



# CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

## Rehabilitation, Recovery and Community Participation Following Stroke

### Part Two: Delivery of Stroke Rehabilitation to Optimize Functional Recovery Evidence Tables

7<sup>th</sup> edition, update 2025

### *Lower Limb Spasticity Following Stroke*

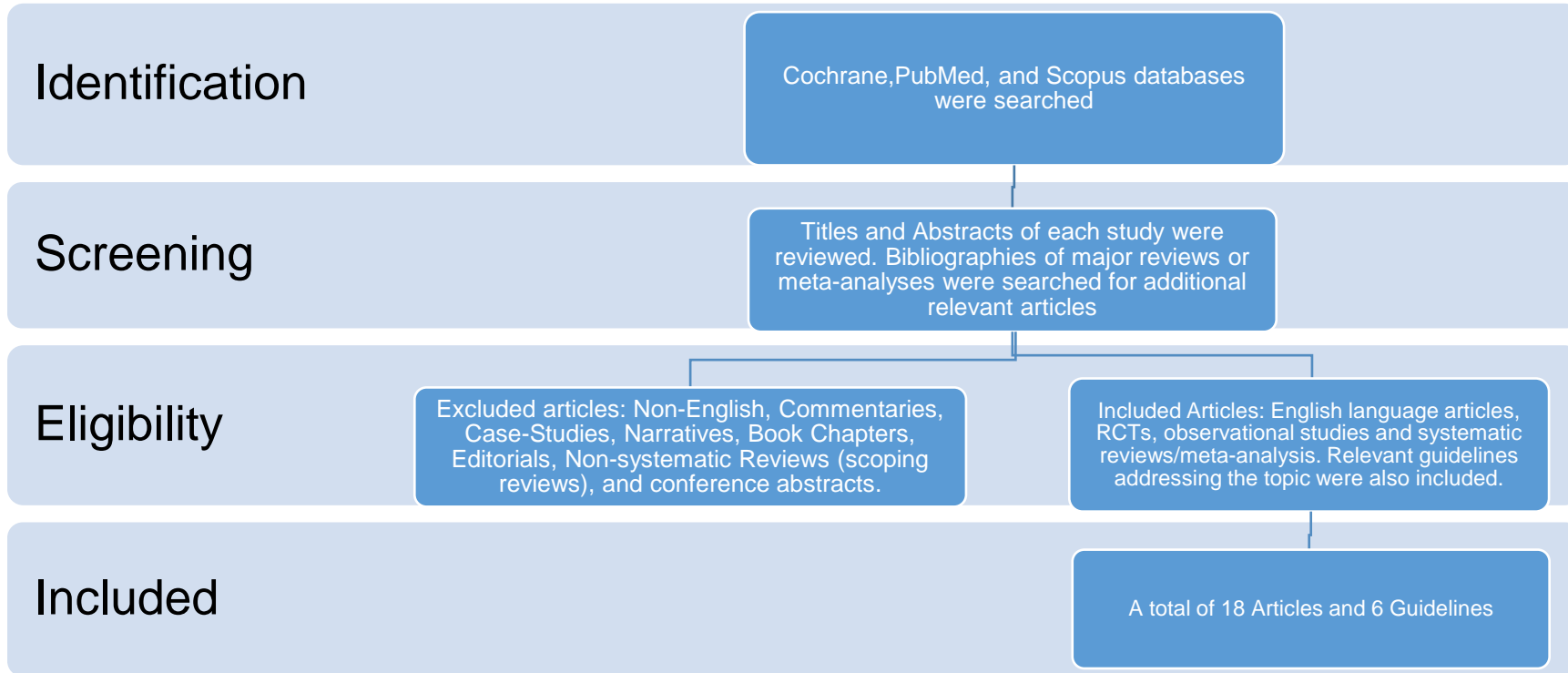
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Stroke Rehabilitation and Recovery Writing Group*

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## Search Strategy



Cochrane, PubMed, and Scopus databases were searched using terms such as: (Stroke OR cerebrovascular disease) AND (“spasticity” OR “contracture”) AND (“lower extremity” OR “lower limb”) AND (rehabilitation OR therapy OR intervention). Titles and abstract of each article were reviewed for relevance. Bibliographies were reviewed to find additional relevant articles. Articles were excluded if they were: non-English, commentaries, case-studies, narrative, book chapters, editorials, non-systematic review, or conference abstracts. Additional searches for relevant best practice guidelines were completed and included in a separate section of the review. A total of 18 articles and 6 guidelines were included and were separated into categories designed to answer specific questions.

