Effectiveness of Manual Physical Therapy for Painful Shoulder Conditions: A Systematic Review

James Camarinos, DPT[1]; Lee Marinko, PT, ScD, OCS, FAAOMPT[1]

Over 13 million Americans visited their doctor for painful shoulder conditions in 2003[1]. The prevalence of shoulder pain has been reported in up to 50% of the general population[2], and according to the *American Academy of Orthopedic Surgeons*, it ranks as the third most common musculoskeletal complaint behind knee and spinal disorders[1]. Furthermore, over one half of individuals receiving care still complain of symptoms in their shoulder after one year[3]. The majority of these cases involve diagnoses associated with painful movement and functional deficits[4], and physical therapy is often the first choice for conservative management[5].

A number of disease-specific systematic reviews examining efficacy of physical therapy[6-11] negate the effects of therapeutic modalities and support the utilization of manual therapy and exercise. To our knowledge, there are two dedicated reviews examining the effectiveness of manual therapy specifically: 1) one for subacromial impingement[8] and 2) the other for subacromial impingement, adhesive capsulitis, and non-specific shoulder disorders[10]. Both reviews support manual therapy as an intervention, however with caution, as the evidence is limited due to methodological flaws and small sample sizes that falsely inflated any effect demonstrated[8,10]. The most recent review[10] examined the effects of manual therapy for several common shoulder pathologies but included studies that used cervical and/or thoracic interventions as well as interventions specific to the shoulder complex. That review also failed to identify specific types of manual therapy interventions that were most useful. Further, both reviews examined the effectiveness of manual therapy within the context of a specific diagnostic label (e.g., impingement, adhesive capsulitis), despite evidence to suggest that treatment effectiveness specified toward a diagnosis is limited[6-12].

Diagnostic labeling related to shoulder pathologies has been found to demonstrate limited uniformity and variability of defined signs and symptoms per diagnosis as well as no beneficial treatment effect by utilizing such an approach[12]. Furthermore, individual variability in pain complaints[13], variations in disease classification, limited agreement in identifying diagnostic severity[14], and inconsistency in report of mobility of the

ABSTRACT: Multiple disease-specific systematic reviews on the effectiveness of physical therapy intervention for shoulder dysfunction have been inconclusive. To date, there have been two systematic reviews that examined manual therapy specifically but both considered effects within diagnoses. The purpose of this systematic review was to identify the effectiveness of manual therapy to the glenohumeral joint across all painful shoulder conditions. A search of MEDLINE, CINAHL, Web of Science, and Cochrane Central Register of Randomized Controlled Trials for articles dated 1996 to June 2009 was performed. Inclusion for review were manual therapy performed to the glenohumeral joint only; non-surgical painful shoulder disorders; subjects 18-80 years; and outcomes of range of motion, pain, function, and/or quality of life. Quality assessment was performed using the PEDro scale with subsequent data extraction. Seventeen related articles were found with seven fitting the inclusion criteria. The average PEDro score was 7.86, meeting the cutoff score for high quality. Significant heterogeneity in outcome measures prohibited meta-analysis. Five studies demonstrated benefits utilizing manual therapy for mobility, and four demonstrated a trend towards decreasing pain values. Functional outcomes and quality-of-life measures varied greatly among all studies. Manual therapy appears to increase either active or passive mobility of the shoulder. A trend was found favoring manual therapy for decreasing pain, but the effect on function and quality of life remains inconclusive. Future research utilizing consistent outcome measurements is necessary.

KEYWORDS: Glenohumeral Joint, Musculoskeletal Manipulations, Physical Therapy, Shoulder, Shoulder Pain

[1]College of Health and Rehabilitation Sciences; Sargent College, Boston University, Boston, MA. 635 Commonwealth Ave, Boston, MA 02115, Boston University

Address all correspondence and requests for reprints to: Lee Marinko, lmarinko@bu.edu

shoulder across pathothogies[14,15] suggest that a specific patho-anatomical diagnosis is less than optimal to guide a treatment plan. Similar challenges exist during diagnosis and treatment of the low back[16-18]. Consequently, the purpose of this systematic review is to examine the effectiveness of manual physical therapy as an intervention specific to the glenohumeral joint as a conservative management across all painful shoulder conditions. Of particular interest were specific types of manual therapy (e.g., mobilization, manipulation, soft tissue mobilization, etc) to further delineate the individual value of approaches.

Methods

Search Strategy

Ovid MEDLINE, CINAHL, Web of Science, and Cochrane Central Register of Controlled Trials were searched to retrieve the papers for this review. Key words utilized across databases were *manipulation, mobilization, manual therapy, shoulder, shoulder pain, impingement, frozen shoulder, adhesive capsulitis, physical therapy*, and *randomized control trial*. As subject headings varied between the databases, various combinations of these key words were used. The search was limited to studies published on humans, in the English language, and between the years of 1996 and June 2009 so as to capture more recent publications. Finally, the search was also done utilizing the same strategy directly in the *Journal of Orthopedic and Sports Physical Therapy, Physical Therapy Journal, Journal of Manual and Manipulative Therapy, Archives of Physical Medicine and Rehabilitation,* and *Manual Therapy*. A search of bibliographies of acquired studies was also performed.

