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Literature Review

Effect of supervised physiotherapy versus home exercise program in patients with subacromial impingement syndrome: A systematic review and meta-analysis

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ABSTRACT

Objective: To determine whether supervised physiotherapy is more effective for functional improvement and pain relief than a home exercise program in subjects with subacromial impingement syndrome.
Design: Systematic review and meta-analysis of randomized clinical trials.
Methods: An electronic search was performed in Medline, Central, Embase, PEDro, Lilacs, Cinahl, SPORTDiscus, and Web of Science databases. The eligibility criteria for selecting studies included randomized clinical trials that compared supervised physiotherapy versus home exercise program, in the shoulder function, pain, and range of motion in subjects older than 18 years of age with a medical diagnosis of subacromial impingement syndrome treated conservatively.
Results: Seven clinical trials met the eligibility criteria, and for the quantitative synthesis, four studies were included. The standardized mean difference for shoulder function was −0.14 points (95% CI: −1.04 to 0.76; p = 0.760), mean difference 0.21 cm (95% CI: −1.36 to 1.78; p = 0.790) for pain, and mean difference 0.62° (95% CI: −7.15 to 8.38; p = 0.880) for range of motion of flexion.
Conclusion: Supervised physical therapy and home-based progressive shoulder strengthening and stretching exercises for the rotator cuff and scapular muscles are equally effective in patients with subacromial impingement syndrome treated conservatively.
Trial registration number: CRD42018086348.

1. Introduction

Shoulder pain has been suggested to be the most common non-traumatic complaint arising from an arm, neck and shoulder region. The 1-year prevalence of shoulder pain among the general population has been estimated to vary between 7% and 30%, while lifetime prevalence up to 70% (Feleus et al., 2008; Luime et al., 2004). Shoulder impingement syndrome (SIS) has been proposed as the most common source of shoulder pain (Juel & Natvig, 2014), and is a common diagnostic label for this patients (Braman, Zhao, Lawrence, Harrison, & Ludewig, 2014). Neer introduced the concept and diagnostic of SIS in 1972, based on the mechanism of structural impingement of the structures of the subacromial space (Neer, 1972). However, the label of SIS is now controversial, as recent evidence suggests that this concept does not fully explain the mechanisms (Ludewig, Lawrence, & Braman, 2013; Papadonikolakis, Mc Kenna, Warme, Martin, & Matsen, 2011). Until a few years ago, SIS was a widely accepted 'umbrella' term for a number of possible underlying structural or biomechanical causes.

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Throughout the years, the description progressed from SIS to 'impingement related shoulder pain', with the growing opinion that 'impingement' represents a cluster of symptoms and a possible mechanism for the pain, rather than a pathoanatomic diagnose itself (Cools & Michener, 2017). In this new perspective, physiotherapists focus on movement-related mechanisms or biomechanical precipitating factors for evaluation and treatment of this condition (Braman et al., 2014; Ludewig et al., 2013, 2017)."

Currently, SIS is considered a multifactorial condition for which that etiology has been explained by intrinsic and extrinsic mechanisms of rotator cuff pathology (Michener, McClure, & Karduna, 2003; Seitz, McClure, Finucane S, Boardman, & Michener, 2011). Extrinsic factors are related with external mechanical compression of the anatomical structures that are within the subacromial space including (Seitz, McClure, Finucane, Boardman, & Michener, 2011): i) anatomical factors such as variation in the type and shape of the acromion, the acromio-clavicular joint and the thickening of the coracoacromial ligament and ii) biomechanical factors such as alterations in posture, loss of extensibility of the posterior capsule and the pectoralis minor muscle, and alterations in the glenohumeral and scapulohumeral kinematics associated with deficits in the muscular performance of the rotator cuff and the scapular muscles (Ludewig & Braman, 2011; Michener et al., 2003; Seitz et al., 2011).

The treatment of SIS is mainly focused on reducing the common impairments related to pain, and on improving shoulder and upper extremity function (Steuri et al., 2017). SIS treatment strategies vary according to SIS stage; in the early stages (1 or 2), conservative interventions are effective (Dong et al., 2015; Steuri et al., 2017). Conversely, in stage 3, treatment is based on surgical procedures (Farfaras, Sernet, Rostgard Christensen, Hallström, & Kartus, 2018; Koester, George, & Kuhn, 2005; Neer, 1972). The most common conservative interventions are corticosteroid injections, non-steroidal anti-inflammatory drugs and physiotherapy (therapeutic exercise plus other physical therapies, such as manual therapy or kinesio taping (Dong et al., 2015; Karel et al., 2017; Steuri et al., 2017). Although therapeutic exercise has been described as an important component for the conservative management of SIS, its effectiveness remains unclear (Abdulla et al., 2015; Dong et al., 2015; Ellenbecker & Cools, 2010; Hanratty et al., 2016; Karel et al., 2017; Michener, Walsworth, & Burnet, 2004; Steuri et al., 2017). Seven previous systematic reviews have analyzed the effectiveness of therapeutic exercise for the management of SIS, generally showing a decrease of pain and an increase of shoulder function (Abdulla et al., 2015; Gebremariam et al., 2014; Hanratty et al., 2012; Kelly, Wrightson, & Meads, 2010; Kromer, Tautenhahn, de Bie, Staal, & Bastiaenen, 2009; Kuhn, 2009; Steuri et al., 2017). There is no exercise protocol as a reference standard, although a recent network meta-analysis concluded that general exercises plus other therapies such as specific exercises, manual therapy, kinesio taping and acupuncture are effective treatments for patients at early stages of SIS (Dong et al., 2015)."