## Published Guidelines

Guideline	Recommendations
<p><b>Management of Stroke Rehabilitation Working Group. VA/DoD clinical practice guideline for the management of stroke rehabilitation. Washington (DC): Veterans Health Administration, Department of Defense; Version 5.0 – 2024.</b></p> <p>Available at: <a href="https://www.healthquality.va.gov/guidelines/Rehab/stroke/">https://www.healthquality.va.gov/guidelines/Rehab/stroke/</a></p>	<p>24. We suggest botulinum toxin for patients with focal spasticity depending on patient characteristics and preferences. Weak (for)</p> <p>25. There is insufficient evidence to recommend for or against the use of acupuncture or dry needling for spasticity management. Neither for nor against</p> <p>26. There is insufficient evidence to recommend for or against whole body or localized muscle vibration for spasticity management. Neither for nor against</p> <p>27. There is insufficient evidence to recommend for or against extracorporeal shock wave therapy for spasticity management. Neither for nor against</p>
<p><b>National Clinical Guideline for Stroke for the UK and Ireland. London: Intercollegiate Stroke Working Party; 2023 May 4.</b></p> <p>Available at: <a href="http://www.strokeguideline.org">www.strokeguideline.org</a>.</p> <p>(selected)</p>	<p><b>New for 2023</b></p> <p>People with spasticity in the upper or lower limbs after stroke should <b>not</b> be treated with electrical stimulation to reduce spasticity.</p> <p>People with spasticity in their wrist or fingers who have been treated with botulinum toxin may be considered for electrical stimulation (cyclical/neuromuscular electrical stimulation) after the injection to maintain range of movement and/or to provide regular stretching as an adjunct to splinting or when splinting is not tolerated.</p> <p>People with stroke at high risk of contracture should be monitored to identify problematic spasticity and provided with interventions to prevent skin damage, or significant difficulties with hygiene, dressing, pain or positioning.</p>
<p><b>Zhang T, Zhao J, Li X, Bai Y, Wang B, Qu Y et al. 2019</b></p> <p><b>Chinese Stroke Association guidelines for clinical management of cerebrovascular disorders: executive summary and 2019 update of clinical management of stroke rehabilitation.</b></p> <p><i>Stroke Vasc Neurol.</i> 2020 Sep;5(3):250-259.</p> <p>(selected)</p>	<p>17. Oral medications, including eperisone, baclofen and tizanidine, are recommended, and local botulinum toxin injection is recommended for local muscle spasm after stroke (Grade I recommendation, Level B evidence).</p> <p>18. Combined transcranial direct current stimulation, repetitive transcranial magnetic stimulation and transcutaneous electrical nerve stimulation (TENS) with conventional physiotherapy is reasonable to relieve spasticity (Grade IIa recommendation, Level B evidence).</p> <p>19. It is reasonable that acupuncture used selectively in combination with clinical practice in spasticity after stroke (Grade IIa recommendation, Class B evidence).</p>

Guideline	Recommendations
<p><b>Clinical Guidelines for Stroke Management 2017. Melbourne (Australia): National Stroke Foundation. Section 5. Rehabilitation</b></p>	<p>For stroke survivors with lower limb spasticity, Botulinum Toxin A in addition to rehabilitation therapy may be used to reduce spasticity but is unlikely to improve motor function or walking. (weak recommendation)</p> <p>For stroke survivors with spasticity, acupuncture should <b>not</b> be used for treatment of spasticity in routine practice other than as part of a research study. (weak recommendation)</p> <p>For stroke survivors with spasticity, adjunct therapies to Botulinum Toxin A, such as electrical stimulation, casting and taping, may be used. (weak recommendation)</p> <p>For stroke survivors, the routine use of stretch to reduce spasticity is not recommended. (weak recommendation)</p> <p>For stroke survivors at risk of developing contracture, routine use of splints or prolonged positioning of upper or lower limb muscles in a <u>lengthened position (stretch)</u> is not recommended. (strong recommendation)</p>
<p><b>Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC et al; on behalf of the American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Quality of Care and Outcomes Research.</b></p> <p><b>Guidelines for adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart Association/American Stroke Association.</b></p> <p><b>Stroke 2016;47:e98–e169</b></p>	<p>Recommendations targeting lower limb spasticity:</p> <p>Targeted injection of botulinum toxin into lower limb muscles is recommended to reduce spasticity that interferes with gait function. (A)</p> <p>Recommendations not specific to lower limb spasticity:</p> <p>Oral antispasticity agents can be useful for generalized spastic dystonia but may result in dose-limiting sedation or other side effects (A)</p> <p>Physical modalities such as NMES or vibration applied to spastic muscles may be reasonable to improve spasticity temporarily as an adjunct to rehabilitation therapy. (A)</p> <p>Intrathecal baclofen therapy may be useful for severe spastic hypertonia that does not respond to other interventions. (A)</p> <p>Postural training and task-oriented therapy may be considered for rehabilitation of ataxia. (A)</p>
<p><b>Intercollegiate Stroke Working Party. National clinical guideline for stroke, 5th edition. London: Royal College of Physicians, 2016.</b></p>	<p><b>4.15 Spasticity and contractures</b></p> <p>People with motor weakness after stroke should be assessed for spasticity as a cause of pain, as a factor limiting activities or care, and as a risk factor for the development of contractures.</p> <p>People with stroke should be supported to set and monitor specific goals for interventions for spasticity using appropriate clinical measures for ease of care, pain and/or range of movement.</p> <p>People with spasticity after stroke should be monitored to determine the extent of the problem and the effect of simple measures to reduce spasticity e.g. positioning, passive movement, active movement (with monitoring of the range of movement and alteration in function) and/or pain control.</p> <p>People with persistent or progressive focal spasticity after stroke affecting one or two areas for whom a therapeutic goal can be identified (e.g. ease of care, pain) should be offered intramuscular botulinum toxin. This should be within a specialist</p>

