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An Update of Systematic Reviews Examining the Effectiveness of Conservative Physical Therapy Interventions for Subacromial Shoulder Pain

OBJECTIVE: To update a systematic review published in 2013 that focused on evaluating the effectiveness of interventions within the scope of physical therapy, including exercise, manual therapy, electrotherapy, and combined or multimodal approaches to managing shoulder pain.

DESIGN: Umbrella review.

LITERATURE SEARCH: An electronic search of PubMed, Web of Science, and CINAHL was undertaken. Methodological quality was assessed using the AMSTAR (A MeaSurement Tool to Assess systematic Reviews) checklist for systematic reviews.

STUDY SELECTION CRITERIA: Nonsurgical treatments for subacromial shoulder pain.

DATA SYNTHESIS: Sixteen systematic reviews were retrieved. Results were summarized qualitatively.

RESULTS: A strong recommendation can be made for exercise therapy as the first-line treatment to improve pain, mobility, and function in patients with subacromial shoulder pain. Manual therapy may be integrated, with a strong recommendation, as additional therapy. There was moderate evidence of no effect for other commonly prescribed interventions, such as laser therapy, extracorporeal shockwave therapy, pulsed electromagnetic energy, and ultrasound.

CONCLUSION: There is a growing body of evidence to support exercise therapy as an intervention for subacromial shoulder pain. Ongoing research is required to provide guidance on exercise type, dose, duration, and expected outcomes. A strong recommendation may be made regarding the inclusion of manual therapy in the initial treatment phase. *J Orthop Sports Phys Ther 2020;50(3):131-141. Epub 15 Nov 2019. doi:10.2519/jospt.2020.8498*

KEY WORDS: *conservative treatment, exercise, rotator cuff, shoulder pain, systematic review, tendinopathy*

Shoulder pain is common, increases with age, and is often associated with incomplete resolution of symptoms.[17,28] *Subacromial shoulder pain* (SSP)[2] describes the clinical presentation of pain and impairment of shoulder movement and function, usually experienced during shoulder elevation and external rotation. Other terms to describe these symptoms include *subacromial impingement syndrome*, *rotator cuff tendinopathy*,[22] and, more recently, *rotator cuff–related shoulder pain*.[20] Multiple structures, including the subacromial bursa, the rotator cuff muscles and tendons, the acromion, the coracoacromial ligament, and capsular and intra-articular tissue, may be involved in the pathogenesis of SSP.[18] Other factors, such as altered shoulder kinematics associated with capsular tightness,[37] rotator cuff and scapular muscle dysfunction,[7,19,23] overuse due to sustained intensive work,[6,13,25] and poor posture,[3,21] have also been hypothesized as contributing to the pathogenesis of SSP. Although change in load is implicated as the main factor associated with onset, the pathogenesis is possibly multifactorial, and this has led to a multitude of suggestions for management.[24,39]

In 2013, Littlewood et al[22] reviewed the scientific literature regarding management of rotator cuff tendinopathy. Although the magnitude of the improvement was uncertain, the review reported that exercise and multimodal physical therapy might be effective in the management of rotator cuff tendinopathy. Consequently, it is recommended that graduated exercise should be prioritized as the primary treatment option, due to its clinical effectiveness (equivalent to surgery), cost-effectiveness (less expensive than surgery), and other associated health benefits.

We aimed to update the findings reported by Littlewood et al[22] to determine whether more recently published literature

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provided further understanding of the best management of SSP. The study background and findings are summarized in **APPENDIX A** (available at www.jospt.org).

METHODS

Data Sources and Search Strategy

An electronic search of 3 databases (PubMed, Web of Science, CINAHL) was independently conducted by 3 researchers. The search terms used are displayed in **APPENDIX B** (available at www.jospt.org). As the search limits of the Littlewood et al[22] systematic review were dated up to August 2012, data limits of this review were September 2012 to September 2018.

Study Selection

Study selection was undertaken by 3 reviewers independently. Systematic reviews that included randomized controlled trials (RCTs) involving people with signs and symptoms suggestive of SSP were included. The following diagnostic categories were considered as being equivalent to SSP: rotator cuff tendinopathy, painful arc syndrome, subacromial bursitis, rotator cuff tendinosis, supraspinatus tendinitis, and contractile dysfunction. Systematic reviews had to evaluate the effectiveness of the following nonsurgical, nonpharmacological treatments: exercise, exercise combined with manual therapy, multimodal physical therapy, corticosteroid injection, laser, ultrasound, extracorporeal shockwave therapy, or pulsed electromagnetic energy. Corticosteroid injection is not an intervention within the scope of physical therapy, but as this intervention was already discussed in the Littlewood et al[22] systematic review and is strongly related to physical therapy rehabilitation policies, we included this intervention in the review.

Data Extraction

Three reviewers, using a data-extraction tool developed for this review, individually extracted data regarding methodological quality, design, population, sample size, intervention, outcome, and results, and a consensus was subsequently reached.

