

# Fractures of the Distal Humerus

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# Objectives

Background: Anatomy & Epidemiology

Clinical Evaluation

Classification

Approaches

Conclusions

# 1. Background: Anatomy & Epidemiology

- 1950-1960 – Mainly nonsurgical management
- Difficult injury to manage due to:
  - a. Complex anatomy
  - b. Limited bone stock
  - c. Proximity to neurovascular structures

# Epidemiology

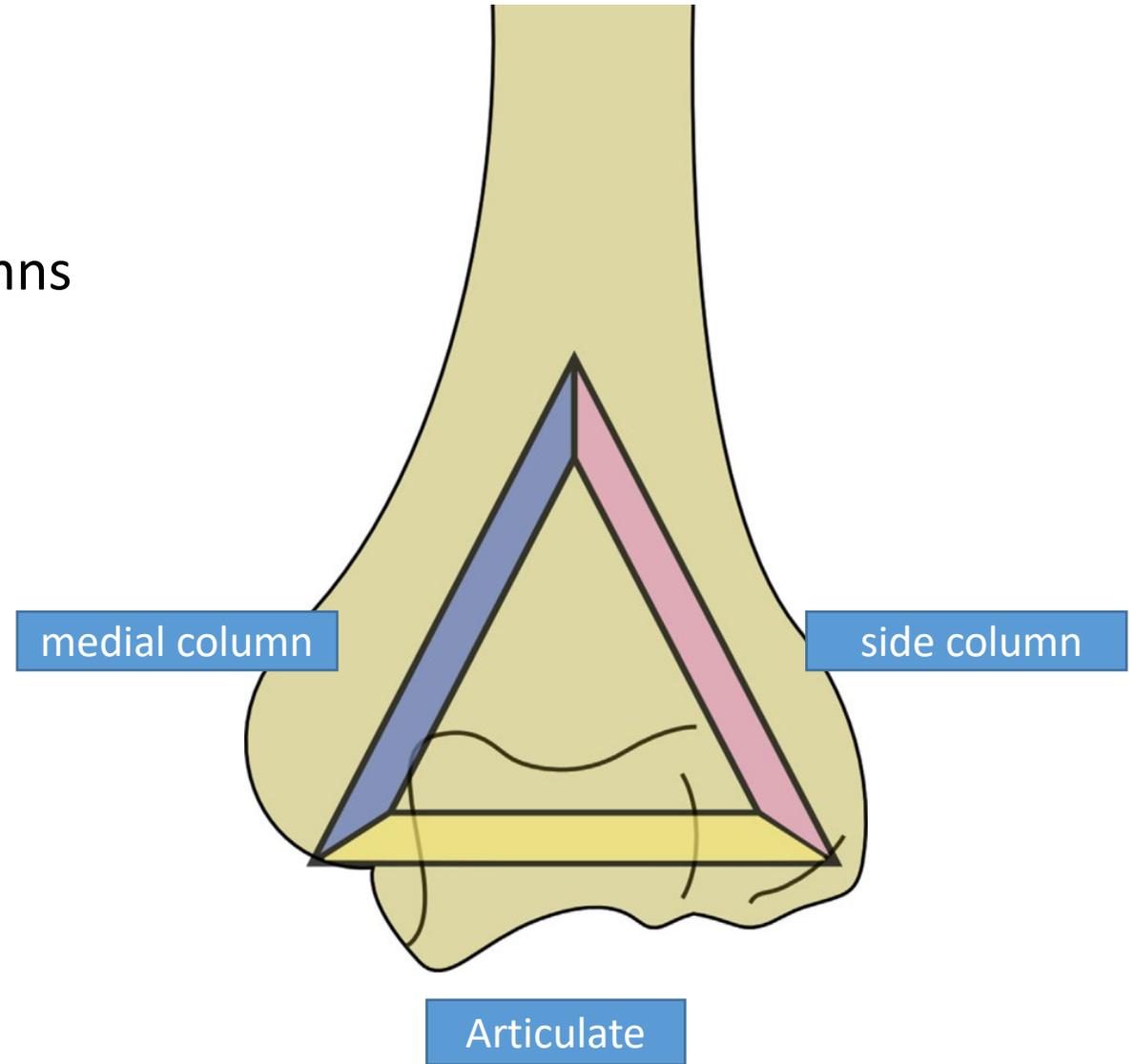
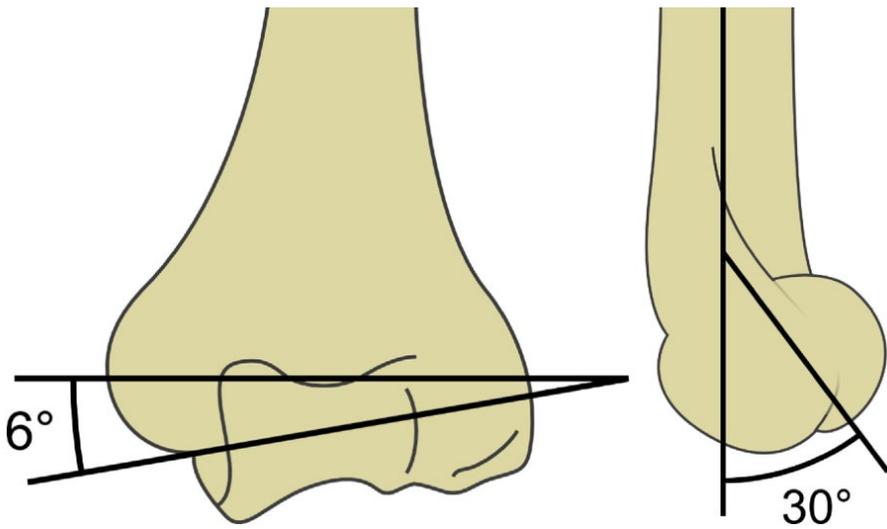
- 2-6% of all fractures
- 30% of elbow fractures
- Bimodal Distribution:
  - a. Young (men) high-energy injuries
  - b. Over 60 years (women) low-energy injuries

