Arthroscopic Acromioclavicular Joint Reduction and Coracoclavicular Stabilization

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DEFINITION

- Acromioclavicular separations are relatively rare injuries that result in disruption of the acromioclavicular (AC) complex.
- Overall incidence of the injury is 3 to 4 per 100,000 in general population, with up to 52% of cases occurring during sporting events[5].
- The degree of injury is based upon the amount of force transmitted through the acromion to the distal clavicle and the surrounding deltotrapezial fascia[1, 18, 26].
- Increased force transmission leads to dissociation of the AC joint and tearing of the coracoclavicular ligaments.
- Determination of the injury type will guide operative versus non-operative management[18].

ANATOMY

- The AC joint is a diarthrodial joint composed of the medial acromial margin and the distal clavicle.
- A fibro-cartilaginous intra-articular disk between the two bony ends decreases contact stresses[17-19].
- Dynamic stability of the AC joint is provided by the trapezial fascia and the overlying anterior deltoid.
- Static stability of the AC joint is provided by the:
    - Acromioclavicular Ligaments-
        - Superior ligament –provides the greatest restraint to anterior translation of the distal clavicle[6, 8].
        - Anterior, Posterior and Inferior ligaments add additional horizontal stability to the AC joint.
    - Coracoclavicular Ligaments
        - Conoid – arises from the posteromedial aspect of the coracoid and inserts on the posteromedial clavicle.
            - Measures ~ 2.5cm long and 1cm wide[4, 18, 20].
            - Provides primary resistance against anterior and superior loading of the clavicle [6,8,14].
        - Trapezoid- arises from the anterolateral coracoid just posterior to the pectoralis minor and attaches to the lateral/central clavicle.
            - Measures ~ 2.5cm long and 2.5cm wide[4, 18, 20].
            - Provides resistance against posterior loading of the clavicle[6, 8, 14].

PATHOGENESIS (Mechanism of Injury)

- AC separations are the result of a direct force to the lateral aspect of the shoulder with the arm adducted, (i.e. fall on point of the shoulder) [1, 8, 10, 14,18,19,26].

- Degree of injury to the AC joint, deltopectoral fascia and /or coracoclavicular ligaments will determine the resultant deformity.
- Most low grade injuries involve only the AC joint and are often self-limited.
- Severe arm abduction during the AC separation can result in subacromial or subcoracoid displacement of the distal clavicle[18].

PHYSICAL FINDINGS

- A complete physical examination of both upper extremities with the patient appropriately attired and in the upright position is standard.
- Evaluation of the neck and a complete neurological examination is essential, as higher grade injuries may manifest brachial plexus compromise.
- Low grade injuries will be tender to palpation at the AC joint with mild elevation possible. Increased deformity is commonly seen as the injury grade increases, but acutely the deformity may be masked by swelling.

CLASSIFICATION

- Rockwood (modification of Allman, Tossey, and Bannister's work) described six types of injuries to the acromioclavicular joint[1, 2, 18, 26].
- This classification scheme has proven to be effective for prognosis and for treatment.
    - **Type I and II** - incomplete with no or mild subluxation of the AC joint
    - **Type III**- complete disruption of the AC ligaments and coracoclavicular ligaments. Degree of separation is up to 100% of the coracoclavicular interval.
    - **Type IV**- posterior displacement of the clavicle through the trapezius muscle.
    - **Type V**- Severe displacement with 100-300% increase in CC interval, (Bannister III-C) involves injury to the deltotrapezial fascia.
    - **Type VI**- inferior displacement of the clavicle to a subacromial or subcoracoid position.

IMAGING STUDIES

- Standard shoulder radiographs can be useful for diagnosis but over penetrance may result in poor visualization of the AC joint.
- Include an axillary view to avoid missing a glenohumeral dislocation and to help assess A/P translation of the clavicle.
- A 10-15 degree Cephalic tilt view (Zanca) avoids superposition of the scapular spine and improves visualization of the AC joint. This also allows evaluation for

loose bodies or small fractures that may be missed with standard views of the shoulder[18], (Figure 1).

