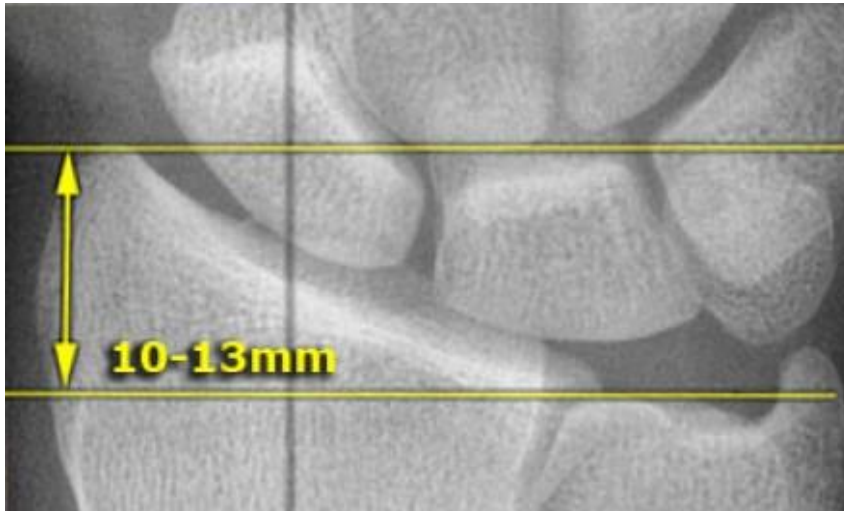


INTERPRETATION OF UPPER LIMB

FRACTURE

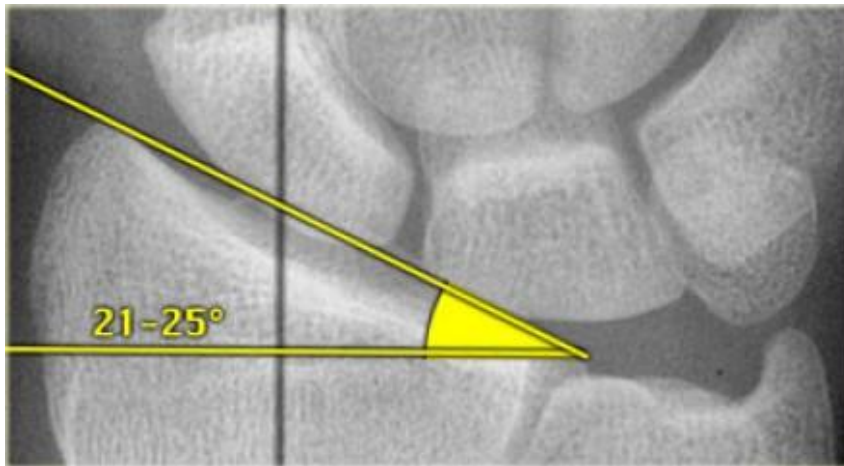
- A fracture can be defined as a '**break in the continuity of a bone**' and is included in the International Classification of Disease (ICD-10) under M84 as 'Disorders of continuity of bone'¹
- Conventionally the upper limb is divided into 'parts' by the three major joints of wrist, elbow and shoulder and imaging should be tailored around clinical findings and appropriate application of this principle will also be discussed

RADIAL HEIGHT



- Radial length or height
- Radial length is measured on the PA radiograph as the distance between one line perpendicular to the long axis of the radius passing through the distal tip of the radial styloid.
- A second line intersects distal articular surface of ulnar head.
- This measurement averages 10-13 mm.

RADIAL INCLINATION ANGLE



- Radial inclination or angle
- Radial inclination represents the angle between one line connecting the radial styloid tip and the ulnar aspect of the distal radius and a second line perpendicular to the longitudinal axis of the radius.
- The **radial inclination ranges between 21 and 25 degrees** .
- Loss of radial inclination will increase the load across the lunate.

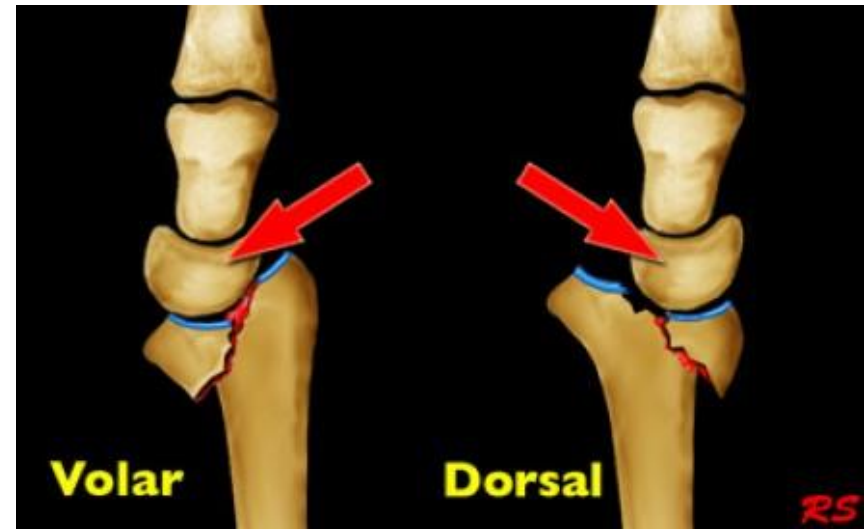
RADIAL TILT

- Radial tilt
- Radial tilt is measured on a lateral radiograph.
- The radial tilt represents the angle between a line along the distal radial articular surface and the line perpendicular to the longitudinal axis of the radius at the joint margin.
- The normal volar tilt averages **11** degrees and has a range of **2-20** degrees



BARTON'S FRACTURE

- **Barton's fracture**
- Volar-type Barton's is a fracture-dislocation of the volar rim of the radius.
- This type is the most common.
- Dorsal-type Barton's is a **fracture-dislocation of the dorsal rim of the radius.**
- Dislocation of the radiocarpal joint is the hallmark of Barton's fractures.
- These are shear type fractures of the distal articular surface of the radius with translation of the distal radial fragment and the carpus.
- These fractures have a great tendency for redislocation and malunion.
- They usually require operative treatment.



