Systematic Review of Nondrug, Nonsurgical Treatment of Shoulder Conditions

Cheryl Hawk, DC, PhD,[a] Amy L. Minkalis, DC, MS,[b] Raheleh Khorsan, MA,[c] Clinton J. Daniels, DC, MS,[d] Dennis Homack, DC, MS,[e] Jordan A. Gliedt, DC,[f] Julie A. Hartman, DC, MS,[b] and Shireesh Bhalerao, DC, MCR[g]

Abstract

Objective: The purpose of this review was to evaluate the effectiveness of conservative nondrug, nonsurgical interventions, either alone or in combination, for conditions of the shoulder.

Methods: The review was conducted from March 2016 to November 2016 in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), and was registered with PROSPERO. Eligibility criteria included randomized controlled trials (RCTs), systematic reviews, or meta-analyses studying adult patients with a shoulder diagnosis. Interventions qualified if they did not involve prescription medication or surgical procedures, although these could be used in the comparison group or groups. At least 2 independent reviewers assessed the quality of each study using the Scottish Intercollegiate Guidelines Network checklists. Shoulder conditions addressed were shoulder impingement syndrome (SIS), rotator cuff-associated disorders (RCs), adhesive capsulitis (AC), and nonspecific shoulder pain.

Results: Twenty-five systematic reviews and 44 RCTs met inclusion criteria. Low- to moderate-quality evidence supported the use of manual therapies for all 4 shoulder conditions. Exercise, particularly combined with physical therapy protocols, was beneficial for SIS and AC. For SIS, moderate evidence supported several passive modalities. For RC, physical therapy protocols were found beneficial but not superior to surgery in the long term. Moderate evidence supported extracorporeal shockwave therapy for calcific tendinitis RC. Low-level laser was the only modality for which there was moderate evidence supporting its use for all 4 conditions.

Conclusion: The findings of this literature review may help inform practitioners who use conservative methods (eg, doctors of chiropractic, physical therapists, and other manual therapists) regarding the levels of evidence for modalities used for common shoulder conditions. (J Manipulative Physiol Ther 2017;40:293-319)

Key Indexing Terms: *Manual Therapy; Shoulder; Spinal Manipulation; Chiropractic; Conservative Treatment*

Introduction

Painful conditions of the shoulder are the third leading musculoskeletal complaint in primary care, with a point prevalence as high as 26%.[1] Two-thirds (67%) of adults experience shoulder pain at some time in their life,[2] and prevalence is highest in middle age (40-65 years).[3] Chronic shoulder pain characterizes a substantial subset of those with shoulder conditions because only 50% of patients recover within 6 months of onset.[2]

Disorders of the rotator cuff, including shoulder impingement syndrome (SIS), are among the most common causes of shoulder pain.[4] Other conditions include those that are unspecified and adhesive capsulitis (AC).[5,6] Primary treatment options considered in usual care typically consist of analgesics or exercises and progress to secondary and tertiary options of steroid injections or surgery if necessary.[7,8] Compared with more conservative treatments, surgery is likely more costly and risky.[4] The utilization of arthroscopic interventions for the shoulder has quickly increased in recent decades, with an estimated complication rate of 4.8%-10.6%.[9] Additionally, there are some negative effects of glucocorticoid injections on cellular characteristics and

[a] Texas Chiropractic College, Pasadena, TX.
[b] Palmer Center for Chiropractic Research, Palmer College of Chiropractic, Davenport, IA.
[c] Department of Planning, Policy and Design, University of California, Irvine, CA.
[d] VA Puget Sound Health Care System, Tacoma, WA.
[e] New York Chiropractic College, Seneca Falls, NY.
[f] Logan University College of Chiropractic, Chesterfield, MO.
[g] University of Western States, Portland, OR.
Corresponding author: Cheryl Hawk, DC, PhD. Tel.: +1 971 806 7302. (e-mail: *cherylkhawk@gmail.com*).
Paper submitted January 6, 2017; in revised form April 3, 2017; accepted April 7, 2017.
0161-4754

http://dx.doi.org/10.1016/j.jmpt.2017.04.001

mechanical properties of tendons, especially when used for long-term treatment.[10]

Patients pursuing treatment for shoulder pain seek care from manual therapy (MT) providers such as physical therapists, chiropractic practitioners, and others who use conservative interventions such as mobilization and manipulation. A study conducted in the Netherlands reported that shoulder complaints constituted 9.8% of physical therapy (PT) patients,[11] and in a survey of chiropractic practice in Australia, 12% of patients presented with shoulder pain.[12]

Reviews of MTs (eg, manipulation and mobilization) and multimodal treatments have found favorable effects supporting their use for the management of shoulder conditions.[13-17] However, clinical trials studying these treatments are inconsistently conducted, tend to have low to moderate levels of scientific rigor, and infrequently collect long-term outcomes. Therefore, evidence is still inconclusive regarding the appropriate use of many MTs for shoulder conditions. Furthermore, evidence is inconclusive regarding other nondrug, nonsurgical interventions that are commonly combined and employed in multimodal management in clinical practice.[13,14] The purpose of this review was to evaluate the evidence for conservative nondrug, nonsurgical interventions, either alone or in combination, for conditions of the shoulder.

Methods

The systematic review was performed from March 2016 to November 2016. Its purpose was to answer the following question: What is the effectiveness of nondrug, nonsurgical interventions, either alone or in combination, for conditions of the shoulder? The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), and was registered with PROSPERO (No. 42016046341).

Literature Search Parameters

We developed a search strategy in collaboration with a health sciences librarian. The following items were considered in developing the strategy.

Participants/Population and Setting. We included adult (age ≥18 years) patients in ambulatory care settings who were eligible for the included trials and had diagnoses of conditions of the shoulder. Studies including only acute cases (<4 weeks' duration) were excluded. No restrictions were placed on age, but mean ages were recorded.

Interventions. A nondrug, nonsurgical intervention had to be used in at least 1 of the study groups. This could be any combination of treatments, as long as no medications or surgical procedures were a formal part of the intervention.

Comparators. There were no restrictions on composition of the comparison group. Active treatments, placebos or shams, wait list, and no treatment were all included.

Outcomes. We included only pain and function/disability assessed by valid and reliable patient-based outcome measures. When other outcomes were reported, we excluded them from the data extraction tables. We included studies whether or not they reported on occurrence of adverse events, but noted adverse events in those that did.

Eligibility Criteria

The eligibility criteria for articles in the search are listed in Figure 1.

Search Strategy

The following databases were included in the search: PubMed, Index to Chiropractic Literature, Cochrane Database of Systematic Reviews, and Cumulative Index of Nursing and Allied Health Literature (CINAHL). A health sciences librarian worked with the investigators to develop the search strategies for each database; details of these are provided as appendices. Search terms related to a broad spectrum of shoulder diagnoses and any nondrug, nonsurgical interventions that serve as management strategies of these conditions were included. The terms were tailored for use in each database along with filters for systematic reviews and controlled trials. Titles and abstracts were screened independently by at least 2 reviewers for eligibility. Disagreements on eligibility were resolved by discussion. To attempt to address possible publication bias, we searched the US National Institutes of Health database (https://clinicaltrials.gov/) for trials that were conducted with no published results. This approach reflects methodology included in the updated guideline for systematic reviews published by the Cochrane Back and Neck Group.[18]

An additional strategy was to use reference tracking on the systematic reviews identified in the search. We did not extract data from the systematic reviews themselves. The randomized controlled trials (RCTs) identified by this method were added to RCTs identified through the formal literature search. For the complete search strategies for all included databases, please see Appendix A (available online only).

Evaluation of Risk of Bias

We evaluated articles using modified versions of the Scottish Intercollegiate Guideline Network (SIGN) checklists (http://www.sign.ac.uk/methodology/checklists.html) for systematic reviews/meta-analyses (both of these are abbreviated as "SRs") and RCTs. In the SIGN checklists, each article is scored as "high quality, low risk of bias," "acceptable quality, moderate risk of bias," "low quality, high risk of bias," or "unacceptable" quality, which resulted in rejection. We defined each level based on

Inclusion	Exclusion
• Published in a peer-reviewed journal between January 2011 and April 2016 • Human subjects aged 18 or older presenting to ambulatory care • English language • Treatment of non-acute (≥ 4 weeks' duration) shoulder pain/condition • Intervention included at least one group with only nondrug, nonsurgical treatment(s) • Systematic review • Randomized controlled trial	• Interventions delivered only to hospitalized patients • Commentaries/editorials/letters • Non-peer-reviewed publications • Conference abstracts • Case reports/series • Pilot RCTs not designed or powered to assess effectiveness • No treatment outcomes • Non-clinical studies • Medications/surgery used in all treatment groups

Fig 1. *Inclusion and exclusion criteria.*

1.1.	The research question was clearly defined and the inclusion/exclusion criteria listed in the paper (if "no," then reject).
1.2.	A comprehensive literature search was carried out (if "no," then reject).
1.3.	At least two people selected studies.
1.4.	At least two people extracted data.
1.5.	The status of publication was not used as an inclusion criterion.
1.6.	The excluded studies were listed.
1.7.	The relevant characteristics of the included studies were provided.
1.8.	The scientific quality of the included studies was assessed and reported.
1.9.	The scientific quality of the included studies was used appropriately.
1.10.	Appropriate methods were used to combine the individual study findings.
1.11.	The likelihood of publication bias was assessed appropriately.
1.12.	Conflicts of interest were declared.

Fig 2. *Systematic review checklist.*

scoring the checklists by assigning a value of 1 for each "yes" response.[19]

For SR checklists, which had 12 items, quality scores were assigned as follows: high quality, low risk of bias, >9; acceptable, moderate risk of bias, 6-9; low, high risk of bias <6; if items 1.1 and/or 1.2 were marked "no," then the article was unacceptable and was rejected (Fig 2).

For RCTs, checklists had 10 items and quality scores were assigned as follows: high quality, low risk of bias, 9-10; acceptable, moderate risk of bias, 6-8; low, high risk of bias, 3-5; unacceptable (reject), 0-2 (Fig 3).

At least 2 investigators evaluated each article. If there was disagreement between reviewers, a third also reviewed the paper and the majority rating was used after discussion among reviewers. Studies of unacceptable quality were excluded from the evidence tables.

Strength of Evidence

Strength of evidence was based on the quality and quantity of evidence on a specific topic. We used criteria for determining strength of evidence modified from that described in the UK report[20,21] and detailed in Table 1: high quality, positive or negative; moderate quality, positive or negative; and inconclusive, favorable or unfavorable.

Data Extraction

Data were not extracted from SRs. Instead, we searched each included review for RCTs and added any eligible ones not identified in our literature search. We summarized the systematic review conclusions to compare to our findings with respect to the RCTs, as has been done elsewhere.[22]

Data were extracted from all included studies by at least 2 investigators, with 1 serving as primary extractor and the second verifying the data. Disagreements were resolved by discussion, including a third reviewer if necessary. Data extracted were entered into a Microsoft Word table grouped by the condition as outlined in the included studies. Items included on the data extraction form were as follows: study identification (first author and year of publication); quality score; population (age); duration of complaint; dosage (number of treatment sessions over period); pain and function outcome measures used; results in terms of pain and function outcomes; conclusions; and limitations.

Results

Figure 4 illustrates the results of the search. There were 77 full-text articles screened (26 SRs and 51 RCTs). Eight were excluded as follows: 1 systematic review was outside the scope of this review (it did not include RCTs of shoulder conditions),[23] leaving 25 SRs; 5 articles designated as RCTs did not actually meet the definition of an RCT (did not test efficacy or did not test between-group differences)[24-28]; and 2 were outside the scope of our review (1 did not measure patient-based outcomes,[29] and the other was a prognostic study[30]), leaving 44 RCTs.

1.1	The study addressed an appropriate and clearly focused question.
1.2	The assignment of patients to treatment groups was randomized.
1.3	The sample size was justified by a power calculation.
1.4	An adequate concealment method (blinding) was used so that investigators were unaware of patients' treatment group status.
1.5	Patients were blinded to group assignment.
1.6	The treatment and control groups were similar at the start of the trial.
1.7	The only difference between groups was the treatment under investigation.
1.8	All relevant outcomes were measured in a standard, valid and reliable way.
1.9	The required sample size was attained. Or, if no power calculation was made, attrition was less than 25%.
1.10	All patients were analyzed in the groups to which they were randomly allocated (intention to treat analysis).

Fig 3. *Randomized controlled trial checklist.*

Table 1. *Rating of Evidence*[a,20,21]

Quality and Quantity of Evidence	Rating
Consistent results found in at least 2 low risk-of-bias studies	High
Results of at least 1 low risk-of-bias study or at least 2 low risk-of-bias studies with some inconsistency in results, or at least 2 acceptable-quality studies with consistent results	Moderate
Only acceptable-quality studies with inconsistent results or only high risk-of-bias studies	Inconclusive

[a] Evidence from randomized controlled trials and systematic reviews.

Systematic Reviews of Effectiveness

Table 2 lists the SRs of high, acceptable, or low quality (risk of bias) and condition addressed. One of the 25 was of unacceptable quality[48] and was not considered further, leaving 24 reviews. Twenty of the reviews addressed only 1 condition; 4 addressed multiple conditions.[13,21,46,47] In the sections below, the reviews covering multiple conditions are cited under each of the conditions they addressed.