Figure 1

- Stress Radiographs- Standing views with 10-15 lbs of traction applied to the wrists are recommended by some authors to help distinguish the grade of injury as patients may guard with standard standing views. Recent literature does not support the routine use of stress radiographs[28]. Stress radiographs do not affect the decision making process for operative versus non-operative management[18, 19, 28]. However, one AP view with both AC joints visible is helpful to account for normal variants and determine the degree of displacement.

DIFFERENTIAL DIAGNOSIS

- Distal Clavicle fracture
- Acromial fracture
- Glenohumeral dislocation
- Sternoclavicular dislocation
- Scapulothoracic dissociation

NON-OPERATIVE MANAGEMENT

- Type I and II- most authors agree that non-operative management is the treatment of choice of these incomplete injuries[1, 9, 12, 17-19, 23, 27]. A simple sling for comfort with progression to range of motion as tolerated in 1-2 weeks. Return to sports is authorized when the patient has pain free range of motion and normal strength.

- Type III- Controversial. Conservative treatment is often successful[2, 3, 12, 17,18,21,22]. Sling for comfort, range of motion exercises and avoidance of contact sports for 6- 8 weeks may suffice. Padding of the residual deformity for contact athletes may be beneficial. Additional trauma may lead to the development of a higher grade injury.
- Type IV-VI are routinely treated operatively[2,5,7,11,12,14,16,18,19,22,23,26]

SURGICAL MANAGEMENT

INDICATIONS

- Acute Rockwood Types III-VI in active patients unwilling to accept the cosmetic deformity and dysfunction of the affected shoulder.

PRE-OPERATIVE PLANNING

- Thorough evaluation of all radiologic studies to rule out associated fractures of the clavicle, coracoid or glenoid.
- Scrutinize films together with a careful physical exam to diagnose sternoclavicular or glenohumeral dislocations.

POSITIONING

- Standard Beach chair position with all bony and soft tissue prominences well padded.
- The use of an arm positioner (McConnell Orthopaedics, Greenville Texas or Tenet Medical Engineering, Calgary, Alberta) is optional.
- Prep in the standard fashion. Use an arthroscopy drape.

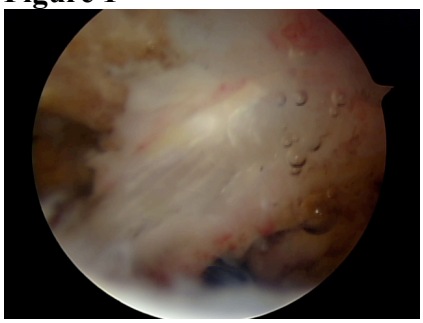
PROCEDURE- **TightRope Fixation** (Arthrex, Naples, Florida)

- The TightRope fixation system was originally designed for the treatment of syndesmotic injuries. It has two metal fixation buttons with a continuous loop of #5 Fiberwire (Arthrex) running between them[24].
- The technique allows for a quick and relatively simple arthroscopic fixation of acute, high grade AC separations. Chronic injuries should have the CC ligaments reconstructed with autologous or allograft tissue.
- Identify anatomy
    - Coracoid
    - Acromion

