Technical Note

Anchorless Acromioclavicular and Coracoclavicular Ligament Repair Using a Graft-Passing Instrument to Pass Suture Under the Coracoid

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Abstract: Acromioclavicular joint separation is a common shoulder injury. Grade I and II separation may be treated nonoperatively, whereas higher grades tend to require surgical intervention. Various repair techniques have been described in the literature, with no consensus on the gold standard. This Technical Note describes our use of a graft-passing instrument to pass suture under the coracoid during an anatomic reconstruction of both the acromioclavicular and coracoclavicular ligaments. Although this approach is technically challenging, it avoids coracoid drilling and requires smaller-diameter clavicle and acromion drilling. Furthermore, using suture instead of graft material increases the cost-effectiveness of the procedure.

Acromioclavicular joint (ACJ) separation is a common shoulder injury. Up to 10% of shoulder injuries involve the ACJ, and ACJ injuries account for 40% to 50% of all shoulder injuries in contact sports.[1,2] It has been described as early as 400 BC, when Hippocrates recognized that ACJ separation was a discrete injury from glenohumeral joint injury.[3] Cadenat,[4] in 1917, was the first to classify ACJ separation as either complete or incomplete and described a progressive mechanism of ACJ injury. In 1963, Tossy et al.[5] classified ACJ injuries into 3 categories (I, II, and III) based on the extent of disruption of the acromioclavicular (AC) and coracoclavicular (CC) ligaments. This was expanded by Rockwood[6] in 1984 to include types IV, V, and VI; this classification is currently in use today. Although consensus exists on conservative versus surgical management of most ACJ injuries, there is equipoise regarding type III injuries. Indeed, even experienced shoulder surgeons show a lack of consensus on radiographic classification and management of ACJ injury.[7]

There exists greater discord regarding technique, with over 100 different approaches mentioned in the literature.[8] Current operative treatments can be broadly classified into 2 groups: those that facilitate primary healing of the CC ligaments by holding the clavicle and coracoid in a reduced position and those that attempt reconstruction of the CC ligaments. There is further variation regarding open versus arthroscopic procedures, anatomic versus nonanatomic CC ligament repair or reconstruction, and whether sutures or tissue grafts are used. This article details our technique of using a suture passer to pass a shuttle suture under the coracoid during anatomic repair of the CC ligaments, as well as repair of the AC ligaments.

Surgical Technique

Patient Setup

The patient is positioned in the beach-chair position, and the bony prominences are well padded. The operative upper extremity is then prepared and draped in the usual sterile fashion.

Approach to ACJ

The anatomic landmarks of the ACJ and coracoid are outlined. A 10-cm curvilinear incision is made over the

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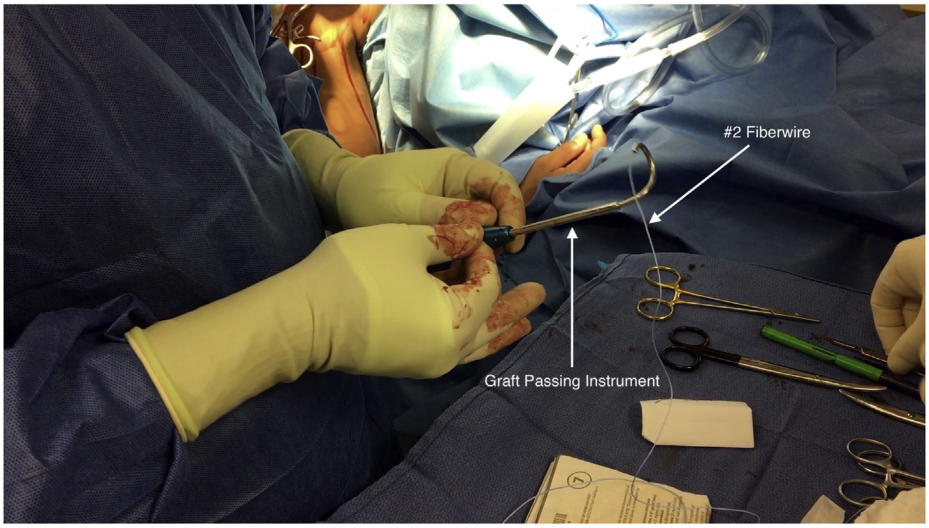

Fig 1. The graft-passing instrument is loaded with No. 2 FiberWire suture. This suture will be used as a passing suture to pass No. 5 Fiber-Tape under the coracoid.

