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SHOULDER

Minor or occult shoulder instability: an intra-articular pathology presenting with extra-articular subacromial impingement symptoms

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Abstract
Purpose Disruption in the balance of shoulder stability can produce a widely varied spectrum of clinical symptoms, ranging from minor shoulder instability to frank shoulder dislocation, followed by recurrent instability. In this study, a series of patients suffering from minor shoulder instability, all with clinical signs of preoperative subacromial impingement associated with instability, were treated. The shoulder instability alone was addressed, with the aim of eliminating the clinical symptoms of subacromial impingement and pain.
Material In this study, 20 patients with minor shoulder instability, presenting with subacromial impingement symptoms, underwent arthroscopic treatment to address capsule-labral pathology. All patients underwent a preoperative assessment by one independent physiotherapist, using Constant and WOSI scores, as well as the Castagna test, on both the affected and non-affected sides. The Hawkins test and subacromial pain in 90° of abduction and internal rotation were also evaluated.
All patients followed the same rehabilitation protocol by a second physiotherapist. All patients were followed up at 6, 12 and 24 months postoperatively by the same independent physiotherapist.
Results We observed that 20/20 patients had a positive Hawkins sign at >20° of internal rotation preoperatively, while 4/19 had a positive Hawkins sign—all with less pain—at the 24-month follow-up ($P < 0.0001$). Moreover, 20/20 had a positive Castagna test preoperatively, while 1/20 had a positive Castagna test at the 24-month follow-up. In terms of shoulder scores, at 24 months, the Constant score had improved from a median value of 70 (51–91) preoperatively to a median value of 91 (86–100). The median WOSI score was 48.3 (12.7–78.6) preoperatively and improved to 84.9 (39.5–98.5) at 24 months postoperatively.
Conclusion Minor shoulder instability is an intra-articular pathology presenting with extra-articular subacromial impingement symptoms. By treating the intra-articular pathology, the extra-articular symptoms can be relieved in the vast majority of patients.
Level of evidence III.

Keywords Minor · Occult · Painful shoulder · Instability · Impingement · Secondary

Introduction

Shoulder stability is the result of complex, delicate interaction between static and dynamic shoulder restraints [16, 17]. Disruption in this balance can produce a widely varied spectrum of clinical symptoms, ranging from minor shoulder instability to frank shoulder dislocation, followed by recurrent instability [5, 7]. Interestingly, some authors have shown that patients with a subtle gleno-humeral subluxation can present with a secondary impingement

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[9, 12, 18]. In particular, this phenomenon has been observed in throwing athletes and it has recently been claimed that this concept explains why certain athletes do not show any clinical improvement after a subacromial acromioplasty [8, 12, 18].

Recently, the concept of a relationship between shoulder instability and subacromial impingement has been reviewed, and shoulder instability has been indicated as a possible cause of atypical impingement syndrome [4]. Differently from traditional or outlet impingement syndrome, which are related to extrinsic factors, such as a type I or II acromion, subacromial spurs, or spurs of acromioclavicular joint as well as a thickened coraco-acromial ligament; the atypical impingement might result from scapular dyskinesia, posterior capsule contractures or occult shoulder instability. However, the inter-relationship between instability and subacromial impingement is still poorly understood and this issue therefore remains controversial.

Minor shoulder instability, also called occult instability or subtle instability, is a different terminology used in the literature to indicate a painful, unstable shoulder without any history of subluxation or dislocation [10].

This pathological condition does not only affect athletes and it can often represent a major diagnostic challenge, because the symptoms and signs of instability and subacromial impingement most frequently occur in combination [10, 12, 15].

The aim of the present study is to report on a clinical series of patients suffering from minor or occult shoulder instability, with clinical signs of preoperative subacromial impingement associated with instability. The hypothesis is that surgical treatment, where the shoulder instability alone is addressed, eliminates the clinical symptoms of subacromial impingement, as well as pain.

Materials and methods

This series includes the data for 21 patients (11 men and 10 women), all suffering from minor, and occult shoulder instability. All the patients underwent an arthroscopic procedure between 2005 and 2006.

None of the patients reported a previous dislocation or subluxation of the shoulder and none had undergone any previous shoulder surgery.

One patient was excluded from the study due to unexpected findings of grade II shoulder osteoarthritis during arthroscopic surgery.

Data from the clinical history and preoperative clinical evaluation were analysed (Tables 1, 2, 3, 4, and 5).

The mean age at the time of surgery was 22.5 years ± 7.3 years (range 16–36).