Quality Appraisal

An appraisal of methodological quality was undertaken by 3 reviewers independently using the AMSTAR (A MeaSurement Tool to Assess systematic Reviews) checklist (**TABLE 1**). The AMSTAR checklist consists of 11 items. Each item can be answered with "yes," "no," "can't answer," or "not applicable."[33] The AMSTAR checklist characterizes quality at 3 levels: 8 to 11 is high quality, 4 to 7 is moderate quality, and 0 to 3 is low quality.[32] The AMSTAR checklist was chosen to provide homogeneity with the review findings reported by Littlewood et al.[22] Recent

TABLE 1 Results of the AMSTAR Quality Appraisal[a]

	Item[b]											
Study	1	2	3	4	5	6	7	8	9	10	11	Total
Abdulla et al[1]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	8/11
Bury et al[5]	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	8/11
Desjardins-Charbonneau et al[8]	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	9/11
Desmeules et al[9]	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	7/11
Desmeules et al[10]	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	7/11
Dong et al[11]	Yes	Yes	No	Yes	No	No	Yes	No	No	No	Yes	5/11
Goldgrub et al[14]	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	8/11
Haik et al[15]	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	8/11
Haslerud et al[16]	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	No	7/11
Page et al[26]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	9/11
Page et al[27]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	9/11
Saito et al[29]	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	7/11
Saracoglu et al[30]	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	8/11
Steuri et al[35]	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	8/11
van der Sande et al[38]	Yes	Yes	No	Yes	No	No	Yes	Yes	No	No	No	5/11
Yu et al[40]	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	Yes	6/11

Abbreviation: AMSTAR, A MeaSurement Tool to Assess systematic Reviews.

[a] *Criteria from Shea et al.*[33]

[b] *Items: 1, Was an a priori design developed? 2, Was there duplicate study selection and data extraction? 3, Was a comprehensive literature search performed? 4, Was the status of publication used as an inclusion criterion? 5, Was a list of studies (included and excluded) provided? 6, Were the characteristics of the included studies assessed and documented? 7, Was the scientific quality of the included studies assessed and documented? 8, Was the scientific quality of the included studies used appropriately in formulating conclusions? 9, Were the methods used to combine the findings of the studies appropriate? 10, Was the likelihood of publication bias assessed? 11, Was the conflict of interest stated?*

guidelines for updating systematic reviews advise researchers to replicate the original methods as closely as possible.[12]

Cohen's kappa coefficient was calculated to compare the preconsensus scoring of the different reviewers. As kappa was greater than 0.81 ($\kappa = 0.92$), it can be interpreted as almost perfect.

Appraisal of individual component studies was beyond the scope of our umbrella review, as this was the aim of the original systematic reviews, which included an appraisal of studies' quality. With respect to the selected systematic reviews, methods were used to capture essential features of the quality of the evidence, and these are described in detail in the next section.

Data Analysis

The level of evidence used in the tables (**TABLES 2** through **9**) to present the different reviews is the evidence that was reported in every original review (high/moderate/low).

The method to evaluate the strength of recommendation is as follows: a strong recommendation was made when at least 50% of the reviews considering a specific topic had at least moderate-level evidence, with at least 1 review having high-level evidence. A moderate recommendation was made when at least 50% of the reviews had moderate-level evidence. A weak recommendation was made when fewer than 50% of the reviews had moderate-level evidence.

RESULTS

Study Selection

The study-selection process is detailed in the **FIGURE**. The electronic literature search (PubMed, Web of Science, and CINAHL) resulted in 107, 109, and 40 articles, respectively. Duplicates were identified and removed using EndNote X8 (Clarivate Analytics, Philadelphia, PA), and 202 abstracts remained. Screening the title and abstract of the remaining articles resulted in the exclusion of 160 articles on the basis of population, intervention, outcome, and design. After reading the full text of the remaining articles, another 26 articles were excluded. Two articles were excluded because they were already included in the previous review.[22] To reach a consensus on the eligibility of studies, the reviewers had a consensus meeting. Consequently, full agreement was obtained (100%) between all 3 reviewers, which made arbitration by an external reviewer unnecessary. After the consensus meeting between the 3 reviewers, 16 relevant studies were appropriate for data extraction.

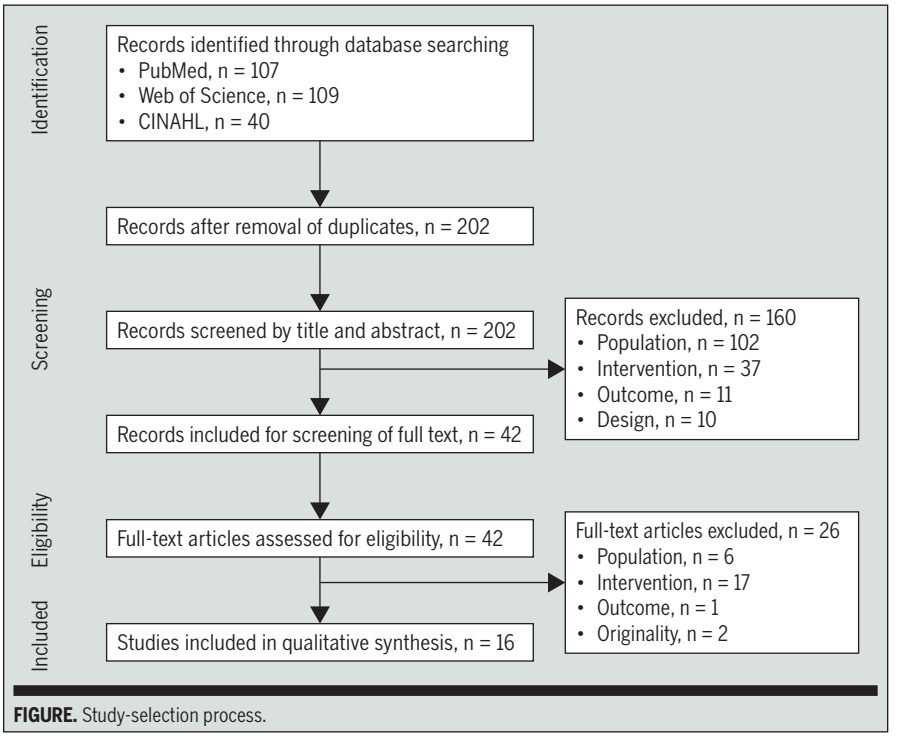

FIGURE. Study-selection process.