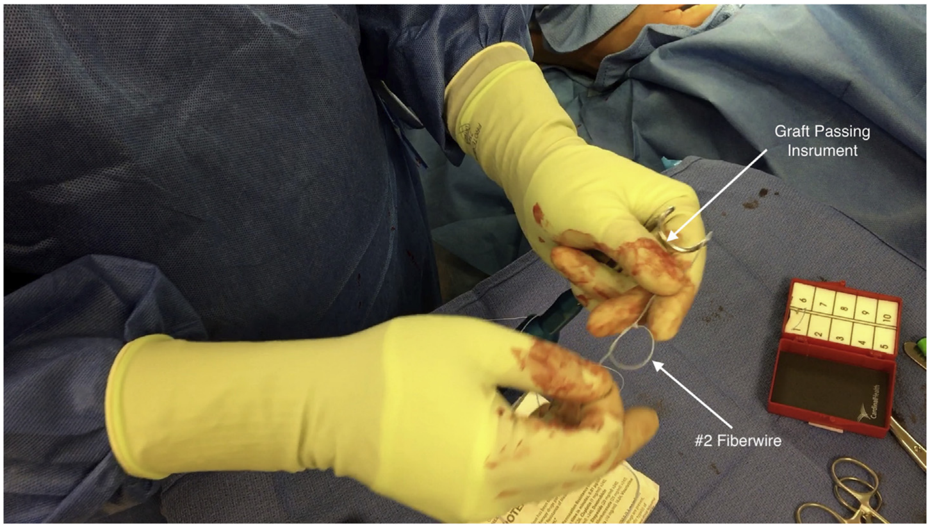

Fig 2. Knots are tied in the loaded No. 2 FiberWire to prevent the suture from retracting back into the device, as well as to facilitate grasping the suture once it has been passed under the coracoid.

Table 1. Pearls and Pitfalls for Technique of Anchorless Acromioclavicular and Coracoclavicular Ligament Repair

Pearls
Tying knots in the suture after loading it onto the GPI prevents it from shifting while being passed under the coracoid.
The sutures should be kept organized by clamping them to the side separately.
Applying downward pressure on the clavicle while tying knots maintains reduction.
Pitfalls
Failure to repair the acromioclavicular ligaments can lead to anterior-posterior instability of the ACJ.
The surgeon should take care and protect the neurovascular structures when drilling the clavicle and acromion.

ACJ, acromioclavicular joint; GPI, graft-passing instrument.

ACJ, extending to the distal clavicle and superiorly over the coracoid. Dissection is performed through the trapezius and deltopectoral fascia to expose the superior border of the clavicle. A Cobb elevator and electrocautery are used to reflect the trapezius attachments and periosteum from the distal clavicle and acromion, revealing the ACJ.

Approach to Coracoid Process

Dissection is continued down proximally until the top of the coracoid process can be palpated (Video 1). The conjoint tendon should be palpable at the tip of the coracoid.

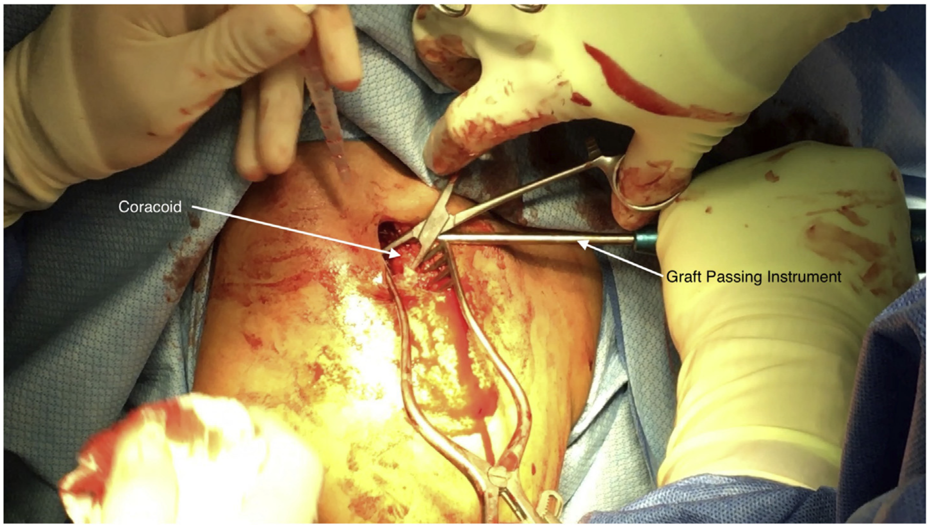

Fig 3. View of the right shoulder looking downward onto the acromion and clavicle. The graft-passing instrument is passed under the coracoid, and the No. 2 FiberWire passing suture is retrieved.

