○ Stride length (+exp) ○ Step length (-) ○ Single support time (+exp) ○ Double support time (-) • Non-affected side ○ Stride length (+exp) ○ Step length (-) ○ Single support time (-) ○ Double support time (-)

Chae et al. (2011) RCT (5) Nstart=21 Nend=21 TPS=Chronic	E: Spinal stabilization exercise + postural control visual biofeedback C: Conventional rehabilitation Duration: 30min/d, 5d/wk for 8wks	• Gait speed (-) • Cadence (-) • Step length (-) • Step length asymmetry ratio (-) • Single support time (-) • Functional Ambulation Category (-)
Rehabilitation with EMG biofeedback vs Conventional Therapy		
Dost Surucu & Tezen (2021) RCT (4) Nstart=40 Nend=40 TPS=Subacute	E: EMG biofeedback + Conventional physical therapy C: Conventional physical therapy Duration: 20min/d, 5d/wk, 3wks EMG biofeedback	• Modified Ashworth scale (+exp) • Active dorsiflexion ankle range of motion (+exp) • Brunnstrom recovery stages (+exp) • Modified Motor assessment scale ○ Sitting to standing (+con) ○ Walking (+con) • EMG activity of Tibialis Anterior (+exp)
Gamez et al. (2019) RCT (6) Nstart=40 Nend=28 TPS=Acute	E: Surface electromyography-biofeedback (sEMG-B) + conventional care C: Conventional care Duration: 60min/d, 2d/wk, for 12wks	• Mean activity of EMG signals ○ Upper limb hemiparetic side (+exp) ○ Upper limb normal side (-) ○ Lower limb hemiparetic side (+exp) ○ Lower limb normal side (+exp) • Barthel Index (+exp) • Fugl Meyer Assessment ○ Upper limb (-) ○ Lower limb (+exp) • Isometric strength of the wrist (-) • Daniels and Worthingham's muscle testing (-) • Kendall's Manual Muscle Test (-) • Lovett's test (-)

Tsaih et al., 2018 RCT (7) Nstart= 33 Nend = 33 TPS= Chronic	E1: Constant-force EMG-biofeedback Tibalis anterior training + general Physiotherapy E2: Variable-force EMG-biofeedback Tibalis anterior training + general Physiotherapy C: Upper extremity exercise + general Physiotherapy Duration: 40min/d, 3d/wk for 6wks	E1/E2 v C • Single support time (-) • Functional Ambulation Category (-) • Berg Balance scale (+exp) • Fall Efficacy scale (+exp) • Tibialis Anterior Muscle strength (+exp1, +exp2) • Limit of stability: ○ Anterior (-) ○ Posterior (+exp1) E1 v E2 • Tibialis Anterior Muscle strength (-) • Limit of stability ○ Anterior (-) ○ Posterior (+exp2) • Timed Up and Go (-) • 6min Walk test (-) • 10m Walk (-)
Xu et al. (2015) RCT (5) Nstart=40 Nend=40 TPS=Subacute	E: Comprehensive rehabilitation + EMG biofeedback C: Conventional rehabilitation Duration: 20min/d, 5d/wk EMG & 40min/d, 5d/wk comprehensive rehabilitation	• Fugl-Meyer Assessment (+exp) • Functional Ambulation Category (+exp) • Integrated Electromyography of Gastrosnemius (+exp)
Jonsdottir et al. (2010) RCT (7) Nstart=20 Nend=20 TPS=Chronic	E: Rehabilitation + EMG biofeedback C: Conventional rehabilitation Duration: 45min/d, 3d/wk, 6wks (20 sessions totally)	• Gait speed (+exp) • Stride length (+exp) • Ankle power (+exp) • Knee flexion (-)
Bradley et al. (1998) RCT (4) Nstart=23 Nend=19 TPS=Acute	E: EMG biofeedback + conventional physical therapy C: Sham biofeedback + conventional physical therapy Duration: If inpatients: 3d/wk EMG + PT and 2d/wk PT only & If discharged: 3d/wk EMG + PT, 18sessions/ 6wks.	• Modified Bobath Scale (-) • Modified Ashworth Scale (-) • Sensation and Proprioception (-) • 10 metre walk test ○ Time in seconds (-) ○ Number of steps (-) • Step Length (-) • Stride Width (-) • Foot angle (-) • Rivermead Mobility Index (-) • Nottingham Extended ADL index (-) • Mental Status Questionnaire (-) • National Adult Reading Test (-) • Ravens' Coloured Progressive Matrices (-) • Rey Auditory Verbal Learning Test (-) • Rey Osterrieth Figure Copying Test (-) • Token Test (-)
Intiso et al. (1994) RCT (6) Nstart=16 Nend=14 TPS=Chronic	E: EMG biofeedback training + conventional physiotherapy C: Conventional physiotherapy Duration: 60min/d, 7d/wk, 8wks physiotherapy & 30 sessions EMG-biofeedback	• Step length (-) • Gait velocity (-) • Ankle dorsiflexion (foot drop) recovery in swing phase (+exp)
Cozean et al. (1988) RCT (6) Nstart=36 Nend=32	E1: Rehabilitation + EMG biofeedback E2: Rehabilitation + Functional electrical stimulation	E1/E2/E3 vs C • Knee flexion (+exp3) • Ankle dorsiflexion (+exp3) • Stride length (-)

TPS=Chronic	E3: Rehabilitation + EMG biofeedback + Functional electrical stimulation C: Conventional rehabilitation Duration: 30min/d, 3d/wk for 6wk	• Cycle time (+exp3)
Mulder et al. (1986) RCT (4) Nstart=12 Nend=12 TPS=Chronic	E: Motor relearning + EMG biofeedback C: Motor relearning Duration: 40min/d, 3d/wk for 5wk	• EMG activity (-) • Gait velocity (-) • Range of motion (-)
Burnside et al. (1982) RCT (6) Nstart=22 Nend=22 TPS=Chronic	E: Rehabilitation + EMG biofeedback C: Conventional rehabilitation Duration: 15min/d, 2d/wk for 6wk	• Muscle strength (+exp) • Active range of motion (-) • Basmajian Gait Rating Scale (-) •
Lokomat Training vs Galvanic Vestibular Stimulation or Physiotherapy with Visual Feedback		
Krewer et al. (2013a) RCT Crossover (5) Nstart=25 Nend=24 TPS=Chronic	E1: Galvanic vestibular stimulation E2: Lokomat gait training E3: Physiotherapy with visual feedback Duration: 20min session – 1d washout	E1 vs E2/E3: • Burke Lateropulsion Scale (-) • Scale for Contraversive Pushing (-) E2 vs E3: • Burke Lateropulsion Scale (+exp2) • Scale for Contraversive Pushing (-)
Balance Training with Computer-based Visual Feedback vs Mirror Feedback		

Yang et al. (2015)
RCT (7)
Nstart=12
Nend=12
TPS=Subacute
	E: Computer-generated interactive visual feedback balance training + Physical therapy
	C: Mirror visual feedback balance training + Physical therapy
	Duration: 20min/d - Balance training, 20min/d - Physical therapy, 3d/wk, 3wks
		• Pusher syndrome severity (+exp)
		• Berg Balance Scale (+exp)
		• Fugl-Meyer assessment
		  ○ Upper extremity (-)
		  ○ Lower extremity (-)

Cycling Training with Biofeedback vs Conventional Rehabilitation		
Yang et al. (2014) RCT crossover (7) Nstart=31 Nend=30 TPS=Chronic	E: Conventional Rehabilitation + Cycling training + biofeedback C: Conventional Rehabilitation (CR) Duration: 30min/d for 4wks Cycling ; 120min/d for 4wks Conventional rehabilitation – no washout	• Fugl-Meyer assessment-lower limb (+exp) • 6min Walk test (+exp) • 10m Walk Test (+exp) • Modified Ashworth Scale (+exp)
Overground Gait Training with Auditory Feedback vs Gait Training		

Jung et al., (2020)
RCT (7)
Nstart=20
Nfinal=20
TPS=Chronic
	E: Gait training (walking overground) + auditory feedback + conventional exercise
	C: Gait training (walking overground) + conventional exercise
	Duration: 60 mins, 5d/wk, 4 wks
		• Peak vertical force on cane (+exp)
		• EMG (Muscle activation % peak activity) (+exp)
		• Trunk impairment scale (-):
		  ○ Static (-)
		  ○ Dynamic (-)
		  ○ Coordination (-)
		• Timed Up and Go Test (+exp)

Choi et al. (2019) RCT (6) Nstart=24 Nend=24 TPS=Chronic	E1: Gait training with auditory feedback caused by active weight bearing on their paralyzed foot E2: General gait training over the ground Duration: 20min gait intervention + 30min conventional rehabilitation, 3x/wk, for 6wks	• 10m walk test (+exp) • Functional gait assessment (+exp) • Timed up and go test (+exp) • Center of pressure path length (+exp)
Cha et al., (2018) RCT (8) Nstart= 31 Nend = 31 TPS= Chronic	E1: Gait training by active weight bearing on the paretic heel with auditory feedback + Conventional therapy E2: Gait training by active weight bearing on the paretic metatarsals with auditory feedback + Conventional therapy C: General gait intervention + Conventional therapy Duration: 30min, 3d/wk, 6wks conventional therapy & 20min, 3d/wk, 6wks gait training	E1,/E2 vs C • 10-metre walking test (-) • Functional gait assessment(+exp2) • Timed Up and Go test (-) • Center of loading- path length: ○ Eyes open (+exp1, +exp2) ○ Eyes closed (-) • Center of loading- path velocity: ○ Eyes open (+exp1, +exp2) ○ Eyes closed (-)
Jung et al. (2015) RCT (7) Nstart=22 Nend=21 TPS=Chronic	E: Gait training + Auditory feedback from cane + Conventional rehabilitation C: Gait training + Conventional rehabilitation Duration: 30min/d, 5d/wk for 4wks – Conventional rehabilitation	• Walking speed (+exp) • Single limb support phase (+exp) • Surface EMG ○ Gluetus medius (+exp) ○ Vastus medialis oblique (+exp)
Ki et al. (2015) RCT (3) Nstart=30 Nend=30 TPS=Chronic	E: Overground gait training + Auditory feedback C: Gait training Duration: 1hr/d, 5d/wk for 6wk	• Timed Up and Go Test (+exp) • Stance Phase (+exp) • Single Leg Stance (+exp)
Sungkarat et al. (2011) RCT (7) Nstart=40 Nend=35 TPS=Subacute	E: Gait training with Insole Shoe Wedge and Sensors + Auditory feedback + Conventional rehabilitation C: Conventional gait training + Conventional rehabilitation Duration: 30min/d, 5d/wk for 3wks - Conventional rehabilitation, 30min/d, 5d/wk for 3wks - Gait training	• Gait speed (+exp) • Step length asymmetry ratio (+exp) • Single support time asymmetry ratio (+exp) • Berg balance scale (+exp) • Timed up and go (+exp) • Loading on paretic leg during stance (+exp)
Dobkin et al. (2010) RCT (7) Nstart=179 Nend=162 TPS=Acute	E: Gait training + positive reinforcement about walking speed C: Gait training Duration: 4wk	• Gait speed (+exp) • Walking distance (-) • Functional Ambulation Classification (-)
Aruin et al. (2003) RCT (3) Nstart=16 Nend=16	E: Gait training + Auditory feedback C: Conventional gait therapy	• Step Width (+exp)

TPS=Acute	Duration: 25min (2sessions/d), for 10d	
Verbal Feedback During Walking vs Tactile Feedback During Walking		
Ploughman et al. (2018) RCT crossover (7) N_{start}=10 N_{end}=10 TPS=Subacute	E1: Verbal Cues and Feedback During Walking E2: Tactile Cues and Feedback During Walking Duration: Single Session, 7-10 day washout	• Gait Velocity (+exp2) • Cadence (+exp2) • Step Length Symmetry (-) • Double support time (+exp2) • Hip kinematics (-) • Knee kinematics (-) • Ankle kinematics (-) • EMG muscle activity ○ Gluteus maximum (-) ○ Gluteus medius (-) ○ Vastus lateralis (+exp1) ○ Medial hamstrings (-) ○ Tibialis anterior (-) ○ Medial gastrocnemius (+exp1)
Biofeedback combined with sit-to-stand training		
Cheng et al. (2001) RCT (5) Nstart=54 Nend=48 TPS=Subacute	E: Standing postural symmetry training with a visual and auditory biofeedback trainer + repetitive sit-to-stand training+ conventional rehabilitation C: Conventional rehabilitation Duration: 30min/d postural training & 20min/d sit-to-stand training, 5d/wk for 3wks	• Sit-to-stand performance (+exp) • Rate of falls (+exp)
Hyun et al. (2021) RCT (5) Nstart=40 Nend=30 TPS=Subacute	E: Sit-to-stand training + visual feedback with Wii Balance Board + Standard physiotherapy C: Sit to Stand Training + Standard physiotherapy Duration: 20min/d, 5d/wk, for 6 wks sit-to-stand training & 30min/d, 5d/wk, for 6wks physiotherapy	• Berg Balance Scale (+exp) • 10-meter walking test (+exp) • Timed Up and Go test (+exp) • Stroke-Specific Quality of Life (+exp) • Manual muscle Strength test of the Lower Extremities ○ Hip flexor (+exp) ○ Hip abductor (+exp) ○ Knee extensor (+exp) • Centre of Pressure (+exp)
Engardt & Knutsson, (1994) RCT (5) Nstart=40 Nend=36 TPS=Subacute	E: Continuous Auditory Feedback During Sit to Stand Training C: No Feedback During Sit to Stand Training Duration: 15min, 3sessions/d, 5d/wk, 6wks	• Peak Torque ○ Knee Flexion (-) ○ Knee Extension (-)
Balance Training with Biofeedback vs Balance Training or Conventional Therapy		
Elshinnawy et al. (2022) RCT (7) Nstart=56 Nend=56 TPS=Chronic	E: Visual biofeedback training + Conventional rehabilitation C: Conventional rehabilitation Duration: 15min visual biofeedback & 50min/d, 3d/wk for 24 sessions conventional rehabilitation	• Overall index stability (+exp) • Anterior/posterior index (+exp) • Medial-lateral index (+exp)
Liao et al. (2018) RCT (8) Nstart=56	E1: Routine rehabilitation + Balance training + Visual biofeedback	E1/E2 vs C

Nend=51 TPS=Chronic	E2: Routine rehabilitation program + lateral wedge insole C: Routine rehabilitation program Duration: 20min/d, 3d/wk, 6wks balance training & 6 wks usual standing and walking with the show insole	• Balance computerized adaptive test (+exp1, +exp2) • Timed up and go (TUG) (+exp1, +exp2) <u>E1 vs E2</u> • Balance computerized adaptive test (-) • Timed up and go (TUG) (-)
Lupo et al. (2018) RCT (7) Nstart=15 Nend=15 TPS=Subacute	E: Biofeedback Balance training (RIABLO training) C: Conventional balance training Duration: 20min/d, 3d/wk, 10 sessions total	• Berg Balance scale (+exp) • Rivermead mobility index (-) • Modified Barthel index (-) • NIH Stroke scale (+exp) • Canadian Neurological scale (-) • Center of pressure (+exp)

Hung et al. (2016)
RCT (5)
Nstart=27
Nend=23
TPS=Chronic
	E: Tetrax biofeedback balance training + Conventional care
	C: Conventional care
	Duration: 100min/d, 3d/wk Conventional care & 20min/d, 3d/wk for 6wks Tetrax balance training
		• Physiologic Profile Assessment
		  ○ Proprioception (+exp)
		  ○ Muscle strength (-)
		  ○ Reaction time (+exp)
		  ○ Postural sway area (-)
		• Weight bearing (+exp)
		• Timed Up and Go (+exp)
		• Forward reach distance (-)

Maciaszek et al. (2014) RCT (6) Nstart=21 Nend=21 TPS=Subacute	E: Biofeedback training on posturographic platform C: Standard hospital treatment Duration: 15d	• Timed Up and Go test (+exp)
Target or Reach Visual Feedback Training vs Conventional Rehabilitation		

Pak et al. (2020)
RCT (4)
Nstart=30
Nend=21
TPS=Chronic
	E: Visual feedback training with visual targets + conventional rehabilitation
	C: Visual feedback training on weight shifting + conservative physiotherapy
	Duration: 30min/d conventional rehabilitation & 60min/d visual feedback training, 5d/wk, for 4wks
		• EMG muscle activity
		  ○ Rectus femoris (-)
		  ○ Gluteus medius (+exp)
		  ○ Tensor fascia lata (-)
		  ○ Biceps femoris (-)
		• Lateral reach test (-)
		• Velocity (-)
		• Path length (-)
		• Affected side weight bearing (+exp)
		• 10-Metre Walk Test (-)

Khumsapsiri et al. (2018)
RCT (8)
Nstart=16
Nend=14
TPS=Chronic
	E: Multidirectional reach training with visual feedback + conventional physical therapy
	C: Conventional physical therapy
	Duration: 30min/d, 3d/wk for 4wks multidirectional training & 30min/d, 3d/wk for 4 wks conventional therapy
		• Passive joint speed (-)
		• Limits of Stability (+exp)
		• Movement velocity (-)
		• Endpoint excursion
		  ○ Forward EE (% LOS) (-)
		  ○ Forward EE fractional difference (-)
		  ○ Backward EE (% LOS) (-)
		  ○ Backward EE fractional difference (+exp)
		  ○ Affected side EE (% LOS) (-)
		  ○ Affected side EE fractional difference (-)
		  ○ Less affected side EE (% LOS) (-)
		  ○ Less affected side EE fractional difference (+exp)
		• Maximum excursion
		  ○ Forward ME (% LOS) (-)

		◦ Forward ME fractional difference (-) ◦ Backward ME (% LOS) (-) ◦ Backward ME fractional difference (-) ◦ Affected side ME (% LOS) (-) ◦ Affected side ME fractional difference (-) ◦ Less affected side ME (% LOS) (-) ◦ Less affected side ME fractional difference (+exp) • Weight-bearing squat ◦ 0° (% body weight) fractional difference (+exp) ◦ 30° (% body weight) fractional difference (+exp) ◦ 60° (% body weight) fractional difference (-) ◦ 90° fractional difference (+exp) • Fullerton Advanced Balance scale (+exp)
Strength Training with Visual Feedback vs Physical Therapy		
Cho et al. (2021) RCT (8) Nstart=25 Nend=23 TPS=Chronic	E: Bi-axial ankle-resistive strengthening muscle training + visual feedback C: Ankle Physical therapy Duration: 40min/d, 5d/wk, 4 wks	• Fugl-Meyer Assessment lower extremity score (+exp) • Berg balance Scale (-) • 10-meter walking test (-) • Ankle co-contraction index ◦ Dorsiflexion (+exp) ◦ Plantarflexion (+exp) ◦ Inversion (+exp) ◦ Eversion (+exp) ◦ Ankle proprioception (-) ◦ Ankle co-activation index (+exp)
Perceptual Feedback vs Conventional Treatment		
Morioka et al. (2003) RCT (6) Nstart=28 Nend=26 TPS=Subacute	E: Perceptual learning exercises by feedback from hardness discrimination (sensory training) + Conventional therapy C: Conventional therapy Duration: 5d/wk for 2wks sensory training exercises	• Postural sway when eyes open ◦ Locus length (+exp) ◦ Enveloped area (+exp) ◦ Rectangular area (-) • Postural sway when eyes closed ◦ Locus length (-) ◦ Enveloped area (-) ◦ Rectangular area (-)
Robot-Assisted Gait Training with Biofeedback vs No Biofeedback or Conventional Biofeedback		
Maggio et al. (2021) RCT (6) Nstart=45 Nend=45 TPS=Subacute	E: Robot-Assisted Gait Training + Visuomotor feedback C: Robot-Assisted Gait Training Duration: 60min/d, 5d/wk, 8wks	• Body-esteem scale (+exp) • Body Uneasiness Test-A ◦ Global Severity Index (-) ◦ Weight Phobia (+exp) ◦ Body Image Concern (-) ◦ Avoidance (+exp) ◦ Compulsive self-monitoring (-) ◦ Depersonalization (+exp) • Body Uneasiness Test-B ◦ Positive Symptom Total (+exp) ◦ Positive Symptom Distress Index (+exp) ◦ I Mouth (+exp) ◦ II Face shape (+exp) ◦ III Thighs (+exp) ◦ IV Legs (+exp)

		○ V Arms (+exp) ○ VI Moutsache (-) ○ VII Skin (-) ○ VIII Blushing (-) • Fugl-Meyer assessment (+exp) • Frontal assessment battery (-) • Montreal Cognitive assessment (-) • Beck Depression Inventory (-) • Short form-12 ○ Total (-) ○ Physical Health (-) ○ Mental Health (-) • EEG (+exp)
Tamburella et al. (2019) RCT crossover (5) Nstart=12 Nend=10 TPS=Subacute	E: Lokomat robotic training + EMG biofeedback + Conventional therapy C: Lokomat robotic training + Commercial joint torque biofeedback + Conventional therapy Duration: 40min/d, 5d/wk for 6 session - Conventional therapy, 40min/d, 3d/wk for 6 sessions - Lokomat with EMG, 40min/d, 3d/wk for 6 sessions - Lokomat with Joint torque feedback	• Modified Ashworth scale hip (-) ○ Knee (-) ○ Ankle (-) • Manual Muscle test: ○ Hip (-) ○ Knee (-) ○ Ankle (-) • Functional Ambulation category (-) • Visual Analogue scale-pain (-) • Barthel index (-) • Berg Balance scale (-) • Trunk Control test (-)
Visual Biofeedback with Orthotic Devices vs Sham Feedback		
Tamburella et al. (2017) RCT (7) Nstart=10 Nend=10 TPS=Subacute	E: Ankle treatment + biomechanical visual biofeedback (using an active sensorized AFO) C: Ankle treatment + an inactive sensorized AFO (sham) Duration: 60min/d, 5d/wk, 6wks	• Active/passive ankle ROM (-) • Modified Ashworth Scale (+exp) • Coactivation index (+exp) • Active joint speed (+exp) • Passive joint speed (-)
Neurofeedback vs Sham		
Lee et al. (2015) RCT (6) Nstart=25 Nend=20 TPS=Subacute	E: Neurofeedback + Conventional care C: Sham neurofeedback + Conventional care Duration: 30min/d, 3x/wk for 8wks	• Sensorimotor rhythm wavs (+exp) • 10m Dual Task Test (+exp) • 10m walk velocity (+exp) • Cadence (+exp) • Stance phase (-) • Plantar foot pressure ○ Entire foot (+exp) ○ Forefoot (+exp) ○ Hindfoot (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Biofeedback

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Gait training with visual biofeedback** may not have a difference in efficacy compared to **conventional therapy or gait training alone** for improving motor function.	1	Pignolo et al. 2020
1b	**Rehabilitation with EMG biofeedback** may produce greater improvements in motor function compared to **conventional therapy.**	4	Dost Surucu & Tezen 2021; Gamez et al. 2019; Xu et al. 2015; Bradley et al. 1998
1b	**Balance training with computer-based visual feedback** may not have a difference in efficacy compared to **mirror feedback** for improving motor function.	1	Yang et al. 2015
1b	**Cycling training with biofeedback** may produce greater improvements in motor function compared to **conventional rehabilitation.**	1	Yang et al. 2014
1b	**Strength training with visual feedback** may produce greater improvements in motor function compared to **physical therapy.**	1	Cho et al. 2021
1b	**Robot-assisted gait training with biofeedback** may produce greater improvements in motor function compared to **no feedback or conventional feedback.**	1	Maggio et al. 2021

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Gait training with visual feedback** may not have a difference in efficacy when compared to **gait training or conventional therapy** for improving functional ambulation**.**	2	Kim et al. 2020; Byl et al. 2015
1a	**Treadmill training with visual biofeedback** may not have a difference in efficacy when compared to **treadmill training** for improving functional ambulation.	4	Druzbicki et al. 2018; Druzbicki et al. 2016b; Druzbicki et al. 2015; Brasileiro et al. 2015
1b	**Treadmill training with auditory biofeedback** may not have a difference in efficacy when compared to **treadmill training** for improving functional ambulation.	1	Brasileiro et al. 2015
1b	**Gait training with activity feedback** may not have a difference in efficacy when compared to **gait training or conventional therapy** for improving functional ambulation.	4	Phonthee et al. 2020; Danks et al. 2016; Dorsch et al. 2015; Mansfield et al. 2015
1b	**Gait training with postural control visual feedback** may not have a difference in efficacy when compared to **gait training or EMG biofeedback** for improving functional ambulation.	1	Balci et al. 2013

1b	**Postural control visual feedback** may not have a difference in efficacy when compared to **vestibular rehabilitation** for improving functional ambulation.	1	Balci et al. 2013
2	**EMG with biofeedback with rhythmic positional feedback** may produce greater improvements in functional ambulation compared to **no treatment.**	1	Mandel et al. 1990
1b	There is conflicting evidence about the effect of **trunk training with visual biofeedback** to improve functional ambulation when compared to **conventional therapy.**	4	Shin et al. 2020; Shin & Song 2016; Chung et al. 2014; Chae et al. 2011
1b	**Rehabilitation with EMG biofeedback** may not have a difference in efficacy when compared to **conventional therapy** for improving functional ambulation.	6	Tsaih et al. 2018; Xu et al. 2015; Jonsdottir et al. 2010; Bradley et al. 1998; Intiso et al. 1994; Mulder et al. 1986
1b	**Constant force EMG biofeedback** may not have a difference in efficacy when compared to **variable force EMG biofeedback** for improving functional ambulation.	1	Tsaih et al. 2018
1b	**Cycling training with biofeedback** may produce greater improvements in functional ambulation compared to **conventional rehabilitation.**	1	Yang et al. 2014
1a	There is conflicting evidence about the effect of **overground gait training with auditory feedback** to improve functional ambulation when compared to **gait training.**	6	Jung et al. 2020; Choi et al. 2019; Cha et al. 2018; Ki et al. 2015; Sungkarat et al. 2011; Dobkin et al. 2010
1b	**Verbal feedback during walking** may not have a difference in efficacy when compared to **tactile feedback during walking** for improving functional ambulation.	1	Ploughman et al. 2018
2	**Biofeedback with sit-to-stand training** may produce greater improvements in functional ambulation compared to **conventional rehabilitation or no feedback.**	2	Hyun et al. 2021; Cheng et al. 2001
1b	**Balance training with biofeedback** may produce greater improvements in functional ambulation compared to **balance training or conventional therapy.**	3	Liao et al. 2018; Hung et al. 2016; Maciaszek et al. 2014
1b	**Balance training with biofeedback** may not have a difference in efficacy when compared to **conventional therapy with lateral wedge insole** for improving functional ambulation.	1	Liao et al. 2018
1b	**Target or reach visual feedback training** may not have a difference in efficacy when compared to **conventional rehabilitation** for improving functional ambulation.	2	Pak et al. 2020; Khumsapsiri et al. 2018
1b	**Strength training with visual feedback** may not have a difference in efficacy when compared to **physical therapy** for improving functional ambulation.	1	Cho et al. 2021

2	**Robot-assisted gait training with biofeedback** may not have a difference in efficacy when compared to **no biofeedback or conventional biofeedback** for improving functional ambulation.	1	Tamburella et al. 2019
1b	**Neurofeedback** may produce greater improvements in functional ambulation compared to **sham feedback.**	1	Lee et al. 2015

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Rehabilitation with EMG biofeedback** may not have a difference in efficacy compared to **conventional therapy** for improving functional mobility.	1	Bradley et al. 1998
1b	**Balance training with biofeedback** may not have a difference in efficacy compared to **conventional therapy or balance training** for improving functional mobility.	1	Lupo et al. 2018

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Gait training with visual biofeedback** may not have a difference in efficacy compared to **gait training alone or conventional therapy** for improving balance.	2	Pignolo et al. 2020; Byl et al. 2015
1b	**Treadmill training with visual biofeedback** may not have a difference in efficacy compared to **treadmill training** for improving balance.	1	Druzbicki et al. 2016b
1b	**Gait training with postural control visual feedback** may not have a difference in efficacy compared to **gait training or EMG biofeedback** for improving balance.	1	Balci et al. 2013
1b	**Postural control visual feedback** may not have a difference in efficacy compared to **vestibular rehabilitation** for improving balance.	1	Balci et al. 2013
1a	**Trunk training with visual biofeedback** may produce greater improvements in balance when compared to **conventional therapy.**	3	Shin et al. 2020; Jung et al. 2017; Shin & Song 2016
1b	**Rehabilitation with EMG biofeedback** may produce greater improvements in balance when compared to **conventional therapy.**	1	Tsaih et al. 2018
2	**Galvanic vestibular stimulation** may not have a difference in efficacy compared to **physiotherapy with visual feedback** for improving balance.	1	Krewqer et al. 2013a
2	There is conflicting evidence about the effect of **Lokomat gait training** compared to **physiotherapy with visual feedback** for improving balance.	1	Krewqer et al. 2013a
1b	There is conflicting evidence about the effect of **constant force EMG biofeedback** compared to	1	Tsaih et al. 2018

	variable force EMG biofeedback for improving balance.		
1b	**Balance training with computer-based visual feedback** may produce greater improvements in balance when compared to **mirror feedback.**	1	Yang et al. 2015
1a	There is conflicting evidence about the effect of **overground gait training with auditory feedback** compared to **gait training** for improving balance.	5	Jung et al. 2020; Choi et al. 2019; Cha et al. 2018; Ki et al. 2015; Sungkarat et al. 2011
2	**Biofeedback with sit-to-stand training** may produce greater improvements in balance when compared to **conventional rehabilitation or no feedback.**	2	Hyun et al. 2021; Cheng et al. 2001
1b	**Balance training with biofeedback** may produce greater improvements in balance when compared to **balance training or conventional therapy.**	4	Elshinnawy et al. 2022; Lupo et al. 2018; Liao et al. 2018; Hung et al. 2016
1b	**Balance training with biofeedback** may not have a difference in efficacy compared to **conventional therapy with lateral wedge insole** for improving balance.	1	Liao et al. 2018
1b	There is conflicting evidence about the effect of **target or reach visual feedback training** compared to **conventional rehabilitation** for improving balance.	2	Pak et al. 2020; Khumsapsiri et al. 2018
1b	**Strength training with visual feedback** may not have a difference in efficacy compared to **physical therapy** for improving balance.	1	Cho et al. 2021
1b	**Perceptual feedback** may not have a difference in efficacy compared to **conventional treatment** for improving balance.	1	Morioka et al. 2003
2	**Robot-assisted gait training with biofeedback** may not have a difference in efficacy compared to **conventional biofeedback or no biofeedback** for improving balance.	1	Tamburella et al. 2019
1b	There is conflicting evidence about the effect of **neurofeedback** compared to **sham feedback** for improving balance.	1	Lee et al. 2015

GAIT

LoE	Conclusion Statement	RCTs	References
2	There is conflicting evidence about the effect of **gait training with visual feedback** when compared to **gait training or conventional therapy** for improving gait	2	Kim et al. 2020; Byl et al. 2015
1a	**Treadmill training with visual biofeedback** may not have a difference in efficacy compared to **treadmill training** for improving gait.	4	Druzbicki et al. 2018; Druzbicki et al. 2016a; Druzbicki et al. 2015; Brasileiro et al. 2015
1b	**Treadmill training with auditory biofeedback** may not have a difference in efficacy compared to **treadmill training** for improving gait.	1	Brasileiro et al. 2015

1a	**Gait training with activity feedback** may not have a difference in efficacy compared to **gait training or conventional therapy** for improving gait.	2	Ponthee et al. 2020; Mansfield et al. 2015
1b	There is conflicting evidence about the effect of **gait training with postural control visual feedback** when compared to **gait training or EMG biofeedback** for improving gait.	1	Khallaf et al. 2014; Balci et al. 2013
1b	**Postural control visual feedback** may not have a difference in efficacy compared to **vestibular rehabilitation** for improving gait.	1	Balci et al. 2013
1b	There is conflicting evidence about the effect of **trunk training with visual biofeedback** when compared to **conventional therapy** for improving gait.	3	Shin et al. 2020; Chung et al. 2014; Chae et al. 2011
1b	**Rehabilitation with EMG biofeedback** may not have a difference in efficacy compared to **conventional therapy** for improving gait.	3	Tsaih et al. 2018; Jonsdottir et al. 2010; Bradley et al. 1998; Intiso et al. 1994; Cozean et al. 1988; Burnside et al. 1982
1b	There is conflicting evidence about the effect of **rehabilitation with EMG biofeedback and FES** when compared to **conventional therapy** for improving gait.	1	Cozean et al. 1988
1b	**Overground gait training with auditory feedback** may produce greater improvements in gait when compared to **gait training.**	6	Choi et al. 2019; Cha et al. 2018; Jung et al. 2015; Ki et al. 2015; Sungkarat et al. 2011; Aruin et al. 2003
1b	**Verbal feedback during walking** may not have a difference in efficacy compared to **tactile feedback during walking** for improving gait.	1	Ploughman et al. 2018
2	**Balance training with biofeedback** may produce greater improvements in gait when compared to **balance training alone or conventional therapy.**	1	Hung et al. 2016
2	**Target or reach visual feedback training** may produce greater improvements in gait when compared to **conventional rehabilitation.**	1	Pak et al. 2020
1b	There is conflicting evidence about the effect of **neurofeedback** when compared to **sham feedback** for improving gait.	1	Lee et al. 2015

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1b	**Gait training with visual feedback** may produce greater improvements in activities of daily living when compared to **conventional therapy or gait training alone.**	1	Pignolo et al. 2020
1b	**Treadmill training with visual biofeedback** may not have a difference in efficacy compared to **treadmill training alone** for improving activities of daily living.	1	Druzbicki et al. 2015

1b	**Gait training with activity feedback** may not have a difference in efficacy compared to **gait training or conventional therapy** for improving activities of daily living.	1	Mansfield et al. 2015
1b	**Rehabilitation with EMG biofeedback** may not have a difference in efficacy compared to **conventional therapy** for improving activities of daily living.	3	Dost Surucu & Tezen 2021; Gamez et al. 2019; Bradley et al. 1998
1b	**Balance training with biofeedback** may not have a difference in efficacy compared to **balance training alone or conventional therapy** for improving activities of daily living.	1	Lupo et al. 2018
2	**Robot-assisted gait training with biofeedback** may not have a difference in efficacy compared to **no biofeedback or conventional biofeedback** for improving activities of daily living.	1	Tamburella et al. 2019

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Gait training with visual feedback** may not have a difference in efficacy when compared to **gait training alone or conventional therapy** for improving range of motion.	1	Byl et al. 2015
1a	**Treadmill training with visual feedback** may not have a difference in efficacy when compared to **treadmill training** for improving range of motion.	2	Druzbicki et al. 2016a; Brasileiro et al. 2015
1b	**Treadmill training with auditory feedback** may not have a difference in efficacy when compared to **treadmill training** for improving range of motion.	1	Brasileiro et al. 2015
1b	**Rehabilitation with EMG biofeedback** may not have a difference in efficacy when compared to **conventional therapy** for improving range of motion.	3	Dost Surucu & Tezen 2021; Mulder et al. 1986; Burnside et al. 1982
1b	**Visual biofeedback with orthotic devices** may not have a difference in efficacy when compared to **sham feedback** for improving range of motion.	1	Tamburella et al. 2017

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Gait training with visual feedback** may not have a difference compared to **gait training or conventional therapy** for improving muscle strength.	2	Pignolo et al. 2020; Byl et al. 2015
2	**EMG with biofeedback and rhythmic positional feedback** may not have a difference compared to **EMG biofeedback alone** for improving muscle strength.	1	Mandel et al. 1990

2	**EMG with biofeedback** may not have a difference compared to **no treatment** for improving muscle strength.	1	Mandel et al. 1990
1b	**Trunk training with visual biofeedback** may not have a difference compared to **conventional therapy** for improving muscle strength.	1	Jung et al. 2017
1a	There is conflicting evidence about the effect of **rehabilitation with EMG biofeedback** when compared to **conventional therapy** for improving muscle strength.	3	Gamez et al. 2019; Tsaih et al. 2018; Burnside et al. 1982
1b	**Constant force EMG biofeedback** may not have a difference compared to **variable force EMG biofeedback** for improving muscle strength.	1	Tsaih et al. 2018
2	**Biofeedback during sit-to-stand** may not have a difference compared to **conventional rehabilitation or no feedback** for improving muscle strength.	1	Hyun et al. 2021; Engardt & Knutsson 1994
1b	**Target or reach visual feedback training** may not have a difference compared to **conventional rehabilitation** for improving muscle strength.	1	Khumsapsiri et al. 2018
1b	**Strength training with visual feedback** may produce greater improvements in muscle strength when compared to **physical therapy.**	1	Cho et al. 2021
2	**Robot-assisted gait training with biofeedback** may not have a difference compared to **no biofeedback or conventional biofeedback** for improving muscle strength.	1	Tamburella et al. 2019

SPASTICITY

LoE	Conclusion Statement	RCTs	References
2	There is conflicting evidence about the effect of **rehabilitation with EMG biofeedback** when compared to **conventional therapy** for improving spasticity.	2	Dost Surucu & Tezen 2021; Bradley et al. 1998
1b	**Biofeedback while cycling** may produce greater improvements in spasticity when compared to **conventional rehabilitation.**	1	Yang et al. 2015
2	**Robot-assisted gait training with biofeedback** may not have a difference compared to **no biofeedback or conventional biofeedback** for improving spasticity.	1	Tamburella et al. 2019
1b	**Visual biofeedback with orthotic devices** may produce greater improvements in spasticity when compared to **sham feedback.**	1	Tamburella et al. 2017

PROPRIOCEPTION

LoE	Conclusion Statement	RCTs	References

2	**Rehabilitation with EMG biofeedback** may not have a difference in efficacy when compared to **conventional therapy** for improving proprioception.	1	Bradley et al. 1998
1b	**Strength training with visual feedback** may not have a difference in efficacy when compared to **physical therapy** for improving proprioception.	1	Cho et al. 2021

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **rehabilitation with EMG biofeedback** when compared to **conventional therapy** for improving stroke severity.	1	Lupo et al. 2018

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Gait training with activity feedback** may not have a difference in efficacy when compared to **gait training or conventional therapy** for improving quality of life.	1	Dorsch et al. 2015
1b	**Gait training with postural control visual feedback** may not have a difference in efficacy when compared to **gait training or EMG biofeedback** for improving quality of life.	1	Balci et al. 2013
1b	**Postural control visual feedback** may not have a difference in efficacy when compared to **vestibular rehabilitation** for improving quality of life.	1	Balci et al. 2013
2	**Biofeedback with sit-to-stand training** may not have a difference in efficacy when compared to **conventional rehabilitation or no feedback** for improving quality of life.	1	Hyun et al. 2021
1b	**Robot-assisted gait training with biofeedback** may not have a difference in efficacy when compared to **conventional biofeedback or no biofeedback** for improving quality of life.	1	Maggio et al. 2021

Key Points

Combining different types of biofeedback with rehabilitation training may not be beneficial in improving functional mobility, activities of daily living, range of motion, muscle strength, proprioception, and quality of life after stroke.

The literature is mixed regarding the effect of different types of biofeedback combined with rehabilitation trainings on improving motor function, functional ambulation, balance, gait, and spasticity after stroke, and the effect is widely dependent on the type of biofeedback and the type of training.

Dual-Task Training (cognitive-motor interference)

Adapted from: https://link.springer.com/chapter/10.1007/978-3-030-23762-2_40

Dual-tasking training requires subjects to simultaneously perform complex tasks, such as cognitive and motor tasks, allowing them to improve their coordination of various tasks (Kim et al., 2014a). Cognitive-motor tasks are important for various activities of daily living, such as walking while holding a conversation (Liu et al., 2017). Additionally, dual tasks can be two motor tasks to allow for different motor processes to occur simultaneously to further stimulate the damaged brain.

24 RCTs were found evaluating dual-task training interventions for lower extremity motor rehabilitation. Five RCTs compared dual motor tasks to conventional therapy (Iqbal et al., 2020; Kannan et al., 2019; Liu et al., 2017; Park & Lee, 2019; Yang et al., 2007). Nine RCTs looked at dual motor task interventions compared to single task training (Baek et al., 2021; Cho et al., 2015b; Choi et al., 2015c; Durfee et al., 2011; Fishbein et al., 2019; Meester et al., 2019; Pang et al., 2018; Plummer et al., 2022; Shim et al., 2012). Four RCTs looked at performing motor and cognitive tasks compared to balance training (Choi et al., 2015a; Hong et al., 2020; Jiejiao et al., 2012; Seo et al., 2012). One RCT compared problem-oriented willed-movement therapy to conventional treatment (Tang et al., 2005). One RCT compared dual-task training to aerobic and resistance exercise (Antonio et al., 2022). One RCT compared dual-task training with different instruction sets (Sengar et al., 2019). One RCT compared cognitive and motor dual-task training to motor imagery (Mishra, 2015). One RCT compared dual-task training to vestibular rehabilitation (Saleem et al., 2019). Finally, one RCT compared a cognitive or motor task to no task requirement, performed in various settings (Lord et al., 2006).

The methodological details and results of all 24 RCTs evaluating dual-task training interventions for lower extremity motor rehabilitation are presented in Table 17.

Table 17. RCTs Evaluating Dual-Task Training Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Cognitive Dual Motor Task vs Conventional Therapy or No Treatment		
Iqbal et al. (2020) RCT (4) Nstart=64 Nend=64 TPS=Chronic	E: Dual task training C: Conventional physiotherapy Duration: 40min/d, 4d/wk, 4wks	• Timed Up and Go Test (+exp) • 10-meter walk test (+exp) • Step length (+exp) • Stride length (+exp) • Cycle time (+exp) • Cadence (+exp)
Kannan et al. (2019) RCT (4) Nstart=25 Nend=23 TPS=Chronic	E: Cognitive motor exergaming training C: Conventional training (stretching, strengthening, balance and endurance training) Duration: 90min/d, 10d, 6wk	• Limit of Stability (+exp) • Movement velocity (+exp) • Postural center of mass (-) • Letter-number sequencing (+exp) • Wii Gaming scores (-)
Park & Lee. (2019) RCT (6) Nstart=30 Nend=30 TPS=Chronic	E: Cognitive-motor dual task program C: Conventional occupational therapy Duration: 30min/d, 3dwk, for 6wks	• Fugl-Meyer Assessment (-) • Modified Functional Reach Test ○ Forward (-) ○ Affected (-) ○ Nonaffected (-) • Berg Balance Scale (+exp) • Trail Making Test ○ A (-) ○ B (-) • Digit Span Test ○ Forward (+exp) ○ Backward (+exp) • Stroop Test ○ Colour (+exp) ○ Word (-)
Liu et al. (2017) RCT (5) Nstart=28 Nend=28 TPS=Chronic	E1: Cognitive dual task training (Gait training + cognitive task) E2: Motor dual task training (Gait training + motor task) C: Conventional therapy Duration: 30min/d, 3d/wk for 4wk	E1 vs E2/C: • Gait speed (-) • Cadence (+exp) • Stride length (-) • Stride time (-)
Yang et al. (2007) RCT (7) Nstart=25 Nend=25 TPS=Chronic	E: Dual-task based training (ball exercise) C: No intervention Duration: 30min/d, 3d/wk for 4wk	Single-Task Measures • 10-m walk Speed (+exp) • Cadence (+exp) • Stride time (+exp) • Stride length (+exp) • Temporal symmetry index (-) Dual-Task Measures • 10-m walk Speed (+exp) • Cadence (-) • Stride time (+exp) • Stride length (+exp) • Temporal symmetry index (-)
Dual Task vs Single Task Training or Control		
Plummer et al. (2022)	E1: Dual-task gait training	• Single-task Gait speed (preferred/fast) (-)

RCT (8) NStart=37 NEnd=36 TPS=Chronic	C: Single-task gait training Duration: 30min/d, 3d/wk, for 4wks	• Dual-task Stroop Gait speed (preferred/fast) (-) • Dual-task clock Gait speed (preferred/fast) (-) • 10-m walk speed (-) • Timed Up and Go (-) • Lower Extremity Fugl-Meyer (-) • Activities-specific Balance Confidence scale (-) • Stroke Impact Scale (-) • Computerized Stroop, reaction time interference (-) • Computerized Stroop, accuracy interference (+exp)
Baek et al. (2021) RCT (7) Nstart=34 Nend=31 TPS=Chronic	E: Dual-task gait training with treadmill C: Single-task gait training with treadmill Duration: 30min, 2d/wk, 6wks	• Gait Measures in Single-task Condition ○ Speed (-) ○ Stride Length (-) ○ Stance Phase Variability (-) ○ Cadence (-) ○ Correct response rate (-) • Gait Measures in Dual-task Condition ○ Speed (+exp) ○ Stride Length (+exp) ○ Stance Phase Variability (+exp) ○ Cadence (-) ○ Correct response rate (-) • Dual-task Cost-motor task ○ Speed (+exp) ○ Stride Length (-) ○ Stance Phase Variability (+exp) ○ Cadence (-) • Dual-task Cost-cognition task (-) • Fall Efficacy Scale (-)
Fishbein et al. (2019) RCT (6) Nstart=22 Nend=22 TPS=Chronic	E: Dual-task (VR-based UL training while walking on treadmill) C: Single task treadmill walking	• 10 m walk test ○ Time (+exp) ○ Steps (+exp) • Timed Up and Go (-) • Functional Reach Test (+exp) • Lateral Reach Test (+exp) • Activities Specific Balance confidence (+exp) • Berg Balance Scale (+exp)
Pang et al. (2018) RCT (8) NStart=84 NEnd=78 TPS=Chronic	E1: Dual-task balance/mobility E2: Single-task balance/mobility C: Upper limb exercise Duration: 60min/d, 3d/wk, for 8wks	E1 vs E2/C • Percent dual-task effect(%DTE) in walking time ○ When forward walking + verbal fluency (+exp1) ○ When forward walking + serial-3-subtractions (+exp1) ○ When TUG + verbal fluency (+exp1) ○ When TUG + serial-3-subtractions (-) • %DTE in correct response rate ○ When forward walking + verbal fluency (-) ○ When forward walking+ serial-3-subtractions (-) ○ When TUG + verbal fluency (-) ○ When TUG + serial-3-subtractions (-) • Activities-specific Balance Confidence Scale (-) • Frenchay Activities Index (-) • Stroke-specific Quality of Life Scale (-)

		E2 v C: • DTE%-all tasks (-) • DTE% in correct response rate-all tasks (-) • Activities-specific Balance Confidence Scale (-) • Frenchay Activities Index (-) • Stroke-specific Quality of Life Scale (-)
Choi et al. (2015a) RCT (7) Nstart=37 Nend=37 TPS=Chronic	E: Cognitive-motor dual task training while treadmill walking + Conventional rehabilitation C: Single task training on Treadmill walking + Conventional rehabilitation Duration: 15min/d, 3d/wk, 4wk task training & 5d/wk, 4wk conventional rehabilitation	• Static Balance ○ Anteroposterior sway velocity with eyes open (-) ○ Mediolateral sway velocity with eyes open (+exp) ○ Anteroposterior sway velocity with eyes closed (+exp) ○ Mediolateral sway velocity with eyes closed (+exp) • Timed Up & Go Test (-)
Meester et al. (2019) RCT (6) Nstart=50 Nend=43 TPS=Chronic	E: Walking training with simultaneous cognitive demand (dual task) C: Treadmill walking training Duration: 30min/d, 2d/wk, 10wks	• 2-Minute Walk Test ○ Distance (-) ○ Distance with dual task (-) ○ Walking distance change (-) ○ Number of cognitive responses (-) • Step activity (-) • Physical Activity Scale for Elderly (-) • SF-36 (-) • EQ-5D (-) • Community walking confidence (-)
Cho et al. (2015b) RCT (8) Nstart=24 Nend=22 TPS=Chronic	E: Virtual reality with cognitive load + conventional rehabilitation C: Treadmill walking with virtual environment + conventional rehabilitation Duration: 30min/d, 5d/wk, 4wk Virtual reality training and 60min/d, 5d/wk, 4wk conventional therapy	• Under single task condition ○ Gait velocity (-) ○ Cadence (-) ○ Paretic side step length (-) ○ Stride length (-) • Under dual task condition ○ Gait velocity (+exp) ○ Cadence (+exp) ○ Paretic side step length (+exp) ○ Stride length (+exp)
Shim et al. (2012) RCT (5) Nstart=35 Nend=33 TPS=Chronic	E: Motor dual task training + conventional therapy C: Conventional therapy Duration: 30min/d, 3d/wk for 6wks dual task training & 30min/d, 5d/wk, for 6wks conventional physical therapy	• Gait speed (+exp) • Cadence (+exp) • Stride length (+exp) • Step length (+exp) • Single limb support (+exp) • Double limb support (-)
Durfee et al. (2011) RCT (4) Nstart=19 Nend=16 TPS=Chronic	E: Ankle movements + following a target waveform (cognitively demanding task) C: Ankle movements Duration: 180 movements/d, 5d/wk, for 4wks	• Ankle DF/PF angle (+exp) • Clearance (-) • Gait temporal symmetry ratio (-) • Stride length (-) • 10-Meter Walking Test (-) • Cortical activation by fMRI (-)
Dual Cognitive-Motor Task vs Balance Training		
Hong et al. (2020) RCT (4) Nstart=24 Nend=17 TPS=Chronic	E: Dual task of balance and cognition C: Balance training Duration: 30min/d, 3d/wk, 4wks	• Timed Up and Go (+exp) • Berg Balance scale (-) • Stride velocity (-) • Stride length (-) • Double support time (-)

Choi et al. (2015b) RCT (5) Nstart=21 Nend=21 TPS=Subacute	E: Balance training + cognitive training C: Balance training with balance board Duration: 1hr/d, 3d/wk for 4wk	• Berg Balance Scale (-) • Fugl-Meyer Assessment (-) • Modified Barthel Index (-)
Jiejiao et al. (2012) RCT (8) Nstart=92 Nend=85 TPS=Chronic	E: Balance training + cognitive training C: Balance training Duration: 40min/d, 5d/wk for 8wks	• Center of Pressure (-) • Mediolateral Sway Distance (+exp) • Anteroposterior ○ Eyes Open (+exp) ○ Eyes Closed (-)
Seo et al. (2012) RCT (4) Nstart=40 Nend=40 TPS=Chronic	E: Dual-task balance training C: Single-task balance training Duration: 30min/d, 5d/wk for 4wks	• Sway path (-) • Sway area (+exp) • Max velocity (+exp)
Problem-Oriented Willed-Movement Therapy vs Conventional Treatment		
Tang et al. (2005) RCT (6) Nstart=48 Nend=47 TPS=Subacute	E: Problem-oriented willed-movement therapy C: Neurodevelopmental treatment Duration: 50min/d, 5-6d/wk, for 8wks	• Rehabilitation Assessment of Movement (+exp) ○ Upper Extremity (+exp) ○ Lower Extremity (+exp) ○ Basic Mobility (+exp) • Mini-Mental State Examination (-)
Dual-Task vs Aerobic and Resistance Exercise		
Antonio et al. (2022) RCT (8) Nstart=26 Nend=26 TPS=Chronic	E: Dual Task (Consisting aerobic and resistance exercises while performing cognitive task) C: Aerobic and Resistance Exercises, without Performing Cognitive Task Duration: 60-90min, 2d/wk, for 15wks	• Timed-up-and-go Test (+exp) ○ Cognitive Performance in TUG Dual Task (-) ○ Dual Task Cost in in TUG (-) • 10-M Walk Test (-) ○ 10MWT Dual Task (-) ○ Cognitive Performance in 10MWT Dual Task (-) ○ Dual Task Cost in 10MWT (-) • 6-M Walk Test (-) • Maximum Ballistic Voluntary Isometric Contraction (-) • Montreal Cognitive Assessment (-) • Falls Efficacy Scale (FES-I) (-) • Stroke Impact Scale (-) • Mini-BESTest (-)
Dual-task with Various Instructional Sets		
Sengar et al. (2019) RCT (4) Nstart=30 Nend=30 TPS=Chronic	E: Dual-task training with variable priority instructional sets C: Dual-task training with fixed priority instructional sets Duration: 45min/d, 3d/wk, for 4wks	• 10-m walk test ○ Comfortable speed (+exp) ○ Maximal speed (+exp)] • Step length (+exp) • Stride Length (+exp)
Cognitive and Motor Dual-Task Training vs Motor Imagery		
Mishra et al. (2015) RCT (5) Nstart=15 Nend=15 TPS=Not Reported	E1: Motor dual task training + Conventional care E2: Cognitive dual task training + Conventional care E3: Motor imagery + Conventional care Duration: 15min/session, 5d/wk for 2wks	E1 v E2/E3: • Berg Balance scale (-) • Functional gait assessment scale (+exp1)

Dual-Task Training vs Vestibular Rehabilitation		
Saleem et al. (2019) RCT (4) Nstart=30 Nend=30 TPS=Subacute	E: Vestibular Rehabilitation + Conventional PT C: Dual Task training + Conventional PT Duration: 45min/d, 3d/wk, 4wks interventions & 45min/d, 5d/wk, 4wks Conventional PT	• Wisconsin Gait Scale (+exp) • Mini-BEST (+exp)
Cognitive Task vs Motor Task vs No Task in Various Settings		
Lord et al. (2006) RCT (6) Nstart=27 Nend=27 TPS=Chronic	E1: No task in suburban street E2: Cognitive task in suburban street E3: Motor task in suburban street E4: No task in shopping mall E5: Cognitive task in shopping mall E6: Motor task in shopping mall C1: No task in clinic C2: Motor task in clinic C3: cognitive task in clinic Duration: 6 min walk	• 6-minute walk test (-) • Cadence (-) • Step Length (-)

Abbreviations and table notes: ANOVA=analysis of variance; C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Dual-Task Training Interventions

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Cognitive dual motor task** may not have a difference in efficacy compared to **conventional therapy or no treatment** for improving motor function.	1	Parl & Lee 2019
1b	**Dual task** may not have a difference in efficacy compared to **single task training or control** for improving motor function.	1	Plummer et al. 2022
2	**Dual cognitive-motor task** may not have a difference in efficacy compared to **balance training** for improving motor function.	1	Choi et al. 2015b

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Dual cognitive-motor training** may produce greater improvements in functional ambulation than **conventional therapy or no treatment.**	4	Iqbal et al. 2020; Kannan et al. 2019; Liu et al. 2017; Yang et al. 2007

2	**Cognitive dual task training** may not have a difference in efficacy compared to **motor dual task training** for improving functional ambulation.	1	Liu et al. 2017
1b	**Dual task** may not have a difference in efficacy compared to **single task training or control** for improving functional ambulation.	8	Plummer et al. 2022; Baek et al. 2021; Fishbein et al. 2019; Meester et al. 2019; Choi et al. 2015a; Cho et al. 2015; Shim et al. 2012; Durfee et al. 2011
2	**Dual cognitive-motor task** may produce greater improvements in functional ambulation than **balance training.**	1	Hong et al. 2020
1b	**Dual task** may not have a difference in efficacy compared to **aerobic and resistance exercise** for improving functional ambulation.	1	Antonion et al. 2022
2	**Dual-task training with variable instructional sets** may produce greater improvements in functional ambulation than **dual-task training with fixed instructional sets.**	1	Sengar et al. 2019
1b	**Cognitive and motor tasks in one location** may not have a difference in efficacy compared to **cognitive and motor tasks in various other settings** for improving functional ambulation.	1	Lord et al. 2006

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1a	**Dual task** may produce greater improvements in functional mobility compared to **single task training or control.**	2	Meester et al. 2019; Pang et al. 2018
1b	**Problem-oriented willed-movement therapy** may produce greater improvements in functional mobility compared to **conventional treatment.**	1	Tang et al. 2005
1b	**Dual task** may not have a difference in efficacy compared to **aerobic and resistance exercise** for improving functional ambulation.	1	Antonion et al. 2022

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **cognitive dual motor task** to improve balance when compared to **conventional therapy or no treatment**.	2	Parl & Lee 2019; Kannan et al. 2019
1a	There is conflicting evidence about the effect of **dual task** to improve balance when compared to **single task training or control**.	5	Plummer et al. 2022; Baek et al. 2021; Fishbein et al. 2019; Pang et al. 2018; Choi et al. 2015a
1b	**Dual cognitive-motor task** may not have a difference in efficacy compared to **balance training** for improving balance.	4	Hong et al. 2020; Choi et al. 2015b; JieJiao et al. 2012; Seo et al. 2012

1b	**Dual task** may not have a difference in efficacy compared to **aerobic and resistance exercise** for improving balance.	1	Antonion et al. 2022
2	**Motor dual task training** may not have a difference in efficacy compared to **cognitive dual task training** for improving balance.	1	Mishra et al. 2015
2	**Motor dual task training** may not have a difference in efficacy compared to **motor imagery training** for improving balance.	1	Mishra et al. 2015
2	**Dual task training** may produce greater improvements in balance compared to **vestibular rehabilitation.**	1	Saleem et al. 2019

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **cognitive dual motor task training** to improve gait when compared to **conventional therapy or no treatment**.	3	Iqbal et al. 2020; Liu et al. 2017; Yang et al. 2007
2	**Cognitive dual task training** may not have a difference in efficacy compared to **motor dual task training** for improving gait.	1	Liu et al. 2017
1b	**Dual task** may not have a difference in efficacy compared to **single task training or control** for improving gait.	4	Baek et al. 2021; Cho et al. 2015; Shim et al. 2012; Durfee et al. 2011
2	**Dual cognitive-motor task** may not have a difference in efficacy compared to **balance training** for improving gait.	1	Hong et al. 2020
2	**Dual task training with variable instructional sets** may produce greater improvements in gait compared to **dual task training with fixed instructional sets.**	1	Sengar et al. 2019
2	**Motor dual task training** may produce greater improvements in gait compared to **cognitive dual task training.**	1	Mishra et al. 2015
2	**Motor dual task training** may produce greater improvements in gait compared to **motor imagery training.**	1	Mishra et al. 2015
2	**Dual task training** may produce greater improvements in gait compared to **vestibular rehabilitation.**	1	Saleem et al. 2019
1b	**Cognitive and motor tasks in one setting** may not have a difference in efficacy compared to **cognitive and motor tasks in various other settings** for improving gait.	1	Lord et al. 2006

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**

1b	**Dual task** may not have a difference in efficacy compared to **aerobic and resistance exercise** for improving muscle strength.	1	Antonion et al. 2022

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Dual task** may not have a difference in efficacy compared to **single task training or control** for improving activities of daily living.	2	Meester et al. 2019; Pang et al. 2018
2	**Dual cognitive-motor task** may not have a difference in efficacy compared to **balance training alone** for improving activities of daily living.	1	Choi et al. 2015b

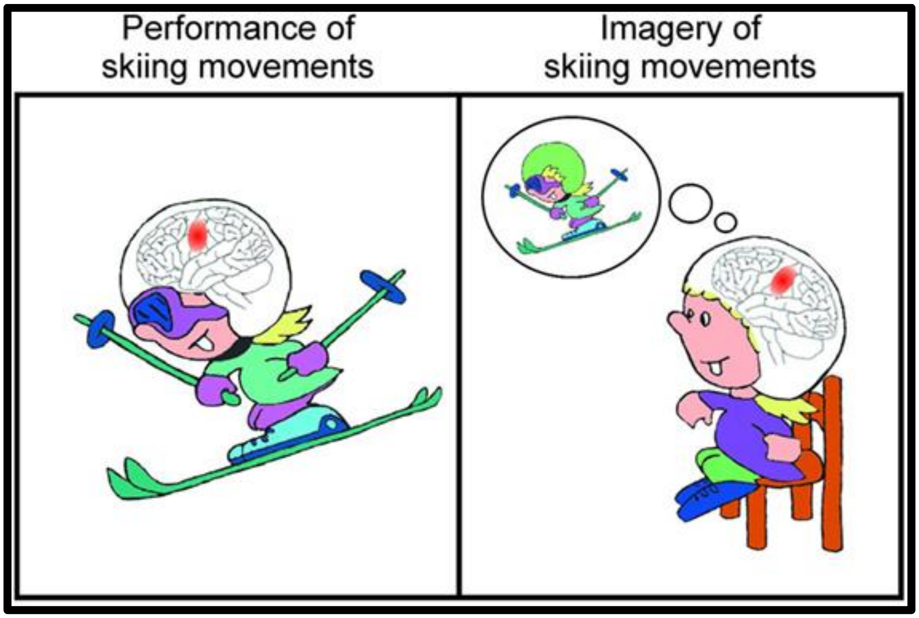
QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Dual task** may not have a difference in efficacy compared to **single task training or control** for improving quality of life.	3	Plummer et al. 2022; Meester et al. 2019; Pang et al. 2018
1b	**Dual task** may not have a difference in efficacy compared to **aerobic and resistance exercise** for improving quality of life.	1	Antonion et al. 2022

Key points

The literature is mixed regarding the effect of dual task training on functional ambulation, functional mobility, balance, and gait after stroke.

Dual task training may not be beneficial in improving motor function, muscle strength, activities of daily living, and quality of life.

Mental Practice



Adopted from: https://www.ucbmsh.com/motor-imagery-for-improvement-of-gait-in-stroke-patient/

Mental practice as the name suggests, involves cognitively rehearsing a specific task by repetitively imagining oneself performing the precise movements involved in the task in the absence of performing the physical movement (Page & Peters, 2014). Mental practice is speculated to be effective because of its ability to use the same motor schema as when physically practicing the same task through the activation of similar neural regions and networks during mental practice (Page & Peters, 2014). The use of mental practice was adapted from the field of sports psychology where the technique has been shown to improve athletic performance, when used as an adjunct to standard training methods (Page & Peters, 2014). The technique is believed to be advantageous in stroke survivors because certain motor skills may be difficult to physically practice; stroke survivors spend a majority of their time inactive and alone; and repetitive task-specific practice is a prerequisite for cortical plasticity and subsequent motor changes (Page & Peters, 2014). Mental practice can be used to supplement conventional therapy and can be used at any stage of recovery.

22 RCTs were found evaluating mental practice for lower extremity motor rehabilitation. Three RCTs compared gait training with motor imagery or mental practice to gait training alone (Anwar et al., 2022; Cho et al., 2013b; Sawant, 2020). One RCT compared task-specific training with mental practice to task-specific training alone (Kumar et al., 2016). Two RCTs compared task-specific training with mental practice to conventional training or no treatment (Malouin et al., 2009; Verma et al., 2011). One RCT compared proprioception training and motor imagery to proprioception training alone (Lee et al., 2015a). One RCT compared action observation, motor imagery and conventional therapy to each other (Kim & Lee, 2013). One RCT compared neurofeedback facilitation with motor imagery to sham feedback (Mihara et al., 2021). One RCT compared mental practice to muscle relaxation (Oostra et al., 2015). One RCT compared circuit training with mental practice to circuit training with education (Bovonsunthonchai et al., 2020). One RCT compared mental imagery to mental imagery with auditory stimulation (Kim et al.,

2011b). Seven RCTs compared mental imagery to conventional training or sham (Bovend'Eerdt et al., 2010; Braun et al., 2012; Dickstein et al., 2013; Hosseini et al., 2012; Liu et al., 2004; Schuster et al., 2012; Yin et al., 2021). One RCT compared body awareness therapy to continuing usual daily activities (Lindvall & Forsberg, 2014). One RCT compared cognitive and motor dual-task to motor imagery (Mishra, 2015). One RCT compared cognitive sensory motor training to conventional therapy (Kim & Jang, 2021a).

The methodological details and results of all 22 RCTs are presented in Table 18.

Table 18. RCTs Evaluating Mental Practice Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Gait Training with Motor Imagery or Mental Practice vs Gait Training		
Anwar et al. (2022) RCT (6) Nstart=44 Nend=44 TPS=Subacute	E: Motor imagery + gait training C: Gait training Duration: 30min/d motor imagery & 30min/d gait training 3d/wk, 6wks	• 10 metre Walk test (-) • Fugl-Meyer Assessment (-) • Motor Imagery Questionnaire ○ visual (+exp) ○ kinesthetic (+exp) • Imagery/actual walking time ratio (-)
Sawant (2020) RCT (4) Nstart=82 Nend=82 TPS=Not Reported	E: Gait training + guided motor imagery + conventional exercises C: Gait training + conventional exercises Duration: E: 20min/d, 3d/wk, 4wks gait training + 10min/d, 3d/wk, 4wks motor imagery C: 30min/d, 3d/wk, 4wks gait training	• Functional Gait Assessment (+exp) • 10-Meter Walk Test (+exp)
Cho et al. (2013b) RCT (6) Nstart=28 Nend=28 TPS=Chronic	E: Gait training + Mental practice C: Gait training Duration: 15min/d, mental practice & 30min gait training, 3d/wk, 6wks	• Fugl-Meyer Assessment (+exp) • 10-Metre Walk Test (+exp) • Timed Up & Go Test (+exp) • Functional Reach Test (+exp)
Task-Specific Training with Mental Practice vs Task-Specific Training		
Kumar et al. (2016) RCT (7) Nstart=40 Nend=40 TPS=Chronic	E: Task-specific training + Mental practice (Motor Imagery) C: Task-specific training Duration: 45-60min/d, 4d/wk for 3wks task-specific training & 15min/d, 4d/wk, for 3wks motor imagery	• 10-Metre Walk Test (+exp) • Hip flexor and extensor strength (+exp) • Knee extensor strength (+exp) • Knee flexor strength (-) • Ankle dorsiflexor strength (+exp) • Ankle plantarflexor strength (-)
Task-Specific Training with Mental Practice vs Conventional Training or No Treatment		
Verma et al. (2011) RCT (8) Nstart=30 Nend=30	E: Task-oriented circuit class training + Motor imagery C: Standard rehabilitation based on Bobath techniques	• Functional ambulation category (+exp) • Rivermead Visual gait assessment (+exp) • Step length asymmetry (-) • Cadence (+exp)

TPS=Subacute	Duration:
	E: 15min/d, 7d/wk, 2wks mental imagery + 25min/d, 7d/wk, 2wks task-oriented circuit class training
	C: 40min/d, 7d/wk, 2wks standard rehabilitation
		• Stride length asymmetry (-)
		• 10m Walk test
		  ○ Maximum speed (-)
		  ○ Comfortable speed (+exp)
		• 6min Walk test (+exp)

Malouin et al. (2009) RCT (6) Nstart=12 Nend=12 TPS=Chronic	E1: Task-specific training + Mental practice E2 Task-specific training + Cognitive training C: No training Duration: 3d/wk for 4wk	<u>E1 vs E2 vs C</u> • Limb loading (+exp)
Proprioception Training + Motor Imagery vs Proprioception Training		
Lee et al. (2015a) RCT (5) Nstart=36 Nend=36 TPS=Chronic	E: Proprioception training + Motor imagery C: Proprioception training Duration: 30min/d, 5d/wk, for 8wks proprioception training & (25+5min/d) proprioception training and motor imagery	• Berg Balance Scale (+exp) • Timed Up & Go Test (-) • Weight Bearing Ratio (+exp) • Joint Position Sense Error (+exp)
Action Observation vs Motor Imagery vs Conventional Therapy		
Kim et al. (2013) RCT (7) Nstart=30 Nend=27 TPS=Chronic	E1: Action observation training + physical training E2: Motor imagery training + physical training C: physical training Duration: 30min/d action observation and motor imagery & 1h/d, physical training, 5d/wk for 4wks	<u>E1 vs C</u> • Timed Up and Go (+exp1) • Functional Reach test (-) • Walking Ability questionnaire (-) • Functional ambulation category (-) • Gait speed (+exp1) • Cadence (+exp1) • Step length (-) • Single limb support (+exp1) • Double limb support (-) <u>E2 v E1/C</u> • Timed Up and Go (-) • Functional Reach test (-) • Walking Ability questionnaire (-) • Functional ambulation category (-) • Gait speed (-) • Cadence (-) • Step length (-) • Single limb support (-) • Double limb support (-)
Neurofeedback Facilitation with Motor Imagery vs Sham		

Mihara et al. (2021)
RCT (8)
Nstart=57
Nend=54
TPS=Chronic
	E: Neurofeedback facilitation + motor imagery
	C: Sham neurofeedback + motor imagery
	Duration: 3 session/wk, 2wks
		• Timed Up and Go (+exp)
		• Functional Independence measure (-)
		• Fugl-Meyer assessment
		  ○ Upper extremity (-)
		  ○ Lower extremity (-)
		• Berg Balance scale (+exp)
		• Gait speed (-)

Mental Practice vs Muscle Relaxation		

Oostra et al. (2015)
RCT (6)
Nstart=44
	E: Motor imagery training + standard rehabilitation program
	C: Muscle relaxation + Standard rehabilitation program
		• Movement Imagery Questionnaire-revised
		  ○ Visual (-)
		  ○ Kinesthetic (+exp)

Nend=44 TPS=Subacute	Duration: 180min/d, 5d/wk, 6wks MIT or MR	• Walking trajectory test (imagery walking time/actual walking time) (-) • 10-m walk test (exp) • Lower-extremity Fugl-Meyer assessment scale (-)
Circuit Training with Mental Practice vs Circuit Training with Education		
Bovonsunthonchai et al. (2020) RCT (8) Nstart=40 Nend=40 TPS=Chronic	E: Structured Progressive Circuit Training (SPCCT) + Motor Imagery (MI) C: Structured Progressive Circuit Training + Health Education (HE) Duration: 25min HE or MI + 65min SPCCT) 90min/d, 3d/wk, 4wks	• Step Length (-) • Stride Length (-) • Step Time ○ Affected (-) ○ Unaffected (+exp) • Gait Speed (+exp) • Cadence (+exp) • Symmetry Index ○ Step Time (-) ○ Step Length (-) • Muscle Strength ○ Hip flexor (+exp) ○ Hip extensor (-) ○ Knee flexor (-) ○ Knee extensor (+exp) ○ Ankle dorsiflexor (-) ○ Ankle plantar flexor (-)
Mental Imagery vs Mental Imagery with Auditory Stimulation		
Kim et al. (2011) RCT crossover (4) Nstart=18 Nend=15 TPS=Chronic	E1: Visual Locomotor Imagery Training E2: Kinesthetic Locomotor Imagery Training E3: Visual Locomotor Training with Auditory Step Rhythm E4: Kinesthetic Locomotor Imagery Training with Auditory Step Rhythm Duration: 15 min/condition, 24 hr washout	E1 vs E2 • Timed Up and Go Test (-) E1 vs E3 • Timed Up and Go Test (-) E1 vs E4 • Timed Up and Go Test (+exp4) • Muscle Activation by EMG Parameter (+exp4) E2 vs E3 • Timed Up and Go Test (-) E2 vs E4 • Timed Up and Go Test (-) E3 vs E4 • Timed Up and Go Test (-)
Mental Imagery vs Conventional Training or Sham		
Yin et al. (2021) RCT (5) Nstart=39 Nend=32 TPS=Subacute	E: Motor imagery training + conventional care C: Conventional care Duration: 20min/d, 5d/wk, 6wks MT & 180min/d, 5d/wk, 6wks conventional care	• Fugl Meyer Assessment (+exp) • Functional Independence Measure (+exp) • Berg Balance Scale (+exp)
Dickstein et al. (2013) RCT (6) Nstart=25 Nend=23 TPS=Chronic	E: Integrated imagery practice C: Conventional care for upper extremity Duration: 15min/d, 3d/wk, 4wks	• Falls-efficacy scale - Swedish version (-) • Step Activity monitor (-) • 10m Walk test (+exp)
Braun et al. (2012) RCT (7) Nstart=36	E: Mental practice + multi-professional rehabilitation	• 10 Point Numeric Rating scale (-) • Motricity Index (-) • Barthel Index (-) • 9 Hole Peg test (-)

Nend=34 TPS=Subacute	C: multi-professional rehabilitation Duration: 6wks	• Berg Balance scale (-) • Rivermead Mobility index (-) • 10m Walk Test (-)
Schuster et al. (2012) RCT (7) Nstart=41 Nend=39 TPS=Chronic	E1: Conventional rehabilitation + Embedded mental practice E2: Conventional rehabilitation + Added mental practice C: Conventional rehabilitation + listen to a sham tape Duration: 45-50min total (25-30 min PT + 20min MI/taping)/session, 6 sessions/ 2wks	• Chedoke-McMaster Stroke Assessment (-) • Time needed to perform the motor task (-) • Barthel index (-) • Berg Balance Scale (-) • Computer-based Imaprax questionnaire (-) • Kinesthetic and Visual Imagery Questionnaire (-) • Activities-Specific Balance Confidence Scale (-) • Edinburgh Handedness Inventory (-) • Mini-Mental State Examination (-)
Hosseini et al. (2012) RCT (8) Nstart=30 Nend=30 TPS=Chronic	E: Mental Practice + Conventional Treatment C: Conventional Treatment Duration: 45min/d, 3d/wk, 5wks	• Timed Up and Go Test (+exp) • Berg Balance Test (+exp)
Bovend'Eerdt et al. (2010) RCT (8) Nstart=30 Nend=30 TPS=Subacute	E: Motor imagery + Conventional therapy C: Sham + Conventional therapy Duration: 120min/d, 2-3d/wk, 5-6wks	• Goal Attainment Scaling (-) • Barthel index (-) • Rivermead Mobility Index (-) • Timed UP and GO (-) • Action Research Arm Test (-) • Nottingham Extended ADL scale (-) • Imagery Questionnaire (-)

Liu et al. (2004)
RCT (7)
Nstart=49
Nend=46
TPS=Acute
	E: Mental imagery program
	C: Conventional functional training
	Duration: 60min/d, 5d/wk, for 3wks
		• Task Performance
		  ○ Trained (+exp)
		  ○ Untrained (+exp)
		• Color Trails Test (+exp)
		• Fugl-Meyer Assessment
		  ○ Upper Extremity (-)
		  ○ Lower Extremity (-)
		  ○ Sensation (-)

Body Awareness Therapy vs Continuing Usual Daily Activities		
Lindvall et al. (2014) RCT (7) Nstart=46 Nend=43 TPS=Chronic	E: Body awareness therapy C: Continuing usual daily activities Duration: 60min/d, 1d/wk, 8wks	• Berg Balance Scale (-) • Timed Up and Go Test (-) ○ Cognitive (-) • 6-minte walk test -) • Timed-Stands Test (-) • Activities-specific Balance Confidence Scale (-) • Short Form 36 (SF36) (-)
Cognitive and Motor Dual-Task Training vs Motor Imagery		
Mishra et al. (2015) RCT (5) Nstart=15 Nend=15 TPS=Not Reported	E1: Motor dual task training + Conventional care E2: Cognitive dual task training + Conventional care E3: Motor imagery + Conventional care Duration: 15min/session, 5d/wk for 2wks	E1 v E2/E3: • Berg Balance scale (-) • Functional gait assessment scale (+exp1)
Cognitive Sensory Motor Training vs Conventional Therapy		

Kim et al. (2021)
RCT (6)
Nstart=39
Nend=35
TPS=Chronic
	E: Cognitive Sensory Motor Training + conventional physical therapy
	C: Conventional physical therapy
	Duration: E: 30min/d CSMT + 30min/d Conventional PT, 5d/wk, 6wks
	C: 30min, 2sessions/d, 5d/wk, 6wks conventional physical therapy
		• Lower extremity muscle strength of tibialis anterior (+exp)
		• Medical research council (+exp)
		• Romberg balance test
		  ○ Eye open surface area (+exp)
		  ○ Eye open average speed (+exp)
		  ○ Eye close surface area (+exp)
		  ○ Eye close average speed (+exp)
		• Limits of stability (+exp)

Abbreviations and table notes: ANOVA=analysis of variance; C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Mental Practice

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	There is conflicting evidence about the effect of **mental practice combined with gait training** to improve motor function when compared to **gait training alone**.	2	Anwar et al. 2022; Cho et al. 2013
1b	**Neurofeedback facilitation with motor imagery** may not have a difference in efficacy compared to **sham feedback** for improving motor function.	1	Mihara et al. 2021
1b	**Mental practice** may not have a difference in efficacy compared to **muscle relaxation** for improving motor function.	1	Oostra et al. 2015
1b	**Mental Imagery** may not have a difference in efficacy compared to **conventional training or sham** for improving motor function.	3	Yin et al. 2021; Schuster et a. 2012; Liu et al. 2004

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Gait training with motor imagery or mental practice** may produce greater improvements in functional ambulation than **gait training alone.**	3	Anwar et al. 2022; Sawant 2020; Cho et al. 2013
1b	**Task-specific training with mental practice** may produce greater improvements in functional ambulation than **task-specific training.**	1	Kumar et al. 2016
1b	**Task-specific training with mental practice** may produce greater improvements in functional ambulation than **conventional training or no treatment.**	1	Verma et al. 2011

2	**Proprioception training with motor imagery** may not have a difference in efficacy compared to **proprioception training alone** for improving functional ambulation.	1	Lee et al. 2015
1b	**Motor imagery** may not have a difference in efficacy compared to **action observation** for improving functional ambulation.	1	Kim et al. 2013
1b	There is conflicting evidence about the effect of **action observation** to improve functional ambulation when compared to **conventional therapy**.	1	Kim et al. 2013
1b	**Motor imagery** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	1	Kim et al. 2013
1b	There is conflicting evidence about the effect of **neurofeedback facilitation with motor imagery** to improve functional ambulation when compared to **sham**.	1	Mihara et al. 2021
1b	**Mental practice** may produce greater improvements in functional ambulation than **muscle relaxation.**	1	Oostra et al. 2015
1b	**Circuit training with mental practice** may produce greater improvements in functional ambulation than **circuit training with education.**	1	Bovonsunthonchai et al. 2020
2	**Visual locomotor imagery training** may not have a difference in efficacy compared to **kinesthetic locomotor imagery training** for improving functional ambulation.	1	Kim et al. 2011
2	**Visual locomotor imagery training** may not have a difference in efficacy compared to **visual locomotor training with auditory step rhythm** for improving functional ambulation.	1	Kim et al. 2011
2	**Kinesthetic locomotor imagery training with auditory step rhythm** may produce greater improvements in functional ambulation than **visual locomotor imagery training.**	1	Kim et al. 2011
2	**Kinesthetic locomotor imagery training** may not have a difference in efficacy compared to **visual locomotor training with auditory step rhythm** for improving functional ambulation.	1	Kim et al. 2011
2	**Kinesthetic locomotor imagery training** may not have a difference in efficacy compared to **kinesthetic locomotor imagery training with auditory step rhythm** for improving functional ambulation.	1	Kim et al. 2011
2	**Visual locomotor training with auditory step rhythm** may not have a difference in efficacy compared to **kinesthetic locomotor imagery training with auditory step rhythm** for improving functional ambulation.	1	Kim et al. 2011

1a	There is conflicting evidence about the effect of **mental imagery** to improve functional ambulation when compared to **conventional training or sham**.	4	Dickstein et al. 2013; Braun et al. 2012; Hosseini et al. 2012; Bovend'Eerdt et al. 2010
1b	**Body awareness therapy** may not have a difference in efficacy compared to **continuing usual daily activities** for improving functional ambulation.	1	Lindwell et al. 2014

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1a	**Mental imagery** may not have a difference in efficacy compared to **conventional training or sham** for improving functional mobility.	1	Dickstein et al. 2013; Braun et al. 2012; Bovend'Eerdt et al. 2010
1b	**Body awareness therapy** may not have a difference in efficacy compared to **continuing usual daily activities** for improving functional mobility.	1	Lindwell et al. 2014

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	**Gait training with motor imagery or mental practice** may produce greater improvements in balance compared to **gait training alone.**	1	Cho et al. 2013
2	**Proprioception training with motor imagery** may produce greater improvements in balance compared to **proprioception training.**	1	Lee et al. 2015
1b	**Motor imagery** may not have a difference in efficacy compared to **action observation** for improving balance.	1	Kim et al. 2013
1b	**Action observation** may not have a difference in efficacy compared to **conventional therapy** for improving balance.	1	Kim et al. 2013
1b	**Motor imagery** may not have a difference in efficacy compared to **conventional therapy** for improving balance.	1	Kim et al. 2013
1b	**Neurofeedback facilitation with motor imagery** may produce greater improvements in balance compared to **sham feedback.**	1	Mihara et al. 2021
1b	**Mental imagery** may not have a difference in efficacy compared to **conventional training or sham** for improving balance.	5	Yin et al. 2021; Dickstein et al. 2013 Braun et al. 2012; Schuster et al. 2012; Hosseini et al. 2012
1b	**Body awareness therapy** may not have a difference in efficacy compared to **continuing usual daily activities** for improving balance.	1	Lindwell et al. 2014
2	**Cognitive and motor dual-task training** may not have a difference in efficacy compared to **motor imagery** for improving balance.	1	Mishra et al. 2015

2	**Cognitive and motor dual-task training** may not have a difference in efficacy compared to **conventional care** for improving balance.	1	Mishra et al. 2015
1b	**Cognitive sensory motor training** may produce greater improvements in balance compared to **conventional therapy.**	1	Kim et al. 2021

GAIT			
LoE	Conclusion Statement	RCTs	References
2	**Gait training with motor imagery or mental practice** may produce greater improvements in gait compared to **gait training alone.**	1	Sawant 2020
1b	There is conflicting evidence about the effect of **task-specific training with mental practice** to improve gait when compared to **conventional training or no treatment**.	1	Verma et al. 2011
2	**Proprioception training with motor imagery** may produce greater improvements in gait compared to **proprioception training alone.**	1	Lee et al. 2015
1b	**Motor imagery** may not have a difference in efficacy compared to **action observation** for improving gait.	1	Kim et al. 2013
1b	There is conflicting evidence about the effect of **action observation** to improve gait when compared to **conventional therapy**.	1	Kim et al. 2013
1b	**Motor imagery** may not have a difference in efficacy compared to **conventional therapy** for improving gait.	1	Kim et al. 2013
1b	**Circuit training with mental practice** may not have a difference in efficacy compared to **circuit training with education** for improving gait.	1	Bovonsunthonchai et al. 2020
2	**Motor imagery** may not produce greater improvements in gait compared to **Cognitive and motor dual-task.**	1	Mishra et al. 2015

ACTIVITIES OF DAILY LIVING			
LoE	Conclusion Statement	RCTs	References
1b	**Neurofeedback facilitation with motor imagery** may not have a difference in efficacy compared to **sham feedback** for improving activities of daily living.	1	Mihara et al. 2021
1b	There is conflicting evidence about the effect of **mental practice** to improve activities of daily living when compared to **muscle relaxation**.	1	Oostra et al. 2015
1b	**Mental imagery** may not have a difference in efficacy compared to **conventional training or sham** for improving activities of daily living.	5	Yin et al. 2021; Braun et al. 2012; Schuster et a. 2012; Bovend'Eerdt et al. 2010; Liu et al. 2004

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **mental practice with task-specific training** to improve muscle strength when compared to **task-specific training**.	1	Kumar et al. 2016
1b	**Task-specific training with mental practice** may produce greater improvements in muscle strength compared to **conventional training or no treatment.**	1	Malouin et al. 2009
1b	**Task-specific training with mental practice** may produce greater improvements in muscle strength compared to **task-specific training with cognitive practice.**	1	Malouin et al. 2009
1b	**Circuit training with mental practice** may not have a difference in efficacy compared to **circuit training with education** for improving muscle strength.	1	Mihara et al. 2021
1b	**Mental imagery** may not have a difference in efficacy compared to **conventional training or sham** for improving muscle strength.	1	Braun et al. 2012
1b	**Cognitive sensory motor training** may produce greater improvements in muscle strength compared to **conventional therapy.**	1	Kim et al. 2021

PROPRIOCEPTION

LoE	Conclusion Statement	RCTs	References
1b	**Gait training with motor imagery or mental practice** may produce greater improvements in proprioception compared to **gait training alone.**	1	Anwar et al. 2022
2	**Proprioception training with motor imagery** may produce greater improvements in proprioception compared to **proprioception training alone.**	1	Lee et al. 2015
1b	**Mental imagery** may not have a difference in efficacy compared to **conventional training or sham** for improving proprioception.	1	Schuster et a. 2012

SPASTICITY

LoE	Conclusion Statement	RCTs	References
1b	**Mental imagery** may not have a difference in efficacy compared to **conventional training or sham** for improving spasticity.	1	Braun et al. 2012

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
1b	**Body awareness therapy** may not have a difference in efficacy compared to **continuing usual daily activities** for improving quality of life.	1	Lindwell et al. 2014

Key Points

The literature is mixed regarding mental practice combined with different types of physical therapy (task-specific training, conventional therapy, gait training) for improving functional ambulation, balance, gait, and muscle strength after stroke.

Motor imagery and mental practice may not be beneficial in improving motor function, functional mobility, activities of daily living, spasticity, and quality of life after stroke.

Motor imagery may be beneficial in improving proprioception after stroke.

Action Observation

Adopted from: https://www.youtube.com/watch?v=QE3CUhmKi7U

Action observation is a form of therapy whereby an individual observes another individual performing a motor task, either on a video or a real demonstration, and then may attempt to perform the same task themselves. For example, the patient may be instructed to watch a video showing an adult stretching out his hand to pick up a cup, bringing the cup to his mouth, and then returning the cup to its initial position - the act of drinking. After observing the video sequence for a time, the participants may or may not be asked to perform the same action (Borges et al., 2018).

The therapy is considered a multisensory approach designed to increase cortical excitability in the primary motor cortex by activating central representations of actions through the mirror neuron system (Kim & Kim, 2015). Although action observation has been evaluated mainly in healthy volunteers, a few studies have evaluated its benefit in motor relearning following stroke.

14 RCTs were found evaluating action observation for lower extremity motor rehabilitation.

Two RCTs compared backward walking action observation to sham or conventional therapy (Moon & Bae, 2019, 2022). Two RCTs compared action observation physical training to sham action observation training (Kim & Lee, 2018a; Shamsi et al., 2022). One RCT compared functional action observation to general action observation (Oh et al., 2019). Five RCTs compared action observation with gait training to gait training alone or no training (Kim & Lee, 2013; Kim & Kim, 2012; Park & Hwangbo, 2015; Park et al., 2017b; Park et al., 2014a). One RCT compared action observation with treadmill training to treadmill training (Bang et al., 2013). Two RCTs compared action observation with gait training and FES to gait training and FES (Bae & Kim, 2017; Park & Kang, 2013). One RCT compared action observation with rhythmic auditory stimulation (Cho & Kim, 2020).

The methodological details and results of all 14 RCTs are presented in Table 19.

Table 19. RCTs Evaluating Action Observation Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Backward Walking Action Observation vs Sham or Conventional therapy		
Moon et al. (2022) RCT (6) Nstart=29 Nend=24 TPS=Chronic	E: Backward walking observational training & Conventional therapy C: Landscape observational training (sham) & Conventional therapy Duration: 30min/d, 3d/wk, for 4wks observational training & 30min/d, 5d/wk, for 4wks conventional therapy	• Gait velocity (+exp) • Step length (+exp) • Stride length (+exp) • 5 timed sit-to stand(+exp) • Activities-specific balance confidence scale(+exp) • Affected side Weight distribution (+exp) • Center of pressure displacement (+exp) ○ Velocity (+exp) ○ Length (+exp)
Moon & Bae (2019) RCT (6) Nstart=17 Nend=14 TPS=Chronic	E: Action observation of backward walking C: Landscape video + Backward walking training Duration: 30min/d, 5d/wk for 4wks - Conventional therapy, 10min/d - Action observation or Landscape video, 20min/d - Backwards walking training	• Dynamic Gait Index (+exp) • 10-Metre Walking Test (+exp) • Timed Up and Go Test (+exp)
Action Observation Physical Training vs Sham Action Observation Training		
Shamsi et al. (2022) RCT (8) Nstart=14 Nend=14 TPS=Chronic	E: Observation training depicting exercises C: Observation nature pictures (sham) Duration: 12min/d, 3d/wk, for 4wks action observation training/sham	• Stride length (Affected/Unaffected) (-) • Step length (Affected/Unaffected) (-) • Gait Velocity (Affected/Unaffected) (-) • Stance phase ○ Affected (-) ○ Unaffected (+exp) • Peaks of vertical ground reaction force (Affected/Unaffected) (-) • Gait asymmetry index (-)
Kim et al., (2018) RCT crossover (5) Nstart= 24 Nend = 21 TPS= Chronic	E: Action observation physical training C: Landscape imagery observation physical training (Sham) Duration: 30min/d, 3d/wk, for 6wks - no washout	• Limit of Stability (+exp) • Weight Distribution Index (-) • Timed-up-and go (-) • Dynamic Gait Index (-)
Functional Action Observation vs General Action Observation		
Oh et al. (2019) RCT (4) Nstart=40 Nend=35 TPS=Subacute	E: Functional Action Observation C: General Action Observation Duration: 30min/d, 5d/wk, for 4wks	• Velocity (+exp) • Step length (+exp) • Stride length (+exp) • Cadence (+exp) • Functional Gait Assessment (+exp)
Action Observation Training with Gait Training vs Gait Training		
Park et al. (2017) RCT (6)	E: Action observation of community ambulation +	• 10-meter Walk Test (+exp) • Community Walk Test (+exp)

Nstart= 26 Nend = 25 TPS= Chronic	Functional training based on neurodevelopmental techniques C: Landscape observation + Functional training based on neurodevelopmental techniques Duration: 30min/d, 5sessions/d for 4wks Functional training & 30min/d, 3d/wk for 4wks Action or landscape observation	• Activity-specific Balance Confidence Scale (+exp) • Gait Cycle Time (-) • Stride Length (+exp) • Single Support (+exp) • Double Support (-) • Gait Velocity (+exp) • Symmetry Index (-) ○ Swing (-) ○ Stance (-) ○ Step (-)
Park et al. (2015) RCT (4) Nstart=40 Nend=40 TPS=Chronic	E: Gait training + Action observation + General physical therapy C: Gait training + Nature video + General physical therapy Duration: 70min/d, 5d/wk for 8wks	• 10-Metre Walk Test (+exp) • Timed Up & Go Test (+exp) • Limit of stability (+exp) • Sway speed (+exp) • Sway area (-)
Park et al. (2014) RCT (7) Nstart=24 Nend=-21 TPS=Chronic	E: Action observation + Gait training C: Sham + Gait training Duration: 30min/d, 3d/wk, 4wks	• 10m Walk Test (+exp) • Figure-of-8 Walk Test (+exp) • Dynamic Gait Index (+exp) • Gait Symmetry Scores (-)
Kim et al. (2013) RCT (7) Nstart=30 Nend=27 TPS=Chronic	E1: Action observation training + physical training E2: Motor imagery training + physical training C: physical training Duration: 30min/d action observation and motor imagery & 1h/d, physical training, 5d/wk for 4wks	E1 vs C • Timed Up and Go (+exp1) • Functional Reach test (-) • Walking Ability questionnaire (-) • Functional ambulation category (-) • Gait speed (+exp1) • Cadence (+exp1) • Step length (-) • Single limb support (+exp1) • Double limb support (-)
Kim & Kim (2012) RCT (5) Nstart=30 Nend=-30 TPS=Subacute	E: Physical therapy + Action observation C: Sham + Physical therapy Duration: 10min action observation & 30min physical therapy	• Gait speed (+exp) • Step length (+exp) • Stride length (+exp) • Single support time (+exp) • Double support time (+exp) • Cadence (+exp)
Action Observation with Treadmill Training vs Treadmill Training		
Bang et al. (2013) RCT (7) Nstart=30 Nend=30 TPS=Chronic	E: Action observational training + Treadmill training C: Sham action observational training + Treadmill training Duration: 40min/d, 5d/wk for 4wks	• Timed Up and Go test (+exp) • 10m Walk test (+exp) • 6min Walk test (+exp) • Max Knee Angle in Swing Phase (+exp)
Action Observation with FES and Gait Training vs Gait Training and FES		
Bae et al. (2017) RCT (6) Nstart=18 Nend=18 TPS=Chronic	E: Dual-afferent sensory input (EMG-triggered FES + Action Observation) C: Functional electric stimulation (FES) Duration: 20min/d, 5d/wk, for 4wks	• Movement-related Cortical Potential ○ Bereitschafts Potential (-) ○ Negative Slope (-) ○ Motor Potential (+exp) • Muscle Activity ○ Tibialis Anterior (-)

		○ Medial Gastrocnemius (-) • H-reflex (-) • Balance ○ Surface Area Ellipse (-) ○ Surface Area Length (-) ○ Limit Of Stability (+exp)
Park & Kang (2013) RCT (5) Nstart=20 Nend=20 TPS=Chronic	E: Gait training + FES + Action observation C: Gait training + FES Duration: 15min/d, 5d/wk for 6wks	• Weight distribution ○ Right Left (+exp) ○ Anterior Posterior (-) • Stability index (+exp) • Gait speed (+exp)
Action Observation with Rhythmic Auditory Stimulation		
Cho et al. (2020) RCT (6) Nstart=30 Nend=30 TPS=Chronic	E: Action observation training + Rhythmic auditory stimulation + PT C: Action observation + PT Duration: 15min, 2sessions/d, 3d/wk, for 8wks action observation & 5d/wk, for 8wks PT	• Postural stability test ○ Overall balance index (+exp) ○ Anteroposterior balance index (+exp) ○ Mediolateral balance index (+exp) • Fall Risk (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Action Observation

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Action observation with gait training** may produce greater improvements in functional ambulation than **gait training or no training.**	5	Park et al. 2017; Park et al. 2015; Park et al. 2014; Kim et al. 2013; Kim & Kim 2012
1b	**Action observation with treadmill training** may produce greater improvements in functional ambulation than **treadmill training.**	1	Bang et al. 2013
2	**Action observation combined with gait training and FES** may produce greater improvements in functional ambulation than **gait training combined with FES.**	1	Park and Kang 2013
2	**Functional action observation** may produce greater improvements in functional ambulation compared to **general action observation.**	1	Oh et al. 2019
1b	**Action observation physical training** may not have a difference in efficacy when compared to **sham action observation training** for improving functional ambulation.	2	Shamsi et al. 2022; Kim et al. 2018
1b	**Action observation with physical training** may not have a difference in efficacy when compared to **motor imagery training with physical training** for improving functional ambulation.	1	Kim et al. 2013
1a	**Backward walking training with action observation** may produce greater improvements in functional ambulation compared to **sham or conventional therapy.**	2	Moon et al. 2022; Moon & Bae 2019

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **action observation with gait training** to improve balance when compared to **gait training**.	3	Park et al. 2017; Park et al. 2015; Kim et al. 2013
1b	**Action observation combined with gait training and FES** may produce greater improvements in balance compared to **gait training combined with FES.**	2	Bae et al. 2017; Park and Kang 2013
1b	**Action observation with physical training** may not have a difference in efficacy when compared to **motor imagery training with physical training** for improving balance.	1	Kim et al. 2013
2	There is conflicting evidence about the effect of **action observation physical training** to improve balance when compared to **sham action observation training**.	1	Kim et al. 2018

1b	**Backward walking training with action observation** may produce greater improvements in balance compared to **sham or conventional therapy.**	1	Moon et al. 2022
1b	**Action observation with rhythmic auditory stimulation** may produce greater improvements in balance compared to **action observation alone.**	1	Cho et al. 2020

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **action observation with gait training** to improve gait when compared to **gait training**.	4	Park et al. 2017; Park et al. 2014; Kim et al. 2013; Kim & Kim 2012
1b	**Action observation with treadmill training** may produce greater improvements in gait than **treadmill training alone.**	1	Bang et al. 2013
1b	**Backward walking training with action observation** may produce greater improvements in gait compared to **sham or conventional therapy.**	1	Moon et al. 2022; Moon & Bae 2019
2	**Functional action observation** may produce greater improvements in gait compared to **general action observation.**	1	Oh et al. 2019
1b	**Action observation physical training** may not have a difference in efficacy when compared to **sham action observation training** for improving gait.	2	Shamsi et al. 2022; Kim et al. 2018
1b	**Action observation with physical training** may not have a difference in efficacy when compared to **motor imagery training with physical training** for improving gait.	1	Kim et al. 2013

Key Points

Action observation with gait or treadmill training may be beneficial for improving functional ambulation, balance, and gait.

Mirror Therapy

Adopted from: https://en.wikipedia.org/wiki/Mirror_box

In mirror therapy, a mirror is placed beside the unaffected limb, blocking view of the affected limb and creating an illusion of two limbs as if they are both functioning normally. Mirror therapy functions through a process known as mirror visual feedback wherein the movement of one limb is perceived as movement from the other limb (Deconinck et al., 2015). In the brain, mirror therapy is thought to induce neuroplastic changes that promote recovery by increasing excitability of the ipsilateral motor cortex which projects to the paretic limb (Deconinck et al. 2015). Ramachandran et al. (1995) first used this method to understand the effect of vision on phantom sensation and pain in arm amputees. Only recently has it been explored as method for lower limb rehabilitation in stroke survivors (Li et al., 2018).

24 RCTs were found evaluating mirror therapy for lower extremity motor rehabilitation.

12 RCTs compared mirror therapy to conventional therapy or a sham condition (Arya et al., 2019; Bhoraniya et al., 2018; Cui et al., 2022; İkizler May et al., 2020; Ji & Kim, 2015; Kim et al., 2016b; Mohan et al., 2013; Salem & Huang, 2015; Simpson et al., 2019; Sutbeyaz et al., 2007; Verma et al., 2021; Wang et al., 2017b). One RCT compared camera-based mirror therapy to conventional therapy (Ding et al., 2019). One RCT compared intensive mirror therapy to standard mirror therapy (Gamez Santiago et al., 2022). One RCT compared treadmill training with mirror therapy to treadmill training alone (Broderick et al., 2019). Two RCTs compared mirror therapy with task-oriented training to task-oriented training alone (Cha & Oh, 2016; Choi et al., 2015b). Two RCTs looked at mirror therapy combined with stimulation (Lee et al., 2015c; Lin et al., 2014b). Two RCTs combined mirror therapy with NMES (Lee et al., 2016a; Xu et al., 2017). One RCT compared mirror therapy with FES to conventional therapy (Salhab et al., 2016). One RCT compared mirror therapy with rTMS to mirror therapy and sham stimulation (Cha & Kim, 2015). One RCT compared mirror therapy with virtual reality to conventional therapy (Miclaus et al., 2021).

The methodological details and results of all 24 RCTs evaluating mirror therapy for lower extremity motor rehabilitation are presented in Table 20.

Table 20. RCTs Evaluating Mirror Therapy Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Mirror Therapy vs Conventional Therapy or Sham Therapy		
Cui et al. (2022) RCT (4) Nstart=40 Nend=32 TPS=Acute	E: Mirror Therapy (MT) + conventional rehabilitation C: Conventional rehabilitation Duration: 30min/d, 5d/wk, for 3wks	• Fugl-Meyer Assessment-Lower Extremity (+exp) • Berg Balance Scale (+exp) • Modified Rivermead mobility index (+exp) • Modified Barthel Index (+exp) • Functional connectivity (+exp) • Regional homogeniety (+exp) • Fractional amplitude of low-frequency fluctuations (+exp)
Verma et al. (2021) RCT (5) Nstart=64 Nend=56 TPS=Chronic	E: Mirror therapy + conventional rehabilitation C: Comprehensive rehabilitation + sham therapy Duration: 30min/d, 6d/wk, for 6wks	• Brunnstrom stages (no stat) • Modified Ashworth Scale (no stat) • Functional Ambulation Category (+exp) • Berg Balance Scale (+exp)
Ikizler May et al. (2020) RCT (6) Nstart=42 Nend=42 TPS=Subacute	E: Mirror Therapy (MT) + Conventional rehabilitation (CR) C: Conventional Rehabilitation (CT) Duration: 60-120min/d conventional care & 30min/d - mirror therapy, 5d/wk, for 4wks	• Brunnstrom (+exp) • Functional Independence Measure (+exp) ○ Motor (+exp) • Berg Balance Scale (+exp) • Motricity Index (+exp) • 6-minute walking test (+exp) • Functional Ambulation Category (+exp) • Modified Ashworth Scale (-)

Arya et al. (2019)
RCT (8)
Nstart=36
Nend=33
TPS=Chronic
	E: Activity-based Mirror Therapy + Conventional Therapy
	C: Conventional Therapy
	Duration: 60min (30min Mirror therapy + 30min conventional /60 min conventional therapy), 30 sessions, 3-4d/wk, for 12wks
		• Fugl-Meyer Assessment (+exp)
		• Brunnstrom recovery stages-LE (+exp)
		• Fugl-Meyer assessment-LE (+exp)
		• Rivermead visual gait assessment (+exp)
		• 10-metre walk test:
		  ○ Comfortable speed (-)
		  ○ Maximum speed (-)

Simpson et al. (2019) RCT (7) Nstart=35 Nfinal=31 TPS=Chronic	E: Home-based isometric unilateral strength training + mirror therapy C: Home-based isometric unilateral strength training Duration: 20min/d, 3d/wk, for 4wks	• Trained ankle maximum voluntary contraction (-) • Untrained ankle maximum voluntary contraction (-) • 10-Metre Walk Test (-) • Timed Up & Go Test (-) • Modified Ashworth Scale (-) • London Handicap Scale (-)

Bhoraniya et al. (2018)
RCT (4)
Nstart=26
Nend=26
TPS=Chronic
	E: Mirror therapy + Conventional Therapy
	C: Conventional therapy
	Duration: 45min/d, 5d/wk, for 4wks
		• Step length
		  ○ Paretic side (+exp)
		  ○ Non-paretic Side (+exp)
		• Stride length
		  ○ Paretic side (+exp)
		  ○ Non-paretic Side (+exp)
		• Cadence (+exp)

		• Velocity (+exp)
Wang et al. (2017) RCT (4) NStart=36 NEnd=36 TPS=Subacute	E: Mirror therapy C: Conventional therapy Duration: 40min/d. 5d/wk, 1wk	• Brunnstrom Staging Score (+exp) • Berg Balance Scale (+exp) • Functional Ambulation Category (+exp) • Functional Independence Measure (+exp)
Kim et al. (2016) RCT (7) Nstart=40 Nend=40 TPS=Subacute	E: Mirror therapy + Conventional rehabilitation C: Sham mirror therapy + Conventional rehabilitation Duration: 30 min/d, 5d/wk, for 4wks MT/Sham MT + 30 min/d, 5d/wk, for 4wks conventional rehabilitation	• Balance Index ○ Overall stability index (+exp) ○ Anterior and posterior index (-) ○ Medial and lateral stability index (+exp)
Ji & Kim (2015) RCT (7) Nstart=34 Nend=31 TPS=Subacute	E: Mirror therapy + Conventional therapy C: Sham mirror therapy + Conventional therapy Duration: 15min/d, 5d/wk, for 4wks mirror/sham therapy & 30min/d, 5d/wk, for 4wks conventional therapy	• Single stance (+exp) • Step length (+exp) • Stride length (+exp) • Velocity (-) • Stance phase (-) • Swing phase (-) • Step width (-) • Cadence (-)
Salem et al. (2015) RCT (4) Nstart=30 Nend=30 TPS=Chronic	E: Mirror therapy + Conventional therapy C: Conventional therapy + Sham mirror therapy Duration: 2-5h/d, 5d/wk for 4wks Conventional therapy & 30min/d, 5d/wk for 4wks Mirror/sham therapy	• Passive ankle dorsiflexion range of motion (+exp) • Modified Ashworth scale (-) • Brunnstrom stages for the lower extremity (+exp) • 10-Metre Walk Test (+exp) •
Mohan et al. (2013) RCT (7) Nstart=22 Nend=22 TPS=Acute	E: Mirror therapy + conventional therapy C: Sham mirror therapy + conventional therapy Duration: 60min/d, 6d/wk, for 2wks	• Fugl-Meyer assessment of lower extremity (-) • Brunel Balance assessment (-) • Functional ambulation categories (+exp)
Sütbeyaz et al. (2007) RCT (7) Nstart=40 Nend=40 TPS=Subacute	E: Mirror therapy + conventional therapy C: Sham mirror therapy + conventional therapy Duration: 30min/d, 5d/wk, for 4wks mirror/placebo therapy & 120-300min/d, 5d/wk, for 4wks conventional therapy	• Brunnstrom stages of motor recovery (+exp) • Modified Ashworth Scale (-) • Functional Ambulation Categories (-) • Functional Independence Measure (motor) (+exp)
Camera-Based Mirror Therapy vs Conventional Therapy		
Ding et al. (2019) RCT (7) Nstart=20 Nend=20 TPS=Subacute	E: Camera-based mirror feedback + Conventional intervention C: Conventional intervention Duration: 90min/d, 5d/wk, for 4wks	• Functional Independence Measure (+exp) ○ Self-care (-) ○ Sphincter control (-) ○ Transfers (+exp) ○ Locomotion (+exp) ○ Communication (-) ○ Social cognition ability (-)

		• Berg Balance Scale (-) • EEG signal-resting state (+exp)
Intensive Mirror Therapy vs Standard Mirror Therapy		
Gamez Santiago et al. (2022) RCT (8) Nstart=44 Nend=41 TPS=Acute	E: Intensive mirror therapy + Conventional physiotherapy C: Standard mirror therapy + Conventional physiotherapy Duration: 1session/d, 5d/wk, for 6wks intensive mirror therapy & 1session/d, 3d/wk, for 10wks standard mirror therapy & 60min/d physiotherapy	• EMG activity (+exp) • Barthel Index (+exp) • Fugl-Meyer Assessment (-)
Treadmill Training Combined with Mirror Therapy vs Treadmill Training		
Broderick et al. (2019) RCT (6) Nstart=30 Nend=23 TPS=Chronic	E: Treadmill Training + Mirror Therapy C: Treadmill Training + Sham Duration: 30min, 3d/wk, for 4wks	• 10-Meter Wak Test (-) • 6-Minute Walk Test (-) • Modified Ashworth Scale ○ Hip flexion (-) ○ Hip extension (-) ○ Hip abduction (-) ○ Knee flexion (-) ○ Knee extension (-) ○ Ankle dorsiflexion (+exp) ○ Ankle plantarflexion (+exp) • Fugl-Meyer Assessment (-)
Mirror Therapy with Task Oriented Training vs Task Oriented Training		
Cha et al. (2016) RCT (6) Nstart=25 Nend=20 TPS=Chronic	E: Task-oriented training + mirror therapy C: Task oriented training Duration: 30min/d, 2sessions/d, 5d/wk for 4wks	• Berg Balance scale (+exp) • Timed Up-and-Go test (+exp) • Balance index (+exp) • Dynamic limit of stability (+exp)
Choi et al. (2015) RCT (4) Nstart=26 Nend=24 TPS=Chronic	E: Stepper Exercise + Visual Feedback (with mirror) C : Stepper Exercise Duration: 30min/d, 3d/wk, 6wks	• Muscle Strength ○ Hip joint extensor muscle (+exp) ○ Knee joint extensor muscle (-) • 10-Meter Walking Test (+exp) • 11 Stair Climbing Test (-)
Mirror Therapy with Stimulation vs Mirror Therapy or Task Oriented Training		
Lee et al. (2015) RCT (7) Nstart=48 Nend=47 TPS=Chronic	E1: Mirror therapy E2: Mirror therapy + Mesh glove (afferent stimulation) C: Mirror therapy + Sham mesh glove Duration: 90min/d, 5d/wk, for 4wks	E1 vs E2 • ED muscle tone (+exp2) • FCR muscle tone (-) • Muscle stiffness (-) • FIM motor (+exp2) • Fugl-Meyer Assessment (-) • Revised Nottingham Sensory Assessment (-) • 10-Meter Walk Test (-) E2 vs C • ED muscle tone (-) • FCR muscle tone (+con) • ED muscle stiffness (-) • FCR muscle stiffness (+exp2) • FIM motor (-) • Fugl-Meyer Assessment (-) • Revised Nottingham Sensory Assessment (-)

		• 10-Meter Walk Test (-) E1 vs C • ED muscle tone (-) • FCR muscle tone (-) • Muscle stiffness (-) • FIM motor (+con) • Fugl-Meyer Assessment (-) • Revised Nottingham Sensory Assessment (-) • 10-Meter Walk Test (-)
Lin et al. (2014) RCT (7) Nstart=43 Nend=42 TPS=Chronic	E1: Mesh glove providing afferent sensory stimulation + Mirror Therapy + Conventional care E2: Mirror Therapy + Conventional care C: Task-oriented training + Conventional care Duration: 1.5h/d, 5d/wk, for 4wks	E1 vs E2/C • 10-Meter Walk Test ○ Self-paced gait velocity (+exp1) ○ Self-paced stride length (+exp1) ○ As quick as possible velocity (+exp1) ○ As quick as possible stride length (-) E2 vs C • 10-Meter Walk Test ○ Self-paced gait velocity (+con) ○ Self-paced stride length (+con) ○ As quick as possible velocity (+con) ○ As quick as possible stride length (-)
Mirror Therapy combined with NMES vs Mirror Therapy with Sham NMES or Conventional Therapy		
Xu et al. (2017) RCT (7) Nstart=69 Nend=69 TPS=Subacute	E1: conventional rehabilitation + mirror therapy + neuromuscular electrical stimulation E2: conventional rehabilitation + mirror therapy C: conventional rehabilitation + Sham mirror therapy Duration: 240min/d, 5d/wk, for 4wks conventional rehabilitation + 30min/d mirror/sham/mirror+NMES	E1/E2 v C • 10-meter walk test (+exp1, +exp2) • Brunnstrom stages of lower extremity (+exp1, +exp2) • Modified Ashworth Scale (+exp1) • Passive ROM (+exp1, +exp2) E1 v E2 • 10-meter walk test (+exp1) • Brunnstrom stages of lower extremity (-) • Modified Ashworth Scale (-) • Passive ROM (-)
Lee et al. (2016a) RCT (6) Nstart=30 Nend=27 TPS=Chronic	E: Mirror therapy + cyclical neuromuscular electrical stimulation + conventional physical therapy C: Conventional therapy Duration: 60min/d, 5d/wk, for 4wks conventional PT & 1session/d, 5d/wk, for 4wks MT + NNES	• Ankle Dorsiflexor Strength (+exp) • Modified Ashworth Scale (-) • Berg Balance Scale (+exp) • Timed-up-and-go (-) • 6-minute Walk Test (-)
Mirror Therapy combined with FES vs Conventional Therapy		
Salhab et al. (2016) RCT crossover (5) Nstart=18 Nend=18 TPS=Chronic	E: Mirror therapy + Functional electrical stimulation C: Conventional therapy Duration: E: 50 min, 4d/wk, for 2wks MT + 16min/session ES treatment C: 50 min, 4d/wk, for 2wks CT 1wk washout	• Ankle dorsiflexion range of motion (+exp) • Fugl-Meyer assessment-lower extremity (+exp) • 10m Walk test (+exp)
Mirror Therapy with rTMS vs Mirror Therapy with Sham Stimulation		
Cha & Kim (2015) RCT (6) Nstart=36 Nend=31	E: Mirror therapy + Repetitive transcranial magnetic stimulation	• Dynamic limits of stability (+exp) • Berg Balance Scale (-) • Timed Up & Go Test (-) • Balance Index (+exp)

TPS=Subacute	C: Mirror therapy + Sham stimulation Duration: 30min/d, 5d/wk for 4wks Mirror therapy & 10min/d, 5d/wk, for 4wks rTMS or Sham	
Mirror Therapy with Virtual Reality vs Conventional therapy		
Miclaus et al. (2021) RCT (7) Nstart=64 Nend=64 TPS=Chronic	E: Virtual reality (VR) therapy and mirror therapy (MT) exercises C: Standard lower extremity rehabilitation Duration: 70min/d, 5d/wk, for 2wks	• Functional Independence Measure (-) • Modified Rankin Scale (-) • Modified Ashworth Scale (-) • Fugl Meyer Lower Extremity Assessment ○ Motor (+exp) ○ Passive (+exp) ○ Pain (-) • Manual Muscle Testing (+exp) • Active Range of Motion (+exp) • Functional Reach Test (+exp) • Time Up to Go (-)

Abbreviations and table notes: ANCOVA=analysis of covariance; ANOVA=analysis of variance; C=control group; D=days; E=experimental group; FES=functional electrical stimulation; H=hours; Min=minutes; NMES=neuromuscular electrical stimulation; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Mirror Therapy

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Mirror therapy** may produce greater improvements in motor function than **conventional therapy or a sham condition**.	7	Cui et al. 2022; Ikizler May et al. 2020; Arya et al. 2019; Wang et al. 2017; Salem et al. 2015; Mohan et al. 2013; Sütbeyaz et al. 2007
1b	**Intensive mirror therapy** may not have a difference in efficacy when compared to **standard mirror therapy** for improving motor function.	1	Gamez Santiago et al. 2022
1b	**Mirror therapy with treadmill training** may not have a difference in efficacy when compared to **treadmill training** for improving motor function.	1	Broderick et al. 2019
1b	**Mirror therapy** may not have a difference in efficacy when compared to **mirror therapy with mesh glove** for improving motor function.	1	Lee et al. 2015
1b	**Mirror therapy with mesh glove** may not have a difference in efficacy when compared to **mirror therapy with sham mesh glove** for improving motor function.	1	Lee et al. 2015
1b	**Mirror therapy** may not have a difference in efficacy when compared to **mirror therapy with sham mesh glove** for improving motor function.	1	Lee et al. 2015

1b	**Mirror therapy with cyclic NMES** may produce greater improvements in motor function compared to **sham mirror therapy and conventional therapy**.	1	Xu et al. 2017
1b	**Mirror therapy with conventional therapy** may produce greater improvements in motor function compared to **sham mirror therapy.**	1	Xu et al. 2017
1b	**Mirror therapy with NMES** may not have a difference in efficacy when compared to **mirror therapy with conventional therapy** for improving motor function.	1	Xu et al. 2017
2	**Mirror therapy with FES** may produce greater improvements in motor function compared to **conventional therapy**.	1	Salhab et al. 2016
1b	There is conflicting evidence about the effect of **mirror therapy with virtual reality** to improve motor function when compared to **conventional therapy**.	1	Miclaus et al. 2021

FUNCTIONAL AMBULATION

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **mirror therapy** to improve functional ambulation when compared to **conventional therapy or sham**.	10	Verma et al. 2021; Ikizler May et al. 2020; Arya et al. 2019; Simpson et al. 2019; Bhoraniya et al. 2018; Wang et al. 2017; Salem et al. 2015; Ji & Kim 2015; Mohan et al. 2013; Sütbeyaz et al. 2007
1b	**Mirror therapy combined with treadmill training** may not have a difference in efficacy when compared to **treadmill training** for improving functional ambulation.	1	Broderick et al. 2019
1b	There is conflicting evidence about the effect of **mirror therapy with task-oriented training** to improve functional ambulation when compared to **task-oriented training**.	2	Cha et al. 2016; Choi et al. 2015
1b	**Mirror therapy combined with mesh glove** may not have a difference in efficacy when compared to **mirror therapy alone** for improving functional ambulation.	1	Lee et al. 2015
1b	**Mirror therapy combined with mesh glove** may not have a difference in efficacy when compared to **mirror therapy with sham mesh glove** for improving functional ambulation.	1	Lee et al. 2015
1b	**Mirror therapy combined with sham mesh glove** may not have a difference in efficacy when compared to **mirror therapy alone** for improving functional ambulation.	1	Lee et al. 2015
1b	**Mirror therapy with mesh glove and conventional care** may produce greater improvements in functional	1	Lin et al. 2014

	ambulation compared to **task oriented training and conventional training**.		
1b	**Mirror therapy combined with conventional care** may not have a difference in efficacy when compared to **task oriented training and conventional training** for improving functional ambulation.	1	Lin et al. 2014
1b	**Mirror therapy with mesh glove and conventional care** may produce greater improvements in functional ambulation compared to **mirror therapy and conventional care**.	1	Lin et al. 2014
1b	**Mirror therapy with NMES** may produce greater improvements in functional ambulation compared to **sham mirror therapy and conventional therapy**.	1	Xu et al. 2017
1b	**Mirror therapy with conventional therapy** may produce greater improvements in functional ambulation compared to **sham mirror therapy**.	1	Xu et al. 2017
1b	**Mirror therapy with NMES** may produce greater improvements in functional ambulation compared to **mirror therapy with conventional therapy**.	1	Xu et al. 2017
1b	**Mirror therapy combined with NMES** may not have a difference in efficacy when compared to **mirror therapy with sham NMES or conventional therapy** for improving functional ambulation.	1	Lee et al. 2016
2	**Mirror therapy with FES** may produce greater improvements in functional ambulation compared to **conventional therapy**.	1	Salhab et al. 2016
1b	**Mirror therapy combined with rTMS** may not have a difference in efficacy when compared to **mirror therapy with sham stimulation** for improving functional ambulation.	1	Cha & Kim 2015
1b	**Mirror therapy combined with virtual reality** may not have a difference in efficacy when compared to **conventional therapy** for improving functional ambulation.	1	Miclaus et al. 2021

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Mirror therapy** may produce greater improvements in balance compared to **conventional therapy or sham.**	7	Cui et al. 2022; Verma et al. 2021; Ikizler May et al. 2020; Wang et al. 2017; Kim et al. 2016; Ji & Kim 2015; Mohan et al. 2013
1b	**Camera-based mirror therapy** may not have a difference in efficacy when compared to **conventional therapy** for improving balance.	1	Ding et al. 2019
1b	**Mirror therapy combined with task-oriented training** may produce greater improvements in balance than **task-oriented training.**	1	Cha et al. 2016

1b	**Mirror therapy combined with NMES** may produce greater improvements in balance than **mirror therapy with sham NMES or conventional therapy.**	1	Lee et al. 2016
1b	There is conflicting evidence about the effect of **mirror therapy with rTMS** to improve balance when compared to **mirror therapy with sham stimulation**.	1	Cha & Kim 2015
1b	**Mirror therapy with virtual reality** may produce greater improvements in balance than **conventional therapy.**	1	Miclaus et al. 2021

GAIT

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **mirror therapy** to improve gait when compared to **conventional therapy or a sham condition**.	3	Arya et al. 2019; Bhoraniya et al. 2018; Ji & Kim 2015
1b	There is conflicting evidence about the effect of **mirror therapy with mesh glove stimulation and conventional care** to improve gait when compared to **conventional therapy and task-oriented training**.	1	Lin et al. 2014
1b	**Mirror therapy with conventional care** may not have a difference in efficacy when compared to **task-oriented training with conventional training** for improving gait.	1	Lin et al. 2014
1b	There is conflicting evidence about the effect of **mirror therapy with mesh glove stimulation and conventional care** to improve gait when compared to **mirror therapy and conventional care**.	1	Lin et al. 2014

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
2	**Mirror therapy** may produce greater improvements in functional mobility compared to **conventional therapy or sham**.	1	Cui et al. 2022

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1b	**Mirror therapy** may produce greater improvements in activities of daily living compared to **conventional therapy or sham**.	4	Cui et al. 2022; Ikizler May et al. 2020; Wang et al. 2017; Sütbeyez et al. 2007
1b	**Camera-based mirror therapy** may not have a difference in efficacy when compared to **conventional therapy** for improving activities of daily living.	1	Ding et al. 2019
1b	**Intensive mirror therapy** may produce greater improvements in activities of daily living compared to **standard mirror therapy.**	1	Gamez Santiago et al. 2022

1b	**Mirror therapy** may not have a difference in efficacy when compared to **mirror therapy with mesh glove** for improving activities of daily living.	1	Lee et al. 2015
1b	**Mirror therapy with mesh glove** may not have a difference in efficacy when compared to **mirror therapy with sham mesh glove** for improving activities of daily living.	1	Lee et al. 2015
1b	**Mirror therapy** may not have a difference in efficacy when compared to **mirror therapy with sham mesh glove** for improving activities of daily living.	1	Lee et al. 2015
1b	**Mirror therapy with virtual reality** may not have a difference in efficacy when compared to **conventional therapy** for improving activities of daily living.	1	Miclaus et al. 2021

RANGE OF MOTION

LoE	Conclusion Statement	RCTs	References
2	**Mirror therapy** may produce greater improvements in range of motion compared to **conventional therapy or a sham condition** for improving range of motion.	1	Salem et al. 2015
1b	**Mirror therapy with NMES** may produce greater improvements in range of motion compared to **sham mirror therapy and conventional therapy** for improving range of motion.	1	Xu et al. 2017
1b	**Mirror therapy with conventional therapy** may produce greater improvements in range of motion compared to **sham mirror therapy** for improving range of motion.	1	Xu et al. 2017
1b	**Mirror therapy with NMES** may not have a difference in efficacy when compared to **mirror therapy with conventional therapy** for improving range of motion.	1	Xu et al. 2017
2	**Mirror therapy with FES** may produce greater improvements in range of motion than **conventional therapy**.	1	Salhab et al. 2016
1b	**Mirror therapy with virtual reality** may produce greater improvements in range of motion than **conventional therapy**.	1	Miclaus et al. 2021

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1a	**Mirror therapy** may not have a difference in efficacy when compared to **conventional therapy or a sham condition** for improving muscle strength.	2	Ikizler May et al. 2020; Simpson et al. 2019
2	There is conflicting evidence about the effect of **mirror therapy combined with task-oriented training** to improve muscle strength when compared to **task-oriented training**.	1	Choi et al. 2015

1b	**Mirror therapy with virtual reality** may produce greater improvements in muscle strength than **conventional therapy**.	1	Miclaus et al. 2021

SPASTICITY			
LoE	Conclusion Statement	RCTs	References
1b	**Mirror therapy** may not have a difference in efficacy when compared to **conventional therapy or a sham condition** for improving spasticity.	4	Ikizler May et al. 2020; Simpson et al. 2019; Salem et al. 2015; Sütbeyez et al. 2007
1b	**Mirror therapy combined with treadmill training** may not have a difference in efficacy when compared to **treadmilling training** for improving spasticity.	1	Broderick et al. 2019
1b	**Mirror therapy with NMES** may produce greater improvements in spasticity compared to **sham mirror therapy with conventional therapy**.	1	Xu et al. 2017
1b	**Mirror therapy with conventional therapy** may not have a difference in efficacy when compared to **sham mirror therapy** for improving spasticity.	1	Xu et al. 2017
1b	**Mirror therapy with NMES** may not have a difference in efficacy when compared to **mirror therapy with conventional therapy** for improving spasticity.	1	Xu et al. 2017
1b	**Mirror therapy with NMES** may not have a difference in efficacy when compared to **mirror therapy with sham NMES or conventional therapy** for improving spasticity.	1	Lee et al. 2016
1b	**Mirror therapy with virtual reality** may not have a difference in efficacy when compared to **conventional therapy** for improving spasticity.	1	Miclaus et al. 2021

PROPRIOCEPTION			
LoE	Conclusion Statement	RCTs	References
1b	**Mirror therapy** may not have a difference in efficacy when compared to **mirror therapy with mesh glove** for improving proprioception.	1	Lee et al. 2015
1b	**Mirror therapy with mesh glove** may not have a difference in efficacy when compared to **mirror therapy with sham mesh glove** for improving proprioception.	1	Lee et al. 2015
1b	**Mirror therapy** may not have a difference in efficacy when compared to **mirror therapy with sham mesh glove** for improving proprioception.	1	Lee et al. 2015

QUALITY OF LIFE			
LoE	Conclusion Statement	RCTs	References

1b	**Mirror therapy** may not have a difference in efficacy when compared to **conventional therapy or sham** for improving quality of life.	1	Simpson et al. 2019

Key Points

Mirror therapy may be helpful in improving motor function, balance, and activities of daily living compared to conventional treatment after stroke.

