Canadian Stroke Best Practices

CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

Rehabilitation and Recovery following Stroke Evidence Tables

Management of Shoulder Pain & Complex Regional Pain Syndrome (CRPS) Following Stroke

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on Behalf of the Canadian Stroke Best Practice Recommendations
Rehabilitation and Recovery following Stroke Writing Group

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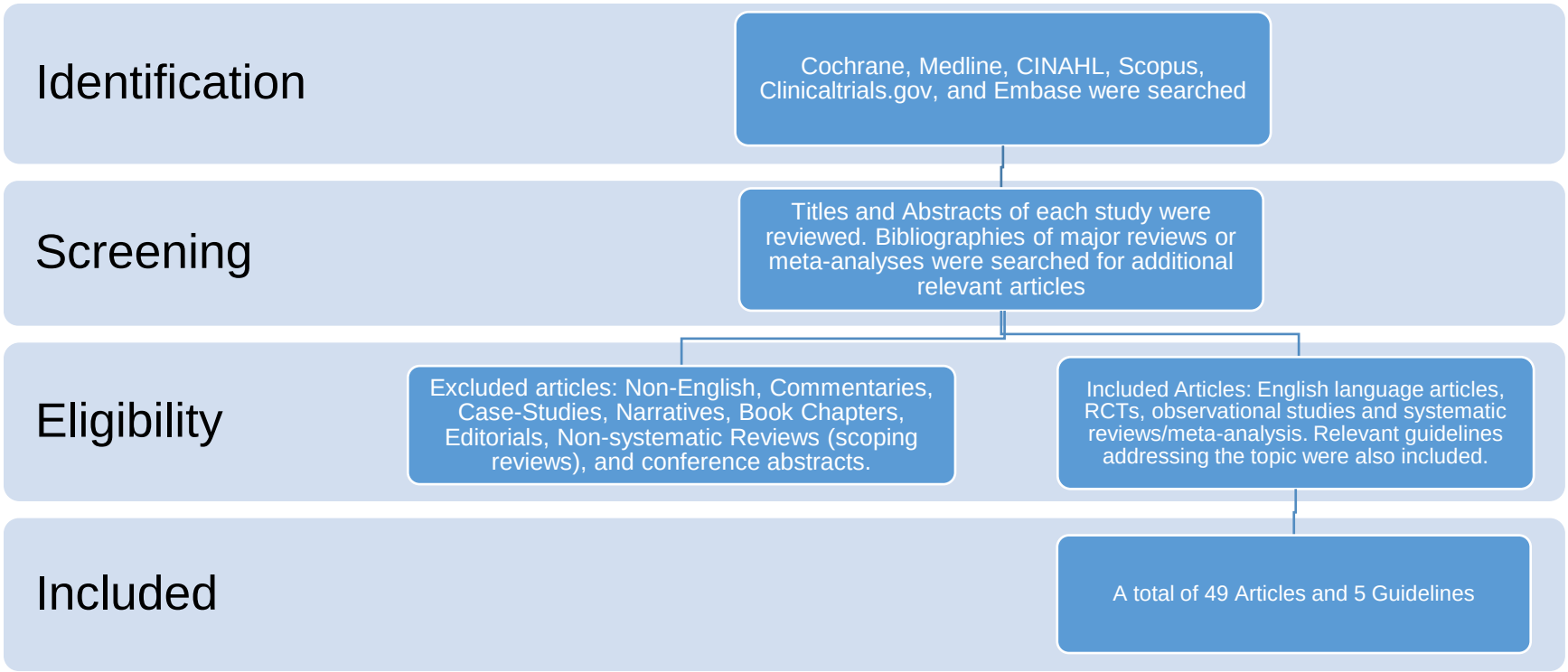
Search Strategy



Cochrane, clinicaltrials.gov, Medline, EMBASE, CINAHL and Scopus were searched using the keywords: Stroke AND Shoulder Pain and Stroke AND complex regional pain syndrome. One new section, acupuncture, was added for the 2015 update. 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 49 articles (18 new for the 2019 update) and 5 guidelines were included and were separated into categories designed to answer specific questions.

Published Guidelines (Pain & Subluxation)

Guideline	Recommendations
Clinical Guidelines for Stroke Management 2010. Melbourne (Australia): National Stroke Foundation; 2017. Section 5. Rehabilitation	**Subluxation** For stroke survivors at risk of shoulder subluxation, electrical stimulation may be used in the first six months after stroke to prevent or reduce subluxation. (weak recommendation) For stroke survivors at risk of shoulder subluxation, shoulder strapping is not recommended to prevent or reduce subluxation. (weak recommendation) For stroke survivors at risk of shoulder subluxation, firm support devices (e.g. devices such as a laptray) may be used. A sling maybe used when standing or walking. To prevent complications related to shoulder subluxation, education and training about correct manual handling and positioning should be provided to the stroke survivor, their family/carer and health professionals, and particularly nursing and allied health staff. **Contracture** For stroke survivors at risk of developing contracture, routine use of splints or prolonged positioning of upper or lower limb muscles in a lengthened position (stretch) is not recommended. (strong recommendation) For stroke survivors, serial casting may be trialled to reduce severe, persistent contracture when conventional therapy has failed. For stroke survivors at risk of developing contracture or who have developed contracture, active motor training or electrical stimulation to elicit muscle activity should be provided. Overhead pulley exercise should NOT be used routinely to maintain range of motion of the shoulder. **Shoulder Pain** For stroke survivors with shoulder pain, shoulder strapping may be used to reduce pain. (weak recommendation) For stroke survivors with shoulder pain, shoulder injections (either sub acromial steroid injections for patients with rotator cuff syndrome, or methylprednisolone and bupivacaine for suprascapular nerve block) may be used to reduce pain. (weak recommendation) For stroke survivors with shoulder pain and upper limb spasticity, Botulinum Toxin A may be used to reduce pain. (weak recommendation) For stroke survivors with shoulder pain, electrical stimulation is not recommended to manage pain. (weak recommendation) For stroke survivors with severe weakness who are at risk of developing shoulder pain, management may include: shoulder strapping; education of staff, carers and stroke survivors about preventing trauma; active motor training to improve function. For stroke survivors who develop shoulder pain, management should be based on evidence-based interventions for acute musculoskeletal pain.
Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC, Deruyter F, Eng JJ, Fisher B, Harvey RL, Lang CE,	Positioning of hemiplegic shoulder in maximum external rotation while the patient is either sitting or in bed for 30 minutes daily is probably indicated. (B) Patient and family education (ie, range of motion, positioning) is recommended for shoulder pain and shoulder care after

Guideline	Recommendations
MacKay-Lyons M, Ottenbacher KJ, Pugh S, Reeves MJ, Richards LG, Stiers W, Zorowitz RD; 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. **Guidelines for adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart Association/American Stroke Association.** ***Stroke* 2016;47:e98–e169**	stroke, particularly before discharge or transitions in care. (C) Botulinum toxin injection can be useful to reduce severe hypertonicity in hemiplegic shoulder muscles. (A) A trial of neuromodulating pain medications is reasonable for patients with hemiplegic shoulder pain who have clinical signs and symptoms of neuropathic pain manifested as sensory change in the shoulder region, allodynia, or hyperpathia. (A) It is reasonable to consider positioning and use of supportive devices and slings for shoulder subluxation. (C) NMES may be considered (surface or intramuscular) for shoulder pain. (A) Ultrasound may be considered as a diagnostic tool for shoulder soft tissue injury. (B) Usefulness of acupuncture as an adjuvant treatment for hemiplegic shoulder pain is of uncertain value. (B) Usefulness of subacromial or glenohumeral corticosteroid injection for patients with inflammation in these locations is not well established. (B) Suprascapular nerve block may be considered as an adjunctive treatment for hemiplegic shoulder pain. (B) Surgical tenotomy of pectoralis major, lattisimus dorsi, teres major, or subscapularis may be considered for patients with severe hemiplegia and restrictions in shoulder range of motion. (C) The use of overhead pulley exercises is not recommended. (C)
Intercollegiate Stroke Working Party. *National clinical guideline for stroke,* 5th edition. London: Royal College of Physicians, 2016.	**3.11.1 Positioning** When lying or sitting, patients with acute stroke should be positioned to minimise the risk of aspiration and other respiratory complications, shoulder pain and subluxation, contractures and skin pressure ulceration. **4.12.3 Shoulder pain and subluxation** People with functional loss in their arm after stroke should have the risk of shoulder pain reduced by: – careful positioning of the arm, with the weight of the limb supported; – ensuring that family/carers handle the affected arm correctly, avoiding mechanical stress and excessive range of movement; – avoiding the use of overhead arm slings and pulleys. People with arm weakness after stroke should be asked regularly about shoulder pain. People who develop shoulder pain after stroke should: – have the severity monitored and recorded regularly, using a validated pain assessment tool; – have preventative measures put in place; – be offered regular simple analgesia. People with shoulder pain after stroke should only be offered intra-articular steroid injections if they also have inflammatory arthritis.
Scottish Intercollegiate Guidelines Network (SIGN). Management of patients with stroke: rehabilitation, prevention and management of complications, and	Prevention & Treatment of Shoulder Subluxation (4.10.1) **Consider** Electrical stimulation **Insufficient evidence**

