Anatomic Coracoclavicular Reconstruction Surgical Technique

For Treatment of Chronic Acromioclavicular (AC) Instabilities

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Arthrex®

SURGICAL PROCEDURE

APPROACH

In osteological analyses of 120 clavicles, the mean length from the end of the clavicle, or the acromioclavicular joint, to the conoid ligament was 46.3 ± 5 mm; the distance between the center of the trapezoid and the conoid medially was 21.4 ± 4.2 mm.[8] Thus, we center our incision roughly 3.5 cm from the distal clavicle or acromioclavicular joint and make it curvilinear in the lines of Langer toward the coracoid process. Control of the superficial skin bleeders down to the fascia of the deltoid is accomplished with a needle-tip bovie. Once the entire clavicle is palpated, full-thickness flaps are made from the midline of the clavicle both posteriorly and anteriorly, skeletonizing the clavicle. This is done in the area of the coracoclavicular ligament (Fig. 1).

RETENTION VS. REMOVAL OF LATERAL CLAVICLE

For the surgeon who prefers to perform a distal claviculectomy, 10 mm of the distal clavicle is removed in a perpendicular fashion using an oscillating saw. The posterior one third of the distal clavicle is beveled with an oscillating saw or rasp to avoid potential contact with the spine of the scapula.

For the surgeon who prefers to leave the lateral clavicle intact for improved stability, the AC joint soft tissue should be opened carefully as it may be necessary to dissect scar at or below the joint to assist with anatomic reduction.

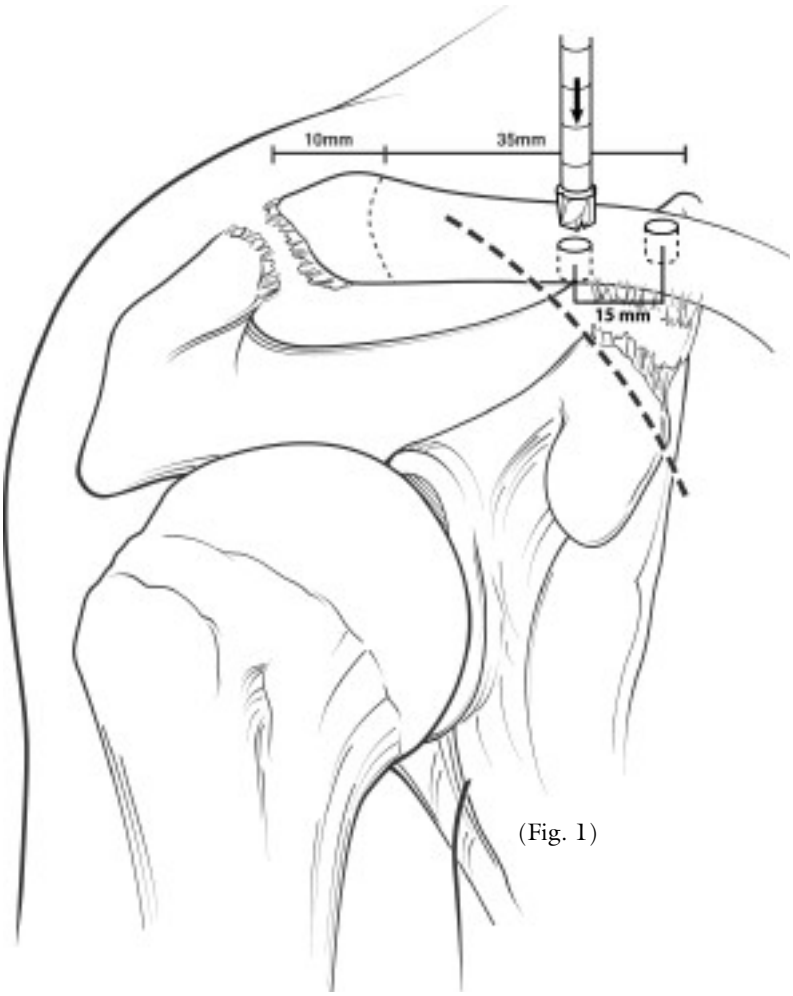
GRAFT PREPARATION

Depending on surgeon preference, allograft or autograft (semitendinosus, anterior tibialis) can be used for this procedure. Lee and coworkers[7] found no difference in peak load-to-failure among semitendinosus, toe extensors, and gracilis tendons for reconstruction of the acromioclavicular joint.

