Diaphyseal Humerus Fractures

OTA Course
Dallas, TX    1/20/17
Ellen Fitzpatrick MD
OBJECTIVES

- TREATMENT OPTIONS
- SURGICAL INDICATIONS
- CONTROVERSIES IN MANAGEMENT
Humerus Fractures

Treatment Goals:
- Functional Union
- Acceptable Deformity
Coaptation splint

- Temporary to provide initial comfort and edema reduction
- Mold to counteract deformity
  - *Valgus mold*
- High into axilla
  - *Avoid bunching*
- Mold over deltoid into neck
- Allow arm to hang
  - *Seated or upright patient*
FUNCTIONAL BRACE  “SARMIENTO BRACE”

- Switch to brace at 1-2 weeks
- Prefabricated
- Frequent re-tightening
- Early elbow ROM
  - Helps with hydrostatic pressure reduction/stabilization
- Shoulder ROM when ‘sticky’
- Average time of brace 10-12 weeks
- No Slings. Collar and Cuff
NON-OPERATIVE TREATMENT

- Frequent x-rays required
- Skin breakdown from prolonged splinting/bracing
- Limited ability for weight bearing
- Surgery for nonunion outcomes inferior to primary ORIF
  - 98% union vs 10-20% nonunion
  - May be patient selection
    - Proximal oblique or simple diaphyseal not as predictable
Nonoperative Treatment: Outcomes

- **922** patients with humeral shaft fxs treated with functional bracing
- **620** followed past fx union
- **< 2%** nonunion in closed fx/ **6%** nonunion in open fx
- **> 80%** < 16 degrees angulation in any plane
- **60%** full ROM shoulder
- **75%** full ROM elbow
- **Pain and functional outcome not studied**

Sarmiento, et. al., JBJS, 2000.

- 78 patients underwent functional bracing
- SFMA, SF-36, patient rated recovery at 1 year
- Radiographic assessment
- Outcomes:
  - 10% overall nonunion rate
  - 20% nonunion in AO/OTA type A fractures
  - 50% full recovery
Nonoperative treatment: Alignment

Good outcome general found with:
- < 20 degrees angulation in sagittal plane
- < 30 degrees varus/valgus angulation
- < 2-3 cm limb shortening

- After nearly 50 years, no additional information is available to refine this knowledge.

Conclusion: Some degree of malalignment is well tolerated.
Predictors of Failure

- Transverse fractures
- Distraction at fracture site
- Segmental fractures
- Holstein-Lewis type distal fractures
- Large person with Varus producing breasts and unbraceable arm
Humeral Shaft Fractures: Operative Indications

- Failure of closed management
  - Poor alignment, intolerance, lack of compliance, body habitus
- Open fractures
- Ipsilateral radius and ulna fractures
- Polytrauma patients
- Brachial plexus palsies
- Pathologic fractures
- Segmental fractures
No randomized or quasi-randomized studies exist

“There is no evidence available from randomized controlled trials to ascertain whether surgical intervention of humeral shaft fractures gives a better or worse outcome than no surgery.”

“Sufficiently powered good quality multi-centre randomized controlled trials comparing surgical versus non-surgical interventions for treating humeral shaft fractures in adults are needed.”
Absolute Stability

- Lag screw, neutralization plating
- Compression plating

Relative Stability

- IMN
- Bridge plating
- Ex-fix
Internal Fixation

- **Compression Plating**
  - Highly effective
  - Rigid fixation
  - No shoulder/elbow irritation
  - Longer incision
  - Longer operative procedure

- **Intramedullary Fixation**
  - Effective
  - Biomechanical advantage with upper ext. wt. bearing
  - Brief procedure
  - Short incisions
  - Limited blood loss
  - Antegrade technique may affect shoulder
Open Reduction, Plating

Closed Reduction, Nailing
■ 24 plate, 21 nail

■ No difference in:
  – ASES Scores
  – VAS pain scores
  – Strength/ROM
  – Return to activity

■ IM Nail Group had more:
  ▪ Shoulder impingement
    ▪ 6 IMN, 1 Plate
  ▪ Complications
    ▪ 13 IMN, 3 Plate
  ▪ Secondary procedures
    ▪ 7 IMN, 1 Plate

