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Title:
Old Unreduced Acromio-clavicular Joint Separation

by

Dr. Hermawan Nagar Rasyid, MD, PhD

Department of Orthopaedics and Traumatology
Faculty of Medicine Universitas Padjadjaran
dr. Hasan Sadikin Hospital
Bandung - Indonesia
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Hermawan Nagar Rasyid

Department of Orthopaedics and Traumatology
Faculty of Medicine Universitas Padjadjaran
Dr. Hasan Sadikin Hospital, Bandung – INDONESIA

Abstract

Acromio-clavicular joint (AC joint) injuries commonly result from a fall onto the point of the shoulder with the arm in adduction that produce a downward force on the acromion, it can lead to rupture of the AC and coracoclavicular (CC) ligaments leading to complete separation. It comprises 3-5% of all shoulder girdle injuries. Along with clinical examination for tenderness and instability, radiographic examination is critical in the evaluation of AC joint injuries. Recommended treatment for stabilization in cases of old unreduced AC dislocation included reconstruction of coracoacromio (CA) and CC ligaments. In this presentation, we choose the old unreduced dislocation (Allman classification Type-III) as the subject, and treated using Neviaser method. Nine patients treated by this technique and followed up were done. All patients were male and the average age was 38.5 (20 to 57) years. The causes of separation were falls on the shoulder in five (50%), traffic accidents in three (30%) and direct trauma to the shoulder in one (11%). The average interval between the accident and the surgery was 12 weeks (range 10 to 16 weeks). The cases were followed up with an average period of two and a half years. The results were evaluated by Imatani’s scoring system including movement, relief of pain, functional ability. The results were good in six (66%) patients, two patients (22%) had fair results with pain of the upper extremity and one (11%) patient had poor result. Since anatomic reduction and firm are imperative to maintain the integrity post-repaired, old unreduced are best treated surgically, in particular for young and active persons, severely displaced cases and overhead workers. We consider that Neviaser method by reconstruct some important ligament is a good alternative in the treatment of old unreduced acromio-clavicular dislocation.

Keywords: Imatani’s scoring system, Neviaser’s methods, Old unreduced acromio-clavicular joint separation
Introduction
The AC joint is a joint in the shoulder where the collar-bone (clavicle) meets the shoulder blade (scapula). This is in contrast to the glenohumeral joint, the main “ball and socket” shoulder join. Comprises 3-5% of all shoulder girdle injuries, 40% of high-performance athletes’ shoulder injuries. Trauma may tear AC ligaments as well as result in apparent superior subluxation of the clavicle. The majority of injuries to the AC joint, which lies between the outer end of the clavicle and part of the scapula called the acromion are sprains. These normally occur after a fall onto the point of the shoulder with the arm in adduction that produce a downward force on the acromion or tackle where the structures that normally control the joints stability are loaded and partially torn. The forces from the fall can lead to rupture of the CC ligaments leading to complete separation of the joint, along with clinical examination for tenderness and instability. Radiographic examination is critical in the evaluation of AC joint injuries. Most sprains although painful will settle with time, applied ice and physiotherapy to rehabilitate the injured area. If these structures are completely disrupted and the joint is rendered unstable early surgery may be occasionally required particularly in younger patients, particularly those engaged in contact and overhead sports (basketball, soccer, tennis). In some cases of longstanding instability of the joint reconstructive surgery may be required to restore more normal relationships between the scapula and clavicle. Common reconstruction techniques include either coracoclavicular (CC) ligament reconstruction with or without clavicle resection such as modified Weaver-Dunn or CC stabilization with Bosworth screw with repair or reconstruction of the CC ligaments. In these cases stabilizing of old unreduced AC dislocation with CA ligament transfer, CC ligament reconstruction and imbrication of AC joint roof were performed.