Guideline	Recommendations
	<p data-bbox="678 264 1982 345">multidisciplinary team and be accompanied by rehabilitation therapy and/or splinting or casting for up to 12 weeks after the injections. Goal attainment should be assessed 3-4 months after the injections and further treatment planned according to response.</p> <p data-bbox="678 362 1982 443">People with generalised or diffuse spasticity after stroke should be offered treatment with skeletal muscle relaxants (e.g. baclofen, tizanidine) and monitored for adverse effects, in particular sedation and increased weakness. Combinations of antispasticity drugs should only be initiated by healthcare professionals with specific expertise in managing spasticity.</p> <p data-bbox="678 459 1982 516">People with stroke should only receive intrathecal baclofen, intraneural phenol or similar interventions in the context of a specialist multidisciplinary spasticity service.</p> <p data-bbox="678 532 1982 605">People with stroke with increased tone that is reducing passive or active movement around a joint should have the range of passive joint movement assessed. They should only be offered splinting or casting following individualised assessment and with monitoring by appropriately skilled staff.</p>

## Evidence Tables

### Botulinum Toxin-Type A (BTX-A)

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
<p><b>Doan et al. 2021</b></p> <p><b>Taiwan</b></p> <p><b>Systematic review &amp; meta-analysis</b></p>	<p>PEDro scores for all trials were 9 or 10</p>	<p>12 RCT's including patients with lower-limb spasticity following stroke. No demographic info was reported. Time since stroke was &gt;3 months in 8 trials, &lt;3 months in 3 trials and was not reported in one trial.</p>	<p>Trials compared treatment with BTX-A (Botox or Dysport) vs. placebo. Doses of Botox ranged from 100-450U; doses of Dysport were 500, 1,000 and 1,500U.</p> <p>Concomitant physical therapy was provided in 5 trials.</p>	<p><b>Primary Outcome:</b> Ashworth Scale, Modified Ashworth Scale (MAS)</p> <p><b>Secondary Outcome:</b> Gait speed</p>	<p>At 4, 8 and 12 weeks after treatment, measures of spasticity were reduced significantly in the BTX-A group (SMD=-0.61, 95% CI -0.92 to -0.3; 6 trials, SMD=-0.66, 95% CI -1.22 to -0.09; 2 trials; and SMD=-0.27, 95% CI -0.45 to -0.08; 4 trials, respectively).</p> <p>BTX-A was not associated with a significant improvement in gait speed at 8 weeks (MD=0.07 m/sec, 95% CI -0.10 to 0.23; 3 trials).</p> <p>Dosage analysis from 8 trials suggest the optimum dose for the spastic plantar flexors is approximately 300U Botox or 1000 U Dysport.</p>
<p><b>Wein et al. 2018, Patel et al. 2020</b></p> <p><b>Canada/USA</b></p> <p><b>RCT</b></p> <p><b>REFLEX Study</b></p>	<p>CA: <input checked="" type="checkbox"/></p> <p>Blinding: Patient <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/></p> <p>ITT: <input checked="" type="checkbox"/></p>	<p>468 patients, recruited from 60 centres with spasticity of the ankle (MAS ≥3) following stroke of duration &gt;3 months. Mean age was 56 years, 65% were men. 153 patients had a stroke ≤24 months, 315 had a stroke &gt;24 months.</p>	<p>Participants were randomized to receive either BTX-A (Botox 300–400 U) or placebo and followed for 12 weeks during the double-blind phase. During the open label study phase in which patients in both groups could receive up to 3 treatments of BTX-A (up to 400 U) were given approximately every 12 weeks over a 42-week period. (n=447).</p> <p>The initiation of physical therapy or the use of static or dynamic splints within 14 days of the first study visit was also</p>	<p><b>Primary Outcome:</b> Modified Ashworth Scale (MAS), average of weeks 4 and 6 change from baseline</p> <p><b>Secondary Outcomes:</b> Physician-assessed Clinical Global Impression of Change (CGI), Goal Attainment Scale, pain</p>	<p>413 patients completed the trial.</p> <p>There was significantly greater improvement in mean MAS ankle scores from baseline to 4-6 weeks in the BTX-A group (-0.81 vs. -0.61, Δ= -0.20, p= 0.01) during the double-blind period. The benefit was greater in persons with stroke ≤24 months (-0.99 vs. -0.68; Δ=-0.31, p=0.02). Among patients with stroke &gt;24 months, mean change from baseline was greater in the BTX-A group (-0.75 vs. -0.58; Δ=-0.17, p=0.09), with additional improvements continued throughout the open label period. At the end of the 6<sup>th</sup> week of the 3<sup>rd</sup> treatment the mean reduction in mean MAS scores was significantly greater in the BTX-A group (-1.4 vs. -1.2).</p> <p>There was significantly greater improvement in CGI change from baseline to 4-6 weeks in the BTX-A groups (0.86 vs. 0.65; Δ=0.22, p=0.01).</p>

