Treatment of Proximal Humeral Fractures with IM Nails

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Disclosures
- Stryker Trauma
  - Research and Design Consultant
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  - Stock Ownership
- DepuySynthes
  - Stock Ownership, J&J

Epidemiology
- 4-5% of all fx occur in the proximal humerus
- Injuries to the shoulder girdle change with time
  - Children
    - 85% clavicle fractures
    - Result of play or sports
  - Adults
    - 30% clavicle fractures
    - 30% proximal humerus fractures
    - 18% shoulder dislocations
    - Result of higher energy trauma
Epidemiology

• Elderly
  – 80% proximal humerus fractures
  – Result of low energy falls
  – High incidence due to age-related increase in osteoporosis
  – Proximal humeral fractures more reliably correlate to poor bone quality than fractures of the pelvis, distal radius, or proximal femur
  – Approximately 75% of all surgical neck fractures occur in patients >65yo

(Wentworth, NYJ Med, 1940)

Anatomic Considerations

• Humeral head is retroverted 35-40° relative to the epicondylar axis of the distal humerus
• The shoulder joint is neither in the sagittal or coronal plane of the body; the scapular plane of motion is 35-40° anterior to the coronal plane

Radiographic Considerations

• Trauma series includes three views
  – AP Shoulder
  – Lateral ("Y") view
  – Axillary view
    • Only useful as an adjunct to assess glenohumeral relationship – not effective in assessment of fracture orientation

Simon, et al. (Orthopedics, 2004)
Radiographic Considerations

- CT scan
  - Useful in delineating comminution, articular extension
  - Glenoid rim fractures
  - Hill-Sachs lesions
- MRI
  - Integrity of rotator cuff
  - Capsule
  - Labrum

Associated Injuries

- Rotator Cuff Tears
  - Not common
  - Usually premorbid
- Ipsilateral Fractures
- Nerve Injuries
  - 30-50% axillary nerve injury
    - Noted primarily in displaced fractures
    - Effect on Rehab?
  - 5-7% brachial plexus injury, noted primarily with 4-part fractures
    (Visser, et al., Shoulder Elbow Surg, 2001)
- Vascular Injuries
  - Rare

Classification

- Neer added to Codman's '4-Part' classification by determining association of displacement and its effect on blood supply
  - 1 cm
  - 45° angulation
    (Neer, CS, JBJS, 1970)
- Displacement considerations may be dated, but the shoulder can tolerate significant deformity
Classification

Poor inter-observer agreement on fracture type and displacement

(Brornson, et al, Int Orthop, 2002)

Treatment Options

• Conservative Management
  – 50-80% of proximal humeral fractures are non-displaced
  – Closed reduction?
  – Sling, shoulder immobilizer, hanging arm cast

Surgical Treatment Options

• Percutaneous Pinning
  – Pin infection, migration ...
• ORIF
  – Traditionally associated with AVN, malunion, hardware failure, etc.
• IM Nailing
  – Enders, Rush
  – Standard locked nail
  – Proximal humeral nail
• Arthroplasty
  – Usually reserved for displaced 4-part fractures
Proximal Humeral Nailing

- Traditional devices provide unique locking options for the proximal humerus
- Fixation in the proximal segment an issue with this mode of fixation as it is with most others

Proximal Humeral Nailing

- Advantages of intramedullary devices
  - Minimally invasive compared to ORIF
    - Indirect reduction
    - Less soft-tissue stripping
    - Less blood loss?
    - Earlier transition to rehab?
  - Biomechanic advantage over pinning or plating with diminished moment arm
  - Cost

Proximal Humeral Nailing

- Complications with traditional intramedullary devices
  - Loss of fixation
  - Failure of fixation
  - Lack of adequate locking options to accommodate different fracture patterns
  - No locking technology to compete with locking plates
Proximal Humeral Nailing

- Literature Review, Polarus Device
    - 27 fractures - 23 pt’s 2-part, 4 pt’s 3-part
    - equal number of pt’s < 60 yrs as > 60
    - 80% excellent results; 1 non-union
    - “...satisfactory device with good functional results in the young and the elderly”
  - Adedapo and Ikpeme, Injury, 2001
    - 23 fractures – 3 and 4-part fractures, 7 with shaft involvement
    - 1 year Neer score 89 (3-part) and 60 (4-part)
    - Noted issue of proximal crosslock loosening

Proximal Humeral Nailing

- Literature Review, Polarus Device
    - 20 fractures
    - 11 healed without complications
    - 3 patients (15%) had evidence of proximal fixation loosening
    - 2 patients (10%) underwent revision surgery for proximal fixation failure
    - Question use in unstable fracture patterns

The Next Generation
Locking Proximal Humeral Nails

- Concept
  - Provide stable internal fixation for proximal humeral fractures
  - Ability to encourage immediate PROM in rehab
  - Maintain principles of minimal fracture exposure and indirect reduction
  - Reduce proximal fixation failure
  - Proximal crosslocks thread into the nail
  - Orientation of proximal crosslocks allow multi-plane fixation

Proximal Humeral Nailing

  - Prospective, randomized study, 51 pts
  - 2-part fractures
  - Minimum 3 year followup
  - Locking IM nail (25) vs locking plate (26)
  - No difference in healing
  - Significant difference noted in complications at one year (plate 31%, nail 4%)
  - Although functional scores/supraspinatus strength were better in plate group at one year, by three years there was no significant difference

Proximal Humeral Nailing

  - Retrospective
  - 72 pts with at least 3 years of followup
  - 31 3-part fractures (23 PHN, 8 LP)
  - 41 4-part fractures (21 PHN, 20 LP)
  - No differences in functional, clinical, and radiographic outcomes between locked nails and locked plates
Locking Proximal Humeral Nails

• Pearls for insertion
  – Jackson Table
  – Supine with small bump
  – Fluoroscopy position vital
  – Incision based on anterolateral corner of acromion
    • Extending the shoulder vs the acromion can improve the ability to get starting point
    • Limited acromioplasty ok

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• Pearls for insertion
  – Use joysticks or other devices to indirectly reduce fracture
  – Consider articular starting point
    • Move nail entry away from rotator cuff insertion
    • Side-to-side simple repair
  – Always maintain reduction during insertion
  – Proximal screws should lie within central subchondral bone of humeral head

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Locking Proximal Humeral Nail
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• Consider a long device when treating an obese patient with surgical neck comminution

8 months post op

Case Review
Case #1: 84yo female, s/p fall

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3 weeks post op

Case #1: 84yo female, s/p fall

9 weeks post-op

Case #2: 69yo female s/p fall
Case #2: 69yo female s/p fall

9 weeks post-op