The literature is mixed regarding the effect of mirror therapy on functional ambulation and gait after.

Mirror therapy may not be beneficial for improving spasticity, proprioception, and quality of life after stroke.

Aquatic Therapy

Adopted from: https://completept.com

Aquatic therapy employs the natural properties of water (i.e. buoyancy, hydrostatic pressure, hydrodynamic forces, thermodynamics and viscosity) to act as a rehabilitation intervention in supporting weight and offsetting gravity during exercises related to balance and gait performed in water (Becker, 2009).

Aquatic therapies may vary, with some forms including traditional exercises, neurodevelopmental techniques, proprioceptive neuromuscular facilitation, and task-specific training. The Halliwick Method is an example of a motor rehabilitation program that is based on neurodevelopmental techniques, in which core stability is a major focus (Martin, 1981). The Bad Ragaz Ring Method is an example of a motor rehabilitation program that is based on proprioceptive neuromuscular facilitation techniques, in which improving range of motion is a major focus (Boyle, 1981). Alternative and complementary medicine techniques have also been integrated into aquatic therapy programs, examples include Ai chi, which is derived from tai chi, as well as Watsu, which is derived from shiatsu (Lutz, 1999; Ross & Presswalla, 1998).

26 RCTs were found evaluating aquatic therapy for lower extremity motor rehabilitation.

13 RCTs compared aquatic therapy to conventional therapy (Cha et al., 2017; Chan et al., 2017; Eyvaz et al., 2018; Furnari et al., 2014; Kim et al., 2015c; Kim et al., 2015e; Ku et al., 2020; Noh et al., 2008; Park et al., 2016; Park et al., 2011b; Tripp & Krakow, 2014; Vakilian et al., 2021; Zhu et al., 2016b). One RCT compared aquatic therapy to land-based upper extremity exercises (Chu et al., 2004). Six RCTs compared aquatic treadmill walking or aerobic therapy to overground or treadmill walking (Franciulli et al., 2019; Han & Im, 2018; Kim et al., 2020c; Lee et al., 2018d; Park et al., 2012; Zhang et al., 2016). Two RCTs compared aquatic ai chi therapy with dry land therapy to aquatic ai chi therapy (Perez-De la Cruz, 2020, 2021). Two RCTs compared aquatic dual-task training to neurodevelopmental techniques or land-based dual motor tasks (Kim et al., 2016a; Saleh et al., 2019). One RCT compared aquatic therapy with strength training to aquatic therapy (Gu et al., 2022). One RCT compared sequential preparatory approach aquatic therapy to standard aquatic therapy (Temperoni et al., 2020).

The methodological details and results of all 26 RCTs evaluating aquatic therapy for lower extremity motor rehabilitation are presented in Table 21.

Table 21. RCTs Evaluating Aquatic Therapy Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Aquatic Therapy vs Conventional Therapy		
Vakilian et al. (2021) RCT (5) Nstart=36 Nend=36 TPS=Chronic	E1: Aqua therapy in shallow water E2: Aqua therapy in deep water C: Usual treatment Duration: 30min/d, 3d/wk, for 6wks	<u>E1 v C</u> • Static balance (+exp1) • Semi-dynamic balance (+exp1) <u>E2 v C</u> • Static balance (+exp2) • Semi-dynamic balance (+exp2) <u>E1 v E2</u> • Static balance (-) • Semi-dynamic balance (-)
Ku et al. (2020) RCT (8) Nstart=20 Nend=20 TPS=Chronic	E: Ai Chi (modified aquatic therapy) C: Conventional Water Based Exercise Duration: 60min/d, 3d/wk, for 6wks	• Berg Balance Scale (-) • Limit of Stability: ○ Movement velocity (-) ○ Directed control (-) ○ Max excursion (-) ○ End excursion-AP (+exp) • Fugl-Meyer Assessment Lower Extremity (+exp) • Gait speed (-) • Stride length (-) • Stride time (-) • Cadence (-)
Eyvaz et al. (2018) RCT (5) Nstart=65 Nend=60 TPS=Chronic	E: Water based exercise (WBE) therapy + Land based exercise (LBE) C: Land based exercise Duration: E: WBE for 3d/wk, 6 wk+ LBE for 40min/d, 5d/wk, for 6wks C: LBE for 40min/d, 5d/wk, for 6wks	• Berg Balance Scale (+con) • Functional Independence Measure (-) • Timed Up and Go scale (-) • Static Balance Index (-) • Dynamic Balance Index (-) • Isokinetic Peak torque-LE (-) • Short Form 36 (-)
Cha et al. (2017) RCT (8) Nstart=22 Nend=22 TPS=Chronic	E: Aquatic therapy (Bad Ragaz Ring Method) + conventional therapy C: Conventional therapy Duration: 60min/d, 3d/wk for 6wks	• Muscle activation by EMG (+exp) • Balance index (+exp) • Timed Up and Go (-)
Chan et al. (2017) RCT (5) Nstart=32 Nend=25 TPS=Subacute	E: In-water exercise training + Land exercise training C: Land exercise training Duration: 60min/d, 2d/wk, for 6wks	• Berg Balance Score (-) • Community Balance and Mobility Score (-) • Timed Up and Go Test (-) • 2-Minute Walk Test (-)
Park et al. (2016) RCT (5) Nstart=28 Nend=28 TPS=Chronic	E: Aquatic therapy (Halliwick, Watsu, and Trunk Training) C: Trunk control exercises Duration: 30min/d, 3d/wk, 4wks	• Gait Speed (-) • Walking cycle (+con) • Affected side stance phase (-) • Affected side stride length (+con) • Symmetry index of stance phase (-)

		• Symmetry index of stride length (-)
Zhu et al. (2016) RCT (8) Nstart=28 Nend=28 TPS=Chronic	E: Aquatic therapy C: Conventional therapy Duration: 45min/d, 5d/wk for 4wks	• Berg Balance Scale (-) • Functional Reach Test (+exp) • Timed Up and Go Test (-) • 2-Minute Walk Test (+exp)
Kim et al. (2015) RCT (4) Nstart=20 Nend=20 TPS=Chronic	E: Aquatic therapy (based on proprioceptive neuromuscular facilitation) C: Proprioceptive neuromuscular facilitation on the ground Duration: 30min/d, 5d/wk for 6wks	• Berg Balance Scale (+exp) • Timed Up and Go Test (+exp) • Functional Reach Test (+exp) • One Leg Stand Test (+exp) • Functional Independence Measure (+exp)
Kim et al. (2015b) RCT (4) Nstart=20 Nend=20 TPS=Chronic	E: Aquatic therapy (based on proprioceptive neuromuscular facilitation) C: Conventional therapy Duration: 30min/d, 5d/wk for 6wks conventional rehabilitation for both groups	• Berg Balance Scale (+exp) • Functional Reach Test (+exp) • 10-Meter Walk Test (+exp) • Timed Up and Go Test (+exp)
Furnari et al. (2014) RCT (5) Nstart=40 Nend=40 TPS=Chronic	E: Hydrokinesytherapy + Conventional PT C: Conventional PT Duration: E: 60min/d, 3d/wk, for 8wks hydrokinesytherapy + 60min/d, 3d/wk, for 8wks conventional PT; C: 60min/d, 6d/wk, for 8wks conventional PT	• Plantar surface (-) • Plantar load (-) • Length of ball (+exp) • Speed (+exp) • Semi step length (+exp) • Cadence (+exp) • Stance phase (+exp) • Swing phase (+exp) • Double support phase (+exp)
Tripp et al. (2014) RCT (7) Nstart=30 Nend=27 TPS=Subacute	E: Aquatic therapy (Halliwick therapy) + conventional therapy C: Conventional therapy Duration: E: 45min/d, 2d/wk, for 2wks conventional PT + 45min/d, 3d/wk, for 2wks aquatic therapy ; C: 45min/d, 5d/wk, for 2wks conventional PT	• Berg Balance Scale (-) • Functional reach (-) • Functional Ambulation Categories (+exp) • Rivermead Mobility Index (-)
Park et al. (2011) RCT (4) Nstart=44 Nend=44 TPS=Chronic	E: Aquatic therapy C: Conventional therapy Duration: 35min/d, 6d/wk for 6wks	• Performance-Oriented Mobility Assessment (+exp) • Joint Position Sense (+exp)
Noh et al. (2008) RCT (4) Nstart=25 Nend=20 TPS=Chronic	E: Aquatic therapy (Halliwick and Ai Chi methods) C: Conventional therapy Duration: 60min/d, 3d/wk for 8wks	• Berg Balance Scale (+exp) • Balance assessment; o Rising from a chair (-) o Weight shift laterally (-) o Weight shift forward affected (+exp) o Weight shift forward intact (-) o Weight shift backward affected (+exp) o Weight shift backward intact (-) • Muscle strength; o Knee extensor peak torque affected (-)

		○ Knee flexor peak torque affected (+exp) ○ Knee flexor peak torque intact (-) • Modified Motor Assessment Scale (-)
Aquatic Therapy vs Land-Based Upper Extremity Exercises		
Chu et al. (2004) RCT (6) Nstart=13 Nend=12 TPS=Chronic	E: Group aqua therapy C: Arm function program Duration: 60min/d, 3d/wk, for 8wks	• VO_2 Max (+exp) • Maximal Workload (+exp) • 8 Meter Walk Test Self Selected Gait Speed (+exp) • Berg Balance Scale (-) • Isokinetic Muscle Strength of Knee and Hip ○ Paretic Side (+exp) ○ Nonparetic Side (-)
Aquatic Treadmill Walking or Aerobic Therapy vs Overground or Treadmill Walking or Cycle Ergometer		
Kim et al. (2020) RCT (7) Nstart= 22 Nfinal= 21 TPS=Chronic	E: Underwater gait training + conventional therapy C: Overground gait training + conventional rehabilitation 60min/d, 5d/wk, for 12wks conventional therapy & Duration: 30min/d, 2d/wk, for 12wks	• Postural Assessment Stroke Scale (+exp) • Center of Pressure (-) • Stance time (second) (-) • Swing time (second) (-) • Step time difference (second) (-) • Step length (cm) (-) • Step length difference (cm) (-) • Walking velocity (cm/second) (-)
Franciulli et al. (2019) RCT (5) Nstart=12 Nend=12 TPS=Chronic	E: Aerobic Aquatic therapy C: Aerobic Treadmill training Duration: 40min/d, 3d/wk, for 9wks	• Berg Balance scale (-) • Timed Up and Go (-) • EMG root mean squared change (+con)
Lee et al. (2018) RCT (7) Nstart=37 Nend=32 TPS=Subacute	E: Water-based aerobic exercise on a motorized aquatic treadmill + Conventional rehabilitation therapy C: Aerobic Exercise (by upper and lower body ergometers) + Conventional rehabilitation therapy Duration: 60min/d, 5d/wk, for 4wks conventional therapy (30min PT + 30min OT) & 30 min/d, 5d/wk, for 4wks Water-based aerobic exercise / Land-based aerobic exercise	• Fugl Meyer Assessment Lower Extremity (-) • Berg Balance Scale (-) • Korean- Modified Barthel Index (-) • Maximal Isometric strength (torque) of Knee Flexors ○ Paretic (+exp) ○ Non Paretic (-) • Maximal Isometric strength (torque) of Knee Extensors: ○ Paretic (+exp) ○ Non Paretic (-) • EQ-5D (-) • Cardiovascular parameters-stress test (-) • baPWV test for arterial stiffness (-)
Han et al. (2018) RCT (6) Nstart=20 Nend=20 TPS=Subacute	E: Aquatic-based treadmill aerobic training + conventional care C: Land-based aerobic exercises on cycle ergometer + conventional care Duration: 50min aerobic exercise (aquatic or land)/d + conventional care (duration/d not specified), 5d/wk, for 6wks	• Modified Barthel index (-) • 6min Walk test (-)
Zhang et al. (2016) RCT (7) Nstart=36	E: Aquatic therapy (PT exercises) + aquatic treadmill	• Maximum isometric voluntary contraction and Co-contraction Ratio ○ Knee Extension Torque (+exp)

Nend=33 TPS=Subacute	C: Conventional PT exercise + land-based treadmill Duration: 40min/d, 5d/wk, for 8wks	○ Knee Flexion Torque (-) ○ Knee Extension co-contraction Ratio (+exp) ○ Knee Flexion co-contraction Ratio (-) ○ Anke dorsiflexion Torque (-) ○ Ankle plantarfelxion Torque (+exp) ○ Ankle dosifelxion co-contraction Ratio (-) ○ Ankle plantarlfexion co-contraction Ratio (-) • Modified Ashworth ○ Knee (-) ○ Ankle (-) • Functional ambulation category (+exp) • Barthel Index (+exp)
Park et al. (2012) RCT (4) Nstart=20 Nend=20 TPS=Chronic	E: Underwater treadmill walking C: Overground treadmill walking Duration: 30min/d, 4d/wk for 6wks	• Body weight on foot (+exp) • Short Physical Performance Battery (-) • Joint flex ○ Hip (+exp) ○ Knee (+exp) ○ Ankle (-)
Aquatic Ai Chi Therapy with Dry Land Therapy vs Aquatic Ai Chi Therapy		
Perez-de la Cruz et al. (2021) RCT (8) Nstart=45 Nend=45 TPS=Chronic	E1: Aquatic Ai Chi therapy + Dry land therapy E2: Aquatic Ai Chi therapy C: training on dry land Duration: 45min/d, 2d/wk, for 12wks	E1 vs E2 • Berg Balance Scale (+exp2) • Tandem stance (-) • Five time sit-to-stand test (+exp2) • Timed Up and Go Test (-) E1/E2 vs C • Berg Balance Scale (+exp2) • Tandem stance (+exp1, +exp2) • Five time sit-to-stand test (+exp1, +exp2)
Perez-de la Cruz et al. (2020) RCT (8) Nstart=40 Nend=40 TPS=Chronic	E1: Aquatic Ai Chi therapy + Dry land therapy E2: Aquatic Ai Chi therapy C: Training on dry land Duration: 45-50min/d, 2d/wk, for 12wks dry land therapy/aquatic therapy & 45-50min/d, 4d/wk, for 12wks combined group alternating dry and aquatic training	E1 vs E2 • Pain Visual Analog Scale (-) • Tinetti test (-) • 360 degrees turn test (+exp2) • 30-Second Sit-to-Stand Test (+exp1) • Single leg stance (no stat) E1/E2 vs C • Pain Visual Analog Scale (+exp1, +exp2) • Tinetti test (+exp1, +exp2) • 360 degrees turn test (+exp1, +exp2) • 30-Second Sit-to-Stand Test (+exp1) • Single leg stance (no stat)
Dual-Task Aquatic Training vs Neurodevelopmental Techniques or Land-Based Dual Motor Task		
Saleh et al. (2019) RCT (6) Nstart=50 Nend=50 TPS=Chronic	E: Aquatic-based Dual-task Motor Training C: Land-based Dual-task Motor Training Duration: 45min, 3d/wk, for 6wks	E v C • Overall Stability Index (+exp) • Anteroposterior Stability Index (+exp) • Mediolateral Stability Index (+exp) • Walking speed (+exp) • Step length (+exp) • Support time affected side (+exp)

Kim et al. (2016) RCT (4) Nstart=20 Nend=NR TPS=Chronic	E: Aquatic therapy (Dual-task training with upper extremity tasks) C: Neurodevelopmental techniques Duration: 1h/d, 5d/wk for 6wks	• Berg Balance Scale (+exp) • Five-Time Sit to Stand Test (+exp) • Functional Reach Test (+exp) • 10-Meter Walk Test (+exp) • Timed Up and Go Test (+exp) • Functional Gait Assessment (+exp)
Aquatic Therapy with Strength Training vs Aquatic Therapy		
Gu et al. (2022) RCT (6) Nstart=61 Nend=56 TPS=Subacute	E: Aquatic training + under water strength training C: Aquatic training Duration: 45min/d, 5d/wk for 6wks	• Timed up and go (+exp) • Berg Balance scale (+exp) • 2-minute walk test (+exp) • Stride length (+exp) • Stride width (+exp) • Stride frequency (+exp) • Walking speed (+exp)
Sequential Preparatory Approach Aquatic Therapy vs Standard Aquatic Therapy		
Temperoni et al. (2020) RCT (7) Nstart=33 Nend=28 TPS=Chronic	E: Sequential preparatory approach aquatic therapy C: Standard aquatic therapy Duration: 45min/d, 2d/wk, for 4wks	• Berg Balance scale (+exp) • Modified Barthel index (-) • Tinetti Balance and Gait scale (-) • Stroke specific QoL (+exp) • Modified Ashworth scale-LE (+exp)

Abbreviations and table notes: ANCOVA=analysis of covariance; C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Aquatic Therapy

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Ai Chi** may produce greater improvements in motor function than **conventional water-based exercise.**	1	Ku et al. 2020
1b	**Aquatic treadmill walking or aerobic therapy** may not have a difference in efficacy when compared to **overground or treadmill walking or cycle ergometer** for improving motor function.	1	Lee et al. 2018

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **aquatic therapy** to improve functional ambulation when compared to **land-based or conventional therapy**.	9	Eyvaz et al. 2018; Cha et al. 2017; Chan et al. 2017; Zhu et al. 2016; Park et al. 2016; Kim et al. 2015a; Kim et al. 2015b; Furnari et al. 2014; Tripp et al. 2014
1b	**Ai Chi** may not have a difference in efficacy when compared to **conventional water-based exercise** for improving functional ambulation.	1	Ku et al. 2020

1b	**Aquatic therapy** may produce greater improvements in functional ambulation compared to **land-based upper extremity exercises.**	1	Chu et al. 2004
1b	**Aquatic treadmill walking or aerobic therapy** may not have a difference in efficacy when compared to **overground or treadmill walking or cycle ergometer** for improving functional ambulation.	4	Kim et al. 2020; Franciulli et al. 2019; Han et al. 2018; Zhang et al. 2016
1a	**Aquatic Ai Chi therapy with dry land therapy** may not have a difference in efficacy when compared to **aquatic Ai Chi therapy alone** for improving functional ambulation.	2	Perez-de la Cruz 2021; Perez-de la Cruz 2020
1a	**Aquatic Ai Chi therapy with dry land therapy** may produce greater improvements in functional ambulation compared to **dry land therapy.**	2	Perez-de la Cruz 2021; Perez-de la Cruz 2020
1a	There is conflicting evidence about the effect of **aquatic Ai Chi therapy** to improve functional ambulation when compared to **dry land therapy**.	2	Perez-de la Cruz 2021; Perez-de la Cruz 2020
1b	**Aquatic dual-task training** may produce greater improvements in functional ambulation than **neurodevelopmental techniques or land-based dual motor task.**	2	Saleh et al. 2019; Kim et al. 2016
1b	**Aquatic therapy with strength training** may produce greater improvements in functional ambulation than **aquatic therapy.**	1	Gu et al. 2022

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1b	**Aquatic therapy** may not have a difference in efficacy when compared to **land-based or conventional therapy** for improving functional mobility.	1	Tripp et al. 2014
2	**Aquatic treadmill walking or aerobic therapy** may not have a difference in efficacy compared to **overground or treadmill walking or cycle ergometer** for improving functional mobility.	1	Park et al. 2012

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **aquatic therapy** to improve balance when compared to **land based or conventional therapy**.	10	Vakilian et al. 2021; Eyvaz et al. 2018; Chan et al. 2017; Cha et al. 2017; Zhu et al. 2016; Kim et al. 2015a; Kim et al. 2015b; Tripp et al. 2014; Park et al. 2011; Noh et al. 2008
2	**Aquatic therapy in shallow water** may not have a difference in efficacy when compared to **aquatic therapy in deep water** for improving balance.	1	Vakilian et al. 2021

1b	**Ai Chi** may not have a difference in efficacy when compared to **conventional water-based exercise** for improving balance.	1	Ku et al. 2020
1b	**Aquatic therapy** may not have a difference in efficacy when compared to **land-based upper extremity exercises** for improving balance.	1	Chu et al. 2004
1b	**Aquatic treadmill walking or aerobic therapy** may not have a difference in efficacy when compared to **overground or treadmill walking or cycle ergometer** for improving balance.	3	Kim et al. 2020; Franciulli et al. 2019; Lee et al. 2018
1b	**Aquatic Ai Chi therapy with dry land therapy** may not have a difference in efficacy when compared to **aquatic Ai Chi therapy** for improving balance.	2	Perez-de la Cruz 2021; Perez-de la Cruz 2020
1b	**Aquatic Ai Chi therapy with dry land therapy** may produce greater improvements in balance compared to **dry land therapy alone.**	2	Perez-de la Cruz 2021; Perez-de la Cruz 2020
1b	**Aquatic Ai Chi therapy** may produce greater improvements in balance compared to **dry land therapy.**	2	Perez-de la Cruz 2021; Perez-de la Cruz 2020
1b	**Dual-task aquatic training** may produce greater improvements in balance compared to **neurodevelopmental techniques or land-based dual motor task.**	2	Saleh et al. 2019; Kim et al. 2016
1b	**Aquatic therapy with strength training** may produce greater improvements in balance compared to **aquatic therapy alone.**	1	Gu et al. 2022
1b	There is conflicting evidence about the effect of **sequential preparatory approach aquatic therapy** to improve balance when compared to **standard aquatic therapy**.	1	Temperoni et al. 2020

GAIT

LoE	Conclusion Statement	RCTs	References
1b	**Aquatic therapy** may not have a difference in efficacy when compared to **land-based or conventional therapy** for improving gait.	2	Park et al. 2016; Furnari et al. 2014
1b	**Ai Chi therapy** may not have a difference in efficacy when compared to **conventional water-based exercise** for improving gait.	1	Ku et al. 2020
1b	**Aquatic treadmill walking or aerobic therapy** may not have a difference in efficacy when compared to **overground or treadmill walking or cycle ergometer** for improving gait.	2	Kim et al. 2020; Park et al. 2012
1b	**Aquatic dual-task training** may produce greater improvements in gait compared to **neurodevelopmental techniques or land-based dual motor task.**	2	Saleh et al. 2019; Kim et al. 2016

1b	**Aquatic therapy with strength training** may produce greater improvements in gait compared to **aquatic therapy.**	1	Gu et al. 2022

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
2	**Aquatic therapy** may not have a difference in efficacy when compared to **land-based or conventional therapy** for improving activities of daily living.	3	Eyvaz et al. 2018; Kim et al. 2015; Noh et al. 2008
1a	**Aquatic treadmill walking or aerobic therapy** may not have a difference in efficacy when compared to **overground or treadmill training or cycle ergometer** for improving activities of daily living.	3	Han et al. 2018; Lee et al. 2018; Zhang et al. 2016
1b	**Sequential preparatory approach aquatic therapy** may not have a difference in efficacy when compared to **standard aquatic therapy** for improving activities of daily living.	1	Temperoni et al. 2020

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
2	**Aquatic therapy** may not have a difference in efficacy when compared to **land-based or conventional therapy** for improving muscle strength.	2	Eyvaz et al. 2018; Noh et al. 2008
1a	**Aquatic treadmill walking or aerobic therapy** may not have a difference in efficacy when compared to **overground or treadmill walking or cycle ergometer** for improving muscle strength.	2	Lee et al. 2018; Zhang et al. 2016
1b	**Aquatic therapy** may produce greater improvements in muscle strength compared to **land-based upper extremity exercises.**	1	Chu et al. 2004

SPASTICITY

LoE	Conclusion Statement	RCTs	References
1b	**Aquatic treadmill walking or aerobic therapy** may not have a difference in efficacy when compared to **overground or treadmill walking or cycle ergometer** for improving spasticity.	1	Zhang et al. 2016
1b	**Sequential preparatory approach aquatic therapy** may produce greater improvements in spasticity compared to **standard aquatic therapy.**	1	Temperoni et al. 2020

PROPRIOCEPTION

LoE	Conclusion Statement	RCTs	References
2	**Aquatic therapy** may produce greater improvements in proprioception compared to **land-based or conventional therapy.**	1	Park et al. 2011

Key Points

The literature is mixed regarding the effects of aquatic therapy for improving motor function, functional ambulation, balance, gait, and spasticity after stroke.

Aquatic therapy may not be beneficial for improving functional mobility, muscle strength, and activities of daily living after stroke.

Aquatic therapy may be beneficial for improving proprioception.

Strength and Resistance Training

Adopted from: https://aspirefitnessrehab.com.au/our-services/

Gray et al. (2012) found that individuals experience decreases in muscle fibre length and lean muscle mass post stroke. Neural input to muscle groups are reduced, resulting in weakness and a decrease in muscle fibre length, which the fibres may adapt to if the muscle is not moved through the full range of motion (Gray et al., 2012). In contrast, Klein et al. (2013) did not find any significant differences in muscle volume or atrophy between the contralesional and ipsilesional limbs in relation to weakness. However, the authors reported lower levels of maximal voluntary contraction torque in the contralesional limb, which was associated with deficits in muscle activation and electromyographic amplitude.

Muscle strengthening as an intervention is designed to improve the force-generation capacity of hemiplegic limbs and enhance functional abilities. Conventional physiotherapy rehabilitation programs may not include muscle strengthening as there is a belief that strength training may increase spasticity (Miller & Light, 1997). While the effectiveness of strength training is difficult to assess due to variability in training programs, it has been suggested that strength training should be recommended as part of a stroke rehabilitation program (Ada et al., 2006).

Strength or resistance training can take various forms in which eccentric, isometric, or concentric exercises are performed. The muscle lengthens during contraction in eccentric training, stays constant during isometric training, and shortens during concentric training. Other forms of strength or resistance training can include the way in which the exercise is performed. For example, in the case of isokinetic strength training, the exercise machines used produce a constant pace of work or speed regardless of the effort expended. Alternatively, functional strength training involves performing functional exercises that mimic common real-life activities and that require the muscles to work together. Progressive resistance training involves performing exercises in which additional load is continuously added to facilitate adaptation. Strength or resistance training can also be coupled with other forms of exercises such as aerobic training, can be administered in various settings, and also at various intensities.

49 RCTs were found evaluating strength and resistance training for lower extremity motor rehabilitation.

28 RCTs compared strength and resistance training to conventional therapy (Akbari & Karimi, 2006; Bale & Strand, 2008; Cooke et al., 2010; Fernandez-Gonzalo et al., 2016; Flansbjer et al., 2008; Gambassi et al., 2019; Glasser, 1986; Hendrey et al., 2018; Knox et al., 2018; Kwakkel et al., 1999; Lattouf et al., 2021; Lee et al., 2013c; Lee & Kang, 2013; Lovell et al., 2009; Mares et al., 2014; Moreland et al., 2003; Patel et al., 2021; Patil & Rao, 2011; Sekhar et al., 2013; Şen et al., 2015; Sims et al., 2009; Son et al., 2014; Wu et al., 2020a; Yang et al., 2006; Zou et al., 2015). Five RCTs compared strength and resistance training to stretching or relaxation (Ivey et al., 2017;

Kim et al., 2001; Mead et al., 2007; Moore et al., 2016; Ouellette et al., 2004). Seven RCTs compared aerobic and resistance training to conventional therapy or aerobic training alone (Lee et al., 2010; Lee et al., 2015d; Lund et al., 2018; Marzolini et al., 2018; Severinsen et al., 2014; Teixeira-Salmela et al., 1999). Four RCTs compared different strength and resistance training modalities (Alabdulwahab et al., 2015; Chen et al., 2015a; Clark & Patten, 2013; Pandian et al., 2015). One RCT compared different strength and resistance training intensities (Lamberti et al., 2017). One RCT compared strength training with mirror therapy to strength training alone (Simpson et al., 2019). One RCT compared strength training with visual feedback to physical therapy (Cho et al., 2021). Two RCTs compared resistance training with balance training to conventional therapy (Vahlberg et al., 2017a; Vahlberg et al., 2017b). One RCT compared ankle strength training with rTMS to ankle strength training or rTMS alone (Cha & Kim, 2017). One RCT compared resistance training with dietary supplements to resistance training alone (Yoshimura et al., 2019). One RCT compared strength training in paralytic muscles to non-paralytic muscles (Park et al., 2021b).

The methodological details and results of all 49 RCTs are presented in Table 22.

Table 22. RCTs Evaluating Strength and Resistance Training Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Strength or Resistance Training vs Conventional Therapy or Educational Classes		
Lattouf et al. (2021) RCT (5) Nstart=37 Nend=37 TPS=Chronic	E: Eccentric muscle strengthening + Standard rehabilitative care C: Standard rehabilitative care Duration: 60min/d, 5d/wk, for 4wks	• 10-Metre Walk Test (-) • 6-Minute Walk Test (+exp) • One-repetition maximum- paretic LE (+exp)
Patel et al. (2021) RCT (6) Nstart=37 Nend=37 TPS=Chronic	E: Force-control training C: Ballistic ankle contraction strength training Duration: 90min/d, 2d/wk, for 2wks	<u>Post-hoc analysis (main effect)</u> • Stride length (-) • Stride Time (-) • Gait speed (-) • Ankle motor control ○ Accuracy paretic (+exp) ○ Accuracy nonparetic (-) ○ Steadiness paretic (-) ○ Steadiness nonparetic (+exp) • Ankle strength ○ Plantarflexion (+con) ○ Dorsiflexion (-)
Wu et al. (2020) RCT (7) Nstart=31 Nend=31 TPS=Acute	E: Early conventional PT + intensive strength exercises C: Conventional physiotherapy Duration: 20-30min/d, 5d/wk conventional PT & 30min/d, 5d/wk, for 2wks strength exercises	• Fugl-Meyer Assessment (+exp) • Functional Independence Measure - Ability to walk 50m (-) • Berg Balance Scale (-) • Barthel Index (-) • Modified Rankin Scale (-)

Gambassi et al. (2019) RCT (6) Nstart=22 Nend=22 TPS=Chronic	E: Resistance training + Conventional care (physical therapy) C: Conventional care (physical therapy) Duration: E: 2d/wk resistance training, 8wk + 2d/wk conventional care, for 8wks	• 10-meter Walk test (+exp) • 5 repetition-Sit-to-Stand (+exp) • Timed Up and Go (+exp) • Heart rate (+exp) • Double product (+exp) • Cardiac Autonomic Modulation ○ Time domain indexes (+exp) ○ Nonlinear indexes (+exp) ○ Oxidative stress markers (-)
Hendrey et al. (2018) RCT (8) Nstart=30 Nend=26 TPS=Subacute	E: Ballistic Strength Training C: Conventional Therapy Duration: 45min/d, 3d/wk, for 6wks	• 10-Metre Walk Test ○ Comfortable (+exp) ○ Fast (-) • Timed Up and Go (-) • Peak Jump height ○ Paretic (+exp) ○ Non paretic (-) • Peak propulsive velocity ○ Paretic (+exp) ○ Non paretic (-) • Muscle torque ○ hip flexors (-) ○ knee extensors (-) ○ knee flexors (-) ○ ankle plantar flexors (-) ○ ankle dorsiflexors (-) ○ hip extensors prone knee straight (-) ○ hip extensors prone knee bent (-) ○ hip extensors supine (-)
Knox et al. (2018) RCT (7) NStart=144 NEnd=128 TPS=Subacute	E1: Task oriented circuit gait training E2: Strength training of lower extremities C: Educational session on stroke management Duration: E1/E2: 60min/d, 6d/12wk intervention sessions & C: 90min/d, 1d	<u>E1/E2 vs C</u> • Berg Balance Scale (+exp1) • 10m walk ○ Comfortable Gait Speed (+exp1) ○ Fast gait speed (+exp1) • Timed Up and Go test (+exp1) • 6-minute walk test (+exp1, +exp2) <u>E1 vs E2</u> • Berg Balance Scale (+exp1) • 10m walk ○ Comfortable Gait Speed (+exp1) ○ Fast gait speed (+exp1) • Timed Up and Go test (+exp1) • 6-minute walk test (+exp1)

Fernandez-Gonzalo et al. (2016)
RCT (5)
Nstart=32
Nend=29
TPS=Chronic
	E: Eccentric resistance training
	C: Conventional therapy (daily routine)
	Duration: 7reps/4sets, 2d/wk, for 12wks
		• Timed Up-and-Go Test (+exp)
		• Maximal Isometric force (-)
		  ○ Maximal dynamic force (+exp)
		  ○ Peak power (+exp)
		• Modified Ashworth Scale (-)
		• Berg Balance Scale (+exp)
		• Talking while walking-Dual Task (+exp)
		• Digits Span subtest from the WAIS-III (+exp)
		• Spatial Span - the Wechsler Memory Scale (WMS-III) (-)
		• Conners Continuous Performance Test-II (CPT-II) (-)
		• Rey Auditory Verbal Learning Test (-)
		• Stroop Test
		  ○ Color (+exp)
		  ○ Word (-)
		  ○ Word and Color (-)
		• Verbal Fluency test (+exp)
		• Trail Making test A (-)
		• Trail making test B (-)
		• SF-36 (-)

Şen et al. (2015) RCT (4) Nstart=50 Nend=50 TPS=Subacute	E: Isokinetic strength training + Conventional rehabilitation C: Conventional rehabilitation Duration: 5d/wk for 3wks	• 10-Metre Walk Test (+exp) • 6-Minute Walk Test (+exp) • Timed Up-and-Go Test (+exp) • Berg Balance Scale (+exp) • Stair Climbing Test (+exp) • Rivermead Mobility Index (+exp) • Functional Independence Measure (+exp) • Stroke Specific Quality of Life Scale (+exp)
Zou et al. (2015) RCT (8) Nstart=56 Nend=51 TPS=Chronic	E: Lower Body Resistance Training C: Conventional therapy Duration: 40min/d, 3d/wk, for 8wks	• Lower Limb Muscle Strength (1RM) (+exp) • Fugl-Meyer Lower Extremity (-)

Mares et al. (2014)
RCT (6)
Nstart=52
Nend=44
TPS=Chronic
	E1: Functional strength training - upper limb
	E2: Functional strength training - lower limb
	Duration: 60min/d, 4d/wk, for 6wks
		• Functional Ambulation Categories (-)
		• Modified Rivermead Mobility Index (-)
		• Action Research Arm Test (-)
		• Timed Up and Go Test
		  ○ Time (+exp1)
		  ○ Ability to complete (-)
		• Nine Hole Peg Test (-)

Son et al. (2014) RCT (3) Nstart=28 Nend=28 TPS=Chronic	E: Resistance training C: Conventional therapy Duration: 30min/d, 5d/wk for 6wks	• Berg Balance Scale (+exp) • Timed Up-and-Go Test (+exp) • Sway Distance (+exp)
Lee et al. (2013c) RCT (4) Nstart=28 Nend=28 TPS=Chronic	E: Progressive resistance training + Foot-ankle compression C: Conventional therapy Duration: 30min/d, 5d/wk for 6wks	• Gait velocity (+exp) • Step time (+exp) • Double limb support (+exp) • Step length (+exp) • Stride length (+exp) • Heel-to-heel support (+exp)
Lee & Kang (2013) RCT (5) Nstart=20	E: Isokinetic strength training C: Conventional therapy	• Gait velocity (+exp) • Timed Up-and-Go Test (+exp) • Stair up and down time (+exp)

Nend=20 TPS=Not Reported	Duration: 60min/d, 3d/wk for 6wks	• Peak torque flexion (+exp) • Peak torque extension (+exp)
Sekhar et al. (2013) RCT (5) Nstart=40 Nend=40 TPS=Not Reported	E: Isokinetic strength training + balance exercises C: Conventional physiotherapy Duration: 6wks	• Isokinetic peak torque ○ 30° (+exp) ○ 60° (+exp) ○ 90° (+exp) • Berg balance scale (+exp)
Patil et al. (2011) RCT (2) Nstart=20 Nend=16 TPS=Subacute	E: Theraband + conventional therapy + gait training C: Conventional Therapy + Gait Training Duration: 45min/d, 3d/wk, for 6wks	• Wisconsin Gait Scale (-) • Rivermead Mobility Index (-)
Cooke et al. (2010) RCT (8) Nstart=109 Nend=99 TPS=Subacute	E1: Functional strength training E2: High-intensity physiotherapy C: Low-intensity physiotherapy Duration: 60min/d, 4d/wk for 6wks	E1/E2 vs C: • Walking speed (+exp2) • Modified Rivermead index (-) • step length (-) • symmetry step time (-) • EuroQuol Health state (-) • EuroQuol Self-perceived health (-)
Lovell et al. (2009) RCT (5) Nstart=24 Nend=24 TPS=Not Reported	E: Strength Training (Incline Squat Machine) C: Conventional Therapy Duration: 3 sets of 6-10 repetitions at 70-90% 1RM, 3d/wk, for 16wks	• Leg Strength (+exp)
Sims et al. (2009) RCT (6) Nstart=45 Nend=43 TPS=Chronic	E: Community-based progressive resistance training C: Conventional care Duration: 2d/wk, for 10wks	• Centre for Epidemiologic Studies for Depression scale (-) • Assessment of Quality-of-Life Instrument (-) • Short Form-12 Health Survey Questionnaire (-) • stroke specific QOL (-) • Stroke Impact Scale (-) • Satisfaction with Life Scale (-) • Social Support Survey (-) • Life Orientation Test Revised (-) • Self Esteem Scale (-) • Recovery Locus of Control Scale (-)
Bale et al. (2008) RCT (7) Nstart=18 Nend=18 TPS=Subacute	E: Functional strength training C: Conventional therapy Duration: 50min/d, 5d/wk for 4wks	• Habitual gait speed (+exp) • Maximum gait speed (-) • Knee muscle strength (-) • Maximum weight bearing (-)
Flansbjer et al. (2008) RCT (6) Nstart=25 Nend=24 TPS=Chronic	E: Progressive resistance training + Conventional therapy C: Conventional therapy Duration: 90min/d, 2d/wk for 10wks	• Dynamic Knee strength (+exp) • Isokinetic knee strength (-) • Modified Ashworth scale (-) • Timed Up and Go (-) • 10meter walk test (-) • 6min Walk test (-) • Stroke Impact scale 3.0-Swedish version (-)
Akbari & Karimi, (2006) RCT (5) Nstart=34 Nend=34 TPS=Chronic	E: Functional + balance + strengthening exercises C: Functional + balance exercises Duration: 3hrs/d, 3d/wk, for 4wks	• Modified Ashworth Scale (+exp) • Muscle Strength-LE ○ Hip (+exp) ○ Knee flexor (+exp) ○ Knee extensor (-) ○ Ankle (+exp)

Yang et al. (2006)
RCT (7)
Nstart=48
Nend=48
TPS=Chronic
	E: Task-oriented progressive resistance strength training
	C: No treatment
	Duration: 30min/d, 3d/wk for 4wks Task-oriented resistance training
		• Muscle strength
		  ○ Hip & knee flexor (+exp)
		  ○ Hip & knee extensor (+exp)
		  ○ Ankle dorsiflexor & plantarflexor (+exp)
		• 10-m Walk Velocity (+exp)
		• Cadence (+exp)
		• Stride length (+exp)
		• 6-Minute Walk Test (+exp)
		• Step Test (+exp)
		• Timed Up-and-Go Test (+exp)

Moreland et al. (2003) RCT (8) Nstart=133 Nend=124 TPS=Subacute	E: Progressive resistance exercises + Conventional therapy C: Exercises without progressive resistance + Conventional therapy Duration: 30min/d, 3d/wk for 4wks	• 2-Minute Walk Test (-) • Chedoke-McMaster Stroke Assessment Disability Inventory (-) • Days in the Program Before Discharge (-) • Days before Discharge (-) • Adverse Effects (-) • Modified Ashworth Scale (-) • Discharge Living Arrangements (-)
Kwakkel et al. (1999) RCT (7) Nstart=101 Nend=89 TPS=Acute	E1: Rehabilitation program with leg training E2: Rehabilitation program with Arm training C: Rehabilitation program with arm & leg immobilized Duration: 30min/d, 5d/wk, for 20wks	<u>E1/E2 vs C</u> • Barthel index (+exp1) • Functional ambulation categories (+exp1) • Action Research Arm test (+exp1, +exp2) • 10m walk test (+exp1) <u>E1 vs E2</u> • Barthel index (-) • Functional ambulation categories (-) • Action Research Arm test (-) • 10m walk test (-)
Glasser (1986) RCT (4) Nstart=20 Nend=20 TPS=Subacute	E: Isokinetic strength training (Kinetron) C: Conventional therapy Duration: 1hr/session, 2 sessions/d, 5d/wk for 5wks	• Functional Ambulation Profile (-) • Ambulation time (-)
Strength or Resistance Training vs Stretching or Relaxation		

Ivey et al. (2017)
RCT (4)
NStart=38
NEnd=30
TPS=Chronic
	E: Bilateral strength training
	C: Conventional care (Supervised Stretching and ROM exercises)
	Duration: 45min/d, 3d/wk for 3mo
		• 6-Minute Walk test (+exp)
		• 10-Meter Walking test
		  ○ Fastest comfortable speed (-)
		  ○ Self-selected walking speed (-)
		• One-repetition maximum
		  ○ Paretic side(+exp)
		  ○ Non-paretic side (+exp)
		• Skeletal muscle endurance
		  ○ Non-paretic (+exp)
		  ○ Paretic (+exp)

Moore et al. (2016) RCT (7) Nstart=40 Nend=40 TPS=Chronic	E: Progressive mixed exercise program (aerobic/strength/balance/flexibility) C: Stretching Duration: 45-60min/d, 3d/wk for 19wks	• 6-Minute Walk Test (+exp) • 10-Metre Walk Test (+exp) • Timed Up-and-Go Test (+exp) • Berg Balance Scale (+exp) • Peak Oxygen (+exp) • Peak Work Rate (+exp)
Mead et al. (2007) RCT (7)	E: Progressive endurance and resistance training	• Functional Independence Measure (-)

Nstart=66 Nend=64 TPS=Subacute	C: Relaxation Duration: 75min/d, 3d/wk, for 12wks	• Nottingham Extended Activities of Daily Living (-) • Rivermead Mobility Index (-) • Functional Reach (-) • Sit to Stand (-) • Timed Up & Go (+exp) • SF-36 (-) • Comfortable walking speed (-) • Leg extensor power (-)

Ouellette et al. (2004)
RCT (7)
Nstart=42
Nend=37
TPS=Chronic
	E: High-intensity resistance training
	C: Upper extremity stretching
	Duration: 3d/wk, for 12wks
		• Knee Extensor Strength (Paretic/Nonparetic) (+exp)
		• Leg Press Strength (Paretic/Nonparetic) (+exp)
		• Ankle Dorsiflexor Strength
		  ○ Paretic (+exp)
		  ○ Nonparetic (-)
		• Ankle Plantarflexion Strength (Paretic/Nonparetic) (+exp)
		• Six-Minute Walk (-)
		• Stair Climb (-)
		• Five Times Sit to Stand (-)
		• Gait Velocity (-)
		• Geriatric Depression Scale (-)
		• Sickness Impact Profile (-)
		• Ewart's Self Efficacy Scale (-)
		• PF 10 (-)
		• Late Life Function and Disability Instrument
		  ○ Function Total (-)
		  ○ Upper Extremity (-)
		  ○ Basic Lower Extremity (-)
		  ○ Advanced Lower Extremity (+exp)
		  ○ Frequency Dimension Total (-)
		  ○ Social Role (-)
		  ○ Personal Role (-)
		  ○ Limitation Dimension Total (+exp)
		  ○ Instrumental Role (+exp)
		  ○ Management Role (-)

Kim et al. (2001) RCT (8) Nstart=20 Nend=20 TPS=Chronic	E: Isokinetic strength exercises (active ROM) using dynamometer C: Passive range of motion exercises using dynamometer Duration: 30min/d, 3d/wk for 6wks	• Gait speed (-) • Stair climbing (-) • SF-36 (-) • LE Muscles strength (-)
Aerobic and Resistance Training vs Conventional Therapy or Aerobic Training		
Lund et al., (2018) RCT (5) Nstart= 43 Nend = 43 TPS= Chronic	E1: Aerobic training on cycle ergometer E2: Resistance training of lower extremities C: Sham training of upper extremities Duration: 3sets/wk for 12wks	E1 v E2 v C • Berg Balance Scale (-) • 6-minute walking test (-) • 10 meter walk speed (-)

Marzolini et al. (2018)
RCT (6)
Nstart=73
Nend=68
TPS=Chronic
	E: Aerobic training + Resistance training
	C: Aerobic Training
	Duration: 20-60mins/d, 5d/wk for 6mo
		• 6-minute walk test (-)
		• Stair climb time (-)
		• Sit to stand time (-)
		• Muscular strength
		  ○ Elbow flexion affected side (+exp)
		  ○ Elbow flexion nonaffected side (+exp)
		  ○ Knee extension affected side (-)

		○ Knee extension nonaffected side (+exp)
Lee et al. (2015d) RCT (6) Nstart=30 Nend=30 TPS=Chronic	E: Resistance training + Aerobic training C: Conventional therapy Duration: 1hr/d, 3d/wk for 16wks	• 6-Minute Walk Test (+exp) • 10-Metre Walk Test (+exp) • Timed Up-and-Go Test (-) • 30-Second Chair Test (-)
Severinsen et al. (2014) RCT (5) Nstart=48 Nend=43 TPS=Chronic	E1: Aerobic training E2: Progressive resistance training C: Resistance training of the arms (sham) Duration: 65min/d, 3d/wk, for 12wks	<u>E1 vs E2</u> • 6-min walk test (-) • 10m walk test (-) • Knee muscle strength (nonparetic/paretic) (+exp2) • Short-Form 36 (-) <u>E1/E2 vs C</u> • 6-min walk test (-) • 10m walk test (-) • Knee muscle strength (nonparetic) (+exp1) • Knee muscle strength (paretic) (-) • Short-Form-36 (-)
Lee et al. (2010) RCT (5) Nstart=52 Nend=48 TPS=Chronic	E1: Progressive resistance training + Cycling E2: Progressive resistance training + Sham cycling E3: Sham progressive resistance training + Cycling E4: Sham progressive resistance training + Sham cycling Duration: 60min/d, 3d/wk for 10wks	<u>E1/E2 vs E3/E4</u> • Muscle strength – LE (+exp_1, +exp_2) • Muscle endurance (+exp_1, +exp_2) • Peak power (+exp_1, +exp_2) <u>E1 vs E2</u> • Muscle strength – LE (-) • Muscle endurance (-) • Peak power (-) <u>E3 vs E4</u> • Muscle strength – LE (+exp_3) • Muscle endurance (+exp_3) • Peak power (+exp_3)
Lee et al. (2010) RCT (5) Nstart=52 Nend=48 TPS=Chronic	E1: Aerobic cycling + progressive resistance training (PRT) E2: Aerobic cycling + sham PRT E3: Sham cycling + PRT C: Sham cycling + Sham PRT Duration: 60min/d, 3d/wk for 10wks	<u>E1/E2/E3 v C</u> • 6MWT ○ distance (-) ○ endurance-affected (+exp3, +exp1) ○ Endurance unaffected side (+exp1, +exp2, +exp3) • 10MWT ○ Fast speed (-) ○ Habitual speed (-) • Stair climbing power (+exp1, +exp3) • Treadmill walking physical cost index (+exp1, +exp2) • Treadmill walking oxygen cost (-) • Power in affected leg (+exp1, +exp3) • SF-36 (-)
Teixeira-Salmela et al. (1999)	E: aerobic exercises and lower extremity muscle strengthening	• Peak Isokinetic Torque of Muscle (Affected) (+exp)

RCT (3) Nstart=13 Nend=13 TPS=Chronic	C: No intervention Duration: 60-90min/d, 3d/wk for 10wks	• Pendulum Test (+exp) • Nottingham Health Profile (+exp) • Gait speed (+exp) • Human Activity Profile (+exp) • Stair Climbing (+exp)
Strength and Resistance Training Modalities		
Alabdulwahab et al. (2015) RCT (6) Nstart=26 Nend=23 TPS=Chronic	E: Functional task-oriented gait training with limb overloading C: Limb overloading resistance training Duration: 1hr/d, 3d/wk for 4wks	• Gait Speed (+exp) • Cadence (+exp) • Weight Bearing (+exp) • Stroke Impact Scale (+exp)
Chen et al. (2015) RCT (4) Nstart=31 Nend=24 TPS=Subacute	E: Isokinetic strengthening exercise C: Isometric strengthening exercise Duration: 3 sets/d, 5d/wk, for 4wks	• Peak isometric torque of knees at 90° ○ Flexion sound side (-) ○ Flexion lesion side (-) ○ Extension sound side (-) ○ Extension lesion side (-) • Peak torque of isometric knee at angular velocities 60° ○ Extension lesion side (-) ○ Extension sound side (-) ○ Flexion lesion side (+exp) ○ Flexion sound side (-) • Peak torque of isometric knee at angular velocities 120° ○ Extension lesion side (-) ○ Extension sound side (-) ○ Flexion lesion side (+exp) ○ Flexion sound side (-) • Short-Form 36 (-) • Timed Up and Go test (-)
Pandian et al. (2015) RCT (8) Nstart=35 Nend=35 TPS= Chronic	E: Motor therapy for Less Affected side (Progressive resistive and strengthening exercise + Bimanual-task training) C: neurophysiological-based conventional therapy Duration: 60min/d, 3d/wk for 8wks	• Brunnstrom Recovery Stage- LE (+exp) • Fugl-Meyer Assessment- LE (+exp)
Clark & Patten (2013) RCT (8) Nstart=35 Nend=33 TPS=Chronic	E1: Eccentric resistance training + Gait training E2: Concentric resistance training + Gait training Duration: 90min/session, 3d/wk, for 5wks resistance training, then 90min/session, 3d/wk, for 3wks gait training.	<u>E1 vs E2</u> • Muscle power-paretic leg (+exp1) • Walking speed (+exp1)
Strength and Resistance Training Intensity		
Lamberti et al. (2017) RCT (7) Nstart=35 Nend=30 TPS=Chronic	E1: Low intensity walking and resistance training program E2: High intensity walking and resistance training program Duration: 60min/d, 3d/wk, for 8wks	• 6-minute Walking Distance Test (+exp1) • SF-36 (+exp1) • Peak Power of the Femoral Quadriceps and Biceps (+exp1) • 10-meter Walk Test (-) • Berg Balance Scale (-)

		• Lower-limb Strength (-) • 5 Sit-to-Stand Test (-)
Strength Training Combined with Mirror Therapy		
Simpson et al. (2019) RCT (7) Nstart=35 Nend=31 TPS=Chronic	E: Home based Isometric Unilateral Strength Training + Mirror Therapy C: Home based Isometric Unilateral Strength Training Duration: 20min/d, 3d/wk, for 4wks	• Maximal Voluntary Contraction in Trained and Untrained Ankles (-) • Modified Ashworth Scale (-) ○ Hip (-) ○ Knee (-) ○ Ankle (-) • 10 Meter Walk Test (-) • Timed Up-and-Go (-) • London Handicap Scale (-)
Strength Training with Visual Feedback vs Physical Therapy		
Cho et al. (2021) RCT (8) Nstart=25 Nend=23 TPS=Chronic	E: Bi-axial ankle-resistive strengthening muscle training + visual feedback C: Ankle Physical therapy Duration: 40min/d, 5d/wk, for 4wks	• Fugl-Meyer Assessment lower extremity score (+exp) • Berg balance Scale (-) • 10-meter walking test (-) • Ankle co-contraction index ○ Dorsiflexion (+exp) ○ Plantarflexion (+exp) ○ Inversion (+exp) ○ Eversion (+exp) ○ Ankle proprioception (-) ○ Ankle co-activation index (+exp)
Resistance Training with Balance Training vs Conventional Therapy		
Vahlberg et al. (2017a) RCT (7) Nstart=43 Nend=43 TPS=Chronic	E: Progressive resistance + balance training and motivational session C: Usual activity Duration: 75min/d, 2d/wk, for 12wks	• Bergs Balance Scale (-) • Body Mass Index (-) • Physical Activity Scale for the Elderly (-) • Six-minute Walking (+exp) • Short Physical Performance Test (-) • Chair Rise 5times (-)
Vahlberg et al. (2017b) RCT (8) Nstart=67 Nend=57 TPS=Chronic	E: Progressive resistance + balance training and motivational session C: Usual activity Duration: 75min/d, 2d/wk, for 12wks	• Berg Balance Scale (+exp) • Short Physical Performance Battery (-) • Six-Minute Walk Test (+exp) • 10 Meter Walk Test (+exp) • Euro-QoL-5D (-) • Fall-Related Self-Efficacy Scale (-) • Geriatric Depression Scale (-) • Physical Activity Scale for the Elderly (-)
Resistance Training with and without rTMS vs Resistance Training or rTMS Alone		
Cha et al. (2017) RCT (7) NStart=30 NEnd=30 TPS=Subacute	E1: Ankle Strengthening E2: Ankle Strengthening with high frequency (10Hz) Repetitive Transcranial Magnetic Stimulation (rTMS) C: rTMS Duration: 10min/d, 5d/wk, for 8wks	<u>E2 vs C</u> • Motor evoked potential amplitude (+exp2) • plantar flexor (+exp2) • Dorsiflexor (+exp2) • 10-Meter walk test (+exp2) <u>E2 vs E1</u> • Motor evoked potential amplitude (+exp2) • Plantar flexor (+exp2) • Dorsiflexor (+exp2) • 10-Meter walk test (+exp2)
Dietary Supplements with Resistance training vs Resistance Training Alone		

Yoshimura et al. (2019) RCT (6) Nstart=49 Nend=44 TPS=Acute	E: Leucine enriched amino acid + resistant training E: resistant training Duration: 1 session/d leucine, vitamin, carbohydrate supplement, & ≤3 hr/d rehabilitation, for 8wks	• Functional independence measure ○ Motor (+exp) ○ Cognitive (-)
Muscle Strength Training to Paralytic Muscles vs Muscle Strength Training to Non-paralytic Muscles		
Park et al. (2021) RCT (6) Nstart=21 Nend=21 TPS=Chronic	E: Muscle strengthening training to non-paralytic dorsiflexion muscles + neurodevelopmental therapy C: Muscle strengthening training to paralytic dorsiflexion muscles + neurodevelopmental therapy Duration: 60min/d, 5d/wk, for 6wks neurodevelopmental therapy & 30min/d, 3d/wk, for 6wks muscle strengthening exercises	• Timed Up & Go Test (-) • 10-Metre Walk Test (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Strength and Resistance Therapy

MOTOR FUNCTION			
LoE	Conclusion Statement	RCTs	References
1b	**Strength training with visual feedback** may produce greater improvements in motor function than **physical therapy.**	1	Cho et al. 2021
1b	**Resistive and strengthening exercise with bimanual tasks** may produce greater improvements in motor function than **conventional therapy.**	1	Pandian et al. 2015
1a	**Strength or resistance training** may not produce greater improvements in motor function than **conventional therapy.**	4	Patel et al. 2021; Wu et al. 2020; Zou et al. 2015; Moreland et al. 2003

FUNCTIONAL AMBULATION			
LoE	Conclusion Statement	RCTs	References
1a	**Resistance training with balance training** may produce greater improvements in functional ambulation than **conventional therapy.**	2	Vahlberg et al. 2017a; Vahlberg et al. 2017b
1b	**Task-oriented circuit gait training** may produce greater improvements in functional ambulation than **strength training.**	1	Knox et al. 2018

1b	**Ankle strengthening with high frequency rTMS** may produce greater improvements in functional ambulation than **ankle strengthening or rTMS alone.**	1	Cha et al. 2017
1b	**Functional limb overloading** may produce greater improvements in functional ambulation than **limb overloading resistance training.**	1	Alabdulwahab et al. 2015
1b	**Eccentric resistance training with gait training** may produce greater improvements in functional ambulation than **concentric resistance training with gait training.**	1	Clark & Patten 2013
1a	There is conflicting evidence about the effect of **strength or resistance training** to improve functional ambulation when compared to **conventional therapy**.	20	Lattouf et al. 2021; Patel et al. 2021; Gambassi et al. 2019; Hendrey et al. 2018; Knox et al. 2018; Lund et al. 2018; Fernandez-Gonzalo et al. 2016; Sen et al. 2015; Severinsen et al. 2014; Son et al. 2014; Lee et al. 2013; Lee & Kang et al. 2013; Cooke et al. 2010; Bale et al. 2008; Flansbjer et al. 2008; Lee et al. 2008; Yang et al. 2006; Moreland et al. 2003; Kwakkel et al. 1999; Glasser et al. 1986
1b	There is conflicting evidence about the effect of **aerobic and resistance training** when compared to **conventional or aerobic training.**	4	Marzoilini et al. 2018; Lee et al. 2015; Lee et al. 2008; Teixeira-Salme et al. 1999
1b	There is conflicting evidence on the effect of **low intensity resistance training** when compared to **high intensity resistance training** for improving functional ambulation.	1	Lamberti et al. 2017
1a	**Strength or resistance training** may not produce greater improvements in functional ambulation than **stretching or relaxation.**	5	Ivey et al. 2017; Moore et al. 2016; Mead et al. 2007; Ouellette et al. 2004; Kim et al. 2001
1a	**Lower limb strength training** may not produce greater improvements in functional ambulation than **upper limb strength training.**	1	Mares et al. 2014; Kwakkel et al. 1999
1b	**Strength training with visual feedback** may not produce greater improvements in functional ambulation than **physical therapy.**	1	Cho et al. 2021
1b	**Muscle strength training to paralytic muscles** may not produce greater improvements in functional ambulation than **muscle strength training to non-paralytic muscles.**	1	Park et al. 2021
1b	**Strength training with mirror therapy** may not produce greater improvements in functional ambulation than **strength training.**	1	Simpson et al. 2019

2	**Resistance training** may not produce greater improvements in functional ambulation than **aerobic training.**	2	Lund et al. 2018; Severinsen et al. 2014
2	**Isokinetic strengthening exercises** may not produce greater improvements in functional ambulation than **isometric strengthening exercises.**	1	Chen et al. 2015

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Strength or resistance training** may not have a difference in efficacy when compared to **conventional therapy** for improving functional mobility.	5	Fernandez-Gonzalo et al. 2016; Sen et al. 2015; Mares et al. 2014; Patil et al. 2011; Cooke et al. 2010;
1a	**Resistance training with balance training** may not produce greater improvements in functional mobility than **conventional therapy.**	2	Vahlberg et al. 2017a; Vahlberg et al. 2017b
1a	**Strength or resistance training** may not have a difference in efficacy when compared to **relaxation** for improving functional mobility.	2	Mead et al. 2007; Ouellette et al. 2004
1b	**Lower limb strength training** may not produce greater improvements in muscle strength than **upper limb strength training.**	1	Mares et al. 2014

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Task-oriented circuit gait training** may produce greater improvements in balance than **strength training.**	1	Knox et al. 2018
1a	There is conflicting evidence on the effect of **strength or resistance training** when compared to **conventional care** for improving balance.	7	Wu et al. 2020; Knox et al. 2018; Lund et al. 2018; Fernandez-Gonzalo et al. 2016; Sen et al. 2015; Son et al. 2014; Sekhar et al. 2013
1b	There is conflicting evidence about the effect of **strength or resistance training** to improve balance when compared to **stretching or relaxation**.	2	Moore et al. 2016; Mead et al. 2007;
1a	There is conflicting evidence about the effect of **aerobic and resistance training** to improve balance when compared to **conventional therapy or aerobic training.**	4	Marzolini et al. 2018; Lee et al. 2015; Teixeira-Salmela et al. 1999; Duncan et al. 1998
1a	**Resistance training with balance training** may not produce greater improvements in balance than **conventional therapy.**	2	Vahlberg et al. 2017a; Vahlberg et al. 2017b
2.	**Resistance training** may not have a difference in efficacy when compared to **home-based exercise** for improving balance.	1	Page et al. 2008

1b	**Strength training with visual feedback** may not produce greater improvements in balance than **physical therapy.**	1	Cho et al. 2021
1b	**Low intensity endurance and resistance training** may not have a difference in efficacy when compared to **high intensity endurance and resistance training** for improving balance.	1	Lamberti et al. 2017
1b	**Strength training with mirror therapy** may not have a difference in efficacy when compared to **strength training alone** for improving balance.	1	Simpson et al. 2019
2	**Resistance training** may not produce greater improvements in balance than **aerobic training.**	1	Lund et al. 2018

GAIT

LoE	Conclusion Statement	RCTs	References
1b	**Functional limb overloading** may produce greater improvements in gait than **limb overloading resistance.**	1	Alabdulwahab et al. 2015
1a	There is conflicting evidence about the effect of **strength or resistance training** to improve gait when compared to **conventional therapy**.	7	Patel et al. 2021; Hendrey et al. 2018; Lee et al. 2013; Patil et al. 2011; Cooket et al. 2010; Bale et al. 2008; Yang et al. 2006

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
2	**Aerobic and resistance training** may produce greater improvements in the performance of activities of daily living than **conventional or aerobic training alone.**	1	Teixeira-Salme et al. 1999
1b	There is conflicting evidence on the effect of **dietary supplements with resistance training** when compared to **resistance training alone** for improving the performance of activities of daily living.	1	Yoshimura et al. 2019
1a	**Strength and resistance training** may not produce greater improvements in activities of daily living than **conventional therapy**	1	Wu et al. 2020; Sen et al. 2015; Kwakkel et al. 1999
1a	**Resistance training with balance training** may not produce greater improvements in the performance of activities of daily living than **conventional therapy.**	2	Vahlberg et al. 2017a; Vahlberg et al. 2017b
1a	**Strength or resistance training** may not have a difference in efficacy when compared to **relaxation** for improving activities of daily living.	1	Mead et al. 2007; Ouellette et al. 2004
1b	**Lower limb strength training** may not produce greater improvements in the performance of activities of daily living when compared to **upper limb strength training.**	1	Kwakkel et al. 1999

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Strength or resistance training** may produce greater improvements in muscle stregtnh than **conventional therapy.**	15	Lattouf et al. 2021; Patel et al. 2021; Hendrey et al. 2018; Fernandez-Gonzalo et al. 2016; Zou et al. 2015; Severinsen et al. 2014; Lee & Kang 2013; Sekhar et al. 2013; Lee et al. 2010; Lovell et al. 2009; Bale et al. 2008; Flansbjer et al. 2008; Lee et al. 2008; Akbari & Karimi et al. 2006; Yang et al. 2006
1b	**Strength training with visual feedback** may produce greater improvements in muscle strength than **physical therapy.**	1	Cho et al. 2021
1b	**Aerobic and resistance training** may produce greater improvements in muscle strength than **conventional or aerobic training.**	4	Marzolini et al. 2018; Lee et al. 2010; Lee et al. 2008; Teixeira et al. 1999
1b	**Ankle strengthening with high frequency rTMS** may produce greater improvements in muscle strength than **Ankle strengthing or rTMS alone.**	1	Cha et al. 2017
1b	**Eccentric resistance and progressive resistance training** may produce greater improvements in muscle strength than **concentric resistance and sham progressive resistance,** respectively**.**	1	Clark & Patten et al. 2013
2	**Resistance training** may produce greater improvements in muscle strength than **aerobic training.**	2	Severinsen et al. 2014; Lee et al. 2010
1a	There is conflicting evidence on the effect of **strength or resistance training** when compared to **stretching or relaxation** for improving muscle strength	4	Ivey et al. 2017; Mead et al. 2007; Ouellette et al. 2004; Kim et al. 2001
1b	There is conflicting evidence on the effect of **low intensity resistance training** when compared to **high intensity resistance training** for improving muscle strength.	1	Lamberti et al. 2017
1b	**Strength training with mirror therapy** may not have a difference in efficacy when compared to **strength training alone** for improving muscle strength.	1	Simpson et al. 2019
2	**Isokinetic strength training** may not produce greater improvements in muscle strength than **isometric strength training.**	1	Chen et al. 2015
2	**Aerobic and resistance training** may not produce greater improvements in muscle strength than **resistance training alone.**	1	Lee et al. 2010

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**

1b	**Low intensity resistance training** may produce greater improvements in quality of life than **high intensity resistance training.**	1	Lamberti et al. 2017
1b	**Limb overload resistance training** may produce greater improvements in quality of life than **functional limb overloading training.**	1	Alabdulwahab et al. 2015
2	**Aerobic and resistance training** may produce greater improvements in quality of life than **conventional or aerobic training.**	2	Lee et al. 2008; Teixeira-Salme et al. 1999
1a	**Strength or resistance training** may not produce greater improvements in quality of life than **conventional therapy.**	7	Fernandez-Gonzalo et al. 2016; Sen et al. 2015; Severinsen et al. 2014; Sims et al. 2009; Flansbjer et al. 2008; Lee et al. 2008
1a	**Strength or resistance training** may not produce greater improvements in quality of life than **stretching or relaxation.**	3	Mead et al. 2007; Ouellette et al. 2004; Kim et al. 2001
1b	**Strength training combined with mirror therapy** may not produce greater improvements in quality of life than **strength training alone.**	1	Simpson et al. 2019
2	**Isokinetic strength training** may not produce greater improvements in quality of life than **isometric strength training.**	1	Chen et al. 2015
2	**Resistance training** may not produce greater improvements in quality of life than **aerobic training.**	1	Severinsen et al. 2014

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Strength or resistance training** may not produce greater improvements in spasticity than **conventional therapy.**	4	Fernandez-Gonzalo et al. 2016; Flansbjer et al. 2008; Akbari & Karimi et al. 2006; Moreland et al. 2003
1b	**Strength training combined with mirror therapy** may not produce greater improvements in spasticity than **strength training alone.**	1	Simspon et al. 2019

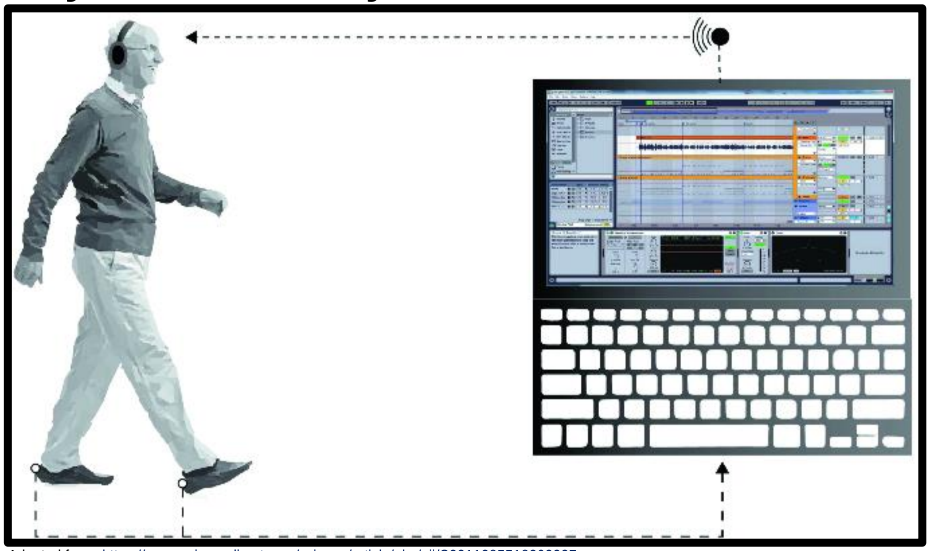
Key Points

The literature is mixed regarding strength and resistance training for motor function, functional ambulation, balance, gait, and quality of life after stroke.

Strength and resistance training may be helpful for improving muscle strength after stroke.

Strength and resistance training may not be beneficial for improving spasticity after stroke.

Rhythmic Auditory Stimulation



Adapted from: https://www.sciencedirect.com/science/article/abs/pii/S2211285518302337

Rhythmic auditory stimulation (RAS) is a form of gait training that involves the sensory cueing of motor systems. The rhythmic auditory stimulus provides a time reference for motor gait response, such that the gait response and auditory stimulus develop into a stable temporal relationship (Thaut et al., 1997). This is possible due to the strong connection between auditory and motor systems across cortical, subcortical and spinal levels.

RAS can be implemented through use of metronomes or music cues that set a tempo to which a patient follows during a training session. Various mechanisms have been proposed to explain how rhythm may influence motor rehabilitation, including through accelerating motor learning, providing a different type of motor learning process, acquiring or refining temporal skills, and lastly through improving emotional engagement and motivation (Schaefer, 2014).

22 RCTs were found evaluating rhythmic auditory stimulation for lower extremity motor rehabilitation. Four RCTs compared treadmill training with rhythmic auditory stimulation to treadmill training (Mainka et al., 2018; Song & Ryu, 2016; Yang et al., 2016; Yoon & Kang, 2016). Four RCTs compared physical therapy with rhythmic auditory feedback to physical therapy or conventional therapy (Bunketorp-Kall et al., 2017; Jeong & Kim, 2007; Raglio et al., 2017; Young et al., 2021). Nine RCTs compared overground gait training with rhythmic auditory stimulation to overground gait training (Cha et al., 2014b; Elsner et al., 2020; Johannsen et al., 2010; Kim & Oh, 2012; Lee et al., 2018c; Schauer & Mauritz, 2003; Suh et al., 2014b; Thaut et al., 2007; Thaut et al., 1997). One RCT compared rhythmic auditory stimulation to overground gait training with rhythmic auditory stimulation (Park et al., 2015a). One RCT compared auditory stimulation with robot-assisted gait training to robot-assisted gait training, virtual reality with robot-assisted gait training, or treadmill training (Park & Chung, 2018). One RCT compared auditory stimulation with mental imagery to mental imagery alone (Kim et al., 2011b). One RCT compared rhythmic auditory stimulation to visual cueing or conventional treatment (Chouhan & Kumar, 2012). One RCT compared action observation with rhythmic auditory stimulation to action observation alone (Cho & Kim, 2020).

The methodological details and results of all 22 RCTs are presented in Table 23.

Table 23. RCTs Evaluating Rhythmic Auditory Stimulation Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Treadmill Training with Rhythmic Auditory Stimulation vs Treadmill Training		
Mainka et al. (2018) RCT (6) Nstart=45 Nend=35 TPS=Subacute	E1: Rhythmic auditory stimulation + treadmill training + conventional PT E2: Treadmill training + conventional PT C: Neurodevelopmental treatment + conventional PT Duration: 15-20min/d, 5d/wk, for 4wks treadmill training with or without the Rhythmic auditory stimulation & 30min/d, 5d/wk, for 4wks Neurodevelopmental treatment & 30-60min/wk conventional PT	<u>E1/E2 Vs C</u> • Fast Gait Speed Test ○ Velocity (+exp1) ○ Cadence (+exp1) ○ Stride Length (-) • Gait analysis with the locometre ○ Velocity (-) ○ Cadence (+exp1) ○ Stride Length (-) • Three Minute Walk Test (-) • Instrumental Evaluation of Balance (-) <u>E1 Vs E2</u> • Fast Gait Speed Test ○ Velocity (+exp1) ○ Cadence (+exp1) ○ Stride Length (-) • Gait analysis with the locometre (-) • Three Minute Walk Test (+) • Instrumental Evaluation of Balance (-)
Song & Ryu (2016) RCT (5) Nstart=40 Nend=40 TPS=Chronic	E: Treadmill training + Rhythmic auditory stimulation C: Treadmill training Duration: 30min/d, 5d/wk for 4wks	• 10-Metre Walk Test (+exp) • Dynamic Gait Index (+exp) • Cadence (+exp) • Step length (+exp)
Yang et al. (2016) RCT (6) Nstart=24 Nend=22 TPS=Chronic	E: Treadmill training + Rhythmic auditory feedback C: Treadmill training Duration: 30min/d, 3d/wk for 4wks	• Gait speed (+exp) • Cadence (+exp) • Stride length (+exp) • Step length (+exp) • Limb support (+exp) • Gait asymmetry (+exp) • Timed Up & Go Test (+exp)
Yoon & Kang (2016) RCT (5) Nstart=30 Nend=28 TPS=Chronic	E1: Inclined treadmill training + Rhythmic auditory stimulation E2: Inclined treadmill training C: Treadmill training Duration: 30min/d, 5d/wk for 4wks	<u>E1 vs E2/C</u> • Timed Up & Go Test (+exp1) • Berg Balance Scale (+exp1) • 6-Minute Walk Test (+exp1) • Gait speed (+exp1) • Symmetry Index (+exp1) • Single Limb Support (+exp1) • Cadence (+exp1) <u>E2 vs C</u> • Timed Up & Go Test: (+exp2) • Berg Balance Scale: (+exp2)

		• 6-Minute Walk Test: (+exp2) • Gait speed: (+exp2) • Symmetry index: (+exp2) • Single Limb Support: (-) • Cadence: (-)
Overground Gait Training with Rhythmic Auditory Stimulation vs Overground Gait Training		
Elsner et al. (2020) RCT (6) Nstart=12 Nend=12 TPS=Chronic	E: Overground gait training + Rhythmic auditory stimulation C: Overground gait training Duration: 30min/d, 3d/wk, for 4wks	• 10-Meter Walk Test (-) • 6-Min Walk Test (-) • Berg Balance Scale (-) • Stride Length (-)
Lee et al. (2018) RCT (6) Nstart=45 Nend=44 TPS=Chronic	E: Gait training + Rhythmic auditory cueing + Conventional rehabilitation C: Gait training + conventional rehabilitation Duration: 30min/d, 5d/wk, for 6wks	• Gait symmetry on step time (-) • Gait symmetry on step length (-) • Gait velocity (+exp) • Cadence (+exp) • Timed-up-and-go (-) • Berg balance score (-) • Fugl-Meyer Lower extremity (-)

Cha et al. (2014b)
RCT (7)
Nstart=20
Nend=20
TPS=Chronic
	E: Intensive gait training + Rhythmic auditory stimulation
	C: Intensive gait training
	Duration: 30min/d, 5d/wk for 6wks
		• Gait speed (+exp)
		• Stride length
		  ○ Affected side (+exp)
		  ○ Less affected side (-)
		• Double Support Period
		  ○ Affected side (+exp)
		  ○ Less affected side (-)
		• Cadence (+exp)
		• Berg Balance Scale (+exp)
		• Stroke Specific Quality of Life Scale (+exp)

Suh et al. (2014b) RCT (6) Nstart=16 Nend=16 TPS=Chronic	E: gait training + Rhythmic auditory stimulation + conventional therapy (bobath) C: Gait training + conventional therapy (bobath) Duration: 15min/d, 5d/wk, for 3wks gait training with/without RAS & 30min/d, 5d/wk, for 3wks bobath	• Cadence (-) • Stride strength (-) • 10 metre-walk (-) • Overall stability index (+exp) • Anteroposterior Index (+exp) • Mediolateral Index (+exp)
Kim & Oh (2012) RCT (4) Nstart=20 Nend=20 TPS=Chronic	E: Overground gait training + Rhythmic auditory stimulation C: Overground gait training Duration: 10min/d, 3d/wk for 6wks	• Gait speed (+exp) • Stride length (+exp) • Single support time (+exp)
Johannsen et al. (2010) RCT (7) Nstart=24 Nend=21 TPS=Chronic	E: Bilateral leg training with rhythmic auditory cueing C: Bilateral arm training with rhythmic auditory cueing Duration: 45min/d, 2d/wk, for 5wks	• Fugl-Meyer- Lower Extremity (+exp • 10-meters walk test (-) • Step length (-) • Repetitive aiming tasks for the hand and foot (-)
Thaut et al. (2007) RCT (7) Nstart=78 Nend=78 TPS=Acute	E: Rhythmic auditory stimulation + Gait training C: Neurodevelopmental techniques based on Bobath + Gait training Duration: 30min/d, 5d/wk for 3wks	• 10m Walk test (+exp) • Stride length (+exp) • Cadence (+exp) • Swing ratio symmetry index (+exp)

Schauer et al. (2003) RCT (4) Nstart=23 Nend=23 TPS=Subacute	E: Musical motor feedback + Conventional gait therapy + Neurodevelopmental therapy C: Conventional gait therapy + Neurodevelopmental therapy Duration: 20min/d, 5d/wk for 3wks Gait therapy, 45min/d Neurodevelopmental therapy	• Gait Velocity (No stats) • Stride Length (No stats) • Cadence (No stats) • Symmetry Deviation (+exp) • Heel-on-toe-off Distance (+exp)
Thaut et al. (1997) RCT (6) Nstart=20 Nend=20 TPS=Acute	E: Gait training + Rhythmic auditory stimulation C: Gait training Duration: 60min/d, 5d/wk, for 6wks	• Gait velocity (+exp) • Stride length (+exp) • Symmetry (-) • Cadence (-)
Physical Therapy with Rhythmic Auditory Feedback vs Physical Therapy or Conventional Therapy		

Young et al. (2021)
RCT (7)
Nstart=47
Nend=45
TPS=Chronic
	E: Movement-to-music exercise
	C: Newsletters with information on overall health
	Duration: 60 min/d, 3d/wk, for 12wks Movement to music
		• 6MWT (-)
		• FTSST (-)
		• TUG (-)
		• Patient-Reported Outcomes Measurement Information System
		  ○ Fatigue (-)
		  ○ Pain (-)

Bunketorp-Käll et al. (2017) RCT (8) Nstart=123 Nend=117 TPS=Chronic	E1: Rhythm and Music-based therapy E2: Horse-riding therapy C: No treatment Duration: 2d/wk, for 12wks	E1/E2 vs C: • Stroke Impact Scale (+exp1, +exp2) • Timed Up and Go Test (+exp 2) • Berg Balance Scale (+exp 2) • Backstrand, Dahlberg and Liljenas Balance Scale (+exp1, +exp2) • Grip Strength • Right Hand Final (-) • Right Hand Mean (-) • Right Hand Max (+exp1) • Left Hand Final (+exp1) • Left Hand Mean (-) • Left Hand Max (-) • Barrow Neurological Institute Screen (+exp1) • Letter Number Sequencing (+exp1)

Raglio et al. (2017)
RCT (6)
Nstart=38
Nend=38
TPS=Subacute
	E: Relational active music therapy + Standard rehabilitation
	C: Standard rehabilitation only
	Duration: 30min/d, 3d/wk, 20sessions music therapy & 7d/wk standard rehabilitation
		• NIHSS-Italian (-)
		• Functional independence measure (-)
		• Grip pinch test
		  ○ Dominant hand grip (-)
		  ○ Nondominant hand grip (+exp)
		  ○ Dominant hand pinch (-)
		  ○ Nondominant hand pinch (-)
		• 9Hole Peg test
		  ○ Dominant hand (-)
		  ○ Nondominant hand (-)
		• Timed Up and Go (-)
		• Hospital Anxiety and Depression scale
		  ○ Anxiety (-)
		  ○ Depression (+exp)
		• McGill Quality of life questionnaire (-)

Jeong & Kim (2007)
RCT (5)
Nstart=36
Nend=33
TPS=Chronic
	E: Movement exercise + Rhythmic auditory stimulation
	C: Referral information about usual care
	Duration: 2hr/wk, for 8wks
		• Active Range of motion:
		  ○ Shoulder flexion (-)
		  ○ Ankle flexion (-)
		  ○ Ankle extension (+exp)
		• Back scratch test

		○ Upward the affected arm (+exp) ○ Downward the affected arm (+exp)] • Profile of Mood states (+exp) • Relationship Change Scale (+exp) • Stroke Specific Quality of life (-)
Treadmill Training with Rhythmic Auditory Stimulation vs Overground Gait with Rhythmic Auditory Stimulation		
Park et al. (2015a) RCT (5) Nstart=19 Nend=19 TPS=Chronic	E: Treadmill training + Rhythmic auditory stimulation C: Overground training + Rhythmic auditory stimulation Duration: 30min/d, 5d/wk for 3wks	• Gait speed (+exp) • 6-Minute Walk Test (+exp) • Functional Gait Assessment (+exp) • Step cycle (+exp) • Step length ○ Paretic side (-) ○ Nonparetic side (+exp) • Timed Up & Go Test (-)
Auditory Stimulation with Robot Training vs Virtual Reality with Robot Training or Conventional Training		
Park et al. (2018) RCT (6) Nstart=40 Nend=40 TPS=Chronic	E1: Virtual reality + robot-assisted gait training (Treadmill)+ conventional physical therapy E2: Auditory stimulation + robot-assisted gait training (Treadmill) + conventional physical therapy C: Conventional physical therapy + treadmill training Duration: 45min/d, 3d/wk, for 6wks trainings & 30min/d, 5d/wk, for 6wks Conventional therapy	E1 vs E2 • Medical Research Council (+exp1) • Berg Balance Scale (-) • Timed Up & Go Test (-) • 10 Meter Walk test (-) • Fugl-Meyer Assessment (+exp1) • Modified Barthel Index (-) E1/ E2 vs C • Medical Research Council (+exp1+exp2) • Berg Balance Scale (+exp1, +exp2) • Timed Up & Go Test (+exp1, +exp2) • 10 Meter Walk test (+exp1) • Fugl-Meyer Assessment (+exp1) • Modified Barthel Index (-)
Auditory Stimulation with Mental Imagery vs Mental Imagery		
Kim et al. (2011) RCT crossover (4) Nstart=18 Nend=15 TPS=Chronic	E1: Visual Locomotor Imagery Training E2: Kinesthetic Locomotor Imagery Training E3: Visual Locomotor Training with Auditory Step Rhythm E4: Kinesthetic Locomotor Imagery Training with Auditory Step Rhythm Duration: 15 min/condition, 24 hr washout	E1 vs E2 • Timed Up and Go Test (-) E1 VS E3 • Timed Up and Go Test (-) E1vs E4 • Timed Up and Go Test (+exp4) E2 vs E3 • Timed Up and Go Test (-) E2 vs E4 • Timed Up and Go Test (-) E3 vs E4 • Timed Up and Go Test (-)
Rhythmic Auditory Stimulation vs. Visual Cueing or Conventional Treatment		
Chouhan et al. (2012) RCT (7) Nstart=45 Nend=45 TPS=Subacute	E: Rhythmic auditory stimulation + conventional treatment E2: Visual cueing + conventional treatment C: Conventional treatment Duration: 120min/d, 3d/wk, for 3wks	E1 vs E2 • Dynamic gait index (+exp2) • Fugl-Meyer Assessment (-) E1/E2 vs C • Dynamic gait index (+exp1, +exp2) • Fugl-Meyer Assessment (+exp1, exp2)
Action Observation with Rhythmic Auditory Stimulation		
Cho et al. (2020) RCT (6) Nstart=30	E: Action observation training + Rhythmic auditory stimulation + PT	• Postural stability test ○ Overall balance index (+exp) ○ Anteroposterior balance index (+exp)

Nend=30 TPS=Chronic	C: Action observation + PT Duration: 15min, 2sessions/d, 3d/wk, 8wks action observation & 5d/wk, for 8wks PT	○ Mediolateral balance index (+exp) • Fall Risk (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Rhythmic Auditory Stimulation

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Virtual reality with robot-assisted gait training** may produce greater improvements in motor function than **auditory stimulation with robot-assisted gait training or treadmill training.**	1	Park et al. 2018
1b	**Rhythmic auditory stimulation** may produce greater improvements in motor function than **conventional treatment.**	1	Chouhan et al. 2012
1a	There is conflicting evidence on the effect of **gait training with rhythmic auditory stimulation** when compared to **gait training alone** for improving motor function.	2	Lee et al. 2018; Johannsen et al. 2010.
1b	**Auditory stimulation with robot-assisted gait training** may not produce greater improvements in motor function than **treadmill training.**	1	Park et al. 2018
1b	**Rhythmic auditory stimulation** may not produce greater improvements in motor function than **visual cueing.**	1	Chouhan et al. 2012

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Treadmill training with rhythmic auditory stimulation** may produce greater improvements in functional ambulation than **treadmill training.**	4	Mainka et al. 2018; Song & Ryu 2016; Yang et al. 2016; Yoon & Kang 2016
1a	**Overground gait training with rhythmic auditory stimulation** may produce greater improvements in functional ambulation than **overground gait training.**	8	Elsner et al. 2020; Lee et al. 2018; Cha et al. 2014; Suh et al. 2014; Kim & Oh 2012; Johannsen et al. 2010; Thaut et al. 2007; Thaut et al. 1997
2	**Inclined treadmill training with rhythmic auditory stimulation** may produce greater improvements in functional ambulation than **inclined treadmill training alone.**	1	Yoon & Kang
2	**Treadmill training with rhythmic auditory stimulation** may produce greater improvements in	1	Park et al. 2015

	functional ambulation than **overground gait training with rhythmic auditory stimulation.**		
2	**Kinesthetic locomotor imagery training with auditory step rhythm** may produce greater improvements in functional ambulation than **visual locomotor imagery training.**	1	Kim et al. 2011
1b	There is conflicting evidence about the effect of **auditory stimulation with robot-assisted gait training** when compared to **treadmill training** for improving functional ambulation.	1	Park et al. 2018
1a	**Physical therapy with rhythmic auditory feedback** may not produce greater improvements in functional ambulation than **physical therapy or conventional therpay.**	3	Young et al. 2021; Bunketorp-Käll et al. 2017; Raglio et al. 2017
1b	**Treadmill training with rhythmic auditory stimulation** may not produce greater improvements in functional ambulation when compared to **neurodevelopmental treatment.**	1	Mainka et al. 2018.
1b	**Virtual reality with robot-assisted gait training** may not produce greater improvements in functional ambulation than **auditory stimulation with robot-assisted gait training.**	1	Park et al. 2018
2	**Visual locomotor imagery training** may not produce greater improvements in functional ambulation than **kinesthetic locomotor imagery training or visual locomotor training with auditory step rhythm.**	1	Kim et al. 2011
2	**Kinesthetic locomotor imagery training** may not produce greater improvements in functional ambulation than **visual locomotor training with auditory step rhythm or kinesthetic locomotor imagery training with auditory step rhythm.**	1	Kim et al. 2011
2	**Visual locomotor training with auditory step rhythm** may not produce greater improvements in functional ambulation than **kinesthetic locomotor imagery training with auditory step rhythm.**	1	Kim et al. 2011

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	**Action observation with rhythmic auditory stimulation** may produce greater improvements in balance than **action observation alone.**	1	Cho et al. 2020
1b	**Robot-assisted gait training with either virtual reality or auditory stimulation** may produce greater improvements in balance than **treadmill training.**	1	Park et al. 2018
1a	There is conflicting evidence about the effect of **gait training with rhythmic auditory stimulation** when compared to **gait training alone** for improving balance.	4	Elsner et al. 2020; Lee et al. 2018; Cha et al. 2014; Suh et al. 2014.

1b	There is conflicting evidence about the effect of **treadmill training with rhythmic auditory stimulation** when compared to **treadmill training alone** for improving balance.	2	Mainka et al. 2018; Yoon & Kang 2016
1b	There is conflicting evidence about the effect of **physical therapy with rhythmic auditory feedback** when compared to **physical therapy or conventional therapy** for improving balance.	1	Bunketorp-Käll et al. 2017
1b	**Virtual reality with robot-assisted gait training** may not produce greater improvements in balance than **auditory stimulation with robot-assisted gait training.**	1	Park et al. 2018

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Overground gait training with rhythmic auditory stimulation** may produce greater improvements in gait than **overground gait training.**	9	Elsner et al. 2020; Lee et al. 2018; Cha et al. 2014; Suh et al. 2014; Kim & Oh 2012; Johannsen et al. 2010; Thaut et al. 2007; Schauer et al. 2003; Thaut et al.1997
1a	**Treadmill training with rhythmic auditory stimulation** may produce greater improvements in gait than **treadmill training.**	4	Mainka et al. 2018; Song & Ryu 2016; Yang et al. 2016; Yoon & Kang 2016
1b	**Rhythmic auditory stimulation** may produce greater improvements in gait than **visual cueing or conventional treatment.**	1	Chouhan et al. 2012
2	**Treadmill training with rhythmic auditory stimulation** may produce greater improvements in gait than **overground gait training with rhythmic auditory stimulation.**	1	Park et al. 2015

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Physical exercise with rhythmic auditory stimulation** may not produce greater improvements in range of motion than **conventional therapy.**	1	Jeong & Kim 2007

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Virtual reality with robot-assisted gait training** may not produce greater improvements in the performance of activities of daily living than **treadmill training or auditory stimulation with robot-assisted gait training.**	1	Park et al. 2018
1b	**Physical therapy with rhythmic auditory feedback** may not produce greater improvements in the performance of activities of daily living when compared to **physical therapy alone.**	1	Raglio et al. 2017

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Physical therapy with rhythmic auditory feedback** may not produce greater improvements in stroke severity than **physical therapy.**	1	Raglio et al. 2017

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Gait training with rhythmic auditory stimulation** may produce greater improvements to quality of life than **gait training alone.**	1	Cha et al. 2014
1a	**Physical therapy with rhythmic auditory feedback** may not produce greater improvement to quality of life than **physical therapy or conventional therapy.**	3	Bunketorp-Käll et al. 2017; Raglio et al. 2017; Jeong & Kim 2007.

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Virtual reality with robot-assisted gait training** may produce greater improvements in muscle strength than **auditory stimulation with robot-assisted gait training or treadmill training.**	1	Park et al. 2018
1b	**Auditory stimulation with robot-assisted gait training** may produce greater improvements in muscle strength than **treadmill training.**	1	Park et al. 2018

Key Points

Rhythmic auditory stimulation combined with treadmill training or gait training may be helpful in improving functional ambulation and gait.

Respiratory Training and Devices

Adopted from Inspiratory Muscle Training - Franklin Square Health Group (franklinsquarept.com)

After a stroke, not only are muscles of the upper and lower extremities impacted, but patients can also experience respiratory muscle weakness (Liaw et al., 2020). The respiratory muscle strength post-stroke can be less than half of what would be expected for a healthy adult (Menezes et al., 2016). This weakness impacts swallowing and cough ability, which in turn can lead to secondary complications such as aspiration, pneumonia or respiratory failure (Zhang et al., 2022a).

To avoid these post-stroke complications, patients can participate in respiratory muscle training. Patients repeat breathing exercises with a device that provides a pressure threshold or flow-dependent resistance against exhalation or inhalation (Menezes et al., 2016; Zhang et al., 2024). This resistance stimulates the respiratory muscles, which in turn must adapt their structure (Zhang et al., 2024; Menezes et al., 2016). This training should increase muscle strength.

A total of seven RCTs were found to investigate respiratory training and devices. Five RCTs compared respiratory muscle training to sham training or conventional rehabilitation (Aydogan Arslan et al., 2022; Choi et al., 2021a; Kim et al., 2014b; Vaz et al., 2021; Yoo & Pyun, 2018). One RCT compared respiratory training to conventional rehabilitation with Liuzijue Qigong (Zheng et al., 2021). One RCT compared continuous positive airway pressure (CPAP) to conventional rehabilitation (Ryan et al., 2011).

The methodological details and results of all seven RCTs are presented in Table 24.

Table 24. RCTs Evaluating Respiratory Training and Devices for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start	Interventions	Outcome Measures Result (direction of effect)

Sample Size end Time post stroke category	Duration: Session length, frequency per week for total number of weeks	
Respiratory Muscle Training vs Conventional Rehabilitation or Sham Respiratory Muscle Training		
Aydogan Arslan et al. (2022) RCT (7) Nstart= 21 Nend = 21 TPS=Chronic	E: Inspiratory Muscle Training + Neurodevelopmental Bobath Treatment C: Neurodevelopmental Bobath Treatment Duration: 1x/d, 5d/wk, 6wks	• Trunk Impairment Scale (+exp) • Timed-Up and Go Test (-) • Berg Balance Scale (-) • Six-Minute Walk Test (-)
Choi et al. (2021) RCT (3) Nstart= 64 Nend = 44 TPS=Subacute	E: Respiratory muscle training + Conventional rehabilitation C: Conventional rehabilitation Duration: 30min/sessions, 5d/wk for 1mo RMT	• Functional ambulation category (-) • Modified Barthel Index (+exp)
Vaz et al. (2021) RCT (7) Nstart= 50 Nend= 42 TPS=Chronic	E: Inspiratory Muscle Training + standard rehabilitation C: Sham Inspiratory Muscle Training + standard rehabilitation Duration: 15min/session, 2sessions/d, 5d/wk for 6wks	• 6-min Walking Test (-) • Functional Independence Measure (-) • Quality of Life (-)
Yoo et al. (2018) RCT (5) Nstart= 45 Nend = 40 TPS= Acute	E: Respiratory muscle training + conventional rehabilitation C: Conventional rehabilitation Duration: 60min/d, 7d/wk respiratory muscle training & 60min/d, 5d/wk, for 3wks conventional rehabilitation	• National Institutes of Health Stroke Scale (-) • Berg Balance Scale (-) • Fugl-Meyer Assessment (-) • Mini-Mental State Examination (-)
Kim et al. (2014b) RCT (4) Nstart= 20 Nend = 20 TPS=Chronic	E: Conventional exercise + automated full-body workout machine + respiratory training C: Conventional exercise + automated full-body workout machine Duration: 30min/d, 3d/wk, for 4wks conventional exercise & 20min/d, 3d/wk, for 4wks automated full-body workout machine & 20min/d respiratory training, 3d/wk, for 4wks	• 6-Minute Walk Test (+exp)
Respiratory Training vs Conventional Rehabilitation with Liuzijue Qigong		

Zheng et al. (2021)
RCT (8)
Nstart=60
Nend=60
TPS=Acute
	E: Conventional rehabilitation training with Liuzijue Qigong
	C: Respiratory relaxation training + conventional training
	Duration: 45min/d, 5d/wk, for 3wks
		• Trunk Impairment Scale
		    ○ Static sitting balance (+exp)
		    ○ Dynamic sitting balance (+exp)
		    ○ Coordination of trunk movement (+exp)
		• Berg Balance Scale (-)
		• Modified Barthel Index (+exp)

Continuous Positive Airway Pressure vs Conventional Rehabilitation		

Ryan et al. (2011)
RCT (7)
Nstart= 48
Nend= 44
TPS=Acute
	E: Continuous positive airway pressure (CPAP) + standard rehabilitation
	C: Standard rehabilitation
	Duration: 6h/d, 4wks CPAP, 45min/d, 5d/wk, 4wks standard rehabilitation
		• Canadian Neurologic scale (+exp)
		  ○ Cognitive (+exp)
		  ○ Motor (+exp)
		• 6min Walk test (-)
		• Sustained attention response time
		• Functional Independence measure (-)
		  ○ Motor (+exp)
		  ○ Cognitive (-)
		• Chedoke-McMaster Stroke assessment (+exp)
		• Berg Balance scale (-)
		• Perdue pegboard test (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Respiratory Training and Devices

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Respiratory muscle training** may produce greater improvements in motor function when compared to **conventional care or sham training.**	1	Yoo et al. 2018
1b	**Continuous positive airway pressure** may not produce greater improvements in motor function when compared to **conventional care.**	1	Ryan et al. 2011

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Respiratory muscle training** may not produce greater improvements in functional ambulation when compared to **conventional care or sham training.**	4	Aydogan Arslan et al. 2022; Choi et al. 2021; Vaz et al. 2021; Kim et al. 2014
1b	**Continuous positive airway pressure** may not produce greater improvements in functional ambulation when compared to **conventional care.**	1	Ryan et al. 2011

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence on the effect of **conventional care with Liuzijue Qigong** when compared to **conventional care** for improving the performance of activities of daily living.	1	Zheng et al. 2021
1b	**Respiratory muscle training** may not produce greater improvements in balance when compared to **conventional care or sham training.**	2	Aydogan Arslan et al. 2022; Yoo et al. 2018

1b	**Continuous positive airway pressure** may not produce greater improvements in balance when compared to **conventional care.**	1	Ryan et al. 2011
STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Continuous positive airway pressure** may produce greater improvements in stroke severity when compared to **conventional care.**	1	Ryan et al. 2011
1b	**Respiratory muscle training** may not produce greater improvements in stroke severity when compared to **conventional care or sham training.**	1	Yoo et al. 2018
MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Respiratory muscle training** may produce greater improvements in muscle strength when compared to **conventional care or sham training.**	1	Vaz et al. 2021
ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Conventional care with Liuzijue Qigong** may produce greater improvements in the performance of activities of daily living when compared to **conventional care alone.**	1	Zheng et al. 2021
1b	There is conflicting evidence on the effect of **continuous positive airway pressure** when compared to **conventional rehabilitation** for improving the performance of activities of daily living.	1	Ryan et al. 2011
1b	**Respiratory muscle training** may not produce greater improvements in the performance of activities of daily living when compared to **conventional care or sham training.**	2	Choi et al. 2021; Vaz et al. 2021

Key Points

Respiratory muscle training and continuous positive airway pressure may not be beneficial in stroke management to improving any of the outcomes after stroke.

Home-Based and Caregiver-Mediated Exercise Programs

Adopted from: https://www.vchri.ca/stories/2022/08/03/improving-patient-safety-during-home-based-exercise

Home-based and Caregiver-mediated programs are programs that allow a patient to receive exercise treatment in the comfort of their own home (van den Berg et al., 2016). These programs are run by a person who is not a licensed healthcare professional but instead more of a member of the patient's social network (Wang et al., 2015). This can help a patient feel more comfortable and may decrease their anxiety about starting a new program (van den Berg et al., 2016).

A total of 38 RCTs were found evaluating home-based and caregiver mediated programs. Nineteen RCTs compared home-based physiotherapy and exercise programs to conventional therapy or no therapy (Baskett et al., 1999; Brouwer et al., 2018; Duncan et al., 1998; Duncan et al., 2003; Hsieh et al., 2018; Jarbandhan et al., 2022; Kara & Ntsiea, 2015; Lin et al., 2004; Mahmood et al., 2022a; Malagoni et al., 2016; Mandigout et al., 2021; McClellan & Ada, 2004; Olaleye et al., 2014; Roderick et al., 2001; Saadatnia et al., 2020; Treger et al., 2014; Walker et al., 1999; Widen Holmqvist et al., 1998; Young & Forster, 1992). One RCT compared home-based oculomotor stability exercise to conventional rehabilitation (Correia et al., 2021). Seven RCTs evaluated caregiver-mediated programs against conventional care (Galvin et al., 2011; Mant et al., 2000; Mayo et al., 2000; Mudzi et al., 2012; Nordin et al., 2019; Sackley et al., 2006; Wang et al., 2015). Seven RCTs compared nursing mediated programs to conventional care (Chen et al., 2021b; Guan et al., 2019; Hui et al., 1995; Jones et al., 2005; Wang et al., 2021b; Zhang et al., 2021b; Zhang et al., 2018). One RCT compared home-based overground walking with home-based cycling (Mayo et al., 2013). One RCT compared early discharge with at-home training to conventional discharge rehabilitation (Askim et al., 2006). One RCT compared outpatient clinic care follow-up with conventional care (Welin et al., 2010). One RCT compared a specialist community rehabilitation program to a conventional rehabilitation program (Rudd et al., 1997).

The methodological details and results of all 38 RCTs evaluating home-based and caregiver mediated programs for lower extremity motor rehabilitation are presented in Table 25.

