

THE ELBOW JOINT X-RAY



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Introduction



Anatomy of the ELBOW joint.



Ossification of Bones.



X ray Projections.



Major Lines in X ray joint.



Fracture Classification.



Common fractures and Dislocations.



Conclusion.

ANATOMY

- ❖ Compound Synovial Joint
- ❖ Distal end of humerus and Proximal end of Radius & Ulna
- ❖ Formed by three joints
 - *Humeroulnar joint (ulna trochlear)*
 - *Humeroradial joint (radio capitellar)*
 - *Proximal radio ulnar joint*
- ❖ Most upper extremity movements involve the elbow & radioulnar joints
- ❖ These two joints are usually grouped together due to close anatomical relationship



DISTAL HUMERUS

The long mid center of the humerus is the body (shaft), and the **humeral condyle** is its expanded distal end.

- ❖ Articular part of the humeral condyle is made up of **trochlear** and the **capitulum**.
- ❖ **Trochlear** is more medial and articulates with the ulna.
- ❖ **Capitulum** is more lateral and will articulate with head of radius.
- ❖ **Lateral epicondyle** is a small projection on lateral aspect of distal humerus.
- ❖ **Medial epicondyle** (larger and more prominent) is located on medial edge of distal humerus.

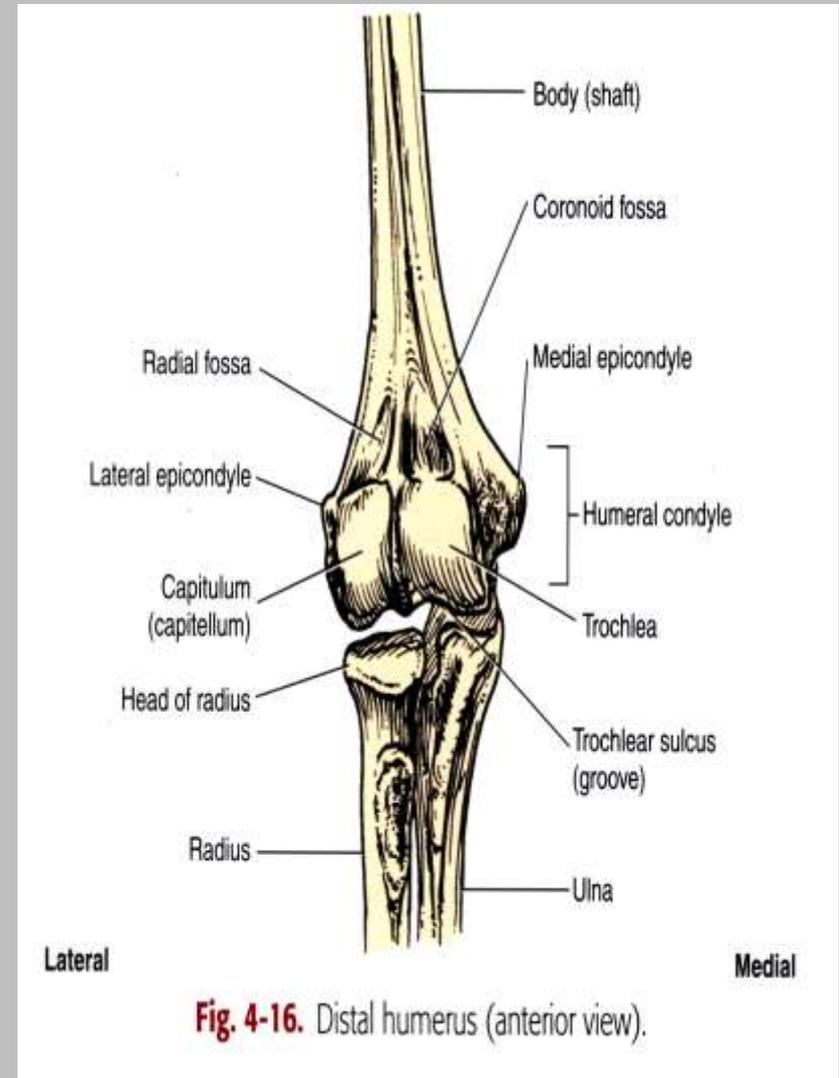
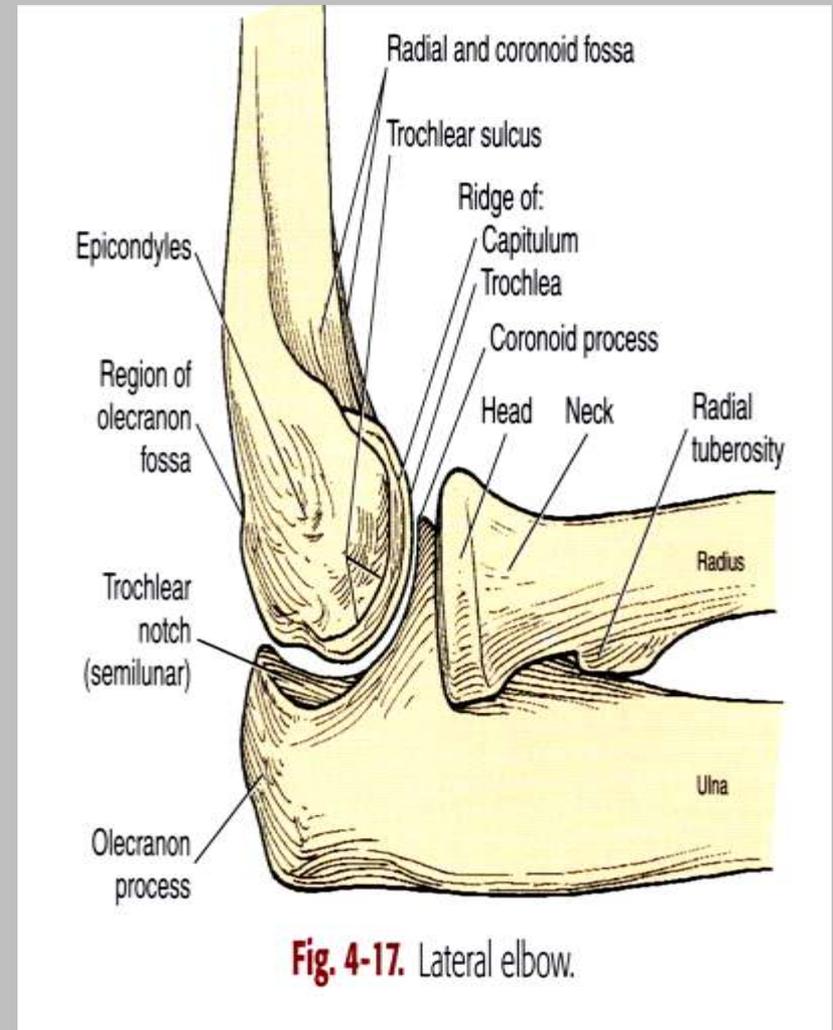