Colles'



- A Colles' fracture is a fracture of the distal metaphysis of the radius with dorsal angulation and displacement leading to a 'silver fork deformity'.
- Colles fractures are seen more frequently with advancing age and in women with osteoporosis.
- In many cases a Colles' fracture is an extraarticular, uncomplicated and stable fracture, but it can be intraarticular.
- So look for signs of instability in all Colles' fractures, especially:
 - Intraarticular radiocarpal or DRUJ extension of the fracture
 - Radial shortening
 - Loss of radial inclination

Smith's fracture / Reverse colles

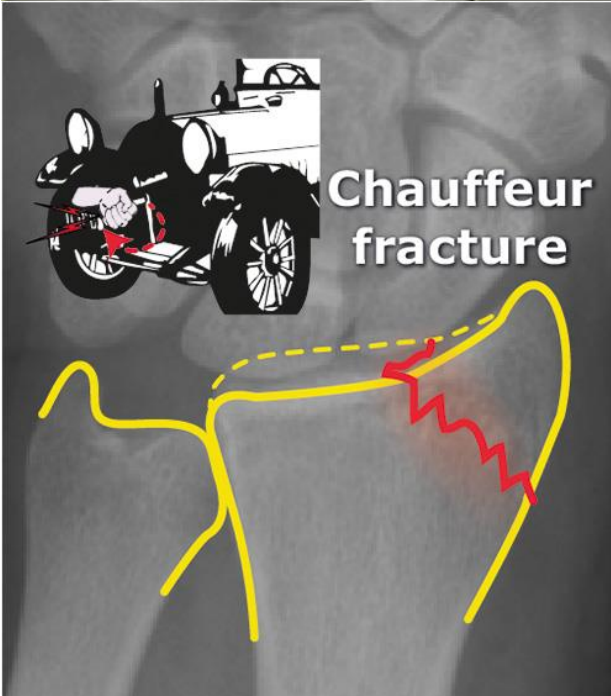


- Smith's fractures occur in younger patients and are the result of high energy trauma on the volar flexed wrist.
- Volar comminution and intraarticular extension are more common.
- On the left an extraarticular Smith's fracture with palmar and radial angulation and displacement.
- There is also an avulsion of the ulnar styloid process.

Chauffeur's fracture



- An isolated fracture of the radial styloid process is also called a Hutchinson's or chauffeur's fracture.
- Displacement of the fragment is uncommon.
- There can be associated injury to the scapholunate ligament.
- In most cases a fracture of the radial styloid process is part of a comminutive intraarticular fracture.



COLLE'S & SMITH

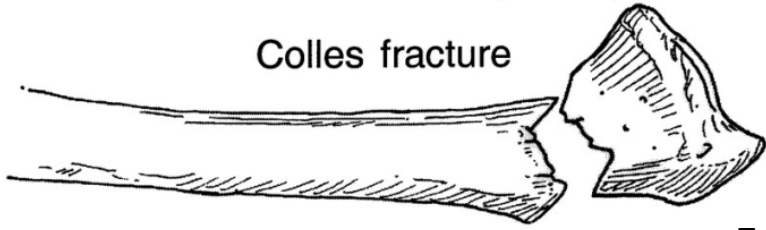
Fracture Description

Location	Extraarticular or Intraarticular
Configuration	Simple: transverse or oblique or Comminutive
Displacement	Radial tilt Radial length Radial angle Intra-articular incongruity: - offset of 2 mm in any plane
Ulna / DRUJ	Fracture at the tip, mid portion or base Subluxation or instability - compare to non-involved side

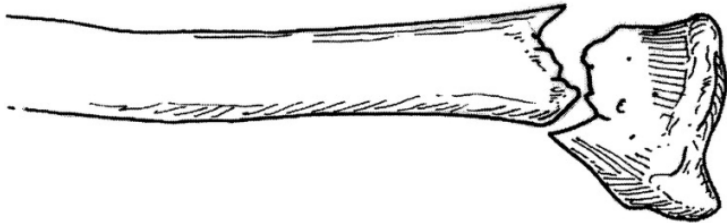


DORSAL ↑

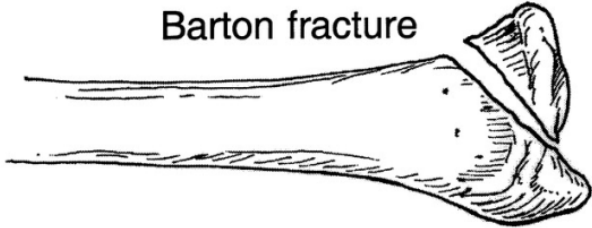
Colles fracture



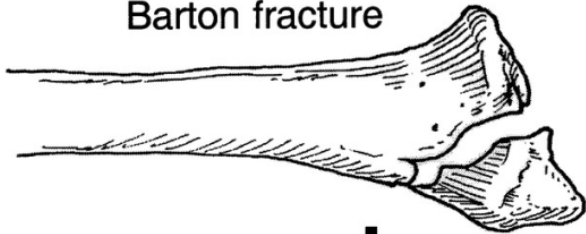
Smith fracture



Barton fracture



Barton fracture



VENTRAL ↓

Eponymous Name	Fracture of Distal Radius	Intra-articular	Angulation	Displacement
Colles Fracture	Transverse	No	Dorsal	Dorsal
Smith Fracture	Transverse	No	Dorsal	Dorsal
Barton Fracture	Dorsal	Yes	N/A	+/- Dorsal
Chauffeur Fracture	Lateral (Radial Styloid)	Yes	N/A	+/- Lateral