Noncalcific Rotator Cuff-Associated Conditions

Nine articles addressed various treatments for rotator cuff-associated disorders (RCs). Three focused on various types of MT[13,17,21]; 2 on extracorporeal shockwave therapy (ESWT)[34,37]; and 1 each on transcutaneous nerve stimulation (TENS),[31] taping,[32] multimodal therapies,[46] and exercise.[33]

For MT (skilled hand movements performed by a therapist[17]), manipulation and mobilization were included. One acceptable-quality study found low- to moderate-quality evidence that MT may have a beneficial effect on pain, but the evidence was unclear for function.[17] Another acceptable-quality study found that the evidence was fair that MT including manipulation either alone or combined with exercise and modalities was effective.[13] A high-quality review found that manipulation/mobilization combined with exercise had a moderate level of positive evidence for effectiveness.[21] The last study in this group[46] reported evidence from an RCT[49] that found dietary advice combined with acupuncture was superior to supervised passive, active-assisted, and active range of motion (ROM) exercises combined with soft tissue and MT for rotator cuff tendinitis for ≥6 weeks. The study also reported statistically and clinically significant increases in patients' perceived improvements. At follow-up, statistically and clinically significant differences favored the diet-based multimodal program of care in pain and disability. A detailed description of the soft tissue and MT was not provided by the single study.[49]

For ESWT, 2 acceptable-quality reviews both found that ESWT was not effective for noncalcific rotator cuff tendinitis.[37,49]

For TENS, a high-quality review found that because of the scarcity of evidence and high risk of bias of existing studies, no conclusions could be made about its effectiveness.[31] For *taping,* an acceptable-quality review found that the evidence for taping alone or with other therapies was insufficient to make a conclusion.[32] For *exercise,* 1 acceptable-quality review compared PT exercise therapy with surgery for patients with rotator cuff tears. It found moderate evidence that surgery was superior to exercise therapy in the mid- to long term.[33]

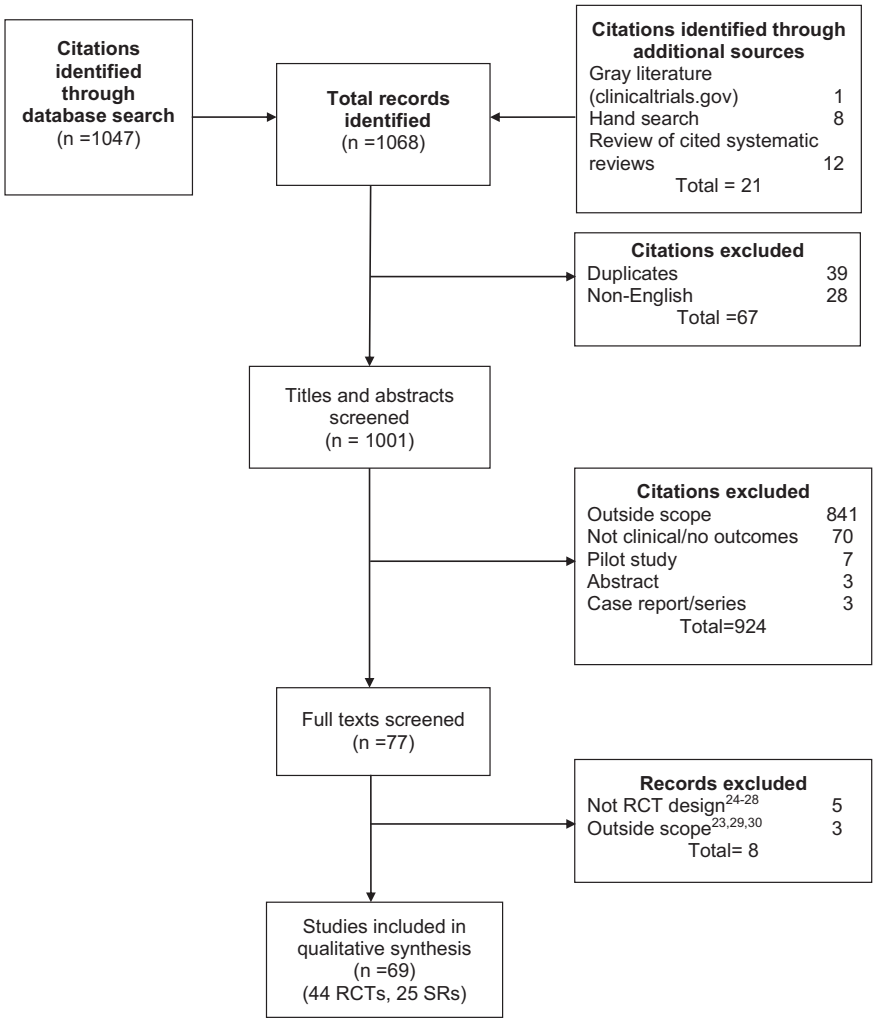

Fig 4. *Results of literature search.*

Rotator Cuff Calcific Tendinitis

Five acceptable-quality reviews[36,38,47,49,50] and 1 high-quality review[35] addressed rotator cuff calcific tendinitis (RC-CT). The first SR included 20 individual studies (1544 participants). It found that high-energy ESWT is the most thoroughly investigated minimally invasive treatment option in the short term to midterm and has proven to be a safe and effective treatment.[35] The second review[36] by the same team found that with the 22 studies that were included (1258 shoulders), many patients can achieve good to excellent clinical outcomes after high-energy ESWT, US-guided needling, and arthroscopy for calcific tendinopathy of the shoulder. Two additional acceptable-quality reviews both found that ESWT was effective for RC-CT.[37,49]

The other reviews in this category analyzed similar treatments and outcomes. One review (6 studies included, 460 patients) evaluated the effectiveness of ESWT for functional improvement and reduction of pain in patients with calcific tendinitis of the shoulder.[50] Meta-analysis was performed in 4 of the 6 studies included for review because these had 2 treatment groups; the other 2 studies were analyzed descriptively because they had 3 treatment groups. This SR found that ESWT increases shoulder function, reduces pain, and is effective in dissolving calcifications. Improvements continued over the 6-month follow-up period. The last review found that all 5 RCTs included (359 patients) reported greater improvement in functional outcomes in patients treated with high-energy ESWT, compared with patients treated with low-energy ESWT, at 3 and 6 months.[38]

One acceptable-quality study[47] included patients diagnosed with RC-CT, nonspecific shoulder pain (SP), and SIS. The study reported that compared with control groups, shockwave therapy is effective for reducing shoulder pain and disability in adults with persistent calcific tendinitis.

According to these SRs, ESWT has been proven to be an effective and safe treatment option after failed nonsurgical

Table 2. *Systematic Reviews of Effectiveness by Condition and Quality (Risk of Bias) Rating*

Condition	Quality	First Author, Year Published
RCs	High	Desmeules 2016[31]
	Acceptable	Desjardins-Charbonneau 2015 (taping)[32]
	Acceptable	Desjardins-Charbonneau 2015 (manual therapy)[17]
	Acceptable	Huisstede 2011[33]
RC-CT	Acceptable	Huisstede 2011[34] (ESWT) (noncalcific and RC-CT)
	High	Louwerens 2014[35]
	Acceptable	Louwerens 2016[36]
	Acceptable	Speed 2014[37] (noncalcific and RC-CT)
	Acceptable	Verstraelen 2014[38]
AC	Acceptable	Favejee 2011[39]
	High	Page 2014 (electrotherapy)[5]
	High	Page 2014 (manual therapy)[6]
	Acceptable	Jain 2014[40]
	Acceptable	Noten 2016[41]
SP	High	Chang 2016[42]
	High	Peek 2015[43]
	Acceptable	Kong 2013[44]
SIS	Acceptable	Saltychev 2014[4]
	Low	Wang 2014[45]
Multiple conditions	High	Clar 2014[21] (RC, AC, SP)
	Acceptable	Brantingham 2011[13] (RC, SP)
	High	Goldgrub 2016[46] (RC, SIS, SP)
	Acceptable	Yu 2015[47] (RC-CT, SP, SIS)

AC, adhesive capsulitis; *SP,* nonspecific shoulder pain; *RC,* rotator cuff-associated disorder; *RC-TC,* rotator cuff calcific tendinitis; *SIS,* shoulder impingement syndrome.

treatment of calcific tendinitis. Those studies that reported adverse events associated with the treatment found that only a small number of the treated participants were affected, and all of the adverse effects resolved within a few days.

Adhesive Capsulitis

Six studies analyzed a variety of therapeutic interventions for restoring motion and diminishing pain in patients with primary AC. Three studies[5,6,21] were scored as high quality, and 3 were scored as acceptable quality.[39-41]

Two of the high-quality studies were conducted by the same research team.[5,6] The first meta-analysis reviewed the evidence of electrotherapy modalities, delivered alone or in combination with other interventions, for the treatment of AC.[5] Nineteen trials (RCTs and controlled clinical trials, 1249 participants) were included in the review. Two electrotherapy modalities studies compared low-level laser therapy (LLLT) and pulsed electromagnetic field therapy (PEMF) with placebo. No trial in this SR compared an electrotherapy modality plus MT and exercise with MT and exercise alone. The benefit and harm of electrotherapy modalities were investigated in 9 trials. Five of the 9 studies measured adverse events. They reported low-quality evidence that LLLT, over a 6-day period, may improve global assessment of treatment success more than placebo. No participant in either group reported any adverse events. It is unclear whether 2 weeks of PEMF improves pain or function any more than placebo because of the very low quality evidence from 1 trial. There was moderate-quality evidence that LLLT plus exercise for 8 weeks may improve pain for up to 4 weeks and function for up to 4 months longer than placebo plus exercise.[5] The overall conclusion of this SR is that only 1 electrotherapy modality, LLLT, has evidence of benefit when compared when placebo or when used as an adjunct to exercise.

The second meta-analysis from the above team reviewed the benefit and harm of MT and exercise, alone or in combination, for the treatment of patients with AC.[6] They found 32 studies (1836 participants). No studies compared a combination of MT and exercise with placebo or no intervention. Meta-analysis was difficult because 7 trials compared a combination of MT and exercise with other interventions but were clinically heterogeneous in that a number of different interventions were used in the comparison groups. In the short term, the higher-quality studies in the Page et al meta-analysis[6] indicated that a combination of MT and exercise may not be as effective as glucocorticoid injection. They were unable to assess whether a combination of MT, exercise, and electrotherapy was an effective adjunct to glucocorticoid injection or oral nonsteroidal anti-inflammatory drugs. Following arthrographic joint distension with glucocorticoid and saline, MT and exercise may confer effects similar to those of sham ultrasound in terms of overall pain, function, and quality of life, but may provide greater patient-reported treatment success and active ROM.

Table 3. *Risk-of-Bias Assessment of Included RCTs*

First Author and Year Published	Items on SIGN Checklist [a]											
	1	2	3	4	5	6	7	8	9	10	Total	Quality [b]
Shoulder Impingement Syndrome												
Abrisham 2011[51]	1	1	0	1	1	1	1	1	1	1	9	H
Atya 2012[52]	1	1	0	0	0	1	1	1	0	0	5	L
Cook 2014[53]	1	1	1	0	0	1	1	1	1	0	7	A
Delgado-Gil 2015[54]	1	1	1	0	1	1	1	1	1	1	9	H
Engebretsen 2011[55]	1	1	1	1	0	0	0	1	1	1	7	A
Galace de Freitas 2014[56]	1	1	1	1	1	1	1	1	1	1	10	H
Granviken 2015[57]	1	1	1	1	0	1	1	1	1	1	9	H
Haik 2014[58]	1	1	0	1	1	1	1	1	1	1	9	H
Kardouni 2015[59]	1	1	1	0	1	1	1	1	1	1	9	H
Kardouni 2015[60]	1	1	1	0	1	1	1	1	1	1	9	H
Kaya 2014[61]	1	1	1	1	0	1	1	1	1	1	9	H
Kocyigit 2012[62]	1	0	0	1	1	1	1	1	1	0	7	A
Kromer 2013[63]	1	1	1	1	1	0	1	1	1	1	9	H
Rhon 2014[64]	1	1	1	1	0	0	0	1	1	0	6	A
Senbursa 2011[65]	1	1	0	0	0	1	1	1	0	0	5	L
Shakeri 2013[66]	1	1	1	1	1	0	0	1	1	0	7	A
Shakeri DASH 2013[67]	1	1	1	0	0	1	1	1	1	0	7	A
Simsek 2013[68]	1	1	1	1	1	1	1	1	1	1	10	H
Yavuz 2014[69]	1	1	1	1	0	1	1	1	1	1	9	H
Adhesive Capsulitis												
Chen 2014[70]	1	1	1	1	0	1	1	1	1	1	9	H
Doner 2013[71]	1	1	0	0	0	1	1	1	0	0	5	L
Hsieh 2012[72]	1	1	0	1	0	0	0	1	1	0	5	L
Klc 2015[73]	1	1	0	1	0	1	1	1	1	0	7	A
Ma 2013[74]	1	1	1	1	0	1	1	1	1	1	9	H
Maryam 2012[75]	1	1	0	0	0	1	1	1	0	1	6	A
Shi 2012[76]	1	1	1	1	1	0	1	0	1	0	7	A
Smitherman 2015[77]	1	1	0	0	0	1	1	1	0	1	6	A
Rotator Cuff-Associated Disorders												
Eslamian 2012[78]	1	0	1	1	1	1	1	1	1	1	9	H
Kolk 2013[79]	1	1	1	1	1	1	1	1	1	1	10	H
Kukkonen 2014[80]	1	1	1	0	0	0	0	1	1	1	6	A
Kukkonen 2015[81]	1	1	1	0	0	0	0	1	1	1	6	A
Liu 2012[82]	1	1	0	0	1	0	1	0	0	0	5	L
Moosmayer 2014[83]	1	1	1	1	0	1	1	1	1	1	9	H
Rabini 2012[84]	1	1	1	1	0	1	1	1	1	1	9	H
Tornese 2011[85]	1	1	0	1	0	0	1	1	1	1	7	A
Nonspecific Shoulder Pain												
Bron 2011[86]	1	1	1	1	0	0	0	1	0	1	6	A
Montes 2012[87]	1	1	1	1	1	1	1	1	1	1	10	H
Riley 2015[88]	1	1	1	1	1	0	0	1	1	1	8	A
Teys 2013[89]	1	1	1	0	0	1	1	1	1	1	8	A

RCT, randomized controlled trial; *SIGN,* Scottish Intercollegiate Guideline Network.

