Treating Patients with Hemiplegic Shoulder Pain

ABSTRACT


Studies on the efficacy of available methods of treatment for hemiplegic shoulder pain are reviewed in an attempt to identify the most effective treatment for this problem. Because of the poor quality of the 14 selected studies, no definite conclusion can be drawn about the most effective method of treatment. However, functional electrical stimulation and intra-articular triamcinolone acetonide injections seem to be the most promising treatment options.

Key Words: Systematic Review, Stroke, Treatment, Hemiplegic Shoulder Pain

Shoulder pain is a common problem after stroke; the occurrence reported in the literature varies from 16 to 84%.1–8 Patients with hemiplegic shoulder pain remain hospitalized longer, and shoulder pain complicates the rehabilitation process.2,7 Physicians and therapists from many different disciplines are involved in the treatment of these patients, and many different methods of treatment have been described and applied to patients with hemiplegic shoulder pain.1,9 Many different measures have also been recommended to prevent hemiplegic shoulder pain.1–3,10–13

In recent decades, several reviews on hemiplegic shoulder pain have been published.1,6,9,10,12,14 These reviews focus mainly on the etiology and treatment of hemiplegic shoulder pain. In general, the causes of hemiplegic shoulder pain can be divided into two categories: distant sources of (referred) shoulder pain (e.g., neck problems, visceral referred pain, thalamic pain) and local problems (e.g., rotator cuff disorders, adhesive capsulitis, subluxation of the glenohumeral joint, tendinitis, spasticity).1,6,9,12,14 Pain in the hemiplegic shoulder may also be caused by shoulder-hand syndrome or reflex sympathetic dystrophy.6,10,12,14 From the reviews that have been published, no conclusion could...
be drawn about the most effective method of treatment for hemiplegic shoulder pain for the following reasons. First, because they were not systematic. Second, no attempt has been made to estimate the methodological quality of the published studies, and third, success rates were not always mentioned. Furthermore, since the most recent review was published, several interesting intervention studies on hemiplegic shoulder pain have been published. In an attempt to identify the most effective method of treatment for hemiplegic shoulder pain, the literature was searched for studies that describe the results of an intervention to treat hemiplegic shoulder pain.

METHODS

A search was made in MEDLINE (from 1966 to October 1999), Embase (from 1988 to September 1998), CI-NAHL (from 1982 to September 1999), REHABDATA (from 1994 to July 1999), and the Cochrane Library (issue 2, 1999). The following keywords were used: (1) hemiparesis, hemiplegia, stroke, cerebrovascular disorder, cerebrovascular disease, brain injury, or brain ischemia; (2) shoulder, arm, or upper extremity; and (3) pain. For practical reasons, only studies published in Dutch, English, French, or German were selected. Further selection was based on the title and abstract. Only studies concerning the treatment of hemiplegic shoulder pain were included, and pain had to be one of the outcome measures. No restrictions were made with regard to study design. The references of the available articles were tracked for further possible studies.

The selected studies were rated for methodological quality independently by two reviewers (I. Snels and J. Dekker). One study was reviewed by the third author (J. van der Lee) because it was written by the second author. The review process was not blinded. The criteria list used to assess the methodological quality of the selected studies is presented in Table 1. Similar criteria have been used in other reviews.19–22

Although most studies described more than one outcome measure, only the scores for the outcome pain were taken into account in the calculation of the methodological score (item 13). The methodological score for each study was calculated by adding the points for each item together, the maximum possible score being 48 (100%). Thus, the higher the score, the higher the quality. A score of zero for an item meant that either the information about that item was not well described, or there was no information about it at all in the publication.

Data on study design, study population, and intervention were extracted. If possible, success rates for each treatment group were calculated as the percentage of patients treated successfully (according to the authors) divided by the total number of patients allocated to that specific treatment group (intention-to-treat).

RESULTS

Selected Studies

On the basis of both the title and abstract, 25 articles were identified. Of these, 11 articles were excluded for the following reasons: in one study, the intervention was diagnostic instead of therapeutic;23 in two studies, the outcome measures did not include pain;24,25 three studies dealt with primary prevention;18,26,27 in two studies, the intervention was aimed at reducing spasticity instead of pain;28,29 and three studies dealt with reflex sympathetic dystrophy and shoulder-hand syndrome instead of hemiplegic shoulder pain.30–32 Reference tracking resulted in one additional publication33 that met the criteria; however, it referred to a study by Caldwell et al.34 that had already been selected, so the data of these two articles were combined.

