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Systematic Review

The effectiveness of manual therapy in the management of musculoskeletal disorders of the shoulder: A systematic review

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ABSTRACT

A systematic review of randomised controlled trials (RCTs) was conducted to determine the effectiveness of manual therapy (MT) techniques for the management of musculoskeletal disorders of the shoulder. Seven electronic databases were searched up to January 2007, and reference lists of retrieved articles and relevant MT journals were screened. Fourteen RCTs met the inclusion criteria and their methodological qualities were assessed using the PEDro scale. Results were analyzed within diagnostic subgroups (adhesive capsulitis (AC), shoulder impingement syndrome [SIS], non-specific shoulder pain/dysfunction) and a qualitative analysis using levels of evidence to define treatment effectiveness was applied. For SIS, there was no clear evidence to suggest additional benefits of MT to other interventions. MT was not shown to be more effective than other conservative interventions for AC, however, massage and Mobilizations-with-Movement may be useful in comparison to no treatment for short-term outcomes for shoulder dysfunction.

1. Introduction

Various physiotherapy approaches have been suggested for shoulder musculoskeletal disorders, including manual therapy (MT), electrotherapy, acupuncture and exercise therapy (Brox, 2003). MT, including massage, joint mobilization and manipulation (such as Maitland, 1991), may be used with the aim of decreasing pain and improving range of motion (ROM), thereby improving function.

To date, a number of systematic reviews have evaluated the effectiveness of conservative treatment in shoulder disorders (Van der Heijden et al., 1997; Green et al., 1998; Desmeules et al., 2003; Green et al., 2003; Ejnisman et al., 2004; Grant et al., 2004; Gibson et al., 2004; Harniman et al., 2004; Michener et al., 2004; Faber et al., 2006; Trampas and Kitsios, 2006). Although there was some evidence of an additional benefit of MT with exercise in patients with shoulder impingement syndrome (SIS), conclusions from these reviews (Desmeules et al., 2003; Green et al., 2003; Michener et al., 2004; Faber et al., 2006; Trampas and Kitsios, 2006) were limited due to small number of studies including MT. To our knowledge, there is no systematic review specifically for the effectiveness of MT in addition or in comparison to other conservative interventions for patients with musculoskeletal disorders of the shoulder. Therefore, the purpose of this systematic review was to determine the level of evidence of the effectiveness of MT in the management of shoulder musculoskeletal disorders.

2. Methodology

2.1. Types of studies and participants

Studies included randomised controlled clinical trials with language restricted to English or German (Fig. 1). Research papers on humans with disorders of the shoulder girdle, including fractures, dislocation, degenerative/osteoarthritis and orthopedic surgery were included. Studies including subjects with systemic diseases such as rheumatoid arthritis, neurological disorders such as stroke, or shoulder symptoms of spinal origin were excluded.

2.2. Interventions and outcomes

Studies where at least one application of MT (manipulation, passive joint or soft tissue mobilization techniques or massage) was applied to either the shoulder girdle, cervical or thoracic spine were included (Paris, 2000; Vernon et al., 2007). Multi-modal interventions were included if the effects of MT could be differentiated from the other interventions. Studies reporting pain, ROM, functional outcomes, patient satisfaction or recovery rate were considered.

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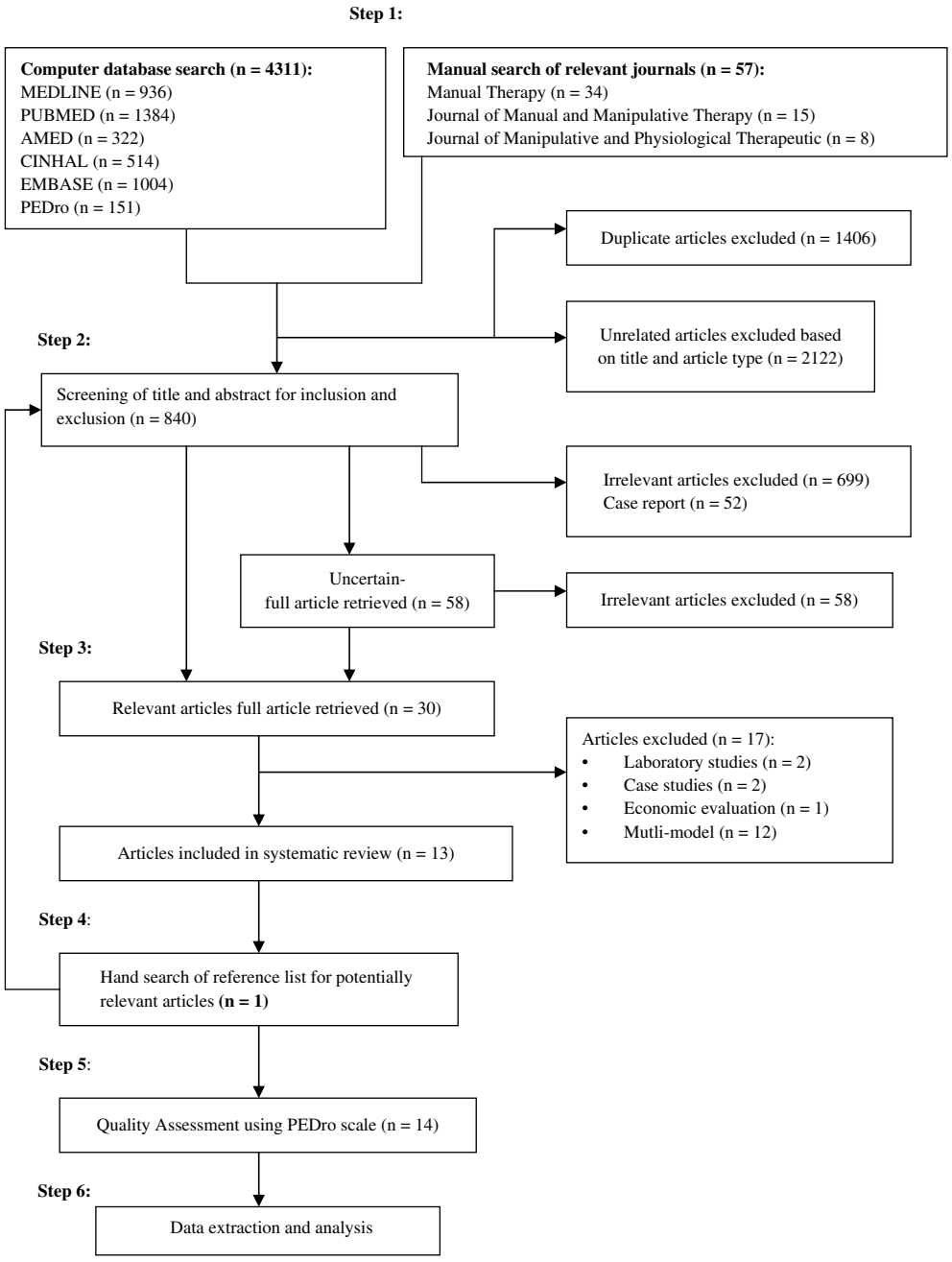

Fig. 1. Flow diagram of study selection process.

2.3. Search strategy

An electronic search was performed of MEDLINE (1950 to January 2007), CINAHL (1982 to January 2007), AMED (1985 to January 2007), EMBASE (1988 to January 2007), PUBMED (1950 to January 2007) and PEDro (1950 to January 2007), and included a combination of search terms related to shoulder musculoskeletal disorders and to MT (Appendix I). Supplementary searches were done on the PEDro database, and by hand searching all volumes of three relevant MT journals and reference lists of the included studies.

2.4. Study selection

One assessor (CH) screened all titles for relevance and duplication. Two independent assessors (CH and GS) blinded to journal, authors and institutions screened potentially relevant titles and abstracts for inclusion. Full articles were retrieved if there was insufficient information from the title and abstract to determine relevance. If consensus for study eligibility was not reached, a third assessor (JM) was involved.