[a] Quality assessment items from modified SIGN checklist:

1. Study addresses appropriate and clearly focused question.
2. Assignment of patients to treatment groups is randomized.
3. Sample size is justified by a power calculation.
4. Investigators are adequately blinded to patients' group assignment.
5. Patients are blinded to group assignment.
6. Treatment and control groups are similar at baseline.
7. Only difference between groups is the treatment under investigation.
8. All relevant outcomes are measured in a standard, valid and reliable way.
9. Required sample size was reached; or, if no power calculation was made, attrition was <25%.
10. Intention-to-treat analysis was used.

[b] Quality rating: 9-10 = high (H); 6-8 = acceptable (A); 3-5 = low (L); 0-2 = unacceptable (U, reject).

Table 4. *Evidence Table for Included Randomized Controlled Trials of Nondrug, Nonsurgical Treatment of Shoulder Impingement Syndrome*

Citation and Quality	Patient Population Mean Age, Mean Symptom Duration	Intervention	Comparison Group(s)	Dosage	Pain and/or Disability Outcome Measures	Outcomes (Mean Change Within and Between Groups)	Conclusions	Limitations
Spinal Manipulative Therapy								
Cook 2014[53] High	n = 68 age: 53, both groups duration: >12 mo	Cervical mobilization and shoulder MT	Shoulder MT	Individualized treatment d: TG = 60; CG = 52 Total visits: TG = 10; CG = 9	NPRS (0-10) QuickDASH	Within group (% change): 60% NPRS; 54% QuickDASH Between groups: NS for NPRS or QuickDASH	No additional benefit of cervical mobilization	Single-blind Short-term
Haik 2014[58] High	n = 50 age: TG = 34; CG = 30 duration: TG = 49 mo CG = 43 mo	Thoracic SMT	Sham thoracic SMT	1 treatment visit	NPRS (0-10)	Within group (mean change): TG = –0.8; CG = –0.2 $p = 0.004$ Between groups: $p = 0.11$	No significant difference between groups	SMT directed to T3-T7 only Potential floor effect on NPRS 1 treatment
Kardouni 2015[60] High	n = 45 age: 31, both groups duration: ≥6 wk	Active thoracic SMT	Sham thoracic SMT with identical positioning	1 treatment visit	NPRS (0-10) PSS (0-100)	Within group (mean change): TG = –0.9; CG = –1.5 $p \leq 0.001$ Between groups: $p = 0.28$ Within group: TG = 9.2; CG = 11.0 $p \leq 0.001$ Between groups: $p = 0.52$	Thoracic SMT no better than sham	1 treatment Sample did not reach power calculation
Kardouni 2015[59] High	n = 52 age: TG = 31 CG = 33 duration: ≥6 wk	Active thoracic SMT	Sham thoracic SMT with identical positioning	1 treatment visit	NPRS (0-10) PSS (0-100)	Within group (mean change): TG = –0.9; CG = –1.2 $p \leq 0.001$ Between groups: $p = 0.74$ Within group: TG = 8.6; CG = 9.3 $p < 0.001$ Between groups: $p = 0.89$	Thoracic SMT no better than sham	Potential floor effect on NPRS Only 1 treatment
Manual Therapy								
Delgado-Gil 2015[54] High	n = 42 age: TG = 55 CG = 54 duration: >3 mo	MWM	Sham manual contact	2 sessions/wk for 2 wk (total 4)	VAS	Within group: $p \leq 0.001$ Between groups: $p = 0.011$	MWM superior to sham for pain	Short-term follow up MWM applied in isolation 4 treatments
Kaya 2014[61] High	n = 54 age:	MT and exercise	KT and exercise	1×/wk for 6 wk	VAS (0-10 cm)	Within group (mean change): TG = 1.61 ($p \leq 0.001$);	MT and KT with exercise	No untreated comparison group

	TG = 47 CG = 51 duration: 6-28 wk				VAS for night pain DASH (0-100)	CG = 1.07 (p = 0.04) Between groups: p = 0.58 Within group: TG = 1.96 ($p \leq 0.001$); CG = 3.64 ($p \leq 0.001$) Between groups: p = 0.01 Within group: TG = 29.36 ($p \leq 0.001$); CG = 26.3 ($p \leq 0.001$) Between groups: p = 0.46	similar short-term effects; KT had additional benefit for night pain	Unbalanced attrition rate
Kromer 2013[61] High	n = 90 mean age: TG = 50 CG = 54 duration: ≥4 wk	IAEX plus MT	IAEX only	10 sessions within 5 wk	 NPRS (0-10) SPADI (0-100)	Within group (mean change): TG = 2.3; CG= 1.6 p = 0.001 Between groups: p = 0.15 Within group: TG = 16.2; CG = 14.4 p = 0.001 Between groups: p = 0.64	IAEX effective; no additional benefit of MT	No sham or no-treatment comparison group
Rhon 2014[64] Acceptable	n = 104 mean age: TG = 40 CG = 42 duration: >4 mo	MPT	CSI	TG: 2×/wk for 3 wk CG: ≤3 injections (>1 mo apart) in 1 y	SPADI NPRS GRC 1, 3, 6, and 12 mo	Within group: Significant improvement for all measures at 12 mo, both groups Between groups: NS for all measures	Both groups experienced significant improvement	No blinding; trial recruited only patients referred to MPT No standardized diagnostic criteria
Senbursa 2011[65] Low	n = 77 mean age: TG1 = 48 TG2 = 51 CG = 48 duration not reported	TG1: Supervised and home-based exercise TG2: MT, supervised and home-based exercise	CG: Home-based exercise only	TG1, TG2: Supervised exercise 3×/wk; TG2: MT 3×/wk All groups: Daily home-based exercise	VAS (0-10 cm) MASES	Within group: Significant improvement in pain and function in all groups at 4 and 12 wk Between groups: NS for all measures	MT may relieve pain and/or shorten treatment periods	Power calculation not done Evaluators not blinded
				Kinesiotaping				
Shakeri 2013[67] Acceptable	n = 30 age: 47, both groups duration: TG = 8 mo CG = 9 mo	Standardized therapeutic KT	Standardized sham KT	72 h of initial application; reapplied for 48 h	DASH	Within group: TG: p = 0.001; CG: p = 0.02 Between groups: p = 0.01	KT improved disability of shoulder, arm, and hand	Convenience sampling Small sample 1-wk follow-up
Shakeri 2013[66] Acceptable	n = 30 age: 46, both groups duration at least 1 wk within last 6 mo prior to study	Standardized therapeutic KT	Standardized sham KT	72 h of initial application; reapplied for 48 h	VAS	Within group: Significant for TG for pain; significant for CG for night pain Between groups: NS for pain	No significant difference between therapeutic KT and sham KT	Did not measure functional ability Symptoms may have been acute

(continued on next page)

Table 4. (*continued*)

Citation and Quality	Patient Population Mean Age, Mean Symptom Duration	Intervention	Comparison Group(s)	Dosage	Pain and/or Disability Outcome Measures	Outcomes (Mean Change Within and Between Groups)	Conclusions	Limitations
Simsek 2013[68] High	n = 38 age: TG = 48 CG = 53 duration: ≥4 wk	Standardized therapeutic KT and exercise	Standardized sham KT and exercise	Tape was applied at baseline and every 3 d for a total of 12 d	VAS (0-10 cm) At rest During activity During sleep DASH (0-100) CSS[a]	Within group (mean change): TG = 1.31 ($p \leq 0.001$); CG = 0.56 ($p \leq 0.05$) Between groups: $p = 0.116$ Within group: TG = 2.8 ($p \leq 0.001$); CG = 1.68 ($p \leq 0.001$) Between groups: $p = 0.009$ Within group: TG = 3.86 ($p \leq 0.001$); CG = 1.92 ($p \leq 0.001$) Between groups: $p = 0.018$ Within group: TG = 21.01 ($p \leq 0.001$); CG = 5.59 ($p \leq 0.01$) Between groups: $p = 0.001$ Within group: TG = 20.42 ($p \leq 0.001$); CG = 8.37 ($p \leq 0.001$) Between groups: $p = 0.146$	KT is effective in rehabilitation of SIS when combined with exercise	Short follow-up time
Low-Level Laser Therapy								
Abrisham 2011[51] High	n = 40 age: TG = 52 CG = 51 duration not reported	LLLT, exercise therapy	Placebo laser, exercise therapy	6 min/session; 10 total	VAS (0-10 cm)	Significant difference between groups in VAS ($p = 0.00$), with significant pain reduction TG	LLLT combined with exercise therapy is more effective than exercise therapy alone in relieving pain	Outcome measures limited No long-term follow-up
Yavuz 2014[69] High	n = 31 age: TG = 44 CG = 45 duration: >4 wk	LLTL, hot packs, and exercise program	CG: Ultrasound, hot packs and exercise program	5×/wk for 2 wk (10 total)	VAS (0-100 mm) –First month –Third month	Within group (mean change): TG = 17.0 ($p = 0.026$); CG = 14.9 ($p = 0.034$) Between groups: $p > 0.05$ Within group: TG = 19.0 ($p = 0.023$); CG = 14.3 ($p = 0.032$) Between groups: $p > 0.05$ Within group: TG = 20.0 ($p = 0.004$);	Efficacy of LLLT and ultrasound seemed comparable regarding pain and disability reduction in patients with impingement	No nontreatment comparison group Small sample size Short-term follow-up

						CG = 19.8 (p = 0.025) Between groups: p > 0.05 Within group: TG = 22.8 (p = 0.005); CG = 23.4 (p = 0.043) Between groups: p > 0.05		
					SPADI (0-100) –First month –Third month			
Microcurrent								
Atya 2012[52] Low	n = 40 age: 49, both groups duration: TG = 6 mo CG = 7 mo	Microcurrent stimulation	Sham; identical procedure except electrodes not connected	Duration: 20 min 3×/wk for 6 wk (total of 18 treatments)	VAS SDQ	Within group (mean change): TG = –1.65 (p = 0.001); CG = –0.45 (p = 0.156) Between groups: p = 0.015 Within group: TG = -5.35 (p = 0.003); CG = 0.55 (p = 0.52) Between groups: p = 0.007	Microcurrent stimulation may be effective for improving pain and function in patients with SIS	No power calculation and sample size was small Did not report attrition
Extracorporeal Shockwave Therapy								
Engebretsen 2011[55] Acceptable	n = 94 age: TG = 49 CG = 47 duration: >3 mo	rESWT	Supervised exercise and home exercise	rESWT: 1×/wk for 4-6 wk SE: 2 45-min sessions/wk for maximum of 12 wk	SPADI	Within group: Significant improvement (p = 0.001) in both groups Between groups: No significant difference at 1-y follow-up (p = 0.093).	No significant differences between groups at 1-y follow-up	No placebo control Possible misclassification bias Possible attrition bias
Pulsed Electromagnetic Field Therapy								
Galace de Frietas 2014[56] High	n = 56 age: TG = 50 CG = 51 duration: TG = 22 mo CG = 21 mo	PEMF and exercises	Placebo PEMF and exercises	30-min treatments. 9 sessions (3/wk for 3 wk)	VAS UCLA shoulder rating scale Constant-Murley shoulder score	Within group: Significant in both groups for improved function and decreased pain ($p \leq 0.05$). Between groups: No significant difference for pain or function at 3 wk, 9 mo, and 3 mo	Lack of Between-group differences indicate PEMF has no additional benefit to exercise	No verification of patients performing their exercises
Transcutaneous Nerve Stimulation								
Kocyigit 2012[62] Acceptable	n = 20 age: TG = 49 CG = 45 duration: ≥1 mo	Low-frequency TENS	Sham TENS	1 treatment	VAS (0-100 mm)	Within group (mean change): TG = 18.0 (p = 0.015); CG = 0.8 (p = 0.624) Between groups: Significant difference VAS	TENS showed significant reduction in pain	Only 1 treatment and no follow-up

(continued on next page)

Table 4. (*continued*)

Citation and Quality	Patient Population Mean Age, Mean Symptom Duration	Intervention	Comparison Group(s)	Dosage	Pain and/or Disability Outcome Measures	Outcomes (Mean Change Within and Between Groups)	Conclusions	Limitations
Exercise								
Granviken 2015[57] High	n = 46 age: 48, both groups duration: >12 wk	SE and HE	HE only	6 wk TG: 10 SE sessions and HE CG: 1 training session for daily HE	Pain scale (0-10) SPADI (0-100)	Within group (mean change): 6 wk: TG = −2.1; CG = −1.8 Between groups: NS Within group: 26 wk: TG = −27; CG = −26 Between groups: NS	Supervision of more than the first session of a 6-wk exercise regimen did not yield significant differences from HE alone	There may be subgroups that benefit from supervision

CG, comparison group; *CSI*, corticosteroid injection; *DASH*, Disabilities of the Arm, Shoulder and Hand Questionnaire; *ECWT*, extracorporeal shockwave therapy; *GRC*, Global Rating of Change; *HE*, home exercise; *IAEX*, individually adapted exercises; *KT*, kinesiotaping; *LLLT*, low-level laser therapy; *MASES*, Modified American Shoulder and Elbow Surgery questionnaire; *MT*, manual therapy, including any type of mobilization, stretching, or soft tissue technique applied to the shoulder and surrounding tissue, not the vertebral joints, unless otherwise specified; *MPT*, manual physical therapy; *MWM*, mobilization with movement; *NPRS*, Numeric Pain Rating Scale; *NS*, nonsignificant; *PASS*, Patient Acceptable Symptom State; *PEMF*, pulsed electromagnetic field therapy; *PSS*, Penn Shoulder Score; *QuickDASH*, Quick Disabilities of the Shoulder and Hand Questionnaire; *SDQ*, Shoulder Disability Questionnaire; SE, supervised exercise; *SIS*, shoulder impingement syndrome; *SMT*, spinal manipulative therapy, including manipulation and/or mobilization of vertebrae unless otherwise specified; *SPADI*, Shoulder Pain and Disability Index; *TENS*, transcutaneous nerve stimulation; *TG*, treatment group; *VAS*, visual analog scale for pain.

