Arthroscopic treatment of the atraumatic shoulder instability: a case series with two-year follow-up evaluation

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Summary

***Background*: The purpose of this work is to evaluate the results of arthroscopic capsulolabroplasty in patients affected by atraumatic shoulder instability (ASI).**
***Methods:* A retrospective review was performed of 10 patients (7 women and 3 men) who underwent arthroscopic treatment of symptomatic ASI. Mean age at evaluation was 27.9 (19-35) years and the mean follow-up was 23.3 (12-37) months. We evaluated recurrence rate, range of movement, apprehension and relocation tests, hyperlaxity, and sport activity. The ASES score, the Rowe score, the Simple Shoulder Test (SST) and Visual Analogue Scale (VAS) were also used as outcomes measure.**
***Results*: None of the patients experienced episodes of dislocation or subluxation after surgery. The apprehension and relocation tests produced positive results in 2 patients. Six out of 10 patients reported apprehension with the arm in specific positions. The ASES mean score was 93.4 (55-100); the Rowe mean score was 85.5 (70-100); the SST mean score was 9.1 (5.8-10). On average, external rotation is reduced by 10° in adduction, and by 8° in abduction in 6 out of 10 patients; internal rotation is reduced on average by 6.6° in abduction with the arm abducted, and was overall limited in 6 out of 10 patients.**
***Conclusions:* Arthroscopic capsulolabroplasty ensures excellent results in patients showing atraumatic shoulder instability in terms of recurrence. Still, an underlying insecurity persists and the risk of residual stiffness is tangible.**
Level of evidence: V.

KEY WORDS: atraumatic shoulder instability, multidirectional shoulder instability, capsulolabral reconstruction, AMBRII.

Introduction

The majority of cases reported in the literature and defined as "multidirectional instability" actually are episodes of unidirectional instability in patients with hyperlaxity, which corresponds to about 30% of the instability cases[1]. The dynamic of the first episode of dislocation – whether or not as a direct consequence of a trauma – is crucial in the understanding of the instability: most of the classification systems, in fact, takes into consideration the etiology of the issue[2]. Thanks to a study conducted by Kuroda et al. on 573 shoulders in 341 patients, we know that an atraumatic instability, if not treated, shows spontaneous recovery only in 8.7% of cases[3]. Certainly, the initial therapeutic approach has to be conservative, consisting of reinforcement of the scapular stabilizers, cuff, and deltoid, and proprioceptive exercises[4]. Unfortunately, physiotherapy alone may lead to unsatisfactory results and, according to a recent meta-analysis[5], about 20% of the patients require surgical treatment. The most common surgical procedures to treat multidirectional instability are capsuloligamentous techniques, which include open inferior capsular shift, arthroscopic plication and thermal capsulorraphy[6]. Thermal capsulorraphy has progressively been abandoned. Unfortunately, the identification of the actual results of a rehabilitative or surgical treatment can be misleading, since studies of patients with multidirectional instability include both subjects with traumatic and atraumatic instability. Recently, Katthagen et al.[7] also made the same observation in the field of posterior instability.
Our work aims at evaluating the outcomes of patients who underwent surgery for purely atraumatic shoulder instability with a 2-year follow-up.

Methods

We retrospectively recruited 12 consecutive patients who underwent arthroscopic shoulder stabilization

due to multidirectional atraumatic instability. All arthroscopic stabilization procedures performed between January 2013 and December 2015 in the Ospedale Civile of Latisana (UD), Italy, by the senior Author (E. G.).

Excluded from the study were patients whose first dislocation occurred as a consequence of a non-negligible energy trauma; whose instability was due to overhead sports; who have already undergone surgery on the same shoulder; who received only anterior or only posterior repair of the labral capsular complex; who showed chondral lesions; on whom less than three suture-anchor sutures were used and who suffered the dislocation because of over-head sporting activity.

Included from the study were patients whose first dislocation occurred as a consequence of a daily life movement or a minor trauma; whose capsulolabroplasty treated both the anterior and the posterior sides (straddling the 6 o'clock position); with multidirectional instabilities; constitutionally lax.