Inclusion Criteria for Review

Randomized controlled trials of manual physical therapy treatment for shoulder pain of adults 18–80 years of age were considered for review. Only randomized controlled trials were included because this study design is generally considered the highest level of evidence short of systematic reviews/meta-analysis[19]. Any age range was captured if the condition was considered a standard form of care by rehabilitation clinicians. All participants were referred to physical therapy for conservative management of shoulder pain and all interventions were performed by a physical therapist. Studies were excluded if participants reported or demonstrated any symptoms associated with cervical or thoracic symptoms, arm pain other than the shoulder, or radicular symptoms. Also excluded were studies that reported participants who had undergone surgical management for the present condition or for any condition in the upper quarter including the cervical and thoracic spine less than one year previous, had any evidence of gross instability of the glenohumeral joint, or had a history of traumatic dislocation.

The interventions of interest were manual therapy performed by a physical therapist, including low- and high-velocity mobilizations, directed only to the glenohumeral joint *without* additional joint mobilization to the shoulder girdle, thoracic spine, or cervical spine. Previous studies have shown that treatment to the cervical and/or thoracic spine can be beneficial in treating impingement[20]; therefore, studies that included joint mobilization to these areas were excluded so as not to confound any effects of manual therapy to the glenohumeral joint. Studies that performed manipulation under general anesthesia were also excluded from this review. Finally, articles were chosen if they included at least one of the following outcome measures: active or passive range of motion, a functional outcome measure specific to the shoulder, a quality-of-life measure, and a pain measure.

Review Process

From the initial search, the primary author reviewed article titles to assess relevance to the review, and if deemed appropriate, abstracts were subsequently reviewed. Full texts were obtained of articles that appeared to match the review criteria as well as articles that were ambiguous in their abstract so as not to exclude any possible articles due to underreporting exact interventions in the abstract.

Full texts were reviewed by a team of reviewers consisting of three licensed physical therapists (LM, AF, BB) and one third-year DPT student (JC). Of the therapists, one is a fellow in the American Academy of Orthopedic Manual Physical Therapy with 20 years of orthopedic clinical practice (LM), one practices in a hospital-based outpatient orthopedic clinic with 28 years of experience in orthopedics (AF), and the third practices in an outpatient private practice orthopedic clinic with 4 years of experience (BB).

The four reviewers performed data extraction with a data extraction form[21]. Prior to the review, reviewers were trained by reading an unrelated article about low back pain and performing quality scoring using the PEDro scale and extracting pertinent data. Each author individually extracted data and assessed applicability of the reviewed study for inclusion in the review. Reviewers were not blinded to the authors or titles of articles reviewed. After reading was done and inclusion criteria applied, the reviewers compared which articles to exclude.

The quality of research articles was assessed using the PEDro (Physiotherapy Evidence Database) scale[22]. This scale utilizes 11 items to assess quality of randomized controlled trials. This scale is scored by giving one point for an answer of yes and zero points for an answer of no, with a potential for 10 possible points. While there are 11 questions, the first pertains to the external validity of the article being rated and is not computed as a part of the score. When items on the PEDro scale were not mentioned in articles included in the review, the reviewers were asked to report an answer of no, and no points were awarded. Items that were unclear were noted as such and brought up for discussion among the reviewers. A reliability study done by Maher et al (2003)[23] demonstrated fair to good inter-rater reliability with an ICC of .68 when using consensus ratings generated by 2 or 3 raters. Furthermore, consensus scores for this scale were within 1 point on 85% and within 2 points in 99% of all reviews. This scale has also found to be a more comprehensive assessment of quality

with similar reliability to the commonly used Jadad Scale in stroke rehabilitation literature[24]. A cut point of 6 on the PEDro scale was used to indicate high-quality studies as this has been reported to be sufficient to determine high quality versus low quality in previous studies[23].

Results

The search strategy yielded 1,214 potential articles (Figure 1). The primary author evaluated the titles and found 22 to be suitable for this review and reviewed abstracts for inclusion/exclusion criteria. Of the 22 abstracts, 17 full texts were retrieved that either met the inclusion criteria or did not provide sufficient information in the abstract to exclude. Each of the four reviewers then read and applied the inclusion/exclusion criteria as well as PEDro scoring independently. After review, 7 articles were agreed upon among the readers to be excluded from the review and 3 articles had mixed reviews. The readers met regarding the 3 articles and a final decision was made to exclude these articles because the mobilizations performed included mobilization to the spine and/or ribs, or had a study design in which every participant received an injection of some kind. This left a total of 7 articles included in the analysis (see Table 1).

Of the 7 articles reviewed, there was significant heterogeneity in duration of treatment, type of treatment, and outcome measures used (Table 2). Some studies evaluated active range of motion[25,27-31] while others evaluated passive range of motion[26,31]. Pain outcomes, while evaluated with a visual analog scale in all but 2 studies[25,30] were done under various conditions such as at rest, with movement, or at night so consolidation of results was impossible. Furthermore, there was no consistent use between studies of a quality-of-life measure or functional outcome tools. This significant heterogeneity in outcome measures prohibited meta-analysis.

Excluded Studies

Ten articles that initially were chosen for review were subsequently excluded because two included subjects with concomitant neck pain[32,33], one included mobilization to adjacent areas along with the glenohumeral joint[34], two did not include manual therapy as an intervention[35,36], one failed to report clear outcome measurements[37], one study's outcomes reported did not match our review[38]; another was excluded due to a combination of manual therapy and exercise with no actual description of procedures performed[39], and one gave every subject an injection, placebo, or anti-inflammatory, a treatment that physical therapists cannot perform[40].