Three acceptable-quality SRs evaluated conservative treatments for AC. One reviewed 12 RCTs involving 810 patients.[41] This SR found that mobilization techniques have beneficial effects in patients with primary AC of the shoulder. It reported that the Maitland technique and spine mobilization, combined with glenohumeral stretching and both angular and translational mobilization, seem to be most beneficial in reducing pain. Adverse events were not reviewed for each study included. The next study looked at the effectiveness of physiotherapeutic interventions in treatment of AC.[40] This SR found that of the 39 studies (4350 patients) included, therapeutic exercises and mobilization therapy are the most effective for reducing pain and improving function in patients with stage 2 and 3 AC. Also, high-grade posterior mobilization along with self-exercise is also suggested for improving function. LLLT is strongly recommended for pain relief and moderate improvement of function, but not for improvement of ROM. Adverse events were not assessed in this SR.

A high-quality review of treatments for RC, AC, and SP patients[21] found evidence for MT and manipulative therapy with multimodal or exercise therapy (MT included high-velocity low-amplitude manipulation, mid- or end-range mobilization, and mobilization with movement [MWM]) for the treatment of AC. However, because of a lack of research on MT and AC, the study concluded that further research is required to draw conclusions.[21]

The last study reviewed 5 Cochrane reviews and 18 RCTs on the effectiveness of oral medication, injection therapy, physiotherapy, acupuncture, arthrographic distension, and suprascapular nerve block (SSNB).[39] This SR found strong evidence for the effectiveness of LLLT and steroid injections on pain in the treatment of frozen shoulder in the short term. They reported moderate evidence in favor of mobilization techniques in the short and long term and for steroid injections in the midterm. And lastly, moderate evidence was found for the effectiveness of distension alone and as an addition to active PT in the short term.[39]

It is difficult to assess the safety of the interventions for AC because many of the included studies did not report on adverse events.

Nonspecific SP

Seven SRs assessed the effectiveness of nonconventional therapies for SP (3 studies on SP exclusively and 4 studies on multiple conditions including SP).

Four of the 7 studies were rated as high quality[21,42,43,46] and 3 as acceptable quality.[13,44,47] The first high-quality SR assessed the effectiveness of SSNB compared with PT, placebo, and intra-articular injections.[42] Eleven RCTs (591 patients) compared SSNB with PT, placebo, and intra-articular injections. This review found that SSNB provided better pain relief and improvement in function when compared with placebo injections and PT, but had results similar to those for

intra-articular injection of the glenohumeral joints. Adverse events were reported, but none were severe, and no long-term complications were encountered.

The second high-quality SR assessed thoracic MT (TMT).[43] Three RCTs met the eligibility criteria of this SR. All 3 used usual care as a comparison (ie, general practitioner's advice, steroid injections, or PT). This SR concluded that TMT helped accelerate recovery and reduced pain outcomes and disability measures immediately and for up to 52 weeks compared with usual care. Adverse events were not assessed.

There were 4 reviews of multiple conditions that included SP; 2 of the 4 were high quality.[13,21,46,47] The third high-quality study[46] reported minor benefits with multimodal PT programs compared with wait list control or guideline-based usual care performed by general practitioners.

Two SRs concluded that there is limited evidence for use of mobilization and/or high-velocity low-amplitude manipulation with soft tissue release and exercise for SP.[13,21] Mobilization alone was not an effective treatment for SP. These large SRs found that none of the SRs in their meta-analysis included a specific statement on adverse events. Therefore, the safety of manipulation and mobilization for SP is unknown.

The Yu et al review reported that neither ultrasound nor interferential current therapy is more effective than placebo treatment for SP of variable duration.[47]

The last SR evaluated the effectiveness of massage therapy for SP.[44] The meta-analysis reported significant immediate and short-term effects of massage for SP compared with inactive therapies (both p values < 0.01). However, these results were not significant for massage for pain when compared with other active therapies. Also, massage therapy did not significantly differ from other therapies with respect to functional status of the shoulder. Adverse events were not assessed.

Shoulder Impingement Syndrome

We found 4 SRs that evaluated the quality of RCTs for SIS (2 studies on SIS exclusively[4,45] and 2 studies on SIS and other conditions[46,47]). Two were of high quality,[4,46] 1 was of acceptable quality,[47] and the last was of low quality.[45]

The first SR[4] reviewed trials that compared surgical techniques targeting release of shoulder impingement with any type of conservative treatment including physical training, education, and passive physiotherapy, or comparable treatment. Seven RCTs were considered to fulfill the inclusion criteria of the SR. The meta-analysis estimating the reduction of pain intensity contained moderate evidence that surgery and conservative methods have similar effects on the reduction of pain intensity.

The second review[47] found that pretensioned tape and shockwave therapy are not more effective than placebo treatment for the management of SIS. The third study[46] reported multimodal care may not be superior to placebo interventions. However, they also reported that when comparing SIS of variable duration there are minor changes that may lead to improvements in recovery and pain when compared with corticosteroid injections (CSIs).

The last SR evaluated the effect of isokinetic training in patients with SIS.[45] Two RCTs met the inclusion criteria. Therefore, pooling of the data for a meta-analysis was not possible. Overall, the included studies found improvement in pain and disability after isokinetic training. However, both RCTs reported no statistically significant difference between isokinetic training and a comparison group. Therefore, they reported that there was not enough evidence to support or refute the effectiveness of isokinetic training for SIS because of the lack of evidence.[45]

Only 1 SR assessed safety and adverse events of the individual studies included.[47] They found that 8 of 11 RCTs reported on adverse events and that none of these observed any serious adverse events.

Randomized Controlled Trials

Table 3 lists the RCTs of high, acceptable, or low quality (risk of bias) with each item on the quality assessment instrument. Of the 44 RCTs, 5 were of unacceptable quality[90-94] and were not included in the table or considered further, leaving a total of 39 included RCTs.

Tables 4-7 summarize the data extraction for all RCTs by condition addressed.

Shoulder Impingement Syndrome

There were 19 RCTs focusing on SIS. Four compared spinal manipulative therapy (SMT) with another treatment or sham; 5 compared MT with another treatment or sham, and 10 compared various modalities with another treatment or sham (Table 4).

SMT Trials. For all 4 trials, both treatment and comparison groups improved. One high-quality trial (n = 68) with patients of mean age 53 with SIS symptom duration >12 months found no additional benefit from combining cervical SMT with MT, compared with MT alone.[53] Three high-quality trials found no significant difference between thoracic SMT and sham thoracic SMT. However, in all 3 of these, only 1 SMT session was included and only short-term effects on pain were measured, with patients whose mean age was in the early 30s.[58-60] Only 1 of these trials[54] reported on adverse events, and in that case, there were none.

MT Trials. For all 5 trials, both treatment and comparison groups improved significantly. One trial found a statistically significant difference between the treatment and comparison groups.[54] In that study, the type of MT was MWM, and it was compared with a sham manual contact. Pain intensity was significantly improved in the MT group, compared with the sham, in a sample of 42 patients in their mid-50s with SIS of greater than 3 months' duration.

Table 5. *Evidence Table for Included Randomized Controlled Trials of Nondrug, Nonsurgical Treatment of Adhesive Capsulitis*

Citation and Quality	Patient Population, Mean Age, Mean Symptom Duration	Intervention	Comparison Group(s)	Dosage	Pain and/or Disability Outcome Measures	Outcomes (Mean Change Within and Between Groups)	Conclusions	Limitations
Doner 2013[71] Low	n = 40 age: 59, both groups duration: >3 mo	Mulligan's shoulder mobilization, hot packs, TENS	Passive shoulder stretching, hot packs, TENS	Both groups: 3 sets of 10 reps/d; 5 d/wk for 3 wk	VAS at rest and during activity CSS SDQ Measured at 3 wk and 3 mo	Within group: Both groups improved at 3 wk and 3 mo Between groups: VAS at rest at 3 mo ($p = 0.02$) VAS during activity at 3 wk and 3 mo ($p = 0.005$, 0.003) CSS and SDQ at 3 wk and 3 mo ($p < 0.05$)	Mulligan's mobilization is more effective than passive stretching	Blinding of therapists not possible Outside care difficult to control Compliance to study protocol in question
Hsieh 2012[72] High	n = 63 age: TG = 56 CG = 53 duration: ≥3 mo	Hyaluronic acid intra-articular injection + PT	PT: therapeutic exercises, heat and electric therapy	TG: 1 injection/wk for 3 wk, in addition to PT for 12 wk CG: 3 1-h sessions/wk for 12 wk	SPADI SDQ SF-36 (QoL)	Within group: Significant improvement in pain, disability and QoL ($p < 0.05$) Between groups: NS for any measure	Addition of intra-articular hyaluronic acid injections to PT did not produce a significant added benefit	No untreated control group Injection using blind technique may have reduced procedure accuracy
Klc 2015[73] Acceptable	n = 41 age: TG = 55 CG = 62 duration: >1 mo	Suprascapular nerve block injection before PT	PT alone (hot pack, TENS, US, exercises, stretching)	TG: 1 injection prior to PT CG: 5×/wk for 3 wk of PT	CSS BPI-SF Measured immediately after course of PT and 1 mo later	Within group: CSS and BPI-SF both significantly improved at both measurement intervals Between groups: Significantly greater improvement in TG immediately post-intervention in CSS and BPI-SF No difference in CSS at 1-mo follow-up; significantly greater improvement on BPI-SF	PT and nerve block both effective for function and pain, with greater pain reduction with nerve block	Younger age of the TG Small sample size Short follow-up
Ma 2013[74] High	n = 30 age: 57, both groups duration: ≥3 mo	WBC plus PT	PT only	3×/wk for 4 wk (12 sessions total)	VAS ASES measured immediately post-intervention (at 4 wk)	Within group: Both groups had significant improvement in VAS and ASES Between groups: Significant difference favoring WBC for VAS and ASES ($p < 0.01$)	WBC exhibits additional benefit when combined with PT	Small sample size No group receiving no treatment Short follow-up

Maryam 2012[75] Acceptable	n = 87 age: TG1 & TG2 = 54 CG = 53 duration: TG1 = 4 mo TG2 = 6 mo CG = 7 mo	TG1: CSI, home exercise TG: CSI, PT, home exercise	CG: PT (TENS, ice, active ROM), home exercise	TG1: 1 CSI; TG2: 1 CSI prior to PT TG2 and CG: 10 sessions PT	Pain score Disability score SPADI Measured 6 wk post-intervention	Within group: Not analyzed Between groups: Significant improvement in disability and SPADI, but not pain, favoring combination of CSI and PT	CSI + PT was more successful at 6 wk post-intervention than CSI or PT alone	Small sample size High attrition rate
Chen 2014[70] High	n = 40 age: TG = 54 CG = 52 duration: ≥3 mo	ESWT	Oral steroids (prednisone)	ESWT: 3 treatments 2 wk apart Prednisone: 30 mg/d for 2 wk, 15 mg/d for 2 wk	CSS OSS	Within group: Both groups had significant improvement throughout study on both CSS and OSS Between groups: Significant difference favoring ESWT at 4 wk on CSS ($p = 0.009$) and on both CSS ($p \leq 0.001$) and OSS ($p = 0.020$) at 6 wk and ($p = 0.041$) and 12 wk ($p = 0.045$)	Both groups had improvement after receiving treatment, but those receiving ESWT had statistically significantly greater improvement	Small sample size Participants not blinded to treatment group
Shi 2012[76] Acceptable	n = 174 age: TG1 = 52 TG2 = 55 CG = 54 duration: 2-24 wk	TG: Electroacupuncture TG2: Warming needles	CG: Filiform needle	30 min each visit, with a total of 5 visits occurring every other day	VAS measured after 5-visit course of treatment	Within group: Significant improvement in all groups ($p \leq 0.01$) Between groups: TG1 and 2 significantly more effective than CG; TG1 significantly more effective than TG2 ($p = 0.01$)	All 3 therapies effective but electroacupuncture and warming needles are superior to filiform needless, with electroacupuncture outperforming warming needles	Short-term follow- up
Smitherman 2015[77] Acceptable	n = 26 age: 52, both groups duration not stated, but all patients were treated at least 4 mo with PT before enrolling in study	Arthroscopic capsular release, MUA, home stretching program	Home stretching program only	Stretches were 2×/d for at least 15 min for at least 3 mo	SPADI at 12 wk and 1 y	Within group: Both groups improved significantly at 12 wk and 1 y Between groups: NS differences	Both treatments provide significant improvement in function	Small sample size Relatively large loss to follow-up

ASES, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; *BPI-SF*, Brief Pain Inventory—Short Form; *CG*, comparison group; *CSI*, corticosteroid injection; *CSS*, Constant Shoulder Score; *DASH*, Disabilities of the Arm, Shoulder and Hand Questionnaire; *ESWT*, extracorporeal shockwave therapy; *MT*, manual therapy, including any type of mobilization, stretching, or soft tissue technique applied to the shoulder and surrounding tissue, not the vertebral joints, unless otherwise specified; MUA, manipulation under anesthesia; *NPRS*, Numeric Pain Rating Scale; *NS*, nonsignificant; *OSS*, Oxford Shoulder Score; *PT*, physical therapy, including modalities such as heat, ultrasound, and electrotherapy, plus passive and/or active exercise, unless otherwise specified; *QoL*, quality of life; *rESWT,* radial ESWT; *SDQ*, Shoulder Disability Questionnaire; *SPADI*, Shoulder Pain and Disability Index; *TENS*, transcutaneous nerve stimulation; *TG*, treatment group; *US*, ultrasound; *VAS,* visual analog scale for pain; *WBC*, whole-body cryotherapy

