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Technical Note

All-Arthroscopic Coracoclavicular Ligament Reconstruction Surgical Technique Using a Semitendinosus Allograft and Tenodesis Screws

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Abstract: Acromioclavicular joint injuries account for 9% of shoulder girdle injuries and are most often associated with direct blows to the shoulder or axially directed forces onto the ipsilateral extremity. Type IV, V, and VI injuries are generally managed surgically, whereas type I and II injuries are treated with sling immobilization, early shoulder range of motion, and physical therapy. Type III injuries are more controversial but are generally managed surgically in the active and high-demand patient. When surgical treatment is indicated, the primary goal of a coracoclavicular (CC) ligament reconstruction is to restore anatomic reduction of the acromioclavicular joint and reconstruct the biomechanical forces of the CC ligaments. Many open surgical techniques are currently used to achieve these goals but can increase patient morbidity. We describe a technique for an all-arthroscopic CC ligament reconstruction using a semitendinosus allograft and BioComposite tenodesis screws (Arthrex) without disruption of the deltoid attachment onto the distal clavicle.

Acromioclavicular (AC) joint injuries account for 9% of shoulder girdle injuries and are most often associated with direct blows to the shoulder or axially directed forces onto the ipsilateral extremity.[1] The AC joint is stabilized at the distal clavicle by the AC ligament as well as the coracoclavicular (CC) ligaments. The Rockwood classification system is used to classify AC joint injuries by the extent of damage to these ligaments, as well as displacement or the position of the distal clavicle.[1] Type IV, V, and VI injuries are generally managed surgically, whereas type I and II injuries are treated with sling immobilization, early shoulder range of motion, and physical therapy. Type III injuries are more controversial but are generally managed surgically in the active and high-demand patient.[2]

When surgical treatment is indicated, the primary goals of a CC ligament reconstruction are to restore anatomic reduction of the AC joint and reconstruct the biomechanical forces of the CC ligaments.[3] Many open surgical techniques are currently used to achieve these goals. These techniques may use screw fixation, a button with a TightRope (Arthrex, Naples, FL), suture anchors, or an acromial hook plate.[3,4] Other techniques use free tendon grafts (frequently semitendinosus allograft or autograft) for open reconstruction of the CC ligament, with the use of internal fixation into the distal clavicle to anatomically reinforce the tendon construct.[2,5] We describe a technique for an all-arthroscopic CC ligament reconstruction using a semitendinosus allograft and BioComposite tenodesis screws (Arthrex) without disruption of the deltoid attachment onto the distal clavicle (Video 1).

Surgical Technique

The patient is placed in the beach-chair position. The graft is prepared on the back table with either a semitendinosus allograft or autograft. Although the senior author (X.L.) prefers to use a semitendinosus allograft for this procedure, an autograft is also applicable for this technique. The graft is prepared with a No. 2 braided suture (FiberWire; Arthrex), which is used to whipstitch across the length of the entire graft for augmentation. Another No. 2 braided suture is passed on either end of the graft in a Krackow fashion to help

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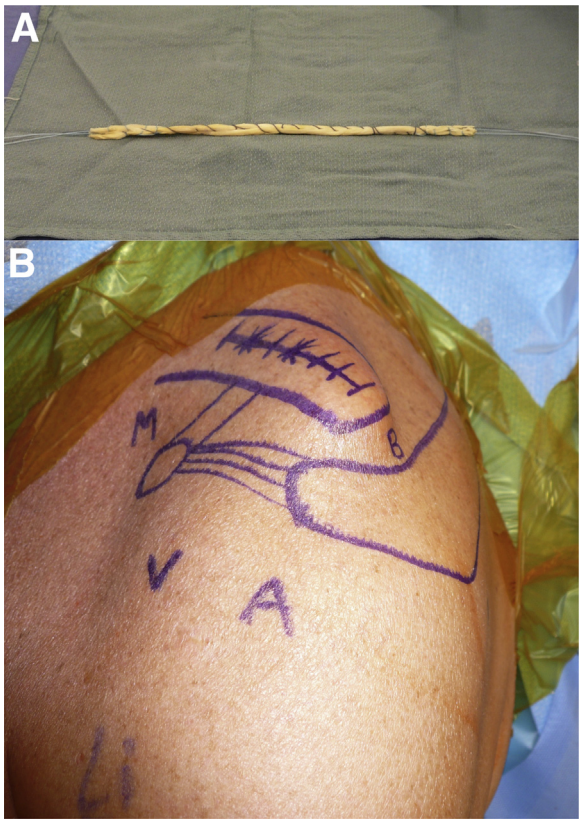