Die-punch fracture



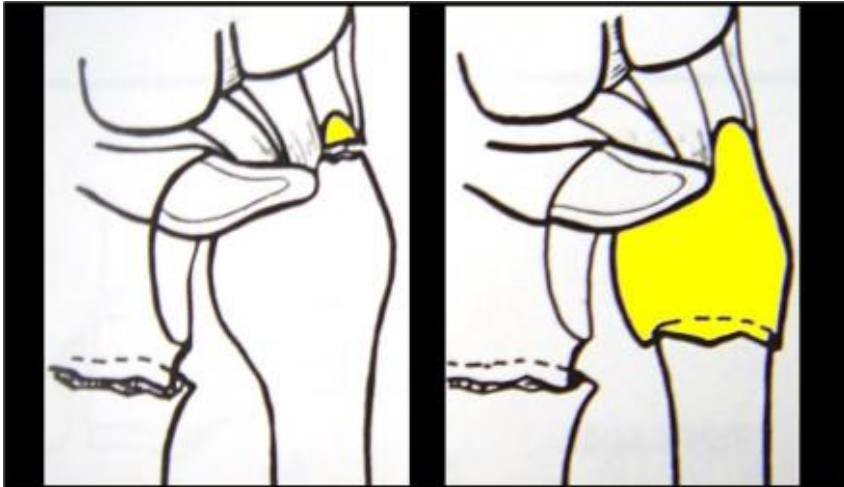
- A die-punch fracture is a depression fracture of the lunate fossa of the distal radius.
- It is the result of a transverse load through the lunate.
- The radiographic findings can be very subtle.
- In many cases there is also a subtle proximal displacement of lunate, seen as a break in carpal arc I.
- (see the article Wrist - Carpal instability).

Die-punch fracture

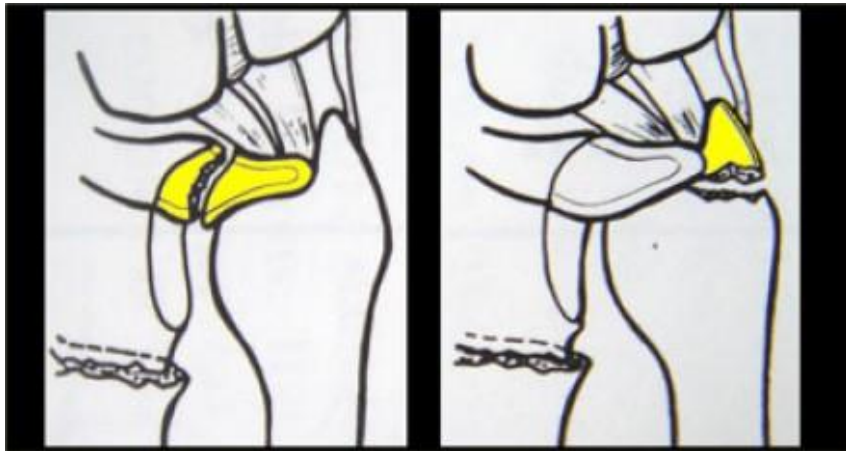


- On the left a typical die-punch fracture.
- The blue arrow indicates the depressed fragment of the lunate fossa.
- Notice the articular step-off.
- The yellow arrow indicates a subtle fracture of the radial styloid process.
- There is no disruption of carpal arc I.
- Notice that you can easily overlook such a fracture.

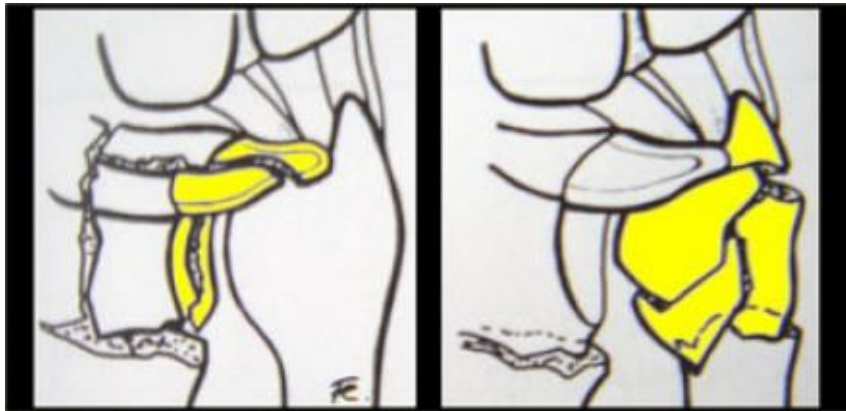
Ulna and Distal radioulnar joint (DRUJ)



- Assessment of a wrist fracture must also include a description of the distal ulna and distal radioulnar joint
- The distal ulna articulates with the sigmoid notch of the radius.
- Type I: stable
- Avulsion fractures of the tip of the ulnar styloid and stable fractures of the ulnar neck have a good prognosis.
- Following reduction of the radius the DRUJ is congruent and stable.
- Extraarticular unstable fractures however, require plate fixation.



- Type II: unstable
- There is subluxation or dislocation of the ulnar head as a result of avulsion of the base of the ulnar styloid or tear of the TFCC and/or capsular ligaments.
- The subluxation has to be reduced with closed or operative treatment to avoid chronic instability and arthrosis.



