Arthroscopically Assisted Anatomic Coracoclavicular Ligament Reconstruction Technique Using Coracoclavicular Fixation and Soft-Tissue Grafts

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Abstract: Acromioclavicular joint injuries are common and are often seen in contact athletes. Good to excellent clinical results have been reported using soft-tissue grafts to reconstruct the coracoclavicular ligaments; however, complications remain. Some complications are unique to the surgical technique, particularly clavicle and coracoid fractures that are associated with drilling large or multiple bone tunnels. The described technique allows for an anatomic coracoclavicular reconstruction using a large soft-tissue graft while minimizing the risk of clavicle fracture by avoiding large bone tunnels.

Acromioclavicular (AC) joint injuries account for a significant number of injuries in contact athletes.[1] AC joint injuries are classified by the Rockwood grade,[2] with grades I and II treated nonoperatively and grades IV, V, and VI treated operatively. The ideal management of grade III injuries remains controversial, with many surgeons performing surgery acutely in high-level athletes and manual laborers.[3-5]

The original Weaver-Dunn method of AC joint reconstruction has been modified over the past 4 decades, most recently with anatomic coracoclavicular ligament reconstruction with soft-tissue grafts, which have shown superiority on biomechanical testing.[6] Bone tunnels through the clavicle are commonly used to reconstruct the coracoclavicular ligaments; however, they have been associated with a significant decrease in clavicle strength with a subsequent increase in the risk for postoperative fracture.[7] The surgical technique presented in this report illustrates an arthroscopically assisted method of anatomic coracoclavicular ligament reconstruction using a soft-tissue allograft that eliminates the need for large bone tunnels in the clavicle.

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Surgical Technique

The surgical technique is shown in Video 1. After the administration of a regional interscalene block and the induction of general anesthesia, the patient is placed in the modified beach-chair position. Under sterile conditions, the index shoulder is prepared and draped with the arm secured in a pneumatic arm holder. Standard posterior and anterosuperior portals are established. Diagnostic arthroscopy is performed, and all intra-articular pathologies are treated as necessary. It is important to address and treat concomitant intra-articular pathologies because they have been reported in up to 30% of patients with AC dislocations.[8] An accessory lateral portal is established when access to the subacromial space is necessary for the treatment of rotator cuff or other subacromial pathologies.

After diagnostic arthroscopy, a window is created within the rotator interval between the superior and middle glenohumeral ligaments, with care being taken to preserve these ligaments. An accessory anteroinferolateral portal is established through this window under direct visualization (Fig 1). This portal allows access to the subcoracoid space for dissection around the inferior coracoid and to facilitate graft passage. Through the posterior portal, a 70° arthroscope is used to visualize the inferior coracoid arch and the

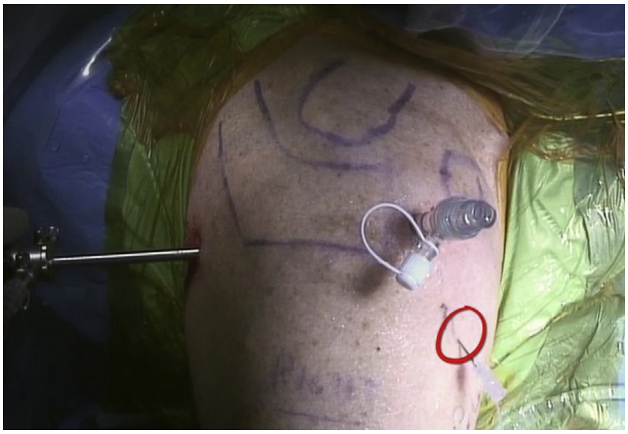

Fig 1. The anteroinferolateral portal is established, as shown in a right shoulder (red circle). This portal is created within the rotator interval between the superior and middle glenohumeral ligaments. It should be created under direct arthroscopic visualization. This portal allows for access to the subcoracoid space.

subcoracoid space during dissection. The coracoid is identified, and its undersurface is skeletonized using radiofrequency ablation. The bone of the coracoid is then gently abraded with a shaver to create an optimal healing surface for the graft.