Table 25. RCTs Evaluating Home-Based and Caregiver-mediated Exercise Programs for Lower Extremity Motor Rehabilitation

Authors (Year) **Study Design (PEDro Score)** **Sample Size start** **Sample Size end** **Time post stroke category**	**Interventions** **Duration: Session length, frequency per week for total number of weeks**	**Outcome Measures** **Result (direction of effect)**
Home-Based Physiotherapy and Exercise Programs vs Conventional Therapy or No Therapy		
Mahmood et al. (2022) RCT (7) Nstart=58 Nend=52 TPS=Acute	E: Standard in-hospital rehabilitation + individualized home exercises + Educating personalized adherence and facilitating strategies C: Standard in-hospital rehabilitation + individualized home exercises Duration: One-time 2hr active task practice + 45min/d, 5d/wk in-hospital rehabilitation & minimum of 60min/d, 12wks home exercises & 30-45min/session, 5x over 2wks adherence education	• Adherence proportion (+exp) • Stroke-Specific Measure of Adherence to Home-based Exercises (SS-MAHE) (+exp) • Mobility Disability Scale (+exp) • Stroke Impact Scale (-)
Jarbandhan et al. (2022) RCT crossover (5) Nstart=30 Nend=24 TPS=Chronic	E: Home-based physiotherapy program supervised in the first 4wk and tele-supervised during the next 4wk C: Usual care Duration: 3d/wk, for 8wks	• Six-minute walking test (+exp) • Berg Balance Score (-) • Disabilities of the Arm, Shoulder and Hand Questionnaire (+exp) • Grip strength (-)
Mandigout et al. (2021) RCT (6) Nstart=83 Nend=73 TPS=Subacute	E: Individualized coaching on physical activity at home C: Standard physical activity Duration: E: 6mo individual coaching + 6mo conventional treatment; C: not specified	• Six-minute walk test (-) • Barthel index (-) • Motricity index (-) • Modified Functional Ambulatory Category (-) • Maximal strength knee extension (paretic & non paretic) (-)
Saadatnia et al. (2020) RCT (4) Nstart=57 Nend=40 TPS=Acute	E: Home-based exercise rehabilitation C: Conventional care Duration: 120min/d, for 12wks	• Barthel Index (+exp) • Modified Rankin Scale (+exp) • Fugl-Meyer Assessment (+exp)
Brouwer et al. (2018) RCT (6) Nstart=103 Nend=70 TPS= Chronic	E: Tune Up sessions (patient-centered individualized home-based physical therapy) C: No treatment and natural progression Duration: 60min/d, 3d/wk, for 2wks at 6mo and at 12mo post-discharge (4wks total)	• Timed Up and Go test (-) • Berg Balance Scale (-) • 6 Minute Walk Test (-) • Stair test score (-) • Subjective Index of Physical and Social Outcomes (-) ○ Physical Integration (-) ○ Social Integration (-) • SF-36

		○ Physical component (-) ○ Mental component (-)
Hsieh et al. (2018) RCT crossover (5) Nstart=26 Nend=18 TPS=Chronic	E1: Home rehabilitation, then Clinic rehabilitation E2: Clinic rehabilitation, then home rehabilitation. Both settings involved mirror therapy and functional task practice Duration: 45-60min functional task training+ 30-45min mirror therapy/d, 3d/wk, for 4wks - 4wk washout	• Motor Activity Log ○ Amount of Use (+exp1) ○ Quality of Movement (-) • 10-meter walk test (-) • Sit to stand test (+exp1) • COPM ○ Satisfaction (-) ○ Performance (-) • EuroQOL ○ Index (+exp1) ○ EQ-VAS (-)
Malagoni et al. (2016) RCT (6) Nstart=12 Nend=12 TPS=Chronic	E: Structured home-based exercise program C: Standard supervised rehabilitation Duration: 20min/d, 6d/wk, for 10wks home-based program, 60min/d, 3d/wk, for 10wks standard rehabilitation program	• Client Satisfaction Questionnaire (-) • 6-Mminute Walk Test (-) • Timed Up-and -go test (-) • Stair Climb test (-) • Short Form-36 (-)
Kara et al. (2015) RCT (7) Nstart=42 Nend=36 TPS=Subacute	E: Written, pictorial and verbal at-home exercise instructions + exercise logbook to document adherence C: Verbal at-home exercise instructions + exercise logbook to document adherence Duration: 7d/wk, for 4wks	• Modified Rivermead Mobility Index (-) • Barthel index (-) • Adherence rate (-)
Olaleye et al. (2014) RCT (6) Nstart= 56 Nend= 52 TPS= Not Reported	E: Rehabilitation in patient's own home C: Rehabilitation at a primary health centre Duration: 45-60min/d, 2d/wk, for 10wks	• Modified Motor Assessment Scale (-) • Short Form-Postural Assessment Scale for Stroke (-) • Reintegration to normal living index (-) • 10-metre walk (-)
Treger et al. (2014) RCT (8) Nstart=56 Nend=53 TPS=Subacute	E: Home-based exercise program C: No intervention Duration: 45min/d, 7d/wk, for 12wks	• 10-metre walk test (-) • 6-minute walk test (+exp) • Timed Up & Go (-) • DUKE Health Profile ○ general health (-) ○ perceived health (-) ○ self-esteem (+exp) ○ anxiety (-) ○ depression (-) ○ pain (-) ○ disability (-)
Lin et al. (2004) RCT crossover (6) Nstart=20 Nend=19 TPS=Chronic	E: Home-based Physical Therapy C: No therapy Duration: 50-60min/d, 1d/wk, for 10wks – 1wk washout	• Barthel Index (-) • Stroke Rehabilitation Assessment of Movement (-)

McClellan & Ada (2004) RCT (7) Nstart=26 Nend=21 TPS=Sub-acute and Chronic	E: Home-based mobility exercise C: Home-based upper limb sham exercise Duration: 6wks	• Functional Reach Test (+exp) • Modified Ashworth Scale-5 Item (-) • Sickness Impact Profile-30 Item (-)
Duncan et al. (2003) RCT (8) Nstart=100 Nend=92 TPS=Subacute	E: Home-based supervised exercise program C: Conventional rehabilitation Duration: 90min/d, 3d/wk for 12wks	• Ankle Isometric Dorsiflexion (-) • Knee Isometric Extension (-) • Fugl-Meyer Assessment – UE, LE (-) • Wolf Motor Function Test (-) • Grip Strength (-) • 10-Metre Walk Test (+exp) • 6-Minute Walk Test (+exp) • Berg Balance Scale (+exp) • Functional Reach Test (-)
Roderick et al. (2001) RCT (7) Nstart=140 Nend=112 TPS=Subacute	E: Domiciliary rehabilitation service C: Day-hospital conventional therapy Duration: Not Reported	• Barthel Index (+exp) • Rivermead Mobility Index (-) • Philadelphia Geriatric Morale Scale (-) • Frenchay Activities Index (-) • Short-Form 36 (-) • Abbreviated Mental Test (-)
Baskett et al. (1999) RCT (8) Nstart=100 Nend=90 TPS=Subacute	E: Self-directed home-based exercise C: Conventional outpatient therapy Duration: 300min/session, 2-3sessions/wk for 3 mo Conventional therapy	• 10-m Walking Speed (-) • Motor Assessment Score (-) • Barthel Index (-)
Walker et al. (1999) RCT (7) Nstart=185 Nend=163 TPS=Acute	E: Occupational therapy at home C: No intervention Duration: 24-90min/d, 1-15d/5 mo	• Extended activities of daily living (+exp) • Barthel index (+exp) • Rivermead motor assessment (gross function) (+exp) • London handicap scale (+exp) • General health questionnaire 28 (-) • Carer strain index (+exp)
Duncan et al. (1998) RCT (7) Nstart=20 Nend=20 TPS=Subacute	E: Home-based exercise program C: Conventional therapy Duration: 90min/d, 3d/wk for 8wks with supervision, for 4wks without supervision	• Fugl-Meyer Assessment- LE (+exp) • 10-Metre Walk Test (+exp) • 6-Minute Walk Test (-) • Berg Balance Scale (-) • Barthel Index (-) • Lawton IADL (-) • Study-36 Health Status Measurement (-)
Widen Holmqvist et al. (1998) RCT (7) Nstart=83 Nend=81 TPS=Acute	E: Early supported discharge with continuity of rehabilitation at home C: Routine rehabilitation service Duration: 30min/d, 2d/wk, 3-4 months at-home rehabilitation	• Frenchay Social Activity Index (-) • Extended Katz Index (-) • Barthel Index (-) • Lindmark Motor Capacity Assessment (-) • Nine-Hole Peg Test (-) • Walking speed over 10 m (-) • Falls (-) • Sickness Impact Profile (-)
Young et al. (1992) RCT (5) Nstart=124 Nend=108 TPS=Subacute	E: Home-based physiotherapy C: Day hospital-based physiotherapy Duration: 6mo	• Functional Ambulation Category (+exp) • Barthel index (+exp) • Motor Club assessment (+exp) • Frenchay activities index (-) • Nottingham Health Profile (-) • General Health Questionnaire 28 (-)

Home-based Oculomotor/Gaze Stability Exercises vs Conventional Rehabilitation		
Correia et al. (2021) RCT (5) Nstart=79 Nend=68 TPS=Subacute	E: Conventional rehabilitation + home-based Oculomotor/gaze stability exercises C: Conventional rehabilitation Duration: 2d/wk for 3wks	• Fall rate (-) • Risk of fall (cumulative results of Berg Balance and Timed Up and Go tests) (+exp)
Caregiver-Mediated Programs vs Conventional Care		
Nordin et al. (2019) RCT (8) Nstart=91 Nend=83 TPS=Chronic	E: Caregiver Mediated Home-based Therapy C: Conventional Hospital Outpatient Clinic Therapy Duration: 45-60min/d, 4d/wk, for 12wks at-home therapy, 120min/d, 1d/wk, for 12wks hospital therapy	• Rivermead mobility index (-) • Berg balance scale (-) • Five Times Sit to Stand (-) • 10-m walk test (-) • EQ5D-Health utility (-) • EQ-VAS (-)

Wang et al. (2015)
RCT (6)
Nstart=51
Nend=51
TPS=Chronic
	E: Caregiver-mediated home-based intervention
	C: Conventional care
	Duration: 2-7d/wk, for 12wks Caregiver-Mediated Intervention
		• 10-Metre Walk Test
		  ○ Max speed (-)
		  ○ Free-walking speed (+exp)
		• 6-Minute Walk Test (+exp)
		• Berg Balance Scale (+exp)
		• Stroke Impact Scale
		  ○ Composite physical (+exp)
		  ○ Memory (-)
		  ○ Communication (+exp)
		  ○ Emotion (-)
		  ○ Social Participation (+exp)
		  ○ General recovery (+exp)
		• Barthel Index (+exp)
		• Caregiver Burden Scale (-)

Mudzi et al. (2012) RCT (6) Nstart=200 Nend=200 TPS=Acute	E: Individualized hands-on training for carers + standard rehabilitation stroke care C: Standard rehabilitation stroke care Duration: 45-60min/d, 1d & 1d at 3mo follow up if needed carer training	• Barthel Index (-) • Rivermead Mobility Index (-)
Galvin et al. (2011) RCT (8) Nstart=40 Nend=35 TPS=Acute	E: Family-Mediated Exercise Intervention (FAME) C: Conventional Care Duration: 35min/d, for 8wks	• Fugl-Meyer Assessment (+exp) • Modified Ashworth Scale (+exp) • Berg Balance Scale (+exp) • 6-Minute Walk Test (+exp) • Barthel Index (+exp)
Sackley et al. (2006) RCT (8) Nstart=118 Nend=105 TPS=Not Reported	E: Occupational therapy + carer education C: Usual care Duration: 4.5hr/mo, for 3mo	• Barthel Index (-) • Rivermead Mobility Index (-)
Mayo et al. (2000) RCT (6) Nstart=114 Nend=96 TPS=Acute	E: Received home care which involved prompt discharge from hospital with immediate enrollment in follow-up services of nursing, physical therapy, occupational therapy,	• SF-36 (+exp) • Stroke Rehabilitation Assessment of Movement (-) • Timed Up & Go (-) • Barthel Index (-) • Older Americans Resource Scale for Instrumental ADL (+exp)

	speech therapy and dietary consultation C: Conventional care Duration: 4wks	
Mant et al. (2000) RCT (6) Nstart=520 Nend=323 TPS=Acute	E: Family-support group C: Conventional care Duration: 6mo	E vs C for Patients • Frenchay Activities Index (-) • Barthel Index (-) • Rivermead Mobility Index (-) • London Handicap Scale (-) • Hospital Anxiety and Depression Scale (-) E vs C for Carers • Frenchay Activities Index (+exp) • Short Form-36 ○ Energy and vitality (+exp) ○ Mental health (+exp) ○ Pain (+exp) ○ Physical function (+exp) ○ General health perception (+exp)
Nursing Mediated Program vs Conventional Care		
Chen et al. (2021) RCT (5) Nstart=140 Nend=121 TPS=Subacute	E: Nurse-guided home-based PT exercise program + conventional rehabilitation C: Conventional Rehabilitation Duration: 30min/session, 3d/wk for first 3mo, 1d/wk for second 3mo, 1d/mo for the rest up to 12mo, home-based exercise	• Fugl-Meyer assessment (+exp) • Modified Ashworth Scale (+exp) • 10-Meter Walk Test (+exp) • Barthel Index (+exp)
Wang et al. (2021) RCT (6) Nstart=102 Nend=102 TPS=Acute	E: Comprehensive Rehabilitation Nursing C: Routine Nursing	• Fugl-Meyer assessment (+exp) • Barthel index (+exp) • Self-rated anxiety scale (+exp) • Brunnstrom assessment (+exp) • Complications (+con)
Zhang et al. (2021) RCT (5) Nstart=84 Nend=84 TPS=Acute	E: Nursing Rehabilitation Program C: Conventional Nursing Practices Duration: 1mo	• Fugl-Meyer assessment (+exp) • Barthel index (+exp) • Self-rated anxiety scale (+exp) • Self-rated depression scale (+exp) • National Institute of Health Stroke Scale (+exp)
Guan et al. (2019) RCT (5) Nstart=128 Nend=120 TPS=Acute	E: Continuous care teams C: Standard treatment Duration: Intervention received treatment 3mo after discharge & control received treatment until discharge	• National Health Assessment Scale (+exp) • Family Function (+exp)
Zhang et al., (2018) RCT (4) Nstart= 143 Nend = 143 TPS= Subacute	E: High-quality nursing services + Conventional rehabilitation therapy C: Conventional rehabilitation therapy Duration: 3mo	· Clinical nerve function limitation score (+exp) · Barthel index (+exp) · Short Form-36 ○ Physiological Function (+exp) ○ Role Physical (+exp) ○ Role Emotional (+exp) ○ Vitality (+exp) ○ Social Function (+ exp) ○ Mental Health (+exp) ○ General Health (+exp)

		· Manual muscle testing (+exp)
Jones et al. (2005) RCT (6) Nstart=120 Nend=83 TPS=Acute	E: Patients treated by nursing staff who received patient positioning teaching package C: Patients treated by nursing staff without patient positioning care teaching package Duration: 1d studying package, 2.5d/mo workshop, 5mo nursing staff training, patient visits varied (upto 4visits/d, 30min apart each)	• Rivermead Mobility Index (-) • Motricity Index (-) • Ashworth Scale ○ Shoulder Abduction (-) ○ Elbow Flexion (-) ○ Elbow Extension (-) • Frenchay Arm Test (-) • 6-m Walk (-) • Sit to Stand (-)
Hui et al. (1995) RCT (5) Nstart=120 Nend=120 TPS=Acute	E: Day hospital rehabilitation with geriatric team C: Conventional care Duration: Not Reported	• Barthel Index (-)
Home Based Overground Walking vs Home Based Cycling		
Mayo et al. (2013) RCT (6) Nstart=87 Nend=65 TPS=Chronic	E1: Home-based cycle ergometer exercise E2: Home-based overground walking exercise Duration: 30min/d, 5d/wk for 3wk	• 6-Minute Walk Test (-)
Early Discharged At-Home Supported Training vs Conventional Post-Discharge Rehabilitation		
Askim et al. (2006) RCT (7) Nstart=62 Nend=58 TPS=Acute	E: Early and intensive home-based task specific program (early supported discharge group) C: Standard follow-up rehabilitation Duration: 4wks Standard post-discharge care or home based-task specific exercise	• Berg Balance Scale (-) • Fast Walking Speed (-)
Outpatient Clinic Care Follow-up vs Conventional Control		
Welin et al. (2010) RCT (5) Nstart=163 Nend=115 TPS=Acute	E: Follow-up care at a stroke outpatient clinic C: Conventional control Follow-up at 12mo and 3-4yr	• Modified Rankin Scale (-) • Barthel Index (-) • Scandinavian Stroke Scale (-)
Specialist Community Rehabilitation vs Conventional Rehabilitation		
Rudd et al. (1997) RCT (7) Nstart=331 Nend=262 TPS=Acute	E: Specialist community rehabilitation C: Conventional rehabilitation Duration: 3mo	• Modified Barthel Index (-) • Rivermead Activities of Daily Living (-) • 5-Meter Timed Walk (-) • Motricity Index (-) • Minimental State Examination (-) • Hospital Anxiety and Depression Scale (-) • Nottingham Health Profile (-) • Caregiver Strain Index (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Home-Based and Caregiver-mediated Exercise Programs

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Nursing mediated programs** may produce greater improvements in motor function than **conventional care**.	3	Chen et al. 2021; Wang et al. 2021; Zhang et al. 2021
1b	**Caregiver-mediated programs** may produce greater improvements in motor function than **conventional care**.	1	Galvin et al. 2011
1a	**Home-based physiotherapy and exercise programs** may not have a difference in efficacy compared to **conventional or no therapy** for improving motor function.	6	Saadatnia et al. 2020; Hsieh et al. 2018; Duncan et al. 2003; Walker et al. 1999; Duncan et al. 1998; Widen Holmqvist et al. 1998

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Home-based oculomotor/gaze stability exercise** may produce greater improvements in functional ambulation than **conventional rehabilitation**.	1	Correia et al. 2021
1a	**Home-based physiotherapy and exercise programs** may not have a difference in efficacy compared to **conventional or no therapy** for improving functional ambulation.	12	Jabandhan et al. 2022; Mandigout et al. 2021; Brouwer et al. 2018; Hsieh et al. 2018; Malagoni et al. 2016; Olaleye et al. 2014; Treger et al. 2014; Duncan et al. 2003; Baskett et al. 1999; Duncan et al. 1998; Widen Holmqvist et al. 1998; Young et al. 1992
1a	**Caregiver-mediated programs** may not produce greater improvements in functional ambulation when compared to **conventional care**.	4	Nordin et al. 2019; Wang et al. 2015; Galvin et al. 2011; Mayo et al. 2000
1b	**Nursing mediated programs** may not produce greater improvements in functional ambulation when compared to **conventional care**.	2	Chen et al. 2021; Jones et al. 2005
1b	**Home-based overground walking** may not produce greater improvements in functional ambulation than **home-based cycling.**	1	Mayo et al. 2013
1b	**Early discharge with at-home training** may not produce greater improvements in functional ambulation than **conventional discharge rehabilitation.**	1	Askim et al. 2006

1b	**Specialist community rehabilitation** may not produce greater improvements in functional ambulation than **conventional rehabilitation.**	1	Rudd et al. 1997

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1a	**Home-based physiotherapy and exercise programs** may not have a difference in efficacy compared to **conventional or no therapy** for improving functional mobility.	4	Kara et al. 2015; Lin et al. 2004; Roderick et al. 2001; May o et al. 2000
1a	**Caregiver-mediated programs** may not have a difference in efficacy compared to **conventional care** for improving functional mobility.	3	Nordin et al. 2019; Mudzi et al. 2012; Sackley et al. 2006
1b	**Nursing mediated programs** may not have a difference in efficacy compared to **conventional care** for improving functional mobility.	1	Jones et al. 2005

BALANCE

LoE	Conclusion Statement	RCTs	References
1a	**Caregiver-mediated programs** may produce greater improvements in balance when compared to **conventional care**.	3	Nordin et al. 2019; Wang et al. 2015; Galvin et al. 2011
2	There is conflicting evidence about the effect of **home-based oculomotor/gaze stability exercise** when compared to **conventional rehabilitation** for improving balance.	1	Correia et al. 2021
1a	**Home-based physiotherapy and exercise programs** may not have a difference in efficacy compared to **conventional or no therapy** for improving balance.	7	Jarbandhan et al. 2022; Brouwer et al. 2018; Olaleye et al. 2014; McClellan & Ada 2004; Duncan et al. 2003; Duncan et al. 1998; Widen Holmqvist et al. 1998
1b	**Early discharged at-home training** may not produce greater improvements in balance than **conventional discharge rehab.**	1	Askim et al. 2006
1b	**Nursing mediated programs** may not have a difference in efficacy compared to **conventional care** for improving balance.	1	Jones et al. 2005

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1a	**Nursing mediated programs** may produce greater improvements in the performance of activities of daily living when compared to **conventional care**.	6	Chen et al. 2021; Wang et al. 2021; Zhang et al. 2021; Zhang et al. 2018; Jones et al. 2005; Hui et al. 1995

1a	There is conflicting evidence about the effect of **caregiver-mediated programs** to improve activities of daily living when compared to **conventional care**.	6	Wang et al. 2015; Mudzi et al. 2012; Galvin et al. 2011; Sackley et al. 2006; Mant et al. 2000; Mayo et al. 2000
1a	**Home-based physiotherapy and exercise programs** may not have a difference in efficacy compared to **conventional or no therapy** for improving activities of daily living.	13	Mandigout et al. 2021; Saadatnia et al. 2020; Brouwer et al. 2018; Hsieh et al. 2018; Kara et al. 2015; Olaleye et al. 2014; Lin et al. 2004; Roderick et al. 2001; Baskett et al. 1999; Walker et al. 1999; Duncan et al. 1998; Widen Holmqvist et al. 1998; Young et al. 1992
1b	**Specialist community rehabilitation** may not produce greater improvements in the performance of activities of daily living when compared to **conventional rehabilitation.**	1	Rudd et al. 1997
2	**Outpatient clinic care follow-up** may not produce greater improvements in the performance of activities of daily living when compared to **conventional care.**	1	Welin et al. 2010

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **nursing mediated programs** to improve muscle strength when compared to **conventional care**.	2	Zhang et al. 2018; Jones et al. 2005
1a	**Home-based physiotherapy and exercise programs** may not have a difference in efficacy compared to **conventional or no therapy** for improving activities of muscle strength.	2	Mandigout et al. 2021; Duncan et al. 2003
1b	**Specialist community rehabilitation** may not produce greater improvements in muscle strength when compared to **conventional rehabilitation.**	1	Rudd et al. 1997

SPASTICITY

LoE	Conclusion Statement	RCTs	References
1b	**Caregiver-mediated programs** may produce greater improvements in spasticity than **conventional care**.	1	Galvin et at. 2011
1b	There is conflicting evidence about the effect of **nursing mediated programs** to improve spasticity when compared to **conventional care**.	2	Chen et al. 2021; Jones et al. 2005
1b	**Home-based physiotherapy and exercise programs** may not have a difference in efficacy compared to **conventional or no therapy** for improving activities of spasticity.	1	McClellan & Ada 2004

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Nursing mediated programs** may produce greater improvements in stroke severity when compared to **conventional care**.	2	Zhang et al. 2021; Guan et al. 2019
2	**Outpatient clinic care follow-up** may not produce greater improvements in stroke severity when compared to **conventional care.**	1	Welin et al. 2010

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Nursing mediated programs** may produce greater improvements in quality of life than **conventional care.**	1	Zhang et al. 2018
1a	**Home-based physiotherapy and exercise programs** may not have a difference in efficacy compared to **conventional or no therapy** for improving quality of life.	10	Mahmood et al. 2022; Brouwer et al. 2018; Hseih et al. 2018; Malagoni et al. 2016; Treger et al. 2014; McClellan & Ada 2004; Roderick et al. 2001; Walker et al. 1999; Widen Holmqvist et al. 1998; Young et al. 1992
1a	**Caregiver-mediated programs** may not produce greater improvements in quality of life than **conventional care.**	4	Nordin et al. 2019; Wang et al. 2015; Mayo et al. 2000; Mant et al. 2000
1b	**Specialist community rehabilitation** may not produce greater improvements in quality of life than **conventional rehabiltiation.**	1	Rudd et al. 1997

Key Points

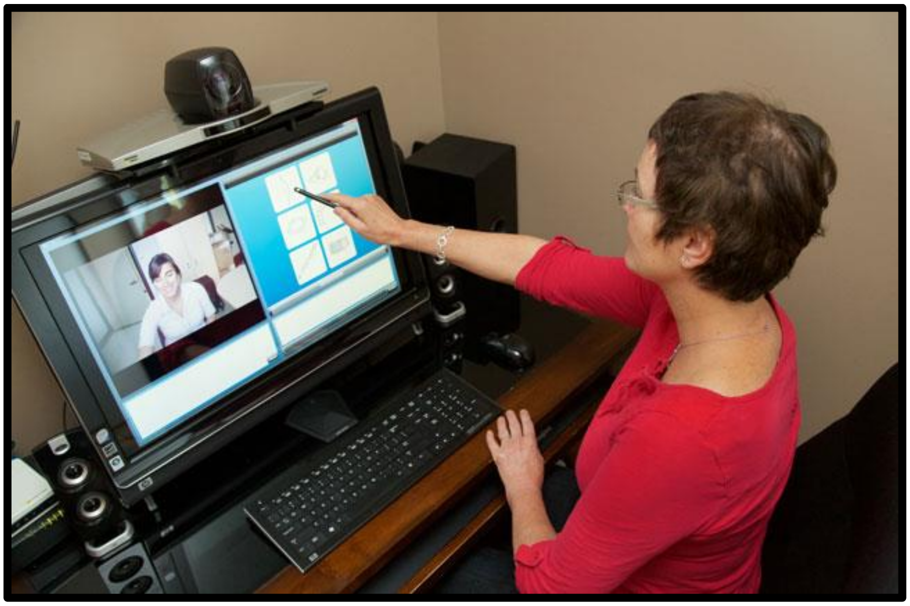
Home-based physiotherapy and exercise programs may not be beneficial in improving any of the post-stroke outcomes when compared to conventional rehabilitation.

Caregiver-mediated programs may be beneficial in improving motor function and balance, but not other outcomes after stroke.

Nursing-mediated programs may be beneficial in improving motor function, activities of daily living, stroke severity, and quality of life.

Technology-Based Interventions

Telerehabilitation and Technology-Based Home Exercise Programs



Adopted from: http://www.telereadaptation.com/en/projet/telerehabilitation-in-speech-therapy/

Telerehabilitation is the process of providing rehabilitation services remotely through information and communication technologies (e.g. a kiosk, telephone and computer) (Dodakian et al., 2017; Emmerson et al., 2017). This rehabilitation method is particularly useful for patients who cannot access a rehabilitation center (Benvenuti et al., 2014). Additionally, this intervention can be delivered for a longer duration and at a reduced cost when compared to therapies provided in the inpatient rehabilitation setting (Benvenuti et al., 2014).

A total of 16 RCTs were found that evaluated telerehabilitation and other home-based physiotherapy programs for lower extremity motor rehabilitation. Ten RCTs compared home-based physiotherapy using telerehabilitation and technology to conventional therapy (Ada et al., 2003; Chen et al., 2021b; Chen et al., 2021c; Chung et al., 2020a; Lim et al., 2021; Lin et al., 2014a; Saywell et al., 2021; Vahlberg et al., 2021; Vloothuis et al., 2019; Wu et al., 2020b). One RCT compared telerehabilitation computerized complex repetitive ankle movement training to simple ankle movement training (Deng et al., 2012). Two RCTs compared telerehabilitation physiotherapy with EMG-NMES to conventional therapy with EMG-NMES (Chen et al., 2017; Chen et al., 2020). Three RCTs compared a caregiver-mediated exercise program using telerehabilitation or technology with conventional care (Esteki-Ghashghaei et al., 2020; van den Berg et al., 2016; Zhou et al., 2019). The methodological details and results of all 16 RCTs evaluating telerehabilitation and other home-based physiotherapy programs for lower extremity motor rehabilitation are presented in Table 26.

Table 26. RCTs Evaluating Telerehabilitation and Technology-based Home Exercise Programs for Lower Extremity Motor Rehabilitation

Authors (Year)	Interventions	Outcome Measures

Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Duration: Session length, frequency per week for total number of weeks	Result (direction of effect)
Home Based Therapy Using Technology and Telerehabilitation vs Conventional Therapy or No Therapy		
Chen et al. (2021) RCT (5) Nstart=30 Nend=30 TPS=Chronic	E: Telerehabilitation using a Kinect camera-based interactive telerehabilitation system C: Conventional physiotherapy Duration: 40min/d, 3d/wk, for 4wks	• Berg Balance Scale (-) • Timed up and Go test (-) • Modified Falls Efficacy Scale (-) • Motricity Index (-) • Functional Ambulation Category (-)
Lim et al. (2021) RCT (6) Nstart=17 Nend=17 TPS=Chronic	E: Coordination exercises at home and telehealth C: Conventional Clinic-based exercises Duration: 5d/wk, for 6wks	• 10-meter walk test ○ Comfortable (-) ○ Fast (-) • Figure of 8 walk test ○ Speed (+exp) ○ Step (-) • Four-square step test (-) • SF-36 (-)
Saywell et al. (2021) RCT (7) Nstart=95 Nend=91 TPS=Chronic	E: Augmented Community Telerehabilitation Intervention (4 face-to-face visits, 5 structured phone calls, personalized text messages) C: Usual care Duration: 6mo	• Stroke Impact scale (-) • Step test (-) • Stroke Self-efficacy Questionnaire (-) • EuroQOL-5D-Visual Analogue Scale (+exp)
Vahlberg et al. (2021) RCT (7) Nstart=79 Nend=71 TPS=Acute	E: Standard care and daily mobile-phone delivered training messages C: Standard care Duration: 12wks	• 6-minute walking test (+exp) • 5 time chair-stand test (+exp) • 10-metre walk test (-) • Short Physical Performance Battery (-)
Chen et al. (2021) RCT (5) Nstart=140 Nend=121 TPS=Subacute	E: Home-based nurse guided Telerehabilitation Exercise Program C: Conventional Care Duration: 30min, 3d/wk, first 3mo	• Fugl-Meyer Assessment (-) • Modified Ashworth Scale (-) • 10-Meter Walk Test ○ Gait Speed (-) ○ Step Size (-) • Barthel Index (+exp)
Chung et al. (2020) RCT (7) Nstart=60 Nend=56 TPS=Subacute	E: Customized video-guided home-exercise C: Customized paper-based (pamphlet) home-exercise Duration: 10-30min/d, for 3mo	• Self-efficacy for exercise-Chinese version (+Exp) • Modified Barthel index-Chinese version (-) • Modified Functional Ambulatory category (+exp) • Adherence to program (+exp)
Wu et al. (2020) RCT (7) Nstart=64 Nend=61 TPS=Subacute	E: Home remote rehabilitation based on a collaborative care model C: Routine rehabilitation Duration: 1-2d/wk, for 12wks	• Fugl-Meyer Motor Function Assessment (+exp) • Berg Balance Scale (+exp) • Timed Up and Go Test (+exp) • 6-minute walking test (+exp) • Modified Barthel Index (+exp) • Stroke-Specific Quality of Life Scale (+exp)

Lin et al. (2014) RCT (7) Nstart=24 Nend=23 TPS=Chronic	E: Telerehabilitation program C: Conventional therapy Duration: 50min/d, 3d/wk, for 4wks	• Berg Balance Scale (-) • Barthel Index (-) • Satisfaction with training (-)
Ada et al. (2003) RCT (7) Nstart=29 Nend=27 TPS=Chronic	E: Treadmill training and overground gait training C: Placebo program of low-intensity home exercise program + Telerehabilitation Duration: 30min/d, 3d/wk, for 4wks Treadmill and overground walking, 3d/wk, for 4wks Placebo program	• 6-Minute Walk Test (+exp) • 10-Metre Walk Test (+exp) • Stroke-Adapted Sickness Impact Profile (-) • Step Length (+exp) • Step Width (-) • Cadence (-)
Telerehabilitation Computerized Complex Repetitive Ankle Movement Training vs Simple Ankle Movement Training		
Deng et al. (2012) RCT (4) Nstart=19 Nend=16 TPS=Chronic	E: Computerized complex repetitive ankle movement training C: Simple repetitive ankle movement training Duration: time-matched 60 training blocks/d, 20d over 4wks	• Paretic ankle Dorsiflexion during the swing phase of gait (+exp) • Paretic ankle Plantarflexion during the swing phase of gait (-) • 10-m walk test (-) • Gait temporal symmetry ratio (-) • Variance of toe clearance (-) • Stride length (-)
Telerehabilitation Physiotherapy Combined with EMG-NMES vs Conventional Therapy Combined with EMG-NMES		
Chen et al. (2020b) RCT (7) Nstart=52 Nend=44 TPS=Acute	E: Telerehabilitation therapy (including PT, OT, ETNS guide by therapist over videocalls) C: In-person rehabilitation (including PT, OT, ETNS) Duration: 60min OT & PT + 20min ETNS/ session, 10d over 12wks.	• Fugl-Meyer Assessment (+exp) • Modified Barthel Index (-)
Chen et al. (2017) RCT (8) Nstart=54 Nend=51 TPS=Acute	E: Tele-supervising rehabilitation (PT+ EMG-NMES) C: Conventional Care Duration: 1hr, 2x/d, 5d/wk, for 12 wks PT + 20min, 2x/d, 5d/wk, for 12wks	• Modified Barthel Index (-) • Berg Balance Scale (-) • Caregiver Strain Index (-)
Caregiver-Mediated Programs using Telerehabilitation or Technology vs Conventional Care		
Esteki-Ghashghaei et al. (2020) RCT (5) Nstart=57 Nend=40 TPS=Not Reported	E: BASNEF model motivational training + home-based rehabilitation C: Conventional Care Duration: 3 sessions of training	• Fugl-Meyer Assessment (+exp) • Questionnaire based on BASNEF model (+exp)
Vloothuis et al. (2019) RCT (8) Nstart=66 Nend=62 TPS=Subacute	E: Caregiver-mediated exercise program with e-health support + telerehabilitation C: Conventional therapy Duration: 30min/d, 5d/wk for 8wks - Caregiver-mediated exercise program	• Stroke Impact Scale (-) • Length of stay (-) • Fugl-Meyer Assessment (-) • Motricity Index (-) • 6-Minute Walking Test (-) • 10-Metre Walk Test (-) • Timed Up & Go Test (-) • Berg Balance Scale (-) • Rivermead Mobility Index (-) • Barthel Index (-) • Nottingham Extended ADL scale (-)

		• Modified Rankin Scale (-) • Caregiver Strain Index (-) • Carer Quality of Life Scale (-) • Fatigue Severity Scale (-) • General Self-Efficacy Scale (-)
Zhou et al. (2019) RCT (7) Nstart=246 Nend=244 TPS=Acute	E: Nurse-organized, family caregiver delivered rehabilitation (supported by a custom-designed smartphone application) C: Usual care Duration: 15-30min/session, 2-3d caregiver training sessions, outcome measured at 6mo	• Barthel index (-) • Modified Rankin scale (-) • Functional ambulation category (+con) • Patient health questionnaire 9 (-) • EuroQol-5-dimension (-) • Caregiver burden index (-)

Van Den Berg et al. (2016)
RCT (8)
Nstart=63
Nend=60
TPS= Acute
	E: Caregiver-mediated iPad exercise program + FitBit activity monitor (real-time feedback)
	C: Usual care
	Duration: 30min/d, 5x/wk for 8wks Caregiver-mediated program
		• Stroke Impact Scale (-)
		• Rivermead Mobility Index (-)
		• Barthel Index (-)
		• Nottingham Extended ADL (+exp)
		• Timed Up-and-Go (-)
		• 10-Meter Timed Walk (-)
		• Fugl-Meyer Assessment Lower Extremity (-)
		• Motricity Index (-)
		• Berg Balance Scale (-)
		• General Self-efficacy Scale
		  ○ Patient (-)
		  ○ Caregiver (-)
		• Carer QOL (-)
		• Caregiver Strain Index (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Telerehabilitation and Technology-Based Home Exercise Programs

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Home-based exercise programs** may not have a difference in efficacy compared to **conventional therapy** for improving motor function.	2	Chen et al. 2020a; Duncan et al. 2003
1b	**Telerehabilitation EMG-NMES physiotherapy** may produce greater improvements in motor function than **standard EMG-NMES physiotherapy**	1	Chen et al. 2020b
1b	**Caregiver-mediated exercise programs** may produce greater improvements in motor function than **conventional therapy.**	2	Esteki-ghashghaei et al. 2020; Galvin et al. 2011

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**

1a	There is conflicting evidence about the effect of **caregiver-mediated programs** to improve functional ambulation when compared to **conventional care**.	3	Nordin et al. 2019; Wang et al. 2015; Galvin et al. 2011
1a	**Home-based exercise programs** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	3	Chen et al. 2020a; Ada et al. 2003

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Home-based exercise programs** may not have a difference in efficacy compared to **no therapy** for improving functional mobility.	1	Lin et al. 2004
1b	**Caregiver-mediated exercise programs** may not have a difference in efficacy compared to **conventional therapy** for improving functional mobility.	1	Nordin et al. 2019

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Home-based exercise programs** may produce greater improvements in balance than **conventional therapy.**	**1**	Duncan et al. 2003
1a	There is conflicting evidence about the effect of **caregiver-mediated programs** to improve balance when compared to **conventional care**.	3	Nordin et al. 2019; Wang et al. 2015; Galvin et al. 2011

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	There is conflicting evidence about the effect of **caregiver-mediated programs** to improve activities of daily living when compared to **conventional care**.	3	Van Den Berg et al. 2016; Wang et al. 2015; Galvin et al. 2011
1b	There is conflicting evidence about the effect of **home-based exercise programs** to improve activities of daily living when compared to **conventional therapy or no therapy**.	2	Chen et al. 2020a; Lin et al. 2004

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Home-based exercise programs** may not have a difference in efficacy compared to **conventional therapy** for improving muscle strength.	1	Duncan et al. 2003

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Home-based exercise programs** may not have a difference in efficacy compared to **conventional therapy** for improving spasticity.	1	Chen et al. 2020a

1b	**Caregiver-mediated exercise programs** may produce greater improvements in spasticity than **conventional therapy.**	1	Galvin et al. 2011

Key Points

Home-based telerehabilitation programs may not be beneficial in improving any of the post-stroke outcomes when compared to conventional rehabilitation and treatments.

Virtual Reality

Adopted from https://www.hvhcc.com/services

Virtual reality (VR) is a technology that allows individuals to experience and interact with virtual environments, often through a game. VR simulates life-like learning and can be used to increase intensity of training while providing three-dimensional feedback of a visual, sensory, and auditory nature (Saposnik et al., 2010).

VR tools are classified as either immersive (i.e. three-dimensional environment via head-mounted display) or non-immersive (i.e. two-dimensional environment via conventional computer monitor or projector screen). Customized VR programs have been created and tested in rehabilitation research, although commercial gaming consoles (e.g. Nintendo Wii) have also been used to deliver VR training.

A total of 71 RCTs were found evaluating virtual reality for lower extremity motor rehabilitation.

34 RCTs compared virtual reality to conventional therapy or no treatment (Anwar et al., 2021; Barcala et al., 2013; Bower et al., 2015; Cano-Manas et al., 2020; Cho et al., 2012; Choi et al., 2017a; da Silva Ribeiro et al., 2015; Fritz et al., 2013; Henrique et al., 2019; Hsieh, 2019; Hung et al., 2017; Hung et al., 2014; Hung et al., 2016; In et al., 2016; James & A, 2017; Junata et al., 2021; Kim et al., 2012; Kim et al., 2009; Lee et al., 2014b; Lee et al., 2017a; Lee et al., 2018a; Lee et al., 2012; Lin et al., 2020; Llorens et al., 2015a; Marques-Sule et al., 2021; Miranda et al., 2019; Morone et al., 2014; Park et al., 2017a; Pedreira da Fonseca et al., 2017; Rajaratnam et al., 2013; Sheehy et al., 2020; Simsek & Cekok, 2016; Utkan Karasu et al., 2018; You et al., 2005). Five RCTs compared virtual reality to balance training (Braun et al., 2016; James & A, 2017; Jung et al., 2011; Yatar & Yildirim, 2015; Zhang et al., 2020). Two RCTs compared virtual reality to an exercise program (Cannell et al., 2018; Chung et al., 2014). One RCT compared virtual reality to treadmill training (Bang et al., 2016). One RCT compared virtual reality-based constraint-induced movement therapy to physical therapy (Choi et al., 2017a). Nine RCTs compared virtual reality with treadmill training to conventional therapy or treadmill training (Cho & Lee, 2013, 2014; de Rooij et al., 2021; Jung et al., 2012; Kang et al., 2012; Kim et al., 2016c; Kim et al., 2015f; Yang et al., 2011; Yang et al., 2008). One RCT compared virtual reality with treadmill training to overground gait training (Jaffe et al., 2004). Four RCTs compared virtual reality robotic training to robotic training and conventional therapy (Bergmann et al., 2018a; Calabro et al., 2017; Kayabinar et al., 2021; Mirelman et al., 2009). One RCT compared virtual reality robotic training to robotic training, auditory stimulation, and conventional therapy (Park & Chung, 2018). Eleven RCTs compared various modalities of administered virtual reality (Aslam et al., 2021; Bower et al., 2014; dos Santos et al., 2019; Forrester et al., 2016; Llorens et al., 2015b; Malik & Masood,

2021; McEwen et al., 2014; Miclaus et al., 2021; Mirelman et al., 2010; Tollar et al., 2021; Yom et al., 2015). Three RCTs compared brain-computer interface-controlled training with sham training (Li et al., 2021a; Yuan et al., 2021; Zhao et al., 2022a).

The methodological details and results of all 71 RCTs are presented in Table 27.

Table 27. RCTs Evaluating Virtual Reality Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Sizestart Sample Sizeend Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Virtual Reality vs Conventional Therapy or No Treatment		
Marques-Sule et al. (2021) RCT (9) Nstart=29 Nend=29 TPS=Chronic	E: Virtual reality balance training with Nintendo Wii + conventional physical therapy C: Conventional physical therapy Duration: 120min/d, 2d/wk, for 4wks Conventional PT & 30min/d, 2d/wk, for 4wks VR training	• Timed up and go (+exp) • Tinetti Performance-Oriented Mobility Assessment (+exp) • Berg Balance Scale (+exp) • Barthel Index (+exp) • Frenchay Activity Index (+exp)
Anwar et al. (2021) RCT (6) NStart=74 NEnd=68 TPS=Not Reported	E: Virtual Reality with Wii C: Conventional Physical Therapy Duration: 60min/d, 3d/wk, for 6wks	• Berg Balance Scale (+exp) • Fugl-Meyer Assessment (+exp)
Junata et al. (2021) RCT (6) NStart=30 NEnd=30 TPS=Chronic	E: Kinect-based Rapid Movement Training (real-time feedback) C: Conventional balance training Duration: 60min/d, 3d/wk, for 7wks (20 sessions)	• Berg Balance Scale (-) • Timed-Up-and-Go Test (-) • Fugl-Meyer Assessment (-) • Activities specific balance confidence scale (-) • Barthel index (-) • Step displacement (+exp) • Step length (+exp) • Step width (-) • Movement onset & completion time (-) • Number of steps (-) • Center of mass (-)
Cano-Manas et al. (2020) RCT (6) Nstart=56 Nend=48 TPS=Subacute	E: Video game based therapy + Conventional rehabilitation C: Conventional rehabilitation Duration: 90min, 5x/wk, for 8wks rehabilitation & 20min video game/d, 3x/wk, for 8wks	• Modified Ranking Scale (+exp) • Barthel Index (+exp) • Tinetti Scale for Balance and Gait (+exp) • Functional Reach Test (+exp) • Get Up and Go Test (+exp) • EuroQOL-5D ○ Mobility (-) ○ Activities (-) ○ Pain/discomfort (+exp) ○ Anxiety and depression (+exp) ○ VAS (+exp)
Lin et al. (2020) RCT (8)	E: Virtual Reality (Kinect) with Early Conventional Rehabilitation	• Manual Muscle Testing scale (-) • Hospital Anxiety and Depression Scale (+exp) • Postural Assessment Stroke Scale (-)

Nstart=152 Nend=143 TPS=Acute	C: Early Conventional Rehabilitation Duration: 60min/d, 5d/wk during inpatient stay, rehabilitation & 30min/d, 5d Virtual Reality	• Barthel index (-)
Sheehy et al. (2020) RCT (7) Nstart=76 Nend=69 TPS=Subacute	E: Virtual Reality Training with leaning and reaching + standard rehabilitation C: Virtual Reality Training with trunk restrained (placebo) + standard rehabilitation Duration: 30-45min/d, 5d/wk, 10-12 sessions total VRT & 2-3 sessions/d standard rehabilitation	• Function in Sitting Test (-) • Ottawa Sitting Scale (-) • Reaching Performance Scale (-) • Wolf Motor Function Test (-)
Henrique et al. (2019) RCT (5) Nstart=31 Nend=31 TPS=Chronic	E: Motion Rehab AVE 3D (Exergames) C: Conventional care Duration: 30min/d, 2d/wk for 12wk	• Berg Balance scale (-)
Hsieh et al. (2019) RCT (7) Nstart=54 Nend=54 TPS=Subacute	E: Modified PC Balance Training Gaming Platform C: PC gaming with Mouse Duration: 40 mins/d, 3d/wk, for 12wks	• Centre of pressure kinematics ○ sway path (+exp) ○ sway area (+exp) ○ sway velocity (+exp) • Berg Balance Scale (+exp) • Fullerton Advanced Balance Scale (-) • Timed Up and Go tests (+exp)
Miranda et al. (2019) RCT (6) Nstart=29 Nend=29 TPS=Chronic	E: Nintendo Wii Fit balance platform training C: No treatment Duration: One 60-min session and two 30-min sessions over a week	• Rhythmic Weight Shift ○ Anteposterior (-) ○ Laterolateral (-) • Limit of stability (-) • Endpoint excursion (-)
Utkan Karasu et al. (2018) RCT (7) Nstart=23 Nend=23 TPS=Subacute	E: Wii Fit-based balance exercise + conventional rehabilitation C: Conventional rehabilitation Duration: 120-180min/d, 5d/wk, for 4 wks conventional therapy & 20min/d, 5d/wk, for 4 wks Wii Fit training	• Berg Balance Scale (+exp) • Functional Reach Test (+exp) • Postural Assessment Scale for Stroke Patients (-) • Timed Up and Go Test (-) • Static Balance Index (-) • Postural sway ○ AP/ML (eye open) (+exp) ○ AP (eye closed) (+exp) ○ ML (eye closed) (-) ○ COP displacement during weight shift (to affected/non affected) (+exp) • Functional Independence Measure ○ transfer (+exp) ○ locomotion (-)

Lee et al. (2018) RCT (6) NStart=31 NEnd=30 TPS=Subacute	E: Conventional rehabilitation program + game-based virtual reality (VR) canoe paddling training C: Conventional rehabilitation program Duration: 60min, 2x/d, 5d/wk, for 5wks conventional rehabilitation program & 30min/d, 3d/wk, for 5wks VR training	• Modified Functional Reach Tests ○ Forward (-) ○ Unaffected side (+exp) ○ Affected side (+exp) • Postural sway test ○ Center of pressure path length (+exp) ○ Sway Velocity (+exp) • Manual function test of UE ○ Upper limb (+exp) ○ Hand (-)
Choi et al. (2017) RCT (7) NStart=36 NEnd=36 TPS=Chronic	E1: Game-based CIMT + Traditional physical therapy; E2: General game-based training + Traditional PT C: Traditional physical therapy Duration: 30min/d, 3d/wk, for 4wks game training & 60min/d, 5d/wk, for 4wks traditional PT	<u>E1/E2 vs C</u> • Center of Pressure ○ AP (+exp1) ○ ML (+exp1) • Sway Mean Velocity (-) • Sway Area (+exp1) • Symmetric Weight Bearing (+exp1, +exp2) • Functional Reach Test (-) • Modified Functional Reach Test (+exp1, +exp2) • Timed Up-and-go Test (-) <u>E1 vs E2</u> • Center Of Pressure ○ AP (-) ○ ML (+exp1) • Sway Mean Velocity (-) • Sway Area (+exp1) • Symmetric Weight Bearing (+exp1) • Functional Reach Test (-) • Modified Functional Reach Test (-) • Timed Up-and-go Test (-)
Hung et al. (2017) RCT (7) Nstart=43 Nend=37 TPS=Chronic	E1: Wii Fit balance training E2: Tetrax biofeedback balance training C: Conventional weight-shifting training Duration: 30min/d, 2d/wk for 12wks	<u>E1/E2 vs C</u> • Berg Balance Scale (-) <u>E1 vs E2</u> • Berg Balance Scale (-)
James et al. (2017) RCT (6) Nstart=10 Nend=10 TPS=Acute	E: Gaming Assisted Visual feedback for balance training + Conventional therapy C: Balance training exercises + Conventional therapy Duration: 60min, 2x/d, for 4d (8 sessions total)	• Berg Balance Scale (+exp) • AP-Postural sway (-) • Lat-Postural Sway (+exp) • Stance symmetry (+exp) • Active ankle ROM dorsiflexion (-) • Active ankle ROM plantarflexion (+exp) • Lateral reach test (-)
Lee et al. (2017) RCT (6) Nstart=50 Nend=47 TPS=Chronic	E: Virtual reality balance training + Standard treatment C: Standard treatment Duration: 90min/d, 2d/wk, for 6wks	• Berg Balance Scale (-) • Functional Reach Test (-) • Timed Up and Go-cognitive (-) • Modified Barthel Index (-) • Activities-Specific Balance Confidence (-) • Stroke Impact Scale (-)
Park et al. (2017) RCT (6) Nstart=24 Nend=20	E: Virtual reality through Xbox Kinect + Conventional physical therapy	• Fugl-Meyer Assessment (-) • Berg Balance Scale (+exp) • Timed Up and Go (+exp) • 10-m Walk Test (+exp)

TPS=Chronic	C: Conventional physical therapy Duration: 30min/d, 7d/wk, for 6wks Virtual reality/ Conventional physical therapy	
Pedreirada Fonseca (2016b) RCT (7) Nstart=30 Nend=27 TPS=Chronic	E: Virtual rehabilitation + conventional PT C: Conventional PT Duration: 60min/d, 2d/wk, for 10wks	• Dynamic Gait Index (-) • Fall rate (-)
Hung et al. (2016b) RCT (5) Nstart=27 Nend=27 TPS=Chronic	E: Virtual reality-based balance training C: Conventional rehabilitation Duration: 20min/d, 3d/wk for 6wks	• Timed Up & Go Test (+exp) • Weight bearing (+exp) • Proprioception (+exp) • Muscle strength - quadriceps (-) • Sway Area (-)
In et al. (2016) RCT (5) Nstart=30 Nend=25 TPS=Chronic	E: Virtual reality reflection therapy (VRRT) + Conventional therapy C: Placebo VRRT + Conventional care Duration: 60min/d, 5d/wk for 4wks	• Berg Balance Scale (+exp) • Functional Reaching Test (+exp) • Timed Up and Go Test (+exp) • 10-meter Walking Velocity (+exp) • Static Balance Ability ○ Anterior-posterior Sway Distance (Eye Open) (+exp) ○ Anterior-posterior Sway Distance (Eye Close) (-) ○ Medial-lateral Sway Distance (Eye Open/Eye Close) (-) ○ Total Sway Distance (Eye Open) (+exp) ○ Total Sway Distance (Eye Close) (-)
Şimşek & Cekok (2016) RCT (7) Nstart=44 Nend=42 TPS=Chronic	E: Nintendo Wii game training C: Conventional rehabilitation Duration: 45-60min/d, 3d/wk, for 10wks	• Functional Independence Measure (-) ○ Motor (-) ○ Cognitive (-) • Nottingham Health Profile (-) ○ Energy level (-) ○ Pain (-) ○ Emotional reaction (-) ○ Social isolation (-) ○ Sleep (-) ○ Physical activity (-) • Visual Analogue scale-satisfaction (+exp)
Bower et al. (2015) RCT (4) Nstart=16 Nend=16 TPS=Subacute	E: Virtual reality training (PrimeSense) C: Conventional rehabilitation Duration: 40min/d, 2d/wk for 4wk	• 6-Minute Walk Test (-) • Functional Independence Measure (-) • Step Test (-) • Functional Reach Test (-) • Motor Assessment Scale (-)
Da Silva Ribeiro et al. (2015) RCT (7) Nstart=30 Nend=30 TPS= Chronic	E: Virtual rehabilitation using Wii (videogame) C: Conventional physical therapy Duration: 60min/d, 2d/wk for 2mo	• Fugl-Meyer assessment (-) ○ UE (-) ○ LE (-) ○ Passive motion and pain (-) ○ Sensitivity (-) ○ Balance (-) • 36-item Short-form (-) ○ Physical functioning (+exp) ○ Physical aspects (-) ○ Pain (-) ○ General Health (-) ○ Vitality (-) ○ Social aspects (-)

		○ Emotional aspects (-) ○ Mental health (-)
Llorens et al. (2015a) RCT (8) Nstart=22 Nend=20 TPS=Chronic	E: Conventional physiotherapy + Virtual reality-based stepping exercise C: Conventional physiotherapy Duration: 60min/d, 5d/wk, for 4wks	• 10-m Walk Test (+exp) • Brunel Balance Assessment (+exp) • Berg Balance Scale (-) • Tinetti performance-oriented mobility assessment ○ balance (-) ○ gait (-)
Hung et al. (2014) RCT (6) Nstart=30 Nend=28 TPS=Chronic	E: Wii Fit Balance board + Routine rehabilitation C: Conventional weight-shift training + routine rehabilitation Duration: 30min/d, 2d/wk, for 12 wks interventions + routine rehabilitation	• Static standing balance in 8 positions ○ Head straight with eyes open while standing on solid surface (-) ○ Head straight with eyes closed while standing on solid surface (-) ○ Head straight with eyes open while standing on a foam surface (+exp) ○ Head straight with eyes closed while standing on foam surface (-) ○ Eyes closed while standing on a solid surface with head turned at 30 to the right (-) ○ Eyes closed while standing on a solid surface with head turned at 30 to the left (+exp) ○ Eyes closed while standing on a solid surface with head up (+exp) ○ Eyes closed while standing on a solid surface with head down (-) • Weight bearing on affected leg in 8 positions (-) • Timed Up and Go (-) • Forward reach test (-) • Falls Efficacy Scale-international (-) • Physical Activity Enjoyment Scale (+exp)
Morone et al. (2014) RCT (7) Nstart=50 Nend=47 TPS=Subacute	E: Video Game-Based Balance Training + conventional PT C: Conventional PT + Balance Training Duration: 20min/d balance training + 80min/d conventional physical therapy, 3d/wk, for 4wks	• Berg Balance Scale (+exp) • Barthel Index (+exp) • 10-Metre Walk Test (-) • Functional Ambulation Category (-)
Lee et al. (2014b) RCT (7) Nstart=21 Nend=19 TPS=Chronic	E: Augmented reality based postural control training + conventional physical therapy C: Conventional physical therapy Duration: 30min/d, 3d/wk, for 4wks VR-Postural Training & 30min/d, 4d/wk, for 4wks PT	• Timed Up and Go test (-) • Berg Balance Scale (-) • Gait velocity(+exp) • Cadence (-) • Step length (+exp) • Stride length (+exp)
Barcala et al. (2013) RCT (7) Nstart=20 Nend=20 TPS=Chronic	E: Wii-based balance training C: Conventional rehabilitation Duration: 60min/d, 2d/wk, 5wks Conventional therapy ; 30min/d, 2d/wk, 5wks Wii Fit balance training	• Berg Balance Scale (-) • Timed Up & Go Test (-) • Functional Independence Measure (-) • Stabilometry (-) • Body symmetry (-)

Fritz et al. (2013) RCT (8) Nstart=30 Nend=38 TPS=Chronic	E: Virtual reality training C: No Treatment Duration: 1hr/d, 4d/wk for 5wks	• Fugl-Meyer Assessment (-) • 6-Minute Walk Test (-) • 3-Metre Walk Test (-) • Dynamic Gait Index (-) • Berg Balance Scale (-) • Timed Up & Go Test (-) • Stroke Impact Scale (-)
Rajaratnam et al. (2013) RCT (5) Nstart=19 Nend=19 TPS=Acute	E: Interactive virtual-reality balance-related video games + conventional therapy C: Conventional therapy Duration: E: 40min VR + 20min conventional/session, 15 sessions; C: 60min/session, 15 sessions	• Functional Reach Test (+exp) • Timed Up and Go (-) • Berg Balance Scale (-) • Centre of Pressure (-) • Modified Barthel Index (-)
Cho et al. (2012) RCT (5) Nstart=24 Nend=22 TPS=Chronic	E: Wii-based balance training C: Conventional rehabilitation Duration: 30min/d, 3d/wk, for 6wks virtual reality balance training & 1hr/d, 5d/wk, for 6wks conventional care	• Antero-posterior postural sway velocity (-) • Medio-lateral postural sway velocity (-) • Berg Balance Scale(+exp) • Timed up and Go test(+exp)
Kim et al. (2012) RCT (4) Nstart=20 Nend=17 TPS=Chronic	E: Wii-based balance training C: Control group Duration: 30min/d, 3d/wk for 3wks	• Postural Assessment Scale (+exp) • Modified Motor Assessment Scale (+exp) • Functional Independence Measure (-)
Lee et al. (2012) RCT (8) Nstart=40 Nend= 40 TPS=Chronic	E: Balance training with Balance Control Trainer C: Conventional rehabilitation Duration: 60min/d, 5d/wk, for 4wks conventional rehabilitation & 20min/d, 5d/wk, for 4wks balance training	• Berg Balance Scale (+exp) • Timed Up & Go Test (+exp) • Functional Ambulation Categories (+exp) • Modified Barthel Index (-) • 10-Metre Walking Test (+exp) • Manual Muscle Test (-)
Kim et al. (2009) RCT (6) Nstart=24 Nend=24 TPS=Chronic	E: Virtual reality-based balance training C: Conventional therapy Duration: 30min/d, 4d/wk, for 4wks VR- balance training & 40min/d, 4d/wk, for 4wks Conventional therapy	• Berg Balance Scale (+exp) • Static balance ○ Sway area (-) ○ Sway path (-) ○ Maximal Velocity (-) • Dynamic balance ○ AP angle (+exp) ○ ML angle (+exp) • Modified Motor Assessment Scale (+exp) • 10-Metre Walk Test (+exp) • Cadence (+exp) • Step time (+exp) • Swing time (-) • Stance time (-) • Single Limb Support time (-) • Double Limb Support time (-) • Step length (+exp) • Stride length (-)
You et al. (2005) RCT (5) Nstart=10 Nend=10 TPS=Chronic	E: Virtual reality training (computer) C: No Treatment Duration: 60min/d, 5d/wk for 4wks	• Functional Ambulation Category (+exp) • Modified Motor Assessment Scale (+exp)
Virtual Reality vs Balance Training		

Zhang et al., (2020) RCT (5) Nstart=40 Nfinal=40 TPS=Subacute	E: Conventional balance training + visual balance training with Pro-kin system + Game training C: Conventional balance training Duration: 20min/d, 5d/wk, for 3wks	• Berg Balance Scale (+exp) • Timed Up & Go Test (+exp) • Functional Ambulation Classification (+exp) • Barthel Index (+exp) • Pro-kin system parameters: ○ perimeter EO (+exp) ○ ellipse area EO (+exp) ○ perimeter EC (+exp) ○ ellipse area EC (+exp)
James et al. (2017) RCT (6) Nstart=10 Nend=10 TPS=Acute	E: Gaming Assisted Visual feedback for balance training + Conventional therapy C: Balance training exercises + Conventional therapy Duration: 60min/d, 2x/d, for 4d (8 sessions total)	• Berg Balance Scale (+exp) • AP-Postural sway (-) • Lat-Postural Sway (+exp) • Stance symmetry (+exp) • Active ankle ROM dorsiflexion (-) • Active ankle ROM plantarflexion (+exp) • Lateral reach test (-)
Braun et al. (2016) RCT (8) Nstart=28 Nend=28 TPS=Subacute	E: Dynamic balance training with Balance Trainer C: Static balance training with a conventional standing frame Duration: 30min/session, 3-5x/wk for 5wks	• Berg Balance Scale (+exp) • Functional Ambulation Category (+exp) • De Morton Mobility Index (+exp) • Functional Independence Measure (+exp)
Yatar et al. (2015) RCT (5) Nstart=33 Nend=30 TPS=Chronic	E: Wii-based balance training C: Progressive balance training Duration: 1hr/d, 3d/wk for 4wks	• Berg Balance Scale (-) • Timed Up & Go Test (-) • Functional Reach Test (-) • Activity-Specific Balance Confidence Scale (-) • Dynamic Gait Index (-) • Frenchay Activities Index (-)
Jung et al. (2011) RCT (4) Nstart=22 Nend=22 TPS=Chronic	E: 3D balance exercises (3D Thera-Balance) with visual feedback C: Weight shifting exercises Duration: 50min/d, 5d/wk for 6wks	• Berg Balance Scale (+exp) • 10-Metre Walk Test (-)
Virtual Reality Exercise Program vs Exercise Program		
Cannell et al. (2018) RCT (8) Nstart=81 Nend=73 TPS=Subacute	E: Customized Physiotherapy plan using interactive Motion Capture Rehabilitation (VR-based) C: Customized Physiotherapy plan Duration: Maximum of 1hr/d, 5d/wk, for 8wks or up to discharge (whichever comes first)	• Functional reach Test (-) • Lateral reach Test (-) • Sitting balance Test (-) • Modified Motor assessment scale (-) • Box and Block (-) • Step test (-) • Timed Up and Go (-) • Gait Velocity (-)
Chung et al. (2014) RCT (4) Nstart=26 Nend=19 TPS=Chronic	E: Core stability exercises + real time feedback + conventional physical therapy C: Core stability exercises + conventional physical therapy Duration: 30min/session, 3d/wk for 6wks	• Timed Up and Go test (+exp) • Gait velocity (+exp) • Gait cadence (-) Affected side • Stride length (+exp) • Step length (-) • Single support time (+exp) • Double support time (-) Non-affected side • Stride length (+exp) • Step length (-) • Single support time (-) • Double support time (-)

Virtual Reality Training vs Treadmill Training		

Bang et al. (2016)
RCT (4)
Nstart=40
Nend=37
TPS=Chronic
	E: Virtual reality training (Wii fit board)
	C: Treadmill training
	Duration: 40min/d, 3d/wk for 8wks
		• Weight bearing
		  ○ Left/right (+exp)
		  ○ Anterior/posterior (+exp)
		• Stance phase (-)
		• Swing phase (-)
		• Cadence (-)

Virtual Reality with Treadmill Training vs Conventional Therapy or Treadmill Training		
De Rooij et al. (2021) RCT (8) Nstart=55 Nend=52 TPS=Subacute	E: Virtual reality Gait training (using Gait Real-time Analysis Interactive Lab (GRAIL)) C: Treadmill training + Gait exercises Duration: 30min/d, 2d/wk, for 6wks	• Utrecht scale for Evaluation of Rehabilitation-Participation (-) • Stroke Impact scale-16 (-) • Fatigue Severity scale (-) • Hospital Anxiety and Depression scale (-) • Falls Efficacy Scale-International (-) • Stroke Specific Quality of Life Scale (-) • Timed Up & Go (-) • 6min walking test (-) • Mini-Balance Evaluation Systems Test (Mini-BEST) (-) • Number of steps/day (-) • Cadence (-) • Walking Duration (-)
Kim et al. (2016c) RCT (7) Nstart=30 Nend=27 TPS=Chronic	E1: VR treadmill training-based community ambulation E2: Community ambulation training C: Conventional rehabilitation Duration: 30min/d, 3d/wk for 4wks Treadmill training and community ambulation & 30min/session, 10sessions/wk for 4wks general exercise program control.	<u>E1/E2 vs C</u> • Timed Up & Go Test: (+exp1) • Activities-specific Balance Confidence Scale (+exp1/2) • 6-minute Walking Test (+exp2) • Gait Speed (-) • Cadence (-) • Stride Length (-) • Step Length (-) <u>E1 vs E2</u> • Timed Up and Go Test (-) • Activities-specific Balance Confidence Scale (-) • 6-minute Walking Test (-) • Gait Speed (-) • Cadence (-) • Stride Length (-) • Step Length (-)
Kim et al. (2015) RCT (4) Nstart=20 Nend=17 TPS=Chronic	E: Treadmill training + Virtual reality C: Conventional rehabilitation Duration: 30min/d, 3d/wk, 4wks interventions + 60min/d, 5d/wk, 4wks Conventional PT	• Postural sway path length (+exp) • Postural sway speed (+exp)
Cho et al. (2014) RCT (7) Nstart=32 Nend=30 TPS=Chronic	E: Treadmill training based real-world video recording + standard rehabilitation C: Treadmill training + Standard rehabilitation Duration: 30min/d, 3/wk for 6wks treadmill trainings; 80min/d, 5/wk, 6wks standard rehabilitation program	• Berg Balance Scale (+exp) • Timed Up and Go test (+exp) • Postural sway velocity (-) • Gait speed (+exp) • Cadence (+exp) • Stride length (+exp) • Paretic side step length (+exp) • Single time support (+exp) • Double time support (+exp)

Cho et al. (2013) RCT (7) Nstart=16 Nend=14 TPS=Chronic	E: Virtual walking training + standard rehabilitation program C: Treadmill gait training + standard rehabilitation Duration: 30min/d, 3d/wk for 6wks trainings & 80min/d, 5d/wk for 6wks standard rehabilitation program	• Berg Balance Scale (+exp) • Timed Up and Go test (+exp) • Gait performance ○ Velocity (+exp) ○ Cadence (+exp) ○ Step length (-) ○ Stride length (-) ○ Single limb support (-)
Jung et al. (2012) RCT (5) Nstart=25 Nend=21 TPS=Chronic	E: Treadmill training + Virtual reality C: Treadmill training Duration: 30min/d, 5d/wk for 3wks	• Timed Up & Go Test (+exp) • Activities-Specific Balance Confidence Scale (+exp)
Kang et al. (2012) RCT (7) Nstart=32 Nend=30 TPS=Chronic	E1: Treadmill with optic flow + conventional physical therapy E2: Treadmill + conventional physical therapy C: Conventional therapy Duration: 30min/session, 3d/wk, 4wks + conventional physical therapy 5d/wk, for 4wks	<u>E1 vs E2</u> • 10-Metre Walk Test (+exp1) • 6-Minute Walk Test (+exp1) • Timed Up & Go Test (+exp1) • Functional Reach Test (-) <u>E2 vs C</u> • 10-Metre Walk Test (-) • 6-Minute Walk Test (-) • Timed Up & Go Test (-) • Functional Reach Test (exp2) <u>E1 vs C</u> • 10-Metre Walk Test (+exp1) • 6-Minute Walk Test (+exp1) • Timed Up & Go Test (+exp1) • Functional Reach Test (exp1)
Yang et al. (2011) RCT (4) Nstart=14 Nend=14 TPS=Chronic	E: Treadmill training + Virtual reality + Conventional rehabilitation C: Treadmill training + Conventional rehabilitation Duration : 20min/d, 3x/wk for 3wks - Treadmill training & 40min/d, 7x/wk for 3wks - Conventional rehabilitation	• Quiet stance Center of pressure ○ anterior-posterior (-) ○ mediolateral (+exp) ○ excursion (-) ○ sway area (-) • Sit to stand ○ anterior-posterior (-) ○ mediolateral (-) ○ excursion (-) ○ sway area (-) ○ symmetric index (+exp) • Level walking ○ Stance time (-) ○ contact area (-) ○ number of steps (-)
Yang et al. (2008) RCT (6) Nstart=24 Nend=20 TPS=Chronic	E: Treadmill training + Virtual reality C: Treadmill training Duration: 20min/d, 3d/wk for 3wks	• Gait speed (+exp) • Community walk test (+exp) • Walking Ability Questionnaire (-) • Activities Specific Balance Confidence Scale (-)
Virtual Reality with Treadmill Training vs Overground Gait Training		
Jaffe et al. (2004) RCT (4) Nstart=20 Nend=20 TPS=Chronic	E: Treadmill training + Virtual reality C: Stepping over real objects on 10m walkway Duration: 60min/d, 6d/2wks	• Performance-Oriented Assessment of Mobility (-) • Physical Performance Test (-) • Fast Walk Test (+exp) • Self-Selected Walk Test (-) • Cadence (-) • Stride Length (-)

		• Step Length (-) • 6-Minute Walk Test (-) • Obstacle Clearance (-)
Virtual Reality Robotic Training vs Robotic Training and Conventional Therapy		
Kayabinar et al. (2021) RCT (6) Nstart=37 Nend=30 TPS=Chronic	E: VR augmented robot-assisted gait training + conventional care C: Robot-assisted gait training + conventional care Duration: gait training 45min/d, 2d/wk, for 6wks + conventional care 30min/d, 3d/wk, for 6wks	• 10-metre walk test (-) • Motor task added 10-metre walk test (-) • Cognitive task added 10-metre walk test (-) • Motor dual-task performance (-) • Cognitive dual task performance (-) • Functional Gait assessment (-) • Rivermead Mobility Index (-) • Berg Balance Scale (-) • Falls Efficacy Scale-I (-) • Functional Independence Measure total (-)
Bergmann et al., (2018) RCT crossover (6) Nstart= 27 Nend = 20 TPS= Subacute	E: Robot-assisted gait training + Virtual reality C: Robot-assisted gait training Duration: 3x/wk for 4wks interventions + one extra crossover session	• Intrinsic Motivation inventory • Self-management (-) • External assessment (-) • Walking time per session (+exp) • Total walking time (+exp) • Distance per session (-) • Walking speed (-) • Guidance force paretic side (-) • Body weight support (-)

Calabrò et al. (2017)
RCT (8)
Nstart=24
Nend=24
TPS=Chronic
	E: Robot-assisted gait training (Lokomat) + Virtual reality
	C: Robot-assisted gait training (Lokomat)
	Duration: 45min/d, 5d/wk, for 8wks
		• Rivermead Mobility Index (+exp)
		• Tinetti Performance Oriented Mobility Assessment (+exp)
		• Modified Ashworth Scale (-)
		• Hamilton Rating Scale for Depression (-)
		• Knee Force (+exp)
		• Hip Force (+exp)
		• EEG-Brain Activation
		    ○ BA6 Brain Area (+exp)
		    ○ BA7 Area (+exp)
		    ○ BA17 Area (+exp)
		• Parieto-occipital activation- μ and Hγ (+exp)

Mirelman et al. (2009)
RCT (5)
Nstart=18
Nend=18
TPS=Chronic
	E: Virtual reality robotic training (computer)
	C: Robotic training
	Duration: 60min/d, 3d/wk for 4wks
		• 7-Metre Walk Test- self-selected speed (-)
		• 6-Minute Walk Test (-)
		• Community activity measures
		    ○ Distance in 7 days (+exp)
		    ○ Steps per day (-)
		    ○ Speed (-)
		    ○ Step length (-)
		    ○ Top speed (-)

Virtual Reality Robotic Training vs Robotic Training, Auditory Stimulation, and Conventional Therapy		
Park et al. (2018) RCT (6) Nstart=40 Nend=40 TPS=Chronic	E1: Virtual reality + robot-assisted gait training (Treadmill)+ conventional physical therapy E2: Auditory stimulation + robot-assisted gait training (Treadmill) + conventional physical therapy C: Conventional physical therapy + treadmill training Duration: 45min/d, 3d/wk, for 6wks trainings & 30min/d, 5d/wk, for 6wks Conventional therapy	<u>E1 vs E2</u> • Medical Research Council (+exp1) • Berg Balance Scale (-) • Timed Up & Go Test (-) • 10 Meter Walk test (-) • Fugl-Meyer Assessment (+exp1) • Modified Barthel Index (-) <u>E1/ E2 vs C</u> • Medical Research Council (+exp1, +exp2) • Berg Balance Scale (+exp1, +exp2) • Timed Up & Go Test (+exp1, +exp2) • 10 Meter Walk test (+exp1) • Fugl-Meyer Assessment (+exp1)

		• Modified Barthel Index (-)
Virtual Reality with Other Modalities		
Aslam et al. (2021) RCT (8) Nstart=30 Nend=30 TPS=Chronic	E: Videogame exercises (x-box) C: Task-specific training Duration: 15-20 min, 5d/wk, for 6wks	• Berg Balance Scale (+exp) • Timed Up and Go test (+exp)
Malik et al. (2021) RCT (6) Nstart=52 Nend=43 TPS=Subacute	E: Task-oriented training + Virtual reality training C: Task-oriented training Duration: 40-45min/d, 3d/wk, for 8wks task-oriented training & 15-20min/d 3d/wk for 8wks virtual reality training	• Fugl-Meyer Assessment-Lower Extremity (+exp) • Berg Balance Test (+exp) • Timed Up and Go test (+exp) • Dynamic Gait Index (-)

Miclaus et al. (2021)
RCT (7)
Nstart=64
Nend=64
TPS=Chronic
	E: Virtual reality (VR) therapy and mirror therapy (MT) exercises
	C: Standard lower extremity rehabilitation
	Duration: 70min/d, 5d/wk, for 2wks
		• Functional Independence Measure (-)
		• Modified Rankin Scale (-)
		• Modified Ashworth Scale (-)
		• Fugl Meyer Lower Extremity Assessment
		  ○ motor (+exp)
		  ○ passive (+exp)
		  ○ pain (-)
		• Manual Muscle Testing (+exp)
		• Active Range of Motion (+exp)
		• Functional Reach Test (+exp)
		• Time Up to Go (-)

Tollar et al. (2021) RCT (7) Nstart=680 Nend=641 TPS=Acute	E1: one session daily high intensity Videogame exercises + medical massage E2: two sessions daily high intensity Videogame exercises + medical massage C: standard physical therapy + medical massage Duration: E1: 60min/d, 5d/wk, 5wks exergaming + 20min/d, 5d/wk, 5wks massage E2: 120min/d, 5d/wk, 5wks exergaming + 40min/d, 5d/wk, 5wks massage C: 60min/d standard care + 20min/d massage	<u>E1/E2 v C</u> • Modified Ranking Scale (+exp1, +exp2) • Barthel Index (+exp1, +exp2) • EQ5-VAS (+exp2) • EQ5-Sum (-) • Berg Balance Scale (+exp2) • 6-minute walk test (+exp2) • Beck Depression Inventory (-) • Mini Mental State Examination (-) • Center of pressure path (wide/narrow stance & open/closed eye) (+exp2) • Resting HR (+exp1, +exp2) • Resting SBP/DBP (+exp1, +exp2) • Peak HR (+con) • Rate of perceived exertion (+con) <u>E1 v E2</u> • Modified Ranking Scale (-) • Barthel Index (+exp2) • EQ5-VAS (+exp2) • EQ5-Sum (-) • Berg Balance Scale (+exp2) • 6-minute walk test (+exp2) • Beck Depression Inventory (-) • Mini Mental State Examination (-) • Center of pressure path (wide/narrow stance & open/closed eye) (+exp2) • Resting HR (no stat) • Resting SBP/DBP (no stat) • Peak HR (-) • Rate of perceived exertion (-)

dos Santos Junior et al. (2019)
RCT (6)
Nstart=48
Nend=40
TPS=Chronic
	E1: Virtual Reality (Nintendo Wii)
	E2: Virtual Reality + Proprioceptive Neuromuscular Facilitation
	C: Proprioceptive Neuromuscular Facilitation
	Duration: 50min/d, 2d/wk, for 8wks
		E1/E2 vs C
		• Fugl-Meyer Assessment (-)
		  ○ Passive Motion and Pain (-)
		  ○ Sensory Assessment (-)
		  ○ Lower Limb Motor Function (-)
		  ○ Balance (-)
		
		E1 vs E2
		• Fugl-Meyer Assessment (-)
		  ○ Passive Motion and Pain (-)
		  ○ Sensory Assessment (-)
		  ○ Lower Limb Motor Function (-)
		  ○ Balance (-)

Forrester et al. (2016) RCT (4) Nstart=35 Nend=26 TPS=Chronic	E: Treadmill training + Virtual reality + Ankle robotics C: Seated training + Virtual reality + Ankle robotics Duration: 45min/d, 5d/wk for 6wks	• Gait speed (+exp) • Paretic limb support (+exp) • Ankle range of motion (+exp) • Ankle target speed (+exp) • Ankle target accuracy (+exp) • Centre of pressure (-)
Llorens et al. (2015b) RCT (8) Nstart=31 Nend=30 TPS=Chronic	E: Virtual reality-based telerehabilitation in Home + conventional physical therapy C: Virtual reality-based rehabilitation in clinic + conventional physical therapy Duration: 45min/d, 3d/wk, for 7wks (20 total session)	• Brunel Balance Assessment (-) • Berg Balance Scale (-) • Tinetti Performance-Oriented Mobility Assessment (-) • System Usability Scale (-) • Intrinsic Motivation Inventory (-)
Yom et al. (2015) RCT (6) Nstart=20 Nend=20 TPS=Chronic	E: Virtual reality ankle training C: Watch a documentary irrelevant to ankle exercise. Duration: 30min/d, 5d/wk for 6wks	• Timed Up & Go Test (+exp) • Modified Ashworth Scale (+exp) • Tardieu Scale (+exp) • Gait Speed (+exp) • Cadence (+exp) • Step Length (+exp) • Stride Length (+exp) • Stance Time Percentage (+exp) • Swing Time Percentage (+exp) • Double Support (+exp)

Bower et al. (2014)
RCT (8)
Nstart=30
Nend=21
TPS= Acute
	E: Wii Fit Plus video game (Balance training)
	C: Wii Sports video game (Upper limb training)
	Duration: 45min/session, 3d/wk for 2-4wks
		• Step Test
		  ○ Affected (+exp1)
		  ○ Unaffected (-)
		• Functional Reach Test (-)
		• Timed Up and Go Test (-)
		• Centre of Pressure Measures (+exp1)
		• Short Falls Efficacy Scale – International (-)
		• Upper Limb - Motor Assessment Scale (-)
		• Stroke Rehabilitation Assessment of Movement (-)

McEwen et al. (2014) RCT (4) Nstart=74 Nend=59 TPS=Subacute	E: Regular rehabilitation therapy + Virtual Reality Exercise in standing position C: Regular rehabilitation therapy + Virtual Reality Exercise in sitting position Duration: 30min/d, 3wks (10-12 sessions in total)	• Timed Up & Go Test (-) • Two-Minute Walk Test (-) • Chedoke-McMaster Stroke Assessment Scale (+exp)

Mirelman et al. (2010)
RCT (3)
Nstart=18
Nend=18
TPS=Chronic
	E: Platform Force-Feedback + Virtual Reality
	C: Platform Force-Feedback
	Duration: 60min/d, 3d/wk, for 4wks
		• Self-selected walking speed (+exp)
		• Ankle push off power
		  ○ Barefoot (+exp)
		  ○ Shoes on (-)
		• Barefoot Ankle Range of Motion (-)
		• Barefoot affected Knee range of motion stance (+exp)
		• Barefoot affected Knee range of motion swing (+exp)
		• Shoe ankle range of motion (-)
		• Shoe kinematic changes in knee joints (-)

Brain-Computer Interface Controlled Training vs Sham		

Zhao et al. (2022)
RCT (9)
NStart=31
NEnd=28
TPS=Subacute
	E: Brain-computer interface-controlled training robot + Conventional Physiotherapy
	C: Sham brain-computer interface-controlled training robot + Conventional Physiotherapy
	Duration: 60 min/d, 6d/wk, for 4wks
		• Loewenstein Occupational Therapy Cognitive Assessment (+exp)
		• Fugl-Meyer Assessment
		  ○ Lower Extremity (-)
		  ○ Balance (-)
		• Functional ambulation category (-)
		• Modified Barthel Index (-)
		• Serum BDNF (-)
		• MEP
		  ○ Latency (-)
		  ○ Amplitude (-)

Li et al. (2021)
RCT (6)
NStart=26
NEnd=25
TPS=Subacute
	E: Brain-computer interface-operated lower limb rehabilitation robot
	C: Sham (Lower limb pedal training without image, video, sound hint)
	Duration: 30min/d, 1session/d for 4wks
		• NIH stroke scale (+exp)
		• Fugl-Meyer: Upper limb (-)
		  ○ Lower limb (+exp)
		  ○ Balance (-)
		• Holden walking scale (-)
		• EMG parameters
		  ○ MEP amplitude (+exp)
		  ○ MEP latency (+exp)
		  ○ Fractional anisotropy (-)

Yuan et al. (2021) RCT (8) NStart=30 NEnd=30 TPS=Subacute	E: Brain-computer interface-controlled pedaling training C: Sham BCI-controlled pedaling training Duration: 2sessions/d, 6d/wk, for 2wks	• Fugl-Meyer Assessment (+exp) • Digital Span Test (+exp) • Symbol Digit Modalities Test (+exp) • Attention Index (+exp) • Mini-Mental State Examination (-) • Montreal Cognitive Assessment (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Virtual Reality Training

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Task-oriented training with virtual reality** may produce greater improvements in motor function than **task-oriented training alone.**	1	Malik et al. 2021

1b	**Virtual reality with treadmill training** may produce greater improvements in motor function than **treadmill training or conventional care.**	1	Park et al. 2018
1b	**Virtual reality robotic training** may produce greater improvements in motor function than **robotic training with auditory stimulation.**	1	Park et al. 2018
2	**Virtual reality exercise in a standing position** may produce greater improvements in motor function than **virtual reality in a seated position.**	1	McEwen et al. 2014
1a	There is conflicting evidence on the effect of **brain-computer interface-controlled training** when compared to **sham training** for improving motor function.	3	Zhao et al. 2022; Li et al. 202; Yuan et al. 2021
1b	There is conflicting evidence on the effect of **virtual reality with mirror therapy** when compared to **conventional care** for improving motor function.	1	Miclaus et al. 2021
1a	**Virtual reality training** may not have a difference in efficacy compared to **conventional care** for improving motor function.	5	Anwar et al. 2021; Junata et al. 2021; Park et al. 2017; Da Silva Ribeiro et al. 2015; Fritz et al. 2013
1b	**Virtual reality with proprioceptive neuromuscular facilitation** may not produce greater improvements in motor function than **virtual reality or proprioceptive neuromuscular stimulation alone.**	1	Dos Santos Junior et al. 2019
2	**Virtual reality with treadmill training** may not produce greater improvements in motor function than **overground training.**	1	Jaffe et al. 2004

FUNCTIONAL AMBULATION

LoE	Conclusion Statement	RCTs	References
1b	**Videogame exercises** may produce greater improvements in functional ambulation than **task-specific training.**	1	Aslam et al. 2021
1b	**Task-oriented training with virtual reality** may produce greater improvements in functional ambulation than **task-oriented training.**	1	Malik et al. 2021
1b	**High intensity videogame exercises** may produce greater improvements in functional ambulation than **moderate intensity videogame exercises or physical therapy.**	1	Tollar et al. 2021
1b	**Virtual reality with ankle training** may produce greater improvements in functional ambulation than **watching a documentary.**	1	Yom et al. 2015
2	**Treadmill training with virtual reality and ankle robotics** may produce greater improvements in functional ambulation than **seated training with virtual reality and ankle robotics.**	1	Forrester et al. 2016
2	**Virtual reality with platform force training** may produce greater improvements in functional ambulation than **platform force training alone.**	1	Mirelman et al. 2010

1a	There is conflicting evidence about the effect of **virtual reality training** to improve functional ambulation when compared to **balance training or conventional therapy**.	21	Junata et al. 2021; Marques-Sule et al. 2021; Cano-Manas et al. 2020; Hseih et al. 2019; Karasu et al. 2018; Choi et al. 2017; Lee et al. 2017; Park et al. 2017; Jung et al. 2016; In et al. 2016; Bower et al. 2015; Llorens et al. 2015; Hung et al. 2014; Lee et al. 2014; Morone et al. 2014; Barcala et al. 2013; Fritz et al. 2013; Rajaratnam et al. 2013; Cho et al. 2012; Lee et al. 2012; Kim et al. 2009; You et al. 2005
1a	There is conflicting evidence on the effect of **virtual reality with treadmill training** when compared to **virtual reality** for improving functional ambulation.	8	De Rooj et al. 2021; Park et al. 2018; Kim et al. 2016; Cho et al. 2014; Cho et al. 2013; Kang et al. 2012; Yang et al. 2011; Yang et al. 2008
1b	There is conflicting evidence on the effect of **virtual reality** when compared to **balance training** for improving functional ambulation.	4	Zhang et al. 2020; Braun et al. 2016; Yatar et al. 2015; Jung et al. 2011
1b	There is conflicting evidence on the effect of **virtual reality** when compared to **an exercise program** for improving functional ambulation.	2	Cannell et al. 2017; Chung et al. 2014
1a	**Brain-computer interface training** may not produce greater improvements in functional ambulation than **sham training.**	2	Zhao et al. 2022; Li et al. 2021
1a	**Virtual reality with robotic training** may not produce greater improvements in functional ambulation than **robotic training.**	3	Kayabinar et al. 2021; Bergmann et al. 2018; Mirelman et al. 2009
1b	**Virtual reality with mirror therapy** may not produce greater improvements in funcitonal ambulation than **conventional care.**	1	Miclaus et al. 2021
1b	**Virtual reality with robotic training** may not produce greater improvements in functional ambulation than **robotic training with auditory stimulation.**	1	Park et al. 2018
1b	**Virtual-reality game-based constraint-induced movement therapy** may not produce greater improvements in functional ambulation than **physical therapy.**	1	Choi et al. 2017
1b	**Virtual reality with treadmill training** may not produce greater improvements in functional ambulation than **overground training.**	1	Kim et al. 2016; Jaffe et al. 2004
1b	**Upper extremity targeting Wii fit plus video games** may not produce greater improvements in functional ambulation than **upper extremity targeting Wii fit plus video games.**	1	Bower et al. 2014

2	**Virtual reality balance training** may not produce greater improvements in functional ambulation than **virtual reality seated training.**	1	McEwen et al. 2014

FUNCTIONAL MOBILITY			
LoE	Conclusion Statement	RCTs	References
1b	**Virtual reality training** may produce greater improvements in functional mobility than **balance training.**	1	Braun et al. 2016
1a	**Virtual reality robotic training** may not produce greater improvements in functional mobility than **robotic training.**	2	Kayabinar et al. 2021; Calbro et al. 2017
1b	**Lower extremity targeting Wii fit plus video games** may not produce greater improvements in functional mobility than **upper extremity targeting Wii fit plus video games.**	1	Bower et al. 2014

BALANCE			
LoE	Conclusion Statement	RCTs	References
1b	**Task-oriented training with virtual reality** may produce greater improvements in balance than **task-oriented training alone.**	1	Malik et al. 2021
1b	**Virtual reality with mirror therapy** may produce greater improvements in balance than **standard rehabilitation.**	1	Miclaus et al. 2021
1b	**High intensity videogame exercise with massage** may produce greater improvements in balance when compared to **moderate intensity videogame exercise with massage or physical therapy.**	1	Tollar et al. 2021
1a	There is conflicting evidence about the effect of **virtual reality training** to improve balance when compared to **balance training or conventional therapy**.	31	Anwar et al. 2021; Junata et al. 2021; Marques-Sule et al. 2021; Cano-Manas et al. 2020; Lin et al. 2020; Sheehy et al. 2020; Henrique et al. 2019; Hsieh et al. 2019; Miranda et al. 2019; Karasu et al. 2018; Lee et al. 2018; Choi et al. 2017; Hung et al. 2017; James et al. 2017; Lee et al. 2017; Park et al. 2017; Pedreirada Fonseca et al. 2017; Hung et al. 2016; In et al. 2016; Bower et al. 2015; Llorens et al. 2015; Hung et al. 2014; Lee et al. 2014; Morone et al. 2014; Barcala et al. 2013; Fritz et al. 2013; Rajaratnam et al. 2013; Cho et al. 2012; Kim et al. 2012; Lee et al. 2012; Kim et al. 2009

1a	There is conflicting evidence on the effect of **virtual reality with treadmill training** when compared to **treadmill training or conventional care** for improving balance.	10	De Rooij et al. 2021; Park et al. 2018; Kim et al. 2016; Kim et al. 2015; Cho et al. 2014; Cho et al. 2013; Jung et al. 2012; Kang et al. 2012; Yang et al. 2011; Yang et al. 2008
1a	There is conflicting evidence on the effect of **virtual reality training** when compared to **balance training** for improving balance.	5	Zhang et al. 2020; James et al. 2017; Braun et al. 2016; Yatar et al. 2015; Jung et al. 2011.
1b	There is conflicting evidence on the effect of **virtual reality-based constraint-induced movement therapy** when compared to **general game-based training or physical therapy** for improving balance.	1	Choi et al. 2017
1a	**Virtual reality robotic training** may not produce greater improvements in balance when compared to **robotic training or conventional therapy.**	2	Kayabinar et al. 2021; Calabro et al. 2017
1b	**Videogame exercises** may not produce greater improvements in balance than **task-specific training.**	1	Aslam et al. 2021
1b	**Virtual reality robotic training** may not produce greater improvements in balance than **robotic training with auditory stimulation.**	1	Park et al. 2018
1b	**Virtual reality balance training** may not produce greater improvements in balance than **exercise programs.**	1	Cannell et al. 2017
1b	**Virtual reality with treadmill training** may not produce greater improvements in balance than **overground gait training.**	2	Kim et al. 2016; Jaffe et al. 2004
1b	**Virtual reality telerehabilitation at home** may not produce greater improvements in balance than **virtual reality rehabilitation in clinic.**	1	Llorens et al. 2015b
1b	**Wii-based balance training** may not have a difference in efficacy compared to **Wii-based upper limb training** for improving balance.	1	Bower et al. 2014
2	**Treadmill training combined with virtual reality and ankle robotics** may not produce greater improvements to balance when compared to **seated training with virtual reality and ankle robotics**.	1	Forrester et al. 2016

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Virtual reality ankle training** may produce greater improvements in gait than **video-based ankle training.**	1	Yom et al. 2015
2	**Virtual reality with treadmill training and ankle robotics** may produce greater improvements in gait than **virtual reality with seated training and ankle robotics.**	1	Forrester et al. 2016

1b	There is conflicting evidence about the effect of **virtual reality training** to improve gait when compared to **balance training**.	2	James et al. 2017; Yatar et al. 2015
1a	**Virtual reality with treadmill training** may not produce greater improvements in gait than **overground gait training, treadmill training, or conventional therapy.**	6	De Rooij et al. 2021; Kim et al. 2016; Cho et al. 2014; Cho et al. 2013; Yang et al. 2011; Jaffe et al. 2004
1a	**Virtual reality robotic training** may not produce greater improvements in gait than **robotic training with conventional therapy.**	2	Kayabinar et al. 2021; Bergmann et al. 2018
1a	**Virtual reality** may not have a difference in efficacy compared to **conventional therapy** for improving gait.	6	Junata et al. 2021; James et al. 2017; Pedreirada Fonseca et al. 2017; Lee et al. 2014; Fritz et al. 2013; Kim et al. 2009
1b	**Task-oriented training with virtual reality** may not produce greater improvements in gait than **task-oriented training alone.**	1	Malik et al. 2021
2	**Virtual reality** may not have a difference in efficacy compared to **treadmill training** for improving gait.	1	Bang et al. 2016
2	**Virtual reality training** may not produce greater improvements in gait than **exercise programs.**	1	Chung et al. 2014
2	**Virtual reality robotic training** may not produce greater improvements in gait than **robotic training.**	1	Mirelman et al. 2010

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1b	**High or moderate intensity videogame exercise with massage** may produce greater improvements in activities of daily living than **physical therapy.**	1	Tollar et al. 2021
1b	**Virtual reality training** may produce greater improvements in activities of daily living when compared to **balance training.**	3	Zhang et al. 2020; Braun et al. 2016; Yatar et al. 2015
1b	There is conflicting evidence on the effect of **high intensity videogame exercise with massage** when compared to **moderate intensity videogame exercise with massage** on improving activities of daily living.	1	Tollar et al. 2021
1a	**Virtual reality training** may not have a difference in efficacy compared to **balance training or conventional therapy** for improving activities of daily living.	16	Junata et al. 2021; Marques-Sule et al. 2021; Cano-Manas et al. 2020; Lin et al. 2020; Karasu et al. 2018; Lee et al. 2017; Simsek & Cekok 2016; Bower et al. 2015; Hung et al. 2014; Morone et al. 2014; Barcala et al. 2013; Rajaratnam et al. 2013; Kim et al. 2012; Lee et

			al. 2012; Kim et al. 2009; You et al. 2005
1a	**Virtual reality robotic training** may produce greater improvements in activities of daily living than **robotic training with either auditory stimulation or conventional care.**	2	Kayabinar et al. 2021; Park et al. 2018
1b	**Brain-computer interface-controlled training** may not produce greater improvements in activities of daily living than **sham training.**	1	Zhao et al. 2022
1b	**Virtual reality with mirror therapy** may not produce greater improvements in activities of daily living than **standard rehabilitation.**	1	Miclaus et al. 2021
1b	**Virtual reality with treadmill training** may not produce greater improvements in activities of daily living than **treadmill training or conventional care.**	1	Park et al. 2018
1b	**Virtual reality training** may not produce greater improvements in activities of daily living than **exercise programs.**	1	Cannell et al. 2017

RANGE OF MOTION

LoE	Conclusion Statement	RCTs	References
1b	**Virtual reality with mirror therapy** may produce greater improvements in range of motion than **standard rehabilitation.**	1	Miclaus et al. 2021
2	**Virtual reality with treadmill training and ankle robotics** may produce greater improvements in range of motion than **virtual reality with seated training and ankle robotics.**	1	Forrester et al. 2016
1b	There is conflicting evidence on the effect of **virtual reality** when compared to **conventional therapy or balance training** for improving range of motion.	1	James et al. 2017
2	There is conflicting evidence on the effect of **virtual reality with platform force feedback** when compared to **platform force feedback alone** for improving range of motion.	1	Mirelman et al. 2010

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1a	**Virtual reality robotic training** may produce greater improvements in muscle strength than **robotic training with either auditory stimulation or conventional care.**	2	Park et al. 2018; Calabro et al. 2017
1b	**Virtual reality with mirror therapy** may produce greater improvements in muscle strength than **standard rehabilitation.**	1	Miclaus et al. 2021
1b	**Virtual reality with treadmill training** may produce greater improvements in muscle strength than **treadmill training or conventional care.**	1	Park et al. 2018

1b	**Virtual reality training** may not have a difference in efficacy compared to **conventional therapy** for improving muscle strength.	2	Lin et al. 2020; Hung et al. 2016

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Virtual reality with ankle training** may produce greater improvements in spasticity than **watching a movie.**	1	Yom et al 2015
1b	**Virtual reality with mirror therapy** may not produce greater improvements in spasticity than **standard rehabilitation.**	1	Miclaus et al. 2021
1b	**Virtual reality robotic training** may not have a difference in efficacy compared to **robotic training with conventional therapy** for improving spasticity.	1	Calabro et al. 2017

PROPRIOCEPTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Virtual reality training** may produce greater improvements in proprioception than **conventional therapy.**	1	Hung et al. 2016

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Brain-computer interface-controlled training** may produce greater improvements in stroke severity than **sham training.**	1	Li et al. 2021

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Virtual reality training** may not produce greater improvements to quality of life than **conventional care.**	5	Cano-Manas et al. 2020; Lee et al. 2017; Simsek & Cekok 2016; Da Silva Ribeiro et al. 2015; Fritz et al. 2013
1b	**Virtual reality with treadmill training** may not produce greater improvements to quality of life than **treadmill training or conventional care.**	1	De Rooij et al. 2021
1b	**High intensity videogame exercise with massage** may not produce greater improvements to quality of life than **moderate intensity videogame exercise with massage or physical therapy.**	1	Tollar et al. 2021

Key Points

The literature is mixed with respect to the effect of virtual reality training on functional ambulation, balance, and gait.

Virtual reality training may not be beneficial in improving activities of daily living.

Virtual reality with treadmill training may be helpful in improving balance and functional ambulation.

Electromechanical and Robotic Devices

Adopted from: http://internationalmedipol.com/lokomat-robotic-walking-system; https://www.odtmag.com/contents/view_breaking-news/2018-03-02/hybrid-assistive-limb-hal-treatment-for-spinal-cord-injury-available-in-us

Recently, considerable effort has been invested in developing electromechanical-assisted training devices for gait training. Most of these devices are generally classified as either an "end-effector device" (i.e. patients are placed on foot plates that stimulate the stance and swing phases of gait) or an "exoskeleton device" (i.e. patients are outfitted with a programmable device that moves the hips and knees during gait). The most commonly studied end-effector device is the Gait Trainer (Reha-Stim; Berlin Germany), while the Lokomat (Hokoma; Zurich, Switzerland) is the most studied exoskeleton device (Mehrholz & Pohl, 2012). Other exoskeleton devices that have been studied can be classified as either an exoskeleton system or an exoskeleton portable device. A third category of electromechanical devices can be described as a robotic arm control system group, as described by Ochi et al. (2015).

The main advantage electromechanical devices may offer over conventional gait training is that they may increase the number of repetitions performed and reduce the need for intensive therapist involvement, thereby increasing therapist productivity and accelerating patient recovery.

A table of various robotic devices used in stroke rehabilitation is outlined below (Table 28).

Table 28. Electromechanical devices used for lower limb rehabilitation post-stroke

Electromechanical Devices	Description
End-Effectors • G-EO System • Gait Trainer I and II (GT I, GT II)	The G-EO system is a gait-trainer robotic device that provides a supportive harness and uses foot plates to simulate floor walking and also walking up and down stairs (Hesse et al., 2012).
	The GT II is a gait-trainer robotic device that offers body weight support through a harness and also endpoint feet trajectories through foot plates (Iosa et al., 2011).
Exoskeleton Systems • Lokomat • Walkbot • Hybrid Assistive Limb (HAL) • AutoAmbulator	The Lokomat is a widely used exoskeleton device that features a treadmill, a dynamic body weight support system, and a motor-driven robotic orthosis (Bae et al., 2016). The robotic orthosis is used to control gait pattern through adjusting gait speed, guidance force,

• LokoHelp	and support from body weight (Bae et al., 2016).
	The Walkbot is a gait rehabilitation exoskeleton that features powered hip-knee-ankle joint drive motor design as well as a biofeedback platform (Kim et al., 2015h).
	The HAL is a wearable robotic exoskeleton that supports participants in walking, standing, and performing other leg movements (Yoshikawa et al., 2018). The HAL detects bioelectrical signals generated by muscles and floor-reaction-force signals and responds to the user's voluntary movements instead of following a predefined motion (Yoshikawa et al., 2018).
	The AutoAmbulator is a gait rehabilitation exoskeleton that provides body weight support treadmill training with the assistance of a harness and robot arms. The robot arms have four degrees of freedom and control various aspects of the gait cycle (Fisher et al., 2011).
	The LokoHelp device is placed on top of a treadmill and is an easily installed or removed. It works through transmitting the treadmill movement to levers on either side of the device which then create movements that imitate stance and swing phases of gait (Freivogel et al., 2009).
Exoskeleton Portable Devices • Stride Management Assist (SMA) • Anklebot • Bionic Leg	The Stride Management Assist (SMA) device is a robotic exoskeleton that provides assistance with high flexion and extension in each leg. This device uses neural oscillators and the user's Central Pattern Generator to generate assist torques during the gait cycle to regulate walking patterns (Buesing et al., 2015).
	The Anklebot is a robotic device consisting of a knee brace that is attached to a custom shoe (Forrester et al., 2013). It is designed to strengthen the ankle and the lower extremity through adjusting the force applied depending on varying requirements (Forrester et al., 2013).
	The Bionic Leg device is a powered knee orthosis that uses sensors, accelerometers, and joint angle detectors to detect the user's movements and provide mechanical assistance (Stein et al., 2014).

<u>Robotic Arm Control System</u> • Gait-Assistance Robot (GAR)	The gait-assistance robot is a robotic arm control system that includes 4 robotic arms, a full weight-bearing system, and a visual foot pressure biofeedback system (Nakanishi et al., 2014). The four separate robotic arms provide the ability to move the lower body automatically and independently (Ochi et al., 2015). This device does not suspend a patient with a harness and thus promotes full body weight bearing while on a treadmill (Ochi et al., 2015).

97 RCTs were found that evaluated lower limb robotics for motor rehabilitation.

15 RCTs compared robot-assisted gait training to conventional therapy and overground gait training (Alingh et al., 2021; Bizovicar et al., 2017; Chua et al., 2016; Hesse et al., 2012; Kim et al., 2019b; Kooncumchoo et al., 2021; Lee et al., 2019b; Morone et al., 2016; Morone et al., 2018; Ng et al., 2008; Peurala et al., 2009; Picelli et al., 2015; Song et al., 2021a; Stolz et al., 2019; Thimabut et al., 2022). One RCT compared early robot-assisted gait training to late start robot-assisted gait training (Kim et al., 2020a). One RCT compared robot-assisted gait training to balance training (Gandolfi et al., 2019). Four RCTs compared electromechanical gait training to conventional treatment or no treatment (Peurala et al., 2005; Pohl et al., 2007; Tanaka et al., 2012; Tong et al., 2006). Two RCTs compared end-effector gait training to body weight supported treadmill training (Kim et al., 2020b; Werner et al., 2002b). 42 RCTs compared exoskeleton systems to conventional therapy or overground gait training (Bergmann et al., 2018b; Calabro et al., 2018; Chang et al., 2012; Cho et al., 2015a; Fisher et al., 2011; Freivogel et al., 2009; Han et al., 2016; Hidler et al., 2009; Hornby et al., 2008; Husemann et al., 2007; Kang et al., 2021; Kelley et al., 2013; Kim et al., 2019a; Kim et al., 2015h; Kotov et al., 2021; Lee et al., 2019b; Lewek et al., 2009; Li et al., 2021b; Li et al., 2021c; Louie et al., 2021; Mayr et al., 2018; Molteni et al., 2021; Morone et al., 2011; Mustafaoglu et al., 2020; Nam et al., 2022; Nam et al., 2019; Nam et al., 2020; Ochi et al., 2015; Palmcrantz et al., 2021; Park et al., 2020a; Rojek et al., 2020; Schwartz et al., 2009; Sczesny-Kaiser et al., 2019; Taveggia et al., 2016; Ucar et al., 2014; van Nunen et al., 2015; Wall et al., 2019; Wall et al., 2020; Watanabe et al., 2014; Wu et al., 2014; Yu et al., 2021; Yun et al., 2018). Two RCTs compared exoskeleton systems to treadmill training (Bang & Shin, 2016; Westlake & Patten, 2009b). One RCT compared exoskeleton gait training to functional task-specific training (Jayaraman et al., 2019). One RCT compared the use of the Lokomat using heart rate reserve administration method to rate of perceived exertion administration method (Bae et al., 2016). Six RCTs compared exoskeleton portable devices to overground gait training or stretching and AFO (Buesing et al., 2015; Goodman et al., 2014; Stein et al., 2014; Waldman et al., 2013; Wright et al., 2021; Yeung et al., 2021). Two RCTs compared exoskeleton portable devices to stretching (Forrester et al., 2014; Zhai et al., 2021). One RCT compared exoskeleton portable devices with AFO to sham AFO (Yeung et al., 2018). Two RCTs evaluated robotic-assisted gait training with restraint (Bonnyaud et al., 2014a; Kang et al., 2018). Three RCTs robotics combined with virtual reality to robotics, robotics combined with auditory stimulation or conventional training (Calabro et al., 2017; Kayabinar et al., 2021; Park & Chung, 2018). One RCT compared Lokomat training to galvanic vestibular stimulation or physiotherapy with visual feedback (Krewer et al., 2013). One RCT compared robotic gait training as needed to robot assisted gait training full time (Seo et al., 2018). One RCT compared robot-assisted trunk training to conventional therapy (Kim et al., 2022). One RCT compared gait training with GEAR to gait training with treadmill (Ogino et al., 2020). One RCT compared gait training with GEAR to overground gait training (Tomida et al., 2019). One RCT compared robotic verticalization and FES

to conventional therapy (Calabro et al., 2015). One RCT compared robotic-assisted stretching to conventional therapy (Yoo et al., 2018). One RCT compared regent suit and neuromotor rehabilitation to neuromotor rehabilitation (Monticone et al., 2013). One RCT compared vibration on sole of foot to contact on sole of foot with no vibration (Onal et al., 2020). One RCT compared robot-assisted gait training with visuomotor feedback (Maggio et al., 2021). Three RCTs compared robotics with treadmill training and virtual reality to seated training (Bustamante Valles et al., 2016; Forrester et al., 2016; Tamburella et al., 2019). One RCT compared robot-assisted task-specific training to task-specific walking (Buesing et al., 2015).

The methodological details and results of all 99 RCTs are presented in Table 29.