Quality Appraisal

The results of the AMSTAR quality appraisal are shown in **TABLE 1.** Nine of 16 included systematic reviews were high quality (8/11 or greater). The remaining 7 studies were moderate quality. The main reason for not meeting an AMSTAR criterion was failure to assess the likelihood of publication bias. This means that the authors of these systematic reviews did not assess potential publication bias by means of graphical aids (eg, a funnel plot) and/or statistical tests (eg, the Egger regression test or Hedges-Olken test).

Study Characteristics

A summary of all details and characteristics of all systematic reviews included is presented in **TABLES 2** through **9**.

Exercise for SSP

Seven systematic reviews relating to the effectiveness of exercise for SSP were retrieved (**TABLE 2**). The reviews were of variable quality (AMSTAR range, 5-8/11). Abdulla et al[1] reported high-level evidence that supervised progressive shoulder exercises alone or combined with home-based shoulder exercises were effective in the short term for the management of SSP of variable duration (exercise program of 8 weeks). Dong et al[11] (moderate-level evidence) reported exercise therapy as an ideal treatment in the early stage of SSP. For persistent SSP, supervised and home-based progressive strengthening exercises led to similar outcomes as shoulder decompression surgery in the long term. Supervised strengthening and stretching exercises

provided similar short-term benefits to those of a single corticosteroid injection or a multimodal program for the management of low-grade nonspecific shoulder pain of varied duration.[1,5] Bury et al[5] (moderate-level evidence) and Saito et al[29] (high-level evidence) reported that a scapula-focused approach could offer benefits over generalized approaches at short-term follow-up (4-6 weeks); both pain and shoulder function were significantly improved. For construction workers with SSP, there was low- to moderate-level evidence that exercise was effective for pain reduction and improvement of return-to-work time when compared with a control intervention or placebo.[9] Exercise therapy was effective for improving pain scores, active range of motion, and overall shoulder function at short-term (6-12 weeks) and long-term follow-ups (greater than 3 months).[15,35] Multiple forms of exercise were reported to be beneficial: scapular stability exercises, rotator cuff strengthening, and shoulder flexibility exercises.[15,29,35] A strong recommendation can be made in favor of exercise therapy for patients with SSP.

Exercise Combined With Manual Therapy for SSP

Six systematic reviews evaluated the effect of manual therapy combined with exercises (**TABLE 3**). The systematic reviews were of variable quality (AMSTAR range, 5-9/11). Four reviews[8,15,26,35] reported moderate- and high-level evidence that manual therapy in addition to exercise reduced pain in the short term. Desmeules et al[9] (low-level evidence) reported no significant improvement in outcome when exercise was combined with manual therapy, compared to exercise alone. Dong et al[11] concluded (low-level evidence) that exercise resulted in a better effect on pain reduction when combined with manual therapy, but this review had the lowest quality of the studies considering the effects of manual therapy combined with exercise. Based on the results, a strong recommendation may be made in favor of exercises combined with manual therapy.

Multimodal Physical Therapy for SSP

Three systematic reviews reported the effect of multimodal physical therapy (**TABLE 4**). The systematic reviews were of variable quality (AMSTAR range, 5-8/11). Multimodal therapy was defined as combined nonsurgical treatment, including passive physical modalities, exercise, manual therapy, taping, corticosteroids,

TABLE 2 Systematic Reviews Relating to the Effectiveness of Exercise Therapy for SSP

Study	Sample Size	Patients Included	Results[a]	Risk of Bias[b]	Level of Evidence[b]
Abdulla et al[1]	11	466	Evidence suggests that supervised and home-based progressive shoulder-strengthening and stretching exercises for the RC and scapular muscles are effective options for the management of SSP in both the short and long term No effect sizes reported	Low (SIGN criteria)	High
Bury et al[5]	7	190	Evidence that a scapula-focused approach (exercise therapy and stretching) benefits patients with SSP over generalized approaches up to 6 weeks post commencement of treatment Effect size for short-term pain, 0.714 (0.402, 1.026); effect size for short-term function, 14.008 (11.159, 16.857)	Unclear (PEDro scale)	Moderate
Desmeules et al[9]	10	788	Low- to moderate-grade evidence that therapeutic exercises provided in a clinical setting are an effective modality to treat workers suffering from RC tendinopathy and to promote return to work No effect sizes reported	Low (Cochrane risk-of-bias tool)	Moderate
Dong et al[11]	33	2300	Evidence that exercise and other exercise-based therapies are ideal treatments for patients at an early stage of SSP No effect sizes reported	Low (Cochrane risk-of-bias tool)	Moderate
Haik et al[15]	64	6319	High evidence that exercise therapy should be the first-line treatment to improve pain, function, and range of motion No effect sizes reported	Low (PEDro scale)	High
Saito et al[29]	6	250	High evidence that scapula-focused interventions can improve shoulder pain and function in the short term (4 weeks post commencement of treatment) Effect size for pain, −0.88 (−1.19, −0.58); effect size for shoulder function, −11.31 (−17.20, −5.41)	Low (Cochrane risk-of-bias tool)	High
Steuri et al[35]	200	10529	Evidence that, for pain and shoulder function, exercise was superior to nonexercise control interventions. Specific exercises were superior to generic exercises Effect size for pain, −0.94 (−1.69, −0.19); effect size for shoulder function, 0.57 (−0.85, −0.29)	Low (Cochrane risk-of-bias tool)	Moderate (GRADE approach)