Supervised physiotherapy is a structured therapy performed under the supervision of a physiotherapist that includes the prescription of a therapeutic exercise program together with other interventions (i.e. advice, manual therapy or physical agents). The advice by a physiotherapist is considered important at early stages of SIS where the patients need help and support to deal with pain and shoulder dysfunction, and to perform the exercises correctly (Granviken & Vasseljen, 2015). Therefore, supervised physiotherapy is usually the first choice for the conservative treatment of the SIS (Hanratty et al., 2016; Steuri et al., 2017). However, the effectiveness of supervised physiotherapy compared to a home exercise program has not been previously established in patients with SIS. Thus, the aim of this systematic review and meta-analysis was to determine whether the supervised physiotherapy is more effective in the improvement of shoulder function, range of motion and pain relief than home exercise program in subjects with SIS treated conservatively.

2. Methods

2.1. Protocol and registration

This systematic review was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement and followed the recommendations of the Cochrane Collaboration Handbook (Higgins & Green, 2011; Liberati et al., 2009; Moher, Liberati, Tetzlaff, Altman, 2009). The register number in the International Prospective Register of Systematic Review (PROSPERO) is CRD42018086348.

2.2. Eligibility criteria

Studies on the effectiveness of supervised physiotherapy versus home exercise program were regarded eligible for inclusion if the following criteria were fulfilled. (1) Population: subjects older than 18 years old with medical diagnosis of SIS based on clinical criteria, with at least one of the following signs: pain with overhead activities, painful arc sign, positive Neer impingement test, Hawkins test or Jobe test. Additionally, studies that include any of the signs described above in combination with radiological criteria, such as ultrasound and/or magnetic resonance imaging, to confirm the diagnosis of SIS were included. (2) Type of intervention: supervised physiotherapy including several types of therapeutic exercise (i.e. scapular stabilization exercises, exercises of strengthening of the rotator cuff, specific exercises, active exercises to improve range of motion and muscle stretching exercises). The exercise program should be supervised by a physiotherapist, and can be applied alone or together with other interventions such as manual therapy, physical agents, or pharmacological interventions. (3) Type of comparison: exercise programs conducted at home. (4) Types of outcomes: shoulder or upper extremity function, pain intensity and active or passive range of motion. (5) Types of studies: randomized clinical trials or controlled clinical trials, published in English, German or Spanish. The exclusion criteria were as follows: (1) studies involving subjects with other pathologies of the shoulder joint complex, such as fractures/dislocations, osteoarthritis in the acromioclavicular or glenohumeral joints, calcific tendinitis, adhesive capsulitis, and glenohumeral instability, (2) studies involving subjects with SIS stage 3 (partial or full-thickness tear rotator cuff), (3) subjects with a history of acute trauma or previous surgery in the affected shoulder and (4) studies including postoperative physiotherapy interventions.

2.3. Electronic search

We systematically searched MEDLINE (via PubMed), the Cochrane Central Register of Controlled Trials (CENTRAL), EMBASE, the Physiotherapy Evidence Database (PEDro), the Latin American and the Caribbean Literature in Health Sciences (LILACS), the Cumulative Index to Nursing and Allied Health Literature (CINAHL), SPORTDiscus, and Web of Science databases from inception until May 2019.

The search strategy used included a combination of the following Medical Subjects Headings (MeSH) terms: "*Shoulder impingement syndrome*"; "*Shoulder pain*"; "*Rotator cuff injuries*"; "*Physical therapy modalities*"; "*Exercise therapy*"; "*Exercise*". These were combined with the free-text terms: "*Rotator cuff tendinopathy*"; "*Shoulder tendonitis*"; "*Supervised therapy*"; "*Supervised exercise*"; "*Home*

exercise program"; "*Home program*"; "*Home treatment*"; "*Home-based exercise*". To identify randomized trials in the Medline, Central, and Embase databases, the Cochrane Highly Sensitive Search Strategies was used (Higgins & Green, 2011). We also manually searched the references of selected articles to identify additional potentially relevant studies. The literature search was independently conducted by two reviewers (HG-E, and FA-Q). We involved a third reviewer if a consensus could not be reached (IC-R).

2.4. Study selection

Two authors (HG-E, and FA-Q) independently screened the titles and abstracts of references retrieved from searches. We obtained the full text for references that either author considered to be potentially relevant. We involved a third reviewer if a consensus could not be reached (IC-R).

2.5. Data collection process

Two authors (HG-E, and FA-Q) used a standardized form to independently extract data on outcomes for each trial. The following data were extracted from the original reports: i) authors and year of publication, ii) country, iii) sample characteristics (sample size, age distribution, and sex), iv) characteristics of supervised physiotherapy program, v) characteristics of home exercise program, vi) length of follow-up and main outcomes and vii) main results.