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			prohibited.		<p>The benefit was greater in persons with stroke <math>\leq 24</math> months. There was no significant difference in mean change between groups in patients with stroke <math>&gt; 24</math> months. During the open-label phase, CGI scores by physician continued to improve and were sustained across 3 treatment cycles</p> <p>Treatment with BTX-A was associated with significantly greater improvements in physician-assessed passive goal at week 12 and the patient-assessed passive goal at weeks 8 and 12.</p> <p>A significantly greater proportion of patients treated with BTX-A progressed (<math>GAS \geq 1</math>) toward physician-assessed active (<math>NNT = 9</math>) and passive (<math>NNT = 11</math>) goals at week 8, and achieved (<math>GAS \geq 0</math>) physician-assessed passive goal at week 12.</p> <p>There were no significant differences between groups in pain scores during the double-blind, or open label phases of the trial.</p> <p>There were 3 treatment-related adverse events of severe intensity in the BTX-A group</p>
<p><b>Gracies et al. 2017</b></p> <p><b>France</b></p> <p><b>RCT</b></p>	<p>CA: <input checked="" type="checkbox"/></p> <p>Blinding: Patient <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/></p> <p>ITT: <input checked="" type="checkbox"/></p>	<p>381 patients (331 with stroke, 50 with TBI) with spastic hemiparesis causing gait dysfunction; comfortable barefoot walking speed 0.1–0.8 m/s, and MAS score <math>\geq 2</math> in gastrocnemius–soleus complex (GSC). Mean age was 52.6 years, 67.2% were men. Mean time since stroke was 4.6 years.</p>	<p>Patients were randomized to receive a single injection of Dysport (1,000 U or 1,500 U), or placebo into both soleus and gastrocnemius muscles and <math>\geq 1</math> other (investigator-selected) lower limb muscle.</p> <p>In the open-label extension, participants were offered additional injections of Dysport at weeks 12, 16, 20, or 24,</p>	<p><b>Primary outcome:</b> Muscle tone (MAS)</p> <p><b>Secondary outcomes:</b> Physician global assessment (PGA), 10 m comfortable barefoot walking speed without walking aids</p> <p>In the double-blind portion of the trial, outcomes were assessed at baseline, 4 and 12 weeks.</p>	<p>In the placebo group, mean baseline MAS score was 3.9, decreasing to 3.4 at 4 weeks (<math>\Delta -0.5</math>, 95% CI -0.7 to -0.4).</p> <p>In the 1,000U Dysport group, mean baseline MAS score was 3.8, decreasing to 3.2 at 4 weeks (<math>\Delta -0.6</math>, 95% CI -0.8 to -0.5).</p> <p>In the 1,500U Dysport group, mean baseline MAS score was 3.7, decreasing to 3.1 at 4 weeks (<math>\Delta -0.8</math>, 95% CI -0.7 to -0.9).</p> <p>Compared with placebo, the change in MAS was significant in the 1,500U group, but not the 1,000U group.</p>

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			based on investigators judgement.		<p>At week 12, mean MAS scores and change from baseline were 3.5 and -0.4 (95% CI -0.5 to -0.2) in the placebo group, 3.4 and -0.4 (95% CI -0.5 to -0.2) for the 1,000U group; and 3.3 and -0.6 (95% CI -0.7 to -0.4) in the 1,500U group. Compared with placebo, the change in MAS was significant in the 1,500U group, but not the 1,000U group.</p> <p>Mean week 4 PGA scores were 0.7 (95% CI 0.5-0.9) in the placebo group, 0.9 (95% CI 0.7- 1.1) in the 1,000 U group and 0.9 (95% CI 0.7-1.1) in the 1,500 U groups). The differences between groups (placebo vs. 1,000U and placebo vs. 1,500U) were not significant. However, using ranked PGA scores, both doses of Dysport were superior to placebo.</p> <p>There was no significant difference in mean comfortable barefoot walking speed change from baseline among the 3 groups at weeks 4 or 12.</p> <p>There were 7 treatment emergent adverse events of special interest in the placebo group, 8 in the 1,000U group and 16 in the 1,500U group.</p> <p>There were 22 dropouts (7, 7 and 8)</p>
<p><b>Dunne et al. 2012</b></p> <p><b>Australia</b></p> <p><b>RCT</b></p>	<p>CA: <input checked="" type="checkbox"/></p> <p>Blinding: Patient <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/></p> <p>ITT: <input checked="" type="checkbox"/></p>	<p>85 stroke patients (<math>\geq 6</math> weeks post stroke), with lower extremity hypertonia (AS <math>\geq 2</math>). Mean age was 58.4 years, 76.5% were men. Mean time since stroke was 3.4 years.</p>	<p>Patients were randomized to receive a single injection of 200 U Botox (n=28), 300 U Botox (n=28) or saline injections to the tibialis posterior, soleus and flexor digitorum longus or medial gastrocnemius.</p>	<p><b>Primary Outcomes:</b> Adverse event incidence, Ashworth Scale (AS) (ankle plantar flexors)</p> <p><b>Secondary Outcomes:</b> Self-reported spasm frequency, physician rated hypertonia (7- point Likert scale).</p>	<p>Data from the 2 Botox groups were not different and combined.</p> <p>At 12 weeks, there was no significant between-group difference in the number of patients who had improved by at least 1 grade on AS scores (6/54 vs. 5/29, p=0.22)</p> <p>A significantly greater number of patients in the Botox group who reported an improvement in the mean number of leg spasms/week, at 12 weeks (22/26 vs. 4/19, p=0.01).</p>