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; PEDro, Physiotherapy Evidence Database; RC, rotator cuff; SIGN, Scottish Intercollegiate Guidelines Network; SSP, subacromial shoulder pain.
[a]*Values in parentheses are 95% confidence interval.*
[b]*Reported in the original review.*

or electrotherapy. One study[11] concluded, based on low-level evidence, that exercise combined with other therapies (Kinesio Taping, specific exercises, and acupuncture) provided a beneficial treatment effect. For taping as adjunct therapy, the effectiveness was weak for improvement of pain, disability, range of motion, and strength[30] (low-level evidence). Pulsed electromagnetic field therapy, localized corticosteroid injection, and ultrasound therapy were suggested as potential additional second-line treatments. Goldgrub et al[14] reported low-level evidence to support the effectiveness of multimodal care

TABLE 3 Systematic Reviews Relating to the Effectiveness of Exercise Combined With Manual Therapy for SSP

Study	Sample Size	Patients Included	Results[a]	Risk of Bias[b]	Level of Evidence[b]
Desjardins-Charbonneau et al[8]	21	554	Moderate evidence that manual therapy intervention added to an exercise program significantly reduces pain in individuals with SSP. Unclear whether manual therapy can improve function No effect sizes reported	Low (Cochrane risk-of-bias tool)	Moderate
Desmeules et al[9]	10	788	No significant difference between exercise therapy or exercise combined with manual therapy No effect sizes reported	Low (Cochrane risk-of-bias tool)	Low
Dong et al[11]	33	2300	Low-level evidence that exercise results in a better effect on pain reduction when combined with manual therapy No effect sizes reported	Low (Cochrane risk-of-bias tool)	Low
Haik et al[15]	64	6319	High evidence regarding the effectiveness of exercises associated with mobilizations to optimize improvements in pain and function in the short term No effect sizes reported	Low (PEDro scale)	High
Page et al[26]	60	3620	High evidence that no clinically important differences are measured between manual therapy combined with exercise and placebo with respect to overall pain, function, pain on motion, global treatment success, quality of life, and strength in the short term No effect sizes reported	High (Cochrane risk-of-bias tool)	High (GRADE approach)
Steuri et al[35]	200	10529	Evidence that manual therapy plus exercise is superior to placebo or exercise alone for pain and shoulder function, but only at short-term follow-up (immediately after the intervention) Effect size for shoulder function compared to placebo, −0.35 (−0.69, −0.01); effect size for shoulder function compared to exercise alone, −0.32 (−0.62, −0.01)	Low (Cochrane risk-of-bias tool)	Moderate (GRADE approach)

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; PEDro, Physiotherapy Evidence Database; SSP, subacromial shoulder pain.
[a]*Values in parentheses are 95% confidence interval.*
[b]*Reported in the original review.*

TABLE 4 Systematic Reviews Relating to the Effectiveness of Multimodal Physical Therapy for SSP

Study	Sample Size	Patients Included	Results	Risk of Bias[a]	Level of Evidence[a]
Dong et al[11]	33	2300	Evidence suggests that most combined treatments based on exercise demonstrated better effects than exercise alone No effect sizes reported	Low (Cochrane risk-of-bias tool)	Low
Goldgrub et al[14]	19	1217	Little evidence to support that multimodal care provides superior effectiveness compared with individual interventions for the management of SSP or nonspecific shoulder pain. For SSP, multimodal care may be associated with small and non–clinically important improvement in pain and function compared with corticosteroid injections No effect sizes reported	Low (SIGN criteria)	Low
Saracoglu et al[30]	4	135	Low evidence that clinical taping in addition to other physical therapy interventions (exercise, manual therapy, electrotherapy) provides superior effectiveness for the initial stage of the treatment No effect sizes reported	High (PEDro scale)	Low

Abbreviations: PEDro, Physiotherapy Evidence Database; SIGN, Scottish Intercollegiate Guidelines Network; SSP, subacromial shoulder pain.
[a]*Reported in the original review.*

over isolated interventions in the management of SSP. The clinical significance of multimodal physical therapy remains unclear, possibly due to the variety of different treatment modalities. Currently, only a weak recommendation for including multimodal therapy in the management of SSP can be made.

Corticosteroid Injection for SSP

Four systematic reviews relating to the effectiveness of corticosteroid injection for SSP were retrieved (**TABLE 5**). The systematic reviews were of variable quality (AMSTAR range, 5-8/11). Steuri et al[35] (moderate-level evidence) reported that in the short term (immediately after the intervention), corticosteroid injection was superior to negative control (no therapy) and physical therapy modalities for reducing pain and improving shoulder function. Ultrasound-guided corticosteroid injections were superior to blind injections for both pain and overall shoulder function. Dong et al[11] (low-level evidence) recommended corticosteroid injection as a second-line treatment, in addition to exercise-based therapies. In another review, there was moderate-level evidence regarding the usefulness of corticosteroid injections compared to placebo in the short and the long term.[38] There was low-level evidence that corticosteroid injection and exercise both led to similar outcomes as multimodal physical therapy for the treatment of nonspecific shoulder pain.[14] Overall, a moderate recommendation can be made regarding the clinical significance of corticosteroid injection as a solitary treatment or in addition to exercise-based therapy.