# Broad Management Options

- Open reduction and internal fixation (ORIF) with plates and screws has been the preferred surgical option for most of these fractures.
- Elbow arthroplasty has emerged as an alternative surgical option for elderly patients.
- Nonoperative management “Bag of Bones” is an option for low demand, medically unwell patients

# Anatomy

- Essential Architecture:
  - 3 columns forming a triangle.
  - Mechanical restoration of the columns and articular surface is essential
- Internal Rotation 5-7°
- Valgus 5-8°
- Recurvatum 30°



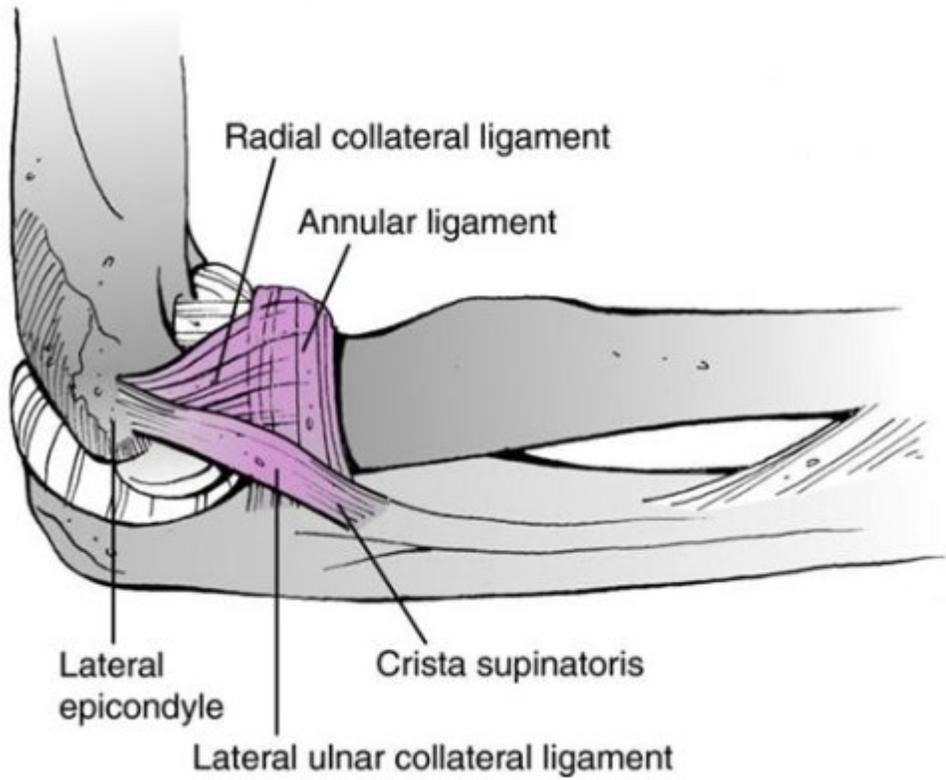
Figures courtesy of AO Foundation

## Dynamic structures are important:

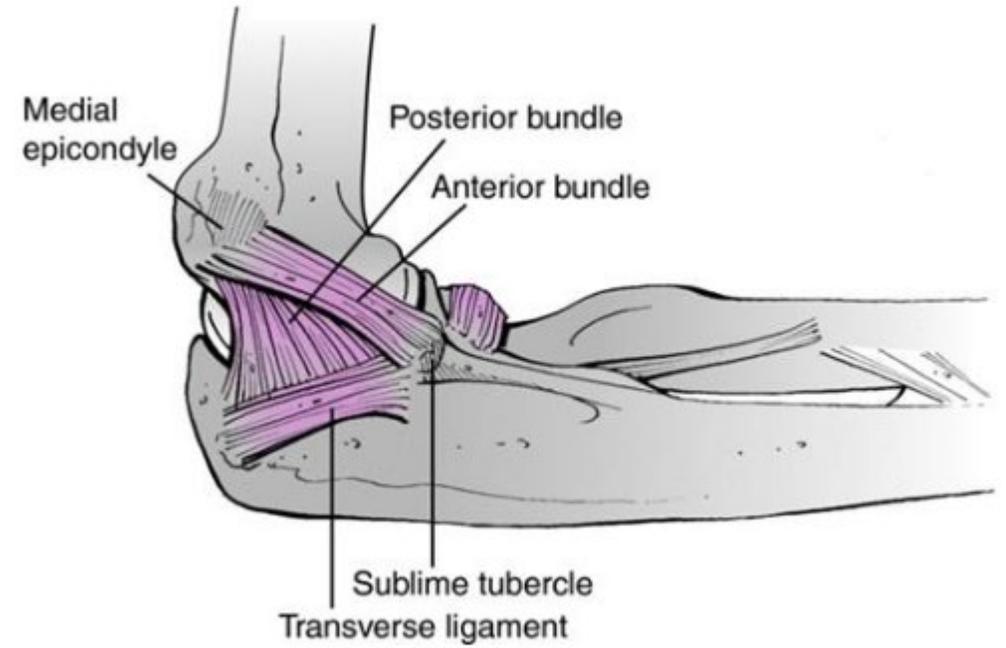
- Lateral epicondyle - collateral ligament and muscles: supinators and extensors
- Medial epicondyle (most prominent) - ulnar collateral ligament and muscles: pronators and flexors
- Normal ROM is 0° extension to 140° flexion
- Functional ROM is 30° to 130°



Photos from Athwal GS and Raniga S. Distal Humerus Fractures. In: Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019



