Shoulder Injuries in Hockey: Acromioclavicular, Clavicle, and Sternooclavicular

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KEEP YOUR EDGE
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Disclosures
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Acromioclavicular Joint Anatomy

Acromioclavicular Ligaments

- Resists 90% of AP translation and joint distraction

- Transection of the AC capsule:
  - 100% increase in posterior translation
  - No increase in superior translation
Acromioclavicular Joint Anatomy

Coracoclavicular Ligaments

- Conoid: Resists 60% of superior and 70% of anterior motion
- Trapezoid: Resists 75% of AC joint compression

Coracoclavicular ligaments function independently
Rockwood Classification – 1998

Type I
Ligament stretched
Clavicle displaced posterior
Over acromion

Type II
Partial rupture
A.C. ligaments

Type III
Complete rupture
A.C. and C.C. ligaments
Clavicle underneath
Coracoid (very rare!)

Type IV
Clavicle displaced
Just under skin

Type V

Type VI
Type III AC Separation

Definition (Rockwood Classification)

- Complete disruption of both AC and coracoclavicular ligaments without disruption of deltoid or trapezial fascia
- 100% superior clavicular displacement
Injuries that Mimic Type III Separations

- **Type V injury**
  - >100% superior displacement
  - It *cannot* be manually reduced

- **AC dislocation with intact CC ligaments and a fracture of the coracoid process**
  - AC dislocation normal CC distance (<13 mm)

- **Salter-Harris injury to the distal clavicular physis with periosteal disruption**
Imaging of the Acromioclavicular Joint

20° Cephalic Tilt (Zanca) View
- Must be centered on the AC joint

Axillary Lateral
- Axial view is important in differentiating Type III and IV injuries

Stryker Notch View
- Useful to rule out a coracoid fracture when CC distance is normal

Axillary Lateral
Stryker Notch View
Zanca View
The “Unstable” Type III Separation

*Type III-B*

Beitzel, et al, ISAKOS Upper Extremity Committee Consensus Statement, 2014
Type III: Operative vs. Non-operative

- Phillips et al. (*CORR*, 1998)
  - Meta-analysis of 1172 patients
  - 87% satisfactory outcome in both groups
  - Surgical treatment: *infection* (6% vs. 1%), *re-operation* (59% vs. 6%)
  - Non-operative treatment: returned to pre-injury activities sooner, more nearly normal strength, but *greater deformity* (37% vs. 3%)
  - *No difference in pain or strength between groups*

- Spencer (*CORR*, 2006)
  - Systematic review of 9 trials (448 patients)
  - *Surgery: higher complication rates, longer convalescence, and longer time away from work and sport*

• What are the sequelae we would like to minimize?
• What constitutes an acceptable outcome?
Indications for Surgical Treatment

Acute Injuries
- Types IV and VI injuries
- Combined AC separation and coracoid fracture
- Bipolar clavicular dislocation ("floating clavicle")
- "Pseudodislocation" with significant displacement in children
- Open injuries

Chronic Type III
- Type III and V injuries with persistent symptoms
  - Pain
  - Increased instability
  - Decreased strength
  - Impingement due to scapular dyskinesia
  - Posterior abutment of the scapular spine
Preferred Anatomic Reconstruction

Gracilis and Suture Tape

Conoid tubercle

Trapezoid

Highest bone density between 20 mm and 50 mm from AC joint

Acromial facet

Drill Hole Placement
Preferred Anatomic Reconstruction

Graft and FiberTape Passed

Interference Fixation (PEEK)

One hole placed in collision athletes
Preferred Anatomic Reconstruction

Final Construct

Wound Closure
Complications of Surgical Reconstruction

Martetschläger (AJSM, 2013): 27% Complication Rate; 83% Survivorship

- Infection
- Persistent pain
- Hardware failure
- Recurrent instability/loss of reduction
- Hardware migration resulting in injury to the great vessels
- Aseptic foreign body reaction with synthetic implants
- Early or late fracture of the coracoid process
- Clavicle fracture through drill holes
- Risk to the brachial plexus and subclavian/axillary artery