Laser Therapy for SSP

Six systematic reviews discussed the effect of laser therapy on SSP (**TABLE 6**). These systematic reviews were of variable quality (AMSTAR range, 5-9/11). Dong et al[11] (low-level evidence) and Haik et al[15] (high-level evidence) did not provide any evidence of the benefit of low-level laser therapy in the treatment of SSP. Haslerud et al[16] concluded, based on moderate-level evidence, that laser therapy could reduce pain and improve function when used as an adjunct therapy to exercise or in a physical therapy treatment program. Other reviews[35,40] (moderate-level evidence) reported that laser therapy, when combined with other therapies, was superior to a placebo, but showed no benefits alone. Page et al[27] suggested low-quality evidence for the effect of laser treatment on pain, shoulder function, active mobility, and strength. Overall, a strong recommendation can be made to not use laser therapy in the treatment of SSP, as there was no evidence supporting the effectiveness of laser therapy as a monotherapy compared to other interventions.

Ultrasound for SSP

Five systematic reviews evaluating the effectiveness of ultrasound for SSP were reviewed (**TABLE 7**). The systematic reviews were of variable quality (AMSTAR range, 5-9/11). Although there is only a weak recommendation, the reviews consistently concluded that there was no evidence for the effectiveness of therapeutic ultrasound.[10,11,27,35,40]

Extracorporeal Shockwave Therapy for SSP

Three systematic reviews relating to the effectiveness of extracorporeal shockwave therapy for SSP were reviewed (**TABLE 8**). The systematic reviews were of variable quality (AMSTAR range, 5/11-8/11). Although there is only a moderate recommendation, all 3 reviews consistently concluded that the evidence did not support the effectiveness of extracorporeal shockwave therapy.[11,35,40]

TABLE 5 Systematic Reviews Relating to the Effectiveness of Corticosteroid Injection for SSP

Study	Sample Size	Patients Included	Results[a]	Risk of Bias[b]	Level of Evidence[b]
Dong et al[11]	33	2300	Localized corticosteroid injection may be considered as second-line treatment. Exercise and exercise-based therapies are the first-line choices No effect sizes reported	Low (Cochrane risk-of-bias tool)	Low
Goldgrub et al[14]	19	1217	Evidence that corticosteroid injection leads to a similar outcome to that of multimodal physical therapy in cases of nonspecific shoulder pain No effect sizes reported	Low (SIGN criteria)	Low
Steuri et al[35]	200	10529	Evidence that corticosteroid injection is superior to active physical therapy modalities for improvement in pain and overall shoulder function, but only at short-term follow-up Effect size for pain, −0.25 (−0.46, −0.05); effect size for shoulder function, −0.43 (−0.71, −0.15)	Low (Cochrane risk-of-bias tool)	Moderate (GRADE approach)
van der Sande et al[38]	8	852	Conflicting evidence was found in favor of the effectiveness of corticosteroid injection versus placebo in the short-term and long-term treatment of SSP No effect sizes reported	Low (Furlan's 12 criteria)	Moderate

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; SIGN, Scottish Intercollegiate Guidelines Network; SSP, subacromial shoulder pain.
[a]*Values in parentheses are 95% confidence interval.*
[b]*Reported in the original review.*

Pulsed Electromagnetic Energy for SSP

Four systematic reviews evaluated the effectiveness of pulsed electromagnetic energy for treating SSP (**TABLE 9**). The systematic reviews were of variable quality (AMSTAR range, 5-9/11). None of the reviews found a greater effect of pulsed electromagnetic energy on pain reduction or improvement of shoulder function than a placebo treatment. With a strong recommendation, the conclusion can be made that there is no evidence supporting the effectiveness of pulsed electromagnetic energy for treating SSP.[11,15,27,35]

DISCUSSION

The aim of this review was to perform an updated review of systematic reviews to investigate the effectiveness of conservative physical therapy treatment for SSP. Littlewood et al[22] suggested that exercise and multimodal physical therapy were promising interventions for SSP, but the extent of their effectiveness remains unclear. The conclusions of the current update were able to support and strengthen the recommendation regarding exercise therapy. Evidence for exercise as an intervention for SSP is increasing and strengthening, although the optimal type, dose, and load still remain unclear.

A large group of the included reviews (7/16) included exercise therapy as a treatment for SSP, and all of them had high- or moderate-level evidence. A strong recommendation may be made for including exercise for those diagnosed with SSP. But because many RCTs and systematic reviews do not describe the exercise program in detail, what constitutes the most appropriate exercise regime is unclear. For example, whether treatment for patients with SSP should be designed around loading that can temporarily reproduce and aggravate patients' pain and symptoms is still a matter of debate.[34] Based on surveys concerning the instructions physical therapists give during the rehabilitation of a musculoskeletal shoulder problem, the following foundations are the most commonly used[4,36]: exercises may be performed at home and/or at a clinic, patients are permitted to perceive some discomfort (less than 5/10 on a visual analog scale), the exercises should include resistance, and the expected duration of therapy is 12 weeks.