Fourteen studies met the inclusion criteria and were rated for methodological quality.15–17,33–44 Before the consensus meeting, the reviewers disagreed on 64 out of 672 items (9.5%). Most disagreements between the reviewers resulted from reading errors and were easily resolved. The final methodological score was determined by consensus. Table 2 presents the study characteristics of the 14 studies, which are grouped according to the aim of the intervention: (1) normalization of muscle tone, (2) reduction of glenohumeral subluxation, and (3) treatment of the shoulder capsule. Within these three groups, the various studies are ranked in order of decreasing methodological score.

The methodological scores ranged from 2 to 25 of 48 (4–52% of the maximum score), indicating the overall poor methodological quality. Eight studies scored less than 10 points (21% of the maximum score), two of which were not even above the minimum score of 2 points. This minimum score of 2 points implies that only the type of intervention is mentioned (1 point) and that pain is an outcome measure that is clinically relevant (1 point). These factors were inherent to the inclusion criteria.

Table 2 shows that the success rates vary from 0 to 100%. It was not possible to calculate the success rate for the interventions described in four of the studies because the results were only reported at group level17,39 or because the number of patients who were treated successfully was not mentioned.41,43 As shown in Figure 1, success rates are inversely related to methodological quality. Only the success rates in the studies carried out by Williams34 (52%), Chantraine et al.15 (67%) and Dekker et al.16 (46%) conform to an intention-to-treat analysis.
Characteristics of Selected Studies

As can be seen in Table 2, the study designs of the selected studies are very divergent. There are three randomized clinical trials (RCTs), one randomized trial with a crossover design, a controlled study (not randomized), one multiple baseline design, five case series, and three case reports. Of the fourteen studies, two included more than 50 patients and five included less than 10 patients. Nine studies did not include a control group.