The acromioclavicular and sternoclavicular joints (anatomy and biomechanics)
The clavicle may be regarded as a link, jointed at each end, connecting the scapula to the sternum (Fig. 1). Movement of the scapula must occur about a fulcrum at one or both ends if this link. In the normal shoulder movement of the scapula, with consequent movement at the AC and SC joints, occurs mainly 1) during elevation of
the arm above 90 degrees; and 2) when the shoulders are braced backwards or drawn forwards.²

Joint Stability:
Dynamic stability: deltoid and trapezius muscles inserts blended to the superior AC ligament and capsule. Anterior deltoid origin in the clavicle is just medial to the AC joint, and superior trapezius fascia insertion blends to the posterior-superior AC joint capsule and dorsal clavicle. May add strength and stability when contracted but dynamic stability in this joint is poorly understood. Static stability: AC and CC ligaments play an important role, wherein AC ligament works as a horizontal stability and the CC ligaments for vertical stability. Conoid ligament located in 46 mm medial to AC joint and posterior, and trapezoid ligament located 26 mm medial to AC joint, mid-portion of the inferior surface of the clavicle.⁴

Biomechanics:
Osteokinematics of the AC joint includes clavicle rotation on its own axis and scapular upward and downward rotations, sagital and horizontal plane adjustments. The superior, inferior, and posterior AC ligaments insert an average of 16 to 20 mm medial to the AC joint on the clavicle undersurface. The implication of this anatomic observation is that aggressive distal clavicle excision (DCE) can destabilize the AC joint and lead to symptomatic posterior impingement against the acromion. Motion in the clavicle is necessary although when fused (AC or CC bone bar) still allows normal elevation and abduction. Under physiological loads, AC ligaments and capsule are the primary restraints for both horizontal and vertical forces. Under greater forces and displacements the CC ligaments resist to vertical, horizontal and compressive forces.³ Trapezoid ligament resists axial compression.⁴

Figure 1. Anatomy and biomechanics of the AC and SC joints.³
Clavicle rotates 40-50 degrees on its own axis in synchrony with scapular motion. Most of the motion occurs on the sternoclavicular joint (SCJ). There are only 5 to 8 degrees of motion at the AC joint. Scapulothoracic elevation is an elevation on the SCJ and downward rotation at the AC joint; wherein scapulothoracic retraction is defined as retraction of the SCJ with slight horizontal slides and adjustments of the AC joint; scapulothoracic upward rotation is defined as elevation of the SCJ and upward rotation at the AC joint. Clavicle motion is necessary to assist scapular movements on the thoracic wall. It helps to keep the scapula in its functional position and motion, critical to the shoulder normal function. It has a great role on maintaining scapulohumeral rhythm. Although most of clavicle motion occurs on the SCJ, the AC joint contributes with an important role in the shoulder biomechanics and it's a very common source of traumatic, inflammatory and degenerative problems.

**What structures are damaged in AC joint instability?**

Persistent upward displacement of the lateral end of the clavicle is a common sequel to traumatic dislocation or subluxation of the AC joint. In most cases the displacement is slight and causes no symptoms. Exceptionally there is pain, worse during full elevation of the arm. On examination the lateral end of the clavicle is unduly prominent, and a distinct step can be felt between it and the surface of the acromion.

**Classification**
The most widely used classification is that of Rockwood et al. It is important to note that this is a purely radiographic classification system. In a type I injury, there is sprain of the AC ligament only. There is no radiographic abnormality. In type II injury, the AC ligament and joint capsule are disrupted. The CC ligaments are intact but sprained. There is 50% vertical subluxation of the distal clavicle. In Type III injury, the AC ligaments and joint capsule as well as the CC ligaments are disrupted. The deltotrapezial fascia is sprained. There is 100% superior displacement of the distal clavicle. In Type IV injury, there is posterior subluxation of the clavicle into the trapezius. This is best seen on axillary radiographs. A type V injury is an
exaggeration of a type III because of additional complete rupture of the deltotrapezial with 300% superior displacement of the clavicle. In the rare type VI injury, there is subacromial or subcoracoid displacement of the clavicle.

**Approach to patient evaluation**

Symptoms of all injuries are local superior shoulder pain over the AC joint, deformity occurs with types 2 and 3 injuries. Pain over AC joint with active internal rotation can be found. On inspection looks swelling, muscle wasting, deformity, outerclavicle prominence, changing in scapular posture. Whereas failure to reduce indicates violation of this fascia with the distal clavicle buttonholed through it (type V). Distinguishing between type III and V injuries may facilitate by having the patient shrug both shoulders, which in a type V injury exaggerates the degree of displacement. Asking the patient to shrug his/her shoulder is a useful method to determine if the deltotrapezial fascia is intact (clavicle reduces, type III injury) or if it has been violated (clavicle remains dislocated, type V injury). Other symptoms are localized tenderness to ACJ, piano-key sign range of motion (ROM) is usually minimally affected.

