Scapula Fracture Injuries and Treatment

William T Obremskey MD MPH
Peter Cole MD
Paul Tornetta MD
Cliff Jones MD

Overview
• 1) Fractures, associated injuries and initial w/u – Bill Obremskey - 15 minutes
• 2) Non operative Management – Paul Tornetta - 15 minutes
• 3) Early ORIF – Cliff Jones - 15 minutes
• 4) Malunions/Nonunions - Peter Cole
• 5) Case review and Questions - 30 minutes

Associated Injuries
• Clavicle
• AC Joint
• Ribs
• Humerus
Associated Injuries

- Clavicle – fix if “displaced”
- AC Joint – repair ≥3rd degree
- Ribs – talk to Trauma colleagues
- Humerus – fix it

Clavicula: Latin for little key

Anatomy

Collinge, JOT 2006
Slide 7

Clavicle Fxs

• Which ones to fix?
• Droopy ones!

Slide 8

Who will develop a droopy shoulder?

We don’t know!

Should we fix all displaced fractures?

Slide 9

Operative vs nonoperative treatment

<table>
<thead>
<tr>
<th>Displaced Fractures</th>
<th>Nonunions</th>
<th>Infection (Total)</th>
<th>Infection (Deep)</th>
<th>Fixation Failures</th>
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<tbody>
<tr>
<td>Nonoperative (n = 159)</td>
<td>15.1</td>
<td>N/A</td>
<td>N/A</td>
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<td>Fixing (n = 469)</td>
<td>2.2</td>
<td>4.6</td>
<td>2.4</td>
<td>1.2</td>
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<tr>
<td>Nonun solicitating (n = 552)</td>
<td>2.0</td>
<td>6.6</td>
<td>0.0</td>
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<td>Total (N = 771)</td>
<td>4.8</td>
<td>5.1</td>
<td>1.8</td>
<td>1.1</td>
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Zlowodzki et al. JOT 2005 (3.5–10.1) (2.6–7.19) (1.0–3.20) (0.0–5.33)
Operative vs nonoperative treatment

<table>
<thead>
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<th></th>
<th>Surgery</th>
<th>Sling</th>
<th>p</th>
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<tr>
<td>Nonunion</td>
<td>3%</td>
<td>11%</td>
<td>0.042</td>
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<tr>
<td>Symptomatic malunion</td>
<td>0%</td>
<td>18%</td>
<td>0.001</td>
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<tr>
<td>Removal of hardware</td>
<td>8%</td>
<td>0%</td>
<td>0.065</td>
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<tr>
<td>Total complications</td>
<td>37%</td>
<td>63%</td>
<td>0.008</td>
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</tbody>
</table>

- COTS: JBJS Am 2007

So, let’s operate all displaced fx!

- Sling: 66% asymptomatic unions
- The group as a whole would benefit
- Many individuals would have unnecessary surgery

COTS: JBJS Am 2004
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Fixation methods

- ORIF
- IM nailing

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Floating Shoulder - Operative

- Rikli D, Regazzoni P, and Renner N. JOT 2:93, 1995
- 12 patients w/ clavicle and scapula fxs w ORIF of clavicle
- No measure of fx displacement
- 100% union
- one frozen shoulder
- Constant score 96/100 on ave.
- "scapular neck reduced indirectly"

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Floating Shoulder - Operative
AC Joint Injury Grades

**Grade III**
- Definition
  - Injury to AC Joint Capsule
  - Complete Tear of CC Ligament
  - Minimal or No Deltoid/Trapezius Stripping

**Grade IV**
- Definition
  - Injury to AC Joint Capsule
  - Complete Tear of CC Ligament
  - Clavicle Directed Posteriorly, Into Trapezius Muscle

**Physical Exam**
- Tender at AC Joint
- Tender at CC Ligament
- Increased AP Translation
- Increased SI Translation
- Clavicle in Trapezius and Painful

**Imaging**
- Radiographs Posterior Displacement
AC Joint Injury Grades

**Slide 25**

**Grade V**

Definition
- Injury to AC Joint Capsule
- Complete Tear of CC Ligament
- Deltoid/Trapezius Stripping

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**Grade V**

Physical Exam
- Tender at AC Joint
- Tender at CC Ligament
- Increased AP Translation
- Increased SI Translation