**Lateral View**



**Medial View**

Illustrations from Athwal GS and Raniga S. Distal Humerus Fractures. In: Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019

# Clinical Evaluation

- History of trauma
- Deformity and pain
- Neurovascular exam: ulnar nerve
- Monitored for development of compartment syndrome: Pain with passive stretch, paleness, pulse and pressure

# Images

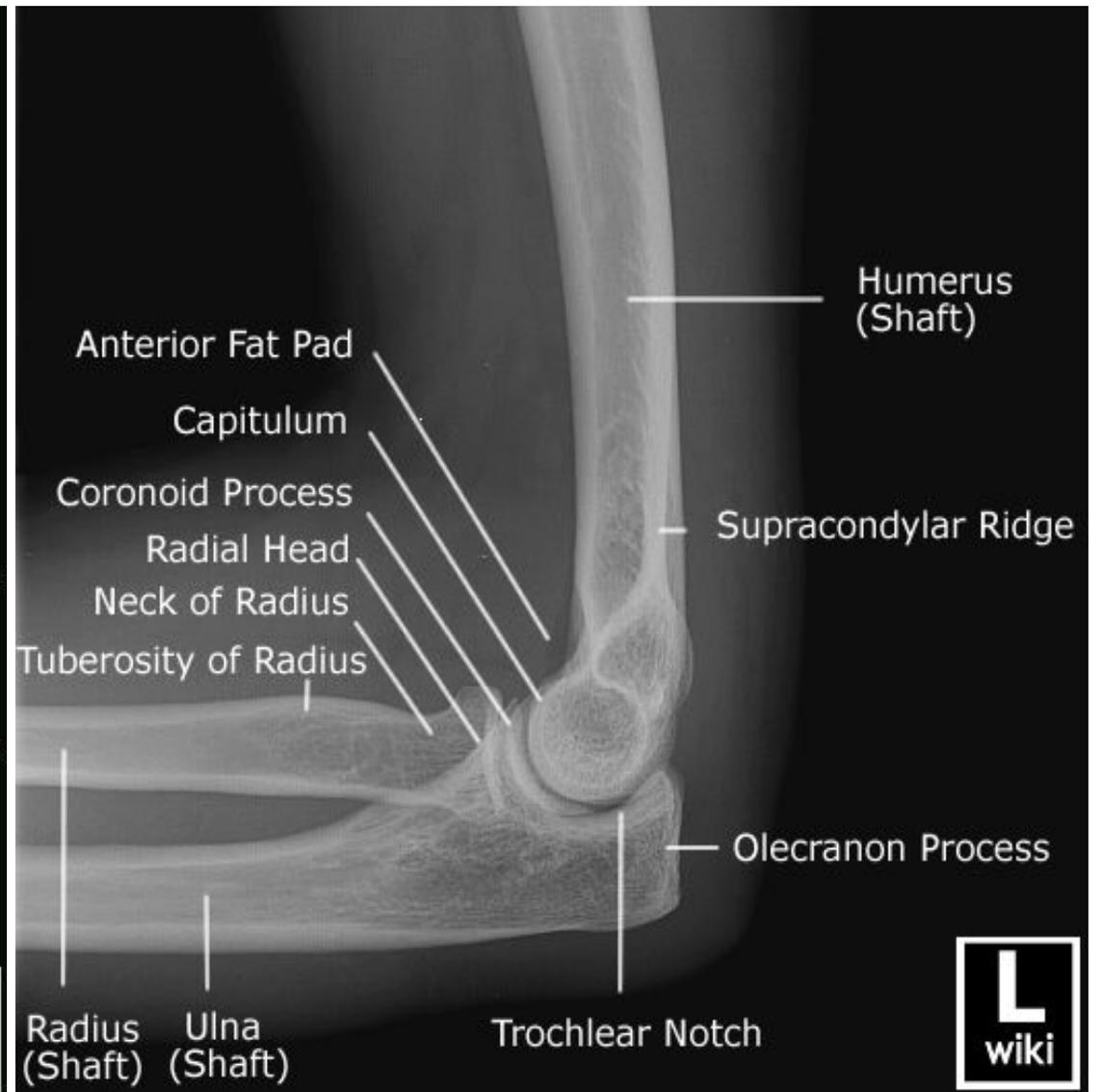
- Xrays - AP and Lateral
  - gold standard
- difficult on occasion because of the pain
- Traction Xray helps identify components
- CT scan assists with proper articular visualization



