***Case study***

# Effectiveness of functional massage of the teres major muscle in patients with subacromial impingement syndrome. A randomized controlled case series study.


## Abstract

**Aims:** Subacromial impingement syndrome is the most common shoulder condition. Myofascial trigger points in teres major muscle can be associated with this syndrome. Our objective is to find out if adding manual therapy specifically for teres major trigger points can produce better results in these patients.

**Study design**: Randomized controlled case series.

**Place and Duration of Study:** Public Primary Care Center of the Spanish National Health System (Cornellà de LLobregat - Barcelona) and Mutual Society for Work-related Injuries and Occupational Disease FREMAP (Arnedo - La Rioja), between January to March 2014.

**Methodology:** Fifty-eight people were recruited but 8 subjects were lost during the follow-up period. Sample was constituted by 50 patients (17 male and 33 female, age range 23-80 years) randomly assigned to one of two groups: intervention group or control group. Both groups received a protocolized physical therapy treatment while the intervention group additionally received manual therapy for teres major trigger points.

**Results:** Pain intensity (p=.01) and function (p=.01) showed significant improvement in the control group, whereas pain intensity (p=.01), function (p=.01) and active range of motion (p=.01) showed significant improvement in the intervention group. Between-group differences were statistically significant for abduction (p=.01), extension (p=.02) and lateral rotation (p=.02), and clinically significant (Cohen's d) for function, flexion, extension, lateral rotation and abduction.

**Conclusion:** Although our findings must be considered as preliminary, they suggest that adding manual therapy to treat teres major trigger points allows achieving better results in glenohumeral range of motion.


*Keywords: Subacromial impingement syndrome. Manual therapy. Teres major muscle. Physical therapy.*

## 1. INTRODUCTION

Shoulder pathology prevalence ranges between 16% in general population [1] and 21% in population older than age 70 years [2]. In Spanish population within working age, the shoulder is the extremity region with more percentage of subjects affected by musculoskeletal symptoms (13.8%) only overcome by the lumbar (44.9%), cervical (34.3%) and dorsal (27.1%) spines [3]. The incidence has been estimated in 11.2 per 1000 patients/year, with a majority of cases (41%) diagnosed with subacromial impingement syndrome (SIS) [4]. SIS is characterized by a pain which emanate from subacromial space structures that increase with upper extremity elevation, and a greater or lesser restriction of mobility that provokes functional limitation which affects patient´s quality of life [5].

A biomechanical cause that can provoke the impingement of the subacromial structures is the lack of coordination of the muscle activation during extremity elevation [6]. Most of the studies about muscle coordination have been based on the model of Inman et al, [7] which focuses on the role of the infraspinatus, teres minor and subscapularis muscles opposing to deltoid muscle in order to minimize the impact of the humeral head under the coracoacromial arch during elevation. Nevertheless, a recent study has included the evaluation of other adductor muscles considering the classic concept of normal function of the shoulder obtained by a balance between deltoid and rotator cuff muscles as inadequate [8].

Hawkes et al, in a study evaluating the muscle activity during a functional elevation and depression movement of the extremity, have demonstrated that the teres major muscle is more active during elevation than during depression in asymptomatic subjects. Moreover, during elevation phase, the maximal activity peak of the adductor group (latissimus dorsi and teres major) appears earlier and it maintained more time than the rotator cuff [8]. The role of these muscles in the dynamic balance of the glenohumeral joint may be more important than what is usually considered and their dysfunction should be taken into account in the evaluation of patients with SIS.

In our daily clinical practice, we frequently observed that patients diagnosed with SIS present myofascial trigger points in the teres major muscle, whose palpation reproduces a pain that patients identify as their usual pain. However, only a few studies have analyzed the involvement of this muscle in the clinical context of SIS and it seems that there is no agreement on the role of the adductor muscles in the management of SIS. Some authors recommend that strengthening exercises of the adductor (due to their

depressor moment arm) [9] and the rotator cuff muscles [10], should be included while others recommend the stretching of the medial rotators (all of them adductors) and the isolated strengthening of the lateral rotators due to the fact that these muscles are less in number and weaker [11].