Table 29. RCTs Evaluating Electromechanical and Robotic Devices for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size start Sample Size end Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Robot Assisted Gait Training vs Conventional Therapy and Overground Gait Training		

Thimabut et al. (2022)
RCT (7)
Nstart=26
Nend=26
TPS=Subacute
	E: Robot assisted gait training + Overground walk training + Conventional PT
	C: Overground walk training + Conventional PT
	Duration: E: 40min RAGT + 20 min overground walking + 60min PT 5d/wk, for 6wks
	C: 60min overground walking + 60min PT 5d/wk, for 6wks
		• Functional independence measure
		  ○ walk (-)
		  ○ Efficacy (+exp)
		• 6min Walk test (-)
		• Barthel index (-)
		• Gait speed (-)
		• Cadence (-)
		• Step length (-)
		• Step width (-)
		• Gait symmetry ratio (+exp)

Alingh et al. (2021)
RCT (7)
Nstart=34
Nend=31
TPS=Subacute
	E: Robotic gait training + conventional gait training
	C: Conventional gait training
	Duration:
	E: 30min/d, 3d/wk Robot training + 30min, 1-2d/wk conventional training for 6wks.
	C: 30min, 3-5d/wk for 6wks conventional training
		• External Mechanical Work (-)
		• 6-minute Walk Test (-)
		• Gait Speed (-)
		• Step Width (+exp)
		• Step Length (-)
		• Single-Support Time (-)
		• 10-Metre Walk Test (-)
		• Timed Up-and-Go Test (-)
		• Functional Gait Assessment (-)
		• Motricity Index
		  ○ Leg Score (-)
		• Fugl-Meyer Assessment
		  ○ Leg Score (-)

Kooncumchoo et al. (2021)
RCT (6)
Nstart=30
Nend=30
TPS=Chronic
	E: I-Walk machine + Conventional training
	C: Overground training + Conventional training
	Duration: 60min/d, 3d/wk, for 8wks
		• 6-minute walk test (-)
		• 10-meter walk test (+exp)
		• Timed Up and Go test (-)
		• Fugl-Meyer Assessment
		  ○ Total (-)
		  ○ Lower extremity (+exp)
		  ○ Coordination/speed (-)
		  ○ Total motor function (-)
		  ○ Sensation (-)
		  ○ Passive joint motion (-)
		  ○ Joint pain (-)

Song et al. (2021) RCT (4)	E: Robot-assisted gait training + conventional PT	• Cortical activation (no stat) • Functional Ambulation Category (-)

Nstart=60 Nend=36 TPS=Subacute	C: Conventional PT Duration: E: 30min/d, 5d/wk, for 3wks robot-assisted gait training + 60min/d, 5d/wk, for 3wks conventional PT & C: 90min/d, 5d/wk, 3wks conventional PT	• 10 Meter Walk Test (+exp) • Modified Barthel Index (-) • Berg Balance Scale (+exp) • Motricity Index (+exp) • Rivermead Mobility Index (-) • Gait speed (+exp)
Stolz et al. (2019) RCT (5) Nstart=40 Nend=36 TPS=Acute	E: Cable-driven gait trainer (RoboWalk) + conventional physiotherapy C: Conventional physiotherapy Duration: 60min/d, 5d/wk, until discharge	• 10m Walk test ○ Speed (-) ○ Cadence (-) • 6min Walk test (-) • Functional Independence measure (-) • Timed Up and Go (-) • Step test (-) • EuroQoL-5D (-)
Kim et al. (2019) RCT (4) Nstart=58 Nend=48 TPS=Subacute	E: Robotic End-Effector training (Morning Walk) C: Conventional physiotherapy Duration: 30minutes conventional therapy + 1 hr robot training in experimental group, 1.5hr conventional therapy in control group 5d/wk, for 3wks (15 sessions total)	• Functional Ambulation Category (-) • Motricity Index Lower Paretic Limb (+exp) • 10-Meter Walk Test (-) • Modified Barthel Index (-) • Rivermead Mobility index (-) • Berg Balance Scale (+exp)
Lee et al. (2019) RCT (5) Nstart=28 Nend=26 TPS=Chronic	E: Gait training program (half overground walking, half treadmill training) + Hip-assist robot C: Gait training program (half overground walking, half treadmill training) Duration: 45min/d, 3d/wk, for 4wks (10 sessions)	• Fugl-Meyer Assessment (+exp) • Gait speed (+exp) • Cadence (+exp) • Stride length (+exp) • Gait symmetry ratio (+exp) • Maximum voluntary contraction symmetry (+exp)
Morone et al. (2018) RCT (6) Nstart=110 Nend=100 TPS=Acute	E: Gait Trainer GT I + standard rehabilitation (PT) C: Overground walking + standard rehabilitation (PT) Duration: 2 sessions (3hr)/d, 5d/wk PT for 1wk, then, 1 session PT+ 40min RAGT or walking training 5d/wk for 4wks	• Functional Ambulation category (+exp) • Trunk Control test (+exp) • Barthel index (-)
Bizovicar et al. (2017) RCT (5) Nstart=22 Nend=19 TPS=Subacute	E: Overground gait training using E-Go device + Standard Physiotherapy C: Overground walking training + Standard Physiotherapy Duration: 45min/d, 3wks physiotherapy, followed by gait training at convenient duration, 15 sessions	• Walking speed (-) • Walking distance (-) • Berg Balance Scale (-) • Fugl-Meyer Assessment (-) • Functional Ambulation Category (-)
Chua et al. (2016) RCT (6) Nstart=107 Nend=77 TPS=Acute	E: Electromechanical Gait Trainer (GT I Rehastim) + Conventional physiotherapy C: Conventional physiotherapy	• Functional Ambulation Category (-) • Barthel Index (-) • Gait speed (-) • Stroke Impact Scale (-) ○ Physical (-) ○ Participation (-)

	Duration: 45min/d, 6d/wk, for 8 wks	
Morone et al. (2016) RCT (6) Nstart=44 Nend=42 TPS=Subacute	E: Overground walking training with i-Walker robotic assistive device C: Conventional overground walking training Duration: 80min/d, 5d/wk, 4wks	• 10-Meter Walk Test (+exp) • 6-Minute Walk Test (+exp) • Tinetti Scale (+exp) • Modified Ashworth Scale (-) • Barthel Index (-) • Canadian Neurological Scale (-) • Upright gait stability (-)
Picelli et al. (2012) RCT (9) Nstart=30 Nend=30 TPS=Chronic	E1: Robot-assisted gait training (G-EO) + Anodal tDCS (2mA) + sham tsDCS (transcutaneous spinal direct current stimulation); E2: Robot-assisted gait training (G-EO) + sham tDCS + Cathodal tsDCS (2.5mA); E3: Robot-assisted gait training (G-EO) + Anodal tDCS (2mA) + Cathodal tsDCS (2.5mA) Duration: 20min/d, 5d/wk for 2wks RAGT	<u>E1 v E2</u> • 6min Walk test (-) • Functional Ambulation category (-) • Motricity index-leg (-) • Ashworth scale (-) • Cadence (-) • Single-double limb support time ratio (-)
Hesse et al. (2012) RCT (6) Nstart=30 Nend=30 TPS=Subacute	E: G-EO System (Reha Technology) training C: Conventional rehabilitation Duration: 1hr/d, 5d/wk for 4wks	• Motricity Index (+exp) • Resistance to passive movement scale (-) • Functional Ambulation Category (+exp) • Rivermead Mobility Index (+exp)
Peurala et al. (2009) RCT (5) Nstart=56 Nend=47 TPS=Acute	E1: Gait Trainer GT I (Rehastim) E2: Overground gait training C: Conventional physiotherapy Duration: 60min/d, 5d/wk, for 3wks interventions & 55min/d, for 3wks Conventional physiotherapy	<u>E1/E2 vs C</u> • Functional Ambulation Category (+exp1, +exp2) • 10-Metre Walk Test (-) • 6-Minute Walk Test (-) • Rivermead Motor Assessment -) • Rivermead Mobility Index (-) • Modified Motor Assessment Scale (+exp1, +exp2) <u>E1 vs E2</u> • Functional Ambulation Category (-) • 10-Metre Walk Test (-) • 6-Minute Walk Test (-) • Rivermead Motor Assessment (-) • Rivermead Mobility Index (-) • Modified Motor Assessment Scale (-)
Ng et al. (2008) RCT (6) Nstart=54 Nend=50 TPS=Acute	E1: Gait Trainer GT II (Rehastim) + Functional electrical stimulation + Regular rehabilitation E2: Gait Trainer GT II (Rehastim) + Regular rehabilitation C: Overground gait training Duration: 20min/d, 5d/wk, for 4wks intervention sessions & 130min/d, 5d/wk, for 4wks Regular rehabilitation	<u>E1 vs E2:</u> • Elderly Mobility Scale (-) • Berg Balance Scale (-) • Functional Ambulatory Category (-) • Motricity Index (-) • Functional Independence Measure (-) • Barthel Index (-) • 5-m Gait Speed (-) <u>E1/E2 vs C:</u> • Elderly Mobility Scale (+exp1, +exp2) • Berg Balance Scale (-) • Functional Ambulatory Category (+exp1) • Motricity Index (-)

		• Functional Independence Measure (-) • Barthel Index (-) • 5-m Gait Speed (+exp1, +exp2)
Early Robot Assisted Gait Training vs Late Start Robot Assisted Gait Training		
Kim et al. (2020) RCT (6) Nstart=11 Nend=11 TPS=Subacute	E: Early start robot-assisted gait training + Conventional physiotherapy C: 4wk late start robot-assisted gait training + Conventional physiotherapy Duration: 45min/d, 5d/wk, for 4wks robot-assisted gait training	• Mean diffusivity by fMRI (+exp)
Robot Assisted Gait Training vs Balance Training		
Gandolfi et al. (2019) RCT (8) Nstart=32 Nend=28 TPS=Chronic	E: Robot-assisted stair climbing training (G-EO System) C: Sensory integration balance training Duration: 50min/session, 2d/wk, for 5wks	• Berg Balance Scale (-) • 10-metre Walk test (-) • 6min Walk test (+exp) • Dynamic gait index (-) • Stair climbing test ○ Up (-) ○ Down (-) • Timed Up and Go (-) • Postural sway (-) • Centre of Pressure perimeter ○ Open eyes-stable surface (-) ○ Closed eyes-stable surface (+exp) ○ dome-stable surface (-) ○ Open eyes-compliant surface (-) ○ Closed eyes-compliant surface (+exp) ○ dome-compliant surface (+exp) • Center of Pressure sway area ○ Open eyes-stable surface (-) ○ Closed eyes-stable surface (-) ○ dome-stable surface (-) ○ Open eyes-compliant surface (+exp) ○ Closed eyes-compliant surface (-) ○ dome-compliant surface (+exp)
Electromechanical Gait Training vs Conventional Treatment or No Treatment		
Tanaka et al. (2012) RCT Crossover (5) Nstart=12 Nend=12 TPS=Chronic	E: Electromechanical gait training C: No treatment Duration: 20min/d, 2-3d/wk, for 4-6wks (12sessions total)	• 10m Gait speed (+exp) • Timed up-and-go test (-)
Pohl et al. (2007) RCT (8) Nstart=155 Nend=144 TPS=Subacute	E: Repetitive locomotor therapy on electromechanical gait trainer + Physiotherapy C: Conventional physiotherapy Duration: 45min/d, 5d/wk, for 4wks	• Functional Ambulation Category (+exp) • Barthel Index (+exp) • 10-m Walk (+exp) • 6-min Walk (+exp) • Rivermead Mobility Index (+exp) • Motricity Index (+exp)
Tong et al. (2006) RCT (7) Nstart=50 Nend=46 TPS=Acute	E1: Electromechanical gait trainer + Functional electrical stimulation + Conventional PT E2: Electromechanical gait trainer + Conventional PT C: Gait training + Conventional PT	E1/E2 vs C • Motricity Index Leg Score (+exp$_1$, +exp$_2$) • Five-Meter Walking Speed Test (+exp$_1$, +exp$_2$) • Elderly Mobility Scale (+exp$_1$, +exp$_2$) • Berg Balance Scale (-) • Barthel Index (-) • Functional Ambulatory Category (+exp$_1$, +exp$_2$) • FIM Instrument Score (-)

	Duration: 20min/d, 5d/wk, for 4wks Experimental intervention, 40min/d, 5d/wk, for 4wks Conventional PT	E1 vs E2 • Motricity Index Leg Score (-) • Five-Meter Walking Speed Test (-) • Elderly Mobility Scale (-) • Berg Balance Scale (-) • Barthel Index (-) • Functional Ambulation Category (-) • FIM Instrument Score (-)
Peurala et al. (2005) RCT (6) Nstart=45 Nend=45 TPS=Chronic	E1: Electromechanical gait trainer + Functional electrical stimulation + Conventional therapy E2: Electromechanical gait trainer + Conventional therapy C: Overground gait training + Conventional therapy Duration: 20min/d, 5d/wk, for 3wks gait training, 55min/d, 5d/wk, for 3 wks Conventional therapy	E1/E2 vs C • Walking Distance (+exp1) • 10-m Walking Time (-) • 6-Minute Walk (-) • Static Balance Test (-) • Dynamic Balance (time/trip) (-) • Postural Sway (-) • Muscle Force (-) • Functional Independence Measure (-) • Centre of Pressure (AP & ML) (-) • Modified Motor Assessment Scale (-) E1 vs E2 • Walking Distance (-) • 10-m Walking Time (-) • 6-Minute Walk (-) • Static Balance Test (-) • Dynamic Balance (time/trip) (-) • Postural Sway (-) • Muscle Force (-) • Functional Independence Measure (-) • Centre of Pressure (AP & ML) (-) • Modified Motor Assessment Scale (-)
End-Effector Gait Training vs Body Weight Supported Treadmill		
Kim et al. (2020) RCT (7) Nstart=30 Nend=28 TPS= Chronic & Subacute	E: End-effector Robot-Assisted Gait Training C: Body Weight Supported Treadmill Training Duration: 30min/d, 5d/wk, for 4wks	• Fugl-Meyer assessment (+exp) • Timed up and go test (-) • 10-m walk test (-) • Regional cortical activity (-)
Werner et al. (2002b) RCT Crossover (7) Nstart=30 Nend=30 TPS=Subacute	E1: Electromechanical gait trainer therapy + Conventional rehabilitation E2: Body weight-supported treadmill training + Conventional rehabilitation Duration: 15-20min/d, 5d/wk for 6wks Interventions, 45min/d, 7d/wk, Conventional rehabilitation	• Functional Ambulation Category (+exp1) • Rivermead Motor Assessment (-) • 10-Metre Gait Velocity (-) • Modified Ashworth Score (-)
Exoskeleton Systems vs Conventional Therapy or Overground Gait Training		
Nam et al. (2022) RCT (6) Nstart=144 Nend=109 TPS=Chronic	E: Electromechanical-assisted gait training C: Basic rehabilitation + conventional gait rehabilitation treatment by therapists	• Functional ambulatory category (-) • Rivermead mobility index (-) • 10-m walk test (-) • 6-minute walk test (-) • Motricity index (-) • Berg balance scale (-)

	Duaration: 30min/d, 5d/wk, for 4wks	• Swing-time symmetry (-) • Step-length symmetry (-)
Kang et al. (2021) RCT (6) Nstart=30 Nend=30 TPS=Chronic	E: Robot-Assisted gait training (SUBAR) C: Conventional Physiotherapy Duration: 10 treatment sessions, 30 min each, over 3 wks	• 10-meter walk test (-) • Berg Balance Scale (+con) • Functional Ambulation Category (-) • Modified Ashworth Scale (-) • Motricity Index (-) • Rivermead Mobility Index (-) • Timed up and go test (-) • Gait analysis ○ Step length (-) ○ Stride length (-) ○ Single support (-) ○ Double support (-) ○ Cadence (-) ○ Speed (-)
Louie et al. (2021) RCT (8) Nstart=36 Nend=34 TPS=Subacute	E: Exoskeleton-based physical therapy program + Standard physical therapy C: Standard physical therapy Duration: 60min/d, 3d/wk, for 8wks exoskeleton-based physiotherapy & 45-60min/d, 4-5d/wk standard physiotherapy	• Functional Ambulation Category (-) • Gait speed (-) • 6-minute walk test (-) • Berg Balance Scale (-) • Fugl-Meyer Assessment (lower extremity) (-) • Montreal cognitive assessment (-) • Patient Health Questionnaire-9 (-) • Short-Form 36 ○ Physical (-) ○ Mental (-)
Kotov et al. (2021) RCT (5) Nstart=47 Nend=41 TPS=Subacute	E1: ExoAtlet exoskeleton exercises + standard rehabilitation E2: Ortorent MOTO pedal trainer for active-passive training + standard rehabilitation Duration: 10-30min/d, 5d/wk, for 2wks	<u>E1 v E2</u> • Medical research council scale (+exp1) • Modified Ashworth scale (-) • Hauser Ambulation index (+exp1) • 10m Walk test (+exp1) • Berg Balance scale (+exp1) • Modified Rankin scale (+exp1) • Barthel index (+exp1) • Romberg test (Statokinesiogram Measures) ○ length with eye open (+exp) ○ area with eye open/closed (-) ○ energy index eye open/closed (-)
Li et al. (2021) RCT (6) Nstart=130 Nend=114 TPS=Subacute	E: Exoskeletal robot locomotor training C: Routine overground walking training Duration: 30min/session, 2x/d, 5d/wk for 4 wks	• 6-minute walk test (+exp) • Fugl-Meyer Assessment Lower Extremity (-) • Functional Ambulation Category (-) • Cadence (-) • Gait Cycle (-) • Swing phase symmetry (-) • Step length symmetry (-)
Li et al. (2021) RCT (6) Nstart=36 Nend=32 TPS=Subacute	E: BEAR-H1 exoskeleton + routine rehabilitation C: Conventional gait training + routine rehabilitation Duration: 30min/d, 5d/wk, for 4wks	• 6-Minute Walk Test (+exp) • Fugl-Meyer Assessment (+exp) • Functional Ambulatory Classification (-) • Modified Ashworth Scale (-) • Gait speed (+exp) • Cadence (+exp) • Step length (+exp) • Stride length (-) • Cycle duration (+exp)

		• Swing time (-)
Molteni et al. (2021) RCT (6) Nstart=80 Nend=75 TPS=Subacute	E: Overground Robot-Assisted Gait training + conventional rehabilitation C: Conventional gait training + Conventional Rehabilitation Duration: 120min/d, 6d/wk, for 3wks Conventional care & 60min/d, 5d/wk, for 3wks gait training	• 6min Walk test (-) • Modified Ashworth scale-affected limb (-) • Motricity index-affected limb (-) • Trunk Control test (-) • Functional Ambulation category (-) • 10m Walk test (-) • Modified Barthel index (-) • Walking Handicap scale (-)
Palmcrantz et al. (2021) RCT (5) Nstart=55 Nend=48 TPS=Chronic	E: Hybrid Assistive Limb (HAL) + Conventional care C1: Conventional care C2: No treatment Duration: 90min/d, 3d/wk, for 6wks	<u>E v C1</u> • 6min Walk test (-) • Fugl-Meyer assessment-lower extremity (-) • 10-m Walk test (-) • Borg Rating of Perceived Exertion (-) • Berg balance scale (-) • Barthel index (-) • Stroke Impact scale (-) <u>E v C2</u> • 6min Walk test (-) • Fugl-Meyer assessment-lower extremity (-) • 10-m Walk test (-) • Borg Rating of Perceived Exertion (-) • Berg balance scale (-) • Barthel index (-) • Stroke Impact scale (-) <u>C1 v C2</u> • 6min Walk test (+con1) • Fugl-Meyer assessment-lower extremity (-) • 10-m Walk test (-) • Borg Rating of Perceived Exertion (-) • Berg balance scale (-) • Barthel index (-) • Stroke Impact scale (-)
Yu et al. (2021) RCT (5) Nstart=85 Nend=54 TPS=Subacute	E: Robot-assisted gait training + Conventional physiotherapy C: Overground gait training + Conventional physiotherapy Duration: 120min/d, 7d/wk for 2wks	• Fugl-Meyer Assessment (-) • Timed-Up and Go test (-) • Gait parameters: ○ Stride time and length (-) ○ Single and Double stance time (-) ○ Swing phase time (-) ○ Gait velocity (-) ○ Cadence (-) ○ Gait width (-) ○ Toe out angle (+con)
Mustafaoglu et al. (2020) RCT (6) Nstart=51 Nend=51 TPS=Chronic	E1: Robot Assisted Gait Training (Lokomat)+ Conventional Therapy E2: Robot Assisted Gait Training (Lokomat) C: Conventional therapy Duration: 45min/d, 5d/wk, for 6wks conventional training & 45min/d, 2d/wk, for 6wks robot-assisted gait training	<u>E1 vs C</u> • Barthel Index (+exp1) • Stroke Specific Quality of Life Scale (+exp1) • 6-Minute Walk Test (+exp1) • Stair Climbing Test (+exp1) • Fugl Meyer Assessment-Lower Extremity (+exp1) • 10-m Walk Test: ○ Fast(+exp1) ○ Comfortable (+exp1)

		• Borg Rating of Perceived Exertion (+exp1)
		
		<u>E1 vs E2</u>
		
		• Barthel Index (+exp1)
		• Stroke Specific Quality of Life Scale (+exp1)
		• 6-Minute Walk Test (+exp1)
		• Stair Climbing Test (+exp1)
		• Fugl Meyer Assessment-Lower Extremity (-)
		• 10-m Walk Test:
		  ○ Fast (-)
		  ○ Comfortable (+exp1)
		• Borg Rating of Perceived Exertion (-)
		
		<u>E2 vs C</u>
		
		• Barthel Index (-)
		• Stroke Specific Quality of Life Scale (-)
		• 6-Minute Walk Test (-)
		• Stair Climbing Test (-)
		• Fugl Meyer Assessment-Lower Extremity (-)
		• 10-m Walk Test:
		  ○ Fast (-)
		  ○ Comfortable (+exp)
		• Borg Rating of Perceived Exertion (-)

Nam et al. (2020) RCT (6) Nstart=40 Nend=38 TPS=Chronic	E: Electromechanical gait training (Exowalk) + conventional therapy C: Gait training + conventional therapy Duration: 60min/d, 5d/wk, for 2wks	• Functional ambulation category (-) • 10-meter walk test (-) • 6-minute walk test (-) • Motricity index (-) • Berg balance scale (-)
Park et al. (2020) RCT (5) Nstart=14 Nend=14 TPS=Acute	E: Robot-assisted gait training (Walkbot) + physical therapy C: Conventional locomotor gait training + physical therapy Duration: 60min/d, 7d/wk, for 2wks physical therapy & 30min/d, 7d/wk, for 2wks gait training/Walkbot training	• Berg Balance Scale (-) • Functional Ambulation Category (+exp) • Heart rate (+exp) • Borg Rating of Perceived Exertion (+exp) • Beck Depression Inventory-II (+exp) • Activities-specific balance confidence scale (+exp)

Rojek et al., (2020)
RCT (5)
Nstart=60
Nfinal=44
TPS=Subacute and chronic
	E: Ekso Gait Training exoskeleton-assisted gait training + conventional physiotherapy
	C: Conventional physiotherapy
	Duration: 45min/d, 5d/wk, for 4wks therapeutic session & 60min/d 5d/wk, for 4wks physical therapy
		• COP path length
		  ○ open eye (+con)
		  ○ closed eye (-)
		• COP velocity:
		  ○ open eye (+con)
		  ○ closed eye (-)
		• Length of minor axis (closed/open) (-)
		• Length and Angle of major axis (closed/ open) (-)
		• COP deviation X (closed/open) (-)
		• COP deviation Y (closed/open) (+con)
		• Forefoot load involved (closed/open) (-)
		• Forefoot load uninvolved (closed/open) (+con)
		• Backfoot load involved (closed/open)
		• Backfoot load uninvolved (closed/open (+con)
		• Total load involved/uninvolved (closed/open) (-)
		• Barthel Index (+exp)

		• Rivermead Mobility Index (-)
Wall et al. (2020) RCT (6) Nstart=36 Nend=32 TPS=Subacute	E: Hybrid assistive limb (HAL) training + Conventional training C: Conventional training Duration: 30min/d, 4d/wk, for 4wks - HAL training & 30-60min/d, 5d/wk, for 4wks - Conventional training	• Functional Ambulation Categories (-) • Fugl-Meyer Assessment (-) • 2-minute walk test (-) • Berg Balance Scale (-) • Barthel Index (-)

Lee et al. (2019)
RCT (5)
Nstart=28
Nend=26
TPS=Chronic
	E: Gait training program (treadmill + overground walking) wearing a hip-assist robot
	C: Gait training (treadmill training + over ground walking)
	Duration: 45min/session, 10x for 4wks.
		• Gait speed (+exp)
		• Cadence (+exp1)
		• Stride length (+exp)
		• Fugl-Meyer Assessment scale (+exp)
		• Temporal symmetry ratio (+exp)
		• Spatial step symmetry ratio (+exp)
		• Muscle maximum voluntary contraction
		  ○ Rectus femoris (+exp)
		  ○ Tibialis anterior (+exp)
		  ○ Biceps femoris (+exp)
		  ○ Medial of gastrocnemius (+exp)
		• Metabolic energy cost (+exp)
		• Korean- Fall Efficacy Scale (+exp)
		• Berg Balance Scale (neg)
		• Motricity Index (+exp)

Nam et al. (2019) RCT (5) Nstart=40 Nend=34 TPS=Chronic	E: Electromechanical gait training assisted by an exoskeleton device C: Physical therapist-assisted conventional gait training Duration: 30min/d, 5d/wk, for 4wks	• Functional Ambulatory Category (-) • Rivermead Mobility Index (-) • 10-Metre Walk Test (-) • 6-Minute Walk Test (-) • Motricity Index (-) • Berg Balance Scale (-) • Modified Barthel Index (-)
Sczesny-Kaiser et al. (2019) RCT crossover (4) Nstart=28 Nend=26 TPS=Chronic	E: Hybrid Assistive Limb (HAL) exoskeleton with Bodyweight supported treadmill training C: Conventional Physical therapy Duration: 30min/d, 5d/wk, for 6wks HAL exoskeleton training & 30-45min/d, 5d/wk, for 6wks Conventional care, 1wk washout.	• 10m Walk test (-) • Timed Up and Go (-) • 6min Walk test (-) • Functional Ambulation category (-) • Berg balance scale (-)

Wall et al. (2019)
RCT (5)
Nstart=34
Nend=28
TPS=Subacute
	E: Electromechanically assisted gait training with the Hybrid Assistive Limb + Conventional care
	C: Conventional care
	Duration: 4d/wk, for 4wks
		• Stroke Impact Scale
		  ○ Mobility (-)
		  ○ Strength (-)
		  ○ ADL (-)
		  ○ Participation (-)
		  ○ Perceived recovery (-)

Kim et al. (2019)
RCT crossover (7)
Nstart=19
Nend=17
TPS=Chronic
	E: Robot Assisted Gait Training (Lokomat) + conventional physiotherapy
	C: Conventional physical therapy
	Duration: 60 mins/d, 5d/wk, for 4 wks (No Washout)
		• Berg Balance Scale (-)
		• Static Balance
		  ○ COP ML (feet separated, eyes closed/open) (+exp)
		  ○ COP ML (feet together, eyes closed/open) (-)
		  ○ COP AP (-)
		  ○ COP Area (-)]

		• Trunk Impairment Scale (-)
		• Fugl-Meyer Assessment Lower Extremity (+exp)
		• Functional Ambulation Category (-)
		• Ten Meter Walk Test (-)
		• Falls Efficacy Scale (-)
		• Scale for the Assessment and Rating of Ataxia
		  ○ Gait (+exp)
		  ○ Stance (+exp)
		• Sitting (-)

Bergmann et al. (2018) RCT (6) Nstart=38 Nend=30 TPS=Subacute	E: Robot-assisted gait therapy (Lokomat) C: Conventional Physical Therapy Duration: 60min/d of physiotherapy & minimum of 20min/d on Lokomat, 5d/wk, for 2wks	• Burke Lateropulsion scale (+exp) • Scale for Contraversive Pushing (+exp) • Performance-oriented Mobility assessment (-) • Functional Ambulation classification (-) • Subjective visual vertical (-)
Mayr et al., (2018) RCT (7) Nstart= 74 Nend= 66 TPS=Subacute	E: Robot-Assisted gait training (Lokomat) C: Conventional overground gait training Duration: 120min/d, 5d/wk, for 8wks	• modified Emory Functional Ambulation Profile (-) • Rivermead Motor Index (-) • Mobility Milestones (-) • Hochzirl Walking Aids Profile (-)

Yun et al., (2018)
RCT (6)
Nstart= 38
Nend= 36
TPS=Subacute
	E: Robot-assisted gait training (Lokomat)
	C: Conventional Physical Therapy
	Duration: 30min/d, 5d/wk, for 3wks
		• Burke Lateropulsion Scale (+exp)
		• Berg Balance Scale (+exp)
		• Postural Assessment Scale for Stroke (+exp)
		• [Fugl-Meyer Assessment (-)
		  ○ Upper Extemity (-)
		  ○ Lower Extremity (-)
		• Korean of the modified Barthel Index (-)
		• Somatosensory Evoked Potentials (-)

Calabro et al. (2018) RCT (7) Nstart=40 Nend=40 TPS=Chronic	E: Exoskeleton GaitTrainer (Ekso) + conventional Physiotherapy C: Overground Walking Training + conventional Physiotherapy Duration: 60min Physiotherapy & 45min Gait training, 5d/wk for 8wks	• 10metre Walk Test (+exp) • Rivermead Mobility index (+exp) • Timed Up and Go (+exp) • Step cadence (+exp) • Gait quality index (+exp) • Gait cycle (+exp) • Stance/swing ratio (+exp) • Frontoparietal effective Connectivity (+exp) • Corticospinal excitability- affected side (+exp) • Sensory-motor integration (+exp) • Motor evoked potential (+exp)

Han et al. (2016)
RCT (5)
Nstart=60
Nend=6056
TPS=Acute
	E: Robot-assisted gait therapy (Lokomat) + Conventional care (occupational therapy + physiotherapy)
	C: Conventional care (occupational therapy + physiotherapy)
	Duration: E: (30min RAGT + 30min physical therapy + 30min occupational therapy)/d, 5d/wk, for 4wks;
	C: (60min physical therapy + 60min occupational therapy)/d, 5d/wk, for 4wks
		• Modified Barthel index Korean (-)
		• Berg Balance scale (-)
		• Functional Ambulation category (-)
		• Fugl-Meyer assessment- Paretic Lower limb (-)
		• Arterial stiffness Blood pressure (+exp)
		• V02 peak (+exp)
		• Diastolic blood pressure
		  ○ Resting (-)
		  ○ Peak (-)
		• Systolic blood pressure
		  ○ Resting (-)
		  ○ Peak (-)
		• Heart rate
		  ○ Resting (-)
		  ○ Peak (-)

		• Exercise tolerance test duration (-)
Taveggia et al. (2016) RCT (7) Nstart=28 Nend=28 TPS=Subacute	E: Lokomat gait training + conventional treatment C: Conventional treatment + overground treatment to walking improvement Duration: 60min/d, 5d/wk for 5wks - conventional therapy & 30min/d, 5d/wk for 5wks lokomat	• 6-minute Walk Test (-) • 10-mter Walk test (-) • Functional Independence Measure (-) • Short Form-36 (-) • Tinetti Scale (-)
Cho et al. (2015a) RCT (4) Nstart=20 Nend=20 TPS=Chronic	E: Robot-assisted gait training (Lokomat) C: Conventional rehabilitation Duration: 30min/d, 3d/wk for 4wks Lokomat & 30min/d, 5d/wk for 4wks conventional	• Berg Balance Scale (-) • Modified Funciontal Reach Test (-) • Functional Ambulation Category (-) • Modified Ashworth Scale (-) • Fugl-Meyer Assesment (-) • Motricity Index (-) • Modified Barthel Index (-) ○ Transfer (+exp) ○ Ambulation (-)
Kim et al. (2015h) RCT (5) Nstart=30 Nend=26 TPS=Subacute	E: Walkbot gait training + Conventional locomotor rehabilitation C: Conventional locomotor rehabilitation Duration: 80min/d, 5d/wk, for 4wks	• Function Ambulation Category (+exp) • Berg Balance Scale (+exp) • Korean modified Barthel index (+exp) ○ Grooming (-) ○ Bathing (-) ○ Feeding (-) ○ Toilet use (-) ○ Stairs (-) ○ Dressing (+exp) ○ Bowels (-) ○ Bladder (-) ○ Ambulation (+exp) ○ Transfers (-) • Modified Ashworth scale (-) • EuroQol-5 dimensions
Ochi et al. (2015) RCT (6) Nstart=26 Nend=26 TPS=Acute	E: Robot-assisted gait training + standard physical therapy C: Overground gait training + standard physical therapy Duration: 60min/d, 5d/wk, for 4wks standard PT & 20min/d, 5d/wk, for 4wks overground gait training/robot gait training	• Fugl-Meyer Assessment (lower extremity) (-) • Muscle torque ○ Affected (-) ○ Unaffected (+exp) • Functional Ambulation Classification (+exp) • 10-m walking test (-) • Functional Independence Measure (-)
van Nunen (2015) RCT (4) Nstart=37 Nend=30 TPS=Subacute	E: Lokomat + Conventional physical therapy C: Conventional physical therapy Duration: 3.5hr/wk, for 8wks	• 10-Metre Walk Test (-) • Berg Balance Scale (-) • Timed Up & Go Test (-) • Motricity Index (-) • Rivermead Mobility Index (-) • Fugl-Meyer Assessment (-) • Functional Ambulation Category (-) • Maximal voluntary isometric torque (-) • Short form-36 (-) • Stroke Impact Scale (-)

Ucar et al. (2014) RCT (4) Nstart=22 Nend=22 TPS=Chronic	E: Active robotic training (Lokomat) C: Conventional home exercise Duration: 20min/d, 5d/wk, for 2wks	• 10m Walk Test (+exp) • Timed Up & Go Test (+exp)
Watanabe et al. (2014) RCT (4) Nstart=32 Nend=22 TPS=Subacute	E: Gait training using a Hybrid Assistive Limb (HAL) C: Conventional gait training Duration: 20min/d, 3d/wk, for 4wks	• Functional ambulation category (+exp) • 10-m Maximal walking speed (-) • Stride (-) • Cadence (-) • 6-minute walking distance (-) • Fugl-Meyer Assessment (-) • Short Physical Performance Battery (-) • Timed Up & Go Test (-) • Isometric muscle strength (hip flexion/extension, knee flexion/extension) (-)
Wu et al. (2014) RCT (5) Nstart=30 Nend=28 TPS=Chronic	E1: Resistance load Robotic gait system training E2: Assistance Robotic gait system training Duration: 45min/d, 3d/wk for 6wks	<u>E1 v E2</u> • 10m walk test ○ Self selected (-) ○ Fast (-) • 6min walk test (-) • Modified Ashworth scale (no stat) • Berg Balance Scale (-) • Activities-specific Balance Confidence scale (no stat) • Short form-36 (no stat)
Kelley et al. (2013) RCT (6) Nstart=21 Nend=20 TPS=Chronic	E: Lokomat gait training C: Overground gait training Duration: 1h/d, 5d/wk for 8wks	• 10-Metre Walk Test (-) • 6-Minute Walk Test (-) • Stroke Impact Scale (-) • Fugl-Meyer Assessment (-) • Barthel Index (-)
Chang et al. (2012) RCT (7) Nstart=48 Nend=37 TPS=Acute	E: Lokomat gait training + conventional rehabilitation C: Conventional rehabilitation Duration: 100min/d, 5d/wk for 4wks	• Peak VO2 (+exp) • Ventilatory response (-) • respiratory exchange ratio (-) • Blood pressure (-) • Rate of perceived exertion (-) • Fugl-Meyer assessment (+exp) • Motricity index (-) • Functional Ambulation category (-)
Fisher et al. (2011) RCT (5) Nstart=20 Nend=20 TPS=Chronic	E: AutoAmbulator gait training + Conventional rehabilitation C: Conventional rehabilitation Duration: 60min/d, 3-5d/wk, for 6-8wks (24 sessions totally)	• 8-Metre Walk Test (-) • 3-Minute Walk Test (-) • Tinetti Balance Assessment (-)
Morone et al. (2011) RCT (6) Nstart=48 Nend=27 TPS=Acute	E1: High Motricity patients receiving Robot-assisted gait training + Conventional care; E2: Low Motricity patients receiving Robot-assisted gait training + Conventional care C1: High motricity patients receiving conventional gait training + Conventional care; C2: Low motricity patients receiving conventional gait	<u>E1 v C1</u> • Functional Ambulation category (-) • Ashworth scale (-) • Rivermead mobility index (-) • Motricity index (-) • Trunk Control Test (-) • Canadian Neurological scale (-) • Barthel index (-) • Rankin scale (-) • 6min walk test (-) • 10m Walk test (-)

	training + Conventional care Duration: 3h/d for 5d/wk - Conventional care, 40min/d, 5x/wk for 4wks - Robot-assisted gait training, 40min/d, 5x/wk for 4wks - Conventional gait training	<u>E2 v C2</u> • Functional Ambulation category (+exp2) • Ashworth scale (-) • Rivermead mobility index (+exp2) • Motricity index (-) • Trunk Control Test (+exp2) • Barthel index (+exp2) • Rankin scale (+exp2) • 6min walk test (+exp2) • 10m Walk test (-)
Freivogel et al. (2009) RCT Crossover (8) Nstart=16 Nend=16 TPS=Acute	E: LokoHelp gait training C: Conventional gait training Duration: 30min/d, 3-5d/wk, 20 treatments, crossover after 6wks	• Functional Ambulation Category (-) • Gait Velocity (-) • Motricity Index (-) • Rivermead Mobility Index (-) • Berg Balance Scale (-) • Modified Ashworth Scale (-)
Hidler et al. (2009) RCT (5) Nstart=72 Nend=63 TPS=Subacute	E: Lokomat gait training C: Conventional gait training Duration: 60min/d, 3d/wk, for 8-10wks	• Motor assessment scale (-) • Functional Ambulation Category (-) • Berg Balance test (-) • Rivermead Mobility (-) • Gait Cadence (-) • 6-minute walk distance (+exp) • 5-meter walk test- speed (+exp) • National Institutes of Health Stroke Scale (-) • Frenchay Activities Index (-) • 36-Item Health Survey; - General health (-); - Social functioning (-)
Lewek et al. (2009) RCT (5) Nstart=26 Nend=20 TPS=Chronic	E1: Therapist-assisted locomotor training E2: Robotic-assisted locomotor training Duration: 30min/d, 3d/wk for 4wks	• Hip and Knee Average Coefficient of Correspondence (-) • Self-selected gait speed (-) • Cadence (-) • Stride length (-) • Hip kinematics (-) • Knee kinematics (-) • Ankle kinematics (-) • Circumduction (-)

Schwartz et al. (2009)
RCT (6)
Nstart=67
Nend=56
TPS=Acute
	E: Lokomat gait training
	C: Conventional therapy
	Duration: 30min/d, 3d/wk, for 6wks Robotic-Assisted Gait Training & 30-60min/d, 5d/wk, for 6wks Conventional therapy
		• Functional Ambulation Category (+exp)
		• National Institutes of Health stroke scale (+exp)
		• Functional Independence Measure
		  ○ Motor (+exp)
		  ○ Cognitive (-)
		• Stroke Activity Scale (-)
		<u>Subgroup Analysis for (FAC >=3):</u>
		• 10-m walk (-)
		• Time Up and Go test (-)
		• 2-minute walk test (-)
		• stairs climbed test (+exp)

Hornby et al. (2008)
RCT (5)
Nstart=48
Nend=48
TPS=Chronic
	E Robotic assisted Locomotor training
	C: Therapist assisted locomotor training
	Duration: 30min/d, 3d/wk for 4wks
		• 10m walk test
		  ○ Self-selected velocity (+con)
		  ○ Fast velocity (+con)
		• impaired leg stance time
		  ○ Self-selected velocity (-)
		  ○ Fast velocity (+con)
		• Step asymmetry
		  ○ Self-selected velocity (-)

		○ Fast velocity (-) • 6min Walk test (-) • Modified Emory Functional Ambulation profile (-) • Berg Balance scale (-) • Frenchay Activities index (-) • Short form-36 (+con)
Husemann et al. (2007) RCT (7) Nstart=30 Nend=30 TPS=Subacute	E: Lokomat gait training + Conventional care C: Conventional care Duration: 30min/d, 20 sessions Lokomat + 20 sessions Conventional care; 30min/d, 40 sessions Conventional care	• Functional Ambulation Category (-) • Modified Ashworth Scale (-) • Motricity Index (-) • Barthel Index (-) • 10-Metre Walk Test (-) • Cadence (-) • Stride Duration (-) • Stance Duration (-) • Single Support Time (-) ○ Affected leg (+exp) ○ Unaffected leg (-)
Exoskeleton Systems vs Treadmill Training		
Westlake & Patten (2009a) RCT (6) Nstart=16 Nend=16 TPS=Chronic	E: Lokomat gait training C: Manually assisted body-weight supported treadmill training Duration: 30min/d, 3d/wk for 4wks	• Self-selected walking speed (-) • 6-Minute Walk Test (-) • Berg Balance Scale (-) • Fugl-Meyer Assessment (-) • Short Physical Performance Battery (-) • Step length ratio (-)
Bang & Shin (2016) RCT (7) Nstart=18 Nend=18 TPS=Chronic	E: Lokomat gait training C: Treadmill gait training Duration: 60min/d, 5d/wk, for 4wks	• Gait speed (+exp) • Cadence (+exp) • Step Length (+exp) • Berg Balance Scale (+exp) • Activities-Specific Balance Confidence (+exp) • Double-support phase (+exp)
Exoskeleton Gait Training vs Functional Task-Specific Training		
Jayaraman et al. (2019) RCT (5) Nstart=34 Nend=34 TPS=Chronic	E: over-ground gait training with the Honda Stride Management Assist (SMA) exoskeleton C: Functional task-specific training Duration: 45min/d, 3d/wk, for 6-8wks (18 sessions total)	• 10-metre walk test (+exp) • 6-minute walk test (+exp) • functional gait assessment (-) • Berg Balance Scale (+exp) • 5 Times Sit-to-Stand Test (-) • Fugl-Meyer Assessment (-) • Spatiotemporal gait analysis (no stat) • Corticomotor excitability ○ lateral hamstrings (-) ○ tibialis anterior (-) ○ rectus femoris (paretic) (+exp) ○ rectus femoris (nonparetic) (-) • Activities-Specific Balance Confidence Scale (-) • Numeric Pain Rating Scale (-) • Modified Falls Efficacy Scale (-) • Stroke-Specific Quality of Life (-) • Patient Health Questionnaire for depression (-) • Step count ○ during therapy days (+exp) ○ during non-therapy days (-) ○ energy expenditure (+exp)
Exoskeleton Systems Administration Method		
Bae et al. (2016) RCT (8)	E: Heart rate reserve (HRR)-guided high-intensity robot-	• Fugl-Meyer Assessment (+exp) • 10-metre Walk Test (+exp)

Nstart=34 Nend=34 TPS=Chronic	assisted gait training (RAGT) using Lokomat C: Rate of perceived exertion (RPE)-guided high-intensity robot-assisted gait training (RAGT) using Lokomat Duration: 60min/d, 3d/wk for 6wks	• Gait Speed (+exp) • Cadence (+exp) • Stride Length (+exp) • Step Length (+exp) • Swing Time (+exp) • Single/Double Support Time (+exp) • Symmetrical Index of Swing/Stance (+exp)
Exoskeleton Portable Devices vs Overground Gait Training or Stretching vs Sham Ankle Foot Orthosis		
Wright et al. (2021) RCT (7) Nstart=34 Nend=31 TPS=Chronic	E: Home-based overground Robot-assisted gait training (AlterG Bionic Leg) + Usual care E: Physical Activity + Usual physiotherapy Duration: 30 min/d PT & minimum 30 min/d robot gait training, 6d/wk, for 10wks	• 6min Walk test (+exp) • Rating Perceived exertion (-) • Timed Up and Go (-) • Dynamic gait index (+exp) • Berg balance scale (+exp) • Functional ambulation category (+exp) • Modified Rankin scale (no stats)
Yeung et al. (2021) RCT (7) Nstart=47 Nend=43 TPS=Acute	E1: Robot-assisted training with Power-assisted ankle robot + Conventional training E2: Robot-assisted training with Swing-controlled ankle robot + Conventional training C: Conventional training Duration: 30min/d, 2d/wk, (20sessions total) PAAR/SCAR & 2h/d, 5d/wk conventional therapy	<u>E1 vs C</u> • Functional Ambulation Category (-) • Berg Balance Scale (-) • 10-Metre Walk Test (+exp1) <u>E2 vs C</u> • Functional Ambulation Category (+exp2) • Berg Balance Scale (-) • 10-Metre Walk Test (-) <u>E1 vs E2</u> • Functional Ambulation Category (-) • Berg Balance Scale (-) • 10-Metre Walk Test (+exp1)

Buesing et al. (2015)
RCT (6)
Nstart=50
Nend=50
TPS=Chronic
	E: Task-specific walking training while wearing a robotic device (Stride Management Assistant system)
	C: Functional task specific walking
	Duration: 45min/session, 3x/wk for 6-8wks
		• Gait velocity (-)
		• Gait Candence (-)
		• Step time (-)
		• Stance time (-)
		• Swing time (-)
		• Double support time (-)
		• Step length
		  ○ Impaired side (+exp)
		  ○ Non-impaired side (-)
		• Stride length (no stats)
		• Spatial asymmetry
		  ○ At fast speed (+exp)
		  ○ At self speed (-)
		• Temporal asymmetry (-)

Goodman et al. (2014)
RCT (3)
Nstart=17
Nend=10
TPS=Chronic
	E: High reward (monetary, social and performance) Anklebot training
	C: Low reward (reduced social, scoring feedback, prizes) Anklebot training
	Duration: 1h/d, 3x/wk, for 3wks
		• 8m Walk test (-)
		• Ankle motor control
		  ○ Peak Speed (-)
		  ○ Mean Speed (-)
		  ○ Normalized Jerk (+exp)
		  ○ Number of successful gate passages (-)
		• Velocity (-)
		• Gait cadence (-)

		• Step time
		  ○ Non paretic (-)
		  ○ Paretic (-)
		• Step length
		  ○ Non paretic (+exp)
		  ○ Paretic (-)
		• Paretic Single limb support (-)
		• Double limb support (-)
		• Stride length (+exp)
		• EEG measures spectral (+exp)
		• EEG Coherence to Motor Planning
		  ○ Theta (+con)
		  ○ Alpha (+con)
		  ○ Low Beta (+con)
		• EEG Frontoparietal Coherence
		  ○ Theta (+exp)
		  ○ Low Beta (+exp)

Stein et al. (2014) RCT (7) Nstart=24 Nend=24 TPS=Chronic	E: Gait training with robotic leg brace C: Group exercise without robotic leg brace Duration: 60min/d, 3d/wk for 6wks	• Timed Up and Go (-) • 10-m walk test (-) • 6-min walk test (-) • Five-Times-Sit-to-Stand test (-) • Berg Balance scale (+exp) • California Functional Evaluation 40 (-) • Emory Functional Ambulation Profile (+con) • Romberg (open eye/ closed eye) (-)
Waldman et al. (2013) RCT (5) Nstart=24 Nend=23 TPS=Chronic	E: Robot assisted passive stretching and active movement training C: At-home passive ankle stretching Duration: 60min/d, 3d/wk for 6wks	• Modified Ashworth Scale (+exp) • Stroke Rehabilitation Assessment of Movement (+exp) • Berg Balance Scale (+exp) • 6 minute Walk Test (-) • Ankle Dorsiflexion Passive Range of Motion (+exp) • Ankle Dorsiflexion Active Range of Motion (-) • Isometric Muscle Strength (+exp) • Maximal Voluntary Contraction (+exp) • Vertical Ground Reaction during Stance Phase (+exp)
Exoskeleton Portable Devices vs Stretching		

Zhai et al. (2021)
RCT (8)
Nstart=20
Nend=20
TPS=Subacute
	E: Robot assisted ankle stretching device (Beijing LTK Science and Technology Co., Ltd., Beijing, China).
	C: Manual stretching by the appointed physiotherapist
	Duration: 20min/d, 5d/wk, for 2wks
		• Modified Ashworth Scale (-)
		• Fugl-Meyer Lower Extremity (-)
		• Berg Balance Scale (-)
		• Modified Barthel Index (-)
		• Biomechanical
		  ○ DF PROM (-)
		  ○ DF strength (-)
		  ○ DF Stiffness (-)
		  ○ PF Stiffness (-)

Forrester et al. (2014) RCT (5) Nstart=39 Nend=34 TPS=Acute	E: Performance-based training with Anklebot stretching C: Manual stretching of ankle Duration: Performance Based Training: 60min, daily Duration not specified	• 8 m Walk (-) • Berg Balance Scale (-) • AROM (-) • Muscle strength (-) • Functional Independence Measure (-) • Interlimb temporal symmetry (+exp) • Step time ratio (+exp) • Interlimb spatial symmetry (+exp) • Step length ratio (-) • Peak angular velocity (+exp)

		• Mean angular velocity (-)
		• Movement smoothness Normalized jerk (+exp)
		• Target success (+exp)
		
		• Step time
		  ○ Paretic (-)
		  ○ Non paretic (-)
		  ○ Step time symmetry (+exp)
		• Step length
		  ○ Paretic (-)
		  ○ Non paretic (-)
		  ○ Step length symmetry (+exp)

Exoskeleton Portable Devices with Ankle Foot Orthosis vs Sham Ankle Foot Orthosis		

Yeung et al. (2018)
RCT (5)
Nstart=19
Nend =15
TPS=Chronic
	E: Robot-assisted ankle-foot-orthosis (AFO) with dorsiflexion assistance
	
	C: Sham Ankle foot orthosis (AFO) with torque impedance
	
	Duration: 30min/d, 2-4d/wk, for 5wks (20 session total)
		• Functional Ambulation Categories (+exp)
		• Fugl-Meyer Assessment (+exp)
		• Modified Ashworth Scale (-)
		• Berg Balance Scale (-)
		• 10-Meter Walk Test (+exp)
		• Six-Minute Walk Test (-)
		• Walking Speed (+exp)
		• Step Length (-)
		• Stance Time (-)
		• Swing Time (-)
		• Peak Kinetic Gait Parameters
		  ○ Vertical Force loading response (+exp)
		  ○ Vertical Force loading response unaffected (-)
		  ○ Vertical Force terminal stance (-)
		  ○ Braking Force loading response (-)
		  ○ Propulsive Force terminal stance (-)
		• Peak Kinematic Gait Parameters
		  ○ Foot Tilting at initial contact (-)
		  ○ Ankle Dorsiflexion at stance (-)
		  ○ Ankle Dorsiflexion at swing (-)
		  ○ Knee Flexion at stance (-)
		  ○ Knee Flexion at swing affected (-)
		  ○ Knee Flexion at swing unaffected (+exp)
		  ○ Knee Flexion at swing (-)
		  ○ Hip Flexion at stance (-)
		  ○ Hip Flexion at swing (-)

Robotic-Assisted Gait Training and Restraint		
Kang et al. (2018) RCT (7) Nstart=20 Nend=20 TPS=Subacute	E: Robot-assisted (Lokomat) walking training with rhythmic arm swing facilitated + conventional care C: Robot-assisted (Lokomat) walking training with arm fixation + conventional care Duration: 30min/d, 5d/wk, for 6wks	• Spatiotemporal Gait Analysis (-) • 10 metre walk test (-) • Berg Balance Scale (+exp) • Timed Up and Go test (-) • Tetrax Fall index (-) • Fugl-Meyer Assessment (+exp) • Modified Barthel Index (+exp)
Bonnyaud et al. (2014) RCT (4) Nstart=26 Nend=26 TPS=Chronic	E: Lokomat Gait Training + Restraint of Non-paretic Limb C: Lokomat Gait Training Duration: Single 30min Session	• Spatiotemporal Gait Analysis (-) • Kinematic Gait analysis (-) • Kinetic Gait Analysis (-) • Vertical GRF Single-support Phase ○ Paretic side (+exp)

		○ Nonparetic side (-)
Robotics Combined with Virtual Reality vs Robotics, Robotics Combined with Auditory Stimulation or Conventional Training		
Kayabinar et al. (2021) RCT (6) Nstart=37 Nend=30 TPS=Chronic	E: VR augmented robot-assisted gait training + conventional care C: Robot-assisted gait training + conventional care Duration: gait training 45min/d, 2d/wk, for 6wks + conventional care 30min/d, 3d/wk, for 6wks	• 10-metre walk test (-) • Motor task added 10-metre walk test (-) • Cognitive task added 10-metre walk test (-) • Motor dual-task performance (-) • Cognitive dual task performance (-) • Functional Gait assessment (-) • Rivermead Mobility Index (-) • Berg Balance Scale (-) • Falls Efficacy Scale-1(-) • Functional Independence Measure total (-)
Park et al. (2018) RCT (6) Nstart=40 Nend=40 TPS=Chronic	E1: Virtual reality + robot-assisted gait training (Treadmill)+ conventional physical therapy E2: Auditory stimulation + robot-assisted gait training (Treadmill) + conventional physical therapy C: Conventional physical therapy + treadmill training Duration: 45min/d, 3d/wk, for 6wks trainings & 30min/d, 5d/wk, for 6wks Conventional therapy	E1 vs E2 • Medical Research Council (+exp1) • Berg Balance Scale (-) • Timed Up & Go Test (-) • 10 Meter Walk test (-) • Fugl-Meyer Assessment (+exp1) • Modified Barthel Index (-) E1/ E2 vs C • Medical Research Council (+exp1+exp2) • Berg Balance Scale (+exp1, +exp2) • Timed Up & Go Test (+exp1, +exp2) • 10 Meter Walk test (+exp1) • Fugl-Meyer Assessment (+exp1) • Modified Barthel Index (-)
Calabro et al. (2017) RCT (8) Nstart=24 Nend=24 TPS=Chronic	E: Robotic-assisted gait training (Lokomat-Pro) + VR C: Robotic-assisted gait training (Lokomat-Nanos) Duration: 45min/d, 5d/wk, for 8wks	• Riverhead Mobility Index (+exp) • Tinetti Performance Oriented Mobility Assessment (+exp) • Modified Ashworth Scale (-) • Hip force (+exp) • Knee force (+exp)
Lokomat Training vs Galvanic Vestibular Stimulation or Physiotherapy with Visual Feedback		
Krewer et al. (2013) RCT crossover (5) Nstart=25 Nend=24 TPS=Chronic	E1: Galvanic vestibular stimulation E2: Gait training (Lokomat) E3: Physiotherapy with visual feedback Duration: 20min session - 1d washout	E1 vs E2/E3 • Burke Lateropulsion Scale (-) • Scale for Contraversive Pushing (-) E2 vs E3 • Burke Lateropulsion Scale (+exp2) • Scale for Contraversive Pushing (-)
Robot as Gait Training as Needed vs Robot Assisted Gait Training Full Time		
Seo et al. (2018) RCT (5) Nstart=24 Nend=12 TPS=Chronic	E1: Assist-as-needed robot-assisted gait training for unaffected limb + fully-assisted robot-assisted training for affected limb E2: Assist-as-needed robot-assisted gait training for affected limb + fully-assisted robot-assisted training for unaffected limb	E1 v E2 • Fugl Meyer Motor Assessment (-) • Functional Ambulation Category (-) • Motricity Index (-) • Trunk Control Test (-) • Gait speed (-) • Cadence (-) • Step length asymmetric ratio (-) • Stride length (-) • Double support time (-) • Single support time (-) • Kinematic

	Duration: 45min, 2x/wk, for 10wks	○ Hip extension (-) ○ Knee extension (-) ○ Hip flexion (-) ○ Knee flexion (-) ○ Ankle dorsiflexion affected (+exp) ○ Ankle dorsiflexion unaffected (-)
Robot-assisted Trunk Training vs Conventional Therapy		
Kim et al. (2022) RCT (6) Nstart=40 Nend=40 TPS=Not Reported	E: Robot-assisted trunk control training + Conventional trunk stabilization exercise C: Conventional trunk stabilization exercise + stretching exercise Duration: 30 min/d, 5d/wk for 8 wks trunk stabilization exercise & 15min/d, 5d/wk for 8 wks robot-assisted trunk control therapy/stretching exercise	• Trunk Impairment Scale (+exp) • Berg Balance Scale (+exp) • Functional Reach Test (+exp) • Limit of Stability (+exp) • Centre of Pressure (+exp)
Gait Training with Gait Exercise Assist Robot (GEAR) vs Gait Training with Treadmill		
Ogino et al. (2020) RCT (6) Nstart=20 Nend=19 TPS=Chronic	E1: Gait training with Gait Exercise Assist Robot (GEAR) E2: Gait training with treadmill Duration: 60min/d, 5d/wk, for 4wks	<u>E1 vs E2</u> • Timed Up and Go Test (+exp1) • 6-min walk test (+exp1) • SF-8 (-) • Global rating of change scale (-) • 10-m walk test ○ Gait speed (-) ○ Cadence (-) ○ Stride length (-) • Gait distance (+exp2)
Gait Training with Gait Exercise Assist Robot (GEAR) vs Overground Gait Training		
Tomida et al. (2019) RCT (4) Nstart=26 Nend=26 TPS=Acute	E: Robot-assisted gait training (GEAR) + Conventional rehabilitation C: Overground gait training + Conventional rehabilitation Duration: 40min/d, 7d/wk, for 4wks	• Functional Independence Measure ○ Walk score (+exp) • Stroke Impairment Assessment Set total lower limb motor function score (-)
Robotic Verticalization + FES vs Conventional therapy		
Calabro et al. (2015) RCT (5) Nstart=20 Nend=20 TPS=Subacute	E: Robotic verticalization + FES + dynamic foot support C: Physiotherapy-assisted verticalization (simple tilt-table) Duration: 30min/d, 5d/wk for 6wks	• Visual analog scale (+exp) • Ravens Coloured Progressive Matrices (+exp) • Fugl-Meyer Lower Extremity scale (+exp) • Medical Research Council scale (+exp) • Postural assessment scale for Stroke Patients (+exp) • Sensory-Motor plasticity (+exp)
Robotic-assisted Stretching vs Conventional Therapy		
Yoo et al. (2018) RCT (4) Nstart=16 Nend=16 TPS=Chronic	E: Robotic ankle stretching exercises C: Conventional stretching board 2d/wk, for 3.5wks (7 sessions total)	• Ankle ROM (+exp) • Sensory organization test (+exp) • Speed (-) • Cadence (-) • Step Length affected (-) • Step Length unaffected (+exp)
Regent Suit + Neuromotor rehabilitation vs Neuromotor rehabilitation		

Monticone et al. (2013) RCT (8) Nstart=60 Nend=55 TPS=Acute	E: Neuromotor rehabilitation sessions + neuromotor exercises wearing the Regent Suit C: Neuromotor rehabilitation sessions Duration: 90min/d, 20d	• 6-minute walking test o gait speed (+exp) o oxygen saturation (-) o heart rate (-) • Berg balance scale (+exp) • 10-m walking test o gait speed (+exp) o step length (+exp) o cadence (-) o length symmetry index (-) o time symmetry index (-) • Functional independence measure (+exp) • Barthel index (+exp) • Global perceived effect scores (+exp)
Vibration on sole of foot vs Contact on Sole of Foot with No Vibration		
Onal et al. (2020) RCT (6) Nstart=34 Nend=30 TPS=Chronic	E: Vibration on sole of foot C: Contact on sole of foot with No vibration Duration: 15min single treatment	• Postural Stability Test (+exp) • Anteroposterior stability test (+exp) • Mediolateral stability (-) • Fall risk test (+exp)
Robot-Assisted Gait Training with Visuomotor Feedback		
Maggio et al. (2021) RCT (6) Nstart=45 Nend=45 TPS=Subacute	E: Robot-Assisted Gait Training + Visuomotor feedback C: Robot-Assisted Gait Training Duration: 60min/d, 5d/wk, for 8wks	• Body-esteem scale (+exp) • Body Uneasiness Test-A o Global Severity Index (-) o Weight Phobia (+exp) o Body Image Concern (-) o Avoidance (+exp) o Compulsive self-monitoring (-) o Depersonalization (+exp) • Body Uneasiness Test-B o Positive Symptom Total (+exp) o Positive Symptom Distress Index (+exp) o I Mouth (+exp) o II Face shape (+exp) o III Thighs (+exp) o IV Legs (+exp) o V Arms (+exp) o VI Moutsache (-) o VII Skin (-) o VIII Blushing (-) • Fugl-Meyer assessment (+exp) • Frontal assessment battery (-) • Montreal Cognitive assessment (-) • Beck Depression Inventory (-) • Short form-12 o Total (-) o Physical Health (-) o Mental Health (-) • EEG (+exp)
Robotics with Treadmill Training and Virtual Reality vs Seated Training		
Forrester et al. (2016) RCT (4) Nstart=35 Nend=26 TPS=Chronic	E: Treadmill training + Virtual reality + Ankle robotics C: Seated training + Virtual reality + Ankle robotics	• Gait speed (+exp) • Paretic limb support (+exp) • Ankle range of motion (+exp) • Ankle target speed (+exp) • Ankle target accuracy (+exp) • Centre of pressure (-)

	Duration: 45min/d, 5d/wk for 6wks	
Bustamante Valles et al. (2016) RCT (3) Nstart=27 Nend=20 TPS=Chronic	E: Circuit Training (NESS L300 & Motomed Viva 2 FES+ Cycling & Brain trainer) C: Conventional Care Duration: 120min, 24 sessions over 6-8wks	• Fugl-Meyer Assessment ○ Upper Extremity (-) ○ Lower extremity (+exp) • 6-minute walk test (-) • 10-meter walk test (-) • Timed Up-and-Go (-)
Tamburella et al. (2019) RCT crossover (5) Nstart=12 Nend=10 TPS=Subacute	E: Lokomat robotic training + EMG biofeedback + Conventional therapy C: Lokomat robotic training + Commercial joint torque biofeedback + Conventional therapy Duration: 40min/d, 5d/wk for 6 session - Conventional therapy, 40min/d, 3x/wk for 6 sessions - Lokomat with EMG, 40min/d, 3x/wk for 6 sessions - Lokomat with Joint torque feedback	• Modified Ashworth scale hip (-) ○ Knee (-) ○ Ankle (-) • Manual Muscle test: ○ Hip (-) ○ Knee (-) ○ Ankle (-) • Functional Ambulation category (-) • Visual Analogue scale-pain (-) • Barthel index (-) • Berg Balance scale (-) • Trunk Control test (-)
Robot-assisted Task Specific Training vs Task Specific Walking		
Buesing et al. (2015) RCT (6) Nstart=50 Nend=50 TPS=Chronic	E: Task-specific walking training while wearing a robotic device (Stride Management Assistant system) C: Functional task specific walking Duration: 45min/session, 3d/wk for 6-8wks	• Gait velocity (-) • Gait Candence (-) • Step time (-) • Stance time (-) • Swing time (-) • Double support time (-) • Step length ○ Impaired side (+exp) ○ Non-impaired side (-) • Stride length (no stats) • Spatial asymmetry ○ At fast speed (+exp) ○ At self speed (-) • Temporal asymmetry (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Electromechanical and Robotic Devices

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Robot assisted gait training** may not have a difference in efficacy compared to **conventional therapy and overground gait training** for improving motor function.	4	Alingh et al. 2021; Kooncumchoo et al. 2021; Bizovicar et al. 2017; Peurala et al. 2009

1b	**Exoskeleton systems** may not have a difference in efficacy compared to **conventional therapy, overground gait training, or treadmill trainings** for improving motor function.	18	Yu et al. 2021; Louie et al. 2021; Li et al. 2021a; Li et al. 2021b; Palmcrantz et al. 2021; Mustafaoglu et al. 2020; Wall et al. 2020; Lee et al. 2019; Kim et al. 2019; Mayr et al. 2018; Yun et al. 2018; Han et al. 2016; Cho et al. 2015; Ochi et al. 2015; van Nunen et al. 2015; Watanabe et al. 2014; Kelley et al. 2013; Chang et al. 2012
1b	**Exoskeleton systems** may not have a difference in efficacy compared to **treadmill training** for improving motor function.	1	Westlake & Patten 2009
2	**Exoskeleton systems** may not have a difference in efficacy compared to **functional task-specific training** for improving motor function.	1	Jayaraman et al. 2019
2	**Exoskeleton portable devices** may not have a difference in efficacy compared to **overground gait training or stretching or sham AFO** for improving motor function.	1	Goodman et al. 2014
1b	**Exoskeleton portable devices** may not have a difference in efficacy compared to **stretching** for improving motor function.	1	Zhai et al. 2021
2	**Robotic gait training with assistance as needed** may not have a difference in efficacy compared to **robotic gait training with full assistance** for improving motor function.	1	Seo et al. 2018
1b	There is conflicting evidence about the effect of **robotics combined with virtual reality** to improve motor function when compared to **robotics with conventional training or other stimulation.**	1	Park et al. 2018
1a	There is conflicting evidence about the effect of **end-effector assisted gait training** to improve motor function when compared to **body weight supported treadmill training.**	2	Kim et al. 2020; Werner et al. 2002
1b	**Lokomat assisted gait training guided by heart rate reserve** may produce greater improvements in motor function than **Lokomat assisted gait training guided by perceived exertion.**	1	Bae et al. 2016
2	**Exoskeleton portable devices with AFO** may produce greater improvements in motor function compared to **sham AFO.**	1	Yeung et al. 2018
1b	**Robot-assisted gait training with restraint** may produce greater improvements in motor function compared to **training without restraint.**	1	Kang et al. 2017
1b	**Virtual reality with robot-assisted gait training** may produce greater improvements in motor function	1	Park et al. 2018

	compared to **auditory stimulation with robot-assisted gait training.**		
2	**Robot verticalization and FES** may produce greater improvements in motor function compared to **conventional therapy.**	1	Calabro et al. 2015
1b	**Robot-assisted gait training with visuomotor feedback** may produce greater improvements in motor function compared to **robot-assisted gait training alone.**	1	Maggio et al. 2021
2	**Robotics with treadmill training and virtual reality** may produce greater improvements in motor function compared to **seated training.**	1	Bustamante Valles et al. 2016

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1b	**Robot-assisted gait training** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving functional mobility.	5	Song et al. 2021; Kim et al. 2018; Hesse et al. 2012; Peruala et al. 2009; Ng et al. 2008
1b	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training alone** for improving functional mobility.	1	Ng et al. 2008
1b	**Electromechanical gait training with FES** may not have a difference in efficacy compared to **electromechanical gait training alone** for improving functional mobility.	1	Tong et al. 2006
1b	**Exoskeleton systems** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving functional mobility.	10	Nam et al. 2022; Kang et al. 2021; Rojek et al. 2020; Nam et al. 2019; Calabro et al. 2018; van Nunen et al. 2015; Watanabe et al. 2014; Morone et al. 2011; Freivogel et al. 2009; Hidler et al. 2009
1b	**Exoskeleton systems** may not have a difference in efficacy compared to **treadmill training** for improving functional mobility.	1	Westlake & Patten 2009
1a	**Robotics combined with virtual reality** may not have a difference in efficacy compared to **robotics with conventional training or other stimulation** for improving functional mobility.	2	Kayabinar et al. 2021; Calabro et al. 2017
1a	**Electromechanical gait training** may produce greater improvements in functional mobility compared to **conventional treatment or no treatment.**	2	Pohl et al. 2007; Tong et al. 2006
1b	**Electromechanical gait training with FES** may produce greater improvements in functional mobility compared to **gait training.**	1	Tong et al. 2006
2	**Exoskeleton portable devices** may produce greater improvements in functional mobility compared to	1	Waldman et al. 2013

	overground gait training or stretching or sham AFO.		

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Robot-assisted gait training** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving functional ambulation.	13	Thimabut et al. 2022; Alingh et al. 2021; Kooncumchoo et al. 2021; Song et al. 2021; Stolz et al. 2019; Kim et al. 2018; Morone et al. 2018; Bizovicar et al. 2017; Morone et al. 2016; Chua et al. 2016; Hesse et al. 2012; Peurala et al. 2009; Ng et al. 2008
1b	**Robot-assisted gait training with anodal tDCS** may not have a difference in efficacy compared to **robot-assisted gait training with cathodal tsDCS** for improving functional ambulation.	1	Picelli et al. 2012
1b	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training** for improving functional ambulation.	1	Ng et al. 2008
1b	**Robot-assisted gait training** may not have a difference in efficacy compared to **balance training** for improving functional ambulation.	1	Gandolfi et al. 2019
1a	**Electromechanical gait training with FES** may not have a difference in efficacy compared to **electromechanical gait training** for improving functional ambulation.	2	Tong et al. 2006; Peruala et al. 2005
1a	There is conflicting evidence about the effect of **electromechanical gait training with FES** to improve functional ambulation when compared to **gait training.**	2	Tong et al. 2006; Peruala et al. 2005
1a	**End-effector gait training** may not have a difference in efficacy compared to **body weight support treadmill training** for improving functional ambulation.	2	Kim et al. 2020; Werner et al. 2002
1a	**Exoskeleton systems** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving functional ambulation.	40	Nam et al. 2022; Kang et al. 2021; Kotov et al. 2021; Molteni et al. 2021; Palmcrantz et al. 2021; Yu et al. 2021; Louie et al. 2021; Li et al. 2021a; Li et al. 2021b; Mustafaoglu et al. 2020; Nam et al. 2020; Park et al. 2020; Wall et al. 2020; Kim et al. 2019; Nam et al. 2019; Lee et al. 2019; Sczensny-Kaiser et al. 2019; Calabro et al. 2018; Mayr et al. 2018; Bergmann et al. 2018;

			Traveggia et al. 2016; Han et al. 2016; van Nunen et al. 2015; Ochi et al. 2015; Cho et al. 2015; Kim et al. 2015; Wu et al. 2014; Ucar et al. 2014; Watanabe et al. 2014; Kelley et al. 2013; Chang et al. 2012; Morone et al. 2011; Fisher et al. 2011; Hidler et al. 2009; Freivogel et al. 2009; Lewek et al. 2009; Schwartz et al. 2009; Hornby et al. 2008; Husemann et al. 2007
1a	**Exoskeleton systems** may not have a difference in efficacy compared to **treadmill training** for improving functional ambulation**.**	2	Bang & Shin 2016; Westlake & Patten 2009
1b	**Portable exoskeletons** may not have a difference in efficacy compared to **overground gait training or stretching or sham AFO** for improving functional ambulation**.**	6	Yeung et al. 2021; Wright et al. 2021; Buesing et al. 2015; Stein et al. 2014; Goodman et al. 2014; Waldman et al. 2013
2	**Robotic gait training with assistance as needed** may not have a difference in efficacy compared to **robotic gait training with full assistance** for improving functional ambulation.	1	Seo et al. 2018
2	**Exoskeleton portable devices** may not have a difference in efficacy compared to **stretching** for improving functional ambulation.	1	Forrester et al. 2014
2	**Exoskeleton portable devices with AFO** may not have a difference in efficacy compared to **sham AFO** for improving functional ambulation.	1	Yeung et al. 2018
1b	**Robot-assisted gait training with restraint** may not have a difference in efficacy compared to **training without restraint** for improving functional ambulation.	1	Kang et al. 2017
1a	**Robotics combined with virtual reality** may not have a difference in efficacy compared to **robotics with conventional training or other stimulation** for improving functional ambulation.	2	Kayabinar et al. 2021; Park et al. 2018
1b	**Virtual reality with robot-assisted gait training** may not have a difference in efficacy compared to **robot-assisted gait training with auditory stimulation** for improving functional ambulation.	1	Park et al. 2018
1b	**Gait training with gait exercise assist robot** may not have a difference in efficacy compared to **gait training with treadmill** for improving functional ambulation.	1	Ogino et al. 2020
2	**Robot-assisted stretching** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	1	Yoo et al. 2018

2	**Robotics with treadmill training and virtual reality** may not have a difference in efficacy compared to **seated training** for improving functional ambulation.	3	Bustamante Valles et al. 2016; Forrester et al. 2016; Tamburella et al. 2016
1b	**Robot-assisted task-specific training** may not have a difference in efficacy compared to **task-specific walking** for improving functional ambulation.	1	Buesing et al. 2015
1b	There is conflicting evidence about the effect of **electromechanical gait training** to improve functional ambulation when compared to **conventional treatment or no treatment.**	4	Tanaka et al. 2012; Pohl et al. 2007; Tong et al. 2006; Peurala et al. 2005
2	There is conflicting evidence about the effect of **exoskeleton systems** to improve functional ambulation when compared to **functional task-specific training.**	1	Jayaraman et al. 2019
1b	There is conflicting evidence about the effect of **robot-assisted training with power-assisted ankle robot** to improve functional ambulation when compared to **robot-assisted training with swing-controlled ankle robot.**	1	Yeung et al. 2021
1b	**Lokomat assisted gait training guided by heart rate reserve** may produce greater improvements in functional ambulation compared to **Lokomat assisted gait training guided by perceived exertion.**	1	Bae et al. 2016
1b	**Robot-assisted gait training with conventional therapy** may produce greater improvements in functional ambulation compared to **robot assisted gait training.**	1	Mustafaoglu et al. 2020

GAIT

LoE	Conclusion Statement	RCTs	References
1a	**Robot-assisted gait training** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving gait.	2	Thimabut et al. 2022; Alingh et al. 2021
1b	**Robot-assisted gait training with anodal tDCS** may not have a difference in efficacy compared to **robot-assisted gait training with cathodal tsDCS** for improving gait.	1	Picelli et al. 2012
1b	**Robot-assisted gait training** may not have a difference in efficacy compared to **balance training** for improving gait.	1	Gandolfi et al. 2019
1b	**Exoskeleton systems** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving gait.	12	Nam et al. 2022; Kang et al. 2021; Li et al. 2021a; Li et al. 2021b; Yu et al. 2021; Lee et al. 2019; Calacro et al. 2018; Watanabe et al. 2014; Hidler et al. 2009; Lewek et al. 2009; Hornby et al.

			2008; Husemann et al. 2007
2	**Exoskeleton systems** may not have a difference in efficacy compared to **functional task-specific training** for improving gait.	1	Jayaraman et al. 2019
1b	**Portable exoskeletons** may not have a difference in efficacy compared to **overground gait training or stretching or sham AFO** for improving gait.	4	Wright et al. 2021; Buesing et al. 2015; Goodman et al. 2014; Waldman et al. 2013
2	**Portable exoskeletons with AFO** may not have a difference in efficacy compared to **sham AFO** for improving gait.	1	Yeung et al. 2018
1b	**Exoskeletons with restraint** may not have a difference in efficacy compared to **exoskeletons alone** for improving gait**.**	2	Kang et al. 2017; Bonnyaud et al. 2014
1b	**Robotics with virtual reality** may not have a difference in efficacy compared to **robotics with conventional training or other stimulation** for improving gait**.**	1	Kayabinar et al. 2021
2	**Robotic gait training with assistance as needed** may not have a difference in efficacy compared to **robotic gait training with full assistance** for improving gait.	1	Seo et al. 2018
1b	**Gait training with GEAR** may not have a difference in efficacy compared to **gait training with treadmill** for improving gait.	1	Ogino et al. 2020
2	**Robot-assisted stretching** may not have a difference in efficacy compared to **conventional therapy** for improving gait.	1	Yoo et al. 2018
1b	**Robot-assisted task-specific training** may not have a difference in efficacy compared to **task-specific walking** for improving gait.	1	Buesing et al. 2015
1b	**Lokomat assisted gait training guided by heart rate reserve** may produce greater improvements in gait than **Lokomat assisted gait training guided by perceived exertion.**	1	Bae et al. 2016
1b	**Exoskeleton systems** may produce greater improvements in gait compared to **treadmill training.**	1	Bang & Shin 2016
2	**Exoskeleton portable devices** may produce greater improvements in gait compared to **stretching.**	1	Forrester et al. 2014
2	**Robotics with treadmill training and virtual reality** may produce greater improvements in gait compared to **seated training.**	1	Forrester et al. 2016

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training** for improving balance.	1	Ng et al. 2008

1b	**Robot-assisted gait training** may not have a difference in efficacy compared to **balance training** for improving balance.	1	Gandolfi et al. 2019
1a	**Electromechanical gait training** may not have a difference in efficacy compared to **conventional treatment or no treatment** for improving balance.	2	Tong et al. 2006; Peurala et al. 2005
1a	**Electromechanical gait training with FES** may not have a difference in efficacy compared to **electromechanical gait training** for improving balance.	2	Tong et al. 2006; Peurala et al. 2005
1a	**Electromechanical gait training with FES** may not have a difference in efficacy compared to **gait training** for improving balance.	2	Tong et al. 2006; Peurala et al. 2005
1a	**Exoskeleton systems** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving balance.	27	Nam et al. 2022; Palmcrantz et al. 2021; Kang et al. 2021; Louie et al. 2021; Kotov et al. 2021; Molteni et al. 2021; Nam et al. 2020; Park et al. 2020; Wall et al. 2020; Rojek et al. 2020; Lee et al. 2019; Nam et al. 2019; Sczensny-Kaiser et al. 2019; Kim et al. 2019; Yun et al. 2018; Bergmann et al. 2018; Han et al. 2016; Traveggia et al. 2016; Cho et al. 2015; Kim et al. 2015; van Nunen et al. 2015; Wu et al. 2014; Morone et al. 2011; Fisher et al. 2011; Hidler et al. 2009; Freivogel et al. 2009; Hornby et al. 2008
2	**Exoskeleton systems** may not have a difference in efficacy compared to **functional task-specific training** for improving balance**.**	1	Jayaraman et al. 2019
1b	**Robot-assisted training with power-assisted ankle robot** may not have a difference in efficacy compared to **robot-assisted training with swing-controlled ankle robot** for improving balance**.**	1	Yeung et al. 2021
1b	**Exoskeleton portable devices** may not have a difference in efficacy compared to **stretching** for improving balance**.**	2	Zhai et al. 2021; Forrester et al. 2014
2	**Exoskeleton portable devices with AFO** may not have a difference in efficacy compared to **sham AFO** for improving balance**.**	1	Yeung et al. 2018
1b	**Virtual reality with robot-assisted gait training** may not have a difference in efficacy compared to **auditory stimulation with robot-assisted gait training** for improving balance**.**	1	Park et al. 2018

2	**Galvanic vestibular stimulation** may not have a difference in efficacy compared to **Lokomat training or physiotherapy with visual feedback** for improving balance.	1	Krewer et al. 2013
2	**Robot-assisted gait training as needed** may not have a difference in efficacy compared to **robot-assisted gait training full-time** for improving balance.	1	Seo et al. 2018
2	**Robotics with treadmill training and virtual reality** may not have a difference in efficacy compared to **seated training** for improving balance.	2	Tamburella et al. 2016; Forrester et al. 2016
1b	There is conflicting evidence about the effect of **robot-assisted gait training** to improve balance when compared to **conventional therapy or overground gait training.**	6	Song et al. 2021; Kim et al. 2018; Morone et al. 2018; Bizovicar et al. 2017; Morone et al. 2016; Ng et al. 2008
1a	There is conflicting evidence about the effect of **exoskeleton systems** to improve balance when compared to **treadmill training.**	2	Bang & Shin 2016; Westlake & Patten 2009
1b	There is conflicting evidence about the effect of **exoskeleton portable devices** to improve balance when compared to **overground gait training or stretching or sham AFO.**	4	Wright et al. 2021; Yeung et al. 2021; Stein et al. 2014; Waldman et al. 2013
1b	There is conflicting evidence about the effect of **robot-assisted gait training with restraint** to improve balance when compared to **gait training alone.**	1	Kang et al. 2017
1a	There is conflicting evidence about the effect of **robotics combined with virtual reality** to improve balance when compared to **robotics with conventional training or other stimulation.**	3	Kayabinar et al. 2021; Park et al. 2018; Calabro et al. 2017
2	There is conflicting evidence about the effect of **Lokomat training** to improve balance when compared to **physiotherapy with visual feedback.**	1	Krewer et al. 2013
1b	**Robot-assisted trunk training** may produce greater improvements in balance compared to **conventional therapy.**	1	Kim et al. 2022
2	**Robotic verticalization and FES** may produce greater improvements in balance compared to **conventional therapy.**	1	Calabro et al. 2015
2	**Robotic-assisted stretching** may produce greater improvements in balance compared to **conventional therapy.**	1	Yoo et al. 2018
1b	**Vibration on sole of foot** may produce greater improvements in balance compared to **contact on sole of foot with no vibration.**	1	Onal et al. 2020

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**

1a	**Robot-assisted gait training** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving spasticity.	2	Morone et al. 2016; Hesse et al. 2012
1b	**Robot-assisted gait training with anodal tDCS** may not have a difference in efficacy compared to **robot-assisted gait training with cathodal tsDCS** for improving spasticity.	1	Picelli et al. 2012
1b	**End-effector gait training** may not have a difference in efficacy compared to **body weight support treadmill training** for improving spasticity.	1	Werner et al. 2002
1b	**Exoskeleton systems** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving spasticity.	9	Kang et al. 2021; Kotov et al. 2021; Li et al. 2021b; Molteni et al. 2021; Cho et al. 2015; Kim et al. 2015; Morone et al. 2011; Freivogel et al. 2009; Husemann et al. 2007
2	**Exoskeleton portable devices** may produce greater improvements in balance compared to **overground gait training or stretching or sham AFO.**	1	Waldman et al. 2013
1b	**Exoskeleton portable devices** may not have a difference in efficacy compared to **stretching** for improving spasticity.	1	Zhai et al. 2021
2	**Exoskeleton portable devices with AFO** may not have a difference in efficacy compared to **sham AFO** for improving spasticity.	1	Yeung et al. 2018
1b	**Robotics combined with virtual reality** may not have a difference in efficacy compared to **robotics with conventional training or other stimulation** for improving spasticity.	1	Calabro et al. 2017
2	**Robotics with treadmill training and virtual reality** may not have a difference in efficacy compared to **seated training** for improving spasticity.	1	Tamburella et al. 2016

RANGE OF MOTION

LoE	Conclusion Statement	RCTs	References
2	**Portable exoskeleton devices** may not have a difference in efficacy compared to **stretching** for improving range of motion.	1	Forrester et al. 2014
2	There is conflicting evidence about the effect of **exoskeleton portable devices** to improve range of motion when compared to **overground gait training or stretch or sham AFO.**	1	Waldman et al. 2013
2	**Robot-assisted stretching** may produce greater improvements in balance compared to **conventional therapy.**	1	Yoo et al. 2018
2	**Robotics with treadmill training and virtual reality** may produce greater improvements in balance compared to **seated training.**	1	Forrester et al. 2016

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Robot-assisted gait training** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving activities of daily living.	8	Thimabut et al. 2022; Song et al. 2021; Stolz et al. 2019; Kim et al. 2018; Morone et al. 2018; Chua et al. 2016; Peurala et al. 2009; Ng et al. 2008
1b	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training alone** for improving activities of daily living.	1	Ng et al. 2008
1a	**Electromechanical gait training** may not have a difference in efficacy compared to **conventional treatment or no treatment** for improving activities of daily living.	3	Pohl et al. 2007; Tong et al. 2006; Peurala et al. 2005
1a	**Electromechanical gait training with FES** may not have a difference in efficacy compared to **electromechanical gait training** for improving activities of daily living.	2	Tong et al. 2006; Peurala et al. 2005
1a	**Electromechanical gait training with FES** may not have a difference in efficacy compared to **gait training** for improving activities of daily living.	2	Tong et al. 2006; Peurala et al. 2005
1b	**Exoskeleton systems** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving activities of daily living.	19	Palmcrantz et al. 2021; Kotov et al. 2021; Molteni et al. 2021; Mustafaoglu et al. 2020; Rojek et al. 2020; Wall et al. 2020; Nam et al. 2019; Yun et al. 2018; Han et al. 2016; Traveggia et al. 2016; Cho et al. 2015; Kim et al. 2015; Ochi et al. 2015; Kelley et al. 2013; Morone et al. 2011; Schwartz et al. 2009; Hidler et al. 2009; Hornby et al. 2008; Husemann et al 2007
1b	**Portable exoskeletons** may not have a difference in efficacy compared to **stretching** for improving activities of daily living.	2	Zhai et al. 2021; Forrester et al. 2014
1a	**Robotics combined with virtual reality** may not have a difference in efficacy compared to **robotics and conventional training or other stimulation** for improving activities of daily living.	2	Kayabinar et al. 2021; Park et al. 2018
1b	**Virtual reality with robot-assisted gait training** may not have a difference in efficacy compared to **auditory stimulation with robot-assisted gait training** for improving activities of daily living.	1	Park et al. 2018
2	**Robotics with treadmill training and virtual reality** may not have a difference in efficacy compared to **seated training** for improving activities of daily living.	1	Tamburella et al. 2016

1b	**Robot-assisted gait training with conventional therapy** may produce greater improvements in activities of daily living compared to **robot-assisted gait training.**	1	Mustafaoglu et al. 2020
1b	**Robot-assisted gait training with restraint** may produce greater improvements in activities of daily living compared to **robot-assisted gait training alone.**	1	Kang et al. 2017
2	**Gait training with GEAR** may produce greater improvements in activities of daily living compared to **overground gait training.**	1	Romida et al. 2019

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1b	**Robot-assisted gait training with anodal tDCS** may not have a difference in efficacy compared to **robot-assisted gait training with cathodal tsDCS** for improving muscle strength.	1	Picelli et al. 2012
1b	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training** for improving muscle strength.	1	Ng et al. 2008
1a	**Electromechanical gait training with FES** may not have a difference in efficacy compared to **electromechanical gait training** for improving muscle strength.	2	Tong et al. 2006; Peurala et al. 2005
1a	**Exoskeleton systems** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving muscle strength.	15	Nam et al. 2022; Kang et al. 2021; Kotov et al. 2021; Molteni et al. 2021; Nam et al. 2020; Lee et al. 2019; Nam et al. 2019; Cho et al. 2015; van Nunen et al. 2015; Ochi et al. 2015; Watanabe et al. 2014; Chang et al. 2012; Morone et al. 2011; Freivogel et al. 2009; Husemann et al. 2007
2	**Portable exoskeletons** may not have a difference in efficacy compared to **stretching** for improving muscle strength.	1	Forrester et al. 2014
2	**Robotic gait training with assistance as needed** may not have a difference in efficacy compared to **robotic gait training with full assistance** for improving muscle strength.	1	Seo et al. 2018
2	**Robotics with treadmill training and virtual reality** may not have a difference in efficacy compared to **seated training** for improving muscle strength.	1	Tamburella et al. 2016
1b	There is conflicting evidence about the effect of **robot-assisted gait training** to improve muscle strength when compared to **conventional therapy or overground gait training**.	5	Alingh et al. 2021; Song et al. 2021; Kim et al. 2018; Hesse et al. 2012; Ng et al. 2008

1a	There is conflicting evidence about the effect of **electromechanical gait training** to improve muscle strength when compared to **conventional therapy or no treatment**.	3	Pohl et al. 2007; Tong et al. 2006; Peurala et al. 2005
1a	There is conflicting evidence about the effect of **electromechanical gait training with FES** to improve muscle strength when compared to **gait training.**	2	Tong et al. 2006; Peurala et al. 2005
2	There is conflicting evidence about the effect of **exoskeleton portable devices** to improve muscle strength when compared to **overground gait training, stretching or sham AFO.**	1	Waldman et al. 2013
1b	**Robotics combined with virtual reality** may produce greater improvements in muscle strength than **robotics and conventional training or other stimulation.**	1	Park et al. 2018
1b	**Virtual reality with robot-assisted gait training** may produce greater improvements in muscle strength than **auditory stimulation with robot-assisted gait training.**	1	Park et al. 2018
2	**Robotic verticalization with FES** may produce greater improvements in muscle strength than **conventional therapy.**	1	Calabro et al. 2015

PROPRIOCEPTION

LoE	Conclusion Statement	RCTs	References
1b	**Exoskeleton systems** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving proprioception.	1	Bergmann et al. 2018

STROKE SEVERITY

LoE	Conclusion Statement	RCTs	References
1b	**Robot-assisted gait training** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving stroke severity.	1	Morone et al. 2011
1b	**Exoskeleton systems** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving stroke severity.	3	Morone et al. 2011; Hidler et al. 2009; Schwartz et al. 2009
2	**Gait training with GEAR** may not have a difference in efficacy compared to **overground gait training** for improving stroke severity.	1	Romida et al. 2019

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
1b	**Robot-assisted gait training** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving quality of life.	1	Chua et al. 2016
1b	**Exoskeleton systems** may not have a difference in efficacy compared to **conventional therapy or overground gait training** for improving quality of life.	9	Louie et al. 2021; Palmcrantz et al. 2021; Mustafaoglu et al. 2020; Wall et al. 2019; Traveggia et al. 2016; van Nunen et al. 2015; Kelley et al. 2013; Hidler et al. 2009; Hornby et al. 2008
1b	**Exoskeleton systems** may not have a difference in efficacy compared to **treadmill training** for improving quality of life.	1	Westlake & Patten 2009
2	**Exoskeleton systems** may not have a difference in efficacy compared to **functional task-specific training** for improving quality of life.	1	Jayaraman et al. 2019
1b	**Gait training with GEAR** may not have a difference in efficacy compared to **gait training with treadmill** for improving quality of life.	1	Ogino et al. 2020
1b	**Robot-assisted gait training with conventional therapy** may produce greater improvements in quality of life than **robot-assisted gait training.**	1	Mustafaoglu et al. 2020
2	**Robotic verticalization with FES** may produce greater improvements in quality of life than **conventional therapy.**	1	Calabro et al. 2015
1b	**Robot-assisted gait training with visuomotor feedback** may not have a difference in efficacy compared to **robot-assisted gait training** for improving quality of life.	1	Maggio et al. 2021

Key Points

End-effector assisted gait training may not be beneficial for improving motor function, functional ambulation, functional mobility, gait, balance, activities of daily living, spasticity, stroke severity, and muscle strength after stroke, when compared to conventional gait training.

End-effector assisted gait training combined with functional electrical stimulation or virtual reality may be beneficial in improving motor function, functional mobility, gait, balance, range of motion, and muscle strength after stroke, when compared to conventional gait trainings.

Exoskeleton systems may not be beneficial for improving motor function, functional ambulation, functional mobility, gait, balance, activities of daily living, spasticity, and muscle strength after stroke, when compared to conventional overground gait trainings.

Sensorimotor Stimulation

Functional Electrical Stimulation

Adopted from: http://inirehab.com/functional-electrical-stimulation-fes-explained/

Functional electrical stimulation (FES), the integration of neuromuscular electrical stimulation with functional activity or training, was first implemented with the goal of assisting stroke patients with foot drop (Liberson et al., 1961; Peckham & Knutson, 2005). FES is currently used to improve the function of the paretic extremity during various motor tasks (Liberson et al., 1961). FES works through applying short, programmed bursts of current to the nerve and muscles in the affected region to produce muscle contractions in a coordinated way.

A total of 65 RCTs were found evaluating FES for lower extremity motor rehabilitation.

11 RCTs compared FES to conventional therapy or sham stimulation (Bogataj et al., 1995; Burridge et al., 1997; Dujović et al., 2017; Kottink et al., 2007; Kottink et al., 2008; Lairamore et al., 2014; Macdonell et al., 1994; Newsam & Baker, 2004; Wilkinson et al., 2015; Yan et al., 2005; You et al., 2014). Ten RCTs compared gait training with FES to gait training or conventional therapy (Araki et al., 2020; Cozean et al., 1988; Daly et al., 2006; Daly et al., 2007; Daly et al., 2011; Embrey et al., 2010; Kojovic et al., 2009; Sheffler et al., 2015; Spaich et al., 2014; van Bloemendaal et al., 2021). Nine RCTs compared cycling with FES to conventional therapy or cycling with or without sham FES (Ambrosini et al., 2012; Ambrosini et al., 2011; Bauer et al., 2015; Bustamante Valles et al., 2016; de Sousa et al., 2016; Ferrante et al., 2008; Janssen et al., 2008; Lo et al., 2012; Peri et al., 2016). One RCT compared interval cycling with FES to linear cycling with FES (Shariat et al., 2021). Four RCTs compared treadmill training with FES to treadmill training with or without sham FES (Awad et al., 2016; Cho et al., 2015c; Hwang et al., 2015; Lee et al., 2013a). Three RCTs compared robot-assisted FES to gait training or robot-assisted gait training (Bae et al., 2014; Peurala et al., 2005; Tong et al., 2006). Two RCTs compared balance training with FES to balance training or conventional care (Kunkel et al., 2013; Lee, 2020). One RCT compared FES with proprioceptive neuromuscular facilitation to proprioceptive neuromuscular facilitation (Shim et al., 2020). Two RCTs compared ankle training

with brain-computer interface-based FES to ankle training with FES (Chung et al., 2020b; Chung et al., 2015). Two RCTs compared FES with a tilt table to conventional therapy or a simple tilt table (Calabro et al., 2015; Solopova et al., 2011). One RCT compared FES with motor training on a rocker board to conventional exercises (Cheng et al., 2010). One RCT compared FES to electrical muscle stimulation (Sharif et al., 2017). One RCT compared FES with EMG-triggered neuromuscular stimulation (NMES) to EMG-triggered NMES (Mitsutake et al., 2019). Two RCTs compared four-channel FES to dual-channel FES or sham (Tan et al., 2014; Zheng et al., 2018). One RCT compared faradic electrical stimulation to Russian electrical stimulation (Ganesh et al., 2018). One RCT compared mirror therapy with FES to conventional therapy (Salhab et al., 2016). One RCT compared FES to transcranial direct current stimulation (tDCS) (Zhang et al., 2021c). One RCT compared gait training with FES to gait training with tDCS or gait training with tDCS and FES (Mitsutake et al., 2021). Five RCTs compared peroneal nerve FES (foot-drop stimulator) to ankle-foot orthoses (Bethoux et al., 2014; Everaert et al., 2013; Kluding et al., 2013; Salisbury et al., 2013; Sheffler et al., 2006). Three RCTs compared peroneal nerve FES (foot-drop stimulator) to conventional therapy or gait training (Hachisuka et al., 2021; Kottink et al., 2012; Sheffler et al., 2013). Three RCTs compared peroneal nerve stimulation to sham stimulation or conventional therapy (Mrachacz-Kersting et al., 2019; Sheffler et al., 2015; Yavuzer et al., 2007).

The methodological details and results of all 65 RCTs are presented in Table 30.

Table 30. RCTs Evaluating Functional Electrical Stimulation Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
FES vs Conventional Therapy or Sham Stimulation		
Dujovic et al. (2017) RCT (7) N_{start}=16 N_{end}=16 TPS=Subacute and Chronic	E: Multi-pad FES (40Hz) + Conventional stroke rehabilitation C: Conventional Therapy Duration: 30-40min/d, 7d/wk for 4wks – FES; 60min/d 5d/wk for 4wks - Conventional stroke rehabilitation	• Fugl-Meyer Assessment (-) • Berg Balance Scale (-) • Barthel Index (-) • 10-Metre Walk Test (+exp)
Wilkinson et al. (2015) RCT (7) N_{start}=20 N_{end}=20 TPS=Chronic	E: FES + conventional physiotherapy C: Conventional physiotherapy Duration: 60min/session, 12session/6wks	• 10-Metre Walk Test (-) • 6-Minute Walk Test (-) • Rivermead Mobility Index (-) • Rivermead Visual Gait Analysis (-) • Psychosocial Impact of Assistive Devices Scale (-) • Hospital Anxiety and Depression Scale (-) • Canadian Occupational Performance Measure (-)
Lairamore et al. (2014) RCT (6) N_{start}=32 N_{end}=26 TPS=Acute	E: Functional Electrical Stimulation + conventional PT C: Sensory (Sham) stimulation + conventional PT Duration: 90min/d, 5d/wk conventional PT & 45min/d, 4d/11d (average) FES/Sham	• Gait speed (-) • EMG TA Activity (-) • Functional independence measure ○ Locomotion (-)
You et al. (2014) RCT (6) N_{start}=42 N_{end}=37	E: Functional Electrical Stimulation (FES) + standard rehabilitation C: standard rehabilitation	• Fugl-Meyer Assessment (+exp) • Modified Barthel Index (+exp) • Berg Balance Scale (+exp) • Postural Assessment Scale for Stroke (-)

TPS=Acute	Duration: 30min/d FES & 60min/d standard rehabilitation, 5d/wk, for 3wks	• Composite Spasticity Scale (+exp)

Kottink et al. (2008)
RCT (6)
N_{start}=29
N_{end}=27
TPS=Chronic
	E: Implantable 2-channel peroneal nerve stimulator (FES) + conventional care
	C: Conventional care
	Duration: 26wk
		• Root Mean Square maximal voluntary contraction Tibialis anterior
		  ○ Knee in flexion (-)
		  ○ Knee in extension (+exp)
		• RMS MVC Peroneus Longus
		  ○ Knee in flexion (-)
		  ○ Knee in extension (-)
		• RMS MVC medial gastrocnemius
		  ○ Knee in flexion (+exp)
		  ○ Knee in extension (+exp)
		• Root Mean Square soleus (uV)
		  ○ Knee in flexion (-)
		  ○ Knee in extension (-)
		• Walking speed (-)
		• Tibialis anterior Activity During Swing Phase (-)

Kottink et al. (2007) RCT (7) N_{start}=29 N_{end}=27 TPS=Chronic	E: Implantable 2-channel peroneal nerve stimulator (FES) + conventional care C: Conventional care Duration: 26wk	• 10-Metre Walk Test (+exp) • 6-Minute Walk Test (-) • Activity level (-)
Yan et al. (2005) RCT (6) N_{start}=46 N_{end}=41 TPS=Acute	E1: Standard rehabilitation + FES E2: Standard rehabilitation + Placebo stimulation C: Standard rehabilitation Duration: 60min/d, 5d/wk, for 3wks Standard rehabilitation, 30min/d, 5d/wk, for 3wks FES, 60min/d, 5d/wk, for 3wks Placebo stimulation	E1/E2 vs C: • Composite Spasticity Scale (+exp1) • EMG Co-Contraction Ratio (+exp1) • Integrated EMG (+exp1) • Max Isometric Voluntary Contraction Torque (+exp1) • Timed Up and Go (+exp1) • % Subject Able to Walk (+exp1) E1 vs E2 • Composite Spasticity Scale (+exp1) • EMG Co-Contraction Ratio (+exp1) • Integrated EMG (+exp1) • Max Isometric Voluntary Contraction Torque (+exp1) • Timed Up and Go (+exp1) • % Subject Able to Walk (+exp1)
Newsam & Baker (2004) RCT (4) N_{start}=19 N_{end}=19 TPS=Subacute	E: FES + Standard physical therapy C: Standard physical therapy Duration: 60min/d, 6d/wk Physical therapy, 5d/wk FES during PT sessions, for 3wks	• Maximum Voluntary Isometric Torque-Knee Extension (-) • Supramaximal Contraction Torque (+exp) • Interpolated Twitch Test- Knee Extensor (+exp)
Burridge et al. (1997) RCT (5) N_{start}=33 N_{end}=32 TPS=Chronic	E: FES + conventional physiotherapy C: Conventional physiotherapy Duration: 60min/session, 10 sessions/month PT	• 10-m walk test (+exp) • Physiological Cost Index (+exp)
Bogataj et al. (1995) RCT crossover (6) N_{start}=20 N_{end}=20 TPS=Subacute	E: Multichannel FES C: Customized Conventional Therapy	• Fugl-Meyer score (+exp) • Stride length (+exp) • Gait speed (+exp) • Gait cadence (+exp)

	Duration: 60-120min/d, 5d/wk, for 3wks physical therapy & 30-60min/d, 5d/wk, for 3wks FES	
MacDonell et al. (1994) RCT (5) N_{start}=38 N_{end}=38 TPS=Acute	E: FES physical therapy + Cyclical electrical stimulation C: Conventional physical therapy Duration: 20min/d, 3-5d/wk for 4wks	• Functional Ambulation Category (-) • Barthel Index (-) • Fugl-Meyer Assessment (-) • Electrophysiological Findings (-)
FES Combined with Gait Training vs Gait Training or Conventional Therapy		
VanBloemendaal et al. (2021) RCT (8) N_{start}=40 N_{end}=34 TPS=Acute	E: Gait training + multi-channel functional electrical stimulation C: Conventional gait training Duration: 30min/d, 5d/wk, for 10wks	• Adherence (-) • Satisfaction with treatment (-) • Step length symmetry (-) • Step time asymmetry (-) • Single-leg stance time asymmetry (-) • Stride length (-) • Stride time (-) • 10m Walk test (-) • Functional gait assessment (-) • Berg Balance Scale (-)
Araki et al. (2020) RCT (5) N_{start}=14 N_{end}=14 TPS=Chronic	E: 14-m walking with FES on gluteus medius and tibialis anterior muscles C: 14-m walking without FES Duration: Single session	• Gait velocity (+exp) • Cadence (-) • Stride length (+exp) • Range of motion ○ Affected hip (-) ○ Affected knee (-) ○ Affected thigh (-) ○ Affected shank (+exp)
Sheffler et al. (2015) RCT (6) N_{start}=110 N_{end}=96 TPS=Subacute	E: Gait training + FES C: Gait training Duration: 1hr/d, 2d/wk for 12wks	• Gait speed (-) • Stride length (-) • Hip power (-) • Ankle power (-) • Cadence (-)
Spaich et al. (2014) RCT (6) N_{start}=30 N_{end}=28 TPS=Subacute	E: Physiotherapy-based gait training + FES on foot arch + Conventional Physiotherapy C: Physiotherapy-based gait training + Conventional Physiotherapy Duration: 30min/d, 20d/4wks Physiotherapy-based gait training; 40min/d, 5d/wk, for 4wks Conventional Physiotherapy	• Functional Ambulation category (-) • Walking speed ○ Preferred (-) ○ Maximum (-) • Stance time symmetry ratio (-) • For those with FAC0 ○ Stance phase (-) ○ Gait cycle (-) • For those with FAC1 ○ Stance phase (-) ○ Gait cycle (-) • For those with FAC2 ○ Stance phase (+exp) ○ Gait cycle (-)
Daly et al. (2011) RCT (7) N_{start}=53 N_{end}=44 TPS=Chronic	E: Gait training + Intramuscular FES C: Gait training Duration: 90min/d, 4d/wk for 12wks	• Gait Assessment & Intervention Tool (+exp)
Embrey et al. (2010) RCT crossover (4) N_{start}=33 N_{end}=28	E: FES of Dorsiflexors and Plantar Flexors + Overground Walking program	• 6min Walk Test (+exp) • Emory Functional Ambulatory profile (-) • Isometric muscle strength of ankle (-) • Modified Ashworth scale (-)

TPS=Chronic	C: Overground Walking program Duration: 6-8h/d, 7d/wk, for 3mo FES & 1h/d, 6d/wk, for 3mo Walking program	• Stroke Impact scale-16 (+exp)
Kojovic et al. (2009) RCT (5) N_{start}=13 N_{end}=13 TPS=Acute	E: Gait training + FES C: Gait training Duration: 45min/d, 5d/wk for 4wks	• 6-Metre Walk Test (+exp) • Fugl-Meyer Assessment (+exp) • Barthel Index (+exp) • Physiological Cost Index (+exp)
Daly et al. (2007) RCT (5) N_{start}=32 N_{end}=29 TPS=Chronic	E: Gait training + FNS-IM C: Gait training Duration: 90min/d, 5d/wk, for 12wks	• Hip/Knee Coordination Consistency ○ Involved Limb (+exp) ○ Uninvolved Limb (+exp)
Daly et al. (2006) RCT (7) N_{start}=32 N_{end}=29 TPS=Chronic	E: Gait training + Functional neuromuscular stimulation with intramuscular electrodes C: Gait training Duration: 90min/d, 4d/wk, for 12wks	• Tinetti Gait Scale (+exp) • Tinetti Balance Scale (-) • 6-Minute Walk Test (-) • Fugl-Meyer Assessment - Lower Extremity (-) • Knee Flexion Coordination (+exp) • Self-Reported Functional Milestones (-)
Cozean et al. (1988) RCT (6) N_{start}=36 N_{end}=32 TPS=Chronic	E1: Gait training + FES E2: Gait training + Biofeedback E3: Gait training + FES + Biofeedback C: Standard care Duration: 30min/d, 3d/wk for 6wks	E3 vs E1/E2/C • Gait cycle time (+exp3) • Stride length (-) • Knee flexion (+exp3) • Ankle flexion (+exp3)
Cycling with FES vs Cycling with or without Sham FES or Conventional Therapy		
Bustamante Valles et al. (2016) RCT (3) N_{start}=27 N_{end}=20 TPS=Chronic	E: Circuit Training (NESS L300 & Motomed Viva 2 FES+ Cycling) C: Conventional Therapy Duration: 2hrs, 24 sessions over 6-8wks	• Fugl-Meyer Assessment (+exp) • 6-Minute Walk Test (-) • 10-Meter Walk Test (-) • Timed Up and Go Test (-)
De Sousa et al. (2016) RCT (8) N_{start}=40 N_{end}=39 TPS=Subacute	E: Cycling + FES + conventional care C: Conventional care Duration: 32min/d of FES cycling + 1h conventional therapy 5d/wk, for 4wks experimental group, 60min conventional therapy in control	• Functional Independence Measure (-) • Muscle Strength ○ Affected Leg Knee Extensors (-) ○ Unaffected Leg Knee Extensors (-) • Manual Muscle Testing of Key of Affected LE Muscles (+exp) • Maximal Force (-) • Modified Tardieu Scale for Plantar Flexors o Affected Leg (-)
Peri et al. (2016) RCT (7) N_{start}=16 N_{end}=16 TPS=Acute	E: Active cycling + FES C: Physiotherapy Duration: 75min/d, 5d/wk for 3wks	• Mechanical Efficiency Index (+exp) • 6-Minute Walk Test (-) • Functional Independence Measure ○ Motor (-) ○ Cognitive (-) • Gait speed (-) • Double Support Time (-) • Unbalance U Score (-) • Area Symmetry Index (-) • Work Produced by Paretic Leg (-)

Bauer et al. (2015) RCT (7) N_{start}=40 N_{end}=39 TPS=Subacute	E: Active Leg Cycling + FES (unilaterally on the paretic lower limb) C: Active Leg Cycling Duration: 20min/d, 3d/wk for 4wks Cycling	• Functional Ambulation Category (+exp) • Performance-Oriented Mobility Assessment (+exp) • Motricity Index (-) • Modified Ashworth Scale (-) • Gait speed (+con)
Lo et al. (2012) RCT (4) N_{start}=29 N_{end}=23 TPS=Chronic	E: Functional electrical stimulation + cycling C: Cycling Duration: 20 min single session	• Limits of stability • Reaction time ○ Forward (-) ○ Backward (-) ○ Affected (-) ○ Unaffected (-) • Movement velocity ○ Forward (+con) ○ Backward (-) ○ Affected (-) ○ Unaffected (-) • Directional control ○ Forward (+exp) ○ Backward (-) ○ Affected (-) ○ Unaffected (-) • Endpoint excursion ○ Forward (+con) ○ Backward (-) ○ Affected (-) ○ Unaffected (-) • Maximum excursion ○ Forward (+exp) ○ Backward (-) ○ Affected (-) ○ Unaffected (-) • Muscle tone ○ H/M ratio (-) ○ Relaxation index (-)
Ambrosini et al. (2012) RCT (6) N_{start}=35 N_{end}=30 TPS=Subacute	E: Cycling induced by FES + Conventional Rehabilitation C: Cycling placebo FES + Conventional Rehabilitation Duration: 25min/d, 5d/wk, 4wks	• Motricity Index (+exp) • Gait Speed (-)
Ambrosini et al. (2011) RCT (8) N_{start}=35 N_{end}=30 TPS=Subacute	E: Cycling + FES C: Cycling + Sham FES Duration: 25min/d, 5d/wk for 4wks	• 50-Metre Walk Test (+exp) • Motricity Index (+exp) • Trunk Control Test (+exp) • Upright Motor Control Test (+exp) • Pedaling Unbalance (+exp)
Ferrante et al. (2008) RCT (6) Nstart=20 Nend=20 TPS=Subacute	E: FES + Cycling Ergometer + Conventional Care C: Conventional Care Duration: 35min/d, 5d/wk, for 4wks FES+ cycling & 3hr/d Conventional Care	• Trunk Control test (-) • Motricity index (-) • Upright Motor control test (-) • 50m Walk test (-) • Sit to Stand test ○ Raising speed from slow to self-selected (+exp) ○ Raising speed from self-selected to fast (-) • Maximal Voluntary contraction (+exp)
Janssen et al. (2008) RCT (4) N_{start}=16 N_{end}=12	E: Cycling + FES C: Cycling + Sham FES Duration: 30min/d, 2d/wk for 6wks	• MVC torque (-) • 6-Minute Walk Test (-) • Berg Balance Scale (-) • Rivermead Mobility Index (-)

TPS=Chronic		
Interval Cycling + FES vs Linear Cycling + FES		
Shariat et al. (2021) RCT (7) Nstart=36 Nend=30 TPS=Chronic	E: Leg cycling + FES with interval patterns timing C: Leg cycling + FES with linear patterns timing Duration: 28min/d, 3d/wk, for 4wks	• Functional ambulation classification (-) • 10-M Walk Test (-) • Timed up and go test (+exp) • Single leg stance (-) • Active Ankle ROM affected side (+exp) • Active Knee ROM affected side (+exp) • Spasticity in quadriceps (+exp) • Modified Ashworth scale (+exp) • Spasticity in plantar flexor (+exp)
Treadmill Training with FES vs Treadmill Training with or without Sham FES		
Awad et al. (2016) RCT (6) N_{start}=50 N_{end}=45 TPS=Chronic	E: Fast speed treadmill training + FES C1: Self-Selected Speed Treadmill Training C2: Fast Speed Treadmill Training Duration: 36 min (30min on treadmill + 6min overground walking)/session, 3d/wk, for 12wks	E vs C1/C2 • 6-Minute Walk Test (-) • Energy Cost at Comfortable Walking Speed (+exp) • Energy Cost at Fast Walking Speed (+exp)
Cho et al. (2015c) RCT (6) N_{start}=34 N_{end}=31 TPS=Chronic	E1: Treadmill training + FES on gluteus medius and tibialis anterior E2: Treadmill training + FES on tibialis anterior C: Treadmill training Duration: 30min, 5d/wk for 4wks treadmill training; 1hr, 5d/wk, for 4wks regular physical therapy	E1 vs E2/C • Medical research council scale (+exp1) • Berg Balance Scale (+exp1) • 6-min walk test (+exp1) • Cadence (+exp1) • Gait velocity (+exp1) • Muscle strength o TA (+exp1) o GM (+exp1) • Temporal asymmetry (+exp1) • Spatial asymmetry (+exp1) • Single support time (+exp1) • Double support time (+exp1) • Stride length (-)
Hwang et al. (2015) RCT (7) N_{start}=32 N_{end}=30 TPS=Chronic	E: Treadmill training with Tilt sensor FES + conventional physical therapy C: Treadmill training with Placebo Tilt sensor FES + conventional physical therapy Duration: 30min/d treadmill training with FES or placebo FES + 1hr/d conventional care, for 4wks	• 10m Walk Test (+exp) • Timed Up-and-Go Test (+exp) • Berg Balance Scale (+exp) • Muscle architecture Resting phase o Pennation angle paretic side (-) o Pennation angle non paretic side (-) o Muscle thickness paretic side (+exp) o Muscle thickness non paretic side (-) • Muscle architecture Contraction phase o Pennation angle paretic side (+exp) o Pennation angle non paretic side (-) o Muscle thickness paretic side (+exp) o Muscle thickness non paretic side (-)
Lee et al. (2013) RCT (6) N_{start}=30 N_{end}=30 TPS=Subacute	E: Body Weight-Supported Treadmill Training + functional electrical stimulation C: Body Weight Supported Treadmill Training Duration: 30mins/d, 5d/wk, for 4wks	• Berg Balance Scale (+exp) • Timed Up and Go test (+exp) • Stroke Rehabilitation Assessment of Movement (+exp) • Gait velocity (+exp) • cadence (+exp) • paretic step length (+exp) • stride length (+exp)
Robot-assisted Gait Training with FES vs Gait Training or Robot-assisted Gait Training		

Bae et al. (2014) RCT (7) N_{start}=20 N_{end}=20 TPS=Chronic	E: Robot-assisted (Lokomat) gait training + FES on the ankle dorsiflexor of affected side C: Robot-assisted (Lokomat) gait training Duration: 30min/d, 3d/wk for 5wks	• Modified Motor Assessment Scale (-) • Timed Up and Go Test (-) • Berg Balance Scale (-) • Maximal knee flexion (+exp) • Maximal knee extension (-) • Ankle dorsi/plantarflexion (-) • Pelvic range of motion (-) • Gait speed (-) • Cadence (-) • Stride Length (-)
Tong et al. (2006) RCT (7) N_{start}=50 N_{end}=46 TPS=Acute	E1: Electromechanical gait trainer + Functional electrical stimulation + Conventional PT E2: Electromechanical gait trainer + Conventional PT C: Gait training + Conventional PT Duration: 20min/d, 5d/wk, for 4wks Experimental intervention, 40min/d, 5d/wk, for 4wks Conventional PT	E1/E2 vs C • Motricity Index Leg Score (+exp1, +exp2) • Five-Meter Walking Speed Test (+exp1, +exp2) • Elderly Mobility Scale (+exp1, +exp2) • Berg Balance Scale (-) • Barthel Index (-) • Functional Ambulatory Category (+exp1, +exp2) • FIM Instrument Score (-) E1 vs E2 • Motricity Index Leg Score (-) • Five-Meter Walking Speed Test (-) • Elderly Mobility Scale (-) • Berg Balance Scale (-) • Barthel Index (-) • Functional Ambulation Category (-) • FIM Instrument Score (-)
Peurala et al. (2005) RCT (6) N_{start}=45 N_{end}=45 TPS=Chronic	E1: Electromechanical gait trainer + Functional electrical stimulation + Conventional therapy E2: Electromechanical gait trainer + Conventional therapy C: Overground gait training + Conventional therapy Duration: 20min/d, 5d/wk, for 3wks gait training, 55min/d, 5d/wk, for 3 wks Conventional therapy	E1/E2 vs C: • Walking Distance (+exp1) • 10-m Walking Time (-) • 6-Minute Walk (-) • Static Balance Test (-) • Dynamic Balance (time/trip) (-) • Postural Sway (-) • Muscle Force (-) • Functional Independence Measure (-) • Centre of Pressure (AP & ML) (-) • Modified Motor Assessment Scale (-) E1 vs E2: • Walking Distance (-) • 10-m Walking Time (-) • 6-Minute Walk (-) • Static Balance Test (-) • Dynamic Balance (time/trip) (-) • Postural Sway (-) • Muscle Force (-) • Functional Independence Measure (-) • Centre of Pressure (AP & ML) (-) • Modified Motor Assessment Scale (-)
Balance Training + FES vs Balance Training or Conventional Care		

Lee et al., (2020) RCT (7) N_{start}=49 N_{final}=49 TPS=Chronic	E: Balance Training + EMG-triggered FES + General Rehabilitation C: Balance Training without FES + General Rehabilitation Duration: 40mins/d, 5d/wk, for 6 wks General Rehabilitation & 40 mins/d, 5d/wk, for 6wks Balance trainings +/- FES	• Static balance (+exp) • Timed Up and Go (+exp) • Functional reach test (+exp) • Berg Balance scale (+exp) • Surface EMG (Leg muscle activation) (+exp)
Kunkel et al. (2013) RCT (6) N_{start}=21 N_{end}=21 TPS= Subacute	E1: Standing balance exercises + FES E2: Standing balance exercises C: Usual care Duration: 1hr/d, 4d/wk for 2wks interventions	E1 v E2 v C: • Symmetry of weight transfer ○ Weight through affected limb in parallel stance (-) ○ Weight transferred onto affected limb in parallel stance (-) ○ Weight transferred onto affected limb in stride stance (-) • Berg Balance Scale • Rivermead Mobility Index (-) • 10-Metre Walk Test ○ Normal walking (-) ○ Fast walking (-)
FES + Proprioceptive Neuromuscular Facilitation vs Proprioceptive Neuromuscular Facilitation		
Shim et al., (2020) RCT (4) N_{start}=40 N_{final}=33 TPS= Chronic	E: Proprioceptive neuromuscular facilitation (PNF) trunk pattern + EMG-triggered FES C: Proprioceptive neuromuscular facilitation (PNF) trunk pattern Duration: 30min/d, 5d/wk, for 4wks	• Trunk impairment scale (-) • Berg balance scale (-) • Dynamic gait index (-)
Ankle Training + BCI-based FES vs Ankle Training + FES		
Chung et al. (2020) RCT (6) N_{start}=26 N_{end}=25 TPS=Chronic	E: Ankle strengthening training + BCI-based FES on TA C: Ankle strengthening training + FES on TA Duration: 30min/session, 3d/wk for 5wks	• Timed-up and-go (-) • Berg Balance scale (-) • Gait velocity (+exp) • Gait cadence (+exp) • Stride length (-) • Step length (-) • Single support time (-)
Chung et al. (2015) RCT (5) N_{start}=10 N_{end}=10 TPS=Chronic	E: Ankle training + Brain-computer interference-based FES C: Ankle training + FES Duration: 30min/d, 5d	• Timed Up and Go Test (-) • Berg Balance Scale (-) • Cadence (-) • Step length (-) • Stride length (-)
FES + Tilt Table vs Conventional Therapy or Simple Tilt Table		
Calabro et al. (2015) RCT (5) N_{start}=20 N_{end}=20 TPS=Subacute	E: Robotic verticalization (ERIGO tilt table) + FES + dynamic foot support C: Physiotherapy-assisted verticalization (simple tilt-table) Duration: 30min/d, 5d/wk for 6wks	• Visual analog scale (+exp) • Ravens Coloured Progressive Matrices (+exp) • Fugl-Meyer Lower Extremity scale (+exp) • Medical Research Council scale (+exp) • Postural assessment scale for Stroke Patients (+exp) • Sensory-Motor plasticity (+exp)

