Acromioclavicular and Sternoclavicular Injuries

Jon B. Carlson, M.D.
University of Louisville
Goals and Objectives

• Review AC and SC anatomy
• Review AC and SC imaging
• AC joint injuries
  • Nonoperative indications and management
  • Operative indications and management
• SC joint injuries
  • Nonoperative indications and management
  • Operative indications and management
AC Joint Anatomy

• Diarthrodial joint
  • Medial acromion
  • Lateral clavicle

• Ligaments
  • AC – Primarily anterior to posterior stabilizers
    • Superior is the strongest
  • CC
    • Trapezoid
    • Conoid
      • Vertical stabilizers
      • Stronger than AC
AC Joint Anatomy

• Average dimensions of AC joint
  • 9 x 19mm

• Innervation – Branches of:
  • Axillary
  • Suprascapular
  • Lateral pectoral

History / Mechanism:

• Direct impact to the superior shoulder
• Downward force vector
• Sports injuries (hockey player checked into the boards)
• Fall from height
• Equestrian injuries
• Motor vehicle crashes

Physical Examination

• Inspect skin to evaluate for open injury or threatened skin
• Evaluate distal motor and sensory function
• Evaluate distal extremity perfusion/pulses
• Attempt to evaluate ROM
  • May be too painful in acute injury
• If unilateral, compare to contralateral side
• Palpation

Image courtesy of Prof. Michael D. McKee, MD, FRCS(C)
Radiographs

• AP

• Zanca view
  • AP centered on the AC joint with 10-15 degrees of cephalic tilt

Radiographs

• Stress view
  • Sit or stand upright with 10-pound weight in ipsilateral hand
  • Rarely used

• Axillary lateral
  • Evaluate for posterior displacement
  • Beware, normal x-rays may mimic posterior clavicle subluxation

First two images courtesy of Prof. Michael D. McKee, MD, FRCS(C)
Classification

• Allman and Tossy
  • Initially classified 3 types (I, II and III)

• Rockwood
  • Added types IV, V and VI

• Inter- and intra-observer agreement on classification poor
  • Especially types III-V


Type I

- Sprain of acromioclavicular ligament
- AC joint intact – normal x-rays
- Coracoclavicular ligaments intact
- Deltoid and trapezius muscles intact
Type II

• AC joint disrupted
• Sprain of the coracoclavicular ligaments
• < 50% Vertical displacement on x-ray
• CC ligaments intact
• Deltoid and trapezius muscles intact
Type III

• AC ligaments and CC ligaments all disrupted

• AC joint dislocated and the shoulder complex displaced inferiorly

• CC interspace greater than the normal shoulder (25-100%)

• Deltoid and trapezius muscles usually detached from the distal clavicle

Type III variants

- “Pseudo-dislocation”
  - Intact periosteal sleeve
- Physeal injury
- Coracoid process fracture
Type IV

• AC and CC ligaments disrupted
• AC joint dislocated and clavicle displaced posteriorly into or through the trapezius muscle
• Deltoid and trapezius muscles detached from the distal clavicle

Clinical Image courtesy of Prof. Michael D. McKee, MD, FRCS(C)
Type V

• AC ligaments disrupted
• CC ligaments disrupted
• AC joint dislocated and gross disparity between the clavicle and the scapula (100-300%)
• Deltoid and trapezius muscles detached from the distal half of clavicle
Type VI

• AC joint dislocated and clavicle displaced inferior to the acromion or the coracoid process
• AC and CC ligaments disrupted
• Deltoid and trapezius muscles detached from the distal clavicle
Treatment of Type I and II

- Nonsurgical
- Rest, ice and protection
- Sling
  - 1-2 weeks
  - Important to instruct patient to move distal joints to avoid stiffness
- Return to sports as pain allows
- Specialized braces generally not helpful
Surgical indications Type II

• Chronic Pain after nonoperative treatment

• Multiple techniques
  • Distal clavicle excision
  • Reconstruction of the coracoclavicular ligaments
    • Various techniques
  • Possible additional fixation (hook plate)
Treatment of Type III