# AP Xray

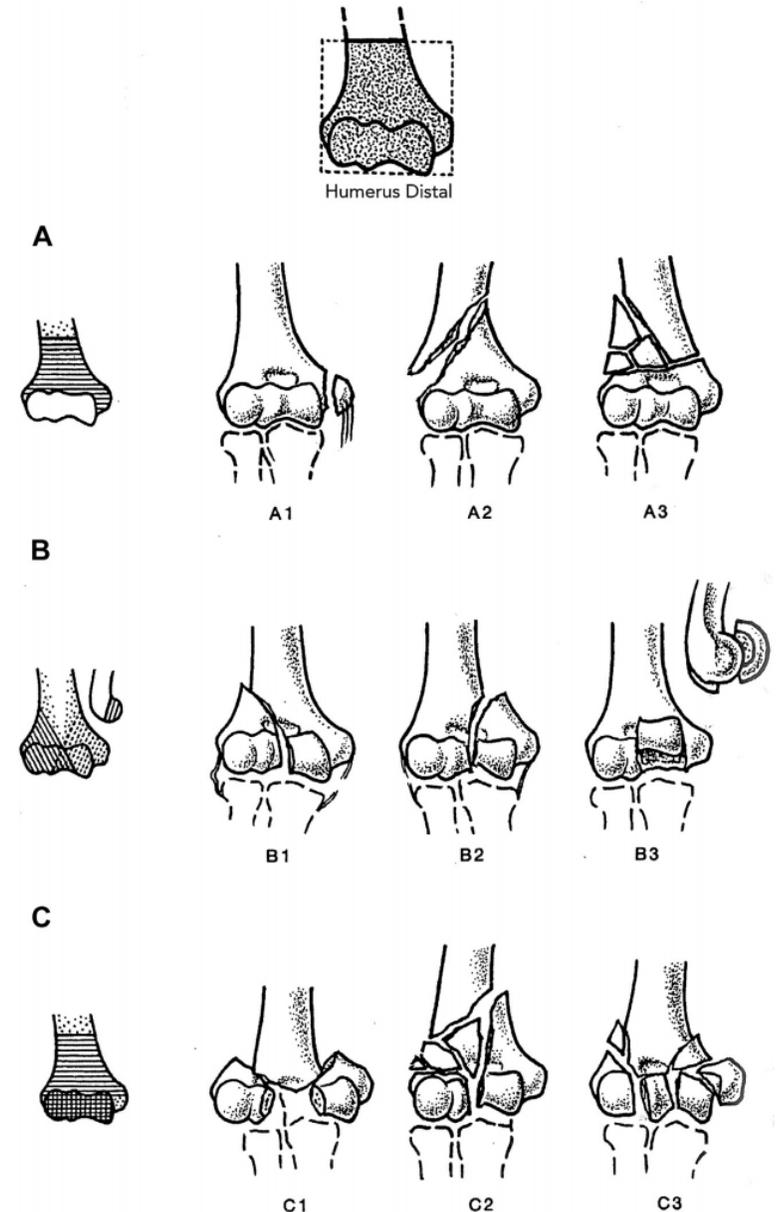


# Lateral Xray



# OTA/AO Classification

- A. Extra Articular
- B. Partial Articular
  - Includes isolated capitellum and trochlea fractures
- C. Complete Articular
  - C1 simple articular and metaphyseal
  - C2 simple articular and multifragmentary metaphyseal
  - C3 multifragmentary articular





AO. 13 A 2. 2



**Oblique**

This fracture type is classified by the AO/OTA as 13A2.2.



**Transverse**

This fracture type is classified by the AO/OTA as 13A2.3.

# Therapeutic Approach

This injury is often the result of high-energy accidents so it requires a comprehensive assessment ATLS

## I. Conservative Treatment

- Patients at high surgical risk
- Low physical demand (non-dominant arm)

Complications include:

- Loss of motion
- Chronic pain
- Nonunion
- Aesthetic issues



# Nonoperative treatment

## ***Indications***

- Minimal/no displacement and stable fracture
- No nerve or vessel injury
- Unacceptable surgical risk
- Supracondylar humeral fractures in children – type 1

## ***Contraindications***

- Noncompliant patient
- Displacement

## ***Advantages***

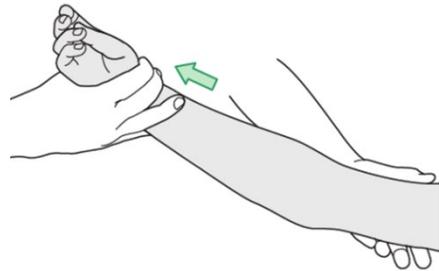
- Avoid surgical risks

## ***Disadvantages***

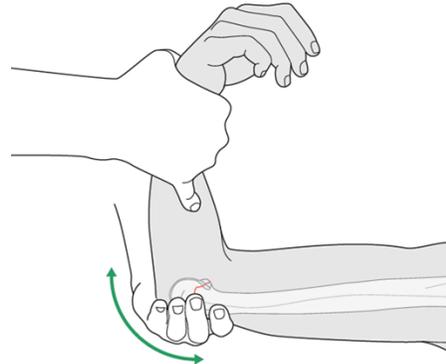
- Risk of secondary displacement
- Immobilization
- Subsequent joint stiffness
- Patient discomfort

# Closed Reduction and Splinting

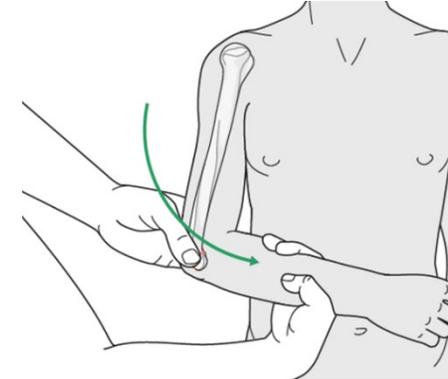
For pediatric supracondylar humerus fractures, or in situations where operative treatment is not a possibility for adult patients



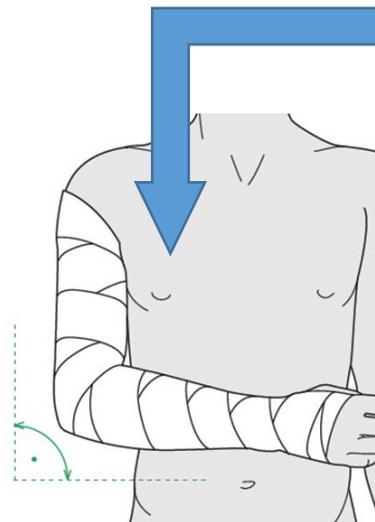
**Distract with traction**



**Flex elbow**



**Correct rotation**



**Apply splint**

Immobilize the elbow in 90° flexion and the forearm in neutral rotation.

## **Follow up**

The patient should be seen weekly for follow-up examination and x-rays for 4 weeks, and thereafter every 4-6 weeks, until union is secure and full functional range of motion and strength have returned.

## **Load bearing**

Minimum of 6-8 weeks after the fracture.