This technique involves looping the tendon graft around the coracoid process or securing into the coracoid process and anchoring each tendon's free end in the clavicle with Tenodesis™ (interference) Screws. One to two Krakow sutures are placed in the two free ends of the graft and the graft is placed on the table in a moist sponge until the bone tunnels are prepared.

GRAFT FIXATION TO CORACOID PROCESS - LOOP TECHNIQUE

Looping the graft around the base of the coracoid process can be facilitated by the Coracoid Graft Passers. In addition, a curved aortic cross-clamp (Satinsky clamp) and various suture passing devices can be used. At the same time that the graft is passed, a #2 FiberWire® is also passed around the base of the coracoid (Fig. 2).



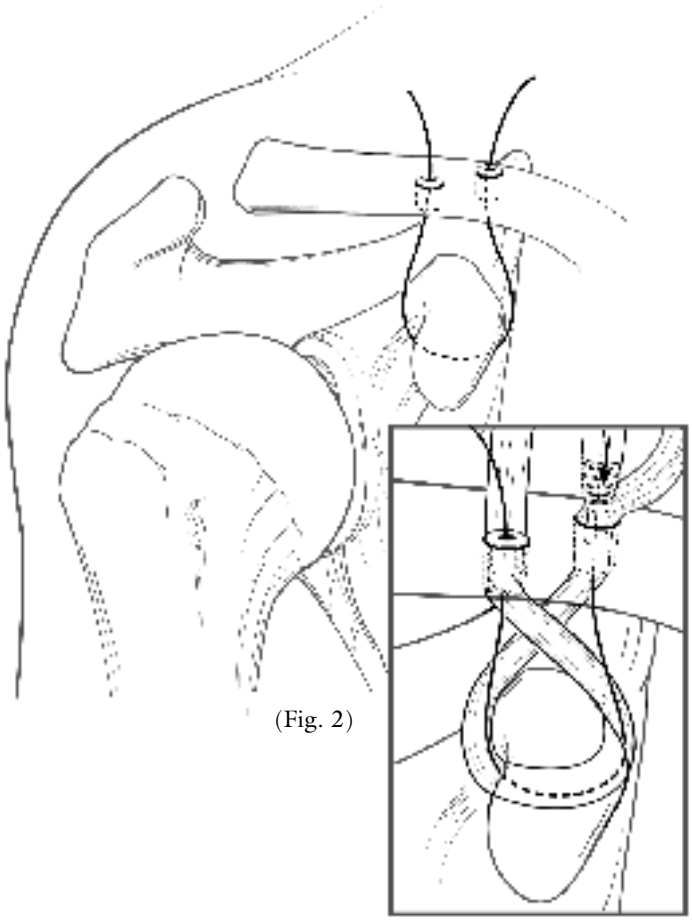
(Fig. 1)