Quality Assessment

The quality scores, agreed by the 4 reviewers for each item, are presented in Table 1. The mean quality score for the 7 included studies was 7.86, with a standard deviation of 1.245 and a range of 6 to 9. The predetermined cutoff of 6 was exceeded by all of the studies included, indicating they all were considered to be of high quality; however, the articles by Johnson et al[29] and Guler-Uysal and Kozanoglu[26] were at the limit of the cutoff with scores of 6. Studies by Teys et al[25], Vermeulen et al[31], and Kachingwe et al[28] each received the high score of 9. The items on the PEDro scale that showed highest percentage of "yes" answers across included studies were item 4 (groups equal at baseline), item 10 (between-group statistical comparison), and item 11 (provision of point measures and measures of variability), each being

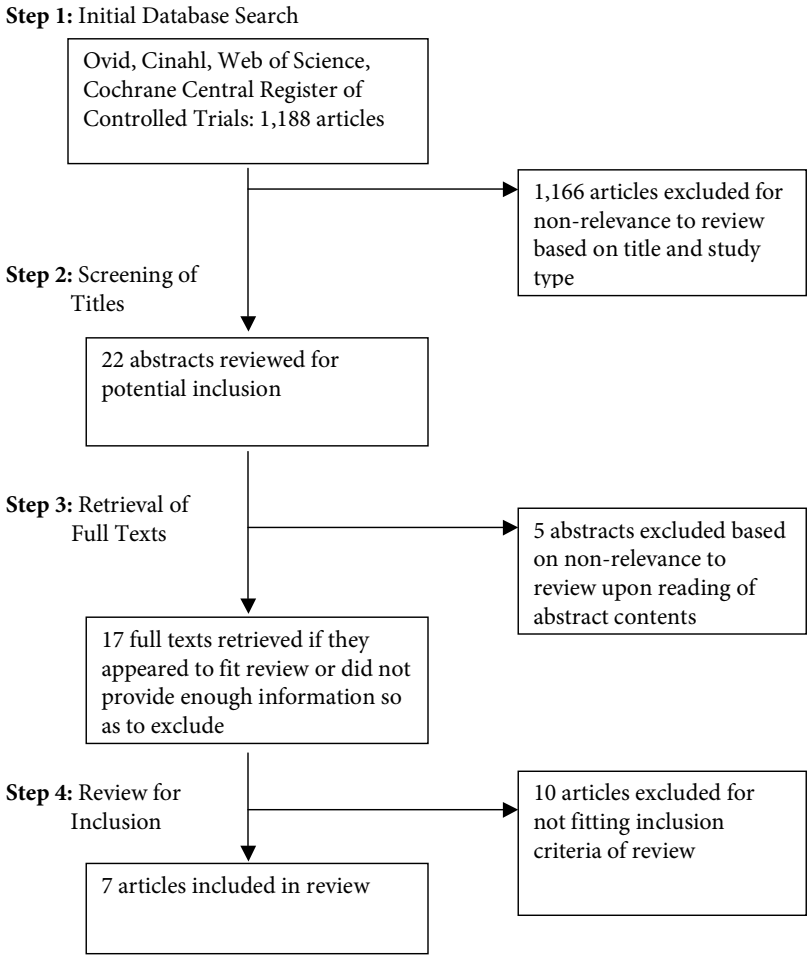

FIGURE 1. Search Results.

TABLE 1. PEDro scale of quality for included articles.

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Total Score
Teys et al[25]	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	9
Johnson et al[29]	Y	Y	Y	Y	Y	N	N	N	N	Y	Y	6
Yang et al[30]	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Kachingwe et al[28]	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	9
Vermeulen et al[31]	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	9
Guler-Uysal & Kozangolu[26]	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	6
Conroy & Hayes[27]	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	8
% "Yes"	100	100	66.6	100	66.6	0	83.3	83.3	66.6	100	100	
Average PEDro Score												7.86

PEDro Criteria
Item 1: (Not scored) eligibility criteria specified.
Item 2: Subjects were randomly allocated.
Item 3: Allocation was concealed.
Item 4: Groups were similar at baseline for most important prognostic indicators.
Item 5: There was blinding of all subjects.
Item 6: There was blinding of all therapists.
Item 7: There was blinding of assessors of outcomes.
Item 8: Measures of at least one key outcome were collected from 85% of subjects initially allocated.
Item 9: Intention-to-treat analysis was performed.
Item 10: Between-group comparisons reported for at least one key outcome.
Item 11: Study provided point measures and measures of variability for at least one key outcome.

identified in 100% of included studies. Item 6 (blinding of therapists) was answered as "no" in all 7 studies, which is reasonable with this intervention since blinding of therapists is nearly impossible when performing manual therapy.

Manual Therapy for Reduction of Pain, Improving Function, and Increasing Range of Motion

The detailed design of each study included can be found in Table 2. Range of motion was included as an outcome for all seven of the included studies[25-31], and all demonstrated some improvement with intervention. Of these seven studies, however, only four[25,26,29,31] demonstrated significant improvements between groups utilizing manual therapy as an intervention. The studies by Teys et al[25] and Guler-Uysal and Kozanoglu[26] found significant increases in passive mobility with just one treatment[25] or within one week[26] as well as significant improvement from baseline to completion of the studies. Johnson et al[29] found significant increases in active external rotation range of motion at the completion of the study, and Vermeulen et al[31] found significant improvement in active range of motion at 12 months and passive range of motion at 3 and 12 months.

Six of the seven studies used some form of pain measurement scale[25-29, 31]. All studies demonstrated reduction of pain with treatment; however, only two demonstrated significant differences[25,27] between groups for pain measurement. Teys et al[25] performed a cross-over trial in subjects with painful limited shoulders. The mobilization with movement group improved significantly between both groups in pain measures as measured by pain pressure algometry. Conroy and Hayes[27] compared two groups with subacromial impingement syndrome with the intervention group receiving mid-range joint mobilization. At the completion of the trial, the mobilization group showed significant improvement compared to the non-mobilization group in measures of pain within the last 24 hours and pain with subacromial impingement testing.