Table 6. *Evidence Table for Included Randomized Controlled Trials of Nondrug, Nonsurgical Treatment of Rotator Cuff-Associated Disorders*

Citation and Quality	Patient Population, Mean Age, Mean Symptom Duration	Intervention Group(s)	Comparison Group(s)	Dosage	Pain and/or Disability Outcome Measures	Outcomes (Mean Change Within and Between Groups)	Conclusions	Limitations
				Physical Therapy				
Kukkonen 2014[80] Acceptable	n = 167 age: 65, all groups duration: TG = 26 mo CG1 = 28 mo CG2 = 28 mo	PT only (consists of PT plus home exercises)	CG1: PT plus acromioplasty CG2: PT plus acromioplasty and RC repair	10 PT sessions (after surgery and home exercises for CG1 and CG2)	CSS Measured at 1-y follow-up	Within group: All groups improved significantly at 1 y Between groups: No significant difference ($p = 0.34$) Pain ($p = 0.03$) and ADL ($p < 0.00001$) subscales were significantly different, favoring CG1 and CG2 (strength and ROM did not differ)	All 3 approaches effective in long term, although surgery superior to PT for pain and ADL	Outcomes for ROM and strength were emphasized more than those for pain and ADL
Kukkonen 2015[81] Acceptable	n = 167 age: TG = 65 CGI & CG2 = 66 duration: TG = 26 mo CG1 = 26 mo CG2 = 28 mo	PT only (consists of PT plus home exercises)	CG1: PT plus acromioplasty CG2: PT plus acromioplasty and RC repair	10 PT sessions (after surgery and home exercises for CG1 and CG2)	CSS VAS	Within group: All groups improved significantly at 2 y Between groups: NS difference ($p = 0.38$) Pain ($p = 0.01$) and ADL ($p < 0.01$) subscales were significantly different, favoring CG1 and CG2 (strength and ROM did not differ) Pre-post mean change: TG, −1.3; CG1, −1.8; CG2, −2.0 Between group ($p = 0.45$)	Surgical treatment of nontraumatic rotator cuff tears had no benefit over conservative treatment	7 patients with both shoulders enrolled in the study 5 crossovers in group 1
Moosmayer 2014[83] High	n = 103 age: TG = 59 CG = 61 duration: acute and chronic	Tendon repair followed by sling and passive ROM for 6 wk, active assisted motions wk 6-12	PT with individualized exercises	Group 1: 12 wk Group 2: 40 min PT sessions 2×/wk for 12 wk	CSS, ASES, SF-36 (Physical), VAS Measured at 5-y follow-up	Within group: Both groups improved on all measurement scales Between groups: All measures significantly favored TG	Small, but statistically significant difference in favor of primary tendon repair of small and medium-sized full-thickness tears of RC over PT	PT and surgery were not completely standardized Traumatic and nontraumatic RC tears included Study group consisted exclusively of patients referred for secondary health care

								Biceps pathology treated with tenodesis in the surgical group, but not PT
Extracorporeal Shockwave Therapy								
Kolk 2013[79] High	n = 82 patients with RC tendinitis age: TG = 48 CG = 46 duration: TG = 24 mo CG = 29 mo	rESWT	Sham rESWT	3 sessions within 10- to 14-d period	VAS CMS SST Measured 3 and 6 mo post-intervention	Within group: Significant for all measures ($p < 0.001$) Between group: No significant differences in any measure ($p > 0.05$)	rESWT does not have benefit greater than sham	Power calculation based on observations in a small sample No subgroup analysis for patients with and without calcific tendinitis
Liu 2012[82] High	n = 79 patients with long bicipital tenosynovitis age: TG = 56 CG = 55 duration: TG = 22 mo CG = 18 mo	Active rESWT	Sham/detuned rESWT	4 treatments 1×/wk without anesthesia	VAS L'Insalata Shoulder Questionnaire Measured 1, 3, and 12 mo post-intervention	Within group: VAS and L'Insalata significantly different in TG at all time points ($p = 0.000$), but not in CG Between-group Significant differences favoring ESWT ($p = 0.000$)	Recommend rESWT in treatment of chronic, primary long-head bicipital tenosynovitis	May not have been a clinically meaningful effective dose Time of each treatment not clarified Unclear if disability questionnaire has been previously validated
Tornese 2011[85] Acceptable	n = 35 patients with calcific tendinitis age: TG = 52 CG = 53 duration not reported	ESWT with internal rotation positioning of glenohumeral joint and exercise	ESWT with neutral positioning and exercise	3 treatments 1×/wk	CSS Measured 3 mo post-intervention	Between-group: NS ($p > 0.05$) Deposit resorption was statistically better in TG group ($p < 0.05$)	GH internal rotation positioning for ESWT is beneficial when compared with neutral positioning for deposit resorption	Small sample size Primary outcome (radiographic evidence of deposit resorption) may not correlate with functional and pain outcomes
Low-Level Laser Therapy								
Eslamian 2012[78] High	n = 50 age: 50, both groups duration not specifically reported	LLLT and PT	Sham LLLT and PT (heat, ultrasound, TENS, exercise	3×/wk for 10 sessions	VAS SDQ Measured 3 wk post-intervention	Within group: VAS and SDQ significantly improved, both groups ($p < 0.001$) Between groups: Significant	LLLT provides added benefit to PT	Unclear if CG and TG treated similarly during trial Short follow-up interval

(continued on next page)

Table 6. (*continued*)

Citation and Quality	Patient Population, Mean Age, Mean Symptom Duration	Intervention Group(s)	Comparison Group(s)	Dosage	Pain and/or Disability Outcome Measures	Outcomes (Mean Change Within and Between Groups)	Conclusions	Limitations
						differences in favor of TG VAS ($p = 0.031$); SDQ ($p = 0.029$)		
				Diathermy				
Rabini 2012[84] High	n = 82 age: TG = 56 CG = 59 duration: >3 mo	Subacromial corticosteroid injection	Microwave Diathermy	TG: 3 (1 injection every 2 wk) CG: 12 sessions (3/wk for 4 wk), 30 min each	QuickDASH CSS VAS Measured 4, 12, and 24 wk post-intervention	Within group: Significant effect in both groups on all measures Between groups: NS ($p = 0.255$)	Both treatments were effective	No placebo group No exercise treatment group

ADL, activities of daily living; *ASES*, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; *CG*, comparison group; *CMS*, Constant-Murley Score; *CSS*, Constant Shoulder Score; *ESWT*, extracorporeal shockwave therapy; *LLLT*, low-level laser therapy; *MT*, manual therapy, including any type of mobilization, stretching or soft tissue technique applied to the shoulder and surrounding tissue, not the vertebral joints, unless otherwise specified; *NS*, nonsignificant; *PT*, physical therapy, including modalities such as heat, ultrasound, and electrotherapy, plus passive and/or active exercise, unless otherwise specified; *QuickDASH*, Quick Disabilities of the Shoulder and Hand Questionnaire; *rESWT*, radial ESWT; *ROM*, range of motion; *SDQ*, Shoulder Disability Questionnaire; *SPADI*, Shoulder Pain and Disability Index; *SST*, Simple Shoulder Test; *TENS*, transcutaneous nerve stimulation; *TG*, treatment group; *VAS*, visual analog scale

Two MT trials compared MT plus exercise with exercise alone; 1 was high quality[63] and 1 low quality.[65] Both found no added benefit from MT.

One high-quality MT trial compared MT plus exercise with kinesiotaping (KT) plus exercise.[61] Both groups improved significantly in pain and function, but there was no significant between-group difference except for night pain, in which case KT was superior.

One acceptable-quality trial compared MT (manual PT) with CSIs,[64] and both groups improved significantly, with no significant between-group difference. This was the only study reporting on adverse events, and these were transient pain from the injections.

Modalities and Exercise Trials. Ten trials investigated the following: KT (3); low-level laser treatment (2); microcurrent (1); ESWT (1); pulsed electromagnetic field therapy (1); transcutaneous electrical nerve stimulation (1); and exercise (1).

Kinesiotaping. One high-quality[68] and 2 acceptable-quality trials compared KT with sham KT.[66,67] The 2 acceptable-quality trials used standardized therapeutic KT and sham KT; the high-quality trial compared KT plus exercise with sham KT plus exercise. An acceptable-quality trial comparing KT and sham used the Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH) as the primary outcome and found significant between-group improvement.[67] The other acceptable-quality trial comparing KT with sham KT used the visual analog scale for pain (VAS), and found no significant difference between groups, although both groups improved.[66] The third trial, which was high quality and included exercise in both groups, found significant improvement both within and between groups for both pain (VAS) and function (DASH), favoring the therapeutic KT group.[68]

Low-Level Laser Therapy. Two high-quality trials investigated LLLT. Both used LLLT combined with exercise. One used placebo laser with exercise as the comparison group,[51] and the other used ultrasound and hot packs with exercise.[69] One found significant improvement in pain (VAS) in the active LLLT group, but not in the placebo group.[51] The other trial found a within-group improvement in pain (VAS) and function (Shoulder Pain and Disability Index [SPADI]) for both LLLT plus exercise and ultrasound plus exercise, but no significant difference between groups.[69]

Microcurrent. One low-quality study comparing microcurrent with sham found significant improvement in pain (VAS) and disability (Shoulder Disability Questionnaire) both within and between the groups.[74]

Extracorporeal Shockwave Therapy. One acceptable-quality trial compared radial ESWT with supervised and home exercise.[55] Within-group improvements in the SPADI were significant at 1-year follow-up; however, the between-group difference was not significant.

Table 7. *Evidence Table for Included Randomized Controlled Trials of Nondrug, Nonsurgical Treatment of Nonspecific Shoulder Pain*

Citation and Quality	Patient Population, Mean Age, Mean Symptom Duration	Intervention Group(s)	Comparison Group(s)	Dosage	Pain and Function/Disability Outcome Measures	Outcomes (Mean Change Within and Between Groups)	Conclusions	Limitations
Bron 2011[86] Acceptable	n = 65 age: TG = 43 CG = 45 duration: ≥6 mo	PT including MT, cold and heat application, home exercises with portable myofeedback device, posture advice	Wait list	1 session/wk for maximum of 12 wk	DASH (0-100) VAS (0-100)	Within-group: Significantly greater improvement in DASH and VAS in TG, but not CG at 6 and 12 wk Between-group: NS on both measures at 6 wk, but significant at 12 wk ($p < 0.05$)	PT superior to wait list control at 12-wk measurement	Sample size not met Possible misclassification if examiners gave CG patients advice TG had higher level of education than CG
Riley 2015[88] Acceptable	n = 88 age: 49 duration: 6 mo	TG1: Thoracic SMT, home exercise and positive message TG2: Thoracic SMT, home exercise, neutral message	CG1: Sham SMT, home exercise, positive message CG2: Sham SMT, home exercise, neutral message	1 treatment visit	SPADI NPRS measured immediately post-intervention and 1 wk later	Within-group Statistically significant improvement in all groups except NPRS immediately post-intervention Between-group NS	No significant differences in outcomes between type of message or type of SMT (active or sham)	Statistically significant difference in symptom duration between the groups at baseline
Montes 2012[87] High	n = 198 age: TG = 57 CG = 54 duration varied from acute to chronic; most were chronic (>90 d)	Interferential laser	Conventional laser	3 sessions/wk, total of 10 treatments	VAS SPADI Assessed immediately post-intervention	Within-group: Significant improvement in VAS at night and SPADI ($p < 0.001$) Between-group: NS for VAS ($p = 0.89$) and SPADI ($p = 0.80$)	Both types of laser were effective with no significant difference between groups	Short- term outcomes Some patients in each group performed exercises Heterogeneity of conditions
Teys 2013[89] Acceptable	n = 25 age: 45 duration: >4 wk	3 sets of 10 repetitions of MWM	3 sets of 10 repetitions of MWM with KT	1 treatment session of each therapy (following 1-wk washout period and crossover)	VAS (0-100 mm) Measured immediately post-intervention and 30 min, 24 h, and 1 wk later	Within-group: Both groups significantly improved immediately and 30 min ($p \leq 0.001$) only Between-group: NS at any time point ($p = 0.7$)	Significant improvements in pain up to 30 min post-intervention but NS differences between groups	Inclusion criteria of immediate positive response to screening procedure may limit generalizability Lack of blinding of outcome assessor and participants

CG, comparison group; *DASH*, Disabilities of the Arm, Shoulder and Hand Questionnaire; *GRC*, Global Rating of Change; *KT*, kinesiotaping; *MT*, manual therapy, including any type of mobilization, stretching, or soft tissue technique applied to the shoulder and surrounding tissue, not the vertebral joints, unless otherwise specified; *MWM*, mobilization with movement; *NPRS*, Numeric Pain Rating Scale; *NS*, nonsignificant; *PT*, physical therapy; including modalities such as heat, ultrasound, and electrotherapy, plus passive and/or active exercise, unless otherwise specified; *SMT*, spinal manipulative therapy, including manipulation and/or mobilization of vertebrae unless otherwise specified; *SPADI*, Shoulder Pain and Disability Index; *TG*, treatment group; *VAS*, visual analog scale for pain.

Pulsed Electromagnetic Field Therapy. One high-quality trial compared PEMF and exercise with placebo PEMF and exercise.[56] Although within-group improvements in both pain (VAS) and function (UCLA shoulder rating scale) were significant, there were no significant between-group differences at any follow-up interval.

Transcutaneous Electrical Nerve Stimulation. One acceptable-quality trial compared TENS with sham TENS with 1 treatment.[62] The active TENS group had a significant improvement in pain (VAS) and the sham group did not; there was a significant between-group difference.