# Surgical

- Indications - Most fractures:
  - Difficult to reduce
  - Difficult to maintain by external means
  - Frequently articular

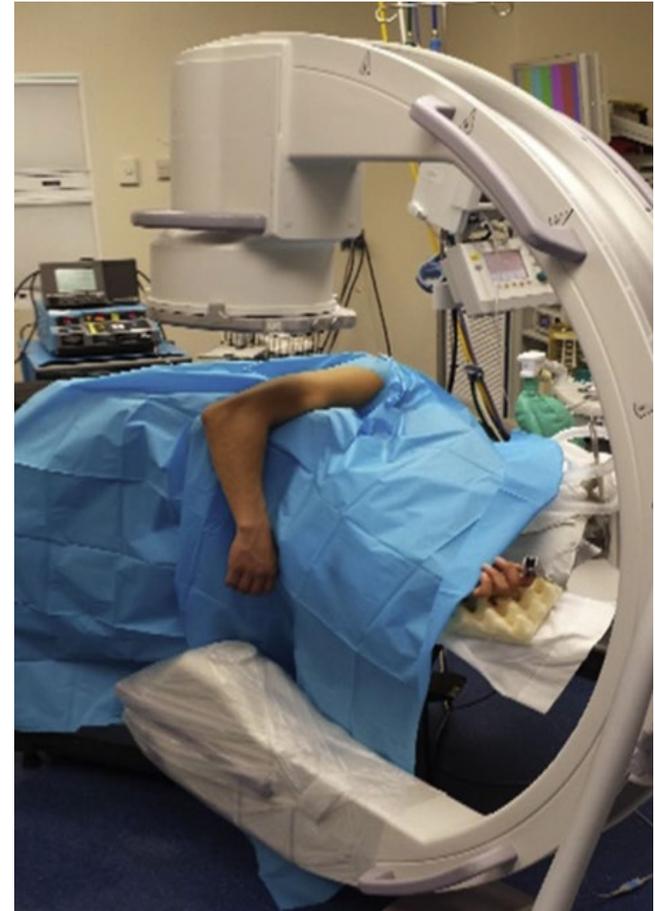
Key points

- a. Anatomic reduction
- b. Stable fixation
- c. Early mobilization



# Lateral Positioning

- Regional anesthesia may be employed, for the management of post-surgical pain
- Lateral beanbag, elbow in flexion
- C-arm
- Arm over bolster – allows gravity to assist in maintaining reduction - ligamentotaxis
- A mayo stand cover may be used to collect drainage



# Prone Positioning

- Allows easier access with C-arm for imaging
- Gravity ligamentotaxis
- In general less favored by anesthesia
- Facilitates bilateral surgery

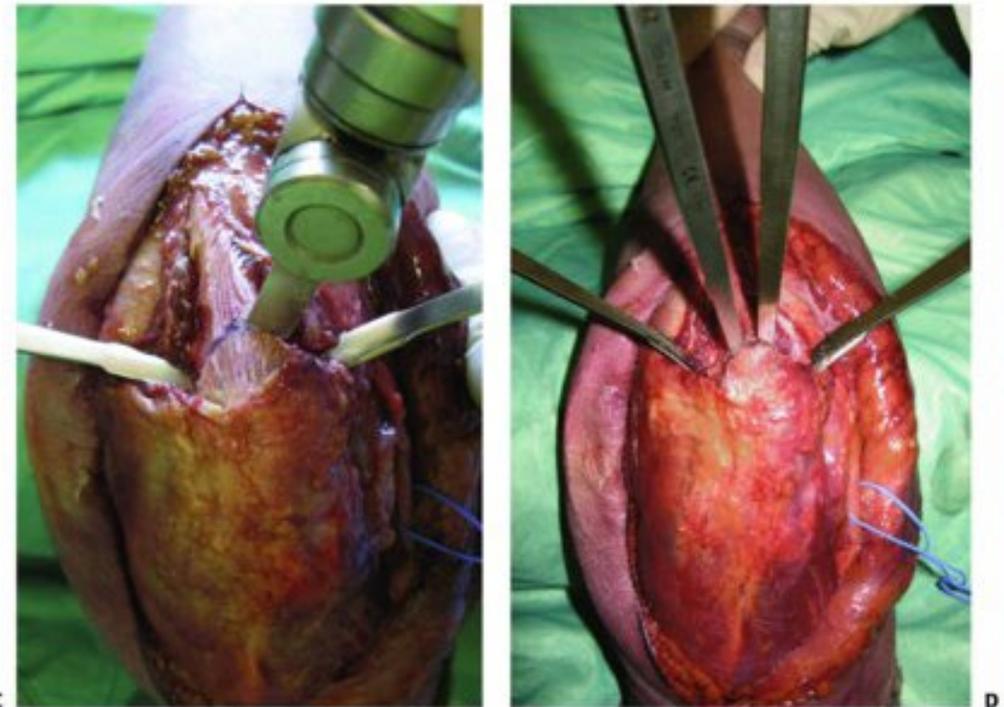
# ORIF

## a. Olecranon Osteotomy (Chevron).

- View 57% of articular surface
- Reintervention 8-13% for non-union
- Useful in type B3 and C, especially when articular surface is multifragmentary
- Finishing cut with an osteotome creates more irregular ends to allow for interdigitation

## Complications:

- Nonunion
- Prominent hardware



Intraoperative images from Athwal GS and Raniga S. Distal Humerus Fractures. In: Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019

