AOSSM-AANA 2021 ICL #306

Case-based Approach to the Management of AC Joint Injuries – An International Perspective

American Orthopaedic Society for Sports Medicine – Arthroscopy Association of North America Combined Annual Meeting, Nashville, TN

Faculty	Title of talk	Time Allotted
Mary K. Mulcahey	Introduction	5 minutes
Mary K. Mulcahey	Anatomy, Evaluation, and Non-op Management of AC Joint Injuries	15 minutes
Guillermo Arce	Acute AC Joint reconstruction – When is it appropriate in Rockwood 3A and 3B?	15 minutes
Anthony A. Romeo	Chronic AC Joint Injuries – What I do to fix this	15 minutes
Matthew T. Provencher	How to Treat Common Complications of AC joint injuries	15 minutes
All faculty	Case-based discussion, Q&A	30 minutes

Total scheduled time: 1 hour 35 minutes

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Mary K. Mulcahey, MD

Anatomy, Evaluation, and Non-op Management of AC Joint Injuries

Anatomy, Evaluation, and Non-op Management of AC Joint Injuries

Overview:

- Anatomy of AC joint
- Mechanism of Injury
- Classification of AC injuries
- Diagnosis
- Management

Case Presentation

- 59 y/o RHD M
- 2 days s/p fall off a stool directly onto his L shoulder
- Immediate pain over the superior aspect of the shoulder
- Difficulty with shoulder ROM
- Works as a campus security officer

PEx

- Mild swelling over AC joint
- Prominence of distal clavicle
- FF 45 degr (increased to 90 degr passively); ER 30 degr
- Pain over ACJ with cross-body adduction at 90 degr FF

X-rays

Plan

- Steroid injection into AC joint
- PT
    - Scapular strengthening
    - Keep scapula retracted during all exercises
    - McConnell taping

Follow-up

- 2 weeks later
    - Initial pain relief with injection
    - Pain now back to baseline
    - Pain and limitation with shoulder ROM (FF 80 degrees)
    - MRI L shoulder (evaluate for cuff tear)
- 2 weeks after prior visit (now 4 weeks from injury)
- Substantial improvement in shoulder ROM and pain
- HEP/PT
- MRI L shoulder
    - Tear of AC ligaments

    - CC ligaments intact
    - Rotator cuff intact
- June 2021
- 1 week of L shoulder pain
- No trauma
- Pain with overhead motion and reaching away from his body
- Difficulty sleeping

X-rays June 2021

Anatomy of AC Joint

- AC joint anatomy[1]
    - Diarthrodial joint between the medial facet of the acromion and lateral aspect of the clavicle
    - Allows gliding movement
    - Assists in shoulder abduction and flexion
    - Stabilizes the scapula in relation to the clavicle by means of complex of ligaments and muscles
    - Clavicle rotates 40°- 50° with overhead motion
    - Only 5°- 8° of motion occurs at AC joint
    - As clavicle rotates upward, scapula rotates downward and AC joint motion decreases (synchronous scapuloclavicular motion)
    - 2 main ligaments stabilize the joint
        - Acromioclavicular (AC) Ligament
        - Coracoclavicular (CC) Ligaments
- AC Ligaments[2]
    - Superior, inferior, anterior and posterior components
    - Thickenings of the joint capsule
    - Major stabilizer against horizontal translation and posterior rotational forces – generated by scapular protraction
    - *Nakazawa et al. AJSM 2016*[3]
        - Two separate bundles
            - Superoposterior: higher quality structural composition
            - Anteroinferior: inconsistent; thin and narrow – important for horizontal instability
- CC Ligaments[4,5]
    - Conoid and trapezoid ligaments
    - Vertical stability
    - Work as restraints against scapular internal rotation
    - Trapezoid
        - 22 mm – 25 mm from lateral end of the clavicle
        - Attaches to undersurface of clavicle
        - Provides resistance to AC joint compression