2.6. Risk of bias of individual studies

Assessment of risk of bias of individual studies was performed as recommended by the Cochrane Collaboration Handbook (Higgins & Green, 2011). This tool evaluates the risk of bias according to seven domains: generation of the random sequence, concealment of the randomization sequence, blinding of participants and treatments, blinding of the evaluation of the results, incomplete results data, selective reporting of results and other biases. Each domain could be considered as low risk of bias, unclear risk of bias or high risk of bias. Data extraction and quality assessment were independently performed by two reviewers (HG-E, and FA-Q). We involved a third reviewer if a consensus could not be reached (IC-R). The agreement rate between reviewers was calculated using kappa statistics.

2.7. Statistical methods

The DerSimonian and Laird random effect or Mantel-Haenszel fixed effect methods were used (DerSimonian & Kacker, 2007; Mantel & Haenszel, 1959), depending on the heterogeneity, to compute a pooled estimate of mean difference (MD) or standardized mean difference (SMD), and respective 95% confidence intervals (CI) for shoulder function, pain intensity and range of motion. The heterogeneity of results across studies was evaluated using the I^2 statistic (Higgins & Thompson, 2002), which is considered as: might not be important (0%–40%), may represent moderate (30%–60%), substantial (50%–90%), and considerable (75%–100%) heterogeneity (Higgins & Green, 2011). Also, the corresponding p-values were considered. Meta-analyses were performed with RevMan 5.3. Publication bias will be evaluated through a visual inspection of funnel plots, as well as by using the method proposed by Egger (Sterne, Egger, & Smith, 2001).

3. Results

3.1. Study selection

A total of 298 studies were found through the electronic searching (Fig. 1). Finally, seven studies met eligibility criteria and were included in the systematic review (Granviken & Vasseljen, 2015; Holmgren, Björnsson Hallgren, Öberg, Adolfsson, & Johansson, 2012; Pekyavas & Ergun, 2017; Senbursa, Baltaci, & Atay, 2011; Vinuesa-Montoya et al., 2017; Walther, Werner, Stahlschmidt, Woelfel, & Gohlke, 2004; Werner, Walther, Ilg, Stahlschmidt, & Gohlke, 2002). The kappa agreement rate between reviewers was 0.9.

3.2. Study characteristics

A summary of included studies is presented in Table 1. The overall population included 371 patients (205 and 166 in supervised physiotherapy and home exercise program, respectively), with 158 males and 136 females. The mean age was 48.8 years, and mean follow-up was 14.5 weeks (5–26).

In the studies included the diagnosis of SIS was based on clinical criteria, such as pain with overhead activities, painful arc sign, positive Neer impingement test, Hawkins test or Jobe test. Three trials confirmed the diagnosis with ultrasound (Holmgren et al., 2012; Walther et al., 2004; Werner et al., 2002), and two with magnetic resonance imaging (Pekyavas and Ergun, 2017; Senbursa et al., 2011). With respect to the therapeutic interventions occupied in the supervised physiotherapy program in the included studies, the therapeutic exercise programs within the trials generally was based on strengthening for the rotator cuff and/or scapular muscles (Granviken and Vasseljen, 2015; Holmgren et al., 2012; Senbursa et al., 2011; Vinuesa-Montoya et al., 2017; Walther et al., 2004; Werner et al., 2002). Four studies added stretching exercises to this exercise program (Holmgren et al., 2012; Senbursa et al., 2011; Walther et al., 2004; Werner et al., 2002), two studies added different manual therapy techniques: one study used cervicothoracic manipulation (Vinuesa-Montoya et al., 2017), and other joint and soft tissue mobilization (Senbursa et al., 2011). Finally, the other study used exercises with virtual reality games (Pekyavas and Ergun, 2017).

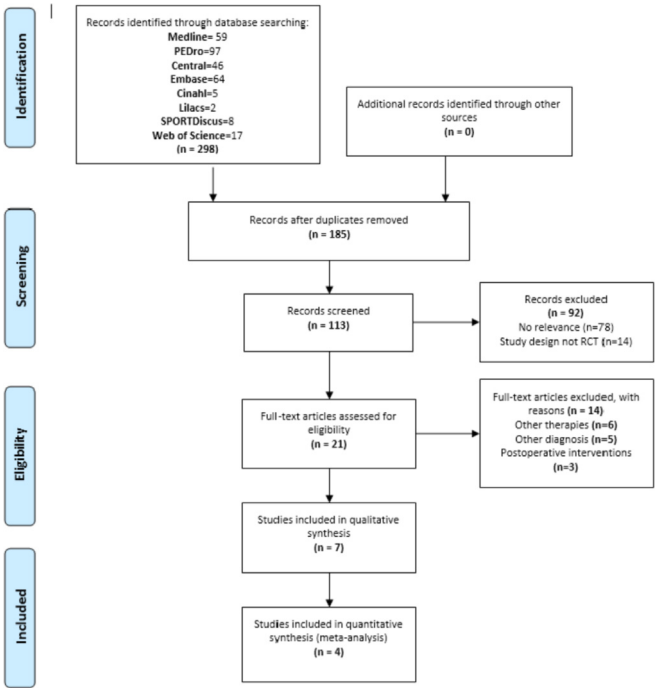

Fig. 1. Flow diagram for study selection process.