Examination of function was included in five[27-31] of the seven studies. All of these studies demonstrated improvement in the perspective of functional measurements with intervention; however, only the two[30, 31] studies that compared manual therapy techniques for patients with adhesive capsulitis demonstrated significant between-group differences. Yang et al[30] found that both end-range mobilization and mobilization with movement treatment approaches demonstrated statistically significant improvements in function as measured by the FLEX-SF when compared to mid-range mobilization. Vermeulen et al[31] found that function as measured by the shoulder rating questionnaire and shoulder disability questionnaire significantly improved in the high-grade mobilization group over the 12-month period.

Comparing the Effects of Different Types of Manual Therapy

Four different types of manual therapy were implemented within the seven included studies: mobilization with movement, a Cyriax approach, and static mobilization performed either at end-range or mid-ranges of motion. Three of the studies utilized mobilization with movement[25,28,30]. Of these, Teys et al[25] and Yang et al[30] reported improvement in range of motion utilizing this approach, while Kachingwe et al[28] found no significant difference between groups; however, they noted that the mobilization with

TABLE 2. Details of included studies.

Study	Participants	Study Design	Pathology	Interventions	Outcome Measures	Protocol	Outcomes (mean change from pre to post with 95% CI if supplied)
Teys et al[25]	n= 24	Cross-over trial (control, sham, mobilization with movement): Each group lasted for one PT session. Total duration of study=1 week	Pain limited shoulders	Control: No mobilization Sham: Sham mobilization Intervention: Mobilization with movement (MWM) during scaption	1. AROM: Scaption 2. Pain: Pain pressure threshold →Outcomes assessed at baseline and after each PT session	Total of 3 visits with at least one day in between visits	1) AROM (scaption): MWM: 15.6º (5.5) * Sham: 3.9º (4) Control: 0.27º (2.73) 2) Pain Pressure: MWM: 62.6 (28.9) * Sham 25.9 (25.7)* Control: 20 (21.5)
Guler-Uysal & Kozangolu[26]	n=40	Between group comparison: PT without mobilization vs. PT using Cyriax approach	Idiopathic adhesive capsulitis	Cyriax Group: Deep friction massage and manipulation, active stretching and pendulum exercises PT Group: Hot packs, short-wave diathermy, active stretching and pendulum exercises	1. PROM: Flexion, abduction, internal rotation, external rotation 2. Pain: Visual Analog Scale: measured for pain at night, with movement, and spontaneous pain	Cyriax Group: 3 x week for 1 hour → Outcomes assessed at baseline, 1, and 2 weeks PT Group: Every weekday for one hour → Total for both groups was 2 weeks or until 80% of ROM achieved	1. PROM: Flexion Cyriax: 26.9^, PT: 20.6 PROM: Abduction Cyriax: 42.9, PT: 29.3 PROM: ER Cyriax: 33.6*, PT: 16.5 PROM: IR Cyriax: 18.5*, PT: 13.4 2. Pain: VAS (spontaneous) Cyriax: 15.4, PT: 15.9 Pain: VAS (movement) Cyriax: 18.5, PT: 23.7 Pain: VAS (night) Cyriax: 21.8, PT 20
Conroy & Hayes[27]	n=14	Between group comparison: Physical therapy with and without manual therapy (MT)	Shoulder impingement syndrome	- Both groups received hot packs, performed AROM, physiologic stretching, strengthening exercises, soft tissue mobilization, and patient education - Intervention group received grades I-IV Maitland mobilization at mid-range	1. AROM: Abduction, elevation (scaption), internal rotation, external rotation 2. Pain: Visual Analog Scale: measured for pain in last 24 hours, pain with subacromial impingement testing 3. Function: Graded ability to reach behind head, reach across body, and lift to 130º of flexion (can complete movement, can complete with pain, cannot complete) → Outcomes assessed at baseline and after 3 weeks	3 x week (45 min –1 hr) for a total of 3 weeks	Note: Only pain values are reported as AROM values were combined between groups in the reporting of quantitative data 1. 24 hour pain (VAS): MT: 37.21, Control: 2.21 2. Pain with Impingement testing MT: 28.07, Control: 3.14