BONE TUNNELS IN THE CLAVICLE

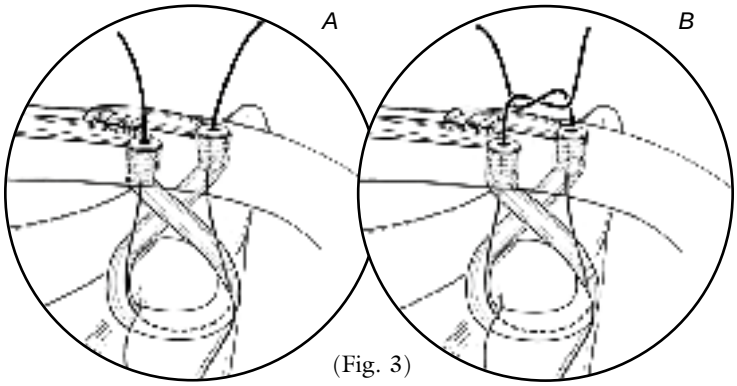
It is important to make the bone tunnels in as accurate a position as possible to recreate the coracoclavicular ligament. The complex osteological measurements provided are to aid the surgeon in finding the insertions of the conoid and the trapezoid and not meant as absolute numbers. A Drill Tip Guide Pin is used for placement of the tunnels. The first tunnel is for the conoid ligament, and that is roughly 45 mm away from the distal end of the clavicle in the posterior one half of the clavicle. (Fig. 1) The footprint of the conoid ligament is extremely posterior, along the entire posterior edge of the clavicle. That is why making this bone tunnel as posterior as possible is important. Once the guide pin is inserted in the direction of the eventual bone tunnel, the appropriate cannulated reamer is placed over the guide pin and confirmation that the tunnel will be as posterior as possible without "blowing out" the posterior cortical structure of the clavicle is established. The reamer size is proportionate to the outer diameter of the graft limb and the bone quality. The authors recommend using 5.5 mm x 8 mm PEEK Tenodesis Screws since this length accurately matches the thickness of the clavicle. Since the outer diameter of the PEEK Tenodesis Screw is 5.5 mm, generally you will start with a 5 mm or 5.5 mm reamer. If screw purchase upon insertion is too tight, "up ream" incrementally by half millimeter sizes until screw purchase is appropriate. The bone tunnel is created bicortically with the Cannulated Headed Reamer (Fig. 1) and the bone tunnel may be pretapped if the surgeon feels this is

necessary. If 5.5 mm x 15 mm Bio-Tenodesis™ Screws are chosen, generally you will start with a 6 mm reamer. If the graft outer diameter is equal to or larger than 6 mm, use a reamer with an outer diameter of one-half millimeter larger than the graft outer diameter.

The same procedure is repeated for the trapezoid ligament. This is a more anterior structure than the conoid and is usually placed in the center point of the clavicle, approximately 15 mm away from the center portion of the previous tunnel. (Fig. 1) Two Drill Tip Guide Pins are used before reaming, to confirm accurate placement of the tunnels. The tunnels are reamed completely through the entire thickness of the clavicle. Copious irrigation follows to remove any bone fragments.



(Fig. 2)



(Fig. 3)

INTERFERENCE SCREW FIXATION OF GRAFT TO CLAVICLE

At this point, the more lateral limb of the biologic graft is taken and placed through the posterior/medial bone tunnel, recreating the conoid ligament. Next, the medial limb is fed through the anterior/lateral bone tunnel recreating the trapezoid ligament. Passing the limbs in this manner creates a crossing pattern of the biologic graft. At the same time that the graft is brought through, each limb of the #2 FiberWire should be fed through the respective bone tunnels as well. *Note: FiberWire limbs are fed straight through tunnels and not crossed* (Fig. 2). Passage of the graft through the tunnels can be facilitated with a Nitinol Graft Prep Needle. Alternatively, the FiberTape®, instead of #2 FiberWire, can be used for backup mechanical fixation.