2.5. Quality assessment

Randomised controlled trials (RCTs) were rated independently by two assessors (CH and JM) using the PEDro scale. Disagreements in scores were resolved by consensus or a third opinion (GS) where required. A study was considered to be of high quality if the PEDro score was greater than five and of low quality if the PEDro score was five or less (Maher et al., 2003).

Table 1
Levels of evidence by van Tulder et al. (2003).

Level of evidence	Description
Strong evidence	Consistent findings among multiple high-quality RCTs
Moderate evidence	Consistent findings among multiple low-quality RCTs and/or CCTs and/or one high-quality RCT
Limited evidence	One low-quality RCT and/or CCT
Conflicting evidence	Inconsistent findings among multiple trials
No evidence	No RCTs or CCTs.

RCT: randomised clinical trial; CCT: clinical controlled trial.

2.6. Data extension and analysis

Data were extracted by one author (CH) for characteristics of participants, shoulder conditions, interventions and outcomes of pain, ROM and function using a standardized form (Fig. 1, Step 6). If a study reported more than one measure for an outcome, the measure most commonly used between studies or deemed to be more representative of function was used. Data were extracted for outcomes immediately following the intervention period (initial follow-up) and, where available, at the final follow-up time point (long-term follow-up).

Pain outcomes for overall pain, functional pain, 24-h pain and pain on movement and night pain were considered. For ROM, active (and passive for studies with patients with adhesive capsulitis [AC]) measures of abduction in degrees were extracted. For function, patient satisfaction and functional outcome questionnaires were considered. For continuous variables, the mean difference (95% confidence intervals, CI) between groups was calculated from end-point scores or change scores (Herbert, 2000a, Clare et al., 2004). For dichotomous outcomes, relative risks (RR, with 95% CI) were calculated (Herbert, 2000b).

Results for each study were analyzed within commonly reported diagnostic subgroups. Trials were assessed for clinical heterogeneity with respect to the participants, intervention and outcomes. Due to the wide range of disorders and interventions, meta-analysis was not performed. A qualitative analysis using levels of evidence to define treatment effectiveness was performed (Table 1, van Tulder et al., 2003). These levels of evidence criteria considers participants, interventions, controls, outcomes, both high and low methodological quality of the included studies and consistency of findings between studies, and are widely used (Faber et al., 2006; Woodley et al., 2007).

3. Results

3.1. Selection of studies and study characteristics

Fourteen RCTs ($n = 888$ subjects) from 840 citation postings and hand searching results were included (Fig. 1). The studies investigated patients with AC (Table 2), SIS (Table 3) and non-specific shoulder pain/dysfunction (Table 4). Sample sizes ranged from 14 to 172 patients, averaging 64 patients per study. The mean age of patients ranged from 44 to 65 years.

3.1.1. Interventions

Interventions included joint mobilizations (Maitland concept) of the shoulder girdle (Bulgen et al., 1984; Conroy and Hayes, 1998; Maricar and Chok, 1999; Vermeulen et al., 2006) mobilization of the upper quarter (Winters et al., 1997; Bang and Deyle, 2000; Bergman et al., 2004), manipulation (Winters et al., 1997; Bergman et al., 2004), Cyriax' manipulation and deep transverse frictions (Guler-Uysal and Kozanoglu, 2004), "Mobilization-with-Movement" (MWM) (Teys et al., 2008) or soft tissue massage (Van den Dolder and Roberts, 2003). Bang and Deyle (2000) used a pragmatic combination of joint and soft tissue mobilization techniques based on the upper quartile movement impairment assessed for the individual participant in the experimental group; whereas Conroy and Hayes (1998) used glenohumeral joint mobilizations for the experimental group, but included soft tissue mobilization techniques as part of "conventional physiotherapy" for both participant groups.

Table 2
Study characteristics: adhesive capsulitis.

Author/year	Condition	Participants characteristics	Interventions	Outcomes
Bulgen et al. (1984)	MOR: Not stated Four groups: intra-articular injection; mobilizations; ice therapy and no treatment	$n = 42$, 28 female, 14 male *Mobilization group*: $n = 11$ *Ice therapy group*: $n = 12$ *Steroid group*: $n = 11$ *Control group*: $n = 8$ Age = 55.8 (44–74) y DOS = 4.8 (1–12) months	Intervention period: varied between groups. All subjects were taught pendular exercises 2–3 min every hour and pain medication if required. *Mobilization group*: Maitland's mobilizations Three times weekly for 6 weeks *Ice therapy group*: Ice pack followed by PNF Three times weekly for 6 weeks *Steroid group*: Intra-articular /subacromial injection weekly for 3 weeks *Non-treatment group*: Pendular exercises and pain medication	Follow-up period: weekly for the first 6 weeks then monthly for a further 6 months *Outcome measures*: Verbal reports of progress Passive ROM (goniometry): Total flexion Total abduction External rotation Glenohumeral flexion Internal rotation
Binder et al. (1984)	MOR: Not stated Four groups: intra-articular injection; mobilizations; ice therapy and no treatment	$n = 40$, Gender not stated *Mobilization group*: $n = 11$ *Ice therapy group*: $n = 11$ *Steroid group*: $n = 10$ *Control group*: $n = 8$ Age = not stated DOS = not stated	Follow-up from original study (Bulgen et al., 1984)	Follow-up period: 40–48 months after initial presentation *Outcome measures*: Persistent or recurrent pain/or restriction of movement Passive ROM (goniometry): Total flexion Total abduction External rotation Total rotation

(*continued on next page*)

Table 2 (*continued*)

Author/year	Condition	Participants characteristics	Interventions	Outcomes
Guler-Uysal and Kozanoglu (2004)	MOR: Not stated Two groups: Cyriax approach; physical modalities	$n = 40$ *Experimental group*: $n = 20$, 15 female, 5 male Age = 53.6 ± 6.9 (43–70) y DOS = 7.6 ± 3.9 (2–12) months *Control group*: $n = 20$, 13 female, 7 male Age = 58.4 ± 9.7(44–82) y DOS = 5.6 ± 3.9 (2–12) months	3-week intervention Active stretching and pendulum movements were performed by both groups after each session. *Experimental group*: Deep transverse frictions and manipulation. 1 h session three times weekly. *Control group*: Hot packs and shorts wave diathermy. 1 h session 5 times weekly.	Follow-up period: End of 1 and 2 week *Outcome measures*: Pain using VAS: Spontaneous pain Night pain Pain with motion Passive ROM (goniometry): Flexion Abduction Internal rotation External rotation Recovery rate
Maricar and Chok (1999)	MOR: Not stated Two groups: manual therapy + exercises and exercises alone	$n = 32$ *Experimental group*: $n = 16$, 7 female, 9 male Age = 57.9 ± 9.5 y *Control group*: $n = 16$, 6 female, 10 male Age = 54.9 ± 5.4 y DOS of both groups = average: 3 months	8-week intervention *Experimental group*: Mobilization of upper quadrant using Maitland Grade III+ and IV and exercises Once weekly for 8 weeks *Control group*: Exercises Once weekly for 8 weeks	Follow-up period: 3, 5, 7, and 8 week *Outcome measures*: AROM (goniometry) Flexion External rotation Internal rotation Hand-behind-back
Nicholson (1985)	MOR: Toss of coin Two groups: joint mobilization + exercises and exercises alone	$n = 20$ *Experimental group*: $n = 10$, 6 female, 4 male Age = 51(31–70) ±12.16 y DOS = 27.6 ± 33.41 (1–104) weeks *Control group*: $n = 10$, 4 female, 6 male Age = 55 ± 16.43 (20–77) y DOS = 30.8 ± 31.28 (3–104) weeks	4-week intervention *Experimental group*: Gliding and distractive mobilization techniques and exercises Two to three times weekly for 4 weeks *Control group*: Exercises Repeat the exercises three times daily independently	Follow-up period: Weekly for 4 weeks Outcome measures: Pain questionnaire ROM (goniometry): Active internal rotation Active external rotation Active abduction Passive abduction
Vermeulen et al. (2006)	MOR: Random-number generator Two groups: high-grade mobilization (HG) and Low grade (LG)	$n = 100$ *HG mobilizations*: $n = 49$, 32 female, 17 male Age = 51.6 (7.6) y DOS = 8 (5–14.5) months *LG mobilizations*: $n = 51$, 34 female, 17 male Age = 51.7 (8.6) y DOS = 8(6–14) months	12-week intervention Subjects might have further treatments as suggested by orthopedic surgeon following intervention period *LG mobilizations*: Maitland grade I and II joint mobilization Number of sessions 18.6 ± 4.9 *HG mobilizaionts*: Maitland grade III and IV joint mobilization Number of sessions 21.5 ± 2.5 2 times weekly for 30 min for a maximum of 12 weeks A minimal duration of exposure to the therapy of at least 6 weeks	Follow-up period: 3, 6 and 12 month *Outcome measures*: Active and Passive ROM (goniometry): Abduction Forward flexion External rotation Shoulder Rating Questionnaire (SRQ) Shoulder Disability Questionnaire (SDQ) Pain using VAS: Pain at rest Pain during movement Pain during the night General Health using SF-36