    - Clavicle-length and width
    - AC joint
- Mark Portals
    - Posterior Portal
    - Anterior Inferior portal
    - Anterolateral portal
- The posterior portal is created for viewing 2cm inferior and 2 cm medial to the posterolateral edge of the acromion in the "soft spot". Diagnostic arthroscopy with a 30 degree scope of the intra-articular space is routine[27].
- Enter the subacromial space from this portal using standard technique.
    - **Note**- We do not find it necessary to move through the rotator interval to identify the coracoid base, although it is recommended in the technique guide.
    - A 70 degree scope may be helpful if you use the trans-interval technique.
- The anterolateral portal is made using an "outside –in technique" in-line with the lateral edge of the acromion and the coracoid as a working portal.
- Introduce a 5-7mm cannula to assist with pressure control.
- With the scope in the posterior portal, identify the anterolateral acromion and the coracoacromial (CA) ligament. Preserve the CA ligament, (Figure 1).
- Follow the CA ligament to its attachment site on the coracoid, (Figure 2).
- Through the anterolateral portal an arthroscopic ablator or chondrotome is used to resect the subcoracoid bursa and allow better visualization of the inferior aspect of the coracoid and its base.
- There is no need to remove soft tissue from the superior aspect of the coracoid, (Figure 3).
- Be cautious when placing instruments medial to the coracoid as the scapular notch lies in close proximity. Injury to the neurovascular bundle is a possibility.
- Use an 18 gauge spinal needle for localization and an "outside-in technique" to make the anteroinferior portal (A/I) just lateral and slightly inferior to the coracoid. Insert an 8.25mm cannula.
- Insert the Adaptor drill guide C-Ring and Coracoid Drill stop through the A/I portal under base of coracoid, (Figure 4).
    - **TIP** -stay as far posterior, near the coracoid base, as possible, and central from a medial/lateral standpoint.
- A 1-2cm incision is made over the clavicle in-line with the drill guide and the coracoid.
- Under arthroscopic visualization with the clavicle reduced, a 2.4mm guide pin is advanced through the center of the clavicle and coracoid. It is captured by the drill stop, (Figure 5).
- The guide pin is over-reamed with a 4mm cannulated reamer using the drill stop to prevent plunging. The scope allows visualization of each step, (Figure 6).
- Remove the guide pin and pass the solid end of the Nitinol wire loop antegrade through the cannulated reamer. Grasp and remove it out the A/I portal with a push/pull technique, (Figures 7 and 8).
- The TightRope comes fixed with two 2-0 Fiberwires (Arthrex) to lead the suture button through the bone tunnel and flip accordingly.

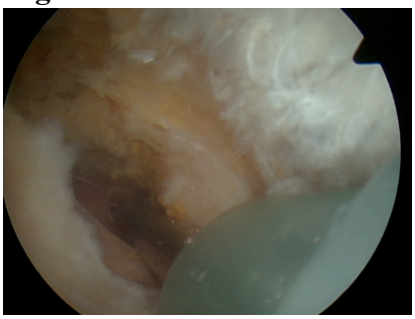
- Pass these with the wire loop through the clavicle/coracoid and out the A/I portal.
    - **TIP-** Color one suture strand purple with a marking pen for easier differentiation of the "lead" suture from the "flip" suture, (Figures 9 and 10).
- The TightRope button is passed and flipped when visualized with the arthroscope, (Figures 11 and 12).
- The upper extremity is then elevated and the AC joint is over reduced.
- Two to three square knots are placed over the cephalad suture button, (Figure 13).
- The sutures end should be left about 1cm long to allow the knot to lay flat under the soft tissues, (Figure 14).
- For additional stability, the soft tissue capsule of the AC joint may be sutured, as this is an important component to acromioclavicular stability.
- Open versus arthroscopic AC resection should be considered as the potential exists for the development of painful AC joint arthrosis; however, this is not routinely done.
- The wounds are closed and dressed in the usual fashion.

