UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL
ESCOLA DE EDUCAÇÃO FÍSICA, FISIOTERAPIA E DANÇA
CURSO DE FISIOTERAPIA

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AVALIAÇÃO DA FORÇA MUSCULAR DO COMPLEXO DO OMBRO DE PESSOAS COM SÍNDROME DO IMPACTO: UMA REVISÃO SISTEMÁTICA

Porto Alegre
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Assessment of Shoulder Complex Muscle Strength of People with Shoulder Impingement Syndrome: a Systematic Review

Trabalho de Conclusão de Curso apresentado ao curso de Fisioterapia da Escola de Educação Física, Fisioterapia e Dança da Universidade Federal do Rio Grande do Sul, como requisito parcial para a obtenção do título de Bacharel em Fisioterapia.

Orientadora: Prof Dra Cláudia Silveira Lima

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RESUMO

Objetivo: Avaliar força e equilíbrio musculares do complexo do ombro, comparando pessoas com Síndrome do Impacto do Ombro (SIO) e controles, e pessoas com SIO antes e depois de intervenções fisioterapêuticas.
Método: As bases de dados PubMed, Cochrane, Web of Science, Scopus, Embase, Science Direct, Google Schoolar, PEDro e LILACS foram consultadas eletronicamente desde seu início até agosto de 2016. Os critérios de inclusão dos estudos foram desfecho força muscular do ombro e/ou da escápula, amostra de pessoas com SIO na faixa etária entre 18 e 60 anos. A seleção dos estudos, assim como a análise do risco de viés e a extração dos dados foram feitos em duplicata.
Resultados: Dos 900 estudos encontrados, oito foram incluídos na revisão. Três estudos compararam pessoas com SIO e controles. Pessoas com SIO apresentaram diminuição de força na musculatura escapular. Cinco artigos avaliaram pessoas com SIO antes e depois de intervenções fisioterapêuticas como campo eletromagnético pulsado (CEMP), exercício, auto-treinamento e terapia manual. CEMP aumentou a força muscular quando exercícios foram adicionados no *follow up*. Exercícios de alta dose aumentaram mais a força do que aqueles de baixa dose. Exercício supervisionado, auto-treinamento e terapia manual foram igualmente efetivos em aumentar força muscular.
Conclusão: Ao comparar a força muscular de pessoas com e sem SIO, estudos indicam que não há diferença em relação aos músculos do ombro, enquanto há redução de força no serrátil anterior. A respeito de modalidades fisioterapêuticas, o exercício parece ser fator diferencial em programas de reabilitação para aumento da força.

Palavras-chave:
Revisão sistemática, síndrome do impacto do ombro, escápula, força muscular, técnicas fisioterápicas.

ABSTRACT

Purpose: Evaluate strength and muscle balance of the shoulder complex comparing people with Shoulder Impingement Syndrome (SIS) to controls, and people with SIS before and after physiotherapeutic interventions.

Method: PubMed, Cochrane, Web of Science, Scopus, Embase, Science Direct, Google Schoolar, PEDro and LILACS were searched. Inclusion criteria were shoulder or scapular muscle strength assessment, sample with SIS, age range 18-60 years. Study selection, risk of bias analysis, and data extraction were done in duplicate.

Results: Out of 900 studies, eight were included. Three studies compared people with SIS to controls. People with SIS presented decreased strength on scapular muscles. Five articles assessed people with SIS before and after physiotherapy interventions as pulsed electromagnetic field (PEMF), exercise, self-training, and manual therapy. PEMF increased muscle strength when exercises were added during follow up. High dose exercises increased more strength than low dose exercises. Supervised exercise program, self-training and manual therapy equally improved shoulder muscle strength.

Conclusion: Comparing muscle strength of people with and without SIS, studies indicate that there is no difference regarding shoulder muscles, while there is a reduction of strength on serratus anterior. Regarding physiotherapy interventions, exercise seems to be the differential factor on rehabilitation programs to enhance muscle strength.

Keywords: systematic review, impingement syndrome, scapula, muscle strength, physical therapy modalities.

