Forearm fractures need understanding of principles for diaphyseal and articular fractures

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Learning outcomes

• Review the concept of the forearm as a “joint”

• Describe the assessment, problems and treatment options of forearm fractures

• Review the options for surgical approaches

• Discussion complications and outcomes

Understand why it is not “just another shaft fracture”
Introduction

- Work as functional unit
- Never injured in isolation
- Never injury one without affecting the other

Must always be treated together
The radial bow and the relations between the proximal and distal radio-ulnar joints comprise a complex 3-dimensional functional unit.

Even small deformities caused by fracture malunion can result in significant functional impairment.
**Function:** position hand in space

**Requires:**
- Mobility
- Stability
- Alignment
Anatomy

- Brachioradialis
- Extensor carpi radialis longus and brevis
- Extensor digitorum
- Extensor digit minimi
- Extensor carpi ulnaris
- Aconeus

- Flexor carpi ulnaris
- Palmaris longus
- Flexor carpi radialis
- Pronator teres

- Brachioradialis
- Extensor carpi radialis longus and brevis
- Extensor digitorum
- Extensor digiti minimi
- Extensor carpi ulnaris
- Abductor pollicis longus
- Extensor pollicis longus
Articulations

Ulno-humeral
Radio-capitellar
Proximal radio-ulnar

Distal radio-ulnar
Radio-carpal
Interosseous membrane
Extrinsic stabilizers

(1) dynamic tensioning of the ECU
(2) semirigid sixth dorsal compartment
(3) pronator quadratus,
(4) interosseous ligament

Intrinsic stabilizers

(1) superficial (green) & deep (blue) radioulna fibers
(2) 2 disc-carpal ligaments (lunate and triquetral)
(3) central articular disc (white).
90° of forearm supination, at which point the two forearm bones are essentially parallel and the interosseous space widest

90° of pronation, at which point the radius has rotated across the anterior surface of the fixed ulna
Muscle forces
Consequences of injury

- Shortening
- Angulation
- Radial bow loss
- Loss of aligment
- Loss of relationship
- Dysfunction of unit
- Disability
Fracture mechanisms

- Axial compression
- Bending
- Rotation
- Direct trauma

Determines

- Fracture configuration
- Displacement
- Soft tissue injury
- Associated injuries
Clinical evaluation

**Soft tissue**
- Wounds
- Swelling
- Blisters

**Neurological**
- Careful exam
- Document

**Vascular**
- Pulses
- *Compartment syndrome*
Radiographic evaluation

**Full length AP & lateral**
- elbow
- wrist

**Ct scan**
- selected articular fractures

**MRI**
- ligament injury

**Angiography**
## Classification

### Simple Fractures
- **22-A1** ulna, radius intact
- **22-A2** radius, ulna intact
- **22-A3** both bones

### Wedge Fractures
- **22-B1** ulna, radius intact
- **22-B2** radius, ulna intact
- **22-B3** one bone wedge, other simple or wedge

### Complex Fractures
- **22-C1** ulna complex, radius simple
- **22-C2** radius complex, ulna simple
- **22-C3** both bones complex
Monteggia type

- Ulnar shaft fracture with dislocated radial head
- Types I-IV depending on direction of radial head dislocation fracture
Monteggia type

- Line drawn through radial head and shaft should line up with capitellum in all views
Galleazzi type

- Radial shaft fracture with dislocated distal ulna
- Multiple variant in location of radius fracture
- Can be very subtle
Signs of DRJU Injury

- ulnar styloid fx
- widening of joint on AP view
- dorsal or volar displacement (lateral view)
- radial shortening (≥5mm)

If radial fracture is <7.5 cm from articular surface unstable in 55%
If radial fracture is >7.5 cm from articular surface unstable in 6%
Personality of fracture

- Soft tissue damage
- Fracture displacement
- Osteoporosis
- Comminution
- Joint involvement
- Neuro/vascular injury
Goals of treatment

- **Restore**
  - relative length
  - rotation
  - radial bow

- **Reduce joints**
  - stabilize if needed

- **Repair soft tissues**

- **Stabilize the fracture**
  - absolute or relative

- **Early functional movement**
Conservative treatment?

3 weeks

12 weeks
Surgical indications

- All unstable bone fractures
- Displaced isolated fractures
  - 10 degrees of angulation
  - 50% of displacement
- Monteggia and Galeazzi
- Every open fracture
Preoperative decisions

- Timing of surgery?
- Surgical approach
  - Henry (palmar)
  - Thompson (dorsolateral)
  - Boyd (proximal ulna)
- Ulna/radius first?
- Type of reduction
- Type of fixation
- Bone graft?
Timing of surgery

- **Splint and elective surgery** for simple closed displaced fractures
  - Reasonable alignment
  - Joints reduced

- **Immediate fixation** for:
  - Open fractures
  - Impending open fractures
  - Compartment syndrome
  - Unreducible dislocations
Approaches

Henry
Characteristics

Articular

- Anatomic reduction
  - open
- Interfragmentary compression
- Stable fixation

Diaphyseal

- Realignment
  - length & rotation
- Bridge plating
- Relative stability
Reduction/fixation
Surgical tactics

- Reduced “simpler” fracture
- Provisional fixation:
  - clamps
  - plate with few screws
- Reduce more complex fracture
  - provisional fixation
- Confirm alignment/rotation
- Definite fixation
Plate fixation

- The gold standard treatment for more diaphyseal forearm fractures
- Stable, strong anatomical fixation
- Union rates more than 95%
Postoperative care

- Temporary splinting
- Avid prolonged immobilization
  - if you fix internally, do not fix it externally
- Immobilize the minimum time needed to protect soft tissues
  - Dislocations or instability may require more time of immobilization
Complications

- nonunion 2-4%
- Infection 1-2%
- Hardware irritation
- Synostosis
- Malunion
- Compartment syndrome
- Refracture
Intramedullary fixation

- Relative indications
- Children
- Single fractures
- Bad soft tissues
- Pathologic fracture
Take-home messages

- Complete understanding of injury
- Understand functional unit
- Both bony and soft injuries must be addresses
- Combination of articular & diaphyseal principles
- ORIF with plates is standard