Table 1 Castagna test pre-operatively versus 24 months post-operatively; operated side

Castagna test	Preop	24 months postop	*P* value
Positive	20/20	1/20	$P < 0.0001$

Statistical methods The differences between the 6-month (12 and 24 months) value and the preoperative values for the same side were evaluated using Fisher's exact test for paired comparisons, a non-parametric test based on the original values

Table 2 Castagna test pre-operatively versus 24 months post-operatively; non-operated side

Castagna test	Preop	24 months postop	*P* value
Positive	7/19	3/19	NS

NS not significant

Table 3 Hawkins test pre-operatively versus 24 months post-operatively; operated side

Hawkins test	Preop	24 months postop	*P* value
Positive > 20° IR	20/20	4/20	$P < 0.0001$

Table 4 Constant score pre-operatively versus 24 months post-operatively; operated side

Constant score	Preop	24 months postop	*P* value
Median value	70 (51–91)	91 (86–100)	$P < 0.0001$

Table 5 WOSI score pre-operatively versus 24 months post-operatively

WOSI score	Preop	24 months postop	*P* value
Median value	48.3 (12.7–78.6)	84.9 (39.5–98.5)	$P < 0.0001$

The injured shoulder was the dominant one in 14 patients, while the non-dominant side was treated in 5 patients, and 1 patient was ambidextrous. The mean duration of symptoms was 4.5 months ± 4.5 months.

The pre- and postoperative evaluation consisted of a patient-reported questionnaire and standardised physical examination, including the measurement of gleno-humeral range of motion (ROM) using a goniometer. The shoulder examination focused on signs of MDI (multidirectional instability), according to the Carter-Wilkinson scale [6]. Moreover, the Castagna test [7], apprehension and relocation tests, Rockwood test, Speed test and Hawkins tests were assessed,

The Constant score and Western Ontario Instability Index (WOSI) [13] were used to assess shoulder function. A VAS (visual analogue scale) was used to evaluate the degree of pain, with 0 indicating the absence of pain and 10 indicating the worst possible pain.

Surgical treatment was performed in all patients by one experienced shoulder surgeon, after the failure of conservative treatment of at least 4 months duration consisting of activity modification, anti-inflammatory medication, as well as physical therapy and an exercise regimen focused to strengthening the external and internal rotator of the rotator cuff tendon and proprioceptive exercise of the scapula-thoracic joint.

Before surgery, all patients complained of shoulder pain aggravated by overhead activities. Night pain was present in 15/20 patients. Seven of the patients complained of shoulder pain after a trauma during sporting activities, while in the other 13, no such traumatic event was identified from their history. In these 13 shoulders, the symptoms started in relation to overuse related to sports or working activities. Fifteen patients were active in sports: 6 European handball, 2 tennis, 2 golf, 1 badminton, 1 swimmer, 1 volleyball, 1 soccer goalkeeper and 1 gymnastic exercise. Five patients complained of shoulder pain in conjunction with labour/work in the overhead position.

The clinical examination revealed a limitation in active and passive elevation of the arm due to pain. The apprehension fulcrum test was considered positive in all patients. In 17/20 patients in particular, posterior pain was present, while discomfort was noted in three patients. One patient had more than three positive signs and 18 had 2 or fewer positive signs on the Carter-Wilkinson scale.

Apprehension and relocation tests performed with the arm in 45° of abduction and external rotation (the Castagna test) were found to be positive in all 20 patients The Speed test was negative in all patients. The Rockwood test was positive in 15/20 patients. The Hawkins test elicited a positive response in all patients, but at a different degree of abduction and internal rotation. In no case we observed at preoperative time a significant reduction of internal rotation.

The arthroscopic procedure was performed with the patient in the lateral decubitus position. Routine antero-superior and postero-lateral portals were created to inspect the entire joint and address all lesions.

A standard postoperative rehabilitation protocol for labral repair was implemented. In particular, the arm was immobilised in an Ultrasling II (Donjoy) in 15° of abduction and slight internal rotation in order to avoid retropulsion. After 10 days, passive forward elevation and pendulum exercises were allowed. Formal supervised physical therapy consisted of a gradual resumption of passive and active assisted ROM of the shoulder and progressive muscular strengthening was started at 4 weeks postoperatively, when the use of the arm sling was discontinued.

Patients were reviewed by an independent observer using the evaluation parameters mentioned above at 6, 12 and 24 months postoperatively.

Statistical analysis

The changes from the preoperative state to the follow-up time were studied using Fisher's exact test for paired comparisons [11], a non-parametric test, using the original values. The level of significance was set at a P value of < 0.01.

Results

No significant differences were observed in passive and active range of motion compared with the unaffected arm. More specifically, no limitation in external rotation as compared with the uninjured side was noted at the 24-month follow-up. Furthermore, no differences in the scapula-thoracic motion between both shoulders were observed. Apprehension tests were negative at the final follow-up evaluation in all patients.

