1 Adult Elbow Trauma
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2 drhearon.com
   education > residents’ file
   outline
   updated references

3 Periarticular Elbow Fractures
   • Radial head
   • Coronoid
   • Olecranon
   • Distal humerus

4 Radial Head Fractures – Epidemiology
   • 2–5% of all fractures
   • 33% of elbow fractures
   • 85%, 20–60 years of age
   • Mean age 30–40 years
   • Females : males = 2:1

5 Mechanism of Injury
   • FOOSH – axial load on pronated forearm fractures the anterolateral radial head
   • Direct blow to lateral elbow

6 Biomechanics – Radial Head
   • If collateral ligaments intact, RH not necessary for stability
   • In MCL deficient elbow, RH is an important secondary stabilizer

7 Long-Term Results of Radial Head Resection for Fx in Patients <40 Yrs
   Antuna et al., JBJS, 92A: 558–66, 2010
   • Retrospective study 26 RHFx rx w/excision
   • Mean follow-up 25 years (minimum 15 yrs)
   • 92% good or excellent; 81% no elbow pain
   • Ulnohumeral arthrosis in 100%
   • No significant functional impairment

8 Physical Exam
   • Tenderness, crepitus at radial head
   • Elbow effusion
   • Limited elbow motion
   • Elbow instability
   • Ecchymosis from other injuries

9 Imaging
   • Plain radiographs may include AP, lateral, RH views; stress views elbow, forearm; PA, lateral both wrists
CT scan in selected cases

10 Mason Classification
   Type 1 – Nondisplaced
   Type 2 – Displaced partial head fx (may be comminuted)
   Type 3 – Displaced complete head fx (may be comminuted)

11 Hotchkiss Classification – Management-Based System
   Type 1 – Nondisplaced (< 2 mm) are treated nonoperatively
   Type 2 – Mechanically significant (> 2 mm) are treated with ORIF
   Type 3 – Comminuted, irreparable are treated with prosthetic replacement

12 Mason Type 1
   Sling for comfort
   Early active ROM
   Aspirate hemarthrosis prn
   Expect mild flexion contracture
   Arthrofibrosis is possible

13 Mason Type 2
   Indications – Displaced > 2 mm; involves > 30% articular surface; or mechanical block to motion
   Intraoperative decision-making – ORIF vs excision head w/replacement
   Operative goals – Stable internal fixation allows early active ROM

14 Radial Head Fx ORIF – Basic Principles
   Kocher approach
   Preserve LUCL
   Assess fx comminution
   Assess soft tissue injury
   ORIF, bone graft
   Observe “Hotchkiss Safe Zone” for screw placement

15 Mason Type 3
   Indications – Comminuted radial head fx, not repairable, associated soft tissue injury
   Implant selection – Silastic vs. metal, monoblock vs. modular, appropriate size
   Operative goals – Identify & address all pathology, secure ligamentous repair, early ROM

16 ORIF of Radial Head Fractures
   Ring et al., JBJS, 84A: 1811–5, 2002
   Retrospective review 56 ORIF pts, 1990–97
   4/15 comminuted Mason Type 2 unsatisfactory
   13/14 Mason Type 3 (>3 frags) unsatisfactory
   Reserve ORIF for fx with 3 fragments or less

17 Radial Head Fracture: A Potentially Complex Injury
   Davidson et al., CORR, 297: 224–30, 1993
   Prospective study 50 consecutive RHFx
• Valgus stress radiographs, clinical stress tests
• Minimally or nondisplaced fx were all stable
• Comminuted or displaced fx were unstable

18 Elbow Stress Tests
• Valgus stress test assesses medial collateral ligament integrity
• Axial load stress test assesses TFCC, IOM integrity

19 Associated Injuries Occurring with Radial Head Fracture
van Riet & Morrey, CORR, 466: 130–4, 2008
• Retrospective study 333 adult RHFx
• 26% associated elbow fx or ligament injuries
• Proposed modified Mason classification
• Used suffixes to describe associated injury

20 Mayo Classification Associated Injury Suffix
• Associated fracture – c = coronoid fx, o = olecranon fx
• Ligamentatous injury – m = medial collateral tear, l = lateral collateral tear, d = DRUJ disruption

21 Radial Head Fractures
• At least 25% are complex injuries
• Remember to assess for elbow instability
• Preserve radial head if associated injuries
• ORIF is preferred over replacement
• Replace the radial head if fx not salvageable

22 Coronoid Fractures – Key Anatomy Points
• Anterior capsule attaches 4–6 mm distal to coronoid tip
• Coronoid process & radial head provide anterior buttress, resisting posterior ulnohumeral subluxation
• Medial collateral ligament attaches to the sublime tubercle of the anteromedial facet
• 50% loss of coronoid height gives rise to ulnohumeral instability, especially if radial head is fractured

23 When you see a coronoid fracture...think elbow fracture–dislocation.

24 O’Driscoll Classification
• Type 1 – Coronoid tip
• Type 2 – Anteromedial facet
• Type 3 – Coronoid base

25 Coronoid Fracture Patterns
Doornberg & Ring, JHS, 31A: 45–52, 2006
• Retrospective analysis 67 elbow fx–dislocations
• Massachusetts General, Dr. Ring, 1997–2004
• Coronoid fracture type correlates w/specific elbow injury patterns
• Fracture type guides optimal treatment