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					<p>Improvement in Physician rating of hypertonia of <math>\geq 1</math> at 12 weeks was significantly greater in the Botox group (29/54 vs. 8/29, <math>p=0.04</math>)</p> <p>Significantly more patients in the Botox group reported an improvement in pain (<math>\geq 20\%</math>) at 12 weeks (8/14 vs. 1/8, <math>p=0.02</math>), and an increase in ankle dorsiflexion (<math>\geq 15\%</math>) at 12 weeks (8/54 vs. 1/29, <math>p=0.03</math>).</p> <p>There were 5 dropouts, all in the experimental group.</p> <p>There were 6 serious adverse events in the Botox group and 3 in the placebo group.</p>
<p><b>Foley et al. 2010</b></p> <p><b>Canada</b></p> <p><b>Systematic review and meta-analysis</b></p>	N/A	<p>8 trials (5 RCTs, 3 uncontrolled trials, including 228 participants) with spastic equinovarus deformity, who could ambulate with/without a device and with/without assistance for at least 5 metres.</p> <p>Mean of median interval from stroke to entry into study was &gt; 6 months in all trials.</p>	<p>Comparisons of a single injection of BTX-A vs. placebo or before and after single injection.</p> <p>Doses varied from 190 to 400 U of Botox and 500 to 2,000 U of Dysport</p>	<p><b>Primary Outcomes:</b></p> <p>Gait speed</p>	<p>BTX-A was associated with a significant increase in gait speed (SMD=0.193±0.081, 95% CI 0.033 to 0.353, <math>p&lt;0.018</math>).</p>
<p><b>Kaji et al. 2010</b></p> <p><b>Japan</b></p> <p><b>RCT</b></p>	<p>CA: <input checked="" type="checkbox"/></p> <p>Blinding: Patient <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/></p> <p>ITT: <input checked="" type="checkbox"/></p>	<p>120 patients from 19 medical institutions with lower limb spasticity (MAS&gt;3) of the ankle flexors, following stroke &gt; 6 months previously. Mean age was 62.5 years, 80% were men. Mean time since stroke was 76 months.</p>	<p>Patients were randomized to receive a single treatment of 300 U Botox or placebo. 75 U was injected per muscle group (gastrocnemius, soleus and tibialis posterior).</p>	<p><b>Primary Outcomes:</b></p> <p>MAS</p> <p><b>Secondary Outcomes:</b></p> <p>Gait pattern scale assessed using a -1 to 9-point scale, based on 3 parameters over 10m (initial foot contact, foot contact at midstance and gait assisting devices), gait speed. Clinical Global</p>	<p>Mean baseline MAS scores were 3.28 (Botox) and 3.24 (placebo). At weeks 4 and 8, the mean decrease in MAS scores from baseline was significantly greater in the Botox group, but not at week 12.</p> <p>There were no significant differences between groups at week, 4, 8 or 12 in mean change in the Gait pattern scale or gait speed.</p> <p>There was significantly greater improvement in</p>

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
				Impression scale (CGI) scored from -5 to 5.	<p>mean CGI (investigator) scores at 4 and 8 weeks, but not 12 weeks in the Botox group, while there were no significant differences in mean change scores in CGI at 4,8 or 12 weeks, assessed by the patient.</p> <p>There were 6 withdrawals in the Botox group and 1 in the placebo group.</p> <p>Adverse events (serious): experimental group n=9%, control group n=2%</p>

### Intrathecal Baclofen (ITB)

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
<p><b>Creamer et al. 2018 a,b</b></p> <p><b>USA</b></p> <p><b>RCT</b></p> <p><b>Spasticity In Stroke– Randomised Study’ (SISTERS)</b></p>	<p>CA: <input checked="" type="checkbox"/></p> <p>Blinding: Patients <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/></p> <p>ITT: <input checked="" type="checkbox"/></p>	<p>60 patients recruited from 11 rehabilitation centres in Europe and the US with chronic stroke with spasticity in ≥2 extremities and an Ashworth Scale (AS) score ≥3 in at least two affected muscle groups in the lower extremities. Mean age was 56 years. 70% were men. Mean time since stroke was 4.6 years.</p>	<p>After a run-in period (which varied from 2-25 or 21 days, depending on group assignment), patients were randomized 1:1 to ITB or conventional medical management (CMM) with a combination of oral antispastic medications, comprising at least one of oral baclofen, tizanidine, diazepam (or other benzodiazepines), or dantrolene.</p> <p>Both treatment arms received standardized physiotherapy throughout the trial.</p>	<p><b>Primary Outcomes</b> Ashworth Scale (AS)</p> <p><b>Secondary Outcomes:</b> FIM, adverse events</p> <p>Outcomes were assessed at baseline and after 6 months (active study duration).</p>	<p>The mean reduction in lower extremity AS scores was significantly greater in the ITB group (-0.99 vs. -0.43, p=0.0140).</p> <p>At 6 months, there were no significant differences between groups in the mean improvement in total FIM scores or motor or cognition subscores from baseline. However, there were FIM point gains in the ITB group and losses in the CMM group.</p> <p>Total adverse events and treatment-emergent serious adverse events occurred more frequently in the ITB group (155 vs. 79 and 35 vs. 24, respectively).</p> <p><i>Additional reporting (Creamer et al. 2018b)</i> At 6 months there was a significantly greater reduction in pain scores (actual, best, but not worst), EQ-5D-3L scores and patient satisfaction in the ITB group.</p>
<p><b>Meythaler et al. 2001</b></p>	<p>Screening period:</p>	<p>21 patients with disabling and painful intractable</p>	<p>Patients were randomized to receive a</p>	<p><b>Primary Outcome:</b> Ashworth Scale (AS)</p>	<p>The MAS score decreased from 3.7 at baseline to 1.8 at 12 months p&lt;0.0001).</p>