The characteristics of the study populations are also presented in
<table>
<thead>
<tr>
<th>1st Author, Methodologic Score (MS) (%)</th>
<th>Study Design (n) and Study Population</th>
<th>Intervention</th>
<th>Co-intervention</th>
<th>Main Outcome Measures</th>
<th>Follow-Up Reported Results and Conclusions, Success Rate (SR)</th>
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<tbody>
<tr>
<td>1. Interventions aimed at normalization of muscle tone</td>
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<tr>
<td><strong>Williams</strong>&lt;sup&gt;44&lt;/sup&gt;</td>
<td>MS 25 (52)</td>
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<tr>
<td>Randomized crossover trial (n = 20) Hemiparesis or hemiplegia based on vascular disease; 3–16 wk. after stroke; HSP; no shoulder pain prior to stroke; no spasmyotic medication; informed consent</td>
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<td></td>
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<td>Group 1 (n = 10): EMG biofeedback for 30 min on 5 days</td>
<td>Conventional PT for 1 hr, frequency not mentioned</td>
<td>Pain: Pain Rating Index and Present Pain Intensity scale of McGill Pain Questionnaire</td>
<td>Group 1: 2 wk Group 2: 3 wk Both groups: pain down, ROM up; between groups: no significant differences SR pain (after 2 wk) Group 1: 5/10 (50%); group 2: 8/10 (60%) SR ROM nc</td>
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<td>Group 2 (n = 10): relaxation exercises for 30 min on 2 days; after 1 wk, subjects were reassigned to the opposite treatment group</td>
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<td>ROM: electrogoniometer</td>
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<td><strong>Hecht</strong>&lt;sup&gt;38&lt;/sup&gt;</td>
<td>MS 7 (15)</td>
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<td>Cases series (n = 13) hemiplegia &gt;3 mo and &lt;2 yr based on CVA (11) or head injury (2); passive SLROM &lt;50% of normal spasticity; pain in shoulder or upper arm at rest or in ROM; conventional treatment failed over last 2 wk; no other causes for pain, no allergy to alcohol, phenol, or local anesthetics</td>
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<td>6.7% aqueous phenol solution in nervus subscapularis after local skin anesthesia with xylocaine</td>
<td>Sedation for head-injured patient with low threshold for discomfort</td>
<td>ROM: not mentioned (improvement in % of normal ROM) pain: comparison by therapist of clinical response (e.g., facial expressions, vocalizations, and patient subjective response)</td>
<td>None ROM flex, abd and SLROM up (immediately after injection); pain down in all patients in the original arc of motion but was still present at new extremes Side effects: during the procedure some discomfort and, in one patient, generalized increase in shoulder soreness the day after the injection SR pain 13/13 (100%) SR ROM up, pain down SR pain 2/2 (100%) SR ROM 2/2 (100%)</td>
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<td><strong>Chironna</strong>&lt;sup&gt;35&lt;/sup&gt;</td>
<td>MS 4 (8)</td>
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<td>Case report (n = 2) hemiplegia based on cerebral infarction (one woman) or intracerebral hematoma and skull fracture (one man)</td>
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<td>Phenol motor point block to subscapularis muscle</td>
<td>Not mentioned (woman), combination of US, antiinflammatory drugs and PT, motor point block to the pectoralis major muscle (man)</td>
<td>ROM: examination Pain: patient complaint (woman), examination? (man)</td>
<td>3 mo (woman); not mentioned (man) ROM up, pain down SR pain 2/2 (100%) SR ROM 2/2 (100%)</td>
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<td><strong>Partridge</strong>&lt;sup&gt;41&lt;/sup&gt;</td>
<td>MS 17 (35)</td>
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<td>Multicenter RCT, (n = 85, 20 were withdrawn before completing the treatment)</td>
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<td>Group 1: cryotherapy (ice towels applied to the shoulder for max 10 min, followed by exercises)</td>
<td>General PT (but not for shoulder during the intervention period), including advice and instruction about management and positioning of the shoulder</td>
<td>Pain in rest and on movement: severity 6-point scale, frequency of occurrence 5-point scale, affective response to pain 4-point scale</td>
<td>None Both groups: pain down between groups no significant differences; only the frequency of occurrence of pain was less in the Babath group SR pain nc SR ROM nc</td>
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<tr>
<td>1st Author, Methodologic Score (MS) (%)</td>
<td>Study Design (n) and Study Population</td>
<td>Intervention</td>
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<tr>
<td>2. Interventions aimed at reducing subluxation</td>
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<td>Chantraine15</td>
<td>Non-randomized controlled study (n = 120)</td>