Upper displacement of the scapulohumeral complex, by the assistant, reduces the acromioclavicular joint. A large point-of-reduction forceps placed on the coracoid process and the clavicle can assist, while securing the tendon grafts. The acromioclavicular joint should be over reduced during initial fixation due to an inevitable amount of creep in the tendon graft. With complete upper displacement on the graft ensuring its tautness, a 5.5 mm x 8 mm PEEK Tenodesis Screw is placed in either the posterior or anterior bone tunnels. The #2 FiberWire is brought up through the cannulation of this screw and cannulation of the driver. After assessment that screw fixation has been successful, the second PEEK Tenodesis Screw is placed in the final bone tunnel (Fig. 2). Alternatively, 5.5 mm x 15 mm Bio-Tenodesis Screws can be used. *Note: If 15 mm Bio-Tenodesis Screws are used, a 1.1 mm Nitinol guide pin can be used in the bone tunnel and through the cannulation of the Tenodesis Driver to guide screw orientation through the cortices during insertion. Nitinol guide pin and suture can not be run through driver cannulation at the same time.*

A C-arm can now be used to obtain Zanca view for confirmation of reduction. Next, the lateral portion of the remaining tendon graft should be routed to reconstruct the AC ligaments using sutures. Alternatively, the remaining portions of the tendon graft can be sewn to each other as a tissue bridge between the screw heads using #2 FiberWire. Once both graft limbs have been secured, the #2 FiberWire is tied over the top (Figs. 3A and 3B).

CLOSURE

One of the most important concepts with acromioclavicular or coracoclavicular joint reconstruction is the closure of the deltotrapezial fascial flaps that were made previously. A nonabsorbable suture in a modified Mason-Allen type stitch is placed through the deltoid fascia. Six or seven stitches are used at this point and are tied at the end. The knots are tied on the posterior aspect of the trapezius. This should completely obscure the grafts, as well as the clavicle.

The deltotrapezial internal and AC joint capsule are closed with 0 ETHIBOND. The subdermal skin is closed with 2-0 or 3-0 absorbable sutures. The skin itself is closed with either running 2-0 Prolene or interrupted nylon, everting the edge of the skin. A compression dressing is placed.

POSTOPERATIVE COURSE

Zanca, as well as axillary radiographs, are taken immediately postoperatively and compared with those taken six weeks postoperatively. The patient is placed in a modified "gunslinger" brace to completely support the arm. The use of brace support is critical. Bilateral Zanca views are obtained during the first postoperative visit to measure coracoclavicular distance in both shoulders, for comparison to normal. The patient should be in the brace for six weeks. Pendulum exercises three times a day are started immediately. From 6 - 12 weeks, the brace is generally discontinued; however, no strengthening or lifting can be done as the graft is still maturing. From 12 - 24 weeks, isometric exercises are begun. Contact athletics are allowed six months postoperatively.

COMPLICATIONS

The primary author has noted a few mostly radiographic failures and one case of a sterile abscess that resolved when suture was removed. Additional potential complications include infection, clavicle fracture, coracoid fracture, or osteolysis of the distal clavicle. Of course, complete failure due to nonhealing of the ligament grafts is always a potential consequence.

CONCLUSIONS

The biomechanical analysis of the acromioclavicular and coracoclavicular ligaments and their influence on the acromioclavicular joint have aided and directed the proposed operative technique.[1, 2, 3, 4, 5, 9] The use of autogenous semitendinosus graft for reconstruction of the acromioclavicular joint has been reported by Jones and coworkers[6] and Lee and coworkers.[7] These studies, along with the development of the Bio-Tenodesis System, led to this eventual technique.

The anatomic coracoclavicular joint reconstruction technique is designed to place tendon grafts in the exact anatomic location. It also attempts to provide and reconstruct any remnants of the acromioclavicular joint capsule ligaments, specifically the superior and posterior portions. This procedure does not purport to be the "best," but it does allow anatomic recreation of damaged anatomy. It does this with the previously described interference screw fixation to bone, which has worked successfully in other applications.

REFERENCES

1. K. Fukuda, E.V. Craig, A. Kai-Nan et al., *Biomechanical study of the ligamentous system of the acromioclavicular joint*, J Bone Joint Surg 68 (1986), pp. 434–439.

2. M.R. Urist, *Complete dislocations of the acromioclavicular joint. The nature of the traumatic lesion and effective methods of treatment with an analysis of forty-one cases*, J Bone Joint Surg 28 (1946), pp. 813–837.