Table 1
Characteristics of the studies included in the systematic review and meta-analyses of the effects of supervised physiotherapy versus home exercise program in patients with subacromial impingement syndrome.

		Supervised Physiotherapy				Home Exercise Program				Outcomes	
References	Country	n, males (%)	Age mean (SD)	Intervention	Dose	n, males (%)	Age mean (SD)	Intervention	Dose	Follow-up/ Outcomes	Results between groups
Vinuesa-Montoya et al., 2017 [45]	Spain	21, (71.4)	46.9 (8.02)	-Cervicothoracic manipulation:Cervical mobilizations and thoracic manipulations -Stretching and strengthening exercises for the rotator cuff and scapular muscles	-30 min -2 sessions/w -5 weeks	20, (65.0)	51.2 (5.3)	-Stretching and strengthening exercises for the rotator cuff and scapular muscles at home	-30 min -2 times/d -5 weeks	Not follow-up -VAS -DASH -SDQ -ROM: Flexion, Extension, IR, ER, Abd and Add	At end of treatment: -VAS: −0.09 (−1.6, 1.5) p = 0.859 -DASH: 18.3 (5.2, 31.4) p = 0.012 * -SDQ: 10.6 (−4.8, 26.1) p = 0.061 -ROM Flex: −0.12 (−10.9, 10.6) p = 0.761 Ext: N.R Abd: 5.5 (−13.8, 24.9) p = 0.461 Add: N.R ER: −7.7 (−19.3, 3.9) p = 0.572 IR: −6.4 (−18.6, 5.8) p = 0.217
Pekyavas and Ergun, 2017 [37]	Turkey	15, (6.7)	40,3 (13.2)	-Nintendo Wii games (boxing, bowling, and tennis) -Warming and cooling exercises -Capsular and pectoral stretching	-45 min -2 sessions/w - 6 weeks	15, (13.3)	40.6 (11.7)	- Capsular and pectoral stretching -Serratus strengthening bilateral -Shoulder elevation -Scapular mobility exercises	-45 min -2 times/w -6 weeks	1-month follow-up -VAS (at rest, activity, night) -SPADI	At end of the follow-up: -VAS Rest: p = 0.263 Activity: p = 0.446 Night: p = 0.050 -SPADI: p = 0.536
Granviken and Vasselijen, 2015 [12]	Norway	23, (52.2)	47.6 (10.0)	-Supervised strengthening exercises for the rotator cuff and scapular muscles -Pain free ROM exercises	-3 sets of 30 rep -4 to 6 exercises -2 times/d -6 weeks	23, (52.2)	48.2 (9.8)	-Strengthening exercises for the rotator cuff and scapular muscles at home -Pain free ROM exercises at home	-3 sets of 30 rep -4 to 6 exercises -2 times/d -6 weeks	26 weeks' follow-up -SPADI -VAS -ROM (Flexion, Abd, IR and ER)	At 6 week -SPADI: 0 (−14, 14) p=>0.05 -VAS: −0.1 (−1.8, 1.6) p=>0.05 ROM -Flex: 0 (−16, 16) p=>0.05 -Abd: −14 (−43, 15) p=>0.05 -ER: 2 (−14, 18) p=>0.05 -IR: 0 (−10, 11) p=>0.05 At end of the follow-up: -SPADI: −2 (−21, 17) p=>0.05 -VAS: p=>0.05 ROM -Flex: p=>0.05 -Abd: p=>0.05 -ER: p= >0.05

(*continued on next page*)

Table 1 (*continued*)