Guideline	Recommendations
discharge planning. A national clinical guideline. Edinburgh (Scotland): Scottish Intercollegiate Guidelines Network (SIGN); 2010 June. p.34	Slings or supportive devices Prevention & Treatment of Post-Stroke shoulder Pain (4.12.1) **Not recommended** Overhead pulleys, functional electrical stimulation **Insufficient evidence** prolonged shoulder positioning, enhanced physical therapy (including EMG-biofeedback, behavioural interventions or device-delivered continuous passive motion), shoulder strapping, slings, transcutaneous electrical nerve stimulation, *Clostridium botulinum* toxin type A in patients with shoulder spasticity but without pain at baseline, intra-articular steroid injections, non-steroidal anti-inflammatory agents, ultrasound, intramuscular electrical stimulation, complementary therapies compared to standard care in at-risk individuals.
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; 2010.	(No specific shoulder section) Shoulder mobility should be monitored and maintained during rehabilitation. Subluxation can be reduced and pain decreased using functional electrical stimulation applied to the shoulder girdle. [B] p. 18 Recommend FES for patients who have shoulder subluxation. [B] p. 36

Evidence Tables (Shoulder Pain)

Supportive Devices (Slings & Strapping)

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Systematic reviews					
Nadler and Pauls 2017 **UK** **Systematic review**	N/A	8 studies (1 RCT, 1 quasi-RCT, 1 pre-post, 5 observational) evaluating the effect of shoulder orthoses on preventing or reducing gleno-humeral subluxation and hemiplegic shoulder pain	Studies evaluating the effect of shoulder orthoses on preventing or reducing gleno-humeral subluxation and hemiplegic shoulder pain.	**Primary Outcomes:** Immediate repositioning of the humeral head, subluxation, pain, range of movement, spasticity, hand edema, patient satisfaction.	Orthoses which comprise only a proximal (humeral) support are less effective. However, results suggest that once vertical subluxation has already developed some weeks after stroke, improvements are not maintained without the orthosis, unless there is concurrent recovery of muscle power. There is some evidence to suggest that wearing this type of orthosis for four weeks may improve shoulder pain. There was no increase in adverse effects of contracture, spasticity or hand edema and orthoses were tolerated well by the majority of patients
Appel et al. 2014 **UK** **Systematic review**	N/A	8 studies (4 RCTs, 2 case series, 1 quasi-RCT, 1 case study), with participants <6mo of stroke onset.	To determine i) the efficacy, and ii) any potential adverse effects of shoulder strapping used to reduce upper limb and shoulder impairments and dysfunction caused by stroke. Types of interventions were any form of strapping applied to the shoulder with therapeutic intent. Studies could include placebo strapping or no strapping as a control or comparator, but uncontrolled studies were also eligible for inclusion.	**Primary Outcomes:** i) participation restriction ii) upper limb function; iii) impairment outcomes including pain, subluxation, range of movement of the shoulder; iv) adverse events and v) participant experience outcomes.	The efficacy of shoulder strapping to alleviate upper limb dysfunction and shoulder impairments caused by stroke remains unknown. Strapping may, however, delay the onset of pain in those with severe weakness or paralysis.
Ada et al. 2005 **Australia** **Cochrane review**	N/A	4 RCTs (142 subjects) evaluating strapping (n=3) and hemisling (n=1). All participating subjects were in the acute phase of stroke (<4 weeks) with	3 differing strapping regimes using adhesive tape to support the shoulder, and changed every 2-4 days for up to 6 weeks. Subjects in 1	**Primary Outcomes:** Subluxation **Secondary Outcomes:** Pain, function (items 6-8 of	Prevention of subluxation (number of participants with over 10 mm of subluxation). Pooling of data not possible as the outcome

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		a flaccid arm with no history of shoulder pain.	study wore a hemisling during waking hours for 2-3 weeks.	the Motor Assessment Scale), contracture (degree of shoulder external rotation following intervention) Outcomes were assessed before and after treatment and up to 7 months, in 1 study.	was assessed in a single trial and only 1 subject developed subluxation. Pain Number of pain-free days after admission to study WMD: 13.6, 95% CI 9.7 to 17.8, p<0.0001. Results from 2 studies included Function WMD=0.83, 95% CI -1.46 to 3.12, p=0.5. Results from 1 study included. Contracture WMD=-1.40, 95% CI -10.9 to 8.10, p=0.8. Results from 1 study included. Adverse events: The effect of strapping as a risk factor for the development of contracture was examined in a single trial, but no increase was reported. Dropouts: a total of 17 subjects from all studies combined.
Clinical Trials					
Ada et al. 2017 **Australia** **RCT**	CA: ☑ Blinding: Patient ☒ Assessor ☑ ITT: ☑	46 acute stroke survivors within 3wk of stroke onset at risk of subluxation recruited from 3 inpatient units.	The experimental group used a modified lap-tray while sitting and a triangular sling while standing to support the affected arm for four weeks. The control group used a hemi-sling while sitting and standing.	**Primary Outcome:** Shoulder subluxation. **Secondary Outcomes:** Visual analog scale (VAS), Shoulder external rotation, forearm supination, wrist extension, Motor Assessment Scale.	There was no significant difference between groups in terms of shoulder subluxation (MD -3 mm, 95% CI -8 to 3), pain at rest (MD -0.7 out of 10, 95% CI -2.2 to 0.8), shoulder external rotation (MD -1.7 out of 10, 95% CI -3.7 to 0.3) or having less contracture of shoulder external rotation (MD -10 deg, 95% CI -22 to 2). There was no significant difference between groups in terms of other contractures and activity of the upper limb.
Van Bladel et al. 2017 **Belgium** **RCT**	CA: ☑ Blinding: Patient ☒ Assessor ☒ ITT: ☒	28 stroke inpatients, with severe upper limb impairments	Participants were randomly allocated to 3 groups (Actimove, Shoulderlift, No sling). Patients wore their supportive device for 6 weeks and no sling in the control group.	**Primary Outcomes:** Acromiohumeral distance (AHD), visual analog scale for pain (VAS). **Secondary Outcomes:** passive ROM, spasticity,	There was no significant difference between groups on shoulder subluxation at post-intervention. No other outcome was found to be significantly different between groups at post-intervention; except for VAS where the

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				Trunk Impairment Scale, Fugl Meyer assessment upper limb. Outcomes were assessed at pre- and post-intervention.	patients in the Actimove group reported more pain at rest (P=0.036) compared to the other two groups.
Chatterjee et al. 2016 **India** **RCT**	CA: ☒ Blinding: Patient ☒ Assessor ☑ ITT: ☒	30 patients with acute stroke	All participants received conventional neurorehabilitation 5 days a week over 6 weeks. Half of the sample (*n* = 15) were randomly assigned to the control group (neuro-rehabilitation only) and the other half (*n* = 15) were randomly assigned to the treatment group (neuro-rehabilitation and shoulder taping using the California tri-pull shoulder method).	**Primary Outcomes:** Visual Analog Scale (VAS), active shoulder flexion range of motion (AFLXN), Fugl Meyer Assessment Upper Limb total score (FMA-T), proximal (FMA-P), distal (FMA-D). Outcomes were assessed at pre- and post-intervention.	At posttest, the patients in the treatment group (M = 4.667, SD = 2.410) reported significantly less pain at rest than the control group (M = 7.467, SD = 1.684). That is, the patients in the treatment group reported, on average, 2.80 points less pain than the patients in the control group. At posttest, the level of AFLXN was significantly higher among the patients in the treatment group (M = 24.267, SD = 6.006) than in the control group (M = 19.133, SD = 3.270). There were significant and positive differences between the treatment and control group at posttest on the FMA proximal and total subscale. Specifically, the patients in the treatment group (M = 12.867, SD = 2.134) scored, on average, 1.80 points higher on the FMA proximal subscale than the patients in the control group at posttest (M = 11.067, SD = 1.580).
Huang et al. 2016 **Taiwan** **RCT**	CA: ☒ Blinding: Patient ☑ Assessor ☑ ITT: ☒	44 subacute stroke patients with hemiplegia	Subacute stroke patients with hemiplegia participated in this study and were randomly allocated to the control group (sham kinesiology taping (KT)) or experimental group (therapeutic KT). In the experimental group, a 3-week therapeutic KT with conventional inpatient rehabilitation was applied for 5 days per week. In the control group, the patients received a 3-week sham KT with conventional inpatient	**Primary Outcomes:** Shoulder subluxation (finger-breadth), shoulder spasticity (MAS), shoulder flexion, extension, abduction, external rotation, internal rotation, presence of shoulder pain, Visual analog scale (VAS), FMA-UE, modified BI, SSQOL, biceps tendon (effusion, tenosynovitis, tendinitis, tear), supraspinatus tendon (tendinitis, tear),	There was no significant difference between the two groups at post-intervention on any of the outcomes. The presence of shoulder pain was significantly different between the two groups; the presence of pain increased from 70% to 87% in the control group, while the presence of pain in the experimental group remained the same from pre- to post-intervention.