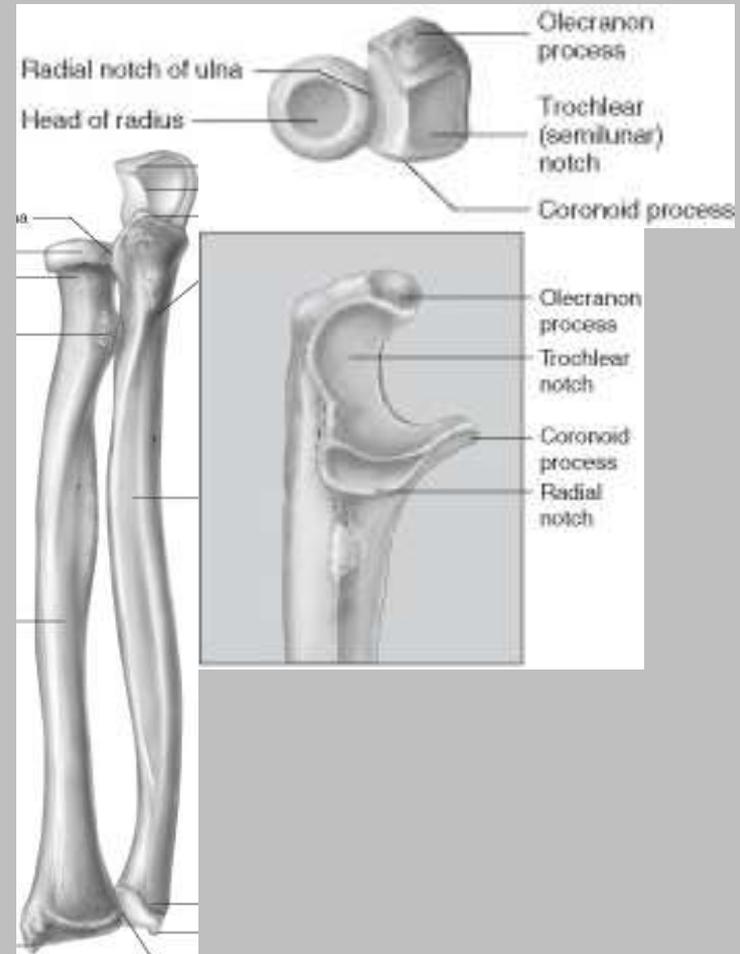
Fig. 4-16. Distal humerus (anterior view).

- ❖ Anterior depressions:
Coronoid fossa and radial fossa.
- ❖ Posterior depression: is the **olecranon fossa.**
- ❖ Lateral view of elbow shows proximal radius and ulna with radial head and neck and radial tuberosity.



JOINTS:

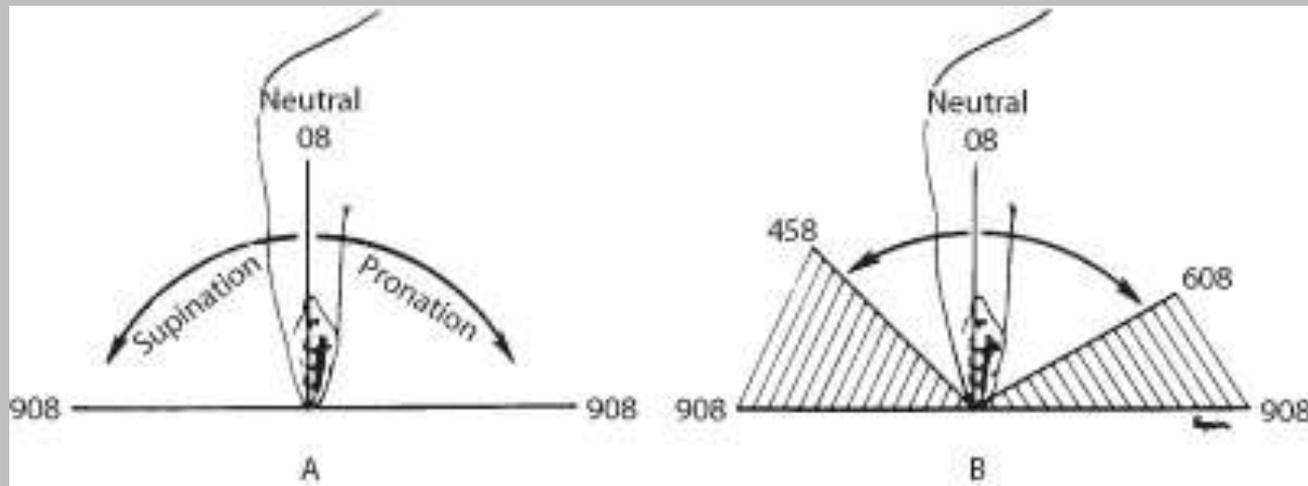
- Radioulnar joint
 - Trochoid or pivot-type joint
 - Radial head rotates around at proximal ulna
 - Distal radius rotates around distal ulna
 - Annular ligament maintains radial head in its joint