Good to excellent outcomes seen only in those patients who did not have a complication
Summary: AC Separation in Hockey Players

- No definitive data to support acute fixation
- Majority of outcome measures equal to or better with non-operative treatment
- Improved cosmesis is the only *proven* benefit of surgery
- Indications for surgery:
  - Types IV-VI
  - Clavicular instability
  - Chronic pain
  - Decreased strength
  - Posterior scapular impingement

Avoid large drill holes in clavicle and coracoid in hockey players!
Mechanism of Clavicle Fractures

**Direct:** Fall onto shoulder or blow to clavicle

- Higher energy $\rightarrow$ displacement and comminution
- More likely to be open and associated with pneumothorax, N/V injury, and non-union

**Indirect:** Fall onto hand with proximal force

- Attributed to strong ligamentous support
- More likely to lead to plastic bowing in young
Classification of Clavicle Fractures

Group I: Fracture of the Middle Third - 80%
Group II: Fracture of the Distal Third - 15%

- **Type I:** Minimal displacement
- **Type II:** Medial to coracoclavicular ligaments
  - A: Conoid and trapezoid attached to distal fragment
  - B: Conoid ruptured, trapezoid attached to distal fragment

Type IIA  
Type IIB  
Type IV
Non-operative Treatment of Clavicle Fractures

Indications
- Majority of mid-shaft fractures
- Group II (lateral) Types I and III
- Group III (medial) without N/V symptoms

Treatment
- Anatomic reduction *not* required
- No difference in outcome between immobilization methods
- Shoulder sling for comfort for distal fractures
- Warn patients of the “bump” of healing callus
Operative Treatment of Clavicle Fractures

Indications:

- Open fractures
- Shortening $\geq 20$ mm
- Vascular injury
- Bilateral fractures
- Severe displacement with persistent tenting of the skin
- Combined fracture with SC dislocation
- Type II-B injuries
Plate Fixation

- 3.5 mm reconstruction or pre-contoured plate
- Anatomic reduction
- Bone graft comminuted fractures

Hardware may become symptomatic!
Elastic Titanium Nails

- 3.0 mm nails inserted at medial clavicle
- Exposure of fracture often necessary
- Ideal for:
  - Non-comminuted, displaced diaphyseal fractures
  - Osteopenia
  - Poor skin
- Contact sports at 6 weeks
Complications of Clavicle Fractures

Mal-union

- Rarely symptomatic if <15 mm of shortening
- Typically remodels over 6 to 12 months
- Treated with osteotomy and plate fixation

Non-union

- 1% to 3% in all age groups
- Multivariate analysis for non-union:
  - Greater displacement
  - Increased comminution
  - Female gender
  - Advancing age

Asymptomatic non-unions do not require treatment
Indications for Hardware Removal

- Pain over plate with impending skin compromise
- More common with antero-superior plating
- **Contact sports limited for 2 months after removal**
Sternoclavicular Joint Injury

- Anterior: 97%; posterior: 3%
- Posterior: Potentially life-threatening injury
- Few reports in rugby and American football players
  - Only 1 case report in hockey players JPO (1984)
- Rarity combined with subtle exam findings → difficult diagnosis
- Most often due to physeal fracture (pseudo-dislocation) in kids

Only 120 cases described in the orthopedic literature
Sternoclavicular Joint

Ligamentous Stability

Posterior capsular ligament provides primary stability
Posterior Sternoclavicular Dislocation

Retrosternal Anatomy

Brachiocephalic vein: 6.5 mm from the medial clavicle
A Potentially Life-threatening Injury

Acute Complications
- Pneumothorax
- Respiratory distress
- Brachial plexus compression
- Subclavian / carotid compression
- Tracheal and mediastinal compression
- Brachiocephalic / subclavian venous obstruction