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			rehabilitation for 5 days per week.	subscapularis tendon (tendinitis, tear), subacromial-subdeltoid bursa (effusion or bursitis). Outcomes were assessed at pre-and post-intervention.	
Pandian et al. 2013 **Australia** **RCT**	CA: ☑ Blinding: Patient ☒ Assessor ☑ Therapists ☑ ITT: ☑	162 subjects with upper limb weakness <48 hours post stroke.	Subjects were randomized to two groups: 1) taping of the affected shoulder (i.e., tri-pull method) with conventional treatment, or 2) control group - sham taping of the affected shoulder with conventional treatment.	**Primary Outcomes**: VAS; Shoulder Pain and Disability Scale (SPDS) Outcomes were assessed at day 14 and 30 post treatment.	Compared to the control group, a greater reduction in VAS (day 14 p=0.45; day 30 p=0.03) and SPAD scores (day 14 p=0.33; day 30 p=0.04) was reported in the treatment group.
Griffin & Bernhardt 2006 **Australia** **RCT**	CA: ☑ Blinding: Patient ☒ Assessor ☑ ITT: ☑	33 patients at risk for the development of shoulder pain, with no previous history of shoulder pain who were admitted for inpatient stroke rehabilitation within 3 weeks of stroke onset.	Comparison of no strapping vs. therapeutic vs. placebo strapping technique using 2 lengths of adhesive tape. Strapping tape was removed and reapplied every 3-4 days, for 4 weeks. Patients in all groups received conventional rehabilitation therapies based on both Bobath and Motor Skill learning.	**Primary Outcomes:** Pain free days measured using the Ritchie Articular Index **Secondary Outcomes:** Modified Ashworth Scale, Motor Assessment Scale (MAS)(upper-arm component). Assessments were conducted at baseline and at the end of treatment.	The mean (±sd) number of pain-free days was highest in the therapeutic strapping group. Mean: 26.2 ± 3.9 vs. 19.1 ±10.8 (control strapping) vs. 15.9 ±11.6 (no strapping), p=0.023. 1 patient in the therapeutic strapping group developed pain over the study period compared with 5 patients in the other 2 groups. Median MAS scores at the end of treatment: 1 (therapeutic strapping) vs. 1 (placebo strapping) vs. 0 (control), p=0.346. Median Modified Ashworth Scale scores at the end of treatment: 1 (therapeutic strapping) vs. 1 (placebo strapping) vs. 2 (control), p=0.186. Drop-outs: therapeutic strapping group n=1, control group, n=2. Adverse events: 1 due to skin irritation

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Hanger et al. 2000 **New Zealand** **RCT**	CA: ☑ Blinding: Patient☒ Assessor ☑ ITT: ☑	98 patients with acute stroke (mean of < 12 days post onset) with persistent weakness of shoulder abduction.	Comparison of strapping with 3 lengths of nonstretch tape + comprehensive inpatient rehabilitation program of task-specific therapy or therapy only Strapping was continued for 6 weeks, or until patients achieved active abduction of the affected arm to 90 degrees against gravity for 2 seconds with a flexed elbow, or until discharge from the hospital. Strapping remained on at all times and was removed and replaced every 2-3 days.	**Primary Outcomes:** Pain, shoulder lateral range of movement measured at the point of pain (SROMP), VAS (10cm) **Secondary Outcomes:** Items 6-8 on the Motor Assessment Scale (MAS), FIM, Rankin Disability Scale Outcomes were at baseline, end of treatment, and 2 months later	There were no significant differences between groups at either the end of treatment or at final follow-up. The median value for patients in the strapping and control groups at baseline and final assessment were: SROMP (degrees): 55 and 35 vs. 60 and 40, p=0.15 Pain: 0 and 0 vs. 0 and 2, p=0.34 FIM: 29.5 and 47 vs. 31.5 and 41, p=0.71 Rankin: 4 and 3.5 vs. 4 and 4, p=0.64 Dropouts: strapping group n=13, control group n=12 Adverse events: skin reaction in 3 patients in the strapping group

Positioning

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Borisova & Bohannon 2009 **USA** **Systematic review & meta-analysis**	CA: ☒ Blinding: Patient ☒ Assessor ☑ ITT: ☒	5 RCTs that focused on stroke and included a clear description of a positioning programme. Mean time from stroke onset ranged from 14 to 84 days.	Comparison of positioning programmes in addition to conventional rehabilitation vs. rehabilitation only. Programmes were provided for 20-30 minutes, 2-3x/day, 5-7 days/week for 4-12 weeks or from admission to discharge from hospital.	**Primary outcome:** Shoulder external ROM (degrees).	There was no significant difference in mean (± SE, 95% CI) losses in ROM at the end of treatment: Control vs. positioning groups were 15.0±7.7, -0.06 to -30.0 vs. 13.6 ± 5.5, 2.90 to -24.34 degrees. SMD= -0.216, -0.573 to 0.141, p=ns. Adverse events: No reporting
De Jong et al. 2006	CA: ☑	19 subjects who had experienced their first	Subjects in the experimental group	**Primary Outcomes:** Passive range of motion	At the end of the treatment period the mean (± sd) loss of shoulder abduction (degrees) was

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Netherlands **RCT**	Blinding: Assessor ☑ ITT: ☒	stroke less than 12 weeks previously, with no premorbid impairments of their affected arm and without severe shoulder pain and with Brunnstrom stage of recovery <4.	participated in a positioning procedure twice a day for 30 minutes x 5 weeks. The arm was positioned with maximal shoulder abduction, external shoulder rotation, and elbow extension and forearm supination + conventional inpatient rehabilitation. Subjects in the control group received conventional rehabilitation only.	(ROM) in external shoulder rotation, shoulder flexion, shoulder abduction, elbow extension, forearm supination. **Secondary Outcomes:** Ashworth Scale (elbow extension), Fugl-Meyer Assessment Scale (FMA), Barthel Index (BI) Assessments were conducted before and after treatment and 5 weeks follow-up.	significantly less among subjects in the experimental group: -5.3 ±18 vs. -23 ± 13.4, p=0.042. There were no other significant differences in losses of passive ROM between groups (mean ± sd) over the study period. External shoulder rotation: -19.2 ± -18.4, shoulder flexion: -23.3 ± 19.6 vs. -28.8 ± 27.5, elbow extension: 0.6 ± 3.3 vs. -4 ±5.6, forearm supination: -11.5 ± 9.5 vs. -2.7 ± 12.7 There was no significant difference in the median FMA or BI change scores between groups: 1 vs. 0, p=0.917 and 6 vs. 4, p=ns The median change score for FMA scores was significantly greater among subjects in the experimental group: 11 vs. 1, p=0.038. (Statistical tests were not conducted for follow-up assessments due to high dropouts.) Dropouts: experimental group n=6, control group n=3 Adverse events: severe shoulder pain was reported by 1 patient
Ada et al. 2005 **Australia** **RCT**	CA: ☒ Blinding: Assessor ☑ ITT: ☒	36 subjects at risk for the development of contracture (hemiplegia and little or no arm function) admitted for inpatient rehabilitation within 20 days of first stroke.	Subjects in the experimental group received 2-30 minute sessions of shoulder positioning, 5 days a week for 4 weeks (1 abduction in external rotation position, shoulder/elbow at 90 degrees flexion) + 10 minutes of shoulder exercises vs. 10 minutes of shoulder exercises only.	**Primary Outcomes:** Maximum passive shoulder external rotation and flexion **Secondary Outcome:** Motor Assessment Scale (Item 6) Assessments were conducted before and after treatment	Mean (± sd) maximum passive external shoulder rotation before and after treatment (degrees). Experimental group: 71.0 ±10.5 to 64.9 ± 11.4 Control group:74.3 ± 11.8 to 56.4 ± 21.5, p=0.03 Mean (± sd) maximum passive shoulder flexion before and after treatment (degrees). Experimental group: 158.5 ± 12.7 to 6146.8 ± 13.7 Control group:164.3 ± 13.5 to 155.3 ± 16.6, p=0.88 Median MAS scores were not significantly different: 0 to 1 (exp. group) vs. 0 to 0 (control group), p=0.37 Dropouts: n=5 (experimental group =3, control group=2) Adverse events: no reporting

Electrical Stimulation

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Systematic Reviews					
Lee et al. 2017 **Korea** **Systematic review and meta-analysis**	N/A	11 studies (432 subjects) evaluated the effectiveness of neuromuscular electrical stimulation (NMES) for the management of shoulder subluxation.	The effect of NMES versus control was evaluated in the acute and chronic populations. The treatment duration (short or long) was also evaluated across the different phases of stroke recovery. Data on stimulation protocol was not provided.	**Primary Outcomes:** Shoulder subluxation, motor function, shoulder pain. Outcomes were assessed for differences between groups at post-intervention.	Acute subgroup: Shoulder subluxation (n=8): SMD=-1.1, 95% CI -1.53 to -0.68, p<0.001 in favor of NMES. Short daily treatment on shoulder subluxation (n=5): SMD=-0.91, 95% CI -1.43 to -0.40, p<0.0005 in favor of NMES. Long daily treatment on shoulder subluxation (n=3): SMD=-1.49, 95% CI -2.31 to -0.67, p=0.0004 in favor of NMES. Motor arm function (n=3): SMD=1.06, 95% CI -0.17 to 2.29, p=0.09. Pain (n=2): SMD=-1.07, 95% CI -4.43 to 2.29, p=0.53. Chronic subgroup: Shoulder subluxation (n=4): SMD=-1.25, 95% CI -1.61 to 0.11, p=0.07. Short daily treatment on shoulder subluxation (n=3): SMD=-0.68, 95% CI -1.11 to -0.25, p=0.002, in favor of NMES. Long daily treatment on shoulder subluxation (n=1): SMD=-0.51, 95% CI -1.51 to 0.49, p=0.32. Motor arm function (n=2): SMD=0.43, 95% CI -0.51 to 1.02, p=0.15. Pain (n=1): SMD=-0.28, 95% CI -0.90 to 0.35, p=0.38.
Vafadar et al. 2015 **Canada** **Systematic review and meta-**	N/A	10 trials (9 RCTs and 1 quasi-RCT) evaluated the evidence for the effect of FES on shoulder subluxation, pain and UE motor function when added to	Comparison of conventional therapy or conventional PT with OT versus electrical stimulation. Frequency of the	**Primary Outcomes:** Shoulder subluxation, shoulder pain, upper limb motor function. Assessment time point of outcomes was not	Early after stroke: Shoulder subluxation (n=6): SMD=-0.70, 95% CI -0.98 to -0.42, p<0.001. Shoulder pain free range of lateral rotation (n=3): SMD=0.31, 95% CI -0.13 to 0.75, p=0.16. Shoulder pain (n=3): SMD=-0.28, 95% CI -0.67 to