<td>Exp group (n = 60): FES in wk 1, 130 min in three sequences: first 90 min, 8 Hz; second 30 min, 40 Hz; third 10 min, 1 Hz; in wk 2–3 the first and third sequence lasted 5 min longer, and in wk 4–5, another 5 min longer</td>
<td>Conventional rehabilitation therapy according to the Bobath concept</td>
<td>Pain: recorded by physician (present or absent during active and passive motion), VAS, no pain = all these variables negative</td>
<td>24 mo</td>
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<td>MS 23 (48)</td>
<td>One-sided HSP with subluxation; rehabilitation started between 2 and 4 wk after causal lesion (no tumor); no previous shoulder pain; no trauma of shoulder; no sympathetic dystrophy; informed consent</td>
<td>Control group (n = 60): no additional FES</td>
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<td>Faghri17</td>
<td>RCT (n = 26)</td>
<td>Exp group (n = 13): FES duration and intensity progressively increased to 6 h/d, 6 wk; control group (n = 13): no additional FES</td>
<td>Conventional, PT for both groups</td>
<td>Arm function: modified Bobath assessment chart pain: SLROM (goniometer) arm function recovery: surface EMG of deltoidus posterior muscle subluxation: x-ray spasticity: modified Gross clinical scales</td>
<td>6 wk</td>
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<td>MS 16 (33)</td>
<td>Recent stroke; shoulder muscles flaccidity; no pacemaker</td>
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<td>Caldwell34</td>
<td>Case series (n = 25) Stroke patients with HSP and spasticity; regular therapy failed; marked restriction of SIROM and abd</td>
<td>Exp group (n = 13): surgical release of subscapularis tendon and of the insertion of pectoralis major muscle</td>
<td>Exercise program started on the second postoperative day and an abduction brace and suspension sling</td>
<td>ROM: not mentioned</td>
<td>Exp group: 2 mo Control group: 6 mo</td>
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<td>Braun33</td>
<td>MS 8 (17)</td>
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<td>Gruskin 37</td>
<td>Case series (n = 6) Hemiplegia based on CVA (4), brain injury (1), aneurysm (1), painful inferior subluxation, slings were not successful</td>
<td>Surgery</td>
<td>Lifelong sling after operation</td>
<td>Subluxation: X-rays Pain: subjective patient’s satisfaction</td>
<td>10–39 mo (mean 27.2 mo)</td>
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<td>Rajaram43</td>
<td>Case report (n = 1) left hemiplegia after CVA</td>
<td>Auditory feedback device</td>
<td>Intensive program of PT and OT</td>
<td>Pain: patient’s complaints</td>
<td>None</td>
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<td>Krempen40</td>
<td>Case series (n = 20) stroke; painful, flaccid upper extremity</td>
<td>Sling consisting of a shoulder and a forearm support</td>
<td>Not mentioned</td>
<td>Subluxation: X-rays Pain: patient’s report</td>
<td>Not mentioned</td>
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<tr>
<td>Pinzur82</td>
<td>Case series (n = 6) Hemiplegia based on CVA (4), brain injury (1), aneurysm (1), painful inferior subluxation, slings were not successful</td>
<td>Surgery</td>
<td>Lifelong sling after operation</td>
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**TABLE 2 Continued**
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<th>Co-intervention</th>
<th>Main Outcome Measures</th>
<th>Follow-Up</th>
<th>Reported Results and Conclusions, Success Rate (SR)&lt;sup&gt;a&lt;/sup&gt;</th>
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<tbody>
<tr>
<td>Egan&lt;sup&gt;36&lt;/sup&gt; MS 2  (4)</td>
<td>Case report (n = 1)</td>
<td>“Splint jacket”</td>
<td>Not mentioned</td>
<td>Pain: not mentioned</td>
<td>Not mentioned</td>
<td>After the jacket had been worn for some time, pain subsided SR pain 1/1 (100%)</td>
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<tr>
<td>Dekker&lt;sup&gt;16&lt;/sup&gt; MS 22 (46)</td>
<td>Multiple baseline (n = 9)</td>
<td>Three i.a. triamcinolone acetonide injections, 40 mg/ml, on days 1, 8, 22 (seven patients treated, two dropped out before treatment)</td>
<td>Regular rehabilitation program, no therapies on the day of injection</td>
<td>Pain: VAS SLROM: goniometer Spasticity: Ashworth scale Arm function: FM, ARA Side effects</td>
<td>7–12 d</td>
<td>Five patients: pain down, 4 ROM up Five patients: side effects: flaring SR pain&lt;sup&gt;b&lt;/sup&gt; 5/9 (56%) SR SLROM&lt;sup&gt;b&lt;/sup&gt; 4/9 (44%)</td>
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<tr>
<td>Inaba&lt;sup&gt;39&lt;/sup&gt; MS 18 (38)</td>
<td>RCT (n = 33)</td>
<td>Control group (n = 13): self ROM exercises three times per day and arm positioning during 4 wk, exp group (n = 10): at least 15 times US (0.5–2 W/cm&lt;sup&gt;2&lt;/sup&gt;) prior to the exercises; placebo group (n = 10): same as exp group with US turned off</td>
<td>Not mentioned</td>
<td>ROM: goniometer Pain: protective reactions and complaints</td>
<td>None</td>
<td>No difference in the three groups before and after 4 wk of treatment; insufficient data to analyze change in pain SR ROM nc SR pain nc</td>
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</table>