Chronic Complications
- Post-traumatic arthritis
- Dysphagia
- Thoracic outlet syndrome
- Fatal tracheoesophageal fistula
Mechanism of Injury in Hockey

- Posterolateral force levers the medial (75%-95%)
- Direct force to the medial clavicle is less frequent (10%-25%)
‘Serendipity’ Radiograph

- X-ray angled at 40° centering on the manubrium
- Low sensitivity
Advanced Imaging of the SC Joint

- X-rays alone are not enough to assess for SC joint injury ➔ axial imaging should be obtained

- CT imaging is preferred
  - Excellent skeletal detail
  - Both SC joints evaluated

- MRI useful in skeletally immature (<25 yrs)

Often difficult to confirm reduction
Closed Reduction - Posterior Dislocation

- **Standard of Care**: Closed reduction of SC joint under general anesthesia

  - Use radiolucent table with a bolster between scapulae

  - Shoulder gradually extended while traction applied

  - **Prepare for open reduction if necessary**

Vascular surgeon should be *immediately* available
Confirmation: Intra-operative CT

- Success of closed reduction difficult to confirm
- Intra-operative x-rays difficult to interpret
- Intra-operative CT scan can confirm successful reduction
- SC joint stressed posteriorly and repeat scan confirmed reduction
Surgical Reconstruction: Figure-of-8

Indications: dislocation beyond 48° and/or persistent instability
Return-to-Play: Posterior SC Dislocation

- Closed reduction: 3 weeks to 3 months of immobilization reported
- Prognosis of return to play difficult
- No reports regarding elite-level athletes
- **Key exam: Ability to do push-ups**


- 18 of 30 pts. able to return to play
- 6 pts. changed to sport with less contact
- No recommendation on timing of play

Literature based on Level V (expert opinion) evidence
Conclusion: Sternoclavicular Dislocation

- Rare injury associated with serious short and long-term complications due to thoracic compression
- CT scan imaging modality of choice
- Closed reduction is seldom successful after 48°
- All unreduced posterior dislocations should be surgically reduced with a thoracic surgeon present
- Return to play warranted if joint is stable and player has full ROM and strength (minimum 4-5 weeks)

Little objective data to guide treatment decisions
Hockey Specific Rehabilitation of Clavicle, SC and AC Joint Injuries

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Rehabilitation Goals

• Decrease pain

• Regain ROM

• Introduce hockey-specific rehabilitation ASAP

• Safe return to game play

• Address deficiencies to prevent future injury
Contemporary Therapeutic Modalities

• Bio-Wave Pro Neuromodulation pain therapy

• Use of the Bio-Wave allows earlier pain-free ROM of the AC or SC joints which facilitates earlier hockey-related rehabilitation

Limited research On pain therapy devices For AC and SC Injuries
Contemporary Therapeutic Modalities


- Low Level Laser Therapy (LLLT) (photobiomodulation) has been shown to accelerate tissue healing and increase blood flow
- Class IV laser
Contemporary Therapeutic Modalities

- Kinesio-Tape
- Dr. Kenzo Kase (1979)
- Conflicting research on its benefits
- Regular tape restricts ROM
- Kinesio-Tape allows full ROM
- Stimulation of the CNS
Basic Shoulder Rehabilitation Exercises

- External rotation
- Internal rotation
- Horizontal ADD/ABD
- Crossing pattern
- SlamBall shrugs
- Horizontal pulls
- MedBall pass
- SlamBall chops
- Cornell 7 min. program
- UBE
Stickhandling Progression

• Shoulder strength
• Puck proprioception
• Work outside the midline
• Puck shooting
• Movement while stickhandling
• Return to practice / play
Return-To-Play Criteria

- Backhand – last skill
- Pain-free movement
- Ability to protect oneself
- Ability to receive and deliver contact in drills or practice
- Player confidence
- Team M.D. clearance
Thank You