Our hypothesis is that teres major muscle involvement in the clinical status of patients diagnosed with SIS is greater than what is classically considered, with a need of a specific treatment. Our objective is to find out if adding manual therapy specifically for teres major muscle to a conventional physical therapy program produces better results than the application of a conventional physical therapy program alone for patients with SIS.

## 2. METHODOLOGY

A randomized controlled experimental case series study was carried out. Participants were recruited in two centers: one from a Primary Care of the Spanish National Health System (Cornellà de LLobregat - Barcelona) and another from the Mutual Society for Work-related Injuries and Occupational Disease FREMAP (Arnedo - La Rioja). The IDIAP Jordi Gol Clinical Research Ethics Committee approved the protocol of this study on 2013-10-02, code number P13/082. This study was registered with the US National Institutes of Health website: ClinicalTrials.gov identifier NCT02374073.

Due to the lack of previous studies with specific treatment of teres major muscle, there were no statistical data to estimate a previous calculation of the sample size. Involvement in the study was offered to the patients of both centers which were referred for SIS treatment within the period of January to March of 2014.

The inclusion criteria were: age 18 years and over, a clinical diagnosis of SIS, the presence of myofascial trigger points in the teres major muscle and the signing of the informed consent. For the clinical diagnosis of SIS, Hawkins-Kennedy [12] and Neer [13] tests were used. This inclusion criteria was satisfied if one (or both) of these tests were positive, that is, if the patient´s pain was reproduced. The trigger point localization in the teres major muscle was carried out with the patient in supine lying, with a shoulder in a non-painful abduction position in the scapular plane and looking for nodule presence within a taut band with a digital pincer grip. It was considered as positive if the patient showed some pain or signs of pain avoidance.

The exclusion criteria were: the presence of wounds or cutaneous alterations in the shoulder region, previous surgery in the shoulder, presence of acute inflammatory process in the shoulder (< 7 days), being involved in litigation or compensation processes and not having a domain of the language that could make the informed consent not understandable.

Figure 1 shows the design of the study and the flow of the participants throughout each stage of the study from the initial contact to the analysis of the results. Ninety-eight patients were asked to participate in this study and no one refused to take part, but 40 were excluded. From the 98 patients contacted, 86 showed positive results in the clinical tests for SIS and 12 didn't. From the 86 patients with positive result in the clinical test for SIS, 60 presented trigger points in the teres major muscle, and 26 didn't. From the 60 people that meet inclusion criteria, 2 were excluded for being pending for litigation or compensation.