Joints

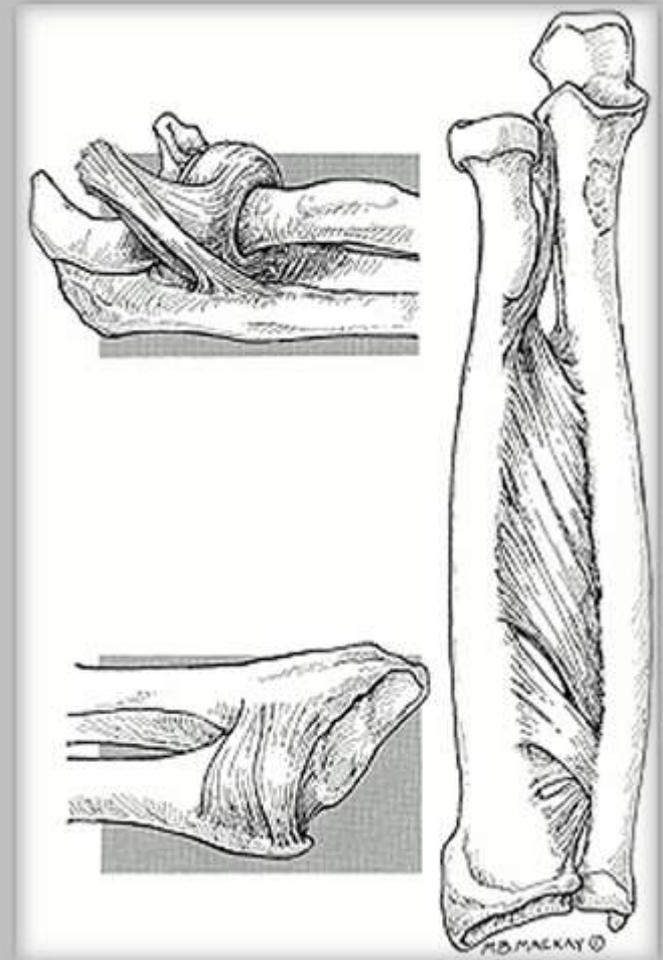
- Radioulnar joint

- Supinate 80 to 90 degrees from neutral
- Pronate 70 to 90 degrees from neutral



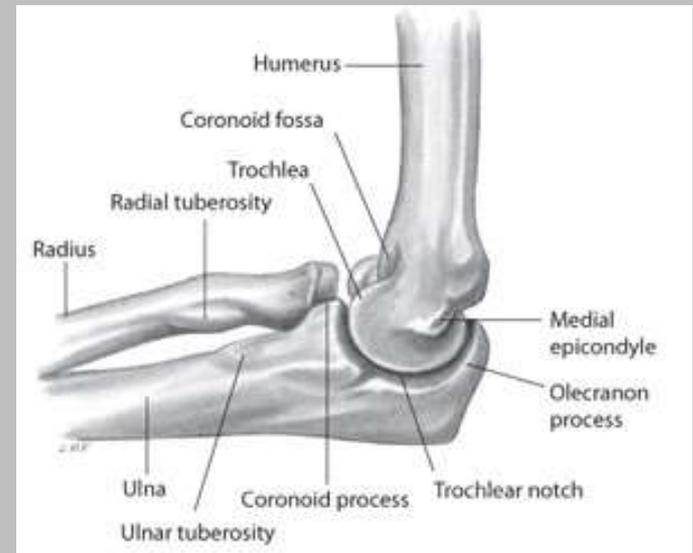
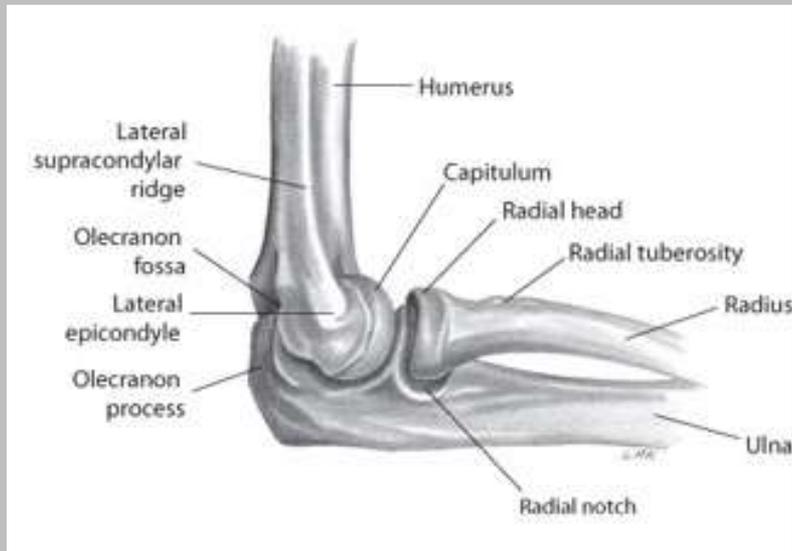
Joints

- Radioulnar joint
 - Joint between shafts of radius & ulna held tightly together between proximal & distal articulations by an interosseus membrane (syndesmosis)



Bones

- Key bony landmarks
 - Medial epicondyle
 - Lateral epicondyle
 - Lateral supracondylar ridge



Bones

- Bony landmarks
 - Medial condyloid ridge
 - Olecranon process
 - Coronoid process
 - Radial tuberosity

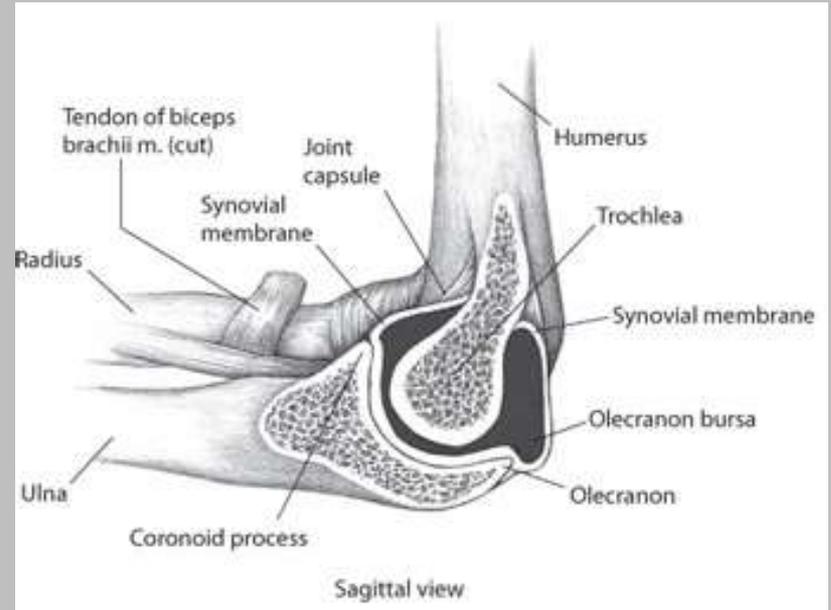


Joints

- Elbow motions
 - primarily involve movement between articular surfaces of humerus & ulna
 - specifically humeral trochlear fitting into ulna trochlear notch
 - radial head has a relatively small amount of contact with capitulum of humerus
 - As elbow reaches full extension, olecranon process is received by olecranon fossa
 - increased joint stability when fully extended