		Supervised Physiotherapy				Home Exercise Program			Outcomes		
References	Country	n, males (%)	Age mean (SD)	Intervention	Dose	n, males (%)	Age mean (SD)	Intervention	Dose	Follow-up/ Outcomes	Results between groups
Holmgren et al., 2012 [17]	Sweden	51, (72.5)	52 (9.0)	-Subacromial corticosteroid injection -Stretching and strengthening exercises for the rotator cuff and scapular muscles	-3 sets of 15 repetition -2 to 3 sessions/w -8 to 12 weeks.	46, (47.8)	52 (8.0)	-Subacromial corticosteroid injection -Nonspecific exercises for neck and shoulder without external load at home	-3 sets of 10 repetition -2 times/d -8 to 12 weeks	3 months' follow-up -CM score -DASH -VAS (rest, activity, night)	-IR: p= >0.05 At end of the follow-up: -CM: 15 (8.5, 20.6) p=<0.05 * -DASH: 8 (2.3, 13.7) p=<0.05 * VAS -Rest: −5.4 (−14.1, 3.4) p=>0.05 -Activity: −10.6 (−23.6, 2.4) p=>0.05 -Night: −20 (−30.9, −7.2) p=<0.05 *
Senbursa et al., 2011 [39]	Turkey	SP1: 25, (N.R) SP2: 30, (N.R)	SP1: 48.2 (7.9) SP2: 50.5 (10.6)	SP1: Stretching and strengthening exercises for the rotator cuff and scapular muscles SP2: -Manual therapy -Stretching and strengthening exercises for the rotator cuff and scapular muscles	-3 sets of 10 repetition/d -12 weeks	22, (N.R)	48 (9.0)	-Stretching and strengthening exercises for the rotator cuff and scapular muscles at home	-3 sets of 10 repetition/d -12 weeks	12 weeks' follow-up -VAS -ROM -MASES	At 4 weeks: VAS -Night: p = 0.698 -Rest: p = 0.191 -Movement: p = 0.631 -ROM: P=>0.05 -MASES: p = 0.013 * At end of the follow-up: VAS -Night: p = 0.825 -Rest: p = 0.66 -Movement: p = 0.095 -ROM: p=<0.05 -MASES: p = 0.080
Walther et al., 2004 [47]	Germany	SP1 = 20, (45.0) SP2 = 20, (55.0)	SP1: 48.6 SP2: 51.5	SP1: Functional shoulder brace SP2: Centering training for rotator cuff.	SP1: -Long as possible during the day also at night -12 weeks SP2: -10 sessions 2 to 3 times/w -12 weeks	20, (70.0)	52.1 (N.R)	-Strengthening and stretching exercises for the rotator cuff and scapular muscles	-10 to 15 min 5 times/w -12 weeks	Not follow-up -CM score -VAS	At end of treatment: -CM: p=>0.05 VAS -Rest: p=>0.05 -Night: p=>0.05 -Under stress: p=>0.05
Werner et al., 2002 [48]	Germany	20, (55.0)	51.5	-Centering training for the rotator cuff	-10 to 15 min -5 times/w -12 weeks	20, (45.0)	52.0 (N.R)	-Strengthening and stretching exercises for the rotator cuff and scapular muscles	-10 to 15 min -5 times/w -12 weeks	Not follow-up -CM score -VAS	At end of treatment: -CM: p=>0.05 -VAS: p=>0.05

SP: Supervised physiotherapy; **VAS**: Visual analog scale; **DASH:** Disabilities of the Arm, Shoulder, and Hand; **SDQ:** Shoulder Disability Questionnaire; **ROM:** Range of movement; **IR**: Internal rotation; **ER:** External rotation; **Abd**: Abduction; **Add:** Adduction; **SPADI**: Shoulder Pain and Disability Index; **CM**: Constant-Murley; **MASES**: Modified American Shoulder and Elbow Surgeon's; **N.R**: Not reported. * = Statistically significant.

Regarding home exercise programs, six studies performed similar interventions, stretching and strengthening the rotator cuff and scapular muscles (Granviken and Vasseljen, 2015; Pekyavas and Ergun, 2017; Senbursa et al., 2011; Vinuesa-Montoya et al., 2017; Walther et al., 2004; Werner et al., 2002). Only one study applied unspecific exercises for neck and shoulder without an external load, in addition to subacromial corticosteroid injection (Holmgren et al., 2012). Also, the studies showed variability in the doses provided. Three studies applied a home exercise program for 5–6 weeks, 2 days per week, and 30–45 min per day (Granviken and Vasseljen, 2015; Pekyavas and Ergun, 2017; Vinuesa-Montoya et al., 2017), and four studies once or twice a day for 12 weeks (Holmgren et al., 2012; Senbursa et al., 2011; Walther et al., 2004; Werner et al., 2002).

Six studies assessed the shoulder function with different questionnaires: two studies used the Shoulder Pain and Disability Index (SPADI) questionnaire at the first month (Granviken and Vasseljen, 2015; Pekyavas and Ergun, 2017), three studies used the Constant-Murley questionnaire at the three months (Holmgren et al., 2012; Walther et al., 2004; Werner et al., 2002), and one study used Shoulder Disability Questionnaire (SDQ) (Vinuesa-Montoya et al., 2017). All studies examined pain intensity with visual analog scale (VAS). Four studies for night, rest and during activity pain (Holmgren et al., 2012; Pekyavas and Ergun, 2017; Senbursa et al., 2011; Walther et al., 2004) and the three studies only for rest pain (Granviken and Vasseljen, 2015; Vinuesa-Montoya et al., 2017; Werner et al., 2002). Only three studies included assessed active range of motion. Two studies analyzed shoulder movements in all directions (Granviken and Vasseljen, 2015; Vinuesa-Montoya et al., 2017), and the other did not specify the movement directions (Senbursa et al., 2011). In two studies, range of motion was assessed with a goniometer (Senbursa et al., 2011; Vinuesa-Montoya et al., 2017), and in the other with an inclinometer.