3. K.-W. Lee, R.E. Debski, C.-H. Chen et al., *Functional evaluation of the ligaments at the acromioclavicular joint during anteroposterior and superoinferior translation*, Am J Sports Surg 25 (1997), pp. 858–862.

4. J.J. Klimkiewicz, G.R. Williams, J.S. Sher et al., *The acromioclavicular capsule as a restraint to posterior translation of the clavicle: A biomechanical analysis*, J Shoulder Elbow Surg 8 (1999), pp. 119–124.

5. R.E. Debski, I.M. Parsons, S.L.-Y. Woo et al., *Effect of capsular injury on acromioclavicular joint mechanics*, J Bone Joint Surg 83-A (2001), pp. 1344–1351.

6. H.P. Jones, M.J. Lemos and A.A. Schepsis, *Salvage of failed acromioclavicular joint reconstruction using autogenous semitendinosus tendon from the knee. Surgical technique and case report*, Am J Sports Med 29 (2001), pp. 234–237.

7. S.J. Lee, S.J. Nicholas, K.H. Akizuki et al., *Reconstruction of the coracoclavicular ligaments with tendon grafts. A comparative biomechanical study*, Am J Sports Med 31 (2003), pp. 648–654.

8. C.G. Rios, R.A. Arciero, and A.D. Mazzocca, *Anatomy of the Clavicle and Coracoid Process for Reconstruction of the Coracoclavicular Ligaments*, Am J Sports Med 35 (2007), pp. 811–817.

9. A.D. Mazzocca, S.A. Santangelo, S.T. Johnson, C.G. Rios, M.L. Dumonski, and R.A. Arciero, *A Biomechanical Evaluation of an Anatomical Coracoclavicular Ligament Reconstruction*, Am J Sports Med 34 (2006), pp. 236–246.

Ordering Information

Implants:

PEEK Tenodesis Screw, 5.5 mm x 8 mm	AR-1655PS
Bio-Tenodesis Screw, 5.5 mm x 15 mm	AR-1555B

Acromioclavicular Joint Reconstruction Master Set (AR-2255MS) includes:

Drill, 4 mm, cannulated	AR-1204L
Drill, 4.5 mm, cannulated	AR-1204.5L
Headed Reamer, 5 mm, cannulated	AR-1405
Headed Reamer, 5.5 mm, cannulated	AR-1405.5
Headed Reamer, 6 mm, cannulated	AR-1406
Headed Reamer, 6.5 mm, cannulated	AR-1406.5
ACL Guide Frame Handle	AR-1510H
AC Guide, left	AR-2254L
AC Guide, right	AR-2254R
Fixed Guide	AR-2255CG-01
Guide Pin Sleeve	AR-2255CG-02
Clavicle Drill Positioner	AR-2255CG-03
Drill Stop	AR-2255CG-04
Drill Sleeve, 3 mm	AR-2255CG-05
AC Tenodesis Screw Driver	AR-2255D
AC Joint Coracoid Graft Passer, left	AR-2256L
AC Joint Coracoid Graft Passer, right	AR-2256R
Graft Sizer	AR-2265
Forked Probe	AR-6002
AC Joint Reconstruction Instrument Case	AR-2255MC

Required Disposables:

Drill Tip Guide Pin, 2.4 mm, qty. 2	AR-1250LS
SutureLasso SD Wire Loop	AR-4068-05SD
#2 FiberWire, 38 inches w/Tapered Needle, 26.5 mm 1/2 circle, qty. 3	AR-7200
#2 FiberWire, 38 inches	AR-7233

Optional Instruments/Disposables:

Guide Pin, 1.1 mm, Nitinol	AR-1249
Bio-Tenodesis Tap, 5.5 mm x 15 mm	AR-1555T
Tear Drop Handle (required w/tap)	AR-2001
Bio-Tenodesis Disposables Kit	AR-1676DS

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