Fig 1. (A) Semitendinosus allograft preparation used for coracoclavicular ligament reconstruction. A No. 2 braided suture (FiberWire) is used to whipstitch the entire allograft to reinforce the biomechanical strength of the reconstruction. (B) The 4 portals used in the all-arthroscopic technique: portal M (medial portal), portal V (anterolateral viewing portal), portal A (accessory anterolateral portal), and portal B (acromioclavicular joint portal). A left shoulder is shown with the patient in the beach-chair position.

in the passage of the graft (Fig 1A). The graft thickness is measured, and the size of the tunnel drilled on the distal clavicle is adjusted as needed.

The senior author (X.L.) prefers to use either a 5.0- or 5.5-mm cannulated head reamer over a drill bit for the 2 tunnels and 5.5 × 8—mm PEEK (polyether ether ketone) tenodesis screws (Arthrex) for the fixation. The tunnel position for the conoid medially should be located around 4.5 cm from the distal clavicle and in the posterior aspect of the clavicle. The tunnel position for the trapezoid is located around 3.0 cm from the distal clavicle or 1.5 cm away from the coronoid drill tunnel and slightly anterior on the distal clavicle.

Four portals are used in this all-arthroscopic technique (Fig 1B): a medial portal (portal M, located just medial to the coracoid process), an anterolateral primary viewing portal (portal V), an accessory anterolateral portal (portal A, located 1 cm lateral to the anterolateral corner of the acromion), and an AC joint portal (portal B, located just lateral to the AC joint). A standard 30° arthroscope is used for most of the procedure, with occasional supplementation with a 70° arthroscope for visualization of the coracoid and clavicular undersurfaces during the drilling of the distal clavicle.

Starting with the 30° arthroscope located in the standard posterior portal, a spinal needle is used to locate the rotator cuff interval anteriorly. A radiofrequency (RF) device is subsequently introduced through this interval, and debridement of the rotator interval and coracoid base is performed. If visualization of the coracoid base is difficult, alternatively, a 70° arthroscope can be used in the posterior viewing portal to facilitate this step.

Once the rotator interval and coracoid base are debrided, the 30° arthroscope is switched to portal V, which is the primary viewing portal for this all-arthroscopic CC ligament reconstruction technique. This portal affords an excellent view of the subscapularis tendon and the coracoid base (Fig 2). The RF wand is inserted through accessory portal A, and further debridement of the superior and inferior aspects of the coracoid base is performed (Fig 2). Then, a spinal needle is inserted around portal M to locate a working portal medial to the coracoid base (Fig 3A). Once direct visualization of the spinal needle is seen, a trocar is placed to widen this tunnel. The RF device is inserted through portal M to thoroughly debride the medial aspect of the coracoid base and release the pectoralis minor tendon (Fig 3B). The debridement is complete once the RF wand can be passed from the medial to inferior aspect of the coracoid base.

A 90° suture passer is introduced into portal M with the tip of the passer visualized on the medial and inferior side of the coracoid base. The suture shuttle is passed laterally around the undersurface of the

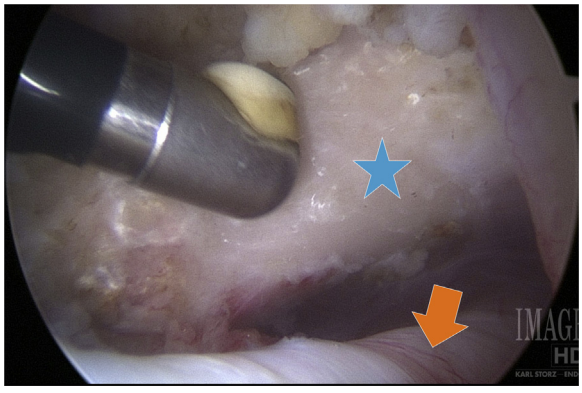

Fig 2. Viewing with a 30° arthroscope using portal V, a radiofrequency wand is inserted into the anterior glenohumeral joint through the accessory portal to further debride the base of the coracoid (star) and the subscapularis tendon (arrow). A left shoulder is shown with the patient in the beach-chair position.