- Type III: potentially unstable
- Intraarticular fractures of the sigmoid notch and intraarticular fractures of the ulnar head are potentially unstable because the incongruity of the DRUJ.
- Subluxation is possible.

Torus fracture



- Torus fractures, or buckle fractures, are extremely common injuries in children.
- Because children have softer bones, one side of the bone may buckle.
- The word torus is derived from the Latin word 'Tori' meaning swelling or protuberance.
- These injuries tend to heal much more quickly than the similar greenstick fractures.

Green stick fracture



- These are partial fractures, since only one part of the bone is broken and the other side is bent.
- The name is derived from an analogy of breaking a young, fresh tree branch.
- Most often the greenstick fracture must be bent back into the proper position.
- Greenstick fractures can take a long time to heal because they tend to occur in the middle, more slowly growing parts of bone.

INSTABILITY

Indication of Instability

> 10° loss of angulation
> 5 mm of axial radial shortening
> 2 mm of articular incongruity
Comminution of cortex across the midaxial line
on lateral X-ray
Comminution of dorsal and palmar cortices
Irreducible fracture
Loss of reduction at follow up

- Instability is defined as a high risk of secondary displacement after initial adequate reduction.
- Radiographic signs that favor instability are displacement and an oblique or comminuted configuration (as mentioned above).
- These signs are listed in the table on the left.
- Although the initial x-ray after reduction may look good, always look for loss of reduction at follow up.
- Articular incongruity is the most important factor in the development of posttraumatic osteoarthritis of the wrist

WRIST

A correctly positioned PA view will show the extensor carpi ulnaris groove radial to the midportion of the ulnar styloid.

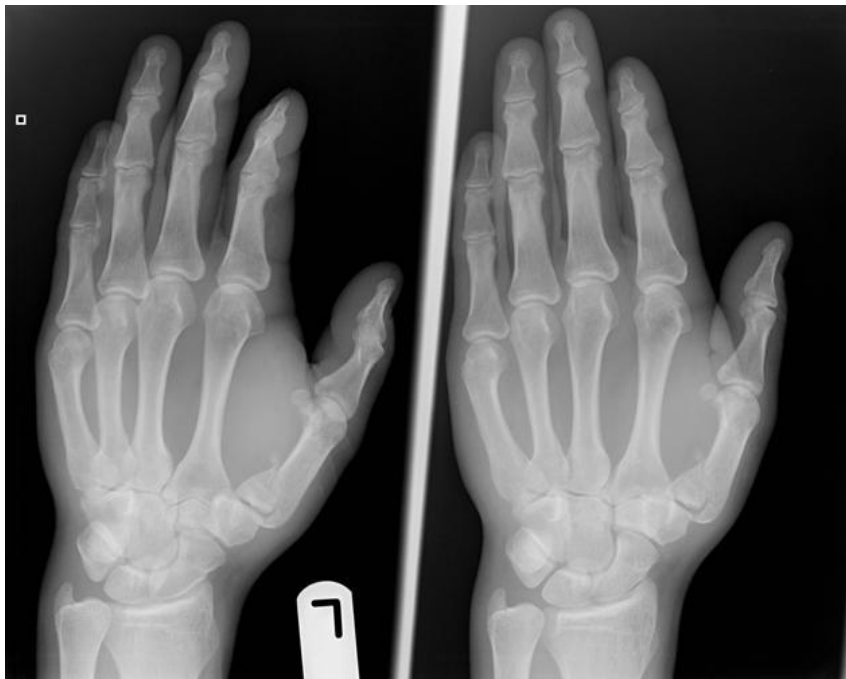
The PA and lateral view are equally important and thus should both be studied carefully.



SCAPHOID FRACTURE



Bennett fracture dislocation



ROLANDO

Rolando fracture is a three part or comminuted intra-articular fracture-dislocation of the base of thumb (proximal first metacarpal). It can be thought of as a comminuted Bennett fracture.



BOXER FRACTURE



Gamekeeper's thumb



ulnar collateral ligament (UCL)
of the thumb-AVULSION



Forearm

Upper Extremity Trauma

Part 3: Elbow & Forearm

		Monteggia vs Galeazzi	
<p>Anatomy</p> <p>Radiographs</p> <p>FOPH</p> <p>BBFF</p> <p>Monteggia</p> <p>● Galeazzi</p> <p>Essex-Lop.</p> <p>Fat Pads</p> <p>Peds Elbow</p> <p>Supracond.</p> <p>Lat. condyle</p> <p>Med. epicon.</p> <p>4 </p>		<p>Fracture:</p> <ul style="list-style-type: none"> ➤ Proximal ✓ Ulna <p>Dislocation:</p> <ul style="list-style-type: none"> ➤ Proximal ✓ Rad-Cap 	
<p>“MU/GR”</p> <p><i>“I was attacked by a MUGGER”</i></p>			
<p>Monteggia = Ulna fx</p> <p>MU Proximal ½ =</p> <p>Fx & Disloc are Proximal</p>		<p>Galeazzi = Radius fx</p> <p>GR Distal ½ =</p> <p>Fx & Disloc are Distal</p>	

Galeazzi Fracture

- Distal Radius Fracture
 - Distal radio-ulnar dislocation
- Mechanism of Injury
 - Direct blow to back of wrist
 - Fall on outstretched hand
- Complication = Ulnar nerve injury
- Treatment = ORIF



