Journal of Hand Therapy xxx (2017) 1–10

Contents lists available at ScienceDirect

Journal of Hand Therapy

journal homepage: www.jhandtherapy.org

Scientific/Clinical Article

Pain, motion and function comparison of two exercise protocols for the rotator cuff and scapular stabilizers in patients with subacromial syndrome

Eva Vallés-Carrascosa PT [a], Tomás Gallego-Izquierdo PT, PhD [a], José Jesús Jiménez-Rejano PT, PhD [b], Gustavo Plaza-Manzano PT, PhD [c], Daniel Pecos-Martín PT, PhD [a], Fidel Hita-Contreras MD, PhD [d], Alexander Achalandabaso Ochoa PT, PhD [d,*]

[a] Department of Physical Therapy and Nursing, Universidad de Alcalá de Henares, Spain
[b] Faculty of Physical Therapy, Nursing and Podiatry, Universidad de Sevilla, Spain
[c] Department of Physical Medicine and Rehabilitation, Universidad Complutense de Madrid, Spain
[d] Department of Health Sciences, Universidad de Jaén, Spain

ARTICLE INFO

Article history:
Received 4 August 2017
Received in revised form
23 October 2017
Accepted 27 November 2017
Available online xxx

Keywords:
Eccentric exercise
Shoulder impingement
Pain management
Function management

ABSTRACT

Study Design: Randomized clinical trial.
Introduction: Eccentric exercise (EE) was shown to be an effective treatment in tendinopathies. However, the evidence of its effectiveness in subacromial syndrome (SS) is scarce. Moreover, consensus has not been reached on whether best results for SS are obtained by means of EE with or without pain.
Purpose of the Study: The purpose of this is to compare the effect on pain, active range of motion (AROM), and shoulder function of an exercise protocol performed with pain <40 mm Visual Analog Scale (VAS) and without pain, in patients with SS.
Methods: Twenty-two subjects (mean age: 59 years [Q1 = 48.50-Q3 = 70], 54.5% women) were randomized into a not-painful EE group (NPEE; G0: $n = 11$) and a painful EE group (PEE; G1: $n = 11$). The intervention lasted 4 weeks. Pain was recorded using VAS; AROM was measured using a goniometer; and shoulder function using the modified Constant-Murley Score (CMS) before and after intervention.
Results: All dependent variables improved significantly in both groups ($P < .05$): NPEE VAS median: pretest = 55.0 posttest = 28.0; CMS median: pretest = 36.0 posttest = 65.0. PEE VAS median: pretest = 37.0 posttest = 12.0; CMS median: pretest = 35.0 posttest = 59.0. The comparison between groups showed no significant differences, with small effect size values (VAS = 0.09; CMS = 0.21; AROM = 0.12-0.43).
Discussion: In contrast to the previous findings, our results suggest that PEE do not add benefit in SS patients compared to NPEE.
Conclusion: Our results suggest that both interventions are effective in terms of pain, function, and shoulder AROM. Furthermore, PEE does not provide greater benefits. Further studies are needed with long-term follow-up to reinforce these results.

Introduction

Shoulder pain, with a prevalence of 47%,[1-3] is the third most common cause for seeking medical care in musculoskeletal disorders.[2] It represents a considerable impact on health, being recurrent and having low recovery rates.[4] Subacromial syndrome (SS), which comprised impingement of rotator cuff tendons, bursa, or ligaments alterations in the subacromial space and responsible for 45%-65% of cases of shoulder pain,[1,5-7] has an incidence of about 2.8% in subjects aged over 30 years and 15% in subjects over 70 years.[2] Symptoms

The study protocol was approved by the Comisión de Investigación y Ensayos Clínicos del Hospital de Manises (Spain), by the Human Research Committee of the Hospital La Fe (Spain) and by the Human Research Committee of the Universidad de Alcalá (Spain), and registered in Australian New Zealand Clinical Trials Registry (ACTRN12616000196448). The authors certify that they have no affiliations with or financial involvement in any organization or entity with a direct financial interest in the subject matter or materials discussed in the article.

Conflict of interest: All named authors hereby declare that they have no conflicts of interest to disclose.
Clinical trial registration number: ACTRN12616000196448.

* Corresponding author. Department of Health Sciences (b-3/010), University of Jaén, Campus Las Lagunillas s/n, 23071 Jaén, Spain. Tel.: +34 670 596145; fax: +34 953 211875.
E-mail address: aaochoa@ujaen.es (A. Achalandabaso Ochoa).