Kachingwe et al[28]	n= 33	Between-group comparison with 4 groups: supervised exercise only, supervised exercise with glenohumeral mobilizations, supervised exercise with mobilization with movement, and control of only physician advice	Shoulder impingement syndrome	Supervised Exercise: (A) Posterior capsule stretching, postural, rotator cuff, and scapular exercises Glenohumeral Mobilization (B): Grades 1–4 mobilizations in either anterior, posterior, inferior directions, determined on patient by patient basis Mobilization with Movement (C): Posterior mobilization with movement glide with patient actively flexing Control (D): Advice on posture and avoidance of overhead activities, also received standard HEP	1. AROM: Flexion and scaption 2. Pain: Visual Analog Scale measuring pain in last 24 hours and with Neer and Hawkins Kennedy test 3. Function: SPADI (Shoulder pain and disability index)	One visit per week for 6 weeks	Note: Values represent % change 1. AROM: Flexion A: 27.6%, B: -15.9%, C: 46.7%, D: 42.6% AROM: Scaption A: 19.8%, B: 2.5%, C: 66.5%, D: 29.8% 2. Pain: VAS (24 hr) A: 20.8%, B: 44.2%, C: 55.2%, D: 14.4% Pain: VAS (Neer) A: 44%, B: 57.6%, C: 66.5%, D: 46.4% Pain: VAS (Hawkins/Kennedy) A: 39.5%, B: 52.1%, C: 60.2%, D: 11.2% Function: SPADI A: 61.6%, B: 56.7%, C: 55.5%, D: 34.2%
Johnson et al[29]	n=18	Between-group comparison: Anterior mobilization vs. Posterior mobilization (no control group)	Idiopathic adhesive capsulitis anteriorly	Anterior Mobilization (AM): Kaltenborn grade III mobilization directed Posterior Mobilization (PM): Kaltenborn grade III mobilization directed posteriorly →Both groups received ultrasound	1. AROM: External rotation 2. Pain: Visual Analog Scale measuring general unpleasantness 3. Function: Functional questionnaire adapted for motions requiring ER →AROM measured after each of 6 PT sessions; pain and function measured at baseline and after completion of study	6 total treatment sessions (average duration for anterior group was 15.4 days, 21.6 days for posterior group)	1. AROM: ER AM: 3.0, PM 31.3* 2. Pain: VAS (general) AM: 1.7, PM: 2.5 3. Function (questions 1–3) AM: 1, PM: 0 (Question 2) AM: -.5, PM .5 (Question 3) AM: 1.5, PM: 3

TABLE 2. Details of included studies. (*continued*)

Study	Participants	Study Design	Pathology	Interventions	Outcome Measures	Protocol	Outcomes (mean change from pre to post with 95% CI if supplied)
Yang et al[30]	n=28	Multiple treatment trial: Mid-range mobilization/End-range mobilization/Mobilization with movement (no control group) 2 Groups: ABAC and ACAB (A=Mid-range, B=End-range, C=Mobilization with movement)	Idiopathic adhesive capsulitis	Mid-Range Mobilization (MRM): Mobilization at 40° abduction End-Range Mobilization (ERM): Mobilization at end range of several motions (not described) Mobilization with Movement (MWM): Mobilization applied during several motions (not described)	1. AROM: Scaption, external rotation, internal rotation →Uses kinematic motion system rather than goniometer 2. Function: Flexi-level scale of shoulder function (FLEX-SF) → Outcomes assessed at end point of each treatment (3, 6, 9, 12 weeks)	2 visits per week (30-minute session) for 12 weeks	*Note: Values represent mean % change after 12 weeks of only ERM and MWM, both of which were significantly different from MRM group for most values* 1. AROM: Scaption ERM: 8.8%, MWM: 10.3% AROM: ER ERM: 35.2%, MWM: 32.7% AROM: IR ERM: 40.6%, MWM: 19.5% 2. Function (FLEX-SF) ERM: 19.2%, MWM: 17.9%
Vermeulen et al[31]	n=100	Between-group comparison: High-grade mobilization (end-range) vs. Low-grade mobilization (mid-range) (no control group)	Unilateral adhesive capsulitis	High-Grade Mobilization (HG): Maitland grades III & IV mobilization at end range (not described of which osteokinematic positions) Low-Grade Mobilizations (LG): Maitland grades I & II closer to neutral	1. AROM: Flexion, abduction, external rotation 2. PROM: Flexion, abduction, external rotation 3. Pain: Visual Analog Scale: measured at rest, during movement, and at night 4. Function: Shoulder Rating Questionnaire and Shoulder Disability Questionnaire 5. Health Status: SF-36 →Outcomes assessed at baseline, 3, 6, 12 months	2 visits per week (30-minute sessions) for 12 weeks	*Note: Values represent outcomes at 1 year* 1. AROM: Flexion HG: 47, LG: 42.9 AROM: Abduction HG: 72.9, LG: 60.3 AROM: ER HG: 20.8*, LG: 15.9 2. PROM: Flexion HG: 44.6, LG: 41.4 PROM: Abduction HG: 72.4*, LG: 59.9 PROM: ER: HG: 21.9*, LG: 15.4 3. Pain: VAS (rest) HG: -23.9, LG: -23 Pain: VAS (movement) HG: -39.2, LG: -32.6 Pain: VAS (night) HG: -43.7, LG: -35.9 4. Function (SRQ) HG: 38.3*, LG: 31.7 Function (SDG) HG: --50*, LG: -38.8 5. QOL (SF-36 physical) HG: 23.2, LG: 22.8 QOL (SF-36 mental) HG: 7.7, LG: 10.2

* = Significant between-group differences

^= Significant between-group difference at first follow-up point of Week 1, but not at Week 2

movement group gained the highest percentage change in range of motion. Teys et al[25] reported improvement in pain values as measured by pain pressure algometry, while Kachingwe et al[28] did not find significant improvement in pain values. Only Yang et al[30] found significant improvement in functional outcomes utilizing mobilization with movement while Kachingwe et al[28] reported no significant between-group difference; however, again the mobilization-with-movement group demonstrated the highest percentage change.

The Cyriax manual therapy approach consisting of deep friction massage and manipulation was utilized only by Guler-Uysal and Kozanoglu[26]. After one week of treatment, patients in the Cyriax group demonstrated significant improvements in passive range of motion into flexion, external rotation, and internal rotation compared to the modality group. After two weeks, the Cyriax group continued to demonstrate significantly improved passive range of motion into external and internal rotation compared to the modality group.