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
<b>USA</b>  <b>Randomized crossover followed by open-label follow-up</b>	assessor <input checked="" type="checkbox"/> patient <input checked="" type="checkbox"/>  Open-label portion: assessor <input checked="" type="checkbox"/> patient <input checked="" type="checkbox"/>  ITT: <input checked="" type="checkbox"/>	hypertonia (AS score $\geq 3$ in one affected extremity or an average spasm score of at least 2 in the affected extremities on the day of screening) following stroke of at least 6 months duration, and failure to respond to oral antispasticity medications. Mean age was 53 years. Time since stroke was >6 months.	screening bolus trial of either 50 µg baclofen or saline placebo. 17 patients responded to the active drug and were then implanted with a continuous-infusion pump and continued to receive treatment for up to a year, with the dose increasing up to an average of 268 ± 175 µg/day.	(average of hip abduction, knee flexion, knee extension, ankle dorsiflexion)  <b>Secondary Outcomes:</b> 5-point Penn Spasm Frequency Scale, 6-point reflex scale (patella, Achilles)  At 1 year, data from 13 subjects were available.	There was no significant reduction in the mean spasm score from baseline (1.2 to 0.6).  There was a significant decrease in the mean Reflex Score from baseline (2.4 to 1.0, $p < 0.0001$ ).  3 patients who were wheelchair dependent at the start of treatment progressed to independent ambulation with assistive devices.  Several mild and transient adverse events were reported.

## Physical Therapy

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
<b>Chen et al. 2021</b>  <b>China</b>  <b>RCT</b>	CA: <input checked="" type="checkbox"/>  Blinding: Patients <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/>  ITT: <input checked="" type="checkbox"/>	121 patients discharged from inpatient rehabilitation with lower limb spasticity. Mean age was 55.5 years, 70% were men. Mean time since stroke was 3.3 months.	Patients were randomized to receive either a nurse-guided home-based rehabilitation exercise program (HREPro) or conventional rehabilitation, consisting of standard health education (control group). HREPro consisted of exercises aimed at reducing spasticity and improving mobility and was supervised by a nurse for the first 3 months (30-minutes session, 3x/week), whereafter the visits were reduced and the	<b>Primary Outcomes:</b> Fugl-Meyer assessment-lower extremity (FMA-LE), Modified Ashworth Scale (MAS), 10-Meter Walk, Barthel Index (BI)  The outcome assessment was performed before, and at 3, 6, and 12 months after initiation of the programs.	There was significantly greater improvement in mean MAS ankle score from baseline to 12 months in the HEPRo group (from 3.32 to 1.07 vs. 3.27 to 1.69, $p$ for group x time interaction = 0.004)  There was significantly greater improvement in all other outcomes from baseline to 12 months for all other outcomes of interest, compared with the control group.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			patient/family continued the program independently. Total duration of the program was 12 months.		
<b>Cho &amp; Park 2020</b> <b>South Korea</b> <b>RCT</b>	CA: <input checked="" type="checkbox"/>  Blinding: Patients <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/>  ITT: <input checked="" type="checkbox"/>	45 patients with chronic stroke (>6 months) and MAS score of 1-3 of the ankle, who could walk for >10 m without walkers or mobility aids. Mean age was 64 years, 73% were men. Mean time since stroke was 12 months.	Patients were randomized to a joint mobilization group (JMG, n = 15), active stretching group (ASG, n = 15), or joint mobilization and active stretching group (JMASG, n = 15). Treatment was provided for 6 weeks in total (3 days per week, 15 min per day).	<b>Primary outcomes:</b> ROM (assessed using a goniometer), cadence, gait speed, stride length  Outcomes were assessed before and after treatment	Post intervention there was significant improvement from baseline in mean ankle dorsi flexion ROM (degrees) in the sitting position in the JMG and JMASG. The difference in mean scores between groups was significant for the comparison of JMASG and JMG and JMASG and ASG.  Post intervention there was significant improvement from baseline in mean ankle dorsi flexion ROM (degrees) in the supine position in all groups with no significant differences between groups.  Post intervention there was significant improvement from baseline in all gait assessments in the ASG and the JMASG, with no significant improvement in the JMG. The difference in mean scores between groups was significant for the comparison of JMASG and JMG.
<b>Kluding &amp; Santos 2008</b> <b>USA</b> <b>RCT</b>	CA: <input checked="" type="checkbox"/>  Blinding: Patient <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/>  ITT: <input checked="" type="checkbox"/>	16 participants with hemiparesis persisting from 6 months to 5 years following stroke with less than 8° of passive ankle dorsiflexion ROM on the hemiparetic side. Mean age was 56 years, 56% were men. Mean time since stroke was 21 months.	Participants were randomized to receive 8, 30-minute sessions for 4 weeks of either functional task practice combined with ankle joint mobilizations (FP/M) or functional task practice only (FP).	<b>Primary Outcomes:</b> Ankle ROM, ankle kinematics during sit-to-stand (STS) and gait, and lower-extremity weight-bearing symmetry during STS and static standing, Rivermead Mobility Index (RMI)  Outcome measures were assessed before and after treatment.	There was significantly greater improvement from baseline in the FP/M group in mean dorsiflexion passive ROM (5.7 degrees vs. 0.2, p<0.01) and total active ROM (17.3 degrees vs. 2.6, p<0.05)  There were no significant differences between groups in mean peak dorsiflexion during STS (-1.88 degrees vs. 1.42, p=ns) or peak dorsiflexion in gait (0.38 degrees vs. 2.58, p=ns).  There was significantly greater improvement from baseline in the FP/M group in peak weight bearing difference during STS (-0.79 degrees vs. -14.9, p<0.05).  There was significantly greater improvement from