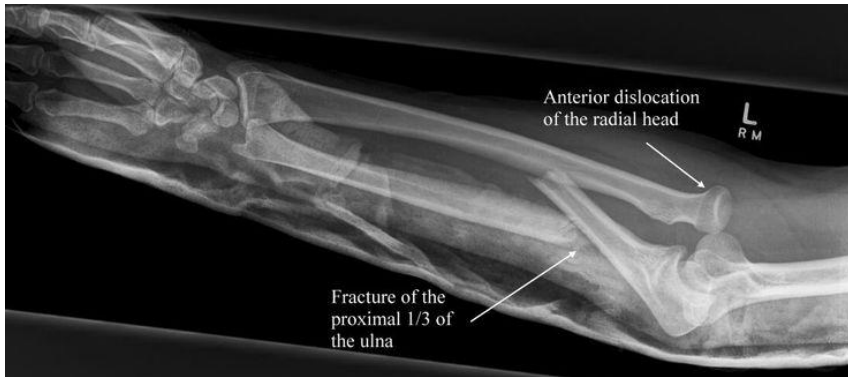
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<http://www.learningradiology.com/caseofweek/caseoftheweekpix2/cow157lg.jpg>

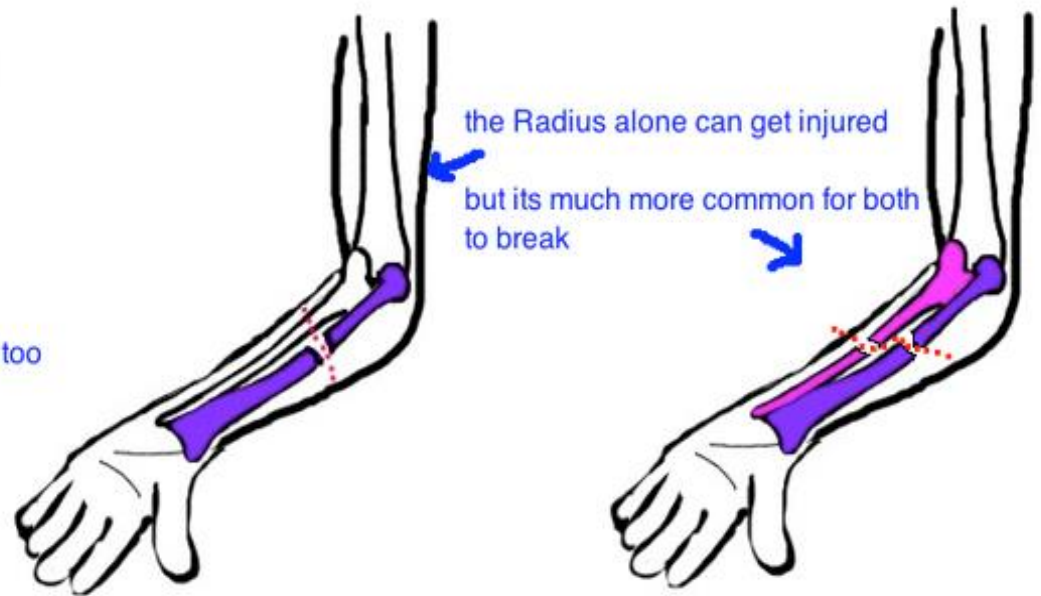
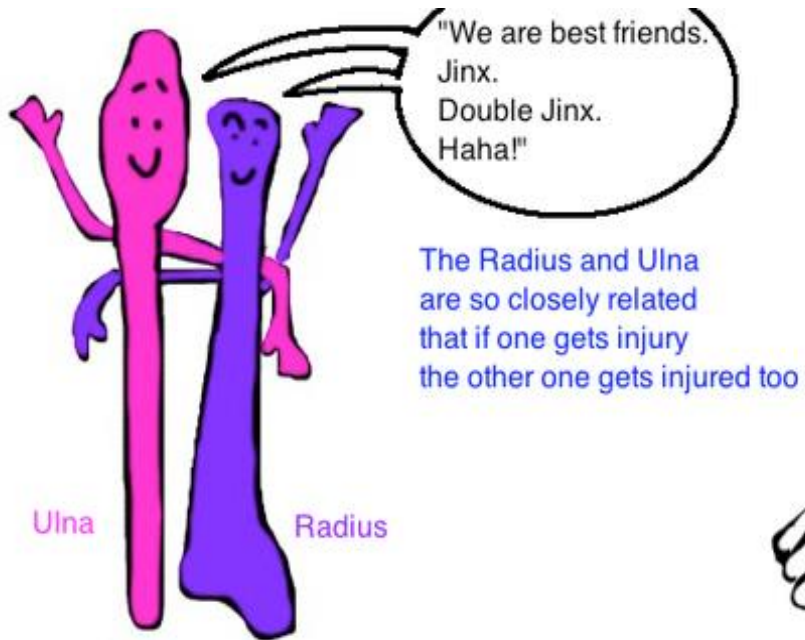
GR