A strong recommendation may be made regarding the effectiveness of manual therapy when combined with exercise. In 2013, Littlewood et al[22] reported no clear evidence regarding any benefits of manual therapy. Manual therapy was mainly described as joint mobilizations, specific soft tissue techniques, manipulations, neurodynamic mobilizations, and mobilizations with movement of the

TABLE 6 Systematic Reviews Relating to the Effectiveness of Laser Therapy for SSP

Study	Sample Size	Patients Included	Results[a]	Risk of Bias[b]	Level of Evidence[b]
Dong et al[11]	33	2300	Low-level laser therapy is not recommended for patients with shoulder pain syndrome No effect sizes reported	Low (Cochrane risk-of-bias tool)	Low
Haik et al[15]	64	6319	Low-level laser therapy is ineffective in reducing pain and improving function in individuals with SSP No effect sizes reported	Low (PEDro scale)	High
Haslerud et al[16]	17	801	Evidence that, for reducing pain, low-level laser therapy is significantly better than placebo or no therapy. Laser therapy reduces pain and accelerates improvement when used as an add-on therapy to exercise or in a physical therapy treatment regimen. No strong evidence was found for laser therapy alone regarding shoulder function Effect size for pain compared to placebo, 23.54 (15.72, 31.36); effect size for pain as adjunct therapy, 10.00 (−19.74, 39.74)	Unclear (PEDro scale)	Moderate
Page et al[27]	47	2388	Little evidence with respect to pain, function, active mobility, and strength. Low-quality evidence for benefits of laser therapy combined with physical therapy interventions No effect sizes reported	High (Cochrane risk-of-bias tool)	Low (GRADE approach)
Steuri et al[35]	200	10529	Evidence that laser therapy is superior to placebo. Evidence that laser therapy in combination with exercise is superior to placebo in combination with exercise Effect size for pain compared to placebo, −0.88 (−1.48, −0.27); effect size for pain in combination with exercise, −0.65 (−0.99, −0.31)	Low (Cochrane risk-of-bias tool)	Moderate (GRADE approach)
Yu et al[40]	22	1195	Low-level laser is more effective than placebo or ultrasound in providing short-term pain reduction for patients with SSP. The effect is of variable duration No effect sizes reported	Low (SIGN criteria)	Moderate

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; PEDro, Physiotherapy Evidence Database; SIGN, Scottish Intercollegiate Guidelines Network; SSP, subacromial shoulder pain.
[a]*Values in parentheses are 95% confidence interval.*
[b]*Reported in the original review.*

shoulder girdle or spine,[9] but other reviews defined manual therapy as "movement of the joints and other structures by a healthcare professional."[8] Lack of a well-described definition and the variety of included interventions make it difficult to draw a conclusion about which type of manual therapy would most benefit patients with SSP. As the evidence for exercise as an intervention for SSP is strengthening and the findings of this review suggest that manual therapy in addition to exercise may, in the short term, further reduce pain and improve function, this intervention may be considered. There is a clear need for research to investigate different types of both exercise and manual therapy in the management of SSP to provide clear instructions and recommendations.

With respect to the effectiveness of multimodal therapy, no clear conclusions may be provided, and only a weak recommendation can be made. Multimodal physical therapy appeared to provide outcomes superior to those of a placebo or no treatment, although the clinical significance of

TABLE 7 Systematic Reviews Relating to the Effectiveness of Ultrasound for SSP

Study	Sample Size	Patients Included	Results[a]	Risk of Bias[b]	Level of Evidence[b]
Desmeules et al[10]	11	792	Low-level evidence that ultrasound is not superior to a placebo and does not have an additional benefit when used in conjunction with exercise, in terms of pain reduction and self-reported function Effect size, −0.26 (−3.84, 3.32)	Unclear (Cochrane risk-of-bias tool)	Low
Dong et al[11]	33	2300	Ultrasound can be considered as a second-line treatment. Exercise and exercise-based therapies are the first-line choices No effect sizes reported	Low (Cochrane risk-of-bias tool)	Low
Page et al[27]	47	2388	Low-level evidence that ultrasound is not more effective than placebo with respect to pain, global treatment success, or shoulder function No effect sizes reported	High (Cochrane risk-of-bias tool)	Low (GRADE approach)
Steuri et al[35]	200	10529	Nonsignificant results of ultrasound for pain, overall shoulder function, and active range of motion No effect sizes reported	Low (Cochrane risk-of-bias tool)	Moderate (GRADE approach)
Yu et al[40]	22	1195	Ultrasound was not more effective than a placebo for the treatment of nonspecific shoulder problems No effect sizes reported	Low (SIGN criteria)	Moderate

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; SIGN, Scottish Intercollegiate Guidelines Network; SSP, subacromial shoulder pain.
[a]*Values in parentheses are 95% confidence interval.*
[b]*Reported in the original review.*

TABLE 8 Systematic Reviews Relating to the Effectiveness of Extracorporeal Shockwave Therapy for SSP

Study	Sample Size	Patients Included	Results[a]	Risk of Bias[b]	Level of Evidence[b]
Dong et al[11]	33	2300	Low-level evidence that extracorporeal shockwave therapy does not have an additional benefit when used in conjunction with exercise, in terms of pain reduction and self-reported function No effect sizes reported	Low (Cochrane risk-of-bias tool)	Low
Steuri et al[35]	200	10529	Nonsignificant results of extracorporeal shockwave therapy for pain, overall shoulder function, and active range of motion Effect size for pain compared to a placebo, −0.39 (−0.78, −0.01)	Low (Cochrane risk-of-bias tool)	Moderate (GRADE approach)
Yu et al[40]	22	1195	Extracorporeal shockwave therapy was not more effective than placebo for the management of SSP No effect sizes reported	Low (SIGN criteria)	Moderate

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; SIGN, Scottish Intercollegiate Guidelines Network; SSP, subacromial shoulder pain.
[a]*Values in parentheses are 95% confidence interval.*
[b]*Reported in the original review.*

any positive effect remained unclear. The heterogeneity of the different components defining multimodal therapy could explain the variety of conclusions. Multimodal therapy can include many different interventions, which makes it difficult to draw a conclusion about its effectiveness.