    - Conoid
        - 42 mm – 47 mm from lateral edge of the clavicle
        - Responsible for 60% of the restraint to anterior and superior clavicular displacement and rotation
- AC capsule and CC ligaments[4,6]
    - Allow controlled rotation of > 40°- 50° for the acromion in relation to the lateral clavicle while preserving centered motion
    - Very important characteristic of normal scapulothoracic motion
    - Disruption of this rotation = ↓ function, poor clinical symptoms
- *Dyrna et al. AJSM 2018*[7]
    - Purpose:
        - To perform a detailed biomechanical evaluation of the specific capsular structures of the AC joint and to determine their contribution to translational and rotational stability
    - Results:
        - Posterior translational force → specimens with a completely cut AC capsule demonstrated significant loss of resistance force against translational motion
        - Cutting 50% of capsule reduced the resistance torque for all segments and testing modalities compared with native state ($p<.05$)
        - All groups demonstrated significant increase of motion in all directions when the AC capsule was cut by 50%
    - Conclusion
        - Cutting the entire capsule reduced the resistance force to less than 25% during translational testing; < 10% during rotational testing compared to native state
        - Anterior segments of the capsule provided the greatest stability under rotational loading
        - Amplitude of the joint's motion significantly increased under rotational stress

Classification of ACJ injuries

- Classification of Injuries[5,8]
    - Minor sprains and subluxations to complete dislocations
    - Often associated with other injuries to the shoulder joint
    - 1st classified by Tossy in 1963
    - Rockwood classification system for AC joint injuries (1984)
        - Type I, II, III, IV, V, VI
    - Type I
        - Sprain of the AC joint without a complete tear of the AC ligaments or CC ligaments
        - Joint tenderness & swelling
        - No widening of ACJ on x-ray

    - Type II
        - Tear of the AC ligament
        - Sprain or partial tear of CC ligaments
        - Vertical subluxation of the distal clavicle
    - Type III
        - Complete tears of both the AC and CC ligaments
        - 25%–100% displacement of the clavicle compared to contralateral side
        - IIIA – horizontally stable
        - IIIB – horizontally unstable
            - Characterized by overriding of the distal part of the clavicle on AP radiograph with the cross-arm adduction view
            - Often have substantial scapular dyskinesia that does not respond to PT
            - May benefit from early operative fixation
    - Type IV
        - Posterior subluxation of the clavicle into the trapezius
    - Type V
        - Both the AC and CC ligaments are completely torn
        - 100%–300% displacement of the clavicle compared with the contralateral side
    - Type VI
        - Rare
        - Distal clavicle is displaced inferiorly into the subcoracoid position
- Associated shoulder pathology[9,10]
    - 15%–18% of patients have associated pathology
    - Most common
        - SLAP lesions (14%)
        - Rotator cuff injury (4%)

Mechanism of Injury[5,11,12]

- Injuries to the AC joint comprise approximately 12% of all shoulder injuries
- 5-10x more common in males
- Most often occur in the first 3 decades of life
- Direct blow to the shoulder, while arm in adducted position or fall on an adducted arm
- Common in bicycling, skiing, ice hockey, rugby, football, and soccer
- More severe downward forces may tear the deltoid and trapezius muscle attachments from the clavicle
- Uncommon mechanisms for injury
    - Traumatic force by substantial inferior pull through the upper extremity
    - Lateral directed force as the scapula externally rotates

Diagnosis

- Clinical presentation[5]
    - Suspect ACJ injury in any patient who has shoulder trauma with pain in vicinity of the acromion and clavicle
    - Injured upper extremity in an adducted and supported position to alleviate pain
    - Localized pain, swelling, and point tenderness around the AC joint
    - Pain accentuated with abduction and cross-body adduction
    - Tenting of the skin by distal aspect of the clavicle (type-III or V)
    - Sternoclavicular joint pain may also be present in type-IV injuries
    - Pain in the neck or trapezius muscle may also indicate a type-V or type-VI injury
- Physical exam[13]
    - Different techniques can be used to identify an AC joint injury on physical examination
        - Cross arm adduction test
        - Paxinos test
        - O'Brien's test
        - AC resisted extension test
    - Cross Arm Adduction Test
        - Arm is elevated to 90^{o} and adducted across chest with elbow flexed to 90^{o}
    - Paxinos Test
        - Evaluates tenderness by applying thumb pressure at the posterior AC joint
    - O'Brien's Test[14]
        - Determines whether the pain is caused by injury to the AC joint or labral or biceps pathology
        - Apply downward force with arm elevated to 90^{o} and adducted to 10^{o}-15^{o}
        - Pain referred to AC joint – AC joint injury
        - Pain referred to anterior GHJ – labral or biceps injury
    - AC resisted extension test[14]
        - Shoulder and elbow in 90° flexion
        - Patient attempts to extend elbow against resistance
    - Evaluate for horizontal instability
        - Assess posterior translation of clavicle
        - One hand to shift clavicle, other hand to maintain position of the acromion
- Imaging[5, 15,16,17]
    - X-rays - initial imaging modality of choice for diagnosis and classification
    - Zanca view is the most accurate radiograph to use
        - Bilateral Zanca view is recommended to visualize both AC joints on a single cassette
        - Use ½ of the x-ray exposure that's used in standard radiograph of the shoulder
    - *Bearden et al. J Sports Med 1973*[18]