Supervised Exercise. A high-quality trial compared supervised exercise (SE) and home exercise with home exercise only.[57] Both groups exhibited a significant improvement in pain (VAS) and function (SPADI) at 6 and 26 weeks, but no significant between-group differences at either time point.

Adhesive Capsulitis

There were 8 RCTs focusing on AC. Five studies compared a treatment combined with standardized PT with standardized PT alone.[72-75,77] In 4 of 5, both groups improved significantly; in the fifth trial; within-group changes were not reported.[75]

In the low-quality trial comparing a specific PT technique with standardized PT alone, the specific technique (Mulligan's mobilization) was superior to passive stretching at 3 weeks and 3 months post-intervention.[71] In a high-quality trial comparing standardized PT with standardized PT plus intra-articular hyaluronic acid injection, both groups improved significantly but there was no added benefit to the injection.[72] In an acceptable-quality trial comparing SSNB injection before a course of PT with PT alone, both groups improved significantly immediately and 1 month post-intervention. However, the nerve block group had significantly greater improvement in pain and function at both intervals.[73] In a high-quality trial of whole-body cryotherapy added to PT compared with PT alone, both groups improved significantly in pain and function immediately post-intervention, but the whole-body cryotherapy group improved significantly more.[74] A high-quality, 3-arm trial of CSI compared CSI alone, CSI plus PT, and PT alone.[75] Although within-group changes were not reported, the combination of CSI plus PT resulted in significantly greater improvement in disability, but not in pain, at 6 weeks post-intervention.[75]

Three trials compared various modalities and treatments. A high-quality trial compared ESWT with oral prednisone and found that although both groups improved significantly, ESWT was significantly superior at 4, 6, and 12 weeks post-intervention.[70] An acceptable-quality trial compared 3 types of acupuncture approaches: electroacupuncture, warming needles, and filiform needles. Pain was the only measurement, assessed immediately post-treatment, and was improved in all 3 groups. However, in the between-group comparison, electroacupuncture and warming needles were both superior to filiform needles, and electroacupuncture was superior to warming needles.[76] Another acceptable-quality trial compared arthroscopic capsular release combined with both manipulation under anesthesia and a home stretching program to a home stretching program alone. Both groups improved in function significantly at 12 weeks and 1 year post-intervention, but there were no significant between-group differences at any time point.[77]

Rotator Cuff-Associated Disorders

There were 8 RCTs addressing RC. Three investigated PT,[80,81,83] 3 ESWT,[79,82,85] 1 LLLT,[78] and 1 diathermy.[84]

Physical Therapy. Two acceptable-quality trials compared PT (including home exercises, but not MT) with PT combined with acromioplasty or PT combined with acromioplasty and RC repair. Outcomes were measured at 1[80] and 2[81] years. At both 1 and 2 years, all 3 groups improved significantly in function and pain. There were no significant differences between groups with respect to function, but pain and activities of daily living were significantly better in the surgical groups compared with the PT-only group. A high-quality study[83] compared PT with individualized exercises to tendon repair with a sling followed by 6 weeks of passive ROM and 6 additional weeks of active assisted motions. Both groups exhibited significant improvement in pain and function at 5-year follow-up, but between-group measures significantly favored the tendon repair group at 5 years.

Extracorporeal Shockwave Therapy. Two high-quality studies compared ESWT with sham ESWT.[79,82] One found that both groups improved significantly in pain and function at 3 and 6 months post-intervention, with no significant between-group differences.[79] The other found significant within-group improvement on all measures at 1, 3, and 12 months post-intervention, but a significantly greater improvement at all time points favoring ESWT over sham.[82] One acceptable-quality trial compared ESWT with internal rotation positioning of the glenohumeral joint plus exercise with neutral positioning of the joint plus exercise.[85] Both groups improved, but the group with internal rotation had greater resorption of calcium deposits.

Low-Level Laser Therapy. One high-quality study compared LLLT plus PT with sham LLLT plus PT. PT, in this study, consisted of heat, ultrasound, TENS, and exercise.[78] Both groups improved significantly at 3 weeks post-intervention in both pain and function, but there were significantly greater improvements in pain and function in the active LLLT group compared with the sham.

Diathermy. One high-quality trial compared subacromial CSI with microwave diathermy.[84] They found significant improvements in pain and function at 4, 12, and 24 weeks post-intervention in both groups and no significant between-group differences at any time point on any measure.

Nonspecific SP

Four RCTs addressed SP.[86-89] One investigated thoracic SMT, 2 investigated different PT protocols, and 1 investigated 2 types of LLLT.

Thoracic SMT. An acceptable-quality trial compared thoracic SMT with sham SMT, with outcomes measured after a single treatment and 1 week later.[88] Both groups were also instructed to do home exercises. At 1 week post-intervention, both groups had statistically significantly improved in pain and function, but there were no significant differences between groups.

PT Protocols. One acceptable-quality trial compared a PT protocol including MT, application of heat and cold, posture advice, and home exercises done using a portable myofeedback device with a wait list control.[86] There were weekly PT sessions for a maximum of 12 weeks. At 6 and 12 weeks, the PT group improved significantly in pain and function, but the wait list control did not. Between-group differences in pain and function were not statistically significant at 6 weeks but were at 12 weeks.

Another acceptable-quality trial compared a PT protocol, MWM, with MWM plus KT.[89] Three sets of 10 repetitions of MWM were done in each group for a total of 1 treatment session, followed by a 1-week washout and crossover. Pain was assessed immediately post-intervention and 30 minutes, 24 hours, and 1 week later. Both groups significantly improved immediately and at 30 minutes only, and there were no significant between-group differences at any time point.

Low-Level Laser Therapy. One high-quality trial compared inferential LLLT with conventional LLLT, with 3 sessions per week for a total of 10 treatments.[87] Pain and function were assessed immediately post-intervention. There was significant improvement in both groups in night pain and in function, with no significant between-group differences.

Adverse Events Reported in RCTs

RCTs of Treatments for SIS. Of 19 trials, 5 included a report of adverse events. Three of the 5 reported that there were no adverse events in any group. One of these was on LLLT[51]; 1 on MT, specifically cervical mobilization[53]; and 1 on spinal manipulation.[58] Engebretsen et al[55] reported that 2 patients in the ESWT group dropped out because of pain, with 1 crossing over to the supervised exercise group, and that 1 patient in the supervised exercise group reported increased pain.[55] Rhon et al[64] reported that in their trial of MT PT compared with CSIs, transient pain from the injection was the only adverse event reported.

RCTs of Treatments for AC. Four of 9 studies included a report on adverse events. Three of the 4 reported that there were no side effects or complications in any treatment group, which included nerve block injections and PT,[73] PT and whole-body cryotherapy,[74] and PT and arthroscopic capsular release.[77] Chen et al[70] reported that 9 patients in the ESWT group had transient swelling and redness after treatment, and 2 had petechial bleeding at the treatment site.

RCTs of Treatments for RCs. Five of 8 trials included a report on adverse events. Four of the 5 reported that there were no adverse events in any of the groups, which included PT, acromioplasty, and rotator cuff repair[81]; PT and tendon repair[83]; diathermy and CSIs[84]; and ESWT and sham ESWT.[79] Liu et al[82] reported that 4 patients had transient post-intervention pain from ESWT and 2 reported local hyperemia.

RCTs of Treatments for SP. Two of 4 trials included a report on adverse events. Both reported that no adverse effects were observed in patients in any of the treatment groups, which included inferential light therapy[87] and PT MWM and taping.[89]

Strength of Evidence

Strength of evidence, based on criteria in Table 1, is summarized by condition and treatment.

Shoulder Impingement Syndrome

Spinal Manipulative Therapy. Strong evidence indicates that a single application of thoracic SMT is no better than placebo for pain and function related to SIS.

Manual Therapy. Moderate evidence indicates that MWM is better than sham MT for pain related to SIS. Evidence was inconclusive but favorable for MT compared with other treatments, in that both MT and the comparison treatment appeared to be beneficial.

Kinesiotaping. Moderate evidence supports the use of KT for SIS.

Low-Level Laser Therapy. Moderate evidence supports the use of LLLT for SIS.

Microcurrent. Evidence was inconclusive because of the scarcity of studies.

Extracorporeal Shockwave Therapy. The evidence was inconclusive but favorable for ESWT for SIS pain and function, in that it appeared to be as effective as exercise.

Pulsed Electromagnetic Field Therapy. Moderate evidence indicates that both PEMF and exercise are effective for pain and function for SIS at any interval.

Transcutaneous Electrical Nerve Stimulation. Evidence was inconclusive because of the scarcity of studies.

Supervised Exercise. Moderate evidence indicates that both supervised and home exercises are effective for pain and function for SIS in both the short and long term.

Adhesive Capsulitis

Manual Therapy. Low to moderate evidence supports mobilization in the short and long term.

Low-Level Laser Therapy. Low to moderate evidence supports LLLT either alone or combined with exercise in the short and long term.

Modalities Other Than LLLT Added to Standardized PT for AC. Because of the heterogeneity of the treatments, evidence is inconclusive.

Modalities Alone. Because of the scarcity of trials for any 1 modality except LLLT, evidence is inconclusive.

Rotator Cuff-Associated Disorders

Manual Therapy. Low to moderate evidence indicates that MT, including manipulation and mobilization, is effective, either alone or combined with other therapies.

PT Compared With Surgical Interventions. Moderate evidence indicates that although PT alone is effective for RCs, various surgical approaches combined with PT appear to be superior in the long term.

Extracorporeal Shockwave Therapy. For noncalcific tendinitis, evidence is inconclusive, but unfavorable because of inconsistencies in results. For calcific tendinitis, moderate evidence indicates that ESWT is effective.

Low-Level Laser Therapy. Moderate evidence indicates that, although PT with sham LLLT was effective, PT with LLLT resulted in greater improvements in pain and function in the short term.

Diathermy. Moderate evidence indicates that both microwave diathermy and CSI improved pain and function in both the short and long term.

Taping and TENS. Evidence is inconclusive.

Shoulder Pain

Spinal Manipulative Therapy. Evidence is conclusive, but unfavorable for the effect of a single application of thoracic SMT on pain and function in SP. The evidence is inconclusive, but favorable that thoracic SMT provided in multiple sessions may help reduce pain and accelerate recovery in the short and long term.

PT Protocols. The evidence was inconclusive but favorable because of the heterogeneity of protocols.

Low-Level Laser Therapy. Moderate evidence indicates that both inferential LLLT and conventional LLLT are beneficial for pain and function in SP in the short term.

Discussion

This review evaluated the evidence for a variety of nondrug, nonsurgical interventions for the treatment of shoulder disorders commonly seen in practice. The disorders focused on in our overall findings were categorized as rotator cuff conditions (calcific or noncalcific), AC, SIS, and SP.

Rotator Cuff-Associated Disorders

We found variable-quality (low to high) evidence that MT, including manipulation and mobilization, may be effective either alone or when combined with exercise or passive modalities. A moderate level of evidence was reported in doses ranging from 10 to 24 sessions for the effectiveness of PT alone or when combined with active LLLT; however, surgery may be of more benefit in the mid- to long term. Also, there is moderate evidence to suggest diathermy 3 times per week for 4 weeks is effective in the short and long term. Studies consistently reported the effectiveness of high-energy ESWT for calcific but not noncalcific tendinitis. Treatment for calcific tendinitis was reported at approximately once per week for 2-4 weeks. Insufficient evidence exists to conclude on the effectiveness of KT or TENS for this type of shoulder pain.

Adhesive Capsulitis

Mostly moderate-quality evidence suggests that manual mobilization techniques are beneficial when used alone or in combination with exercise for primary AC in the short and long term. In general, PT (3-12 weeks) was an effective treatment, but studies indicated enhanced improvement when combined with injections and whole-body cryotherapy. Low to moderate evidence indicated the effectiveness of LLLT alone over a period of 6 days or paired with an injection or exercise in the short and long term.

Shoulder Impingement Syndrome

We found moderate evidence that MWM twice per week for 2 weeks provided more relief than a sham treatment. In general, studies reported improved outcomes with MT interventions; however, the benefits seemed to be as effective when combining MT with other treatments such as SMT, exercise, and KT. Moderate-quality studies also reported similar effectiveness for MT compared with injections and surgery for shoulder impingement. MT doses varied from 1 to 3 times per week for 3-6 weeks. Inconsistencies were found for KT and ESWT treatments, but LLLT (10 sessions) and PEMF with exercise (3 times per week for 3 weeks) and supervised or home exercises (6 weeks) were effective. There was inconclusive evidence for microcurrent and TENS.

Nonspecific SP

The evidence for SMT was inconclusive and unfavorable for 1 treatment, but favorable for multiple treatment sessions in the short and long term. A high-quality review indicated that when compared with usual care, TMT

accelerated recovery and improved pain and function immediately and for up to 1 year. Limited evidence exists for the effectiveness of mobilization or manipulation techniques combined with soft tissue release and exercise; additionally, mobilization was not found effective when administered alone. Massage therapy was reported to have significant immediate and short-term effects over inactive treatment for pain, but not compared with active therapies for pain or function. We found inconclusive but favorable evidence for PT combined with MT at 1 treatment per week for 12 weeks and a single treatment of both MWM and MWM with KT. There was moderate evidence of the effectiveness of interferential and conventional LLLT at 3 treatments per week for a total of 10.