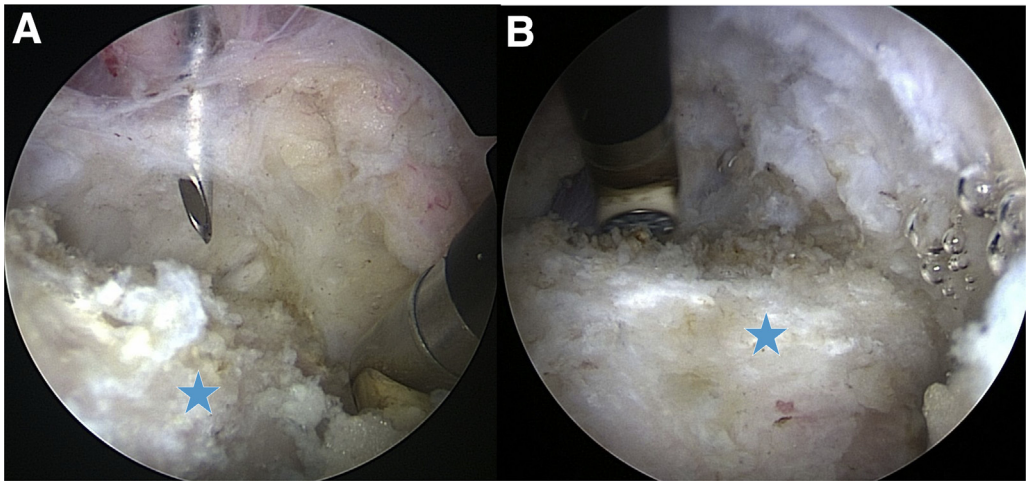

Fig 3. (A) Viewing from portal V with a 30° arthroscope, a spinal needle is used to help locate the medial aspect of the coracoid base (star) through portal M. A left shoulder is shown with the patient in the beach-chair position. (B) A radiofrequency wand is used through portal M to help debride the pectoralis minor off the medial aspect of the coracoid (star) to help facilitate graft passage around the base. A left shoulder is shown with the patient in the beach-chair position.

coracoid base, at which point the suture passer is deployed. A grasper is inserted through portal A to grasp the deployed suture (Fig 4A), which subsequently shuttles a No. 2 braided suture around the base of the coracoid. The limbs of this suture will be used in a future step to help facilitate the passage of the semitendinosus graft around the coracoid base.

Attention is now turned to debridement of the inferior aspect of the clavicle. Three spinal needles are used to delineate the anterior and posterior borders of the clavicle, and a 70° arthroscope is inserted into portal V to view the undersurface of the distal clavicle. With the RF wand in accessory portal B, the undersurface of the clavicle is debrided, with the spinal needles used as reference guides for the anterior and posterior extents of the clavicle (Fig 4B). Thorough soft-tissue debridement more than 4.5 cm from the distal clavicle is paramount for accurate drill tunnel positioning.

Once the inferior clavicle has been debrided and is completely visualized, a 3-cm incision in line with the distal clavicle is made superiorly over the distal clavicle. A drill tunnel over a guide pin is created from superiorly to inferiorly at a location 3.0 cm (trapezoid) and 4.5 cm (conoid) medial to the distal end of the clavicle. During this process, the 2-drill guide pins are visualized arthroscopically on the inferior aspect of the distal clavicle by use of the 70° arthroscope through portal V. Once these 2 tunnels are made, the RF wand is used to debride the tunnel both superiorly and inferiorly. The senior author (X.L.) prefers using 5.0- or 5.5-mm cannulated reamers over a drill bit and 5.5 × 8—mm PEEK tenodesis screws for the 2 tunnels.