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
analysis		conventional therapy. 9 studies evaluated UE motor function, of which only 6 applied FES during the early stages of stroke recovery (<6mo). Data from 5 trials was used to generate a meta-analysis (295 subjects).	intervention ranged from 1x/d to 5x/d and lasted from 4 to 6wk. Data on stimulation parameters was not provided.	indicated.	0.11, p=0.16. Motor function (n=5): SMD=0.36, 95 % CI -0.27 to 0.99, p=0.26. Later after stroke: Shoulder subluxation (n=2): SMD=-0.42, 95% CI -1.04 to 0.21, p=0.19. Adverse events: No reporting.
Mathieson et al. 2014 **New Zealand** **Systematic Review**	N/A	14 studies (11 RCTs, 3 case reports; N=348 patients) that examined the use of functional electrical stimulation (FES) combined with mirror therapy and other treatment modalities for upper limb dysfunction post-stroke. Mean age: 63 yr Gender: males=209, females=139 Time since stroke: less than 12 days-7 years.	Studies were categorized into four groups: 1) Passive studies (N=4) comprised of interventions which act on patients who are not actively involved in the intervention (FES + botulinum toxin A, ROM bracing, splinting). 2) Active-assisted (2 studies) where the interventions assisted the patients with the task at hand (FES, finger tracking device) 3) Usual care (N=6) where the interventions combined with FES were common exercise-based therapies (Bobath techniques, upper limb therapy) 4) Imagery (N=2), FES+ mirror therapy, and FES+mental imagery.	**Primary Outcomes**: Upper Extremity Fugl-Meyer (UEFM); Motor Assessment Scale; Action Research Arm Test **Secondary Outcomes:** Barthel Index; Modified Ashworth Scale; Motor Activity Log	1) Passive: Variable findings whereby there were two positive and two negatives studies. 2) Active-Assisted: Variable findings whereby there was one positive and one negative study. 3) Usual Care: Demonstrated significant functional improvements in four of six studies. 4) Imagery: Demonstrated the most clinically significant results, with significant improvements in the UEFM when compared to controls. Of all interventions, FES and mirror therapy was found to be the most effective.
Ada & Foongchomcheay 2002 **Australia** **Systematic review & meta-**	NA	Included 7 trials that compared surface electrical stimulation at a frequency > 30Hz + conventional rehabilitation vs. conventional rehabilitation +/-	Electrical stimulation ranged from 10 to 35 Hz, sufficient to produce muscle contraction Target muscles: supraspinatus, supraspinous fossa and	**Primary Outcomes:** Subluxation (mm) **Secondary Outcomes:** Function (Bobath Assessment chart, Motor Assessment Scale, Fugl-Meyer-all scores were	Subluxation Early: WMD (95% CI) =6.5 mm, 4.4 to 8.6, p<0.001 Late: WMD (95% CI) =1.9 mm, -2.3 to 6.1, p=0.40 Function Early: WMD (95% CI) =18.6%, 0.4 to 36.7, p=0.06 Late: WMD (95% CI) =14.4%, -5.4 to 34.2, p=0.15

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
analysis		hemisling, wheelchair support, joint mobilizations and/or stretching Subjects with subluxation or shoulder muscle paralysis were included. 4 trials (145 subjects) were considered early (mean of 2 to 50 days post stroke) and 3 (38 subjects) were considered late (mean of 60 to 434 days post stroke)	deltoid Treatment duration: maximum of 15 minutes to 7 hours of stimulation, 1-4 sessions/day, 5-7 days/week for 4-6 weeks.	converted to a %), Pain (pain-free passive shoulder external rotation, pain free active shoulder external rotation using goniometry, 15cm VAS)	Pain ROM (degrees): WMD (95% CI) =3.7 degrees, -1.2 to 8.6, p=0.14. Results from 3 studies included. VAS (cm): WMD (95% CI)=1.6 cm, 0.1 to 3.0, p=0.04. Results from 2 studies included.
Price & Pandyan 2000 **UK** **Cochrane review**	N/A	4 RCTs (170 subjects) with hemiparesis following acute (n=2), sub-acute (3 months, n=1) and chronic (> 6 months, n=1) stroke. A small number of subjects in 2 trials had shoulder pain at baseline assessment	RCTs included comparisons of: 1) no sham treatment vs. FES; 2) sham treatment vs. high-intensity TENS, vs. low intensity TENS; 3) no sham treatment vs. electrical stimulation (neither FES, nor TENS) and 4) no sham treatment vs. low-frequency TENS. Electrical stimulation: 30-35 Hz, Target muscles: supraspinatus, posterior deltoid, most tender areas of shoulder girdle, wrist extensors. Treatment frequency: 1) maximum of 6 hours/day, 7 days/week; 2) 3 sessions of unknown duration, 3 days/week; 3) 0.5-1 hr sessions, 4	**Primary Outcomes:** New incidence of pain, changes in pain intensity from baseline **Secondary Outcomes:** Pain-free range of passive humeral lateral rotation (PHLR), motor function, subluxation, Ashworth Scale	New reports of shoulder pain: OR=0.64, 95% CI 0.19 to 2.14, p=0.5. Results from 2 studies included Change in pain intensity: SMD=0.10, 95% CI, -0.34 to 0.54, p0.7, Results from 2 studies included. PHLR (relative to baseline): WMD=6.53, 95% CI 4.71 to 8.35, p<0.0001. Results from 4 studies included. Motor score change from baseline: SMD=0.24, 95% CI 0.01 to 2.91, p=0.2. Results from 2 studies included Subluxation compared with baseline: SMD= -1.13, 95% CI -1.66 to -0.60, p=p<0.03. Results from 2 studies included. Change in AS scores from baseline: WMD=0.05, 95% CI -0.28 to 0.37, p=0.80. Results from 2 studies included.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			sessions/day, 7 days/week; 4) 6-minute sessions, 5 days/week Treatment duration: 4 weeks, 6 weeks (n=2) and 3 months		
Clinical Trials					
Jeon et al. 2017 **Korea** **RCT**	CA: ☑ Blinding: Assessor ☑ ITT: ☒	20 participants with subacute hemiparetic stroke	Participants were recruited for this study and were randomly divided into two groups: experimental group (n=10) and control group (n=10). Subjects in the experimental group participated in task-oriented electromyography triggered stimulation for 30 minutes, five times a week for four weeks, whereas the control group received cyclic functional electrical stimulation for 30 minutes, five times a week for four weeks. Subjects in both groups received conventional physical therapy for four weeks (30min/day, five times/week).	**Primary Outcomes:** Shoulder subluxation, visual analog scale for pain (VAS), Fugl Meyer Assessment (FMA-UE). Outcomes were assessed before and after the 4-week intervention period.	There was a significant difference between groups on shoulder subluxation, with the experimental group demonstrating significantly lower scores after treatment (p=0.027). The experimental group demonstrated significantly lower VAS scores during both abduction and external rotation compared to the control group after treatment (p=0.048, p=0.047). There was no significant difference between groups on the FMA-UE total score at post-intervention.
Wilson et al. 2014 **USA** **RCT**	CA: ☒ Blinding: Patient ☑ Assessor ☑ ITT: ☒	25 subjects (Brief Pain Inventory (BPI) range 4-10; shoulder abduction weakness ≤4), ≥3 months post stroke.	Subjects were randomized into two groups: 1) peripheral nerve stimulation (PNS) 6 hours per day for 3 weeks, or 2) usual care (UC) plus 8 hours of outpatient physical therapy for a 4-week period.	**Primary Outcomes:** Brief Pain Inventory (BPI-SF3) for pain intensity and interference **Secondary Outcome:** ShoulderQ, Short-Form 36 version 2 (SF-36 v2) Outcomes were assessed post treatment and weeks 1,	Both groups had a significant reduction in pain intensity as assessed by BPI-SF3, although more so in the treatment group (IIT, p=0.04; per protocol, p=0.068). There were no significant differences between groups on pain interference (p=0.398), ShoulderQ (p=0.059), and SF-36 v2 (p=0.98).

