



## Research article

# Open versus arthroscopic surgery in acromioclavicular separation

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### Abstract

Acromioclavicular separation is a very serious injury at the level of shoulder. Lesion of the acromioclavicular joint is a usual clinical condition because of its superficial situation. It is often involved in trauma of the shoulder girdle. Rockwood classification involves VI types of modifications. First three types are treated conservatively, type IV to VI surgically. Arthroscopic techniques, lead to same middle and long-term results as open surgery.

Arthroscopic procedures have theoretical advantages of no deltoid disruption and may help the surgeon to diagnose and treat associated lesions such as rotator cuff ruptures. More recently, arthroscopic surgeries for fresh and/or chronic acromioclavicular disjunctions were proposed. We analyzed 13 cases of acromioclavicular separation: 7 cases were treated with open surgery and 6 arthroscopically using tightrope, or dog bone button.

### Keywords

: acromio-clavicular separation, arthroscopy, tight-rope, Rockwood classification

### Highlights

- ✓ Acromioclavicular separation is pretty common injury in athletic patients. Type I and II are treated nonoperatively, while type IV, V and VI are treated operatively.
- ✓ Arthroscopic assisted AC reconstruction has the advantage of minimally invasive procedure, allowing a good visualization of the coracoid and glenohumeral joint.

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## Introduction

AC joint is a diarthrodial joint with a variety of movements with an intra-articular meniscal type disc. It is surrounded by the capsular who is thickest superior and thinnest inferior. Coracoclavicular ligaments connect clavicle with thorax and offer stability (superior-inferior). There are two ligaments: conoid medial and trapezoid lateral. The biomechanics of AC joint include a range of 3 mm of translation in all planes, 45 degrees of rotation but in relation to acromion only 5-8 degrees and most of the motion occurs in extremes. Antero-posterior stability is conferred by AC joint capsule of which the anterior, inferior and posterior give 44% stability and superior capsule 56% stability (1).

Acromioclavicular (AC) joint dislocation is very frequent injury among physically active people and was a topic of interest and treatment controversy since writings of ancients Hippocrates and Galen. It is typically a result of a direct trauma to the superior aspect of the shoulder, as is in falling directly on the shoulder. In this situation, the collar bone (clavicle) separates from the shoulder blade (scapula). In the process the scapula is drove downward and medial. During the trauma, the ligaments that stabilize the AC joint are injured, and if the force is severe enough, they are torn, which produces separation of clavicle from the shoulder blade. This produces a bump or bulge above the shoulder. The injury can range from a mild sprain without a bump to a complete disruption with a very large bump (2, 3).

The AC joint is a diarthrodial joint. Static stability comes from capsular thickening and ligaments and from another two extracapsular coraco-clavicular (CC) ligaments: the coronoid and trapezoid. The CC ligaments are the main restraint to inferior and medial translation of the scapulohumeral complex in relation with to the clavicle (4).

After trauma, the first symptom is pain at the anterosuperior part of the AC joint. A thorough physical examination find: in type I and II swelling and bruising at the level of joint; in type III to VI a bulge. At palpation AC joint is sensitive, an edema could be detected and prominence of the joint. Positive piano key sign and drawer test can be noticed. The range of motion is painful and limited (5).

An important investigation is the radiographic assessment of the injured and uninjured shoulder. A standard radiograph is done (anteroposterior, axillary and lateral view). On x-ray is determined the degree of clavicular displacement. Sometimes, a stress

radiographs is necessary. This is obtained asking the patient to take 10-15 lbs. weights in each hand. Supplementary imagistic procedures are not usually necessary (6).

Using the Rockwood classification, type I and II are universally treated nonoperatively. Type IV, V, VI are absolute indication for surgical correction. Management of patients with type III separation is still in debate, with 87-96% rate of success in both operative, or nonoperative treatment. In orthopedic literature, there are a lot of techniques described, the purpose being to stabilize the distal clavicle to acromion (7).

Fixation with TightRope suture button (Naples, Florida, USA) is one of the many surgical procedures available to address acromioclavicular separation. It consists of tensioning of a no. 5 Fibrewire suture secured at both ends to low-profile metallic buttons. This technique provides a various advantages with only a few possible complications (8).

## Materials and Methods

We analyzed 13 cases of acromioclavicular separation type V (Figure 1, a - b); 7 cases were treated with open surgery and 6 arthroscopically using TightRope, or Dogbone Button. 9 cases were acute, and 4 cases were chronic needing allograft wrap: gracilis (9).