26 Coronoid Fracture Patterns
• Terrible Triad (PLRI) – lateral approach
• Anteromedial facet fracture (PMRI) – medial approach
• Trans-olecranon fracture-dislocation – posterior approach

27 Evaluation
• History of elbow dislocation, self-reduced
• Examine for tenderness, bruising collateral ligaments, common flexor & extensor origins
• Plain AP & lateral elbow radiographs
• CT (2D, 3D) scan to assess fracture anatomy is strongly recommended
• EUA, stress radiographs to assess stability

28 Small Coronoid Tip Fractures
• Shear fx from elbow dislocation
• Not an elbow capsular avulsion
• If elbow concentric and stable, treat as simple elbow dislocation
• Early protected elbow ROM

29 Terrible Triad Injury
• Coronoid fracture (type I) w/radial head fracture after elbow dislocation
• Anterior elbow capsular avulsion
• LCL avulsion from humerus
• Elbow PLRI pattern
• Address w/lateral Kocher approach
• Order of repair is medial to lateral

30 Anteromedial Facet Fracture
• O’Driscoll type 2 fracture
• MCL at sublime tubercle
• Varus mechanism of injury
• Associated with PMRI
• Medial approach to fracture
• Fix w/screws or buttress plate

31 Medial Approach & Fixation Technique Depends on Fragment Size

32 Coronoid Base Fracture
• O’Driscoll type 3 fracture
• Through the coronoid base or body
• Often trans-olecranon fx-dislocation
• Less soft tissue disruption
• Posterior or posteromedial approach

33 Olecranon Fractures – Anatomy
• Subcutaneous location, vulnerable to trauma
• Triceps inserts on olecranon (extends elbow)
• Linear area of absent cartilage in sigmoid notch is key landmark
• Proximal–distal dimension of notch must be preserved in reconstruction

34 Mayo Classification (Morrey)
• Type I – Nondisplaced
- Type II – Displaced, Stable
- Type III – Unstable

35 **Olecranon Fractures – Type I**
- Plaster immobilization 3–4 weeks
- Early protected elbow range of motion
- No active flexion > 90 degrees until 4 weeks
- Older patients, earlier motion

36 **Olecranon Fractures – Type II**
- Posterior approach to fracture
- ORIF tension band technique
- Preserve sigmoid notch anatomy
- Posterior splint immobilization
- Early gentle AROM in 3–7 days
- Remove K–wires > 8 weeks

37 **Olecranon Fractures – Type III**
- Posterior approach
- Rigid neutralization fixation
- Contoured plate & screws
- Short period immobilization
- Early protected elbow ROM

38 **Salvage Situations**
- Open, unstable fractures – external fixator
- Comminuted fx (< 30%) – excision prox fragment, triceps advancement
- Pre–existing disease (RA) – semi–constrained TER

39 **Distal Humerus Fractures – Basics**
- Incidence – Rare, 2% all fx
- Anatomy – Complex bone & soft tissue
- Fx Patterns – Many & varied
- Treatment – Operative
- Surgeon Experience – Limited

40 **Fix Lateral or Medial Epicondyle Fx w/cannulated screw(s)**

41 **Mechanisms of Injury**
- FOOSH or direct trauma
- Axial loading into coronoid may split trochlea
- Elbow subluxation may shear articular surface

42 **DHFx Classifications**
- Milch classification for unicondylar fractures
- Riseborough & Radin classification for intercondylar fractures
- Mayo classification for capitellar fractures

43 **Davies–Stanley Classification**
- Type I – Extra–articular
- Type II – Intra–articular
- Type III – Articular

44 **Operative Treatment Is Almost Always Required for DHFx**
Surgical Approach
- Extensile posterior approach (most)
- Extensile lateral approach (some)

Triceps Management
- Retraction – Mobilize medial & lateral for Type I
- Split – Central triceps for fractures w/proximal extension
- Reflection – Detach triceps from ulna for possible TER
- Osteotomy – Olecranon osteotomy for Type II or Type III

Treatment Goals
- Anatomic reduction
- Rigid internal fixation
- Limited immobilization
- Early active elbow ROM

Comparison of Double-Plate Fixation Methods for Complex Distal Humerus Fractures
Self et al., JSES, 4: 11–16, 1995
- Biomechanical cadaver study
- Three reconstruction configurations
- Cyclic loading specimens to failure
- Posterolateral plates > distal screws failed
- Dual plates bolted together is most rigid

Intercondylar Fractures – Keystone Arch Concept

Fracture Reconstruction – Sequential Steps
- Provisional assembly articular surface
- Preserve troclear anatomy
- Plate placement & provisional reduction
- Articular fixation w/screws through plates
- Supracondylar compression & fixation
- Final screw fixation

Dubberley Classification for Articular Fractures
- Type 1 – Capitellar
- Type 2 – Capitellar and trochlear
- Type 3 – Comminuted

Take Home Messages
- Standard of acceptable surgical treatment has been set higher now than ever before
- Rigid internal fixation with latest techniques allows for early active elbow motion
- For comminuted radial head fractures, modular metallic implants are preferred
- For coronoid fractures, think elbow fracture-dislocation and address instability
- Prefer stiff congruent joint to an incongruent elbow joint with good range of motion