Three studies utilized an approach of mobilizations performed at the end range of motion[29-31]. Johnson et al[29] performed anterior and posterior mobilizations at the end of available range of motion; however, they did not describe the technique or grade of force used such as Kaltenborn or Maitland, while both Yang et al[30] and Vermeulen et al[31] utilized end-range mobilization following Maitland techniques. All three studies reported improvement in range of motion using end-range mobilization. Johnson et al[29] and Vermeulen et al[31] both reported no significant between-group differences in pain measures. Yang et al[30] and Vermeulen et al[31] both reported improvement in function favoring end-range mobilization, while Johnson et al[29] reported only within-group significant differences and no between group-differences using the anterior and posterior mobilization techniques.

Four studies included experimental groups utilizing mid-range mobilization[27,28,30,31]. Conroy and Hayes[27] and Vermeulen et al[31] performed mobilizations at the mid-range of available range of motion utilizing Maitland techniques, while Yang et al[30] utilized both Maitland and Kaltenborn techniques. Kachingwe et al[28] did not describe the technique used in terms of either Kaltenborn or Maitland but performed joint mobilizations at mid-position. Of the four, none demonstrated range-of-motion improvements utilizing mid-range mobilizations. Only Conroy and Hayes[27] reported significant reduction in pain values between groups, while Vermeulen et al[31] reported a significant within-group difference for mid-range mobilizations. Kachingwe et al[28] did not report any improvement in pain values for mid-range mobilization. Of the four, there were no reported significant improvements in function using mid-range mobilizations.

Discussion

The intent of this systematic review was to determine the effectiveness of manual therapy directed towards the glenohumeral joint for painful shoulder conditions in improving range of motion, pain, and shoulder functional activity and/or quality of life. A secondary purpose was to explore the individual value of specific manual therapy techniques. In terms of improving shoulder mobility, the evidence suggests that patients receiving manual therapy interventions for shoulder pain will demonstrate improvements in range of motion (ROM). Five of the seven included studies[25,26,28-30] demonstrated improvement in either active or passive range of motion, while Conroy and Hayes[27] and Kachingwe et al[28] did not report significant between-group differences.

Although the optimal form of manual therapy technique cannot be identified from the existing literature, there does seem to be preliminary evidence to support selected types of positioning techniques. When evaluating the results from Yang et al[30] and Vermeulen et al[31], both of which reported greater benefit utilizing high-grade/end-range mobilizations, the lack of significant ROM improvements in Conroy and Hayes[27] and Kachingwe et al[28] can at least be partially explained by the fact that only mid-range mobilizations were performed and the exact positioning of the techniques were not reported; however, in the studies, they were pictured as being performed in loose-pack position, respectively. Nonetheless, these results may be confounded by the differences in types of measurements used. Teys et al[25], Conroy and Hayes[27], Johnson et al[29], Yang et al[30], and Kachingwe et al[28] assessed active range of motion. Guler-Uysal and Kozanoglu[26] only measured passive range of motion, while Vermeulen et al[31] assessed both active and passive. Active ROM (AROM) has been found to have limited intra-rater reliability (ICC ranging from .35–.75) and limited inter-rater reliability (ICC ranging from .06–.65)[41]. Passive range of motion (PROM) has been demonstrated to have good intra-rater reliability for all shoulder motions (ICC ranging from .87–.99)[42]. Given the limited inter- and intra-rater reliability reported with AROM, the significance of the results reported in these studies may be limited.

Furthermore, using active motion to assess outcomes in ROM in response to manual therapy may pose a problem with construct validity. One of the proposed mechanisms by which manual therapy increases joint motion is through stretching of the joint capsule and surrounding tissues[2]. AROM of the shoulder requires sufficient strength in the muscles crossing the joint to move the arm against gravity[43]. Active ROM is, therefore, an assessment of muscular performance, functional mobility, and willingness of the individual to move. There can be limitations in active ROM; however, since it is not a true measure of the joint's mobility, these limits may be present when there are no passive restrictions in joint motion[43]. On the other hand, passive range of motion allows the examiner to determine the amount of available motion within the individual joint and the resistance of connective tissue to stretch[44]. The normal limiting factors with PROM are soft tissues, ligaments, joint capsule, or boney architecture. Perhaps to truly assess the effectiveness of manual therapy at the glenohumeral joint, PROM with scapula stabilization may be a better outcome to measure. Since most of the included studies in this review only measured active range of motion, and not many per-

formed consistent measurements, it may be more appropriate to conclude that manual therapy has a positive impact on functional movement in patients with shoulder pain being conservatively managed.

Although the use of manual therapy has been described to reduce pain[2], our analysis of the research could not completely support this conclusion. In four of the six studies that evaluated pain values[25,27,29,31], a trend was found favoring the use of manual therapy for decreasing some measure of pain values. These measurements, however, demonstrated significant heterogeneity in the conditions in which pain was measured, limiting the ability to definitively support or negate the use of manual therapy for pain management. In addition, those studies in which pain outcomes were evaluated used assessments that have good reliability in chronic musculoskeletal disorders[45] and high reliability for acute pain[46] but to date, there does not appear to be any literature that reports reliability or validity in this measure specifically for shoulder pain.

Much like the pain measures, significant heterogeneity in functional outcome measures also made conclusions related to the effectiveness of manual therapy difficult. Only five of the seven studies evaluated functional outcome measures (see Table 2). While three of the studies[28,30,31] did indicate a positive impact of manual therapy, specifically end-range mobilizations, the differences in measurements made definitive conclusions impossible. Only one study[31] administered a quality-of-life measure, the SF-36, and found no significant differences between groups; however, there were significant within-group differences from baseline to completion, suggesting that there may be a general positive impact of manual therapy on quality of life.