RCT = randomized controlled trial; MOR = method of randomization; DOS = duration of symptoms; ROM = range of motion; PNF = proprioceptive neuromuscular facilitation; MWM = mobilization with movement; s = seconds; min = minutes; VAS = visual Analogue Scale; y = years; data given as means ± SD (range), unless otherwise stated.

MT was used in isolation (Winters et al., 1997; Winters et al., 1999; Van den Dolder and Roberts, 2003; Vermeulen et al., 2006; Teys et al., 2008) or in combination with exercises (Nicholson, 1985; Conroy and Hayes, 1998; Maricar and Chok, 1999; Bang and Deyle, 2000; Guler-Uysal and Kozanoglu, 2004; Citaker et al., 2005), hot packs (Conroy and Hayes, 1998; Citaker et al., 2005) or medical care (Bergman et al., 2004). One study compared high-grade (HG) joint mobilizations, defined as grade III or higher on Maitland grading system (Maitland, 1991), to low grade (LG) in patients with AC (Vermeulen et al., 2006). This study was included as there was consensus amongst the current authors to consider LG mobilizations a control condition as clinical lore would usually indicate the use of high rather than low-grade mobilization techniques with the aim of improving ROM in patients with AC. Control interventions included ice therapy (Binder et al., 1984; Bulgen et al., 1984), electrophysical modalities (Guler-Uysal and Kozanoglu, 2004), exercise (Nicholson, 1985; Conroy and Hayes, 1998; Maricar and Chok, 1999; Bang and Deyle, 2000), education, and proprioceptive neuromuscular facilitation (PNF) (Citaker et al., 2005). The number of intervention sessions ranged from 3 to 20 (average 11 sessions). Twelve studies investigated immediate effects following intervention, with the follow-up period ranging from 3 days to 4 years. Two studies also investigated long-term effects (Bergman et al., 2004; Vermeulen et al., 2006). Two studies investigated long-term results of subjects included in earlier reported studies (Binder et al., 1984; Winters et al., 1999).

3.1.2. Measures

The most common measure was pain (such as visual analogue scales, VAS) and goniometric ROM which were reported in 10 out of 14 studies. Various functional outcome measures were used (Table 2).

Table 3
Study characteristics: shoulder impingement syndrome.

Author/year	Condition	Participants characteristics	Interventions	Outcomes
Bang and Deyle (2000)	MOR: Table of random numbers Two groups: Manual therapy + exercise and exercise alone	$n = 52$ *Manual therapy group*: $n = 28$, 10 female, 18 male Age = 42 ± 10.1 (17–64) y DOS = 5.6 ± 3.7 (1–12) months *Exercise group*: $n = 24$, 12 female, 12 male Age = 45 ± 8.4 (24–60) y DOS = 4.4 ± 2.8 (1–12) months	3-week intervention Twice weekly for a total of 6 visits *Manual therapy group*: standardized flexibility and strengthening program, Joint mobilization of upper quarter and soft tissue massage. *Exercise group*: Standardized flexibility and strengthening program	Follow-up period: After 6 treatment sessions *Outcome measures*: Perception of shoulder function: Functional assessment questionnaire (9 categories): Pain using (VAS): Overall pain intensity Raising arm overhead Behind the back activities Reaching across body Lifting with problem arm Lying on shoulder Pushing and pulling Carrying an object with arm at side Performance of usual physical activity, sport or hobby Resisted break test: IR; ER and abduction Active abduction Isometric strength using a stabilized electronic dynamometer: Internal rotation External rotation Abduction
Citaker et al. (2005)	MOR: not stated Two groups: Hot pack + mobilization + exercises and hot pack + PNF + exercises	$n = 40$, Gender not stated *Mobilization group*: $n =$ not stated Age = 52.8 ± 9.86 y DOS = not stated *PNF group*: $n =$ not stated Age = 55.5 ± 8.95 y DOS = not stated	Length of intervention period: Not stated 20-session treatment followed by 3 weeks of theraband exercises *Mobilization group*: Manual mobilization, hot packs, theraband exercises and Codman pendulum exercises *PNF group*: PNF , hot packs, theraband exercises and Codman pendulum exercises	Follow-up period: Unclear, stated as after intervention period *Outcome measures*: Pain using VAS ROM (goniometry): Flexion Abduction External rotation Internal rotation Hyperextension University of California at Los Angeles Shoulder Rating Scale (UCLA) Categorized into pain, function, AROM, strength and patient satisfaction Total score: 2–35 28 or less = unsatisfactory 29–33 = good 34–35 = excellent
Conroy and Hayes (1998)	MOR: not stated Two groups: joint mobilization + soft tissue massage and soft tissue massage only	$n = 14$, 6 female, 8 male *Experimental group*: $n = 7$ Age = 55 ± 10.2 y DOS = not stated *Control group*: $n = 7$ Age = 50.7 ± 16.5 y DOS = not stated	3-week intervention 3 sessions per week *Experimental group*: Joint mobilization of subacromial and glenohumeral joints, soft tissue mobilization, hot pack, stretching and strengthening exercise, and patient education Manual therapy: oscillatory pressure of 2–3 oscillations per second, each technique was administered 2–4 times (30 s each) *Control group*: Soft tissue mobilization, hot pack, stretching and strengthening exercise and patient education	Follow-up period: 3 week *Outcome measures*: Maximum pain over the preceding 24-hr period (VAS) Pain with subacromial compression test (VAS) AROM (goniometry): Shoulder flexion Abduction Scapular plane elevation Internal rotation External rotation Overhead Function (graded on a 3-point scale): Reach behind head Reach across and around the upper body Touch a mark on the wall that required 135° of shoulder flexion.

RCT = randomized Controlled Trial; MOR = method of randomization; DOS = duration of symptoms; ROM = range of motion; PNF = proprioceptive neuromuscular facilitation; MWM = mobilization with movement; s = seconds; min = minutes; VAS = visual Analogue Scale; y = years; data given as means ± SD (range), unless otherwise stated.

Table 4
Study characteristics: non-specific shoulder pain or dysfunction.