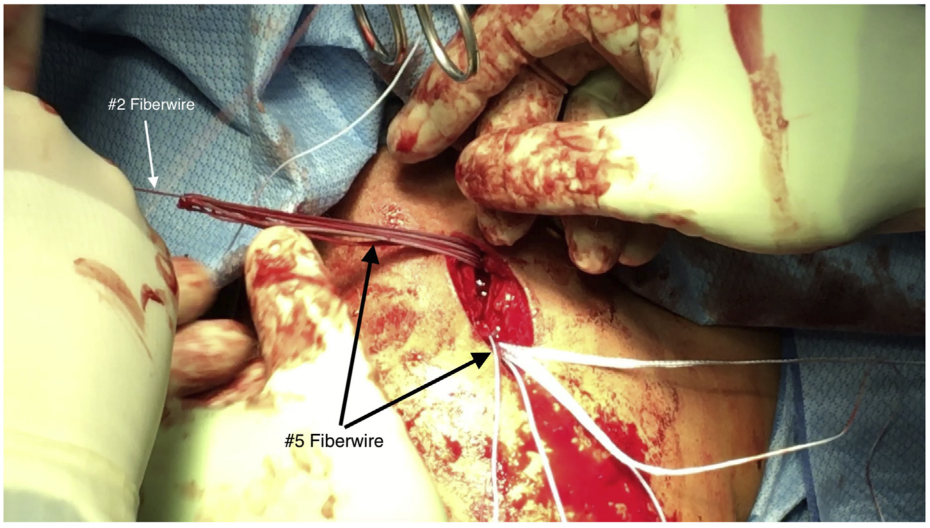

Fig 4. View of the right shoulder looking at the acromion and clavicle from the side. The No. 5 FiberTape is loaded and shuttled under the coracoid using the No. 2 FiberWire passing suture.

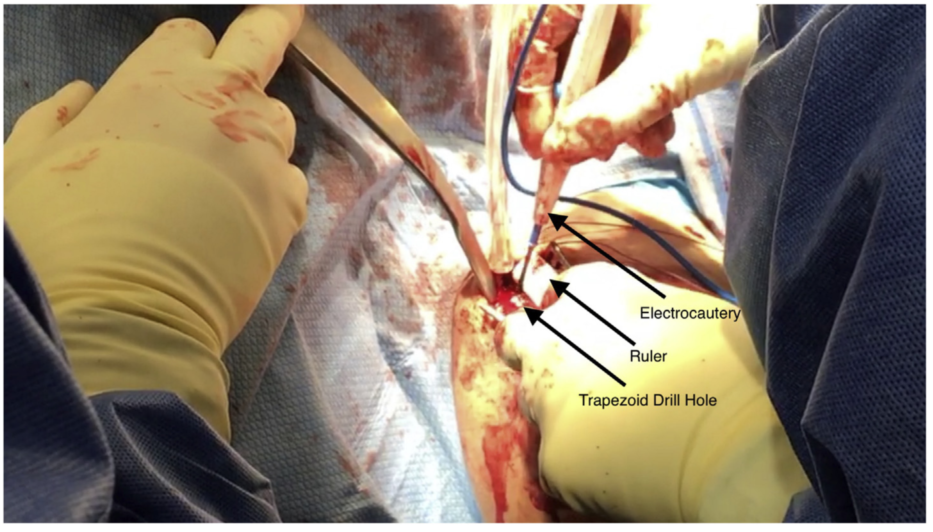

Fig 5. View of the right shoulder looking at the acromion and clavicle from the side. A ruler is used to mark the anatomic attachments of the trapezoid and conoid ligaments on the clavicle. The trapezoid is marked 3 cm medial from the distal end of the clavicle and slightly more anteriorly. The conoid is marked 4.5 cm medial from the distal end of the clavicle and slightly more posteriorly.