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					baseline in the FP/M group in mean STS time (-.82 sec vs. 0.17, p<0.05) and RMI (0.75 vs. 0.63, p<0.05)  There was one dropout in the FP group.

### Extracorporeal Shock Wave Therapy (ESWT)

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
<b>Yoldaş Aslan et al. 2021</b>  <b>Turkey</b>  <b>RCT</b>	CA: <input checked="" type="checkbox"/>  Blinding: Patient <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/>  ITT: <input checked="" type="checkbox"/>	51 patients with ankle plantar flexor spasticity graded > 1 MAS, following stroke. Mean age was 56 years, 55% were men. Mean time since stroke was 35.5 months (active ESWT), 28.9 months (sham ESWT) and 3.8 months (control group).	Patients were randomized 1:1:1 to one of 3 groups: radial ESWT, 1500 shots with a pressure of 2bar and frequency of 10Hz (2 session/week x 2 weeks), sham rESWT and a control group. Patients in all groups received conventional rehabilitation 5 days per week, 2–3 hours/day for 2 weeks.	<b>Primary Outcome:</b> MAS  <b>Secondary outcomes:</b> Tardieu Scale, ROM, BI (lower extremity scores)  Assessments were conducted at baseline, 2 weeks and 6 weeks.	At 2 weeks, there was significantly greater reduction in mean MAS and Tardieu X scores in the active rESWT group compared with the other 2 groups, but not at 6 weeks.  There were no significant differences between groups at 2 or 6 weeks for any of the secondary outcomes.
<b>Lee et al. 2019</b>  <b>South Korea</b>  <b>RCT</b>	CA: <input checked="" type="checkbox"/>  Blinding: Patient <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/>  ITT: <input checked="" type="checkbox"/>	18 patients recruited from a rehabilitation service with stroke of duration >3 months with lower-limb spasticity (MAS>1 in ankle). Mean age was 47 years, 89% were men. Mean time since stroke was 11 months.	Participants were randomly assigned to an ESWT group (n = 9) and received a single session of radial ESWT, given in the medial head of the gastrocnemius muscle of the spastic side at 4 Hz, 2000 shots with intensity of stimulation using energy of 0.1 mJ/mm <sup>2</sup> or control group (n = 9) that received sham stimulation.	<b>Primary Outcome:</b> MAS  <b>Secondary Outcomes:</b> Passive range of motion (PROM), FMA-LE  Assessments were conducted 30 minutes, 1 week, and 4 weeks after treatment.	There was a significantly greater reduction in mean MAS scores from baseline at all assessment points in the ESWT group.  There was no significant difference between groups in the mean change in PROM or FMA-LE scores.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
<b>Taheri et al. 2017</b> <b>Iran</b> <b>RCT</b>	CA: ☑  Blinding: Patient ☑ Assessor ☑  ITT: ☑	28 patients with spasticity of the gastrocnemius (MAS>1+) following stroke of duration >1 month and ability to walk >10m. Mean age was 55.7 years, 68% were men. Mean time since stroke was 30 months.	Patients were randomized 1:1 to receive 3 sessions (1/week) of focused ESWT, given in the medial and lateral head of the gastrocnemius muscle at 4 Hz, 1500 shots with intensity of stimulation using energy of 0.1 mJ/mm <sup>2</sup> + oral anti-spastic medications (4 mg tizanidine) + stretching exercises for 30 min/day; 5 days/week for 12 weeks (intervention group) or oral anti-spastic medications + stretching exercises, as per the intervention group (control group).	<b>Primary outcomes:</b> Pain (VAS), spasticity (MAS), ROM, 3-minute walk duration, lower-extremity functional scores (LEFS)  Assessments were conducted at baseline, week 1, week 3 and week 12	There were 3 withdrawals (one in the intervention group and 2 in the control group).  After controlling for baseline scores, there was significantly greater improvement in mean pain, MAS, 3 m walk duration and LEFS scores in the intervention group.