Joints

- As elbow flexes 20 degrees or more, its bony stability is unlocked, allowing for more side-to-side laxity
- Stability in flexion is more dependent on the lateral (radial collateral ligament) & the medial or (ulnar collateral ligament)

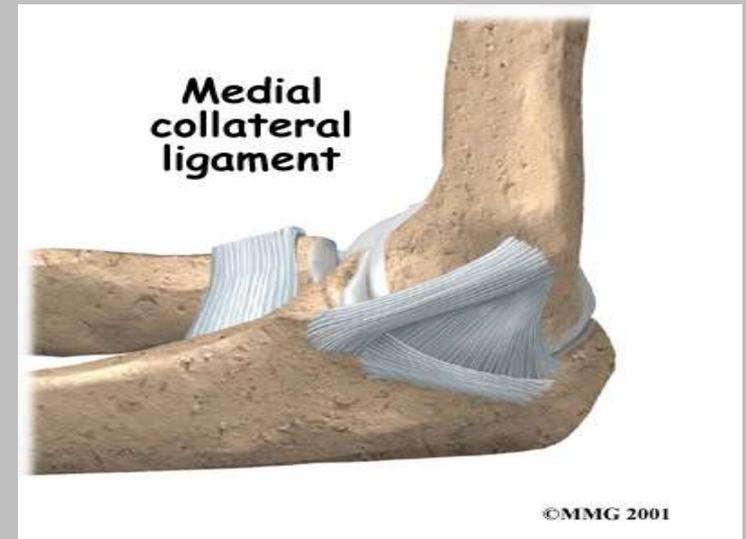
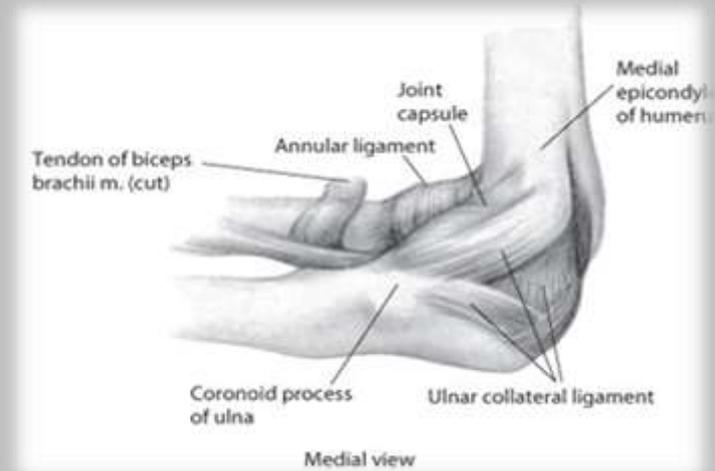


LIGAMENTS OF THE JOINT

- ❖ Stability of joints maintained by ligaments.
 1. **Radial collateral ligament**
 2. **Ulnar collateral ligament :**
 - Anterior bundle
 - Posterior bundle
 - Oblique bundle
 3. **Annular ligament:** that wraps around the radial head and holds it tight against the ulna.

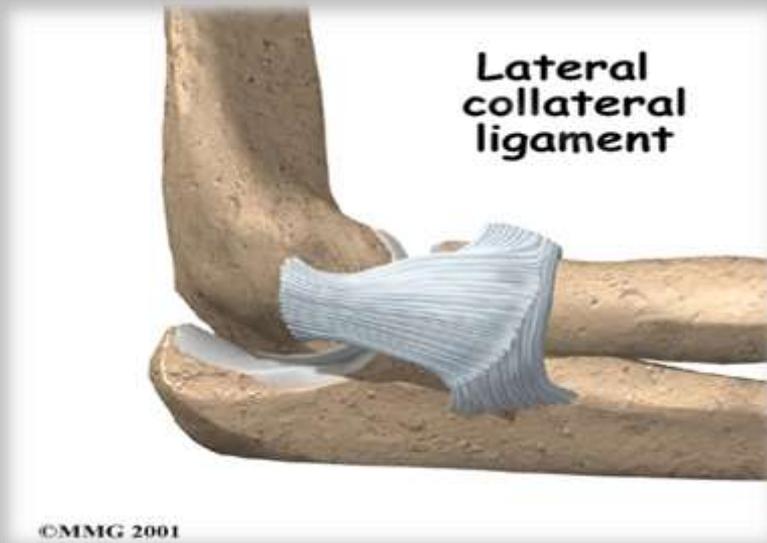
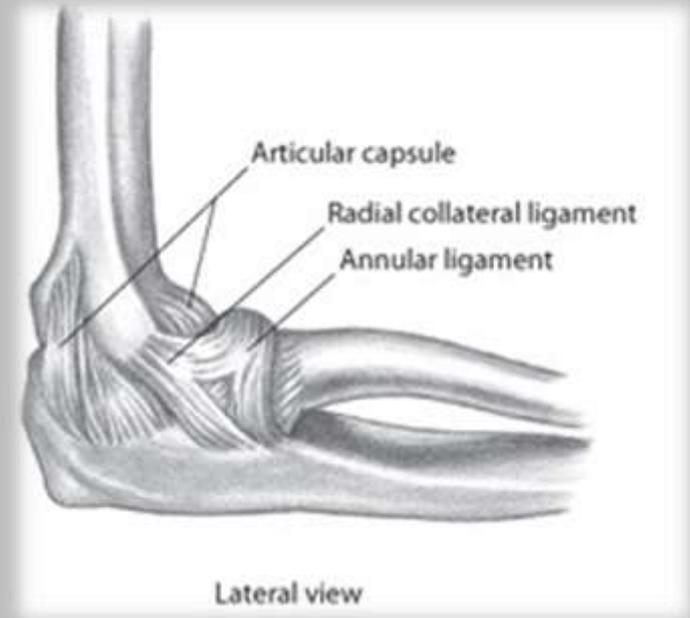
Ulnar Collateral Ligament

- Ulnar collateral ligament is critical in providing medial support to prevent elbow from abducting when stressed in physical activity
 - Many contact sports & throwing activities place stress on medial aspect of joint, resulting in injury



Radial Collateral Ligament

- Radial collateral ligament provides lateral stability & is rarely injured



Annular Ligament

- Annular ligament provides a sling effect around radial head for stability.