Solopova et al. (2011) RCT (4) N_{start}=61 N_{end}=61 TPS=Acute	E: Functional Electrical Stimulation with Tilt Table C: Conventional Care Duration: 30min, 5d/wk, for 2wks	• Maximum Voluntary Contraction of Knee (+exp) • Ankle Range of Movement (+exp) • Fugl Meyer Assessment (+exp) • Barthel index (+exp) • National Institue of Health Stroke Scale (+exp) • European Stroke Scale (+exp)
FES + Motor Training on Rocker Board vs Conventional Exercises		
Cheng et al. (2010) RCT (6) N_{start}=18 N_{end}=15 TPS=Chronic	E: FES + motor training on rocker board + ankle focused ambulation training C: General exercises + ankle focused ambulation training Duration: 45min/d, 3d/wk for 4wks	• Dorsiflexion muscle strength ○ Affected side (-) ○ Nonaffected side (-) • Spasticity index (+exp) • Active ROM of ankle dorsiflexion (-) • Limit of stability ○ Forward (-) ○ Nonaffected side (-) ○ Backward (-) ○ Affected side (-) • Gait velocity (-) • Gait spatial asymmetry ratio (+exp) • Gait temporal asymmetry ratio (-) • Emory Functional Ambulation Profile (+exp) ○ Floor (+exp) ○ Up & go (-) ○ Obstacles (+exp) ○ Stairs (+exp)
FES vs Electrical Muscle Stimulation		
Sharif et al. (2017) RCT (4) N_{start}=38 N_{end}=38 TPS=Subacute	E: Functional Electrical Stimulation + Standard rehabilitation C: Electrical Muscle Stimulation tibialis anterior + Standard rehabilitation Duration: 30min/d, 5d/wk for 6wks	• Fugl-Meyer Assessment (+exp) • Timed-Up-and-Go (+exp) • Berg Balance Scale (+exp) • Modified Ashworth Scale (+exp) • Dynamic Gait Index (+exp)
FES + EMG-triggered NMES vs EMG-triggered NMES		
Mitsutake et al. (2019) RCT (6) N_{start}=41 N_{end}=36 TPS=Subacute	E1: Electromyography-triggered neuromuscular electrical stimulation + tilt sensor functional electrical stimulation training (combined electrical stimulation) + conventional physiotherapy E2: Electromyography triggered neuromuscular electrical stimulation training (single electrical stimulation) + conventional physiotherapy C: Conventional rehabilitation Duration: 60min/day, for 2wks	<u>E1 vs E2</u> • 10-meter walking tests (-) • Body sway ○ Vertical plane (-) ○ Mediolateral plane (-) ○ Anteriposterior plane (-) <u>E1/E2 vs C</u> • 10-meter walking tests (+exp1) • Body sway ○ Vertical plane (-) ○ Mediolateral plane (+exp1) ○ Anteriposterior plane (-)
Four-Channel FES vs Dual-Channel FES vs Sham		
Zheng et al. (2018) RCT (6) N_{start}=60 N_{end}=48 TPS=Acute	E1: Four-channel functional electrical stimulation (FES) + Standard physiotherapy E2: Dual-channel FES + Standard physiotherapy C: Sham FES + Standard physiotherapy	<u>E1 Vs C</u> • Postural Assessment Scale for Stroke Patients (+exp1) • Berg Balance Scale (+exp1) • Brunel Balance Assessment (+exp1) • Modified Barthel Index (+exp1) • Fugl-Meyer Assessment (-) <u>E2 Vs C</u>

	Duration: FES 30min/d + physiotherapy 120min/d, 5d/wk, for 3wks	• Postural Assessment Scale for Stroke Patients (-) • Berg Balance Scale (+exp2) • Brunel Balance Assessment (-) • Modified Barthel Index (+exp2) • Fugl-Meyer Assessment (-) E1 Vs E2 • Postural assessment scale for Stroke patients (+exp1) • Berg Balance Scale (+exp1) • Brunel Balance Assessment (+exp1) • Modified Barthel Index (+exp1) • Fugl-Meyer Assessment (-)
Tan et al. (2014) RCT (6) N_{start}=55 N_{end}=45 TPS=Subacute	E1: Four-channel FES + Conventional therapy E2: Dual-channel FES + Conventional therapy C: Sham stimulation + Conventional therapy Duration: 60min/d, 5d/wk for 3wks Conventional therapy & 30min/d, 5d/wk for 3wks FES/Sham	E1 vs E2 • Postural assessment scale for stroke patients (-) • Fugl-Meyer assessment-lower extremity (+exp1) • Berg Balance scale (-) • Functional Ambulation category (-) • Modified Barthel index (+exp1) E1 vs C • Fugl-Meyer assessment-lower extremity (-) • Berg Balance scale (+exp1) • Postural assessment scale for stroke patients (+exp1) • Functional Ambulation category (-) • Modified Barthel Index (+exp1)
Faradic Electrical Stimulation vs Russian Electrical Stimulation		
Ganesh et al. (2018) RCT (6) N_{start}=94 N_{end}=83 TPS=Chronic	E1: Faradic electrical stimulation + Task-oriented exercise E2: Russian electrical stimulation +Task-oriented exercises C: Conventional care with task-oriented approach Duration: E1, E2: 10min electrical stimulation + 40 min conventional care 5d/wk, for 6wks C: 40 min conventional care 5d/wk, for 6wks	E1 v E2 • Active ankle range of motion (-) • Passive ankle range of motion (+exp2) • Modified Ashworth scale (+exp1) • Modified Emory Functional ambulation profile (-) • Walking speed (-) E2 v C • Active ankle range of motion (-) • Passive ankle range of motion (+exp2) • Modified Ashworth scale (-) • Modified Emory Functional ambulation profile (-) • Walking speed (-) E1 v C • Active ankle range of motion (-) • Passive ankle range of motion (-) • Modified Ashworth scale (+exp1) • Modified Emory Functional ambulation profile (-) • Walking speed (-)
Mirror Therapy with Functional Electrical Stimulation vs Conventional Therapy		
Salhab et al. (2016) RCT crossover (5) N_{start}=18 N_{end}=18 TPS=Chronic	E: Mirror therapy + Functional electrical stimulation C: Conventional therapy Duration: E: 50 min, 4d/wk, 2 wks MT + 16min/session ES treatment C: 50 min, 4d/wk, 2 wks CT 1 wk washout	• Ankle dorsiflexion range of motion (+exp) • Fugl-Meyer assessment-lower extremity (+exp) • 10m Walk test (+exp)
Functional Electrical Stimulation vs Transcranial Direct Current Stimulation		
Zhang et al. (2021) RCT (5) N_{start}=122	E1: Transcranial direct current stimulation + conventional therapy	E1 V E2 • Fugl-Meyer Assessment (+exp1) • Barthel index (+exp1)

N_{end}=122
TPS=Subacute
	E2: Functional electrical stimulation + conventional therapy
	Duration: 20min/d, 5d/wk, for 8wks
		• Functional Ambulation Category (+exp1)
		• Somatosensory evoked potential (-)
		  ○ P40 latency and amplitude (-)
		  ○ N45 latency and amplitude (-)

Gait Training with FES vs Gait Training with tDCS vs Gait Training with tDCS + FES		

Mitsutake et al. (2020)
RCT (7)
N_{start}=37
N_{end}=34
TPS=Subacute
	E1: Gait training with FES + sham tDCS+ conventional rehabilitation
	E2: Gait training with tDCS + conventional rehabilitation
	E3: Gait training with tDCS and FES + conventional rehabilitation
	Duration: 40min/d , 7d/wk Conventional rehabilitation & 20min/d, 7d/wk Gait with Stimulation, for 1wk
		E1 v E2
		• 10m Walk test (-)
		• Trunk Acceleration
		  ○ All axis (-)
		• Autocorrelation coefficient
		  ○ All axis (-)
		• Root mean squared
		  ○ All axis (-)
		E1 v E3
		• 10m Walk test (-)
		• Trunk Acceleration
		  ○ All axis (-)
		• Autocorrelation coefficient
		  ○ Vertical axis (-)
		  ○ Mediolateral (+exp3)
		  ○ Anteroposterior axis (+exp3)
		• Root mean squared
		  ○ All axis (-)
		E2 v E3
		• 10m Walk test (-)
		• Trunk Acceleration
		  ○ All axis (-)
		• Autocorrelation coefficient
		  ○ Vertical and Mediolateral axis (-)
		  ○ Anteroposterior axis (+exp3)
		• Root mean squared
		  ○ All axis (-)

Peroneal Nerve FES (Foot-drop Stimulator) vs Ankle-Foot Orthosis		
Bethoux et al. (2014) RCT (5) N_{start}=495 N_{end}=399 TPS=Chronic	E: Peroneal nerve FES (WalkAide foot-drop stimulator) C: Ankle-foot orthosis Duration: 2wk progressive wearing schedule, followed by wearing devices for all walking throughout the day for 6mo	• 10m Walking Test (-) • 6-Minute Walk Test (-) • Timed Up and Go Test (-) • Berg Balance scale (-) • Functional Ambulation Profile (-) • Modified Emory Functional Ambulation Profile (-) • Stroke Impact Scale (-) • Stroke-specific Quality of Life (-) • Serious adverse event (-)

Everaert et al. (2013)
RCT (6)
N_{start}=120
N_{end}=99
TPS=Chronic
	E1: 6wk of Peroneal nerve FES (WalkAide Foot-Drop Stimulator) followed by 6wk of Ankle Foot Orthosis ; (AFO)
	E2: 6wk of Ankle Foot Orthosis followed by 6wk of Peroneal nerve FES (WalkAide Foot-Drop Stimulator)
	C: Ankle Foot Orthosis only
	Duration:
	E1: 6wk FES followed by 6wk AFO
	E2: 6wk AFO followed by 6wk FES
	C: 12wk AFO
		E1 vs E2/C
		• Modified Rivermead Mobility Index (-)
		• perceived safety level (-)
		• 10-meter speed
		  ○ Device On (-)
		  ○ Device Off (-)
		• Figure-8 speed
		  ○ Device On (-)
		  ○ Device Off (-)
		• Physiological Cost Index
		  ○ Device On (-)
		  ○ Device Off (-)
		E2 vs C
		• Mobility Index (-)
		• perceived safety level (-)
		• 10-meter speed
		  ○ Device On (-)

		○ Device Off (-) • Figure-8 speed ○ Device On (-) ○ Device Off (-) • Physiological Cost Index ○ Device On (+exp3) ○ Device Off (-)
Kluding et al. (2013) RCT (5) N_{start}=197 N_{end}=162 TPS= Chronic	E: Peroneal nerve FES Foot-drop stimulator + conventional therapy + home exercise C: Ankle foot orthosis + conventional therapy + sham stimulation + home exercise Duration: 8 physical therapy sessions over 6wks, then 24wks - physical therapy at home	• 10-meter walk test (-) ○ Comfortable gait speed (-) ○ Fast gait speed (-) • 6-min walk distance (-) • Timed up and go (-) • Berg Balance Scale (-) • Functional reach distance (-) • Fugl-Meyer Lower Extremity (-) • Stroke Impact Scale ○ participation scores (-) ○ mobility (-) • Step activity (-)
Salisbury et al. (2013) RCT (6) N_{start}=16 N_{end}=14 TPS= Subacute	E: Odstock Drop Foot Stimulator (Peroneal nerve FES) C: Ankle-foot orthosis Duration: Not Specified	• 10-Metre Walk Test (-) • Functional Ambulation Classification (-) • Stroke Impact Sale (-)
Sheffler et al. (2006) RCT crossover (5) N_{start}=14 N_{end}=14 TPS=Chronic	E1: Odstock Dropped-foot Stimulator (peroneal nerve FES) E2: Customized unilateral ankle-foot orthosis C: No Intervention Duration: single session - 30min washout	E1/E2 vs C: • Modified Emory Functional Ambulation Profile ○ Carpet (+exp_1, +exp_2) ○ Floor (+exp_2) ○ Up and go (+exp_2) E1 vs E2: • Modified Emory Functional Ambulation Profile (-)
Peroneal Nerve FES (Foot-drop Stimulator) vs Conventional Therapy or Gait Training		
Hachisuka et al. (2021) RCT (6) N_{start}=119 N_{end}=114 TPS=Chronic	E: Self-directed physical training + therapist-assisted gait training with Peroneal nerve FES device C: Self-directed training + therapist-assisted gait training without stimulation device Duration: 480min self-directed training over 4wks, 260min conventional therapy +/- nerve stimulation	• 6-minute walking test (-) • 10 metre walking test (-) • Fugl-Meyer Assessment Lower extremity (-) • Japanese version of Stroke Impact Scale ○ Physical score (-) ○ Stroke recovery (+exp) ○ Function and ADl (-) • Modified Ashworth Scale (-) • Ankle dorsiflexion ROM (-)
Sheffler et al. (2013) RCT (7) N_{start}=110 N_{end}=96 TPS=Chronic	E: Peroneal nerve FES + Gait-based physiotherapy C: Gait-based physiotherapy without FES Duration: 60min/d, 2d/wk, for 5wks training session & up to 8hr/d using devices for home and community mobility	• Fugl-Meyer Assessment LE (-) • Modified Emory Functional Ambulation Profile (-) • Stroke Specific Quality of Life (-)
Kottink et al. (2012) RCT (5) N_{start}=29	E: Peroneal Nerve FES (Implantable 2-Channel Peroneal Nerve Stimulator)	• Walking speed (-) • Stride time (-) • Stride length (-)

N_{end}=23
TPS=Chronic
	C: Conventional Therapy
	Duration: 5 sessions over 26 weeks
		• Stride width (-)
		• Step length
		  ○ Paretic (-)
		  ○ Non-paretic (-)
		• Stance phase
		  ○ Paretic (+exp)
		  ○ Non-paretic (-)
		• First double support phase
		  ○ Paretic (+exp)
		  ○ Non-paretic (-)
		• First single support phase
		  ○ Paretic (-)
		  ○ Non-paretic (+exp)
		• Hip flexion-extension ROM (-)
		• Minimum hip angle during stance (-)
		• Maximum hip angle during swing (-)
		• Knee flexion-extension ROM (-)
		• Minimum knee angle during stance (+exp)
		• Maximum knee angle during initial/mid swing (-)
		• Ankle dorsi-plantarflexion on ROM (+exp)
		• Minimum ankle angle during swing (+exp)
		• Knee angle at initial contact (+exp)
		• Ankle angle at initial contact (-)

Peroneal Nerve Stimulation vs Sham Stimulation or Conventional Therapy		

Mrachacz-Kersting et al. (2019)
RCT (9)
N_{start}=24
N_{end}=24
TPS=Subacute
	E: Cortex activation-based peripheral peroneal nerve stimulation
	C: Sham stimulation
	Duration: 3d/wk, for 4wks
		• Modified Rankin scale (-)
		• Fugl-Meyer-lower extremity motor performance (+exp)
		• Ashworth scale (-)
		• Functional Ambulation category (-)
		• 10-Meter Walk test (-)
		• EMG activity
		  ○ Resting motor threshold (-)
		  ○ Tibialis Anterior MEPs amplitude (-)

Sheffler et al. (2015) RCT (6) N_{start}=110 N_{end}=62 TPS=Subacute	E: Functional gait training + Peroneal nerve stimulator C: Functional gait training Duration: 60min/d, 2-3d/wk, 12wks	• Cadence (-) • Double Support Time (-) • Stride Length (-) • Walking Speed (-) • Peak Ankle Dorsiflexion (-) • Peak Hip Power (-) • Peak Ankle Power (-)
Yavuzer et al. (2007) RCT (7) N_{start}=30 N_{end}=30 TPS=Subacute	E: Conventional therapy + Sensory-Amplitude Electric Stimulation to peroneal nerve of the paretic leg C: Conventional therapy + Sham stimulation Duration: 120-300min/d, 5d/wk, for 4wks conventional therapy & 30min/d, 5d/wk, for 4wks SES/placebo	• Brunnstrom stages of lower extremity (-) • Walking velocity (-) • Step length (-) • stance phase (-) • Pelvis/Hip/Knee/Ankle Sagittal plane total excursion (-) • Maximum ankle DF at swing (-) • Maximum ankle PF at initial contact (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group

+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Functional Electrical Stimulation

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**FES combined with gait training** may produce greater improvements in motor function compared to **gait training or conventional therapy.**	2	Kojovic et al. 2009; Daly et al. 2006
2	**FES combined with a tilt table** may produce greater improvements in motor function than **conventional therapy or a simple tilt table.**	2	Calabro et al. 2015; Solopova 2011
1b	**FES** may produce greater improvements in motor function than **electrical muscle stimulation.**	1	Sharif et al. 2017
2	**FES combined with mirror therapy** may produce greater improvements in motor function than **conventional therapy.**	1	Salhab et al. 2016
2	**FES** may produce greater improvements in motor function than **transcranial direct current stimulation.**	1	Zhang et al. 2021
1a	There is conflicting evidence about the effect of **cycling with FES** to improve motor function when compared to **cycling or conventional therapy.**	3	Bustamante Valles et al. 2016; Ambrosini et al. 2011; Ferrante et al. 2008
1b	There is conflicting evidence about the effect of **FES** to improve motor function when compared to **conventional therapy or sham stimulation**.	4	Dujovic et al. 2017; You et al. 2014; MacDonell et al. 1994; Bogotai et al. 1995
1a	There is conflicting evidence about the effect of **four-channel FES** to improve motor function when compared to **dual-channel FES**.	2	Zheng et al. 2018; Tan et al. 2014
1a	There is conflicting evidence about the effect of **peroneal nerve stimulation** to improve motor function when compared to **sham stimulation**.	2	Mrachacz-Kersting et al. 2019; Yavuzer et al. 2007
1a	**Four-channel FES** may not have a difference in efficacy compared to **sham stimulation** for improving motor function.	2	Zheng et al. 2018; Tan et al. 2014
1b	**Dual-channel FES** may not have a difference in efficacy compared to **sham stimulation** for improving motor function.	1	Zheng et al. 2018
2	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **ankle foot orthoses** for improving motor function.	1	Kluding et al. 2013
1a	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **conventional therapy or gait training** for improving motor function.	2	Hachisuka et al 2021; Sheffler et al. 2013

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Treadmill training with FES** may produce greater improvements in functional ambulation than **treadmill training with or without sham FES.**	4	Awad et al. 2016; Cho et al. 2015; Hwang et al. 2015; Lee et al. 2013
1b	**Treadmill training with FES on gluteus medius and tibialis anterior** may produce greater improvements in functional ambulation than **treadmill training with FES on tibialis anterior.**	1	Cho et al. 2015
1b	**FES** may produce greater improvements in functional ambulation compared to **electrical muscle stimulation.**	1	Sharif et al. 2017
1b	**FES combined with EMG-triggered neuromuscular stimulation** may produce greater improvements in functional ambulation compared to **conventional care.**	1	Mitsutake et al. 2019
2	**Mirror therapy combined with FES** may produce greater improvements in functional ambulation than **conventional therapy.**	1	Salhab et al. 2016
2	**FES** may produce greater improvements in functional ambulation than **transcranial direct current stimulation.**	1	Zhang et al. 2021
1b	There is conflicting evidence about the effect of **FES** to improve functional ambulation when compared to **conventional therapy or sham stimulation.**	8	Dujovic et al. 2017; Wilkinson et al. 2015; Lairamore et al. 2014; Yan et al. 2005; Kottink et al. 2007; Burridge et al. 1997; Bogataj et al. 1995; MacDonell et al. 1994
1a	There is conflicting evidence about the effect of **robot-assisted gait training with FES** to improve functional ambulation compared to **overground walking or conventional therapy.**	2	Tong et al. 2006; Peurala et al. 2005
1b	There is conflicting evidence about the effect of **FES combined with motor training on a rocker board** to improve functional ambulation when compared to **conventional exercises.**	1	Cheng et al. 2010
1b	**FES combined with gait training** may not have a difference in efficacy compared to **gait training or conventional therapy** for improving functional ambulation.	7	VanBloemendaal et al. 2021; Araki et al. 2020; Sheffler et al. 2015; Spaich et al. 2014; Embrey et al. 2010; Kojovic et al. 2009; Daly et al. 2006
1b	**Cycling with FES** may not have a difference in efficacy compared to **cycling or conventional therapy** for improving functional ambulation.	7	Bustamante Valles et al. 2016; Peri et al. 2016; Bauer et al. 2015; Ambrosini et al. 2012; Ambrosini et al. 2011; Ferrante et al. 2008; Janssen et al. 2008
1b	**Interval cycling with FES** may not have a difference in efficacy compared to **linear cycling with FES** for improving functional ambulation.	1	Shariat et al. 2021

1a	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training** for improving functional ambulation.	3	Tong et al. 2006; Peurala et al. 2005; Bae et al. 2014
1a	**Balance training with FES** may not have a difference in efficacy compared to **balance training or conventional therapy** for improving functional ambulation.	2	Lee et al. 2020; Kunkel et al. 2013
1a	**Ankle training with BCI-based FES** may not have a difference in efficacy compared to **ankle training with FES** for improving functional ambulation.	2	Chung et al. 2020; Chung et al. 2015
1b	**FES combined with EMG-triggered neuromuscular stimulation** may not have a difference in efficacy compared to **EMG-triggered neuromuscular stimulation** for improving functional ambulation**.**	1	Mitsutake et al. 2019
1b	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **ankle foot orthoses** for improving functional ambulation.	5	Bethoux et al. 2014; Everaert et al. 2013; Kluding et al. 2013; Salisbury et al. 2013; Sheffler et al. 2006
2	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **no treatment** for improving functional ambulation.	1	Sheffler et al. 2006
1b	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **conventional therapy or gait training** for improving functional ambulation.	3	Hachisuka et al. 2021; Kottink et al. 2012; Sheffler et al. 2013
1b	**Four-channel FES** may not have a difference in efficacy compared to **sham stimulation or dual-channel FES** for improving functional ambulation**.**	1	Tan et al. 2014
1b	**Faradic electrical stimulation** may not have a difference in efficacy compared to **conventional care or Russian electrical stimulation or conventional care** for improving functional ambulation.	1	Ganesh et al. 2018
1b	**Gait training with FES** may not have a difference in efficacy compared to **gait training with tDCS or gait training with tDCS stimulation and FES** for improving functional ambulation.	1	Mitsutake et al. 2020
1a	**Peroneal nerve stimulation** may not have a difference in efficacy compared to **sham stimulation** for improving functional ambulation.	2	Mrachacz-Kersting et al. 2019; Yavuzer et al. 2007
1b	**Peroneal nerve stimulation with functional gait training** may not have a difference in efficacy compared to **gait training alone** for improving functional ambulation.	1	Sheffler et al. 2015

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**

1b	**Treadmill training with FES** may produce greater improvements in functional mobility than **treadmill training with or without sham FES.**	1	Lee et al. 2013
1b	**Robot-assisted gait training with FES** may produce greater improvements in functional mobility compared to **overground walking or conventional therapy.**	1	Tong et al. 2006
1b	**FES** may not have a difference in efficacy compared to **conventional care or sham stimulation** for improving functional mobility.	1	Wilkinson et al. 2015
2	**Cycling with FES** may not have a difference in efficacy compared to **cycling or conventional therapy** for improving functional mobility.	1	Janssen et al. 2008
1b	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training** for improving functional mobility.	1	Tong et al. 2006
1b	**Balance training with FES** may not have a difference in efficacy compared to **balance training or conventional therapy** for improving functional mobility.	1	Kunkel et al. 2013
1b	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **ankle foot orthoses** for improving functional mobility.	1	Everaert et al. 2013

BALANCE

LoE	Conclusion Statement	RCTs	References
1a	**Treadmill training with FES** may produce greater improvements in balance than **treadmill training with or without sham stimulation.**	3	Cho et al. 2015; Hwang et al. 2015; Lee et al. 2013
1b	**Treadmill training with FES on gluteus medius and tibialis anterior** may produce greater improvements in balance than **treadmill training with FES on tibialis anterior.**	1	Cho et al. 2015
2	**FES with a tilt table** may produce greater improvements in balance than **a simple tilt table or conventional therapy.**	1	Calabro et al. 2015
1b	**FES** may produce greater improvements in balance than **electrical nerve stimulation.**	1	Sharif et al. 2017
1a	**Four-channel FES** may produce greater improvements in balance compared to **sham stimulation.**	2	Zheng et al. 2018; Tan et al. 2014
1a	**Four-channel FES** may produce greater improvements in balance compared to **dual-channel FES.**	2	Zheng et al. 2018; Tan et al. 2014
1a	There is conflicting evidence about the effect of **balance training with FES** to improve balance compared to **balance training alone or conventional care.**	2	Lee et al. 2020; Kunkel et al. 2013

1b	There is conflicting evidence about the effect of **dual-channel FES** to improve balance compared to **sham stimulation.**	1	Zheng et al. 2018
1a	**FES** may not have a difference in efficacy compared to **conventional therapy or sham stimulation** for improving balance.	2	Dujovic et al. 2018; You et al. 2014
1a	**FES combined with gait training** may not have a difference in efficacy compared to **gait training or conventional therapy** for improving balance.	2	VanBloemendaal et al. 2021; Daly et al 2006
1a	**Cycling with FES** may not have a difference in efficacy compared to **cycling with or without sham FES or conventional therapy** for improving balance.	5	Bauer et al. 2015; Ambrosini et al. 2011; Ferrante et al. 2008; Lo et al. 2012; Janssen et al. 2008
1b	**Interval cycling with FES** may not have a difference in efficacy compared to **linear cycling with FES** for improving balance.	1	Shariat et al. 2021
1a	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training** for improving balance.	3	Bae et al. 2014; Tong et al. 2006; Peurala et al. 2005
1a	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **overground walking or conventional therapy** for improving balance.	2	Tong et al. 2006; Peurala et al. 2005
2	**FES with proprioceptive neuromuscular facilitation** may not have a difference in efficacy compared to **proprioceptive neuromuscular facilitation** for improving balance.	1	Shim et al. 2020
1a	**Ankle training combined with BCI-based FES** may not have a difference in efficacy compared to **ankle training combined with FES** for improving balance.	2	Chung et al. 2020; Chung et al. 2015
1b	**FES with motor training on a rocker board** may not have a difference in efficacy compared to **conventional exercises** for improving balance.	1	Cheng et al. 2010
1b	**FES with EMG-triggered neuromuscular stimulation** may not have a difference in efficacy compared to **EMG-triggered neuromuscular stimulation or conventional care** for improving balance.	1	Mitsutake et al. 2019
2	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **ankle foot orthoses** for improving balance.	2	Bethoux et al. 2014; Kluding et al. 2013

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Treadmill training with FES** may produce greater improvements in gait than **treadmill training with or without sham stimulation.**	2	Cho et al. 2015; Lee et al. 2013
1b	**Treadmill training with FES on gluteus medius and tibialis anterior** may produce greater	1	Cho et al. 2015

	improvements in gait than **treadmill training with FES on tibialis anterior.**		
1b	**FES** may produce greater improvements in gait when compared to **electrical muscle stimulation.**	1	Sharif et al. 2017
1a	There is conflicting evidence about the effect of **FES** to improve gait compared to **conventional therapy or sham stimulation**.	3	Wilkinson et al. 2015; Bogataj et al. 1995; Kottink et al. 2008
1b	There is conflicting evidence about the effect of **gait training with FES and biofeedback** to improve gait compared to **gait training with FES**.	1	Cozean et al. 1988
1b	There is conflicting evidence about the effect of **gait training with FES and biofeedback** to improve gait compared to **gait training with biofeedback**.	1	Cozean et al. 1988
1b	There is conflicting evidence about the effect of **gait training with FES and biofeedback** to improve gait compared to **conventional care**.	1	Cozean et al. 1988
1b	There is conflicting evidence about the effect of **FES with motor training on a rocker board** to improve gait compared to **conventional exercises.**	1	Cheng et al. 2010
1b	**FES combined with gait training** may not have a difference in efficacy compared to **gait training or conventional therapy** for improving gait.	5	VanBloemendaal et al. 2021; Daly et al. 2011; Araki et al. 2020; Sheffler et al. 2015; Spaich et al. 2014
1b	**Cycling with FES** may not have a difference in efficacy compared to **cycling with or without sham FES and conventional therapy** for improving gait.	1	Peri et al. 2016
1b	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training** for improving gait.	1	Bae et al. 2014
1b	**Balance training with FES** may not have a difference in efficacy compared to **balance training or conventional care** for improving gait.	1	Kunkel et al. 2013
2	**FES with proprioceptive neuromuscular facilitation** may not have a difference in efficacy compared to **proprioceptive neuromuscular facilitation** for improving gait.	1	Shim et al. 2020
1a	**Ankle training with brain-computer interference-based FES** may not have a difference in efficacy compared to **ankle training with FES** for improving gait.	2	Chung et al. 2020; Chung et al. 2015
1b	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **ankle foot orthoses** for improving gait.	1	Everaert et al. 2013
2	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **gait training or conventional therapy** for improving gait.	1	Kottink et al. 2012
1b	**Peroneal nerve stimulation** may not have a difference in efficacy compared to **sham stimulation** for improving gait.	1	Yavuzer et al. 2007

1b	**Peroneal nerve stimulation with functional gait training** may not have a difference in efficacy compared to **gait training** for improving gait.	1	Sheffler et al. 2015

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**FES combined with gait training** may produce greater improvements in activities of daily living when compared to **gait training or conventional therapy.**	1	Kojovic et al. 2009
2	**FES with tilt table** may produce greater improvements in activities of daily living when compared to **conventional therapy or a simple tilt table**.	1	Solopova et al. 2011
1a	**Four-channel FES** may produce greater improvements in activities of daily living when compared to **sham stimulation or dual-channel stimulation**.	2	Zheng et al. 2018; Tan et al. 2014
2	**FES** may produce greater improvements in activities of daily living when compared to **tDCS.**	1	Zhang et al. 2021
1b	**FES** may not have a difference in efficacy compared to **conventional therapy or sham stimulation** for improving activities of daily living.	6	Dujovic et al. 2017; Wilkinson et al. 2015; You et al. 2014; Lairamore et al. 2014; Kottink et al. 2007; MacDonell et al. 1994
1a	**Cycling with FES** may not have a difference in efficacy compared to **cycling with or without sham stimulation or conventional therapy** for improving activities of daily living.	2	De Sousa et al. 2016; Peri et al. 2016
1a	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training** for improving activities of daily living.	3	Bae et al. 2014; Tong et al. 2006; Peurala et al. 2005
1a	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **overground walking or conventional therapy** for improving activities of daily living.	2	Tong et al. 2006; Peurala et al. 2005
1b	**Dual-channel FES** may not have a difference in efficacy compared to **sham stimulation** for improving activities of daily living.	1	Zheng et al. 2018
1b	**Peroneal nerve stimulation** may not have a difference in efficacy compared to **sham stimulation** for improving activities of daily living.	1	Mrachacz-Kersting et al. 2019

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Gait training with FES and biofeedback** may produce greater improvements in range of motion compared to **gait training with FES.**	1	Cozean et al. 1988

1b	**Gait training with FES and biofeedback** may produce greater improvements in range of motion compared to **gait training with biofeedback.**	1	Cozean et al. 1988
1b	**Gait training with FES and biofeedback** may produce greater improvements in range of motion compared to **conventional care.**	1	Cozean et al. 1988
1b	**Interval cycling combined with FES** may produce greater improvements in range of motion compared to **linear cycling combined with FES.**	1	Shariat et al. 2021
2	**FES with a tilt table** may produce greater improvements in range of motion than **conventional care or a simple tilt table.**	1	Solopova et al. 2011
2	**Mirror therapy combined with FES** may produce greater improvements in range of motion compared to **conventional therapy.**	1	Salhab et al. 2016
1b	There is conflicting evidence about the effect of **Russian electrical stimulation** to improve range of motion compared to **Faradic electrical stimulation or conventional care.**	1	Ganesh et al. 2018
2	**FES combined with gait training** may not have a difference in efficacy compared to **gait training alone or conventional therapy** for improving range of motion.	1	Araki et al. 2020
1b	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training** for improving range of motion.	1	Bae et al. 2014
1b	**FES combined with motor training on a rocker board** may not have a difference in efficacy compared to **conventional exercises** for improving range of motion.	1	Cheng et al. 2010
1b	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **conventional therapy or gait training** for improving range of motion.	2	Hachisuka et al. 2021; Kottink et al. 2012
1b	**Faradic electrical stimulation** may not have a difference in efficacy compared to **conventional care** for improving range of motion.	1	Ganesh et al. 2018
1b	**Peroneal nerve stimulation** may not have a difference in efficacy compared to **sham stimulation** for improving range of motion.	1	Yavuzer et al. 2007
1b	**Peroneal nerve stimulation with functional gait training** may not have a difference in efficacy compared to **gait training alone** for improving range of motion.	1	Sheffler et al. 2015

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References

1b	**Treadmill training with FES** may produce greater improvements in muscle strength compared to **treadmill training with or without sham FES.**	1	Cho et al. 2015
1b	**Treadmill training with FES on gluteus medius and tibialis anterior** may produce greater improvements in muscle strength compared to **treadmill training with FES on tibialis anterior.**	1	Cho et al. 2015
2	**FES with a tilt table** may produce greater improvements in muscle strength than **conventional care or a simple tilt table.**	2	Solopova et al. 2011; Calabro et al. 2015
1b	There is conflicting evidence about the effect of **FES** to improve muscle strength compared to **conventional therapy or sham stimulation**.	3	Kottink et al. 2008; Newsam and Baker, 2004; Yan et al. 2005
1a	There is conflicting evidence about the effect of **robot-assisted gait training with FES** to improve muscle strength compared to **conventional therapy or overground walking.**	2	Tong et al. 2006; Peurala et al. 2005
2	**FES combined with gait training** may not have a difference in efficacy compared to **gait training or conventional therapy** for improving muscle strength.	1	Embrey et al. 2010
1a	**Robot-assisted gait training with FES** may not have a difference in efficacy compared to **robot-assisted gait training** for improving muscle strength**.**	2	Tong et al. 2006; Peurala et al. 2005
1a	**Cycling with FES** may not have a difference in efficacy compared to **conventional therapy or cycling with or without sham FES** for improving muscle strength.	6	De Sousa et al. 2016; Bauer et al. 2015; Ambrosini et al. 2012; Ambrosini et al. 2011; Ferrante et al. 2008; Janssen et al. 2008
1b	**FES with motor training on a rocker board** may not have a difference in efficacy compared to **conventional exercises** for improving muscle strength.	1	Cheng et al 2010

SPASTICITY

LoE	Conclusion Statement	RCTs	References
1a	**FES** may produce greater improvements in spasticity compared to **conventional therapy or sham stimulation**.	2	You et al. 2014; Yan et al. 2005
1b	**Interval cycling with FES** may produce greater improvements in spasticity compared to **linear cycling with FES.**	1	Shariat et al. 2021
1b	**FES with motor training on a rocker board** may produce greater improvements in spasticity compared to **conventional exercises.**	1	Cheng et al. 2010
1b	**FES** may produce greater improvements in spasticity compared to **electrical muscle stimulation.**	1	Sharif et al. 2017
1b	**Faradic electrical stimulation** may produce greater improvements in spasticity than **Russian electrical stimulation or conventional care.**	1	Ganesh et al. 2018

2	**FES combined with gait training** may not have a difference in efficacy compared to **gait training or conventional therapy** for improving spasticity.	1	Embrey et al. 2010
1a	**Cycling with FES** may not have a difference in efficacy compared to **cycling with or without sham stimulation or conventional therapy** for improving spasticity.	2	Bauer et al. 2015; De Sousa et al. 2016
1b	**Russian electrical stimulation** may not have a difference in efficacy compared to **conventional care** for improving spasticity.	1	Ganesh et al. 2018
1b	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **conventional therapy or gait training** for improving spasticity.	1	Hachisuka et al. 2021
1b	**Peroneal nerve stimulation** may not have a difference in efficacy compared to **sham stimulation** for improving spasticity.	1	Mrachacz-Kersting et al. 2019

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**FES combined with gait training** may produce greater improvements in quality of life compared to **gait training alone or conventional therapy**.	1	Embrey et al. 2010
2	**FES** may not have a difference in efficacy compared to **conventional therapy or sham stimulation** for improving quality of life.	1	Wilkinson et al. 2015
1b	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **ankle foot orthoses** for improving quality of life.	3	Bethoux et al. 2014; Kluding et al. 2013; Salisbury et al. 2013
1a	**Peroneal nerve FES (foot-drop stimulator)** may not have a difference in efficacy compared to **conventional therapy or gait training** for improving quality of life.	2	Hachisuka et al. 2021; Sheffler et al. 2013

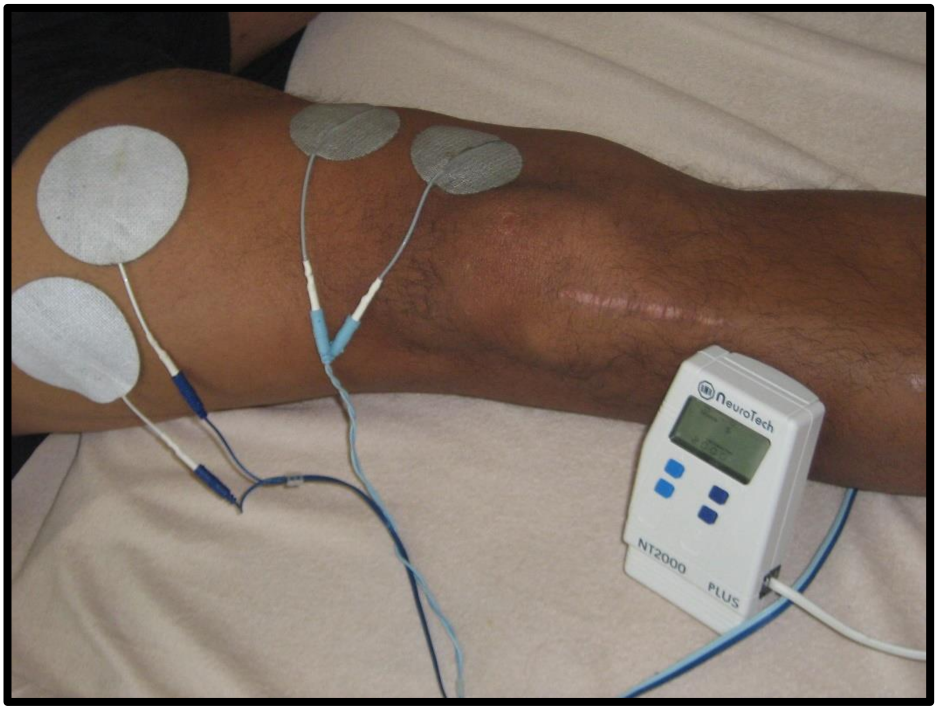
STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**FES with tilt table** may produce greater improvements in stroke severity compared to **conventional therapy or a simple tilt table**.	1	Solopova et al. 2011

Key Points

The literature is mixed concerning the effect of functional electrical stimulation on improving motor function, functional ambulation, balance, gait, range of motion, muscle strength, and spasticity. The effect is varied by the type of intervention combined with functional electrical stimulation.

Functional electrical stimulation may not be beneficial for improving mobility and quality of life after stroke.

Neuromuscular Electrical Stimulation (NMES)



Adopted from: https://swordsphysio.ie/physiotherapy-treatments/neuromuscular-stimulation/

Neuromuscular electrical stimulation (NMES) is a technique used to generate muscle contractions in regions affected by hemiparesis by stimulating lower motor neurons involved in muscle movement through transcutaneous application of electrical currents (Allen & Goodman, 2014; Monte-Silva et al., 2019).

1. Cyclic NMES in which a muscle is repetitively stimulated at near maximum contraction on a pre-set schedule and patient participation is passive (Nascimento et al., 2014).
2. Electromyography (EMG) triggered NMES, in which a target muscle is directly controlled or triggered by volitional EMG activity from the target or a different muscle to elicit a desired stimulation (Monte-Silva et al., 2019).

Interferential current therapy (ICT) is a variation of NMES that uses two medium frequency currents to create a 100Hz interference wave across the skin which exerts its maximal effect deeper in the tissue of the treatment area (Goats, 1990).

A total of 18 RCTs were found that evaluated different NMES techniques.

Two RCTs looked at cyclic NMES compared to conventional therapy or neurodevelopmental techniques (Bakhtiary & Fatemy, 2008; Yavuzer et al., 2007). Two RCTs compared NMES to conventional therapy (Bilek et al., 2020; Yavuzer et al., 2006b). One RCT compared EMG-triggered NMES to stretching (Yang et al., 2018). One RCT compared EMG-triggered NMES to conventional therapy (Mesci et al., 2009). A single RCT compared interferential current NMES with air-pump massage to sham stimulation (Suh et al., 2014a). One RCT compared cyclic NMES with passive movement training to cyclic NMES on its own or passive movement training (Yamaguchi et al., 2012). One RCT compared cyclic NMES with trunk training to cyclic NMES on its own or core training (Ko et al., 2016). One RCT compared various cyclic NMES stimulation intensities (Wang et al., 2016a). Two RCTs compared contralaterally controlled NMES to cyclic NMES (Knutson et al., 2013; Shen et al., 2022). Two RCTs compared cyclic NMES with mirror therapy to conventional therapy (Lee et al., 2016a; Xu et al., 2017). One RCT compared NMES to mirror therapy (Pagilla et al., 2019). One RCT compared NMES with exercise therapy to exercise therapy alone (Busk et al., 2021). One RCT compared NMES with walking therapy to conventional walking training with an ankle foot orthosis (Morone et al., 2012a). One RCT compared Botox injections combined with NMES of injected and agonist muscles to Botox injections combined with NMES of injected muscles alone (Baricich et al., 2019).

The methodological details and results of all 18 RCTs are presented in Table 31.

Table 31. RCTs Evaluating Neuromuscular Electrical Stimulation Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Sizestart Sample Sizeend Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Cyclic NMES vs Conventional Therapy or Neurodevelopmental Techniques		
Bakhtiary & Fatemy (2008) RCT (8) N_{start}=40 N_{end}=35 TPS=Not reported	E: Cyclic NMES + Bobath C: Bobath Approach Duration: 15min/d bobath & 9min/d NMES, 20d	• PROM ankle dorsiflexion (+exp) • Ankle Dorsiflexion Muscle Manual Test (+exp) • Hmax/Mmax Ratio (-) • Modified Ashworth Scale(+exp)
Yavuzer et al. (2007) RCT (7) N_{start}=25 N_{end}=25 TPS=Subacute	E: Cyclic NMES C: Conventional Therapy Duration: 30min/d, 5d/wk, for 4wks	• Brunnstrom Recovery Stage (-) • Gait kinematics (-)
NMES vs Conventional Therapy		
Bilek et al., 2020 RCT (5) N_{start}=60 N_{final}=60 TPS= Not reported	E: NMES (50Hz) + conventional care C: Conventional care Duration: 45min/d of conventional care, 20min/d of NMES, 5d/wk for 6wks	• Follow-up (at wk 6) results: • Brunnel balance assessment (-) • Functional Ambulation classification (-) • Adapted Patient Evaluation and Conference system (-) • Postural assessment scale for stroke patients (+exp) • Short Form-36 (-) • Mini-Mental state examination (-) • Stroke Rehabilitation Movement Assessment (+exp)
Yavuzer et al. (2006b) RCT (7) N_{start}=25 N_{end}=25 TPS=Subacute	E: NMES + Conventional rehabilitation C: Conventional rehabilitation Duration: 10min/d, 5d/wk, for 4wks NMES, 2-5hr/d, 5d/wk, for 4wks Conventional rehabilitation	• Brunnstrom Stage for Lower Extremity (-) • Walking Velocity (-) • Step Length (-) • Stance Phase (-) • Pelvis/Hip/Knee/Ankle Sagittal Plane Total Excursion (-) • Maximum Ankle DF at Swing (-) • Maximum Ankle PF at Initial Contact (-)
EMG-triggered NMES vs Stretching		
Yang et al. (2018) RCT (6) N_{start}=25 N_{end}=25 TPS=Chronic	E1: Neuromuscular electrical stimulation (NMES) on tibialis anterior + ambulation training E2: NMES on medial gastrocnemius + ambulation training C: Stretching & ROM exercise + ambulation training	E1/E2 vs C • Walking velocity (-) • Cadence (-) • Step length affected (-) • Step length unaffected (-) • Spatial asymmetry (+exp1) • Temporal asymmetry (+exp2) • Ankle dorsiflexion strength (+exp1) • Ankle plantarflexion strength (-)

	Duration: 20min/d NMES or stretching & 15min/d ambulation training, 3d/wk, for 7wks	• Modified Ashworth Scale (-) • Spasticity Index (-) • CV of ankle dorsiflexion at HS (-) • CV of ankle plantarflexion in push off (-) • MP of dorsiflexion at HS (-) • MP of plantarflexion in push off (+exp1) E1 vs E2 • Walking velocity (-) • Cadence (-) • Step length affected (-) • Step length unaffected (-) • Spatial asymmetry (-) • Temporal symmetry (-) • Ankle dorsiflexion strength (-) • Ankle plantarflexion strength (-) • Modified Ashworth Scale (-) • Spasticity Index (+exp1) • CV of ankle dorsiflexion at HS (-) • CV of ankle plantarflexion in push off (-) • MP of dorsiflexion at HS (-) • MP of plantarflexion in push off (-)
EMG-triggered NMES vs Conventional Therapy		
Mesci et al. (2009) RCT (6) N_{start}=40 N_{end}=40 TPS=Chronic	E: EMG-triggered NMES C: Conventional therapy Duration: 20min/d, 5d/wk, for 4wks NMES & 5d/wk, for 4wks conventional therapy	• Ankle passive dorsiflexion range of motion (-) • modified Ashworth scale (-) • Brunnstrom Stage (-) • Functional independence measurement (-) • Functional Ambulation Categories (-) • Rivermead motor assessment score (-)
Interferential Current NMES with Air-pump Massage vs Sham		
Suh et al. (2014) RCT (6) N_{start}=42 N_{end}=42 TPS=Chronic	E: Interferential current therapy (ICT) stimulation of gastrocnemius + air-pump massage + standard rehabilitation C: Placebo-ICT + air-pump massage + standard rehabilitation Duration: 60min/session, 1 session ICT & 30min/session, 1 session standard rehabilitation	• Modified Ashworth Scale (+exp) • Functional Reach Test (+exp) • Berg Balance Scale (+exp) • Timed Up and Go (+exp) • 10-meter walk test (+exp) •
Cyclic NMES vs Passive Movement Training		
Yamaguchi et al. (2012) RCT (8) N_{start}=27 N_{end}=27 TPS=Subacute	E1: Passive Movement Training + cyclic NMES E2: Cyclic NMES E3: Passive Movement Training Duration: 20min, 1session	E1 vs E2: • Gait Speed (+exp1) • Modified Ashworth Scale (-) E1 vs E3: • Gait Speed (+exp1) • Modified Ashworth Scale (-) E2 vs E3: • Gait Speed (-) • Modified Ashworth Scale (-)
Cyclic NMES vs Trunk/Core Training		
Ko et al. (2016) RCT (6) N_{start}=34 N_{end}=30 TPS=Acute	E1: Trunk NMES + Core muscle training E2: Trunk NMES C: Core Training Duration: 20min/d, 3d/wk, for 3wks	E1 vs C • Trunk Impairment Scale (-) ○ Dynamic Sitting Balance (+exp1) • Berg Balance Scale (+exp1) • Postural Assessment for Stroke Scale (-) • Modified Barthel Index (-)

		E1 vs E2 • Trunk Impairment Scale (-) 　○ Dynamic Sitting Balance (-) • Berg Balance Scale (+exp1) • Postural Assessment for Stroke Scale (-) • Modified Barthel Index (-)
Comparison of Cyclic NMES Stimulation Intensity		
Wang et al. (2016) RCT (6) N_{start}=72 N_{end}=66 TPS=Acute	E1: Sensory threshold NMES + Conventional therapy E2: Motor threshold NMES + Conventional therapy E3: Full-movement NMES + Conventional therapy C: Conventional therapy Duration: 60min/d, 5d/wk, for 4wks NMES	E3 vs E1/E2/C • Composite Spasticity Scale (+exp3) • Ankle active dorsiflexion (+exp3) • Timed Up & Go Test (-)
Contralaterally Controlled NMES vs Cyclic NMES or NMES		
Shen et al. (2022) RCT (7) N_{start}=44 N_{end}=42 TPS=Subacute	E1: Contralaterally controlled NMES + conventional therapy E2: NMES + conventional therapy Duration: 15min/d, 5d/wk for 3wks	• Fugl-meyer lower extremity (+exp1) • Modified barthel index (+exp1) • Surface electromyography 　○ Average EMG (+exp1) 　○ integrated EMG (+exp1) 　○ Root mean sqaure (+exp1)
Knutson et al. (2013) RCT (6) N_{start}=26 N_{end}=24 TPS=Chronic	E: Contralaterally controlled NMES (self-administered at home) + Conventional gait training C: Cyclic NMES (self-administered at home) + Conventional gait training Duration: 51min, 2x/d, 5d/wk, for 6wks self-administered NMES & 45min/d, 2d/wk, for 6wks conventional gait training	• Fugl-Meyer assessment (-) • Maximum dorsiflexion angle (-) • Ankle movement tracking error (-) • Maximum isometric dorsiflexion (-) • Modified Emory Functional Ambulation profile (-) • Gait velocity (-) • Dorsiflexion angle (-) • Peak knee flexion in swing (-) • Peak hip flexion in swing (-) • Stride length (-) • Cadence (-)
Mirror Therapy with Cyclic NMES vs Conventional Therapy		
Xu et al. (2017) RCT (7) N_{start}=69 N_{end}=69 TPS=Subacute	E1: Conventional rehabilitation + mirror therapy + NMES E2: Conventional rehabilitation + mirror therapy C: Conventional rehabilitation + Sham mirror therapy Duration: 240min/d, 5d/wk, for 4wks conventional rehabilitation + 30min/d mirror/sham/mirror+NMES	E1/E2 v C • 10-meter walk test (+exp1, +exp2) • Brunnstrom stages of lower extremity (+exp1, +exp2) • Modified Ashworth Scale (+exp1) • Passive ROM (+exp1, +exp2) E1 v E2 • 10-meter walk test (+exp1) • Brunnstrom stages of lower extremity (-) • Modified Ashworth Scale (-) • Passive ROM (-)
Lee et al. (2016) RCT (6) N_{start}=30 N_{end}=27 TPS=Chronic	E: Mirror therapy + cyclical NMES + conventional physical therapy C: Conventional therapy Duration: 60min/d, 5d/wk, for 4wks conventional PT & 1x/d, 5d/wk, for 4wks MT + NNES	• Ankle Dorsiflexor Strength (+exp) • Modified Ashworth Scale (-) • Berg Balance Scale (+exp) • Timed-up-and-go (-) • 6-minute Walk Test (-)
NMES vs Mirror Therapy		

Pagilla et al. (2019) RCT (8) N_{start}=30 N_{end}=30 TPS=Acute	E: NMES + Conventional Therapy C: Mirror Therapy + Conventional Therapy Duration: conventional for 60min, mirror/NMES for 30min, 6 consecutive days	• Berg Balance Scale (-) • Barthel Index (-) • Fugl-Meyer Assessment (-)
NMES with Exercise Therapy vs Exercise Therapy		
Busk et al. (2021) RCT (7) N_{start}=50 N_{end}=47 TPS=Acute	E: Neuromuscular electrical stimulation + Exercise therapy C: Exercise therapy Duration: 10min/d, 5d/wk, for 2wks	• Fugl-Meyer Assessment (-) • 6 min walk test (-) • 10 m Walk Test (-) • Guralnik Timed Standing Balance (-) • Sit to Stand (-) • Timed Up and Go (-) • EQ-5D-5L (-) • Montreal Cognitive Assessment (-) • Becks Depression Inventory (-)
NMES with Walking Training vs Conventional Walking Training with Ankle-Foot Orthosis		
Morone et al. (2012b) RCT (5) N_{start}=20 N_{end}=20 TPS=Acute	E: NMES (Walkaide) + walking training + conventional therapy C: Walking training + ankle-foot-orthosis + conventional therapy Duration: 40min/d, 5d/wk, for 4wks Walking training with NMES or AFO & 40min/d, 5d/wk, for 4wks conventional therapy	• 10-Metre Walk Test (+exp) • Functional Ambulation Classification (+exp) • Barthel Index (-) • Rivermead Mobility Index (-) • Medical Research Council Scale (-) • Canadian Neurological Scale (-) • Ashworth Scale (-) • Manual Muscle Test (-)
NMES with Botulinum Toxin Type A		
Baricich et al. (2019) RCT (7) N_{start}=30 N_{end}=30 TPS=Chronic	E: Botox Injections (50U-120U) + Electrical Stimulation of Antagonist and Injected Agonist Muscles C: Botox Injections (50U-120U) + Electrical Stimulation of Injected Agonist Muscles Duration: Physiotherapy 60min/d, 5d/wk, for 2wks - Electrical Stimulation 60min, 1 session for agonist, 5 for antagonist	• 10-Meter Walk Test (-) • Modified Ashworth Scale (-) • Passive Range of Motion (-) • Medical Research Council (-) • 2-Minute Walk Test (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Neuromuscular Electrical Stimulation

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Mirror therapy with cyclic NMES** may produce greater improvements in motor function compared to **conventional therapy**.	1	Xu et al. 2017
1a	There is conflicting evidence about the effect of **contralaterally controlled NMES** to improve motor function compared to **cyclic NMES or NMES.**	2	Shen et al. 2022; Knutson et al. 2013
1b	**Cyclic NMES** may not have a difference in efficacy compared to **conventional therapy or neurodevelopmental techniques for** improving motor function.	1	Yavuzer et al. 2007
1b	**NMES** may not have a difference in efficacy compared to **conventional therapy** for improving motor function.	1	Yavuzer et al. 2006
1b	**EMG-triggered NMES** may not have a difference in efficacy compared to **conventional therapy** for improving motor function.	1	Mesci et al. 2009
1b	**Mirror therapy with cyclic NMES** may not have a difference in efficacy compared to **mirror therapy** for improving motor function.	1	Xu et al. 2017
1b	**NMES** may not have a difference in efficacy compared to **mirror therapy** for improving motor function.	1	Pagilla et al. 2019
1b	**NMES with exercise therapy** may not have a difference in efficacy compared to **exercise therapy** for improving motor function.	1	Busk et al. 2021

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Cyclic NMES combined with passive movement training** may produce greater improvements in functional ambulation than **passive movement training or cyclic NMES alone.**	1	Yamaguchi et al. 2012
1b	**Interferential current NMES with air pump massage** may produce greater improvements in functional ambulation than **sham stimulation.**	1	Suh et al. 2014
1b	**Mirror therapy with cyclic NMES** may produce greater improvements in functional ambulation compared to **mirror therapy alone.**	1	Xu et al. 2017
2	**NMES with walking training** may produce greater improvements in functional ambulation than **conventional walking training.**	1	Morone et al. 2012
1b	**NMES** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	2	Yavuzer et al. 2006; Bilek et al. 2020

1b	**EMG-triggered NMES on the tibialis anterior or medial gastrocnemius** may not have a difference in efficacy compared to **stretching** for improving functional ambulation**.**	1	Yang et al. 2018
1b	**EMG-triggered NMES on the tibialis anterior** may not have a difference in efficacy compared to **EMG-triggered NMES on the medial gastrocnemius** for improving functional ambulation**.**	1	Yang et al. 2018
1b	**EMG-triggered NMES** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	1	Mesci et al. 2009
1b	**Cyclic NMES** may not have a difference in efficacy compared to **passive movement training** for improving functional ambulation.	1	Yamaguchi et al. 2012
1b	**Full-movement NMES** may not have a difference in efficacy compared to **sensory threshold NMES** for improving functional ambulation.	1	Wang et al. 2016
1b	**Full-movement NMES** may not have a difference in efficacy compared to **motor threshold NMES** for improving functional ambulation.	1	Wang et al. 2016
1b	**Full-movement NMES** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	1	Wang et al. 2016
1b	**Contralaterally controlled NMES** may not have a difference in efficacy compared to **cyclic NMES** for improving functional ambulation.	1	Knutson et al. 2013
1a	**Mirror therapy with cyclic NMES** may not have a difference in efficacy compared to **conventional therapy** for improving functional ambulation.	2	Xu et al. 2017; Lee et al. 2016
1b	**NMES with exercise therapy** may not have a difference in efficacy compared to **exercise therapy** for improving functional ambulation.	1	Busk et al. 2021
1b	**NMES of antagonist muscles with Botox injection of agonist muscles** may not have a difference in efficacy compared to **Botox injection combined with NMES of agonist muscles** for improving functional ambulation.	1	Baricich et al. 2019

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
2	**NMES** may produce greater improvements in functional mobility compared to **conventional therapy.**	1	Bilek et al. 2020
2	**NMES with walking training** may not have a difference in efficacy compared to **conventional walking training** for improving functional mobility.	1	Morone et al. 2012

BALANCE

LoE	Conclusion Statement	RCTs	References

1b	**Interferential current NMES with air-pump massage** may produce greater improvements in balance than **sham stimulation.**	1	Suh et al. 2014
2	There is conflicting evidence about the effect of **NMES** for improving balance compared to **conventional therapy.**	1	Bilek et al. 2020
1b	There is conflicting evidence about the effect of **cyclic NMES combined with trunk training** to improve balance when compared to **cyclic NMES** alone.	1	Ko et al. 2016
1b	**Cyclic NMES combined with trunk training** may not have a difference in efficacy compared to **core training** for improving balance.	1	Ko et al. 2016
1b	**Mirror therapy with cyclic NMES** may not have a difference in efficacy compared to **conventional therapy** for improving balance.	1	Lee et al. 2016
1b	**NMES** may not have a difference in efficacy compared to **mirror therapy** for improving balance.	1	Pagilla et al. 2019
1b	**NMES with exercise training** may not have a difference in efficacy compared to **exercise training** for improving balance.	1	Busk et al. 2021

GAIT

LoE	Conclusion Statement	RCTs	References
1b	**Cyclic NMES** may not have a difference in efficacy compared to **conventional therapy or neurodevelopmental techniques** for improving gait.	1	Yavuzer et al. 2007
1b	**NMES** may not have a difference in efficacy compared to **conventional therapy** for improving gait.	1	Yavuzer et al. 2006
1b	**EMG-triggered NMES on the tibialis anterior or on the medial gastrocnemius** may not have a difference in efficacy compared to **stretching** for improving gait.	1	Yang et al. 2018
1b	**EMG-triggered NMES on the tibialis anterior** may not have a difference in efficacy compared to **EMG-triggered NMES on the medial gastrocnemius** for improving gait.	1	Yang et al. 2018
1b	**Contralaterally-controlled NMES** may not have a difference in efficacy compared to **cyclic NMES or NMES** for improving gait.	1	Knutson et al. 2013

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
2	**NMES** may not have a difference in efficacy compared to **conventional therapy** for improving activities of daily living.	1	Bilek et al. 2020

1b	**EMG-triggered NMES** may not have a difference in efficacy compared to **conventional therapy** for improving activities of daily living.	1	Mesci et al. 2009
1b	**Cyclic NMES combined with trunk training** may not have a difference in efficacy compared to **cyclic NMES or core training alone** for improving activities of daily living.	1	Ko et al. 2016
1b	**Contralaterally-controlled NMES** may produce greater improvements in activities of daily living compared to **NMES or cyclic NMES.**	1	Shen et al. 2022
1b	**NMES** may not have a difference in efficacy compared to **mirror therapy** for improving activities of daily living.	1	Pagilla et al. 2019
2	**NMES with walking training** may not have a difference in efficacy compared to **conventional walking training** for improving activities of daily living.	1	Morone et al. 2012

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Cyclic NMES** may produce greater improvements in range of motion compared to **neurodevelopmental techniques or conventional therapy.**	1	Bakhtiary & Fatemy 2008
1b	**Full movement cyclic NMES** may produce greater improvements in range of motion compared to **sensory threshold cyclic NMES.**	1	Wang et al. 2016
1b	**Full movement cyclic NMES** may produce greater improvements in range of motion compared to **motor threshold NMES.**	1	Wang et al. 2016
1b	**Full movement cyclic NMES** may produce greater improvements in range of motion compared to **conventional therapy.**	1	Wang et al. 2016
1b	**Mirror therapy with cyclic NMES** may produce greater improvements in range of motion compared to **conventional therapy.**	1	Xu et al. 2017
1b	**EMG-triggered NMES** may not have a difference in efficacy compared to **conventional therapy** for improving range of motion.	1	Mesci et al. 2009
1b	**Contralaterally-controlled NMES** may not have a difference in efficacy compared to **cyclic NMES or NMES** for improving range of motion.	1	Knutson et al. 2013
1b	**Mirror therapy with cyclic NMES** may not have a difference in efficacy compared to **mirror therapy alone** for improving range of motion**.**	1	Xu et al. 2017
1b	**NMES of antagonist muscles with Botox in agonist muscles** may not have a difference in efficacy compared to **NMES and Botox combined in agonist muscles** for improving range of motion.	1	Baricich et al. 2019

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Cyclic NMES** may produce greater improvements in muscle strength compared to **conventional therapy or neurodevelopmental techniques.**	1	Bakhtiary & Fatemy 2008
1b	**Mirror therapy with cyclic NMES** may produce greater improvements in muscle strength compared to **conventional therapy.**	1	Lee et al. 2016
1b	There is conflicting evidence about the effect of **EMG-triggered NMES on the tibialis anterior or medial gastrocnemius** to improve muscle strength compared to **stretching.**	1	Yang et al. 2018
1b	**EMG-triggered NMES on the tibialis anterior** may not have a difference in efficacy compared to **EMG-triggered NMES on the medial gastrocnemius** for improving muscle strength.	1	Yang et al. 2018
2	**NMES with walking training** may not have a difference in efficacy compared to **conventional walking training** for improving muscle strength.	1	Morone et al. 2012
1b	**NMES of antagonist muscles with Botox of agonist muscles** may not have a difference in efficacy compared to **NMES and Botox combined of agonist muscles** for improving muscle strength.	1	Baricich et al. 2019

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Cyclic NMES** may produce greater improvements in spasticity than **conventional therapy or neurodevelopmental techniques.**	1	Bakhtiary & Fatemy 2008
1b	**EMG-triggered NMES** may produce greater improvements in spasticity compared to **conventional therapy.**	1	Mesci et al 2009
1b	**Interferential current NMES with air-pump massage** may produce greater improvements in spasticity compared to **sham stimulation.**	1	Suh et al. 2014
1b	**Full movement cyclic NMES** may produce greater improvements in spasticity compared to **sensory threshold NMES.**	1	Wang et al. 2016
1b	**Full movement cyclic NMES** may produce greater improvements in spasticity compared to **motor threshold NMES.**	1	Wang et al. 2016
1b	**Full movement cyclic NMES** may produce greater improvements in spasticity compared to **conventional therapy.**	1	Wang et al. 2016

1b	There is conflicting evidence about the effect of **EMG-triggered NMES on the tibialis anterior** to improve spasticity compared to **EMG-triggered NMES on the medial gastrocnemius.**	1	Yang et al. 2018
1a	There is conflicting evidence about the effect of **mirror therapy combined with cyclic NMES** to improve spasticity compared to **conventional therapy.**	2	Xu et al. 2017; Lee et al. 2016
1b	**EMG-triggered NMES on the tibialis anterior or medial gastrocnemius** may not have a difference in efficacy compared to **stretching** for improving spasticity.	1	Yang et al. 2018
1b	**Cyclic NMES combined with passive movement training** may not have a difference in efficacy compared to **cyclic NMES or passive movement training alone** for improving spasticity.	1	Yamaguchi et al 2012
1b	**Cyclic NMES** may not have a difference in efficacy compared to **passive movement training** for improving spasticity.	1	Yamaguchi et al 2012
1b	**Mirror therapy combined with cyclic NMES** may not have a difference in efficacy compared to **mirror therapy alone** for improving spasticity.	1	Xu et al. 2017
2	**NMES with walking training** may not have a difference in efficacy compared to **conventional walking training** for improving spasticity.	1	Morone et al. 2012
1b	**NMES of antagonist muscles with Botox of agonist muscles** may not have a difference in efficacy compared to **NMES and Botox of agonist muscles** for improving spasticity.	1	Baricich et al. 2019

STROKE SEVERITY

LoE	Conclusion Statement	RCTs	References
2	**NMES with walking training** may not have a difference in efficacy compared to **conventional walking training** for improving stroke severity.	1	Morone et al. 2012

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
2	**NMES** may not have a difference in efficacy compared to **conventional therapy** for improving quality of life.	1	Bilek et al. 2020
1b	**NMES with exercise therapy** may not have a difference in efficacy compared to **exercise therapy** for improving quality of life.	1	Busk et al. 2021

Key Points

NMES may not be beneficial for improving motor function, functional ambulation, gait, activities of daily living, and quality of life after stroke.

The literature is mixed regarding the effect of NMES on improving mobility, balance, muscle strength, range of motion and spasticity after stroke.

Transcutaneous Electrical Nerve Stimulation (TENS)

Adopted from: https://nerve-injury.com/transcutaneous-electrical-nerve-stimulation/

Transcutaneous electrical nerve stimulation (TENS) involves the application of electrical current through surface electrodes on the skin to facilitate activation of nerves (Teoli et al., 2024). TENS units are often small, portable, battery-operated devices, and have been used over antagonist muscles to reduce the spasticity of corresponding agonist muscles in stroke rehabilitation practice (Koyama et al., 2016; Teoli et al., 2024).

One possible neural mechanism underlying the reduced spasticity induced by TENS is improved spinal inhibitory reflexes from the stimulated muscle groups or nerve to the reciprocal muscle groups or nerve (Koyama et al., 2016). The application of afferent electrical stimulation at the sensory level may help to enhance neuroplasticity of the brain, through increased activation and recruitment of cortical networks involving contralesional primary sensory cortex, supplementary motor area, dorsal premotor cortex, posterior parietal cortex, and secondary sensory cortices (Sonde et al., 1998; Veldman et al., 2015).

A total of 23 RCTs were found evaluating TENS interventions for lower extremity motor rehabilitation. Nine RCTs compared TENS to sham stimulation, conventional therapy, or no stimulation (Cho et al., 2013a; Ertzgaard et al., 2018; Gürcan et al., 2015; Hussain & Mohammad, 2013; Levin & Hui-Chan, 1992; Martins et al., 2012; Park et al., 2014b; Tyson et al., 2013; Yan & Hui-Chan, 2009). Two RCTs compared TENS combined with exercise to sham TENS with exercise, TENS only, or no treatment (Ng & Hui-Chan, 2009; Tekeoglu et al., 1998). Five RCTs compared TENS and task-related training to sham TENS and no treatment (Chan et al., 2015; Hui-Chan et al., 2009; Laddha et al., 2016; Ng & Hui-Chan, 2007; Ng et al., 2016). One RCT compared unilateral to bilateral TENS (Kwong et al., 2018). One RCT compared TENS to NMES and conventional therapy (Yen et al., 2019). One RCT compared TENS to therapeutic ultrasound or botulinum toxin A injections (Picelli et al., 2014). One RCT compared high and low frequency TENS to electroacupuncture (Johansson et al., 2001). One RCT compared balance training with TENS to balance training with sham TENS and conventional care (Jung et al., 2016). One RCT compared trunk training with balance training and TENS to treadmill training with placebo TENS

(Lim, 2019). One RCT compared TENS with heel-raise-lower training to placebo TENS with heel-raise-lower training (Jung et al., 2020b).

The methodological details and results of all 23 RCTs are presented in Table 32.

Table 32. RCTs Evaluating Transcutaneous Electrical Stimulation Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
TENS vs Sham Stimulation, Conventional Therapy or No Treatment		
Ertzgaard et al. (2018) (Mixed population, cerebral palsy) RCT crossover (10) N_{start}=15 N_{end}=Not reported TPS=Chronic	E: Full-Body TENS (AT, Mollii) at home C: Sham TENS at home Duration: 60min/d, 3-4x/wk, for 6wks - 6wk washout	• 10-Meter Walk Test (-) • Timed Up and Go Test (-) • Modified Ashworth Scale (-)
Gurcan et al. (2015) RCT (5) N_{start}=32 N_{end}=32 TPS= Chronic	E: TENS + Conventional therapy C: Conventional therapy Duration: 20min/d, 5d/wk, for 3wks TENS	• 10-Metre Walk Test (+exp) • Functional Ambulation Scale (-) • Functional Independence Measure (-) • Brunnstrom Recovery Stage (-) • Modified Ashworth Scale (-) • Range of Motion dorsiflexion (-) • Clonus Score (-)
Park et al. (2014) RCT (6) N_{start}=34 N_{end}=29 TPS=Chronic	E: Transcutaneous electrical nerve stimulation (TENS) + therapeutic exercise C: Placebo TENS + therapeutic exercise Duration: 30min/d, 5d/wk, for 6wks	• Modified Ashworth Scale (+exp) • Timed Up and Go test (+exp) • Anterior-posterior postural sway (+exp) • Medial-lateral postural sway (+exp) • Velocity moment (+exp) • Gait velocity (-) • Cadence (+exp) • Paretic step length (+exp) • Paretic stride length (+exp)

Cho et al. (2013)
RCT (5)
N_{start}=50
N_{end}=42
TPS=Chronic
	E: TENS 100Hz + physical therapy
	C: Sham TENS condition + physical therapy
	Duration: One-time 30min physical therapy+ 60min TENS/sham
		• Modified Ashworth Scale (+exp)
		• Ankle plantarflexor spasticity by handheld dynamometer (+exp)
		• Postural sway
		  ○ eyes open (-)
		  ○ eyes closed (+exp)

Hussain et al. (2013) RCT (6) N_{start}=35 N_{end}=30 TPS=Subacute	E: TENS C: No TENS Duration: 30min/d, 5d/wk for 4wks	• 10-Metre Walk Test (+exp) • Brunnstrom Recovery Stage (+exp) • Dorsiflexion range of motion (+exp) • Dorsiflexion strength (+exp) • Modified Ashworth Scale (+exp)

Tyson et al. (2013)
RCT Crossover (6)
N_{start}=29
N_{end}=29
TPS=Chronic
	E: TENS
	C: Sham TENS
	Duration: 2h session
		• Joint position sense of the ankle
		  ○ plantarflexor (+exp)
		  ○ dorsiflexor (-)
		• Maximum isometric strength
		  ○ plantarflexor (+exp)
		  ○ dorsiflexor (-)
		• Reach Test (+exp)
		• 10-m walk (+exp)

Martins et al. (2012) RCT Crossover (4) N_{start}=20 N_{end}=16 TPS=Chronic	E1: Transcutaneous electrical nerve stimulation E2: Cryotherapy C: No treatment Duration: 30min, 1d – non-consecutive washout	E1 vs C • Hmax/Mmax ratio (+exp1) • H-reflex latency (-) E2 vs C • Hmax/Mmax ratio (+exp2) • H-reflex latency (+exp2)

		E1 vs E2 • Hmax/Mmax ratio (+exp1) • H-reflex latency (+exp1)
Yan & Hui-Chan (2009) RCT (5) N_{start}=62 N_{end}=56 TPS=Acute	E1: TENS + standard rehabilitation E2: Sham TENS + standard rehabilitation C: standard rehabilitation Duration: 60min/d, 5d/wk for 3wks TENS/Sham & 60min/d standard rehabilitation	E1/E2 vs C • Composite Spasticity Scale ○ total (-) ○ subjects with normal resistance (+exp1) • EMG co-contraction ratio (+exp1) • Max Isometric Voluntary Contraction torque (+exp1) • Timed Up & Go (-) E1 vs E2 • Composite Spasticity Scale ○ total (-) ○ subjects with normal resistance (+exp1) • EMG co-contraction ratio (-) • Max Isometric Voluntary Contraction torque (-) • Timed Up & Go (-)
Levin & Hui-Chan (1992) RCT (5) N_{start}=13 N_{end}=13 TPS=Chronic	E: TENS C: Sham TENS Duration: 60min/d, 5d/wk, for 3wks	• Composite Spasticity Scale (+exp) • H/Mmax response ratio (-) • Vibratory inhibition H reflex (+exp) • Stretch reflexes (+exp) • Maximal voluntary isometric plantarflexion (-) • Maximal voluntary isometric dorsiflexion (+exp)
TENS + exercise vs Sham TENS + exercise, TENS only, or No Treatment		
Ng & Hui-Chan (2009) RCT (7) N_{start}=109 N_{end}=109 TPS= Chronic	E1: TENS + Exercise E2: Sham TENS + Exercise E3: TENS C: No active treatment Duration: 60min/d, 5d/wk, for 4wks TENS/placebo & 60min/d, 5d/wk, for 4wks exercises	E1/E2/E3 vs C • 6-minute walk test (+exp1, +exp3) • timed up and go (+exp1, +exp2, +exp3) • Gait velocity(+exp1) E1/E2 vs E3 • 6-minute walk test (-) • timed up and go(+exp1) • Gait velocity(+exp1) E1/E3 vs E2 • 6-minute walk test (+exp1) • timed up and go (+exp1) • Gait velocity (+exp1)
Tekeoğlu et al. (1998) RCT (5) N_{start} =60 N_{end}=58 TPS= Subacute	E: TENS during exercise C: Sham TENS during exercise Duration: 30min/d, 5d/wk, for 8wks	• Barthel Index (+exp)
TENS + Task-related Training		
Laddha et al. (2016) RCT (5) N_{start}=44 N_{end}=30 TPS=Chronic	E1: TENS (60min) + Task-related training E2: TENS (30min) + Task-related training C: Task-related training Duration: 60min/d, 5d/wk, for 6wks task-oriented training & 30-60min/d, 5d/wk, for 6wks TENS	E1/E2 vs C • Timed-up-and-go (-) • Modified Composite Spasticity Scale (+exp1) • Ankle passive dorsiflexion ROM (+exp1, +exp2) • Ankle clonus (-) E1 vs E2 • Time-up-and-go (-) • Modified Composite Spasticity Scale (+exp1) • Ankle passive dorsiflexion ROM (+exp1) • Ankle clonus (-)
Ng et al. (2016) RCT (7) N_{start}=76 N_{end}=69 TPS=Subacute	E: TENS + task-oriented balance training + conventional therapy C: Sham TENS + task-oriented balance training + conventional therapy	• Berg Balance Scale (+exp) • 6-minute walk test (-) • Modified Rivermead Mobility Index (-) • Timed up and go test (+exp) • SF-36 ○ Physical function(+exp) ○ Role physical (-) ○ Bodily pain (-)

	Duration: 60min/d, 2d/wk, for 8wks. TENS + TOBT concurrent 150min/d conventional physiotherapy	○ General health (-) ○ Vitality (-) ○ Social functioning (-) ○ Role functioning-emotion (-) ○ Mental health (-)
Chan et al. (2015) RCT (8) N_{start}=37 N_{end}=37 TPS=Chronic	E1: TENS + Task-related training E2: Sham TENS + Task-related training C: No active treatment (health education) Duration: 60min/d, 5d/wk, for 6wks	E1/E2 vs C: • Trunk Impairment Scale (+exp_1, +exp_2) • Trunk Muscle Strength (+exp_1, +exp_2) • Dynamic sitting balance (+exp_1, +exp_2) • Static Sitting Balance (-) • Lateral Reach Test (+exp_1) E1 vs E2: • Trunk Impairment Scale (+exp_1) • Dynamic Sitting Balance (+exp_1) • Trunk Muscle Strength (-)
Hui-Chan et al. (2009) RCT (7) N_{start}=109 N_{end}=101 TPS=Chronic	E1: TENS E2: Placebo TENS + Task-related training E3: TENS + Task-related training C: No treatment Duration: 60min/d, 5d/wk, for 4wks TENS ; 60min/d, 5d/wk, for 4wks Placebo TENS; 60min/d, 5d/wk, for 4wks Task-related training	E1/E2/E3 vs C • Composite spasticity scale (+exp1, +exp2, +exp3) • Maximum isometric contraction ○ Ankle Dorsiflexion (+exp2, +exp3) ○ Ankle Plantarflexion (+exp2, +exp3) • Gait velocity (+exp3) • 6min Walk test (+exp2, +exp3) • Timed Up and Go (+exp2, +exp3) E3 vs E1 • Composite spasticity scale (-) • Maximum isometric contraction ○ Ankle Dorsiflexion (+exp3) ○ Ankle Plantarflexion (exp3) • Gait velocity (+exp3) • 6min Walk test (+exp3) • Timed Up and Go (+exp3) E3 vs E2 • Composite spasticity scale (-) • Maximum isometric contraction ○ Ankle Dorsiflexion (-) ○ Ankle Plantarflexion (-) • Gait velocity (+exp3) • 6min Walk test (-) • Timed Up and Go (+exp3) E1 vs E2 • Composite spasticity scale (-) • Maximum isometric contraction ○ Ankle Dorsiflexion (+exp1) ○ Ankle Plantarflexion (-) • Gait velocity (-) • 6min Walk test (-) • Timed Up and Go (-)
Ng & Hui-Chan (2007) RCT (6) N_{start}=88 N_{end}=80 TPS= Chronic	E1: TENS E2: Placebo TENS + Task-related training E3: TENS + Task-related training C: No active treatment Duration: 60min/d, 5d/wk for 4wks	E1/E2/E3 vs C • Composite Spasticity scale (+exp1, +exp2, +exp3) • Maximum isometric voluntary contradiction ○ peak torque-ankle dorsiflexors (+exp1, +exp2, +exp3) ○ peak torque-ankle plantarflexors (+exp2, +exp3) • Gait velocity (+exp3)

		E3 vs E1/E2
		• Composite Spasticity scale (-)
		• Maximum isometric voluntary contradiction
		  ○ peak torque-ankle dorsiflexors (-)
		  ○ peak torque-ankle plantarflexors (-)
		• Gait velocity (+exp3)

Unilateral vs Bilateral TENS		

Kwong et al. (2018)
RCT (7)
N_{start}=80
N_{end}=69
TPS=Chronic
	E: Bilateral TENS + Task-oriented Training
	C: Unilateral TENS + Task-oriented Training
	Duration: 60min/d, 2d/wk for 10wks
		• Maximum Isometric Voluntary Contraction:
		• Ankle dorsiflexion strength
		  ○ Paretic (+exp)
		  ○ Non Paretic (-)
		• Ankle plantarflexion strength
		  ○ Paretic (-)
		  ○ Non Paretic (-)
		• Knee flexion peak torque
		  ○ Paretic (-)
		  ○ Non Paretic (-)
		• Knee extension peak torque
		  ○ Paretic (-)
		  ○ Non Paretic (-)
		• Timed-Up-and-Go Test (+exp)
		• Lower Extremity Motor Coordination Test (-)
		• Berg Balance Scale (-)
		• Step Test (-)

TENS vs NMES vs Conventional Therapy		
Yen et al. (2019) RCT (7) N_{start}=42 N_{end}=40 TPS=Acute	E1: Transcutaneous Nerve Stimulation (TENS) + Standard Early Rehabilitation E2: Neuromuscular Electrical Stimulation (NMES) + Standard Early Rehabilitation C: Standard rehabilitation Duration: 30min/d, 5d/wk, for 2wks TENS, NMES, 30min/d, 5d/wk, for 2wks standard rehabilitation in all groups	E1 vs C • Postural Assessment Scale for Stroke (+exp) • Functional Independence Measure (+exp) E2 vs C • Postural Assessment Scale for Stroke (-) • Functional Independence Measure (-) E1 vs E2 • Postural Assessment Scale for Stroke (-) • Functional Independence Measure (-)
TENS vs Therapeutic Ultrasound vs Botulinum Toxin A		
Picelli et al. (2014) RCT (6) N_{start}=30 N_{end}=30 TPS=Chronic	E1: Therapeutic ultrasound + Home exercises & conventional therapy E2: TENS + Home exercises & conventional therapy E3: Botulinum toxin A (200U) + Home exercises & conventional therapy Duration: 10min/d, 5d/wk for 2wks - Ultrasound, 15min/d, 5d/wk for 2wks - TENS, 1 injection session - Botulinum toxin A, 40min/d, 5d/wk for 2wks - Bobath training	E1 vs E2 • Modified Ashworth Scale (-) • Ankle passive range of motion (-) E1 vs E3 • Modified Ashworth Scale (+exp3) • Ankle passive range of motion (+exp3) E2 vs E3 • Modified Ashworth Scale (+exp3) • Ankle passive range of motion (+exp3)
Electroacupuncture vs High and Low Frequency TENS		
Johansson et al. (2001) RCT (8) N_{start}=150 N_{end}=138 TPS=Acute	E1: Electroacupuncture E2: High-intensity, low-frequency TENS (2Hz) C: Low-intensity, high-frequency electrostimulation (80Hz)	E1 vs E2 vs C • Rivermead Mobility Index (-) • 10-Metre Walk Test (-) • Nine Hole Peg Test (-) • Barthel Index (-) • Nottingham Health Profile (-)

	Duration: 30min/d, 2d/wk for 10wks	
Balance Training + TENS vs Sham TENS + Balance Training vs Conventional Care		
Jung et al. (2016) RCT (7) N_{start}=61 N_{end}=60 TPS=Subacute	E1: Weight-shifting exercise + TENS + Conventional care E2: Weight-shifting training + Placebo TENS + Conventional care C: Conventional care Duration: 30min/d, 5d/wk, for 6wks intervention sessions + 60min/d, 5d/wk, for 6wks conventional care	E1 vs C • Muscle Activity ○ External Oblique (+exp1) ○ External Spinae (+exp1) • Maximum Reaching Distance (+exp1) • Trunk Impairment Scale (+exp1) ○ Dynamic Sitting balance (+exp1) ○ Coordination (+exp1) ○ Static Sitting Balance (-) E2 vs C • Muscle Activity ○ External Oblique (+exp2) ○ External Spinae (-) • Maximum Reaching Distance (+exp2) • Trunk Impairment Scale (+exp2) ○ Dynamic Sitting Balance (+exp2) ○ Coordination (+exp2) ○ Static Sitting Balance (-) E1 vs E2 • Muscle Activity ○ External Oblique (+exp1) ○ External Spinae (-) • Maximum Reaching Distance (+exp1) • Trunk Impairment Scale (+exp1) ○ Dynamic Sitting Balance (-) ○ Coordination (+exp1) ○ Static Sitting Balance (-)
Trunk Training with Balance Training and TENS vs Treadmill Training and Placebo TENS		
Lim et al. (2019) RCT(7) N_{start}=37 N_{final}=30 TPS=Subacute	E: Multi-sensorimotor training (Stabilize-T and Reha bar exercises + TENS) + Conventional PT C: Treadmill training + Placebo TENS + Conventional PT Duration: 60min/d, 5d/wk for 8wks	• Balance (-) ○ Anterior-posterior (+exp) ○ Medial-lateral (-) • Proprioception (+exp)
TENS with Heel-raise-lower training vs Placebo TENS with Heel-raise-lower training		
Jung et al. (2020) RCT (7) N_{Start}=40 N_{End}=40 TPS=Chronic	E: TENS + Heel-raise-lower training C: Placebo TENS + Heel-raise-lower training Duration: 30min/d, 5d/wk, for 6wks	• Ankle Plantar-Flexor strength (+exp) • Composite Spasticity score (+exp) • 10m Walk test (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Transcutaneous Electrical Stimulation

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	There is conflicting evidence about the effect of **TENS** to improve motor function when compared to **conventional therapy** or **no stimulation**.	2	Gurcan et al. 2015; Hussain et al. 2013
1b	**Bilateral TENS** may not have a difference in efficacy compared to **unilateral TENS** for improving motor function.	1	Kwong et al. 2018

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**TENS + task-related training** may produce greater improvements in functional ambulation than **no active treatment or TENS**.	2	Hui-Chan 2009; Ng & Hui-Chan 2007
1b	**TENS with heel-raise-lower training** may produce greater improvements in functional ambulation than **placebo TENS with heel-raise-lower training.**	1	Jung et al. 2020
1b	**Bilateral TENS with task-oriented training** may produce greater improvements in functional ambulation than **unilateral TENS with task-oriented training.**	1	Kwong et al. 2018
1b	**Sham TENS with task-related training** may produce greater improvements in functional ambulation than **no treatment.**	1	Hui-Chan et al. 2009
1a	There is conflicting evidence about the effect of **TENS with task-related training** to improve functional ambulation when compared to **sham with task-related training.**	3	Ng et al. 2016; Hui-Chan et al. 2009; Ng & Hui-Chan 2007
1b	There is conflicting evidence about the effect of **TENS combined with exercise** to improve functional ambulation when compared to **TENS alone.**	1	Ng & Hui-Chan 2009
1b	There is conflicting evidence about the effect of **TENS combined with exercise** when compared with **sham with exercise or conventional therapy** for improving functional ambulation.	2	Hui-Chan et al. 2009; Ng & Hui-Chan 2007
1a	**TENS** may not have a difference in efficacy compared to **conventional therapy, sham stimulation,** and **no stimulation** for improving functional ambulation.	9	Ertzgaard et al. 2018; Gurcan et al. 2015; Park et al. 2014; Hussain et al. 2013; Tyson et al. 2013; Hui-Chan 2009; Ng & Hui-Chan et al. 2009; Yan & Hui-Chan 2009; Ng & Hui-Chan 2007
1b	**TENS** may not produce greater improvements in functional ambulation than **sham TENS with task-related training.**	1	Hui-Chan et al. 2009
1b	**TENS** may not produce greater improvements in functional ambulation than **sham TENS with exercise.**	1	Ng & Hui-Chan 2009

1b	**Sham TENS with exercise** may not produce greater improvements in functional ambulation than **no treatment.**	1	Ng & Hui-Chan 2009
1b	**High or low frequency TENS** may not have a difference in efficacy compared to **electroacupuncture** for improving functional ambulation.	1	Johansson et al. 2001
2	**TENS with task-related training** may not produce greater improvements in functional ambulation than **TENS or task-related training alone.**	1	Laddha et al. 2016

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**TENS with task-related training** may not have a difference in efficacy compared to **sham TENS** with task-related training for improving functional mobility.	1	Ng et al. 2016
1b	**High intensity TENS** may not produce greater improvements in functional mobility than **low intensity electrostimulation or electroacupuncture.**	1	Johansson et al. 2001

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**TENS** may produce greater improvements in balance than **sham stimulation, conventional therapy, or no stimulation**.	4	Yen et al. 2019; Park et al. 2014; Cho et al. 2013; Tyson et al. 2013
1a	**TENS with task-related training** may produce greater improvements in balance than **sham stimulation with task-related training** and **no active treatment**.	3	Ng et al. 2016; Chan et al. 2015
1b	**Balance training with TENS** may produce greater improvements in balance than **conventional care or sham TENS with balance training.**	1	Jung et al. 2016
1b	**Balance training with sham TENS** may produce greater improvements in balance than **conventional care.**	1	Jung et al. 2016
1b	**Sit-to-stand training with TENS** may produce greater improvements in balance than **sit-to-stand training.**	1	Jung et al. 2017
1b	**TENS with task-related training** may produce greater improvements in balance than **no treatment**	1	Chan et al. 2015
1b	There is conflicting evidence on the effect of **sham TENS with task-related training** when compared to **no treatment** for improving balance.	1	Chan et al. 2015
1b	There is conflicting evidence on the effect of **TENS with trunk training and balance training** when compared to **sham TENS treadmill training** for improving balance.	1	Lim et al. 2019

1b	**TENS** may not have a difference in efficacy compared to **NMES** for improving balance.	1	Yen et al. 2019
1b	**Bilateral TENS with task-oriented training** may not produce greater improvements in balance than **Unilateral TENS with task-oriented training.**	1	Kwong et al. 2018

GAIT

LoE	Conclusion Statement	RCTs	References
1b	**TENS** may produce greater improvements in gait than **sham stimulation**.	1	Park et al. 2014

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
2	**TENS with exercise** may produce greater improvements in activities of daily living than **sham TENS with exercise.**	1	Tekeoglu et al. 1998
1a	There is conflicting evidence about the effect of **TENS** to improve activities of daily living when compared to **conventional therapy** or **no treatment**.	2	Gurcan et al. 2015; Yen et al. 2019
1b	**TENS** may not have a difference in efficacy compared to **NMES** for improving activities of daily living.	1	Yen et al. 2019
1b	**High or low frequency TENS** may not have a difference in efficacy compared to **electroacupuncture** for improving activities of daily living.	1	Johansson et al. 2001

RANGE OF MOTION

LoE	Conclusion Statement	RCTs	References
1b	**TENS (60 minutes) with task-related training** may produce greater improvements range of motion than **TENS (30 minutes) with task-related training** and **task-related training alone.**	1	Laddha et al. 2016
1b	**TENS (30 minutes) with task-related training** may produce greater improvements range of motion than **task-related training alone.**	1	Laddha et al. 2016
1b	**Botulinum toxin A** may produce greater improvements in range of motion than **TENS.**	1	Picelli et al. 2014
1a	There is conflicting evidence on the effect of **TENS** when compared to **sham TENS, conventional therapy, or no treatment .**for improving range of motion	2	Gurcan et al. 2015; Hussain et al. 2013
1b	**TENS** may not have a difference in efficacy compared to **therapeutic ultrasound** for improving range of motion.	1	Picelli et al. 2014

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**TENS + task-related training and sham TENS with task-related training** may produce greater improvements in muscle strength than **no treatment.**	2	Chan et al. 2015; Hui-Chan et al. 2009; Ng & Hui-Chan 2007
1b	**TENS with heel-raise-lower training** may produce greater improvements in muscle strength than **placebo TENS with heel-raise-lower training.**	1	Jung et al. 2020
1a	There is conflicting evidence about the effect of **TENS** to improve in muscle strength when compared to **sham stimulation, no stimulation and conventional therapy**.	6	Hussain et al. 2013; Tyson et al. 2013; Hui-Chan et al. 2009; Yan & Hui-Chan 2009; Ng & Hui-Chan 2007; Levin & Hui-Chan 1992
1a	There is conflicting evidence on the effect of **TENS with task-related training** when compared to **TENS** for improving muscle strength.	2	Hui-Chan et al. 2009; Ng & Hui-Chan et al. 2007
1b	There is conflicting evidence on the effect of **TENS** when compared to **sham TENS with task-related training** for improving muscle strength.	1	Hui-Chan et al. 2009
1a	**TENS with task-related training** may not have a difference in efficacy compared to **sham TENS with task-related training** for improving muscle strength.	3	Chan et al. 2015; Hui-Chan et al. 2009; Ng & Hui-Chan 2007

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**TENS with task-related training and sham TENS with task-related training** may produce greater improvements in spasticity than **no treatment.**	2	Hui-Chan et al. 2009; Ng & Hui-Chan 2007
1b	**TENS with heel-raise-lower training** may produce greater improvements in spasticity than **placebo TENS with heel-raise-lower training.**	1	Jung et al. 2020
1b	**Botulinum toxin A** may produce greater improvements in spasticity than **TENS.**	1	Picelli et al. 2014
1a	There is conflicting evidence about the effect of **TENS** for improving spasticity compared to **sham TENS or no treatment.**	9	Ertzgaard et al. 2018; Gurcan et al. 2015; Park et al. 2014; Cho et al. 2013; Hussain et al. 2013; Yan & Hui-Chan 2009; Hui-Chan et al. 2009; Ng & Hui-Chan 2007; Levin & Hui-Chan 1992
1b	There is conflicting evidence about the effect of **TENS (60 minutes) with task-related training** for improving spasticity compared to **TENS (30 minutes) with task-related training** and **task-related training alone.**	1	Laddha et al. 2016
1b	**TENS (30 minutes) with task-related training** may not have a difference in efficacy compared to **task-related training** for improving spasticity.	1	Laddha et al. 2016
1a	**TENS with task-related training** may not have a difference in efficacy compared to **sham TENS with**	2	Hui-Chan et al. 2009; Ng & Hui-Chan 2007

	task-related training or TENS alone for improving spasticity.		
1b	**TENS** may not have a difference in efficacy compared to **therapeutic ultrasound** for improving spasticity.	1	Picelli et al. 2014
1b	**TENS** may not produce greater improvements in spasticity than **sham TENS with task-related training.**	1	Hui-Chan et al. 2009

PROPRIOCEPTION			
LoE	Conclusion Statement	RCTs	References
1b	**Trunk training with balance training and TENS** may produce greater improvements in proprioception than **treadmill training with placebo TENS.**	1	Lim et al. 2019
1b	There is conflicting evidence on the effect of **TENS** for improving proprioception compared to **sham stimulation.**	1	Tyson et al. 2013

QUALITY OF LIFE			
LoE	Conclusion Statement	RCTs	References
1b	**TNES with task-related training** may not produce greater improvements in quality of life than **sham TENS with task-related training.**	1	Ng et al. 2016
1b	**High or intensity TENS** may not produce greater improvements in quality of life than **electroacupuncture or low intensity electrostimulation.**	1	Johansson et al. 2001

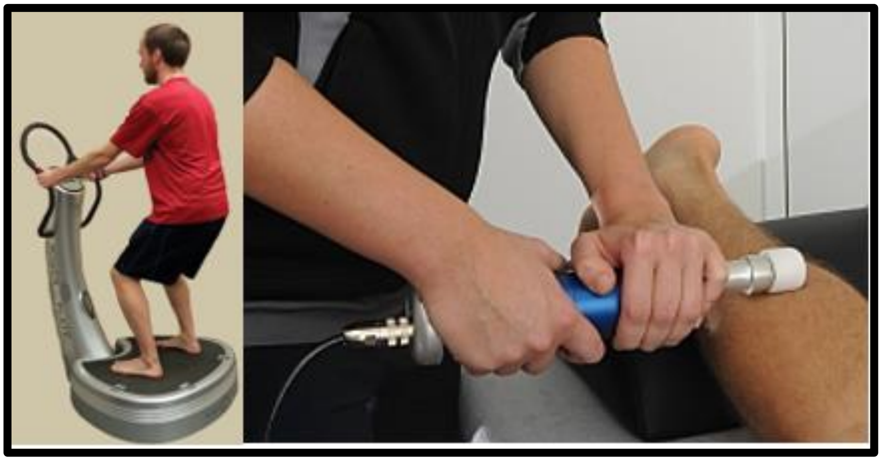
Key Points

TENS may be beneficial for improving balance and gait after stroke.

The literature is mixed concerning the effect of TENS on improving motor function, activities of daily living, range of motion, spasticity, proprioception, and muscle strength after stroke.

TENS may not be beneficial for improving functional ambulation, mobility, and quality of life after stroke.

Muscle Vibration



Adopted from: https://accessphysiotherapy.mhmedical.com/content.aspx?bookid=2223&sectionid=173789797; https://www.joint-surgeon.com/rehabilitation/matrix-therapy/matrix-therapy-and-biomechanical-stimulation.html

Whole body muscle vibration is administered through a vibrating platform which stimulates sensory receptors and can facilitate muscle contractions (Brogårdh et al., 2012). The patient may stand or perform other movements while on the vibration platform. Whole body muscle vibration is being investigated as a therapeutic method of improving muscle function, muscle strength, and gait function following a stroke (Cochrane, 2011; Lee, 2015a).

Muscle vibration produces an indirect vibration to the whole body which can limit the specificity and strength of the vibratory stimulus (Moran et al., 2007). As such, local muscle vibration has recently been examined as a more specific and direct method of applying a vibration stimulation to targeted muscles with the ability to stimulate either the agonist or antagonist muscles, as opposed to stimulating both as would occur during muscle vibration (Custer et al., 2017; Pamukoff et al., 2014; Souron et al., 2017; Tankisheva et al., 2014).

31 RCTs were found that evaluated muscle vibration for lower extremity motor rehabilitation. 19 RCTs compared whole body vibration to sham stimulation, no stimulation, or conventional care (Ahmed Burq et al., 2021; Alp et al., 2018; Brogårdh et al., 2012; Burq et al., 2021; Chan et al., 2012; Guo et al., 2015; Lau et al., 2012; Lee, 2015a; Lee, 2019a; Lee et al., 2017c; Marin et al., 2013; Pang et al., 2013; Sade et al., 2020; Sales et al., 2020; Silva et al., 2016; Silva et al., 2014; Tankisheva et al., 2014; Tihanyi et al., 2010; Tihanyi et al., 2007). One RCT compared whole body vibration to musical exercise therapy (van Nes et al., 2006). One RCT compared matrix rhythm therapy to Bobath therapy (Unal et al., 2021). One RCT compared balance training with whole body vibration to conventional rehabilitation (Merkert et al., 2011). One RCT compared whole body vibration with treadmill training to treadmill training alone (Choi et al., 2017b). Five RCTs compared local muscle vibration to sham stimulation or conventional therapy (Lee et al., 2013d; Magnusson et al., 1994; Onal et al., 2022; Paoloni et al., 2010; Toscano et al., 2019). Three RCTs compared low frequency and high frequency whole body vibration (Liao et al., 2016; Wei & Cai, 2022; Yang et al., 2021).

The methodological details and results of all 31 RCTs are presented in Table 33.