Author/year	Condition	Participants characteristics	Interventions	Outcomes
Bergman et al. (2004)	MOR: Sealed envelope Two groups: Manipulative therapy + medical care and medical care alone	$n = 150$ *Manipulative group*: $n = 79$, 42 female, 37 males Age = 48.4 ± 12.4 y DOS: 0–12 weeks = 53, 12–26 weeks = 26 *Medical care group*: $n = 71$, 32 female, 39 males Age = 47.8 ± 11.8 y DOS: 0–12 weeks = 50, 12–26 weeks = 21	12-week intervention *Manipulative group*: Usual medical care and mobilization or manipulative to cervical spine, upper thoracic spine and adjacent ribs The mean duration of a manipulative session 23 ± 13 min maximum of 6 treatments over a 12-week period *Medical care group*: Usual medical care	Follow-up period: Week 6, 12 , 26 and 52 *Outcome measures*: Patient-perceived recovery (7-point ordinal scale) Patient's perception of "cured" Severity of the main complaint during preceding week on an 11-point scale (0 = best 10 = worst) Shoulder pain (4-point ordinal scale): At rest In motion Night pain Sleeping problems caused by pain Inability to lie on the painful side Degree of radiation General pain Shoulder disability questionnaire for the functional status of the shoulder in the preceding 24 h 16 items EuroQol health: 5 items 3-point ordinal scale
Teys et al. (2008)	MOR: Drawing of lots Three groups: MWM; Sham and control	$n = 24$, 13 female, 11 male Age = 46.1 ± 9.86 (20–64) y DOS = 1–12 months	3-day intervention *Experimental group*: Mobilization with movement: Postero-lateral glide of glenohumeral joint during elevation 3 sets of 10 repetitions with a rest interval of 30 s between each set. *Sham group*: Anterior glide with minimal pressure applied. Elevation through half of available pain-free range. 3 sets of 10 repetitions with a rest interval of 30 s between each set. *Control group*: No manual contact	Follow-up period: Each treatment session *Outcome measures*: Pain-free AROM (goniometry): Scapular plane elevation Pressure pain threshold using pressure pain algometry and by palpating the most sensitive point located over anterior aspect of the shoulder
Van den Dolder and Roberts (2003)	MOR: Sealed envelope Two groups: Massage and control	$n = 29$ *Massage group*: $n = 15$, 4 female, 11 male Age = 63.1 ± 9.9 y DOS = median 26 (13–26) weeks *Control group*: $n = 14$, 5 female, 9 male Age = 65.9 ± 9.2 y DOS = median 30 (23–91) weeks	2-week intervention *Massage group*: 6 treatments of soft tissue massage around the shoulder Each treatment 15–20 min *Control group*: No treatment for 2 weeks	Follow-up period: 2 week *Outcome measures*: Pain intensity using Short Form McGill Pain Questionnaire: 3 sections 1st: A list of 15 words to describe pain 2nd: 100 mm VAS pain experienced over last 24 h 3rd: Present pain index Functional disability using a Patient Specific Functional Disability Measure: Active ROM using photographs: Flexion Abduction Hand-behind-back
Winters et al. (1997)	MOR: Not stated 2 categories: Shoulder girdle and synovial Shoulder girdle: Manipulation and physiotherapy Synovial: Corticosteroid injection; manipulation and physiotherapy	$n = 172$ *Shoulder girdle groups*: *Manipulation:* $n = 29$, 15 female, 14 male Age = 43.9 ± 12.6 y DOS = median 3 weeks *Physiotherapy*: $n = 29$, 18 female, 11 male Age = 46.4 ± 11.2 y DOS = median 4 weeks *Synovial groups*: *Manipulation*: $n = 32$, 17 female, 15 male Age = 46.7 ± 12.1 y DOS = median 9 weeks *Physiotherapy*: $n = 35$, 14 female, 21 male Age = 53.1 ± 12.6 y DOS = median 4 weeks *Corticosteroid injection*: $n = 47$, 32 female, 15 male Age = 53.5 ± 12.5 y DOS = median 8 weeks	Up to 11-week intervention *Manipulation group*: mobilization and manipulation of the cervical spine, upper thoracic spine, upper ribs, acromioclavicular joints and glenohumeral joint Once a week with a maximum of 6 treatments *Physiotherapy group*: Exercise therapy, massage and physical applications Twice a week *Injection group*: 1–3 injections	Follow-up period: 2, 6 and 11 weeks *Outcome measures*: Shoulder pain score (4-point scale): Pain at rest Pain during motion Pain during the night Sleeping problems because of pain Inability to lie on affected side Presence of radiated pain Together with a 101 point numerical pain scale Patient's perception of "cured"

Table 4 (*continued*)

Author/year	Condition	Participants characteristics	Interventions	Outcomes
Winters et al. (1999)	MOR: not stated 2 categories: Shoulder girdle and synovial Shoulder girdle: Manipulation and physiotherapy Synovial: Corticosteroid injection; manipulation and physiotherapy	Questionnaire sent to all 172 subjects, 130 (76%) could be evaluated Gender = not stated Age = not stated DOS = not stated *Shoulder girdle groups*: Manipulation: $n = 18$ Physiotherapy: $n = 22$ *Synovial groups*: Injection: $n = 38$ Manipulation: $n = 26$ Physiotherapy: $n = 26$	Follow-up from original study (Winters et al., 1997)	Follow-up period: 2–3 years after original study *Outcome measures*: Persisting, recurrent or new shoulder complaints Patient's perception of "cured"

RCT = randomized Controlled Trial; MOR = method of randomization; DOS = duration of symptoms; ROM = range of motion; PNF = proprioceptive neuromuscular facilitation; MWM = mobilization with movement; s = seconds; min = minutes; VAS = visual Analogue Scale; y = years; data given as means ± SD (range), unless otherwise stated.

3.2. Methodological quality

PEDro quality scores ranged from 3 to 8 out of 10 (Fig. 2). Eight of the 14 studies scored 6 or more. The most common sources of bias were failure to blind therapists (100% of studies), failure to blind subjects (86% of studies), failure to conceal allocation (79% of studies) and lack of analysis by intention-to-treat (71% of studies). Thirteen of 154 (8%) quality criteria assessed across studies required discussion to reach consensus between assessors. Three criteria required an opinion from the third assessor.

3.3. Effects of manual therapy

All results are reported as mean differences (95% CI) for the effect of MT compared to control for outcome measures of pain, ROM and function unless otherwise stated.

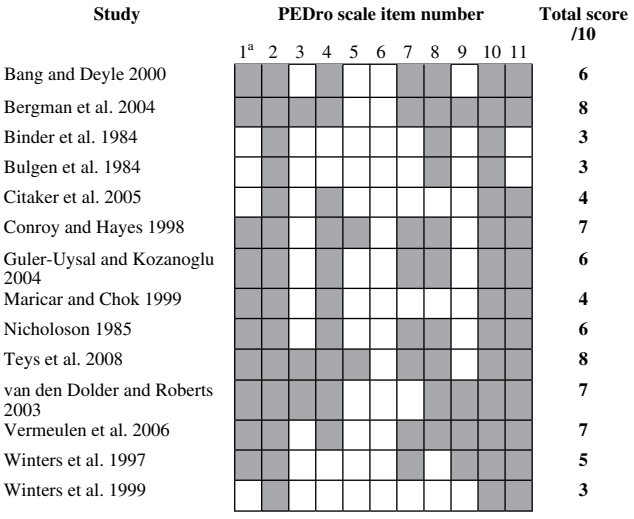

Fig. 2. Pedro score table. [a]Criteria 1 was not used to calculate the PEDro score. □ = criteria not met. ■ = criteria met. Pedro Scale item. 1. Eligibility criteria were specified. 2. Subjects were randomly allocated to groups. 3. Allocation was concealed. 4. The groups were similar at baseline regarding the most important prognostic indicators. 5. There was blinding of all subjects. 6. There was blinding of all therapists who administered the therapy. 7. There was blinding of all assessors who measured at least one key outcome. 8. Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups. 9. All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analyzed by "intention to treat". 10. The results of between-group statistical comparisons are reported for at least one key outcome. 11. The study provides both point measures and measures of variability for at least one key outcome.