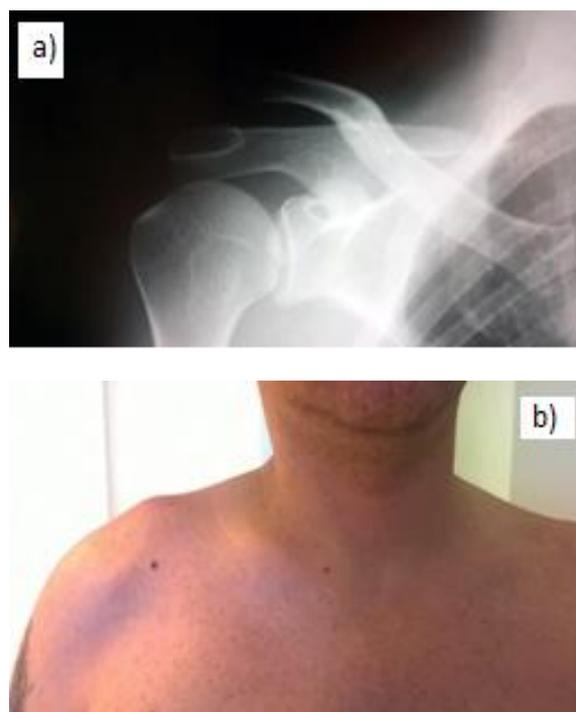


Figure 1. a) radiologic aspect b) clinical aspect of AC separation

Twelve cases were males and only one case was women. Average age in open surgery group was 49 years and in arthroscopic operated group 42 years. In all cases, surgery was performed with the patient in the beach-chair position.

In open procedure we used deltopectoral approach with small disruption of deltoid from the clavicle. In arthroscopic procedures we used standard posterior, anterior, antero-lateral approaches and superior clavicular incision. Arthroscopic procedure allowed us to inspect gleno-humeral joint and subacromial space too, preserving deltoid insertion.

In both procedures was used the same system TightRope, or Dogbone Button (Arthrex) who consisted of two titanium buttons connected by a FiberWire suture (Arthrex) and introduced through a drill hole using a special guiding device. After the inferior subcoracoidal button has been flipped, the TightRope is secured tying a knot onto the clavicle (Figure 2).



**Figure 2.** Subcoracoidal button of TightRope

After surgery, 6 weeks the shoulder was protected in sling, allowing active moving up to 90 degrees. Between 6-12 weeks was allowed active range of motion over 90 degrees of flexion/ abduction and exercises of muscular strengthening. Sports were permitted after 6 months after surgery. One patient with open surgery had a fracture of coracoid process and needed another intervention. Every patient was evaluated using Constant score scale. The mean postoperative follow-up period was 18 months.

## Results

Surgical treatment of acromioclavicular dislocation is typically reserved for full displacements. In acute dislocation of the acromioclavicular joint, reconstruction of the coracoclavicular ligaments has also been employed. Surgical options are numerous; surgeons can choose from dozens of techniques. We currently opted for the Arthrex® TightRope system which seeks to substitute the coracoclavicular ligaments

through four Arthrex® No. 5 Fiberwires so that they are supported in tension through supraclavicular and infracoracoid metal buttons (Figure 3, a-b). In chronic dislocation is necessary augmentation with allograft (gracilis).



**Figure 3.** Postoperative aspect in a) open surgery versus b) arthroscopic surgery

All patients obtained a good Constant score. In group with open surgery score was 89 and in group operated arthroscopically 91. Range of motion at 6 months and 1 year after surgery was normal in 8 open operated cases and in 5 arthroscopic operated group. The rest of patient had a small limitation at internal rotation (up to T12 vertebra). One case of open operated patient needed revision because of coracoid fracture. Vertical and horizontal post-operative AC joint stability (10) are the main factors affecting final outcome; in fact, the best results are recorded in patients with completely stable joints (11) (Figure 4 and Figure 5, a-b).