Table 33. **RCTs Evaluating Muscle Vibration Interventions for Lower Extremity Motor Rehabilitation**

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Whole Body Vibration vs Sham Stimulation, No Stimulation, or Conventional Care		
Ahmed Burg et al. (2021a) RCT (5) N_{start}=64 N_{end}=64 TPS=Chronic	E: Whole-Body Vibration (amplitude: 3 mm, frequency: 20 Hz) + Routine Physiotherapy C: Routine physiotherapy Duration: 15min, 6d/wk, for 2wks vibration & 45min/session, for 2wks physiotherapy	• Stair Negotiation Time (+exp) • Obstacle Clearance Height (+exp) • Obstacle Clearance Depth (-)
Burg et al. (2021b) RCT (6) N_{start}=64 N_{end}=64 TPS=Chronic	E: Whole body vibration (WBV, 20Hz) + Conventional therapy C: Conventional therapy Duration: 15min, 6d/wk, for 2wks WBV	• Timed up and go (-) • 10-meter walk test ○ Self-speed (-) ○ Fast speed (-)
Sales et al. (2020) RCT (8) N_{start}=21 N_{end}=21 TPS=Chronic	E: Whole-body vibration C: Sham Duration: 10min/1session	• Hmax/Mmax ratio (-) • Modified Ashworth Scale (-) • Global perception of change (-)
Lee (2019) RCT (6) N_{start}=24 N_{end}=21 TPS=Chronic	E: Horizontal whole-body vibration + Conventional rehabilitation training C: Conventional rehabilitation training Duration: 30min/d, 3d/wk, for 6wks Whole-body vibration, 60min/d, 3d/wk, for 6wks Conventional rehabilitation	• Gait Velocity (-) • Cadence (-) • Step Length (-) • Single Limb Support Time (-) • Double Limb Support Time (-) • Stride Length (-) • Movement of the Centre of Pressure (-)
Sade et al. (2020) RCT (5) N_{start}=46 N_{end}=43 TPS=Chronic	E: Whole body vibration (35-40Hz) + Conventional therapy C: Conventional therapy Duration: E: 4min/session, 5d/wk, for 3wks vibration + 5d/wk, for 3wks conventional therapy C: 5d/wk, for 3wks conventional therapy	• Berg Balance Scale (+exp) • Timed Up and Go Test (+exp) • Cadence (-) • Single support (-) • Double support (-) • Step length (+exp) • Step time (-) • Walking speed (+exp)
Alp et al. (2018) RCT (6) N_{start}=22 N_{end}=21 TPS=Chronic	E: Whole Body Vibration (40 hz,4 mm) + Exercise (Stretching and active ROM exercise) C: Sham Vibration + Exercise (Stretching and active ROM exercise) Duration: 15min, 3d/wk, for 4wks Exercise & 5min, 3d/wk, for 4wks WBV/Sham	• 10-meter Walk Test (+exp) • Functional Independence Measurement (-) • Modified Ashworth Scale-Ankle (-)
Lee et al. (2017) RCT (7) N_{start}=30 N_{end}=30 TPS=Acute	E: Whole Body Vibration + Conventional Therapy C: Conventional Therapy Duration: 60min/d, 5d/wk, for 2wks	• Functional Ambulation Categories (-) • Berg Balance Scale (-) • Trunk Impairment Scale (-) • Korean Modified Barthel Index (-)

Silva et al. (2016) RCT (6) N_{start}=35 N_{end}=28 TPS=Chronic & Subacute	E: Whole-body vibration training C: No stimulation Duration: 4-8min/d, 3d/wk for 8wks	• Plantar impression area ○ Affected side (-) ○ Unaffected side (-) • 6-Minute Walk Test (-)
Guo et al. (2015) RCT (6) N_{start}=30 N_{end}=30 TPS=Subacute	E: Whole-body vibration C: Sham stimulation Duration: 80min/d for 8wks	• 10-Metre Walk Test (+exp) • Knee hyperextension (+exp) • Fugl-Meyer Assessment (-)
Lee (2015) RCT (4) N_{start}=26 N_{end}=21 TPS=Chronic	E: Whole-body vibration in the horizontal direction + Conventional rehabilitation C: No stimulation + Conventional rehabilitation Duration: 15min/d, 3d/wk for 6wks whole body vibration & 30min/d, 5d/wk, for 6wks conventional rehabilitation	• Berg Balance Scale (+exp) • Timed Up-and-Go Test (-) • Fugl-Meyer Assessment (-)
Silva et al. (2014) RCT (5) N_{start}=43 N_{end}=38 TPS=Chronic	E: Whole body vibration therapy while standing with knees flexed C: Sham Duration: 9min/session - whole body vibration,10min/session - flexed knee position	• Fugl-Meyer assessment (-) • Surface EMG (-) • Voluntary Isometric contraction (-) • Stair Climb test (-) • 6min Walk test (-) • Timed Up and Go (-)
Tankisheva et al. (2014) RCT (7) N_{start}=15 N_{end}=13 TPS=Chronic	E: Whole body vibration during exercise C: No intervention Duration: 10-19min/d, 3d/wk, for 6wks vibration	• Ashworth Scale (-) • Muscle strength: • Isometric knee extension 60° ○ Paretic leg (+exp) ○ Non-paretic leg (-) • Isometric knee flexion 60° ○ Paretic leg (-) ○ Non-paretic leg (-) • Isokinetic knee extension 240°/s ○ Paretic leg (-) ○ Non-paretic leg (-) • Isokinetic knee flexion 240°/s ○ Paretic leg (+exp) ○ Non-paretic leg (-) • Isokinetic knee extension 60°/s ○ Paretic leg (-) ○ Non-paretic leg (-) • Isokinetic knee flexion 60°/s ○ Paretic leg (-) ○ Non-paretic leg (-) • Sensory Organization Test ○ C1 (-) ○ C2 (-) ○ C3 (-) ○ C4 (+exp) ○ C5 (-) ○ C6 (-)
Marin et al. (2013) RCT (6) N_{start}=20 N_{end}=20 TPS=Chronic	E: Whole-body vibration C: Sham stimulation Duration: 2-7min/session for 17sessions	• Berg Balance Scale (-) • Lower limb muscle architecture (-) • Isometric knee extension (-)

Pang et al. (2013) RCT (8) N_{start}=82 N_{end}=76 TPS=Chronic	E: Exercise training + vertical Whole Body Vibration stimulation C: Exercise training + sham WBV Duration: 15min/d, 3d/wk, for 8wks	• Chedoke McMaster Assessment ○ paretic leg (-) ○ paretic foot (-) • Bone turn over marker levels (CTx and BAP) (-) • Modified Ashworth Scale ○ knee (-) ○ ankle (-) • Knee peak power-both sides (-)
Chan et al. (2012) RCT (8) N_{start}=32 N_{end}=30 TPS=Chronic	E: Whole body vibration + regular exercise C: Sham Vibration + regular exercise Duration: single session, 30min	• Hoffman reflex ○ unaffected side (-) ○ affected side (-) • Maximum Hoffman reflex/Maximum M response ratio ○ unaffected side (+exp) ○ affected side (-) • Modified Ashworth Scale (+exp) • Visual Analog Scale – ankle spasticity (+exp) • Achilles Deep Tendon Reflex (-) • Timed up and Go (+exp) • 10-metre walk test (+exp) • Cadence (-) • Total body weight ○ affected (+exp) ○ unaffected (+exp)
Brogårdh et al. (2012) RCT (9) N_{start}=31 N_{end}=31 TPS=Chronic	E: Whole Body Vibration (3.75mm amplitude) C: Sham Vibration (0.2mm Amplitude) Duration: 1 session/day, 2 sessions/wk, for 6wks (12 repetitions of 40-60s WBV per session)	• Stroke Impact Scale (-) • Modified Ashworth Scale (-) • Berg Balance Scale (-) • Timed UP-and-Go (-) • 6-minute walk test (-) • Knee Muscle Strength ○ isometric extension (-) ○ isokinetic flexion (-) ○ isokinetic extension (-) • 10-meters walk test ○ comfortable speed (-) ○ fast speed (-)
Lau et al. (2012) RCT (8) N_{start}=82 N_{end}=76 TPS=Chronic	E: Whole body vibration + dynamic leg exercises C: Dynamic leg exercises Duration: 9-15min/d, 3d/wk, for 8wks	• Berg Balance scale (-) • Dynamic Postural Control (-) • 6-minute walk test (-) • 10-meter walk test (-) • Isometric muscle strength (peak torque value) (-) • Activities-specific balance confidence (-) • Fall-related self-efficacy (-)
Tihanyi et al. (2010) RCT (4) N_{start}=20 N_{end}=20 TPS=Acute	E: Whole Body Vibration (20Hz) + Conventional Care C: Conventional Care Duration: 3x/wk, for 4wks	• Maximum isometric torque paretic (+exp) • Maximum isometric torque non-paretic (+exp) • Rate of torque development paretic (-) • Rate of torque development non-paretic (-) • Maximum eccentric torque paretic (+exp) • Maximum eccentric torque non-paretic (+exp) • Mechanical work during eccentric contraction paretic (-) • Mechanical work during eccentric contraction non-paretic (-) • Maximum isometric torque of vastus lateralis muscle during isometric in paretic (+exp) • Maximum isometric torque of vastus lateralis muscle during isometric in non-paretic (-) • Maximum eccentric torque of vastus lateralis muscle during isometric in paretic (+exp) • Maximum eccentric torque of vastus lateralis muscle during isometric in non-paretic (-) • Myoelectrical activity (EMG) (+exp)

Tihanyi et al. (2007) RCT (6) N_{start}=18 N_{end}=16 TPS=Acute	E: Whole-body vibration C: Sham Duration: ~18min/ single session	• Voluntary force (+exp) • Muscle activation (+exp)
Matrix Rhythm Therapy vs Bobath Therapy		

Unal et al. (2021)
RCT (6)
N_{start}=32
N_{end}=30
TPS=Chronic
	E: Matrix Rhythm Therapy (vibration) from thoracic spine to lower extremity + Bobath Therapy
	C: Bobath Therapy
	Duration: 60min/d, 3d/wk, for 4wks - Bobath therapy & 60min/d, 3d/wk, for 4wks - Matrix rhythm therapy
		• Modified Ashworth Scale
		  ○ Quadriceps (+exp)
		  ○ Hip adductors (-)
		  ○ Gastrocnemius (+exp)
		  ○ Lower extremity total (+exp)
		• ROM
		  ○ Active knee flexion (+exp)
		  ○ Passive knee flexion (+exp)
		  ○ Active ankle dorsiflexion (-)
		  ○ Passive ankle dorsiflexion (+exp)
		  ○ Active ankle plantar flexion (+exp)
		  ○ Passive ankle plantar flexion (+exp)
		• Static balance
		  ○ Single Leg Stance Test right (-)
		  ○ Single Leg Stance Test left (+exp)
		  ○ Single Leg Stance Test total (+exp)
		• Timed Get up and go test (+exp)
		• Gait parameters
		  ○ Cadence (+exp)
		  ○ Velocity (+exp)
		  ○ Gait cycle duration (-)
		  ○ Stride length (-)
		  ○ Stride % length (-)
		  ○ Step length (-)
		  ○ Left stance phase (-)
		  ○ Right stance phase (+exp)
		  ○ Left swing phase (-)
		  ○ Right swing phase (+exp)
		  ○ Double support phase (+exp)
		  ○ Left single support phase (+exp)
		  ○ Right single support phase (-)
		  ○ Gait cycle symmetry (-)
		• Pelvic kinematics in gait
		  ○ Symmetry of pelvic tilt (-)
		  ○ Pelvic tilt angles (-)
		  ○ Symmetry of pelvic obliquity (-)
		  ○ Pelvic obliquity angles (-)
		  ○ Symmetry of pelvic rotation (+exp)
		  ○ Left pelvic rotation angle (+exp)
		  ○ Right pelvic rotation angle (-)

Whole Body Vibration vs Musical Exercise Therapy		
Van Nes et al. (2006) RCT (8) N_{start}=53 N_{end}=51 TPS=Subacute	E: Whole-body vibration + Conventional therapy C: Musical exercise therapy + Conventional therapy Duration: 30-60min/d, 3-5d Regular rehabilitation, 3min/d, 5d/wk for 6wks Whole body vibration or musical exercise therapy	• Berg Balance Scale (-) • Trunk Control Test (-) • Rivermead Mobility Index (-) • Functional Ambulation Categories (-) • Barthel Index (-) • Motricity Index (-) • Somatosensory Threshold (-)
Balance Training + Whole Body Vibration vs Conventional Rehabilitation		
Merkert et al. (2011) RCT (3) N_{start}=66	E: Vibrosphere (balance training+ whole body vibration)	• Berg Balance scale (-) • Functional test of Lower trunk stability (-) • Tinetti Gait test (-)

N_{end}=48
TPS =Acute
	+ conventional geriatric rehabilitation.
	C: Conventional geriatric rehabilitation.
	Duration: 15 sessions of Vibrosphere training
		• Timed Up and Go (-)
		• Mini-mental State examination (-)
		• Barthel index (-)
		  ○ transfer (+exp)
		  ○ dressing (+exp)
		  ○ feeding (+exp)
		  ○ walking (-)
		  ○ climbing stairs (-)

Whole Body Vibration + Treadmill Training vs Treadmill Training		

Choi et al. (2017)
RCT (8)
N_{start}=30
N_{end}=26
TPS=Chronic
	E: Whole body vibration + Treadmill training
	C: Exercises on platform without vibration + Treadmill training
	Duration: 4.5min whole body vibration/ exercises on platform without vibration + 20min treadmill training, 3x/wk, for 6wks
		• 6-minute walk test (-)
		• Walking speed (+exp)
		• Cadence (-)
		• Step length
		  ○ Affected side (+exp)
		  ○ Less affected side (+exp)
		• Stride length (+exp)
		• Single limb support
		  ○ Affected side (-)
		  ○ Less affected side (-)
		• Double limb support (+exp)

Local Muscle Vibration vs Conventional Therapy or Sham Muscle Vibration		
Onal et al. (2022) RCT (5) N_{start}=36 N_{end}=30 TPS=Chronic	E: Plantar vibration therapy (80Hz) + conventional PT C: Conventional PT Duration: 60min/d, 5d/wk, for 4wks	• Overall Stability Index (+exp) • Anteroposterior Stability Index (+exp) • Mediolateral Stability Index (+exp) • Fall risk (+exp) • Berg Balance Scale (+exp) • Functional Reach Test (+exp) • Timed Up & Go (+exp) • Trunk Impairment Scale (-) • 10-Metre Walk Test (+exp)

Toscano et al. (2019)
RCT (9)
N_{start}=22
N_{end}=22
TPS=Acute
	E: Repetitive Focal Muscle Vibration + Physiotherapy
	C: Sham Muscle Vibration + Physiotherapy
	Duration: 30min/d, for 3d Vibration & 60min/d for 3d - Physiotherapy
		• National Institutes Health Status Score (+exp)
		• Fugl-Meyer (+exp)
		  ○ Arm (+exp)
		  ○ Leg (+exp)
		• Motricity Index (+exp)
		• Modified Ashworth Scale (-)

Lee et al. (2013a)
RCT (7)
N_{start}=34
N_{end}=31
TPS=Chronic
	E: Standard rehabilitation programme + local vibration stimulus training
	C: Standard rehabilitation programme + sham local vibration stimulus training
	Duration: 30min/d, 5d/wk, for 6wks vibration & 80min/d, 5d/wk, for 6wks standard rehabilitation program
		• Postural sway
		  ○ Velocity (eyes-open and eyes-closed) (+exp)
		  ○ Distance (eyes-open and eyes-closed) (+exp)
		• 3-meter walk test-speed (+exp)
		• Cadence (+exp)
		• Paretic side step length (-)
		• Paretic single limb support time (+exp)

Paoloni et al. (2010)
RCT (8)
N_{start}=44
N_{end}=44
TPS=Chronic
	E: Segmental Muscle Vibration + Conventional Therapy
	C: Conventional Therapy
	Duration: 50min/d, 3d/wk, for 4wks general therapy & 30min, 3x/wk, for 4wks SMV
		• Time–Distance Characteristics of Gait
		  ○ Toe-off normal (-)
		  ○ Toe-off paretic (+exp)
		• Cadence (-)
		• Step length (-)
		• Stride length (-)
		• Step width (-)
		• Swing velocity (-)
		• Gait speed (-)
		• Knee angle (-)
		• Hip angle (-)
		• Ankle ROM (-)

Magnusson et al. (1994) RCT (3) N_{start}=47 N_{end}=24 TPS=Chronic	E: Vibratory stimulus applied to calf muscles or galvanic stimulation of vestibular nerves C: Conventional care Duration: 30mins	• Maintaining stance during perturbations (+exp) • Sway velocity (-) • Swiftness (+exp) • Stiffness (+exp)
Comparing Whole-Body Vibration Intensity		
Wei et al. (2022) RCT (7) N_{start}=78 N_{end}=72 TPS=Chronic	E1: High-frequency (26 Hz) Whole-body vibration training + Standard therapy E2: Low-frequency (13 Hz) Whole-body vibration training + Standard therapy C: Sham + standard therapy Duration: 6min/d vibration & 40min/d conventional therapy, 5d/wk, for 2wks	E1/E2 vs C • Five sit-to-stand test (+exp2, +exp1) • 10-metre walking test (-) • Timed-up and-go test (+exp1) • Berg Balance Scale (-) E1 vs E2 • Five sit-to-stand test (-) • 10-metre walking test (-) • Timed-up and-go test (-) • Berg Balance Scale (-)

Yang et al. (2021)
RCT (8)
N_{start}=84
N_{end}=80
TPS=Chronic
	E1: High frequency (30Hz) whole body vibration
	E2: Low frequency (20Hz) whole body vibration
	Duration: 1 session/d, 3d/wk, for 8wks
		• Knee extensor work
		  ○ non-paretic concentric (-)
		  ○ paretic concentric (-)
		  ○ non-paretic eccentric (-)
		  ○ paretic eccentric (+exp)
		• Serum cross-linked N-telopeptides of type I collagen (-)
		• 6-min walk test (-)

Liao et al. (2016) RCT (8) N_{start}=84 N_{end}=74 TPS=Chronic	E1: Low-intensity whole-body vibration E2: High-intensity whole-body vibration C: Conventional therapy Duration: 12-18min/d, 3d/wk, for 10wks vibration sessions	E1 vs E2 vs C • Maximal voluntary isometric contraction (paretic/nonparetic) (-) • Modified Ashworth Scale (knee/ankle) (-) • VO_2 max (-) • Timed Up-and-Go (-) • 6-Minute Walk Test (-) • Mini BES Test (-) • Activities-specific Balance Confidence (-) • Frenchay Activity Index (-) • Craig Hospital Inventory of Environmental Factors (-) • Short-Form 12 Health Survey (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Muscle Vibration

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Local muscle vibration** may produce greater improvements in motor function than **sham stimulation.**	1	Toscano et al. 2019
1a	**Whole-body vibration** may not have a difference in efficacy compared to **sham stimulation, no stimulation or conventional care** for improving motor function.	4	Guo et al. 2015; Lee et al. 2015; Silva et al. 2014; Pang et al. 2013

FUNCTIONAL AMBULATION

LoE	Conclusion Statement	RCTs	References
1a	**Local muscle vibration** may produce greater improvements in functional ambulation than **conventional therapy or sham stimulation.**	3	Onal et al. 2022; Lee et al. 2013a; Paoloni et al. 2010
1b	**Matrix rhythm therapy** may produce greater improvements in functional ambulation than **bobath therapy.**	1	Unal et al. 2021
1b	There is conflicting evidence about the effect of **whole-body vibration with treadmill training** for improving functional ambulation compared to **treadmill training.**	1	Choi et al. 2017
1a	**High frequency whole-body vibration** may not have a difference in efficacy compared to **low frequency whole-body vibration** for improving functional ambulation.	3	Wei et al. 2022; Yang et al. 2021; Liao et al. 2016
1a	**High frequency whole-body vibration or low frequency whole-body vibration** may not have a difference in efficacy compared to s**ham or conventional therapy** for improving functional ambulation.	2	Wei et al. 2022; Liao et al. 2016
1a	**Whole-body vibration** may not have a difference in efficacy compared to **sham stimulation, conventional therapy, and no stimulation** for improving functional ambulation.	13	Burq et al. 2021; Burq et al. 2021b; Lee et al. 2019; Sade et al. 2019; Alp et al. 2018; Lee et al. 2017; Silva et al. 2016; Guo et al. 2015; Lee et al. 2015; Silva et al. 2014; Brogardh et al. 2012; Chan et al. 2012; Lau et al. 2012
1b	**Whole-body vibration** may not have a difference in efficacy compared to **music exercise therapy** for improving functional ambulation.	1	Van Nes et al. 2006
2	**Balance training with whole body vibration** may not produce greater improvements in functional ambulation than **conventional care.**	1	Merkert et al. 2011

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1b	**Whole-body vibration** may not have a difference in efficacy compared to **musical exercise therapy** for improving functional mobility.	1	Van Nes et al. 2006

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	**Local muscle vibration** may produce greater improvements in balance than **conventional therapy or sham stimulation.**	2	Onal et al. 2022; Lee et al. 2013a; Magnusson et al. 1994
1b	**Matrix rhythm therapy** may produce greater improvements in balance than **bobath therapy.**	1	Unal et al. 2021
1a	**High frequency whole-body vibration** may not have a difference in efficacy compared to **low frequency whole-body vibration** for improving balance.	2	Wei et al. 2022; Liao et al. 2016

1a	**High frequency whole-body vibration or low frequency whole-body vibration** may not have a difference in efficacy compared to s**ham or conventional therapy** for improving functional ambulation.	2	Wei et al. 2022; Liao et al. 2016
1a	**Whole-body vibration** may not have a difference in efficacy compared to **sham stimulation, conventional therapy, or no stimulation** for improving balance.	8	Sade et al. 2019; Lee et al. 2019; Lee et al. 2017; Lee et al. 2015; Tankisheva et al. 2014; Marin et al. 2013; Brogardh et al. 2012; Lau et al. 2012
1b	**Whole-body vibration** may not have a difference in efficacy compared to **music exercise therapy** for improving balance.	1	Van Nes et al. 2006
2	**Balance training with whole-body vibration** may not have a difference in efficacy compared to **conventional therapy** for improving balance.	1	Merkert et al. 2011

GAIT

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **whole-body vibration with treadmill training** to improve gait when compared to **treadmill training**.	1	Choi et al. 2017
1a	**Whole-body vibration** may not have a difference in efficacy compared to **sham stimulation, no stimulation, or conventional care** for improving gait.	4	Lee et al. 2019; Sade et al. 2019; Silva et al. 2016; Chan et al. 2012
1a	**Local muscle vibration** may not have a difference in efficacy compared to **sham stimulation or conventional therapy** for improving gait.	2	Lee et al. 2013a; Paoloni et al. 2010
1b	**Matrix rhythm therapy** may not produce greater improvements in gait than **bobath therapy.**	1	Unal et al. 2021

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
2	**Balance training with whole-body vibration** may produce greater improvements in activities of daily living than **conventional rehabilitation.**	1	Merkert et al. 2011
1a	**Whole-body vibration** may not have a difference in efficacy compared to **sham stimulation, no stimulation, or conventional care** for improving activities of daily living.	2	Alp et al. 2018; Lee et al. 2017
1b	**High-frequency vibration** may not have a difference in efficacy compared to **low-frequency vibration or conventional therapy** for improving activities of daily living.	1	Liao et al. 2016
1b	**Low-frequency vibration** may not have a difference in efficacy compared to **conventional therapy** for improving activities of daily living.	1	Liao et al. 2016

1b	**Whole-body vibration** may not have a difference in efficacy compared to **musical exercise therapy** for improving activities of daily living.	1	Van Nes et al. 2006

RANGE OF MOTION			
LoE	Conclusion Statement	RCTs	References
1b	**Whole-body vibration** may produce greater improvements in range of motion than **sham stimulation, no stimulation, or conventional care.**	1	Guo et al. 2015
1b	**Matrix rhythm therapy** may produce greater improvements in range of motion than **bobath therapy.**	1	Unal et al. 2021
1b	**Segmental muscle vibration** may not produce greater improvements in range of motion than **conventional therapy.**	1	Paoloni et al. 2010

MUSCLE STRENGTH			
LoE	Conclusion Statement	RCTs	References
1b	**Local muscle vibration** may produce greater improvements in muscle strength than **sham stimulation.**	1	Toscano et al. 2019
1a	There is conflicting evidence on the effect of **whole-body vibration** when compared to **sham stimulation, no stimulation or conventional care** for improving muscle strength.	7	Silva et al. 2014; Tankisheva et al. 2014; Marin et al. 2013; Brogardh et al. 2012; Lau et al. 2012; Tihanyi et al. 2010; Tihanyi et al. 2007
1a	**High-frequency vibration** may not have a difference in efficacy compared to **low frequency whole-body** for improving muscle strength.	2	Yang et al. 2021; Liao et al. 2016
1b	**High-frequency vibration or low-frequency vibration** may not have a difference in efficacy compared to **conventional therapy** for improving muscle strength.	1	Liao et al. 2016
1b	**Whole-body vibration** may not have a difference in efficacy compared to **musical exercise therapy** for improving muscle strength.	1	Van Nes et al. 2006

SPASTICITY			
LoE	Conclusion Statement	RCTs	References
1a	**Whole-body vibration** may not have a difference in efficacy compared to **sham stimulation, no stimulation or conventional care** for improving spasticity.	6	Sales et al. 2020; Alp et al. 2018; Tankisheva et al. 2014; Pang et al. 2013; Brogardh et al. 2012; Chan et al. 2012
1b	**Local muscle vibration** may not have a difference in efficacy compared to **sham stimulation** for improving spasticity.	1	Toscano et al. 2019

1b	**High frequency whole-body vibration** may not have a difference in efficacy compared to **low frequency whole-body vibration or conventional care** for improving spasticity.	1	Liao et al. 2016
1b	**Low frequency whole-body vibration** may not have a difference in efficacy compared to **conventional care** for improving spasticity.	1	Liao et al. 2016

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Local muscle vibration** may produce greater improvements in measures of stroke severity than **sham stimulation.**	1	Toscano et al. 2019

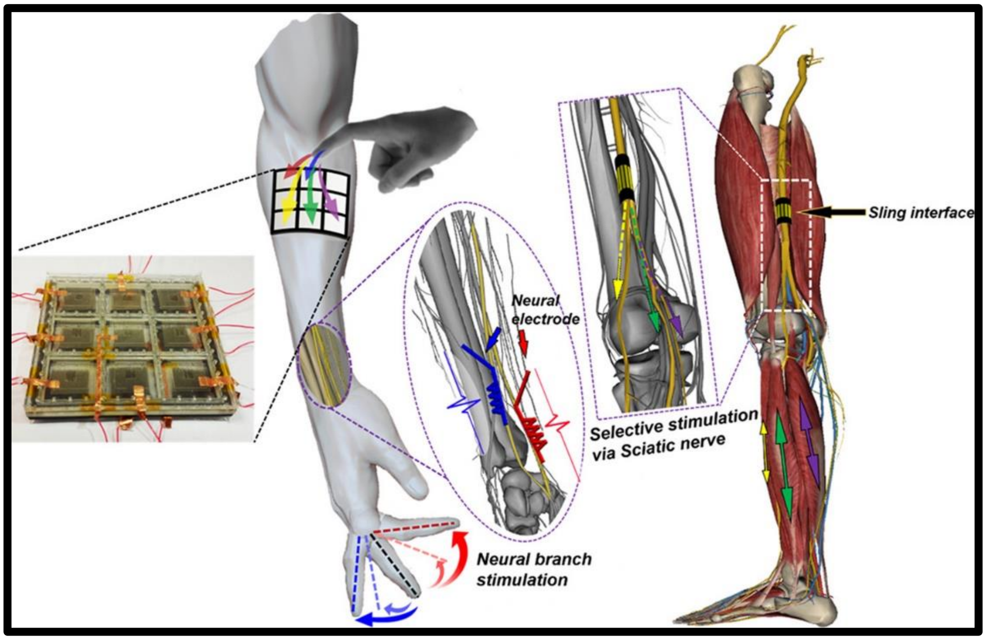
QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Whole-body vibration** may not have a difference in efficacy compared to **sham stimulation, no stimulation or conventional care** for improving quality of life.	2	Sales et al. 2020; Alp et al. 2018; Tankisheva et al. 2014; Pang et al. 2013; Brogardh et al. 2012; Chan et al. 2012
1b	**High frequency whole-body vibration** may not have a difference in efficacy compared to **low frequency whole-body vibration or conventional care** for improving quality of life.	1	Liao et al. 2016
1b	**Low frequency whole-body vibration** may not have a difference in efficacy compared to **conventional care** for improving quality of life.	1	Liao et al. 2016

Key Points

Whole-body vibration may not be beneficial for improving motor function, mobility, balance, functional ambulation, gait, activities of daily living, spasticity, and quality of life after stroke.

The literature is mixed regarding the effect of whole-body vibration on improving muscle strength, and range of motion.

Additional Afferent and Peripheral Stimulation Methods



Adopted from: https://www.sciencedirect.com/science/article/abs/pii/S2211285518302337

Additional sensory stimulation methods evaluated for motor rehabilitation included short wave therapy, repetitive peripheral magnetic stimulation, intermittent pneumatic compression and other sensory stimulation techniques. Short-wave therapy is a non-invasive intervention in which electromagnetic radiation is applied to the region of the body typically at 27.12MHz in a continuous or pulse fashion (Wang et al., 2017a). In repetitive peripheral magnetic stimulation coils are placed over paralysed muscles that generates a magnetic field that passes through the skin, and in turn can depolarize neurons to allow a muscle contraction (Momosaki et al., 2017). Repetitive peripheral magnetic stimulation can stimulate painlessly deep muscle structures that are out of range of traditional electrical stimulation (Momosaki et al., 2017). Intermittent pneumatic compression is the application of inflatable splints where pressure is applied intermittently to increase sensory input (Cambier et al., 2003).

Five RCTs were found that evaluated additional afferent and peripheral stimulation for lower extremity rehabilitation. Two RCTs compared tactile sensory stimulation to conventional care or sham (Goliwas et al., 2015; Lynch et al., 2007). One RCT compared afferent electrical stimulation and mirror to sham mirror therapy and sham stimulation (Lee & Lee, 2019). One RCT compared intermittent pneumatic compression to conventional therapy (Wei et al., 2021). One RCT compared photobiomodulation therapy to sham (Casalechi et al., 2020).

The methodological details and results of all five RCTs are presented in Table 34.

Table 34. RCTs Evaluating Afferent and Peripheral Stimulation Interventions for Upper Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$	Interventions	Outcome Measures Result (direction of effect)

Sample Size$_{end}$ Time post stroke category	Duration: Session length, frequency per week for total number of weeks	
Tactile Sensory Stimulation vs Conventional Care		
Goliwas et al. (2015) RCT (6) N_{start}=27 N_{end}=20 TPS=Chronic	E: Sensorimotor Foot Stimulation Training C: Conventional Care Duration: 45min/d, 5d/wk, for 5wks	• Weight Distribution ○ Eyes Open (+exp) ○ Eyes Closed (-)
Lynch et al. (2007) RCT (6) N_{start}=21 N_{end}=21 TPS=Subacute	E: Sensory Training Program + standard PT C: Relaxation Control + standard PT Duration: 30min/d, 5d/wk, for 2wks Sensory retraining/relaxation sessions & 90-120min/session 2wks standard PT	• Semmes-Weinstein monofilaments ○ First Metatarsal (+exp) ○ Heel (-) ○ Lateral Border of Foot (-) ○ Big Toe (-) ○ Little Toe (-) ○ Medial Border f Foot (-) ○ Fifth Metatarsal (-) • Distal Proprioception test (-) • Berg balance scale (-) • 10-meter timed gait (-) • Use of walking aid (-) • Timed Iowa Level of Assistance Scale (-)
Afferent Electrical Stimulation with Mirror Therapy vs Sham		
Lee & Lee (2019) RCT (7) N_{start}=30 N_{end}=30 TPS=Chronic	E: Electrical stimulation + mirror therapy C: Sham electrical stimulation + sham mirror therapy Duration: 60min/d, 5d/wk, for 4wks	• Muscle strength (+exp) • Modified ashworth scale (-) • Berg Balance Scale (+exp) • Gait Velocity (+exp) • Cadence (-) • Step length (+exp) • Stride length (+exp) • Single Support time (-) • Double Support time (-)
Intermittent Pneumatic Compression vs Conventional Therapy		
Wei et al. (2021) RCT (6) N_{start}=74 N_{end}=72 TPS=Acute	E: Intermittent pneumatic compression + Conventional therapy C: Conventional therapy Duration: 30-45min/d for 14d Conventional therapy; 60min/d, for 14d Intermittent pneumatic compression	• Fugl-Meyer Motor Function Scores (+exp) • Barthel Index (+exp)
Laser Photo-biomodulation vs Sham		
Casalechi et al. (2020) RCT crossover (10) N_{start}=10 N_{end}=10 TPS=Chronic	E1: Photobiomodulation Therapy (50 Jules) E2: Photobiomodulation Therapy (30 Jules) E3: Photobiomodulation Therapy (10 Jules) C: Sham photobiomodulation Therapy (0 Jules) Duration: single session - 1-week washout	E1 vs C: • 6-Minute Wak Test (-) • Timed up and Go Test (-) E2 vs C: • 6-Minute Wak Test (+exp2) • Timed up and Go Test (+exp2) E3 vs C: • 6-Minute Walk Test (-) • Timed up and Go Test (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Additional Afferent and Peripheral Stimulation

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Tactile stimulation** may not have a difference in efficacy compared to **no stimulation** for improving functional ambulation.	1	Lynch et al. 2007
2	**Peroneal nerve stimulation** may not have a difference in efficacy compared to **no stimulation** for improving functional ambulation.	2	Kottinik et al. 2012; Sheffler et al. 2006
1b	**Electrical stimulation with mirror therapy** may produce greater improvements in functional ambulation than **sham mirror and sham stimulation.**	1	Lee et al. 2019
1b	**Photobiomodulation therapy at 30 Jules** may produce greater improvements in functional ambulation than **at 50 Jules, 10 Jules or 0 Jules (sham).**	1	Casalechi et al. 2020

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **tactile stimulation** to improve balance when compared to **no stimulation**.	1	Lynch et al. 2007
1b	**Electrical stimulation with mirror therapy** may produce greater improvements in balance than **sham mirror and sham stimulation.**	1	Lee et al. 2019
1b	**Photobiomodulation therapy at 30 Jules** may produce greater improvements in balance than **at 50 Jules, 10 Jules or 0 Jules (sham).**	1	Casalechi et al. 2020

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	There is conflicting evidence about the effect of **peroneal nerve stimulation** to improve gait when compared to **no stimulation**.	1	Kottinik et al. 2012
1b	There is conflicting evidence about the effect of **electrical stimulation with mirror therapy** to improve gait when compared to **sham mirror and sham stimulation**.	1	Lee et al. 2019

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**

1b	**Electrical stimulation with mirror therapy** may produce greater improvements in muscle strength than **sham mirror and sham stimulation.**	1	Lee et al. 2019

SPASTICITY			
LoE	Conclusion Statement	RCTs	References
1b	**Electrical stimulation with mirror therapy** may not have a difference in efficacy compared to **sham mirror and sham stimulation** for improving spasticity.	1	Lee et al. 2019

PROPRIOCEPTION			
LoE	Conclusion Statement	RCTs	References
1b	**Tactile stimulation** may not have a difference in efficacy compared to **no stimulation** for improving proprioception.	1	Lynch et al. 2007

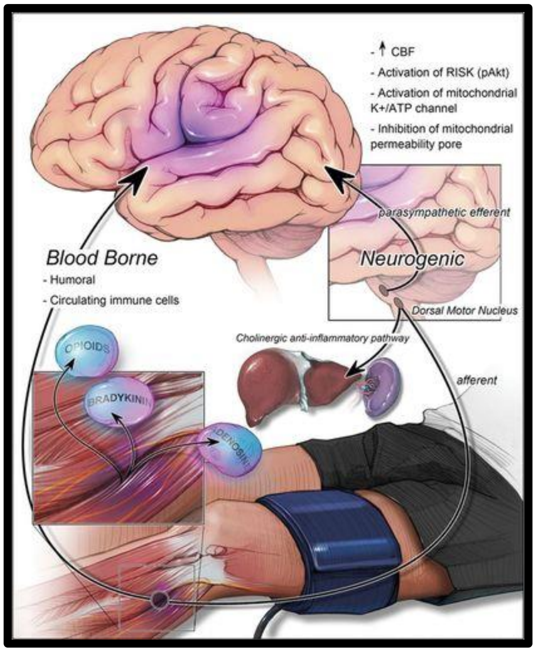
Key Points

Electrical stimulation with mirror therapy may be beneficial for improving functional ambulation, balance, and muscle strength after stroke.

Photobiomodulation therapy may be beneficial for improving functional ambulation and balance after stroke.

Tactile and peroneal nerve stimulation may not be beneficial for improving functional ambulation after stroke.

Remote Ischemic Conditioning



Adopted from: https://www.ahajournals.org/cms/asset/0b2be4cb-6f1a-4b56-a2ab-591da6bf2b5c/1191fig02.jpg

Remote ischemic conditioning (RIC) is a procedure that aims to trigger the body's natural responses against ischemic injury after a stroke and reduce the severity of the damage from the injury (Murray & Lopez, 1997). RIC is accomplished by multiple temporary reductions of blood flow to an upper or lower extremity vascular bed by chemical, mechanical or electrical stimulus (Heusch et al., 2015). After the induced ischemic procedure, physiological and homeostatic processes will upregulate natural protective factors and it is believed that this may benefit the initial injury site. It is sometimes referred to as a synthetic form of aerobic exercise as the cardio-protective benefits from both interventions share some overlap. RIC remains a controversial intervention with some benefits being observed in animal studies but little to no clinical evidence in large human trials.

Three RCTs were found that remote ischemic conditioning for lower extremity motor rehabilitation. All three RCTs compared remote ischemic conditioning to sham or conventional therapy (Durand et al., 2019; Hyngstrom et al., 2018; Pico et al., 2020).

The methodological details and results of all three RCTs are presented in Table 35.

Table 35. RCTs Evaluating Remote Ischemic Conditioning Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Remote Ischemic Conditioning vs Sham or Conventional Therapy		
Pico et al. (2020) RCT (6) N_{start}=188 N_{end}=147 TPS=Acute	E: Remote Ischemic Preconditioning and Conventional Care C: Conventional Care	• Barthel Index (-) • Modified Rankin Score (-)

	Duration: (preconditioning 6hrs after symptom onset), 90d follow up	
Durand et al. (2019) RCT (5) N_{start}=22 N_{end}=20 TPS=Chronic	E: Ischemic Conditioning Training (225 mmHg) C: Sham Duration: 30min/d, 3-4d/wk, for 2wks (7 session totally)	• 10-Meter Walk Test: ○ Self-selected walking speed (+exp) ○ Fast walking speed (-) • Knee extensor Maximum Voluntary Contractions: ○ MVC (-) ○ fatigue task duration (+exp) ○ Reduction in MVC Post Fatigue (-) ○ Resting Twitch Torque (-)
Hyngstrom et al. (2018) RCT crossover (7) N_{start}=10 N_{end}=10 TPS=Chronic	E: Ischemic conditioning (225mmHg) C: Sham ischemic conditioning (25mmHg) Duration: Single session: 5min of compression then 5min of rest, repeated 5 times	• Maximum voluntary contraction in knee extensor (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Remote Ischemic Conditioning Interventions

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	There is conflicting evidence about the effect of **remote ischemic conditioning** for improving functional ambulation compared to **sham or conventional therapy.**	1	Durand et al. 2019

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Remote ischemic conditioning** may not have a difference in efficacy when compared to **sham or conventional therapy** for improving activities of daily living.	1	Pico et al. 2020

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **remote ischemic conditioning** to improve muscle strength when compared to **sham or conventional therapy**.	2	Durand et al. 2019 ; Hyngstrom et al. 2018

Key Points

The literature is mixed concerning the effects of remote ischemic conditioning on improving functional ambulation and muscle strength after stroke.

Remote ischemic conditioning may not be beneficial for improving activities of daily living after stroke.

Thermal Stimulation and Cryotherapy

Adopted from: https://premierhealthmn.com/services/benefits-of-ice-heat-therapy/

Thermal stimulation is a neurologic rehabilitation strategy used to facilitate sensorimotor function by applying thermal stimulation in a noxious or innocuous form on sensory receptors in the body (Lin et al., 2017). Thermal gradations can be distinguished by three types of receptors: cold, warmth, and pain receptors (Tai et al., 2014). Thermal stimulation stimulates innocuous or noxious receptors, which send the signals to several areas in the somatosensory cortex. Imaging studies show that innocuous and noxious stimulation may activate different regions of the brain: whereas innocuous stimulation seems to activate the primary and secondary somatosensory cortex, thalamus, and insula, noxious stimulation induces larger sensory and motor-cortical activations in the brain (Tai et al., 2014). Innocuous thermal stimulation has also been found to induce greater corticomotor excitability, and as such has been suggested to influence cortical reorganization and neuroplasticity (Lin et al., 2017). Cryotherapy decreases tissue temperature and can be used to reduce inflammation, pain and muscle spasms (Costello & Donnelly, 2010; Garcia et al., 2019). Applications may include ice, water immersion and cooling pads (Costello & Donnelly, 2010).

Nine RCTs were found evaluating thermal stimulation or cryotherapy interventions for lower extremity motor rehabilitation.

Six RCTs compared thermal stimulation to sham or no stimulation (Alwhaibi et al., 2021; Chen et al., 2011; Hsu et al., 2013; Liang et al., 2012; Martins et al., 2012; Matsumoto et al., 2014). Two RCTs compared cryotherapy to sham stimulation (Alcantara et al., 2019; Garcia et al., 2019). One RCT compared cryotherapy combined with physical therapy and an ankle-foot orthosis to physical therapy with an ankle-foot orthosis (Elnassag et al., 2019).

The methodological details and results of all nine RCTs are presented in Table 36.

Table 36. RCTs Evaluating Thermal Stimulation Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)

Time post stroke category		
Thermal Stimulation vs Sham or No Stimulation		

Alwhaibi et al. (2021)
RCT (6)
N_{start}=30
N_{end}=30
TPS=Chronic
	E: Thermal stimulation + Standard physiotherapy program
	C: Standard physiotherapy program
	Duration: 30-60min/d, 3d/wk, for 8wks
		• Functional Independence Measure (+exp)
		• Quantitative Electroencephalogram
		  ○ Motor area (-)
		  ○ Parietal area (-)
		  ○ Frontal area (-)

Matsumoto et al. (2014)
RCT (8)
N_{start}=22
N_{end}=22
TPS=Subacute
	E: Hot footbath
	C: No treatment
	Duration: 15min-sessions
		• Modified Ashworth Scale (+exp)
		• F-wave parameters
		  ○ F-wave amplitude (+exp)
		  ○ F/M ratio (+exp)
		  ○ F-wave persistence (+exp)
		  ○ M-response (-)
		• Physiological measurements
		  ○ Body temperature (+exp)
		  ○ Surface skin temperature of thigh (+exp)
		  ○ Surface skin temperature of ankle (+exp)
		  ○ Systolic blood pressure (-)
		  ○ Diastolic blood pressure (-)
		  ○ Heart rate (-)

Hsu et al. (2013)
RCT (7)
N_{start}=34
N_{end}=23
TPS=Chronic
	E: Thermal stimulation + conventional therapy
	C: Sham thermal stimulation + conventional therapy
	Duration: 30min/d, 3d/wk for 8wks
		• Stroke Rehabilitation Assessment of Movement
		  ○ Lower extremity (-)
		  ○ Mobility (-)
		• Functional ambulation category (-)
		• Barthel Index (-)
		• Postural Assessment Scale for stroke patients (-)
		• Modified ashworth scale (-)

Liang et al. (2012) RCT (7) N_{start}=30 N_{end}=25 TPS=Acute	E: Standard rehabilitation (PT, OT) + Thermal Stimulation C: Standard rehabilitation (PT, OT) + discussion sessions Duration: 80 min/d, 5d/wk, for 6wks Standard rehabilitation & 40 min/d, 5d/wk, for 6wks Thermal Stimulation & 20min/d 3d/wk, for 6wks discussion sessions	• Fugl-Meyer lower extremity score (+exp) • Medical Research Council Scale for the Lower Extremity (+exp) • Berg Balance Scale (-) • Modified Motor Assessment Scale(+exp) • Functional Ambulation Classification(+exp) • Barthel Index (-)
Martins et al. (2012) RCT Crossover (4) N_{start}=20 N_{end}=16 TPS=Chronic	E1: Transcutaneous electrical nerve stimulation E2: Cryotherapy C: No treatment Duration: 30min, 1d – non-consecutive washout	E1 vs C • Hmax/Mmax ratio (+exp1) • H-reflex latency (-) E2 vs C • Hmax/Mmax ratio (+exp2) • H-reflex latency (+exp2) E1 vs E2 • Hmax/Mmax ratio (+exp1) • H-reflex latency (+exp1)
Chen et al. (2011) RCT (7) N_{start}=35 N_{end}=33 TPS=Acute	E: Thermal stimulation + Standard rehabilitation C: Standard Rehabilitation Duration: 30-40min/d, 5d/wk, for 6wks thermal stimulation & 40min/d, 5d/wk, for 6wks rehabilitation	• Fugl-Meyer Assessment - Lower Extremity (+exp) • Modified Motor Assessment Scale (+exp) • Functional Ambulation Classification (+exp) • Medical Research Council Scale - Lower Extremity (+exp) • Berg Balance Scale (+exp) • Postural Assessment Scale for Stroke (-) • independent walking rate (-)
Cryotherapy vs Sham		

Alcantara et al (2019)
RCT crossover (7)
N_{start}=16
N_{end}=16
TPS=Chronic
	E: Cryotherapy
	C: Sham
	Duration: 20min/d, 3d Therapy + 1d Assessment familiarization, 1d/wk, for 4wks - 15d washout
		• Modified Ashworth Scale (+exp)
		• Dynamometer- Ankle Flexors Strength (-)
		• Gait Kinematics
		  ○ Ankle (-)
		  ○ Knee (-)
		  ○ Hip (-)

Garcia et al. (2019)
RCT crossover (7)
N_{start}=16
N_{final}=16
TPS=Chronic
	E: Cryotherapy
	C: Sham control
	Duration: 20min/1session - 15d washout
		• Ankle Joint position sense
		  ○ Dorsiflexion (-)
		  ○ Plantarflexion (-)
		• Modified Ashworth Scale (+exp)

Cryotherapy + Physical Therapy with Ankle foot Orthosis vs Physical Therapy with Ankle foot Orthosis		
Elnassag et al. (2019) RCT (6) N_{start}=30 N_{final}=30 TPS=Chronic	E: Cryo-airflow therapy for calf muscle + Physical therapy + Ankle foot orthosis at night C: Physical therapy + Ankle foot orthosis Duration: 3d/wk, for 4wks	• Modified Ashworth Scale (+exp) • EMG H/ M ratio (-) • Ankle Range of Motion (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
$+exp_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Thermal Stimulation and cryotherapy Interventions

MOTOR FUNCTION			
LoE	Conclusion Statement	RCTs	References
1a	**Thermal stimulation** may produce greater improvements in motor function compared **sham or no stimulation**.	2	Liang et al. 2012; Chen et al. 2011

FUNCTIONAL AMBULATION			
LoE	Conclusion Statement	RCTs	References
1a	There is conflicting evidence on the effect of **thermal stimulation** to improve functional ambulation compared to **sham or no stimulation**.	3	Hsu et al. 2013; Liang et al. 2012; Chen et al. 2011

FUNCTIONAL MOBILITY			
LoE	Conclusion Statement	RCTs	References
1b	**Thermal stimulation** may not have a difference in efficacy compared to **sham or no stimulation** for improving functional mobility.	1	Hsu et al. 2013

BALANCE			
LoE	Conclusion Statement	RCTs	References
1a	**Thermal stimulation** may not have a difference in efficacy compared to **sham or no stimulation** for improving balance.	3	Hsu et al. 2013; Liang et al. 2012; Chen et al. 2011

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1a	There is conflicting evidence about the effect of **thermal stimulation** to improve activities of daily living when compared to **no stimulation or sham stimulation**.	4	Alwhaibi et al. 2021; Hsu et al. 2013; Liang et al. 2012; Chen et al. 2011

RANGE OF MOTION

LoE	Conclusion Statement	RCTs	References
1b	**Cryotherapy combined with physical therapy and an ankle-foot orthosis** may produce greater improvements in range of motion compared to **physical therapy with an ankle-foot orthosis.**	1	Elnassag et al. 2019

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1a	**Thermal stimulation** may produce greater improvements in muscle strength compared to **sham or no stimulation**.	2	Liang et al. 2012; Chen et al. 2011
1b	**Cryotherapy** may not have a difference in efficacy compared to **sham stimulation** for improving muscle strength.	1	Alcantara et al. 2019

SPASTICITY

LoE	Conclusion Statement	RCTs	References
1a	There is conflicting evidence about the effect of **thermal stimulation** to improve spasticity when compared to **sham or no stimulation.**	2	Matsumoto et al. 2014; Hsu et al. 2013
1a	**Cryotherapy** may produce greater improvements in spasticity compared to **sham stimulation.**	2	Alcantara et al. 2019; Garcia et al. 2019
1b	**Cryotherapy combined with physical therapy and an ankle-foot orthosis** may produce greater improvements in spasticity compared to **physical therapy with an ankle-foot orthosis.**	1	Elnassag et al. 2019

PROPRIOCEPTION

LoE	Conclusion Statement	RCTs	References
1b	**Cryotherapy** may not have a difference in efficacy compared to **sham stimulation** for improving proprioception.	1	Garcia et al. 2019

GAIT

LoE	Conclusion Statement	RCTs	References

1b	**Cryotherapy** may not have a difference in efficacy compared to **sham stimulation** for improving gait.	1	Alcantra et al. 2019

Key Points

Thermal stimulation may be beneficial for improving motor function, and muscle strength after stroke.

The literature is mixed concerning the effect of thermal stimulation on improving functional ambulation, activities of daily living, spasticity after stroke.

Thermal stimulation may not be beneficial for improving mobility and balance after stroke.

Cryotherapy may be beneficial for improving range of motion and spasticity after stroke.

Cryotherapy may not be beneficial for improving muscle strength, fait, and proprioception after stroke.

Extracorporeal Shockwave Therapy and Therapeutic Ultrasound

Adopted from: https://www.sportsmedbiologic.com.au/shockwave-therapy.html

Extracorporeal shockwave therapy involves the delivery of high-intensity ultrasound waves to affected soft tissue regions of the body. When it comes to stroke treatment, this therapy is used to alleviate spasticity in stroke patients (Taheri et al., 2017). Therapeutic ultrasound may be delivered in a continuous or pulsed mode (Radinmehr et al., 2019). Continuous ultrasound provides a thermal effect, and pulsed effects are usually nonthermal (Ansari et al., 2007). The use of ultrasound has been studied in aiding spasticity.

Ten RCTs were found evaluating extracorporeal shockwave therapy or therapeutic ultrasound for lower extremity rehabilitation.

Three RCTs compared extracorporeal shockwave therapy to sham or conventional therapy (Lee et al., 2019a; Taheri et al., 2017; Yoldas Aslan et al., 2021). One RCT compared focused and radial shockwave therapy (Wu et al., 2018). One RCT compared different locations of shockwave therapy (Yoon et al., 2017). Two RCTs compared therapeutic ultrasound to sham or conventional therapy (Ansari et al., 2007; Sahin et al., 2011). One RCT compared radial extracorporeal shockwave therapy with visual feedback balance training to sham therapy with visual feedback balance training (Mihai et al., 2022). One RCT compared therapeutic ultrasound to TENS and Botulinum Toxin A (Picelli et al., 2014). One RCT compared therapeutic ultrasound to radial extracorporeal shockwave therapy (Radinmehr et al., 2019).

The methodological details and results of the ten RCTs evaluating extracorporeal shockwave therapy or therapeutic ultrasound for lower extremity motor rehabilitation are presented in Table 37.

Table 37. RCTs Evaluating Extracorporeal Shockwave Therapy and Therapeutic Ultrasound Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Extracorporeal Shockwave Therapy vs Sham or Conventional Therapy		

Yoldas Aslan et al. (2021) RCT (8) N_{start}=51 N_{end}=49 TPS=Chronic	E1: Radial Extracorporeal shockwave therapy + Conventional rehabilitation E2: Sham Extracorporeal shockwave therapy + Conventional rehabilitation C: Conventional rehabilitation (Bobath techniques) Duration: 2sessions/wk, for 2wks ESWT or sham ESWT & 120-180min/d, 5d/wk, for 2wks conventional care	E1 vs E2 + C • Modified Ashworth Scale (+exp1) • Tardieu scale-spasticity angle (+exp1) • Ankle Range of Motion (-) • Strain Index (-) • Modified Barthel Index (-) • 6-Minute Walk Test (-)
Lee et al. (2019) RCT (7) N_{start}=20 N_{end}=18 TPS=Chronic	E: Extracorporeal shock wave therapy to the medial head of gastrocnemius muscle on spastic side (4Hz, 2000shots with intensity of stimulation using energy of 0.1mJ/mm2) C: Sham stimulation Duration: Single Session	• Modified Ashworth Scale (-) • Passive Range of Motion (-) • Fugl-Meyer Assessment (-) • Ultrasonographic measures of spasticity ○ Achilles tendon length (+exp) ○ Muscle fasicle length (+exp) ○ Muscle thickness (+exp) ○ Pennation angle (+exp)
Taheri et al. (2017) RCT (5) N_{start}=28 N_{end}=25 TPS=Subacute	E: Extracorporeal Shock Wave Therapy + Standard stretching + Oral anti-spastic drugs C: Standard stretching + Oral anti-spastic drugs Duration: 1x/wk for 3wks Extracorporeal shock wave therapy; 30min/d, 5x/wk, for 3wks Standard Stretching; 2mg/d for 4d then 4mg/d, for 3wks oral anti-spastic	• Modified Ashworth Scale (+exp) • Passive Range of Motion (+exp) • 3-Meter Walk Duration (-) • Lower Extremity Functional Score (+exp) • Clonus score (-) • Visual Analogue scale-pain (-)
Focused vs Radial Shockwave Therapy		
Wu et al. (2018) RCT (7) N_{start}=32 N_{end}=31 TPS=Chronic	E1: Focused Shockwave Therapy E2: Radial Shockwave Therapy Duration: 1 session/wk, for 3wks	E1 v E2 • Modified Ashworth scale (-) • Tardieu scale-angles (-) • Ankle Passive range of motion (+exp2) • Dynamic foot plantar contact area-affected side (+exp2) • 10m Walk test (-) • Adverse events (no stats)
Location of Extracorporeal Shockwave Therapy		
Yoon et al. (2017) RCT (5) N_{start}=54 N_{end}=44 TPS=Chronic	E1: Extracorporeal Shock-wave Therapy on Muscle Belly (0.068 0.093 mJ/mm², 1,500 shots) E2: Extracorporeal Shock-wave Therapy on Myotendinous Junction (0.068 0.093 mJ/mm², 1,500 shots) C: Sham Extracorporeal Shock-wave Therapy (sound only) Duration: 1 session/d, 1d/wk, for 3wks (3 sessions total)	E1 Vs C • Modified Ashworth (+exp1) • Modified Tardieu Scale (+exp1) E2 Vs C • Modified Ashworth (+exp2) • Modified Tardieu Scale (+exp2) E1 Vs E2 • Modified Ashworth (-) • Modified Tardieu Scale (-)
Therapeutic Ultrasound vs Sham or Conventional Therapy		
Sahin et al. (2011) RCT (6)	E: Therapeutic ultrasound + passive stretching exercise	• Modified Ashworth scale(-) • Ankle dorsiflexion ROM (active/passive) (-) • Brunnstrom Motor Recovery Stage (lower) (-) • Functional Independency Measure (-)

N_{start}=46 N_{end}=41 TPS=Chronic	C: Passive stretching exercise Duration: 5d/wk, for 4wks stretching exercise & 10min/d, 5d/wk, for 4wks ultrasound	• MAS, Hmax/Mmax ratio (-)
Ansari et al. (2007) RCT (5) N_{start}=12 N_{end}=12 TPS=Chronic	E: Therapeutic ultrasound C: Sham therapeutic ultrasound Duration: 10min/d, 3d/wk for 5wks	• Hmax/Mmax Ratio (+exp) • Ashworth Scale (-) • Passive ROM (-) • Active ROM (-)
Radial Extracorpeal Shock Wave Therapy with Visual Feedback Balance Training vs Sham with Visual Feedback Balance Training		
Mihai et al. (2022) RCT (7) N_{start}=32 N_{end}=31 TPS=Chronic	E: Radial Extracorporeal Shock Wave Therapy + Prokin (visual feedback balance training) + Conventional therapy C: Sham Radial Extracorporeal Shock Wave Therapy + Prokin (visual feedback balance training) + Conventional therapy Duration: 60min/day, 5d/wk, for 2 wks conventional therapy 7min/day, 1d/wk, for 2 wks rEWST 20min/day, 5d/wk, for 2 wks visual feedback balance training	• Modified ashworth scale (+exp) • Passive Range of Motion ○ Knee (-) ○ Ankle (+exp) • Visual analogue scale (+exp) • Clonus score (+exp) • Trunk Impairment Scale (-) • Tinetti Assessment Tool (+exp) • Functional Ambulation Categories (-) • Fugl-Meyer Assessment for Lower Extremity (+exp) • Stabilometric Outcome measures ○ Dynamic (+exp) ○ Static (+exp) ○ Limit of stability (+exp) ○ Static-perimeter, mm (EO) (+exp) ○ Static-ellipse area, mm2 (EO) (+exp) ○ Static-perimeter, mm (EC) (-) ○ Static-ellipse area, mm2 (EC) (+exp)
Therapeutic Ultrasound vs TENS vs Botulinum Toxin A		
Picelli et al. (2014) RCT (6) N_{start}=30 N_{end}=30 TPS=Chronic	E1: Therapeutic ultrasound + Home exercises & conventional therapy E2: TENS + Home exercises & conventional therapy E3: Botulinum toxin A (200U) + Home exercises & conventional therapy Duration: 10min/d, 5d/wk for 2wks - Ultrasound, 15min/d, 5d/wk for 2wks - TENS, 1 injection session - Botulinum toxin A, 40min/d, 5d/wk for 2wks - Bobath training	E1 vs E2: • Modified Ashworth Scale (-) • Ankle passive range of motion (-) E1 vs E3: • Modified Ashworth Scale (+exp3) • Ankle passive range of motion (+exp3) E2 vs E3: • Modified Ashworth Scale (+exp3) • Ankle passive range of motion (+exp3)
Therapeutic Ultrasound vs Radial Extracorporeal Shock Wave Therapy		
Radinmehr et al. (2019) RCT (7) N_{start}=32 N_{final}=32 TPS=Chronic	E1: Therapeutic ultrasound E2: Radial extracorporeal shock wave therapy (rESWT) Duration: 1session rESWT & 10min therapeutic ultrasound	• Hmax/Mmax ratio (-) • H-reflex latency (-) • Modified Modified Ashworth Scale (-) • Active range of motion (-) • Passive range of motion (-) • Passive plantar flexor torque (-) • Timed up and go (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Extracorporeal Shockwave Therapy and Therapeutic Ultrasound

MOTOR FUNCTION			
LoE	Conclusion Statement	RCTs	References
1b	**Extracorporeal shockwave therapy** may not have a difference in efficacy compared to **sham stimulation or conventional therapy** for improving motor function.	1	Lee et al. 2019
1b	**Therapeutic ultrasound** may not have a difference in efficacy compared to **sham or conventional therapy** for improving motor function.	1	Sahin et al. 2011
1b	**Radial extracorporeal shockwave therapy with visual feedback balance training** may produce greater improvements in motor function than **sham therapy with visual feedback balance training**.	1	Mihai et al. 2021

FUNCTIONAL AMBULATION			
LoE	Conclusion Statement	RCTs	References
1b	**Extracorporeal shockwave therapy** may not have a difference in efficacy compared to **sham or conventional therapy** for improving functional ambulation.	2	Aslan et al. 2021; Taheri et al. 2017
1b	**Focused extracorporeal shockwave therapy** may not have a difference in efficacy compared to **radial extracorporeal shockwave therapy** for improving functional ambulation.	1	Wu et al. 2018
1b	**Radial extracorporeal shockwave therapy with visual feedback balance training** may not have a difference in efficacy compared to **sham therapy with visual feedback balance training** for improving functional ambulation.	1	Mihai et al. 2021
1b	**Therapeutic ultrasound** may not have a difference in efficacy compared to **radial extracorporeal shockwave therapy** for improving functional ambulation.	1	Radinmehr et al. 2019

BALANCE			
LoE	Conclusion Statement	RCTs	References

1b	There is conflicting evidence on the effect of **radial extracorporeal shockwave therapy with visual feedback balance training** to improve balance compared to **sham therapy with visual feedback balance training**.	1	Mihai et al. 2021

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence on the effect of **extracorporeal shockwave therapy** to improve activities of daily living compared to **conventional or sham therapy**.	2	Aslan et al. 2021; Taheri et al. 2017
1b	**Therapeutic ultrasound** may not have a difference in efficacy compared to **conventional or sham therapy** for improving activities of daily living.	1	Sahin et al. 2011

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Radial extracorporeal shockwave therapy** may produce greater improvements in range of motion compared to **focused extracorporeal shockwave therapy.**	1	Wu et al. 2018
1b	There is conflicting evidence on the effect of **radial extracorporeal shockwave therapy with visual feedback balance training** to improve range of motion compared to **sham therapy with visual feedback balance training.**	1	Mihai et al. 2021
1b	**Extracorporeal shockwave therapy** may not have a difference in efficacy compared to **conventional or sham therapy** for improving range of motion.	3	Aslan et al. 2021; Lee et al. 2019; Taheri et al. 2017
1b	**Therapeutic ultrasound** may not have a difference in efficacy compared to **sham or conventional therapy** for improving range of motion.	2	Sahin et al. 2011; Ansari et al. 2007
1b	**Therapeutic ultrasound** may not have a difference in efficacy compared to **TENS** for improving range of motion.	1	Picelli et al. 2014
1b	**Therapeutic ultrasound** may not have a difference in efficacy compared to **radial extracorporeal shockwave therapy** for improving range of motion.	1	Radinmehr et al. 2019

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Therapeutic ultrasound** may not have a difference in efficacy compared to **radial extracorporeal shockwave therapy** for improving muscle strength.	1	Radinmehr et al. 2019

SPASTICITY

LoE	Conclusion Statement	RCTs	References
2	**Extracorporeal shockwave therapy on muscle belly or on myotendinous junction** may produce greater improvements in spasticity than **sham therapy.**	1	Yoon et al. 2017
1b	**Radial extracorporeal shockwave therapy with visual feedback balance training** may produce greater improvements in spasticity compared to **sham therapy with visual feedback balance training.**	1	Mihai et al. 2021
1b	There is conflicting evidence on the effect of **extracorporeal shockwave therapy** to improve spasticity compared to **conventional or sham therapy**.	3	Aslan et al. 2021; Lee et al. 2019; Taheri et al. 2017
1b	**Focused extracorporeal shockwave therapy** may not have a difference in efficacy compared to **radial extracorporeal shockwave therapy** for improving spasticity.	1	Wu et al. 2018
2	**Extracorporeal shockwave therapy on muscle belly** may not have a difference in efficacy compared to **extracorporeal shockwave therapy on myotendinous junction** for improving spasticity.	1	Yoon et al. 2017
1b	**Therapeutic ultrasound** may not have a difference in efficacy compared to **sham or conventional therapy** for improving spasticity.	1	Sahin et al. 2011; Ansari et al. 2007
1b	**Therapeutic ultrasound** may not have a difference in efficacy compared to **TENS** for improving spasticity.	1	Picelli et al. 2014
1b	**Therapeutic ultrasound** may not have a difference in efficacy compared to **radial extracorporeal shockwave therapy** for improving spasticity.	1	Radinmehr et al. 2019

Key Points

The literature is mixed concerning the effect extracorporeal shockwave therapy on improving motor function, balance, activities of daily living, and spasticity after stroke.

Extracorporeal shockwave therapy may not be beneficial for improving functional ambulation, range of motion after stroke.

Therapeutic ultrasound may not be beneficial for improving motor function, functional ambulation, activities of daily living, range of motion, muscle strength, and spasticity after stroke.

Repetitive Peripheral Magnetic Stimulation

Adopted from: https://www.youtube.com/watch?v=h7O5z-_eydw

Repetitive peripheral magnetic stimulation is a treatment that stimulates deep tissue through the usage of magnetic waves (Beaulieu et al., 2017). This can help patients regain function of their limbs which may have been compromised by a traumatic event such as an accident or a stroke (Beaulieu et al., 2015).

Two RCTs were found that evaluated repetitive peripheral magnetic stimulation for lower extremity motor rehabilitation. One of the RCTs compared repetitive peripheral magnetic stimulation to neuromuscular electrical stimulation, muscle tendon vibration and occupational therapy (Beaulieu et al., 2017). The other RCT compared repetitive peripheral magnetic stimulation to sham stimulation (Beaulieu et al., 2015).

The methodological details and results of the two RCTs evaluating stimulant interventions for lower extremity motor rehabilitation are presented in Table 38.

Table 38. RCTs Evaluating Repetitive Peripheral Magnetic Stimulation for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	**Interventions Duration: Session length, frequency per week for total number of weeks**	**Outcome Measures Result (direction of effect)**
Repetitive Peripheral Magnetic Stimulation vs NMES, Muscle Vibration, and Conventional therapy		
Beaulieu et al. (2017) RCT Crossover (6) N$_{start}$=15 N$_{end}$=15 TPS=Chronic	E1: Neuromuscular Electrical Stimulation E2: Repetitive Peripheral Magnetic Stimulation E3: Muscle Tendon Vibration C: Occupational Therapy Duration: 2.5-3h/d, 1d/wk - 1wk washout, 4wks	E1/E2/E3 vs C • Ankle active motor threshold (+exp2) • Intracortical inhibition (+exp2) • Isometric Eversion Strength (+exp2, +exp3) • Range of Motion (-) • Stretch reflex of plantar flexors (-)
Repetitive Peripheral Magnetic Stimulation vs Sham		

Beaulieu et al. (2015) RCT (5) N_{start}=30 N_{end}=30 TPS=Chronic	E: Repetitive peripheral magnetic stimulation C: Sham stimulation Duration: Single session	• Plantar flexor resistance to stretch (+exp) • Dorsiflexor PROM (-) • Dorsiflexor AROM (-) • Dorsiflexor Strength (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Repetitive Peripheral Magnetic Stimulation

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Repetitive peripheral magnetic stimulation** may produce greater improvements in muscle strength than **occupational therapy.**	1	Beaulieu et al. 2017
2	**Repetitive peripheral magnetic stimulation** may not have a difference in efficacy compared to **sham stimulation** for improving muscle strength**.**	1	Beaulieu et al. 2015

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Repetitive peripheral magnetic stimulation** may not have a difference in efficacy compared to **occupational therapy** for improving range of motion**.**	1	Beaulieu et al. 2017
2	**Repetitive peripheral magnetic stimulation** may not have a difference in efficacy compared to **sham stimulation** for improving range of motion**.**	1	Beaulieu et al. 2015

Key Points

Repetitive peripheral magnetic stimulation may be beneficial for improving muscle strength after stroke.

Repetitive peripheral magnetic stimulation may not be beneficial for improving range of motion after stroke.

Non-invasive Brain Stimulation

Repetitive Transcranial Magnetic Stimulation (rTMS)

Adopted from: https://www.rtmscentre.co.uk/rtms-treatment-in-the-uk/

Transcranial magnetic stimulation is a painless and non-invasive method of affecting neural activity through the exogenous generation of an electromagnetic field through a coil placed on the scalp, that consequently induces a change in the electrical fields of the brain (Peterchev et al., 2012). The voltage and current of the electromagnetic field generated are dependent on the parameters of the stimulation device, which is not distorted by the biological tissues in which it is applied in (Peterchev et al. 2012). The neuromodulatory effects of transcranial magnetic stimulation are attributed largely to neural membrane polarization shifts that can lead to changes in neuron activity, synaptic transmission, and activation of neural networks (Peterchev et al. 2012). Repetitive transcranial magnetic stimulation (rTMS) is the application of repetitive trains of transcranial magnetic stimulation at regular intervals.

After a stroke, interhemispheric competition is altered; with cortical excitability increasing in the unaffected hemisphere increasing and decreasing in the affected hemisphere (Zhang et al., 2017a). rTMS can be used to help modulate this interhemispheric competition, with low stimulation frequencies (≤1Hz) decreasing cortical excitability and inhibiting activity of the contralesional hemisphere, while high frequency (>1Hz) stimulation increases excitability and have a facilitatory effect on activity of the ipsilesional hemisphere (Dionisio et al., 2018).

26 RCTs were found evaluating rTMS for lower extremity motor rehabilitation. Eleven RCTs compared low frequency rTMS to sham stimulation (Cha, 2017; Chen et al., 2021a; Du et al., 2016; Gong et al., 2021; Huang et al., 2018; Kim et al., 2014e; Lin et al., 2015; Meng & Song, 2017; Rastgoo et al., 2016; Wang et al., 2020d; Wang et al., 2012). Ten RCTs compared high frequency rTMS to sham stimulation (Chieffo et al., 2014; Chieffo et al., 2021; Choi et al., 2016; Du et al., 2016; Gu & Chang, 2017; Guan et al., 2017; Kakuda et al., 2013; Khedr et al., 2010; Sasaki et al., 2017; Wang et al., 2020d). Four RCTs compared high frequency rTMS to low frequency rTMS (Cha et al., 2014a; Du et al., 2016; Khedr et al., 2010; Wang et al., 2020d). One RCT compared combined high and low frequency rTMS to standard therapy (Bintang et al., 2020). One RCT compared low frequency rTMS vs tDCS or combined rTMS and tDCS or sham (Gong et al., 2021). Two RCTs compared high frequency rTMS with treadmill training to sham rTMS and

treadmill training (Lee & Cha, 2020; Wang et al., 2019b). One RCT compared high frequency rTMS with cathodal tDCS to rTMS alone (Cho et al., 2017). One RCT compared ankle strengthening exercises with high frequency rTMS (Cha & Kim, 2017).

The methodological details and results of all 26 RCTs evaluating rTMS for lower extremity motor rehabilitation are presented in Table 39.

Table 39. RCTs Evaluating Low and High Frequency rTMS Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Low frequency (1Hz) rTMS vs Sham Stimulation		
Chen et al. (2021) RCT (8) N_{Start}=48 N_{End}=47 TPS=Acute	E: Bilateral inhibitory and facilitatory rTMS (1Hz and 10Hz) + Routine treatment C: Sham rTMS + Routine treatment Duration: 30min/d, 5d/wk, for 4wks	• Fugl-Meyer Assessment(+exp) ○ Upper Limb(+exp) • Modified Rankin Scale (+exp) • Activities of daily living (+exp) • GABA +/Cr ratio ○ Lesioned (+exp) • Mini Mental State Examination (+exp)
Huang et al. (2018) RCT (7) N_{Start}=38 N_{End}=37 TPS=Acute	E: Low frequency (1Hz) Repetitive Transcranial Magnetic Stimulation (rTMS) C: Sham rTMS Duration: 15min/d, 7d	• Timed Up and Go Test (-) • Postural Assessment Scale for Stroke (-) • Barthel Index (-) • Fugl-Meyer Assessment (-) • Stroke Specific Quality of Life Chinese version (-) • MEP Amplitude (-)
Cha et al. (2017) RCT (7) N_{Start}=52 N_{End}=30 TPS=Subacute	E: Low frequency (1Hz) Repetitive Transcranial Magnetic Stimulation (rTMS) + mirror therapy C: Sham rTMS + mirror therapy Duration: 15min/d rTMS + 30min/d mirror therapy, 5d/wk, 4 wks	• Postural Sway (+exp) • Wisconsin Gait Scale (+exp) • 6-Minute Walk Test (+exp) • Timed Up and Go Test (+exp)
Meng & Song (2017) RCT (5) N_{Start}=20 N_{End}=20 TPS=Subacute	E: Low frequency (1Hz) Repetitive Transcranial Magnetic Stimulation (rTMS) C: Sham rTMS Duration: 30min/d, 7d/wk for 2wks	• National Institute of Health Stroke Scale (+exp) • Barthel Index (+exp) • Fugl-Meyer Assessment (+exp)
Rastgoo et al. (2016) RCT crossover (5) N_{Start}=20 N_{End}=14 TPS=Chronic	E: Low frequency (1Hz) rTMS C: Sham rTMS Duration: 20min/d for 5d, 4wks washout	• Modified Modified Ashworth scale lower extremity (-) • Hmax/Mmax ratio (-) • Timed Up and Go (-) • Fugl-Meyer assessment lower extremity (-)
Lin et al. (2015) RCT (8) N_{Start}=32 N_{End}=31 TPS=Subacute	E: rTMS (1Hz) + Physical therapy C: Sham rTMS + Physical therapy Duration: 15min/d rTMS + 45min/d Physical therapy, 5d/wk, for 3wks	• Postural Assessment Scale for Stroke Patients (+exp) • Tinetti Performance Oriented Mobility Assessment (+exp) • Timed Up and Go Test (+exp) • Barthel Index (+exp) • Fugl-Meyer Assessment (-)
Kim et al. (2014) RCT (9) N_{start}=32	E: Low frequency (1Hz) Repetitive transcranial	• 10-meter walk test ○ Time (-) ○ Steps (-)

N_{end}=32 TPS=Acute	magnetic stimulation over cerebellum C: Sham rTMS Duration: 15min, 5d/wk, for 1wk (5 consecutive sessions)	• Berg balance scale (-)
Wang et al. (2012) RCT (8) N_{Start}=24 N_{End}=24 TPS=Chronic	E: Low frequency (1Hz) rTMS C: Sham rTMS Duration: 30min/d for 5d/wk for 2wks	• Fugl-Meyer Assessment (+exp) • Gait speed (+exp) • Cadence (+exp) • Bilateral step length (+exp) • Single-leg support time (+exp) • Double-leg support time (+exp) • Spatial asymmetry ratio (+exp)
High Frequency (>1Hz) rTMS vs Sham Stimulation		
Chieffo et al. (2021) RCT crossover (9) N_{Start}=12 N_{End}=11 TPS=Chronic	E: HF-rTMS with Hesed coil during active cycling C: Sham rTMS during cycling Duration: 11 sessions over 3wks, 4wks washout	• Fugl-Meyer Assessment lower extremity (+exp) • Modified Ashworth Scale (+exp) • 10-metre Walk test (-) • 6-min Walk test (-) • Resting motor threshold (+exp)
Gu & Chang (2017) RCT (8) N_{Start}=24 N_{End}=24 TPS=Chronic	E: Repetitive transcranial magnetic stimulation, high frequency (10 Hz) + movement therapy C: Sham Repetitive transcranial magnetic stimulation + movement therapy Duration: ~20min/d, 5d/wk, for 2wks rTMS/ sham, 60-150min/d, 6d/wk movement therapy	• Beck Depression Inventory (+exp) • Hamilton-Depression Rating scale 17 (+exp) • Motricity Index -upper extremity (-) ○ Lower index (-) • Modified Brunnstrom Classification (-) • Functional ambulation category (-)

Guan et al. (2017)
RCT (10)
N_{Start}=42
N_{End}=27
TPS=Acute
	E: High frequency (5Hz) Repetitive Transcranial Magnetic Stimulation (rTMS)
	C: Sham rTMS
	Duration: 1 session/d, 10 consecutive days
		• National Institutes of Health Stroke Scale (-)
		• Barthel Index (-)
		• Modified Rank Score
		  ○ Fugl-Meyer (-)
		  ○ Upper limb (-)
		  ○ Lower limb (-)
		• Resting motor threshold of hemiplegic upper limbs (-)

Sasaki et al. (2017) RCT (8) N_{Start}=21 N_{End}=21 TPS=Acute	E: E: High frequency rTMS (10Hz) + Conventional therapy C: Sham rTMS + Conventional therapy Duration: 10min/d for 5d - rTMS or Sham stimulation, 40-80min/d for 5d - Conventional therapy	• Ability for Basic Movement Scale Revised (+exp)

Choi et al. (2016)
RCT Crossover (7)
N_{Start}=33
N_{End}=30
TPS=Chronic
	E: High frequency (10Hz) rTMS
	C: Sham rTMS
	Duration: 10min/d, 5d/wk for 2wks – 4wk washout
		• Berg Balance Scale (+exp)
		• Sensory Organization Test (+exp)
		  ○ On-axis Velocity – R (+exp)
		  ○ On-axis Velocity – L (+exp)
		  ○ Directional Control L-R (+exp)
		  ○ Directional Control Front-back (+exp)

Chieffo et al. (2014) RCT (9) N_{Start}=10 N_{End}=9 TPS=Chronic	E: Deep rTMS with using H-coil (20Hz) C: Sham rTMS Duration: 30min/session, 11x over 3wks-4wks washout	• Fugl-Meyer Assessment (+exp) • 6-Minute walk test (-) • 10-Metre walk test (-)

Kakuda et al. (2013) RCT Crossover (6) N_{Start}=18 N_{End}=18 TPS=Chronic	E: High frequency (10Hz) rTMS C: Sham rTMS Duration: 20min/session - 24hr washout	• Gait speed (+exp) • Physiological cost index (-)
Khedr et al. (2005) RCT (8) N_{Start}=52 N_{End}=52 TPS=Acute	E: High frequency (3Hz) rTMS C: Sham rTMS Duration: 100s/d for 10d	• Barthel Index (+exp) • NIH Stroke Scale (+exp)
High vs Low Frequency rTMS or Sham rTMS		
Wang et al. (2020) RCT (7) N_{Start}=45 N_{End}=45 TPS=Acute	E1: High frequency rTMS (10Hz) + Conventional therapy E2: Low frequency rTMS (1Hz) + Conventional therapy C: Sham stimulation + Conventional therapy Duration: 7d/wk, for 2wks rTMS & 40min/d, 7d/wk, for 2wks Conventional therapy	E1 vs C • Fugl-Meyer Motor Assessment (+exp1) • Barthel Index (+exp1) • Motor evoked potential amplitude o Abductor pollicis brevis (+exp1) o Biceps brachii (+exp1) • Motor evoked potential latency o Abductor pollicis brevis (+exp1) o Biceps brachii (+exp1) • Corticomotor conduction time (+exp1) • Surface electromyography (+exp1) E1 vs E2 • Fugl-Meyer Motor Assessment (+exp1) • Barthel Index (+exp1) • Motor evoked potential amplitude o Abductor pollicis brevis (+exp1) o Biceps brachii (+exp1) • Motor evoked potential latency o Abductor pollicis brevis (-) o Biceps brachii (+exp1) • Corticomotor conduction time (+exp1) • Surface electromyography (+exp1) E2 vs C • Fugl-Meyer Motor Assessment (-) • Barthel Index (-) • Motor evoked potential amplitude o Abductor pollicis brevis (-) o Biceps brachii (-) • Motor evoked potential latency o Abductor pollicis brevis (-) o Biceps brachii (-) • Corticomotor conduction time (-) • Surface electromyography (-)
Du et al. (2016) RCT (9) N_{Start}=69 N_{End}=69 TPS=Acute	E1: Ipsilesional rTMS (3Hz) + Physical therapy E2: Contralesional rTMS (1Hz) + Physical therapy C: Sham rTMS + Physical therapy Duration: 1session/d (1200 pulses), 5d/wk, for 1wk rTMS & 60min/d, 5d/wk, for 1wk physical therapy	E1/E2 vs C • Fugl-Meyer Assessment (+exp1, +exp2) • Medical Record Council Scale (+exp1, +exp2) • Barthel Index (+exp1, +exp2) • Modified Rankin Scale (+exp1, +exp2) • NIH Stroke Scale (+exp1, +exp2) • Cortical Excitability Affected Hemisphere (+exp1, +exp2) • Cortical Excitability Unaffected Hemisphere (+exp2) E1 vs E2 • Fugl-Meyer Assessment (-) • Medical Record Council Scale (-) • Barthel Index (-) • Modified Rankin Scale (-) • NIH Stroke Scale (-) • Cortical Excitability Affected Hemisphere (-)

		• Cortical Excitability Unaffected Hemisphere (+exp2)
Cha et al. (2014) RCT (7) N_{Start}=24 N_{End}=24 TPS=Subacute	E: High frequency (10Hz) rTMS C: Low frequency (1Hz) rTMS Duration: 20min/d, 5d/wk for 4wks	• Balance Index (+exp) • Berg Balance Scale (+exp) • MEP Amplitude (+exp)
Khedr et al. (2010) RCT (7) N_{Start}=48 N_{End}=38 TPS=Acute	E1: Low frequency (3Hz) repetitive transcranial magnetic stimulation + conventional care E2: High frequency (10Hz) repetitive transcranial magnetic stimulation + conventional care C: Sham repetitive transcranial magnetic stimulation + conventional care Duration: 1session/d, 5d/wk, for 1wk rTMS (5 consecutive days)	E1/E2 vs C • Hemispheric stroke scale ○ Hand grip (+exp1) ○ Shoulder abduction (+exp1, +exp2) ○ Hip flexion (+exp1, +exp2) ○ Toe dorsiflexion (+exp1) • National institute of health stroke scale (+exp1) • Modified Rankin scale (-) E1 vs E2 • Hemispheric stroke scale ○ Hand grip (-) ○ Shoulder abduction (-) ○ Hip flexion (-) ○ Toe dorsiflexion (-) • National institute of health stroke scale (-) • Modified Rankin scale (-)
Combined High and Low Frequency rTMS vs Standard Therapy		
Bintang et al. (2020) RCT (8) N_{Start}=27 N_{End}=27 TPS=Subacute	E: High frequency (5Hz) rTMS ipsilateral lesions and low frequency contralesion (1Hz) + standard stroke treatment C: Standard ischemic stroke therapy Duration: ~20min/d 5d/wk, for 2wks (1200 stimulus per session) rTMS & PT duration not specified	• Stroke Rehabilitation Assessment of Movement ○ Upper Extremity (-) ○ Lower Extremity (-) ○ Mobility (+exp) • Motor Impairment degree (+exp) • Serum BDNF (-)
Low Frequency rTMS vs tDCS or Combined rTMS and tDCS or Sham		
Gong et al. (2021) RCT (7) N_{Start}=65 N_{End}=60 TPS=Acute	E1: rTMS (1Hz) + conventional therapy E2: Cathodal tDCS + rTMS (1Hz) + conventional therapy E3: Anodal tDCS + rTMS (1Hz) + conventional therapy C: Sham rTMS Duration: 40min/d, 5d/wk, for 4wks conventional therapy & 20min/d, 5d/wk, for 4wks tDCS +/- rTMS (total of 1200 pulses)	E1/E2/E3 vs C • National Institute of Health Stroke Scale (-) • Fugl-Meyer ○ Upper Limb (-) ○ Lower Limb (+exp3) • Bilateral Motor Evoked Potentials (+exp2, +exp3) • Barthel Index score (-) • Resting Motion Threshold (-) • Central Motor Conduction Time (-) E1 vs E2 vs E3 • National Institute of Health Stroke Scale (-) • Fugl-Meyer ○ Upper Limb (-) ○ Lower Limb (+exp3) • Bilateral Motor ○ Evoked Potentials (-) ○ Barthel Index score (-) ○ Resting Motion Threshold (-) ○ Central Motor Conduction Time (-)
High Frequency rTMS Combined with Treadmill Training vs Treadmill Training		

Lee et al. (2020) RCT (8) N_{Start}=13 N_{End}=13 TPS=Chronic	E: High frequency rTMS + Treadmill Training C: Sham rTMS + Treadmill Training Duration: 15min/d rTMS or sham + 20min/d treadmill training, 5d/wk, for 4wks	• 10-Meter Walk Test (+exp) • 6-Minute Walk Test (+exp) • Timed Up and Go Test (+exp)
Wang et al. (2019) RCT (6) N_{Start}=14 N_{End} =14 TPS=Chronic	E: High Frequency rTMS (5Hz) + Treadmill Training C: Sham rTMS + Treadmill Training Duration: 15min/d, 3d/wk, for 3wks rTMS 30min, 3d/wk, for 3wks treadmill training	• Walking speed (+exp) • Spatial asymmetry ratio (+exp) • Temporal asymmetry ratio (-) • MEP o Unaffected (-) o Affected (-) o Brain asymmetry ratio (-) • EMG for TA and RA muscles (-) • Fugl-Meyer assessment (+exp)
Ankle Strengthening Exercises With rTMS		
Cha et al. (2017) RCT (7) N_{Start}=30 N_{End}=30 TPS=Subacute	E1: Ankle Strengthening E2: Ankle Strengthening with high frequency (10Hz) Repetitive Transcranial Magnetic Stimulation (rTMS) C: rTMS Duration: 10min/d, 5d/wk, for 8wks	E2 vs C • Motor evoked potential amplitude (+exp2) • Peak torque o Plantar flexor (+exp2) o Dorsiflexor (+exp2) • 10-Meter walk test (+exp2) E2 vs E1 • Motor evoked potential amplitude (+exp2) • Peak torque o Plantar flexor (+exp2) o Dorsiflexor (+exp2) • 10-Meter walk test (+exp2)
High Frequency rTMS with Cathodal tDCS vs rTMS		
Cho et al. (2017) RCT (5) N_{Start}=30 N_{End}=30 TPS=Acute	E: Dual-mode transcranial direct current stimulation (2mA) + rTMS (10Hz) C: rTMS (10Hz) Duration: 20min/d, 5d/wk for 2wks	• Fugl-Meyer Assessment o Lower Extremity (-) o Upper Extremity o Total (+exp)

Abbreviations and table notes: ANCOVA=analysis of covariance; ANOVA=analysis of variance; C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Low and High Frequency rTMS

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Anodal tDCS combined with low rTMS** may have a difference in efficacy compared to low **rTMS** alone for improving motor function.	1	Gong et al. 2021
1b	**Combined high & low frequency rTMS** may produce greater improvements in motor function than **standard treatment.**	1	Bintang et al. 2020
1b	**High frequency rTMS combined with treadmill training** may produce greater improvements in motor function than **sham stimulation combined with treadmill training**	1	Wang et al. 2019

1a	There is conflicting evidence on the effect of **low frequency rTMS** when compared to **sham rTMS** for improving motor function.	9	Chen et al. 2021; Gong et al. 2021; Wang et al. 2020; Huang et al. 2018; Meng & Song 2017; Du et al. 2016; Rastgoo et al. 2016; Lin et al. 2015; Wang et al. 2012
1a	There is conflicting evidence about the effect of **high frequency rTMS** to improve motor function when compared to **sham stimulation**.	6	Chieffo et al. 2021; Wang et al. 2020; Guan et al. 2017; Gu & Chang 2017; Du et al. 2016; Chieffo et al. 2014
1a	There is conflicting evidence on the effect of **high frequency rTMS** when compared to **low frequency rTMS** for improving motor function.	2	Wang et al. 2020; Du et al. 2016
1b	There is conflicting evidence on the effect of **high frequency rTMS with tDCS** when compared to **high frequency rTMS alone** for improving motor function.	1	Cho et al. 2017
1b	**Cathodal tDCS combined with low rTMS** may not have a difference in efficacy compared to **rTMS** alone for improving motor function.	1	Gong et al 2021

FUNCTIONAL AMBULATION

LoE	Conclusion Statement	RCTs	References
1a	**High frequency rTMS combined with treadmill training** may produce greater improvements in functional ambulation than **sham stimulation combined with treadmill training**.	2	Lee et al. 2020; Wang et al. 2019
1b	**High frequency rTMS combined with ankle strengthening** may produce greater improvements in functional ambulation than **ankle strengthening or high frequency rTMS alone.**	1	Cha et al. 2017a
1a	There is conflicting evidence about the effect of **Low frequency rTMS** to improve functional ambulation when compared to **sham stimulation.**	6	Huang et al. 2018; Cha et al. 2017; Rastgoo et al. 2016; Lin et al. 2015; Kim et al. 2014; Wang et al. 2012
1a	There is conflicting evidence about the effect of **high frequency rTMS** to improve functional ambulation when compared to **sham stimulation**.	4	Chieffo et al. 2021; Gu & Chang 2017; Chieffo et al. 2014; Kakuda et al. 2013

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **Combined rTMS** to improve functional mobility when compared to **standard treatment**	1	Bintang et al. 2020

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	**High frequency rTMS** may produce greater improvements in balance than **sham stimulation.**	1	Choi et al. 2016

1b	**High frequency rTMS** may produce greater improvements in balance than **low frequency rTMS.**	1	Cha et al. 2014
1a	There is conflicting evidence about the effect of **low frequency rTMS** to improve balance when compared to **sham stimulation**.	4	Huang et al. 2018; Cha et al. 2017; Lin et al. 2015; Kim et al. 2014

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Low frequency rTMS** may produce greater improvements in gait than **sham stimulation.**	2	Cha et al. 2017; Wang et al. 2012
1b	**High frequency rTMS combined with treadmill training** shows conflicting evidence for improvements in gait compared to **sham stimulation combined with treadmill training.**	1	Wang et al. 2019

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**High frequency rTMS** shows conflicting evidence for improvements in gait compared to **sham rTMS.**	5	Wang et al. 2020; Guan et al. 2017; Sasaki et al. 2017; Du et al. 2016 Khedr et al. 2005
1a	There is conflicting evidence on the effect of **low frequency rTMS** when compared to **sham rTMS** for improving gait.	7	Chen et al. 2021; Gong et al. 2021; Wang et al. 2020; Huang et al. 2018; Meng & Song et al. 2017; Du et al. 2016; Lin et al. 2015
1a	**High frequency rTMS** may not produce greater improvements in gait than **low frequency rTMS.**	2	Wang et al. 2020; Du et al. 2016

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**High frequency rTMS combined with ankle strengthening** may produce greater improvements in muscle strength than **ankle strengthening or high frequency rTMS alone.**	1	Cha et al. 2017a
1b	**Low frequency rTMS** may produce greater improvements in muscle strength than **sham stimulation.**	1	Du et al. 2016
1a	**There is conflicting evidence about the effect of High frequency rTMS** improving muscle strength compared to **sham stimulation.**	2	Du et al. 2016; Gu & Chang 2017
1b	**High frequency rTMS** may not have a difference in efficacy compared to **low frequency rTMS** for improving muscle strength.	1	Du et al. 2016

SPASTICITY

LoE	Conclusion Statement	RCTs	References
1b	**High frequency rTMS may produce greater impovements in spasticity than sham stimulation**	1	Chieffo et al. 2021
2	**Low frequency rTMS** may not have a difference in efficacy compared to **sham stimulation** for improving spasticity.	1	Rastgoo et al. 2016

STROKE SEVERITY			
LoE	Conclusion Statement	RCTs	References
1a	**Low frequency rTMS** may produce greater improvements in stroke severity than **sham stimulation.**	3	Gong et al. 2021; Meng & Song 2017; Du et al. 2016
1a	**High frequency rTMS** may produce greater improvements in stroke severity than **sham stimulation.**	4	Guan et al 2017; Du et al 2016; Khedr et al. 2010; Khedr et al 2005
1a	**High frequency rTMS** may not have a difference in efficacy compared to **low frequency rTMS** for improving stroke severity.	2	Du et al. 2016; Khedr et al. 2010
1b	**Anodal tDCS combined with rTMS** may not have a difference in efficacy compared to **rTMS** alone for improving stroke severity	1	Gong et al 2020
1b	**Cathodal tDCS combined with low rTMS** may not have a difference in efficacy compared to **rTMS** alone for improving stroke severity	1	Gong et al 2020

Key Points

High frequency rTMS may be beneficial for improving balance after stroke.

High frequency rTMS may be beneficial for improving stroke severity after stroke.

The literature is mixed concerning the effect of high frequency rTMS on improving motor function, functional ambulation, activities of daily living, muscle strength after stroke.

Low frequency rTMS may be beneficial for improving gait, muscle strength, and stroke severity.

The literature is mixed concerning the effect of Low frequency rTMS on improving motor function, functional ambulation, balance, activities of daily living after stroke.

Theta Burst Stimulation (TBS)

Adopted from: https://www.psychiatryadvisor.com/home/depression-advisor/intermittent-theta-burst-stimulation-for-major-depressive-disorder-treatment/

Theta Burst Stimulation (TBS) is an emerging treatment modality that is a patterned form of rTMS where stimulation pulses are delivered in triplets or bursts at a high frequency (50Hz), and in a short interval (200ms), intending to mimic naturally occurring theta brain oscillations (Schwippel et al., 2019). TBS can also be used to adjust interhemispheric rivalry after a stroke and promote motor recovery through the delivery of continuous TBS (cTBS) to reduce cortical excitability in the contralesional hemisphere (600 pulses over 40 seconds); or intermittent TBS (iTBS) to increase cortical excitability in the ipsilesional hemisphere (600 pulses over 190 seconds) (Cotoi et al., 2019; Schwippel et al., 2019).

Five RCTs were found evaluating TBS for lower extremity motor rehabilitation. Both RCTs compared iTBS to sham stimulation (Liao et al., 2021; Lin et al., 2019). Two RCTs compared cerebellar iTBS to sham stimulation (Koch et al., 2019; Xie et al., 2021). One RCT compared Peripheral iTBS to sham stimulation (El Nahas et al., 2022).

The methodological details and results of the five RCTs evaluating TBS for lower extremity motor rehabilitation are presented in Table 40.

Table 40. RCTs Evaluating TBS Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Intermittent Theta Burst Stimulation vs Sham Stimulation		
Liao et al. (2021) RCT (7) N$_{Start}$=30 N$_{End}$ =25 TPS=Subacute	E: Intermittent theta-burst stimulation (iTBS) + physiotherapy C: Sham iTBS + physiotherapy Duration: 50min/d, 5d/wk, for 2wks	• Berg Balance Scale (+exp) • Trunk Impairment Scale (+exp) • Fugl-Meyer Assessment (-) • Barthel Index (-) • Corticospinal excitability ○ Resting motor threshold (-) ○ Cortical silent period (-) ○ Motor-evoked potential (-)
Lin et al. (2019) RCT (8) N$_{Start}$=20 N$_{End}$ =20 TPS=Chronic	E: Intermittent Theta Burst Stimulation (5Hz) + Physiotherapy C: Sham + Physiotherapy Duration: 1200 pulses iTBS, 2d/wk, 5wks iTBS 45min/d, 2d/wk, for 5wks (10 sessions)	• Berg Balance Scale (-) • Timed Up and Go Test (-) • 10-Meter Walk Test (-) • Fugl-Meyer Assessment Lower extremity (-) • Barthel Index (-) • Biodex balance ○ Overall index (-) ○ Mediolateral (-) ○ Eyes-open firm surface (-) ○ Eyes-closed firm surface (-) ○ Eyes-open unstable surface (-) ○ Eyes-closed unstable surface (-)
Cerebellar Intermittent Theta Burst Stimulation vs Sham		
Koch et al. (2019) RCT (8) N$_{Start}$=36 N$_{End}$ =34 TPS=Chronic	E: Cerebellar iTBS + Physical therapy C: Sham iTBS + Physical therapy Duration: 90min/d, 7d/wk, for 3wks Physical therapy & 2 runs of CRB-iTBS/d, 7d/wk, for 3wks	• Berg Balance Scale (+exp) • Fugl-Meyer Assessment (-) • Barthel Index (-) • Gait Analysis ○ Step length (-) ○ Step width (+exp) ○ Stance (-) • Cortical Activity ○ Primary motor cortex (-) ○ Posterior parietal cortex (+exp)
Xie et al. (2021) RCT (9) N$_{Start}$=36 N$_{End}$ =34 TPS=Subacute	E: Cerebellar intermittent TBS + Conventional therapy C: Sham TBS + Conventional therapy Duration: 1session/d, 5d/wk, for 2wks iTBS (600 pulses/session) & 50min/d, 5d/wk, for 2wks conventional therapy	• Fugl-Meyer assessment-lower extremity (-) • 10m Walk test: ○ Comfortable walking time (+exp) ○ Maximum walking time (+exp) • Timed Up and Go (-) • Functional ambulation category (-) • MEP ○ Peak amplitude (-) ○ Latency (-)
Peripheral Intermittent Theta Burst Stimulation vs Sham		
El Nahas et al. (2022) RCT (8) N$_{Start}$=42 N$_{End}$ =36 TPS=Chronic	E: Peripheral intermittent theta burst stimulation (piTBS) C: Sham TBS Duration: 3-4d/wk, 8 sessions in total	• Modified Ashworth scale (+exp) • Estimated Botulinum toxin dose (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group

+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about TBS Interventions

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**ciTBS** may not have a difference in efficacy compared to **sham stimulation** for improving motor function**.**	2	Xie et al. 2021; Koch et al. 2019
1a	**iTBS** may not have a difference in efficacy compared to **sham stimulation** for improving motor function**.**	2	Liao et al. 2021; Lin et al. 2019

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**iTBS** may not have a difference in efficacy compared to **sham stimulation** for improving functional ambulation**.**	1	Lin et al. 2019
1b	**ciTBS** may have a difference in efficacy compared to **sham stimulation** for improving functional ambulation**.**	1	Xie et al. 2021

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **ciTBS** to improve balance when compared to **sham stimulation**.	1	Koch et al. 2019
1a	There is conflicting evidence about the effect of **iTBS** to improve balance when compared to **sham stimulation**.	2	Liao et al. 2020; Lin et al. 2019

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**iTBS** may not have a difference in efficacy compared to **sham stimulation** for improving activities of daily living**.**	2	Liao et al. 2020; Lin et al. 2019
1b	**ciTBS** may not have a difference in efficacy compared to **sham stimulation** for improving activities of daily living**.**	1	Koch et al. 2019

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**ciTBS** may not have a difference in efficacy compared to **sham stimulation** for improving gait**.**	1	Koch et al. 2019

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**piTBS** may have a difference in efficacy compared to **sham stimulation** for improving spasticity	1	El Nahas et al. 2022

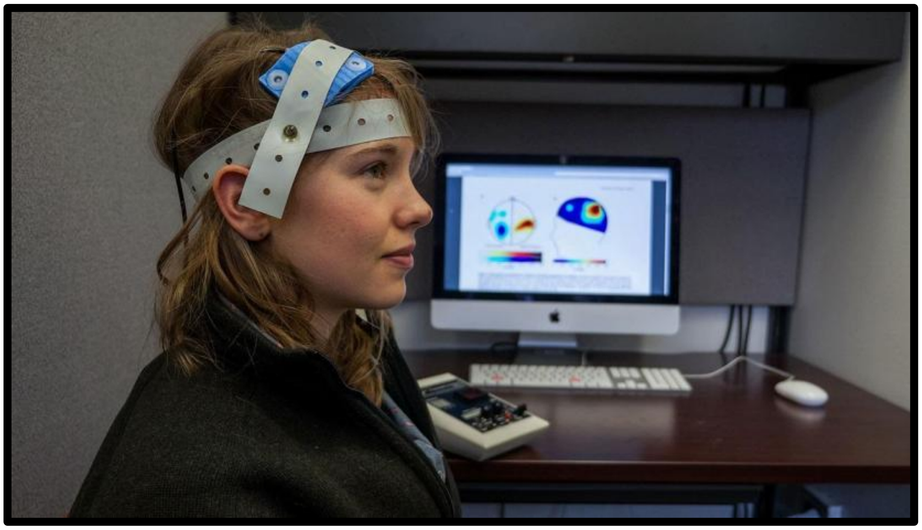
Key Points

The literature is mixed concerning the effect of TBS on improving balance after stroke.

Peripheral TBS may be beneficial for improving spasticity after stroke.

TBS may not be beneficial for improving motor function, functional ambulation, gait, and activities of daily living after stroke.

Transcranial Direct Current Stimulation (tDCS)



Adopted from: https://tryniakaufman.com/2018/01/11/transcranial-direct-current-stimulation-the-drug-of-the-future/

Another form of non-invasive brain stimulation is transcranial direct-current stimulation (tDCS). This procedure involves the application of mild electrical currents (1-2 mA) conducted through two saline-soaked, surface electrodes applied to the scalp, overlaying the area of interest and the contralateral forehead above the orbit. Anodal stimulation is performed over the affected hemisphere and increases cortical excitability, while cathodal stimulation is performed over the unaffected hemisphere and decreases cortical excitability (Schlaug et al., 2008). Additionally, tDCS can be applied on both hemispheres concurrently, this is known as dual tDCS. In contrast to transcranial magnetic stimulation, tDCS does not induce action potentials, but instead modulates the resting membrane potential of the neurons (Cramer, 2016).

A total of 37 RCTs were found evaluating tDCS interventions for lower extremity motor rehabilitation. 15 RCTs compared anodal tDCS to sham stimulation (Andrade et al., 2017; Bornheim et al., 2020; Cattagni et al., 2019; Chang et al., 2015; Khedr et al., 2013; Koo et al., 2018; Ojardias et al., 2020; Pinto et al., 2021; Rossi et al., 2013; Seamon et al., 2021; Shah et al., 2021; Tanaka et al., 2011; Utarapichat & Kitisomprayoonkul, 2018; van Asseldonk & Boonstra, 2016; Wong et al., 2022). Five RCTs investigated Cathodal tDCS to sham stimulation (Andrade et al., 2017; Fusco et al., 2014; Khedr et al., 2013; Shah et al., 2021; Wong et al., 2022). Five RCTs looked at dual tDCS compared to sham stimulation (Andrade et al., 2017; Geiger et al., 2019; Klomjai et al., 2018; Saeys et al., 2015; Tahtis et al., 2014). Five RCTs investigated tDCS with robot assisted gait training (Danzl et al., 2013; Geroin et al., 2011; Leon et al., 2017; Picelli et al., 2015; Seo et al., 2017). One RCT investigated anodal tDCS with cathodal spinal direct current stimulation and robot assisted gait training (Picelli et al., 2019). One RCT investigated tDCS, ankle motor tracking and high-intensity speed-based treadmill training to high-intensity speed-based treadmill training (Madhavan et al., 2020). One RCT compared dual tDCS and task-oriented training to sham tDCS and task-oriented training (Aneksan et al., 2021). One RCT investigated cerebellar tDCS and split-belt training to sham ctDCS and split-belt treadmill training (Kumari et al., 2020). One RCT compared tDCS with body weight supported treadmill training to body weight supported treadmill training alone (Manji et al., 2018), and one RCT compared tDCS with task-related training to sham stimulation and task-related training (Park et al., 2015c). Two RCTs compared tDCS combined with high or low frequency rTMS to rTMS alone or sham stimulation (Cho et al., 2017; Gong et al., 2021). Three RCTs investigated tDCS compared to functional electrical stimulation (Ehsani et al., 2022; Mitsutake et al., 2021; Zhang et al., 2021c).

The methodological details and results of all 37 RCTs evaluating tDCS interventions for lower extremity motor rehabilitation are presented in Tables 41.

Table 41. RCTs Evaluating tDCS Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Comparison of tDCS Stimulation Conditions		
Wong et al. (2022) RCT (8) N_{Start}=48 N_{End}=48 TPS=Chronic	E1: Anodal tDCS (2mA) E2: Bilateral tDCS (2mA) E3: Cathodal tDCS (2mA) C: Sham tDCS Duration: 20min/session for 1 session	E1 vs E2 vs E3 vs C • Cognitive dual task walking performance ○ Cadence (-) ○ Step time unaffected (-) ○ Step time affected (-) ○ Step length unaffected (-) ○ Step length affected (-) ○ Dual task cost (-) • Motor dual task walking performance ○ Cadence (-) ○ Step time unaffected (-) ○ Step time affected (-) ○ Step length unaffected (-) ○ Step length affected (-) ○ Dual task cost (-) • Single walking performance ○ Step time unaffected (-) ○ Step time affected (-) ○ Step length unaffected (-) ○ Step length affected (-) • Corticomotor activity ○ Resting motor threshold (-) ○ Short interval intracortical inhibition (-) • Fugl-Meyer assessment (-) E1 vs E2/ E3 • CDT speed (-) • MDT speed (+exp2, +exp3) • SW speed (+exp2) • SW cadence (-) • Silent period (+exp2) E2 vs E3 • CDT speed (-) • MDT speed (-) • SW speed (-) • SW cadence (-) • Silent period (-) E1/ E2/ E3 vs C • CDT speed (+exp2, +exp3) • MDT speed (+exp2, +exp3) • SW speed (+exp2) • SW cadence (+exp2) • Silent period (+exp2, +exp3)
Andrade et al. (2017) RCT (10) N_{Start}=60 N_{End}=60 TPS=Subacute	E1: Anodal tDCS E2: Dual tDCS E3: Cathodal tDCS C: Sham tDCS Duration: 5d/wk for 2wks	E1/E2/E3 vs C • Rate of falls (+exp, +exp2, +exp3) • Four Square Step Test (+exp, +exp2, +exp3) • Overall Stability Index (+exp, +exp2, +exp3) • Falls Efficacy Scale (+exp, +exp2, +exp3) • Berg Balance Scale (+exp, +exp2, +exp3)

		• 6-Minute Walk Test (+exp, +exp2, +exp3) • Sit-to-Stand Test (+exp, +exp2, +exp3) E2 vs E1/E3 • Rate of falls (-) • Four Square Step Test (-) • Overall Stability Index (-) • Falls Efficacy Scale (+exp2) • Berg Balance Scale (+exp2) • 6-Minute Walk Test (+exp2) • Sit-to-Stand Test (+exp2)
Pinto et al. (2021) RCT (7) N_{Start}=60 N_{End}=53 TPS=mixed: acute & subacute	E: tDCS + Treatment as usual C: Sham tDCS + Treatment as usual Duration: 30min/d, 2sessions/d, 6d/wk for 2wks	• Fugl-Meyer assessment (-): upper extremity (-) lower extremity (-) • Jebson-Taylor Hand Function test (-) • Barthel index (-) • Hamilton Anxiety rating scale (-) • Hamilton depression rating scale (-) • Scandinavian Stroke scale (-) • Digit span test (-): forward (-); backward (-) • Spatial span: forward (-); backward (-) • Serial subtraction test (-) • Category fluency test (-) • Complex figure test (-) • Complex passage test (-) • Paired word associate learning test (-) • Tower of London test (-)

Seamon et al. (2021)
RCT crossover (7)
N_{Start}=18
N_{End}=16
TPS=Chronic
	E: tDCS with 3 different electrode montages
	C: Sham stimulation
	Duration: 20min/1session, 48hr washout
		• Self-selected gait speed (-)
		  ○ Paretic step ratio (+exp)
		  ○ Paretic propulsion (-)
		• Fastest comfortable gait speed (-)
		  ○ Paretic step ratio (-)
		  ○ Paretic propulsion (-)

Shah et al. (2021) RCT (5) N_{Start}=30 N_{End}=30 TPS=Not Reported	E1: Anodal tDCS (2mA) + Conventional care E2: Cathodal tDCS (2mA) + Conventional care C: Sham tDCS + Conventional care Duration: 20min/d, 4d/wk, for 3wks (12 sessions total) stimulation	E1 v E2 • Berg Balance scale (+exp1) • Stroke Specific QoL scale (-) E1/E2 v C • Berg Balance scale (+exp1, +exp2) • Stroke Specific QoL scale (-)

Ojardias et al. (2020)
RCT crossover (6)
N_{Start}=20
N_{End}=18
TPS=Chronic
	E: Anodal tDCS (2mA)
	C: Sham tDCS
	Duration: 20min/1session - 11d washout
		• 6-meter walk test (-)
		• Wade test (gait speed) (-)
		• Balance Assessment
		  ○ Excursion of COP (EO&EC) (-)
		  ○ COP trajectory length (EO&EC) (-)
		• Step time difference (-)
		• Step length difference (-)

Bornheim et al. (2019)
RCT (9)
N_{Start}=50
N_{End}=50
TPS=Acute
	E: Anodal tDCS (2mA) + Conventional therapy
	C: Sham tDCS + Conventional therapy
	Duration: 20min/d, 5d/wk tDCS or sham for 4wks + 120min/d, 5d/wk for 4wks physical therapy
		• Wolf Motor Function Test (+exp)
		• Semmes Weinstein Monofilament Test (+exp)
		• Fugl Meyer Assessment Test
		  ○ Upper extremity (-)
		  ○ Lower extremity(+exp)
		  ○ Sensory (+exp)
		• The Tardieu Spasticity Scale (+exp)
		• Stroke Impact Scale (-)
		• Hospital Anxiety and Depression Scale (+exp)
		• Barthel Index (-)

Cattagni et al. (2019) RCT crossover (8) N_{Start}=24	E: Anodal tDCS 2mA C: Sham tDCS	• Gait velocity (-) • Step length (-) • Swing phase angles

N_{End}=24 TPS=Chronic	Duration: 30min/1session, +1wk washout	○ Peak knee flexion (-) ○ Peak dorsiflexion (-) ○ Peak plantar flexion (-) • Stance phase angles ○ Peak knee extension (-) ○ Peak dorsiflexion (-) • EMG intensity ○ Swing phase (-) ○ Stance phase (-) • EMG duration ○ Swing phase (-) ○ Stance phase (-)
Geiger et al. (2019) RCT crossover (7) N_{Start}=14 N_{End}=13 TPS=Chronic	E: Bilateral transcranial direct current stimulation (tDCS) C: Sham tDCS Duration: 20min/d, 1d - 1wk washout	• Maximum voluntary contraction (-) • Voluntary activation (-) • Potentiated twitch (-) • Contraction time (-) • Half-relaxation time (+exp) • RMS Rectus femoris (-) • RMS Vastus lateralis (-) • Amplitude rectus femoris (-) • Amplitude vastus lateralis (-) • Duration vastus lateralis (-) • Duration rectus femoris (-)
Klomjai et al. (2018) RCT Crossover (8) N_{Start}=19 N_{End}=19 TPS=Subacute	E: Dual tDCS (2mA) + Conventional physiotherapy C: Sham dual tDCS + Conventional physiotherapy Duration: 60min/1session conventional physiotherapy & 20min/1session tDCS - 1wk washout	• Timed Up and Go Test (-) • Five Times Sit to Stand Test (+exp) • Maximum Voluntary Contraction of knee extensor (-)
Koo et al., (2018) RCT (8) N_{start}= 24 N_{end} = 24 TPS= Acute	E: 1mA Anodal transcranial Direct Current Stimulation (tDCS) C: Sham tDCS Duration: 1 mA for 20mins/d, 10d	• Erasmus MC modification to revised Nottingham ○ Sensory Assessment (-) ○ Tactile sense (-) ○ Light touch (-) ○ Pressure (-) ○ Pin prick (-) ○ Kinesthesia affected (+exp) ○ Kinesthesia unaffected (-) ○ Sharp-blunt discrimination (-) • Revised Nottingham Sensory Assessment ○ Affected (+exp) ○ Unaffected (-) • Semmes Weinstein Monofilament Test (-) • Manual function test (-) • Modified Brunnstrom classification (-) • Modified Barthel Index (+exp) • Functional Ambulation Category (-)
Utarapichat & Kitisomprayoonkul (2018) RCT crossover (6) N_{Start}=10 N_{End}=10 TPS=Chronic	E: Anodal tDCS (2 mA) C: Sham Stimulation Duration: 1 session for 10min Anodal tDCS, 30 seconds Sham Stimulation; 48 hr washout period	• Root mean squared amplitude ○ Tibalis anterior (-) ○ Vastus medialis oblique (-) • Median frequency ○ Tibalis anterior (-) ○ Vastus medialis oblique (-) • Timed Up and Go (-)
Van Asseldonk & Boonstra (2016) RCT crossover (7) N_{Start}=10 N_{End} =10	E1: Anodal tDCS E2: Dual tDCS C: Sham Stimulation Duration: 10min/d, 1d/wk, for 3wks - 1wk washout	E1/E2 vs C • Step Length (-) • Gait Stance Duration (-) • Gait Cycle Time (-) • Propulsion Impulse (-)

TPS=Chronic		E1 vs E2 • Step Length (-) • Gait Stance Duration (-) • Gait Cycle Time (-) • Propulsion Impulse (-)
Chang et al. (2015) RCT (8) N_{Start}=24 N_{End}=24 TPS=Acute	E: Anodal tDCS + conventional care C: Sham tDCS + conventional care Duration: 10min/session tDCS, 5d/wk for 2wks	• Motricity Index (+exp) • Fugl-Meyer Assessment (+exp) • Functional Ambulation Category (-) • Balance Berg Scale (-) • Gait speed (-) • Cadence (-) • Stride length (+exp) • Step time (+exp) • Step length (-) • Transcranial Magnetic stimulation ○ Latency (+exp) ○ Amplitude (+exp)
Saeys et al. (2015) RCT crossover (8) N_{Start}=31 N_{End}=31 TPS=Subacute	E: Transcranial Direct Current Stimulation + Conventional Therapy C: Sham Transcranial Direct Current Stimulation + Conventional therapy Duration: 20mins/d, 4d/wk, tDCS/sham & 1hr/d, 5d/wk for 4wks Conventional Therapy	• Tinetti test (-) • Rivermead Motor Assessment (-) • Trunk Impairment Scale (-)
Fusco et al. (2014) RCT (6) N_{start}=14 N_{end}=11 TPS=Acute	E: Cathodal transcranial direct current stimulation + conventional therapy C: Sham transcranial direct current stimulation + conventional therapy Duration: 10min/d, 5d/wk, for 2wks tDCS or sham 45min/session 2sessions/d, 5d/wk, for 2wks conventional therapy	• Barthel index (-) • Functional ambulation category (-) • Canadian Neurological Scale (-) • Rivermead mobility scale (-) • Upper limb fugl-meyer (-) • 10 meter walk test (-) • 6 minute walk test (-) • Timed up and go (-) • 9-hole peg test (-) • Pinch force (-) • Grasp force (-)
Tahtis et al. (2014) RCT (6) N_{Start}=14 N_{End} =14 TPS=Acute	E: Bi-cephalic tDCS (2mA) C: Sham stimulation Duration: 15min/single session	• Timed Up and Go (+exp) • Performance Oriented Mobility Assessment (-)
Khedr et al. (2013) RCT (8) N_{Start}=40 N_{End}=40 TPS=Acute	E1: Anodal tDCS + Conventional care E2: Cathodal tDCS + Conventional care C: Sham tDCS + conventional care Duration: 25 min/d, 6days tDCS & 30min/d, 3d/wk, for 12wks conventional therapy	E1/E2 vs. C • Barthel index (+exp1, +exp2) • Orgogozo's MCA scale (+exp1, +exp2) • National Institute of Health Stroke Scale (-) • Medical Research Council muscle strength scale ○ Hand grip (-) ○ Shoulder abduction (-) ○ Hip flexion (-) ○ Foot dorsiflexion (-) • Resting motor threshold ○ Unaffected hemisphere (-) ○ Affected hemisphere (+exp1, +exp2) ○ Active Motor Threshold ○ Unaffected hemisphere (-) ○ Affected hemisphere (+exp1, +exp2) E1 vs. E2 • Barthel index (-)

		• Orgogozo's MCA scale (-) • National institute of stroke scale (-) • Medical Research Council muscle strength scale ○ Hand grip (-) ○ Shoulder abduction (-) ○ Hip flexion (-) ○ Foot dorsiflexion (-) • Resting motor threshold ○ Unaffected hemisphere (-) ○ Affected hemisphere (-) • Active Motor Threshold ○ Unaffected hemisphere (-) ○ Affected hemisphere (-)
Rossi et al. (2013) RCT (6) N_{Start}=50 N_{End}=50 TPS=Acute	E: Anodal tDCS (2mA) C: Sham stimulation Duration: 20min/d for 5d	• Fugl-Meyer motor scale (-) • National Institute of Health Stroke Scale (-) • Barthel Index (-) • Modified Rankin Scale (-)
Tanaka et al. (2011) RCT Crossover (7) N_{Start}=8 N_{End}=8 TPS=Chronic	E: Anodal tDCS C: Sham tDCS Duration: Single session of each – 1wk washout	• Maximal knee extension force (+exp)
tDCS with Robot-assisted Gait Training vs Sham tDCS + Robot-assisted gait training		
Leon et al. (2017) RCT (6) N_{Start}=50 N_{End}=49 TPS=Subacute	E1: Robot-assisted gait training and anodal tDCS over the leg motor cortex area E2: Robot-assisted gait training and anodal tDCS over the hand motor cortex area C: Robot-assisted gait training only Duration: 5h/d, 5d/wk for 4wks	E1/E2 vs C • Functional Ambulation Category (-) • 10-Metre Walk Test (-)
Seo et al. (2017) RCT (9) N_{Start}=21 N_{End}=21 TPS=Chronic	E: Robot-assisted gait training and anodal tDCS C: Robot-assisted gait training and sham stimulation Duration: 20min/d, 5d/wk, for 4wks tDCS/Sham, 45min/d, 5d/wk, for 4wks RAGT	• Functional Ambulation Category (-) • 10-Meter Walk Test (-) • 6-Minute Walk Test (-) • Berg Balance Scale (-) • Fugl-Meyer Assessment (-) • Medical Research Council Scale (-) • Motor-Evoked Potential Parameters (-)
Picelli et al. (2015) RCT (9) N_{start}=30 N_{end}=30 TPS=Chronic	E1: Robot-assisted gait training (G-EO) + Anodal tDCS (2mA) + sham tsDCS (transcutaneous spinal direct current stimulation) E2: Robot-assisted gait training (G-EO) + sham tDCS + Cathodal tsDCS (2.5mA) E3: Robot-assisted gait training (G-EO) + Anodal tDCS (2mA) + Cathodal tsDCS (2.5mA) Duration: 20min/d, 5d/wk for 2wks RAGT	E1 vs E2 • 6min Walk test (-) • Functional Ambulation category (-) • Motricity index-leg (-) • Ashworth scale (-) • Cadence (-) • Single-double limb support time ratio (-) E1/E2 vs E3 • 6-Minute Walk Test (+exp3) • Cadence (+exp3) • Functional Ambulation Category (-) • Motricity Index (-) • Ashworth Scale (-) • Support Duration (-)
Danzl et al. (2013) RCT (6)	E: Anodal tDCS + Robot-assisted gait training	• Functional Ambulation Category (+exp) • Berg Balance Scale (-)

N_{Start}=10 N_{End}=8 TPS=Chronic	C: Sham tDCS + Robot-assisted gait training Duration: 20min tDCS + 20-40min/d lokomat, 3d/wk for 4wks	• Timed Up and Go Test (-) • 10-Metre Walk Test (-) • Stroke Impact Scale (-)
Geroin et al. (2011) RCT (6) N_{Start}=30 N_{End}=30 TPS=Chronic	E1: Anodal tDCS + Robot-assisted gait training E2: Sham tDCS + Robot-assisted gait training C: Gait training Duration: 50min/d, 5d/wk for 2wks	E1 vs E2 • 10-Meter Walk Test (-) • 6-Minute Walk Test (-) • Cadence (-) • Temporal symmetry ratio (-) • Single-double support duration ratio (-) • Functional Ambulation categories (-) • Rivermead Mobility Index (-) • Motricity Index leg subscore (-) E1/E2 vs C • 10-Meter Walk Test (+exp1, +exp2) • 6-Minute Walk Test (+exp1, +exp2) • Cadence (+exp1, +exp2) • Temporal symmetry ratio (+exp1, +exp2) • Single-double support duration ratio (+exp1, +exp2) • Functional Ambulation Categories (+exp1, +exp2) • Rivermead Mobility Index (+exp1, +exp2) • Motricity Index leg subscore (+exp1, +exp2)
Dual tDCS + Task-oriented training vs Sham tDCS + Task-oriented training		
Aneksan et al. (2021) RCT (5) N_{Start}=25 N_{End}=25 TPS=Subacute	E: Dual-tDCS (Anodal and Cathodal, 2 mA) + Task-oriented Training C: Sham tDCS + Task-oriented Training Duration: 20min/d Stimulation & 50min/d Training, 5d, consecutively	• Gait Velocity (-) • Cadence (-) • Step Time o Affected side (-) o Unaffected side (-) • Step Length o Affected side (-) o Unaffected side (-) • Timed-Up-and-Go Test (-) • Five-Time Sit-to-Stand Test (-) • Muscle Strength o Hip (-) o Knee (-) o Ankle (-) • Gait Cycle o Stance phase (-) o Swing Phase-affected side (+exp) o Swing phase-affected side (-) o Single leg support (-) o Double leg support (-)
Cerebellar tDCS + Split-belt treadmill training vs Sham ctDCS + Split-belt treadmill training		
Kumari et al. (2020) RCT (8) N_{Start}=4 N_{End}=4 TPS=Chronic	E: Cerebellar transcranial direct current stimulation (ctDCS) + split-belt treadmill training C: Sham ctDCS + split-belt treadmill training Duration: 20min/d, 3d/wk, for 1wk	• Treadmill step length symmetry (+exp) • Over-ground step length symmetry (-) • Change in step length symmetry (-) • 10-Metre Walk Test (-)
tDCS + Ankle Motor Tracking + High-intensity speed-based treadmill training vs High-intensity speed-based treadmill training		
Madhaven et al. (2020) RCT (8) N_{Start}=81	E1: tDCS priming only (Transcranial Direct Current Stimulation + High-intensity	E1 vs E2 vs E3 • 10-mt walk test (-) • Corticomotor excitability (-)

N_{End}=72 TPS=Chronic	speed-based treadmill training) E2: AMT priming only (Ankle motor tracking + Sham Transcranial Direct Current Stimulation+ High-intensity speed-based treadmill training) E3: tDCS & AMT priming (Transcranial Direct Current Stimulation + Ankle motor tracking + High-intensity speed-based treadmill training) C: 15min rest + High-intensity speed-based treadmill training Duration: 15mins/d, 3d/wk, for 4wks + 40mins/d, 3d/wk, for 4wks High-intensity speed-based treadmill training	• 6-minute walk test (-) • Berg Balance Scale (-) • Stroke Impact Scale (-) • Timed up and go (-) • Mini Balance Evaluation Systems Test (-) • Fugl-Meyer Assessment motor function (-) • Activities-Specific Balance Confidence Scale (-) E1/E2/E3 vs C • 10-mt walk test (-) • Corticomotor excitability (-) • 6-minute walk test (-) • Berg Balance Scale (-) • Stroke Impact Scale (+exp1) • Timed up and go (-) • Mini Balance Evaluation Systems Test (-) • Fugl-Meyer Assessment motor function (-) • Activities-Specific Balance Confidence Scale (-)
tDCS + Body weight supported treadmill training vs tDCS + Body weight supported treadmill training		
Manji et al. (2018) RCT Crossover (7) N_{Start}=30 N_{End}=30 TPS=Subacute	E: Body weight supported treadmill training + anodal tDCS C: Body weight supported treadmill training with sham tDCS Duration: 20min/d, 7d/wk for 1wk; 3d washout	• 10-Meter Walk Test (+exp) • Timed Up and Go Test (+exp) • Fugl-Meyer Assessment (-) • Performed Oriented Mobility Assessment (-) • Trunk Control Test (-)
tDCS + Task-related training vs Task-related training		
Park et al. (2015) RCT (5) N_{Start}=24 N_{End}=24 TPS=Chronic	E1: tDCS + Task-related training E2: Sham tDCS + Task-related training C: Task-related training Duration: 30min/d, 3d/wk for 4wks	E1 vs C • Gait speed (+exp) • Stance symmetry (+exp) • Swing symmetry (+exp) • Step length (-)
tDCS + Aerobic exercise vs Sham tDCS + Aerobic exercise or tDCS		
Sivaramakrishnan & Madhavan (2021) RCT crossover (7) N_{start}=29 N_{end}=26 TPS=Chronic	E1: Anodal tDCS E2: Aerobic exercise + Sham tDCS E3: Aerboic exercise + Anodal tDCS Duration: 20min/single session – 5-7d washout	E1/E3 vs E2 • Corticomotor excitability (+exp2) • Short interval intra cortical inhibition (-) • Ipsilateral silent period (-) • Index of transcallosal inhibition for tibialis anterior (-) • Index of transcallosal inhibition for ankle reaction time (-)
Contralesionally Cathodal tcDCS (2mA) + Cathodal tsDCS + Robot-Assisted Gait Training vs Ipsileisonally Cathodal tcDCS (2mA) + Cathodal tsDCS + Robot-Assisted Gait Training		
Picelli et al. (2019) RCT (8) N_{start}=40 N_{end}=39 TPS=Chronic	E1: Contralesionally cathodal tcDCS (2mA) + cathodal tsDCS + Robot-assisted gait training E2: Ipsileisonally cathodal tcDCS (2mA) + cathodal tsDCS + Robot-assisted gait training	E1 vs E2 • 6-meter walk test (-) • Functional Ambulation Category (-) • Motricity Index (-) • Modified Ashworth Scale (-) • Cadence (-) • Single/Double Support duration (-)