Once the 2 clavicular drill tunnels are prepared, the 90° suture passer is introduced through the medial (conoid) drill tunnel and the lateral limb of the suture that was previously looped around the coracoid base is now shuttled through the medial drill tunnel with the use of a grasper and the deployed suture passer through portal A (Fig 5A). The result of this step is the medial limb of the suture still exiting through portal M and the lateral limb of the suture now exiting through the medial (conoid) drill tunnel. Then, similar to the previous step, the suture shuttle is introduced through the lateral (trapezoid) drill tunnel and the suture passer is deployed. With the use of a grasper inserted from portal A, the medial limb of the suture is shuttled through the lateral (trapezoid) drill tunnel. The result is a crisscross pattern of suture around the coracoid base with the medial limb exiting through the lateral (trapezoid) drill tunnel and the lateral limb exiting through the medial (conoid) drill tunnel (Fig 5B).

The semitendinosus allograft is then prepared for passage. Mineral oil is applied along the surface of the graft to facilitate passage through the drill tunnels. With the use of the No. 2 suture, the graft is passed through one drill tunnel, around the coracoid base, and out the opposite drill tunnel. The 2 ends of the graft will be visualized through the 3-cm superior incision at the distal end of the clavicle after this maneuver. A BioComposite screw is first inserted into the lateral (trapezoid) drill tunnel to secure this limb of the graft. Then, with a superiorly directed force on the ipsilateral upper extremity and an inferiorly directed

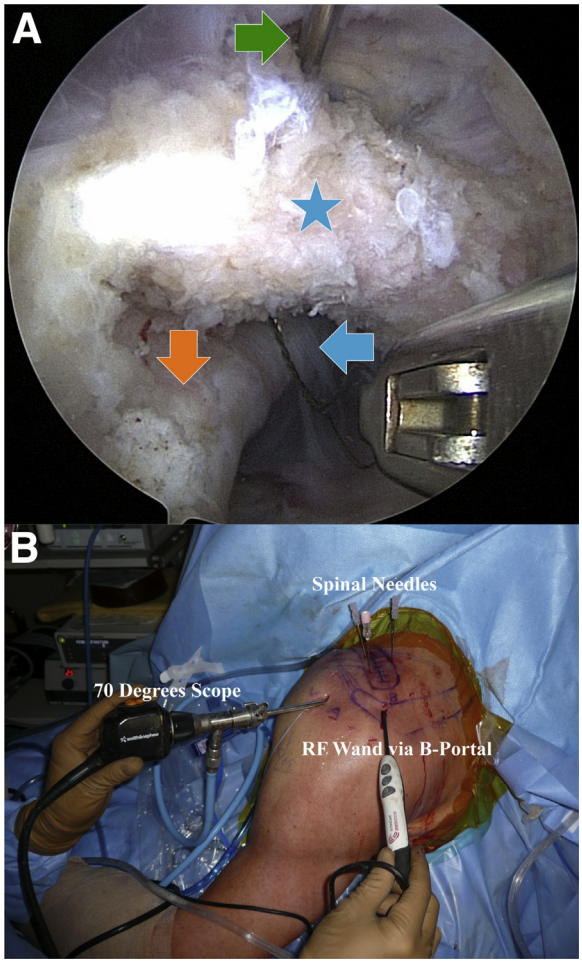

Fig 4. (A) A grasper is inserted through portal A and is used to grasp the deployed Chia device (Mitek Ideal Passer 90°; DePuy Synthes, Raynham, MA) (blue arrow) that is shuttled around the coracoid base (star). A No. 2 suture is shuttled around the base with the 90° Chia passer (green arrow), and the suture is ultimately used to aid the semitendinosus graft passage around the coracoid base. A 30° arthroscope is placed in portal V for viewing, with the patient in the beach-chair position; a left shoulder is shown. The orange arrow shows the top of the subscapularis tendon. (B) Three spinal needles are used anterior and posterior to the distal clavicle as reference guides for the anterior and posterior margins of the clavicle, so the clavicle can be appropriately debrided with the radiofrequency (RF) wand from accessory portal B. A 70° arthroscope is placed in portal V for direct viewing of the undersurface of the distal clavicle, with the patient in the beach-chair position; a left shoulder is shown.

