



Original article

Effects of a movement training oriented rehabilitation program on symptoms, functional limitations and acromiohumeral distance in individuals with subacromial pain syndrome



Alexandre Savoie ^a, Catherine Mercier ^{a, b}, François Desmeules ^{c, d}, Pierre Frémont ^{b, e}, Jean-Sébastien Roy ^{a, b, *}

^a Centre for Interdisciplinary Research in Rehabilitation and Social Integration, Quebec City, Quebec, Canada G1M 2S8

^b Department of Rehabilitation, Faculty of Medicine, Université Laval, Quebec City, Quebec, Canada G1R 1P5

^c Orthopaedic Clinical Research Unit, Maisonneuve-Rosemont Hospital Research Center, University of Montreal Affiliated Research Center, Montreal, Quebec, Canada

^d School of Rehabilitation, Faculty of Medicine, Université de Montréal, Montréal, Quebec, Canada

^e Centre de recherche du Centre Hospitalier Universitaire de Québec, Quebec City, Quebec, Canada

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ABSTRACT

Background: Multiple factors have been associated with the presence of a subacromial pain syndrome (SPS), including deficits in performance of scapular and glenohumeral muscles. Such deficits can lead to inadequate kinematics and decreased acromiohumeral distance (AHD). Exercises that aim at correcting these deficits, such as movement training, were suggested to improve symptoms and functional limitations. To date, few studies have assessed outcomes following an intervention focused on movement training.

Objectives: Evaluate the effects of a rehabilitation program based on movement training on symptoms, functional limitations and AHD in individuals with SPS.

Design: Prospective single group pre-post design.

Methods: Twenty-five participants with SPS (SPS group) participated in a 6-week program. Twenty asymptomatic volunteers were recruited for normative AHD values (control group). Outcomes of both groups were evaluated at baseline and 6 weeks, i.e. immediately following intervention for the SPS group. Changes in symptoms and functional limitations for SPS group were assessed using the Western Ontario Rotator Cuff (WORC) index and Disability of the Arm Shoulder and Hand (DASH) questionnaire. Changes in AHD for both groups were assessed using ultrasonographic measures.

Results: Following the rehabilitation program, the scores on WORC and DASH were significantly improved ($p < 0.001$). AHD increased significantly in the SPS group ($p = 0.019$), especially in a subgroup with initial deficits ($p < 0.001$).

Conclusion: The rehabilitation program yielded improvements in symptoms and functional limitations in participants with SPS. Moreover, it led to an increase of the AHD – thus potentially decreasing subacromial compression, particularly in participants with an initially smaller AHD.

The trial was registered at ClinicalTrials.gov: identifier – NCT02395770.

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1. Introduction

Subacromial pain syndrome (SPS) is frequently termed impingement syndrome based on the underlying mechanisms, which include encroachment of the subacromial space soft tissues underneath the coracoacromial arch as the arm is elevated (Bigliani and Levine, 1997). It is hypothesized that decreased or delayed activation of scapulohumeral and scapulothoracic muscles could

* Corresponding author. Centre interdisciplinaire de recherche en réadaptation et en intégration sociale (CIRRS), 525, boulevard Wilfrid-Hamel, local H-1710, Québec, QC G1M 2S8, Canada. Tel.: +1 418 529 9141x6005; fax: +1 418 529 3548.

E-mail addresses: alexandre.savoie@fmed.ulaval.ca (A. Savoie), catherine.mercier@rea.ulaval.ca (C. Mercier), f.desmeules@umontreal.ca (F. Desmeules), pierre.fremont@fmed.ulaval.ca (P. Frémont), jean-sebastien.roy@rea.ulaval.ca (J.-S. Roy).

explain the compression of the subacromial structures due to the dynamic narrowing of the subacromial space (Roy et al., 2008). Specifically, lower activity of the serratus anterior and lack of coordination between the different parts of the trapezius, reported in individuals with SPS (Cools et al., 2003, 2007), could contribute to a reduction of amplitude in scapular posterior tilting and lateral rotation during arm elevation (Ludewig and Reynolds, 2009). This deficit could cause the acromion to remain in a lower anterolateral position, thus resulting in a dynamic narrowing of the subacromial outlet. Lower activity of the infraspinatus and subscapularis as well as inadequate coactivation of rotator cuff (RC) muscles have also been reported (Reddy et al., 2000; Myers et al., 2009) and could be associated with superior migration of the humeral head, which again leads to a dynamic narrowing.

Given the deficits described, one could hypothesize that retraining an appropriate control of movement should be favored during rehabilitation. Such interventions would aim to correct deficits observed during arm elevation and promote better muscles coordination. To our knowledge, only two studies have specifically explored the effect of such retraining in small samples (Roy et al., 2009b; Worsley et al., 2013) and reported positive effects. Reduction of movement deficits could decrease impingement of subacromial structures during elevation and lead to a normalization of acromiohumeral distance (AHD) (Roy et al., 2008). The AHD is considered a good indicator of the size of the subacromial space outlet (Desmeules et al., 2004). However change in AHD following rehabilitation has only been assessed prospectively in a pilot study (Desmeules et al., 2004). Given the multiple deficits described in individuals with SPS, one could hypothesize that only a subgroup of individuals presenting with SPS would present a particular deficit such as decrease AHD. In fact, a previous study (Graichen et al., 2001) has shown that only a subset of participants with SPS present changes in specific motion patterns.