SUMÁRIO

APRESENTAÇÃO

Ao longo dos anos no curso de Fisioterapia, um dos campos que mais me interessou foi a traumato-ortopedia. Assim, me engajei em atividades relacionadas ao tema disponíveis na universidade. Participei de projeto de extensão de traumato-ortopedia em ambiente hospitar coordenado pela Professora Clarice Rocha, exerci função de monitora das disciplinas de Cinesiologia e Cinesioterapia, e aderi ao Grupo de Pesquisa em Cinesiologia e Cinesioterapia (GPCINE), sendo os dois últimos coordenados pela Professora Cláudia Lima. No GPCINE, minha colega Denise Rigoni e eu tivemos a oportunidade de elaborar e executar nossa própria pesquisa, do princípio ao fim. Com esta "bagagem", surgiu a intenção de realizar meu trabalho de conclusão de curso na área, sob orientação da Prof Cláudia.

Após conversa sobre algumas possibilidades de pesquisa, decidimos juntas pelo tema de força muscular em pessoas com Síndrome do Impacto do Ombro. A ideia inicial tratava-se de um estudo experimental, cujo objetivo seria avaliar características neuromusculares desta população. Elaborei um projeto de pesquisa, o qual foi submetido e aprovado pelo Comitê de Ética da UFRGS. Nesta etapa, porém, tivemos de mudar os planos, pois eu estava prestes a embarcar para a Irlanda, onde moraria e estudaria durante um ano, vinculada ao programa Ciência Sem Fronteiras (CSF). Após meu retorno, eu teria somente seis meses para concluir o TCC, período considerado insuficiente para a execução do citado projeto. Desta forma, quando voltei, optamos por transformar o trabalho em uma revisão sistemática.

O presente estudo consiste em uma revisão sistemática sobre força muscular em pessoas com Síndrome do Impacto do Ombro, abrangendo estudos que compararam pessoas com SIO a controles e estudos que compararam pré e pós intervenções fisioterapêuticas em pessoas com SIO.

Temos como intenção publicar esta revisão sistemática na revista *Disability and Rehabilitation*, qualis A2, fator de impacto 1,985. Assim, o artigo resultante deste trabalho está apresentado nas normas exigidas pela revista, as quais seguem anexas ao final deste documento.

Assessment of Shoulder Complex Muscle Strength of People with Shoulder Impingement Syndrome: a Systematic Review

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Conclusion: Comparing muscle strength of people with and without SIS, studies indicate that there is no difference regarding shoulder muscles, while there is a reduction of strength on serratus anterior. Regarding physiotherapy interventions, exercise seems to be the differential factor on rehabilitation programs to enhance muscle strength.

Keywords: systematic review, impingement syndrome, scapula, muscle strength, physical therapy modalities.

Introduction

The shoulder joint complex can be injured by different pathologies, and Shoulder Impingement Syndrome (SIS) is the most common of them. It may range from simple inflammation until vast degeneration of local structures. Disabilities and loss of function are large implications of SIS

[1,2].

The development of SIS is closely related to biomechanical dysfunction of the shoulder complex. This disorder is yet exacerbated by the repetition of overhead movements. During arm elevation, soft tissue situated between the humeral head and the acromion suffer abrasion, which leads to symptoms of inflammation, irritation of long head of biceps tendon, subacromial bursitis, and even tear of rotator cuff muscle tendons (supraspinatus, infraspinatus, teres minor and subscapularis) [3].

Patients with SIS may present muscle imbalance both on shoulder and scapular muscles. Evidence shows that these patients frequently present less activation of serratus anterior and greater activation of trapezius (upper and lower portions) [4]. Besides, overhead sports athletes present lower peak torque of scapular abductors of the affected shoulder when compared to the contralateral shoulder and to healthy subjects [5]. CHESTER *et al.* [6], on a review, suggest the possibility of a difference on activation and recruitment of upper and lower trapezius in people with SIS and controls. These findings indicate the relation of SIS with the dysfunction of scapular muscles, especially on acromioclavicular and scapulothoracic joints.

Regarding the musculature directly related to the shoulder, current evidence shows that people with SIS present strength deficit on external and internal rotators on the impaired shoulder, in addition to imbalance of these muscle groups [7]. On studies that analyzed abduction and adduction of the shoulder, by the action of deltoid and latissimus dorsi, respectively, the results show that there is no significant difference of muscle strength or activation in patients with SIS and controls [8;9].

Different physiotherapy strategies can be used to treat patients with SIS, such as physical modalities, muscle strengthening, stretching, joint mobilizations, patient education, function

training [10]. The treatment can be more effective when the information of the muscle alterations in this patients establish a base for the prescription of exercises.