MU



RAD/ULNA



OLECRANON FRACTURE

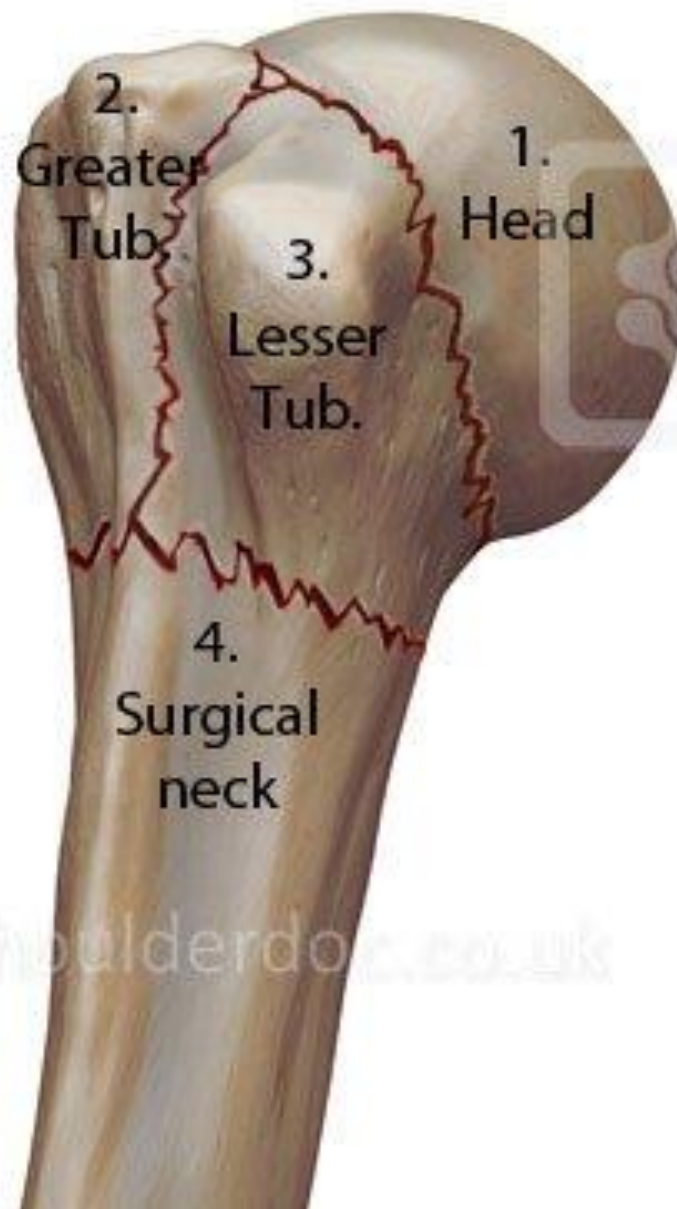
- X-ray
- Olecranon fractures are easy to diagnose provided a lateral x-ray of the elbow is obtained. They appear as a lucency usually reaching the trochlear groove articular surface, and are in most cases displaced.
- Reporting checklist
- Radiology reports should not only include whether or not a fracture is present but also comment on:
 - fracture
 - location, especially whether or not it reaches the articular surface of the trochlear groove
 - displacement and gap distance
 - comminution
 - associated findings and relevant negatives
 - presence of fracture of the coronoid process
 - presence of fracture or dislocation of the radial head
 - presence of fracture of the distal humerus
- Treatment and prognosis
- Due to the unopposed traction of the triceps muscle, these fractures are usually widely displaced and require open reduction and internal fixation (ORIF) 1. Occasionally when undisplaced then non-operative treatment with immobilisation at 30 degrees of flexion is possible 2. Union rates with appropriate treatment are very high (~99%) and other than slight reduction in flexion and extension at the elbow, function is preserved 1-2.
- Unlike many other intra-articular fractures, olecranon fractures result in relatively little secondary osteoarthritic changes, probably on account of most fractures occurring through a relatively non-articular part of the trochlear groove 1.
- Most of the symptoms relate to prominence of hardware given the little overlying soft tissues 1.
- Occasionally ulnar nerve injury can result in long term sensory and motor impairment, most marked in the hand

OLECRANON



HUMERUS



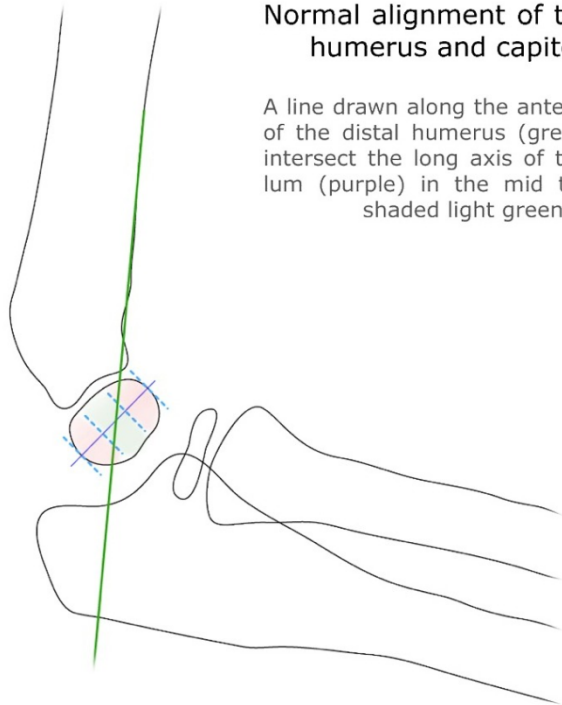


Medial epicondyle fracture



- Treatment depends both of the particulars of the fracture and the patient.
- An undisplaced fracture, particularly in the non-dominant arm of a non-athlete can be treated conservatively (three weeks in an upper arm splint) with good results 2-3.
- Minimally displaced fractures can be treated with either cast immobilisation or an upper arm splint, with a 50% of resulting in a pseudoarthrosis 3.
- Displaced fractures or those occurring in the dominant arm, especially in athletes, need operative management, typically with open reduction and internal fixation with a cannulated screw, which results in rigid fixation permitting early motion 2. Bony union is achieved in 90% of cases 3.
- Comminuted fractures can also be treated by suture fixation 2.
- Fortunately as these injuries involve an apophysis rather than an epiphysis, no growth arrest of the arm occurs, however elbow instability and even recurrent dislocations can result from suboptimal healing 2-3.
- careful assessment of the centers of ossification to ensure they are age appropriate (see CRITOE)
- evidence of elbow dislocation (spontaneous reduction at the time of injury may have occurred)
- coronoid process and radial head fractures (terrible triad of the elbow)

SUPRACONDYLAR



Normal alignment of the distal humerus and capitellum

A line drawn along the anterior border of the distal humerus (green) should intersect the long axis of the capitellum (purple) in the mid third (area shaded light green).