**Figure 4.** Postoperative shoulder X-ray



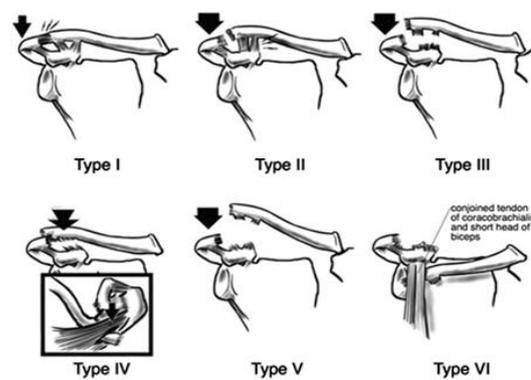
**Figure 5.** Postoperative range of motion at a) 6 weeks, and b) 12 weeks

## Discussions

AC separation is a very painful and common injury among physically active people, the most frequent mechanism being falling onto the superior shoulder girdle. The injury of AC joint produces pain and affects the stability of the entire shoulder and arm. Depending of the severity of the trauma, ligaments can be elongated, or torn. If only the AC ligaments are affected, the clavicle remains stable in its place, but when CC ligaments are ruptured, the whole shoulder unit is involved.

The most common classification for acromioclavicular joint injuries is Rockwood classification (1). It was modified by Allman (1967) and Tossy (1963) (2).

- Type I: clavicle not elevated; CC ligament mild sprain.
- Type II: clavicle elevated, but not above the superior border of the acromion; CC ligament ruptured.
- Type III: Clavicle elevated above the superior border of the acromion, but coracoclavicular distance is less than twice normal (i.e. <25mm).
- Type IV: clavicle displaced posteriorly into trapezius; CC ligament ruptured.
- Type V: Clavicle is severe elevated and coracoclavicular distance is more than double; CC ligament ruptured.
- Type VI: Clavicle inferior displaced behind coracobrachialis and biceps tendon; CC ligament ruptured (Figure 6).



**Figure 6.** Rockwood classification of AC separations

The prevalence of AC separation for Type III, or higher is 14,5 per 100 000 population. The incidence depends on the activity level or what they are doing. Acromioclavicular separation generally occurred less often on women comparable to men (1:9). The high-risk groups are represented by young and active men. Rugby players have 32% incident (3, 4). There are also another associated pathology that occurs at the time of AC dislocation. Pauly et al. and also Tischer et al. (both 2009) proved that 15.0% to 18.2% of any patients with acromioclavicular separation suffered in addition a concomitant intraarticular injury (altogether 20 of 117) (5, 6). The typical concomitant injuries were represented by rotator cuff injuries, and SLAP-lesions (Superior Labral tear, Anterior to Posterior) or fractures. Older patients have a higher incidence of associated pathology (>45 years old 67%, <years old 29%). In chronic cases incidence is higher: > 3 months 56%, <3 months 36%. Injury of the AC joint produces pain and instability in shoulder and superior arm. The pain becomes more severe when patient lift arm overhead, or tries to sleep on the affected side.

Treatment options: Type I, II observe, Type IV and higher operation, Type III controversial (7).

Type III injuries should be surgically managed only in patients with high-demand sport or working activities. As procedures the most common are: K wires across the AC joint, screw fixation into CC, hook place, coracoid circlage and ligament reconstruction (8).

From a biological point of view, the surgical treatment of an acute lesion mainly offers a guide for the remnant fibers of the torn ligament to be correctly aligned and heal along the neo-ligament.

Arthroscopic procedure allowed a better visualization of the base of coracoid process which permitted a better placement of the button. Also avoided rupture of the deltoid muscle and preserved superior AC

capsule. Open surgery group offered also good results. Open technique is a choice for those surgeons who don't have arthroscopic experience.

The literature confirms the effectiveness of the Arthrex® TightRope system, which reinforces the effectiveness of the method and thus encourages the application of this minimally invasive procedure (12, 13).

## Conclusions

AC separation is pretty common injury in athletic patients. Type I and II are treated nonoperatively, while type IV, V and VI are treated operatively. Treatment of type III injury is still controversial, in some situations is operated, but in others is treated conservatively. The purpose of the surgery is to restore the AC joint stability, rebuilding the CC ligaments.

Utilization of Arthrex® TightRope system proved to be very effective in treatment of A-C separation. All 12 cases were treated using Arthrex® TightRope system, because this device recreates the CC ligaments complex.

Arthroscopic assisted AC reconstruction has the advantage of minimally invasive procedure, allowing a good visualization of the coracoid and glenohumeral joint. It is restricted of the experience of the surgeon with this technique. Arthroscopic procedure proved to be very effective in our group, but there is no evidence to sustain the superiority in long term over open technique. Further studies are necessary to confirm the results and optimal treatment.

## Conflict of interest disclosure

There are no known conflicts of interest in the publication of this article, and there was no financial support that could have influenced the outcomes. The manuscript was read and approved by all authors.

## Compliance with ethical standards

Any aspect of the work covered in this manuscript that has involved human patients has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

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