Clinical signs of subacromial impingement as evaluated with the Hawkins sign at >20° of internal rotation preoperatively were positive in 20/20 patients, whether at 24 months of follow-up, 4/20 had a positive Hawkins sign at >20° of internal rotation ($P < 0.0001$). Moreover, 16/20 patients had pain at internal rotation of <45° or more at 90° of abduction preoperatively, and 1/20 had pain at internal rotation of <45° or more at 90° of abduction at the 24-month follow-up ($P < 0.0001$).

In terms of the Castagna test, 20/20 patients had a positive test on the injured side preoperatively, while 1/20 had a positive Castagna test on the injured side at the 24-month follow-up ($P < 0.0001$).

On the non-operated side, 7/19 had a positive Castagna test preoperatively, while 3/19 had a positive Castagna test at the 24-month follow-up ($P = 0.2$).

In terms of the surgical procedure, anterior Bankart lesion was found in 3 patients.

In 5 patients, an antero-superior labral tear with a loose MGHL was noted, while a thin, loose MGHL was found in 15 patients. In 16 patients, there was also some fraying of the superior rotator cuff. Several of these lesions were combined. Moreover, in 4 patients signs of a generally loose shoulder were found.

In patients, where there were only findings corresponding to a loose MGHL (Fig. 1)—in some cases associated with synovitis of the posterior-superior capsule and some fraying on the articular side of the supraspinatus—shaving of the pathological synovitis was performed. The anterior pathology was addressed by reinserting the MGHL in its original location using a suture anchor technique.

In patients in whom the labrum was intact, while the MGHL was loose/elongated, plication of the MGHL was performed by harvesting the ligament with a suture hook

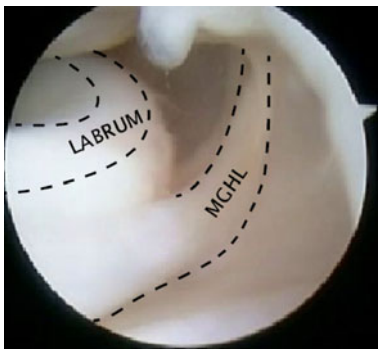

Fig. 1 Viewing from the anterior superior portal, the medial glenohumeral ligament (MGHL) is found to be detached. The MGHL *slides* from the original insertion on the labrum medial/posterior on the glenoid neck, creating a 'minor' shoulder instability

on top of the subscapularis tendon and re-attaching it at the normal anatomical position using the labrum as an anchor, putting the suture hook under the labrum. In 4 patients, in whom signs of generally loose shoulder were seen, the humeral head was balanced by performing posterior plication as well.

In three shoulders, a Bankart lesion was found. None of these patients was aware of any previous dislocation and in these cases, the labral tear was re-attached with suture anchors and, if necessary, the MGHL was also plicated. A slight bleeding in the MGHL/capsule was always created by firmly moving the shaver over the planned plication area without suction to prevent undesirable tissue damage.

Final follow-up

No intra-operative or immediate postoperative complications were encountered.

One patient with a thin MGHL treated with anterior and posterior plication developed a stiff shoulder that improved very slowly with a physical therapy programme.

At the final follow-up, the functional shoulder scores, both Constant and WOSI scores, displayed a significant improvement ($P < 0.01$). In particular, the median preoperative Constant score was 70 (51–91) and improved to 91 (86–100) at 24 months postoperatively. The median WOSI score was 48.3 (12.7–78.6) preoperatively and improved to 84.9 (39.5–98.5) at 24 months postoperatively.

Discussion

In this study, a series of 20 patients suffering from minor or occult shoulder instability are reported.

This group of patients complained primarily of a painful shoulder with symptoms and signs similar to subacromial impingement. Surgical arthroscopic management of joint instability improve symptoms and shoulder scores in all the patients at the follow-up time.

The main finding in the present study is that a secondary subacromial impingement related to occult shoulder instability is a pathology that usually involves young active people.

These data confirm previous reports, in which secondary impingement was reported in people younger than 35 years of age most commonly involved in overhead athletic activities [2]. Jobe et al. are the first to identify a continuum of progressive shoulder pathology termed 'instability complex', in which the repetitive microtrauma involving the static stabilising mechanisms of the GH joint can lead to the occult anterior subluxation of the humeral head, resulting in a secondary impingement involving the rotator cuff and biceps tendon [12]. It frequently happens that recognition of the underlying GH joint instability is missed and the 'secondary impingement' is incorrectly treated as a 'primary impingement'. In patients who have underlying GH instability, as in our series, shoulder pain and subacromial impingement symptoms are probably due to rotator cuff dysfunction, where the rotator cuff fails to stabilise the shoulder, or because of secondary subacromial bursitis with pain and secondary inhibition of cuff function. This can lead to a vicious circle causing the fatigue of the rotator cuff muscles and tendons because of the eccentric contraction and work, thereby allowing the humeral head to translate anteriorly and superiorly, causing secondary mechanical impingement of the rotator cuff and further impairment. This theory can explain the presence of fraying without a real tear as found in the articular portion of supraspinatus in some patients in the present study.