3.3. Risk of bias within studies

As evaluated by the Cochrane Collaboration tool for assessing risk of bias for all clinical trials, 28.6% of the studies showed a high risk of bias (Walther et al., 2004; Werner et al., 2002), 28.6% a medium risk of bias (Pekyavas and Ergun, 2017; Senbursa et al., 2011), and 42.8% a low risk of bias (Granviken and Vasseljen, 2015; Holmgren et al., 2012; Vinuesa-Montoya et al., 2017). When studies were analyzed by individual domains, in 100% of the studies the random sequence generation was suitable. Adequate allocation concealment was observed as low risk of bias in 40% of the studies, unclear in 40% and high risk of bias in 20%. Outcome assessors were blinded in 55% of the studies, while incomplete outcome data and selective reported were observed in 100% as low risk of bias (Fig. 2 and Fig. 3).

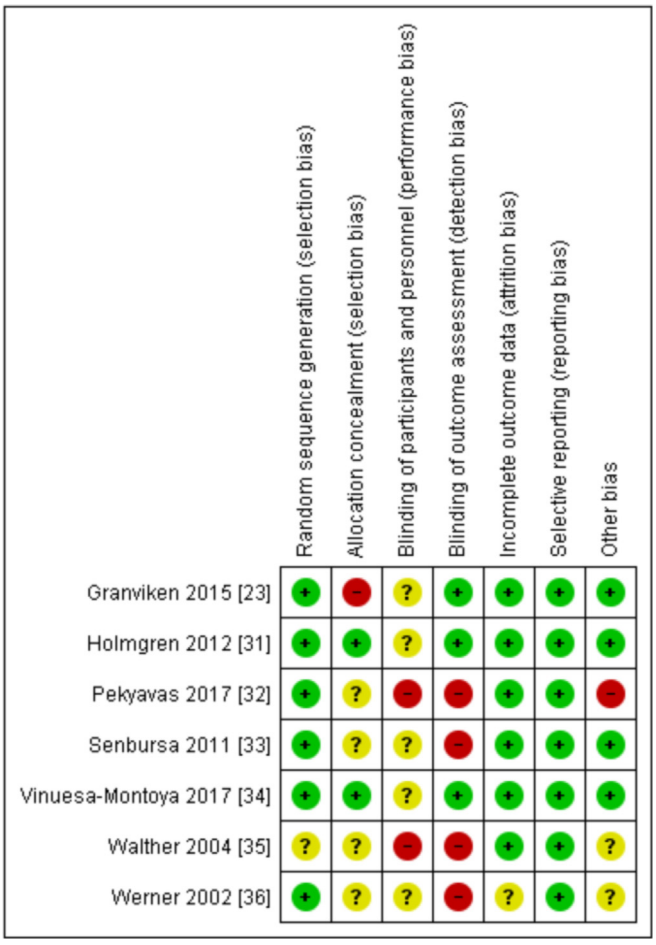

Fig. 2. Risk of bias summary: review authors, judgements about each 'Risk of bias' item for each included study.

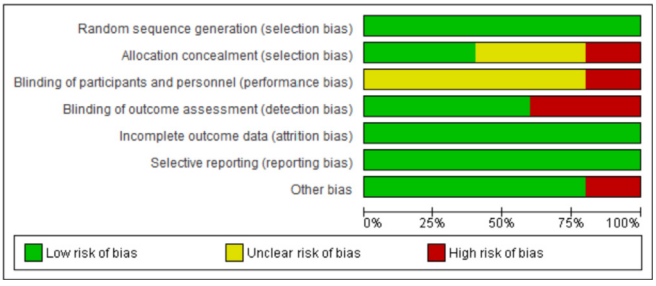

Fig. 3. Risk of bias graph: review authors, judgements about each 'Risk of bias' item presented as percentages across all included studies.

3.4. Synthesis of results

Among the six studies included in the systematic review, the shoulder function was assessed with different questionnaires, and only four reported values (mean and standard deviation for each group). Furthermore, all studies assessed the intensity of pain with VAS, however only four reported values (mean and standard deviation); for each group and only two studies assessed the range of motion and reported values for each group. Therefore, meta-analyses were performed including four studies for shoulder function and intensity of pain and two studies for range of motion.

3.4.1. Shoulder function

There were four studies to conduct meta-analysis for shoulder function (Granviken and Vasseljen, 2015; Holmgren et al., 2012; Pekyavas and Ergun, 2017; Vinuesa- Montoya et al., 2017). The pooled SMD estimate showed no significant difference between shoulder function in supervised physiotherapy group and home exercise program at the end of the treatment, a SMD = −0.14 points, 95% CI = −1.04 to −0.76, p = 0.76 (Fig. 4), with substantial heterogeneity ($I^2 = 90\%$, $p < 0.05$).

3.4.2. Pain

Likewise, these four studies included data to conduct meta-analysis for pain using the VAS (Granviken and Vasseljen, 2015; Holmgren et al., 2012; Pekyavas and Ergun, 2017; Vinuesa-Montoya et al., 2017). The pooled MD estimate showed no

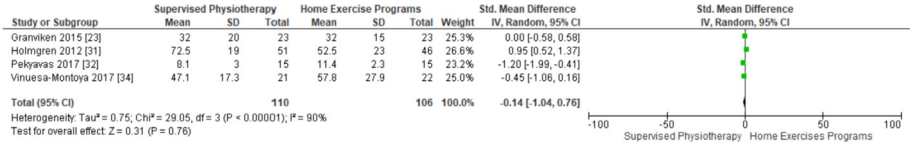

Fig. 4. Forest plot comparison supervised physiotherapy versus home exercises program for the shoulder function.