Special tests:

- Cross-arm adduction test: pain on forced adduction of elevated arm
- O’Brien’s active compression test: pain localized to the superior shoulder.⁶ (A recent analysis of these maneuvers found cross-arm adduction to be sensitive (77%) and the active compression test of O’Brien to be 95% specific).⁶
- Scarf test: forced cross body adduction in 90° flexion, pain at the extreme of motion over the AC joint is indicative of AC joint pathology

**Further Investigation**

**Radiographs**

a. Bilateral anteroposterior (AP) view of AC joint, the distance from the superior aspect of the coracoid process to the inferior aspect of the clavicle on both sides is measured.

b. AP view will show subacromial or subcoracoid displacement of the clavicle (type
VI injury), which is rare and has not been seen in the authors’ practice.

c. The axillary view helps assess posterior displacement of the clavicle through a torn trapezial fascia (type IV injury),

d. Bilateral Zanca view,\textsuperscript{7} Zanca originally described a specialized view for the AC joint whereby the x-ray beam is angled 10 cephalad to eliminate the overlap of the clavicle with the spine of the scapula. Since the AC joint is more subcutaneous than the glenohumeral joint, accurate visualization of the AC joint (Zanca view) requires only a third to half of the radiographic penetration that is used for a standard AP shoulder projection. The normal CC distance is between 1.1 and 1.3 cm, on average. Bearden and colleagues reported that complete CC ligament disruption is indicated by an increase in the CC distance of 25% to 50% compared with the contralateral shoulder.

e. Basmania view defines AC joint injuries as either stable or unstable, and this is determined by the use of an AP radiograph of the affected shoulder with the arm adducted across the chest.\textsuperscript{5}

Management
Where treatment of types I, II, IV, V and VI are generally agreed on, treatment of type III remains controversial. A new suggestion emerged for the Rockwood classification by further subdividing the type III AC joint injuries into IIIA (stable) and IIIB (unstable). The basis for the sub-classification is mainly function rather than anatomic. Dr. Basmanian has introduced the cross body adduction radiograph to differentiate
between stable and unstable AC joint. Patients who recover and regain function within 6-8 weeks and whose X-rays show no override on Basmanaiaview, are considered stable (Type IIIA). If the clavicle overrides the acromion on the cross body adduction AP view, it indicates instability of the CC ligaments in addition to the AC joint disruption corresponding to a type IIIB. Normal positioning may be prognostically positive and direct non-operative treatment. Superimposition of the acromion and distal clavicle suggests instability and may indicate a role for surgery

Illustration

Author experience

According to Allman’s classification\(^8\), on plain radiographs all patients were evaluated having old unreduced AC joint dislocation traumatic type III. Since 2008, the authors have reconstructed in nine patients treated by transference ligament of CA and CC ligaments, and followed in the Department of Orthopaedics and Traumatology of Faculty of Medicine Universitas Padjadjaran/ dr. Hasan Sadikin Teaching Hospital, Bandung, Indonesia. The group comprised 9 men with a mean age of 38.5 years (range, 20-57 years), the right side was affected in all patients. The mechanism of injury was falls on the shoulder in five (50%) cases, traffic accidents in three (30%) cases and direct trauma to the shoulder in one (11%) case. Mean time from injury to surgery was 12 weeks (range, 10-16 weeks). Mean follow-up was 17 (range, 12-43 months). When evaluating the success or failure of the procedure, the outcome measures utilized were variable with variable emphasis on pain, function, movementability. Imatani scoring system was use for this evaluation.