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
				4, 12, and 16.	
Manigandan et al. 2014 **India** **PCT**	CA: ☒ Blinding: Assessor ☑ ITT: ☒	24 subjects who were <3 post stroke	Subjects were consecutively assigned to one of two groups: 1) electrical stimulation to supraspinatus and posterior deltoid plus physio- and occupational therapy for 5 weeks, or 2) electrical stimulation to supraspinatus, posterior deltoid and long head of biceps plus physio- and occupational therapy for 5 weeks.	**Primary Outcomes:** Shoulder subluxation, shoulder pain (measured by passive pain free external rotation), active shoulder abduction ROM. Outcomes were assessed at baseline and 5 weeks of therapy.	Shoulder subluxation was reduced by a greater amount in group 2 (54.74%) compared to group 1 (22.4%; p<0.001). Passive pain free external rotation improved from 33.5 to 42.75 degrees in group 1, and from 30.16 to 46.41 degrees in group 2; improvement was greater for group 2 (p=0.001). The mean improvement in range of active shoulder abduction ROM in group 1 was 8.5 degrees while in group 2 it was 16.84 degrees; again group 2 improved by a greater amount (p<0.001).
Kojima et al. 2014 **Japan** **Cross-over RCT**	CA: ☒ Blinding: Assessor ☒ ITT: ☒	13 subjects with hemiparesis, 30-180 days post stroke.	Subjects were randomized to 1) an immediate NMES mirror therapy group plus physical and occupational therapy (PT + OT) for 4 weeks, followed by 4 weeks with just PT + OT, or 2) delayed NMES where PT + OT was administered alone for the 4 weeks, followed by 4 weeks with NMES.	**Primary Outcomes:** Fugl-Meyer Assessment (FMA), Motor Assessment Log (MAL) **Secondary Outcome:** Active ROM	The immediate NMES group showed a greater gain in FMA during the first 4 weeks of therapy (p=0.003) but not between week 4 and 8 (p=0.20) compared to the delayed NMES group. There were no significant differences between groups on MAL for amount or quality of use between baseline and week 4 or between week 4 and 8 (p>0.05 for both). The delayed NMES group showed a greater gain in active ROM between week 4 and 8 (p=0.01) compared to the immediate NMES group.
de Jong et al. 2013 **Netherlands** **RCT**	CA: ☑ Blinding: Patient ☑ Assessor ☑ ITT: ☑	46 subjects with severe arm motor deficits (1-3 Brunnstrom score; Fugl-Meyer Score ≤18), 2-8 weeks post stroke.	Subjects were randomized to two groups: 1) arm stretch positioning combined with motor amplitude NMES for two 45-minute sessions a day, five days a week, for eight weeks, or 2) sham arm positioning and sham NMES (controls).	**Primary Outcomes:** Passive ROM of arm, pain in the hemiplegic shoulder. Outcomes were assessed at baseline, mid-treatment, at the end of treatment (8 weeks) and follow-up (20 weeks).	There were no significant group x time interactions on all outcomes (p>0.05). The relative risk of shoulder pain in the experimental group was non-significant at 1.44 (95% CI 0.80 to 2.62).
Lin et al. 2014 **Taiwan** **RCT**	CA: ☑ Blinding: Patient ☑ Assessor ☑	43 subjects (Brunnstrom stage 3 or above; Modified Ashworth Scale ≤ 2) with an onset of stroke of ≥6 months.	Subjects were randomized to one of three groups: 1) mirror therapy group (MT) including a 10-minute	**Primary Outcomes:** Fugl-Meyer assessment (FMA); Box and block test (BBT), Motor assessment log (MAL)	For both MT and MT + MG groups, FMA total scores were significantly higher (p = 0.032 and p = 0.0031, respectively) compared to the control group. The MT + MG and control groups showed greater performance compared with MT on the

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
	ITT: ☒		warm-up, an hour of mirror box training, and 20 minutes of functional task practice; 2) MT combined with mesh-glove (MT + MG); 3) Controls - 1.5 hr therapeutic activities equivalent in duration and intensity to MT and MT+MG groups.		BBT (p=0.007 and p=0.036, respectively). There were no significant differences between groups on the MAL amount of use or quality of use subscales (p>0.05).
Church et al. 2006 **UK** **RCT**	CA: ☑ Blinding: Assessor ☑ ITT: ☒	178 patients with a new upper-limb problem resulting from stroke, which occurred within the previous 10 days.	Patients in the intervention group received surface NMES to the shoulder for 1 hour, 3x daily for 4 weeks. Stimulation frequency was 30 Hz, which was increased steadily to produce a muscle contraction. Patients in the control group received sham stimulation. Patients in both groups received standard stroke unit care.	**Primary Outcomes:** ARAT scores at 3 months **Secondary Outcomes:** ARAT (4 weeks), Frenchay Arm test (FAT), Motricity Index (MI), Star Cancellation test, upper-limb pain Assessments were conducted at baseline, 4 weeks and 3 months	Median ARAT scores at baseline, 4 weeks and 3 months FES group: 0, 45.0 and 50.0 Control group: 3, 45.5 and 55.5 =0.888 (4 weeks), p=0.068 (3 months) Median FAT scores at baseline, 4 weeks and 3 months FES group: 0.5, 4, 4 Control group: 0, 4, 5 p=0.923 (4 weeks), p=0.012 (3 months) Median MI scores at baseline, 4 weeks and 3 months FES group: 61.3, 80, 88 p=0.574 (4 weeks), p=0.248 at 3 months) Control group: 63.3, 77, 89 Star Cancellation test (% fail) at baseline, 4 weeks and 3 months FES group: 42, 33, 31 Control group: 36, 34, 24 p=0.870 (4 weeks), p=0.371 (3 months) Upper-limb pain (%) at baseline, 4 weeks and 3 months FES group: 21, 22, 46 Control group: 22, 26, 45 p=0.462 (4 weeks), p=1.00 (3 months)

Botulinum Toxin-Type A (BT-A)

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Singh & Fitzgerald 2010 **USA** **Cochrane review**	N/A	Included 6 RCTs, (164 subjects) 5 of which recruited subjects following stroke. Subjects in 1 study had arthritis. Subjects in 2 studies were recruited more than 3 months following stroke. Subjects in the remaining trials were recruited > 6 months following stroke or had shoulder pain of duration > 6 months.	Treatment contrasts included a single injection of 500 U Dysport vs. placebo (n=3); 50 U Botox vs. placebo (n=2) and 100 U Botox vs. 40 mg triamcinolone acetonide (n=1). Subjects in 1 study received additional physical therapy and subjects in 1 study received treatment with TENS for 6 weeks.	**Primary Outcomes:** Pain, measured using a 10 cm VAS or verbal rating scale, adverse events **Secondary Outcomes:** Modified Ashworth Scale (MAS), ROM (flexion, extension, abduction and adduction)	Pain (4-6 weeks following treatment): MD= -1.12, 95% CI -2.89 to 0.66, p=0.22. Results from 4 studies included. Pain (12-24 weeks): MD= -1.22, 95% CI -2.37 to -0.07, p=0.037. Results from 3 studies included. Total adverse events: RR=1.46, 95% CI 0.64 to 3.36, p=0.37. Results from 3 studies included. MAS (4-6 weeks): MD= -0.62, 95% CI -1.40 to 0.17, p=0.12 Results from 2 studies included. MAS (12-24 weeks): MD= -0.13, 95% CI -0.65 to 0.38, p=0.61. Results from 2 studies included. Passive abduction (0-180 degrees at 4-6 weeks): MD=8.49, 95% CI -2.40 to 19.39, p=0.13. Results from 3 studies included. Passive abduction (0-180 degrees at 12-24 weeks): MD=17.72, 95% CI -9.61 to 45.04, p=0.20. Results from 2 studies included. Shoulder external rotation (0-90 degrees at 4-6 weeks) MD=9.84, 95% CI 0.20 to 19.49, p=0.045. Results from 3 studies included. Shoulder external rotation (0-90 degrees at 12-24 weeks) MD=11.86, 95% CI -0.61 to 24.33, p=0.062. Results from 2 studies included.
De Boer et al. 2008 **The Netherlands**	CA: ☒ Blinding: Assessor ☑	22 patients, an average of 6 months following stroke with significant shoulder pain (> 40 mm on a VAS) of at least 1 week's duration that	Patients in the experimental group received a single injection of either BT-A (2x50 units Botox) vs. placebo injection applied to the	**Primary Outcomes:** Pain (100 mm VAS) Humeral external rotation (degrees) **Secondary Outcomes:**	There was no significant difference in mean (± sd) pain scores between groups at 12 weeks (p=0.08) Experimental group: 44.9±15.2 (baseline) to 38.1 ± 18.2 (12 weeks) Control group: 61.7 ± 23.2 (baseline) to 46.8 ± 27.2 (12 weeks)

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
RCT	ITT: ☒	restricted passive external rotation of the humerus.	subscapularis muscle at two locations. All patients received some form of physical therapy.	None Outcomes were assessed at baseline, 6 and 12 weeks following treatment.	Mean (± sd) humerus external rotation increased significantly more among patients in the experimental group (p=0.001). Experimental group: 20.4 ± 16.6 (baseline) to 32.1 ± 14 (12 weeks) Control group: 10.3 ± 19.5 (baseline) to 23.7 ± 20.7 (12 weeks). Dropouts: n=1 Adverse events: No reporting