0894-1130/$ – see front matter © 2017 Published by Elsevier Inc. on behalf of Hanley & Belfus, an imprint of Elsevier Inc.
https://doi.org/10.1016/j.jht.2017.11.041

Table 1
Exercise protocol

Instructions	Rotator cuff exercise		Scapular stabilization exercise		
	EE of supraspinatus (Fig. 1)	ER and IR exercise (Figs. 2 and 3)	Dynamic Hug exercise (Fig. 4)	Inferior Glide exercise (Fig. 5)	UT stretch (Fig. 6)
Material	Weights	Elastic band and rolled-up towel	Elastic band	A firm supportive surface	
Starting position	Upright sitting position. UL in "full-can" position (Reinold et al., 2007), in the plane of the scapula and ER of the GH joint to prevent compression of the greater tubercle against the subacromial surface (Ronai, 2005); GH joint abducted 45° (not starting at 90° to avoid impingement exacerbation) and complete elbow E.[43-46]	Standing with the towel between the UL and trunk (to decrease the activity of the deltoid, the supraspinatus tendon strain, and pain), and 90° elbow F.[46]	Standing position with the spine against the wall, knees slightly bent, and feet at shoulder width. Starting at 45° elbow F, 60° ABD, and 45° GH IR.	Upright sitting position with the arm abducted to 45° (in scapular plane) with fist clenched on a firm supportive surface.	Sitting with a neutral cervical position.
Implementation	Slowly take UL to ADD. To make the exercise eccentric, go back to starting position with a pulley system, from which the contralateral UL will pull a rope to raise the ipsilateral UL.[30]	Perform ER of GH (maximum 45°) and back to the starting position. Upon completion of the corresponding sets, the same exercise is carried out toward the IR of the shoulder (maximum 45°). In both exercises, there is an eccentric phase and concentric phase.[42,43,47]	Horizontal F of GH drawing an arc with the hands (hugging action). When the hands come into contact with each other (maximum scapular protraction), slowly return to the starting position.[48-50]	Applying pressure with the fist in the direction of arm adduction and inferiorly depress the scapula and maintaining the position for 5 s.[51]	Perform lateral cervical bending until feeling a stretching (not painful). Ditto with left cervical bending.
Parameters	Sets: 3 Reps: 10	Both Sets: 3 Reps: 10	Sets: 3 Reps: 10	Sets: 3 Reps: 10 Each contraction is held for 5 s.	Reps: 3 Each stretch is held for 30 s.

UT = upper trapezius; EE = eccentric exercise; ER = external rotation; IR = internal rotation; UL = upper limb; GH = glenohumeral; ABD = abduction; ADD = adduction.

and dysfunction occur mostly in lifting positions and movements of the upper limb (UL), which can affect the quality of life and socio-economic aspects,[8] with frequent medical sick leave.[2,9,10]

There are electromyographic studies that evidence changes in range of motion and muscular synchrony deficits in patients with SS, which would justify an exercise protocol in its therapeutic approach[11,12]: decreased muscle activity of the middle and lower portion of the serratus anterior and rotator cuff, delayed activation of the middle and lower trapezius, and excess activation of the upper trapezius and middle deltoid; and in many cases, the shortening of the pectoralis minor.[8,11,13-15] Several studies report that conservative treatment is generally recommended as a first option for SS, physical exercise being the most used.[1,12,13,16,17] This helps to improve the clinical symptoms of most patients, and there are no statistically significant differences between the effectiveness of conservative and surgical treatments (the latter involving a greater risk and cost) in the long term.[7,18-20] Exercise is intended to improve the pain, strength,[9] and neuromuscular control and to restore the articular pain-free ROM; even in certain cases of complete rotator cuff tear (although the tear is not solved without surgery), shoulder function could be restored.[2,21] Holmgren et al.[22] argue that the combination of exercises to strengthen the rotator cuff and scapular stabilization optimizes rehabilitation and minimizes the risk of injury and is recommended over placebo treatment and no treatment.[19] As for the type of exercise, in the last decade, eccentric exercise (EE) is being studied as an effective treatment option in achilles and patellar tendinopathies.[5,6,22-25] Although similar histological changes have been found in rotator cuff tendinopathy, there is less evidence on the effectiveness in SS.[5]

Certain studies have questioned the effectiveness of EE in insertional tendinopathy.[26] Frizziero et al.[24] reflected how EE in achilles tendinopathy appeared to be effective when the affected portion of the tendon was the midportion, rather than the insertional portion. For SS, since it is most often associated with insertional tendinopathy of the supraspinatus, the possibility of this promoting differing results has been assessed.[5,24] However, certain studies support the influence of other factors such as an unsuitable combination between the load profile and range of motion when loading[24] or a misdiagnosis of subjects, due to the complexity thereof.[2,10,27,28]

While certain studies find no significant differences between EE and concentric exercise in SS,[29] several studies support the EE application[5,6,24,30] and occasionally have shown that surgery can be avoided.[5]

Regarding the implementation of EE, there is no evidence on the role of pain during exercise. Although a relationship between pain during exercise and beneficial results has been sought,[5] it is currently unknown whether this relationship exists or not.[5,24] This statement is supported by the lack of consensus on the differing results when performing the exercises with or without pain in cases such as achilles and patellar tendinopathies and SS. Moreover, the few studies on EE in SS are subject to limitations such as the lack of a control group, which makes it difficult to extrapolate the results to the population.[5,6,30]

Factors such as the heterogeneity of interventions, no protocol description,[1,5,9,10,13] scarcity of and lack of consensus on pain studies, and EE in SS in both the scientific literature and clinical practice promoted the implementation of this work. The main objective is to determine whether there are differences in terms of pain and shoulder active range of motion (AROM), following the implementation of an EE program with and without pain in patients with SS. The secondary objective is to determine whether there are differences in shoulder function between the 2 groups