Technical Note

Reconstruction of the Acromioclavicular Joint Using a Double Augmentation With Hamstrings Tendon and Dermal Graft

Marta Pérez Rodríguez, M.D., Andrea Paniagua González, M.D., Ignacio González Gómez, M.D., Juan Pablo Aguado Fernández, M.D., and Álvaro José Minuesa Asensio, M.D., Ph.D.

Abstract: The purpose of this article is to describe a technique to restore both vertical and horizontal stability using an augmentation of the acromioclavicular ligament complex (ACLC) and coracoclavicular (CC) ligaments with the combination of synthetic and biological support. Our technique introduces a modification in the surgical procedure for acromioclavicular (AC) joint dislocations; it provides the use of biological supplements not only during the repair of the CC ligaments but also when the ACLC is restored due to the use of a dermal patch as an augmentation allograft after the use of a horizontal cerclage. The main purpose of this technique is to replicate the anatomy and functionality of the native ligaments that stabilize the AC joint to improve both clinical and functional results.

The acromioclavicular (AC) joint dislocations are common injuries, especially in young males. They have been classified by Rockwood based on the damage of the coracoclavicular (CC) ligaments and acromioclavicular ligament complex (ACLC). Surgical treatment for grade IV, V, and VI is globally accepted, but the treatment of grade III injuries remains controversial.

Several surgical techniques for the treatment of these injuries have been described, including CC ligament reconstruction to obtain vertical stability or ACLC repair with dermal or tendinous allograft to achieve horizontal stability. Recently, it has been demonstrated that restoring both horizontal and vertical stability is essential to reproduce the biomechanical behavior of the native AC joint.

The purpose of this article is to describe a technique to restore both vertical and horizontal stability using an augmentation of the ACLC and CC ligaments with the combination of synthetic and biological support. It is indicated for acute and chronic AC dislocations following surgery, especially in grades IV and V of Rockwood’s classification.

Our Case

The patient was a 53-year-old man, a right-handed constructor worker, who had 3-m fall in June 2021. He went under surgery for an immediate fixation of a right subtrochanteric fracture.

The patient had a deformity in his right shoulder and reported pain in the AC joint. X-rays and magnetic resonance imaging were performed, showing a complete tear of the supraspinatus tendon and a grade IV dislocation of the right AC joint (Figure 1). In October 2021, supraspinatus repair was performed using a double-row technique and an augmentation with acellular human dermis allograft.

After a rehabilitation program, the patient had complete range of motion (ROM) but continued with strong AC pain during all motion ranges. Both crossbody adduction test and shoulder pointer sign were positive.
Fig 1. Preoperative shoulder images showing anteroposterior right shoulder X-ray in which an acromioclavicular joint dislocation is shown and a 3-dimensional CT-scan reconstruction showing a posterior displacement of the clavicle (Rockwood’s grade IV).

Fig 2. Initial operating room setting. Patient in beach-chair position. Right arm is put into a surgical bracket.
The technique (see Video 1) was performed in April 2022.

**Surgical Technique**

After preoperative interscalene block and induction of general anesthesia, the patient is placed in a beach-chair position (Fig 2).

The surgical team performs the preoperative scrubbing, and the surgical field is prepared. The anatomic landmarks are drawn with a sterile pen (Fig 3). An approximately 6- to 8-cm incision is made from the acromioclavicular joint to the superior aspect of the coracoid process. (ACR, acromion; CL, clavicle; COR, coracoid process.)

Both lateral and medial flaps are separated on top of deltopectoral fascia. Electrocautery is used to open this fascia, and subperiosteal dissection of the deltoid and the trapezoid is made.

The base of the coracoid process is exposed, and provisional primary reduction is achieved with a 1.2-mm Kirschner wire (K-wire) to reduce the AC joint to its anatomical position (Fig 4).