Limitations

This review has several limitations. The primary author alone (JC) performed the initial search for article and subsequent reading of titles and articles. Therefore, it is possible that articles may have been missed for inclusion. Also, only articles published in English were reviewed, again leading to the possibility that articles may have been missed. A significant limitation of this review is the small sample size of included studies as only one of the included studies had 100 or more participants. One disadvantage to performing a review on a topic with a paucity of research is that whatever is published will typically consist of smaller sample sizes, limiting overall effect size and generalizability. Given the small sample sizes, the authors chose not to present effect sizes but rather present quantitative data in Table 1 as presentation of possibly inflated effect sizes within the context of a qualitative review can be misleading to the reader. The authors chose to only include manual therapy performed at the glenohumeral joint; however, we did not delineate mobilizations performed to the acromioclavicular joint or sternoclavicular joint. None of the excluded studies were excluded because of mobilizations to these joints so a potential major bias was avoided; however, future reviews on manual therapy at the shoulder and future clinical trials on manual therapy to the shoulder should pay closer attention to the entire shoulder complex. The heterogeneity among outcome measures that is pervasive among the studies could have been avoided with more stringent inclusion criteria for the review. The reviewers also chose not to delineate years of experience or expertise in the therapists performing manual therapy interventions, a potential key factor in determining overall effectiveness. However, as this is the first review looking at the intervention of manual therapy across diagnostic categories, the choice to have wider inclusion criteria was made to capture as many randomized controlled trials as possible.

Conclusions

Overall, the studies included in this review demonstrate the benefit of manual therapy for improvements in mobility and a trend in improving pain measures, while increases in function and quality of life are still questionable. Limited data exist to support one form of manual therapy versus another.

Acknowledgements

We would like to acknowledge Ben Barron and Arlette Frederick for their roles as readers for quality scoring and screening for inclusion of full texts retrieved.

REFERENCES

1. AAOS American Academy of Orthopedic Surgeons. http://www.aaos.org. Accessed December 10, 2008.
2. Cook C. *Orthopedic Manual Therapy: An Evidence-Based Approach.* Upper Saddle River, NJ: Pearson Prentice Hall, 2007.
3. Bongers P. The cost of shoulder pain at work. *BMJ* 2001;322:64–65.
4. Kuijpers T, van der Windt D, Boeke AJ, et al. Clinical prediction rules for the prognosis of shoulder pain in general practice. *Pain* 2006;120:276–285.
5. Bennel K, Coburn S, Wee E, et al. Efficacy and cost-effectiveness of a physiotherapy program for chronic rotator cuff pathology: A protocol for a randomized double-blind, placebo-controlled trial. *BMC Musculoskelet Disord* 2007;8:86.
6. Faber E, Kuiper J, Burdoff A, et al. Treatment of impingement syndrome: A systematic review of the effects on functional limitations and return to work. *J Occup Rehab* 2006;16:7–25.
7. Michener L, Walsworth M, Burnet E. Effectiveness of rehabilitation for patients with subacromial impingement syndrome: A systematic review. *J Hand Ther* 2004;17:152–164.
8. Desmeules F, Cote C, Fremont P. Therapeutic exercise and orthopedic manual therapy for impingement syndrome: A systematic review. *Clin J Sport Med* 2003;13:176–182.
9. Cleland J, Durall C. Physical therapy for adhesive capsulitis. *Physiotherapy* 2002;88: 450–457.
10. Ho CYC, Sole G, Munn J. The effectiveness of manual therapy in the management of musculoskeletal disorders of the shoulder: A systematic review. *Man Ther* 2009; DOI: 10.1015/j.math.2009.03.008.
11. Green S, Buchbinder R, Hetrick SE. Physiotherapy interventions for shoulder pain. *Cochrane Database of Systematic Reviews* 2003; Issue 2. Art. No.: CD004258. DOI: 10.1002/14651858.CD004258.
12. Schellingerhout J, Vrhagen A, Thomas S, Koes B. Lack of uniformity in diagnostic la-