        - Avg distance between superior aspect of coracoid and inferior aspect of clavicle = 1.1 cm – 1.3 cm
        - 40 % - 50% difference in CC interspace between normal and affected shoulders indicates complete disruption of CC ligaments
    - *Rockwood and Matsen, The Shoulder, 1990*[19]
        - Documented complete disruption of CC ligaments with side-to-side CC interspace difference of 25%
    - Axillary view is essential in diagnosing type-IV AC separations
    - Stress radiographs can be used to differentiate between type-II and type-III injuries
        - Painful for the patient, so not routinely used for imaging AC joint injuries

Horizontal Instability[13]

- Often missed – can lead to chronic pain and functional limitations
- Can present clinically with significant shoulder pain and disability
- Difficult to diagnose using standard x-ray views
- Recommend using
    - Zanca view
    - Axillary lateral view
    - Alexander view[20]
        - Arm in adducted horizontal stress position
        - Scapula anteverted
    - Supine dynamic lateral view[21]
        - Arm abducted to 90° in the scapular plane

Imaging – MRI[5]

- Directly assess AC and CC ligamentous disruptions
- May be helpful in identifying potential associated injuries that may require surgical intervention

Management

- Types I and II[22,23,24]
    - Non-operative
        - Sling
        - Anti-inflammatory medications
        - Activity modification
        - Physical therapy
    - Avoid contact sports and heavy lifting until
        - Pain free
        - Symmetric range of motion and strength relative to contralateral upper extremity

- *Verstift et al. AJSM 2021*[25]
  - Purpose: to assess the long-term outcome after non-operative therapy for Rockwood I and II ACJ injuries regarding functional and radiologic outcome
  - Results
    - Median follow-up of 85 months
    - Mean constant score of injured shoulder was 88.6 vs 93.3 in contralateral shoulder ($P<0.001$)
    - Median DASH was 4.2; median SST was 100
    - Radiologic outcomes:
      - Similar rates of degeneration
      - More frequent osteolysis of the distal clavicle, ossification of the ligaments, and deformity of the distal clavicle
  - Conclusion:
    - Frequent radiographic changes
    - Long-term functional outcomes after Rockwood I and II ACJ injuries is good
    - Clinically non-relevant functional differences between injured and contralateral side
- Horizontal Instability

- Type III[26,27]
  - Management is controversial
  - To maximize function, some advocate surgery for acute type III AC joint injuries in young and active patients
  - Optimal treatment (surgical or nonsurgical) for an athlete who plays overhead sports and places high functional demands on AC joint may be different than for older, less active patients
  - *Schlegel et al. AJSM 2001*[28]
    - Purpose
      - Evaluate the outcome of patients who received no surgery or formal rehabilitation program for an acute grade III AC separation
    - Results
      - 20 of the 25 patients completed the 1-year evaluation and strength testing protocol
      - 4 of the 20 patients (20%) thought their long-term outcome was suboptimal
      - Examination and strength testing revealed no limitation of shoulder motion in injured extremity
      - No difference between sides in rotational shoulder muscle strength
      - Bench press was the only strength test that showed a significant short-term difference, with the injured extremity being an average of 17% weaker
    - Conclusion