**Achieving Vertical Stability and Augmentation**

To accomplish vertical stability given by the native CC ligaments, a single vertical tunnel is made 3.5 to 4 cm medially to the lateral edge of the clavicle using a 3.5-mm

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**Fig 3.** Anteroposterior surgical view. Beach-chair position. An approximately 6- to 8-cm incision (red line) is made from the acromioclavicular joint to the superior aspect of the coracoid process. (ACR, acromion; CL, clavicle; COR, coracoid process.)

**Fig 4.** Anteroposterior surgical view. Beach-chair position. Provisional anatomical reduction of acromioclavicular joint with a 1.2-mm Kirschner wire. (ACR, acromion; CL, clavicle.)

**Fig 5.** Anteroposterior surgical view. Beach-chair position. Use of Dog Bone guide (Arthrex). *Dog Bone guide. (ACR, acromion; CL, clavicle.)

**Fig 6.** Gracilis tendon allograft prepared with Krakow suture.
Dog Bone guide (Arthrex) and a 2.4-mm cannulated drill (Fig 5). The Dog Bone button (Arthrex) is introduced through the cannulated drill with the assistance of a suture-passing wire, and vertical reduction is obtained.

An 8- to 9-mm and 250-mm-length gracilis tendon allograft is prepared with a No. 2 Krackow suture (Fig 6). This step is followed by positioning the tendinous allograft in an oval shape, inferior to the coracoid process and posterior to medial clavicle. The allograft is sutured medial to the cortical button with a No. 2 nonbioabsorbable suture (Figs 7 and 8). The K-wire is removed to avoid any interferences with the horizontal cerclage positioning.

Achieving Horizontal Stability and Augmentation

We used a modified Recobridge® technique for the reconstruction of the horizontal stability. A 2.4-mm cannulated drill is used to perform a horizontal tunnel in the lateral aspect of the clavicle, 1.5 cm medial to the AC joint (Fig 9). Fibertape (Arthrex) is passed from posterior to anterior into the horizontal tunnel. Electrocautery is used to draw the references of 2 vertical tunnels in the acromion about 1 cm to the center, to measure the length of the dermal patch.

The length of the dermal patch is determined by measuring the distance between both medial tunnel

Fig 7. Anteroposterior surgical view. Beach-chair position. Vertical stability is obtained using Dog Bone button (Arthrex) (red arrow). (ACR, acromion; CL, clavicle.)

Fig 8. Vertical stabilization with Dog Bone button (Arthrex) and augmentation with gracilis tendon allograft in an oval shape; medial end goes posterior to clavicle and lateral end goes anterior to clavicle.

and lateral marks. In this case, a 2 × 4.5-cm-length and a 2-mm-thick dermal patch is used. The references of the acromion vertical tunnels should be drawn in the patch (Fig 10).

Vertical tunnels are performed using a cannulated 2.4-mm drill. Crosslink X shape is obtained by passing the anterior end of the suture tape from superior to inferior through the posterior hole on the lateral surface of the dermal patch and the acromion. The same method is used for inferior to superior with the anterior hole on the acromion and the dermal patch (Fig 11).

The Recobridge technique is finished. Strain should be maintained to avoid losing horizontal reduction. Two small holes on the medial aspect of the patch are done 0.5 cm centered to its edges, and sutures are tied above it, avoiding loss of reduction in this step (Figs 12 and 13). Final configuration is obtained (Fig 14 and Table 1).

Deltoid fascia is repaired using a No. 2 resorbable suture. Layered suture and staples are used to close the skin incision. It is not mandatory to use drainage systems. The arm is put into a sling and an X-ray control is performed to check the adequate reduction of the AC joint (Figs 15 and 16).

During immediate postoperative period, immobilization is kept for 4 weeks. Passive exercises can be started at 4 weeks and active ones at 8 weeks approximately.

**Discussion**

The AC joint is 1 of 4 components of the shoulder girdle, and it plays an essential role as a stabilizing element of the arm in abduction position and as a shock-absorber element of the axial loads over the shoulder. The injuries of the AC joint comprise 12% of
shoulder injuries and approximately 30% to 50% of injuries in professional athletes.\textsuperscript{9,10} The contribution of the CC ligaments vertically and ACLC horizontally (especially the AC superior ligament) maintains the joint’s stability.