According to the study by Kuhn [11], exercises improve pain levels and function, but have no effect on range of motion and strength of patients with SIS. Two systematic reviews [10,12] strongly indicate the implementation of strength exercises for rotator cuff and scapular muscles, as well as stretching, with the intention of improving pain and quality of life of people with SIS. Further, they claim that exercises seem more effective when combined with joint mobilization techniques.

Getting familiarized with the muscle imbalances of people with SIS, as well as knowing the effects of physiotherapy programs on shoulder complex strength, is essential for planning the rehabilitation program for this population. No systematic review was found in the literature, whose main objective was to gather information about muscle strength of shoulder complex muscles.

Thus, the present study is justified by proposing a systematic review about the muscle characteristics of the shoulder complex of people with Shoulder Impingement Syndrome. So the objectives of this study are to evaluate the strength and/or the muscle balance related to the shoulder complex comparing 1) people with SIS to controls, and 2) people with SIS before and after physiotherapeutic interventions.

Methods

Literature search/search strategy

The following databases were searched electronically: Pubmed, Cochrane, Web of Science, Scopus, Embase, Science Direct, Google Schoolar, Physiotherapy Evidence Database (PEDro),

and Centro Latino-Americano e do Caribe de Informação em Ciências da Saúde (LILACS). The search was performed in August 2016 and included studies from inception to this date.

The search consisted of the following terms (along with their corresponding MeSH - Medical Subject Headings): “Shoulder Impingement Syndrome”, “Muscle strength”, and “Torque”, combined with a high sensitivity combination of words used in the search for randomized clinical trials (RCT) [13]. The Boolean terms AND, and OR were used for the combination between the key words. Included articles were in English, Spanish and Portuguese. The complete search strategy used for Pubmed database is shown in table 1.

(insert table 1 here)

Outcome measures

The focus of this review lies on outcome measures for muscle strength.

Eligibility Criteria

We included RCT that assessed shoulder or scapular muscle strength of people with shoulder impingement syndrome (SIS). Participants were both male and females, aged between 18 and 60 years, which comprises the age range of young and intermediate-age adults [14,15]. The exclusion criterion used was samples formed by athletes.

Studies Selection and data extraction

Titles and abstracts of all articles identified by the search strategy were independently evaluated by two investigators, in duplicate. Abstracts that did not provide sufficient information regarding the inclusion and exclusion criteria were selected for full-text evaluation.

The next step was to independently evaluate the full-text articles, and select the ones to be included in the systematic review in accordance with the eligibility criteria. Disagreements

between reviewers were solved by consensus or through a third person review. By means of standardized forms, the same two reviewers independently conducted data extraction with regard to the methodological characteristics of the studies - population, sample size, age, interventions, outcomes, assessment protocol, and results. Disagreements were also solved by consensus.

Quality Assessment

The same two reviewers independently performed quality assessment. Study quality assessment included adequate sequence generation, allocation concealment, blinding of participants, blinding of outcome assessors, description of losses and exclusions, and use of intention-to-treat analysis. Use of intention-to-treat was fulfilled when the number of randomized participants and the analyzed number were identical. When there was a lack of clear description of these characteristics, the studies were considered as unclear or not reporting the latter.

Results

Description of studies

The initial search resulted in 900 studies, among which 48 were considered as potentially appropriate and were retrieved for detailed analysis. Eight of these studies met the eligibility criteria and were thus included in the systematic review (n = 348). Due to methodological differences amongst studies, meta-analysis was not possible. Figure 1 shows the flow diagram of the studies included in this review.

Studies Characteristics

The included studies were published between 2007 and 2014. The sample sizes ranged from 18 to 77 participants, whose age ranged from 18 to 60 years old. The means of symptoms duration

described by participants ranged from 1.5 months to 3.6 years. Specific characteristics of each study (authors, population, sample size, age, outcomes of interest, outcomes measures, intervention, results) are shown in Table 2.

(insert table 2 here)

Risk of Bias

In relation to the total of studies included in this systematic review, 50% had an adequate sequence generation, all of which reported allocation concealment; 25% presented blinding of participants; 25% had blinded assessment of outcomes; 37.5% described losses to follow-up and exclusions; and 37.5% of the studies used the intention-to-treat principle for statistical analyses (Table 3).

(insert table 3 here)

Shoulder Impingement Syndrome versus Control

Among the eight studies included in this systematic review, three have compared people presenting SIS to healthy controls [9,16,17]. Two studies [16,17] found no difference in muscle strength between the two populations, while one study [9] found that people with SIS have decreased strength in comparison with controls.

