Scapular Fractures

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Objectives

• Appreciate the anatomy of the scapula
• Understand radiographic evaluation and diagnosis of scapular fractures
• Develop a framework for treatment options and indications
• Appreciate scope of injury, and outcomes following scapular fractures
Epidemiology

- Uncommon ~1% of all fractures and 3% of peri-shoulder injuries
  - 50% Scapular Body & Spine
  - 25% Glenoid Neck
  - 10% Glenoid Cavity
  - 7% Acromial
  - 7% Coracoid

- Likely uncommon due to:
  - Scapular mobility
  - Significant protection from thoracic cavity and musculature
Injury Mechanism

• High energy Trauma
  • Direct blows
  • Impact to shoulder
Injury Mechanism

- Direct Force
  - Most commonly
- Indirect Force
  - Fall with humeral head impaction into the glenoid

- 80-95% of scapular fractures associated with multiple or life-threatening injuries
Anatomy

• A - Body
• B - Glenoid Fossa (Articular Vault)
• Processes:
  • C - Coracoid Process
  • D - Acromial Process
Anatomy

- Suprascapular nerve (SSN) is main surface Neurovascular structures

- Related neurovascular anatomy:
  - Axillary Nerve (AXN)
  - Circumflex Suprascapular Artery (CSA)

Tornetta, Ricci. Rockwood and Green's Fractures in Adults, 9e, Wolters Kluwer Health Inc, 2020
Superior Shoulder Suspensory Complex (SSSC)

- Defined by Goss - JOT 1993
  - Critical in maintenance of the relationship of the upper extremity and axial skeleton throughout the scapula
- **Complex bone-soft tissue ring:**
  - Coracoid Process
  - Coracoclavicular ligaments
  - Distal Clavicle
  - AC joint
  - Acromial Process
- SSSC “supports” the Clavicle and Scapular body/spine in space
Superior Shoulder Suspensory Complex (SSSC)

- Defined by Goss - JOT 1993
Superior Shoulder Suspensory Complex (SSSC)

• A ‘double disruption’ of the SSSC leads to instability and extremity dysfunction

Evaluation

• Physical examination
  • Skin Abrasions, Bruising, Swelling
  • Painful diffusely, difficulty with motion
  • Careful NV examination required

• Radiographic evaluation
  • Mainstay of treatment
  • May first be appreciated on Trauma Series chest Xray
Imaging Evaluation

• Xray
  • Trauma Series —> True Scapular AP, Glenohumeral axillary and Scapular - Y view
  • Complex 3D anatomy presents difficulty
• Computer Tomography (CT)
  • 3D reconstructions with humeral subtraction can be very helpful
Imaging Evaluation
Imaging Evaluation

- Lateralized Scapular Body
  - Rarely medial glenoid
- Visible fracture lines
- 3D appreciation can be difficult

Imaging Evaluation

- Computer Tomography (CT)
  - 3D reconstructions with Humeral subtraction can be very helpful to understand anatomy & relationships
Imaging Evaluation
Imaging Measurements

• Glenopolar Angle ($\Theta$)

  • Angle generated by the intersection of 2 lines:

    • 1) Inferior glenoid fossa to the superior lip of the glenoid

    • 2) Superior apex of the glenoid fossa to the inferior angle of the scapula
Imaging Measurements

• Medial / Lateral Displacement
  • Displaced between
    • Most lateral point of distal Fragment
    • Most lateral point of proximal fragment
Imaging Measurements

• Angulation
  • Angle generated by the intersection of 2 lines on Scapular Y view or CT reformat:
    • Line along proximal fragment
    • Line along distal fragment
CT Evaluation
Scapulothoracic Dissociation
(Lateral Dislocation of the Scapula)

• Rare disruption of the Scapulothoracic articulation
• Severe energy dissipation - commonly traction
  • Scapula essentially ‘torn away’ from the thoracic wall
• Associated with disruption of at least 1 of the three ‘joints’
  • Glenohumeral, Acromioclavicular, Sternoclavicular
• Associated with injury to the NV structures:
  • Subclavian/Axillary artery, Brachial plexus
Evaluation

- **Physical examination**
  - Vascular and/or neurologic deficit
  - High energy mechanism and significant soft tissue trauma to the shoulder

- **Radiographic evaluation**
  - Lateral displacement of scapula
    - >1cm from contralateral
    - Increased Scapular index (1.43)
    - Widely distraction clavicle fracture or SC joint
Glenoid Classification (Idaberg)

• Type I
  • a - Anterior rim
  • b - Posterior rim
• Type II - Through glenoid exiting inferior
• Type III - Through glenoid exiting medial to coracoid
• Type IV - Through Glenoid exiting medial scapula
• Type V
  • a - Combined II and III
  • b - Combined IV with comminuted acromion
  • c - Combined II, and Vb
• Type VI - Comminuted Glenoid
Coracoid

• Many on location of fracture (Eyres)
  • Type 1 - Tip
  • Type 2 - Shaft
  • Type 3 - Base

Acromial Classification

• Ogawa & Naniwa (1997)
  • Type 1 (Lateral Acromion)
  • Type II (Medial Acromion)
Scapular Classification

• 3 Parts: Fossa, Body, Processes
• Kappa 0.66 for Xray & 0.78 for CT
Scapular Classification

**Locations:**
- Scapula, **process**
  - 14A
- Scapula, **body**
  - 14B*
- Scapula, **glenoid fossa**
  - 14F*

* Qualifications for process fractures:
  - x Coracoid P1
  - y Acromion P2
  - z Both processes P3