3.3.1. Adhesive capsulitis

3.3.1.1. Pain. No differences were found between HG MT and LG MT with respect to pain at initial or long-term follow-up in one high-quality trial (Fig. 3) (Vermeulen et al., 2006). These findings are consistent with the high-quality trial of Guler-Uysal and Kozanoglu (2004) (for initial follow-up), comparing MT using the Cyriax approach (Cyriax, 1984) to hot packs and short wave diathermy (Fig. 3).

3.3.1.2. Range of motion. For *active* ROM, two studies (Nicholson, 1985; Maricar and Chok, 1999) showed that mobilization with exercise was no more effective than exercise alone in the short-term. Vermeulen et al. (2006) found in a high-quality trial that HG joint mobilizations were more effective than LG mobilizations when active ROM was measured both immediately and 12 months following the intervention period (Fig. 3).

For *passive* ROM, Nicholson (1985) showed that mobilization with exercise was more effective than exercise alone. In contrast, Guler-Uysal and Kozanoglu (2004) found that manipulation with deep transverse frictions following the Cyriax approach (Cyriax, 1984) was no more effective than the application of physical modalities. When long-term effects of MT were investigated, Binder et al. (1984) showed in a low-quality trial that MT was no more effective than intra-articular steroid injection, ice therapy or no treatment. Vermeulen et al. (2006) found HG mobilizations were more effective than LG mobilizations at initial and long-term follow-up.

3.3.1.3. Function. Guler-Uysal and Kozanoglu (2004) did not show a better recovery rate (number of patients who reached 80% of normal shoulder ROM) for patients receiving deep massage and manipulation than patients receiving physical modalities [Relative Risk (95% CI) = 1.5 (1.0–2.0)]. HG mobilizations were more effective in improving shoulder function when compared to LG mobilizations for long-term outcomes but not short-term outcomes (Fig. 3) (Vermeulen et al., 2006).

The qualitative analysis defining treatment effectiveness (Table 5) showed moderate evidence that MT was no more effective than other interventions in decreasing pain measures and improving ROM and function. However, there was moderate evidence that HG MT compared to LG MT was more effective for increasing ROM and long-term functional outcomes.

3.3.2. Shoulder impingement syndrome

3.3.2.1. Pain. The addition of pragmatic MT was shown to be effective in reducing pain compared to exercise alone (Bang and Deyle, 2000) and when joint mobilizations were compared to "conventional" physiotherapy alone (Conroy and Hayes, 1998) in

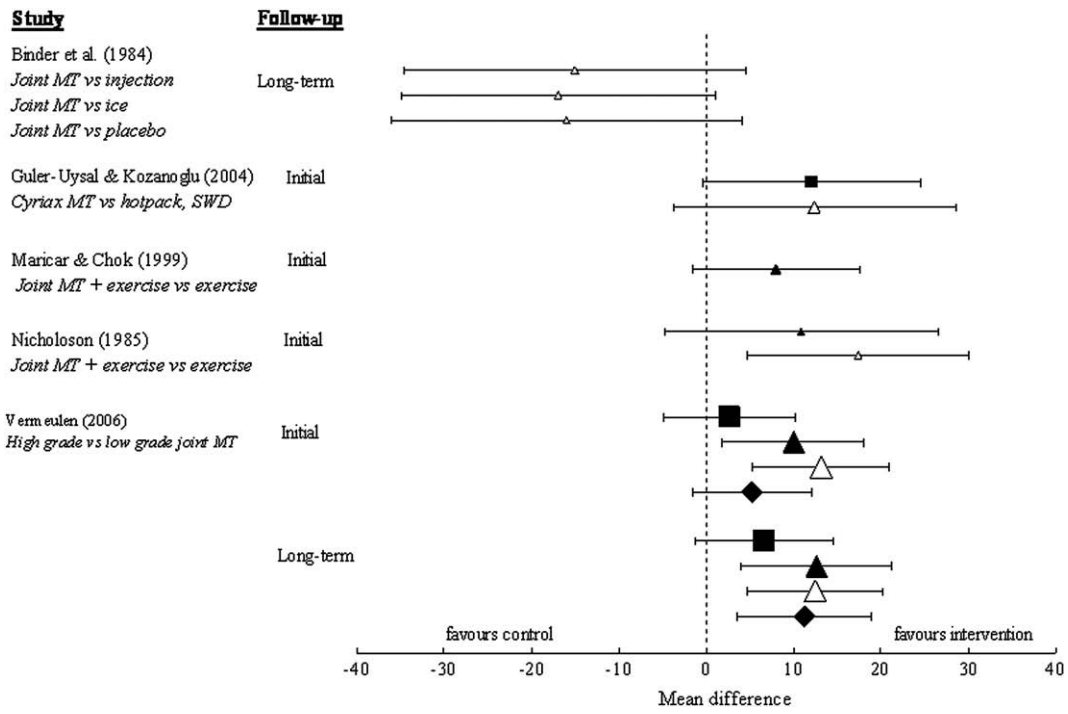

Fig. 3. Distribution of estimates from five studies for the mean difference in effect of manual therapy compared to control (or placebo) on pain (■), AROM (▲), PROM (△) and function (◆) for patients with adhesive capsulitis. The size of each estimate symbol is proportional to the study's sample size. The horizontal bars report 95% confidence intervals. Pain and function are measured on a 0–100 scale, ROM is measured in degrees. Positive results indicate a beneficial effect of manual therapy over control. Mob = mobilization; AROM = active range of motion; PROM = passive range of motion. [a]Vermeulen et al. (2006) compared high-grade to low-grade mobilization techniques. Low-grade mobilization techniques were considered as a control condition for the purpose of the systematic review as these grades would not be applied for the aim of increasing ROM.

high-quality trials. Converseley, Citaker et al. (2005), a low-quality trial, reported that joint mobilizations in addition to exercise and modalities were no more effective than exercise, modalities and PNF in improving pain (Fig. 4).

3.3.2.2. Range of motion. Joint mobilizations were no more effective in improving active ROM than conventional physiotherapy alone (Conroy and Hayes, 1998) and PNF (Citaker et al., 2005) for short-term outcomes (Fig. 4).

3.3.2.3. Function. Bang and Deyle (2000) found that pragmatic MT was effective in improving function compared to exercise alone. Similarly, Citaker et al. (2005) showed that joint mobilizations were effective in comparison to PNF. Assessment of function on overhead reaching (Conroy and Hayes, 1998) showed that there was no additional benefit of joint mobilizations to physiotherapy which included soft tissue mobilization techniques (Fig. 4).

In summary, there was no clear evidence to suggest additional benefits of MT to other interventions in the management of patients with SIS (Table 5).

3.3.3. Non-specific shoulder pain/dysfunction

3.3.3.1. Pain. The additional effect of MT of the upper quarter to medical care was shown to be effective in reducing pain originating from the shoulder girdle at initial follow-up in a high-quality trail (Bergman et al., 2004). In a low-quality trial (Winters et al., 1997) manipulation was beneficial compared to traditional physiotherapy at initial follow-up. However, manipulation was ineffective in treating shoulder complaints where shoulder disorders were classified as originated from synovial structures when compared to traditional physiotherapy or corticosteroid injection (Winters et al., 1997) (Fig. 5). In addition, Van den Dolder and Roberts (2003) found two-weeks of massage more effective for pain relief compared to no treatment. Long-term, effects of MT was no more greater than usual medical care (Bergman et al., 2004).

3.3.3.2. Range of motion. MWM were effective for improving short-term active ROM compared to sham or no treatment in a high-quality trial (Teys et al., 2008). Similarly, massage of the shoulder was effective compared to no treatment in a high-quality trial (Fig. 5, Van den Dolder and Roberts, 2003).

3.3.3.3. Function. Massage was effective for improving function compared to no treatment (Fig. 5) (Van den Dolder and Roberts, 2003). However, the addition of MT to usual medical care was no more effective for improving function at initial and long-term follow-up (Bergman et al., 2004).