Movements

- Flexion
 - Movement of forearm to shoulder by bending the elbow to decrease its angle
- Extension
 - Movement of forearm away from shoulder by straightening the elbow to increase its angle



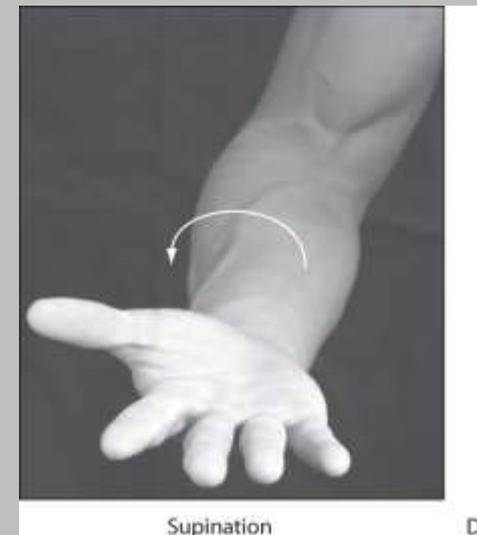
Flexion



Extension

Movements

- Pronation
 - Internal rotary movement of radius on ulna that results in hand moving from palm-up to palm-down position
- Supination
 - External rotary movement of radius on ulna that results in hand moving from palm-down to palm-up position



Muscles

➤ Elbow flexors

- Biceps brachii
- Brachialis
- Brachioradialis
- Weak assistance from Pronator teres

➤ Elbow extensor

- Triceps brachii
- Anconeus provides assistance

• Radioulnar pronators

- Pronator teres
- Pronator quadratus
- Brachioradialis

• Radioulnar supinators

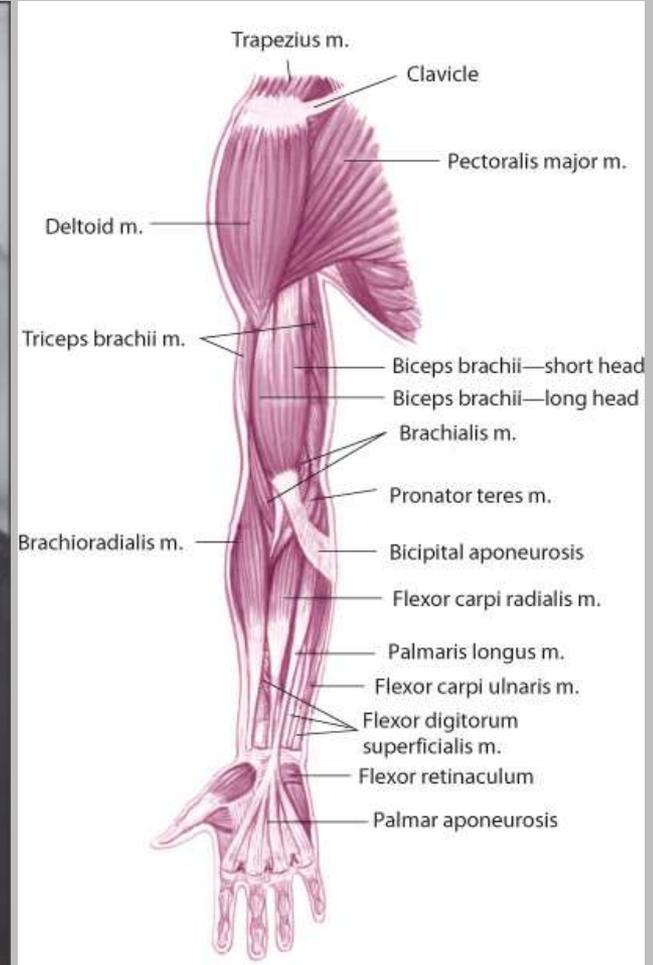
- Biceps brachii
- Supinator muscle
- Brachioradialis

Muscles

❖ Anterior

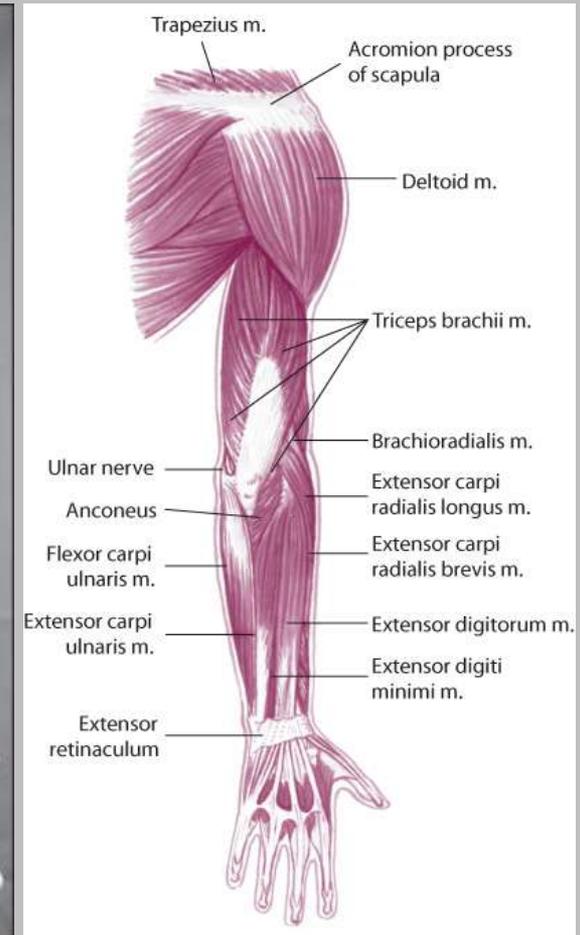
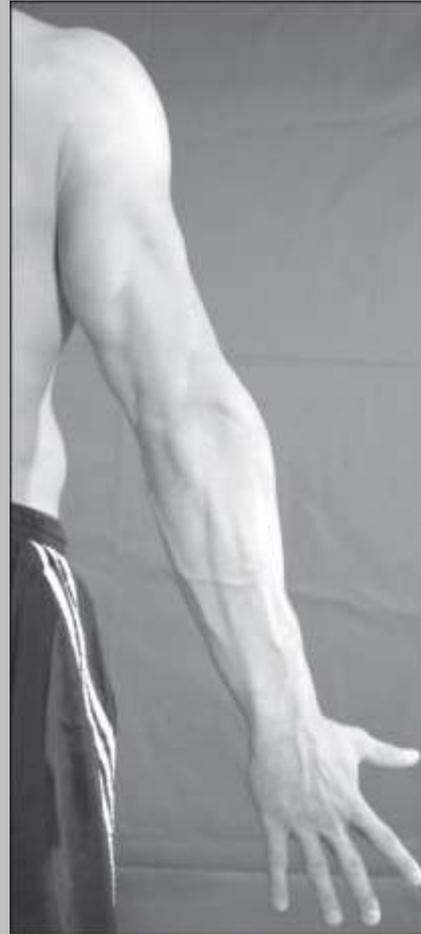
❖ Primarily flexion & pronation