Figure 1



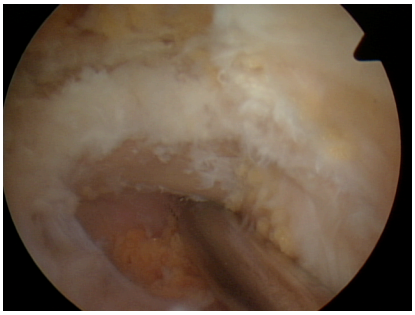
CA ligament identification

Figure 2



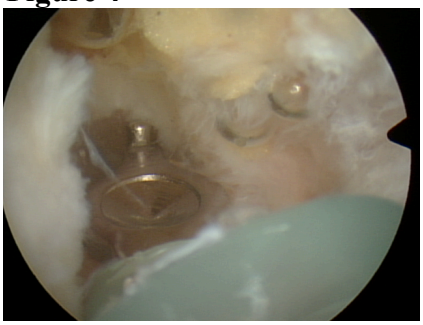
Coracoid identification

Figure 3



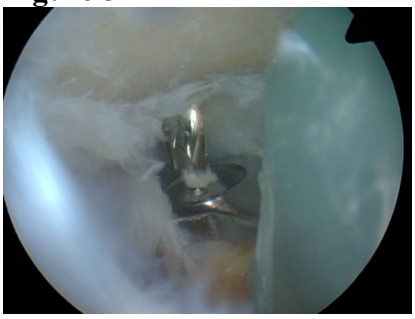
Soft tissue resection coracoid

Figure 4



Coracoid Drill Stop placement
Hug the base posterior

Figure 5

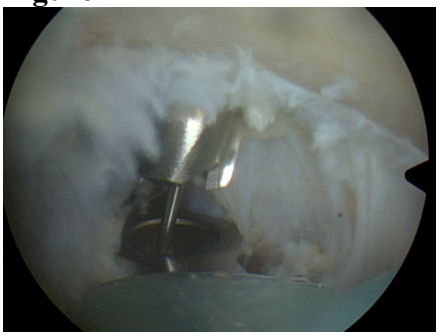


Captured 2.4mm guide pin

Figure 6

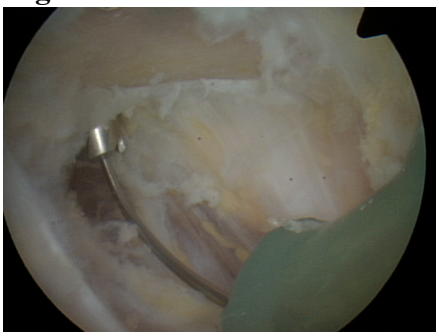
Captured 4mm drill bit

Figure 7



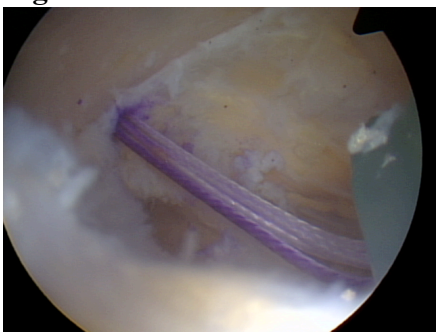
Nitinol wire passage

Figure 8



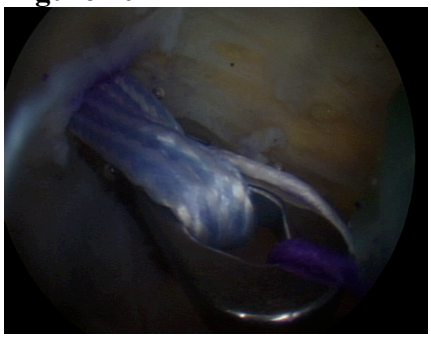
Retrieval of Nitinol- A/I portal

Figure 9



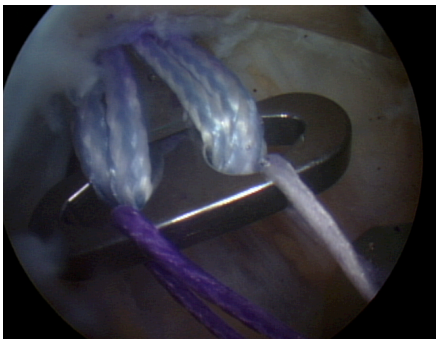
Colored "Lead" suture

Figure 10



Suture button exits coracoid base

Figure 11

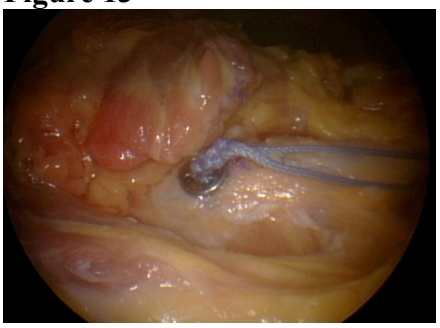


"Flip" button by pulling the trailing, uncolored suture

Figure 12

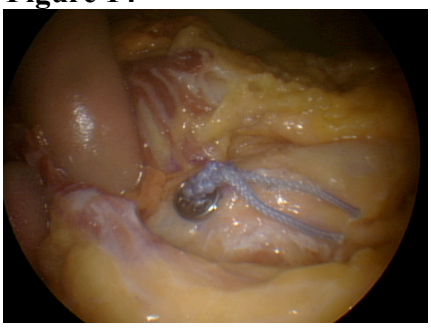
Reduced button on base of Coracoid

Figure 13



Square Knot superiorly

Figure 14



Suture ends left long

POST-OPERATIVE PLAN

- A sling is used for comfort and to slow down the patient for 4 weeks.
- Range of motion of the elbow is permitted immediately as are gentle Codman /pendulum exercises.
- Gentle active motion below the shoulder level is permitted until the 6 week mark, at which time progression to full motion is authorized.
- No heavy work or athletics are permitted for 3 months.
- Post-operative radiographs are compared to radiographs at the 6 week return visit.

COMPLICATIONS

- Infection
- Loss of reduction
- Coracoid fracture[16]
- Clavicle fracture
- Suprascapular neurovascular bundle injury

OUTCOMES

- **The TightRope Fixation System** is a relatively new system for treatment of acute AC separations. It is not intended for chronic injuries. No long term studies or prospective randomized trials are currently available. Biomechanical data is only available for its syndesmotic use[25, 26].