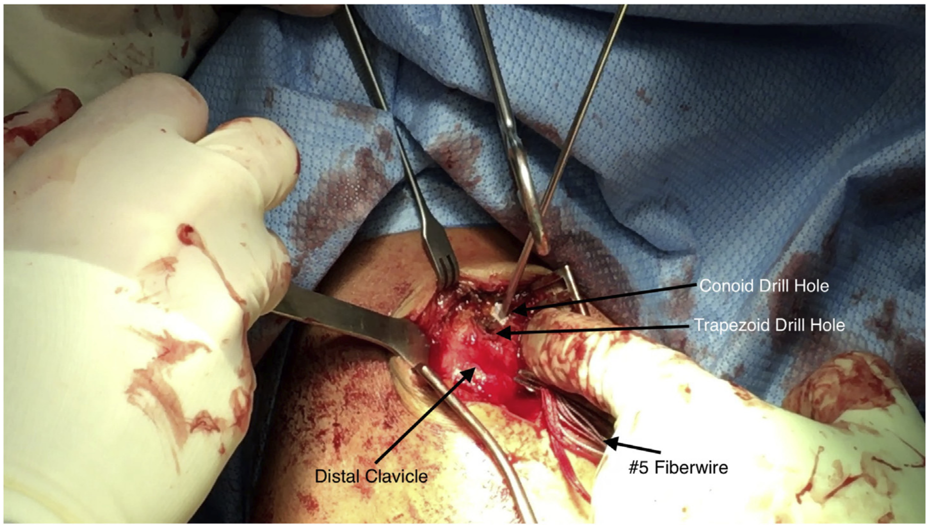

Fig 6. View of the right shoulder looking at the acromion and clavicle from the side. A bicortical hole is drilled through the clavicle at the marked attachment site for the trapezoid ligament. This is repeated for the conoid ligament.

Sutures Passage Under Coracoid Process

A No. 2 FiberWire suture (Arthrex, Naples, FL) is loaded into an AC Joint Coracoid Graft Passing Instrument (GPI) (Arthrex) (Fig 1). Knots are tied in the loaded No. 2 FiberWire to prevent the suture from retracting back into the device, as well as to facilitate grasping the suture once it has been passed under the coracoid (Fig 2, Table 1). The GPI is then hooked around the coracoid process, and the No. 2 FiberWire is passed under the coracoid (Fig 3). A suture shuttle knot is tied with the No. 2 FiberWire, and the 4 strands of No. 5 FiberTape (Arthrex) are placed in the shuttle knot. The No. 5 FiberTape is shuttled around the coracoid process with the No. 2 FiberWire, and the free ends of the No. 5 FiberTape are clamped to the side (Fig 4).

Clavicle Drilling

The native attachment points of the conoid and trapezoid CC ligaments are marked on the clavicle (Fig 5). The trapezoid drill hole is marked 3 cm proximal to the distal end of the clavicle and anterior to the conoid drill hole. The conoid drill hole is marked 4.5 cm proximal to the distal end of the clavicle and posterior with respect to the trapezoid drill hole. Bicortical trapezoid and conoid holes are drilled through the superior border of the clavicle (Fig 6).

AC Reduction

A looped nitinol wire or polydioxanone suture can be used to shuttle No. 2 FiberWire suture through the clavicle drill holes (Fig 7). This FiberWire is then used to shuttle 2 strands of the No. 5 FiberTape through the trapezoid drill hole. This is repeated with the 2 remaining strands of the No. 5 FiberTape for the conoid drill hole, leaving 4 free No. 5 FiberTape strands above the clavicle 1.5 cm apart and 4 still wrapped around the coracoid. An assistant then uses a bone tamp to apply a strong downward force on the distal end of the clavicle,