It was not possible to contact two patients. Ten patients (83% of the total) were clinically re-evaluated – 7 women and 3 men with a mean age at evaluation of 27.9 years (19-35), and a mean age at surgery of 25.8 years (17-33). All patients had followed specific rehabilitation protocols for at least 6 months obtaining such unsatisfying results to require further surgery. Procedures were performed in arthroscopy, in the lateral decubitus position, by using on average 4.6 anchor-sutures for each patients (3-6); in one case we associated remplissage, in another one, we associated a SLAP lesion repair. In four cases the glenoid labrum did not show lesions at the time of diagnostic arthroscopy. In no cases rotator interval closure was performed. During the post- operative period, patients spent 30 days wearing a mini-sling, and further 30 days wearing it just at night. The average follow-up was 23.3 months (12-37).

We evaluated range of movement, apprehension and relocation tests, hyperlaxity, sport activity, recurrence rate. Four clinical scoring systems were administered: the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES)[8], the Rowe score, the Simple Shoulder Test (SST)[9], a Visual Analogue Scale (VAS). We were able to collect TC-3D pre-operative exams of all patients, and we calculated the glenoid bone loss using the "PICO" method.

This research has been conduct ethically according to international standards[10].

Results

The first dislocation occurred at a mean age of 18.7 years (5-26). No case required external manoeuvres to reduce the first displacement. Six patients reported getting the feeling that the humeral head exited the joint anteriorly, while the other 4 patients were not aware of the direction of the dislocation. After the first episode, the incidence rate of the successive dislocations was very variable: from only one episode (one case), to more than five episodes a day (the most unstable case) (Tab. 1). Three out of 10 patients were treated at the ER to reduce the dislocation, but only following the first episode. Five out of 10 patients reported contralateral shoulder instability.

Eight patients showed symptoms of hyperlaxity according to the Beighton score[11].

None of the 10 patients experienced episodes of dislocation or subdislocation after surgery.

Seven patients used to practice sporting activity; 3 patients interrupted sporting activity after the first episode of dislocation (1 because of the shoulder); after surgery, 1 patient interrupted sporting activity for non-medical related reasons. Of the 3 patients who did not do sport, 1 started swimming after surgery. In general, 7 out of 10 patients were practising sporting activity both before the dislocation, and at the time of

Table I. Patients data.

Patient	First dislocation event	Age at first dislocation	Year(s) between dislocation and surgery	Dislocations frequency	Subluxation frequency
1	Wearing a backpack	15	9	5 a day	
2	During the night	5	17	2 a month	
3	Stretching while studying	26	3	1 a day	
4	Table tennis slam dunk	21	2		5 in all
5	During elevation and extra-rotation, while playing basketball (no trauma)	15	2	4 in all	
6	Tightening a pole in the snow	25	2	10 in all	
7	Climbing	26	1	0	3 in all
8	Moving a chair	12	21	1 a week	
9	Hitting a tennis forehand	20	11	1 in all	
10	Doing push-ups at the gym	22	4	3 a week	

the follow-up evaluation.
The mean ASES score was 93.4 (55-100); the mean Rowe score was 85.5 (70-100); and the mean SST score was 9.1 (5.8-10).
One patient rates its pain 8 according to the VAS, mainly in the evening after carrying out particularly heavy tasks during the day. Other patients do not report significant pain in the operated shoulder; mean VAS score was 1.5 (0-8).
The apprehension and relocation tests produced positive results in 2 patients, mild results in 2, and negative results in 6.
Six out of 10 patients reported apprehension with the arm in specific positions as resulted in the Rowe Score.
All patients experienced full recovery of shoulder elevation and abduction, except for 1 subject who shows a 40° difference compared to the contralateral limb. Three patients are slightly stiffer compared to the contralateral side in internal rotation (man on the back), while in external rotation in adduction, 3 patients show a marked stiffness (Fig. 1) (20°- 40° difference), and 3 patients show a mild stiffness (5°). With the arm abducted to 90°, 5 patients show a limitation of internal rotation (1 of 30°, 2 of 10°, 2 of 5°), while in external rotation, 4 patients show a lower articular width: 1 of 30°, 2 of 20°, and 1 of 10°. On average, external rotation is reduced by 10° in adduction, and by 8° in abduction in 6 out of 10 patients; internal rotation is reduced on average by 6.6° in abduction, and was overall limited in 6 out of 10 patients (Tab. II).
None of the patients shows sensory or motor deficits of the axillary nerve, and in no case signs of infection, superficial or deep, did emerge.
Among the ten TC-3D exams retrieved, just one showed glenoid bone loss (equal to 6.1% of the surface area). The apprehension test of the patient in question produced a positive result; she suffered one dislocation each week prior to surgery, and 21 years passed between the first episode of dislocation and surgery. This interval between the first dislocation and surgery was the longest in the entire study (Tab. I); other long intervals were of 17, 11 or 9 years.