Physical Therapy

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Lynch et al. 2005 **USA** **RCT**	CA: ☒ Blinding: Assessor ☑ ITT: ☒	35 patients admitted for inpatient rehabilitation following first, unilateral stroke with significant motor impairment (<3 on MRC scale) in all upper limb muscles and a Fugl-Meyer score < 20 for shoulder/elbow. Subjects were recruited an average of 13 days post stroke	Patients in the experimental group (n=19) received continuous passive motion treatments with the use of a device (25 min sessions, 5 days/week until discharge) in additional to comprehensive rehabilitation. Patients in the control group (n=16) received self-range of motion exercises under the supervision of a physiotherapist All patients received rehabilitation therapies for 3.5 hours per day.	**Primary Outcomes**: Fugl Meyer Assessment (pain) **Secondary Outcomes:** Fugl-Meyer (shoulder & elbow), Modified Ashworth Scale (MAS), FIM (self-care), joint stability (0 to 9 scale, whereby 0 represented a stable joint), Motor Power Scale (wrist/hand, max score of 60) Motor Status Scale (shoulder and elbow, max score of 40) Assessments were conducted at baseline and at hospital discharge.	At discharge there were no significant differences in means between groups for any of the outcomes. Mean ± (SEM) discharge scores for patients in the experimental and control groups Fugl-Meyer (pain): 22.6 ± 0.5 vs. 21.8 ± 0.5, p=0.31 Joint stability: 2.4 ± 0.4 vs. 3.6 ± 0.4, p=0.06 MAS: 1.3 ± 0.5 vs. 2.1 ± 0.5, p=0.29 FIM: 27.7 ± 1.2 vs. 26.4 ± 1.3, p=0.52 Motor Power: 9.7 ± 1.3 vs. 7.0 ± 1.4, p=0.20 Motor Status Scale: 9.2 ± 1.3 vs. 8.3 ± 1.4, p=0.67 Fugl Meyer (shoulder/elbow): 10.9 ±1.1 vs. 8.9 ± 1.2, p=0.26 Dropouts: n=2 experimental group, n=1 control group Adverse events: No reporting

Oral Analgesic Agents

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Poduri 1993 **USA** **Controlled trial**	N/A	43 patients discharged from outpatient stroke rehabilitation with shoulder pain (identified retrospectively from medical charts) for which a referral was made to a physiatrist. 28 of these patients were seen by a physiatrist (group 1), the other 20 patients (group 2) were not due to difficulties with transportation. Subluxation was present in 13 group 1 and 11 group 2 patients	23 patients in group 1 whose shoulder pain was of no discernible etiology received either a nonsteroidal anti-inflammatory agent (Ibuprofen 400-800g tid, and sulindac, 150 mg bid.) taken 30 to 60 minutes prior to occupational therapy. 10 of the patients in group 1 also received ultrasound therapy (3x/week for 2 weeks prior to therapy). A second group of patients received only occupational therapy consisting of range of motion, active assistive and strengthening exercises and activities of daily living training. One patient in Group 2 received ultrasound treatment. Patients in both groups attended therapy sessions an average of 2-3x/week for 4 months.	**Primary Outcome:** Pain relief (% of responders) **Secondary Outcomes**: Increase in ROM in shoulder flexion and abduction (% responders), increase in function (% responders) Timing of assessments was not stated (assumed to be before and after treatment	The percentage of patients in group 1 who responded to treatment was significantly greater compared with subjects in Group 2. Pain relief: 91% vs. 15%, p<0.001 Increase in ROM (flexion): 78% vs. 40%, p<0.006 Increase in ROM (degrees): 28.4 vs. 13.3, p<0.03 Increase in ROM (abduction): 75% vs. 50%, p<0.055; Increase in ROM (degrees) 29.9 vs. 18.3, p=0.125 Increase in function: 100% vs. 55%, p<0.0001. Adverse events: No reporting

Intra-articular Corticosteroid Injections

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Park et al. 2017 **UK**	N/A	20 subacute stroke patients	All patients included in this study underwent ultrasound-guided intra-articular triamcinolone	**Primary Outcomes:** Shoulder pain during passive ROM using the Numerical Rating Scale (NR).	There was no significant difference between the groups at any time interval.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
PCT			(TA) or polydeoxyribonucleotide (PDRN) injections in the hemiplegic shoulder. The TA group received intra-articular injections of TA 40mg/1 mL and normal saline (N/S) 14mL (total 15mL). The PDRN group received intra-articular injections of PDRN 1 ampoule (PDRN sodium 5.625mg/3mL) and N/S 12mL (total 15mL).	Assessment was performed just before the first injection, 1 day after the first injection, 1 week after the first injection, 1 week after the second injection, 2 weeks after the second injection, 3 weeks after the second injection, and 4 weeks after the second injection.	
Huang et al. 2016 **Taiwan** **RCT**	CA: ☒ Blinding: Assessor ☑ Patient ☑ ITT: ☒	26 subacute stroke patients	Patients were enrolled and randomly divided into 2 groups: the experimental group received ultrasound-guided, subacromial HA injections once per week for 3 weeks and conventional rehabilitation, whereas the control group received 0.9% sodium chloride injections once per week for 3 weeks and conventional rehabilitation.	**Primary Outcomes:** Visual analog scale (VAS), Fugl Meyer Assessment (FMA-UE). Outcomes were assessed before and after the intervention.	In the experimental group, significant differences were found in VAS (P = 0.003), shoulder flexion (P = 0.03) and abduction (P = 0.02), and FMA-UE (P = 0.003) after treatment. In the control group, there were significant differences in VAS (P = 0.007), shoulder flexion (P = 0.035), and FMA-UE (P = 0.042) after treatment. The comparison of the changes in the parameters between the experimental and control groups, after each intervention, revealed a significant difference in VAS (P = 0.001).
Jang et al. 2016 **Korea** **RCT**	CA: ☒ Blinding: Assessor ☒ Patient ☒ ITT: ☑	31 patients with HSP and limited range of motion, with a stroke onset time less than 3mo	All subjects were randomly allocated to group A for three weekly IAHA injection or group B for a single intra-articular steroid (IAS) injection. All injections were administered by an expert physician until the 8th week using a posterior ultrasonography-guided approach.	**Primary Outcomes:** Wong-Baker Scale (WBS), Passive range of motion (PROM). The assessment of therapeutic effects was performed prior to the start of the study, and in the 1st, 4th, and 8th weeks.	Group A showed significant improvement in WBS night and movement at 4wk and 8wk (p≤0.003), while Group B showed significant improvement only for movement at 4wk and 8wk (p≤0.001). Group A showed significant improvement in ROM in shoulder flexion and external rotation at 4wk and 8wk (p≤0.006), while Group B showed significant improvement only at 8wk (p≤0.014). There were no significant differences between groups for WBS or ROM (p>0.05).
Dogan et al. 2013	CA: ☒	60 subjects post stroke (time since stroke onset	Subjects were assigned to one of three groups: 1)	**Primary Outcomes:** VAS, ROM	Immediately after treatment joint ROM improved for both experimental groups (p<0.001 for both) but not

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Turkey **PCT**	Blinding: Assessor ☑ Patient ☑ ITT: ☒	not provided).	conventional physical treatment and rehabilitation (PTR); 2) conventional PTR plus intra-articular steroid; 3) conventional PTR plus intra-articular steroid plus hydraulic distention.	Outcomes were assessed at baseline, after treatment and at 1-month follow-up.	controls. All three groups had significantly improved joint ROM at 1-month follow-up (p<0.001) with no significant differences between them. After treatment and at 1-month follow-up, VAS scores at rest and during activity were improved for both experimental groups (p<0.001 for both) but not controls. Among the two experimental groups, there was a greater reduction in at rest VAS scores for the steroid + hydraulic distention group compared to the other two groups (p<0.001).
Rah et al. 2012 **Korea** **RCT**	CA: ☒ Blinding: Subjects ☑ Therapists ☑ Assessor ☑ ITT: ☒	58 subjects with chronic HSP (at least 3/10 on a VAS, of at least 1 month's duration) and evidence of rotator cuff disorder. Deltoid muscle grade of 2 or more on the manual muscle test of the Medical Research Council Scale.	Subjects received a single ultrasound-guided subacromial injection with triamcinolone acetonide 40mg (treatment group, n=29), or lidocaine (placebo group, n=29). All subjects participated in an exercise program, which included (in progressive order) gentle and active range of motion (AROM) exercises without weight, progressive strengthening exercises for the scapular stabilizing muscles and rotator cuff strengthening with closed chain exercises. Exercises were performed 3 times a day for 10 minutes.	**Primary Outcomes:** Average shoulder pain level at day and night (10 cm VAS). **Secondary Outcomes:** Modified Barthel Index, Shoulder Disability Questionnaire (SDQ), and angles of shoulder active range of motion (flexion, abduction, external rotation, and internal rotation). Assessments were conducted at baseline, and at weeks 2, 4 and 8.	Mean (±sd) changes from baseline to week 8 VAS (day) Treatment group: 5.7 ± 1.7 to 3.0 ± 1.8 Control group: 5.7 ± 1.7 to 4.9 ± 2.3 p=0.001 VAS (night) Treatment group: 5.5 ± 1.5 to 2.7 ± 1.7 Control group: 5.9 ± 2.0 to 5.0 ± 2.6 p<0.001 SDQ Treatment group: 16.9 ± 3.8 to 11.1 ± 5.7 Control group: 16.6 ± 2.7 to 15.2 ± 3.9 p<0.001 MBI Treatment group: 75.7 ± 17.8 to 77.5 ± 17.2 Control group: 71.0 ± 26.3 to 72.7 ± 25.6 P=0.737 There were significant differences favouring the treatment group for flexion, external rotation and internal rotation, favouring the treatment group. Drop-outs: treatment group n=1, control group n=1. Adverse events: facial flushing (n=2 treatment), dizziness (n=1 control)
Snels et al. 2000	CA: ☑ Blinding:	37 patients with hemiplegic shoulder pain (≥ 4 on a 0 to 10 VAS), of	Patients received either three injections (1-2 weeks apart) of	**Primary Outcomes:** Pain during the previous week (10 cm VAS)	There were no significant differences in change scores between groups for any of the outcomes

