Proximal Humerus Fracture in the Elderly

Claudia M Medina M
Orthopedic Surgeon
IPS Universitaria - Clínica Leon 13
Medellín - Colombia
Objectives

• To review updated concepts for the management of proximal humerus fractures based on publications from the last 5 years

• To understand the differences in the diagnostic and therapeutic approach of a proximal humerus fracture in the elderly
Elderly

• WHO (World Health Organization)
  • > 65 y

• UN (United Nations)
  • Young old (60 - 74 Y)
  • Old old (75 - 84 Y)
  • Oldest old (>85 Y)
Assesment

• Images (X Ray and CT)
  • Pattern of fracture
  • Displacement

• Treatment
  • Images
  • Age
  • Co-morbidities
2D and 3D CT may improve inter-observer agreement, in order to provide a greater extent in the less experienced observers and in more complex fractures
Neer classification

<table>
<thead>
<tr>
<th></th>
<th>2 Part</th>
<th>3 Part</th>
<th>4 Part</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anatomical Neck</strong></td>
<td>2</td>
<td>0.3%</td>
<td>50 yrs</td>
</tr>
<tr>
<td><strong>Surgical Neck</strong></td>
<td>3</td>
<td>28%</td>
<td>70 yrs</td>
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<tr>
<td><strong>Greater Tuberosity</strong></td>
<td>4</td>
<td>4%</td>
<td>67 yrs</td>
</tr>
<tr>
<td><strong>Lesser Tuberosity</strong></td>
<td>5</td>
<td>0%</td>
<td>65 yrs</td>
</tr>
<tr>
<td><strong>Fracture-Dislocation</strong></td>
<td>6</td>
<td>5%</td>
<td>59 yrs</td>
</tr>
<tr>
<td><strong>Anterior</strong></td>
<td>7</td>
<td>0.2%</td>
<td>54 yrs</td>
</tr>
<tr>
<td><strong>Posterior</strong></td>
<td>11</td>
<td>0.1%</td>
<td>51 yrs</td>
</tr>
<tr>
<td>Articular Surface</td>
<td>15</td>
<td>0.1%</td>
<td>73 yrs</td>
</tr>
</tbody>
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Minimal Displacement

1 49% 63 yrs

2 2% 72 yrs

3 0.3% 65 yrs

4 9% 73 yrs

5 0% 65 yrs

6 5% 59 yrs

7 0.1% 51 yrs

8 1% 73 yrs

9 2% 72 yrs

10 0.1% 77 yrs

11 0.1% 68 yrs

12 12

13 0.7% 75 yrs

14 0.1% 68 yrs
11

**Location:** Humerus, proximal end segment

**Types:**
- Humerus, proximal end segment, extraarticular, unifocal, 2-part fracture
- Humerus, proximal end segment, extraarticular, bifocal, 3-part fracture
- Humerus, proximal end segment, articular or 4-part fracture
Why are they different?
Normal bone

Osteoporotic bone

https://surgeryreference.aofoundation.org/
Differences

• Epidemiology
• Fracture pattern
• Mechanism of trauma
• Surgery indications
• Fixation strategies
• Follow up
Epidemiology
Epidemiology

• 185,000 Emergency Department visits yearly in USA

• > 65 y/o: Second most frequent upper extremity fracture, and third most common non-vertebral osteoporotic fracture, after proximal femur and distal radius

• Females > males

• Surgical treatment 10-40%
Risk factors

- Impaired vision
- Use of hearing aids
- Diabetes Mellitus
- Depression
- Alcohol consumption
- Use of anti-convulsive medication
- Maternal history of hip fracture
Fragility fractures in the upper limb: proximal and distal humerus

10 – 24% of the elderly population depend on walking aids.
Trauma mechanism
Mechanism

- > 60 y/o
- 90% fall from standing height
Associated Injuries

- 17% another fracture
- 7% proximal femur fracture
- 2% Distal radius
- 2% pelvic
- <1% contralateral
- Neurologic 2/3 EMG
- Vascular lesión (Isolated case reports)
- 30% Rotator Cuff tears (Full thickness tear)
Axillary artery contusion and thrombosis.

Fracture pattern
“The trend has been to move away from fracture classification schemes and to concentrate more on the patient’s characteristics and expectations”
Treatment goals
Young patient: Restore function

Elderly patient: Improve pain
Treatment options
Displaced or non displaced

- Age
- Co-morbidities
- Surgeon experience
- Anticipated demand/function
Non operative treatment - Indications

- Surgical neck fractures with contact and no gross instability
- Greater and lesser tuberosity fractures
  - Displacement < 1 cm
  - Overlap with the head < 20%
- Frail, elderly patient with contraindications for anesthesia
Non operative treatment - Indications

• Varus posteromedial fractures
  • Varus < 45 degrees
  • Lesser tuberosity displacement

• Valgus fractures
  • Head not pointing superior or lateral
  • Lesser tuberosity displacement
Non operative treatment - Contraindications

- Fracture-dislocations
- Head splitting fractures
- Head depression fractures involving over 20% of the humeral head surface
Non operative treatment - Relative contraindications

- Open fracture
- Associated vascular injury
- Polytrauma
- Associated disruption of Shoulder’s suspensory complex
- Pathologic fracture
Non operative treatment - Relative contraindications

- Head dislocation
- Severe Head Impaction or Head Splitting
- > 1 cm tuberosity displacement
- Excessive varus (>45 degrees) or valgus displacement
Non operative treatment - How to do it?