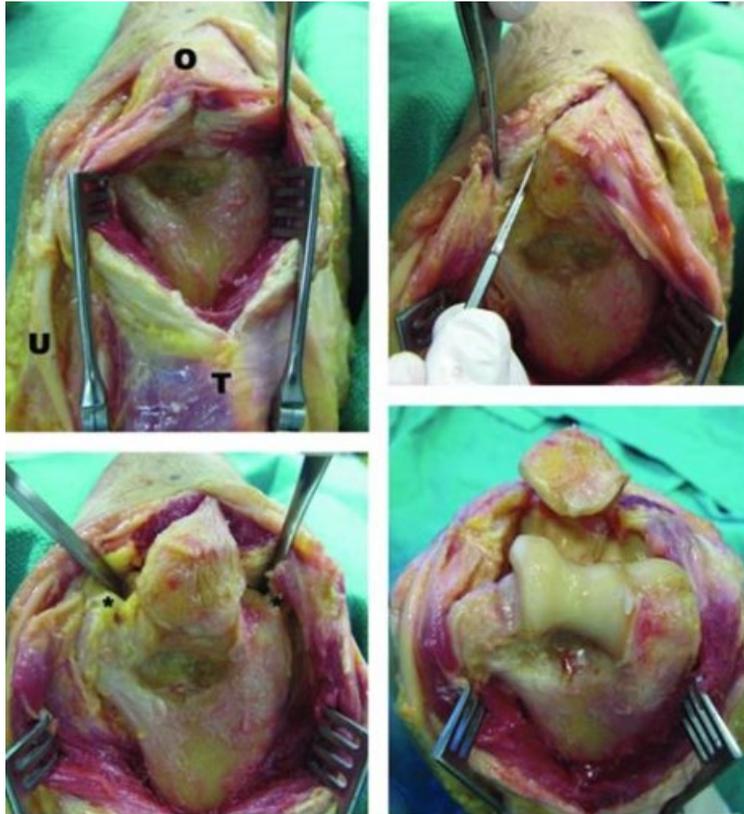
## b. Triceps Split

### Advantages

1. Does not disrupt extensor mechanism
2. Preserve bone
3. Avoids the possibility of prominent osteotomy fixation

### Disadvantages

1. More limited view than osteotomy
2. May limit ability to perform osteotomy if needed



McKee et al (*JBJS Br* 2000) : The use of a triceps-splitting approach did not compromise the quality of the reduction

Intraoperative images from Athwal GS and Raniga S.  
Distal Humerus Fractures. In: Tornetta P, Ricci WM, eds.  
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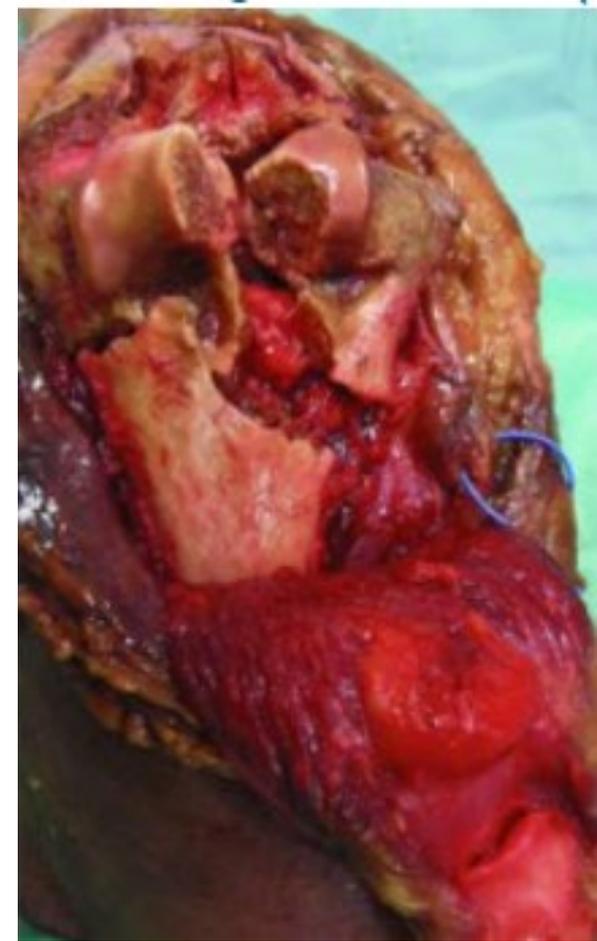
# Approaches

- Wilkinson (Wilkinson JM, Stanley D 2001) reported no differences in functional outcome after treatment of closed intra-articular fractures of the distal humerus through either of these approaches
- In some open fracture, it seems logical that incorporating the defect in the triceps into the surgical approach may involve less trauma and give a better functional outcome than compromising the extensor mechanism further by performing an olecranon osteotomy.
- Triceps-splitting procedures are simpler to perform but critics suggest that they offer a limited exposure
- Whatever approach is used, the ulnar nerve must be dissected free to prevent injury.

# What to do with the ulnar nerve?

- Identify and protect
- Decompress and release
- Translate: Controversial! doing so is decided intraoperatively
- Chen reports up to 33% neuritis in those that don't translate
- No difference if the patient had no symptoms pre-operatively
- In a large RCT, the Ulnar Nerve Entrapment Score, the Mayo Elbow Performance Score (MEPS), VAS and 2-point discrimination were not significantly different at any time point between patients who underwent did and did not undergo anterior transposition,