The CA ligament has been used for the reconstruction of a dislocated AC joint. It lies adjacent to the disrupted CC ligament. Primary fixation across the AC joint was done; secondary stabilization of the joint by recreating the anatomic linkage between the distal clavicle and the coracoid process; dynamic stabilization of the joint by creating an inferiorly directed force on the distal clavicle; and imbrication of the superior roof of the AC joint. The base of coracoid was excavated from scar tissue. Without releasing the conjoined tendon from the tip of coracoid 3, 3-0 dexon sutures and a piece of fascia lata (1.5 cm wide double layered) were passed under the bent portion of coracoid to reconstruct CC ligament. A drill hole was dug in clavicle just above the
coracoid. Two Kirschner wire (1.8 mm) were used to fix the AC joint from acromion.

Results
According to the Imatani scoring system, mean therapeutic results was 66% yield good result, 22% with fair and poor results in 11%.
The incidence of residual subluxation in the AC joint was evaluated at final radiographic follow-up. In our cases subluxation that represented less than 5 mm of superior translation of the clavicle occurred in two cases.
Meanwhile osteoarthritic changes occurred in the AC joint in 2 (22%) patients with age 55 and 57-year old.

Table 1. Shoulder results after shoulder reconstruction of the old AC joint separation (n=9)

<table>
<thead>
<tr>
<th>Results</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>6 (66%)</td>
</tr>
<tr>
<td>Fair</td>
<td>2 (22%)</td>
</tr>
<tr>
<td>Poor</td>
<td>1 (11%)</td>
</tr>
</tbody>
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Discussion
AC joint separation are frequently treated in clinical practice. The degree or direction of translation of the clavicle against the acromion depends on the injury states of the AC and CC ligaments and detachment of deltoid or trapezius muscle from the clavicle. Many surgical procedures exist for AC joint dislocation, including repair of the AC ligament (Phemister\textsuperscript{9} or Neviaser procedures\textsuperscript{10,11}), fixation between the clavicle and the coracoid process (Bosworth procedure), reconstruction of the CC ligament using the CA ligament (Weaver Dunn and Cadenat\textsuperscript{12} procedures), and dynamic stabilization of the CC ligament by the transferred conjoined tendon (Dewar procedure).
Since 2008, the author has reconstructed the anatomical structure of the CC ligaments (trapezoid and conoid ligaments) with ipsilateral fascia lata used as substitute ligaments, and reconstruction using coracoacromial(CAL) ligament. The CAL can be removed from its coracoid attachment or its acromial attachment and
utilized for stabilization of AC joint. Neviaser published the technique of removing CAL from its coracoid attachment to reconstruct superior acromioclavicular ligament.\textsuperscript{10,11} The removal of CAL from its acromial end and subsequent transfer to distal clavicle for AC joint dislocation was first described by Cadenat\textsuperscript{10} in 1917. He described anterior and posterior fascicle off acromion and sutured it to remnants of the conoid ligament and periosteum superior aspect of clavicle.

The modified Neviaser procedure has some disadvantages, including a difficulty to attach the CA ligament to posterior distal of the clavicle, a long period required for range of motion recovery, incidence of residual subluxation, and postoperative osteoarthritic changes on AC joint.

The mechanisms of stabilization for the AC joint established by the CA ligament transferred from the acromion to the clavicle. This transferred CA ligament does not anatomical reconstruct the trapezius and conoid ligaments that compose the CC ligament. The conoid ligament attaches anatomically to the conoid tubercle, which is located at the posterior edge of the clavicle, and the clavicle can make an axial rotation during forward elevation of the shoulder joint. However, in the modified Neviaser procedure it is possible that this axial rotation of the clavicle is restricted because the transferred CA ligament is fixed to the anterior edge of the clavicle. For this assumption, even if the dislocated AC joint is reduced in a normal position, it is possible that osteoarthritic changes can occur to the AC joint.

Since anatomic reduction and firm are imperative to maintain the integrity post-repaired, old unreduced are best treated surgically, in particular for young and active persons, severely displaced cases and overhead workers.

**Conclusion:**

The modified Neviaser procedure can provide satisfactory therapeutic results and avoid postoperative failure or loss of reduction of AC joint separations. Anatomic reconstruction of both CC ligaments and AC ligaments can be best restore AC joint function.

**References:**

1. Mazzocca A: Traumatic shoulder instability involving anterior, inferior, and