All nondrug, nonsurgical treatments included in this review are within the scope of chiropractic practice. Our findings on the effectiveness of these treatments have similarities and distinctions from previously published systematic reviews. Comparison results include those from Green et al,[14] who concluded that exercise was beneficial for short-term recovery and long-term functional improvement for RC, as well as an additional benefit when adding mobilization to exercise. Their results regarding laser therapy also paralleled ours in that it was more effective than placebo for AC.[14] For SIS, 2 reviews[95,96] reported that MT combined with exercise was effective. Bronfort et al[20] concluded that combining MT with medical care was beneficial, and another review[97] found evidence to suggest massage was superior to no treatment. Our results contrasted with several reviews that reported that passive therapies such as LLLT and PEMF were not effective or that results were inconclusive for the treatment of RCs, AC, and SIS.[14,64,95,98] Additionally, 1 review determined that the evidence for MT was conflicting for the treatment of SIS and SP and that it was not more effective when compared with other interventions for AC.[97] Another review reported MT was inconclusive but favorable for RCs.[20] The differences noted in our systematic review are likely due to the inclusion of more recent studies, as all of the mentioned reviews included studies that are about 10 years or older.

Other systematic reviews have also been conducted evaluating manipulation, mobilization, and multimodal (nondrug, nonsurgical) treatments for shoulder conditions.[15,16,23] These reviews found favorable results suggesting these interventions, mostly highlighting multimodal care, are beneficial for pain and function; however, the results are based on mostly low-level evidence from case reports and series. Although reviews report clinical use of multimodal treatments, a description is still lacking regarding what multi-modal components of chiropractic care are appropriate for specific shoulder conditions. Even when a specific diagnosis is made, there are typically other regions and structures involved either contributing to or exacerbating the condition. Therefore, checking adjacent areas for concomitant disorders such as joint dysfunction, myofascial adhesions, or scapular dyskinesis may be justification for the use of multimodal treatments to address all issues involved.

Limitations and Future Study Recommendations

Although we identified 44 relevant RCTs and 25 SRs, they covered such a wide variety of interventions and several different conditions that still the overall quantity and quality of evidence was at best moderate for any 1 intervention. Furthermore, the heterogeneity of protocols and procedures used makes generalizations difficult and did not allow for pooling of results. In particular, wide ranges of dosages were found for most treatments (number of treatments and interval of care), also making it difficult to draw conclusions about optimal dosage, in most cases. It is also possible that some studies were missed, despite the reference tracking and hand searching in addition to the formal literature search.

Additional research is needed concerning the use of various combinations of interventions, as well as the value of single modalities. Studies should clearly describe treatment protocols, including frequency, intensity, and duration.

Conclusion

The findings of this literature review may help inform practitioners who use conservative methods (eg, doctors of chiropractic, physical therapists, and other manual therapists) regarding the levels of evidence for nondrug, nonsurgical interventions used for common shoulder conditions. The evidence found ranged from low to moderate supporting the use of MTs and/or modalities for the conditions SIS, RC, AC, and SP. Exercise, particularly provided as part of PT protocols, was found to be beneficial for SIS and AC. For SIS, moderate evidence was found supporting the use of KT, LLLT, ESWT, and PEMF. For RCs, PT protocols were found to be helpful, although they may not be superior to surgery in the long term. ESWT was supported by moderate evidence only for calcific tendinitis RCs. Of all the modalities studied, LLLT appears to be the only 1 with moderate evidence supporting its use for all the conditions studied.

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jmpt.2017.04.001.

Funding Sources and Conflicts of Interest

The Council on Chiropractic Guidelines and Practice Parameters provided funding for this study and the authors received financial compensation from the Council on Chiropractic Guidelines and Practice Parameters. No conflicts of interest were reported for this study.

Contributorship Information

Concept development (provided idea for the research): C.H., A.M.

Design (planned the methods to generate the results): C.H., A.M., R.K.

Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): C.H., A.L.M.

Data collection/processing (responsible for experiments, patient management, organization, or reporting data): C.H., A.L.M., R.K., C.D., D.H., J.A.G., J.A.H., S.B.

Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): C.H., A.L.M., R.K., C.D., D.H., J.A.G., J.A.H., S.B.

Literature search (performed the literature search): C.H., A.L.M.

Writing (responsible for writing a substantive part of the manuscript): C.H., A.L.M., R.K.

Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): C.H., A.L.M., R.K., C.D., D.H., J.A.G., J.A.H., S.B.

Practical Applications

- Manual therapy is beneficial for common shoulder conditions.
- Low-level laser therapy is beneficial for common shoulder conditions.
- Exercise protocols are beneficial for SIS and AC.

References

1. Linaker CH, Walker-Bone K. Shoulder disorders and occupation. *Best Pract Res Clin Rheumatol.* 2015;29(3):405-423.
2. Struyf F, Geraets J, Noten S, Meeus M, Nijs J. A multivariable prediction model for the chronification of non-traumatic shoulder pain: A systematic review. *Pain Physician.* 2016;19(2):1-10.
3. Bussieres AE, Peterson C, Taylor JA. Diagnostic imaging guideline for musculoskeletal complaints in adults—An evidence-based approach; Part 2. Upper extremity disorders. *J Manip Physiol Ther.* 2008;31(1):2-32.
4. Saltychev M, Aarimaa V, Virolainen P, Laimi K. Conservative treatment or surgery for shoulder impingement: Systematic review and meta-analysis (provisional abstract). *Disabil Rehabil.* 2014;37(1):1-8.
5. Page MJ, Green S, Kramer S, Johnston RV, McBain B, Buchbinder R. Electrotherapy modalities for adhesive capsulitis (frozen shoulder). *Cochrane Database Syst Rev.* 2014;10:CD011324.
6. Page MJ, Green S, Kramer S, et al. Manual therapy and exercise for adhesive capsulitis (frozen shoulder). *Cochrane Database Syst Rev.* 2014;8:CD011275.
7. House J, Mooradian A. Evaluation and management of shoulder pain in primary care clinics. *South Med J.* 2010;103(11):1129-1135 quiz 1136-1127.
8. Mitchell C, Adebajo A, Hay E, Carr A. Shoulder pain: Diagnosis and management in primary care. *BMJ.* 2005;331(7525):1124-1128.
9. Pauzenberger L, Grieb A, Hexel M, Laky B, Anderl W, Heuberer P. Infections following arthroscopic rotator cuff repair: incidence, risk factors, and prophylaxis. *Knee Surg Sports Traumatol Arthrosc.* 2017;25(2):595-601.
10. Dean BJ, Lostis E, Oakley T, Rombach I, Morrey ME, Carr AJ. The risks and benefits of glucocorticoid treatment for tendinopathy: A systematic review of the effects of local glucocorticoid on tendon. *Semin Arthritis Rheum.* 2014;43(4):570-576.
11. Kooijman MK, Barten DJ, Swinkels IC, et al. Pain intensity, neck pain and longer duration of complaints predict poorer outcome in patients with shoulder pain—A systematic review. *BMC Musculoskelet Disord.* 2015;16:288.
12. Pribicevic M, Pollard H, Bonello R. An epidemiologic survey of shoulder pain in chiropractic practice in Australia. *J Manip Physiol Ther.* 2009;32(2):107-117.
13. Brantingham JW, Cassa TK, Bonnefin D, et al. Manipulative therapy for shoulder pain and disorders: Expansion of a systematic review. *J Manip Physiol Ther.* 2011;34(5):314-346.
14. Green S, Buchbinder R, Hetrick S. Physiotherapy interventions for shoulder pain. *Cochrane Database Syst Rev.* 2003;2:CD004258.
15. McHardy A, Hoskins W, Pollard H, Onley R, Windsham R. Chiropractic treatment of upper extremity conditions: A systematic review. *J Manip Physiol Ther.* 2008;31(2):146-159.
16. Pribicevic M, Pollard H, Bonello R, de Luca K. A systematic review of manipulative therapy for the treatment of shoulder pain. *J Manip Physiol Ther.* 2010;33(9):679-689.
17. Desjardins-Charbonneau A, Roy JS, Dionne CE, Fremont P, MacDermid JC, Desmeules F. The efficacy of manual therapy for rotator cuff tendinopathy: A systematic review and meta-analysis. *J Orthop Sports Phys Ther.* 2015;45(5):330-350.
18. Furlan AD, Malmivaara A, Chou R, et al. 2015 Updated method guideline for systematic reviews in the Cochrane Back and Neck Group. *Spine (Phila Pa 1976).* 2015;40(21):1660-1673.
19. Harbour R, Miller J. A new system for grading recommendations in evidence based guidelines. *BMJ.* 2001;323(7308):334-336.
20. Bronfort G, Haas M, Evans R, Leiniger B, Triano J. Effectiveness of manual therapies: The UK evidence report. *Chiropr Osteopat.* 2010;18(1):3.
21. Clar C, Tsertsvadze A, Court R, Hundt GL, Clarke A, Sutcliffe P. Clinical effectiveness of manual therapy for the management of musculoskeletal and non-musculoskeletal conditions: Systematic review and update of UK evidence report. *Chiropr Man Therap.* 2014;22(1):12.
22. Bryans R, Decina P, Descarreaux M, et al. Evidence-based guidelines for the chiropractic treatment of adults with neck pain. *J Manip Physiol Ther.* 2014;37(1):42-63.
23. Brantingham JW, Cassa TK, Bonnefin D, et al. Manipulative and multimodal therapy for upper extremity and temporomandibular disorders: A systematic review. *J Manip Physiol Ther.* 2013;36(3):143-201.

24. Al Dajah SB. Soft tissue mobilization and PNF improve range of motion and minimize pain level in shoulder impingement. *J Phys Ther Sci.* 2014;26(11):1803-1805.
25. Damian M, Zalpour C. Trigger point treatment with radial shock waves in musicians with nonspecific shoulder-neck pain: Data from a special physio outpatient clinic for musicians. *Med Probl Perform Art.* 2011;26(4):211-217.
26. Kumar N, Nehru A, Rajalakshmi D. Effect of taping as a component of conservative treatment for subacromial impingement syndrome. *Health.* 2012;4(4):237-241.
27. Muth S, Barbe MF, Lauer R, McClure PW. The effects of thoracic spine manipulation in subjects with signs of rotator cuff tendinopathy. *J Orthop Sports Phys Ther.* 2012;42(12): 1005-1016.
28. Shrivastava A, Shyam AK, Sabnis S, Sancheti P. Randomised controlled study of Mulligan's vs. Maitland's mobilization technique in adhesive capsulitis of shoulder joint. *Physiother Occup Ther.* 2011;5(4):12-15.
29. Djordjevic OC, Vukicevic D, Katunac L, Jovic S. Mobilization with movement and kinesiotaping compared with a supervised exercise program for painful shoulder: Results of a clinical trial. *J Manip Physiol Ther.* 2012;35(6):454-463.
30. Yang JL, Chen SY, Hsieh CL, Lin JJ. Effects and predictors of shoulder muscle massage for patients with posterior shoulder tightness. *BMC Musculoskelet Disord.* 2012;13:46.
31. Desmeules F, Boudreault J, Roy JS, Dionne CE, Fremont P, MacDermid JC. Efficacy of transcutaneous electrical nerve stimulation for rotator cuff tendinopathy: A systematic review. *Physiotherapy.* 2016;102(1):41-49.
32. Desjardins-Charbonneau A, Roy JS, Dionne CE, Desmeules F. The efficacy of taping for rotator cuff tendinopathy: A systematic review and meta-analysis. *Sports Phys Ther.* 2015;10(4):420-433.
33. Huisstede BMA, Koes BW, Gebremariam L, Keijsers E, Verhaar JAN. Current evidence for effectiveness of interventions to treat rotator cuff tears. *Man Ther.* 2011;16(3): 217-230.
34. Huisstede BM, Gebremariam L, van der Sande R, Hay EM, Koes BW. Evidence for effectiveness of extracorporal shockwave therapy (ESWT) to treat calcific and non-calcific rotator cuff tendinosis—A systematic review. *Man Ther.* 2011;16(5): 419-433.
35. Louwerens JK, Sierevelt IN, van Noort A, van den Bekerom MP. Evidence for minimally invasive therapies in the management of chronic calcific tendinopathy of the rotator cuff: A systematic review and meta-analysis. *J Shoulder Elb Surg.* 2014;23(8):1240-1249.
36. Louwerens JK, Veltman ES, van Noort A, van den Bekerom MP. The effectiveness of high-energy extracorporeal shockwave therapy versus ultrasound-guided needling versus arthroscopic surgery in the management of chronic calcific rotator cuff tendinopathy: A systematic review. *Arthroscopy.* 2016;32(1):165-175.
37. Speed C. A systematic review of shockwave therapies in soft tissue conditions: Focusing on the evidence. *Sports Med.* 2014;48(21):1538-1542.
38. Verstraelen FU, In den Kleef NJ, Jansen L, Morrenhof JW. High-energy versus low-energy extracorporeal shock wave therapy for calcifying tendinitis of the shoulder: Which is superior? A meta-analysis. *Clin Orthop Relat Res.* 2014; 472(9):2816-2825.
39. Favejee MM, Huisstede BM, Koes BW. Frozen shoulder: The effectiveness of conservative and surgical interventions—Systematic review. *Sports Med.* 2011;45(1):49-56.
40. Jain TK, Sharma NK. The effectiveness of physiotherapeutic interventions in treatment of frozen shoulder/adhesive capsulitis: A systematic review (Provisional abstract). *J Back Musculoskelet Rehabil.* 2014;27(3):247-273.
41. Noten S, Meeus M, Stassijns G, Van GF, Verborgt O, Struyf F. Efficacy of different types of mobilization techniques in patients with primary adhesive capsulitis of the shoulder: A systematic review. *Arch Phys Med Rehabil.* 2016;97(5): 815-825.
42. Chang KV, Hung CY, Wu WT, Han DS, Yang RS, Lin CP. Comparison of the effectiveness of suprascapular nerve block with physical therapy, placebo, and intra-articular injection in management of chronic shoulder pain: A meta-analysis of randomized controlled trials. *Arch Phys Med Rehabil.* 2016; 97(8):1366-1380.
43. Peek AL, Miller C, Heneghan NR. Thoracic manual therapy in the management of non-specific shoulder pain: A systematic review. *J Man Manipulative Ther.* 2015;23(4): 176-187.
44. Kong LJ, Zhan HS, Cheng YW, Yuan WA, Chen B, Fang M. Massage therapy for neck and shoulder pain: A systematic review and meta-analysis (provisional abstract). *Database Abstr Rev Effects.* 2013:1-10.
45. Wang TL, Fu BM, Ngai G, Yung P. Effect of isokinetic training on shoulder impingement. *Genet Mol Res.* 2014; 13(1):744-757.
46. Goldgrub R, Cote P, Sutton D, et al. The effectiveness of multimodal care for the management of soft tissue injuries of the shoulder: A systematic review by the Ontario Protocol for Traffic Injury Management (OPTIMa) collaboration. *J Manipulative Physiol Ther.* 2016;39(2):121-139.e121.
47. Yu H, Cote P, Shearer HM, et al. Effectiveness of passive physical modalities for shoulder pain: Systematic review by the Ontario Protocol for Traffic Injury Management collaboration. *Phys Ther.* 2015;95(3):306-318.
48. Lee SY, Cheng BJ, Grimmer SK. The midterm effectiveness of extracorporeal shockwave therapy in the management of chronic calcific shoulder tendinitis. *Ann Acad Med Singap.* 2011;40:S213.
49. Szczurko O, Cooley K, Mills EJ, Zhou Q, Perri D, Seely D. Naturopathic treatment of rotator cuff tendinitis among Canadian postal workers: A randomized controlled trial. *Arthritis Rheum.* 2009;61(8):1037-1045.
50. Ioppolo F, Tattoli M, Di SL, et al. Clinical improvement and resorption of calcifications in calcific tendinitis of the shoulder after shock wave therapy at 6 months' follow-up: A systematic review and meta-analysis. *Arch Phys Med Rehabil.* 2013;94(9):1699-1706.
51. Abrisham SM, Kermani-Alghoraishi M, Ghahramani R, Jabbari L, Jomeh H, Zare M. Additive effects of low-level laser therapy with exercise on subacromial syndrome: A randomised, double-blind, controlled trial. *Clin Rheumatol.* 2011;30(10):1341-1346.
52. Atya AM. Efficacy of microcurrent electrical stimulation on pain, proprioception accuracy and functional disability in subacromial impingement: Randomized controlled trial. *Physiother Occup Ther.* 2012;6(1):15-18.
53. Cook C, Learman K, Houghton S, Showalter C, O'Halloran B. The addition of cervical unilateral posterior-anterior mobilisation in the treatment of patients with shoulder impingement syndrome: A randomised clinical trial. *Man Ther.* 2014;19(1):18-24.
54. Delgado-Gil JA, Prado RE, Rodrigues-de-Souza DP, Cleland JA, Fernandez-De-Las PC, Alburquerque SF. Effects of mobilization with movement on pain and range of motion in patients with unilateral shoulder impingement syndrome: A randomized controlled trial. *J Manip Physiol Ther.* 2015; 38(4):245-252.