        - Treatment of acute grade III AC separation remains controversial
        - Majority of patients will do well without any formal treatment
        - Patients who require the ability to perform heavy lifting or repetitive manual labor may not be able to return to all activities
    - *Longo et al. Br Med Bull 2017*[8]
        - Purpose: to compare the rate of recurrence and outcome scores of operative vs non-operative treatment of patients with type III AC dislocations
        - Conclusion
            - Insufficient evidence to establish the effects of surgical vs conservative treatment on functional outcomes of patients with Type III AC dislocation
            - High-quality randomized controlled clinical trials are needed to establish whether there is a difference in functional outcome
    - Current literature → no difference between operative and non-op
    - Recommendation[5]
        - Start with nonsurgical management for 3 to 4 months
        - Surgical management should be considered in patients who
            - Have significant AC deformity
            - Tenting of the skin
            - Persistent pain despite nonsurgical management
            - Patients with higher functional demand (work or sports) of the injured shoulder
- Scapular dyskinesia[1,29]
    - Clinically important consequences of non-op management
    - Alteration of the normal position or motion of the scapula during coupled scapulohumeral movements
    - Dyskinetic patterns fall into 3 categories characterized by prominence of
        - Inferomedial border of the scapula (Type I)
        - Entire medial border (Type II)
        - Superomedial border (Type III)
- SICK Scapula Syndrome[30]
    - **S**capular malposition
    - **I**nferior medial border prominence
    - **C**oracoid pain and malposition
    - dys**K**inesis of scapular movement
    - *Gumina et al. Arthroscopy 2009*[1]
        - Purpose
            - To evaluate whether scapular dyskinesis and, eventually, SICK scapula syndrome develops in patients with chronic type III AC dislocation
        - Results
            - 70.6% of patients had scapular dyskinesis with arms at rest

        - 2/3 had prominence of inferomedial border of the scapula (Type 1)
        - 58.3% had SICK scapula syndrome
    - Mean SICK scapula rating scale was 6.9 (out of possible 20 pts)
    - Constant score was 83 points for pathologic side and 91 points for contralateral side
- Conclusion
    - Chronic type III AC separation causes scapular dyskinesis in 70.6% of patients (58.3% of which have SICK scapula)
    - Dyskinesis might be due to loss of AC joint as a stable fulcrum of the shoulder girdle or due to superior shoulder pain

Summary

- AC joint assists in arm movement
- Often caused by a direct blow to the shoulder in contact sports
- Rockwood classification system is used to determine extent of injuries (Grade I-VI)
- Non-operative or operative treatment depend on severity of injury

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Guillermo R. Arce, MD

Acute AC Joint reconstruction – When is it appropriate in Rockwood 3A and 3B?

Acute AC Joint reconstruction – When is it appropriate in Rockwood 3A and 3B?

a. Surgical options
b. Factors to take into account
c. Outcome measures, return to play

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Anthony A. Romeo, MD

Chronic AC Joint Injuries – What I do to fix this

Chronic AC Joint Injuries – What I do to fix this

a. Surgical options
b. Factors to take into account
    a. Don’t forget the AC joint; CC reconstruction is not enough
c. Outcome measures, return to play

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Matthew T. Provencher, MD

How to Treat Common Complications of AC joint injuries

How To Treat Common Complications of AC Joint Injuries

I. Introduction

Injuries to the acromioclavicular (AC) joint and ligamentous structures can range in severity and, consequently, subsequent joint instability[1]. AC injuries are common among athletic patient populations, often occurring among young males from a direct fall onto the superior aspect of the shoulder when the arm is adducted[2]. While Type I through Type III injuries are generally treated nonoperatively, surgical intervention is recommended to treat Type IV, V, and VI injuries. There exists, however, discrepancies in the literature of reported outcomes among surgical techniques including use of free tendon graft, suspensory devices, and modified Weaver-Dunn techniques. In light of this data, the reader may find a review of surgical outcomes using various fixation methods to treat AC joint injuries and associated instability[1].

II. Classifications[3]

a. Type I: Mild sprain of AC ligament

b. Type II: Ruptured AC ligament, sprained CC ligaments

c. Type III: Superior dislocation of the AC joint with ruptured AC ligament, CC ligament, and joint capsule

d. Type IV: Posterior dislocation of the AC joint with ruptured AC ligament, CC ligament, and joint capsule

e. Type V: Gross superior dislocation of the AC joint with ruptured AC ligament, CC ligament, and joint capsule

f. Type VI: Inferior dislocation of the AC joint with rupture of the AC ligament, CC ligament, and joint capsule