Despite the frequency of these injuries, horizontal instability usually is unnoticed in common X-rays, requiring other diagnostic methods and a previous high clinical suspicion.\textsuperscript{9} This is why surgical treatment usually has focused on the reconstruction of the CC ligaments using different fixation techniques.\textsuperscript{11} However, most authors agree on inadequate restoration of horizontal stability with these techniques, which leads to worse clinical and functional outcomes.\textsuperscript{6}

Morikawa et al.\textsuperscript{3} published a biomechanical analysis of cadaveric specimens and studied the ability of recovering rotational and posterior translational properties of different surgical constructions, and they observed that both CC and ACLC reconstruction were the closest to native function. However, none of them achieved a healthy shoulder’s results. The use of a

\textbf{Fig 12.} Modified Recobridge technique with a dermal patch as an augmentation. Red rectangle: dermal patch. (AC, acromion; CL, clavicle.)

\textbf{Fig 13.} Anteroposterior surgical view. Beach-chair position. Final setup of the dermal patch with the suture tape following a crosslink shape. (ACR, acromion; CL, clavicle; DA, dermal allograft.)

\textbf{Fig 14.} Anteroposterior surgical view. Beach-chair position. Final configuration of the acromioclavicular joint reconstruction. (ACR, acromion; CL, clavicle.)
dermal patch reproduced better the biomechanics of the native joint. There are many reports using allografts for CC augmentation, but no studies have combined both synthetic and biological systems to reproduce normal ACLC function. Acevedo et al. described multiple uses of dermal allografts in shoulder and elbow injuries. That is why, based on the good results obtained in other procedures that use dermal allografts as an augmentation, such as the Canopy technique described by Hirahara et al. for rotator cuff tears, we have considered the necessity to use augmentation also for better AC joint functional outcomes.

Due to the lack of agreement in the surgical treatment of these injuries, we propose a change that may help to decide which treatments obtain the best functional and clinical results, even though more studies (especially comparative ones) are needed to clarify this issue.

The advantages of this technique, compared with the classic repair procedures, include a strong structural and biological construction for restoring both horizontal and vertical stability addressing an anatomic reduction in both coracoclavicular and superior AC ligaments. The

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**Table 1. Pearls and Pitfalls**

| A 6- to 8-cm incision from the acromioclavicular joint to the superior aspect of the coracoid apophysis allows the surgeon to perform the whole surgery. The deltopectoral fascia must be intact to maintain its stabilizer property. Provisional reduction is achieved under direct vision using a Kirschner wire. By positioning the gracilis allograft in a modified oval shape, loss of its position in the coracoid process is prevented. Strain should be maintained during the dermal allograft positioning to avoid losing horizontal reduction. Two small holes on the medial aspect of the patch are done and sutures are tied above it to prevent the dermal patch to crease. |

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**Fig 15.** Lateral view. Beach-chair position. Arm is put into a sling.

**Fig 16.** Right shoulder, anteroposterior standing control X-ray in which the acromioclavicular joint is reduced. Yellow arrows: Dog Bone system. *Reduction of acromioclavicular joint.

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**Table 2. Advantages and Disadvantages**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages and Limitations</th>
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<tr>
<td>Strong structural construction for restoring both vertical and horizontal stability.</td>
<td>Increased surgical time.</td>
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<tr>
<td>Biological augmentation of both coracoclavicular and superior acromioclavicular ligaments.</td>
<td>Higher cost derived from the use of allografts.</td>
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<tr>
<td>Addresses an anatomical reduction in both vertical and horizontal dimensions.</td>
<td>Longer skin incision.</td>
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<tr>
<td>Immediate postoperative period seems to be less painful and faster, but more studies are needed.</td>
<td>Dermal allograft over the acromioclavicular joint can be bulky.</td>
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disadvantages of this technique mainly are the increased surgical time with higher costs due to the use of allografts (Table 2).

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References