Case Report

Posterior glenohumeral stiffness: Capsular or muscular problem?
A case report

Antonio Poser\textsuperscript{*}, Oscar Casonato

Physical Therapy Department, Centro di Medicina, Viale Venezia 91, 31015 Conegliano, Italy

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1. Introduction

The impingement syndrome’s aetiology is multifactorial. The mechanical factors potentially contributing to this pathology are altered neuromuscular control, decreased force of the rotator cuff and peri-scapular muscles, the acromion’s morphology and posture and stiffness of the posterior capsule (Michener et al., 2003). Amongst these dysfunctions, the authors want to focus on the retraction of the posterior capsule, which can be seen clinically by a limitation in trans-thoracic adduction and internal rotation.

Some authors (Warner et al., 1990; Tyler et al., 2000; Matsen and Artinz, 2004), maintain that a number of patients with impingement syndrome show a decreased trans-thoracic adduction and internal rotation caused by the thickening and shortening of the posterior glenohumeral capsule.

From a clinical point of view, Tyler et al. (2000) and Lin and Yang (2006) have demonstrated that there is a strict correlation between loss of trans-thoracic adduction and limitation of internal rotation. The relationship between these two limitations is that 1 cm of trans-thoracic adduction corresponds to an internal rotation reduction of 4°.

Harryman et al. (1990), in their study on glenohumeral arthrokinematics, introduced for the first time the concept of obligate translation. Obligate translation means a shifting of the humeral head in the opposite direction from the capsule–ligament structure that is being tensed during the physiological movement. For example, during external rotation, the tension from the capsule and the anterior ligaments provokes a posterior translation of the humeral head. The same authors also noticed that a surgical shortening of the posterior capsule caused an “abnormal” obligate translation in an antero-superior direction during arm flexion. Before this one study, Howell et al. (1998) had already observed this particular obligate translation “in vivo”, whilst Werner et al. (2004) and Grossman et al. (2005) confirm the presence of this on cadaver examination. Recently, it has been suspected that this particular mechanism (“abnormal” obligate translation) is also one of the inducing factors not only for sub-acromial impingement, but also for athletes’ Superior Labral Anterior Posterior (SLAP) lesions (baseball, volleyball, tennis, swimming, etc.) (Burkhart and Morgan, 1998; Burkhart et al., 2003; Grossman et al., 2005).

Even though on cadaver specimens it has been demonstrated that a restricted internal rotation and trans-thoracic adduction is caused by the tensing of the posterior capsule (Ovesen and Nielsen, 1986; Terry et al., 1991; Gerber et al., 2003; Grossman et al., 2005), in a clinical setting it is impossible to selectively isolate the tension exercised by the posterior capsule from the tension exercised by the infraspinatus and teres minor muscles, making it, thus, impossible to tell exactly what is the source of the joint restriction.

Excluding the Burkhart et al. (2003) study, which demonstrated the presence of a thickened and retracted
capsule in professional baseball pitchers playing for many years, there is no anatomical or histological study that can demonstrate the presence of this type of alteration in individuals affected by impingement syndrome. The achievement of functional recovery of joint internal rotation is common practice nowadays both as a treatment result in impingement syndrome cases and as a prevention strategy for athletes (Litchfield et al., 1993; Kamkar et al., 1993; Johansen et al., 1995; Burkhard et al., 2003), even though the conclusive evidence of its efficacy is limited (McClure et al., 2004; Aina and May, 2005).

In particular, the McClure et al. (2004) study has demonstrated the existence of a positive relationship between the improvement of joint internal rotation and functionality in patients with impingement syndrome. It seems, therefore, that complete internal rotation needs to be a clinical pre-requisite for normal glenohumeral kinematics and functionality. Even though it is widely accepted that muscular problems may be the cause of a ROM limitation, as regards to a decrease in internal glenohumeral rotation, today’s literature claims it is caused by a stiffness of the posterior capsule.

This case report (and the ongoing study) the authors are presenting was born from our doubt that a restricted internal rotation could only be caused by a retraction of the posterior part of the capsule. This study was based on the hypothesis that limitations in the glenohumeral joint internal rotation may be caused, more or less significantly, by a contracture of the infraspinatus and teres minor muscles.