- Sling
- Slight external rotation
- Active range of motion exercises of the wrist and hand
Non operative treatment - How to do it?

• Codman pendulum exercises (Start at 2 week)
• Allow passive range of motion exercises of the shoulder
• To be performed four to six times per day with the help of an assistant
• During the first 2 to 3 weeks, passive range of motion exercises are best tolerated in the supine position.
• As the patient better adapts to these exercises, they can be continued in the sitting or standing position
Non operative treatment - How to do it?

- Additional Codman pendulum exercises (3 to 6 week)
  - Lean forward while standing
  - The upper extremity is then allowed to freely dangle from the shoulder assisted by gravity
  - As much as 90 degrees of forward shoulder elevation can thereby be achieved
Non operative treatment - How to do it?

- Active assisted range of motion exercises 6 weeks
- Strengthening starting 3 months after the injury
Most three-part PHFs treated conservatively, achieve fracture healing, even a negligible rate of malunion got fair–good functional results with few complications.

Four-part PHF treatment presents high rate of healing with less rate of malunion than the three-part PHF but achieve poorer functional results with few complications.
Operative treatment - Indications

- AP angulation
- Greater tuberosity 5-10mm
- Greater tuberosity > 5-10mm
- Varus > 20°
- Valgus > 40°
- Lateral angulation > 30-45°
- Lateral Displacement > ½ shaft diameter

- LAT
- Lateral angulation

Operative vs Non operative
• There is high to moderate quality evidence that, compared with non-surgical treatment, surgery does not result in a better outcome at one to two years after injury for people with displaced proximal humeral fractures involving the humeral neck and is likely to result in a greater need for subsequent surgery.

• There is insufficient evidence from RCTs to inform the choices between different non-surgical, surgical, or rehabilitation interventions for these fractures.
Many of the studies found no significant difference between the functional outcomes for operative and nonoperative treatment of proximal humerus fractures in patients above the age of 60.

Many studies reported high complication rates in the operative group. Both tension band and locking plate systems did not provide significant benefits over nonoperative treatment.

Treatment of 4-part fractures with hemiarthroplasty found that HRQoL and EQ-5D were significantly better than nonoperative treatment, but the complication rates were high.
Comparison of Surgical versus Non-Surgical Treatment of Displaced 3- and 4-Part Fractures of the Proximal Humerus: A Meta-Analysis

Feng Mao, MS,1 De-Hua Zhang, MS,1 Xiao-Chun Peng, MD,2 Yi Liao, MD3

• No difference in functional outcome was observed between the surgical and non-surgical group. Patient reported a quality of life significantly higher in the surgical group.
• There were no clinically relevant or statistically significant differences between nonsurgical or surgical treatment at 2 and 5 years of follow-up.

• It is extremely important to understand that the range of fractures included in this study does not represent the whole universe of proximal humeral fractures.
Joint preserving vs Arthroplasty
Joint-preserving treatments demonstrated higher Constant scores than arthroplasty. Important: studies exhibited significant heterogeneity.

Constant scores decrease significantly with increasing age, severity of fracture, and rate of osteonecrosis.
Nail vs plate

https://otaonline.org/video-library/45036  
https://surgeryreference.aofoundation.org/
Compared with other fixation strategies, such as locking plate fixation, no compelling evidence exists to suggest one technique over another.
Although the evidence quality was poor, the results suggest that compared with locking plates, intra-medullary nails may be a better choice for the repair of PHFs
• There was no significant difference in functional scores, pain, range of motion, or overall complication rate over the first year after surgery between patients treated with an antegrade locking intra-medullary nail and patients treated with a locking plate.