• Controversial

• Nonsurgical management usually indicated

• Consider surgical treatment
  • Throwing athletes
  • Overhead workers
Treatment of Type III

- Surgical treatment
  - No significant difference with functional outcome
  - 50% loss of reduction with follow up
  - 10% infection rate
  - No significant improvement in cosmesis (bump vs scar)

Treatment of Type III – V: Meta-Analysis

• Systematic review and meta-analysis
• 19 studies, 954 patients
• Better cosmetic outcome with surgery
• Better radiographic outcome with surgery
• Constant scores favored surgery
  • Small difference, may not be clinically relevant
• Nonsurgical group: faster return to work, lower implant complications, fewer infections, no difference in DASH, return to sport, osteoarthritis on x-rays or need for surgery after failed management

Treatment of Type III – V: Randomized Clinical Trial

- Multicenter randomized clinical trial
- 80 patients, 40 each group
- Complete AC separation (III, IV and V)
  - No attempt to subclassify into specific types!
Treatment of Type III – V: Randomized Clinical Trial

• Hook plate vs nonsurgical treatment
  • Better DASH scores at 6 weeks and three month in non-op group
    • No difference at 6 months, 1 year and 2 years
  • Better Constant scores in nonop group at 6 weeks, 3 months and 6 months
    • No difference at 1 year and 2 years
  • Both groups improved to good or excellent results at 2 year follow up

Treatment of Type III – V: Randomized Clinical Trial

- Significantly higher reoperation in operative group
- Implant removal average time 8.2 months
- DASH scores better for non-op pts at 6 wk and 3 mo, no diff thereafter
- Constant scores better in non-op pts 6 wk, 3 and 6 mo, no diff thereafter
- Radiographs outcomes better with surgery at all time points (P<0.001)
- 2 years: 4/22 surgical vs 1/20 non-op had arthritic changes (p 0.36)
- 76% non-op back to work at 3 months vs 43% surgical (p=0.004)
  - No difference at 1 year

- Over-reduction (narrowing) of the A-C joint was the most common cause of mechanical failure after surgery
Treatment of Type III - V

• Follow up to above study
• Assessed health related quality of life
• Mostly type III injuries in both groups
• Physical health scores
  • Better in non-op group at 3 months then no difference through 2 years
• Mental health scores
  • No difference at any time point
• Physical health recovered to norms at 6 months in nonop, 1 year in operative group
• Mental health recovered to norms at 3 months with surgery, 6 months without surgery

Options for surgical treatment

• Over 50 described in the literature
• Primary AC joint fixation
• Primary CC ligament reconstruction
  • Usually allograft, often with augmentation
• Distal clavicle excision
• Dynamic muscle transfers
Weaver-Dunn Procedure

• The distal clavicle is excised.
• The CA ligament is transferred to the distal clavicle.
• The CC ligaments are repaired and/or augmented with a coracoclavicular screw or suture.
• Repair of deltotrapezial fascia
• Original series described 28% failure rate

  From Nuber GW and Bowen MK, JAAOS, 5:11, 1997

  • Modifications of the technique lead to improvements
    • 89% satisfactory results
      • All type III, mix of acute and chronic patients
    • 27/27 return to work and sport, high satisfaction
      • All type III, all chronic dislocations


ORIF with hook plate

• Biomechanical strength most similar to that of intact AC and CC ligaments¹
• Can have high rates of removal
• Concern for damage to rotator cuff
• Possible impingement
• Can have loss of reduction after removal
• Be careful not to over-reduce
  • Pain, stiffness and early failure²


Clinical Image from Prof. Michael D. McKee, MD, FRCS(C)
Bosworth screw

- Biomechanically stronger than hook plates
- Can be done open vs percutaneously
- Can be used to augment suture tape or other constructs