Discussion

An atraumatic dislocation is caused by a low kinetic energy, which in standard conditions would not result in the humerus dislocation. Laxity, instead, is a generalised tissue characteristic that may or may not be related to the instability; likely, it plays a role in predisposing to an atraumatic instability[12], but it is not an absolute condition.
Both in our study and in the one conducted by Kuroda et al.[3], not all atraumatic patients show signs of generalised hyperlaxity. Moreover, constitutional hyperlaxity has no direct connection to apprehension during the post-operative period: between the 2 patients who did not fit the hyperlaxity criteria, 1 shows apprehension while the other does not.
The most used term in literature as opposed to traumatic instability is “multidirectional”; studies that examine these patients, though, have wide inclusion criteria: they include traumatic and atraumatic patients, hyperlax and not hyperlax patients, as well as subjects treated with different surgical techniques. That is because they suffer the absence of a standard definition of multidirectional instability in literature[13]. Al-

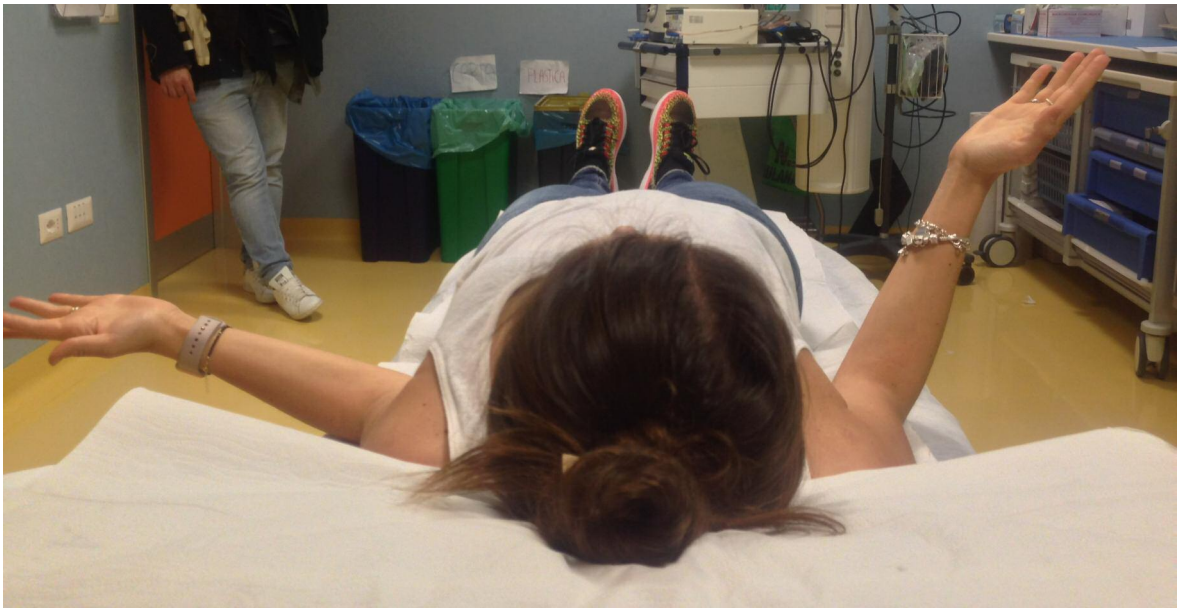

Figure 1. Patient with the broader external rotation deficit in adduction of the series.

Table II. Degrees of difference between the operated limb and the contralateral one in different directions are represented. Adduction position: elbow leaning on the side. 90° abduction: shoulder abducted to 90°. Regarding the internal rotation in adduction, only subjects with a difference compared to the contralateral side (YES) are reported.