MS, methodologic score; SR, success rate; HSP, hemiplegic shoulder pain; EMG, electromyography; PT, physiotherapy; ROM, range of motion; nc, not computable; CVA, cerebrovascular accident; SLROM, shoulder lateral range of motion; flex, flexion of the shoulder; abd, abduction of the shoulder; US, ultrasound; RCT, randomized clinical trial; exp, experimental; FES, functional electrical stimulation; VAS, visual analogue scale; OT, occupational therapy; i.a., intra-articular; FM, Fugl Meyer; ARA, Action Research Arm test.

<sup>a</sup> SR according intention-to-treat.

<sup>b</sup> Improvement is normal position or grade 1 on Bats scale.
Table 2. Many studies investigated hemiplegic shoulder pain in patients with subacute and chronic stroke.

Interventions

The interventions studied were electromyographic (EMG) biofeedback,\textsuperscript{44} functional electrical stimulation (FES),\textsuperscript{15,17} intra-articular triamcinolone acetonide injections,\textsuperscript{16} ultrasound,\textsuperscript{39} cryotherapy,\textsuperscript{41} surgery,\textsuperscript{33,34,42} phenolization,\textsuperscript{35,38} auditory feedback,\textsuperscript{37} sling,\textsuperscript{40} brace,\textsuperscript{40} and splint jacket.\textsuperscript{36} In general, these interventions were quite adequately described (Table 2). The co-interventions were either described in general terms only\textsuperscript{15–17,34,35,37,38,40–42,44} or not mentioned at all.\textsuperscript{36,39,43} The follow-up period varied from 0 to 39 mo. In four studies, the follow-up period was not specified.\textsuperscript{35,36,40,43}

Outcome Assessment

Pain was the outcome of interest in the present review. To estimate the effect of an intervention on pain, it must be clear how the pain was assessed. Williams\textsuperscript{44} used the validated McGill Pain Questionnaire, and Dekker et al.\textsuperscript{16} used a visual analog scale, which has also been validated. Chant-}

Figure 1: Success rate in relation to methodological score of 10 studies. Only the success rates of Williams\textsuperscript{44} (52%), Chantraine et al.\textsuperscript{15} (67%), and Dekker et al.\textsuperscript{16} (46%) are according to intention-to-treat analysis.

Interventions Aimed at Reducing Subluxation. In a controlled non-randomized trial,\textsuperscript{15} compared with patients in a control group who received no (additional) FES therapy, more patients with FES were without pain at 3 and 24 mo posttreatment: 36% vs. 70% and 55% vs. 81%, respectively. In an RCT, no significant effect of FES was found at 12 wk.\textsuperscript{17}

Surgery was used to reduce subluxation, with success rates of 77–83%.\textsuperscript{33,34,42} The surgery was followed by exercises and a sling. Other methods applied in studies to reduce subluxation were a Varney brace,\textsuperscript{40} sling,\textsuperscript{43} auditory feedback\textsuperscript{37} and a splint jacket.\textsuperscript{36} All of these methods resulted in success rates of 90–100%. The methodological score of all studies investigating the effect of surgery or shoulder supports was below 10 points (21%).

Interventions Aimed at Treatment of the Shoulder Capsule. A third category of possible treatments for hemiplegic shoulder pain focuses on the shoulder capsule. The effect of intra-articular triamcinolone acetonide injections as treatment for capsulitis (as a cause for hemiplegic shoulder pain) was investigated in one study.\textsuperscript{16} The success rate of this treatment was 56%. Contractures of the shoulder resulting from capsular tightness can also be treated with ultrasound.\textsuperscript{39} No effect was found for a 4-wk period.
of ultrasound treatment with regard to range of motion in the shoulder. Direct assessment of pain (protective reactions and complaints of patients) yielded insufficient data for analysis of the change in pain. Indirect assessment of pain (range of motion) showed no differences between the intervention and the control groups.

**DISCUSSION**

Fourteen studies were identified during the literature search, and it seems unlikely that any important publication was missed during this thorough search. However, it is possible that relevant studies remained unpublished or have been published in journals that are difficult to retrieve. The design of the selected studies was very divergent and ranged from case reports to RCTs. RCTs provide the most convincing results with regard to the evaluation of interventions. Case reports, on the other hand, are not considered to be convincing at all. To make it possible to compare the methodological quality of studies with such diverse designs, a very detailed criteria list was used. Although it is difficult to attain the maximum score of 48 points, it was disappointing that the study with the best methodological quality only scored 25 points (52%). Eight studies scored less than 10 points, two of which were not even above the minimum score of 2 points. Thus, the methodological quality of the selected studies was found to be poor. In many cases, there was insufficient or inadequate information about the study population; the duration of the shoulder pain; the exact intervention; blinding of the patient, therapist, and the observer of the effect; dropouts; follow-up; co-interventions; and statistical methods. This could have been the result of poor reporting, but it probably indicates real shortcomings in study design and execution.

Surprisingly, the three studies with the highest methodological score were not the three RCTs. The reason for this is probably that no weight factors were assigned to the items on the detailed criteria list. Therefore random treatment allocation and masked outcome assessment were relatively underscored.