(These qualifications may be added to any fracture coded as type B or type F)
Treatment Options

• Non-operative
  • Vast majority
• Operative
  • Specific indications
Non-op Treatment

- Most patients (>80%)
- Surrounding soft tissue provides splinting and prevents additional displacement
- Symptomatic treatment
- Early AAROM
- Close radiographic followup needed
- Most healing or healed by 6-8 weeks.
Operative Treatment

- Percutaneous
- Anterior ORIF
- Posterior ORIF
- MIPO
Indications

• Operative
  • Displaced injuries:
    • Displaced intra-articular gelnoid fractures involving >25% of the articular surface
    • Displaced Scapular Neck fractures
    • Scapular Process fractures:
      • Non-union or Concomitant operative scapular fracture
      • Symptomatic impingement or positioning
    • Comminuted Scapular spine fractures
    • Coracoid Fractures with > 1cm of displacement
    • Glenopolar Angle ≤ 22 degrees

Approaches

• Isolated Process
  • Coracoid - Superior Deltopectoral Approach
  • Acromial - Direct Spine Approach
• Isolated Fossa / Glenoid
  • Deltopectoral variant or Posterior Approach
• Combined or Body:
  • Judet and Variants
Coracoid Approaches

- Superior extension of the Deltopectoral approach
  - 4-5cm in length
  - Incision up to border of clavicle for full exposure and trajectory for fixation
- Isolation of Cephalic Vein and enter Mohrenheim's triangle
- Base of coracoid/glenoid involvement can be seen with Rotator Interval Split

Coracoid Approaches

• Operative Indications:
  • > 1cm displaced
  • Painful non-unions
  • Those associated with disruption of the SSSC

Acromial Approaches

• Incision along acromial spine angled towards anterior tip of the acromion
• Elevate & Reflect deltoid off the acromion to expose fracture as required
• Stout repair of Deltoid, Infraspinatous at end of case
Acromial Approaches


Judet Approach

- Traditional Judet Incision
- Modified Judet Incision

Judet Approach
Judet Approach
Classic Judet

- Scapular fossa musculature is completely lifted
- Wide exposure
  - HH - Humeral Head
  - IF - Infraspinatous
  - TM - Teres Minor
  - TR - Triceps
  - SGN - Spinoglenoid fossa

Modified Judet

- Infraspinatus **not** lifted
- Interval between IF & TM
  - HH - Humeral Head
  - IF - Infraspinatus
  - TM - Teres Minor
  - TR - Triceps
  - SGN - Spinoglenoid fossa

Modified Judet

- Comparison of Scapular exposures

- Many fracture patterns may not require complete exposure for accurate reduction

- Modified Judet sufficient for MIPO or fractures patterns that can be indirectly reduced
Visibility

- Additional exposure may be gained with Tenotomy of the Infraspinatous
- Described by Garlich et al. 2020

**FIGURE 1.** Pre-tenotomy exposure showing glenoid exposure. A, Capsule; B, glenoid; C, humeral head; D, infraspinatus; E, teres minor; F, deltoid. **Editor’s Note:** A color image accompanies the online version of this article.
Fixation

- Areas of Maximal fixation

Final product

• Incision typically heals well
• Robust blood supply
Outcomes

• Literature is limited but growing:
  • Goss 1995
  • Zlowodzki 2006
  • Lantry 2007
  • Herrera 2009
  • Tatora 2018
Outcomes

• Złowodzki et al 2006
  • Systemic Review of 520 Fractures
    • Good / excellent results with operative treatment of Glenoid fractures (82%)
    • Most (86%) scapular body fractures non-op with Good / Excellent results
    • Most (77%) glenoid neck fractures non-op with Good / Excellent results
Outcomes

• Tatora et al. 2018:
  • Retrospective ORIF Cohort of 66 pts mean of 7 year
  • Minimal residual pain scores
  • Majority > 90% returned to work
  • Small but noted shoulder stiffness compared to uninjured side
Complications

• Nerve injury (Traction on Supraspinous)
• Mechanical Failure
• Infection
• Shoulder Stiffness
• Hematoma
Case 1

- 45 yo Male MC accident
- Bilateral Shoulder injuries
- Obese
Case
Case
Case

- Bilateral ORIF
- Prone Positioning
Case 2

- 65yo M
- LHD - Fall from ladder
- Reduction in ED with multiple re-dislocations
- PmHx:
  - DM
  - EtOH
- Isolated injury
Case 2

- Fractures of:
  - Acromial
  - Coracoid
  - Anterior glenoid
5 months post-op

- ORIF - Glenoid (Eden Hybinette), Acromion & Subscap repair using a modified Sabre incision extending deltopectoral interval over the acromion and scapular spine
Case 3

- 38 yo M RHD MC Accident
- Isolated injury
- **Elected non-operative**
  - Displacement
  - Glenopolar
  - Angulation
• CT shows minimal Displacement but some lateralization
Case

• Returns at 4 weeks with increasing pain

• Repeat Imaging:
  • Worsening angulation
  • Minimal ongoing Lateralization
Summary

• Rare, high-energy injuries

• Index of suspicion for scapulothoracic dissociation

• Largely non-operatively treated with good outcomes

• Indications continue to refine but current best include:
  • Intra-articular gap or step > 4mm & > 25% glenoid involvement
  • “Medialization” > 20mm
  • Angular Deformity > 45%
  • Glenopolar Angle ≤ 22deg
  • Double disruption SSSC with ≥ 10mm displacement
References


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