The objective of the present study was twofold. First it aimed to assess the effectiveness of a rehabilitation program focused on movement training on symptoms and functional limitations in individuals with SPS. Second, it aimed to identify whether individuals with SPS presented decrease AHD when compared to asymptomatic volunteers and to look at the effect of a rehabilitation program on AHD. Our hypotheses were that the rehabilitation program would lead to a decrease in symptoms and improvement in function. Furthermore, decrease AHD during arm elevation should be noted in a proportion of individuals with SPS at baseline and the rehabilitation program should lead to a significant increase of AHD in individuals with initial decreased AHD.

2. Method

2.1. Participants

Twenty-nine participants with SPS were recruited. They were aged between 18 and 65 years and presented one positive finding in each of the following categories: 1) painful arc of movement during flexion or abduction; 2) positive Neer or Kennedy-Hawkins impingement signs; and 3) pain on resisted lateral rotation, abduction or empty can test. Combination of these tests has values of sensitivity and specificity ≥ 0.74 (Michener et al., 2009). Participants were excluded if they presented one of the following: 1) previous shoulder surgery; 2) shoulder pain reproduced by neck movement; 3) clinical signs of full-thickness RC tears; or 4) shoulder capsulitis. A control group of 20 participants without shoulder symptoms or limitations was recruited for AHD normative values (comparable age and sex distribution). Participants were recruited through the electronic mailing list of employees and students at *Université Laval*. The ethics committee of the Quebec

Rehabilitation Institute approved the study and participants provided their written consent.

2.2. Study design

This study included three evaluation and 10 supervised physiotherapy sessions over 6 weeks. The evaluation sessions were carried out at *Centre interdisciplinaire de recherche en réadaptation et en intégration sociale (CIRRS)*. The physiotherapy program was conducted in two private clinics by physiotherapists (PT) blinded to baseline evaluations. Participants with SPS first took part in a baseline evaluation during which they completed questions on sociodemographic and symptomatology, as well as questionnaires on symptoms and functional limitations. Ultrasonographic measurements of AHD were conducted at baseline evaluation and repeated within a week for reliability analysis. Thereafter, participants took part in the standardized rehabilitation program. At the end of the program, questionnaires and ultrasonographic measures of AHD were reassessed. A question pertaining to global change since the initial session (*Global rating of Change*) was also completed (scale ranging from -7 “a very great deal worse” to $+7$ “a very great deal better”, including 0 “about the same”) (Jaeschke et al., 1989). It was determined a priori that participants who rated their perceived recovery at $\geq +4$ (*moderately better or greater*) were categorized as having a successful outcome (Tate et al., 2010). Participants in the control group underwent two evaluation sessions separated by 6 weeks and ultrasonographic measurements of AHD was performed in both sessions. The same evaluator performed all evaluations.

2.3. Outcomes

Symptoms and functional limitations were assessed using two self-reported questionnaires: Disability of the Arm Shoulder and Hand (DASH) questionnaire and Western Ontario Rotator Cuff (WORC) index. DASH has 30 items that measures upper limb physical disability and symptoms (Hudak et al., 1996). Final scores range from 0 to 100 (most severe disability). DASH presents excellent reliability, is responsive to change, has a minimal detectable change (MDC) of 11 points and a clinically important difference (CID) of 10 points (Roy et al., 2009a). The WORC is a disease-specific questionnaire designed for patients with RC disorders. Scores vary from 0 to 100 (high functional status). WORC presents excellent reliability, is responsive to change for patients with SPS, has an MDC around 12 points, and a CID of 13 points (Kirkley et al., 2003; Ekeberg et al., 2010). The MDC values were used as benchmarks when the CID was smaller than the MDC.

Ultrasonographic measurements of AHD were performed using MyLab[®]Five (Esaote Biomedics, Genoa, Italy) ultrasound scanner with a 5–12-MHz linear array probe. Measurement of AHD is defined as the tangential distance between the bony landmarks of humeral head and inferior edge of acromion, corresponding to the anterior outlet of subacromial space (Desmeules et al., 2004). Measurements were taken in a sitting position with the arm at rest, and at 45° and 60° of active abduction (elbow flexed at 90°). An inclinometer was placed on subject's arm to position the arm at 45° and 60°. Ultrasonographic measurements were taken by placing the transducer on the anterior aspect of the lateral surface of acromion along the longitudinal axis of the humerus in a frontal plane. Images were taken when the inferior edge of the acromion was optimized, generally around 1 cm posterior to the acromion anterior angle. For each arm position, three measures were taken, and the mean AHD was calculated. At the follow-up evaluation, the evaluator was blinded from baseline data.

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