beling of shoulder pain: Time for a different approach. *Man Ther* 2008;13:478–483.
13. Kelly BT, Williams RJ, Cordasco FA, et al. Differential patterns of muscle activation in patients with symptomatic and asymptomatic rotator cuff tears. *J Shoulder Elbow Surg* 2005;14:165–171
14. Spencer E, Dunn W, Wright R, et al. Interobserver agreement in the classification of rotator cuff tears using magnetic resonance imaging. *Am J Sports Med* 2008;36:99–103.
15. Ludewig P, Reynolds J. The association of scapula kinematics and glenohumeral pathologies. *J Orthop Sports Phys Ther* 2009; 39:90–104.
16. Delitto A, Erhard E, Bowling R. A treatment-based classification approach to low back syndrome: Identifying and staging patients for conservative treatment. *Phys Ther* 1995;75:470–489.
17. Flynn T, Fritz J, Whitman J, et al. A clinical prediction rule for classifying patients with low back pain who demonstrate short-term improvement with spinal manipulation. *Spine* 2002;27:2835–2843.
18. Childs J, Fritz J, Flynn T, et al. A clinical prediction rule to identify patients with low back pain most likely to benefit from spinal manipulation: A validation study. *Ann Intern Med* 2004;141:920–928.
19. Sacket BL, Strauss SE, Richardson WS, Rosenberg W, Haynes RB. *Evidence-Based Medicine: How to Practice and Teach EB.* 2nd ed. Edinburgh, Scotland: Churchill Livingston, 2000.
20. Winters JC, Sobel JS, Groenier KH, et al. Comparison of physiotherapy, manipulation, and corticosteroid injection for treating shoulder complaints in general practice: Randomized, single blind study. *BMJ* 1997;314:1320–1325.
21. Portney L, Watkins M. *Foundations of Clinical Research Applications to Practice.* 3rd ed. Upper Saddle River, NJ: Pearson Prentice Hall, 2009.
22. PEDro scale. *Physiotherapy Evidence Database*. 1999. Available at: http://www.pedro.fhs.usyd.edu.au/scale_item.html. Accessed October 13, 2008.
23. Maher C, Sherrington C, Herbert R, et al. Reliability of the PEDro scale for rating quality of randomized controlled trials. *Phys Ther* 2003;83:713–721.
24. Bhogal S, Teasell R, Foley N, et al. The PEDro scale provides a more comprehensive measure of methodological quality than the Jadad Scale in stroke rehabilitation literature. *J Clin Epi* 2005;58:668–673.
25. 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. *Man Ther* 2008;13:37–42.
26. Guler-Uysal F, Kozanoglu, E. Comparison of the early response to two methods of rehabilitation in adhesive capsulitis. *Swiss Med Wkly* 2004;134:353–358.
27. Conroy D, Hayes K. The effect of joint mobilization as a component of comprehensive treatment for primary shoulder impingement syndrome. *J Orthop Sports Phys Ther* 1998;28:3–14.
28. Kachingwe AF, Phillips B, Sletten E, Plunkett SW. Comparison of manual therapy techniques with therapeutic exercise in the treatment of shoulder impingement: A randomized controlled pilot clinical trial. *J Man Manip Ther* 2008;16:238–247.
29. Johnson A, Godges J, Zimmerman G, Ounanian L. The effect of anterior versus posterior glide joint mobilization on external rotation range of motion in patients with shoulder adhesive capsulitis. *J Orthop Sports Phys Ther* 2007;37:88–99.
30. Yang J, Chang C, Chen S, et al. Mobilization techniques in subjects with frozen shoulder syndrome: Randomized multiple-treatment trial. *Phys Ther* 2007;87: 1307–1315.
31. Vermeulen H, Rozing P, Obermann W, et al. Comparison of high-grade and low-grade mobilization techniques in the management of adhesive capsulitis of the shoulder: Randomized controlled trial. *Phys Ther* 2006; 86:355–368.
32. van der Windt DA, Koes BW, Deville W, et al. Effectiveness of corticosteroid injections versus physiotherapy for treatment of painful stiff shoulder in primary care: Randomised trial. *BMJ* 1998;317:1292–1296.
33. Pajareya K, Chadchavalpanichaya N, Painmanakit S, et al. Effectiveness of physical therapy for patients with adhesive capsulitis: A randomized controlled trial. *J Med Assoc Thai* 2004;87:473–480.
34. Bang M, Deyle G. Comparison of supervised exercise with and without manual physical therapy for patients with shoulder impingement syndrome. *J Orthop Sports Phys Ther* 2000;30:126–137.
35. Ginn K, Herbert R, Khouw W, Lee R. A randomized, controlled clinical trial of treatment for shoulder pain. *Phys Ther* 1997; 77:802–811.
36. Arslan S, Celiker R. Comparison of the efficacy of local corticosteroid injection and physical therapy for the treatment of adhesive capsulitis. *Rheumatol Int* 2001; 21:20–23.
37. Senbursa G, Baltaci G, Atay A. Comparison of conservative treatment with and without manual physical therapy for patients with shoulder impingement syndrome: A prospective, randomized clinical trial. *Knee Surg Sports Traumatol Arthrosc* 2007;15:915–921.
38. van den Hout W, Vermeulen H, Rozing P, Vliet Vlieland T. Impact of adhesive capsulitis and economic evaluation of high-grade and low-grade mobilization techniques. *Aust J Physiother* 2005;51:141–149.
39. Cloke DJ, Watson H, Purdy S, Steen IN, Williams JR. A pilot randomized, controlled trial of treatment for painful arc of the shoulder. *J Shoulder Elbow Surg* 2008;17:17S–21S.
40. Carette S, Tardif J, Bessette L, et al. Intra-articular corticosteroids, supervised physiotherapy, or a combination of the two in the treatment of adhesive capsulitis of the shoulder. *Arthritis & Rheum* 2003;48:829–838.
41. Hoving JL, Buchbinder R, Green S, et al. How reliably do rheumatologists measure shoulder movement? *Ann Rheum Dis* 2002; 61:612–616.
42. Riddle D, Rothstein J, Lamb R. Goniometric reliability in a clinical setting: Shoulder measurements. *Phys Ther* 1987;67:668–673.
43. Clarkson HM. *Joint Motion and Function Assessment: A Research-Based Practical Guide*. Baltimore, MD: Lippincott, Williams & Wilkens, 2005.
44. Gajdosik RJ, Bohannon RW. Clinical measurement of range of motion: Review of goniometry emphasizing reliability and validity. *Phys Ther 1987*; 67:1867–1872.
45. Boonstra AM, Schiphorst Preuper HR, Reneman MF, Posthumus JB, Stewart RE. Reliability and validity of the visual analogue scale for disability in patients with chronic musculoskeletal pain. *Int J Rehab Res* 2008;31:165–169.
46. Bijur PE, Silver W, Gallagher J. Reliability of the Visual Analog Scale for measurement of acute pain. *Acad Emerg Med* 2001;8:1153–1157.