Adequately concealed treatment allocation and masked outcome assessment have been shown to decrease the estimate of the treatment effect in meta-analyses of RCTs, including low-quality RCTs in meta-analyses, which increase the overall estimate of the treatment effect by 30–50%. The three RCTs had major methodological shortcomings, and it is therefore possible that the success rates found in these studies are overestimated.

The review process was not blinded. From meta-analyses of RCTs, it is known that masked assessments, compared with unmasked assessments, of the methodological quality of studies sometimes result in different scores. However, Verhagen et al. showed in their study that there was little difference between blinded assessment and unblinded assessment, and masking assessment did not change the overall conclusion of a meta-analysis of five RCTs.

**Evaluation of the Interventions**

**Interventions Aimed at Normalization Muscle Tone.** Several methods for reducing spasticity were investigated. The study combining EMG biofeedback and relaxation exercises had the best methodological score. However, both methods of treatment are applied without a wash-out period, so it is impossible to draw separate conclusions about the individual effects of EMG biofeedback and relaxation exercises. The combination seems to be successful, regardless of the order in which these treatments are applied. However, the question of whether these methods of treatment are better than no treatment at all, or placebo EMG biofeedback, remains unanswered. Moreover, the follow-up period was very short and was not the same for both groups. In our opinion, the author’s conclusion, that there is a trend that EMG biofeedback reduces pain, is not supported by the results presented in her publication.

The RCT on the effect of cryotherapy vs. the Bobath approach remains inconclusive because, according to the authors’ references, cryotherapy should be applied to reduce pain and spasticity, but 22 patients out of the 65 who completed the treatment suffered from flaccidity, and six patients had normal tone. Moreover, 20 patients dropped out before the end of the treatment period.

The effect of phenol is described in two studies that were of poor methodological quality, so no conclusions can be drawn about its effectiveness. Botulinum toxin and a wrapping technique are other methods of treatment that are applied to reduce spasticity, but these studies were excluded from our review.

**Interventions Aimed at Reducing Subluxation.** FES was investigated in two studies. In both studies, the control group received no (additional) FES therapy. In the non-randomized controlled study, more patients in the intervention group than in the control group were without pain at 3 and 24 mo posttreatment. In the RCT, after 12 wk no differences were found between the groups. Because the control groups received no sham FES, it is possible that the effects of FES are simply nonspecific.

Other techniques used to reduce subluxation are surgery, Varnney brace, sling, auditory feedback, and a splint jacket. No conclusions about the effectiveness of any of these techniques can be drawn because of the poor methodological
quality of the relevant studies. According to Hurd et al., hemiplegic shoulder pain cannot be prevented by a sling. Although a considerable amount of effort is being invested in finding a relationship between subluxation of the hemiplegic shoulder and shoulder pain, no such relationship has yet been found.

Interventions Aimed at Treatment of the Shoulder Capsule. Corticosteroid injections have been shown to be effective in the treatment of capsulitis of the shoulder. The signs and symptoms of hemiplegic shoulder pain are similar to those found in a nonhemiplegic painful shoulder (capsulitis adhaesiva). Triamcinolone acetonide injections seem to be a promising intervention for hemiplegic shoulder pain.

Ultrasound is thought to reveal pain from joint contractures resulting from capsular tightness, scarring, and sprains in a nonhemiplegic shoulder. In an RCT, no effect of ultrasound on hemiplegic shoulder pain was found. Vasodilatation induced by transcutaneous electrical nerve stimulation is reported to reduce myofascial pain, such as hemiplegic shoulder pain.

CONCLUSIONS

Although the success rates seem impressive (up to 100%), the methodological quality of the reviewed studies was moderate to poor. It is therefore concluded that none of the results are convincing enough to provide an answer to the question of which treatment is most effective for patients with hemiplegic shoulder pain. Further research is needed not only to find the best methods to prevent hemiplegic shoulder pain but also to find the most effective treatment for this problem. This research should be directed toward preventive measures and methods of treatment that are the least aggressive and seem to be biologically plausible and the most promising (on the basis of present knowledge). All research should be based on high methodological standards, and therefore, RCTs are recommended. The authors suggest that the most promising methods of treatment for further research at this stage are FES and intra-articular triamcinolone acetonide injections. Phenol injections seem to be biologically plausible for the treatment of muscle hypertonia.

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