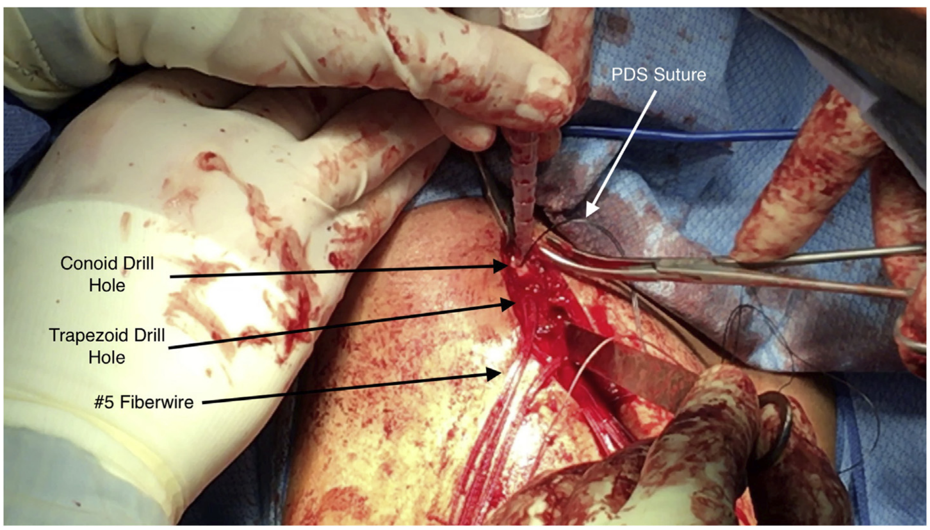

Fig 7. View of the right shoulder looking at the acromion and clavicle from the side. A polydioxanone (PDS) suture can be passed through the conoid drill hole and used to shuttle a No. 2 FiberWire suture. The No. 2 FiberWire is used to shuttle 2 ends of the No. 5 FiberTape suture through the conoid drill hole. The corresponding other 2 ends of the No. 5 FiberTape are shuttled through the trapezoid drill hole in a similar fashion.

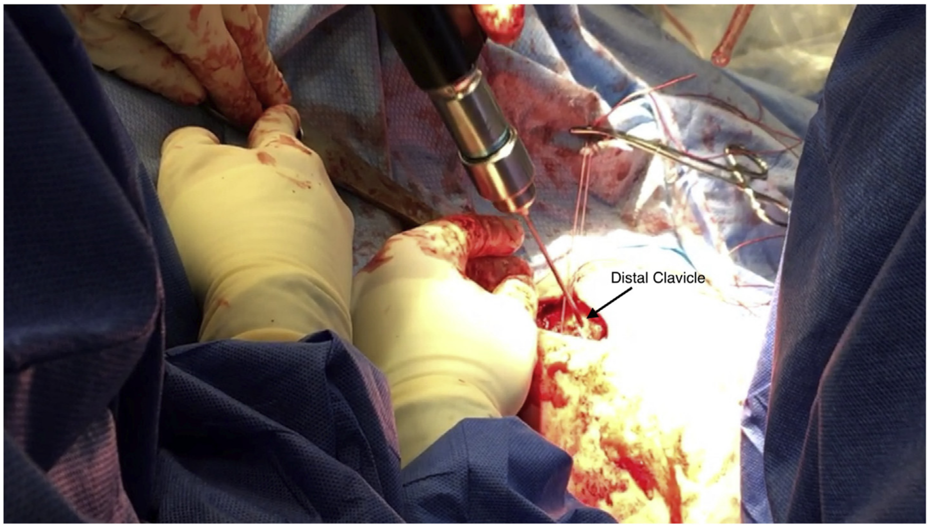

Fig 8. View of the right shoulder looking at the acromion and clavicle from the side. Bicortical holes are drilled in the acromion and distal clavicle for acromioclavicular ligament reconstruction. Two of the remaining No. 5 FiberTape suture ends are shuttled through the acromial hole (not shown). The corresponding remaining ends are shuttled through the distal clavicle hole. These are then tied down to reconstruct the acromioclavicular ligaments (not shown).

reducing the ACJ. As this is performed, 4 suture ends are tied down at both the conoid and trapezoid ligament attachment sites. This secures the reduction. A large C-arm is used to confirm that the distal clavicle and acromion cortices are congruent in the anterior-posterior plane.

Anterior-Posterior Stability

A bicortical hole is drilled in the acromion and the distal clavicle (Fig 8). The remaining 2 strands of No. 5 FiberTape are shuttled through each hole. Surgeon knots are tied over the top of the ACJ to prevent anterior and posterior translation of the distal clavicle, completing the open ACJ repair. Final radiographs are taken to confirm appropriate reduction (Fig 9). Fig 10 shows the final position of the sutures and shows the course of the sutures under the coracoid and through the clavicle and acromion, establishing ACJ stability and CC ligament repair.

Postoperative Protocol

The patient is placed in an immobilizer sling for 6 weeks. A follow-up appointment is scheduled for repeated films. Physical therapy begins at 6 weeks to regain full range of motion. The patient returns to full activities by 12 to 18 weeks.