Images from Prof. Michael D. McKee, MD, FRCS(C)
Suture button

- Reports of high failure rates
  - 10 repairs
  - 9 consecutive patients
  - 80% failure
  - Average of 7 weeks
  - All active-duty military

Images from Prof. Michael D. McKee, MD, FRCS(C)

Suture Button – meta-analysis

• Suture button vs hook plate

• 8 studies
  • 204 suture button patients
  • 195 hook plate patients

• Suture button
  • Better constant scores – may not be clinically significant
  • Lower VAS

• No difference: operative time, reduction quality, complication, loss of reduction

Suture Button – Case Example

• 48yo RHD M assault victim
  • Fell directly on to R shoulder
• Works occasionally in construction
• Homeless
• ½ ppd tobacco
• Cocaine
• Methamphetamine
• Marijuana
Suture Button – Case Example

- CRPP

Image courtesy of Dr. Jiyao Zou
Suture Button – Case Example

• Incidental follow up at 15 months after fall from height
• Good maintenance of reduction on x-rays
• No clinical f/u as we weren’t reconsulted
Relative indications for surgical treatment

• Chronic dislocations with:
  • Pain
  • Concern with cosmetic deformity
  • Weakness
Outcomes of various treatments

• Modified Weaver-Dunn may lead to good functional results in patients with symptomatic chronic type III dislocations

• Suspensory loop fixation may lead to better Constant-Murley scores vs hook plates and less post-operative pain vs hook plates
  • Majority of studies (27/36) included type III injuries

• Suture button fixation vs Bosworth screw
  • Prospective, Randomized Trial. 34 pts each group
  • No difference in radiographic outcomes
  • No significant differences in Constant scores, Oxford Shoulder scores. DASH excellent in both groups.
  • No need for second surgery with suture button fixation


Rehab protocol for surgical treatment

• Sling for 4-6 weeks
  • Encourage PROM during that time
• No pushing, pulling, reaching
• AROM starts at 6 weeks
• Strengthening starts at 8 weeks
• Return to contact sports at 16-20 weeks after removal of implants if planned

ORIF with hook plate and CC ligament transfer
Sternoclavicular Joint Injuries
Sternoclavicular joint - Anatomy

• Diarthrodial joint
• Saddle shaped with poor congruence
• Intra-articular disc
  • Divides SC into 2 separate joint spaces
• Costoclavicular ligament (rhomboid ligament)
  • Short, strong
  • Anterior and posterior fasciculi
Sternoclavicular joint - Anatomy

• Interclavicular ligament
  • Connects superomedial aspects of each clavicle to
    • Capsular ligaments
    • Upper sternum

• Capsular ligament
  • Covers anterior and posterior aspects of the joint
  • Thickenings of the capsule
  • Anterior is the stronger of the two
Sternoclavicular joint - Anatomy

• Epiphysis of the medial clavicle
  • Last ossification center to appear in the body
  • Ossifies at age 18-20
  • Does not unite with clavicle until the 23rd – 25th year
Sternoclavicular joint – Plain Radiographs

• Heinig view

• Hobbs view

Sternoclavicular joint - Imaging

• CT Scan
  • Current gold standard for diagnosis
  • Also allows for evaluation of associated soft tissue injuries
Sternoclavicular joint – Treatment

• Anterior dislocations
  • Non-surgical treatment usually recommended
    • NSAIDs/pain control
    • Immobilization for comfort
    • Closed reduction maneuvers often unsuccessful
      • Direct pressure over medial clavicle may lead to reduction
      • Often can’t be maintained
  • Functional results thought to be generally good
  • Can lead to cosmetic deformity
Sternoclavicular joint – Treatment

• Anterior dislocations
  • Recent literature has questioned nonoperative treatment in active, young patients
    • Pain with activity and inability to return to throwing sports
    • Decreased function reported by 42% of patients
    • Risk of post-traumatic arthritis
    • Noticeable cosmetic deformity