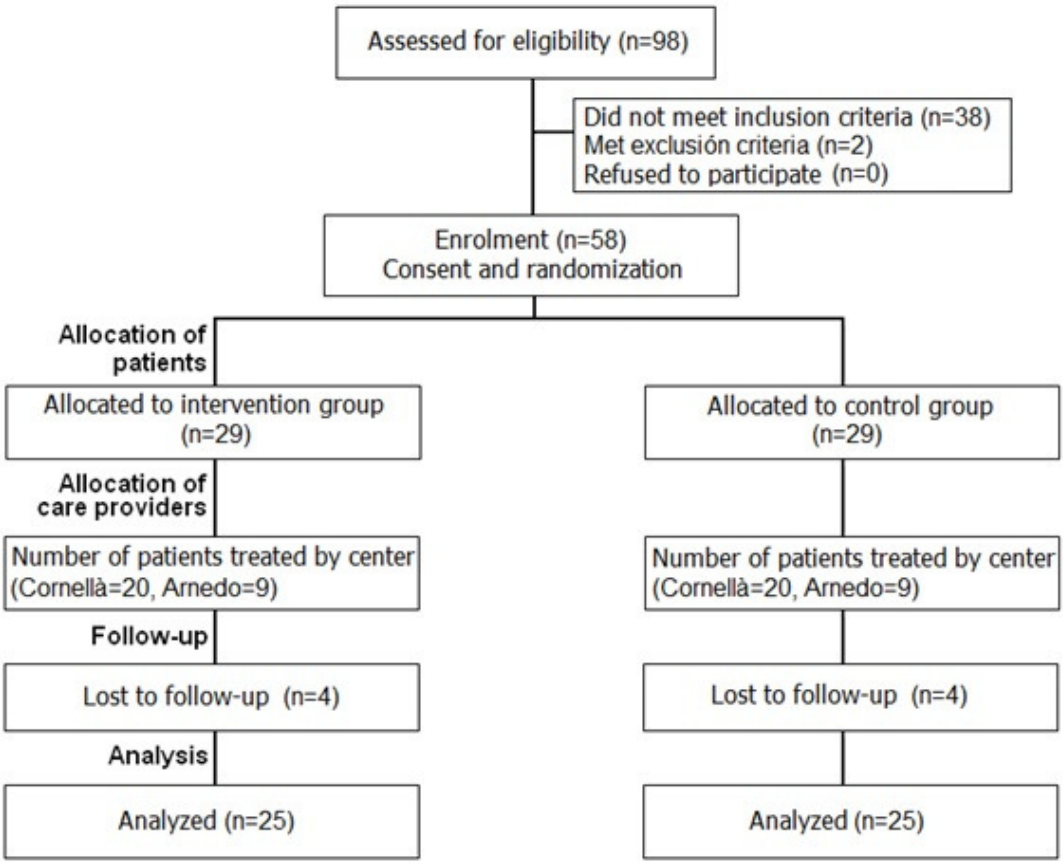


**Figure 1. Consort diagram. Participants flow throughout the study.**

The patients recruited for this study (n=58) were randomly assigned to one of the two groups: intervention group or control group. Randomization was stratified for each center and was carried out before subject recruitment with a computerized program that generated a list of consecutive numbers which were assigned to one of the study groups.

During the treatment period, 8 subjects were lost of follow-up, 4 in the intervention group and 4 in the control group, due to several personal reasons that are not related to the study. The treatment protocol was completed with 50 subjects (25 in each group) which joined the sample of this study.

All participants, regardless of the assigned group, received three weeks of a protocol of treatment, with daily sessions of therapeutic exercises, analgesic electrotherapy and cryotherapy. Additionally, the participants of the intervention group received a functional massage technique in the teres major muscle.

The functional massage is a manual therapy technique, indicated in cases of painful muscle tightness [14] that combines a rhythmical and non-painful passive joint mobilization in the direction of muscle stretching together with compression/decompression of the muscle to be treated [15]. It is started with the compression of the muscle in a position of muscle shortening and progresses with the passive mobilization of the joint in the direction of muscle stretching until tightening reaches the compressed muscle area. Then, muscle compression is removed and the joint is moved to the starting joint position and the procedure is repeated rhythmically (Figure 2).

**Figure 2. Final position of the functional massage technique.**

For our study application, the functional massage was applied within 5 minutes in each treatment session with a frequency of 20 to 25 movements per minute.

The following result variables were measured, immediately before and after the treatment period: pain intensity, level of function and active range of movement. Additionally, the subjective opinion of the subject on the obtained results was registered at the end of the treatment period.

For measuring pain intensity, a Visual Analogue Scale (VAS) of 100 millimeters of length without intermediate references was used [16]. Subjects were asked to register their level of pain in the shoulder region. If the patient felt that pain intensity was variable, the subject was asked to register the pain intensity perceived in the shoulder region at the most painful moment.

The level of function was measured with the simplified Constant-Murley Test, in which force measurement is not considered, with a potential maximal score of 75 points [17]. The use of the simplified test is justified because the force measurement is the less standardized parameter of the original test, with diverse existing procedures for registration (and scoring) that have not been validated. Moreover, the measurement position (abduction) may be painful for the patients with SIS, limiting a precise measurement [18].

The active range of movement in flexion, abduction, extension and lateral rotation was measured with a two-arm universal goniometer and the results were expressed in degrees. The flexion and extension were measured in the sagittal plane, with the elbow in extension and the forearm in the mid position of pronosupination (thumb pointing forward). Abduction was measured in the scapular plane with the elbow in extension and the forearm in the mid position of pronosupination. Lateral rotation was measured in neutral position of the shoulder (arm beside the trunk), elbow in 90º of flexion and forearm in the mid position of pronosupination [19]. The active range of movement in medial rotation was measured with the hand-behind-back reach test. The reached position with the tip of the thumb was marked with a dermographic pencil and the distance between this mark and the lower end of the spinous process of C7 was measured in centimeters; the less distance, the more mobility [19].