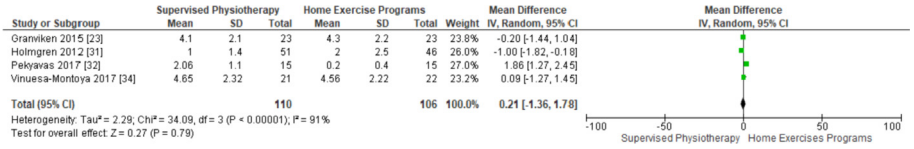

Fig. 5. Forest plot comparison supervised physiotherapy versus home exercises program for the VAS.

significant difference in the level of pain in the supervised physiotherapy group compared with home exercise group at the end of the treatment, a MD = 0.21 cm, 95% CI = −1.36 to 1.78, p = 0.79 (Fig. 5), with considerable heterogeneity ($I^2 = 91\%$, $p < 0.05$).

3.4.3. Active range of motion

Finally, two studies included flexion range of motion data to conduct the meta-analysis (Granviken and Vasseljen, 2015; Vinuesa-Montoya et al., 2017). The pooled MD estimate showed no significant difference in the active flexion in the supervised physiotherapy group compared with home exercise group at the end of the treatment, a MD = 0.62 grades, 95% CI = −7.15 to 8.38, p = 0.88 (Fig. 6), with not important heterogeneity ($I^2 = 0\%$, p = 0.80).

3.4.4. Publication bias

Publication bias was not performed due to only seven articles were included in this systematic review and meta-analysis (Sterne et al., 2011).

4. Discussion

This systematic review and meta-analysis provides an overview of the evidence supporting that both therapeutic interventions, supervised physiotherapy and home exercise programs, have similar effectiveness in SIS treated conservatively. Additionally, our findings suggest no clinical or statistically significant differences in shoulder function, pain, and range of motion between both interventions.

In contrast to previous reviews (Abdulla et al., 2015; Dong et al., 2015; Gebremariam et al., 2014; Hanratty et al., 2012; Kelly et al., 2010; Kromer et al., 2009; Kuhn, 2009; Michener et al., 2004; Steuri et al., 2017), this systematic review specifically examines the effectiveness of supervised physiotherapy compared with home exercise programs in the treatment of patients with SIS. Despite supervised physiotherapy routinely used in the treatment of many shoulder conditions (Dong et al., 2015; Gebremariam et al., 2014; Hanratty et al., 2012; Karel et al., 2017), the optimal clinical application remains unclear (Hanratty et al., 2016; Granviken and Vasseljen, 2015). In addition, there is a lack of evidence-based clinical guidelines to direct physiotherapists in their treatment choices, and there is no clear evidence to guide clinicians and physiotherapists on which patients could benefit from supervised physiotherapy and who could benefit from home exercises alone (Hanratty et al., 2016; Kelley, McClure, & Leggin, 2009). This uncertainty is reflected not only in the wide range of treatments available but also in the subjectivity of their application by the physiotherapist (Hanratty et al., 2016).

Therapeutic exercise is the most common intervention of supervised physiotherapy. For this intervention, the results of our systematic review are consistent with other published reviews, showing that supervised exercises (not including other physical therapy interventions) are not more effective than home exercises in patients with SIS (Hanratty et al., 2012; Kromer et al., 2009; Kuhn, 2009; Michener et al., 2004). Furthermore, one systematic review concluded that supervised and home-based progressive shoulder strengthening and stretching exercises for the rotator cuff and scapular muscles could be effective for the management of SIS of varied duration (Abdulla et al., 2015). In six of the studies included in our systematic review, supervised physiotherapy was based on a program of strengthening exercises of the scapular muscles and/or the rotator cuff (Granviken and Vasseljen, 2015; Holmgren et al., 2012; Senbursa et al., 2011; Vinuesa-Montoya et al., 2017; Walther et al., 2004; Werner et al., 2002). However, there was great variability in the doses, and the use of co-interventions such as stretching exercises (Holmgren et al., 2012; Senbursa et al., 2011; Walther et al., 2004; Werner et al., 2002); cervicothoracic manipulation (Vinuesa-Montoya et al., 2017); and joint and soft tissue mobilization (Senbursa et al., 2011). Therefore, our results should be cautiously interpreted.

