The Upper Extremity: Proximal Humerus Fractures

a quick-hit lecture series based on content from... Orthopaedic Surgery Clerkship: A Quick Reference Guide for Senior Medical Students Orthobullets Amboss Radiopaedia

presented by Underground Ortho

Epidemiology & Etiology

- Common, represent 4-6% of all fractures
- 2 demographics w/respective MOI:
 - Elderly (>65)
 - Low-energy falls
 - Pre-disposing osteoporotic bone
 - 4F:M
 - Increasing age assocw/more complex # types

• Young

- High-energy trauma (ex. MVC)
- Concomitant injuries of ST, NV + adjacent structures (ex. thoracic such as rib #, PTX)





Anatomy Osteology

Anatomic neck (AN)



- Constriction that separates humeral head from tubercles
- Represents old epiphyseal plate
- Anatomic neck and humeral head in same axis
- Surgical neck (SN)
 - Constriction below tubercles
 - Begins at metpahyseal flare
 - Represents weakened area below head
 - More often involved in fractures cf anatomic neck

Anatomy Osteology

- Average anatomic neck-humeral shaft angle 135 degrees, composed of
 - Angle between humeral shaft axis and (reported) trans-epicondylar axis (90 degrees) +
 - Angle between anatomic neck/humeral head axis and (reported) transepicondylar (30-45 degrees). This latter angle is referred to as humeral head retroversion or humeral retrotorsion.







Anatomy Osteology/Musculature

• Lesser tuberosity (LT)

- Insertion site of subscapularis tendon
- Subscap motor function internal rotation + adduction
- Therefore fracture involving LT will displace segment medially

• Greater tuberosity (GT)

• Insertion site of supraspinatus, infraspinatus + teres minor

Motor function

- Supraspinatus: initiation of arm abduction 0-15 degrees
- Infraspinatus: external rotation
- Teres minor: external rotation + adduction
- Combined effect resulting in fracture involving GT displacing segment superiorly + posteriorly



Rotator cuff 1 M. supraspinatus 2 M. infraspinatus 3 M. teres minor 4 M. subscapularis

Anatomy Osteology/Musculature

Proximal humeral segment

- Insertion site of deltoid
 - Motor function
 - Clavicular part: anterversion + internal rotation + adduction
 - Acromial part: abduction 15-100 degrees
 - Spinal part: retroversion + external rotation + adduction
- Combined effect resulting in fracture involving proximal humeral segment displacing segment medially

• Humeral shaft (HS)

- Insertion site of pectoralis major
- Pectoralis major motor function anterversion + internal rotation + adduction
- Therefore fracture involving humeral shaft will displace segment anteriorly + medially



Anatomy Vasculature

- Rich vascular supply to proximal humerus makes avascular necrosis (AVN) 2/2# rare complication
- Anterior humeral circumflex artery (AHCA)
 - AHCA —> anterolateral ascending branch —> arcuate artery (terminal branch and main supply to GT)
 - Anatomic neck fractures at risk of AVN
- Proximal humeral circumflex artery (PHCA)
 - Recent studies suggest it is the primary blood supply to humeral head, previously believed to play less prominent role in humeral head perfusion



A cadaveric study in 1990 established much of the orthopaedic literature on humeral head vascularity for two decades until recent experiments have provided new data. This original study in 1990 concluded that the anterolateral branch of the anterior circumflex artery supplies blood to what aspect of the proximal humerus?

- Anterior portion of humeral head
- Lesser tuberosity 2
- Entire humeral head except posteroinferior portion of lesser tuberosity and head 3
- Entire humeral head except posteroinferior portion of greater tuberosity and head 4
- Entire humeral head except entire greater tuberosity 5

The anterolateral branch of the anterior circumflex artery, called the arcuate artery terminally, provides blood supply to the entire humeral head, lesser tuberosity and greater tuberosity except for a small posterior area. The posterior portion of the greater tuberosity and a small posteroinferior portion of the humeral head are supplied by the posterior circumflex artery.





Anatomy Innervation

Axillary nerve

- Susceptible to injury in proximal humerus fratures, more so w/ combined anterior shoulder disclocation
- Courses off posterior cord —> anterior inferior to GH joint, posterior to axillary artery —> through quadrangular space w/ PHCA



Anatomy Reminder

- Brachial plexus
 - 5 roots (ventral rami C5-T1)
 - 3 trunks (superior C5-6, midde C7, inferior C8-T1)
 - 6 divisions (3 anterior + 3 posterior, each trunk give 1A+1P)
 - 3 cords (posterior, medial, lateral)
 - Of relevance, axillary nerve (C5-6) through quadrangular space to supply motor innervation to deltoid + teres minor and sensory innervation as superior lateral brachial cutaenous nerve

• Quadrangular space (lateral axillary space)

- Boundaries
- Superiorly: teres minor
- Inferiorly: teres major
- Medially: long head of triceps brachii
- Laterally: humerus







Presentation

- **Symptoms:** swelling, pain, decreased ROM
- Exam:
 - Arm held in internal rotation
 - Extensive ecchymlosis of chest, arm and forearm (notably in younger pts/HET)
 - Pucker sign/skin dimpling:
 - Rare occurence after closed PHF suggestive of skin incareceration at fracture site
 - Increased likelihood of necrosis and failure of closed reduction if pursued
 - Sign first reported in proximal humerus fracture, can be applied to any fracture of the extremities
 - Tenderness on palpation
 - Axillary nerve
 - Motor: may be unable to obtain 2/2 pain, Hornblower's test
 - Sensory: altered sensation (decreased, loss, dys/paraesthesia) over lateral proximal arm











Classification

Overview

Neer classification

- Most commonly + consistently used among several different schemes (of note AO/OTA)
- Based on:
 - Anatomic relationship of 4 humeral osseous segments: humeral head, GT, LT, HS
 - Parts (part defined as fragment >1 cm displacement or >45 degrees of angulation)
 - Presence/absence dislocation