2. Case report

2.1. History

A 42-year-old male manual worker came to the authors complaining of right shoulder pain, which had persisted for 12 weeks. The symptom’s onset was insidious. The intermittent pain was caused and aggravated by moving the arm beyond 90°—of elevation or by—sleeping on the right side. The pain intensity was not so strong as to interfere with working activities and when needed the patient would use NSAIDS and ice packs to alleviate pain. The whole of the shoulder was painful (particularly in the deltoid area), but there was no radiation. The patient did not suffer any pain around the cervical area or in the upper extremity. No other significant findings were noted during any part of the history.

2.2. Objective examination (assessment)

The examination did not show any differences on shoulder muscle trophism or significant postural asymmetries. Scapulo-humeral rhythm was harmonic, although at the end of the movement there was evidence of a slight restriction of right elevation, with more elevation towards the top of the scapula and pain appearing at the end of the movement. Passive joint range of motion only showed a restricted internal rotation of the right shoulder in abduction at 90° compared to the left shoulder. Manual muscular tests revealed no weaknesses, although resisted abduction provoked pain. Impingement tests were positive, particularly Hawkins’ (Hawkins and Kennedy, 1980) and Yocum’s tests (Yocum, 1983). The active compression test was also positive (O’Brien et al., 1998).

The cervical spine did not show any movement restrictions or pain during the articular assessment and both the Spurling (Spurling and Scoville, 1944) and Quadrant test (Maitland, 1986) in extension, lateral flexion and same side rotation proved negative.

The sub-acromial impingement diagnosis was confirmed by the patient’s symptomatology matching the inclusion/exclusion criteria identified by many authors (Lukasiewicz et al., 1999; McClure et al., 2004; Bullock et al., 2005) (see Table 1).

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
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<tr>
<td>Presence of Neer’s sign</td>
<td>Pain originating from the cervical spine</td>
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<tr>
<td>Positive Hawkins’ test results</td>
<td>Painful resisted abduction</td>
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<tr>
<td>Painful arc</td>
<td>Previous trauma of the shoulder</td>
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<tr>
<td>Palpation of the rotator cuff tendons was painful</td>
<td>Surgical operation around the shoulder area</td>
</tr>
<tr>
<td>Anterior or lateral shoulder pain</td>
<td>Painful arc</td>
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Table 1: Inclusion/exclusion criteria (Lukasiewicz et al., 1999; McClure et al., 2004; Bullock et al., 2005)

3. Measurements and treatment

Before treating the patient, internal rotation joint range of motion was measured with the patient lying supine and with the arm held in 90° abduction. Measurements were taken with an inclinometer. The force applied by the physiotherapist to internally rotate the arm was measured with an electronic dynamometer attached to the patient’s wrist, while a second physiotherapist fixed the scapula to prevent shoulder anteposition (Awan et al., 2002) (Fig. 1). The force used for pre- and post-treatment measurements was identical. Resisted muscle tests in abduction, internal and external rotation, were done as described by Cyriax (Ombregt et al., 1995). The resulting force was measured...
with a dynamometer in order to use the same values for the control test. Lastly, impingement tests (Yocum’s and Hawkin’s) and the active compression test (O’Brien et al., 1998) were done. This test, originally conceived for differentiating an AC lesion from a SLAP lesion, has been considered extremely useful because it tenses the whole of the posterior structure through trans-thoracic adduction, internal rotation and flexion of the humerus. Theoretically, this particular position should cause a greater obligate translation of the head of the humerus. Parentis et al. (2004) noted that the active compression test in its first part brings the supraspinatus tendon towards the acromion, making this test similar to impingement tests. Even for these tests, the resulting forces were measured with a dynamometer so they could be reproduced exactly during following control tests. Pain provoked by these tests was measured using a visual analogue scale (V.A.S.) immediately after completion of the tests.

In order to treat only the muscle part of the shoulder without affecting the capsule, the patient was positioned prone with the arm held by his side in a relaxed position. The patient was given a 7 min massage of the infraspinatus and a 3 min massage of the teres minor. The authors considered that this time of massage was sufficient to have a change in the muscle. The massage was done only over the areas of the infraspinatus that were contracted and painful to palpation and on the whole of the teres minor (given its small size), moving the fingertips in a circular fashion (Fig. 2). The force applied was related to the patient’s capacity to endure pain.

All of the prior measurements were retaken on completion of the treatment. The treatment consisted of three sessions given on alternate days. During this week of treatment the patient did not take any medication or change his daily routine. Furthermore, he did not receive any other treatment or practice any exercise at home.