			In adduction		In 90° abduction	
Patient	**Elevation(°)**	**Abduction(°)**	**Internal rotation**	**External rotation(°)**	**Internal rotation(°)**	**External rotation(°)**
1	40	40	YES	20	10	20
2	0	0	YES	5	10	20
3	0	0	NO	0	0	0
4	0	0	NO	0	5	0
5	0	0	NO	0	5	0
6	0	0	NO	0	0	0
7	0	0	YES	25	0	0
8	0	0	NO	5	0	10
9	0	0	NO	5	0	0
10	0	0	NO	40	30	30

though all the patients are classified based on their medical history, physical examination, under anaesthesia and arthroscopic evaluations, the wide range of reported lesions indicates that the etiology of the multidirectional instability is multi-factorial and variable[14,15]. It is therefore possible that different pathologies, with different etiologies, are gathered under the same name. By considering only the presence or absence of hyperlaxity, we would not establish a good distinction, since hyperlaxity can be present in both traumatic and atraumatic patients and instability can have different directions[16]. For these reasons, we focused on one aspect of the pathology: the atraumatic onset. In literature, this aspect is rarely considered on its own, but it can be the key to reduce the variables under investigation.

Atraumatic shoulder instability affects a small group of patients: Rowe's classic study shows that 4% of instability cases can be classifiable as atraumatic, while 96% has a traumatic root cause[17]. The distinction between instability of traumatic origin and instability of atraumatic origin is extremely important, to the extent that the majority of classifications considers it; the problem is that the distinction between these two instabilities is not always clear[18]. We need to consider the mechanism that determined the first dislocation, since atraumatic recurrences due to anatomical lesions (capsuloligamentous or bone lesions) or neuromuscular imbalances caused by recurrent dislocations can arise even after traumatic dislocations. Even after the first atraumatic dislocation, or its recurrences, anatomical lesions can arise; considering the long levers involved, small forces are sufficient to cause ligament detachment[19]. For these reasons, excluded from the study were patients with first-time traumatic dislocation, while we included patients with capsuloligamentous lesions. The recruited patients suffered from what we could define as a "Low Energy Dislocation" (LED). In LED cases, low kinetic energies cause the first episode of dislocation/subdislocation: the most part occured while doing activities of daily living (ex. wearing a backpack, moving a chair), others due to an external factor that would have never cause a dislocation (ex. tennis forehand).

When reviewing their results on 43 athletes' shoulders, Baker et al.[14] noted similar outcomes in terms of clinical scores and stability in patients with traumatic and atraumatic onsets. The number of patients in a group or in the other is comparable (21 atraumatic, 22 traumatic). They classified into the atraumatic group patients who "could not recall a traumatic injury to their shoulder". The fact that all the included patients were athletes (of which 52% doing over-head sports) can suggest that the atraumatic onset was actually the result of repeated micro-traumas occurred during sporting gestures: acquired instability in overstressed shoulder (AIOS). This group of patients has completely different characteristics compared with this study.

In order to avoid falling into the group called AIOS, we excluded patients who suffered the dislocation because of over-head sporting activity.

Raynor et al.[20] compared the outcomes of an arthroscopic pancapsular capsulorraphy with suture anchors for the treatment of patients with atraumatic and traumatic multidirectional instability. At final follow-up, at least 2 years out from surgery, patients with traumatic onsets demonstrated higher scores, fewer subluxations and were significantly more satisfied than those with atraumatic onsets.

The Authors of a recent article[21] evaluated the outcomes of 50 patients with atraumatic symptomatic multidirectional instability treated with arthroscopic

plication. They did not include patients with labral or capsular lesions; the surgical technique consists of capsular plications of the antero-inferior portion only, using No. 1 polydioxanone sutures. At a 5-year follow-up, about 83% of the patients achieves a good - excellent Oxford Instability Score. Among the 14 patients described by the Authors as "posterior instability", 2 experienced a recurrence. However, their 4% recurrence rate is lower than the one reported in the literature[5].