**Imaging**
- Radiographs Severe Superior Displacement

**Slide 27**

**Grade VI**

Definition
- Injury to AC Joint Capsule
- Complete Tear of CC Ligament
- Clavicle Inferior to Coracoid
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**AC Joint Injury Grades**

**Grade VI**

- Physical Exam
  - Marked Deformity

- Imaging
  - Radiographs Clavicle inferior to Coracoid

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**Treatment of AC Joint Injuries**

- Grade III, IV, V, IV
- Acute Primary Repair
- Repair CC Ligaments
- Repair AC Capsule
- Augment Repair
  - CC Screw
  - Braided PDS Suture
  - Subcoracoid Screws or Smooth Pins Through Acromion

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**Superior shoulder suspensory complex (SSSC)**

(Owens y Goss, JBJS Br 2006)
Scapular Fractures

SSSC

- Goss, JOT 1993
- The SSSC is a bone-soft-tissue ring at the end of superior and inferior bone strut
- Glenoid process, coracoclavicular ligaments, distal clavicle, AC joint, acromial process

Scapular Fractures

SSSC

- Single disruptions of one of the components of the SSSC are common
- Double disruptions of the SSSC may create an unstable situation

Humerus Fxs
Ribs

- Evolving Indications
  - Who fixes
- Develop a protocol with Trauma Team
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Associated Injuries

- Clavicle – fix if “displaced”
- AC Joint – repair ≥3rd degree
- Humerus – fix it
- Ribs – talk to Trauma colleagues

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Scapula Fractures: Nonoperative?

Paul Tornetta III, MD

Boston Medical Center

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Disclosures

- Publications:
  - Rockwood and Green, Tornetta and Ricci TIFS, Tornetta and Einhorn; Subspecialty series, Crush Brown, Tornetta; Trauma, AAOS; OKU Trauma; JCL Trauma, Tornetta Op Tech in Orthopaedic Incap; OTA slide project
  - Journals: JOT; Deputy editor, CORR, JAAOS, JBJS; Reviewer
- Research:
  - OTA, FOT, AOOS
  - Smith Nephew
- Designer
  - Smith and Nephew, Kinespring

Here are our conflicts
• Need to be talking about the same thing!
• Most important area…. Neck
• Glenoid neck fractures
  • May not be the neck at all
  • May not be medialized!!
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CT Evaluation of Extra-articular Glenoid Neck Fractures: Does the Glenoid Medialize or Does the Scapula Lateralize?

- 18 Patients
  - 4 Medialized (all ≤ 8mm)
  - 14 Lateralized (1mm – 23mm)
  - Overall average lateral 9.8mm

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Understanding the Concept of Medialization in Scapula Fractures

- 70 Patients
  - Glenoid 6 ± 10mm lateral!
  - 54 Lateralized avg 10mm
  - 15 Medialized avg 7.5mm
  - Control group
    - No difference (-0.9mm)

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Is the Deformity Bad?

Analysis of Operative versus Nonoperative Treatment of Displaced Scapular Fractures

Extra-articular Makinations of the Scapula: A Comparison of Functional Outcome Before and After Reconstruction
• 31 Operative patients
• 31 Matched nonop
  - Age, Gender, Occupation
  - Same at 1.5 years
  - Healing, pain, back to work

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Nonoperative (n = 31)</th>
<th>Operative (n = 31)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement (mm)</td>
<td>19.4 (5-33)</td>
<td>30.8 (15-45)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Shortening (mm)</td>
<td>18.1 (5-30)</td>
<td>30.9 (15-55)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Angulation (degrees)</td>
<td>13.3 (0-43)</td>
<td>27.0 (0-100)</td>
<td>0.044</td>
</tr>
</tbody>
</table>

• 5 Patients
• 3 cm lateral border displacement
• 25° Angular deformity (lateral view)
• Glenopolar angle 19° - 29°
• All patients
• Pain, inability to work, weakness

The Droop...
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**Objective Measure?**

- Glenopolar angle
- Correlates with outcome
- < 20° is bad

Conservative treatment of scapular neck fracture: the effect of stability and glenopolar angle on clinical outcome