Dehghan et al, *J Orthop Trauma*, 2021



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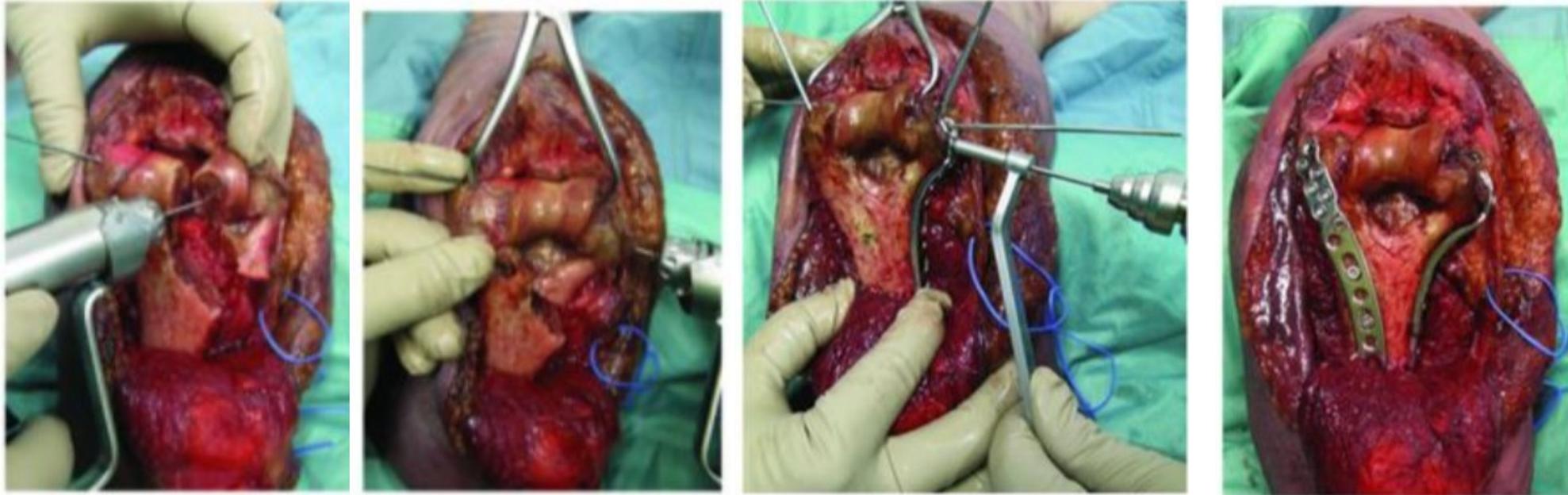
# Operative Technique

Identify the anatomy and mechanism of the fracture

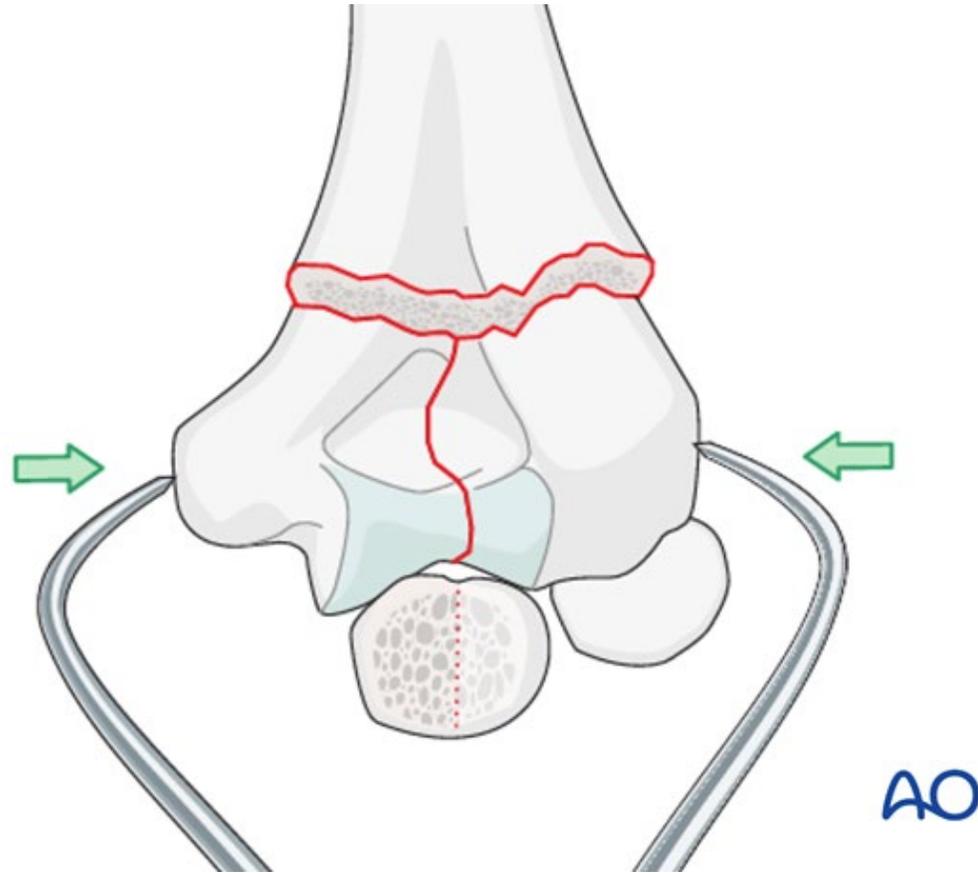
- The most important thing is joint congruence (remembering anatomy)
- Gentle handling of soft tissues and ulnar nerve
- Provisional reduction and stabilization of articular block with k wires and/or clamps
- May further stabilize articular block with 2.0 and 2.7mm that do not interfere with planned plate placement