Bandholm *et al.* [16] used an isokinetic dynamometer to assess shoulder maximal isometric contractions for abduction / adduction (at 45° and 90° of shoulder abduction) and manual resistance to assess external / internal rotations (at 45° of shoulder abduction). They also assessed handgrip strength and equally found no significant difference between groups. Moraes, Faria and Salmela [17] used an isokinetic dynamometer to assess concentric and eccentric contractions for external / internal rotations. The evaluation was done in supine position with 90° of shoulder abduction and elbow flexion.

According to Celik, Sirmen and Demirhan [9] maximal isometric voluntary contraction of upper, middle, lower trapezius, anterior deltoid, serratus anterior, supraspinatus, and latissimus dorsi muscles were assessed using a handheld dynamometer. Significant decrease in muscle strength was only found for middle trapezius, serratus anterior, supraspinatus, and anterior deltoid.

Effects of interventions

Among the eight studies included in this systematic review, five have assessed the effects of interventions on people with SIS. The treatments included pulsed electromagnetic field (PEMF), exercise (high and low doses), self-training, and manual therapy.

On one study, PEMF alone did not produce significant increase in muscle strength, although it did show improvements in pain and function [18]. On a second study, PEMF was only effective to increase muscle strength when exercises were added during follow up [19]. Both studies assessed maximal isometric contractions with a manual dynamometer. Internal and external rotators strength was assessed at scapular plane with the elbow flexed at 90°; and abductor muscles were assessed at 45° of shoulder abduction, 30° of horizontal adduction, and extended elbow.

Osteras *et al.* [20] has shown that high dose exercises were capable of increasing more strength than low dose exercises. Maximal isometric contractions were measured with a manual dynamometer, with regards to abduction (30° abduction), flexion (neutral position), internal and external rotations of the shoulder (neutral shoulder position, 90° of elbow flexion).

Senbursa, Baltaci and Atay [21] compared a supervised exercise program alone (G1) to a supervised exercise program combined with joint and soft tissue mobilization (G2), or a home-

based rehabilitation program (G3), and found significant improve in shoulder muscle strength at all treatments. There was no statistic difference among the three groups.

One study [22] compared conservative treatment with and without manual therapy. Although people were assessed by manual muscle testing for flexion, abduction, internal and external rotations, the results for muscle strength were not clear. The authors do not expose the results for this test, but they present increased muscle strength as a conclusion of the study,

Discussion

This systematic review summarized the muscle characteristics of people with SIS (compared to healthy controls), and the effectiveness of different interventions on the shoulder muscle strength of this population.

Celik, Sirmen and Demirhan [9] suggest that people with SIS may present significant decrease in muscle strength of middle trapezius, serratus anterior, supraspinatus, and anterior deltoid. The way of assessment used in their study may be questioned, given that it only allows conclusions about a muscle group, instead of specific impaired muscles. However, this information can be related to the study by Ludewig and Cook [4], who assessed individuals with and without SIS during arm elevation on the scapular plane, using electromyography. They also found alteration in serratus anterior, by decreased electromyography activation on people with SIS in comparison to asymptomatic people. When assessing the 3D position and orientation of the scapula, SIS people also presented reduction in scapular upward rotation at 60° of shoulder abduction, which is one of the functions of serratus anterior muscle. Hence, it is essential to include the training of scapular muscles on the rehabilitation of people with SIS.

Nonetheless, the specific shoulder musculature seems not to present alteration in strength. Neither the studies by Bandholm *et al.* [16] nor Moraes, Faria and Salmela [17] could show any

difference in muscle strength between people with SIS and controls. This fact is aligned with the study by Politti *et al.* [8], which analyzed shoulder abductors muscle strength, as well as muscle activation of the three parts of deltoid muscle (through electromyography) and found no difference between people with SIS and controls. This information is reinforced by Chester *et al*. [6]'s review, which mentions three studies that assessed electromyography of supraspinatus and found no significant difference between people with and without SIS.

On the literature, Fonseca, Albuquerque and Bertolini [7] is the only study found by the authors that shows the result of decreased strength of rotator muscles when compared to the contralateral shoulder without SIS. This incongruence might be explained by methodological differences among the studies regarding the way of measuring strength.