Arun Baskurt, F. Cari, Vechi Kerdani, Jehar Erdes, Ismail Demirkale, Mustafa Baskurt

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**Outcome**

- Constant score α GPA

GPA = αOutcome

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**Glenopolar Angle**

![Glenopolar Angle Diagram]
Glenopolar Angle

-6°
100 Scapula fractures

Glenopolar angle

3D CT

Plain films

6° ± 0.8° difference

Concluded plain films accurate

Operative Indications

Intraarticular with instability

> 3cm of lateral border translation

GPA < 20°

Severe droop

Associated displaced clavicle

Fix clavicle and re-evaluate
45 Year Old

Fixation

56 Year Old Male
- Right hand dominant
- Active, computer programmer
- Tennis, golf on weekends
- Fell from tree while trimming
- HTN, nonsmoker, previous hernia surgery
- No neurologic symptoms
What do you see???
• Options:
  • Nonop
  • ORIF Clavicle only
  • ORIF Scapula only
  • ORIF BOTH

Intraop Gravity
My Choice

• Enough?
• Keep fixing things?

• NOPE!!!

Smart? Stupid?
• 3 Months
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Smart? Stupid?
• 3 Months
GPA=42°

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5 Months
• Full range of motion
• Back to golf, tennis
• NO pain
• Can sleep on that side
• Very happy

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23 Year Old
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Y View

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Clavicle Only Fixation

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Postop Velpeau
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34 Year Old

- No medical history
- Motorcycle crash
- Isolated shoulder trauma
- Neurovascularly intact
- Works in restaurant

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Presentation
Presentation

Options:
- Nonop
- ORIF Clavicle only
- ORIF Scapula only
- ORIF BOTH

Nonop... 3 Months
- Back to work, pain free

Nonop... 3 Months
- Back to work, pain free
28 Year old Woman

- Legal assistant
- Runs on weekends
- No medical history
- MVA
Presentation

- Options:
  - ORIF glenoid
  - Arthroscopic management
  - Stress exam to decide
  - Nonop

5 Months.. FROM, no issues
5 Months.. FROM, no issues

• GOOD IDEA???

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Conclusions
• Not great data
• Most do well with nonop
• Outcome a GPA
• Indications
  • Instability
  • Severe displacement

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Thank you
Judet Approach

- Inverted L-shaped incision with subcutaneous flap
- Elevate posterior Deltoid off scapula spine
- Scallop out IS muscle
- Reduce fracture with medialization of scapular body
- Fixation between IS and Teres Minor interval
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Pre-op                 Post-op

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Case #2
44 yo male construction worker RHD, isolated injury

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6 months

6 months

Glenoid Fractures

Kavanagh, B. et al. JBJS 75A: 479, 1993

- 10 patients with ORIF of glenoid fossa fractures from 1980-1987
- Displaced 4-8 mm
- 35 year old average age; f/u 2-10 years
- None with ADL pain
- Abduction - 110°-180° (average 167°)
- Flexion - 140°-185° (average 171°)
- HO - one patient
Case #3

• 30 yo male ejected from car
  – Left scapula fx
  – Concern for aortic tear
  – Very swollen left shoulder
  – No neuro exam
  – Pulses ?

Floating Shoulder

• Double disruption - unstable
  Goss, TP., JAAOS Jan/Feb 1995
Floating Shoulder - SSSC

- Delayed union, nonunion, malunion
- Impingement
- Decreased strength
- Abnormal shoulder mechanics
- Arthrosis

Floating Shoulder

- "Ipsilateral fractures of the scapular neck and the clavicular shaft do not produce a floating shoulder without additional disruption of the coracoacromial and acromioclavicular capsular ligaments."