Conclusion:
DCP remains the best treatment for unstable fractures of the shaft of the humerus. Fixation by IMN may be indicated for specific situations, but is technically more demanding and has a higher rate of complications.”
Compression Plating: Approach

**Anterior**
- *Splits brachialis*
- *Avoids radial nerve*

**Posterior**
- *Splits triceps distally*
- *Develop interval between long and lateral heads proximally*
- *Exposes radial nerve*
- *Best in more distal shaft*
ORIF Plate and Screws Approaches

- **Anterior**
  - Proximal 2/3
  - Supine
  - No radial n dissection

- **Posterior**
  - Distal 2/3
  - Lateral
  - Radial n dissection
Distal Approach
Brachialis Split

Retract Biceps medially
Distal Approach
Brachialis Split

Split the Brachialis down to the humerus.

Dual innervation creates an “inter-nervous plane”
Gerwin et al. JBJS 1996
Direct Lateral Approach
Direct Lateral Approach
MIPO APPROACH

A B C
Compression Plating: *Bony Anatomy*

**Anterolateral**
- Plate fits poorly distally
- Better proximally

**Posterior**
- Broad flat surface
- Plate fits very well distally
Compression Plating: *Implant Choices*

- Large fragment plate preferred, 4.5 mm
- Match *wide or narrow* to the patient’s size
- Long working length
- Locking not typically required, but can be considered osteoporotic or metaphyseal fractures
  - Large, narrow (4.5)
  - Large, broad (4.5)

Small fragment (3.5)
Rarely indicated.
Plates vs. Nails: Comparative Studies

- Several studies have been done with somewhat varied findings
  - *Shoulder dysfunction* higher in antegrade nailing
  - *Reoperation* higher with IMN
  - *Plate fixation* generally considered gold standard. Union rate 90-95%

- Heineman, et. al., Acta Orthop, 2010
  - Metanalysis findings: *ORIF has overall lower complication rate than IMN.*
IM Nails: Current Status

- **Potential Benefits Compared to ORIF**
  - *Less invasive*
  - *Load sharing*
  - *Smaller scar*

- **Potential Negatives**
  - *Rotator cuff injury/impingement*
  - *Radial nerve*
  - *Axillary*

- **Current utilization**
  - *Complex polytrauma*
  - *Elderly, osteoporotic*
IMN Tips

- Countersink the nail
- Careful dissection/exposure:
  - Protect RTC and repair cuff/rotator interval
  - Protect Axillary nerve
- Minimal reaming at fracture site to avoid radial nerve injury
- Avoid distraction
Radial Nerve Palsy

- Palsies do Happen
  - 11% of humeral shaft fractures
  - 2% proximal 1/3
  - 24% distal 1/3
- Transverse/spiral > oblique/comminuted
- Open = Closed
- Most palsies recover
Closed Humerus Fracture: RNP at presentation

Lang et al. Int Orthop 2016

Incidence: 16%
At 1 year,
  82% full recovery
  11% functional recovery
  7% severe impairment

• **OBSERVE.** Early exploration not warranted
• Consider EMG at 6-12 weeks if no recover
• If early evidence of functional recovery, continue to observe
Open Humerus Fracture: RNP at presentation

Foster et al, JHS, 1993

14 Patients with rad n. palsy & open fractures

64% nerve interposed or lacerated

Repair not associated w/ good results

Recommendation: explore and ORIF
Consider for penetrating trauma
Closed Humerus Fracture: RNP after closed reduction

Bostman et al., Acta Orthop Scand 1986

- 59 patients: immediate radial nerve palsy
  - Useful recovery: 46/59 (88 %)
- 16 patients: secondary radial nerve palsy
  - Useful recovery: 14/16  (87.5%)
CONCLUSION:

- Non op treatment continues to be gold std but outcomes may not be as good as initially thought.
- Modern plating vs nailing have similar outcomes, but higher complication rate IMN
- Closed, radial nerve palsy ➔ OBSERVE
- Open, radial nerve palsy ➔ explore, ORIF and repair
- Radial nerve palsy following reduction of closed fracture ➔ observe