4. Results

After the three treatment sessions, joint range of motion in internal rotation had increased by 20°, with the initial excursion being 68° and the final range 88° (Fig. 3).

A clear V.A.S. improvement was visible for all of the administered tests. Resisted abduction decreased from an initial 2.8 to 0; Hawkin’s from 3 to 0.3; Yocum’s from 3 to 0.1 and active compression from 2.3 to 0 (Fig. 4).

5. Discussion

The treatment results obtained for this clinical case show how a restricted internal rotation may be caused by the posterior muscle component rather than by a retraction of the posterior capsule.

The results obtained from treatment of the painful component of the impingement tests (Hawkin’s and Yocum’s) and the active compression test, support the hypothesis that the excess of obligate translation may be
caused by the shortening of the posterior structures (capsule/muscles). These tests, in fact, stimulate those structures in a peculiar manner, because they require particular flexion/internal rotation/thoracic adduction movements. Therefore, it is fair to assume that the decrease in pain may be caused by a decrease of the obligate translation and consequently by a decrease of the posterior muscular component.

Lastly, it is also interesting to note that the pain provoked by the resisted abduction had diminished. This improvement, though, is not attributable to the obligate translation phenomena as for the other tests, because the test is done in 20–30° of abduction in a situation in which there is no tensing of the posterior structure. This phenomenon could be explained by assuming that retraction of the posterior muscles keeps the head of the humerus in a slight external rotation, which in turn tenses the anterior part of the supraspinatus tendon and relaxes the posterior part (see Fig. 4). During arm movement this phenomena could provoke a bigger mechanical stimulation of the anterior part of the supraspinatus tendon. This difference in tension between anterior and posterior fibres of the supraspinatus tendon in relation to the rotation state of the humeral head has been demonstrated by Nakajima et al. (2004). When, through treatment, the tension exercised by the infraspinatus/teres minor is decreased, the humeral head goes back to its correct position, promoting thus a uniform distribution of tensions within the supraspinatus tendon (see Fig. 5). Reduction of pain during resisted abduction tests could also be attributable to a decrease of the tension transmitted by the infraspinatus tendon to the supraspinatus tendon, as a result of a muscular relaxation achieved through the massage technique. It is, in fact, well known that there is a certain degree of fusion between the rotator cuff’s tendons (Clark and Harryman, 1992) (see Fig. 6) and this fact leads the authors to believe that a contracture of one of the rotator cuff’s muscles could create an imbalance and therefore a bigger tension of the various tendinous parts that compose the rotator cuff.

Another possible explanation of the pain reduction could be the gate control effect due to the massage, but this phenomenon cannot quite prove the decreasing of the pain until the following treatment.

Fig. 3. V.A.S. for the various tests: resisted abduction, Yocum test, Hawkins test and active compression test.

Fig. 4. Infraspinatus massage.

Fig. 5. (A) Asymmetrical tension of the supraspinatus tendon (arrows) caused by the excessive tension of infraspinatus. (B) After the treatment the infraspinatus tendon is relaxed and the tension inside the supraspinatus tendon is distributed in a well-blended way; IS: infraspinatus; SP: supraspinatus; SC: subscapularis.
The massage was done on all of the areas, which felt contracted and painful during palpation, keeping the patient’s arm in a neutral position and without putting any kind of stress on the joint capsule. The particular technique adopted by the authors gave results in joint excursion at every session. Ten minutes were sufficient to verify whether the joint deficit could have been caused by a muscular dysfunction or by a capsular problem. This technique can therefore represent a quick diagnostic tool for evaluating the dysfunctional state of the supraspinatus and teres minor muscles. A similar, or even greater result may be obtained using other manual or neuromuscular techniques, but the fact remains that the authors were able to treat the patient without stressing the joint capsule using this specific technique. This massage represents a rapid tool for recognizing the presence of a joint restriction which is likely to be muscular in origin.

6. Conclusions

This case report suggests that by massaging the infraspinatus and teres minor muscles it was possible to gain 20° of internal rotation in a patient with impingement syndrome. This leads the authors to believe that an internal rotation deficit could also be caused by a contracture of the muscles and not exclusively by a posterior capsule rigidity. It is obviously necessary to do further studies on a large number of cases to confirm this hypothesis and calculate the incidence of the muscular component versus the capsular component. A larger study is now underway to confirm the hypothesis.

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References