The subjective results were perceived by the subjects after the treatment were measured by a Global Rating of Change scale (GROC scale) [20].

The process of measurement and data collection, and the treatment protocol, were decided by the physical therapists of the two participating centers and practiced during a common training session.

Blinding techniques were not applied during this study. The same physical therapist that collected the variable data applied the manual treatment and could not be blinded. The participants assigned to the control group were aware that no additional manual therapy was applied.

The statistical analysis of the results was carried out with the version 20.0 of the SPSS program using non parametrical tests due to the reduced sample size. The level of signification was established in alfa=.05 and the limits of the confidence interval at 95%. In order to compare between the groups at the beginning of the study, Chi-square and the Fisher exact statistics were used for qualitative variables and the U Mann Whitney test was used for the quantitative variables. Wilcoxon signed Rank test was used in

order to analyze the intra-groups differences in the result variables. ANCOVA was used for the comparison between groups.

To estimate the clinical relevance of the results, apart from the results from the GROC scale that were analyzed with Fisher exact statistics, the effect size of the inter-groups results were estimated (difference of standardized averages, Cohen's *d*) with an on-line calculator (http://www.uccs.edu/~lbecker/). Cohen describes 0.2; 0.5; and 0.8 as small, moderate and large effect size, respectively [21].

## 3. RESULTS AND DISCUSSION

The average age of the participants was 61.6 years (SD 10.71) with a range between 23 and 80 years, 66% were women. The most affected shoulder was the right one (68%). Only one participant was left-handed. The demographic characteristics of the participants, including the values of the result variables at baseline, are shown in table 1.

**Table 1: Baseline characteristics of the participants**

| Variables | Intervention group (n=25) | Control group (n=25) |
|---|---|---|
| Age in years | 58.1 (10.30) | 65.2 (10.08) |
| Sex | | |
| Male N (%) | 11 (44) | 6 (24) |
| Female N (%) | 14 (56) | 19 (76) |
| Affected shoulder | | |
| Right N (%) | 18 (72) | 16 (64) |
| Left N (%) | 7 (28) | 9 (36) |
| Pain duration in months | 13.16 (13.64) | 10.64 (11.38) |
| Occupation (out-home) | | |
| Active N (%) | 11 (44) | 5 (20) |
| Unemployed N (%) | 1 (4) | 1 (4) |
| Retired N (%) | 9 (36) | 13 (52) |
| No N (%) | 4 (16) | 6 (24) |
| Sporting activity | | |
| Yes N (%) | 15 (60) | 17 (68) |
| No N (%) | 10 (40) | 8 (32) |
| Previous trauma | | |
| Si N (%) | 2 (8) | 7 (28) |
| No N (%) | 23 (92) | 18 (72) |
| Type of pain | | |
| Continuous N (%) | 9 (36) | 11 (44) |
| In specific movements N (%) | 16 (64) | 14 (56) |
| Predominant pain | | |
| Daytime pain N (%) | 13 (52) | 8 (32) |
| Nighttime pain N (%) | 12 (48) | 17 (68) |
| Most painful movement | | |
| Lying on the affected side N (%) | 7 (28) | 3 (12) |
| Lying on the non-affected side N (%) | 1 (4) | 1 (4) |

| | | |
|---|---|---|
| Elevation N (%) | 11 (44) | 11 (44) |
| Hand to back N (%) | 5 (20) | 9 (36) |
| Others N (%) | 1 (4) | 1 (4) |
| Pharmacological treatment | | |
| Yes N (%) | 14 (56) | 11 (44) |
| No N (%) | 11 (44) | 14 (56) |
| Pain intensity (1) | 61.0 (21.34) | 63.5 (21,80) |
| Function (Constant-Murley) | 41.4 (12.85) | 45.6 (9.92) |
| Flexion (2) | 118.9 (30.00) | 118.2 (23.91) |
| Abduction (2) | 111.6 (28.27) | 116.4 (22.05) |
| Extension (2) | 41.9 (16.97) | 29.6 (9.77) |
| Lateral rotation (2) | 29.8 (17.24) | 25.6 (13.21) |
| Medial rotation (3) | 26.7 (13.81) | 33.4 (13.30) |