Floating Shoulder - Operative

- Rikli D, Regazzoni P, and Renner N. JOT 2:93, 1995
- 12 patients w/ clavicle and scapula fxs w/ ORIF of clavicle
- No measure of fx displacement
- 100% union
- One frozen shoulder
- Constant score 96/100 on ave.
- "Scapular neck reduced indirectly"
High Energy

- Be aware of scapulothoracic dissociation "intact forequarter amputation"
- Evaluate subclavian vessels, axillary artery, brachial plexus, pulmonary contusions, rib fractures
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Brief history

- 44 y/o M, pipe fitter, smoker
- MCC
- Injuries
  - Ankle sprain
  - L scapula fracture
I. Operative Indications

- Chronic shoulder pain, shoulder weakness or fatigability, and dysfunction after failed operative or non-operative treatment, in the setting of deformity or nonunion.
- Acromion and coracoid process fractures including painful nonunion.
- Indications for internal fixation of extra-articular scapular body and neck fractures may serve as a guide to assessing deformity after healing.
II. Procedure Recommendations for most Neck and Body Variants

- **Positioning** ➔ Lateral decubitus (floppy forward)
- **Extensile Judet approach** ➔ necessary for visualization, osteotomy and fixation.
  - Incision begins 1cm caudal to the scapular spine at its most lateral extent, carried medially to the vertebral body, then curved inferriorly toward the inferior pole.
  - Full thickness flaps are raised down to fascia
  - The posterior deltoid is sharply taken from its origin on the scapular spine and the infraspinatus is elevated from its origin on the medial border of the scapula
  - The important consideration in this approach is to be vigilant about protecting the suprascapular neurovascular bundle from traction
- **Osteotomy** ➔ Defined with drill holes
- **Scapula Reduction Tips**
- **Schanz Pin:** In the glenoid neck to joystick proximal fragment
  - Helps achieve alignment with the distal lateral border segment by allowing for derotation and translation at the neck
- **Shoulder Hook:** To achieve alignment, drill a pilot hole in distal fragment at the lateral border and insert hook and joystick to proximal fragment
- **Pointed Bone Tenaculum:** Anchor in drill holes placed across the primary fracture line, in a serial fashion, at lateral border
- **Small Ex-Fix and 4.0mm Schanz Pins**
  - Helpful to maintain reduction and/or length when pointed bone tenaculum use is not possible due to orientation of fracture line or extensive comminution
- **Lamina Spreader:** Insert between proximal and distal fragments and mobilize fragments to achieve reduction

![Image of surgical tools and procedures]


### Implants
- 3.5mm LCDC “sized” plate (or dual 2.7 DC plates) for lateral pillar
- 2.7 Recon plate to contour for base of spine/vertebral border
- Morselize ICBG for defects

#### III. Case Series
- **Purpose:** Operatively treated scapula malunion and non-union reconstruction, and aims to assess surgical and functional results.
- **Methods:** 26 patients-16 malunions in 15 patients & 18 nonunions in 14 patients. Intervention involved surgical osteotomy of the malunion or debridement of the nonunion and ORIF. Outcome measures included: pre/post-op ROM, strength and DASH scores, and return to work.
- **Results:** Among 21 of 26 (81%) patients with ≥12 months follow-up, mean=36 months. 5 patients were lost to follow-up and excluded. Mean age=48.5 years. Average time from injury to surgery=22.6 months. Preoperative ROM and strength were obtained on 18/26 (69%). Mean DASH score improved from 55 preoperatively to 18 postoperatively (p<0.001). Among the patients with ≥1 year follow-up, range of motion improved from pre-operative to final follow-up in forward flexion and abduction (p= 0.002 and p= 0.001 respectively). Range of motion for ER and all strength measures improved but did not reach significance. Among the 20 of 26 patients for whom occupation data is available, 80% either returned to their original occupation (n = 10) or did not due to reasons other than their reconstructive surgery (n = 6). Two post-operative complications occurred: acromion stress fracture and hardware failure (3 months postoperatively). Both patients went on to heal after revision surgery. All reconstructions subsequently united without malunion.
- **Conclusion:** Scapula reconstruction of malunion and non-union is possible and associated with an acceptable complication rate, restoration of function, and symptom relief.
IV. References


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**Table 2:** Strength, ROM, DASH outcomes pre and post-operatively

<table>
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<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>p-value</th>
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<tr>
<td><strong>FF</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injured</td>
<td>109</td>
<td>140</td>
<td>0.002</td>
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<tr>
<td>Uninjured</td>
<td>148</td>
<td>150</td>
<td>0.795</td>
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<tr>
<td>% I/U</td>
<td>100%</td>
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<td><strong>Range of Motion</strong></td>
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<tr>
<td>(degrees)</td>
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<tr>
<td>Injured</td>
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<td>%</td>
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