Winters et al. (1997, 1999) investigated patients' perception of recovery following an 11-week intervention and also 2–3 years later. Manipulation was more effective than traditional physiotherapy for treating shoulder complaints originating from the shoulder girdle [RR (95% CI): 6.7 (2.2–20)]. In the group with synovial shoulder complaints, manipulation was no more effective than traditional physiotherapy. Further, it was ineffective when compared to corticosteroid injection for synovial shoulder complaints [RR (95% CI): 2 (0.9–4.4); 0.5 (0.3–0.9), respectively]. At the 2–3 year follow-up, manipulation was shown to be no more effective in improving function than traditional physiotherapy and injection in both groups [RR (95% CI): 1.2 (0.8–1.8); 0.9 (0.7–1.2); 1 (0.7–1.3), respectively] (Winters et al., 1999).

For non-specific shoulder pain/dysfunction, there was moderate evidence to suggest MT was effective in the short-term for increasing ROM when compared to sham type treatment and control groups, and massage was effective when compared to no treatment (Table 5). Moderate evidence suggests that MT is no more effective in improving function in the long-term compared to other interventions.

Table 5
Table of level of evidence for the effectiveness of manual therapy for musculoskeletal disorders of the shoulder.

Shoulder pathology	Outcome measures	Follow-up	Evidence
Adhesive capsulitis[a]	Pain[b]	Initial	Moderate evidence exists to suggest that MT is no more effective for improving pain when compared to other interventions.
			Moderate evidence exists to suggest that high-grade MT is no more effective than low-grade MT for improving pain.
		Long-term	Moderate evidence exists to suggest that high-grade MT is no more effective than low-grade MT for improving pain.
	PROM	Initial	Conflicting evidence exists regarding the effect of MT on PROM when compared to other interventions.
			Moderate evidence exists to suggest that high-grade MT is more effective for improving PROM than low-grade manual therapy.
		Long-term	Limited evidence exists to suggest that MT is no more effective for improving PROM when compared to other interventions.
			Moderate evidence exists to suggest that high-grade MT is more effective for improving PROM than low-grade MT.
	AROM	Initial	Moderate evidence exists to suggest that MT is no more effective for improving AROM when compared to other interventions.
			Moderate evidence exists to suggest that high-grade MT is more effective for improving AROM than high-grade MT.
		Long-term	Moderate evidence exists to suggest that high-grade MT is more effective for improving AROM when compared to low-grade MT.
	Function	Initial	Moderate evidence exists to suggest that MT is no more effective for improving recovery when compared to other interventions.
			Moderate evidence exists to suggest that high-grade MT is no more effective for improving shoulder function than low-grade MT.
		Long-term	Moderate evidence exists to suggest that high-grade MT is more effective for improving shoulder function than low-grade MT.
Shoulder impingement syndrome	Pain	Initial	Conflicting evidence exists regarding the effect of MT on pain when compared to other interventions.
	AROM	Initial	Moderate evidence exists to suggest that MT is no more effective for improving AROM when compared to other interventions.
	Function	Initial	Conflicting evidence exists regarding the effect of MT on function when compared to other interventions.
Shoulder pain/dysfunction	Pain	Initial	Conflicting evidence exists regarding the effect of MT on pain when compared to other interventions.
			Moderate evidence exists to suggest that massage is more effective for improving pain compared to no treatment.
		Long-term	Moderate evidence exists to suggest that MT is no more effective for improving pain when compared to other interventions.
	AROM	Initial	Moderate evidence exists to suggest that MT is more effective for improving AROM compared to sham or no treatment.
			Moderate evidence exists to suggest that massage is effective for improving AROM compared to no treatment.
	Function	Initial	Conflicting evidence exists regarding the effect of MT on function compared to other interventions.
			Moderate evidence exists to suggest that massage is effective for improving function compared to no treatment.
		Long-term	Moderate evidence exists to suggest that MT is no more effective in improving function or recovery when compared to other interventions.

AROM = active range of motion; PROM = passive range of motion; MT = manual therapy.

[a] Effect statement for adhesive capsulitis does not include study by Bulgen et al. (1984), because insufficient statistical data of study outcomes were given. They reported "at the end of treatment, the groups were significantly different at the 2% level, but by the end of the study there was no significant difference between the groups".

[b] Effect statement for adhesive capsulitis does not include the study by Nicholson (1985), because the pain scale used was not specified, so the score could not be converted to the scale of 0–100 for effect size calculation. The author reported the change pain score in mean degrees (standard deviation): experimental group = −5.10 (4.56) and control group = −2.90 (4.41) and *P* value = 0.7201.

4. Discussion

This review found inconsistent evidence for the effectiveness of MT for various shoulder disorders compared to control interventions and no treatment, contrasting with other published reviews regarding treatment efficacy for SIS. Green et al. (2003), Michener et al. (2004) and Faber et al. (2006) reported limited evidence suggesting that MT combined with exercise was more effective than exercise alone in patients with SIS, whereas here there was conflicting evidence for the benefit of MT on pain and function. The current inclusion of the study by Citaker et al. (2005), finding that the addition of MT yielded no added benefit in SIS, is likely to have contributed to our differing findings.

Conflicting evidence for effects on pain and function in SIS may be explained by variable definitions of MT. Bang and Deyle (2000) found a pragmatic approach, including joint and soft tissue mobilizations to the individual-specific movement impairment of the upper quadrant to be more effective than therapeutic exercise alone. Conroy and Hayes (1998) included soft tissue mobilizations in both the experimental and the control group, adding joint mobilizations to the former. Different forms of MT may have similar neurophysiological effects, despite differences in mechanical applications (Bialosky et al., 2009). It is thus possible, that these common effects contributed to the lack of significant differences for between-group outcomes by Conroy and Hayes (1998). Based on findings of our review, clinicians should consider incorporating soft tissue and joint mobilization techniques in addition to therapeutic exercises for patients with SIS, based on an individual assessment. Future RCTs should investigate pragmatic approaches to determine the effectiveness of MT in the management of patients with SIS.

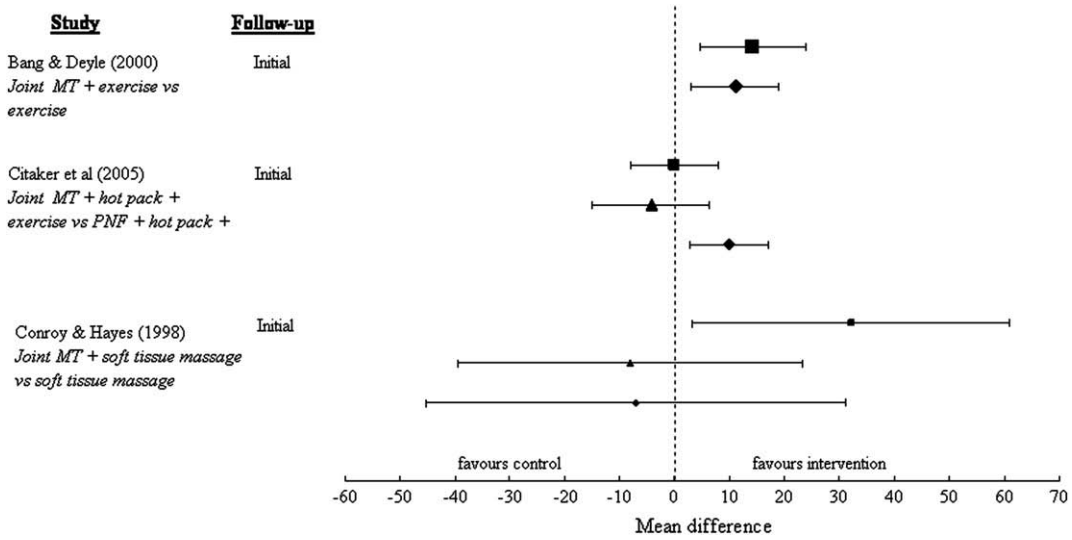

Fig. 4. Distribution of estimates from three studies for the mean difference in the effects of manual therapy compared to control (or placebo) on pain (■), AROM (▲) and function (◆) for patients with shoulder impingement syndrome. The size of each estimate symbol is proportional to the study's sample size. The horizontal bars report 95% confidence intervals. Pain and function are measured on a 0–100 scale, ROM is measured in degrees. Positive results indicate a beneficial effect of manual therapy over the control. AROM = active range of motion.