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Netherlands **RCT**	Subjects ☑ Therapists ☑ Assessor ☑ ITT: ☒	at least 2 week's duration with a limitation of passive ROM. Stroke onset was < 6 months for 24 patients, and ≥6 months for 13 patients	triamcinolone acetonide (40 mg Kenacrot A-40 in 1ml) or three placebo injections (1 ml saline solution).	**Secondary Outcomes:** Passive external rotation, ARAT, Fugl Meyer, BI, Rehabilitation Activities Profile (% of maximum possible score). Outcomes were assessed one week prior to treatment, 1 week later, prior to randomization and prior to first injection, one week later, prior to the second injection, 2 weeks later prior to the third injection. Follow-up assessments were conducted 3 and 9 weeks following the third injection.	Median change in scores from baseline to 3 weeks following last injection Pain: -2.3 vs. -0.2, p=0.06 ARAT: 0 vs. 0, p=0.17 Fugl-Meyer: 3.5 vs. 1.0, p=0.41 Passive external rotation: 2.5 vs. 0, p=0.71 BI: 1.5 vs. 1.0, p=0.85 Rehabilitation Activities Profile: 15.9 vs. 6.3, p=0.17 Dropouts: treatment group: n=2, control group n=2 Adverse events: n=29 (treatment group), n=22 (control group)

Ultrasound

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Inaba & Piorkowski 1972 **USA** **RCT**	CA: ☒ Blinding: Assessor ☑ ITT: ☒	33 subjects with shoulder pain occurring within the range of 0 to 90 degrees of flexion or abduction of the arm following stroke occurring > 3 months previously.	Patients were randomly assigned to 1 of 3 groups: Range of motion (ROM) exercises and positioning group (control); ROM exercises and ultrasound (treatment); or ROM exercises and mock ultrasound (placebo). All patients received ROM exercises for 4 weeks and given a minimum of 15 treatments.	**Primary Outcome:** Shoulder ROM (degrees) Measurements were conducted before and after treatment	Mean (±sd) change in ROM from baseline for control, treatment and placebo groups, respectively: Flexion: 7 ± 19 vs. 5 ± 33 vs. -12.5 ±15, p=ns Abduction in internal rotation: 0 ± 7 vs. -2 ± 14 vs. -2 ± 15, p=ns Abduction in external rotation: 4 ± 13 vs. 2 ± 22 vs. -2 ± 21, p=ns External rotation: 2 ± 15 vs. -6 ± 14 vs. -10 ± 16, p=ns Dropouts: none Adverse reports: No reporting

Acupuncture

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Peng et al. 2017 **China** **Systematic Review and Meta-analysis**	NA	20 studies (1918 subjects) evaluated the effects of acupuncture and traditional rehabilitation. The study does not provide a sub analysis based on stroke chronicity.	Studies that compared the effectiveness of acupuncture plus rehabilitation therapy with that of placebo/sham acupuncture plus rehabilitation therapy or with that of only rehabilitation therapy for post stroke shoulder hand syndrome were included. Any type of rehabilitation therapy was eligible.	**Primary Outcomes:** Change from baseline to endpoint on visual analog scale (VAS), Fugl Meyer Assessment (FMA-UE). **Secondary Outcome**: Barthel Index (BI). Outcomes were evaluated at endpoint.	VAS score change from baseline to 14d (n=1): MD=1.29, 95% CI 0.63 to 1.95, p=0.00021 favoring combination therapy. VAS score change from baseline to 21d (n=1): MD=1.02, 95% CI 0.01 to 2.03, p=0.05. VAS score changes from baseline to 25d (n=1): MD=2.60, 95% CI 1.99 to 3.21, p<0.001 in favor of combination therapy. VAS score changes from baseline to 28d (n=4): MD=1.35, 95% CI 0.95 to 1.76, p<0.001 in favor of combination therapy. VAS score changes from baseline to 30d (n=2): MD=1.53, 95% CI 1.03 to 2.04, p<0.001 in favor of combination therapy. FMA: MD=8.42, 95% CI 6.74 to 10.10, p<0.001 in favor of combination therapy. ADL: SMD=1.31, 95% CI 0.57 to 2.05, p=0.0005 in favor of combination therapy.
Zhao et al. 2015 **China** **RCT**	CA: ☑ Blinding: Assessor ☒ Patient ☒ ITT: ☒	124 stroke patients (<6mo of stroke onset) with hemiplegia and pain or discomfort of the shoulder after hemiplegia	Subjects were randomized into a treatment group and control group. In the treatment group, warm needling therapy and acupuncture at meridian-sinew sites based on the meridian-sinew theory were performed. In the control group, usual care therapy was applied. One treatment was administered for a maximum of 30– 40 min five times per week for 2 weeks.	**Primary Outcomes:** Visual analog scale (VAS), range of motion (ROM). **Secondary Outcomes:** Barthel Index (BI). The VAS score was evaluated after each treatment, and the other three scales (ROM, BI) were applied before and 2 weeks after treatment. The VAS score and BI were also determined 3 months after the end of treatment.	The changes from baseline to after treatment on the VAS were significantly greater in the treatment group compared to the control group (p<0.01). This same trend was found baseline to follow-up (p<0.01). There were significant differences in active and passive ROM between the two groups; the improvement in the treatment group was greater than that in the control group (both $P < 0.01$) after 2wk of treatment. After 2 weeks of treatment, the BI scores were not significantly different between the two groups ($P = 0.25$). At the 3-month follow-up after treatment, the BI scores were greater in the treatment group compared to the control group ($P < 0.01$).
Seo et al.	CA: ☑	29 subjects, 56.5±29.7	Subjects were randomized	Primary Outcomes:	The O-API group showed significant improvement

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
2013 **Korea** **RCT**	Blinding: Assessor ☑ Patient ☑ ITT: ☒	days (experimental) or 53.5±26.7 days (control) post stroke	to two groups: 1) Ouhyul Herbal Acupuncture Point Injections (O-API) 3 times per week for 2 weeks; 2) Controls received saline injections.	Numerical Rating Scale, Passive ROM, Fugl-Meyer Motor Assessment (FMMA) Outcomes were measured at baseline and weeks 1-3.	on the NRS compared with that in the control group after 2 weeks of treatment, and the treatment effect was maintained until the follow-up period (p<0.001). Passive ROM decreased significantly in both groups, but there was no significant difference between groups. FMMA scores increased significantly for both groups but scores were significant higher for O-API group compared to controls (p=0.039).
Sheng & Zhi-yong, 2013 **China** **RCT**	CA: ☑ Blinding: Assessor ☒ Patient ☒ ITT: ☒	60 subjects post stroke	Subjects were randomized into an acupuncture or routine treatment group. Acupuncture was given once a day, for 4 weeks (1 course), with 4 courses given in total.	**Primary Outcomes:** Rates of cure, improvement or ineffectiveness.	The effective rate of acupuncture rehabilitation group was 90.9% (30/33), better than that of 70.4% (19/27) in the routine treatment group ($P < 0.05$).

Hand Edema

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Giang et al. 2016 **Singapore** **Systematic review**	NA	9 trials (5 RCTs, 3 non-RCTs, 1 PCT) consisting of 424 participants 1 trial = acute stroke 4 trials = subacute stroke 1 trial = subacute and chronic stroke 2 trial = did not report on stroke onset	Interventions included: compression therapy (3 trials), orthoses (3 trials), laser therapy (1 trial), mobilization (1 trial) and acupressure (1 trial)	**Primary outcome:** Hand edema	Results show a significant effect on hand edema with the Lycra garment and glove splint, bilateral passive range of upper-limb motion exercises, laser therapy, and acupressure. However, because the intervention period for the Lycra garment with glove splint was only 3 hours, the significance of the study may not be translatable into clinical practice due to its small changes. The mobilization exercises (i.e. range of motion exercises) were effective in reducing post stroke hand edema in patients with acute stroke within the previous 72 hours; the results might not be generalized to subacute or chronic stroke. Nonsignificant treatment effects were found with

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					bandaging, intermittent compression, kinesio tape, neutral functional realignment orthosis, and hand realignment orthosis.
Bernocchi et al. 2017 **Italy** **Pre-Post**	NA	21 hemiplegic stroke patients (Ashworth spasticity index ≤3) discharged from in-hospital rehabilitation	Intervention included a 2-month home-program of intensive hand training using the Gloreha Lite glove that provides computer-controlled passive mobilization of the fingers.	Feasibility: number of patients who completed home program, minutes of exercise, number of sessions/patients performed. Safety: visual analog scale (VAS) for hand pain, Ashworth spasticity for finger flexors, wrist flexors, hand edema (circumference of fingers and wrist). Motor function: motricity index (MI), nine-hole peg test (NHPT), grip strength. Outcomes (i.e. safety and motor function) were evaluated at baseline and after the intervention.	The mean VAS score of hand pain, Ashworth spasticity index and hand edema did not change significantly at T1 compared to T0. The MI, NHPT and Grip test improved significantly ($p = 0.0020$, 0.0156 and 0.0024, respectively) compared to baseline.
Borboni et al. 2017 **Italy** **Prospective trial**	NA	30 stroke patients with partial and full paralysis of the wrist and finger within the acute phase of recovery (16 with full paralysis; 14 with partial paralysis)	Patients in the both groups used the Gloreha device for passive mobilization of the hand twice a day for 2 consecutive weeks.	Outcomes: hand edema (measured using wrist and hand circumference), Visual analog scale (VAS) for pain, Modified Ashworth Scale (MAS), range of motion (ROM). Assessments were conducted before and after the intervention time period.	There was a significant difference between the two groups ($p<0.005$; effect size=1.42) on the VAS. Within group differences indicate that only the group with partial paralysis improved after the intervention ($p<0.05$). There was no significant difference between the groups on hand edema or spasticity.