force on the clavicle, the AC joint is reduced. While holding this reduction, a second BioComposite screw is inserted into the medial (conoid) drill tunnel. The residual 2 ends of the tendon graft are sutured onto themselves with a No. 2 braided suture (Fig 6A). The final reconstruction is seen arthroscopically (Fig 6B). The wound is closed, and the patient is placed in an UltraSling (DJO) with an abduction pillow. Tables 1 and 2 show the advantages and disadvantages of this all-arthroscopic technique along with pearls and pitfalls.

Discussion

The described all-arthroscopic technique minimizes the complications and dissections associated with open CC ligament reconstructions. The portal design of this technique, as well as its use of 30° and 70° arthroscopes, allows for proper visualization of all

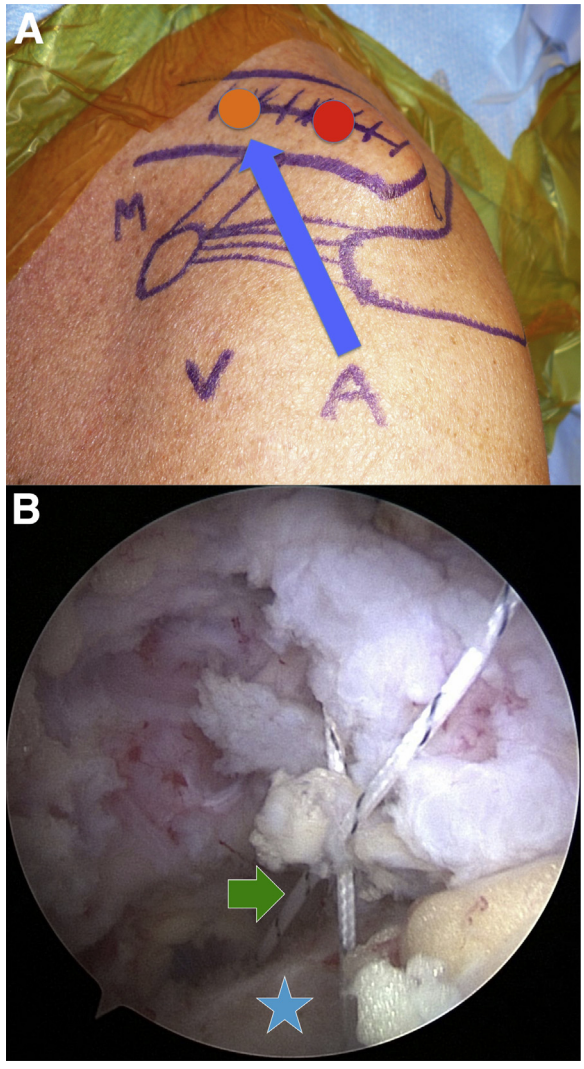

Fig 5. (A) The arrow points to the 2 clavicular drill tunnels as represented by the 2 circles. The No. 2 suture is passed from portal A to the medial drill tunnel in preparation for graft passage. A left shoulder is shown with the patient in the beach-chair position. (B) Crisscross pattern of No. 2 suture (arrow) around the coracoid base (star). A 30° arthroscope is placed in portal V for viewing, with the patient in the beach-chair position; a left shoulder is shown.