55. Engebretsen K, Grotle M, Bautz-Holter E, Ekeberg OM, Juel NG, Brox JI. Supervised exercises compared with radial extracorporeal shock-wave therapy for subacromial shoulder pain: 1-Year results of a single-blind randomized controlled trial. *Phys Ther.* 2011;91(1):37-47.
56. Galace-de Frietas D, Lima MR, Beretta MF, et al. Pulsed electromagnetic field in patients with shoulder impingement syndrome. *J Appl Res.* 2013;13(1):28-33.
57. Granviken F, Vasseljen O. Home exercises and supervised exercises are similarly effective for people with subacromial impingement: A randomised trial. *J Physiother.* 2015;61(3): 135-141.
58. Haik MN, Alburquerque SF, Silva CZ, Siqueira-Junior AL, Ribeiro IL, Camargo PR. Scapular kinematics pre- and post-thoracic thrust manipulation in individuals with and without shoulder impingement symptoms: a randomized controlled study. *J Orthop Sports Phys Ther.* 2014;44:475-487.
59. Kardouni JR, Pidcoe PE, Shaffer SW, et al. Thoracic spine manipulation in individuals with subacromial impingement syndrome does not immediately alter thoracic spine kinematics, thoracic excursion, or scapular kinematics: A randomized controlled trial. *J Orthop Sports Phys Ther.* 2015;45(7): 527-538.
60. Kardouni JR, Shaffer SW, Pidcoe PE, Finucane SD, Cheatham SA, Michener LA. Immediate changes in pressure pain sensitivity after thoracic spinal manipulative therapy in patients with subacromial impingement syndrome: A randomized controlled study. *Man Ther.* 2015;20:540-546.
61. Kaya DO, Baltaci G, Toprak U, Atay AO. The clinical and sonographic effects of kinesiotaping and exercise in comparison with manual therapy and exercise for patients with subacromial impingement syndrome: a preliminary trial. *J Manip Physiol Ther.* 2014;37(6):422-432.
62. Kocyigit F, Akalin E, Gezer NS, Orbay O, Kocyigit A, Ada E. Functional magnetic resonance imaging of the effects of low-frequency transcutaneous electrical nerve stimulation on central pain modulation: A double-blind, placebo-controlled trial. *Pain.* 2012;28(7):581-588.
63. Kromer TO, Bie RA, Bastiaenen CH. Physiotherapy in patients with clinical signs of shoulder impingement syndrome: A randomized controlled trial. *J Rehabil Med.* 2013; 45(5):488-497.
64. Rhon DI, Boyles RB, Cleland JA. One-year outcome of subacromial corticosteroid injection compared with manual physical therapy for the management of the unilateral shoulder impingement syndrome: A pragmatic randomized trial. *Ann Intern Med.* 2014;161(3):161-169.
65. Senbursa G, Baltaci G, Atay OA. The effectiveness of manual therapy in supraspinatus tendinopathy. *Acta Orthop Traumatol Turc.* 2011;45(3):162-167.
66. Shakeri H, Keshavarz R, Arab AM, Ebrahimi I. Clinical effectiveness of kinesiological taping on pain and pain-free shoulder range of motion in patients with shoulder impingement syndrome: A randomized, double blinded, placebo-controlled trial. *Sports Phys Ther.* 2013;8(6):800-810.
67. Shakeri H, Keshavarz R, Arab AM, Ebrahimi I. Therapeutic effect of kinesio-taping on disability of arm, shoulder, and hand in patients with subacromial impingement dyndrome: A randomized clinical trial. *J Novel Physiother.* 2013;3(4):1-5.
68. Simsek HH, Balki S, Keklik SS, Ozturk H, Elden H. Does kinesio-taping in addition to exercise therapy improve the outcomes in subacromial impingement syndrome? A randomized, double-blind, controlled clinical trial. *Acta Orthop Traumatol Turc.* 2013;47(2):104-110.
69. Yavuz F, Duman I, Taskaynatan MA, Tan AK. Low-level laser therapy versus ultrasound therapy in the treatment of subacromial impingement syndrome: A randomized clinical trial. *J Back Musculoskelet Rehabil.* 2014;27(3):315-320.
70. Chen CY, Hu CC, Weng PW, et al. Extracorporeal shockwave therapy improves short-term functional outcomes of shoulder adhesive capsulitis. *J Shoulder Elb Surg.* 2014;23(12): 1843-1851.
71. Doner G, Guven Z, Atalay A, Celiker R. Evaluation of Mulligan's technique for adhesive capsu76. litis of the shoulder. *J Rehabil Med.* 2013;45(1):87-91.
72. Hsieh LF, Hsu WC, Lin YJ, Chang HL, Chen CC, Huang V. Addition of intra-articular hyaluronate injection to physical therapy program produces no extra benefits in patients with adhesive capsulitis of the shoulder: A randomized controlled trial. *Arch Phys Med Rehabil.* 2012;93(6):957-964.
73. Klc Z, Filiz MB, Cakr T, Toraman NF. Addition of suprascapular nerve block to a physical therapy program produces an extra benefit to adhesive capsulitis: A randomized controlled trial. *Phys Med Rehabil.* 2015;94(10, Suppl 1):912-920.
74. Ma SY, Je HD, Jeong JH, Kim HY, Kim HD. Effects of whole-body cryotherapy in the management of adhesive capsulitis of the shoulder. *Arch Phys Med Rehabil.* 2013; 94(1):9-16.
75. Maryam M, Zahra K, Adeleh B, Morteza Y. Comparison of corticosteroid injections, physiotherapy, and combination therapy in treatment of frozen shoulder. *Med Sci.* 2012;28.
76. Shi H, Fang JQ, Li BW, Cong WJ, Zhang Y, Chen L. Efficacy assessment for different acupuncture therapies in the treatment of frozen shoulder. *=5.* 2012;22(2):6-11.
77. Smitherman JA, Struk AM, Cricchio M, et al. Arthroscopy and manipulation versus home therapy program in treatment of adhesive capsulitis of the shoulder: a prospective randomized study. *J Surg Orthop Adv.* 2015;24(1):69-74.
78. Eslamian F, Shakouri SK, Ghojazadeh M, Nobari OE, Eftekharsadat B. Effects of low-level laser therapy in combination with physiotherapy in the management of rotator cuff tendinitis. *Lasers Med Sci.* 2012;27(5):951-958.
79. Kolk A, Auw-Yang KG, Tamminga R, Hoeven H. Radial extracorporeal shock-wave therapy in patients with chronic rotator cuff tendinitis: A prospective randomised double-blind placebocontrolled multicentre trial. *Bone Joint J.* 2013; 95B(11):1521-1526.
80. Kukkonen J, Joukainen A, Lehtinen J, et al. Treatment of nontraumatic rotator cuff tears: A randomised controlled trial with one-year clinical results. *Am.* 2014;96(1):75-81.
81. Kukkonen J, Joukainen A, Lehtinen J, et al. Treatment of nontraumatic rotator cuff tears: A randomized controlled trial with two years of clinical and imaging follow-up. *J Bone Joint Surg Am.* 2015;97(21):1729-1737.
82. Liu S, Zhai L, Shi Z, Jing R, Zhao B, Xing G. Radial extracorporeal pressure pulse therapy for the primary long bicipital tenosynovitis: A prospective randomized controlled study. *Ultrasound Med Biol.* 2012;38(5):727-735.
83. Moosmayer S, Lund G, Seljom US, et al. Tendon repair compared with physiotherapy in the treatment of rotator cuff tears: A randomized controlled study in 103 cases with a five-year follow-up. *J Bone Joint Surg Am.* 2014;96(18):1504-1514.
84. Rabini A, Piazzini DB, Bertolini C, et al. Effects of local microwave diathermy on shoulder pain and function in patients with rotator cuff tendinopathy in comparison to subacromial corticosteroid injections: A single-blind randomized trial. *J Orthop Sports Phys Ther.* 2012;42(4):363-370.
85. Tornese D, Mattei E, Bandi M, Zerbi A, Quaglia A, Melegati G. Arm position during extracorporeal shock wave therapy for calcifying tendinitis of the shoulder: A randomized study. *Clin Rehabil.* 2011;25(8):731-739.

86. Bron C, Gast A, Dommerholt J, Stegenga B, Wensing M, Oostendorp RA. Treatment of myofascial trigger points in patients with chronic shoulder pain: A randomized, controlled trial. *BMC Med.* 2011;9(1):8.
87. Montes-Molina R, Prieto-Baquero A, Martínez-Rodriguez ME, Romojaro-Rodriguez AB, Gallego-Méndez V, Martínez-Ruiz F. Interferential laser therapy in the treatment of shoulder pain and disability from musculoskeletal pathologies: A randomised comparative study. *Physiotherapy.* 2012;98(2): 143-150.
88. Riley SP, Cote MP, Leger RR, et al. Short-term effects of thoracic spinal manipulations and message conveyed by clinicians to patients with musculoskeletal shoulder symptoms: A randomized clinical trial. *J Man Manipulative Ther.* 2015;23(1):3-11.
89. Teys P, Bisset L, Collins N, Coombes B, Vicenzino B. One-week time course of the effects of Mulligan's Mobilisation with Movement and taping in painful shoulders. *Man Ther.* 2013;18(5):372-377.
90. Abdelshafi ME, Yosry M, Elmulla AF, Al-Shahawy EA, Adou Aly M, Eliewa EA. Relief of chronic shoulder pain: A comparative study of three approaches. *Anaesthesiol.* 2011; 21(1):83-92.
91. Bialoszewski D, Zaborowski G. Usefulness of manual therapy in the rehabilitation of patients with chronic rotator cuff injuries: Preliminary report. *Ortop Traumatol Rehabil.* 2011; 13(1):9-20.
92. Bansal K, Padamkumar S. A comparative study between the efficacy of therapeutic utrasound and soft tissue massage (deep friction massage) in supraspinatus tendinitis. *Physiother Occup Ther.* 2011;5(2):80-84.
93. Chauhan V, Saxena S, Grover S. Effect of deep transverse friction massage and capsular stretching in idiopathic adhesive capsulitis. *Physiother Occup Ther.* 2011;5(4):185-188.
94. Sun WP, Han SL, Jun HK. The effectiveness of intensive mobilization techniques combined with capsular distension for adhesive capsulitis of the shoulder. *J Phys Ther Sci.* 2014; 26(11):1767-1770.
95. 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. *J Occup Rehabil.* 2006;16(1):7-25.
96. Michener LA, Walsworth MK, Burnet EN. Effectiveness of rehabilitation for patients with subacromial impingement syndrome: A systematic review. *J Hand Ther.* 2004;17(2): 152-164.
97. Ho CY, Sole G, Munn J. The effectiveness of manual therapy in the management of musculoskeletal disorders of the shoulder: A systematic review. *Man Ther.* 2009;14(5): 463-474.
98. Kukurin GW. Chronic pediatric asthma and chiropractic spinal manipulation: A prospective clinical series and randomized clinical pilot study. *J Manip Physiol Ther.* 2002;25(8):540-541.