	Duration: 20min/d, 5d/wk for 2wks	
tDCS Combined with High or Low Frequency rTMS vs rTMS or Sham		
Gong et al. (2021) RCT (7) N_{Start}=65 N_{End}=60 TPS=Acute	E1: rTMS (1Hz) + conventional therapy E2: Cathodal tDCS + rTMS (1Hz) + conventional therapy E3: Anodal tDCS + rTMS (1Hz) + conventional therapy C: Sham rTMS Duration: 40min/d, 5d/wk, for 4wks conventional therapy & 20min/d, 5d/wk, for 4wks tDCS +/- rTMS (total of 1200 pulses)	E1/E2/E3 vs C • National Institute of Health Stroke Scale (-) • Fugl-Meyer ○ Upper Limb (-) ○ Lower Limb (+exp3) • Bilateral Motor Evoked Potentials (+exp2, +exp3) • Barthel Index score (-) • Resting Motion Threshold (-) • Central Motor Conduction Time (-) E1 vs E2 vs E3 • National Institute of Health Stroke Scale (-) • Fugl-Meyer ○ Upper Limb (-) ○ Lower Limb (+exp3) • Bilateral Motor Evoked Potentials (-) • Barthel Index score (-) • Resting Motion Threshold (-) • Central Motor Conduction Time (-)
Cho et al. (2017) RCT (6) N_{Start}=30 N_{End}=30 TPS=Acute	E: Dual-mode transcranial direct current stimulation (2mA) + repetitive transcrainial magnetic stimulation (10Hz) C: rTMS (10Hz) Duration: 20min/d, 5d/wk for 2wks	• Fugl-Meyer Assessment ○ Lower Extremity (-) ○ Upper Extremity (+exp) ○ Total (+exp)
Transcranial Direct Current Stimulation vs Functional Electrical Stimulation		
Ehsani et al. (2022) RCT (7) N_{Start}=32 N_{End}=32 TPS=Chronic	E1: M1 anodal tDCS + FES + Conventional care E2: Sham tDCS + FES + Conventional care C: 20min/d FES + Conventional care Duration: E1: 20min/d concurrent FES and a-tDCS + 20min/d conventional care, 5d/wk, for 2wks E2: 30s of a-tDCS during 20min/d FES + 20min/d conventional care 5d/wk, for 2wks; C: 20min/d FES + 20min/d conventional care, 5d/wk, for 2wks	E1 vs E2/C • Modified Ashworth scale (+exp1) • Berg Balance scale (+exp1) • EMG root mean squared of lateral Gastrocnemius ○ Active dorsiflexion in velocity of $60.s^{-1}$ (+exp1) ○ Passive dorsiflexion in velocity of $60.s^{-1}$ (+exp1) ○ Active dorsiflexion in velocity of $120.s^{-1}$ (+exp1) ○ Passive dorsiflexion in velocity of $120.s^{-1}$ (+exp1) • EMG root mean squared of Tibialis Anterior ○ Active dorsiflexion in velocity of $60.s^{-1}$ (+exp1) ○ Active dorsiflexion in velocity of $120.s^{-1}$ (+exp1)
Zhang et al. (2021) RCT (5) N_{start}=122 N_{end}=122 TPS=Subacute	E1: Transcranial direct current stimulation + conventional therapy E2: Functional electrical stimulation + conventional therapy Duration: 20min/d, 5d/wk, for 8wks	E1 vs E2 • Fugl-Meyer Assessment (+exp1) • Barthel index (+exp1) • Functional Ambulation Category (+exp1) • Somatosensory evoked potential (-) ○ P40 latency and amplitude (-) ○ N45 latency and amplitude (-)
Mitsutake et al. (2020) RCT (7) N_{start}=37	E1: Gait training with FES + sham tDCS+ conventional rehabilitation	E1 vs E2 • 10m Walk test (-) • Trunk Acceleration

N_{end}=34 TPS=Subacute	E2: Gait training with tDCS + conventional rehabilitation E3: Gait training with tDCS and FES + conventional rehabilitation Duration: 40min/d, 7d/wk Conventional rehabilitation & 20min/d, 7d/wk Gait with Stimulation, 1wk	○ Harmonic ratio-vertical axis (-) ○ Mediolateral (-) ○ Anteroposterior axis (-) • Autocorrelation coefficient ○ Vertical axis (-) ○ Mediolateral (-) ○ Anteroposterior axis (-) • Root mean squared ○ Vertical axis (-) ○ Mediolateral axis (-) ○ Anteroposterior axis (-) <u>E1 vs E3</u> • 10m Walk test (-) • Trunk Acceleration ○ Harmonic ratio-vertical axis (-) ○ Mediolateral (-) ○ Anteroposterior axis (-) • Autocorrelation coefficient ○ Vertical axis (-) ○ Mediolateral (+exp3) ○ Anteroposterior axis (+exp3) • Root mean squared ○ Vertical axis (-) ○ Mediolateral axis (-) ○ Anteroposterior axis (-) <u>E2 vs E3</u> • 10m Walk test (-) • Trunk Acceleration ○ Harmonic ratio-vertical axis (-) ○ Mediolateral (-) ○ Anteroposterior axis (-) • Autocorrelation coefficient ○ Vertical axis (-) ○ Mediolateral (-) ○ Anteroposterior axis (+exp3) • Root mean squared ○ Vertical axis (-) ○ Mediolateral axis (-) ○ Anteroposterior axis (-)

Abbreviations and table notes: ANCOVA=analysis of covariance; ANOVA=analysis of variance; C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about tDCS

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Anodal tDCS with rTMS** may produce greater improvements in motor function than **rTMS, sham rTMS, or Cathodal tDCS with rTMS.**	1	Gong et al. 2021
1b	**rTMS with cathodal tDCS** may produce greater improvements in motor function than **rTMS alone.**	1	Cho et al. 2017
2	**tDCS** may produce greater improvements in motor function than **FES.**	1	Zhang et al. 2021

1a	**Anodal tDCS** may not produce improvements in motor function when compared to **sham stimulation.**	7	Wong et al. 2022; Gong et al. 2021; Pinto et al. 2021; Bornheim et al. 2019; Koo et al. 2018; Chang et al. 2015; Rossi et al. 2013
1a	**Dual tDCS** may not have a difference in efficacy when compared to **sham tDCS** for improving motor function.	2	Wong et al. 2022; Saeys et al. 2015
1b	**Dual tDCS** may not produce greater improvements in motor function than **anodal or cathodal tDCS.**	1	Wong et al. 2022
1b	**Cathodal tDCS** may not produce greater improvements in motor function than **sham stimulation or anodal tDCS.**	1	Wong et la. 2022
1b	**Cathodal tDCS with rTMS** may not produce greater improvements in motor function than **sham rTMS or rTMS**	1	Gong et al. 2021
1b	**Anodal tDCS with body weight support training** may not have a difference in efficacy when compared to **sham tDCS with body weight support training** for improving motor function.	1	Manji et al. 2018
1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in motor function when compared to **high-intensity speed-based treadmill training** alone.	1	Madhaven et al. 2020
1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in motor function when compared to **ankle motor training, sham tDCS and high-intensity speed-based treadmill training**.	1	Madhaven et al. 2020
1b	**Anodal tDCS with robot-assisted gait training** may not have a difference in efficacy when compared to **sham tDCS with robot-assisted gait training** for improving motor function.	1	Seo et al. 2017
1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in motor function when compared to **ankle motor training, tDCS and high-intensity speed-based treadmill training**.	1	Madhaven et al. 2020

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Dual tDCS** may produce greater improvements in functional ambulation than **sham stimulation or anodal tDCS**.	4	Wong et al. 2022; Klomjai et al. 2018; Andrade et al. 2017; Tahtis et al. 2014
1b	**Anodal tDCS with body weight supported treadmill training** may produce greater improvements in functional ambulation than **sham tDCS with body weight supported treadmill training**.	1	Manji et al. 2018

1b	**tDCS or sham tDCS with robot-assisted gait training** may produce greater improvements in functional ambulation than **gait training.**	1	Geroin et al. 2011
2	**Anodal tDCS with task-related training** may produce greater improvements in functional ambulation than **task-related training alone**.	1	Park et al. 2015
1b	There is conflicting evidence on the effect of **anodal and cathodal tDCS with robotic gait training** when compared to **anodal and sham tDCS with robotic gait training** for improving functional ambulation.	1	Picelli et al. 2015
1b	There is conflicting evidence on the effect of **anodal and cathodal tDCS with robotic gait training** when compared to **cathodal and sham tDCS with robotic gait training** for improving functional ambulation.	1	Picelli et al. 2015
1a	**Anodal tDCS** may not have a difference in efficacy when compared to **sham stimulation** for improving functional ambulation.	8	Wong et al. 2022; Seamon et al. 2021; Orjardias et al. 2020; Cattagni et al. 2019; Koo et al. 2018; Utarapichat & Kitisomprayoonkul 2018; Andrade et al. 2017; Chang et al. 2015
1a	**Cathodal tDCS** may not have a difference in efficacy when compared to **sham stimulation** for improving functional ambulation.	3	Wong et al. 2022; Andrade et al. 2017; Fusco et al. 2014
1a	**Dual tDCS** may not produce greater improvements in functional ambulation than **cathodal tDCS.**	2	Wong et al. 2022; Andrade et al. 2017
1a	**Anodal tDCS with robot-assisted gait training** may not have a difference in efficacy when compared to **sham or cathodal tDCS with robot-assisted gait training** for improving functional ambulation.	5	Leon et al. 2017; Seo et al. 2017; Danzl et al. 2013; Picelli et al. 2012; Geroin et al. 20111
1b	**Cathodal tDCS** may not produce greater improvements in functional ambulation than **anodal tDCS.**	1	Wong et al. 2022
1b	**Gait training with FES, sham tDCS** and **conventional rehabilitation** may not improve efficacy of functional ambulation compared with **Gait training with tDCS** or **sham tDCS** and **conventional rehabilitation**	1	Mitsutake et al. 2020
1b	**Cerebellar tDCS and Split-belt treadmill training** may not improve functional ambulation compared with **Sham ctDCS + Split-belt.**	1	Kumari et al. 2020
1b	**Contralesionally cathodal tcDCS (2mA) with cathodal tsDCS and robot-assisted gait training** may not have a difference in efficacy when compared to i**psileisonally cathodal tcDCS (2mA) with cathodal tcDCS and robot-assisted gait training** for improving functional ambulation.	1	Picelli et al. 2019
1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in functional ambulation when compared to **high-intensity speed-based treadmill training** alone.	1	Madhaven et al. 2020

1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in functional ambulation when compared to **ankle motor training, tDCS and high-intensity speed-based treadmill training**.	1	Madhaven et al. 2020
1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in functional ambulation when compared to **ankle motor training, sham tDCS and high-intensity speed-based treadmill training**.	1	Madhaven et al. 2020
2	**Dual tDCS** with **task-oriented training** may not have a difference in efficacy when compared to **Sham tDCS with task-oriented training** for improving functional ambulation.	1	Aneksan et al. 2021

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
1b	**tDCS or sham tDCS with robot-assisted gait training** may produce greater improvements in functional mobility than **gait training.**	1	Geroin et al. 2011
1b	**Cathodal tDCS** may not have a difference in efficacy when compared to **sham stimulation** for improving functional ambulation.	1	Fusco et al. 2014
1b	**TDCS with robot-assisted gait training** may not produce greater improvements in functional mobility than **sham tDCS with robot-assisted gait training.**	1	Geroin et al. 2011

BALANCE

LoE	Conclusion Statement	RCTs	References
1a	**Anodal tDCS** may produce greater balance efficacy when compared to **sham stimulation or cathodal tDCS.**	4	Utarapichat et al. 2018; Andrade et al. 2017; Chang et al. 2015; Shah et al. 2021
1b	**FES** and **tDCS** may produce greater balance efficacy when compared to **FES** alone or with **sham tDCS.**	1	Ehsani et al. 2022
1b	**Cathodal tDCS** may produce greater balance efficacy when compared to **sham stimulation.**	2	Shah et al. 2021; Andrade et al. 2017
1b	There is conflicting evidence about the effect of a**nodal tDCS with body weight supported treadmill training** to improve balance when compared to **sham tDCS with body weight supported treadmill training**.	1	Manji et al. 2018
1a	There is conflicting evidence on the effect of **dual tDCS** when compared to **sham stimulation** for improving balance.	3	Andrade et al. 2017; Saeys et al. 2015; Tahtis et al. 2014
1a	**Anodal tDCS with robot-assisted gait training** may not have a difference in efficacy when compared to	2	Seo et al. 2017; Danzl et al. 2013

	sham tDCS with robot-assisted gait training for improving balance.		
1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in balance when compared to **high-intensity speed-based treadmill training** alone.	1	Madhaven et al. 2020
1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in balance when compared to **ankle motor training, tDCS and high-intensity speed-based treadmill training**.	1	Madhaven et al. 2020
1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in balance when compared to **ankle motor training, sham tDCS and high-intensity speed-based treadmill training**.	1	Madhaven et al. 2020
1b	**tDCS with backwards treadmill training** may not produce greater improvements in balance than **sham tDCS with backwards treadmill training.**	1	Manji et al. 2018
1b	**Dual tDCS** may not produce greater improvements in balance than **anodal or cathodal tDCS.**	2	Andrade et al. 2017

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**tDCS or sham tDCS with robot-assisted gait training** may produce greater improvements in gait than **gait training.**	1	Geroin et al. 2011
1b	There is conflicting evidence about the effect of **Cerebellar tDCS and Split-belt treadmill training** when compared with **Sham ctDCS + Split-belt** treadmill training to improve gait.	1	Kumari et al. 2020
1b	There is conflicting evidence about the effect of **Anodal tDCS with cathodal transcranial spinal cord direct current stimulation with robotic gait training** to improve gait when compared to either **anodal tDCS or cathodal transcranial spinal cord direct current stimulation with robotic gait training**.	1	Picelli et al. 2015
1a	**Anodal tDCS** may not have a difference in efficacy when compared to **sham stimulation or cathodal tDCS** for improving gait.	5	Wong et al. 2022; Ojardias et al. 2020; Cattagni et al. 2019; Van Asseldonk & Boonstra 2016; Chang et al. 2015
1a	**Dual tDCS** may not produce greater improvements in gait than **sham stimulation, anodal tDCS, or cathodal tDCS.**	2	Wong et al. 2022; Van Assekdibj & Boonstra 2016
1a	**Anodal tDCS with robot-assisted gait training** may not have a difference in efficacy when compared to	2	Picelli et al. 2012; Geroin et al. 2011

	sham tDCS with robot-assisted gait training for improving gait.		
1b	**Cathodal tDCS** may not produce greater improvements in gait than **sham stimulation.**	1	Wong et al. 2022
1b	**Cerebellar tDCS with split-belt treadmill training** may not produce greater improvements in gait than **sham tDCS with split-belt treadmill training.**	1	Kumari et al. 2020
1b	**Contralesionally cathodal tcDCS (2mA) with cathodal tsDCS and robot-assisted gait training** may not have a difference in efficacy when compared to i**psileisonally cathodal tcDCS (2mA) with cathodal tcDCS and robot-assisted gait training** for improving gait.	1	Picelli et al. 2019
2	**tDCS with task-oriented training** may not produce greater improvements in gait than **sham tDCS with task-oriented training.**	2	Aneksan et al. 2021; Park et al. 2015

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
2	**tDCS** may produce greater improvements in activities of daily living than **FES.**	1	Zhang et al. 2021
1a	**Anodal tDCS** may not have a difference in efficacy when compared to **sham stimulation** for improving activities of daily living.	6	Gong et al. 2021; Pinto et al. 2021; Bornheim et al. 2019; Khedr et al. 2013; Rossi et al. 2013; Koo et al. 2018
1a	**Cathodal tDCS** may not have a difference in efficacy when compared to **sham stimulation** for improving activities of daily living.	2	Fusco et al. 2014; Khedr 2013

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1a	**Anodal tDCS** may produce greater improvements in muscle strength than **sham stimulation**.	3	Chang et al. 2015; Tanaka et al. 2011; Khedr et al. 2013
1a	**Anodal tDCS with robot-assisted gait training** may not have a difference in efficacy when compared to **sham tDCS with robot-assisted gait training** for improving muscle strength.	3	Seo et al. 2017; Geroin et al. 2011
1b	**Dual tDCS** may not have a difference in efficacy when compared to **sham stimulation** for improving muscle strength.	1	Geiger et al. 2019; Klomjai et al. 2018
1b	**Cathodal tDCS** may not have a difference in efficacy when compared to **sham stimulation or anodal tDCS** for improving muscle strength.	1	Khedr et al. 2013

1b	**Anodal tDCS with cathodal transcranial spinal cord direct current stimulation with robotic gait training** may not have a difference in efficacy when compared to **anodal tDCS or cathodal transcranial spinal cord direct current stimulation with robotic gait training** for improving muscle strength.	1	Picelli et al. 2015
1b	**Contralesionally cathodal tcDCS (2mA) with cathodal tsDCS and robot-assisted gait training** may not have a difference in efficacy when compared to i**psileisonally cathodal tcDCS (2mA) with cathodal tcDCS and robot-assisted gait training** for improving muscle strength.	1	Picelli et al. 2019
1b	**Anodal tDCS with robotic gait training** may not produce greater improvements in muscle strength than **cathodal tDCS with robotic gait training.**	1	Picelli et al. 2012
2	**Dual tDCS** with t**ask-oriented training** may not have a difference in efficacy when compared to **Sham tDCS with task-oriented training** for improving muscle strength.	1	Aneksan et al. 2021

SPASTICITY			
LoE	Conclusion Statement	RCTs	References
1b	**Anodal tDCS** may produce greater improvements in spasticity than **sham stimulation.**	1	Bornheim et al. 2019
1b	**FES** and **tDCS** may have a difference in efficacy when compared to **FES** alone or with **sham tDCS** for improving spasticity.	1	Ehsani et al. 2022
1b	**Anodal tDCS with robot-assisted gait training** may not have a difference in efficacy when compared to **sham tDCS with robot-assisted gait training** for improving muscle strength.	1	Picelli et al. 2012
1b	**Anodal tDCS with cathodal transcranial spinal cord direct current stimulation with robotic gait training** may not have a difference in efficacy when compared to **anodal tDCS or cathodal transcranial spinal cord direct current stimulation with robotic gait training** for improving spasticity.	1	Picelli et al. 2015
1b	**Contralesionally cathodal tcDCS (2mA) with cathodal tsDCS and robot-assisted gait training** may not have a difference in efficacy when compared to i**psileisonally cathodal tcDCS (2mA) with cathodal tcDCS and robot-assisted gait training** for improving spasticity.	1	Picelli et al. 2019

STROKE SEVERITY			
LoE	Conclusion Statement	RCTs	References

1b	**Anodal tDCS** may not have a difference in efficacy when compared to **sham stimulation** for improving stroke severity.	4	Gong et al. 2021; Rossi et al. 2013; Khedr et al. 2013; Pinto et al. 2021
1a	**Cathodal tDCS** may not have a difference in efficacy when compared to **sham stimulation** for improving stroke severity.	2	Khedr et al 2013; Fusco et al. 2014

PROPRIOCEPTION

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence on the effect of **anodal tDCS** when comapred to **sham stimulation** for improving proprioception..	1	Koo et al. 2015

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
1a	**Anodal tDCS** may not produce greater improvements in quality of life than **sham stimulation.**	2	Shah et al. 2021; Bornheim et al. 2019
1b	**Cathodal tDCS** may not produce greater improvements in quality of life than **anodal tDCS or sham stimulation.**	1	Shah et al. 2021
1b	**tDCS with robot-assisted training** may not produce greater improvements in quality of life than **sham tDCS with robot-assisted training.**	1	Danzl et al. 2013
1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in quality of life when compared to **high-intensity speed-based treadmill training** alone.	1	Madhaven et al. 2020
1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in quality of life when compared to **ankle motor training, tDCS and high-intensity speed-based treadmill training**.	1	Madhaven et al. 2020
1b	**TDCS and high-intensity speed-based treadmill training** may not produce greater improvements in quality of life when compared to **ankle motor training, sham tDCS and high-intensity speed-based treadmill training**.	1	Madhaven et al. 2020

Key Points

tDCS may not be beneficial in improving motor function, functional ambulation, mobility, gait, activities of daily living, muscle strength, spasticity, and stroke severity after stroke.

tDCS combined with other interventions may be beneficial for improving motor function and functional ambulation after stroke.

The beneficial effect of tDCS is varied by the modality and intensity. For detailed information, see table 41.

Pharmaceuticals

Antidepressants

Adopted from https://www.abc.net.au/news/2018-09-18/common-antidepressants-may-fuel-growth-of-super-bugs-study-says/10246000

Antidepressants of various kinds are available for medical use, including tricyclics (TCAs), monoamine oxidase inhibitors (MAOIs), selective serotonin reuptake inhibitors (SSRIs), serotonin-noradrenaline reuptake inhibitors (SNRIs, such as venlafaxine, duloxetine and milnacipran), and other agents (mirtazapine, reboxetine, bupropion). SSRIs and SNRIs are two commonly prescribed agents that work by acting to inhibit the reuptake of serotonin and norepinephrine, respectively, from the synaptic cleft (Cipriani et al., 2012). Fluoxetine, citalopram and escitalopram are commonly prescribed selective serotonin reuptake inhibitors (SSRI). There has been interest in examining the effectiveness of pharmacological interventions for motor recovery after stroke (Acler et al., 2009b). Antidepressants may be helpful in recovery after stroke through improving mood, which may in turn improve activity and functional outcome, but also through modulating cerebral sensory-motor activation (Acler et al., 2009b).

11 RCTs were found evaluating antidepressants for lower extremity motor rehabilitation.

Five RCTs compared fluoxetine to placebo (Chollet et al., 2011; Fruehwald et al., 2003; Hankey et al., 2020; Marquez-Romero et al., 2020; Shah et al., 2016). One RCT compared fluoxetine to notriptyline or placebo (Robinson et al., 2000) ((Mikami et al., 2011)(1 yr follow-up)). One RCT compared fluoxetine to maprotiline or placebo (Dam et al., 1996). One RCT compared Shu-Gan-Jie-Yu capsule to fluoxetine or placebo (Gong et al., 2020). One RCT compared citalopram to placebo (Acler et al., 2009b). One RCT compared escitalopram to placebo (Gourab et al., 2015). Finally, one RCT compared citalopram to fluoxetine or placebo (Asadollahi et al., 2018).

The methodological details and results of all 11 RCTs are presented in Table 42.

Table 42. RCTs Evaluating Antidepressant Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Fluoxetine vs Placebo		
Hankey et al. (2020) RCT (10) N$_{start}$=1280 N$_{end}$=1256 TPS=Acute	E: Fluoxetine (20mg) C: Placebo Duration: 20mg/d, for 6mo	• Modified Rankin scale (-) • Stroke Impact Scale ○ Strength (-) ○ Hand ability (-) ○ Mobility (-) ○ Motor (-) ○ Daily activities (-) ○ Physical function (-) ○ Memory (-) ○ Communication (-) ○ Mood and emotional control (+exp) ○ Participation (-) ○ Recovery (VAS) (-) • EQ-5D-5L (-)
Marquez-Romero et al. (2020) RCT (7) N$_{start}$=32 N$_{final}$=30 TPS= Acute	E: Receiving 20 mg/day of fluoxetine C: Placebo Duration: 90 days	• Fugl-Meyer Motor Scale (+exp) • National Institutes of Health stroke scale (-) • Barthel Index (+exp) • Modified Rankin scale (+exp)
Shah et al. (2016) RCT (6) N$_{start}$=89 N$_{end}$=84 TPS=Acute	E: Fluoxetine (10mg to start, increase to 20mg/d after 1wk) C: Placebo Duration: 3mo	• Fugl-Meyer Assessment (+exp) • Modified Rankin Scale (-)
Chollet et al. (2011) RCT (9) N$_{start}$=118 N$_{end}$=113 TPS=Acute	E: Fluoxetine (20mg/d) + standard physiotherapy C: Placebo + standard physiotherapy Duration: 1/d, 90d medications	• Fugl-Meyer Assessment (+exp) ○ Upper Extremity (+exp) ○ Lower Extremity (+exp) • Modified Rankin Scale (+exp) • National Institute of Health Stroke Scale (-)
Fruehwald et al. (2003) RCT (9) N$_{start}$=54 N$_{end}$=50 TPS=Chronic	E: Fluoxetine (20mg/d) C: Placebo Duration: 4wk	• Scandinavian Stroke Scale (-)
Fluoxetine vs Notriptyline vs Placebo		
Robinson et al. (2000) Mikami et al. (2011) (1 yr follow-up) RCT (8) N$_{start}$=104 N$_{end}$=83 TPS=Subacute	E1: Fluoxetine (40mg/d, 3mo) E2: Nortriptyline (100mg/d, 3mo) C: Placebo Duration: 12wk	E2 vs E1/C: • Functional Independence Measure (+exp2) E1 vs C: • Functional Independence Measure (-)
Fluoxetine vs Maprotiline vs Placebo		
Dam et al. (1996) RCT (5) N$_{start}$=52 N$_{end}$=46 TPS=Subacute	E1: Fluoxetine (20mg/d) E2: Maprotiline (150mg/d) C: Placebo Duration: 12wks	E1 vs E2 • Barthel Index (+exp1) • Hemispheric Stroke Scale Gait score (+exp1) • Hamilton Depression Rating Scale (-) E1/E2 vs C • Barthel Index (-)

		• Hemispheric Stroke Scale (-) • Hamilton Depression Rating Scale (-)
Shu-Gan-Jie-Yu vs Fluoxetine vs Placebo		
Gong et al.(2020) RCT (7) N_{start}=254 N_{final}=222 TPS=Acute	E1: Shu-Gan-Jie-Yu capsule, 720 mg E2: Fluoxetine, 20 mg PO daily E3: Shu-Gan-Jie-Yu (2160 mg daily C: Placebo Duration: E1: 720 mg, 3/d, 7d/wk, for 12wks (2160 mg daily) Shu-Gan-Jie-Yu; E2: 20mg 1/d, 7d/wk, for 12wks fluoxetine; E3: 720 mg, 3/d, 7d/wk, for 12wks (2160 mg daily) Shu-Gan-Jie-Yu + 20mg 1/d, 7d/wk, for 12wks fluoxetine	E1/E2/E3 v C • Modified Rankin Scale (+exp1, +exp2, +exp3) • Fugl-Meyer Motor (+exp1, +exp2, +exp3)
Citalopram vs Placebo		
Acler et al. (2009) RCT (6) N_{start}=20 N_{end}=20 TPS=Acute	E: Citalopram (10mg/d) C: Placebo Duration: 4wk	• National Institute of Health Stroke Scale (+exp) • Barthel Index (-)
Escitalopram vs Placebo		

Gourab et al. (2015)
RCT crossover (8)
N_{start}=11
N_{end}=10
TPS=Chronic
	E: Escitalopram (10mg)
	C: Placebo
	Duration: Single dose, 1wk washout
		• Stretch reflex velocity (+exp)
		• Fugl-Meyer Assessment (-)
		• 10-Metre Walk Test (-)
		• 6-Minute Walk Test (-)
		• Muscle strength peak torque (-)
		  ○ Ankle plantarflexion (-)
		  ○ Knee extension peak torque (-)
		• Medial gastrocnemius EMG activity (-)

Citalopram vs Fluoxetine vs Placebo		
Asadollahi et al. (2018) RCT (8) N_{start}=90 N_{end}=75 TPS=Acute	E1: 20mg/d Citalopram & Physiotherapy E2: 20mg/day Fluoxetine & Physiotherapy C: Placebo & Physiotherapy 1/d, for 90d medication/placebo & 1hr/d, 5d/wk, for 12wks PT	E1 vs E2 • Fugl-Meyer Motor Scale (-) E1/E2 vs C • Fugl-Meyer Motor Scale (+exp1, +exp2)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Antidepressants

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Fluoxetine** may produce greater improvements in motor function compared to **placebo.**	5	Marquez-Romero et al. 2020; Gong et al. 2020; Asadollahi et al. 2018; Shah et al. 2016; Chollet et al. 2011
1b	**Shu-Gan-Jie-Yu (low dose and high dose)** may produce greater improvements in motor function compared to **placebo.**	1	Gong et al. 2020
1b	**Citalopram** may produce greater improvements in motor function compared to **placebo.**	1	Asadollahi et al. 2018
1b	**Escitalopram** may not have a difference in efficacy when compared to **placebo** for improving motor function.	1	Gourab et al. 2015
1b	**Citalopram** may not have a difference in efficacy when compared to **fluoxetine** for improving motor function.	1	Asadollahi et al. 2018

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Escitalopram** may not have a difference in efficacy when compared to **placebo** for improving functional ambulation.	1	Gourab et al. 2015

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **fluoxetine** when compared to **placebo** for producing greater improvements in activities of daily living.	7	Marquez-Romero et al. 2020; Gong et al. 2020; Hankey et al. 2020; [Robinson et al. 2000; Mikami et al. 2011]; Shah et al. 2016; Chollet et al. 2011; Dam et al. 1996
1b	**Nortriptyline** may produce greater improvements in activities of daily living compared to **fluoxetine or placebo.**	1	[Robinson et al. 2000; Mikami et al. 2011]
1b	**Shu-Gan-Jie-Yu (720mg)** may produce greater improvements in activities of daily living compared to **placebo.**	1	Gong et al. 2020
1b	**Shu-Gan-Jie-Yu (2160mg)** may produce greater improvements in activities of daily living compared to **placebo.**	1	Gong et al. 2020
2	**Fluoxetine** may produce greater improvements in activities of daily living compared to **maprotiline.**	1	Dam et al. 1996
2	**Maprotiline** may not have a difference in efficacy when compared to **placebo** for improving activities of daily living.	1	Dam et al. 1996

1b	**Citalopram** may not have a difference in efficacy when compared to **placebo** for improving activities of daily living.	1	Acler et al. 2009

MUSCLE STRENGTH			
LoE	Conclusion Statement	RCTs	References
1b	**Escitalopram** may not have a difference in efficacy compared to **placebo** for improving muscle strength.	1	Gourab et al. 2015

STROKE SEVERITY			
LoE	Conclusion Statement	RCTs	References
1a	**Fluoxetine** may not have a difference in efficacy when compared to **placebo** for improving stroke severity.	4	Marquez-Romero et al. 2020; Chollet et al. 2011; Fruehwald et al. 2003; Dam et al. 1996
2	**Fluoxetine** may produce greater improvements in stroke severity compared to **maprotiline.**	1	Dam et al. 1996
2	**Maprotiline** may not have a difference in efficacy when compared to **placebo** for improving stroke severity.	1	Dam et al. 1996
1b	**Citalopram** may produce greater improvements in stroke severity compared to **placebo.**	1	Acler et al. 2009

QUALITY OF LIFE			
LoE	Conclusion Statement	RCTs	References
1b	**Fluoxetine** may not have a difference in efficacy compared to **placebo** for improving quality of life.	1	Hankey et al. 2020

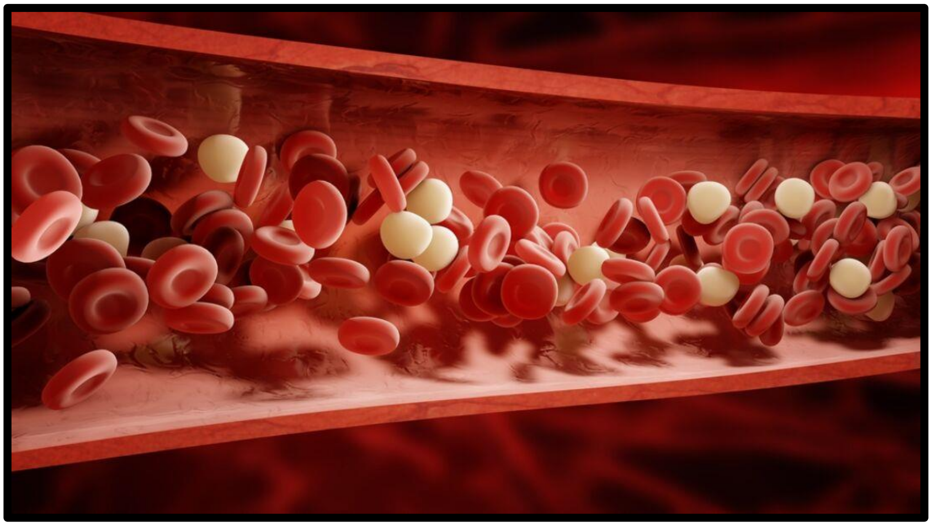
Key Points

The use of antidepressants may be beneficial for improving motor function.

The literature is mixed regarding use of antidepressants for improving activities of daily living after stroke.

The use of antidepressants may not be helpful in improving functional ambulation, muscle strength, quality of life, and stroke severity after stroke.

Secondary Prevention Medications



Adopted from: https://www.medgadget.com/2020/04/anticoagulants-market-size-industry-report-2019-2025.html

Approximately 25% of stroke patients will face a second stroke (Esenwa & Gutierrez, 2015). In addition, many stroke patients face reduced mobility which can lead to increased risk of muscle atrophy in the chronic phase, even if a secondary event does not occur (Naritomi et al., 2010). As such, recovery and secondary prevention is critical for reducing the likelihood of a further injury and increasing quality of life.

Secondary prevention is often a comprehensive approach to managing cardiovascular risk factors such as hypertension, diabetes, dyslipidemia, and smoking cessation. Changes in lifestyle like a healthy diet and aerobic exercise are also recommended strategies (Esenwa & Gutierrez, 2015). Pharmaceuticals such as antithrombotic agents and vasodilators can be deployed to help address these risk factors and manage disease while promoting recovery.

Antithrombotic agents aim to reduce the likelihood of blood clot formation by modulating the clotting cascade but can pose risk to causing a hemorrhagic event. As such, care must be taken in selecting the appropriate agent on a case-by-case basis. However, there is evidence that they can be beneficial for preventing secondary recurrence (Del Brutto et al., 2019).

Vasodilators are a class of medications that help open blood vessels all around the body. This causes increased blood flow to targeted areas of the body which can lead to increased strength and endurance thereby promoting recovery (Di Cesare et al., 2016).

Eight RCTs were found evaluating secondary prevention medication for lower extremity motor rehabilitation. One RCT compared tirofiban to placebo (Bai et al., 2018). One RCT compared a vasodilator PF-3049423 to placebo (Di Cesare et al., 2016). One RCT compared Olmesartan to amlodipine (Matsumoto et al., 2009). One RCT compared heparin use to aspirin (Jivad et al., 2012). One RCT compared rivaroxaban to aspirin (Bosch et al., 2022). One RCT compared naftidrofuryl fumarate to placebo (Gray et al., 1990). One RCT compared nimodipine to placebo (Kaste et al., 1994). One RCT compared lumbrokinase to conventional therapy (Pinzon & Veronica, 2020).

The methodological details and results of the eight RCTs are presented in Table 43.

Table 43. RCTs evaluating Secondary Prevention Medications for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Tirofiban vs Placebo		
Bai et al. (2018) RCT (7) N_{start}=66 N_{end}=55 TPS=Acute	E: Tirofiban injection + Conventional Rehabilitation C: Placebo injection + Conventional Rehabilitation Duration: 1/d, for 3wks Tirofiban/sham injection & 180min/d, 5d/wk, for 3wks Conventional Rehabilitation	• Fugl-Meyer Assessment (+exp) • Sensorimotor network connectivity (-) • Diffusivity of corticospinal tract (-)
PF-3049423 vs Placebo		
Di Cesare et al. (2016) RCT (6) N_{start}=139 N_{end}=137 TPS=Acute	E: PF-3049423 Phosphodiesterase-5 Inhibitor (6mg) C: Placebo Duration: 1/d, for 90d	• Modified Rankin scale (-) • Barthel index (-) • National Institute for Health Stroke Severity (-) • Box Block test (-) • Hand-grip strength (-) • 10-Meter Walk test (-) • Repeatable Battery assessment of Neuropsychological status (-) • Modified Albert's test (-)
Olmesartan vs Amlodipine		
Matsumoto et al. (2009) RCT (6) N_{start}=35 N_{end}=35 TPS=Subacute	E: Olmesartan (10mg) C: Amlodipine (2.5mg with dose increase as needed) Duration: 8wks	• Brunnstrom Stage ○ Total (+exp) ○ Lower extremity (+exp) • Barthel Index (-) • Mini-Mental State Examination (-) • Blood Pressure (-)
Heparin vs Aspirin		
Jivad et al. (2012) RCT (5) N_{start}=60 N_{end}=60 TPS=Not Reported	E: Heparin (5000-10000 BID) with aspirin C: Aspirin (acetylsalicylic acid) 100-325mg, 1 injection and/or dose/d for 3d	• Muscle Power - Lower Limbs (+exp)
Rivaroxaban vs Aspirin		
Bosch et al. (2022) RCT (8) N_{start}=7213 N_{end}=6153 TPS=Subacute	E: Rivaroxaban (15mg) C: Aspirin (100mg) Duration: Either medication once daily for 11mo	• Standard Assessment of Global Everyday Activities (-)
Naftidrofuryl fumarate vs Placebo		
Gray (1990) RCT (5) N_{start}=100 N_{end}=89 TPS=Acute	E: Naftidrofuryl fumarate (316.5 mg) C: Placebo Duration: 12 wks	• Cumulative fatality (-) • Hospital-bed occupancy (-) • Recovery of motor function (-)
Nimodipine vs Placebo		
Kaste et al. (1994) RCT (6) N_{start}=350 N_{end}=299 TPS=Acute	E: Nimodipine taken orally (120 mg/d) C: Placebo Duration: 30mg, 4doses/d, 120mg total/d, for 21d	• Rankin Grades (-) • Mobility (-) • Neurological Score (-)

DLBS1033 (Lumbrokinase) vs Conventional Therapy		
Pinzon et al. (2020) RCT (6) N_{start}=60 N_{end}=54 TPS=Acute	E: DLBS1033 supplement (Lumbrokinase) + Standard therapy C: Standard therapy Duration: 3doses/d - DLBS1033 until discharge	• Modified rankin scale (+exp) • National institute of health stroke scale (+exp) • Barthel index (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Secondary Prevention Medication

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Tirofiban** may produce greater improvements in motor function compared to **placebo**.	1	Bai et al. 2018
1b	**Olmesartan** may produce greater improvements in motor function compared to **amlodipine**.	1	Matsumoto et al. 2009
2	**Naftidrofuryl fumarate** may not have a difference in efficacy when compared to **aspirin** for improving motor function	1	Gray et al. 1990

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Phosphodiesterase-5 inhibitors** may not have a difference in efficacy when compared to **placebo** for improving functional ambulation.	1	Di Cesare et al. 2016

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Nimodipine** may not have a difference in efficacy when compared to **placebo** for improving functional mobility.	1	Kaste et al. 1994

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Phosphodiesterase-5 inhibitors** may not have a difference in efficacy when compared to **placebo** for improving activities of daily living.	1	Di Cesare et al. 2016
1b	**Olmesartan** may not have a difference in efficacy compared to **amlodipine** for improving activities of daily living.	1	Matsumoto et al. 2009

LoE	Conclusion Statement	RCTs	References
1b	**Nimodipine** may not have a difference in efficacy compared to **placebo** for improving activities of daily living.	1	Kaste et al. 1994
1b	**Lumbrokinase** may produce greater improvements in activities of daily living compared to **conventional therapy.**	1	Pinzon et al. 2020

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Heparin** may produce greater improvements in muscle strength compared to **aspirin.**	1	Jiyad et al. 2012

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Phosphodiesterase-5 inhibitors** may not have a difference in efficacy when compared to **placebo** for improving stroke severity.	1	Di Cesare et al. 2016
1b	**Lumbrokinase** may produce greater improvements in stroke severity compared to **conventional therapy.**	1	Pinzon et al. 2020

Key Points

Vasodilators may be beneficial for improving motor function after stroke, with no beneficial effect for improving other post-stroke outcomes.

Edaravone

Adopted from: https://www.newswire.ca/news-releases/mitsubishi-tanabe-pharma-canada-announces-that-company-s-treatment-for-amyotrophic-lateral-sclerosis-als-has-been-added-to-the-provincial-drug-plan-in-alberta-816188000.html

Edaravone (Radicava, Radicut) is a small-molecule drug that with antioxidant properties and has been hypothesized to be beneficial for stroke recovery. It is thought to act as a free-radical scavenger and reduce the oxidative stress that accompanies muscle paralysis following stroke and subsequently improve leg locomotor function (Naritomi et al., 2010; Petrov et al., 2017). However, the precise mechanism of action remains unknown. Edaravone has been approved for use early-stage ALS patients in Japan and is seeking approval for acute stroke in other nations. There remains very limited clinical data for stroke recovery despite some promising pre-clinical studies.

Two RCTs were found evaluating Edaravone for lower extremity motor rehabilitation. One RCT was found investigating long-term Edaravone use compared to short-term Edaravone use (Naritomi et al., 2010). One RCT compared Edaravone to conventional treatment (Sun et al., 2019).

The methodological details and results of the two RCTs are presented in Table 44.

Table 44. RCTs Evaluating Edaravone for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Long-Term Edaravone vs Short-Term Edaravone		
Naritomi et al. (2010) RCT (5) N$_{start}$=47 N$_{end}$=41 TPS=Acute	E1: Long-term Edaravone (30mg, 2x/d) 10-15 days + Conventional care C: Short Term Edaravone (30mg, 2x/d) 3 days + Conventional care Duration: 30mg 2x/d, 3 days for short term, 10-14 days for long term	E1 vs E2 • Disuse muscle atrophy o Paretic leg (+exp1) o Non-paretic leg (+exp1) • Brunnstrom Recovery Stage (-) • 10-Metre Walk Test (+exp1)
Edaravone Injection vs Conventional Treatment		
Sun et al. (2019) RCT (6) N$_{start}$=130 N$_{end}$=130 TPS=Not Reported	E: Edaravone injection (30 mg edaravone) + Conventional Treatment (80mg Ligustrazine in 250mL 0.9% sodium chloride and 100mg aspirin tab) C: Conventional Treatment Duration: E: 30mins/d, 2x/d, for 2wks C: 30mins/d, 1x/d, for 2wks	• Adverse events (-) • Barthel Index (+exp) • Fugl-Meyer Assessment (+exp) • National Institute of Health Stroke Scale (+exp) • Total treatment Efficacy (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Secondary Prevention Medication

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Long-term edaravone** may not have a difference in efficacy when compared to **short-term edaravone** for improving motor function.	1	Naritomi et al. 2010
1b	**Edaravone injection** may produce greater improvements in motor function compared to **conventional treatment.**	1	Sun et al. 2019

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Long-term edaravone** may produce greater improvements in functional ambulation compared to **short-term edaravone.**	1	Naritomi et al. 2010
ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**

1b	**Edaravone injection** may produce greater improvements in activities of daily living compared to **conventional treatment.**	1	Sun et al. 2019

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Edaravone injection** may produce greater improvements in stroke severity compared to **conventional treatment.**	1	Sun et al. 2019

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Long-term edaravone** may produce greater improvements in muscle strength compared to **short-term edaravone.**	1	Naritomi et al. 2010

Key Points

Long-term edaravone may be beneficial for improving functional ambulation and muscle strength compared to short term use.

Edaravone may be beneficial for improving motor function, activities of daily living, and stroke severity compared to standard treatment.

Stimulants

Adopted from: https://www.verywellmind.com/is-ritalin-addictive-21911

Stimulants are drugs that increase cortical excitability in the central nervous system (CNS), often by blocking reuptake and increasing the synaptic concentration and transmission of dopamine, serotonin, and noradrenaline throughout the brain. The neurobehavioral gains ascribed to CNS stimulants include enhanced arousal, mental processing speed, and/or motor processing speed (Herrold et al., 2014).

Two stimulants that are commonly used in rehabilitation include amphetamines and methylphenidates. Amphetamines are sympathomimetic agents that possess potent CNS stimulant effects by releasing monoamines from presynaptic neurons in the brain (Martinsson & Eksborg, 2004). They have been shown to improve motor recovery after brain injury in animal studies, and there is increasing evidence that they may provide symptomatic management for some deficits after brain injury in humans (Walker-Batson et al., 1995). Methylphenidates stimulate the CNS by increasing synaptic concentrations of norepinephrine and dopamine and are thought to modulate cerebral reorganization and improve motor function in stroke patients (Wang et al., 2014b).

11 RCTs were found evaluating stimulant interventions for lower extremity motor rehabilitation. Seven RCTs compared amphetamine use to placebo (Crisostomo et al., 1988; Gladstone et al., 2006; Goldstein et al., 2018; Martinsson & Wahlgren, 2003; Sonde et al., 2001; Treig et al., 2003; Walker-Batson et al., 1995). One RCT compared amphetamine with intensive physiotherapy to amphetamine with conventional physiotherapy (Martinsson et al., 2003). One RCT compared amphetamine to levodopa or placebo (Sonde & Lökk, 2007). One RCT compared methylphenidate to placebo (Grade et al., 1998). One RCT compared methylphenidate to levodopa or placebo (Lokk et al., 2011).

The methodological details and results of all 11 RCTs evaluating stimulant interventions for lower extremity motor rehabilitation are presented in Table 45.

Table 45. RCTs Evaluating Amphetamine Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Amphetamines vs Placebo		
Goldstein et al. (2018) RCT (8) N_{start}=64 N_{end}=59 TPS=Acute	E: Dextroamphetamine + conventional therapy C: Placebo + conventional therapy Duration: 60min/d, q4d (6 sessions total) conventional therapy & 10mg/d, q4d (6 doses total) Dextroamphetamine/sham	• Fugl-Meyer motor score (-) • Modified Rankin Scale (-) • National Institutes of Health Stroke Scale (-) • Canadian Neurological Scale (-) • Action Research Arm Test (-) • Functional Independence Measure (-) • 6-minute walk test (-) • Mini-Mental State Examination (-) • Beck Depression Inventory (-) • Stroke Impact Scale (-)
Gladstone et al. (2006) RCT (7) N_{start}=71 N_{end}=67 TPS=Acute	E: D-Amphetamine sulfate (10mg/d) + Physiotherapy C: Placebo + Physiotherapy Duration: 2d/wk, for 5wks	• Fugl-Meyer Assessment (-) ○ Upper Extremity (-) ○ Lower Extremity (-) • Clinical Outcome Variable Scale ○ Ambulation Performance (-) ○ Independent Ambulation with Environmental Barriers (-) • Functional Independence Measure (-) • Modified Rankin Scale (-) • Chedoke-McMaster Disability Inventory (-) ○ Arm and Hand Activity (-)
Martinsson & Wahlgren (2003) RCT (8) N_{start}=45 N_{end}=38 TPS=Acute	E1: Dexamphetamine (2.5mg) E2: Dexamphetamine (5.0mg) E3: Dexamphetamine (10mg) C: Placebo Duration: 1capsule 2x/d, for 5d	E1/E2/E3 vs C • Lindmark Motor Assessment Chart (+exp1, +exp2, +exp3) • 10-Meter Walk Test (-) • Activity Index (-) • Scandinavian Stroke Scale (+exp1, +exp2, +exp3) • Heart Rate (+exp1, +exp2, +exp3) • Blood Pressure (+exp1, +exp2, +exp3) • Barthel Index (-)
Treig et al. (2003) RCT (9) N_{start}=24 N_{end}=24 TPS=Acute	E: D-Amphetamine (10mg/d) + Physiotherapy C: Placebo + Physiotherapy Duration: Every fourth day (10d total) for 36d Medication/placebo, 45min/d, 5d/wk, for 36d physiotherapy	• Rivermead Motor Assessment (-) • Barthel Index (-)
Sonde et al. (2001) RCT (9) N_{start}=40 N_{end}=39 TPS=Acute	E: Amphetamine (10mg/d) + Physiotherapy + Regular training C: Placebo + Physiotherapy + Regular training Duration: 2d/wk, for 5wks Amphetamine/placebo, 30min/d, 5d/wk, for 5wks Physiotherapy	• Fugl-Meyer Assessment (-) • Barthel Index (-)

Walker-Baston (1995) RCT (6) N_{start}=10 N_{end}=10 TPS=Acute	E: Dextroamphetamine (10mg/d) + physical therapy C: Placebo + physical therapy Duration: Every 4d for 10 sessions	• Fugl-Meyer Assessment (+exp)
Crisostomo et al. (1988) RCT (8) N_{start}=8 N_{end}=8 TPS=Acute	E: Amphetamine (10mg) + physiotherapy C: Placebo + physiotherapy Duration: Single dose injection & single 45min physiotherapy session	• Fugl-Meyer Assessment ○ Upper Extremity (+exp) ○ Lower Extremity (+exp)
Amphetamine with Intensive Physiotherapy vs Amphetamine with Conventional Physiotherapy		
Martinsson et al. (2003) RCT (7) N_{start}=30 N_{end}=28 TPS=Acute	E: Dexamphetamine (10mg, 2x/d) + Intensive physiotherapy C: Dexamphetamine (10mg, 2x/d) + Conventional physiotherapy Duration: 30-45min, 2x/d, for 5d Intensive physiotherapy & 15min/d, for 5d Standard physiotherapy	• Lindmark Motor Assessment Chart (-) • Activity Index (-) • National Institute of Health Stroke Scale (-)
Amphetamine vs Levodopa vs Placebo		
Sonde & Lokk (2007) RCT (7) N_{start}=30 N_{end}=25 TPS=Acute	E1: Amphetamine (10mg/d) + Levodopa (50mg/d) E2: Amphetamine (20mg/d) + Levodopa placebo E3: Amphetamine placebo + Levodopa (100mg/d) C: Amphetamine placebo + Levodopa placebo Duration: 5d/wk for 2wks	<u>E1/E2/E3 vs C</u> • Fugl-Meyer Assessment (-) • Barthel Index (-)
Methylphenidate vs Placebo		
Grade et al. (1998) RCT (7) N_{start}=21 N_{end}=21 TPS=Acute	E: Methylphenidate (30mg/d) C: Placebo Duration: 7d/wk for 3wks	• Functional Independence Measure (+exp) • Fugl-Meyer Assessment (-)
Methylphenidate vs Levodopa vs Placebo		
Lokk et al. (2011) RCT (8) N_{start}=100 N_{end}=78 TPS=Subacute	E1: Methylphenidate (20mg/d) + conventional physiotherapy E2: Levodopa (125mg/d) + conventional physiotherapy E3: Methylphenidate + Levodopa + conventional physiotherapy C: Placebo + conventional physiotherapy	<u>E1/E2/E3 vs C</u> • Barthel Index (+exp1, +exp2, +exp3) • National Institue of Health Stroke Scale (+exp1, +exp2, +exp3) • Fugl-Meyer Assessment (-) <u>E1 vs E2 vs E3</u> • Barthel Index (-) • National Institute of Health Stroke Scale (-) • Fugl-Meyer Assessment (-)

	Duration: 10mg, 2doses/d, 5d/wk, for 3wks (15 total sessions) & 45min/d, 5d/wk, for 3wks physiotherapy	

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Stimulants

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Amphetamines** may not have a difference in efficacy when compared to **placebo** for improving motor function.	8	Goldstein et al. 2018; Gladstone et al. 2006; Sonde et al. 2001; Walker-Baston et al. 1995; Crisostomo et al. 1988; Treig et al. 2003; Martinsson & Wahlgren 2003; Sonde & Lokk 2007
1b	**Amphetamines with intensive physiotherapy** may not have a difference in efficacy when compared to **amphetamines with conventional physiotherapy** for improving motor function.	1	Martinsson et al. 2003
1b	**Amphetamine with levodopa** may not have a difference in efficacy when compared to **placebo** for improving motor function.	1	Sonde & Lokk 2007
1a	**Methylphenidate** may not have a difference in efficacy when compared to **placebo** for improving motor function.	2	Lokk et al. 2011; Grade et al. 1998
1b	**Methylphenidate combined with levodopa** may not have a difference in efficacy compared to **methylphenidate** only, **levodopa** only, or **placebo** for improving motor function.	1	Lokk et al. 2011
1b	**Methylphenidate** may not have a difference in efficacy when compared to **levodopa** for improving motor function.	1	Lokk et al. 2011

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Amphetamines** may not have a difference in efficacy when compared to **placebo** for improving functional ambulation.	2	Goldstein et al. 2018; Martinsson & Wahlgren 2003

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**

1b	**Amphetamines** may not have a difference in efficacy when compared to **placebo** for improving functional mobility.	1	Gladstone et al. 2006

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1a	**Methylphenidate** may produce greater improvements in activities of daily living compared to **placebo**.	2	Lokk et al. 2011; Grade et al. 1998
1a	**Amphetamines** may not have a difference in efficacy when compared to **placebo** for improving activities of daily living.	6	Sond & Lokk 2007; Gladstone et al. 2006; Goldstein et al. 2018; Martinsson & Wahlgren 2003; Treig et al. 2003; Sonde et al. 2001
1b	**Amphetamine with intensive physiotherapy** may not have a difference in efficacy when compared to **amphetamine with conventional physiotherapy** for improving activities of daily living.	1	Martinsson et al. 2003
1b	**Amphetamines with levodopa** may not have a difference in efficacy when compared to **placebo** for improving activities of daily living.	1	Sonde & Lokk 2007
1b	**Methylphenidate combined with levodopa** may produce greater improvements in activities of daily living compared to **placebo**.	1	Lokk et al. 2011
1b	**Methylphenidate** may not have a difference in efficacy when compared to **levodopa** for improving activities of daily living.	1	Lokk et al. 2011
1b	**Methylphenidate combined with levodopa** may not have a difference in efficacy when compared to **levodopa alone or methylphenidate alone** for improving activities of daily living.	1	Lokk et al. 2011

STROKE SEVERITY

LoE	Conclusion Statement	RCTs	References
1a	**Amphetamine** may not have a difference in efficacy when compared to **placebo** for improving stroke severity.	2	Goldstein et al. 2018; Martinsson & Wahlgren 2003
1b	**Amphetamine with intensive physiotherapy** may not have a difference in efficacy when compared to **amphetamine with conventional physiotherapy** for improving stroke severity.	1	Martinsson et al. 2003
1b	**Methylphenidate** may produce greater improvements in stroke severity compared to **placebo**.	1	Lokk et al. 2011
1b	**Methylphenidate** may not have a difference in efficacy when compared to **levodopa** for improving stroke severity.	1	Lokk et al. 2011
1b	**Methylphenidate combined with levodopa** may not have a difference in efficacy when compared to	1	Lokk et al. 2011

	methylphenidate alone or levodopa alone for improving stroke severity.		
1b	**Methylphenidate combined with levodopa** may produce greater improvements in stroke severity compared to **placebo**.	1	Lokk et al. 2011

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Amphetamines** may not have a difference in efficacy when compared to **placebo** for improving quality of life.	1	Goldstein et al. 2018

Key Points

Stimulants may not be beneficial for improving motor function, functional ambulation, functional mobility, activities of daily living, quality of life, and stroke severity after stroke.

Dopamine Agonists

Adopted from: https://medium.com/parkinsons-uk/how-do-levodopa-medications-work-ac6a6e58e143

Dopamine agonists are effective at controlling motor symptoms in patients with Parkinson's disease, with Levodopa being the current gold standard treatment (Antonini, 2007). While levodopa is possibly the most potent of the Parkinsonian drugs, its prolonged use can cause a variety of side effects, thus dopamine agonists are also commonly used in therapy (Kulisevsky & Pagonabarraga, 2010). Dopamine agonists have shown the ability to delay the initiation of levodopa therapy and have even been shown to modify the course of certain motor complications associated with levodopa use, such as dyskinesia (Kulisevsky & Pagonabarraga, 2010). Ropinirole is one such dopamine agonist used in therapy.

Seven RCTs were found evaluating the effect of dopamine agonists for lower extremity motor rehabilitation. Four RCTs compared levodopa use to placebo or no medication (Acler et al., 2009a; Ford et al., 2019; Scheidtmann et al., 2001; Shamsaei et al., 2015). Two RCTs compared levodopa use and levodopa combined with stimulants use or placebo (Lokk et al., 2011; Sonde & Lökk, 2007). One RCT compared ropinirole use to placebo (Cramer et al., 2009).

The methodological details and results of all seven RCTs evaluating stimulant interventions for lower extremity motor rehabilitation are presented in Table 46.

Table 46. RCTs Evaluating Levodopa and Ropinirole Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Levadopa vs Placebo or No Medication		
Ford et al. (2019) RCT (9) N_{start}=593 N_{end}=532	E: Co-careldopa (Sinemet) + conventional rehabilitation C: Placebo + conventional rehabilitation	• 10-meter Walk test (-) • Rivermead Mobility Index (-) • Nottingham extended activities daily living (-) • Barthel index (-)

TPS=Acute	Duration: 62.5mg/d, for the first 2 days, then 125mg/d, 6wks, 45-60 min before	• ABILHAND (-) • Modified Rankin scale (-) • Montreal Cognitive assessment (-) • General Health Questionnaire-12 (-) • Fatigue assessment scale (-) • Caregiver burden scale (+exp)
Shamsaei et al. (2015) RCT (4) N_{start}=114 N_{end}=113 TPS=Not reported	E: Levodopa (100mg/d) C: No medication Duration: 3wks	• Rivermead Mobility Index (+exp) • Barthel Index (+exp)
Acler et al. (2009) RCT crossover (5) N_{start}=12 N_{end}=10 TPS=Chronic	E: L-DOPA 100mg/d E: Placebo Duration: 1/d, 7d/wk, for 5wks	• Rivermead Motor Assessment (-) • Nine Hole Peg Test o Affected hand (+exp) o Unaffected hand (-) • 10-Meter walking test (+exp) • Beck Depression Inventory (-) • Resting Motor Threshold (-) • MEP Amplitude (-) • Cortical Silent Period (-)
Scheidtmann et al. (2001) RCT (7) N_{start}=53 N_{end}=47 TPS=Subacute	E: Levodopa (100mg, 1x) b + PT C: Placebo + PT Duration: 100mg/d, for 3wks levodopa + PT; 60min/d, 5d/wk, for 3wks PT only	• Rivermead Motor Assessment (+exp)
Levodopa with Stimulants		
Lokk et al. (2011) RCT (8) N_{start}=100 N_{end}=78 TPS=Subacute	E1: Methylphenidate (20mg/d) + conventional physiotherapy E2: Levadopa (125mg/d) + conventional physiotherapy E3: Methylphenidate + Levadopa + conventional physiotherapy C: Placebo + conventional physiotherapy Duration: 10mg, 2 doses/d, 5d/wk, for 3wks (15 total sessions) & 45min/d, 5d/wk, for 3wks physiotherapy	E1/E2/E3 vs C • Barthel Index (+exp1, +exp2, +exp3) • National Institue of Health Stroke Scale (+exp1, +exp2, +exp3) • Fugl-Meyer Assessment (-) E1 vs E2 vs E3 • Barthel Index (-) • National Institue of Health Stroke Scale (-) • Fugl-Meyer Assessment (-)
Sonde & Lokk (2007) RCT (7) N_{start}=30 N_{end}=25 TPS=Acute	E1: Levodopa (50mg/d) + Amphetamine (10mg/d) E2: Levodopa (100mg/d) + Amphetamine placebo E3: Levodopa placebo + Amphetamine (20mg/d) C: Amphetamine placebo + Levodopa placebo Duration: 5d/wk for 2wks	E1/E2/E3 vs C • Fugl-Meyer Assessment (-) • Barthel Index (-)
Ropinirole vs Placebo		
Cramer et al. (2009) RCT (6) N_{start}=33 N_{end}=33 TPS=Chronic	E: Ropinirole (4mg/d) + physical therapy C: Placebo + physical therapy Duration: 7d/wk for 9wks medication therapy & 90min/d, 2d/wk, 4wks (after week 5) physical therapy	• Fugl-Meyer Assessment (-) • 50-ft timed walk test (-) • 6-minute walk test (-) • Stroke Impact Scale (-) • Barthel Index (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group

+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Levodopa and Ropinirole

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Levodopa** may not have a difference in efficacy compared to **no medication** and **placebo** for improving motor function.	4	Lokk et al. 2011; Acler et al. 2009; Sonde & Lokk 2007; Scheidtmann 2001
1b	**Levodopa** may not have a difference in efficacy compared to **methylphenidate** for improving motor function.	1	Lokk et al. 2011
1b	**Levodopa combined with methylphenidate** may not have a difference in efficacy compared to **placebo, methylphenidate alone or levodopa alone** for improving motor function.	1	Lokk et al. 2011
1b	**Levodopa combined with amphetamine** may not have a difference in efficacy compared to **placebo** for improving motor function.	1	Sonde & Lokk 2007
1b	**Ropinirole** may not have a difference in efficacy compared to **placebo** for improving motor function.	1	Cramer et al. 2009

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **levodopa** for improving functional ambulation compared to **placebo or no medication.**	2	Ford et al. 2019; Acler et al. 2009
1b	**Ropinirole** may not have a difference in efficacy compared to **placebo** for improving functional ambulation.	1	Cramer et al. 2009

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **levodopa** for improving functional mobility compared to **placebo or no medication.**	2	Ford et al. 2019; Shamsaei et al. 2015

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Levodopa** may not have a difference in efficacy compared to **no medication** and **placebo** for improving activities of daily living.	4	Ford et al. 2019; Shamsaei et al. 2015; Lokk et al. 2011; Sonde & Lokk 2007

1b	**Ropinirole** may not have a difference in efficacy compared to **placebo** for improving activities of daily living.	1	Cramer et al. 2009
1b	**Methylphenidate combined with levodopa** may produce greater improvements in activities of daily living than **placebo**.	1	Lokk et al. 2011
1b	**Levodopa** may not have a difference in efficacy compared to **methylphenidate** for improving activities of daily living.	1	Lokk et al. 2011
1b	**Levodopa combined with methylphenidate** may not have a difference in efficacy compared to **methylphenidate alone or levodopa alone** for improving activities of daily living.	1	Lokk et al. 2011
1b	**Levodopa combined with amphetamine** may not have a difference in efficacy compared to **placebo** for improving activities of daily living.	1	Sonde & Lokk 2007

STROKE SEVERITY

LoE	Conclusion Statement	RCTs	References
1b	**Levodopa** may produce greater improvements in stroke severity compared to **placebo or no medication**.	1	Lokk et al. 2011
1b	**Methylphenidate combined with levodopa** may produce greater improvements in stroke severity compared to **placebo**.	1	Lokk et al.2011
1b	**Levodopa** may not have a difference in efficacy compared to **methylphenidate** for improving stroke severity.	1	Lokk et al. 2011
1b	**Levodopa combined with methylphenidate** may not have a difference in efficacy compared to **methylphenidate alone or levodopa alone** for improving stroke severity.	1	Lokk et al. 2011

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **levodopa** for improving quality of life compared to **placebo or no medication.**	1	Ford et al. 2019
1b	**Ropinirole** may not have a difference in efficacy compared to **placebo** for improving quality of life.	1	Cramer et al. 2009

Key Points

Levodopa may be beneficial for improving stroke severity. Levodopa and Ropinirole may not be beneficial for improving outcomes after stroke.

Nerve Block Agents

Adopted from: https://www.acnr.co.uk/2012/12/phenol-nerve-block-for-management-of-lower-limb-spasticity/

Nerve blocks are a locally acting treatment for spasticity that have the advantage of reducing harmful spasticity in one area, while preserving useful spasticity in another area (Kirazli et al., 1998). Motor nerve blocks can be used to evaluate the potential role of muscle overactivity in abnormal movements. Depending on the pharmacological agent used, the temporary effect of a nerve block reverses within 1–12 h (Gross et al., 2014). Phenol is a commonly used nerve block agent that denatures protein and causes generalized neurolysis that affects both motor and sensory nerve fibers, thus reducing muscle tone by reducing abnormal neural signals. Phenol is effective in spasticity of large proximal leg muscles or as a nerve block in spastic foot drop (Fu et al., 2013). Radiofrequency thermocoagulation is another nerve block agent in which nerve fibres are blocked via thermal damage (Shen et al., 2017).

Five RCTs were found evaluating nerve block agent interventions for lower extremity motor rehabilitation. Two RCTs compared phenol to botulinum toxin (Kirazli et al., 1998; On et al., 1999). One RCT compared phenol to ethyl alcohol (Kocabas et al., 2010). One RCT compared thermocoagulation with AFO to sham thermocoagulation with AFO, thermocoagulation with sham AFO, and sham thermocoagulation with sham AFO (Beckerman et al., 1996b). One RCT compared curare to homeopathic medications (Pramanick et al., 2020).

The methodological details and results of all five RCTs evaluating nerve block agent interventions for lower extremity motor rehabilitation are presented in Table 47.

Table 47. RCTs Evaluating Nerve Block Agent Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	**Interventions Duration: Session length, frequency per week for total number of weeks**	**Outcome Measures Result (direction of effect)**
Botulinum Toxin vs Phenol		
On et al. (1999) RCT (5) N$_{start}$=20 N$_{end}$=20 TPS=Chronic	E1: Botulinum Toxin A (400 U) E2: Phenol Duration: One session	• Ashworth Scale (+exp1) • Achilles Tendon Response (+exp1) • M-response (+exp2) • H-reflex (-) • M:H ratio (-) • ATR:H ratio (+exp2)
Kirazli et al. (1998) RCT (8) N$_{start}$=20 N$_{end}$=20 TPS=Chronic	E1: Botulinum Toxin A (400 U) E2: Tibial nerve blockade (Phenol) Duration: One session	E1 vs E2 • Brace Wear Scale (-) • Ashworth Scale (+exp1) • Global Assessment of Spasticity Scale (+exp1) • 25 Feet Walk Test (+exp1) • Clonus Duration (+exp1)
Nerve block with Phenol vs Ethyl Alcohol		
Kocabas et al. (2010) RCT (5) N$_{start}$=20 N$_{end}$=20 TPS=Chronic	E1: 50% Ethyl alcohol injection (5mL) E2: 5% Phenol injection (5mL) Duration: single treatment	• Modified Ashworth Scale (-) • Passive Range of Motion (-) • Ankle clonus (-) • Medical Research Council ankle strength (-)
Nerve Block with AFO Device		
Beckerman et al. (1996a) RCT (7) N$_{start}$=60 N$_{end}$=58 TPS=Chronic	E1: Tibial nerve block through thermocoagulation + AFO E2: Sham thermocoagulation + AFO E3: Thermocoagulation + Sham AFO E4: Sham thermocoagulation + Sham AFO Duration: 45-60min/1session thermocoagulation	E1/E3 vs E2/E4 • Modified Ashworth Scale (-) • Ankle Clonus Score (+exp1, +exp3) • Achilles tendon reflex (+exp1, +exp3) • Fugl-Meyer Assessment (-) • Spasticity (+exp1, +exp3) • Sickness Impact Profile (-) • Walking Speed (-)
Curare vs Homeopathic Medications		
Pramanick et al. (2020) RCT (6) N$_{start}$=50 N$_{end}$=45 TPS=Chronic	E: Curare 30CH + Conventional therapy C: Individualized homeopathic medicines + Conventional therapy Duration: Each dose=4 globules of medicine. Individualized dosage for each person.	• Oxford Muscle scale-strength grading (-) • Stroke Impact scale ○ Physical Problems (-) ○ Memory And Thinking (-) ○ Mood And Emotion (-) ○ Communication And Understanding (-) ○ Usual Activities (-) ○ Mobility (-) ○ Ability To Use Affected Hand (-) ○ Stroke Affected Ability to Participate in Social Activities (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp$_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Nerve Block Agent Intervention

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Tibial nerve block through thermocoagulation with ankle foot orthosis** may not have a difference in efficacy when compared to **sham thermocoagulation with ankle foot orthosis, thermocoagulation with sham ankle foot orthosis,** or **sham thermocoagulation with sham ankle foot orthosis** for improving motor function.	1	Beckerman et al. 1996

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Phenol** may not have a difference in efficacy when compared to **ethyl alcohol** for improving range of motion.	1	Kocabas et al. 2010

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Phenol** may not have a difference in efficacy when compared to **ethyl alcohol** for improving muscle strength.	1	Kocabas et al. 2010
1b	**Curare** may not have a difference in efficacy when compared to **homeopathic medications** for improving muscle strength.	1	Pramanick et al. 2020

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Tibial nerve block through thermocoagulation with ankle foot orthosis** and **thermocoagulation with sham ankle foot orthosis** may produce greater improvements in spasticity than **sham thermocoagulation with ankle foot orthosis** and **sham thermocoagulation with sham ankle foot orthosis**.	1	Beckerman et al. 1996
1b	**Nerve block with phenol** may not produce greater improvements in spasticity compared to **Botulinum toxin.**	2	Kirazli et al. 1998; On et al. 1998
2	**Phenol** may not have a difference in efficacy when compared to **ethyl alcohol** for improving spasticity.	1	Kocabas et al. 2010

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**

1b	**Nerve block with phenol** may not produce greater improvements in functional ambulation compared to **Botulinum toxin.**	1	Kirazli et al. 1998
1b	**Tibial nerve block through thermocoagulation with ankle foot orthosis** may not have a difference in efficacy when compared to **sham thermocoagulation with ankle foot orthosis, thermocoagulation with sham ankle foot orthosis,** or **sham thermocoagulation with sham ankle foot orthosis** for improving functional ambulation.	1	Beckerman et al. 1996

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Tibial nerve block through thermocoagulation with ankle foot orthosis** may not have a difference in efficacy when compared to **sham thermocoagulation with ankle foot orthosis, thermocoagulation with sham ankle foot orthosis,** or **sham thermocoagulation with sham ankle foot orthosis** for improving quality of life.	1	Beckerman et al. 1996

Key Points

Nerve block agent intervention may not be beneficial for improving post-stroke outcomes, except for spasticity.

Botulinum Toxin

Adopted from: https://www.pointperformance.com/managing-pain-with-botox/

Botulinum toxin is a pharmacological agent, administered through injections, which reduces muscle tone and overactivity in spastic muscles. It exerts a therapeutic effect by presynaptically blocking the release of acetylcholine at the neuromuscular junction. The benefits of botulinum toxin injections are generally dose-dependent and last approximately 2 to 4 months before nerve resprouting reverses the functional blockade (Brashear et al., 2002; Francisco et al., 2002; Pandyan et al., 2002; Simpson et al., 1996; Smith et al., 2000). One of the advantages of botulinum toxin is that it reduces spasticity only in the injected muscles as opposed to other systemic treatments, which can have more widespread antispastic effects (Pandyan et al., 2002). Unlike chemodenervation and neurolytic procedures like phenol or alcohol, botulinum toxin is not associated with skin sensory loss, dysesthesia, or other side effects like fatigue and weakness (Pandyan et al., 2002; Suputtitada & Suwanwela, 2005). The most widely used type of botulinum toxin is botulinum toxin A, which has two further variations known as abobotulinum toxin A and onabotulinum toxin A. Both types share the same pharmacology and are used for similar purposes, however they differ with respect to their unit potency and nontoxin protein content, making their pharmacodynamic properties unique (Nestor & Ablon, 2011). Dynamic EMG studies can be helpful in determining which muscles should be injected (Bell & Williams, 2003).

A total of 42 RCTs were found evaluating botulinum toxin interventions for lower extremity motor rehabilitation.

11 RCTs compared botulinum toxin to placebo (Burbaud et al., 1996; Esquenazi et al., 2019; Fietzek et al., 2014; Kaji et al., 2010; Kerzoncuf et al., 2020; Masakado et al., 2021; Patel et al., 2020; Prazeres et al., 2018; Tao et al., 2015; Ward et al., 2014; Wein et al., 2018). Two RCTs compared botulinum toxin A to ankle-foot orthoses (Ding et al., 2015; Farina et al., 2008). Three RCT compared botulinum toxin A with casting, taping, or stretching (Carda et al., 2011; Karadag-Saygi et al., 2010; Reiter et al., 1998). Two RCTs investigated botulinum toxin A with electrical stimulation (Baricich et al., 2019; Lannin et al., 2018). Three RCTs examined botulinum toxin A with functional electrical stimulation (Baricich et al., 2008; Ding et al., 2017; Johnson et al., 2004).

Two RCTs examined botulinum toxin A with TENS (Bayram et al., 2006; Picelli et al., 2014). One RCT looked at botulinum toxin A compared to a neurotomy (Bollens et al., 2013). Two RCTs compared botulinum toxin A to phenol (Kirazli et al., 1998; On et al., 1999). Two RCTs examined the location of injection (Childers et al., 1996; Im et al., 2014). Six RCTs compared the dosage of injection (Dunne et al., 2012; Gracies et al., 2017; Li et al., 2017; Mancini et al., 2005; Pimentel et al., 2014; Pittock et al., 2003). Two RCTs compared the method of injection guidance (Picelli et al., 2012; Turna et al., 2020). One RCT compared botulinum toxin A with task-oriented rehabilitation (Roche et al., 2015). Two RCTs investigated botulinum toxin in combination with robotic therapy (Erbil et al., 2018; Picelli et al., 2016). One RCT compared botulinum toxin with EMG biofeedback to conventional care (Chen et al., 2015b). One RCT compared the timing of the injections (Oh et al., 2018). Finally, one RCT compared forward versus backwards treadmill training with botulinum toxin A (Munari et al., 2020).

The methodological details and results of all 42 RCTs are presented in Table 48.

Table 48. RCTs Evaluating Botulinum Toxin Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Botulinum Toxin A vs Placebo		
Masakado et al. (2021) RCT (9) N_{start}=208 N_{end}=194 TPS=Chronic	E: Incobotulinumtoxin A (400U) injection in the pes equinus muscles C: Placebo Duration: 1 injection, 12wk observation	• Modified Ashworth Scale (+exp) • 10-Meter Walking Test (-)
Kerzoncuf et al. (2020) RCT (6) N_{start}=49 N_{end}=40 TPS=Chronic	E: E: Botulinum Toxin A injection (<300U) + conventional therapy C: Placebo injection + conventional therapy Duration: Single injection botox up to 300U	• Final countdown number reached (-) • Countdown mistakes (-) • Modified Ashworth Score ○ Gastrocnemius (+exp) ○ Gastrocnemii (-) ○ Soleus (+exp) ○ Tibialis posterior (-) • Range of motion - Tibiotarsal joint knee extended (-) • Sway Area ○ Eyes Open (-) ○ Dual Task (+exp) ○ Eyes Closed (-) • Weight-bearing performances (-) • Walking speed (-) • Functional Independence Measure (-) • Functional Ambulation Category (-)
Patel et al. (2020) RCT (8) N_{start}=468 N_{end}=450 TPS=Chronic	E: Onabotulinumtoxin A 300U-400U C: Placebo Duration: 1 injection session	• Modified Ashworth Scale (+exp) • Clinical Global Impression of Change (+exp) • Goal Attainment Scale (-) • 10-Metre Walk Test (-)
Esquenazi et al. (2019) RCT (8) N_{start}=468 N_{end}=450 TPS=Chronic	E: Onabotuliniumtoxin A (300 U) C: Placebo Duration: 6wks	• Modified Ashworth Scale (+exp) • Global Impression of Change assessed by physician (+exp) • Goal Attainment Scale (+exp)

Prazeres et al. (2018)
RCT (8)
N_{start}=40
N_{end}=37
TPS=Chronic
	E: Botulinum Toxin A injection + conventional therapy
	C: Placebo injection + conventional therapy
	Duration: 30min/d, 2d/wk, for 9mo conventional therapy; 1 dose botox injection at baseline, 3mo, and 6mo
		• Fugl-Meyer Upper limb (-)
		  ○ Coordination (+con)
		  ○ Upper limb speed (+con)
		• Timed Up-and-Go (-)
		• 6-Minute walk test (-)
		• Modified Ashworth
		  ○ Elbow (+exp)
		  ○ Wrist (+exp)

Wein et al. (2018)
RCT (7)
N_{start}=468
N_{end}=450
TPS=Chronic
	E: Onabotulinumtoxin A (300U)
	C: Placebo
	Duration: 12-week intervals, 3 treatment cycles
		• Modified Ashworth scale (+exp)
		• Clinical global impression of change-physician (+exp)
		• Goal Attainment scale (+exp)
		• Pain scale (-)
		• 10m Walk test (-)
		• Modified Tardieu scale
		  ○ Ankle (-)
		  ○ Toe (-)

Tao et al. (2015) RCT (5) N_{start}=23 N_{end}=23 TPS=Acute	E: Botulinum toxin A (200U) C: Placebo Duration: Assessment 8wks post-injection	• Modified Ashworth Scale (+exp) • Fugl-Meyer Assessment (+exp) • Modified Barthel Index (+exp) • 6-Minute Walk Test (+exp) • Gait speed (+exp) • Step length (+exp) • Cadence (+exp)
Fietzek et al. (2014) RCT (8) N_{start}=52 N_{end}=52 TPS=Subacute	E: Botulinum toxin A (230U, 460U) C: Placebo Duration: Single session of injection, repeated at 12wks	• Modified Ashworth Scale (+exp)

Ward et al. (2014)
RCT (8)
N_{start}=274
N_{end}=253
TPS=Chronic
	E: Onabotulinum toxin A + standard care
	C: Placebo + standard care
	Duration: Single injection with possible second injection at 12-24wks, total double-blind study duration 22-34wks
		• Goal Attainment Scaling
		  ○ Principal active functional goal achievement (-)
		  ○ Secondary functional goal achievement (-)
		  ○ Secondary active functional goal achievement (-)
		  ○ Secondary passive goal achievement (-)

Kaji et al. (2010) RCT (9) N_{start}=120 N_{end}=113 TPS=Chronic	E: Botulinum toxin A (300U) C: Placebo Duration: Single treatment of 300U	• Modified Ashworth Scale (+exp) • Physician Gait Rating scale (-) • Clinical global impression (+exp) • 10-Meter walk test (-)
Burbaud et al. (1996) RCT crossover (8) N_{start}=23 N_{end}=23 TPS=Chronic	E: Botulinum toxin (200U) injection under EMG guidance C: Placebo Duration: Single injection	• Modified Ashworth Scale (+exp) • Fugl-Meyer Assessment (+exp) • Gait speed (-) • Active Ankle Dorsiflexion (+exp)
Botulinum Toxin A with Ankle-foot Orthosis		
Ding et al. (2015) RCT (4) N_{start}=103 N_{end}=83 TPS=Acute	E1: Botulinum toxin A under ultrasound guidance + ankle foot orthosis (AFO) + Conventional rehabilitation E2: Botulinum toxin A + Conventional rehabilitation C: Conventional rehabilitation Duration: 6mo follow-up	After 1mo E1 vs E2/C • Clinic Spasticity Influx (-) • Berg Balance Scale (-) • Fugl-Meyer Assessment (-) • Functional Independence Measure (-) After 3 and 6mo E1 vs E2/C • Clinic Spasticity Influx (+exp1) • Berg Balance Scale (+exp1) • Fugl-Meyer Assessment (+exp1) • Functional Independence Measure (+exp1)

Farina et al. (2008) RCT (5) N_{start}=13 N_{end}=13 TPS=Chronic	E: Botulinum toxin A (190-320U) + AFO C: Botulinum toxin A (190-320U) Duration: 4mo	• Modified Ashworth Scale (+exp) • 10-Metre Walk Test (-) • Baropodometric footprint changes (+exp) • Baropodometric changes in time of full load (+exp)
Botulinum Toxin A with Casting or Taping		
Carda et al. (2011) RCT crossover (7) N_{start}=69 N_{end}=67 TPS=Chronic	E1: Botulinum toxin A (100U) + Serial casting + stretching and gait training E2: Botulinum toxin A (100U) + Taping + stretching and gait training E3: Botulinum toxin A (100U) + stretching and gait training Duration: 1wk of serial casting, or 5d of taping, or 30 min, 2sessions/d, 1wk of stretching, then 30min gait training + 20 min stretching, 1session/d, 1wk.	E1 vs E2 • Modified Ashworth Scale (+exp1) • 6min walking test (-) • 10-meter walk test (-) • Functional Ambulation category (-) • Strength of ankle dorsal flexors (-) • Passive range of motion - ankle (-) E1 vs E3 • Modified Ashworth Scale (+exp1) • 6min walking test (-) • 10-meter walk test (-) • Functional Ambulation category (-) • Strength of ankle dorsal flexors (-) • Passive range of motion - ankle (+exp1) E2 vs E3 • Modified Ashworth Scale (-) • 6min walking test (-) • 10-meter walk test (-) • Functional Ambulation category (-) • Strength of ankle dorsal flexors (-) • Passive range of motion - ankle (-)
Karadag-Saygi et al. (2010) RCT (7) N_{start}=20 N_{end}=20 TPS=Chronic	E: Botulinum toxin A (75-100U) + Kinesio Taping + home exercises C: Botulinum toxin A (75-100U) + Sham taping + home exercises Duration: 20min, 2sessions/d, 7d/wk, for 4wks rehabilitation	• Modified ashworth score (-) • Passive ankle dorsiflexion (-) • Step length (-) • 10-Meter walk Velocity (-)

Reiter et al. (1998)
RCT (5)
N_{start}=18
N_{end}=18
TPS=Chronic
	E: Botulinum toxin A (100U) injection into tibialis posterior + ankle-foot adhesive taping
	C: EMG-guided Botulinum toxin A (190-320U) injection into several calf muscles
	Duration: Single injection session & 1d/wk, for 3wks ankle-foot taping
		• Ankle passive ROM
		  ○ Dorsiflexion (+exp)
		  ○ Eversion (-)
		• Ankle Rest Position
		  ○ Foot extension (-)
		  ○ Foot inversion (-)
		• Modified Ashworth scale (-)
		• 10-Meter walk test (-)
		• Step length (-)

Botulinum Toxin A with Electrical Stimulation		
Baricich et al. (2019) RCT (7) N_{start}=30 N_{end}=30 TPS=Chronic	E: Botox Injections (50U-120U) + NMES of Antagonist and Injected Agonist Muscles C: Botox Injections (50U-120U) + NMES of Injected Agonist Muscles Duration: Physiotherapy 60min/d, 5d/wk, 2wks -	• 10-Meter Walk Test (-) • Modified Ashworth Scale (-) • Passive Range of Motion (-) • Medical Research Council (-) • 2-Minute Walk Test (-)

	Electrical Stimulation 60min, 1 session for agonist, 5 for antagonist	
Lannin et al. (2018) RCT (8) N_{start}=37 N_{end}=34 TPS=Chronic	E: Single dose of botulinum toxin-A (500U) + Intensive rehabilitation program (includes electrical stimulation, task-specific training and casting) C1: Single dose of botulinum toxin-A (500U) C2: Intensive rehabilitation program (includes electrical stimulation, task-specific training and casting) Duration: 1 dose botulinum toxin-A & 60min/d, 2d/wk, for 8wks rehabilitation program	E vs C1 vs C2 • 6-Minute Walk Test (-) • Tardieu Scale (-) • Goal Attainment Scale (-)
Botulinum Toxin A with FES		
Ding et al. (2017) RCT (6) N_{Start}=80 N_{End}=80 TPS=Subacute	E: Botulinum toxin A injection with spasmodic muscle therapeutic instrument C: Botulinum toxin A injection Duration: 12wk follow-up	• Fugl-Meyer Assessment (+exp) • Modified Ashworth Scale (+exp) • Modified Barthel Index (+exp) • Walking Speed (+exp) • Step Size (+exp)
Baricich et al. (2008) RCT (6) N_{start}=23 N_{end}=23 TPS=Chronic	E1: Botulinum toxin A (500U) + FES E2: Botulinum toxin A (500U) + Taping E3: Botulinum toxin A (500U) + Stretching Duration: 30min/session, 2sessions/d, 5d FES & 5d taping & 30min/session, 2sessions/d for 7d stretching	E1 vs E2 vs E3 • Modified Ashworth Scale (-) • Passive Range of Motion (-) • Motor Action Potential (-) • Max Dorsiflexion Angle in Stance Phase (-)
Johnson et al. (2004) RCT (6) N_{start}=21 N_{end}=18 TPS=Subacute & Chronic	E: Botulinum toxin type A injection + FES + Conventional physiotherapy C: Conventional physiotherapy Duration: 1 injection (400U) each into gastrocnemius and tibialis posterior, 1/d, 7d/wk, for 12wks FES, 30-45min/d, 2-3d/wk, for 12wks PT	• Walking Speed (+exp) • Physiological Cost Index (+exp) • Modified Ashworth Scale (-) • Rivermead Motor Assessment (-) • SF-36 (-)
Botulinum Toxin A with TENS		
Picelli et al. (2014) RCT (6) N_{start}=30 N_{end}=30 TPS=Chronic	E1: Therapeutic ultrasound + Home exercises & conventional therapy E2: TENS + Home exercises & conventional therapy E3: Botulinum toxin A (200U) + Home exercises & conventional therapy Duration: 10min/d, 5d/wk for 2wks - Ultrasound, 15min/d, 5d/wk for 2wks - TENS, 1 injection session - Botulinum toxin A, 40min/d, 5d/wk for 2wks - Bobath training	E1 vs E2 • Modified Ashworth Scale (-) • Ankle passive range of motion (-) E1 vs E3 • Modified Ashworth Scale (+exp3) • Ankle passive range of motion (+exp3) E2 vs E3 • Modified Ashworth Scale (+exp3) • Ankle passive range of motion (+exp3)

Bayram et al. (2006) RCT (5) N_{start}=12 N_{end}=11 TPS=Chronic	E1: Low-dose Botulinum toxin (100U) + TENS C: High-dose Botulinum toxin (400U) + Sham electrical stimulation Duration: 30min, 6sessions/d, for 3d TENS	• Modified Ashworth Scale (-) • AROM-Ankle (-) • PROM-Ankle (-) • Global Assessment of Spasticity Scale (-) • Clonus Score (-) • Brace Wear Scale (-) • 10-Metre Walk Test (-) • Ankle Resting Position Angle (-)
Botox vs Neurotomy		
Bollens et al. (2013) RCT (8) N_{start}=16 N_{end}=16 TPS=Chronic	E1: Botulinum toxin (200U) E2: Neurotomy Duration: 6mo	• Modified Ashworth Scale (+exp2) • Stroke Impairment Assessment Scale (+exp2) • Passive Range of Motion (-) • 10-Metre Walk Test (-) • Medical Research Council (-)
Botox vs Phenol		
On et al. (1999) RCT (5) N_{start}=20 N_{end}=20 TPS=Chronic	E1: Botulinum Toxin A (400 U) E2: Phenol Duration: One session	• Ashworth Scale (+exp_1) • Achilles Tendon Response (+exp_1) • M-response (+exp_2) • H-reflex (-) • M:H ratio (-) • ATR:H ratio (+exp_2)
Kirazli et al. (1998) RCT (8) N_{start}=20 N_{end}=20 TPS=Chronic	E1: Botulinum toxin A (400U) E2: Phenol Duration: 12wks	• Ashworth Scale (+exp) • Global Assessment Scale (+exp)
Location of Injection		
Im et al. (2014) RCT (8) N_{start}=40 N_{end}=38 TPS=Chronic	E: Proximal gastrocnemius Botulinum toxin A injection 200U C: Distal gastrocnemius Botulinum toxin A injection 200U Duration: 1 200U injection, followed for 8wks	E vs C • Modified Ashworth Scale (-) • R1, angle of catch following a fast velocity stretch (-) • R2, passive range of movement following a slow velocity stretch (-) • Functional Ambulatory Category (-) • Modified Tardieu Scale (-) • Clonus Scale (-) • 10-meter walking test (s) (-) • ABILOCO (-) • Root mean square plantar flexion ○ Tibialis anterior (-) ○ Medial gastrocnemius (-) ○ Lateral gastrocnemius (-) • Root mean square dorsiflexion ○ Tibialis anterior (-) ○ Medial gastrocnemius (-) ○ Lateral gastrocnemius (-)
Childers et al. (1996) RCT (9) N_{start}=17 N_{end}=15 TPS=Chronic	E1: Botulinum toxin A (100U) in mid belly of the gastrocnemius + placebo injected in distal of popliteal fossa E2: Botulinum toxin A (100U) at distal to the popliteal fossa + placebo injected in mid belly Duration: 1 injection and follow-up at 4wks	• Ashworth Scale (-) • Fugl-Meyer Assessment (-) • Ankle passive Range of Motion (-) • 50-Feet Walk Test (-)
Dosage of Injection		

Gracies et al. (2017) RCT(7) N_{Start}=388 N_{End}=366 TPS=Chronic	E1: Single injection of abobotulinum toxin A (1000U) E2: Single injection of abobotulinum toxin A (1500U) C: Placebo Duration: Outcomes at 4wks post-injection	E1 vs C • Modified Ashworth Scale (-) • Physician Global Assessment (-) E2 vs C • Modified Ashworth Scale (+exp2) • Physician Global Assessment (-)
Li et al. (2017) RCT (6) N_{Start}=104 N_{End}=89 TPS=NR	E1: Low-dose/low-concentration Botulinum toxin A (BTX-A) E2: Low-dose/high-concentration BTX-A E3: High-dose/low-concentration BTX-A E4: High-dose/high-concentration BTX-A Duration: One session, Low dose (200U), High dose (400U), Low concentration (50U/mL), High concentration (100U/mL)	After 1wk E4 vs E1 vs E2 vs E3 • Modified Ashworth Scale (-) • 10-Meter Walk Test (-) • Holden Grading (-) • Visual Analogue Scale for Walking Function (-) • Timed Up and Go Test (-) After 12wk E4 vs E1 vs E2 vs E3 • Modified Ashworth Scale (+exp4) • 10-Meter Walk Test (+exp4) • Holden Grading (+exp4) • Visual Analogue Scale for Walking Function (-) • Timed Up and Go Test (+exp4)
Pimentel et al. (2014) RCT (6) N_{start}=26 N_{end}=21 TPS= Chronic	E1: Botulinum toxin A + Conventional Therapy (300U) E2: Botulinum toxin A + Conventional Therapy (100U) Duration: 40min/d, 4-5d/wk, for 12wks	• Modified Ashworth Scale (+exp1) • 10-Metre Walk Test (-) • Modified Functional Independence Measure (-)
Dunne et al. (2012) RCT (7) N_{start}=85 N_{end}=77 TPS=Chronic	E1: OnabotulinumtoxinA (200U) E2: OnabotulinumtoxinA (300U) C1: Placebo (10 ml normal saline) C2: Placebo (15 ml normal saline) Duration: single session, follow-up injection sessions after 12wk if required	E1 vs E2 • Ashworth scale (-) • Active ankle dorsiflexion motion (-) • Pain-VAS (-) • Physicians rating hypertonia scale (-) • Gait quality (-) • Reduced leg spasm (-) E1+E2 vs C1+C2 at 12 wks • Ashworth scale (-) • Active ankle dorsiflexion motion (+exp) • Pain-VAS (+exp) • Physicians rating hypertonia scale (+exp) • Gait quality (+exp) • Reduced leg spasm (+exp)
Mancini et al. (2005) RCT (7) N_{start}=45 N_{end}=45 TPS=Chronic	E1: Botulinum toxin A (167U) E2: Botulinum toxin A (322U) E3: Botulinum toxin A (540U) Duration: 4wks	E1 vs E2 • Modified Ashworth Scale (+exp2) • 10m Gait Velocity (+exp2) • Visual Analogue Scale Gait (+exp2) • Visual Analogue Scale Pain (-) E1 vs E3 • Modified Ashworth Scale (+exp3) • 10m Gait Velocity (+exp3) • Visual Analogue Scale Gait (-) • Visual Analogue Scale Pain (-) E2 vs E3 • Modified Ashworth Scale (-) • 10m Gait Velocity (+exp3) • Visual Analogue Scale Gait (-) • Visual Analogue Scale Pain (-)

Pittock et al. (2003) RCT (6) N_{start}=234 N_{end}=221 TPS=Chronic	E1: Botulinum toxin type A (500U) E2: Botulinum toxin type A (1000U) E3: Botulinum toxin type A (1500U) C: Placebo Duration: 1 session	E1/E2/E3 vs C • Modified Ashworth Scale (+exp1, +exp2, +exp3) • 2-Minute Walk Test (-) • Stepping Rate (-) • Step Length (-) • Rivermead Motor Assessment ○ Leg (-) ○ Trunk (-) • Range of Motion ○ Active (-) ○ Passive (-) • Subjective Pain Assessment – LE (-) • Adverse Events (-) • Decrease Requirement for Walking Aid (+exp2, +exp3)
Method of Injection Guidance		
Turna et al. (2020) RCT (4) N_{start}=40 N_{end}=40 TPS=Chronic	E1: Ultrasonography guided Botulinum toxin A (1000U) E2: Electrical stimulation guided Botulinum toxin A (1000U) Duration: One injection session	• Modified Ashworth Scale (-) • 10m Walk test (-) • Brunnstrom recovery stages (-) • Barthel index (-)
Picelli et al. (2012) RCT (6) N_{start}=49 N_{end}=47 TPS=Chronic	E1: Botulinum toxin A (200U) by ultrasonography E2: Botulinum toxin A (200U) by electrical stimulation E3: Botulinum toxin A (200U) by palpation Duration: 1 injection (200U)	E1 vs E2 • Modified ashworth scale (-) • Ankle passive range of motion (-) • Tardieu spasticity grade (-) • Tardieu spasticity angle (-) E1 vs E3 • Modified ashworth scale (-) • Ankle passive range of motion (+exp3) • Tardieu spasticity grade (-) • Tardieu spasticity angle (-) E2 vs E3 • Modified ashworth scale (+exp3) • Ankle passive range of motion (+exp3) • Tardieu spasticity grade (-) • Tardieu spasticity angle (-)
Botulinum Toxin with Task-Oriented Rehabilitation		
Roche et al. (2015) RCT (4) N_{start}=35 N_{end}=35 TPS=Chronic	E: Botulinum Toxin A Injection + Home-based task-oriented rehabilitation + Usual physiotherapy C: Botulinum Toxin A Injection Duration: 1 injection session – Botulinum toxin A, 30min/d, 7d/wk for 4wks – At-home task-oriented rehabilitation	• Medical research counsel scale (-) • Modified Ashworth Scale (-) • ABILOCO (-) • 10m Walk test (+exp) • Timed Up and Go (-) • 6min Walk test ○ Modified (+exp) ○ With obstacles (+exp) ○ Without obstacles (-) • Stairs test ○ Ascending (-) ○ Descending (-)
Botox Combined with Robotics vs Botox and Conventional Therapy		
Erbil et al. (2018) RCT (5) N_{start}=48 N_{end}=43 TPS=Chronic	E: Botulinum toxin A (BoNTA) + Robot assisted Gait Training (RoboGait) + Conventional Physiotherapy C: Botulinum toxin A (BoNTA) + Conventional Physiotherapy Duration:	• Timed up-and-go (+exp) • Berg Balance Scale (+exp) • Rivermead Visual Gait Assessment (+exp) • Modified Ashworth Scale (-) • Tardieu Scale (-) • Passive range of motion (-)

	E: 30min Robot-assissted training + 60min physical therapy 1session/d, 5d/wk, for 3wks C: 90min physical therapy 1session/d, 5d/wk, for 3wks	
Picelli et al. (2016) RCT (8) N_{start}=22 N_{end}=22 TPS=Chronic	E: Botox (250U) With Robot-Assisted Gait Therapy C: Botox Alone Duration: 1 injection - AbobotulinumtoxinA injection, 30min/d, for 5d - Robot-assisted Gait training	• Modified Ashworth scale (-) • Tardieu scale ○ Spasticity Grade (-) ○ Spasticity Angle (-) • 6-Minute Walk Test (+exp)
Botulinum Toxin A + EMG Biofeedback Treatment + Conventional Care vs Botulinum Toxin A + Conventional Care		
Chen et al. (2015) RCT (4) N_{start}=36 N_{end}=36 TPS=Subacute	E: Botulinum Toxin A injection (under ultrasound guidance) + EMG biofeedback treatment + conventional care C: Botulinum Toxin A injection (under ultrasound guidance) + conventional care Duration: 20min/d, 5d/wk, for 6wks biofeedback & single session botulinum toxin-A nerve block	• Modified Ashworth Scale (+exp) • Step Length (+exp) • Walking speed (+exp)
Comparison of Timing of Botox Administration		
Oh et al. (2018) RCT (5) N_{start}=28 N_{end}=28 TPS=Mixed	E1: Botox (200 units of BT-A) Early (140 Days Post Stroke) E2: Botox (200 units of BT-A) Middle (247 Days Post Stroke) E3: Botox (200 units of BT-A) Late (537 Days Post Stroke) Duration: 4 (2 medial, 2 lateral) Injections given 1x in Gastrocnemius at varying phases post-stroke	E1 vs E2 vs E3 • Modified Ashworth Scale (-) • R1 angle of catch following fast-velocity stretch (-) • R2 passive range of movement following a slow-velocity stretch (-) • ABILOCO, a measure of locomotion ability (-) • Functional Ambulatory Category (-)
Forward vs Backward Treadmill Training with Botulinum Toxin		
Munari et al. (2020) RCT (8) N_{start}=18 N_{end}=18 TPS=Chronic	E: Backward treadmill training + botulinum toxin type A therapy C: Standard forward treadmill training + botulinum toxin type A therapy Duration: 40min/d, 3d/wk, for 4wks	• 10-meter walking test (+exp) • Modified Ashworth scale (-) • Gait analysis ○ Step length (-) ○ Stride length (-) ○ Cadence (-) • Stabilometric assessment ○ Length CoP eyes open (+exp) ○ Sway area eyes open (+exp) ○ Length CoP eyes closed (+exp) ○ Sway area eyes closed (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; FES=functional electrical stimulation; H=hours; Min=minutes; RCT=randomized controlled trial; TENS=transcutaneous electrical nerve stimulation; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Botulinum Toxin Interventions

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Botulinum toxin A** may produce greater improvements in motor function compared to **placebo**.	2	Tao et al. 2015; Burbaud et al. 1996
2	**Botulinum toxin A using ultrasound guidance and AFO** may produce greater improvements in motor function than **botulinum toxin A alone or conventional rehabilitation**.	1	Ding et al. 2015
1b	**Botulinum toxin A with FES** may not have a difference in efficacy compared to **conventional therapy** for improving motor function.	1	Johnson et al. 2004
1b	**Botulinum toxin A with FES** may produce greater improvements in motor function compared to **Botulinum toxin A alone**.	1	Ding et al. 2017
1b	**Botox injection in mid belly of the gastrocnemius with placebo injection in distal popliteal fossa** may not have a difference in efficacy compared to **Botox injection in distal popliteal fossa with placebo injection in mid belly of the gastrocnemius** for improving motor function.	1	Childers et al. 1996
1b	**High dose, moderate dose, and low dose Botulinum toxin A** may not have a difference in efficacy compared to **placebo** for improving motor function.	1	Pittock et al. 2003
2	**Ultrasound guided Botulinum toxin A** may not have a difference in efficacy compared to **electrical stimulation guided Botulinum toxin A** for improving motor function.	1	Turna et al. 2020

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Botulinum toxin A** may not have a difference in efficacy compared to **placebo** for improving functional ambulation.	8	Masakado et al. 2021; Kerzoncuf et al. 2020; Patel et al. 2020; Wein et al. 2018; Prazeres et al. 2018; Tao et al. 2015; Kaji et al. 2010; Burbaud et al. 1996
2	**Botulinum toxin A with AFO** may not have a difference in efficacy compared to **botulinum toxin A alone** for improving functional ambulation.	1	Farina et al. 2008
1b	**Botulinum toxin A with casting and stretching** may not have a difference in efficacy compared to **Botulinum toxin A with taping and stretching** for improving functional ambulation.	1	Carda et al. 2011

1b	**Botulinum toxin A with kinesio taping** may not have a difference in efficacy compared to **Botulinum toxin A with sham taping** for improving functional ambulation.	1	Karadag-Saygi et al. 2010
2	**Botulinum toxin A in tibialis posterior with adhesive taping** may not have a difference in efficacy compared to **Botulinum toxin A in several calf muscles** for improving functional ambulation.	1	Reiter et al. 1998
1b	**Botulinum toxin A with NMES of antagonist and agonist muscles** may not have a difference in efficacy compared to **Botulinum toxin with NMES of agonist muscles** for improving functional ambulation.	1	Baricich et al. 2019
1b	**Botulinum toxin A alone or with casting, electrical stimulation, and task-specific training** may not have a difference in efficacy compared to **botulinum toxin A only, casting, and electrical stimulation with task specific training** for improving functional ambulation.	1	Lannin et al. 2018
1b	**Botulinum toxin A with FES** may produce greater improvements in functional ambulation compared to **conventional therapy**.	1	Johnson et al. 2004
1b	**Botulinum toxin A with FES** may produce greater improvements in functional ambulation compared to **botulinum toxin A alone**.	1	Ding et al. 2017
2	**Low dose Botulinum toxin A with TENS** may not have a difference in efficacy compared to **high dose Botulinum toxin A with sham TENS** for improving functional ambulation.	1	Bayram et al. 2006
1b	**Botulinum toxin A** may not have a difference in efficacy compared to **neurotomy** for improving functional ambulation.	1	Bollens et al. 2013
1b	**Botulinum toxin A in the proximal gastrocnemius** may not have a difference in efficacy compared to **Botulinum toxin A in the distal gastrocnemius** for improving functional ambulation.	1	Im et al. 2014
1b	**Botulinum toxin A in mid belly of gastrocnemius with placebo in distal popliteal fossa** may not have a difference in efficacy compared to **Botulinum toxin A in distal popliteal fossa with placebo in mid belly** for improving functional ambulation.	1	Childers et al. 1996
1a	There is conflicting evidence about the effect of **high dose Botulinum toxin A** to improve functional ambulation when compared to **low dose Botulinum toxin A**.	2	Pimentel et al. 2014; Mancini et al. 2005
1b	There is conflicting evidence about the effect of **high dose Botulinum toxin A** to improve functional ambulation when compared to **placebo**.	1	Pittock et al. 2003

1b	**Low dose Botulinum toxin A** may not have a difference in efficacy compared to **placebo** for improving functional ambulation.	1	Pittock et al. 2003
1b	**High dose Botulinum toxin A** may produce greater improvements in functional ambulation compared to **moderate dose Botulinum toxin A**.	1	Mancini et al. 2005
1b	**Moderate dose Botulinum toxin A** may produce greater improvements in functional ambulation compared to **low dose Botulinum toxin A**.	1	Mancini et al. 2005
1b	There is conflicting evidence about the effect of **moderate dose Botulinum toxin A** to improve functional ambulation when compared to **placebo**.	1	Pittock et al. 2003
1b	**Low dose/low concentration Botulinum toxin A** may not have a difference in efficacy compared to **low dose/high concentration or high dose/low concentration** for improving functional ambulation.	1	Li et al. 2017
1b	**High dose/high concentration Botulinum toxin A** may produce greater improvements in functional ambulation compared to **low dose/low concentration, low dose/high concentration, high dose/low concentration**.	1	Li et al. 2017
2	**Ultrasound-guided Botulinum toxin A** may not have a difference in efficacy compared to **electrical stimulation-guided Botulinum toxin A** for improving functional ambulation.	1	Turna et al. 2020
2	**Botulinum toxin A with home-based task-oriented rehabilitation** may not have a difference in efficacy compared to **Botulinum toxin A alone** for improving functional ambulation.	1	Roche et al. 2015
2	**Botulinum toxin A with EMG biofeedback and conventional care** may produce greater improvements in functional ambulation compared to **Botulinum toxin A with conventional care**.	1	Chen et al. 2015
1b	**Botulinum toxin A with robot-assisted gait training** may produce greater improvements in functional ambulation compared to **Botulinum toxin A alone**.	2	Erbil et al. 2018; Picelli et al. 2016
2	**Early, late, or middle time Botulinum toxin A,** may not have a difference in efficacy compared to **each other** for improving functional ambulation.	1	Oh et al. 2018
1b	**Backwards treadmill training with Botulinum toxin A** may produce greater improvements in functional ambulation compared to **forward treadmill training with Botulinum toxin A.**	1	Munari et al. 2020

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	**Botulinum toxin A** may not have a difference in efficacy compared to **placebo** for improving balance**.**	1	Kerzoncuf et al. 2020

2	**Botulinum toxin A under ultrasound guidance with AFO** may produce greater improvements in balance compared to **Botulinum Toxin A alone or conventional rehabilitation**.	1	Ding et al. 2015
2	**Botulinum toxin A with robot-assisted gait training** may produce greater improvements in balance compared to **Botulinum toxin A alone**.	1	Erbil et al. 2018
1b	**Backwards treadmill training with Botulinum toxin A** may produce greater improvements in balance compared to **forward treadmill training with Botulinum toxin A.**	1	Munari et al. 2020

GAIT			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	There is conflicting evidence about the effect of **Botulinum toxin A** to improve gait when compared to **placebo**.	4	Kerzoncuf et al. 2020; Tao et al. 2015; Dunne et al. 2012; Kaji et al. 2010
1b	**Botulinum toxin A with FES** may produce greater improvements in gait than **Botulinum toxin A alone**.	1	Ding et al. 2017
1b	**Botulinum toxin A with kinesio taping** may not have a difference in efficacy compared to **Botulinum toxin A with sham taping** for improving gait.	1	Karadag-Saygi et al. 2010
2	**Botulinum toxin A in tibialis posterior with adhesive taping** may not have a difference in efficacy compared to **Botulinum toxin A in several calf muscles** for improving gait.	1	Reiter et al. 1998
1b	**High dose Botulinum toxin A** may not have a difference in efficacy compared to **low dose Botulinum toxin A** for improving gait.	1	Dunne et al. 2012
1b	**High/low/moderate dose Botulinum toxin A** may not have a difference in efficacy compared to **placebo** for improving gait.	1	Pittock et al. 2003
2	**Botulinum toxin A with EMG biofeedback and conventional care** may produce greater improvements in gait compared to **Botulinum toxin A with conventional care**.	1	Chen et al. 2015
2	**Botulinum toxin A with robot-assisted gait training** may produce greater improvements in gait than **Botulinum toxin A alone**.	1	Erbil et al. 2018
1b	**Backwards treadmill training with Botulinum toxin A** may not have a difference in efficacy compared to **forward treadmill training with Botulinum toxin A** for improving gait.	1	Munari et al. 2020

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**

1a	There is conflicting evidence on the effect of **Botulinum toxin A** for improving activities of daily living compared to **placebo.**	6	Kerzoncuf et al. 2020; Patel et al. 2020; Esquenazi et al. 2019; Wein et al. 2018; Ward et al. 2014; Tao et al. 2015
2	**Botulinum toxin A under ultrasound guidance with AFO** may produce greater improvements in activities of daily living compared to **Botulinum toxin A alone or conventional rehabilitation**.	1	Ding et al. 2015
1b	**Botulinum toxin A with casting, electrical stimulation and task-specific training** may not have a difference in efficacy compared to **Botulinum toxin A alone or electrical stimulation with task-specific training and casting** for improving activities of daily living.	1	Lannin et al. 2018
1b	**Botulinum toxin A with FES** may produce greater improvements in activities of daily living compared to **Botulinum toxin A alone.**	1	Ding et al. 2017
1b	**High dose Botulinum toxin A** may not have a difference in efficacy compared to **low dose Botulinum toxin A** for improving activities of daily living.	1	Pimental et al. 2014
2	**Ultrasound guided Botulinum toxin A** may not have a difference in efficacy compared to **electrical stimulation guided Botulinum toxin A** for improving activities of daily living.	1	Turna et al. 2020

RANGE OF MOTION

LoE	Conclusion Statement	RCTs	References
1a	There is conflicting evidence on the effect of **Botulinum toxin A** for improving range of motion compared to **placebo.**	3	Kerzoncuf et al. 2020; Dunne et al. 2012; Burbaud et al. 1996
1b	**Botulinum toxin A with casting and stretching** may not have a difference in efficacy compared to **Botulinum toxin A with taping and stretching** for improving range of motion.	1	Carda et al. 2011
1b	**Botulinum toxin A with casting and stretching** may produce greater improvements in range of motion compared to **Botulinum toxin A with stretching.**	1	Carda et al. 2011
1a	**Botulinum toxin A with taping and stretching** may not have a difference in efficacy compared to **Botulinum toxin A with stretching** for improving range of motion.	2	Carda et al. 2011; Baricich et al. 2008
1b	**Botulinum toxin A with kinesio taping** may not have a difference in efficacy compared to **Botulinum toxin A with sham taping** for improving range of motion.	1	Karadag-Saygi et al. 2010

2	There is conflicting evidence on the effect of **Botulinum toxin A in tibialis posterior with adhesive taping** for improving range of motion compared to **Botulinum toxin A in several calf muscles.**	1	Reiter et al. 1998
1b	**Botulinum toxin A with NMES of antagonist and agonist muscles** may not have a difference in efficacy compared to **Botulinum toxin with NMES of agonist muscles** for improving range of motion.	1	Baricich et al. 2019
1b	**Botulinum toxin A with FES** may not have a difference in efficacy compared to **Botulinum toxin with taping/stretching** for improving range of motion.	1	Baricich et al. 2008
1b	**Botulinum toxin A** may produce greater improvements in range of motion compared to **therapeutic ultrasound.**	1	Picelli et al. 2014
1b	**Botulinum toxin A** may produce greater improvements in range of motion compared to **TENS.**	1	Picelli et al. 2014
2	**Low dose Botulinum toxin A with TENS** may not have a difference in efficacy compared to **high dose Botulinum toxin A with sham TENS** for improving range of motion.	1	Bayram et al. 2006
1b	**Botulinum toxin A** may not have a difference in efficacy compared to **neurotomy** for improving range of motion.	1	Bollens et al. 2013
1b	**Botulinum toxin A in proximal gastrocnemius** may not have a difference in efficacy compared to **Botulinum toxin A in distal gastrocnemius** for improving range of motion.	1	Im et al. 2014
1b	**Botulinum toxin A in mid belly of gastrocnemius with placebo in distal popliteal fossa** may not have a difference in efficacy compared to **Botulinum toxin A in distal popliteal fossa with placebo in mid belly** for improving range of motion.	1	Childers et al. 1996
1b	**High dose Botulinum toxin A** may not have a difference in efficacy compared to **low dose Botulinum toxin A** for improving range of motion.	1	Dunne et al. 2012
1b	**High/moderate/low dose Botulinum toxin A** may not have a difference in efficacy compared to **placebo** for improving range of motion.	1	Pittock et al. 2003
1b	**Ultrasound-guided Botulinum toxin A** may not have a difference in efficacy compared to **electrical stimulation-guided Botulinum toxin A** for improving range of motion.	1	Picelli et al. 2012
1b	**Palpation-guided Botulinum toxin A** may produce greater improvements in range of motion compared to **ultrasound-guided or electrical stimulation-guided Botulinum toxin A.**	1	Picelli et al. 2012

2	**Botulinum toxin A with robot-assisted gait training** may not have a difference in efficacy compared to **Botulinum toxin A** for improving range of motion.	1	Erbil et al. 2018
2	**Early, late, and moderate time Botulinum toxin A** may not have a difference in efficacy compared to **each other** for improving range of motion.	1	Oh et al. 2018

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Botulinum toxin A with casting and stretching** may not have a difference in efficacy compared to **Botulinum toxin A with taping and stretching** for improving muscle strength.	1	Carda et al. 2011
1b	**Botulinum toxin A with NMES of antagonist and agonist muscles** may not have a difference in efficacy compared **Botulinum toxin with NMES of agonist muscles** for improving muscle strength.	1	Baricich et al. 2019
1b	**Botulinum toxin A** may not have a difference in efficacy compared to **neurotomy** for improving muscle strength.	1	Bollens et al. 2013
2	**Botulinum toxin A with home-based task-oriented rehabilitation** may not have a difference in efficacy compared to **Botulinum toxin A alone.**	1	Roche et al. 2015

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Botulinum toxin A** may produce greater improvements in spasticity compared to **placebo**.	11	Masakado et al. 2021; Kerzoncuf et al. 2020; Patel et al. 2020; Esquenazi et al. 2019; Prazeres et al. 2018; Wein et al. 2018; Tao et al. 2015; Fietzek et al. 2014; Dunne et al. 2012; Kaji et al. 2010; Burbaud et al. 1996
2	**Botulinum toxin A under ultrasound guidance with AFO** may produce greater improvements in spasticity compared to **Botulinum toxin A or conventional rehabilitation.**	1	Ding et al. 2015
2	**Botulinum toxin A with AFO** may produce greater improvements in spasticity compared to **Botulinum toxin A alone.**	1	Farina et al. 2008
1b	**Botulinum toxin A with casting and stretching** may produce greater improvements in spasticity compared to **Botulinum toxin A with taping and stretching.**	1	Carda et al. 2011

1a	**Botulinum toxin A with taping and stretching** may not have a difference in efficacy compared to **Botulinum toxin A with stretching** for improving spasticity.	2	Carda et al. 2011; Baricich et al. 2008
1b	**Botulinum toxin A with kinesio taping** may not have a difference in efficacy compared to **Botulinum toxin A with sham taping** for improving spasticity.	1	Karadag-Saygi et al. 2010
2	**Botulinum toxin A in tibialis posterior with adhesive taping** may not have a difference in efficacy compared to **Botulinum toxin A in several calf muscles** for improving spasticity.	1	Reiter et al. 1998
1b	**Botulinum toxin A with NMES of antagonist and agonist muscles** may not have a difference in efficacy compared **Botulinum toxin with NMES of agonist muscles** for improving spasticity.	1	Baricich et al. 2019
1b	**Botulinum toxin A with casting, electrical stimulation, and task-specific training** may not have a difference in efficacy compared to **Botulinum toxin A alone** for improving spasticity**.**	1	Lannin et al. 2018
1b	**Botulinum toxin A with casting, electrical stimulation, and task-specific training** may not have a difference in efficacy compared to **electrical stimulation with casting and task-specific training** for improving spasticity**.**	1	Lannin et al. 2018
1b	**Botulinum toxin A** may not have a difference in efficacy compared to **electrical stimulation with casting and task-specific training** for improving spasticity**.**	1	Lannin et al. 2018
1b	**Botulinum toxin A with FES** may not have a difference in efficacy compared to **Botulinum toxin A with taping or stretching** for improving spasticity**.**	1	Baricich et al. 2008
1b	**Botulinum toxin A with FES** may not have a difference in efficacy compared to **conventional therapy** for improving spasticity**.**	1	Johnson et al. 2004
1b	**Botulinum toxin A with FES** may produce greater improvements in spasticity compared to **Botulinum toxin A.**	1	Ding et al. 2017
1b	**Botulinum toxin A** may produce greater improvements in spasticity compared to **therapeutic ultrasound.**	1	Picelli et al. 2014
1b	**Botulinum toxin A** may produce greater improvements in spasticity compared to **TENS.**	1	Picelli et al. 2014
2	**Low dose Botulinum toxin A with TENS** may not have a difference in efficacy compared to **high dose Botulinum toxin A with sham TENS** for improving spasticity**.**	1	Bayram et al. 2006
1b	**Neurotomy** may produce greater improvements in spasticity compared to **Botulinum toxin A**.	1	Bollens et al. 2013

1b	**Botulinum toxin A** may produce greater improvements in spasticity compared to **phenol**.	2	On et al. 1999; Kirazli et al. 1998
1b	**Botulinum toxin A in the proximal gastrocnemius** may not have a difference in efficacy compared to **Botulinum toxin A in the distal gastrocnemius** for improving spasticity**.**	1	Im et al. 2014
1b	**Botulinum toxin A in the mid belly of gastrocnemius and placebo in distal popliteal fossa** may not have a difference in efficacy compared to the **Botulinum toxin A in the distal popliteal fossa and placebo in the mid belly of gastrocnemius** for improving spasticity**.**	1	Childers et al. 1996
1a	There is conflicting evidence about the effect of **high dose Botulinum toxin A** for improving spasticity compared to **low dose Botulinum toxin A.**	3	Pimental et al. 2014; Mancini et al. 2005; Dunne et al. 2012
1a	**High dose Botulinum toxin A** may produce greater improvements in spasticity compared to **placebo**.	2	Gracies et al. 2017; Pittock et al. 2003
1a	There is conflicting evidence about the effect of **low dose Botulinum toxin A** for improving spasticity compared to **placebo.**	2	Gracies et al. 2017; Pittock et al. 2003
1b	**High dose Botulinum toxin A** may not have a difference in efficacy compared to **moderate dose Botulinum toxin A** for improving spasticity.	1	Mancini et al. 2005
1b	**Moderate dose Botulinum toxin A** may produce greater improvements in spasticity compared to **low dose Botulinum toxin A and placebo**.	1	Mancini et al. 2005
1b	**High dose/high concentration Botulinum toxin A** may produce greater improvements in spasticity compared to **low dose/low concentration, low dose/high concentration, high dose/low concentration**.	1	Li et al. 2017
1b	**Ultrasound-guided Botulinum toxin A** may not have a difference in efficacy compared to **electrical stimulation-guided Botulinum toxin A** for improving spasticity.	2	Turna et al. 2020; Picelli et al. 2012
1b	**Palpation-guided Botulinum toxin A** may not have a difference in efficacy compared to **ultrasound-guided Botulinum toxin A** for improving spasticity.	1	Picelli et al. 2012
1b	There is conflicting evidence about the effect of **electrical stimulation guided Botulinum toxin A** to improve spasticity when compared to **palpation guided Botulinum toxin A.**	1	Picelli et al. 2012
2	**Botulinum toxin A with home-based task-oriented rehabilitation** may not have a difference in efficacy compared to **Botulinum toxin A alone** for improving spasticity.	1	Roche et al. 2015
2	**Botulinum toxin A with EMG biofeedback and conventional care** may produce greater improvements in spasticity compared to **Botulinum toxin A with conventional care**.	1	Chen et al. 2015

1b	**Botulinum toxin A with robotic gait training** may not have a difference in efficacy compared **Botulinum toxin A alone** for improving spasticity.	2	Erbil et al. 2018; Picelli et al. 2016
2	**Early, middle time, or late administration of Botulinum toxin A administration** may not have a difference in efficacy compared to **each other** for improving spasticity.	1	Oh et al. 2018
1b	**Backwards treadmill training with Botulinum toxin A** may not have a difference in efficacy compared to **forward treadmill training with Botulinum toxin A** for improving spasticity.	1	Munari et al. 2020

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Neurotomy** may produce greater improvements in spasticity compared to **Botulinum toxin A**.	1	Bollens et al. 2013

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Botulinum toxin A** may produce greater improvements in quality of life compared to **placebo**.	4	Patel et al. 2020; Esquenazi et al. 2019; Wein et al. 2018; Kaji et al. 2010
1b	**Botulinum toxin A with FES** may not have a difference in efficacy compared to **Botulinum toxin A alone** for improving quality of life.	1	Johnson et al. 2004

Key Points

Botulinum Toxin A may be beneficial for improving motor function, spasticity, and quality of life.