Our findings indicate that MT may not be more effective for the management of pain and improving ROM and function for patients with AC than other interventions. However, the studies had a Pedro rating of 6 or less (Binder et al., 1984; Nicholson, 1985; Maricar and Chok, 1999; Guler-Uysal and Kozanoglu, 2004). Vermeulen et al. (2006) found that when comparing high-grade to low-grade joint mobilizations, the former was more effective in improving ROM in the short and the long term, and ROM and function in the long term. In the absence of higher quality RCT, the use of MT in patients with AC still relies predominantly on clinical reasoning, with more support for the aim of improving ROM and function, than for pain management.

The lack of clear description and wide range of MT, further compounded by the difficulty of consistent sub-grouping of patients with unspecific shoulder pain/dysfunction make it difficult to provide clear guidelines for the clinician. The evidence was conflicting or moderate that MT may be more effective than other interventions for pain management and improving ROM and function for patients in this large group.

One study investigated the effect of massage alone on shoulder pain with beneficial short-term effects (Van den Dolder and Roberts, 2003). The control group of patients received no treatment, thus the positive findings for the experimental group may have, in part, indicated

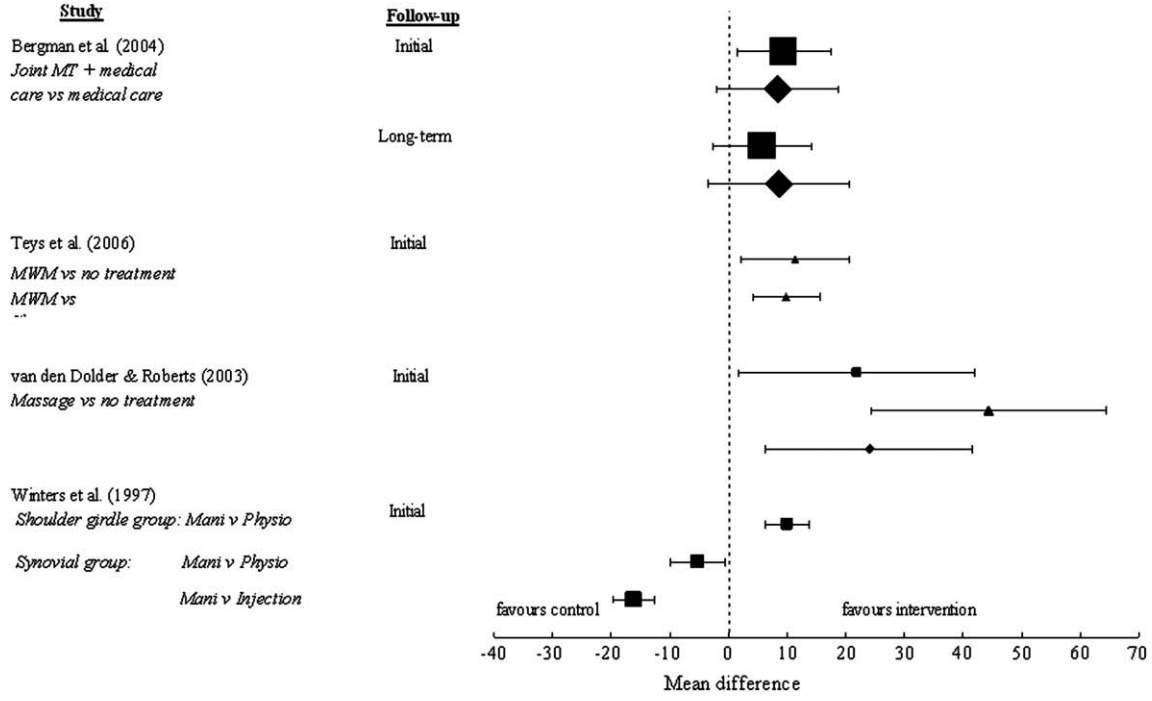

Fig. 5. Distribution of estimates from four studies for the mean difference in the effects of manual therapy compared to control (or placebo) on pain (■), AROM (▲) and function (◆) for patients with non-specific shoulder pain/dysfunction. The size of each estimate symbol is proportional to the study's sample size. The horizontal bars report 95% confidence intervals. Pain and function are measured on a 0–100 scale, ROM is measured in degrees. Positive results indicate a beneficial effect of manual therapy over control. Exp = experimental; Mani = manipulation; Physio = physiotherapy; AROM = active range of motion.

placebo effects. However, the authors (Van den Dolder and Roberts, 2003) proposed that the decrease in pain with the massage was greater than what was previously considered to be decrease of pain as a result of placebo effects of treatment (Hrobjartsson and Gotzsche, 2001).

A qualitative analysis of levels of evidence according to specific criteria van Tulder et al. (2003) was performed to define treatment effectiveness as meta-analysis was inappropriate because of clinical heterogeneity with respect to the interventions and population groups. The average methodological quality of the included studies was defined as high (mean score ≥ 6). The most common sources of bias were failure to blind therapists and subjects. It is difficult to administer MT treatment without distinguishing between the treatments. Blinding of patients is also difficult when divergent treatment techniques are compared. Inability to blind patients may change their responses to treatment and may be affected by the expectations of the assessors, thereby potentially producing biases (Trampas and Kitsios, 2006). When the allocation is not concealed, decisions about participant inclusion may be influenced by knowledge of whether or not the patient receives the treatment condition, potentially producing systematic bias (Trampas and Kitsios, 2006). Lack of analysis of intention-to-treat was another common problem of the included studies, thus potentially biasing results.

In summary, for patients with AC, MT was not more effective than other rehabilitative interventions in the short term for decreasing pain, improving ROM and function. However, there was moderate evidence that HG MT was more effective than LG MT for improving ROM and function in the long-term. For patients with SIS, evidence was conflicting for use of MT for decreasing pain and improving function in the short term, with moderate evidence that MT was no more effective for improving ROM in comparison to other interventions in the short term. However, a pragmatic combination of soft tissue and joint mobilization techniques, in addition to therapeutic exercise may be more effective than an exercise programme alone in this group of patients. The evidence was conflicting for MT in the management of unspecific shoulder pain for decreasing pain and improving function in the short term compared to other interventions. There was moderate evidence that MT was no more effective in improving function and decreasing pain in this patient group in the long term. However, massage and MWM techniques were shown to be useful in managing patients with musculoskeletal disorders of the shoulder for short-term outcomes compared to no treatment. Further research of high quality of RCTs with standardized definitions of shoulder diagnosis, clear descriptions of treatment and adequate follow-up periods and sample sizes is recommended.

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Appendix I

Keywords used for Ovid and Pubmed searches.