*NOTE: The results are presented as the mean and standard deviation except when it is shown as %. (1) EVA in millimeters from 0 to 100. (2) Mobility in degrees from zero until maximal active range of movement. (3) Distance in centimeters from spinous process of C7 to the tip of the thumb.*

No statistically significant between-group difference was found with any of the qualitative demographic variables. Of the quantitative demographic variables, there were statistically significant between-group differences in age (p=.02) and extension range of movement (p=.01) at baseline. Differences in pain duration, pain intensity, function and the remaining mobility variables were not statistically significant.

Intra-groups analysis of the differences between baseline and post-treatment assessments are shown in table 2. In the intervention group, all result variables had a statistically significant improvement. In the control group, pain intensity and level of function variables had a statistically significant improvement, while no mobility variables had a statistically significant improvement.

**Table 2: Changes in each variable between baseline and post-treatment assessments.**

| | Intervention group | | | Control group | | |
|---|---|---|---|---|---|---|
| **Variable** | **Mean (SD)** | **CI 95%** | **P** | **Mean (SD)** | **CI 95%** | **p** |
| Pain intensity (1) | 21.16 (19.16) | 13.2 / 29.1 | .01 | 22.92 (20.90) | 14.3 / 31.5 | .01 |
| Function (C-M) | 10.60 (8.36) | 7.1 / 14.1 | .01 | 6.92 (7.75) | 3.7 / 10.1 | .01 |
| Flexion (2) | 14.76 (17.24) | 7.6 / 21.9 | .01 | 4.48 (19.08) | -3.4 / 12.4 | n.s. |
| Abduction (2) | 23.00 (15.93) | 16.4 / 29.6 | .01 | 1.00 (21.45) | -7.9 / 9.9 | n.s. |
| Extension (2) | 5.64 (9.50) | 1.7 / 9.6 | .01 | 0.84 (7.85) | -2.4 / 4.1 | n.s. |
| Lateral rotation (2) | 8.76 (10.53) | 4.4 / 13.1 | .01 | 0.72 (8.21) | -2.7 / 4.1 | n.s. |
| Medial rotation (3) | 2.60 (4.54) | 0.7 / 4.5 | .01 | 1.56 (6.10) | -1.0 / 4.1 | n.s. |

*NOTE. p: value of the intra-group comparison. n.s. no significant. C-M: Constant-Murley. (1) VAS in millimeters from 0 to 100. (2) Mobility in degrees from zero to maximal active range of motion. (3) C7-thumb distance in centimeters.*

In between-groups comparison, the intervention group showed a larger improvement in all result variables, except the similar result in both groups for pain intensity. ANCOVA results, considering age

and initial values of each result variable as covariables, were statistically significant in abduction (p=.01), extension (p=.02) and lateral rotation (p=.02) movements.

The clinical significance of the between-groups differences, analyzed by the estimation of the effect size (Cohen's *d*) showed a small effect size (.2 to .5) in level of function, flexion, extension and lateral rotation; a moderate effect size (=0.5) in abduction, and no significance for pain intensity and medial rotation. The subjective results expressed by the participants using a GROC scale are shown in table 3 and are very similar for both groups.

**Table 3: Results of the Global Rating of Change scale (GROC scale)**

| | Intervention group | Control group |
|---|---|---|
| Clinical improvement (1) | 17 | 16 |
| Without clinical changes (2) | 8 | 8 |
| Clinical worsening (3) | 0 | 1 |

*NOTE: (1) Values between "Moderately better" and "A very great deal better". (2) Values between "Somewhat better" and "Somewhat worse". (3) Values between "Moderately worse" and "A very great deal worse".*

The results of this study support our hypothesis that teres major muscle is also involved in the clinical status of a great deal of patients diagnosed with SIS and that adding a specific treatment helps obtaining better results than a conventional physical therapy treatment.