The thin and exuberant capsular tissue usually located in this kind of patients can be due to a muscle imbalance: when the dynamic restraints are not working, the capsule remains the first stabiliser against the translating forces, and it can result in fatigue failure[22]. In the surgical treatment of this type of patient, in addition to retensioning the capsuloligamentous complex, it is essential to support also the shoulder neuromotor control, the main pathological element responsible for the atraumatic instability. Treatment must address the entire inferior portion of the articulation, from the anterior to the posterior part. A "bumper" must be re-created along the subequatorial glenoid rim to increase the depth of the glenoid and facilitate concavity-compression. Therefore, we excluded from the study all the procedures where a capsulolabroplasty was performed only anteroinferiorly or only posteroinferiorly.

According to Stanmore classification[18], atraumatic instabilities have to be divided into two groups: instabilities caused by structural issues, and instabilities due to muscle pattering disorders (non-structural). The distinction between the two groups is often not clear; therefore, the Authors suggest using electromyography as diagnostic instrument. To this day, though, it has not being proved how the electromyography could be so useful in these cases, since there is no clear consensus on cases of glenohumeral instability, neither in terms of muscle activity nor in terms of recruitment timing[23]. For this reason, we consider both groups as a single one, since we believe that the atraumaticity and the neuromuscular dysfunction are strictly interrelated, and that the electromyography cannot draw a clear boundary line.

We had no cases of recurrences: dislocation or subluxation. In studies that evaluate patients with multidirectional instabilities using arthroscopic techniques, the incidence rate of dislocation or subluxation recurrences is low (6-7.8%); similar results can also be obtained with open procedures, as the open capsular shift, with a 7.5-9.9% incidence rate of recurrences[5,24]. The recurrences reported in literature were not high neither with the first arthroscopic methodologies, as the Caspari's one[13]. Today, therefore, the recurrence cannot be considered as the main outcome, but it is necessary to evaluate further aspects.

Sixty percent of our patients reports apprehension during specific movements of the superior limb; this factor leads us to believe that the capsulolabroplasty and the creation of a "bumper" using capsular tissue ensure a good stability, but it seems insufficient in helping the patients to regain a good neuromotor and proprioceptive control.

None of the patients complained about the joint range of motion reduction; all the patients were able to carry out daily and work activities without noticeable effort. Residual articular limitation due to surgey, even small, affected a significant percentage of patients (60%). Moreover, since the majority of patients had a constitutional ligament laxity, the articular width is minor compared to the contralateral limb (Fig. 2), even if it would fall into the normal range. During the postoperative period, all patients were advised not to force the full joint recovery until a year after surgery, as suggested by Matsen[19]; this factor, together with capsular plications, can lead to a residual stiffness.

New surgical approaches that need a milder tightening of the joint capsule, in order not to lose ROM, and firmly stimulate the proprioceptive-neuromuscular system to reduce patient apprehension should be considered in the future.

The originality of our study lies in the fact that it investigates surgical results of shoulder instabilities by examining the etiology of the problem (atraumaticity), rather than its direction (multidirectional) or the constitutional component (laxity).

The main limitation of this study is its retrospective nature. We have no pre-operative data regarding scores, ROM or clinical tests. By anamnesis and surgical records, we could be able to collect just: frequency of dislocation/subluxation, age at first dislocation, years between first dislocation and surgery (Tab. I), pre-operative sports and TC-3D. A further limitation is the small sample size: by examining such a small number of patients, it is not possible to draw conclusions able to guide the clinical practice, but we can open the way to remarks useful for further studies. Low incidence of this pathology, infrequent recourse to surgery, and strict inclusion criteria allowed the inclusion of only 10 patients treated during the considered time range (2 years). In 2004, Werner et al.[25] published a study of 43 patients with inclusion criteria similar to ours; this work takes into consideration the anatomic lesions found at diagnostic arthroscopy while not considering the surgical treatment or the clinical results. We broadened the exclusion criteria by exclusively considering surgical procedures with specific characteristics, thus decreasing the number of patients included but standardising the treatment.

The capsulolabroplasty performed on the entire distal portion of the glenoid bone, from the anterior to the posterior part, in patients with atraumatic shoulder instability, ensures good results in terms of short-term follow-up recurrence; however, it does not eliminate the apprehension and it leads to a mild residual stiffness.

Conflicts of interest

The Authors declare no conflicts of interest concerning this article.

Figure 2. The external rotation in abduction of the operated shoulder (at the bottom) fits standard normal distribution but it proves reduced compared with the hypermobile contralateral side (above).

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