Phase 1	Phase 2	Phase 3	Phase 4
1. Shoulder	12. Pain	17. Musculo-skeletal manipulation	33. Ankle
2. Shoulder fracture	13. Injury	18. Spinal manipulation	34. Knee
3. Shoulder dislocation	14. Musculo-skeletal disorder	19. Massage	35. Hip
4. Rotator cuff	15. or/12–14	20. Soft tissue technique	36. Stroke or cerebrovascular accident
5. Bursitis	16. and/1, 15	21. Soft tissue therapy	37. Spinal injury
6. Adhesive capsulitis		22. Manual therapy	38. Rheumatoid arthritis
7. Frozen shoulder		23. Joint mobilization	39. Hemiplegia
8. Joint instability		24. Spinal mobilization	40. Cancer or neoplasm
9. Sternoclavicular joint		25. Osteopathic manipulation	41. Celebral palsy
10. Acromioclavicular joint		26. Chiropractic manipulation	42. Reflex sympathetic dystrophy
11. Glenohumeral joint		27. Acupressure	43. Acupuncture
		28. Traction	44. or/33–43
		29. Physical therapy	45. or/16, 2–11
		30. physiotherapy	46. or/17–27,31,32
		31. or/29,30	47. and/45,46
		32. and/28,31	48. 47 not 44
			49. limit 48 to English or German

References

Bang MD, Deyle GD. Comparison of supervised exercise with and without manual physical therapy for patients with shoulder impingement syndrome. Journal of Orthopaedic and Sports Physical Therapy 2000;30:126–37.
Bergman GJ, Winters JC, Groenier KH, Pool JJ, Meyboom-de Jong B, Postema K, et al. Manipulative therapy in addition to usual medical care for patients with shoulder dysfunction and pain: a randomized, controlled trial. Annals of Internal Medicine 2004;141:432–9.
Bialosky JE, Bishop MD, Price DD, Robinson ME, George SZ. The mechanisms of manual therapy in the treatment of musculoskeletal pain: a comprehensive model. Manual Therapy 2009;14(5):531–8.
Binder AI, Bulgen DY, Hazleman BL, Roberts S. Frozen shoulder: a long-term prospective study. Annals of Rheumatic Diseases 1984;43:361–4.
Brox JI. Regional musculoskeletal conditions: shoulder pain. Best Practice and Research in Clinical Rheumatology 2003;17:33–56.
Bulgen DY, Binder AI, Hazleman BL, Dutton J, Roberts S. Frozen shoulder: prospective clinical study with an evaluation of three treatment regimens. Annals of Rheumatic Diseases 1984;43:353–60.
Citaker S, Taskiran H, Akdur H, Arabaci UO, Ekici G. Comparison of the mobilization and proprioceptive neuromuscular facilitation methods in the treatment of shoulder impingement syndrome. The Pain Clinic 2005;27:197–202.
Clare HA, Adams R, Maher CG. A systematic review of efficacy of McKenzie therapy for spinal pain. Australian Journal of Physiotherapy 2004;50:209–16.
Conroy DE, Hayes KW. The effect of joint mobilization as a component of comprehensive treatment for primary shoulder impingement syndrome. Journal of Orthopaedic and Sports Physical Therapy 1998;28:3–14.
Cyriax J. Treatment by manipulation, massage and injection. In: Textbook of orthopaedic medicine, Vol. 2. Bailiere Tindall; 1984.
Desmeules F, Cote CH, Fremont P. Therapeutic exercise and orthopedic manual therapy for impingement syndrome: a systematic review. Clinical Journal of Sport Medicine 2003;13:176–82.
Ejnisman B, Andreoli CV, Soares BG, Fallopa F, Peccin MS, Abdalla RJ, et al. Interventions for tears of the rotator cuff in adults. Cochrane Database Systematic Reviews 2004. CD002758.
Faber E, Kuiper JI, Burdorf A, Miedema HS, Verhaar JA. Treatment of impingement syndrome: a systematic review of the effects on functional limitations and return to work. Journal of Occupational Rehabilitation 2006;16:7–25.
Gibson K, Growse A, Korda L, Wray E, MacDermid JC. The effectiveness of rehabilitation for nonoperative management of shoulder instability: a systematic review. Journal of Hand Therapy 2004;17:229–42.
Grant HJ, Arthur A, Pichora DR. Evaluation of interventions for rotator cuff pathology: a systematic review. Journal of Hand Therapy 2004;17:274–99.
Green S, Buchbinder R, Glazier R, Forbes A. Systematic review of randomised controlled trials of interventions for painful shoulder: selection criteria, outcome assessment, and efficacy. British Medical Journal 1998;316:354–60.
Green S, Buchbinder R, Hetrick S. Physiotherapy interventions for shoulder pain. Cochrane Database Systematic Reviews 2003. CD004258.
Guler-Uysal F, Kozanoglu E. Comparison of the early response to two methods of rehabilitation in adhesive capsulitis. Swiss Medical Weekly 2004;134:353–8.
Harniman E, Carette S, Kennedy C, Beaton D. Extracorporeal shock wave therapy for calcific and noncalcific tendonitis of the rotator cuff: a systematic review. Journal of Hand Therapy 2004;17:132–51.
Herbert RD. How to estimate treatment effects from reports of clinical trials. I: continuous outcomes. Australian Journal of Physiotherapy 2000a;46:229–35.

Herbert RD. How to estimate treatment effects from reports of clinical trials. II: dichotomous outcomes. Australian Journal of Physiotherapy 2000b;46: 309–13.
Hrobjartsson A, Gotzsche PC. Is the placebo powerless? An analysis of clinical trials comparing placebo with no treatment. New England Journal of Medicine 2001;344:1594–602.
Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro scale for rating quality of randomized controlled trials. Physical Therapy 2003;83:713–21.
Maitland GD. Peripheral manipulation. Butterworth Heineman; 1991.
Maricar NN, Chok B. A comparison of the effect of manual therapy with exercise therapy and exercise therapy alone for stiff shoulders. Physiotherapy Singapore 1999;2:99–104.
Michener LA, Walsworth MK, Burnet EN. Effectiveness of rehabilitation for patients with subacromial impingement syndrome: a systematic review. Journal of Hand Therapy 2004;17:152–64.
Nicholson GG. The effects of passive joint mobilization on pain and hypomobility associated with adhesive capsulitis of the shoulder. Journal of Orthopaedic and Sports Physical Therapy 1985;6:238–46.
Paris SV. A history of manipulative therapy through the ages and up to the current controversy in the United States. Journal of Manual and Manipulative Therapy 2000;8:66–77.
Teys P, Bisset L, Vicenzino B. The initial effects of a Mulligan's mobilization with movement technique on range of movement and pressure pain threshold in pain-limited shoulders. Manual Therapy 2008;13:37–42.
Trampas A, Kitsios A. Exercise and manual therapy for the treatment of impingement syndrome of the shoulder: a systematic review. Physical Therapy Reviews 2006;11:125–42.
van Tulder M, Furlan A, Bombardier C, Bouter L. Updated method guidelines for systematic reviews in the Cochrane Collaboration back review group. Spine 2003;28:1290–9.
Van den Dolder PA, Roberts DL. A trial into the effectiveness of soft tissue massage in the treatment of shoulder pain. Australian Journal of Physiotherapy 2003;49:183–8.
Van der Heijden GJM, Van der Windt DAW, De Winter AF. Physiotherapy for patients with soft tissue shoulder disorders: a systematic review of randomised clinical trials. British Medical Journal 1997;315:25–30.
Vermeulen HM, Rozing PM, Obermann WR, Le Cessie S, Vliet Vlieland TP. Comparison of high-grade and low-grade mobilization techniques in the management of adhesive capsulitis of the shoulder: randomized controlled trial. Physical Therapy 2006;86:355–68.
Vernon H, Humphreys K, Hagino C. Chronic mechanical neck pain in adults treated by manual therapy: a systematic review of change scores in randomized clinical trials. Journal of Manipulative and Physiological Therapeutics 2007;30:215–27.
Winters JC, Sobel J, Groenier K, Arendzen H, Meyboom-de JB. Comparison of physiotherapy, manipulation, and corticosteroid injection for treating shoulder complaints in general practice: randomised, single blind study. British Medical Journal 1997;314:1320–5.
Winters JC, Jorristma W, Groenier KH, Sobel JS, Meyboom-de Jont B, Arendzen HJ. Treatment of shoulder complaints in general practice: long term results of a randomised, single blind study comparing physiotherapy, manipulation, and corticosteroid injection. British Medical Journal 1999;318:1395–6.
Woodley BL, Newsham-West RJ, Baxter GD. Chronic tendinopathy: effectiveness of eccentric exercise. British Journal of Sports Medicine 2007;41:188–98.