Teres major muscle had myofascial trigger points in sixty (70%) of the 86 patients showing positive results in clinical tests for SIS, being similar to the results of Bron et al., that concluded that a 76% of the subjects with pain in the shoulder with a non-traumatic etiology had trigger points (27% active y 49% latent) in the teres major muscle [22]. Travell y Simons reported that the symptoms produced by the trigger point in the teres major muscle could be similar to one of other causes of pain in the shoulder such as subacromial bursitis or supraspinatus tendonitis [23]. In fact, the area of referred pain of the trigger point of teres major is similar to the region where the subjects diagnosed with pathology of the subacromial structures usually perceive the pain [24].

Although the conventional physical therapy treatment has allowed us to achieve satisfactory results for these patients with improvements in pain intensity and level of function, the addition of manual therapy focused on the trigger points in the teres major muscle have improved the mobility results, reaching statistical significance in abduction, extension and lateral rotation; and clinical significance in the level of function, abduction, extension and lateral rotation. Other studies showed similar results. The systematic

review of Kung JE concluded that therapeutic exercises are effective for improving pain and function, but not the range of movement or the force of the subjects with SIS, and that its efficacy improves if manual therapy is added [25].

Pain provocation in the structures of the subacromial space of previously asymptomatic subjects alters the pattern of muscle activation, thereby increasing the activity of the adductor muscles [26]. Also, it has been shown that patients with full-thickness tear of the rotator cuff present an increased activation of the deltoid muscle are considered to compensate the absence of the supraspinatus, together with an increase in the activity of the teres major and latissimus dorsi [27]. This increased activation of the adductor muscles is attributed to the need of stabilizing the humeral head in order to minimize the impingement and protect the subacromial structures. In spite of the almost full pain alleviation (from 7.7 to 0.9 in VAS) provoked by lidocaine subacromial infiltration, it did not recover the pattern of activation considered as normal in the overall sample, but only partially and only in some subjects [27]. In our study, a conventional therapeutic approach focused on the subacromial structures, although it has achieved a significant reduction of the pain intensity independently from the group assignation of the patient, it has not allowed a mobility recovery unless a specific treatment of the dysfunctional muscle is not added, in this case, for myofascial trigger points in the teres major.

Functional massage is a manual therapy technique that shares some characteristics of the trigger point pressure release technique proposed by Travell and Simons as a substitution for ischemic compression technique [28]. In the pressure release technique, a non-painful maintained pressure is applied in a lengthening position of the muscle, while in functional massage technique the pressure is applied intermittently. This reduces the possibility to produce ischemia even more, and passive joint mobilization in the direction of muscle stretching may improve local circulatory flow, thereby minimizing the energy crisis in the myofascial trigger points. Studies on the effects on the pressure release technique of the trigger points show an increase in the restricted mobility of the involved muscles [29,30]. In our study, a mobility increase is also observed after the functional massage treatment of the myofascial trigger points.

Our study supports the existing evidence which revealed that, in the treatment of the pathology of the subacromial space, a therapeutic approach of physical therapy that includes manual therapy techniques is superior to a physical therapy approach that does not include these techniques [31,32]. Choosing the

manual technique to be applied to the specifically affected structures may better increase the results in these patients.

Our study presents some limitations such as the no blinding of the evaluator and reduced sample size. As well, we have not been able to guarantee the representation of our sample, so we cannot ensure that the obtained data have external validity. Additionally, we have to take into account that a potential placebo effect has not been controlled, so this may have an influence on the subjects treated with an additional manual therapy technique.

## 4. CONCLUSION

Although due to the limitations of our study our conclusions must be considered cautiously, our results show that the association between SIS and trigger points in the teres major muscle may be more frequent than what it is considered in the literature, and adding functional massage of the teres major muscle enhances the achievement of better results in the glenohumeral range of movement.

## CONSENT

All authors declare that written informed consent was obtained from all the patients for publication of this article and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

## ETHICAL APPROVAL (WHERE EVER APPLICABLE)

All authors hereby declare that the protocol of this study have been examined and approved by the IDIAP Jordi Gol Clinical Research Ethics Committee on 2013-10-02, code number P13/082. All the experiments have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.”

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