Proximal Humerus Fractures

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Disclosure

- Paid Consultation
- Research Support
- Speakers Bureau

Muscular Anatomy

- Muscular attachments result in predictable deformities
  - GT-Supra, Infra, Teres
  - Posterior & superior displacement
  - LT-Subscap
  - Medial
  - Shaft-Pect & Deltoid
  - Anterior & Superior → Varus Deformity
Deforming Forces

Vascular Anatomy
- **Traditional Teaching**
  - Major blood supply is from the anterior humeral circumflex artery (ascending branch)
  - Gerber et al., JBJS 1990

- **Recent Data**
  - >60% humeral head vascularity from posterior circumflex artery
  - Hettrich et al., JBJS 2010

General Problems
- Not all patients benefit from an operation – best results in younger patients
- Development of locked plating did not solve the problem of proximal humerus fractures
- Conversion surgery is fraught with complications
- Few Level I prospective studies exist to guide treatment
Comparison study of clinical & patient-reported outcomes between RSA & nonoperative treatment groups of patients with 3- and 4-part proximal humerus fractures.

- n = 39 patients (19 nonop, 20 RSA)
  - All nonoperative patients were offered RSA but declined.
  - Measured VAS, SANE, Penn Shoulder Score, ASES Score, Resiliency Score, and VR-12
  - There were no significant differences in ROM or any patient-reported outcomes.

RCTs of Op vs NonOp of Proximal Humeral Fx

- Olerud 2011 – 60 pts, 2 yrs fu
  - Mean age 74
  - Constant score: Non-op 59, OR 61
- Fjalestad 2012 – 50 pts, 1 yr fu
  - Mean age 73
  - Constant score: Non-op 33, OR 35

NonOp Case #1

- 78-year-old female presents to clinic with pain & swelling in her shoulder
- History: She fell on vacation landing on her outstretched arm
- Comorbidities: Diabetes & heart failure
NonOp Case #1

NonOp Case #1: 3 Months s/p Injury

NonOp Case #1: 8 Months s/p Injury
NonOp Case #1: ROM
8 Months s/p Injury

NonOp Case #2
- 89-year-old female sustained proximal humerus fracture after a fall
- Treated with a Sarmiento brace
NonOp Case #2: 3 months S/P injury

NonOp Case #2: ROM 3 Months s/p Injury

NonOp Case #3

- 82 year old retired male who sustained a ground level fall presents to clinic with pain and swelling of the shoulder
- Patient has history of COPD
NonOp Case #3: 17 Days s/p Injury

NonOp Case #3: 10 Months s/p Injury

Problems with Surgery
Successful Sx: Patient Factors
- Proper Patient Selection is Key!
  - HbA1c
  - Physiologic Age
  - Tobacco/ Alcohol
  - Obesity: BMI over 30
  - Neurologic issue i.e. dementia

Successful Sx: Technical Factors
- Avoid varus
- Calcar reduction
- Calcar screws (kickstand screws)
- Augment fixation with heavy sutures (especially GT)

Deforming Forces
- Varus
- Calcar Reduction
Locking Plates: Complications

- The most catastrophic complication was glenoid destruction caused by protruding locking screws.
- This complication was previously undocumented.
- The compromised glenoid then limited the options of future treatment.

How Can we Avoid Screw Cut Out?

Cascading Blunt Tip Screws

Reduction: 4-Part Fractures

Provisional reduction with K-wires
- Fracture union achieved in all patients
- No tuberosity failures

<table>
<thead>
<tr>
<th>n</th>
<th>Fracture Type</th>
<th>x ASES</th>
<th>ASES Range</th>
<th>Complications</th>
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<tbody>
<tr>
<td>81</td>
<td>2-Part</td>
<td>26</td>
<td>80</td>
<td>27-100</td>
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<tr>
<td>41</td>
<td>3-Part</td>
<td></td>
<td></td>
<td>Screw Penetration</td>
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<tr>
<td>14</td>
<td>4-Part</td>
<td></td>
<td></td>
<td>Avascular Necrosis</td>
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</tbody>
</table>

Results of proximal humeral locked plating with supplemental suture fixation of rotator cuff

Brian Badman, MD, Mark Frankle, MD, Christopher Kesting, BS,
Leanne Henderson, PA-C, Jandre Brooks, BS, Mark Higdon, MD
Fracture healing achieved in all patients
Anatomic alignment in 72%

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Outcomes</th>
<th>Complications</th>
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</thead>
<tbody>
<tr>
<td>2-Part</td>
<td>Excellent</td>
<td>Avascular Necrosis</td>
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<tr>
<td>3-Part</td>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>4-Part</td>
<td>Fair</td>
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</tr>
<tr>
<td>6</td>
<td>Poor</td>
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Summary
- Treatment of patients > 75 y.o. remains controversial
- Technical errors likely contribute to high failure rates

"Proximal humerus fracture plates don't intrinsically lead to failure, suboptimal surgical implementation does."

Patient selection is a critical factor for success

Reverse Shoulder Arthroplasty
- Indicated in:
  - Severely comminuted/displaced 3- or 4-part fracture-fx/dx's
  - Age > 70; osteoporotic bone
  - History of rotator cuff disease
  - Less reliant on tuberosity healing due to use of deltoid function
  - Faster rehab than ORIF
  - Older patient population
  - Associated comorbidities
  - Limited PT ability
Implant Factors for Fracture

- Ball-socket joint
- Fixed fulcrum
- Medial cerclage hole
- Tuberosity fixation
- Bone ingrowth surface
- Plasma spray, HA coating
- Grit blasted

RSA for Acute Fracture

- Age > 70 had better outcomes with RSA than with HA
- HA yielded good outcomes if tuberosity healing occurred
- Neither group showed any sign of component loosening at 2 years
Conclusions

- Mobilize tuberosities with heavy sutures
- Avoid biceps tenodesis in 4-part
- Use K-wires to maintain reduction
- Structural graft to fill defect
- Plate is a buttress for head
- Tuberosity reconstruction most critical factor for success
- However, elderly patients with
  - Compromised healing
  - Severe osteoporosis and/or
  - Tuberosity comminution should consider RSA

Case Example: ORIF

- 35-year-old male presents with a fracture of his left shoulder subsequent to flipping an ATV truck
- History is significant for obesity and previous brachial plexopathy which was repaired with little residual effects

Case Example: ORIF

2 days S/P injury
Case Example: ORIF
11 Days s/p ORIF

Case Example: Hemi for Fracture
- 54 year old male, who works as a US Treasury Agent
- Presents with left shoulder pain sustained from a bicycle accident 2 weeks ago
- History significant for hypertension, hyperlipidemia, & claustrophobia
- Radiographs reveal a comminuted humeral head fracture

Case Example: Hemi for Fracture
PreOp Images
Case Example: Hemi for Fracture IntraOp

Case Example: Hemi for Fracture Immediate PostOp Images

Case Example: Hemi for Fracture

What is the reason the humeral head is not well-seated in the glenoid?

A. Improper implant height
B. Rotator cuff failure
C. Deltoid dysfunction
D. Axillary nerve injury
Case Example: Hemi for Fracture
Most Recent PostOp Images

Case Example: RSA for Fracture

- 58 year old female who works as a nurse at a local hospital
- Slipped and fell in the OR, resulting in immediate pain and loss of function of her right arm as well as a dislodged breast implant.
- Radiographs reveal a comminuted impacted right humeral head fracture
- No significant medical history

RSA Case Example: PreOp Images
RSA Case Example: Immediate PostOp

Progressing better than the average patient at this juncture and is most concerned with getting her breast reconstructed.

Thank You