With regards to the different physiotherapy strategies on SIS and their effects on muscle strength, pulsed electromagnetic field (PEMF) was one of the therapies tested for the treatment of SIS. According to MARKOV [23], this therapeutic modality may alter the cascade of biological processes related to tissue growth and repair, since it possibly affects ion binding and/or transport. However, on the study by Freitas *et al*. [18], people with SIS did not benefit from PEMF isolated regarding muscle strength. On the other hand, people with SIS treated with active PEMF for 3 weeks associated with an additional 6-week exercise program had significant improvements on muscle strength, as well as function and pain relief [19].

The study by Osteras *et al*. [20] adds to the cited PEMF studies by demonstrating that the use of exercises on rehabilitation of patients with SIS enhances muscle strength. authors have shown that 12 weeks of high dose exercises (HD) were capable of increasing more strength than low dose exercises (LD), still both groups presented increase of the muscle strength.

On the same way, the study by Senbursa, Baltaci and Atay [21] indicates the importance of exercise on the recovery of strength. The study compared a supervised exercise program alone (G1) to a supervised exercise program combined with joint and soft tissue mobilization (G2), and to a home-based rehabilitation program (G3). The research found significant improve in shoulder muscle strength at all three treatments, but no statistic difference was seen among the groups.

The systematic review by Kuhn [11] strongly suggests exercise as a means of improving symptoms in patients with impingement syndrome, which can reduce pain levels and enhance function. The author reinforces that there is no significant improvement of muscle strength with exercise alone, which goes against the results of the present study. The author brings only three studies with results for strength outcome, and both of them use a non-specific instrument (Constant Murley Score). Althought it does bring a domain regarding strength, the final punctuation of the instrument refers to functionality. On the other hand, the present study reviews studies that used specific strength assessment instruments (dynamometer, manual muscle test).

Conclusion

When comparing muscle strength of people with and without Shoulder Impingement Syndrome, studies indicate that there is no difference regarding shoulder muscles, and there is a reduction of strength on serratus anterior muscle. After assessing physiotherapy interventions on people with SIS, exercise seems to be the differential factor on rehabilitation programs in order to enhance muscle strength.

In the present study, there are no conflicts of interest. It was conducted by the authors' own fundings.

Word count: 2707

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Tables

Table 1. Complete search strategy used for Pubmed database

#1	(randomized controlled trial[pt] OR controlled clinical trial[pt] OR randomized controlled trials[mh] OR random allocation[mh] OR double-blind method[mh] OR single-blind method[mh] OR clinical trial[pt] OR clinical trials[mh] OR ("clinical trial"[tw]) OR ((singl*[tw] OR doubl*[tw] OR trebl*[tw] OR tripl*[tw]) AND (mask*[tw] OR blind*[tw])) OR ("latin square"[tw]) OR placebos[mh] OR placebo*[tw] OR random*[tw] OR research design[mh:noexp] OR follow-up studies[mh] OR prospective studies[mh] OR cross-over studies[mh] OR control*[tw] OR prospectiv*[tw] OR volunteer*[tw]) NOT (animal[mh] NOT human[mh])
#2	"Shoulder Impingement Syndrome" [Mesh] OR "Impingement Syndrome, Shoulder" OR "Impingement Syndromes, Shoulder" OR "Shoulder Impingement Syndromes" OR "Syndrome, Shoulder Impingement" OR "Syndromes, Shoulder Impingement" OR "Subacromial Impingement Syndrome" OR "Impingement Syndrome, Subacromial" OR "Impingement Syndromes, Subacromial" OR "Subacromial Impingement Syndromes" OR "Syndrome, Subacromial Impingement" OR "Syndromes, Subacromial Impingement"
#3	"Muscle strength" [Mesh] OR "Strength, Muscle" OR "Torque" [Mesh] OR "Torques"
#4	#1 AND #2 AND #3

Table 2. Characteristics of studies

Authors (year)	**Population**	**Sample size (n)**	**Age (years)**	**Outcomes of interest**	**Outcomes measures**	**Intervention**	**Results**
Bandholm *et al*., 2006	SIS and healthy control subjects	18 SIS: 9 Control: 9	21–38 SIS: 28.2 +-5.3 Control (CG): 27.7 +-4.2	Pain Muscle activity Shoulder sensory motor control Muscle strength	VAS EMG isokinetic dynamometer manual resistance handheld dynamometer	---	Pain: SIS > CG Muscle activity: - isometric: SIS=CG - isokinetic: SIS>CG Shoulder sensory motor control: - isometric: SIS = CG - isokinetic: eccentric SIS=CG; concentric SIS<CG