Regarding the effectiveness of corticosteroid injection, a moderate recommendation can be made regarding the clinical significance of corticosteroid injection as an isolated treatment or in addition to exercise-based therapy. More research is needed to draw definite conclusions on the effectiveness of corticosteroids for the management of SSP.

Other commonly prescribed interventions, including therapeutic ultrasound, low-level laser, extracorporeal shockwave therapy, and pulsed electromagnetic energy, lack evidence of effectiveness and should not be used when managing SSP.

The methodological quality of the systematic reviews we included was moderate. Littlewood et al[22] reported scores ranging from 3/11 to 9/11, with a mean of 6/11. The range of scores in the current review was between 5/11 and 9/11, with a mean of 7/11.

Future reviews and research should focus on the modalities of exercise therapy (eg, types, repetitions). Also, there is a clear lack of high-quality RCTs and reviews testing the potential added value of manual therapy and indicating when and how it should be applied. As multimodal physical therapy can cover a wide range of different treatment modalities, a clear and well-considered selection should be made to determine which treatment modalities should be used in addition to exercise therapy.

As this review is an umbrella review, only data (eg, comparison groups, follow-up assessments) provided in the original reviews could be used. There were no specific requirements or inclusion/exclusion criteria considering comparators. As in every review, different comparison groups are used, and as this review uses 16 different reviews, the comparison groups were too heterogeneous to present a clear overview.

Potential Limitations of Our Umbrella Review

There is a risk of multiple counting of primary studies that are included in multiple systematic reviews. Hence, those interventions that have been studied the most can be overrepresented in umbrella reviews. We focused on nonsurgical interventions, but certain interventions may have been missed using this search strategy.

Because different terms are used to describe SSP,[31] the included reviews might have missed certain RCTs that used other terms to describe this shoulder problem.

CONCLUSION

Evidence for exercise as the most important management strategy for SSP is increasing and strengthening. Ongoing research is necessary to identify whether there is an optimal dose and type of exercise. Currently, it is not possible to state that one exercise program is more appropriate than another. However, a strong recommendation may be made to include manual therapy as an adjunct intervention with exercise. Conflicting evidence surrounds the effectiveness of multimodal therapy and corticosteroid injection. Other commonly prescribed nonsurgical interventions, such as ultrasound, low-level laser, and extracorporeal shockwave therapy, lack evidence of effectiveness. ◉

KEY POINTS

FINDINGS: Exercise therapy should be considered as a principal intervention in the management of subacromial shoulder pain. Manual therapy may provide further benefit if used as an adjunct therapy.

IMPLICATIONS: Exercise therapy should be prioritized as the primary treatment

TABLE 9 Systematic Reviews Relating to the Effectiveness of Pulsed Electromagnetic Energy for SSP

Study	Sample Size	Patients Included	Results	Risk of Bias[a]	Level of Evidence[a]
Dong et al[11]	33	2300	Pulsed electromagnetic energy can be considered as a second-line treatment. Exercise and exercise-based therapies are the first-line choices No effect sizes reported	Low (Cochrane risk-of-bias tool)	Low
Haik et al[15]	64	6319	Pulsed electromagnetic energy was not effective to reduce pain and improve function in individuals with SSP No effect sizes reported	Low (PEDro scale)	High
Page et al[27]	47	2388	Pulsed electromagnetic energy had no clinically important benefits compared to placebo No effect sizes reported	High (Cochrane risk-of-bias tool)	Low (GRADE approach)
Steuri et al[35]	200	10529	Nonsignificant results of pulsed electromagnetic energy for pain, overall shoulder function, and active range of motion No effect sizes reported	Low (Cochrane risk-of-bias tool)	Moderate (GRADE approach)

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; PEDro, Physiotherapy Evidence Database; SSP, subacromial shoulder pain.
[a]*Reported in the original review.*

option, due to its clinical effectiveness, cost-effectiveness, and other associated health benefits.

CAUTION: Continued research is needed to more fully understand the uncertainty around the optimal type, dose, and duration of exercise for subacromial shoulder pain. All possible effects of manual therapy are seen in the short term and in the initial phase of rehabilitation, and always in addition to an exercise program.

STUDY DETAILS

PATIENT AND PUBLIC INVOLVEMENT: There was no patient-public involvement in the research.

DATA SHARING: All data relevant to the study are included in the article.

AUTHOR CONTRIBUTIONS: All authors contributed to the initial phase of writing the manuscript and to the review process. Final adaptations and approval were given by Drs Lewis and Struyf and Ms Pieters.