Next, re-establish columns, and attach articular block

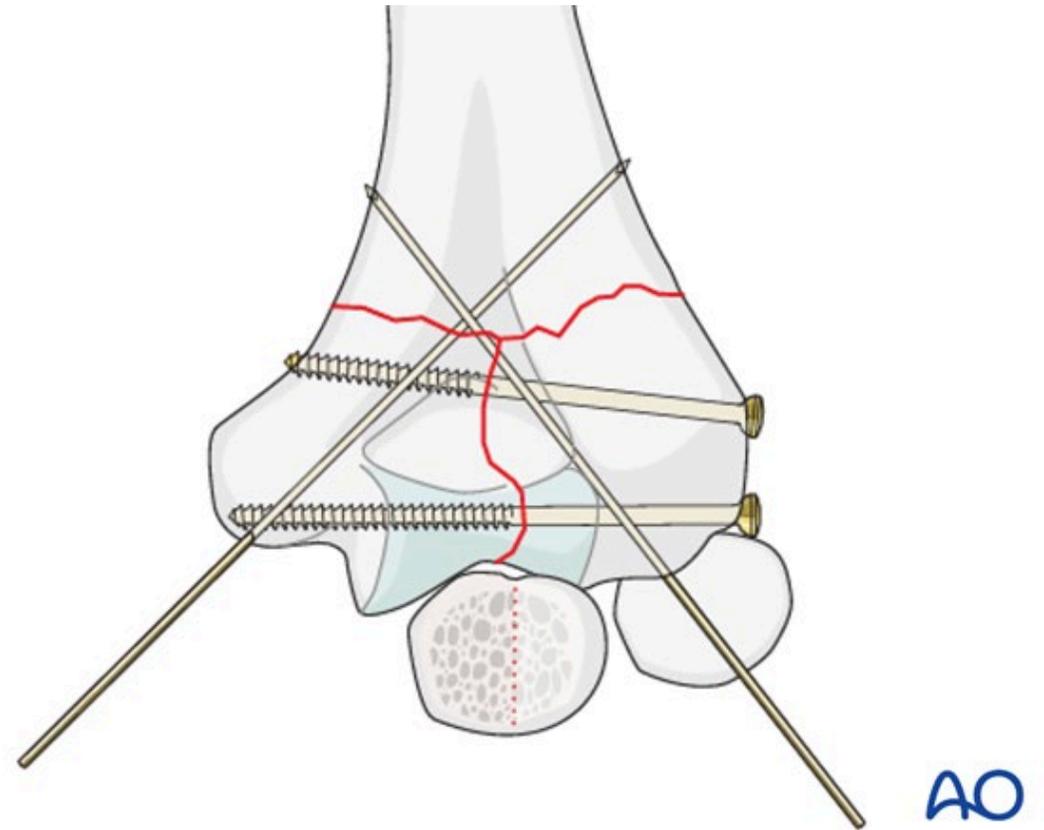
Fragments can be used as a graft that increases stability but beware of shortening, which may lead to limitation in extension



# Compression with pointed reduction forceps



# Reduction and provisional fixation



# Implant

Plate

Anatomic: allows more screws in distal segment

Reconstruction: easier to mold

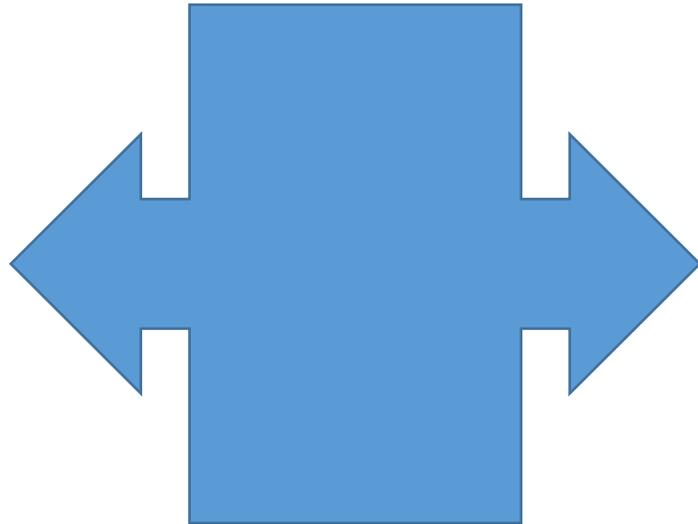
DCP 3.5: difficult to shape



# Surgery

Consensus in surgical management is dual column plates

The optimal plate configuration has been controversial. The two proposed constructs are parallel and orthogonal (perpendicular) plating





## Parallel configuration

- Demonstrates more biomechanical stability (Douglas et al. *JOT* 2016)
- More stable to rotation



## Perpendicular configuration

- May be useful in fractures with coronal plane fracture of the lateral components (i.e. capitellum fracture)

# Plate Configuration

Remember the personality of the fracture

It's not a cookbook recipe

Both configurations are useful when applied thoughtfully

# Post surgery

- Early motion is important!
- Some surgeons Will place in splint at 60° of flexion for 10 – 14 days
- Gradual mobilization 2- 6 weeks
- Xrays: no clear evidence

6 week

12 week



# Complications

61% at 15 months (Nydick et al. 2020)

1. heterotopic ossification, beware especially in patients with head injury
2. Nerve injury (Ulnar 38% Ilyas et al. 2012)
3. Contracture: key to prevention is early mobilization
4. Prominent hardware – usually in cases of olecranon osteotomy and fixation
5. Infection – rare
6. Nonunion – osteotomy nonunion is rare with proper technique (2% in Ring's series (JOT 2004))



# Total Elbow Replacement

- Indication: Elderly, low functional demand patients with unreconstructable joint
- Average age 72 years, arthritis 65 years
- Elderly patients have an increased baseline DASH score and appear to accommodate to objective limitations in function with time.

McKee et al, *JSES* 2009



# CONCLUSIONS

1. Young people (average 35 years) 92% excellent results
2. ORIF has worse outcome in those >65 – consider prosthesis in complex articular injuries
3. Difficult injury to manage due to complex anatomy and complex articular injuries
4. Dual plating is the gold standard for fixation
5. With other exposures, olecranon osteotomy may be avoided in most cases

6. Anatomic plate may help by using as template for reduction and for more points of fixation in distal fragments
7. Fracture personality guides plate orientation
8. Release and protect ulnar nerve – do not transpose routinely

- THANK YOU



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