SHAFT HUMERUS FRACTURE



LATERAL EPICONDYLE- rarer



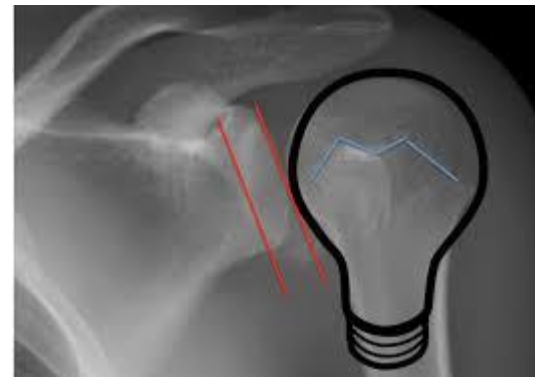
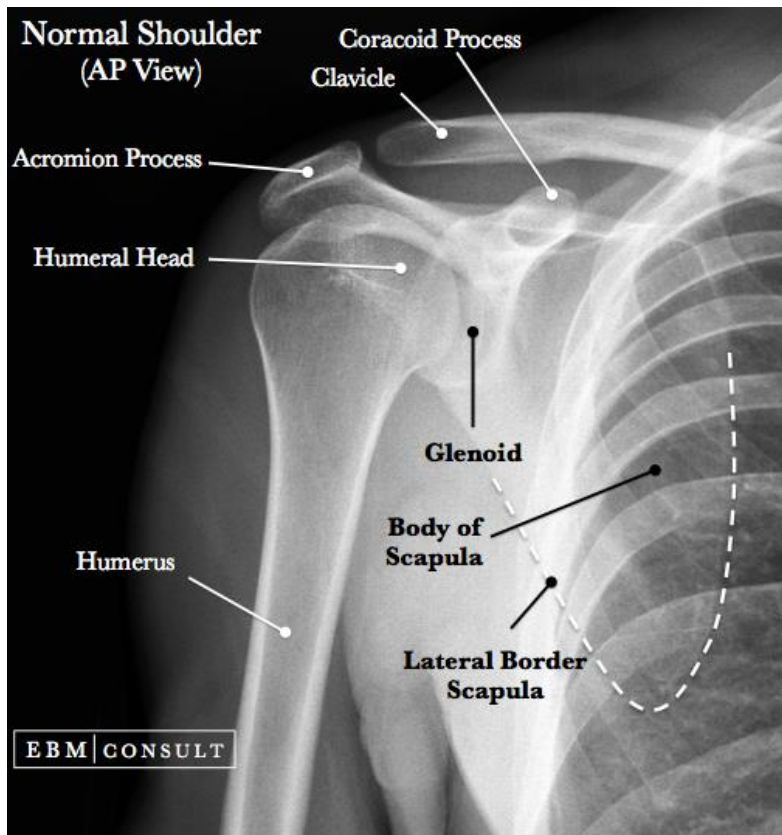
CRITOE



	Ossification Centre	Age of Ossification
C	Capitellum	1
R	Radial Head	3
I	Internal (<i>medial</i>) Epicondyle	5
T	Trochlea	7
O	Olecranon	9
E	External (<i>lateral</i>) Epicondyle	11