Several other studies support this theory. Warner et al. reported on a group of 28 patients with GH instability, where 68% of patients demonstrated significant impingement signs [20]. Bak and Faunö evaluated 36 competitive swimmers with shoulder pain. In 25 shoulders (51%), concomitant signs of impingement and increased GH translation were found [1]. Pieper et al. reported on 66 shoulders in 64 top athletes suffering from chronic anterior or multidirectional instability of the shoulder joint that had caused impingement of the rotator cuff. In all patients, the athlete was unaware of the instability. Castagna et al. [7] described an acquired instability of the overstressed shoulder and atraumatic minor shoulder instability. This condition was related to shoulder micro-instability without any history of a traumatic event. The authors described the positivity of subacromial impingement and rotator cuff tear test caused by a painful reaction or by irritation of the rotator cuff associated with an anterior micro-instability [7]. Recently, Garofalo et al. reported on a series of 23 patients with an isolated anterior superior labral tear responsible for minor shoulder instability. All patients

complained of shoulder pain aggravated by overhead activities; in 30% of them, there was a positive impingement test and in 39%, tests specifically used to evaluate the anterior supraspinatus tendon tear were positive [9]. Boileau et al. described the unstable painful shoulder (UPS) syndrome indicating instability, presenting in a purely painful form, without any apparent history of instability. They described this syndrome in 20 patients, all younger than 41 years, involved in sports or in manual labour. The main complaint was chronic deep anterior shoulder pain that prohibited overhead activities. A quarter of the patients also complained of night pain [3]. The authors did not, however, state whether there was a positivity in subacromial impingement tests in these patients. However, in 40%, the pain radiated to the anterior aspect of shoulder as in rotator cuff tendinosis.

Trott [19] and Maitland [14] evaluated the specific problems related to the association between shoulder instability and subacromial impingement. These authors independently described 2 different tests to assist in the isolation of occult instability from subacromial impingement. These are the compression and distraction test for subacromial impingement and instability, respectively. These tests are, however, difficult to reproduce and if the two conditions as described as occurring concurrently, differentiation will not be so clear.

The diagnosis of occult or minor shoulder instability can be difficult to establish because patients often do not report subluxation or dislocation or refer to a feeling of shoulder instability. The symptoms described by the patients, as reported in our series, are not specific and clinical examination can be confounding. It is important to suspect occult or minor shoulder instability in patients younger than 40 years complaining of shoulder pain without an history of trauma, also in patients in whom a clinical examination reveals positive subacromial impingement tests. On clinical examination, the pain can be reproduced with the apprehension fulcrum test. In the present series, a posterior pain was present in 17/20 patients. The finding of posterior pain using this test is, however, not specific for occult instability, as it may also be positive in cases of postero-superior impingement. The specific pain of occult shoulder instability during this test should be referred deep and anterior, as reported by other authors [3]. Boileau et al. described the hyperabduction test, the knee shoulder test and the direct palpation test as positive in a patient with an occult instability [3]. However, in their series, most of the patients had a Bankart lesion.

In the present series, the Castagna test was positive in all patients preoperatively. This test is specific for testing insufficiency of the upper part of the capsulo-labral complex. The final diagnosis was established during the arthroscopic examination.

The limitations of our study are related to the small sample size and the non-randomised design. Moreover, the patients did not undergo preoperative imaging study.

The small number of patients included in this study, however, only reflects the fact that isolated occult or minor shoulder instability is a rare and perhaps also an underestimated clinical entity.

We claim, however, that the present study has some strength. To begin with, the selection of patients was carefully carried out; patients with associated pathologies, such as the patient with degenerative osteoarthritis, were excluded. Moreover, these patients all had an occult shoulder instability associated with a positive subacromial impingement test. Finally, all the patients were treated by one experienced shoulder surgeon using a standardised surgical technique. In addition, the patients were evaluated by an independent observer and no patient was lost to follow-up.

Conclusion

Minor shoulder instability can occur in athletes and non-athletic persons under 40 years of age. This pathological condition can present clinically as just shoulder pain with associated subacromial symptoms. These symptoms are related to fatigue of the rotator cuff, while attempting eccentrically to contract to limit GH translation, and secondary atypical subacromial impingement. The diagnosis can often be missed because the symptoms are frequently not specific, and a clinical examination can be confounding. At clinical examination apprehension signs, particularly the Castagna test [7], should be carefully assessed because they could suggest minor shoulder instability as a possible cause of shoulder pain and discomfort. Soft tissue lesions consistent with shoulder instability should be carefully checked and treated arthroscopically. The functional outcome was satisfactory in the majority of patients.

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