Sternoclavicular joint – Treatment

- Posterior dislocations
  - Careful physical examination
    - Vascular compromise
    - Difficulty swallowing
    - Stridor
    - Hoarseness
  - If reduction required, have Thoracic Surgeon on standby or transfer to center with Thoracic Surgery available
- Attempt closed reduction
  - Roll/bump between scapulae
  - Abduction/Adduction with traction
  - Percutaneous towel clip or pointed reduction forceps with anterior force
2018 Meta-analysis

- 38 articles reviewed, 26 quantitative
- No level I, II or III studies. Expert opinion and case series only
- 4 questions
  - What is the expected outcome without treatment?
  - What are the indications for closed reduction?
  - What are the indications for open reduction?
  - Is there a need for availability of cardiothoracic surgery for open reduction?

2018 Meta-analysis

- Non-reduced anterior dislocations
  - 38-42% complication rates (pain, activity limitation, arthritis)
- No posterior dislocations were left unreduced
- Thus, closed reduction should be attempted for all dislocations
  - Successful 38% of the time in a series of 21 posterior SC dislocations

Indications for open treatment:
- Irreducible posterior dislocation is an indication for open reduction
- Irreducible anterior dislocation in young, active patients may be a relative indication
- None of the 35 reported cases of open reduction (anterior or posterior) required the intervention of cardiothoracic surgery
  - However, recommended by 18 articles that they are available
- Additionally, high rate of hazardous wire migration when K-wires were used to fix joint.

Open treatment options

• Figure of 8 suture tape
• Allograft reconstruction
• Autograft reconstruction
• Trans-articular plating
OTA Video

• Insert video

Bonyun, Marissa, MD, MEd, Nauth, Aaron, MD, MSc. Techniques for Reduction and Fixation of the Sternoclavicular Joint. J Orthop Trauma. 2020;34:S1-S2. doi:10.1097/BOT.0000000000001831.
Case Example

• 29yo M
  • 3 days from injury
  • Pain with swallowing
  • Shortness of breath with talking
  • Distally NVI

• Posterior R SC dislocation

• Tracheal deviation

• Wide Mediastinum
Case Example

- 29yo M
  - 3 days from injury
  - Pain with swallowing
  - Shortness of breath with talking
  - Distally NVI
- Posterior R SC dislocation
- Tracheal deviation
- Wide Mediastinum
Case Example

- Attempted closed reduction in OR – unsuccessful
- Attempted percutaneous reduction → resubluxation
  - Confirmed with O-Arm
Case Example

• Conversion to ORIF
  • Cardiothoracic surgeon available within 5 minutes
  • General Trauma surgeon immediately available

• 2 cortical screws, 2 locking screws

• Planned removal at 6 months

Image courtesy of Prof. David Seligson
Case Example

• Lost to follow up after 2.5 months

Image courtesy of Prof. David Seligson
Literature Summary

- Bonyun, Marissa, MD, MEd, Nauth, Aaron, MD, MSc. Techniques for Reduction and Fixation of the Sternoclavicular Joint. J Orthop Trauma. 2020;34:S1-S2.
AC Joint Additional Literature


Acknowledgements

• Many thanks to the previous authors for the use of their slide material and several images!

  • Andrew Schmidt, M.D.

  • T. J. McElroy, M.D.

  • Michael D. McKee, MD, FRCS(C)
Summary

• AC Dislocations
  • Best, most recent literature seems to recommend non-surgical treatment for AC dislocations types I-III without other indications (skin, open injury, etc)
    • Possible exception for overhead workers and throwing athletes in type III
    • Treatment of types IV-VI likely surgical. Lack of good literature. Many authors are classifying type III-V as a single cohort.
    • Many options for fixation constructs and surgical techniques

• SC Dislocations
  • Possibly increasing indications for reduction and fixation of anterior SC dislocations in younger, active patients. More literature is needed.
  • All posterior dislocations should be reduced whether closed or open
  • No reports of cardiothoracic surgeon intervention in the literature that I could find. However, due to anecdotal reports of death with S-C manipulation, many authors recommend that having CT Surgeon available.