- ❖ Biceps brachii
- ❖ Brachialis
- ❖ Brachioradialis
- ❖ Pronator teres
- ❖ Pronator quadratus



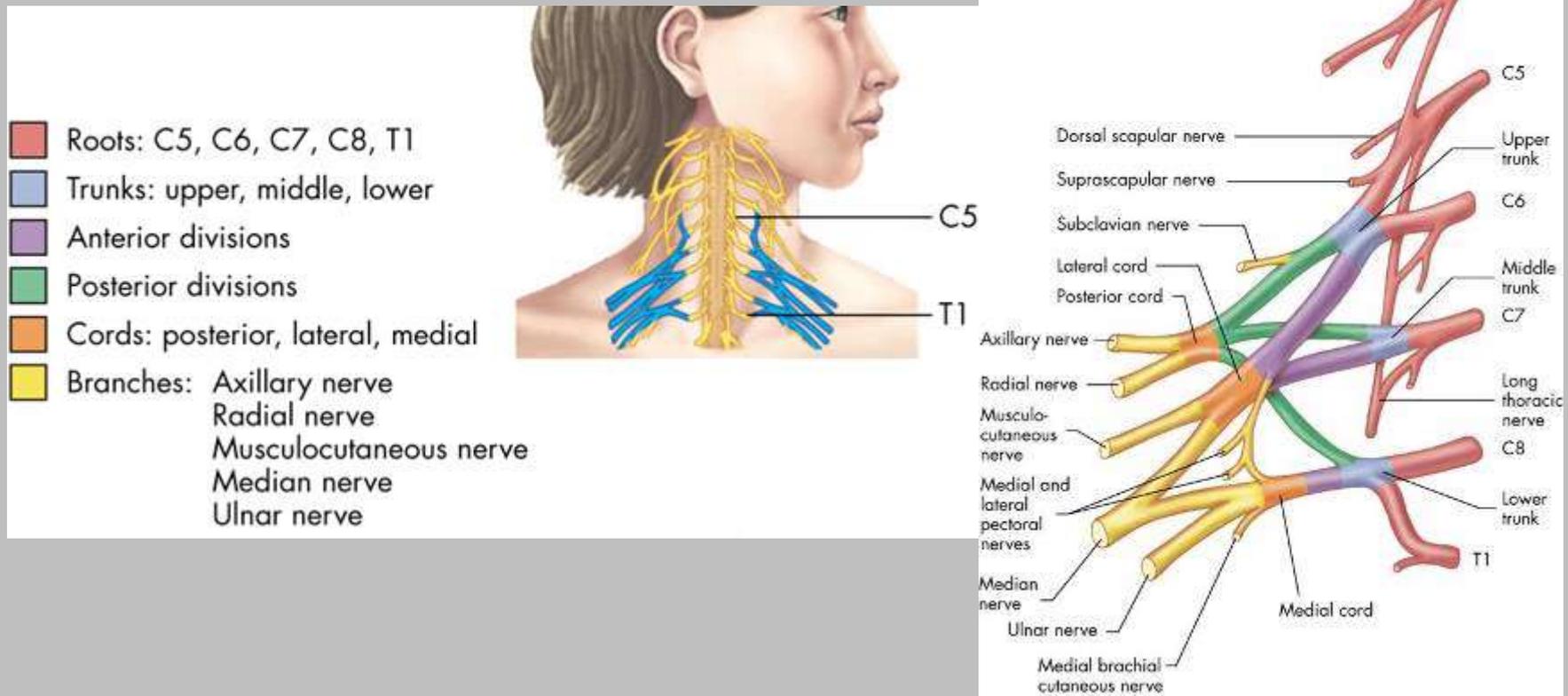
Muscles

- **Posterior**
 - Primarily extension & supination
 - Triceps brachii
 - Anconeus
 - Supinator



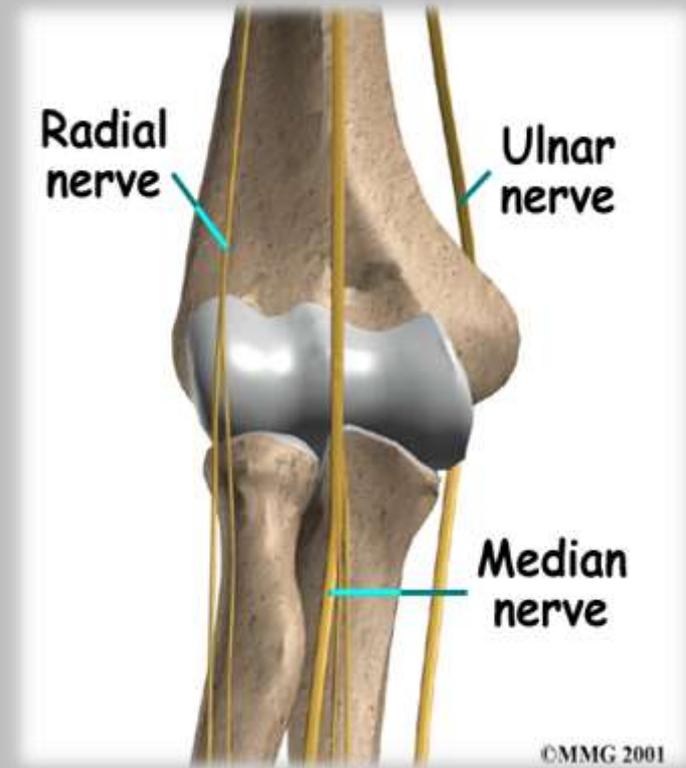
Nerves

- All elbow & radioulnar joints muscles are innervated from median, musculotaneous, & radial nerves of brachial plexus