Approximately 3.5 cm medial to the AC joint line, a 2.0-cm incision is made perpendicular to the long axis of the distal clavicle (Fig 2). The remaining deltotrapezial fascia is incised along the central long axis of the distal clavicle and subperiosteally elevated to allow for adequate imbrication and repair at the conclusion of the procedure. Electrocautery is used to maintain hemostasis. The distal clavicle should be preserved in most cases in light of evidence suggesting improved stability of the distal clavicle after AC reconstruction.[9] However, if there is evidence of post-traumatic osteoarthritis, an 8- to 10-mm distal clavicle excision should be performed. In some chronic, highly unstable cases, the AC capsule should also be imbricated or reconstructed for additional stability.[9]

Coracoclavicular fixation with 2 cortical buttons is then performed. This is necessary to augment the soft-tissue grafts during incorporation because our experience has shown that the use of grafts alone may result in a loss of AC reduction over time. A drill guide is used to place a 2.4-mm cannulated drill (Arthrex, Naples, FL) through the distal clavicle at the level of the conoid tubercle and into the central and posterior portion of the coracoid base. At this point, it is important to use fluoroscopy to confirm positioning of the K-wire (Fig 3). After removal of the K-wire from the central portion of the drill, a passing suture is placed through the cannulation of the drill. The drill is then removed. Four strands of suture tape (Arthrex) are then pulled through the bone tunnels from inferior to superior and pulled out of the anteroinferolateral portal. A cortical fixation button (Dog Bone; Arthrex) is placed onto the suture tape (Fig 4), and the button is pulled into position at the inferior cortex of the coracoid (Fig 5).

At this point, the graft is prepared and passed. Either an allograft or autograft can be used. We typically use an 8-mm (doubled diameter) soft-tissue allograft. To make the passage of the graft easier, the soft tissues are dilated and soft-tissue tunnels are created. A switching stick is passed from posterior on the clavicle to medial on the coracoid under direct arthroscopic visualization. An 8.25-mm cannula dilator is then used to create a soft-tissue tunnel medial to the coracoid. A shuttling suture is passed through the cannula dilator and is retrieved out the anteroinferolateral portal. A second soft-tissue tunnel is created starting anterior on the clavicle and passing lateral to the coracoid. A second shuttling suture is passed on this side and retrieved out the anteroinferolateral portal.

The graft is then whipstitched. An 8-mm tibialis anterior allograft is typically used. By use of the previously placed medial passing suture, the graft is shuttled from posterior on the clavicle through the medial soft-tissue tract to emerge along the medial aspect of the coracoid base under direct arthroscopic visualization. This medial limb of the graft re-creates the conoid ligament. The second shuttling suture is then looped around the graft whipstitch, and the graft is shuttled laterally around the coracoid and anterosuperiorly around the clavicle; thus the graft is shuttled around the base of the coracoid and around the clavicle (Fig 6). The lateral limb of the graft re-creates the trapezoid

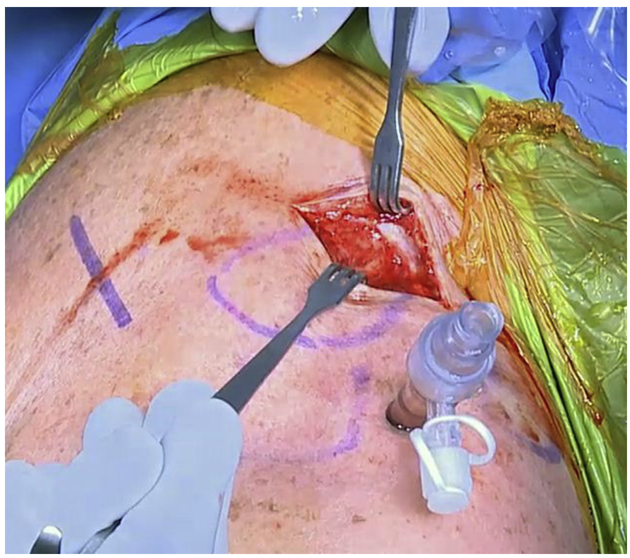

Fig 2. A 2.0-cm incision is made perpendicular to the long axis of the distal clavicle in a right shoulder. The remaining deltotrapezial fascia is incised along the central long axis of the distal clavicle. Electrocautery should be used to maintain hemostasis.