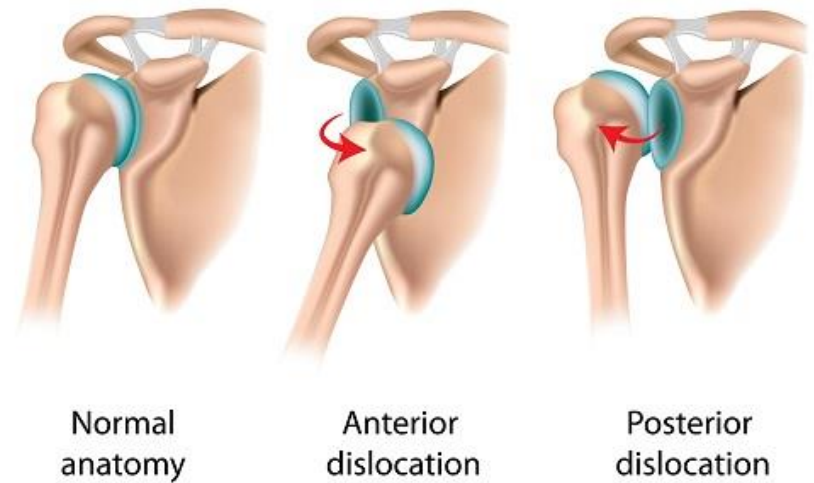
SHOULDER DISLOCATION

LIGHT BULB SIGN- POSTERIOR DISLOCATION



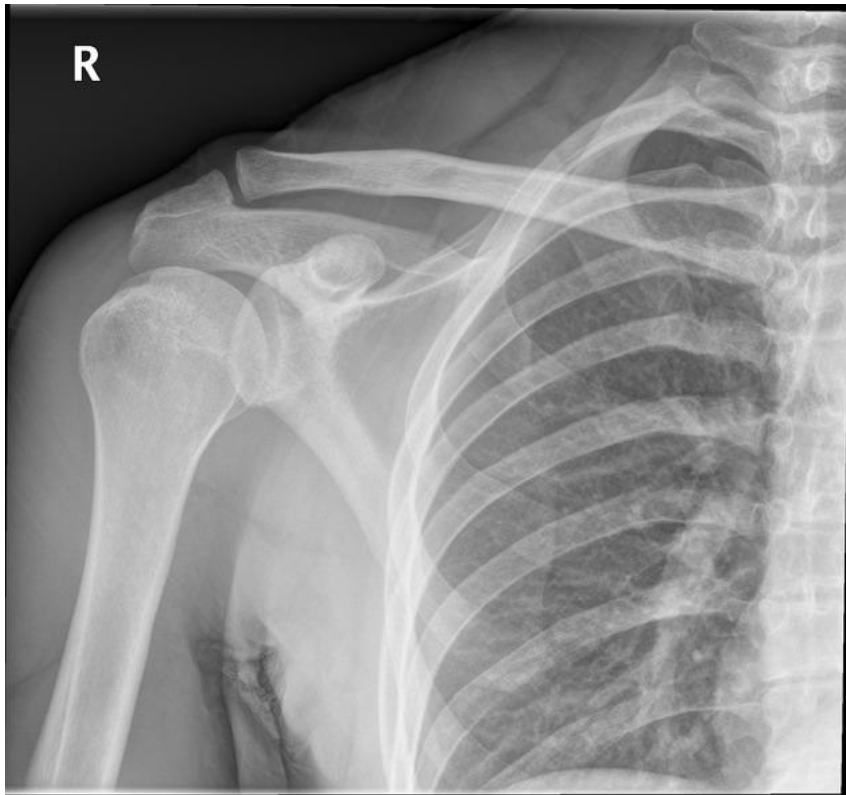


Shoulder Dislocation



NORMAL SHOULDER

FRONTAL AP



LATERAL

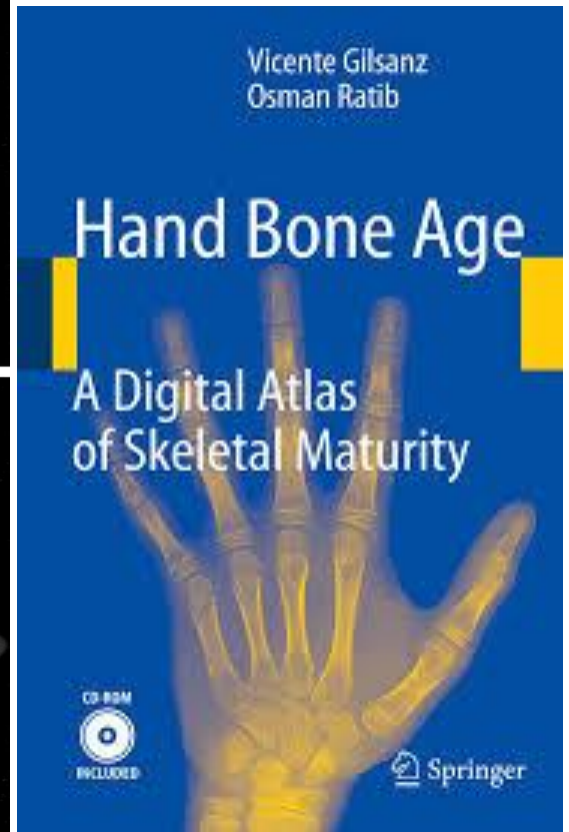


ACROMIOCLAVICULAR INJURY



- Features of acromioclavicular joint injury include 6:
 - soft tissue swelling/stranding
 - may be the only finding in grade I injuries
 - widening of the AC joint
 - normal: 5-8 mm (narrower in the elderly)
 - greater than 2-4 mm asymmetry (compared to radiographs of the contralateral side)
 - increased coracoclavicular (CC) distance
 - normal: 10-13 mm
 - greater than 5 mm asymmetry (compared to radiographs of the contralateral side)
 - superior displacement of the distal clavicle
 - undersurface of the acromion should be level with the under surface of the clavicle

BONE AGE



HEBERDON NODES

Heberden's nodes are hard or bony swellings that can develop in the distal interphalangeal joints (DIP) (the joints closest to the end of the fingers and toes).

O A



Distribution OA vs RA: Hands

OA

- DIPs
- PIPs
- Thumb base
- ✓ CMC
- ✓ STT

Spare

- MCPs
- Rest of the wrist

Hand
PA view



Hand
PA view



RA

- MCPs
- Entire wrist
- ✓ DRUJ

Spare

- DIPs
- PIPs

X
r
a
y

Hallmark X-ray Findings

Erosions \equiv Rheumatoid or Gout



© IPD-ENEL Source Undetermined



© IPD-ENEL Source Undetermined



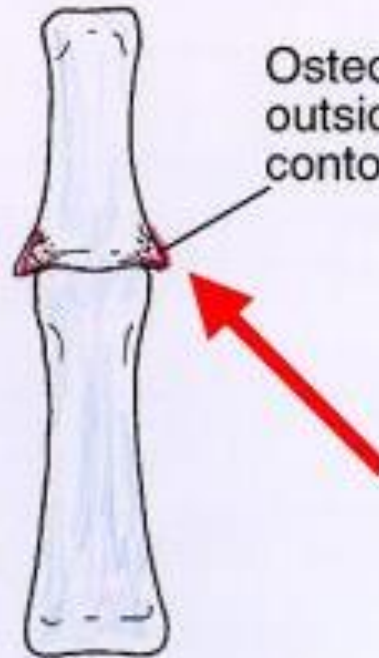
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Periarticular erosion



Rheumatoid arthritis

Osteophytes formed outside normal contour of bone



Osteoarthritis

THANK YOU