Discussion

The ACJ is a diarthrodial joint that rotates and translates in the anterior-posterior and superior-inferior planes. It is surrounded by a synovium and joint capsule and is stabilized by static and dynamic stabilizers. Static stabilizers include the AC ligaments, the CC ligaments (conoid and trapezoid), and the coracoacromial ligament.[9] Fukada

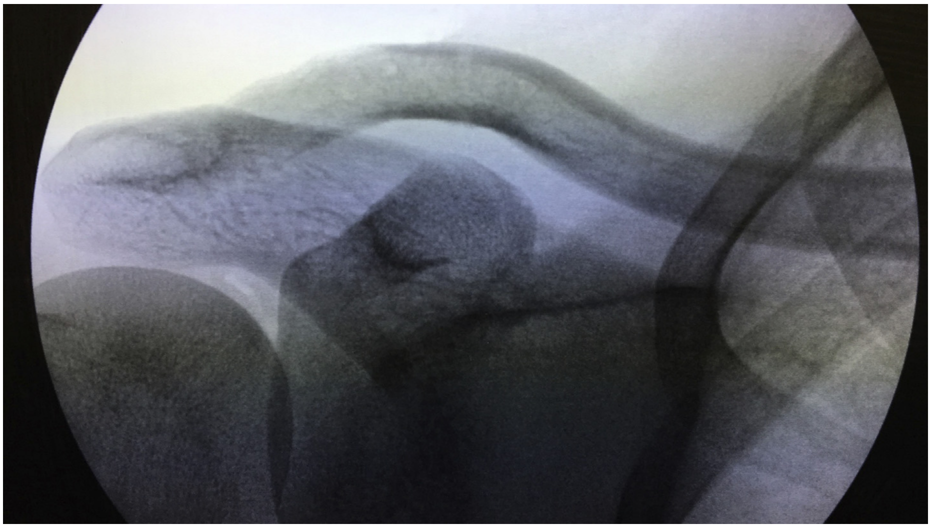

Fig 9. Intraoperative C-arm radiography is performed to confirm appropriate reduction. The acromion and clavicle are congruent.

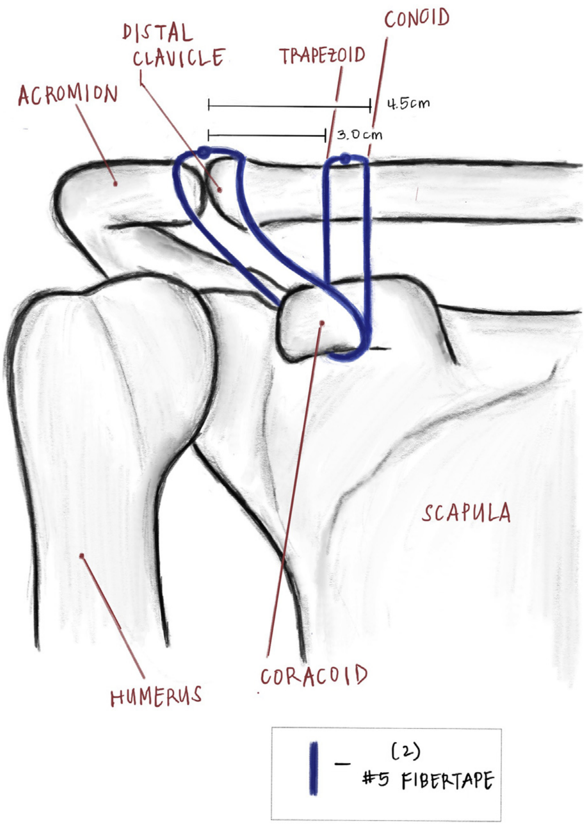

Fig 10. Anchorless acromioclavicular and coracoclavicular ligament repair. The final position of the reduction shows sutures passed under the coracoid, which acts as an anchor for the repair. Coracoclavicular ligament repair is performed by passing suture through the clavicle at the native attachments of the trapezoid and conoid ligaments, 3 cm and 4.5 cm away from the distal clavicle, respectively. The final reduction re-establishes the coracoclavicular distance and acromioclavicular joint stability.

et al.[10] reported that the AC ligaments serve as primary restraints to posterior and superior translation of the clavicle whereas the conoid ligament is the primary restraint to larger superior displacements. They concluded that reconstruction or repair of these ligaments should be anatomic. Lee et al.[11] and Klimkiewicz et al.[12] corroborated these findings, supporting anatomic reconstruction. Debski et al.[13] furthered this idea by recommending that the conoid and trapezoid ligaments should be repaired separately. Furthermore, their findings indicated that intact CC ligaments cannot compensate for loss of capsular function during anterior-posterior loading, supporting our technique of AC ligament repair.[13]

No consensus on the gold-standard technique for ACJ repair exists. As mentioned previously, current operative treatments can be broadly classified into 2 groups: those that facilitate primary healing of the CC ligaments by holding the clavicle and coracoid in a reduced position and those that attempt reconstruction of the CC ligaments.