## Whole Body Vibration

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
<b>Zhang et al. 2023</b> <b>China</b> <b>Systematic review &amp; Meta-analysis</b>	Using Cochrane RoB tool, 7 trials were at low or unclear risk of bias in all 7 domains. In 4 trials risk of bias was high in	11 RCTs, including 475 participants with upper (n=2) or lower spasticity (n=9) following stroke. Mean age ranged from 47.4 to 66 years.  In 5 trials, the time since stroke was 0-6 months, and in 5 trials, time since stroke was >6 months.	Trials compared whole body vibration (WBV) + additional therapies (conventional physiotherapy, exercise therapy, task-related therapy, acupuncture, shock wave therapy, vs. a sham vibration and /or other interventions. In one trial, active WBV was	<b>Primary Outcome:</b> Spasticity (MAS)	WBV was associated with a significant reduction in lower-limb spasticity (SMD= -0.26, 95% CI -0.44 to -0.07, 9 trials, n=412). GRADE: moderate certainty.  WBV was associated with a significant reduction in spasticity in the acute/subacute stage (SMD=-0.39, 95% CI -0.68 to -0.09, 5 trials, n=186. GRADE: low certainty), but not the chronic stage (SMD=-0.16, 95% CI -0.42 to 0.09; 5 trials, n=248. GRADE: moderate certainty).

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
	≥1 domains.	Time since stroke was not reported in one trial.	compared with sham WBV) with no coininterventions.  Therapy was provided for 15-60 minutes/session, 2-5 sessions/week for 4-8 weeks.		WBV was more effective in patients <60 years (SMD = -0.41, 95% CI -0.66 to -0.17, n=6 trials, n=261. GRADE: low certainty vs. ≥65 years SMD=-0.05, 95% CI -0.33 to 0.24; 5 trials, n=204. GRADE: moderate certainty).
<b>Liao et al. 2016</b> <b>China</b> <b>RCT</b>	CA: <input checked="" type="checkbox"/>  Blinding: Patient <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/>  ITT: <input checked="" type="checkbox"/>	84 participants with chronic stroke, living in the community who had the ability to stand with or without aid for more than 90 seconds. Mean age was 61.2 years, 74% were men. Mean time since stroke was 8.5 years.	Participants were randomized 1;1;1; to receive high intensity whole body vibration (WBV) at 30Hz, low-intensity WBV at 20Hz or sham WBV. All participants completed the same movements while standing on the same WBV platform. The intervention was provided 3x/week, (30 sessions).	<b>Primary Outcomes</b> Muscle strength (knee extension and flexion)  <b>Secondary Outcomes:</b> Spasticity of the knee and ankle (MAS), balance, walking endurance, functional mobility, balance self efficacy, participation in daily activities, perception environmental barriers, and Quality of life  Outcomes were evaluated before and after the intervention (10 weeks).	There was no significant improvement in any group in spasticity. Median ankle MAS score was 2 in all groups at baseline and 2 at the end of the intervention. Median knee MAS score was 1 at baseline in all groups and at the end of the intervention.  There was no significant group x time interaction found for any of the other outcomes.
<b>Brogårdh et al. 2012</b> <b>Sweden</b> <b>RCT</b>	CA: <input checked="" type="checkbox"/>  Blinding: Patient <input checked="" type="checkbox"/> Assessor <input checked="" type="checkbox"/>  ITT: <input checked="" type="checkbox"/>	31 participants with the ability to walk at least 300m following chronic stroke and with at least 10% self-perceived muscle weakness in the knee extensors or knee flexors in the paretic lower limb. Mean age was 62 years, 81% were men. Mean time since stroke was 35 months.	Participants were randomized receive 12 sessions of WBV training (amplitude: 3.75 mm, duration of vibration: 7 minutes) or sham WBV, 2/week for 6 weeks.	<b>Primary Outcome:</b> MAS  <b>Secondary outcomes:</b> Timed-up & go, gait speed, 6-Minute Walk Test, Stroke Impact Scale  Outcomes were evaluated before and after the intervention.	There were no significant differences in median MAS scores between groups at baseline or post intervention (1.5 to 1 in the active intervention group vs. 1.0 to 2.0 in the sham group).  There were no significant differences between groups in any of the secondary outcomes at the end of the intervention.

**Abbreviations**

AS: Ashworth Scale	BI: Barthel Index
CA: Concealed Allocation	ITT: Intention to Treat
MAS: Modified Ashworth Scale	N/A: Not Applicable
RCT: Randomized Controlled Trial	RoB: Risk of bias
ROM: Range of Motion	

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