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APPENDIX A

BACKGROUND AND FINDINGS OF THE STUDY

What is known about this subject	• Exercise and multimodal physical therapy might be effective in the management of rotator cuff tendinopathy • Exercise therapy should be prioritized as the primary treatment option, due to its clinical effectiveness, cost-effectiveness, and other associated health benefits
What this study adds to existing knowledge	• The evidence for the use of exercise therapy in the management of subacromial shoulder pain is consistent, and exercise should be considered as a principal intervention in the management of those with subacromial shoulder pain • Manual therapy may provide further benefit if used in addition to exercise therapy • Conflicting evidence surrounds the effectiveness of multimodal therapy and corticosteroid injection • Ultrasound, low-level laser, and extracorporeal shockwave therapy lack evidence of effectiveness

APPENDIX B

SEARCH STRATEGY

Search Type	Search Term
Abbreviated	(subacromial impingement syndrome OR painful arc syndrome OR shoulder impingement OR subacromial bursitis OR rotator cuff tendonitis OR rotator cuff tendinosis OR supraspinatus tendonitis OR contractile dysfunction) AND (conservative treatment OR exercise OR exercise combined with manual therapy OR multimodal physiotherapy OR corticosteroid injection OR laser OR ultrasound OR extracorporeal shock wave therapy OR pulsed electromagnetic energy) AND (systematic review OR meta-analysis)
Detailed	(("shoulder impingement syndrome"[MeSH Terms] OR ("shoulder"[All Fields] AND "impingement"[All Fields] AND "syndrome"[All Fields]) OR "shoulder impingement syndrome"[All Fields] OR ("subacromial"[All Fields] AND "impingement"[All Fields] AND "syndrome"[All Fields]) OR "subacromial impingement syndrome"[All Fields]) OR (("pain"[MeSH Terms] OR "pain"[All Fields] OR "painful"[All Fields]) AND ("Arthrogryposis renal dysfunction cholestasis syndrome"[All Fields] OR "arc syndrome"[All Fields])) OR (("shoulder"[MeSH Terms] OR "shoulder"[All Fields]) AND impingement[All Fields]) OR (subacromial[All Fields] AND ("bursitis"[MeSH Terms] OR "bursitis"[All Fields])) OR (("rotator cuff"[MeSH Terms] OR ("rotator"[All Fields] AND "cuff"[All Fields]) OR "rotator cuff"[All Fields]) AND ("tendinopathy"[MeSH Terms] OR "tendinopathy"[All Fields] OR "tendonitis"[All Fields])) OR (("rotator cuff"[MeSH Terms] OR ("rotator"[All Fields] AND "cuff"[All Fields]) OR "rotator cuff"[All Fields]) AND ("tendinopathy"[MeSH Terms] OR "tendinopathy"[All Fields] OR "tendinosis"[All Fields])) OR (supraspinatus[All Fields] AND ("tendinopathy"[MeSH Terms] OR "tendinopathy"[All Fields] OR "tendonitis"[All Fields])) OR (("muscle contraction"[MeSH Terms] OR ("muscle"[All Fields] AND "contraction"[All Fields]) OR "muscle contraction"[All Fields] OR "contractile"[All Fields]) AND ("physiopathology"[Subheading] OR "physiopathology"[All Fields] OR "dysfunction"[All Fields]))) AND ((conservative[All Fields] AND ("therapy"[Subheading] OR "therapy"[All Fields] OR "treatment"[All Fields] OR "therapeutics"[MeSH Terms] OR "therapeutics"[All Fields])) OR ("exercise"[MeSH Terms] OR "exercise"[All Fields]) OR (("exercise"[MeSH Terms] OR "exercise"[All Fields]) AND combined[All Fields] AND ("musculoskeletal manipulations"[MeSH Terms] OR ("musculoskeletal"[All Fields] AND "manipulations"[All Fields]) OR "musculoskeletal manipulations"[All Fields] OR ("manual"[All Fields] AND "therapy"[All Fields]) OR "manual therapy"[All Fields])) OR (multimodal[All Fields] AND ("physical therapy modalities"[MeSH Terms] OR ("physical"[All Fields] AND "therapy"[All Fields] AND "modalities"[All Fields]) OR "physical therapy modalities"[All Fields] OR "physiotherapy"[All Fields])) OR (("adrenal cortex hormones"[MeSH Terms] OR ("adrenal"[All Fields] AND "cortex"[All Fields] AND "hormones"[All Fields]) OR "adrenal cortex hormones"[All Fields] OR "corticosteroid"[All Fields]) AND ("injections"[MeSH Terms] OR "injections"[All Fields] OR "injection"[All Fields])) OR ("lasers"[MeSH Terms] OR "lasers"[All Fields] OR "laser"[All Fields]) OR ("ultrasonography"[Subheading] OR "ultrasonography"[All Fields] OR "ultrasound"[All Fields] OR "ultrasonography"[MeSH Terms] OR "ultrasound"[All Fields] OR "ultrasonics"[MeSH Terms] OR "ultrasonics"[All Fields]) OR (extracorporeal[All Fields] AND ("shock"[MeSH Terms] OR "shock"[All Fields]) AND wave[All Fields] AND ("therapy"[Subheading] OR "therapy"[All Fields] OR "therapeutics"[MeSH Terms] OR "therapeutics"[All Fields])) OR (pulsed[All Fields] AND ("electromagnetic radiation"[MeSH Terms] OR ("electromagnetic"[All Fields] AND "radiation"[All Fields]) OR "electromagnetic radiation"[All Fields] OR ("electromagnetic"[All Fields] AND "energy"[All Fields]) OR "electromagnetic energy"[All Fields]))) AND (("review"[Publication Type] OR "review literature as topic"[MeSH Terms] OR "systematic review"[All Fields]) OR ("meta-analysis"[Publication Type] OR "meta-analysis as topic"[MeSH Terms] OR "meta-analysis"[All Fields])) AND ((systematic[sb] OR Meta-Analysis[ptyp]) AND ("2012/09/01"[PDAT]: "2018/10/01"[PDAT]) AND "humans"[MeSH Terms])