III. Outcome Scores with Various Fixation Methods

Author	Journal/Year	Study Measure	Fixation Method(s)	Outcome	Conclusions
Krishnan[4]	Knee Surg Sports Traumatol 2017	Retrospective Case Series	Hamstring tendon graft	Improvement in ASES*, VAS*; 93% Return to play	Significantly improved outcomes; successfully controls superior and posterior translation
Moatshe[5]	Arthroscopy 2018	Systematic Review	Tendon graft, suspensory devices, and modified Weaver-Dunn techniques	Improved subjective and radiographic outcomes*; Hook plate and K-wires highest rate of complications (26.3%)	Comparable subjective outcome scores
Gowd[6]	AJSM 2019	Systematic Review	Suture only, Endobutton + suture, TightRope, GraftRope, Synthetic artificial ligament, tendon graft, Weaver-Dunn CC ligament transfer	No difference between arthroscopic vs. open techniques for loss of reduction (p=.858)	Open and arthroscopic AC joint reconstruction are comparable

The above literature suggests that there is no difference among fixation methods for AC joint injuries. All techniques provide sufficiently improved clinical and subjective outcome scores postoperatively. ***Denotes significant improvement ($p < 0.005$)**.

IV. Common Complications

Author	Journal/Year	Study Measure	Fixation Method(s)	Complications	Conclusions
Millett[7]	Arthroscopy 2015	Retrospective Case Series	Tendon graft	8 patients (26%) with complications & required a subsequent surgical procedure 3 cases with loss of reduction (9.7%), 2 clavicle fractures (6.5%), 2 cases of distal clavicle hypertrophy (6.5%), and 1 instance of painful hardware (3.2%).	High complications rates ; More common in pts. originally treated nonoperatively Potentially leading to scapular dyskinesis
Banffy[8]	JSES 2018	Retrospective Case Series	Semitendinosus graft	3 cases with prominent suture stack over top of Dog Bone Button (17.6%)	Can complications be avoided by positioning tunnel and button more posteriorly on clavicle to provide better tissue coverage? Using fewer knots?
Muench[9]	OJSM 2019	Retrospective Case Series	Tendon graft	3 pts. (7%) with ossification and 3 pts. (7%) with osteoarthritis of AC joint were the most common complications All occurring in patients whose surgery was greater than 6 months from injury.	Fixation occurring before 6 months may play a role in delaying degeneration of the AC joint
Galasso[10]	OJSM 2020	Retrospective Case Series	Weaver-Dunn	2 cases with complications (7.4%): 1 peri-incisional dysesthesia and 1 loss of reduction	Low complication rates

The above literature presents substantial information about follow-up with specific techniques and suggests timing of intervention may influence complication rate. **But, what about the studies that directly compare techniques?**

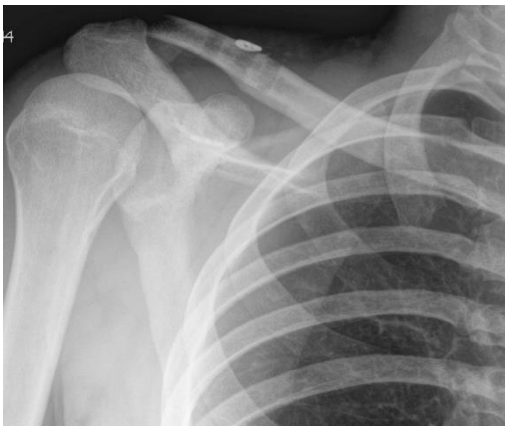
Author	Journal/Year	Study Measure	Fixation Method(s)	Complications	Conclusions
Hegazy[11]	Open Orthop J. 2016	Retrospective Case Series	Modified Weaver-Dunn vs. Semitendinosus Graft	3 pts. experienced failure in Weaver-Dunn group vs. None in semitendinosus group 3 pts. with infection in Weaver-Dunn group	More complications in modified Weaver-Dunn group, but similar subjective outcomes. Optimal operative method is controversial
Lee[12]	Arch Bone Jt. Surg 2018	Retrospective Case Series	Tendon graft (n=12) vs. No graft (n=35)	Graft vs. No graft loss of reduction: 5 pts. (42%) vs. 8 pts (23%) Not statistically significant (p=0.22)	Greater but not statistically significant rate of loss of reduction in group reconstructed with use of a tendon graft