Published Guidelines (Complex Regional Pain Syndrome-Type I)

Guideline	Recommendations
Clinical Guidelines for Stroke Management 2017. Melbourne (Australia): National Stroke Foundation.	For stroke survivors with mild to moderate weakness, complex regional pain syndrome and/or neglect, mirror therapy may be used as an adjunct to routine therapy to improve arm function after stroke. (weak recommendation)
Winstein et al. (2016). Guidelines for adult stroke rehabilitation and recovery: A guideline for Healthcare professionals from the American Heart Association/ American Stroke Foundation. *Stroke,* e1-e72.	None specific to treatment of CRPS
Intercollegiate Stroke Working Party. *National clinical guideline for stroke,* 5th edition. London: Royal College of Physicians, 2016.	None specific to treatment of CRPS
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; 2010.	None specific to treatment of CRPS

Evidence Tables (CRPS-1)

Corticosteroid Treatment

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Kalita et al. 2016 **India** **RCT**	CA: ☒ Blinding: Assessor ☒ Patient ☒ ITT: ☒	52 stroke patients with a mean stroke onset time of 9wk.	The patients were prescribed 40 mg prednisolone for 2 weeks followed by tapering in the next 2 weeks. Patients who responded were randomly assigned	**Primary Outcome**: CRPS score **Secondary Outcomes:** VAS, mRS, BI scores, and severe adverse events (SAE)	Group I patients had further improvement in CRPS score. Fifty percent of patients in group II had deterioration at one month and needed reinstitution of prednisolone; following which 77% of them improved in the next month. The improvement in CRPS score paralleled the VAS score but not mRS and BI scores in the first and second months in

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			prednisolone 10 mg daily (group I) or no prednisolone (group II).	They were followed up for the first and second month of randomization.	group I compared to group II. There was no SAE necessitating withdrawal of prednisolone.
O'Connell et al. 2013 **Australia** **Systematic review**	N/A	19 systematic reviews (6 Cochrane reviews and 13 non-Cochrane systematic reviews) that used any intervention (pharmacologic, surgical, physical, or alternative) aimed at treating pain, disability or both in CRPS. Subjects in all reviews were 18 years or older and suffering from CRPS.	Comparisons of multiple interventions (e.g., intravenous regional blockage, bisphosphates, calcitonin, ketamine, imagery, local anaesthetic, physiotherapy) for relieving pain caused by CRPS.	**Primary Outcomes:** VAS, Numerical Rating Scale (NRS)	There was moderate quality evidence that intravenous regional blockade with guanethidine is not effective in CRPS, and the procedure is associated with adverse events. There was low quality evidence that bisphosphates, calcitonin or a daily intravenous ketamine may be effective for pain compared to placebo. Graded motor imagery may be effective for pain and function when compared with usual care; mirror therapy was effective for pain relief compared to a control condition. Finally, there was low quality evidence that local anaesthetic sympathetic blockade, physiotherapy, and occupational therapy are not effective for CRPS.
Braus et al. 1994 **Germany** **RCT**	CA: ☒ Blinding: Subjects ☒ Therapists ☒ Assessor ☒ ITT: ☒	36 hemiplegic patients with definitive Shoulder Hand Syndrome secondary to a stroke of the middle cerebral artery. Shoulder pain developed from within 12 to 18 weeks following stroke.	Patients were randomized to orally receive either 8 mg 4x/day methylprednisolone for 14 days after which treatment was tapered off for 14 days or a placebo over 4 weeks. For patients in the placebo group, if no improvement was noted in shoulder-hand syndrome then they were given 4 weeks of corticosteroid treatment as per the experimental group. All patients received daily physical therapy	**Primary Outcomes:** Shoulder-Hand Syndrome Scale score (0 to 14-point scale where higher scores indicated greater severity). Cut-off score ≥8 was used to distinguish between patient with and without SHS, Assessments were conducted weekly during inpatient hospital stay and at 6 months.	Since patients in the control group continued to experience symptoms after 4 weeks, all but 2 received corticoid therapy. 31/34 patients became symptom free an average of 10 days following initiation of treatment (range=6 to 14 days). These patients remained symptom free (SHS score < 4) for 6 months. Dropouts: unclear Adverse events: transient increase in blood glucose (n=15), sleeping problems (n=7), steroid acne (n=5), slight increase in blood pressure (n=1)
Kalita et al. 2006 **India**	CA: ☒ Blinding: Subjects ☑ Therapists ☑	60 patients with a diagnosis of CRPS-I following stroke. Diagnosis was confirmed	Patients were randomly assigned to receive 40 mg prednisolone for 14 days followed by a 10	**Primary Outcome:** ≥ 2-point reductions in CRPS score.	Mean (± sd) scores at baseline and 1 months following treatment were: CRPS scores:

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
RCT	Assessor ☑ ITT: ☒	by a score ≥8 on the Shoulder-Hand Syndrome Scale	mg/week taper for 10 days (treatment group) or 20 mg piroxicam (NSAID) (control group) daily.	**Secondary Outcome:** Barthel Index Assessments were conducted before treatment and at 1 month.	Treatment group: 10.73 ± 1.95 and 4.27 ± 2.83 Control group: 9.83 ± 2.34 and 9.37 ± 9.37 ± 2.89 p<0.0001 BI scores: Treatment group: 1.97 ± 4.94 and 9.87 ± 4.43 Control group: 2.57 ± 4.32 and 7.07 ± 5.56 p=0.06 Dropouts: none Adverse events: gastritis (n=4 treatment group, n=1 control group), upper respiratory tract infection (n=1 treatment group, n=1 control group)

Physical Therapy

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Wei et al. 2019 **China** **Systematic review & meta-analysis**	All trials were considered to be of good quality using PEDro scale	13 RCTs (1,040) that included patients with a confirmed diagnosis of type I RSD, mainly due to stroke. Mean ages ranged from 50-62 years, 50% were men.	Trials compared electroacupuncture (EA) +/- conventional rehabilitation with conventional rehabilitation therapy. Treatments were provided 5-7 X/week, for 20-30 minutes, for 2-12 weeks. The intensity of the current was determined by the patient maximum tolerance threshold and local muscles twitch	**Primary outcomes** pain, Fugl-Meyer (FM) upper limb motor score, hand edema	Treatment with AE significantly reduced pain (WMD =- 1.122, 95% CI. -1.682 to -0.562], p<0.0001, n=13 trials), improved FM scores (WMD=6.039, 95% CI 2.231-9.85, p=0.002, n=13 trials) and decreased hand edema (WMD= (-0.800, 95% CI-1.972 to -0.212, p<0.0001, n=5 trials).
Smart et al. 2016 **UK** **Cochrane review**	NA	18 RCTs (739 participants) that included person ≥18 years, with CRPS types I and II, diagnosed using validated criteria. 14 trials included persons with upper-limb pain. Trials	Trials compared physiotherapy interventions, employed as a stand-alone intervention or in combination with other interventions, with the aim of reducing pain or	**Primary outcome:** Change in pain severity (0-100-point VAS) and disability **Secondary outcomes:** Changes in composite scores for CRPS symptoms, HRQoL	There were no trials of CRPS type II. Duration of follow-up was 2 weeks (n=9), ≥8 weeks (n=6), 2-7 weeks (n=3). Pooled analyses were possible for a single treatment contrast (GMI vs. usual care), using the results from 2 trials (same group of authors).

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
		included persons with both acute (n=6) and chronic pain (n=7). CPRS was related to a wide range of etiologies including post fracture, soft-tissue injuries, stroke, surgery, carpal tunnel syndrome, and idiopathic.	disability, compared with placebo, no treatment, another intervention or usual care with the aim of treating pain or disability, or both, associated with CRPS. Treatments included electrotherapy approaches such as TENS and ultrasound, cortically-directed sensory-motor rehabilitation strategies, such as graded motor imagery (GMI) and mirror therapy, exercise, manual lymphatic drainage (MLD) and pain management advice.		GMI was associated with significantly reduced pain post treatment (MD= -14.45, 95% CI -23.02 to -5.87, p<0.001) and improved function (MD=1.87, 95% CI 1.03 to 2.71, p<0.001), assessed using an 11-point numeric rating scale. Results from 2 trials including persons recovering from stroke, suggested that 4 weeks of mirror therapy + conventional stroke rehabilitation was effective for reducing pain at rest and during movement (by 38% and 45%, at 6 months) and reducing disability.

Abbreviations

CA = Concealed Allocation	CI = Confidence Interval
FIM = Functional Independence Measure	IQR = Interquartile Range
ITT = Intention to treat	N/A = Not Applicable
OR = Odds Ratio	RCT= Randomized Controlled Trial
ROM = Range of Motion	VAS = Visual Analogue Scale

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