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REFERENCES

1. Allman FL Jr. Fractures and ligamentous injuries of the clavicle and its articulation. *J Bone Joint Surg Am*. 1967 Jun; 49(4):774-84.

2. Bannister GC, Wallace WA, Stableforth PG, Hutson MA. The management of acute acromioclavicular dislocation. A randomized prospective controlled trial. *J Bone Joint Surg Br*. 1989 Nov; 71(5):848-50.

3. Chernchujit B, Tischer T, Imhoff AB. Arthroscopic reconstruction of the acromioclavicular joint disruption: surgical technique and preliminary results. *Arch Orthop Trauma Surg*. 2006 Nov; 126(9):575-81.

4. Costic RS, Vangura A Jr, Fenwick JA, Rodosky MW, Debski RE. Viscoelastic behavior and structural properties of the coracoclavicular ligaments. *Scand J Med Sci Sports*. 2003 Oct; 13(5):305-10.

5. Costic RS, Labriola JE, Rodosky MW, Debski RE. Biomechanical rationale for development of anatomical reconstructions of coracoclavicular ligaments after complete acromioclavicular joint dislocations. *Am J Sports Med*. 2004 Dec; 32(8):1929-36.

6. Debski RE, Parsons IM 4th, Woo SL, Fu FH. Effect of capsular injury on acromioclavicular joint mechanics. *J Bone Joint Surg Am*. 2001 Sep; 83-A (9):1344-51.

7. Dimakopoulos P, Panagopoulos A, Syggelos SA, Panagiotopoulos E, Lambiris E. Double-loop suture repair for acute acromioclavicular joint disruption. *Am J Sports Med*. 2006 Jul; 34(7):1112-9.

8. Fukuda K, Craig EV, An KN, Cofield RH, Chao EY. Biomechanical study of the ligamentous system of the acromioclavicular joint. *J Bone Joint Surg Am.* 1986 Mar; 68(3):434-40.

9. Imatani RJ, Hanlon JJ, Cady GW. Acute, complete acromioclavicular separation. *J Bone Joint Surg Am*. 1975 Apr; 57(3):328-32.

10. Jari R, Costic RS, Rodosky MW, Debski RE. Biomechanical function of surgical procedures for acromioclavicular joint dislocations. *Arthroscopy*. 2004 Mar; 20(3):237-45.