							Muscle strength: - shoulder: SIS=CG - handgrip: SIS=CG.
Celik, Sirmen and Demirhan, 2011	SIS (SIS shoulder compared to healthy shoulder)	40 SIS shoulder: 20 Healthy shoulder: 20	32-60 48.15± 5.9	Pain Function Muscle strength	VAS Constant score Handheld dynamometer	---	Pain: Not informed Function: Not informed Muscle strength: SIS<healthy
Freitas *et al*., 2013	SIS	56 PEMF 26 Placebo: 30	40-59 (PEMF mean 50.77) (Placebo mean 50.15)	Pain Function Muscle strength	VAS Constant-Murley scale and UCLA manual dynamometer	PEMF and Placebo: 9 sessions, 30 min duration, 3x/wk, 48-hour interval.	Pain: PEMF<placebo Function: PEMF>placebo Muscle strength: PEMF=placebo
Freitas *et al.*, 2014	SIS	46 PEMF: 22 Placebo: 24	40-60 PEMF (50.1 +- 8.2) Placebo PEMF (50.8 +- 9.6)	Pain Function Muscle strength	VAS Constant-Murley scale and UCLA Handheld dynamometer	PEMF and placebo: 9 sessions, 30 min duration, 3x/wk for 3 weeks. After 3 weeks, all subjects: therapeutic exercise program, 2x/wk, for 6 weeks.	Pain: PEMF<placebo Function: PEMF>placebo Muscle strength: PEMF>placebo
Moraes, Faria and Salmela, 2008	SIS and healthy control subjects (CG)	20	20-38 SIS: 28.6 +- 5.89 CG: 29.0 +- 5.35	recruitment patterns and latencies muscle strength	EMG isokinetic dynamometer	---	recruitment patterns: SIS=control latencies: SIS>control muscle strength: SIS=control
Osteras *et*	SIS	61	18-60	Pain	VAS	3x/wk,	Pain: HD<LD

al., 2009		High dose exercise program (HD): 31 Low dose exercise program (LD): 30	HD: 46.1 +- 11.2 LD: 41.8 +- 14.5	Function Muscle strength	functional assessment questionnaire digital dynamometer	12weeks (total 36 sessions) HD: 11 exercises, 3x30 repetitions LD: 6 exercises, 2x10 repetitions.	Function: HD>LD Muscle strength: HD>LD
Senbursa, Baltaci and Atay, 2007	SIS	30 G1 (self-training): 15 G2 (manual therapy): 15	30-55 G1: 49.5 ± 7.9 G2: 48.1 ± 7.5	Pain ROM Function Muscle strength Trigger point tenderness	VAS Goniometer Functional assessment questionnaire Manual muscle test Algometry	G1: 7x/wk, 4 weeks. G2: 3x/wk, 4 weeks.	Pain: G2<G1 ROM: G2>G1 Function: G2>G1 Muscle strength: Not informed Trigger point tenderness: Not informed
Senbursa, Baltaci and Atay, 2011	Partial supraspinatus tear and/or SIS	77 G1 (exercise): 25 G2 (exercise + manual therapy): 30 G3 (self-training): 22	33- 55 G1: 48.2±7.9 G2: 50.5±10.6 G3: 48.0±9.0	Pain (Night pain, rest pain and pain with movement) ROM Muscle strength Function	VAS Goniometer Manual muscle test (0-5) Modified American Shoulder and Elbow Surgeon's (MASES) questionnaire	G1: glenohumeral and scapulothoracic exercises 3x/wk, 12 weeks G2: joint and soft tissue mobilization exercises 3x/wk + exercises of G1, 12 weeks G3: self-exercise program at home, 12 weeks.	Pain: G1=G2=G3 ROM: G1=G2=G3 Muscle strength: G1=G2=G3 Function: G2>G1=G3

SIS – Shoulder Impingement Syndrome; VAS – Visual Analogue Scale; EMG – Electromiography; PEMF – Pulsed Electromagnetic Field; UCLA - University of California at Los Angeles Shoulder Score; ROM – Range of Motion.