Previously, early ACJ fixation with Kirschner wires, Steinmann pins, or cerclage wires was used to reduce the ACJ and allow for CC and AC ligament healing.[1] However, intra-articular hardware can lead to early degenerative changes.[1,8] Furthermore, pins have been reported to break and migrate into the eyes, spinal canal, heart, and lungs.[1] Hook plates initially designed for lateral clavicle fractures have also been used but are associated with numerous complications including infection, arthritis, plate bending, symptomatic hardware, and bone erosion.[1,8] Bosworth screws can be placed between the coracoid and clavicle for CC stabilization; however, this technique reduces joint motion and increases contact pressures, which may fatigue the implant.[1,8] Dynamic muscle transfers involving transfer and fixation of the coracoid process and its muscular attachments to the clavicle have been attempted but are limited by technical complexity and complications.[1]

Reconstruction of the CC ligaments can be achieved through various methods. Perhaps the most well-known technique is the Weaver-Dunn procedure. First described in 1972, this technique resects the distal clavicle and transfers the coracoacromial ligament to the remaining clavicle to augment the torn CC ligaments.[14] The modified Weaver-Dunn procedure further strengthens the repair by adding cerclage wires, screws, grafts, and/or other materials.[15] However, studies have shown inferior results with both of these techniques when compared with anatomic reconstruction of the CC ligaments.[15-19]

Technique variation exists even within CC ligament anatomic reconstruction. Various methods detailing the use of suture, surgical tape, and tendon autograft and allograft have been described.[20-23] Variations on fixation techniques exist, such as drilling through the base of the coracoid to pass grafts and/or sutures or looping grafts and/or sutures under the coracoid.[24-26]

There are considerations regarding CC ligament reconstruction. Drilling through the coracoid carries an intraoperative risk to the neurovascular structures.

Table 2. Advantages and Disadvantages of Technique of Anchorless Acromioclavicular and Coracoclavicular Ligament Repair

Advantages
Coracoid drilling is avoided.
The technique results in anatomic reconstruction.
Using suture instead of graft allows for smaller-diameter tunnels.
The GPI has a blunt end and allows for greater precision when passing suture.
The technique is cost-effective.
Disadvantages
The approach is technically challenging.
Passing material under the coracoid threatens the musculocutaneous nerve.
There exists a theoretical risk of suture eroding through the base of the coracoid.

GPI, graft-passing instrument.

Furthermore, poor drilling technique and/or multiple drill attempts increase the risk of postoperative coracoid and/or clavicle fracture.[27-29] In their 2019 meta-analysis, Gowd et al.[30] reported that graft reconstructions had a significantly higher fracture rate when compared with suture-only techniques. They hypothesized that this was because of the larger-diameter bone tunnels for graft reconstructions compared with suture-only techniques.[30] Grafts increase the cost of the operation and may not lead to better outcomes according to a 2019 randomized controlled trial by Lee et al.[31] Lädermann et al.[32] reported no significant difference in patient-reported outcomes between early and late intervention for ACJ separations. Although grafts are typically used for chronic ACJ injuries, an all-suture technique may be a viable option for most ACJ repairs. Our technique avoids drilling of the coracoid, which can be challenging. Furthermore, using suture instead of graft material results in smaller-diameter tunnels and improves the cost-effectiveness of the procedure (Table 2).

A similar suture-only technique by Youn et al.[33] uses a tensioning cerclage system to apply a precise amount of force on the superior clavicle but requires additional instrumentation, potentially adding complexity and increasing cost. Similarly to our technique, passing material under the coracoid carries inherent risks. The brachial plexus, particularly the musculocutaneous nerve, passes inferior to the distal tip of the coracoid process and is at risk of injury if care is not taken when passing sutures or grafts. Our use of the GPI allows for greater precision when passing the No. 2 FiberWire under the coracoid. Furthermore, the GPI has a blunt end, which minimizes the potential of iatrogenic neurovascular trauma during placement.

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