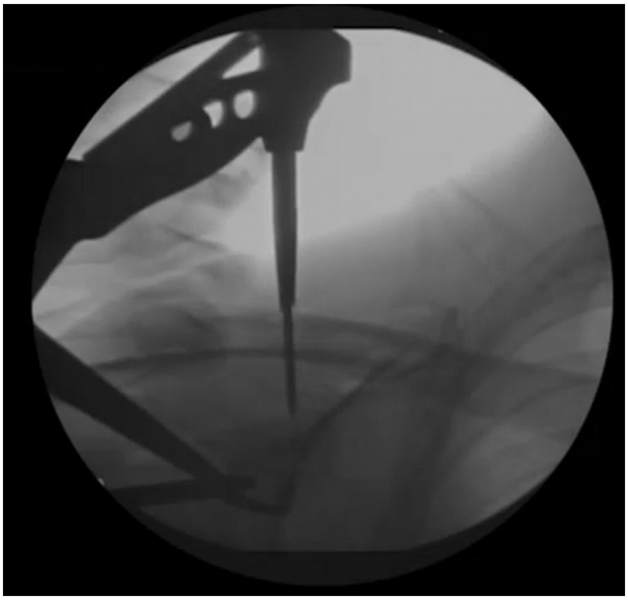

Fig 3. Fluoroscopic image of a right shoulder showing the position of the K-wire. A drill guide is used to place a 2.4-mm cannulated drill through the distal clavicle at the level of the conoid tubercle and into the central and posterior portion of the coracoid base. When the K-wire is removed, a passing suture is placed through the cannulation of the drill that will be used to shuttle the 4 strands of suture tape.

ligament. At this point, the distal clavicle is reduced and fixed as a second cortical fixation button is threaded down the 4 strands of suture tape that were previously placed (Fig 7).

The graft is then cycled to remove creep, and the distal clavicle is manually reduced. While an assistant helps maintain joint reduction, the free ends of the suture tapes are knotted over the button and trimmed. Adequate joint reduction is confirmed by fluoroscopy. The free ends of the graft are then looped together in an overhand configuration and secured with 3 or 4 high-strength sutures placed through the graft knot (Fig 8). To ensure the maintenance of joint reduction with shoulder motion, dynamic examination should be performed under both direct arthroscopic visualization

Fig 4. The cortical fixation button (Dog Bone) is placed onto the 4 strands of suture tape. This button is then inserted and positioned along the inferior cortex of the coracoid.

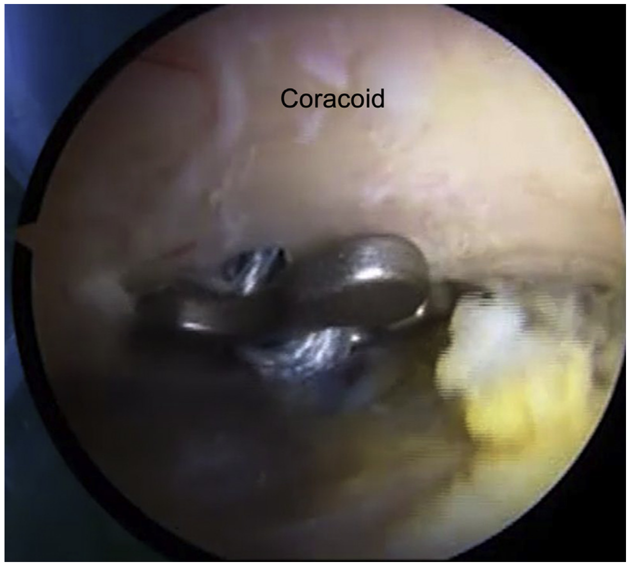

Fig 5. The cortical fixation button (Dog Bone) is placed on the inferior aspect of the coracoid, as shown on an arthroscopic view of a right shoulder through the posterior portal using a 70° arthroscope.

Fig 6. The graft is passed around the base of the coracoid, as shown on an arthroscopic view of a right shoulder through the posterior portal using a 70° arthroscope. The medial limb of the graft re-creates the conoid ligament, whereas the lateral limb re-creates the trapezoid ligament.

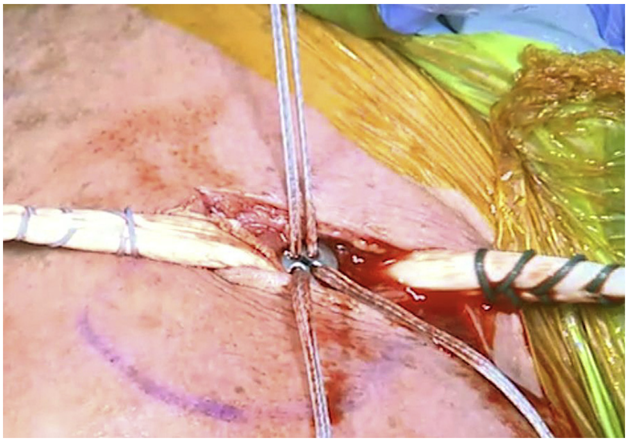

Fig 7. As shown in a right clavicle, a second cortical fixation button is threaded down the 4 strands of suture tape and is used to maintain reduction of the acromioclavicular joint. This button is placed after the graft has been shuttled around the coracoid, thus re-creating the conoid and trapezoid ligament.

and fluoroscopic imaging (Fig 9). The deltotrapezial fascia and superior AC joint capsule are imbricated and repaired. These can be sewn into the graft to provide additional stability. The primary incision is closed in layers with absorbable sutures.