The use of the term SIS as a diagnostic label has been a subject of debate, as it has been used for a spectrum of other shoulder and cervical conditions (Braman et al., 2014; Papadonikolakis et al., 2011; Watts, Williams, Kim, Bramwell, & Krishnan, 2017), because the diagnostic labels based on a pathoanatomic model have failed to accurately classify participants into subgroups for clinical decision-making (Cools & Michener, 2017). An important point for consideration is that physiotherapists focus on movement-related impairments rather than structural anatomy (Braman et al., 2014; Ludewig et al., 2013, 2017). Five of the studies included in our

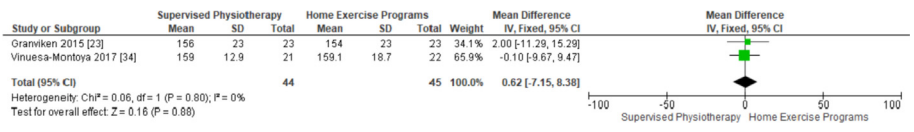

Fig. 6. Forest plot comparison supervised physiotherapy versus home exercises program for the flexion range of motion.

systematic review confirmed their clinical diagnosis with conventional imaging examination (Holmgren et al., 2012; Pekyavas and Ergun, 2017; Senbursa et al., 2011; Walther et al., 2004; Werner et al., 2002). The literature often reports that ultrasound and magnetic resonance imaging are used to confirm a diagnosis of SIS; however, it would be more accurate to state that their primary use is to confirm the exclusion of other pathologies (Watts et al., 2017). Due to insufficient reporting of patients' characteristics regarding classification of impingement (i.e., stage 1 or 2) we were not able to perform separate analysis for the different stages. This would be an important analysis, as each stage needs different intervention targets.

Six studies included in this systematic review assessed the shoulder function, although only three articles showed statistically significant changes in the improvement of function in favor of the group treated with supervised physiotherapy (Holmgren et al., 2012; Senbursa et al., 2011; Vinuesa-Montoya et al., 2017). These results could be explained by the variability of interventions applied: two studies included manual therapy techniques in the exercise program showed significant improvement in short-term shoulder function (Senbursa et al., 2011; Vinuesa-Montoya et al., 2017). However, the mechanism of action is unknown since the type of technique and dose is different in each study. The other study is the only study that used unspecific exercises for neck and shoulder without external load performed in the home group (Holmgren et al., 2012).

All studies included evaluated pain intensity using the VAS, but only one article showed statistically significant changes in the night pain relief in favor of the group treated with supervised physiotherapy (Holmgren et al., 2012). A previous systematic review showed that there is strong evidence that high shoulder pain intensity, concomitant neck pain and a longer duration of symptoms predicts poorer clinical outcomes in patients with shoulder pain (Kooijman et al., 2015). The patients included in our systematic review did not present these factors of poor prognosis. Finally, in contrast with our results a previous meta-analysis showed that protocols using exercises into pain offer a small but significant benefit over pain-free exercises in the short term in adult patients with chronic musculoskeletal pain (Smith et al., 2017).

Regarding active range of motion, no studies found significant differences between supervised physiotherapy and exercises performed at home. These results could be explained by the positive association between baseline range of motion and clinical outcomes (Chester et al., 2013). The patients included in our systematic review had a baseline mean of 148 degrees of anterior shoulder flexion; one study demonstrated that less restriction of range of shoulder flexion was predictive of better functional outcomes (Yang, Chang, Chen, & Lin, 2008). It should also be considered that the natural history the patient with SIS is unclear (Ertan et al., 2015), and the factors that affect the outcomes and the natural course are still unknown (Tangtrakulwanich & Kapkird, 2012). Therefore, it remains unclear whether the pain is completely relieved, motion and function are restored, and finally, full recovery is achieved after this syndrome (Ertan et al., 2015).

To our knowledge, this is the first systematic review to compare the effect of supervised physiotherapy versus home exercise program in subjects with SIS. Based on the PRISMA guidelines, the recommendations of the Cochrane Collaboration Handbook and registering the protocol in PROSPERO, this study used a transparent method of assessing and reporting the evidence.

4.1. Study limitations

The limitations of our study are as follows: (1) although we searched eight databases and included articles in three different languages, we might have missed articles relevant to our search; (2) a high degree of statistical heterogeneity existed among the included studies. Potential sources of heterogeneity could be variations in the type and dose of the interventions occupied, and the outcomes measured; (3) methodological limitations such as lack of adequate sample size, unclear randomization, inadequately concealed allocation, and lack of blinding of the assessors could overestimate the effect size of interventions studied; (4) due to the limited number of included studies, publication bias could not be assessed, (5) in the planning stages, we intended conduct subgroup analyses based on age, gender, and SIS stages, although the results of stratified analysis in the individual trials were not available, and (6) clinical heterogeneity due to the lack of a standardized supervised physiotherapy program and the use of co-interventions make that our findings should be cautiously interpreted.

5. Conclusion

In summary, this systematic review and meta-analysis demonstrates that supervised physiotherapy and home-based progressive shoulder strengthening and stretching exercises for the rotator cuff and scapular muscles are equally effective in patients with SIS treated conservatively. Thus, our study was unable to demonstrate the clinical benefits of direct supervision of a physiotherapist in the early rehabilitation of SIS. Future research should evaluate treatments applied to patients with a more clearly defined diagnosis and stage of SIS, and more standardized physiotherapeutic interventions.

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Ethics

The authors declare they do not have ethics conflicts with regard to the present investigation. The proposed systematic review collects and analyzes secondary data that are associated with individuals. Each included primary study should have been approved by an ethical committee to perform the clinical trial.

Declaration of competing interest

The authors declare they do not have any potential conflict of interest with regard to the investigation, authorship, and/or publication of this article.

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