The literature is mixed regarding the effect of botulinum Toxin A on activities of daily living, and range of motion.

Botulinum Toxin A adjuvant to rehabilitation physical trainings or electrical stimulations may be beneficial for improving balance, functional ambulation, and gait.

Higher doses of Botulinum Toxin A may be beneficial for improving functional ambulation.

The literature is mixed regarding the modalities, location and intensity of treatment of Botulinum Toxin A for improving other lower extremity outcomes after stroke. For more details, please see table 48.

Antispastic Drugs

Adopted from: https://www.indiamart.com/proddetail/baclofen-ip-20249295097.html

Antispastic drugs are used for spastic hypertonia of cerebral origin, usually in oral form, and often include baclofen and tizanidine. These non-selective agents mimic the effects of neurotransmitters in the central nervous system. Tolperisone is a centrally acting muscle relaxant that decreases the frequency and amplitude of action potentials in the membrane. Tizanidine and dantrolene are other oral medications used for management of spasticity. When oral medicines are not adequate, injections of intrathecal baclofen may also be used (Rushton et al., 2002).

Nine RCTs were found evaluating antispastic drug interventions for lower extremity motor rehabilitation. One RCT compared tolperisone to placebo (Stamenova et al., 2005). Three RCTs compared intrathecal baclofen to placebo (Creamer et al., 2018; Meythaler et al., 2001a; Meythaler et al., 1999). Two RCTs compared dantrolene to placebo (Katrak et al., 1992; Ketel & Kolb, 1984). One RCT compared tizanidine to baclofen (Medici et al., 1989). Two RCTs compared tizanidine to placebo (Maupas et al., 2004; Meythaler et al., 2001b).

The methodological details and results of all nine RCTs evaluating antispastic drug interventions for lower extremity motor rehabilitation are presented in Table 49.

Table 49. RCTs Evaluating Antispastic Drugs for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Tolperisone vs Placebo		
Stamenova et al. (2005) RCT (7) N_{start}=120 N_{end}=97 TPS=Chronic	E: Tolperisone hydrochloride (50mg tablets) C: Placebo Duration: 2 tablets/session, 3sessions/d - starting dose (working up to total dosage of 300-900mg/d), for 4wks	• Ashworth Scale (+exp) • 2min Walk Test (+exp) • Modified Barthel Index (+exp) • Safety ○ Physical Exam and Vital Signs (-) ○ Laboratory Screening (-) ○ ECG Test (-) ○ Adverse Events (-)
Intrathecal Baclofen vs Placebo		
Creamer et al. (2018) RCT (6) N_{start}=60 N_{end}=48 TPS=Chronic	E: Intrathecal Baclofen Pump + Conventional Physical Therapy C: Conventional Medical Management (including oral antispastic) + Conventional PT Duration: 21-25d run-in-phase & 6mo active trial phase.	• Ashworth Scale (+exp) • Functional Independence Measure (-) ○ Motor function (-) ○ Cognition (-)
Meythaler et al. (2001a) RCT (7) N_{start}=21 N_{end}=19 TPS=Chronic	E: Intrathecal baclofen (50µg) C: Placebo Duration: 50µg intrathecal baclofen daily for 1yr	• Modified Ashworth Scale (+exp) • Penn Spasm Frequency Scale (+exp) • Reflex Scale (+exp)
Meythaler et al. (1999) RCT Crossover (7) N_{start}=6 N_{end}=6 TPS=Chronic	E: Continuously intrathecally administered bolus injection of 50µg Baclofen C: Continuously intrathetcally administered bolus injection of normal saline. Duration: 3mth	• Modified Ashworth Scale (+exp)
Dantrolene vs Placebo		
Katrak et al. (1992) RCT (7) N_{start}=31 N_{end}=31 TPS=Chronic	E: Dantrolene (200mg) C: Placebo Duration: 50mg of Dantrolene (4doses/d) for 2wks	• Modified Ashworth Scale (-) • Barthel Index (-)
Ketel & Kolb (1984) RCT (4) N_{start}=18 N_{end}=14 TPS=Chronic	E: Dantrolene C: Placebo Duration: 25mg of Dantrolene, 2-3doses/d, for 6wks	• Clonus (+exp) • Resistance to passive movement scale (+exp) • Trunk muscle strength (+exp) • Lower extremity muscle strength (+exp) • Tendon reflex (+exp)
Tizanidine vs Baclofen		
Medici et al. (1989) RCT (6) N_{start}=30 N_{end}=25	E1: Tizanidine (8mg, titrated up to max 20mg) E2: Baclofen (20mg, titrated up to max 50mg)	• Ashworth Scale (-) • Muscle Spasms (-) • Clonus (-) • Muscle Strength (-)

TPS=Chronic	Duration: Continued at optimal dose for 30wks maintenance phase	• Functional Assessment Pedersen Scale (-) • Physician's Global Assessment of Clinical Changes (-) • Global Assessment of Antispastic Efficacy (-)
Tizanidine vs Placebo		
Maupas et al. (2004) RCT Crossover (6) N_{start}=14 N_{end}=14 TPS=Subacute	E: Tizanidine (150µg/kg) C: Placebo Duration: Single dose – 10d washout	• Hmax/Mmax (-) • H Reflex (+exp) • Modified Ashworth Score (+exp)
Meythaler et al. (2001) RCT Crossover (6) N_{start}=17 (9 stroke) N_{end}=15 TPS=Chronic	E: Tizanidine (12-36mg/d) C: Placebo Duration: 12-36mg/d, 7d/wk, for 6wks – 1wk washout	• Ashworth Scale ○ Lower Extremity (+exp) ○ Upper Extremity (+exp) • Penn Spasm Frequency Scale (-) • Tendon Reflex Scale (-) • Range of Motion (-) • Functional Independence Measure – Motor Scale (-) • Craig Handicap Assessment and Reporting Technique (-) • Adverse Events (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Antispastic Drugs

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Tolperisone** may produce greater improvements in activities of daily living compared to **placebo**.	1	Stamenova et al. 2005
1b	**Intrathecal baclofen** may not have a difference in efficacy compared to **placebo or conventional care** for improving activities of daily living.	1	Creamer et al. 2018
1b	**Dantrolene** may not have a difference in efficacy compared to **placebo** for improving activities of daily living.	1	Katrak et al. 1992
1b	**Tizanidine** may not have a difference in efficacy compared to **placebo** for improving activities of daily living.	1	Meythaler et al. 2001

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Tolperisone** may produce greater improvements in functional ambulation compared to **placebo**.	1	Stamenova et al. 2005

RANGE OF MOTION			
LoE	**Conclusion Statement**	**RCTs**	**References**

1b	**Tizanidine** may not have a difference in efficacy compared to **placebo** for improving range of motion.	1	Meythaler et al. 2001

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Tolperisone** may produce greater improvements in spasticity compared to **placebo**.	1	Stamenova et al. 2005
1a	**Intrathecal baclofen** may produce greater improvements in spasticity compared to **placebo or conventional care**.	2	Creamer et al. 2018; Meythaler et al. 2001
1b	**Dantrolene** may produce greater improvements in spasticity compared to **placebo**.	2	Katrak et al. 1992; Ketel & Kolb 1984
1b	**Tizanidine** may not have a difference in efficacy compared to **baclofen** for improving spasticity.	1	Medici et al. 1989
1a	There is conflicting evidence about the effect of **tizanidine** to improve spasticity compared to **placebo.**	2	Maupas et al. 2004; Meythaler et al. 2001

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
2	**Dantrolene** may produce greater improvements in muscle strength compared to **placebo**.	1	Ketel & Kolb 1984
1b	**Tizanidine** may not have a difference in efficacy compared to **baclofen** for improving muscle strength.	1	Medici et al. 1989

Key Points

The literature is mixed regarding antispastic drug intervention for improving functional ambulation, and muscle strength after stroke.

antispastic drugs may not be beneficial for improving activities of daily living after stroke.

Some antispastic drugs (not Tizanidine) may be beneficial for improving spasticity. For more details about the types of drugs, please see table 49.

Cerebrolysin

Adopted from: http://www.gerovitalshop.eu/it/home/18-cerebrolysin-5ml.html

Cerebrolysin is a medication that is a mixture of distinct swine brain-derived peptides that have shown similar pharmacodynamic properties with endogenous neurotrophic factors (Plosker & Gauthier, 2009). It has shown neuroprotective effects both *in vitro* and in neurodegenerative animal models (Plosker & Gauthier, 2009). In humans, there has been some conflicting evidence, but some studies suggest it could help with cognitive rehabilitation in a number of neurological conditions (Ladurner et al., 2005; Zhang et al., 2015). These peptides could act on the molecular level to also help improve motor outcomes in the lower extremity (Chang et al., 2016).

One RCT was found that evaluated cerebrolysin for lower extremity motor rehabilitation. This RCT compared cerebrolysin to a dosage matched placebo (Chang et al., 2016).

The methodological details and results for this RCT are presented in Table 50.

Table 50. RCTs Evaluating Cerebrolysin Intervention for Lower Extremity Motor Rehabilitation

Authors (Year) **Study Design (PEDro Score)** **Sample Size$_{start}$** **Sample Size$_{end}$** **Time post stroke category**	**Interventions** **Duration: Session length, frequency per week for total number of weeks**	**Outcome Measures** **Result (direction of effect)**
Chang et al. (2016) RCT (6) N_{start}=70 N_{end}=66 TPS=Acute	E: Cerebrolysin (30ml) + standard rehabilitation C: Placebo (100mL) + standard rehabilitation	• Fugl-Meyer Assessment (-) • Functional neuroimaging (-)

	Duration: 1dose/d, 21d injection & 3hr, 5d/wk, for 3wks standard rehabilitation	

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

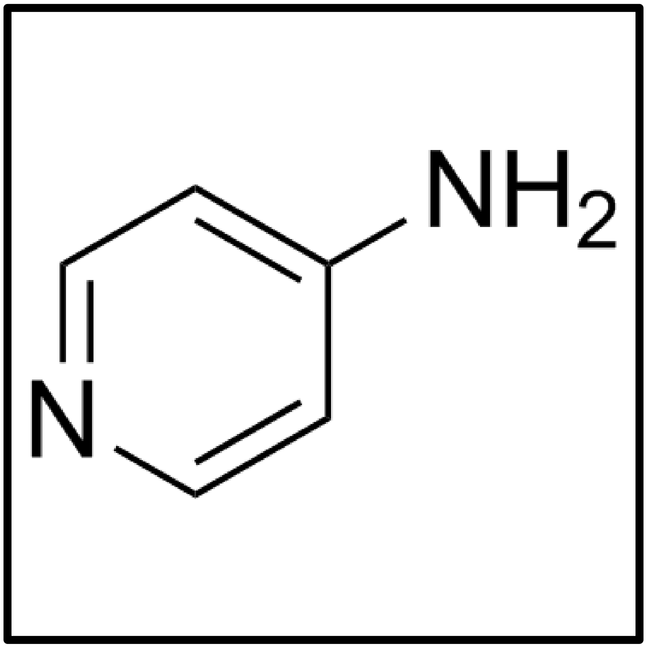
Conclusions about Cerebrolysin

MOTOR FUNCTION			
LoE	Conclusion Statement	RCTs	References
1b	**Cerebrolysin** may not have a difference in efficacy when compared to a **dosage matched placebo** for improving motor function.	1	Chang et al. 2016

Key Points

Cerebrolysin may not be beneficial for improving motor function.

4-Aminopyridine



Adopted from: https://www.adooq.com/4-aminopyridine.html

4-aminopyridine (fampridine, dalfampridine) is an organic pyridine that blocks the opening of intercellular potassium channels, ultimately prolonging neuronal repolarization (Simpson et al., 2015). This can increase neuron excitability and conduction strength, particularly in unmyelinated fibers. In mammalian motor neurons, it greatly potentiates the transmitter release at the unmyelinated neuromuscular junction (Sherratt et al., 1980). Although often used for the treatment of multiple sclerosis, its ability to improve neuromuscular signaling could prove effaceable for lower limb rehabilitation in stroke survivors as well.

Two RCTs were found that evaluated 4-aminopyridine for lower extremity motor rehabilitation. These RCTs compared 4-aminopyridine to a placebo (Page et al., 2020; Simpson et al., 2015).

The methodological details and results for the two RCTs are presented in Table 51.

Table 51. RCTs Evaluating 4-Aminopyridine Treatment for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Dalfampridine vs Placebo		
Page et al. (2020) RCT (6) N_{start}=377 N_{end}=368 TPS=Chronic	E: Dalfampridine-extended release (10mg) E2: Dalfampridine-extended release (7.5mg) C: Placebo Duration: 2doses/d for 12wks	E1/E2 v C • 2-minute Walk test (-) • 12-Item Multiple Sclerosis Walking Scale (-) • Timed Up-and-Go (-) • Adverse events (-)
Simpson et al. (2015) RCT crossover (5) N_{start}=83 N_{end}=70 TPS=Chronic	E: Dalfampridine (4-Aminopyridine) (10mg, 2doses/d) C: Placebo Duration: 2wk, 1 week washout	• 25-Feet Walk Test (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

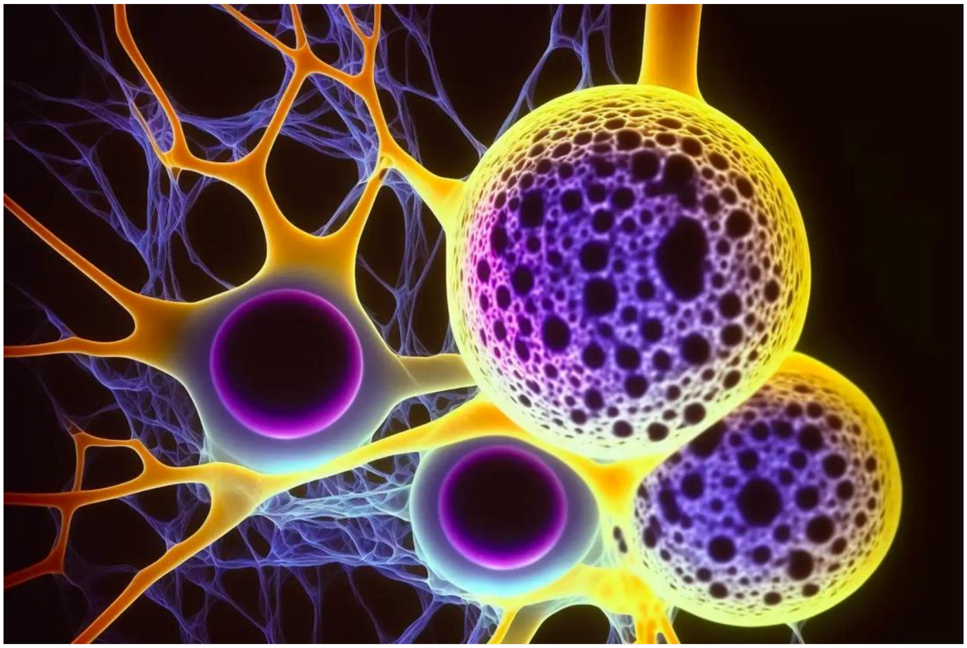
Conclusions about 4-Aminopyridine Treatment

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Dalfampridine** may not have a difference in efficacy compared to **dosage-matched placebo** for improving functional ambulation.	2	Page et al. 2020; Simpson et al. 2015

Key Points

4-aminopyridine may not be beneficial for improving functional ambulation.

Biologics and Targeted Molecular Therapies



Adopted from: https://www.dvcstem.com/post/stem-cell-therapy-stroke

Biologics and targeted molecular therapies may be effective for promoting motor recovery post stroke. Biologics are defined as drugs which are derived from living organisms or from their cells (Health Canada, 2019). Common examples of biologics include antibodies and insulin. In this chapter, targeted agents refer to compounds that act on specific biological pathways related to neural repair and recovery. There are many pathways for promoting recovery including mitochondrial, neurotrophic and oxygen regulation (Mocchetti, 2005; Russo et al., 2018). Overall, these agents aim to reduce neuronal damage and promote neuroplasticity.

There are no approved biologics for promoting stroke motor recovery (Lin et al., 2018). Despite this paucity of approved clinically approved agents, there remains investigations into the application of biological and targeted therapies.

Six RCTs were found evaluating biologics and targeted molecular therapies for lower extremity motor rehabilitation. One RCT compared granulocyte-colony stimulating factor to a placebo (England et al., 2012). One RCT compared ganglioside GM1 to a placebo (SASS Investigators, 1994). One RCT compared different doses of cutamesine to a placebo (Urfer et al., 2014). Two RCT compared mesenchymal stem cell injections to placebo or conventional therapy (Chung et al., 2021; Jaillard et al., 2020). One RCT compared neuronal cell injection to conventional therapy (Kondziolka et al., 2005).

The methodological details and results for the six RCTs evaluating biologics and targeted molecular interventions for lower extremity motor rehabilitation are presented in Table 52.

Table 52. RCTs Evaluating Alternative Pharmaceuticals for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Granulocyte-colony Stimulating Factor vs Placebo		
England et al. (2012) RCT (8) N$_{start}$=60 N$_{end}$=53 TPS=Acute	E: Granulocyte-colony Stimulating factor (GSF) C: Placebo Duration: 1/d for 5d	• National Institute of Health Stroke Severity (-) • Grip Strength (-) • Modified Rankin score (-) • Nottingham extended ADL (-) • Barthel index (-) • Mini-Mental state examination (-) • Zung Depression score (-) • Serious adverse events (-) • CD34/white blood cell count (+exp)
Ganglioside GM1 vs Placebo		
SASS investigators (1994) RCT (6) N$_{start}$=275 N$_{end}$=217 TPS=Acute	E: Ganglioside GM1 + Conventional care C: Placebo + Conventional care Duration: 100 mg IM/d, for 28d	• Toronto Stroke Scale ○ Total (-) ○ Motor (+exp) • Barthel Index (-) • Fugl Meyer Assessment Scale (-) • Neuropsychological battery (-)
Cutamesine vs Placebo		
Urfer et al. (2014) RCT (9) N$_{start}$=60 N$_{end}$=57 TPS=Acute	E1: Cutamesine (1mg) E2: Cutamesine (3mg) C: Placebo Duration: 1x/d for 28d	E1 vs C • NIH Stroke Scale (-) • 10m Walk test (-) • Modified Rankin scale (-) • Barthel index (-) • Geriatric Depression scale (-) E2 vs C • NIH Stroke Scale (+exp2) • 10m Walk test (-) • Modified Rankin scale (-) • Barthel index (-) • Geriatric Depression scale (-)
Mesenchymal Stem Cell Injection vs Placebo or Conventional Therapy		
Chung et al. (2021) RCT (7) N$_{start}$=60 N$_{end}$=54 TPS=Acute	E: One Intravenous Mesenchymal Stem cell injection + conventional management and rehabilitation C: Conventional management and rehabilitation Duration: One session bone marrow collection, 2-4wks cell culture, then one session MSC injection & mean of 30d rehabilitation	• Modified Rankin score (-) • Motricity index (-) • Fugl-Meyer assessment (-) • Functional Ambulatory category (-) • Modified Barthel Index (-)
Jaillard et al. (2020) RCT (8) N$_{start}$=31 N$_{end}$=31 TPS=Subacute	E: Mesenchymal stem cells IV injection + conventional physical therapy C: Conventional physical therapy Duration: 5d/wk, 3-6mo conventional therapy & 100-300 million MSCs single injection	• National institute of stroke scale (+exp) • Barthel index (-) • Modified rankin score (-) • Motor Fugl-Meyer Score (+exp) • FMRI-M14a (-) • FMRI-M14p (-)
Neuronal Cell vs Conventional Therapy		

Kondziolka et al. (2005) RCT (7) N_{start}=18 N_{end}=18 TPS=Chronic	E1: 5million implanted human neuronal cells + Conventional rehabilitation E2: 10million implanted human neuronal cells + Conventional rehabilitation C: Conventional rehabilitation Duration: Not Reported	E1/E2 vs C • European Stroke Scale (-) • National Institutes of Health Stroke Scale (-) • Stroke Impact Scale (-) • Fugl-Meyer Assessment (-) E1 vs E2 • National Institutes of Health Stroke Scale (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp₂ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Biologics and Targeted Molecular Therapies

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Ganglioside GM1** may not have a difference in efficacy when compared to **placebo** for improving motor function.	1	SASS investigators 1994
1a	There is conflicting evidence about the effect of **mesenchymal stem cell injection** to improve motor function compared to **placebo or conventional therapy.**	2	Chung et al. 2021; Jaillard et al. 2020
1b	**Neuronal cells** may not have a difference in efficacy when compared to **conventional therapy** for improving motor function.	1	Konziolka et al. 2005

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Cutamesine (1mg and 3 mg)** may not have a difference in efficacy compared to **placebo** for improving functional ambulation.	1	Urfer et al. 2014
1b	**Mesenchymal stem cell injections** may not have a difference in efficacy compared to **placebo or conventional therapy** for improving functional ambulation.	1	Chung et al. 2021

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Granulocyte-colony stimulating factor** may not have a difference in efficacy compared to **placebo** for improving activities of daily living.	1	England et al. 2012

1b	**Ganglioside GM1** may not have a difference in efficacy compared to **placebo** for improving activities of daily living.	1	SASS investigators 1994
1b	**Cutamesine (1mg and 3mg)** may not have a difference in efficacy compared to **placebo** for improving activities of daily living.	1	Urfer et al. 2014
1a	**Mesenchymal stem cell injection** may not have a difference in efficacy compared to **placebo or conventional therapy** for improving activities of daily living.	2	Chung et al. 2021; Jaillard et al. 2020

STROKE SEVERITY

LoE	Conclusion Statement	RCTs	References
1b	**Granulocyte-colony stimulating factor** may not have a difference in efficacy compared to **placebo** for improving stroke severity.	1	England et al. 2012
1b	There is conflicting evidence about the effect of **ganglioside GM1** to improve stroke severity compared to **placebo.**	1	SASS investigators 1994
1b	**Cutamesine (1mg)** may not have a difference in efficacy compared to **placebo** for improving stroke severity.	1	Urfer et al. 2014
1b	**Cutamesine (3mg)** may produce greater improvements in stroke severity compared to **placebo**.	1	Urfer et al. 2014
1b	**Mesenchymal stem cell injections** may produce greater improvements in stroke severity compared to **placebo or conventional therapy**.	1	Jaillard et al. 2020
1b	**Neuronal cells** may not have a difference in efficacy compared to **conventional therapy** for improving stroke severity.	1	Konziolka et al. 2005
1b	**5 million implanted neuronal cells** may not have a difference in efficacy compared to **10 million implanted neuronal cells** for improving stroke severity.	1	Konziolka et al. 2005

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1b	**Mesenchymal stem cell injections** may not have a difference in efficacy compared to **placebo or conventional therapy** for improving muscle strength.	1	Chung et al. 2021

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
1b	**Neuronal cells** may not have a difference in efficacy compared to **conventional therapy** for improving quality of life.	1	Konziolka et al. 2005

Key Points

Cutamesine may not be beneficial for improving functional ambulation, activities of daily living, and stroke severity after stroke.

Ganglioside GM1 may not be beneficial for improving motor function, and activities of daily living after stroke.

Neuronal cells may not be beneficial for improving motor function, stroke severity, and quality of life after stroke.

Mesenchymal stem cell injections may not be beneficial for improving motor function, functional ambulation, activities of daily living, and muscle strength after stroke.

Granulocyte-colony stimulating factor may not be beneficial for improving activities of daily living and stroke severity after stroke.

Anabolic Steroids

Adopted from: https://simhcottumwa.org/anabolic-steroids/

Anabolic steroids refer to molecular compounds derived from testosterone (Kuhn, 2002). These compounds promote anabolic effects including protein synthesis and muscle growth with negligible androgenizing effects (Mottram & George, 2000). Cerebrovascular accidents lead to reduced muscle function through decreased neural stimulation and activation impairment. To address this, anabolic steroids have been proposed as a possible addition to resistance training to counteract the significant loss in muscle mass and power in stroke survivors which can be as low as 60% of predicted in the lower limb (Patten et al., 2004; Shimodozono et al., 2010).

One RCT was found evaluating anabolic steroids for lower extremity motor rehabilitation. This RCT compared anabolic steroids to conventional therapy (Okamoto et al., 2011).

The methodological details and results for the one RCT evaluating anabolic steroid interventions for lower extremity motor rehabilitation are presented in Table 53.

Table 53. RCTs Evaluating Anabolic Steroid Injections Treatment for Lower Extremity Motor Rehabilitation.

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Okamoto et al. (2011) RCT (7) N_{start}=26 N_{end}=26 TPS=Subacute	E: Metenolone enanthate (Anabolic steroid) injection (100mg) + Usual therapy C: Usual therapy Duration: 1d/wk for 6wks - Steroid injection, 80-120min/d for 6wks - Usual therapy	• Cross Sectional Area (+exp) ○ Affected (+exp) ○ Unaffected (+exp)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Anabolic Steroid Injections

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Anabolic steroids** may produce greater improvements in muscle strength than **conventional therapy.**	1	Okamoto et al. 2011

Key Points

Anabolic steroids may be beneficial for improving muscle strength after stroke.

Supplements and Vitamins

Adopted from: https://www.flintrehab.com/vitamin-b12-stroke-recovery/

Nutrition, in addition to physical and cognitive focussed rehabilitation is critical in optimizing post-stroke recovery. Stroke survivors are at increased risk of developing dietary-related illnesses including sarcopenia and osteoporosis. Moreover, poor nutrition status may hinder gains in both physical and cognitive rehabilitation. Emerging evidence demonstrates that dietary supplements can be associated with better effectiveness of post-stroke rehabilitation as well as brain recovery (Zielińska-Nowak et al., 2021). Likewise, accumulating evidence points towards the effectiveness of vitamin supplementation on improving post-stroke motor recovery (Utkan Karasu & Kaymak Karataş, 2021). Common vitamins studied in post-stroke rehabilitation include Vitamin B, C and D (Lasoń et al., 2022).

Six RCTs were found evaluating dietary and vitamin supplements for lower extremity motor rehabilitation. One RCT compared dietary protein supplementation with cycle ergometer to carbohydrate supplementation with cycle ergometer (Cheng et al., 2020). One RCT compared leucine-enriched amino acid supplementation before exercise to leucine-enriched amino acid supplementation after exercise (Ikeda et al., 2020). One RCT compared leucine-enriched amino acid supplementation with resistance training to resistance training alone (Yoshimura et al., 2019). One RCT compared soy milk supplementation to placebo (Liao et al., 2019). One RCT compared vitamin to placebo (Momosaki et al., 2019). One RCT compared intensive nutritional supplementation to standard nutritional supplementation (Rabadi et al., 2008).

The methodological details and results for the six RCT evaluating dietary and vitamin interventions for lower extremity motor rehabilitation are presented in Table 54.

Table 54. RCTs Evaluating Vitamins and Supplements Treatment for Lower Extremity Motor Rehabilitation.

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Dietary Protein Supplement with Cycle Ergometer vs Carbohydrate Supplement with Cycle Ergometer		
Cheng et al. (2020) RCT (8) N_{start}=20 N_{end}=18 TPS=Chronic	E: Protein supplement + Cycle ergometer exercise C: Carbohydrate supplement + Cycle ergometer exercise Duration: 40min, 3d/wk, for 8wks exercise & 40gr supplement, 3d/wk, for 8wks	• Cardiopulmonary exercise test(+exp) • Timed up-and-go (+exp) • 6-minute walking test(+exp) • Berg Balance Scale(+exp) • Fugl-Meyer Assessment Lower Extremity (+exp) • Body composition changes • Body mass (+exp) • Fat mass (+exp) • Lean mass (+exp)
Leucine-enriched Amino Acid Supplementation		
Ikeda et al. (2020) RCT (7) N_{start}=46 N_{end}=40 TPS=Not Reported	E: Leucine-enriched Amino acid supplement at breakfast before exercise C: Leucine-enriched Amino acid supplement on afternoon after exercise Duration: 2 dose/d supplement & 40 min/d exercise, 7d/wk, for 8wks	• Grip strength (-) • Berg Balance scale (+exp) • Timed Up-and-Go test (-) • Functional independence measure (-) • Leg press strength (+exp) • Body fat mass (+exp) • Skeletal muscle mass (-)

Yoshimura et al. (2019)
RCT (6)
N_{start}=49
N_{end}=44
TPS=Acute
	E: Leucine enriched amino acid + resistance training + conventional therapy
	E: Resistance training + conventional therapy
	Duration: 1/d leucine, vitamin, carbohydrate supplement, for 8wks
		• Functional independence measure
		  ○ Motor (+exp)
		  ○ Cognitive (-)
		• Skeletal muscle mass index (+exp)
		• Handgrip strength (+exp)
		• Mini Nutritional Assessment-Short Form (-)
		• Protein Intake (-)
		• Energy intake (-)
		• Serum albumin (-)

Soymilk Supplementation vs Placebo		
Liao et al. (2019) RCT (7) N_{start}=16 N_{end}=16 TPS=Chronic	E: Soymilk + Conventional Rehabilitation C: Placebo + Conventional Rehabilitation Duration: 120min/d, 3d/wk, for 8wks conventional rehabilitation, 500ml (1 dose)/d, 3d/wk, for 8wks placebo/soymilk	• Hand Grip Strength (+exp) • 8-feet walking speed (+exp) • Walking performance per unit lean mass (+exp) • Lean Mass (-) • 6-minute walk test (+exp) • Short Physical Performance Battery (-)
Vitamin and comprehensive Dietary Supplementation		

Momosaki et al. (2019)
RCT (8)
N_{start}=100
N_{end}=100
TPS=Subacute
	E: Vitamin D2 supplementation (2000IU/day)
	C: Placebo
	Duration: 5pills/d, 7d/wk, for 8wks (2000IU/day)
		• Barthel Index (-)
		• Brunnstrom stage improved
		  ○ Arm (-)
		  ○ Hand (-)
		  ○ Leg (-)
		• Hand grip strength
		  ○ Right (-)
		  ○ Left (-)

		• Calf circumference ○ Right (-) ○ Left (-)
Rabadi et al. (2008) RCT (8) N_{start}=116 N_{end}=102 TPS=Acute	E: Intensive Nutritional Supplement Intervention (120 ml, 240 calories, 11g protein, 90mg Vitamin C) C: Standard Nutritional Supplement intervention (120 ml, 127 calories, 5g protein) Standard Nutritional Supplement intervention (120 ml, 127 calories, 5g protein) Duration: Every 8 hours, given 72 hours after intake, till discharge	• Functional independence measure (+exp) ○ Motor (+exp) ○ Cognitive (-) • 2-Minute Walk test (+exp) • 6-Minute Walk test (+exp) • Length of stay (-) • Discharge disposition (-) • Weight gain (-) • Rates of healing pressure sores (-)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
$+exp_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Supplements and Vitamins

FUNCTIONAL AMBULATION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Dietary protein supplement with cycle ergometer** may produce greater improvements to functional ambulation than **carbohydrate supplement with cycle ergometer.**	1	Cheng et al. 2020
1b	**Soymilk supplementation** may produce greater improvements in functional ambulation than **placebo.**	1	Liao et al. 2019
1b	**Intensive nutritional supplementation** may produce greater improvements in functional ambulation than **standard nutritional supplementation.**	1	Rabadi et al. 2008
1b	**Leucine-enriched amino acid before exercise** may not produce greater improvements in functional ambulation than **leucine-enriched amino acid after exercise.**	1	Ikeda et al. 2020

BALANCE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Dietary protein supplement with cycle ergometer** may produce greater improvements to balance than **carbohydrate supplement with cycle ergometer.**	1	Cheng et al. 2020

1b	**Leucine-enriched amino acid before exercise** may produce greater improvements in balance than **leucine-enriched amino acid after exercise.**	1	Ikeda et al. 2020

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Dietary protein supplement with cycle ergometer** may produce greater improvements to motor function than **carbohydrate supplement with cycle ergometer.**	1	Cheng et al. 2020
1b	**Vitamin D2 supplementation** may not produce greater improvements in motor function than **placebo.**	1	Momosaki et al. 2019

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Intensive nutritional supplementation** may produce greater improvements in activities of daily living than **standard nutritional supplementation.**	1	Rabadi et al. 2008
1b	There is conflicting evidence on the effect of **leucine-enriched amino acid supplementation with resistance training** compared to **resistance training alone** for improving activities of daily living.	1	Yoshimura et al. 2019
1b	**Leucine-enriched amino acid before exercise** may not produce greater improvements in activities of daily living than **leucine-enriched amino acid after exercise.**	1	Ikeda et al. 2020
1b	**Vitamin D2 supplementation** may not produce greater improvements in activities of daily living than **placebo.**	1	Momosaki et al. 2019

FUNCTIONAL MOBILITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Leucine-enriched amino acid before exercise** may produce greater improvements in functional mobility than **leucine-enriched amino acid after exercise.**	1	Ikeda et al. 2020

MUSCLE STRENGTH			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Soymilk supplementation** may not produce greater improvements in muscle strength than **placebo.**	1	Liao et al. 2019

Key Points

Supplements may be beneficial for improving motor function and functional ambulation after stroke. For more details, please see table 54.

Complementary and Alternative Medicine

Acupuncture and Massage

Adopted from: https://www.mccaffreyhealth.com/acupuncture-for-chronic-pain/

The use of acupuncture has recently gained attention as an adjunct to stroke rehabilitation in Western countries even though acupuncture has been a primary treatment method in China for about 2000 years (Baldry, 2005). In China, acupuncture is an acceptable, time-efficient, simple, safe and economical form of treatment used to ameliorate motor, sensation, verbal communication and further neurological functions in post-stroke patients (Wu et al., 2002). According to Rabinstein and Shulman (2003), “Acupuncture is a therapy that involves stimulation of defined anatomic locations on the skin by a variety of techniques, the most common being stimulation with metallic needles that are manipulated either manually or that serve as electrodes conducting electrical currents”. There is a range of possible acupuncture mechanisms that may contribute to the health benefits experienced by stroke patients (Park et al., 2006). For example, acupuncture may stimulate the release of neurotransmitters (Han & Terenius, 1982) and have an effect on the deep structure of the brain (Wu et al., 2002). Lo et al. (2005) established acupuncture, when applied for at least 10 minutes, led to long-lasting changes in cortical excitability and plasticity even after the needle stimulus was removed. With respect to stroke rehabilitation, the benefit of acupuncture has been evaluated most frequently for pain relief and recovery from hemiparesis.

Also, meridian acupressure is a Chinese medicine treatment that involves placing needles on twelve strategic points of the body. These points are known as meridians and placing needles here helps to alleviate the blockage of energy (otherwise known as qi) (Yue et al., 2013).

45 RCTs were found evaluating acupuncture for lower extremity motor rehabilitation. 14 RCTs compared acupuncture to conventional therapy (Alexander et al., 2004; Bai et al., 2013; Chen et al., 2016; Gao et al., 2012; Johansson et al., 1993; Liu et al., 2016a; Mao et al., 2008; Na et al.,

2018; Park et al., 2005; Sanchez-Mila et al., 2018; Sze et al., 2002; Wang et al., 2020a; Wang et al., 2019a; Zhuangl et al., 2012). Three RCTs compared acupuncture to sham (Fink et al., 2004; Ghannadi et al., 2020; Li et al., 2014b). Two RCTs compared acupuncture to no treatment (Gosman-Hedstrom et al., 1998; Salom-Moreno et al., 2014). One RCT compared channel palpation guided acupuncture to traditional acupuncture (Luo et al., 2018). One RCT compared scalp acupuncture with robot assisted training to conventional therapy (Zhang et al., 2021a). Six RCTs compared scalp acupuncture to conventional therapy or other modalities (Hegyi & Szigeti, 2012; Liu et al., 2018; Wang et al., 2020b; Wang et al., 2018; Xiong et al., 2020; Zhu et al., 2013). One RCT compared auricular intradermal acupuncture to conventional therapy (Miao et al., 2020). Two RCTs compared acupuncture with manipulation to acupuncture (Liu et al., 2009; Zhao et al., 2009). One RCT compared eye acupuncture to body acupuncture (Lou et al., 2020). Five RCTs compared multifaceted alternative medicine approaches (Du & Liu, 2022; Shao et al., 2019; Shen et al., 2020; Wei et al., 2016; Zhang et al., 2017b). Eight RCTs compared massage and other integrated rehabilitation techniques (Chen et al., 2019a; Holt et al., 2019; Thanakiatpinyo et al., 2014; Yang et al., 2017; Ye et al., 2022; Zhang et al., 2013; Zhang et al., 2022b; Zheng et al., 2021). One RCT compared meridian acupressure to no acupressure (Yue et al., 2013).

The methodological details and results of all 45 RCTs are presented in Table 55.

Table 55. RCTs Evaluating Acupuncture Interventions for Lower Extremity Motor Rehabilitation.

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Acupuncture vs Conventional Therapy		
Wang et al. (2020) RCT (9) N_{start}=134 N_{end}=124 TPS=Subacute	E: Acupuncture + Conventional therapy C: Conventional therapy Duration: 45min/d, 6d/wk, for 4wks Conventional treatment & 6d/wk, for 4wks Acupuncture	E v C • Barthel Index (-) • Fugl-Meyer (+exp) ○ Upper limb (-) ○ Lower limb (+exp) • Gait analysis (not whole population) ○ Velocity (+exp) ○ Step length (+exp) ○ Cadence (+exp) ○ Step width (+exp) • Range of motion ○ Hip (+exp) ○ Knee (+exp) ○ Ankle (-) • Peak circumduction (+exp) • Peak hip hiking (+exp)
Wang et al. (2019) RCT (8) N_{start}=59 N_{end}=59 TPS=Subacute	E: Acupuncture + conventional therapy C: Conventional therapy Duration: 45min/d, 6d/wk, for 4wks conventional therapy ~20min/d, 6d/wk, for 4wks acupuncture	• Modified Ashworth Scale ○ Knee (+exp) ○ Ankle(+exp) • Short Intracortical Inhibition (+exp) • Hmax/Mmax (+exp) • Fugl-Meyer Lower Limb (+exp) • Barthel Index (-) • Motor Evoked Potential (+exp) • Integrated Electromyogram Overall (+exp)
Sanchez-Mila et al. (2018) RCT (7) N_{start}=26	E: Bobath + dry needling C: Bobath	• Modified modified ashworth scale (+exp) • Fugl-meyer scale ○ Motor (-) ○ Balance (+exp)

N_{end}=26 TPS=Not Reported	Duration: 60min/1session	○ Sensory (+exp) ○ Range of motion (+exp) ○ Joint pain (-) • Computerized dynamic posturography using SMART Equitest System (+exp)
Na et al. (2018) RCT (6) N_{start}=76 N_{end}=76 TPS=Acute	E: Chinese Traditional therapy (Bath in Chinese herbal medicine + Acupuncture with massage) + Conventional care C: Conventional care Duration: 1session/d, 7d/wk for 4wks - Chinese Traditional therapy (30min/d Traditional bath therapy + 30min/d Acupuncture and Massage); 40min/d for 4wks conventional care	• Fugl-Meyer assessment (+exp) • Modified Barthel index (+exp) • Neurological impairments (+exp) • Efficacy of treatment (+exp)
Chen et al. (2016) RCT (8) N_{start}=250 N_{end}=241 TPS=Acute	E: Acupuncture + conventional therapy C: Conventional therapy Duration: 120min/d, 6d/wk, for 3wks conventional rehabilitation & 30min/d, 6d/wk, for 3wks acupuncture	• National Institute of Health Stroke Scale (-) • Fugl-Meyer Assessment (-) • Mini mental state examination (-) • Montreal Cognitive Assessment (-)
Liu et al. (2016a) RCT (6) N_{start}=38 N_{end}=31 TPS=Acute	E: Acupuncture + conventional therapy C: Conventional therapy Duration: 1session/d, for 2wks (10-14 acupuncture sessions total)	• Fugl-Meyer Assessment (-) • Functional Independence Measure (-) • Modified Rankin Scale (-)
Bai et al. (2013) RCT (7) N_{start}=120 N_{end}=120 TPS=Subacute	E1: Acupuncture E2: Physiotherapy E3: Acupuncture + PhysiotherapyNI Duration: 30min/d, 6d/wk acupuncture & 45min/d, 6d/wk, for 4wks physiotherapy	E1 vs E2 vs E3 • Fugl-Meyer Assessment: (-) • Modified Barthel Index (-)
Gao et al. (2012) RCT (5) N_{start}=106 N_{end}=106 TPS=Acute	E1: Contra-lateral Needling (acupuncture on unaffected limbs) E2: Traditional acupuncture C: Convenional Care Duration: 45min/d, 30d	E1 vs E2 • Neurological Deficits Score (+exp1) • Modified Barthel Index (+exp1) • Fugl-Meyer Assessment (+exp1) E1/E2 vs C • Neurological Deficits Score (+exp1, +exp2) • Modified Barthel Index (+exp1, +exp2) • Fugl-Meyer Assessment (+exp1, +exp2)
Zhuang et al. (2012) RCT (7) N_{start}=295 N_{end}=274 TPS=Chronic	E1: Acupuncture E2: Acupuncture + Physiotherapy C: Physiotherapy based on Bobath approach Duration: 30min/d, 6d/wk, for 4wks acupuncture, 105min/d, 6d/wk, for 4wks PT/OT	E1 V E2 V C ; • Fugl-Meyer Assessment (-) • Barthel index (-) • Neurologic defect scale (-)

Mao et al. (2008) RCT (5) N_{start}=60 N_{end}=60 TPS=Acute	E: Acupuncture combined with modern therapy C: Conventional therapy Duration: 30min/d , 5d/wk, acupuncture, 1h/d, 5d/wk, Conventional therapy	• Fugl-Meyer assessment (+exp) • Modified Barthel index (+exp)
Park et al. (2005) RCT (8) N_{start}=116 N_{end}=98 TPS=Acute	E: Acupuncture + Conventional rehabilitation C: Sham acupuncture + Conventional rehabilitation Duration: 20min/d, 9-12d/2wks Acupuncture/Sham	• Motricity Index (-) • Barthel Index (-) • National Institute of Health Stroke Scale (-) • EQ-5D (-) • EQ-VAS (-) • Nottingham Extended ADL Score (-) • Ashworth Spasticity Scale (-) • 10-Metre Walk Test (-) • 9-Hole Peg Test (-) • Bedside Swallow Screening Test (+con)

Alexander et al. (2004)
RCT (6)
N_{start}=32
N_{end}=29
TPS=Subacute
	E: Acupuncture + conventional therapy
	C: Conventional therapy
	Duration: 3h/d, 6d/wk, mean 22d Conventional therapy, 30min/d, 7d/wk, for 2wks Acupuncture
		• Fugl-Meyer Assessment (-)
		  ○ Lower Extremity (+exp)
		• Functional Independence Measure (-)
		  ○ Tub/Shower Transfer Mobility (+exp)

Sze et al. (2002) RCT (8) N_{start}=106 N_{end}=92 TPS=Acute	E: Acupuncture + Standard treatment C: Standard treatment Duration: 30min/d, 2-5d/wk for 10wks Acupuncture, 95min/d, 2-5d/wk, for 10wks Standard treatment	• Fugl-Meyer Assessment (-) • Functional Independence Measure (-) • Barthel Index (-) • Abbreviated Mental Test (-) • National Institute of Health Stroke Scale (-)

Johansson et al. (1993)
RCT (5)
N_{start}=78
N_{end}=70
TPS=Acute
	E: Acupuncture + conventional rehabilitation
	C: Conventional rehabilitation
	Duration: 30min/d, 2d/wk, for 10wks
		• Balance (no stat)
		• Motor function (+exp)
		• Mobility (+exp)
		• Barthel Index (+exp)
		• Nottingham Health Profile
		  ○ Energy (+exp)
		  ○ Mobility (+exp)
		  ○ Emotion (+exp)
		  ○ Social Isolation (+exp)
		  ○ Pain (-)
		  ○ Sleep (-)

Acupuncture vs Sham		
Ghannadi et al. (2020) RCT (9) N_{start}=24 N_{end}=24 TPS=Chronic	E: Dry needling in gastrocnemius C: Sham needling Duration: 3 sessions/wk, for 1wk (48 hrs between sessions)	• Modified Ashworth Scale (+exp) • Timed Up-and-Go (+exp) • Single Leg Stance (+exp) • 10-Metre Walk Test (+exp) • Barthel Index (+exp) • Active Range of Motion (-) • Passive Range of Motion (+exp) • Muscle Architecture (+exp)
Li et al. (2014) RCT (8) N_{start}=263 N_{end}=238 TPS=Acute	E: Acupuncture ("Wang's Jiaji" acupoints) C: Sham acupuncture	• Modified Ashworth scale (+exp) • Fugl-Meyer assessment (+exp) • Modified Barthel index (+exp) • National Institute of Health Stroke Scale (-) • Stroke specialized Quality of Life (+exp) • Modified Rankin scale (+exp)

	Duration: 30min/d, 5d/wk, for 4wks	
Fink et al. (2004) RCT (6) N_{start}=25 N_{end}=25 TPS=Chronic	E: Verum acupuncture C: Placebo acupuncture Duration: 30min/d, 2d/wk for 4wks	• Modified Ashworth Scale (-) • Hmax/Mmax Ratio (+exp) • Clinical Global Impressions (+con) • 2-Minute Walk Test (-) • Rivermead Motor Assessment (-) • Step Length (-) • Cadence (-) • Goniometry (-) • Pain VAS (-) • Nottingham Health Profile (-) • Everyday Life Questionnaire (-) • Von Zerssen Depression Scale (-)
Acupuncture vs No Treatment		
Salom-Moreno et al. (2014) RCT (7) N_{start}=34 N_{end}=34 TPS=Chronic	E: Deep dry needling C: No treatment Duration: Single session	• Modified Ashworth scale (+exp) • Pressure Pain Sensitivity (+exp) • Baropodometric Scores of Forefoot ○ Support surface (unaffected/affected) (+exp) ○ Force distribution (unaffected/affected) (-) ○ Percentage of load (unaffected) (+exp) ○ Percentage of load (affected) (-) • Baropodometric Scores of Rearfoot ○ Support surface (affected) (+exp) ○ Support surface (unaffected) (-) ○ Force distribution (unaffected/affected) (-) ○ Percentage of load (unaffected/affected) (-) • Mean Pressure (unaffected/affected) (+exp) • Maximum Pressure (unaffected/affected) (-)
Gosman-Hedstom et al. (1998) RCT (7) N=104 N_{end}=82 TPS=Acute	E1: Superficial acupuncture E2: Deep acupuncture C: No acupuncture Duration: 1hr/d, 2d/wk for 10wks	• Barthel Index (-) • Sunnaas Index (-)
Channel Palpation Guided Acupuncture vs Traditional Acupuncture		
Luo et al. (2018) RCT (8) N_{start}=143 N_{end}=136 TPS=Subacute	E: Channel palpation guided Acupuncture C: Traditional acupuncture Duration: 30min/d, 5d/wk, for 6wks	• Fugl-Meyer assessment ○ Motor function (-) ○ Balance (-) • Stroke Specific Quality of Life (-) • NIH Stroke Scale (-)
Scalp Acupuncture and Robot Assisted Training vs Basic Treatment		
Zhang et al. (2021) RCT (6) N=231 N_{end}=212 TPS=Subacute	E1: Interactive Dynamic Scalp Acupuncture + lower-limb robot training (SA & LLRT simultaneously) + Basic Treatment	E1/E2 v C • Fugl-Meyer Lower Extremity (+exp1) • Berg balance scale (+exp1) • 6-minute walk test (+exp1) • Modified Barthel index (+exp1) • Stride frequency (+exp1, +exp2)

	E2: Scalp Acupuncture + lower-limb robot training (LLRT + SA separately) + Basic Treatment C: Scalp Acupuncture + Basic Treatment Duration: 30min/d, 6d/wk, for 8wks Interactive Dynamic Acupuncture & 30min/d, 6d/wk, for 8wks traditional acupuncture & 30min, 2sessions/d, 6d/wk, for 8wks combination therapy	• Step length (-) • Step width (-) • Affected side foot angle (-) • Passive range of motion affected side ○ Hip(+exp1) ○ Knee (+exp1) ○ Ankle (+exp1) E1 v E2 • Fugl-Meyer Lower Extremity (+exp1) • Berg balance scale (+exp1) • 6-minute walk test (+exp1) • Modified barthel index (+exp1) • Stride frequency (+exp1) • Step length (-) • Step width (-) • Affected side foot angle (+exp2) • Passive range of motion affected side ○ Hip(+exp1) ○ Knee (+exp1) ○ Ankle (+exp1)
Scalp Acupuncture vs Conventional Therapy or Other Modalities		
Wang et al. (2020) RCT (7) N_{start}=120 N_{end}=115 TPS=Acute	E: Scalp acupuncture + Standard care C: Standard care Duration: 30min/d, 6d/wk, for 14d	• Fugl-Meyer assessment (+exp) • National Institute of Health Stroke Scale (+exp) • Barthel Index (+exp) • Manual Muscle Test (+exp)
Xiong et al. (2020) RCT (7) N=72 N_{end}=70 TPS=Subacute	E: Standard rehabilitation + scalp acupuncture + cognitive training C: Standard rehabilitation + Sham scalp acupuncture + cognitive training Duration: 30min/d cognitive training & 3-4hrs/d acupuncture, 6d/wk, for 8wks & 90min/d standard rehabilitation	• Mini Mental State Examination (-) • Loewenstein Occupational Therapy Cognition Assessment (+exp) • Fugl-Meyer assessment (+exp) • Modified Activity of Daily Living Scale (+exp) • Serum levels of BDNF and NGF (+exp)
Liu et al. (2018) RCT (8) N_{start} =74 N_{end}=74 TPS=Acute	E: Electro-scalp acupuncture (ESA) + Body acupuncture C: Body acupuncture Duration: E: 30min/d, for 28ds with 1d rest every 7d for each method C: 30min/d, for 28ds with 1d rest every 7d	• NIH Stroke Scale (+exp) • Fugl-Meyer Assessment ○ Upper Extremity (+exp) ○ Lower Extremity (-) • Modified Barthel Index (+exp)
Wang et al. (2018) RCT (6) N_{start} =20	E: Rehabilitation training + Scalp-cluster acupuncture with electrical stimulation	• Fugl-Meyer assessment (+exp) • Modified Barthel Index (+exp) • Neurological deficit scale (-)

N_{end}=15 TPS=Subacute	C: Rehabilitation training + Scalp-cluster acupuncture Duration: 360min/d, 5d/wk, 4wks acupuncture & 30-45min/d, 5d/wk Rehabilitation training	
Zhu et al. (2013) RCT (8) N_{start}=188 N_{end}=181 TPS=Acute	E: body and scalp acupuncture + conventional rehabilitation C: conventional rehabilitation Duration: 240min/d, 5d/wk, 12wks conventional rehabilitation & 30min/d, 2-5d/wk, 12wks Acupuncture	• Fugl-Meyer ○ Upper Limb (-) ○ Lower Limb (-) • Barthel Index (-)
Hegyi et al. (2012) RCT (5) N_{start}=50 N_{end}=50 TPS=Acute	E: Yamamoto new scalp acupuncture + conventional therapy C: Conventional therapy Duration: E: Acupuncture 1d/mo, 2y + Standard rehabilitation: 3d/wk, 2y C: Standard rehabilitation: 3d/wk, 2y	• Barthel Index (+exp) • Rivermead Scale Index (+exp) • Visual Analogue Scale for general and physical status (+exp)
Auricular Intradermal Acupuncture vs Conventional Therapy		
Miao et al. (2020) RCT (6) N_{start}=42 N_{end}=41 TPS=Acute	E: Auricular intradermal acupuncture + routine acupuncture + conventional treatment C: Routine acupuncture + conventional treatment Duration: 60min/d, 6d/wk, for 1wk conventional training & 30min/d, 6d/wk, for 1wk routine acupuncture & 240min/d, 6d/wk, for 1wk auricular intradermal acupuncture	• Fugl-Meyer motor assessment ○ Lower extremity (+exp) ○ Upper extremity (+exp) ○ Flexor synergy movement of upper extremity (+exp) ○ Flexor synergy movement of lower extremity (+exp) ○ Extensor synergy movement of upper extremity (-) ○ Extensor synergy movement of lower extremity (+exp)
Acupuncture with Manipulation vs Acupuncture		
Liu et al. (2009) RCT (7) N_{start}=30 N_{end}=30 TPS=Subacute	E: Acupuncture + Needle twisting C: Acupuncture Duration: 20min	• Sit-to-Stand (+exp) • Centre of Gravity Displacement (+exp) • 6-Metre Walk Test (-) • Muscle strength of hip flexor; Paralyzed side (+exp); non-paralyzed side (-); • Muscle strength of knee extensor; Paralyzed side (+exp); non-paralyzed side (+exp)]
Zhao et al. (2009) RCT (6) N_{start}=131 N_{end}=120 TPS=Chronic	E: Acupuncture + Stimulating surface projection C: Acupuncture Duration: 20min/d, 7d/wk, for 4wks	• Fugl-Meyer Assessment (+exp) • Barthel Index (+exp) • Modified Ashworth Scale (+exp) • EMG activity (+exp)
Eye Acupuncture vs Body Acupuncture		

Lou et al. (2020) RCT (4) N_{start}=32 N_{end}=32 TPS=Subacute	E: Eye acupuncture + Routine rehabilitation C: Body acupuncture + Duration: Routine rehabilitation 80min/d, 5d/wk, for 4wks & Acupuncture treatment 30min/d, 5d/wk, for 4wks	• Step length (+exp) • Step pace (+exp) • Step frequency (-) • Joint angle (Ankle & knee) (+exp) • Centre of gravity lateral displacement (+exp) • Peak pressure values ○ 1st phalange AS (+exp) ○ 1st phalange HS (-) ○ Anterior foot (+exp) ○ Midfoot (-) ○ Heel AS (-) ○ Heel HS (+exp) • Total plantar impulse of the healthy side ○ Heel (+exp) ○ Midfoot (-) ○ Anterior foot (-) ○ 1st Phalange (-)
Multifaceted Alternative Medicine Approaches		
Du & Liu (2022) RCT (6) N_{start}=60 N_{end}=60 TPS=Acute	E: Acupoint Injection therapy with mecobalamin + Conventional therapy C: Conventional therapy Duration: 1session/d, 7d/wk for 2wks - acupoint therapy	• National Institute of Health Stroke Severity (-) • Fugl-Meyer assessment (-) • Modified Barthel Index (-)
Shen et al. (2020) RCT (4) N_{start}=35 N_{end}=35 TPS=Acute	E: Needle-pricking arch of foot, then Acupuncture therapy on upper limb + conventional therapy C: Acupuncture on lower and upper limbs + conventional therapy Duration: 30min/d, 6d/wk, for 1wk acupuncture & 30min/d, 6d/wk, for 1wk needle pricking	• Brunnstrom Recovery stage (+exp) • Fugl-Meyer Assessment-lower limb (+exp) ○ Reflex activity (-) ○ Flexor activity (+exp) ○ Extensor activity (+exp) ○ Voluntary movement with little to no synergy (+exp) ○ Out of synergy activity (-) ○ Normal reflex activity (-) ○ Coordination speed (+exp) • Active range of motion-lower limb ○ Ankle extension (+exp) ○ Ankle flexion (+exp) ○ Hip extension (+exp) ○ Hip flexion (+exp) • Modified Ashworth scale-lower limb ○ Ankle extension (-) ○ Ankle flexion (-) ○ Hip extension (-) ○ Hip flexion (+exp) • Manual Muscle test-lower limb ○ Hip flexion (+exp) ○ Hip extension (+exp) ○ Knee extension (+exp) ○ Knee flexion (+exp) ○ Ankle extension (+exp) ○ Ankle flexion (+exp)
Shao et al. (2019) RCT (5)	E: Fuzhengbutu acupuncture + moxibustion therapy + rehabilitation treatment	• Berg balance scale (+exp) • Persistent walking time (+exp) • Pause time (-)

N_{start}=57 N_{end}=57 TPS=Subacute	C: Rehabilitation treatment Duration: E: 30min acupuncture + 30 min rehabilitation/d, 5d/wk, for 4wks; C: 30min/d, 2sessions/d, 5d/wk, for 4wks rehabilitation training	
Zhang et al. (2017) RCT (8) N_{start}=240 N_{end}=233 TPS=Acute	E1: Neuronavigation-assisted aspiration + electroacupuncture E2: Neuronavigation-assisted aspiration E3: Electroacupuncture C: Conservative therapy Duration: 30min/session, 2sessions/d, for 8wks	E1 vs E2 • Fugl-Meyer Assessment (-) • Modified Ashworth Scale (+exp1) • Barthel Index (+exp1) E1 vs E3 • Fugl-Meyer Assessment (-) • Modified Ashworth Scale (+exp1) • Barthel Index (+exp1) E1 vs C • Fugl-Meyer Assessment (+exp1) • Modified Ashworth Scale (+exp1) • Barthel Index (+exp1) E2 vs E3 • Fugl-Meyer Assessment (-) • Modified Ashworth Scale (-) • Barthel Index (-) E2 vs C • Fugl-Meyer Assessment (+exp2) • Modified Ashworth Scale (+exp2) • Barthel Index (-) E3 vs C • Fugl-Meyer Assessment (+exp3) • Modified Ashworth Scale (+exp3) • Barthel Index (-)}
Wei et al. (2016) RCT (5) N_{start}=84 N_{end}=84 TPS=Subacute	E: Moxibustion with Conventional Rehabilitation C: Conventional Rehabilitation Duration: 45min/d, 5d/wk for 4wks – conventional rehabilitation & 23-30min/d, 5d/wk for 4wks Moxibustion therapy	• Brunnstrom Recovery Stages ○ Upper Limb (-) ○ Lower Limb (-) ○ Hand (+exp) • Modified Ashworth Scale (+exp) • Clinical Spasticity Index (+exp) • Fugl-Meyer Assessment-motor (+exp) • Barthel Index (+exp) • Patient Reported Outcome Scale (exp)
Massage and other integrated rehabilitation techniques		
Ye et al. (2022) RCT (8) N_{start}=48 N_{end}=41 TPS=Chronic	E: Baduanjin exercise training + Health education program C: Health education program Duration: 40min/d, 1d/mo, for 24wks Health education program & 40min/d, 3d/wk, for 24wks Baduanjin exercise training	• Fugl-Meyer Assessment (+exp) • Berg Balance Scale (+exp) • Manual Muscle Tests ○ Biceps brachii (-) ○ Triceps brachii (+exp) ○ Quadriceps femoris (+exp) ○ Hamstring tendon (+exp) • Modified Ashworth Scale (-) • % Stance (-) • % Swing (-) • % Double stance (-) • % Single limb support (-) • Step length (+exp) • Stride length (-) • Walking speed (+exp) • Cadence (+exp)

Zhang et al. (2022) RCT (8) N_{start}=160 N_{end}=160 TPS=Subacute	E: Liuzijue Qigong training (LQG) + Conventional Rehabilitation (CT) C: Conventional rehabilitation training + core stability training Duration: 45min/d, 5d/wk, for 2wks	• Berg Balance Scale (+exp) • Fugl-Meyer Assessment (-) • Maximum Phonation Time (+exp) • Modified Barthel Index (+exp) • Diaphragm thickness ○ Quiet breath (-) ○ Deep breath (-) • Diaphragm mobility ○ Quiet breath (+exp) ○ Deep breath (+exp) • Static open eye standing balance test ○ COP trajectory (+exp) ○ COP area (+exp) • Static closed eye standing balance test ○ COP trajectory (-) ○ COP area (-) • Static open eye sitting balance test ○ COP trajectory (+exp) ○ COP area (+exp) • Static closed eye sitting balance test ○ COP trajectory (-) ○ COP area (-)
Zheng et al. (2021) RCT (8) N_{start}=60 N_{end}=60 TPS=Acute	E: Conventional rehabilitation training with Liuzijue Qigong C: Respiratory relaxation training + conventional training Duration: 45min/d, 5d/wk, for 3wks	• Trunk Impairment Scale ○ Static sitting balance (+exp) ○ Dynamic sitting balance (+exp) ○ Coordination of trunk movement (+exp) • Maximum expiratory pressure (+exp) • Maximum inspiratory pressure (+exp) • Forced expiratory volume in the first second (-) • Forced vital capacity (-) • Peak expiratory flow (-) • Maximum expiratory mid-flow (-) • Diaphragmatic movement (-) • Change of intra-abdominal pressure (+exp) • Berg Balance Scale (-) • Modified Barthel Index (+exp)
Chen et al. (2019) RCT (5) N_{start}=72 N_{end}=68 TPS=Subacute	E: Mind-body interactive exercise program (Chan-Chuang qigong) + standard care C: standard care Duration: 15min/d, 10d n	• SF-12 ○ Mental (+exp) ○ Physical (+exp)
Holt et al. (2019) RCT crossover (7) N_{start}=12 N_{end}=12 TPS=Chronic	E: Chiropractic intervention C: Placebo chiropractic intervention Duration: Single session –1wk washout	• Absolute maximum force of contraction (+exp) • V-wave/M_{max} ratio (+exp) • H-reflex parameter (-)
Yang et al. (2017) RCT (9) N_{start}=90 N_{end}=79	E: Chinese massage therapy (Tui Na) + conventional rehabilitation C: Placebo-Tai Na + conventional rehabilitation	• Modified Ashworth Scale ○ Elbow Flexors (+exp) ○ Wrist Flexors (+exp) ○ Knee Flexors (+exp) ○ Knee Extensors (+exp)

TPS=Subacute	Duration: 20-25min/limb, 1session/d, 5d/wk, for 4wks massage therapy (Tui Na) & 80min/d, 5d/wk, for 4wks conventional rehabilitation	○ Other Six Muscle Groups (-) • Fugl-Meyer Assessment (-) • Modified Barthel Index (-)
Thanakiatpinyo et al. (2014) RCT (8) N_{start}=50 N_{end}=45 TPS=Chronic	E: Traditional Thai massage C: Conventional PT Duration: 60min/d, 2d/wk, for 6wks	• Modified Ashworth Scale (-) • Barthel Index (-) • Hospital Anxiety and Depression Scale (-) • Pictorial Quality of Life score (-)
Zhang et al. (2013) RCT (5) N_{start}=69 N_{end}=61 TPS=Acute	E: Integrated Rehabilitation Techniques of Traditional Chinese Medicine (acupuncture + massage) C: Conventional rehabilitation (Bobath neurodevelopmental treatment) Duration: E: 30min/d acupuncture + 30min/d massage, 7d/wk, for 3wks, C: 60min/d, 7d/wk, for 3wks	• Fugl-Meyer Assessment ○ Upper limb (-) ○ Lower limb (+exp) • National Institutes of Health Stroke Scale (+exp) • Barthel Index (-) • Modified Rankin Scale (-)
Meridian Acupuncture vs no Acupuncture		
Yue et al. (2013) RCT (6) N_{start}=78 N_{end}=71 TPS=Chronic	E: Acupressure C: No acupressure Duration: Not Specified	• Fugl-Meyer Assessment (+exp) • Barthel Index (+exp)

Abbreviations and table notes: ANOVA=analysis of variance; C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
$+exp_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Acupuncture and Massage Treatment

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Scalp acupuncture** may produce greater improvements in motor function than **conventional therapy.**	2	Wang et al. 2020; Xiong et al. 2020
1b	**Baduanjin exercise training with a health education program** may produce greater improvements in motor function than **a health education program.**	1	Ye et al. 2022
1b	**Interactive dynamic scalp acupuncture with lower-limb robot training** may produce greater improvements in motor function than **scalp**	1	Zhang et al. 2021

	acupuncture or scalp acupuncture with lower-limb robot training.		
1b	**Auricular intradermal acupuncture** may produce greater improvements in motor function than **conventional therapy.**	1	Miao et al. 2020
1b	**Scalp cluster acupuncture with electrical stimulation** may produce greater improvements in motor function than **scalp cluster acupuncture.**	1	Wang et al. 2018
1b	**Neuronavigation-assisted aspiration with electroacupuncture, neuronavigation-assisted aspiration alone, or electroacupuncture alone** may produce greater improvements in motor function than **conservative therapy.**	1	Zhang et al. 2017
2	**Needle-pricking the arch of the foot and acupuncture on upper limbs** may produce greater improvements in motor function than **acupuncture on lower and upper limbs.**	1	Shen et al. 2020
2	**Contra-lateral needling** may produce greater improvements in motor function than **traditional acupuncture.**	1	Gao et al. 2012
2	**Acupuncture with needle manipulation** may produce greater improvements in motor function than **acupuncture.**	1	Zhao et al. 2009
1b	**Meridian acupressure** may produce greater improvements in motor function compared to **no meridian acupressure**.	1	Yue et al. 2013
1a	There is conflicting evidence about the effect of **acupuncture** to improve motor function when compared to **conventional therapy.**	13	Wang et al. 2020; Wang et al. 2019; Sanchez-Milla et al. 2018; Na et al. 2018; Chen et al. 2016; Liu et al. 2016; Bai et al. 2013; Gao et al. 2013; Zhuang et al. 2012; Mao et al. 2008; Alexander et al. 2004; Sze et al. 2002; Sze et al. 2002
1a	There is conflicting evidence about the effect of **acupuncture** to improve motor function when compared to **sham stimulation.**	2	Li et al. 2014; Fink et al. 2004
1b	There is conflicting evidence on the effect of **massage and acupuncture** when compared to **conventional rehabilitation** for improving motor function.	2	Yang et al. 2017; Zhang et al. 2013
1b	There is conflicting evidence on the effect of **moxibustion** when compared to **conventional rehabilitation** for improving motor function.	1	Wei et al. 2016
1b	**Acupoint injection therapy with mecobalamin** may not produce greater improvements in motor function than **conventional therapy.**	1	Du & Liu 2022
1b	**Liuzijue Qigong training** may not produce greater improvements in motor function than **conventional care.**	1	Zhang et al. 2022
1b	**Scalp acupuncture with lower-limb robot training** may not produce greater improvements in motor function than **scalp acupuncture.**	1	Zhang et al. 2021

1b	**Electro-scalp acupuncture with body acupuncture** may not produce greater improvements in motor function than **body acupuncture.**	1	Liu et al. 2018
1b	**Channel palpitation guided acupuncture** may not produce greater improvements in motor function than **traditional acupuncture.**	1	Luo et al. 2018
1b	**Neuronavigation-assisted aspiration with electroacupuncture** may not produce greater improvements in motor function than **neuronavigation-assisted aspiration or electroacupuncture alone.**	1	Zhang et al. 2017
1b	**Neuronavigation-assisted aspiration** may not produce greater improvements in motor function than **electroacupuncture.**	1	Zhang et al. 2017
1b	**Body and scalp acupuncture** may not produce greater improvements in motor function than **conventional rehabilitation.**	1	Zhu et al. 2013

FUNCTIONAL AMBULATION

LoE	Conclusion Statement	RCTs	References
1b	**Baduanjin exercise training with a health education program** may produce greater improvements in functional ambulation than **a health education program.**	1	Ye et al. 2022
1b	**Interactive dynamic scalp acupuncture with lower-limb robot training** may produce greater improvements in functional ambulation than **scalp acupuncture or scalp acupuncture with lower-limb robot training.**	1	Zhang et al. 2021
1a	There is conflicting evidence on the effect of **acupuncture** when compared to **a sham condition** for improving functional ambulation.	3	Ghannadi et al. 2020; Park et al. 2005; Fink et al. 2004
1a	There is conflicting evidence on the effect of **acupuncture** when compared to **conventional therapy** for improving functional ambulation.	2	Park et al. 2005; Wang et al. 2020
1b	There is conflicting evidence on the effect of **acupuncture with manipulation** when compared to **acupuncture** for improving functional ambulation.	1	Liu et al. 2009
1b	**Scalp acupuncture with lower-limb robot training** may not produce greater improvements in functional ambulation than **scalp acupuncture.**	1	Zhang et al. 2021
1b	**Acupuncture with needle manipulation** may not have a difference in efficacy when compared to **acupuncture** for improving functional ambulation.	1	Liu et al. 2009

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References

2	**Yamamoto new scalp acupuncture** may produce greater improvements in functional mobility than **conventional therapy.**	1	Hegyi et al. 2012

BALANCE

LoE	Conclusion Statement	RCTs	References
1b	**Baduanjin exercise training with a health education program** may produce greater improvements in balance than **a health education program.**	1	Ye et al. 2022
1b	**Interactive dynamic scalp acupuncture with lower-limb robot training** may produce greater improvements in balance than **scalp acupuncture or scalp acupuncture with lower-limb robot training.**	1	Zhang et al. 2021
1b	**Acupuncture** may produce greater improvements in balance than **sham**.	1	Ghannadi et al. 2020
1b	**Acupuncture with needle manipulation** may produce greater improvements in balance than **acupuncture**	1	Liu et al. 2009
2	**Eye acupuncture** may produce greater improvements in balance than **body acupuncture.**	1	Lou et al. 2020
2	**Fuzhengbutu acupuncture with moxibustion therapy and standard care** may produce greater improvements in balance than **standard care.**	1	Shao et al. 2019
1a	**Liuzijue Qigong training** may not produce greater improvements in balance than **conventional care.**	2	Zhang et al. 2022; Zheng et al. 2021
1b	**Scalp acupuncture with lower-limb robot training** may not produce greater improvements in functional ambulation than **scalp acupuncture.**	1	Zhang et al. 2021

GAIT

LoE	Conclusion Statement	RCTs	References
1b	**Acupuncture** may produce greater improvements in gait than **conventional therapy.**	1	Wang et al. 2020
2	There is conflicting evidence on the effect of **eye acupuncture** when compared to **body acupuncture** for improving gait.	1	Lou et al. 2020
1b	**Baduanjin exercise training with a health education program** may not produce greater improvements in gait than **a health education program.**	1	Ye et al. 2022
1b	**Interactive dynamic scalp acupuncture with lower-limb robot training** may not produce greater improvements in gait than **scalp acupuncture or scalp acupuncture with lower-limb robot training.**	1	Zhang et al. 2021

1b	**Scalp acupuncture with lower-limb robot training** may not produce greater improvements in gait than **scalp acupuncture.**	1	Zhang et al. 2021
1b	**Acupuncture** may not produce greater improvements in gait than **sham stimulation**.	1	Fink et al. 2004

ACTIVITIES OF DAILY LIVING			
LoE	**Conclusion Statement**	**RCTs**	**References**
1a	**Liuzijue Qigong training** may produce greater improvements in activities of daily living than **conventional therapy.**	2	Zhang et al. 2022; Zheng et al. 2021
1a	**Yamamoto new scalp acupuncture** may produce greater improvements in activities of daily living than **conventional therapy.**	3	Wang et al. 2020; Xiong et al. 2020; Hegyi et al. 2012
1b	**Interactive dynamic scalp acupuncture with lower-limb robot training** may produce greater improvements in activities of daily living than **scalp acupuncture or scalp acupuncture with lower-limb robot training.**	1	Zhang et al. 2021
1b	**Electro-scalp acupuncture with body acupuncture** may produce greater improvements in activities of daily living than **body acupuncture.**	1	Liu et al. 2018
1b	**Scalp cluster acupuncture with electrical stimulation** may produce greater improvements in activities of daily living than **scalp cluster acupuncture.**	1	Wang et al. 2018
1b	**Neuronavigation-assisted aspiration with electroacupuncture** may produce greater improvements in activities of daily living than **conventional care, electroacupuncture, or neuronavigation-assisted aspiration.**	1	Zhang et al. 2017
1b	**Acupuncture with manipulation** may produce greater improvements in activities of daily living than **acupuncture.**	1	Zhao et al. 2009
1b	**Meridian acupressure** may produce greater improvements in activities of daily living compared to **no meridian acupressure**.	1	Yue et al. 2013
2	**Moxibustion** may produce greater improvements in activities of daily living than **conventional therapy**.	1	Wei et al. 2016
2	**Contra-lateral needling** may produce greater improvements in activities of daily living than **traditional acupuncture.**	1	Gao et al. 2012
1a	There is conflicting evidence about the effect of **acupuncture** to improve activities of daily living when compared to **sham stimulation**.	3	Ghannadi et al. 2020; Park et al. 2005; Li et al. 2014

1b	There is conflicting evidence about the effect of **neuronavigation-assisted aspiration** when compared to **conservative therapy** for improving activities of daily living.	1	Zhang et al. 2017
1b	There is conflicting evidence about the effect of **electroacupuncture** when compared to **conservative therapy** for improving activities of daily living.	1	Zhang et al. 2017
1b	**Acupuncture** may not have a difference in efficacy when compared to **no treatment** for improving activities of daily living.	1	Gossman-Hedstom et al. 1998
1a	**Acupuncture** may not have a difference in efficacy when compared to **conventional therapy** for improving activities of daily living.	12	Wang et al. 2020; Wang et al. 2019; Na et al. 2018; Liu et al. 2016; Bai et al. 2013; Gao et al. 2012; Zhuang et al. 2012; Mao et al. 2008; Park et al. 2005; Alexander et al. 2004; Sze et al. 2002; Johansson et al. 1993
1a	**Massage and acupuncture therapy** may not produce greater improvements in activities of daily living than **conventional care.**	3	Yang et al. 2017; Thanakiatpinyo et al. 2014; Zhang et al. 2013
1b	**Acupoint Injection therapy with mecobalamin** may not produce greater improvements in activities of daily living than **conventional care.**	1	Du & Liu 2022
1b	**Scalp acupuncture with lower-limb robot training** may not produce greater improvements in activities of daily living than **scalp acupuncture.**	1	Zhang et al. 2021
1b	**Neuronavigation-assisted aspiration** may not produce greater improvements in activities of daily living than **electroacupuncture.**	1	Zhang et al. 2017
1b	**Body and scalp acupuncture** may not produce greater improvements in activities of daily living than **conventional care.**	1	Zhu et al. 2013
1b	**Acupuncture** may not produce greater improvements in activities of daily living than **no treatment.**	1	Gossman-Hedstom et al. 1998

RANGE OF MOTION

LoE	Conclusion Statement	RCTs	References
1b	**Interactive dynamic scalp acupuncture with lower-limb robot training** may produce greater improvements in range of motion than **scalp acupuncture or scalp acupuncture with lower-limb robot training.**	1	Zhang et al. 2021
1b	**Acupuncture** may produce greater improvements in range of motion than **sham acupuncture.**	1	Ghannadi et al. 2020
2	**Needle-pricking on the arch of foot and acupuncture on the upper limb** may produce	1	Shen et al. 2020

	greater improvements in range of motion than **acupuncture on the lower and upper limbs.**		
1a	There is conflicting evidence about the effect of **acupuncture** to improve range of motion when compared to **conventional therapy**.	1	Wang et al. 2020
1b	**Scalp acupuncture with lower-limb robot training** may not produce greater improvements in range of motion than **scalp acupuncture.**	1	Zhang et al. 201

MUSCLE STRENGTH

LoE	Conclusion Statement	RCTs	References
1b	**Baduanjin exercise training with a health education program** may produce greater improvements in muscle strength than **a health education program.**	1	Ye et al. 2022
1b	**Scalp acupuncture** may produce greater improvements in muscle strength than **conventional care.**	1	Wang et al. 2020
1b	**Acupuncture with needle manipulation** may produce greater improvements in muscle strength than **acupuncture.**	1	Liu et al. 2009
2	**Needle-pricking on the arch of foot and acupuncture on the upper limb** may produce greater improvements in muscle strength than **acupuncture on the lower and upper limbs.**	1	Shen et al. 2020
1a	There is conflicting evidence about the effect of **Acupuncture** compared to **a sham condition** for improving muscle strength.	2	Park et al. 2005; Ghannadi et al. 2020
1b	**Acupuncture** may not have a difference in efficacy when compared to **conventional rehabilitation** for improving muscle strength.	1	Park et al. 2005

SPASTICITY

LoE	Conclusion Statement	RCTs	References
1b	**Moxibustion** may produce greater improvements in spasticity than **conventional therapy**.	1	Wei et al. 2016
1b	**Acupuncture** may improve spasticity when compared to **no treatment**.	1	Salom-Moreno et al. 2014
2	**Acupuncture with needle manipulation** may produce greater improvements in spasticity than **acupuncture.**	1	Zhao et al. 2009
1a	There is conflicting evidence about the effect of **acupuncture** to improve spasticity when compared to **sham stimulation.**	4	Ghannadi et al. 2020; Park et al. 2005; Fink et al. 2004; Li et al. 2014
1a	There is conflicting evidence about the effect of **acupuncture** to improve spasticity when compared to **conventional therapy.**	3	Wang et al. 2019; Park et al. 2005; Sanchez-Milla et al. 2018

1a	There is conflicting evidence about the effect of **massage and acupuncture therapy** when compared to **conventional care** for improving spasticity.	2	Yang et al. 2017; Thanakiatpinyo et al. 2014
1b	**Baduanjin exercise training with a health education program** may not produce greater improvements in spasticity than **a health education program.**	1	Ye et al. 2022
1b	**Channel palpitation guided acupuncture** may not produce greater improvements in spasticity than **traditional acupuncture.**	1	Luo et al. 2018
2	**Needle-pricking on the arch of foot and acupuncture on the upper limb** may not produce greater improvements in spasticity than **acupuncture on the lower and upper limbs.**	1	Shen et al. 2020

STROKE SEVERITY

LoE	Conclusion Statement	RCTs	References
1b	**Scalp acupuncture** may produce greater improvements in stroke severity than **conventional care.**	1	Wang et al. 2020
1b	**Electro-scalp acupuncture with body acupuncture** may produce greater improvements in stroke severity than **body acupuncture.**	1	Liu et al. 2018
2	**Massage and acupuncture therapy** may produce greater improvements in stroke severity than **conventional care.**	1	Zhang et al. 2013
2	**Contra-lateral needling** may produce greater improvements in stroke severity than **traditional acupuncture.**	1	Gao et al. 2012
1a	**Acupuncture** may not have a difference in efficacy when compared to **conventional therapy** for improving stroke severity.	5	Chen et al. 2016; Zhuang et al. 2012; Gao et al. 2012; Park et al. 2005; Sze et al. 2002
1a	**Acupuncture** may not have a difference in efficacy when compared to **sham stimulation** for improving stroke severity.	2	Li et al. 2014; Park et al. 2005
1b	**Acupoint injection therapy with mecobalamin** may not produce greater improvements in stroke severity than **conventional care.**	1	Du & Liu 2022
1b	**Scalp cluster acupuncture with electrical stimulation** may not produce greater improvements in stroke severity than **scalp cluster acupuncture.**	1	Wang et al. 2018

QUALITY OF LIFE

LoE	Conclusion Statement	RCTs	References
2	**Chan-Chuang Qigong** may produce greater improvements in quality of life than **standard care.**	1	Chen et al. 2019

1a	**Acupuncture** may not produce greater improvements in quality of life than **sham.**	3	Li et al. 2014; Park et al. 2005; Fink et al. 2004
1b	**Channel palpitation guided acupuncture** may not produce greater improvements in quality of life than **traditional acupuncture.**	1	Luo et al. 2018
1b	**Acupuncture** may not produce greater improvements in quality of life than **standard care.**	2	Park et al. 2005; Johansson et al. 1993

PROPRIOCEPTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Acupuncture** may produce greater improvements in proprioception than **no treatment.**	1	Salom-Moreno et al. 2014
1b	**Acupuncture** may not produce greater improvements in proprioception than **sham.**	1	Fink et al. 2004

Key Points

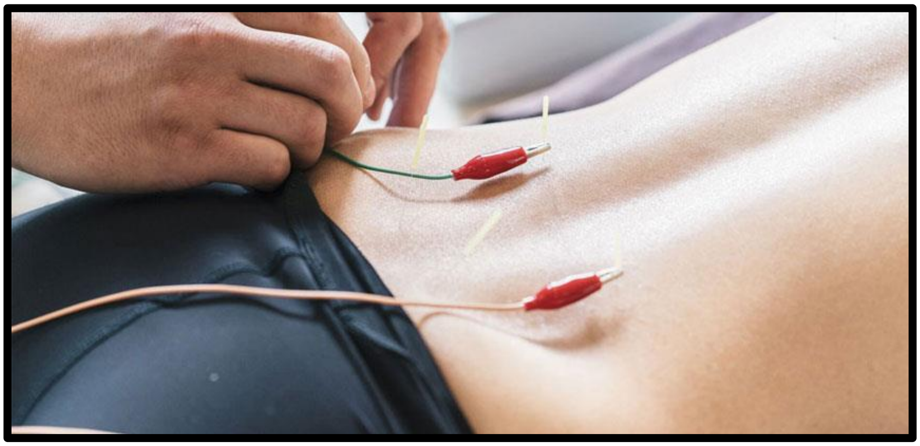
Acupuncture may be beneficial for improving balance, and range of motion after stroke, however the effect varied by the different modalities, for more details see table 55.

The literature is mixed regarding the use of acupuncture for improving motor function, functional ambulation, muscle strength, and spasticity after stroke.

Acupuncture may not be helpful for improving gait, activities of daily living, and stroke severity, and quality of life after stroke.

Meridian acupressure may be beneficial for improving balance and activities of daily living.

Electroacupuncture and Transcutaneous Electrical Acupoint Stimulation



Adopted from: https://www.promotionhealthcare.com/electroacupuncture-treatment-pain-injuries/

Electroacupuncture is a variant of acupuncture techniques practiced in traditional Chinese medicine, the difference being that a minute electrical current of similar intensity to that of a bioelectric current produced endogenously in the body is applied to the needles used (Wang et al., 2014a). The needle is often placed on meridian points throughout the body (Wang et al., 2014a). Similarly, transcutaneous electrical acupoint stimulation (TEAS) stimulates meridian points believed to be associated with a medical condition with electrical impulses given through needles (Zhao et al., 2015). The two techniques have very similar mechanisms of action and their influence on afferent stimulation to the body (Zhao et al., 2015).

Eight RCTs were found evaluating electroacupuncture and transcutaneous electrical acupoint stimulation for lower extremity motor rehabilitation. Four RCTs compared electroacupuncture to conventional therapy (Cai et al., 2021; Hsieh et al., 2007; Tan et al., 2013; Wong et al., 1999). Two RCTs compared electroacupuncture or TEAS to sham stimulation (Hopwood et al., 2008; Zhao et al., 2015). One RCT compared electroacupuncture to high and low frequency TENS (Johansson et al., 2001). One RCT compared electroacupuncture with Heparin to Heparin alone (Si et al., 1998).

The methodological details and results of all eight are presented in Table 56.

Table 56. RCTs Evaluating Electroacupuncture and Transcutaneous Electrical Acupoint Stimulation Interventions for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
Electroacupuncture vs Conventional Therapy		
Cai et al. (2021) RCT (7) N_{start}=30 N_{end}=25 TPS=Subacute	E: Electroacupuncture, usual care C: Usual care Duration: 20-30min/session, 3 sessions/wk, for 4wks	• Modified Ashworth Scale (-) • Fugl-Meyer Assessment (-) • Barthel Index (-)
Tan et al. (2013) RCT (7)	E: Electroacupuncture + Conventional medication	• Fugl Meyer Assessment (+exp)

N_{start}=63 N_{end}=61 TPS=Acute	C: Conventional medication Duration: 20min/d, 6d/wk, for 2wks	• National Institutes of Health Stroke Scale (+exp) • Triple stimulation technique amplitude ratio (+exp)
Hsieh et al. (2007) RCT (8) N_{start}=63 N_{end}=54 TPS=Acute	E: Electroacupuncture + conventional therapy C: Conventional therapy Duration: 20min/d, 2d/wk for 4wks	• Fugl-Meyer Assessment (+exp) ○ Lower extremity (-) ○ UE Motor Shoulder elbow (-) ○ Wrist (+exp) ○ Hand (+exp) ○ UE Coordination and speed (-) • Functional independence measure (-)
Wong et al. (1999) RCT (4) N_{start}=118 N_{end}=118 TPS=Acute	E: Electrical Acupuncture + Conventional Therapy C: Conventional therapy Duration: 30min/d, 5d/wk, for 2wks Electrical Acupuncture, 120min/d, 7d/wk Conventional Therapy	• Brunnstrom Recovery Stage (+exp) ○ Upper limb (+exp) ○ Lower limb (+exp) • Functional Independence Measure (+exp) ○ Self-care (+exp) ○ Sphincter (-) ○ Transfer (-) ○ Locomotion (+exp) ○ Communication (-) ○ Social interaction (-) ○ Cognition (+exp)
Electroacupuncture or TEAS vs Sham		
Zhao et al. (2015) RCT (9) N_{start}=60 N_{end}=54 TPS=Chronic	E1: High-intensity TEAS (100Hz) E2: Low-intensity TEAS (2Hz) C: Sham TEAS Duration: 30min/d, 5d/wk for 4wks	• Functional Ambulation Classification (-) • Modified Ashworth Scale (-) • Disability Assessment Scale (-) • Global Assessment Scale (-) • Barthel Index (-)
Hopwood et al. (2008) RCT (8) N_{start}=105 N_{end}=92 TPS=Acute	E: Electroacupuncture C: Sham TENS Duration: 30min/d, 3d/wk for 4wks	• Motricity Index (-) • Barthel Index (-) • Nottingham Health Profile: -Pain (-); -Energy level (+exp); -Emotional Reaction (-); -Sleep (-); -Social isolation (-); -Physical Activity (-)
Electroacupuncture vs High and Low Frequency TENS		
Johansson et al. (2001) RCT (8) N_{start}=150 N_{end}=138 TPS=Acute	E1: Electroacupuncture E2: High-intensity, low-frequency TENS (80Hz) C: Low-intensity, high-frequency TENS (2Hz) electrostimulation Duration: 30min/d, 2d/wk for 10wks	E1 vs E2 vs C: • Rivermead Mobility Index (-) • 10-Metre Walk Test (-) • Nine Hole Peg Test (-) • Barthel Index (-) • Nottingham Health Profile (-)
Electroacupuncture with Heparin vs Heparin		
Si et al. (1998) RCT (5) N_{start}=42 N_{end}=42 TPS=Acute	E: Electroacupuncture + Heparin, low molecular dextran, nimodipine C: Heparin, low molecular dextran, nimodipine Duration: 30min/d, for 5d electroacupuncture	• Chinese Stroke Scale (+exp) ○ Level of consciousness (-) ○ Extraocular movements (-) ○ Facial palsy (-) ○ Speech (-) ○ Motor shoulder (+exp) ○ Motor hand (+exp) ○ Motor leg (+exp) ○ Capacity walking (-)

Abbreviations and table notes: ANOVA=analysis of variance; C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TEAS=transcutaneous electrical acupoint stimulation; TENS=transcutaneous electrical nerve stimulation; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
+exp_2 indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group

+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Electroacupuncture and Transcutaneous Electrical Acupoint Stimulation

MOTOR FUNCTION			
LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **electroacupuncture** to improve motor function when compared to **conventional therapy.**	4	Cai et al. 2021; Tan et al. 2013; Hsieh et al. 2007; Wong et al. 1999

FUNCTIONAL AMBULATION			
LoE	Conclusion Statement	RCTs	References
1b	**TEAS** may not have a difference in efficacy when compared to **sham stimulation** for improving functional ambulation.	1	Zhao et al. 2015
1b	**Electroacupuncture** may not have a difference in efficacy when compared to **low or high frequency TENS** for improving functional ambulation.	1	Johansson et al. 2001

FUNCTIONAL MOBILITY			
LoE	Conclusion Statement	RCTs	References
1b	**Electroacupuncture** may not have a difference in efficacy compared to **high or low frequency TENS** for improving functional mobility.	1	Johansson et al. 2001

ACTIVITIES OF DAILY LIVING			
LoE	Conclusion Statement	RCTs	References
1b	There is conflicting evidence about the effect of **electroacupuncture** to improve activities of daily living when compared to **conventional therapy.**	3	Cai et al. 2021; Hsieh et al. 2007; Wong et al. 1999
1b	**TEAS** may not have a difference in efficacy when compared to **sham stimulation** for improving activities of daily living.	1	Zhao et al. 2015
1b	**Electroacupuncture** may not have a difference in efficacy when compared to **sham stimulation** for improving activities of daily living.	1	Hopwood et al. 2008
1b	**Electroacupuncture** may not have a difference in efficacy when compared to **low or high frequency TENS** for improving activities of daily living.	1	Johansson et al. 2001

MUSCLE STRENGTH			
LoE	Conclusion Statement	RCTs	References

1b	**Electroacupuncture** may not have a difference in efficacy when compared to **sham stimulation** for improving muscle strength.	1	Hopwood et al. 2008

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Electroacupuncture** may not have a difference in efficacy compared to **conventional therapy** for improving spasticity.	1	Cai et al. 2021
1b	**TEAS** may not have a difference in efficacy compared to **sham stimulation** for improving spasticity.	1	Zhao et al. 2015

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Electroacupuncture** may produce greater improvements in stroke severity compared to **conventional therapy**.	1	Tan et al. 2013
2	**Electroacupuncture with heparin** may produce greater improvements in stroke severity compared to **heparin** on its own.	1	Si et al. 1998

QUALITY OF LIFE			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Electroacupuncture** may not have a difference in efficacy compared to **sham stimulation** for improving quality of life.	1	Hopwood et al. 2008
1b	**Electroacupuncture** may not have a difference in efficacy compared to **TENS** for improving quality of life.	1	Johnasson et al. 2001

Key Points

Electroacupuncture may be beneficial for improving stroke severity after stroke.

The literature is mixed regarding the effect of electroacupuncture for improving motor after stroke.

Electroacupuncture may not be beneficial for improving functional mobility, functional ambulation, spasticity, activities of daily living, spasticity, quality of life, and muscle strength.

Traditional Herbal Medicines

Adopted from: https://drmeelainling.com/herbs-diet/

Traditional Chinese, Japanese and Indian herbal medicine are complementary and alternative forms of medicine that have been utilized as a healthcare system in Asian countries for hundreds of years and are widely used for stroke treatment today (Han et al., 2017; Tsai et al., 2017). Different herbal medicines have various beneficial properties such as anti-inflammatory, increasing cerebral blood flow velocity, inhibiting platelet aggregation, increasing tissue tolerance to hypoxia, etc. (Han et al., 2017). Chinese and Japanese herbal medicines commonly used for stroke rehabilitation generally consist of a mixture of different plant and animal extracts with these varying properties (Han et al., 2017).

11 RCTs were found evaluating Chinese herbal medicine for lower extremity motor rehabilitation. Three RCTs compared NeuroAid to placebo (Chen et al., 2013; Kong et al., 2009; Venketasubramanian et al., 2015). Six RCTs compared other traditional herbal medications (including Dihuang Yinzi, Shaoyao Gancao, Astragalus Membranaceus, Qizhitongluo, Naoxintong and Tokishakuyakusan) to placebo or no medication (Ahmed et al., 2015; Chen et al., 2012; Goto et al., 2009; Tang et al., 2021; Yu et al., 2015; Zhu et al., 2014). One RCT compared Tibetan medicated bathing therapy to conventional rehabilitation (Wang et al., 2020c). One RCT compared different doses of Shu-Gan-Jie-Yu to fluoxetine and placebo (Gong et al., 2020).

The methodological details and results of all 11 RCTs are presented in Table 57.

Table 57. RCTs Evaluating Chinese Herbal Medicine for Lower Extremity Motor Rehabilitation

Authors (Year) Study Design (PEDro Score) Sample Size$_{start}$ Sample Size$_{end}$ Time post stroke category	Interventions Duration: Session length, frequency per week for total number of weeks	Outcome Measures Result (direction of effect)
NeuroAid vs Placebo		
Venketasubramanian et al. (2015) Note: Extension Study based on Chen et al. 2013 (CHIMES) RCT (5) N_{start}= 880 N_{end}= 701 TPS=Chronic	E: NeuroAid (400mg) C: Placebo (400mg) Duration: 4 capsules, 3x/d of NeuroAid OR Placebo for 12wks	• Modified Rankin Scale (-) • Barthel Index (-)
Chen et al. (2013) (CHIMES Study) RCT (7) N_{start}=1100 N_{end}=777 TPS=Acute	E: NeuroAid (400mg) C: Placebo (400mg) Duration: 4 capsules, 3x/d of NeuroAid OR Placebo for 12wks	• Modified Rankin Scale (-) • Barthel Index (-) • Mini Mental State Examination (-) • NIH Stroke Scale (-)
Kong et al. (2009) RCT (7) N_{start}=40 N_{end}=33 TPS=Acute	E: NeuroAid (Amount Not Specified) C: Placebo (Amount Not Specified) Duration: 4 capsules, 3x/d, for 4wks	• Fugl-Meyer Assessment (-) • Functional Independence Measure (-) • NIH Stroke Scale (-)
Other Herbal Medications vs Placebo or No Medication		
Tang et al. (2021) RCT (9) N_{start}=622 N_{end}=529 TPS=Acute	E1: Qizhitongluo (500mg capsules) taken at breakfast and dinner + Placebo taken after lunch E2: Naoxintong (400mg capsules) taken after each meal C: Placebo capsule Duration: Qizhitongluo: 4,-500mg capsules, 2x/d + 4 placebo capsules 1x/d, for 12wks Naoxintong: 4,- 400mg capsules 3doses/d, for 12wks Placebo: 4 placebo capsules 3x/d, for 12wks	E1 vs C • Fugl-Meyer Assessment Lower Limb (+exp1) • Fugl-Meyer Assessment Upper Limb (+exp1) • Aphasia Quotient (+exp1) • Barthel Index (+exp1) E1 vs E2 • Fugl-Meyer Assessment Lower Limb (+exp1) • Fugl-Meyer Assessment Upper Limb (+exp1) • Aphasia Quotient (+exp1) • Barthel Index (-) E2 vs C • Fugl-Meyer Assessment Lower Limb (-) • Fugl-Meyer Assessment Upper Limb (-) • Aphasia Quotient (-) • Barthel Index (-)
Ahmed et al. (2015) RCT (5) N_{start}=40 N_{end}=40 TPS=Chronic	E: Unani Medicine (Herbal and Massage) C: Western Medicine (Piracetam 800mg) Duration: 1dose/d, for 4wks medications & 15min/d, for 2wks massage	• Stroke Rehabilitation Assessment of Movement (+exp)
Yu et al. (2015) RCT (4) N_{start}=100 N_{end}=86 TPS=Chronic	E: Dihuang Yinzi + Physiotherapy (18g) C: Placebo + Physiotherapy (18g) Duration: 18g of Dihuang Yinzi OR placebo (2doses/d) for 12wks	• Fugl-Meyer Assessment (+exp) • Barthel Index (+exp)

Zhu et al. (2014) RCT (5) N_{start}=60 N_{end}=60 TPS=Acute	E: Shaoyao Gancao (10mL) + Physiotherapy C: No medication + Physiotherapy Duration: 10mL of Shaoyoo Gancoo (3doses/d) for 4wks & 30min/d, 6d/wk, for 4wks physiotherapy	• Modified Ashworth Scale (+exp) • Composite Spasticity Scale (+exp) • Fugl-Meyer Assessment (+exp) • Barthel Index (+exp) • Integrated electromyography of all muscles (+exp)
Chen et al. (2012) RCT (9) N_{start}=78 N_{end}=66 TPS=Acute	E: Astragalus Membranaceus (3g) C: Placebo (3g) Duration: 3g of Astragalus Membranaceus OR placebo (3doses/d) for 2wks	• Functional Independence Measure (+exp) • Barthel Index (-) • Modified Rankin Scale (-)
Goto et al. (2009) RCT (6) N_{start}=31 N_{end}=30 TPS=Chronic	E: Tokishakuyakusan (2.5g) C: No medication Duration: 2.5g of Tokishakuyakusan (3x/d) for 1yr	• Stroke Impairment Assessment Scale (+exp) • Functional Independence Measure (+exp)
Other Herbal Medications vs Conventional Therapy		
Wang et al. (2020) RCT (6) N_{start}= 444 N_{end}= 403 TPS=Subacute	E: Tibetan medicated bathing therapy + conventional rehabilitation C: Conventional rehabilitation Duration: 50min/d, 5d/wk, for 4wks conventional rehabilitation & 60min/d, 5d/wk, for 4wks Tibetan medicated bathing	• Modified Ashworth Scale ○ Elbow flexors (+exp) ○ Wrist flexors (+exp) ○ Finger flexors (-) ○ Knee extensors (-) ○ Ankle plantar flexors (+exp) • Fugl-Meyer Assessment (+exp) ○ Upper limb(+exp) ○ Lower limb (-) • Modified Barthel Index (+exp)
Other Herbal Medications vs Fluoxetine vs Placebo		
Gong et al.(2020) RCT (7) N_{start}=254 N_{final}=222 TPS=Acute	E1: Shu-Gan-Jie-Yu capsule, 720 mg E2: Fluoxetine, 20 mg PO daily E3: Shu-Gan-Jie-Yu (2160 mg daily C: Placebo Duration: E1: 720 mg, 3/d, 7d/wk, 12wks (2160 mg daily) Shu-Gan-Jie-Yu; E2: 20mg 1/d, 7d/wk, for 12wks fluoxetine; E3: 720 mg, 3/d, 7d/wk, for 12wks (2160 mg daily) Shu-Gan-Jie-Yu + 20mg 1/d, 7d/wk, for 12wks fluoxetine	E1/E2/E3 vs C • Modified Rankin Scale (+exp1, +exp2, +exp3) • Fugl-Meyer Motor (+exp1, +exp2, +exp3)

Abbreviations and table notes: C=control group; D=days; E=experimental group; H=hours; Min=minutes; RCT=randomized controlled trial; TPS=time post stroke category (Acute: less than 30 days, Subacute: more than 1 month but less than 6 months, Chronic: over 6 months); Wk=weeks.
+exp indicates a statistically significant between groups difference at α=0.05 in favour of the experimental group
$+exp_2$ indicates a statistically significant between groups difference at α=0.05 in favour of the second experimental group
+con indicates a statistically significant between groups difference at α=0.05 in favour of the control group
- indicates no statistically significant between groups differences at α=0.05

Conclusions about Traditional Chinese Herbal Medicine

MOTOR FUNCTION			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Qizhitongluo (500mg capsules) with a placebo dose** may produce greater improvements in motor function compared to **placebo alone.**	1	Tang et al. 2021
1b	**Qizhitongluo (500mg capsules) with a placebo dose** may produce greater improvements in motor	1	Tang et al. 2021

	function compared to **Naoxintong (400mg capsules).**		
1b	**NeuroAid** may not have a difference in efficacy when compared to **placebo** for improving motor function.	1	Kong et al. 2009
1b	**Naoxintong (400mg capsules)** may not have a difference in efficacy when compared to **placebo** for improving motor function.	1	Tang et al. 2021
2	**Dihuang Yinzi** may produce greater improvements in motor function compared to **placebo.**	1	Yu et al. 2015
1b	**Shaoyao Gancao** may produce greater improvements in motor function compared to **no medication.**	1	Zhu et al. 2014
1b	**Tibetan medicated bathing therapy** may not have a difference in efficacy when compared to **conventional rehabilitation** for improving motor function.	1	Wang et al. 2020
1b	**Shu-Gan-Jie-Yu (720mg)** may produce greater improvements in motor function compared to **placebo.**	1	Gong et al. 2020
1b	**Shu-Gan-Jie-Yu (2160mg)** may produce greater improvements in motor function compared to **placebo.**	1	Gong et al. 2020

FUNCTIONAL MOBILITY

LoE	Conclusion Statement	RCTs	References
2	**Unani medicine** may produce greater improvements in functional mobility compared to **Western medicine (piracetam).**	1	Ahmed et al. 2015

ACTIVITIES OF DAILY LIVING

LoE	Conclusion Statement	RCTs	References
1b	**Qizhitongluo (500mg capsules) with a placebo dose** may produce greater improvements in activities of daily living compared to **placebo alone.**	1	Tang et al. 2021
1b	**NeuroAid** may not have a difference in efficacy when compared to **placebo** for improving activities of daily living.	3	Venketasubramian et al. 2015; Chen et al. 2013; Kong et al. 2009
1b	**Qizhitongluo (500mg capsules) with a placebo dose** may not have a difference in efficacy when compared to **Naoxintong (400mg capsules)** for improving activities of daily living.	1	Tang et al. 2021
1b	**Naoxintong (400mg capsules)** may not have a difference in efficacy when compared to **placebo** for improving activities of daily living.	1	Tang et al. 2021
2	**Dihuang Yinzi** may produce greater improvements in activities of daily living compared to **placebo.**	1	Yu et al. 2015

1b	**Shaoyao Gancao** may produce greater improvements in activities of daily living compared to **no medication.**	1	Zhu et al. 2014
1b	**Astragalus membranaceus** may not have a difference in efficacy when compared to **placebo** for improving activities of daily living.	1	Chen et al. 2012
1b	**Tokishakuyakusan** may produce greater improvements in activities of daily living compared to **no medication.**	1	Goto et al. 2009
1b	**Tibetan medicated bathing therapy** may produce greater improvements in activities of daily living compared to **conventional rehabilitation.**	1	Wang et al. 2020
1b	**Shu-Gan-Jie-Yu (720mg)** may produce greater improvements in activities of daily living compared to **placebo.**	1	Gong et al. 2020
1b	**Shu-Gan-Jie-Yu (2160mg)** may produce greater improvements in activities of daily living compared to **placebo.**	1	Gong et al. 2020

SPASTICITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Shaoyao Gancao** may produce greater improvements in spasticity compared to **no medication.**	1	Zhu et al. 2014
1b	There is conflicting evidence about the effect of **Tibetan medicated bathing therapy** to improve spasticity when compared to **conventional rehabilitation.**	1	Wang et al. 2020

STROKE SEVERITY			
LoE	**Conclusion Statement**	**RCTs**	**References**
1b	**Tokishakuyakusan** may produce greater improvements in stroke severity compared to **no medication.**	1	Goto et al. 2009
1a	**NeuroAid** may not have a difference in efficacy when compared to **placebo** for improving stroke severity.	2	Chen et al. 2013; Kong et al. 2009

Key Points

NeuroAid may not be beneficial for improving motor function, activities of daily living, and stroke severity.

Other herbal medications such as Dihuang Yinzi, Shaoyao, Gancao, Astragalus Membranaceus, and Tokishakuyakusan may be beneficial for improving motor function, functional mobility, spasticity and activities of daily living, for more details, please see table 57.

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