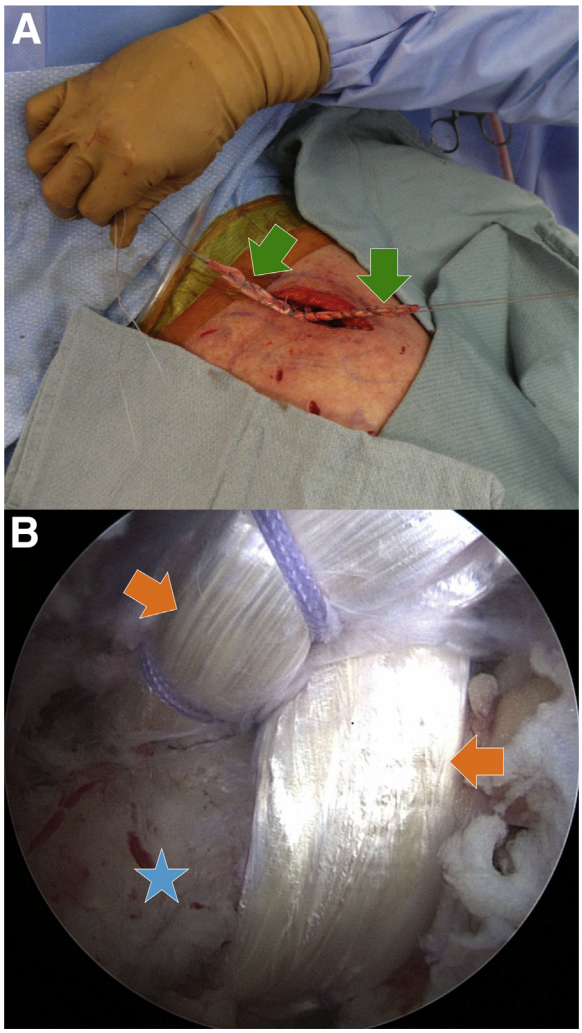

Fig 6. (A) The residual 2 ends of the allograft (arrows) are sutured onto themselves with No. 2 sutures after placement of the 5.5 × 8—mm tenodesis screws. A left shoulder is shown with the patient in the beach-chair position. (B) The final coracoclavicular ligament reconstruction using semitendinosus allograft (arrows) is visualized through portal V with a 30° arthroscope and wrapped around the coracoid base (star). A left shoulder is shown with the patient in the beach-chair position.

Table 1. Advantages and Disadvantages of All-Arthroscopic CC Ligament Reconstruction Technique

Advantages
All-arthroscopic technique
Decreased patient morbidity
Possible faster postoperative recovery
Ability to address intra-articular shoulder pathology at same time as arthroscopic CC ligament surgery
Disadvantages
Technically difficult
Steep learning curve
Need to bail out to open CC ligament reconstruction if difficulties are encountered during the all-arthroscopic technique with graft passage

CC, coracoclavicular.

Table 2. Pearls, Pitfalls, and Limitations

Pearls
The technique is much easier to perform in patients with type V AC separation compared with type III AC separation.
If the surgeon encounters difficulties with graft passage, the anterior deltoid can be taken down to help facilitate a mini-open approach to aid graft passage.
The surgeon should always suture the residual graft over the distal clavicle after fixation with No. 2 braided sutures using a figure-of-8 technique. This will help to reinforce the reconstruction.
The senior author (X.L.) prefers to perform a minimal (5- to 8-mm) distal clavicle resection at the time of the CC ligament reconstruction to help prevent future AC joint arthrosis and pain.
Mini-open CC ligament reconstruction is preferred in cases of revision AC separation. Furthermore, the senior author prefers to use semitendinosus autograft for revision cases.
Pitfalls and limitations
In patients with chronic type V AC separations who have calcification of the CC ligaments, the described all-arthroscopic technique would be very difficult to perform. The senior author recommends performing a mini-open approach.
If the distal clavicle is not reducible with the patient under general anesthesia, the all-arthroscopic technique is contraindicated.

AC, acromioclavicular; CC, coracoclavicular.

relevant anatomy while also allowing for appropriate debridement of the coracoid base and distal clavicle. This technique minimizes the risk of iatrogenic injuries, with the added advantage of an expedient postoperative recovery afforded by its all-arthroscopic nature. The limitations of this technique are similar to those of other CC ligament—tendon graft reconstructions, because the stability of the reduction is balanced against the biomechanical advantage of the tendon graft and the method of fixation. In addition, this all-arthroscopic technique is technically demanding to perform.

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