• There was a lower rate of loss of reduction with screw cut out observed among patients treated with the intra-medullary nail.
MIO vs Open reduction

https://surgeryreference.aofoundation.org/
The MIPO was more suitable than ORIF for treating proximal humeral fracture in elder patients.
• Deltopectoral approach was associated with significantly better function and quality of life scores, when compared to the deltoid split group, as well as a lower incidence of complications

• Skeletally mature patients, with an isolated proximal humerus fracture of Neer Classification II/III
• The deltopectoral approach resulted in significantly better functional and pain scores, and far fewer complications.
Improving fixation in elderly people
Reduction and fixation
AOTrauma Orthogeriatric course
A comprehensive strategy for the improved treatment of osteoporotic fractures must address both biological and mechanical issues and includes 4 specific approaches:

(1) removal of inhibitors to bone healing
(2) introduction of bone healing stimulants
(3) application of bone augmentation or substitutes
(4) modification of fracture fixation constructs
Arthroplasty
Arthroplasty - Indications

- Head depression fractures involving over 40%–50% of the articular surface
- Fracture-dislocations with separation of the head from the shaft and one or both tuberosities
- Valgus impacted fractures with fracture and displacement of both tuberosities
Arthroplasty - Indications

• Very old patient with osteopenia and severe comminution of the greater tuberosity

• Consider it if calcar is less than 8 mm and/or medial hinge disrupted
clear indication for prosthetic replacement

67y
66y
85y
75y

calcar <8mm
medial hinge
mass. disrupted

head split
partial fxdisloc
medial hinge disrupted

TRIAS
anatomic neck
osteoporosis+++ mass. displaced

partial fxdisloc
calcar <8mm
medial hinge disrupted

AOTrauma Orthogeriatric course
AOTrauma Orthogeriatric course
Hemiarthroplasty Vs Reverse shoulder arthroplasty
Reverse Shoulder Arthroplasty

• Reverse shoulder arthroplasty was developed for the surgical management of cuff tear arthropathy.

• Since tuberosity/rotator cuff-related complications are the main reason for a poor functional outcome when a humeral head replacement is implanted for management of a proximal humeral fracture, expanding the indications of reverse arthroplasty to proximal humeral fractures seemed reasonable.
Reverse Shoulder Arthroplasty

• In the treatment of proximal humeral nonunion, not performing a tuberosity repair at the time of reverse arthroplasty has been correlated with a higher rate of dislocation.

• Use of a stem with fracture-dedicated features (proximal ingrowth surface, small cross section, holes for suture fixation) may be beneficial.
• Patients who were treated with reverse shoulder arthroplasty (RSA) had significantly better University of California–Los Angeles, Constant scores, forward elevation, and abduction compared to those who underwent hemiarthroplasty (HA).

• Failure of tuberosity in the HA group demonstrated significantly worse functional outcomes.
Arthroplasty’s outcomes

• Studies reported to date seem to indicate that reverse shoulder arthroplasty provides reliable pain relief and restoration of motion and function, with good subjective shoulder values and overall satisfaction.

• Most but not all studies have reported better outcomes with reverse compared with hemiarthroplasty, internal fixation, or nonoperative treatment.

• The outcome of hemiarthroplasty seems to be directly related to tuberosity healing: anatomic tuberosity healing leads to a very good outcome in terms of pain relief, motion, strength, and function, whereas poor tuberosity healing leads almost universally to limited function (often with “pseudoparalysis”).
Outcomes
• In the treatment of 3- and 4-part humeral fractures, nonoperative treatment was favored over ORIF when rates of adverse events and additional surgery were analyzed.

• Reverse total shoulder arthroplasty was favored over hemiarthroplasty when functional outcome and rate of adverse events were analyzed.
In management of acute, geriatric proximal humerus fractures, reverse shoulder arthroplasty was significantly favored over hemiarthroplasty for outcome related pain, clinical scores, range of forward flexion, and incidence of re-intervention.
RSA had the highest probability for improving functional outcome and lowering the total incidence of complications and requiring additional surgery among the five interventions for treating adults with displaced proximal humeral fracture.
The statistical result suggested, that RSA has become a beneficial choice to treat displaced 3- or 4-part fracture in elderly patients, that might result in more favorable clinical outcomes and reduction of re-intervention rates than other methods performed for the same indication. But the ORIF is the worst.
Underlying Mental Illness and Psychosocial Factors Are Predictors of Poor Outcomes After Proximal Humerus Repair

Rebekah Belayneh, MD,* Jack Haglin, BS,* Ariana Lott, MD,* David Kugelman, MD,*
Sanjit Konda, MD,*† and Kenneth A. E gol, MD*†

• Psychological and social factors at 3 months postoperatively have a strong correlation with negative long-term (1 year) outcomes after proximal humerus fixation.

• Clinicians may offer psychological support and encourage social support to these patients postoperatively to improve pain and treatment outcomes.
The findings suggest that reverse shoulder arthroplasty may result in superior shoulder function compared to plate fixation, particularly in type OTA/AO classified type C2 proximal humeral fractures.
Summary

Proximal humerus fractures in the elderly present several challenges that should be addressed when planning treatment (patient, bone quality, co-morbidities, functionality) and there are differences in technique and strategies to improve the follow up

Long-term follow-ups are required to validate recommendations and findings of studies comparing the results of surgery with those of orthopedic treatment in the elderly
Rockwood and Green's Fractures algorithm
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Claudia M Medina M
Orthopedic Surgeon
IPS Universitaria - Clínica Leon 13
Medellín - Colombia