Postoperatively, an abduction sling is applied to reduce tension on the reconstruction. This sling should be applied for 4 to 6 weeks. Supine passive range-of-motion exercises are started in the immediate postoperative period. Active and active-assisted motion is begun at 4 to 6 weeks, and strengthening exercises are started at 8 weeks postoperatively. Patients are allowed to return to full activities after approximately 16 weeks of rehabilitation.

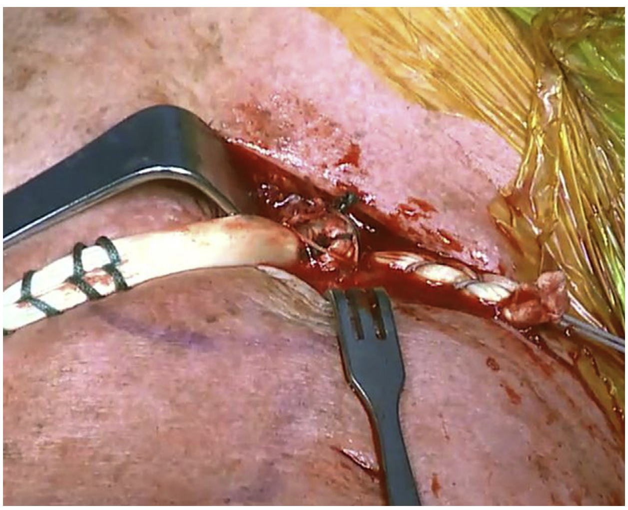

Fig 8. After the second cortical fixation button has been placed and secured, the free ends of the graft are looped together in an overhand configuration. The knot is then reinforced with 3 or 4 high-strength sutures, as shown in a right shoulder.

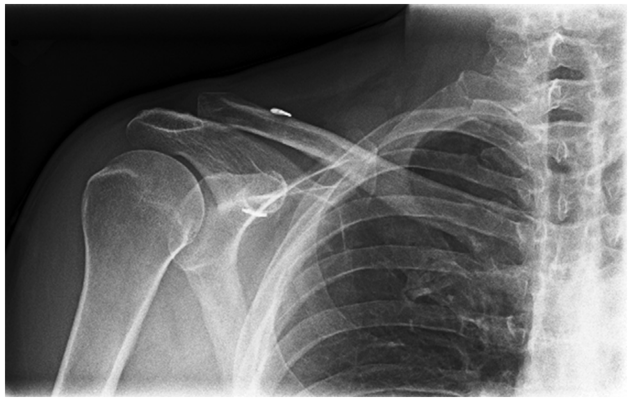

Fig 9. A final fluoroscopic image of a right shoulder is shown, confirming reduction of the acromioclavicular joint. Maintenance of reduction should also be tested with a dynamic examination under direct fluoroscopic and arthroscopic visualization.

Discussion

Several surgical pearls can help when performing our technique while minimizing the risk of complications (Table 1). Good to excellent clinical results have been reported after reconstruction of the coracoclavicular ligaments with soft-tissue grafts[10]; however, complications including graft rupture, hardware failure, and fracture of the clavicle or coracoid through bone tunnels are a concern.[4] A study conducted by Spiegl et al.[7] showed a significant decrease in clavicle strength when bone tunnels were created for graft passage. However, using a single 3-mm bone tunnel placed through the distal clavicle and the coracoid base did not result in a change in clavicular load to failure when compared with the intact state. The presented technique therefore minimizes the risk of clavicle fracture through bone tunnels because the graft is looped around the coracoid and tied above the clavicle rather than placed through large bone tunnels. To date, we have had excellent results using this technique in over 50 cases and have not observed any fractures of the clavicle or coracoid more than 3 years after implementation of this modified technique.

Table 1. Summary of Surgical Pearls

Use a 70° arthroscopic camera to look medially from the posterior glenohumeral portal to visualize the coracoid undersurface.
Make the initial anterior glenohumeral portal more inferior and lateral than normal. This will help instruments reach the undersurface of the coracoid.
Avoid disturbing the soft tissue distal to the tip of the coracoid.
Excise 8-10 mm of the distal clavicle if there is evidence of arthritis or if the joint does not reduce properly.
Use a soft-tissue dilator to create space for the allograft before passage around the clavicle.

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