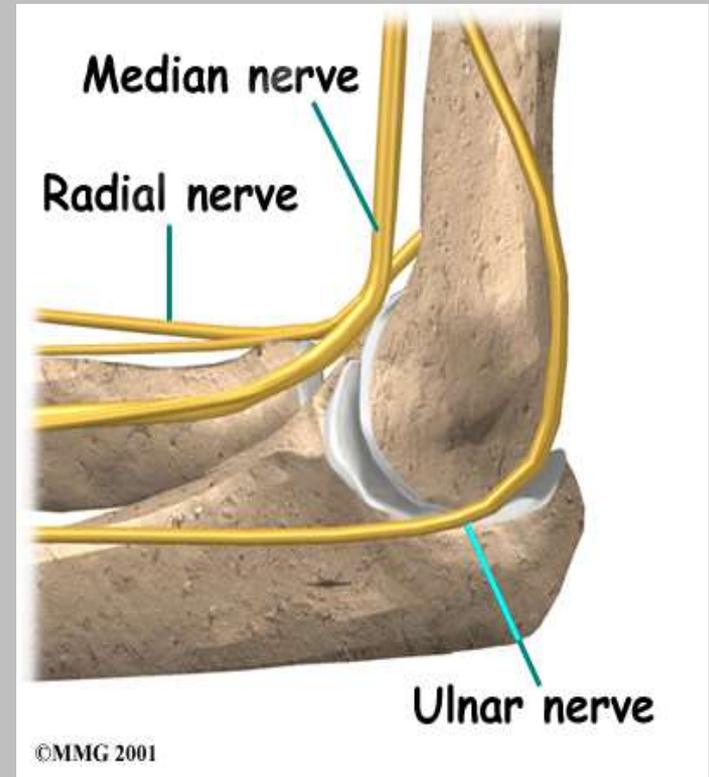
Nerves

- Radial nerve - originates from C5, C6, C7, & C8
 - Triceps brachii
 - Brachioradialis
 - Supinator (posterior interosseous nerve)
 - Anconeus
 - Sensation to posterolateral arm, forearm, & hand



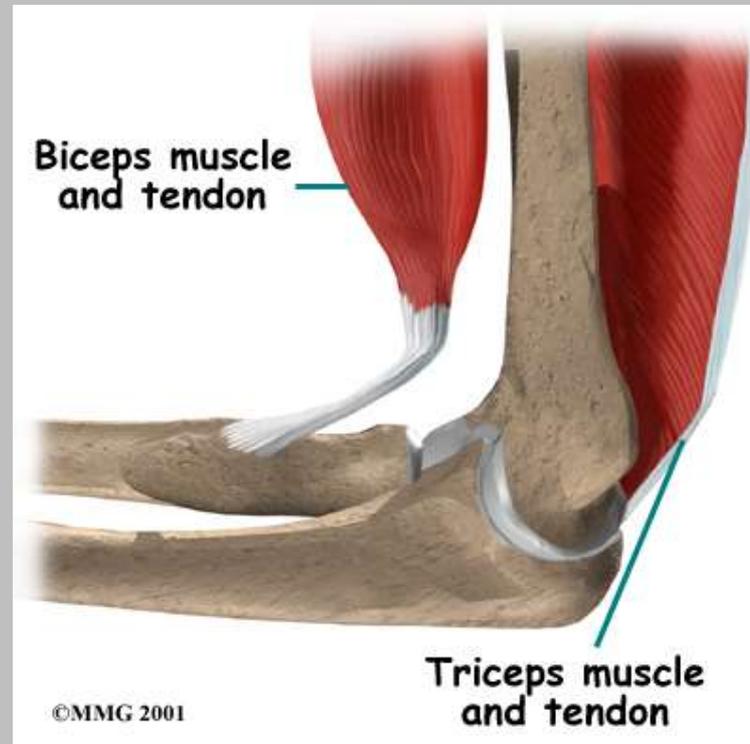
Nerves

- Median nerve - derived from C6 & C7
 - Pronator teres
 - Pronator quadratus (anterior interosseus nerve)
- Musculotaneous nerve - branches from C5 & C6
 - Biceps brachii
 - Brachialis



Tendons:

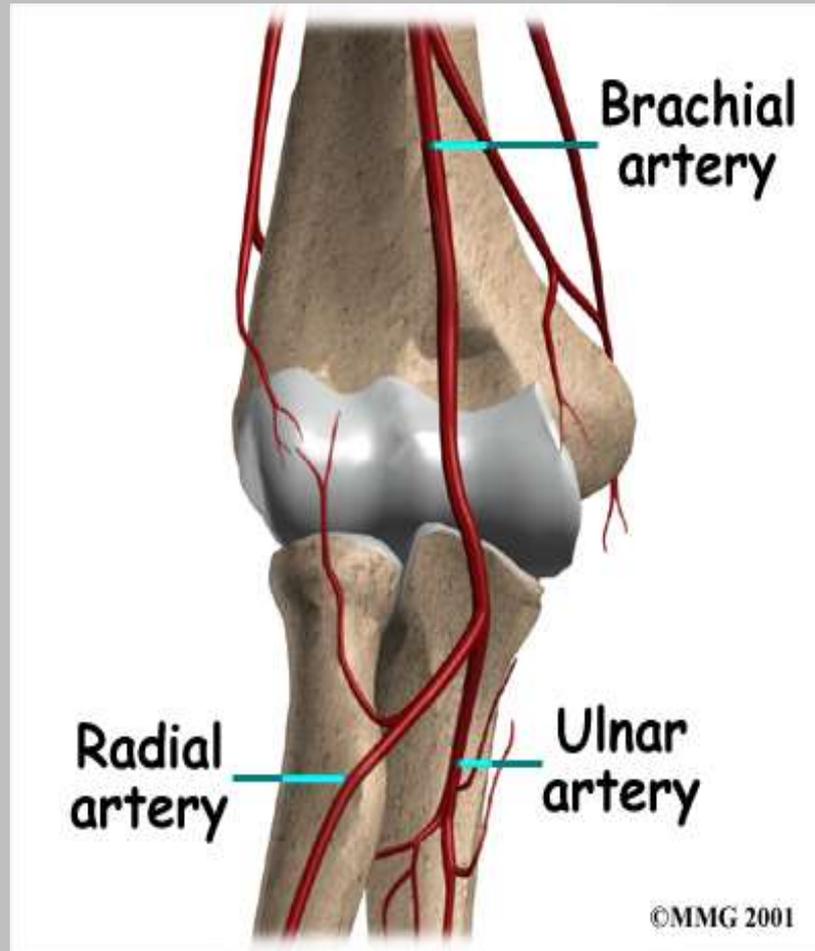
- Biceps tendon anteriorly (allows elbow to flex with force)
- Triceps tendon posteriorly (allows elbow to extend with force)