V. Reoperation Rates

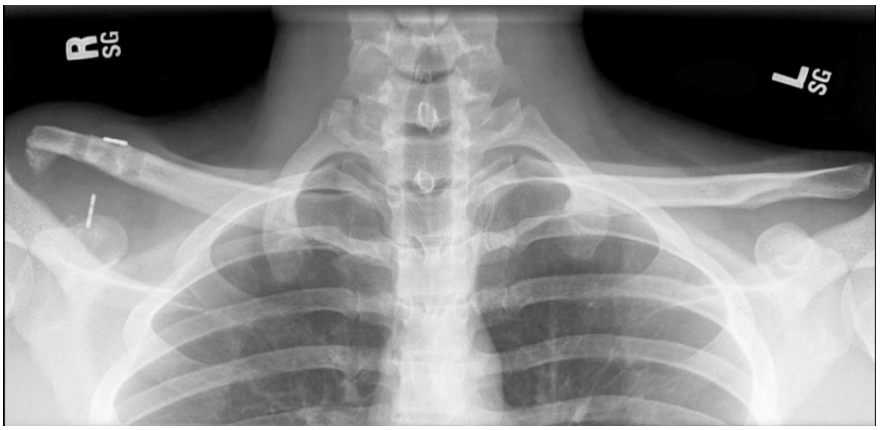
Author	Journal/Year	Study Measure	Fixation Method(s)	Reoperations	Conclusions
Spencer[13]	Bone and Joint Journal 2016	Retrospective Case Series	(1) modified Weaver-Dunn, (2) allograft fixed through coracoid and clavicular tunnels, (3) allograft loop coracoclavicular fixation, and (4) combined allograft loop and synthetic cortical button fixation	Re-operation occurred in 15 pts (9.7%) pts. Combined allograft loop and synthetic cortical button fixation had four-fold lower risk of reoperation (OR: 0.25) Patient age over 40 years had significance for increased risk of re-operation (OR 3.1, p = 0.05)	Combined allograft loop and synthetic cortical button fixation is superior (lower rates of re-operation)
Pill[14]	JSES 2020	Systematic Review	Tendon graft (double tunnel vs. single tunnel)	37 reoperations out of 460 index surgeries (8% of patients) Clavicle fractures accounted for 8 of 37 revisions (21.6%) and were most common reason for revision surgery Significant increase in reoperation using allograft (p=.003) No difference between single and double tunnel	Use of tendon autograft may reduce the risk of reoperation

VI. What are the Common Complications?

1. Loss of reduction / Loss of fixation



Postop



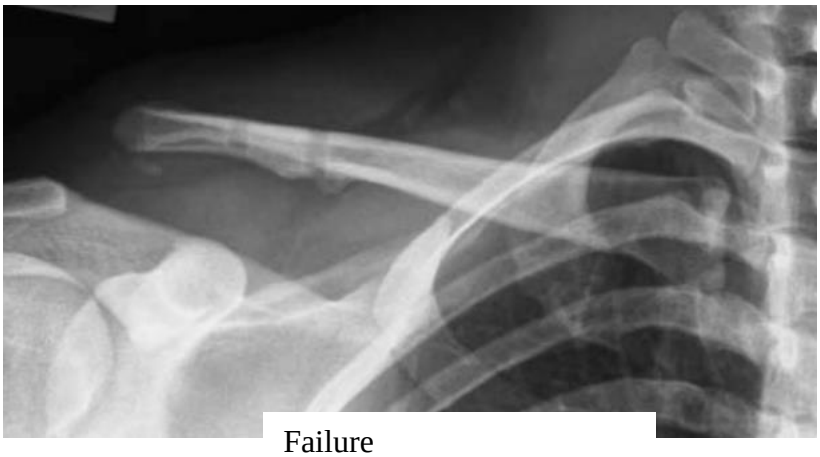
6 Weeks Later …

2. Fractures: Especially thru tunnels clavicle OR coracoid

3. Recurrent / Unsolved posterior instability / Subluxation of clavicle
4. Numbness around incisions (**Note**: This is expected)
5. Hardware migration (especially of pins / wires)
6. Infection

7. Tunnel malposition in coracoid / clavicle
    i. Cook et al., AJSM 2013; 41(1):142-8 : 28 patients (8/28 failed = 28%); Failure = 6mm of superior elevation; Time to failure = 7 weeks; 14 open vs. 14 scope; Medialized tunnels in those that failed; Distance between tunnel was NOT a factor; Open failed 3x more than scope [15]

Success



Failure

Figures Courtesy of: Cook et al., AJSM 2013; 41(1):142-8

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