11. Lancaster S, Horowitz M, Alonso J. Complete acromioclavicular separations. A comparison of operative methods. *Clin Orthop Relat Res*. 1987 Mar; (216):80-8.

12. Larsen E, Bjerg-Nielsen A, Christensen P. Conservative or surgical treatment of acromioclavicular dislocation. A prospective, controlled, randomized study. *J Bone Joint Surg Am*. 1986 Apr; 68(4):552-5.

13. Lee SJ, Nicholas SJ, Akizuki KH, McHugh MP, Kremenic IJ, Ben-Avi S. Reconstruction of the coracoclavicular ligaments with tendon grafts: a comparative biomechanical study. *Am J Sports Med*. 2003 Sep-Oct; 31(5):648-55.

14. Mazzocca AD, Santangelo SA, Johnson ST, Rios CG, Dumonski ML, Arciero RA. A biomechanical evaluation of an anatomical coracoclavicular ligament reconstruction. *Am J Sports Med*. 2006 Feb; 34(2):236-46.

15. Moneim MS, Balduini FC. Coracoid fracture as a complication of surgical treatment by coracoclavicular tape fixation. A case report. *Clin Orthop Relat Res*. 1982 Aug; (168):133-5.

16. Pearsall AW 4th, Hollis JM, Russell GV Jr, Stokes DA Biomechanical comparison of reconstruction techniques for disruption of the acromioclavicular and coracoclavicular ligaments. *J South Orthop Assoc.* 2002 Spring; 11(1):11-7.

17. Powers JA, Bach PJ. Acromioclavicular separations. Closed or open treatment? *Clin Orthop Relat Res*. 1974 Oct; (104):213-23.

18. Rockwood CA Jr, Williams GR Jr, Young DC. Disorders of the Acromioclavicular Joint. In Rockwood CA Jr, Matsen FA III, eds. The Shoulder. Philadelphia PA: WB Saunders, 1998:483-553.

19. Rokito AS, Oh YH, Zuckerman JD. Modified Weaver-Dunn procedure for acromioclavicular joint dislocations. *Orthopedics*. 2004 Jan; 27(1):21-8.

20. Salter EG Jr, Nasca RJ, Shelley BS. Anatomical observations on the acromioclavicular joint and supporting ligaments. *Am J Sports Med*. 1987 May-Jun; 15(3):199-206.

21. Schlegel TF, Burks RT, Marcus RL, Dunn HK. A prospective evaluation of untreated acute grade III acromioclavicular separations. *Am J Sports Med*. 2001 Nov-Dec; 29(6):699-703.

22. Taft TN, Wilson FC, Oglesby JW. Dislocation of the acromioclavicular joint. An end-result study. *J Bone Joint Surg Am*. 1987 Sep; 69(7):1045-51.

23. Tienen TG, Oyen JF, Eggen PJ. A modified technique of reconstruction for complete acromioclavicular dislocation: a prospective study. *Am J Sports Med.* 2003 Sep-Oct; 31(5):655-9.

24. Thornes B, Walsh A, Hislop M, Murray P, O'Brien M. Suture-endobutton fixation of ankle tibio-fibular diastasis: a cadaver study. *Foot Ankle Int*. 2003 Feb; 24(2):142-6.

25. Thornes B, Shannon F, Guiney AM, Hession P, Masterson E. Suture-button syndesmosis fixation: accelerated rehabilitation and improved outcomes. *Clin Orthop Relat Res*. 2005 Feb; (431):207-12.

26. Tossy JD, Mead NC, Sigmond HM. Acromioclavicular separations: useful and practical classification for treatment. *Clin Orthop Relat Res*. 1963; 28:111-9.

27. Wolf EM, Pennington WT. Arthroscopic reconstruction for acromioclavicular joint dislocation. *Arthroscopy.* 2001 May; 17(5):558-63.

28. Yap JJ, Curl LA, Kvitne RS, McFarland EG. The value of weighted views of the acromioclavicular joint. Results of a survey. *Am J Sports Med*. 1999 Nov-Dec; 27(6):806-9.