Table 3. Risk of Bias

Authors, year	**Generation of Random Sequence**	**Allocation concealment**	**Blinding of participants**	**Blinding of outcome assessors**	**Description of losses and exclusions**	**Incomplete outcome data**
Bandholm *et al*., 2006	No	No	No	No	No	No
Celik, Sirmen and Demirhan, 2011	No	No	No	No	No	No
Freitas *et al*., 2013	Yes	Yes	Yes	Yes	Yes	Yes
Freitas *et al.*, 2014	Yes	Yes	Yes	Yes	Yes	Yes
Moraes, Faria and Salmela, 2008	No	No	No	No	No	No
Osteras *et al.*, 2009	Yes	Yes	NC	No	Yes	Yes
Senbursa, Baltaci and Atay, 2007	NI	NI	NI	NI	NI	NI
Senbursa, Baltaci and Atay, 2011	Yes	Yes	NC	NC	NI	NI

NI – not informed
NC – not clear

Figures

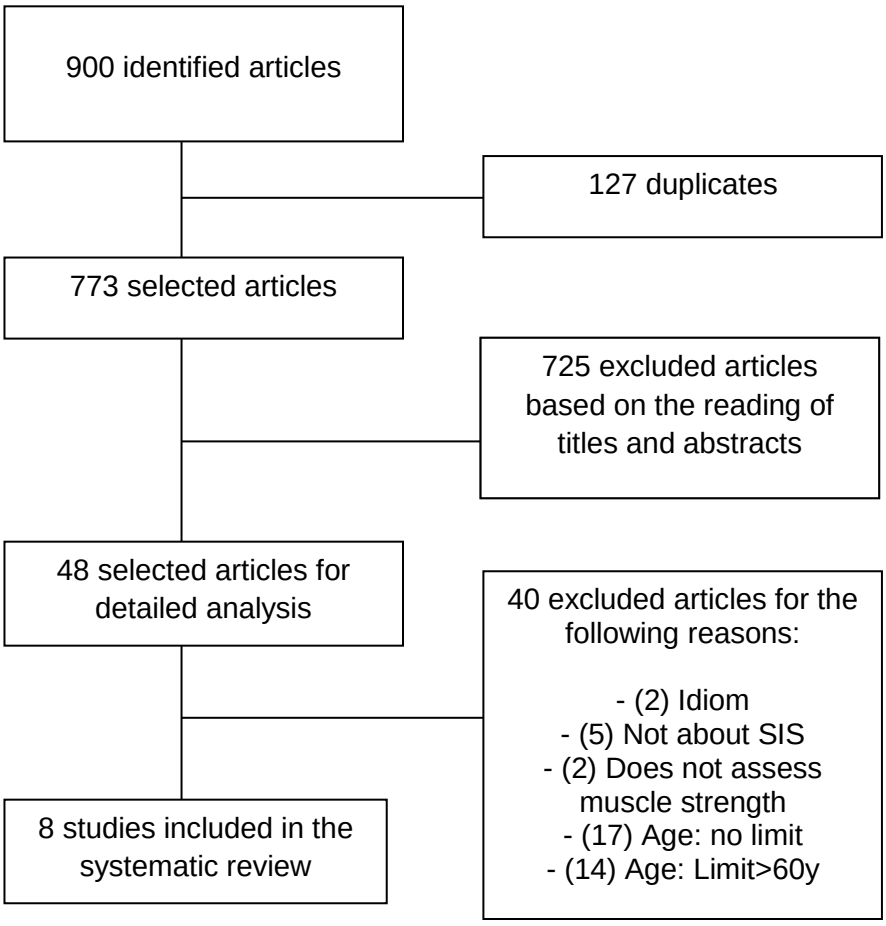

Figure 1. Flow diagram of the studies included in the review

- Implications for rehabilitation

- Muscle balance is important for appropriate functioning of the shoulder complex, so it is crucial to acknowledge muscle characteristics of people with SIS in order to plan their rehabilitation program.

- The treatment of people with SIS should comprise strengthening exercises, especially for serratus anterior muscle.

ANEXO I - NORMAS PARA PUBLICAÇÃO REVISTA DISABILITY AND REHABILITATION

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   - Leprosy is a disabling disease which not only impacts physically but restricts quality of life often through stigmatisation.
   - Reconstructive surgery is a technique available to this group.
   - In a relatively small sample this study shows participation and social functioning improved after surgery.

   Example 2: Multiple Sclerosis

   - Exercise is an effective means of improving health and well-being experienced by people with multiple sclerosis (MS).
   - People with MS have complex reasons for choosing to exercise or not.
   - Individual structured programmes are most likely to be successful in encouraging exercise in this cohort.
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