Capsule:

- The articular surfaces are connected together by a capsule
- Anterior part – from radial and coronoid fossa of humerus to coronoid process of ulna and annular ligament of radius
- Posterior part – from capitulum, olecranon fossa, and lateral epicondyle of humerus to annular ligament of radius, olecranon of ulna, and posterior to radial notch.

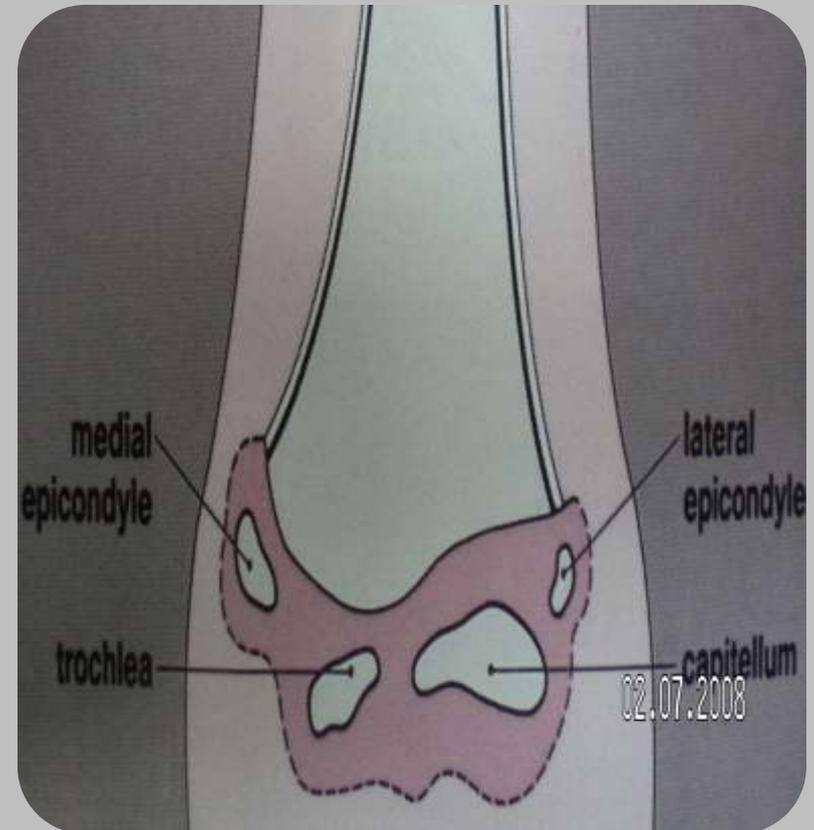
Blood vessels:



Ossification of Bones.

Ossification centre.

- Capitelum - (1-2yrs)
- Medial epicondyle - 4yrs
- Trochlea - 8 yrs
- Lateral epicondyle - 10 yrs



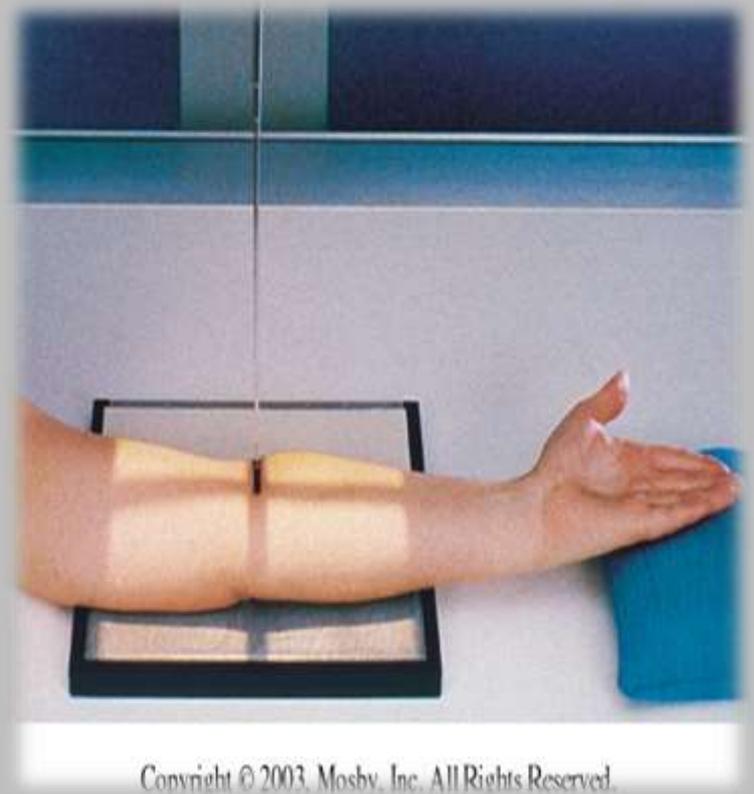
X-RAY PROJECTIONS

TYPES OF PROJECTIONS.

1. LATERAL VIEW
2. ANTERO-POSTERIOR VIEW
3. LATERAL OBLIQUE VIEW
4. MEDIAL OBLIQUE VIEW

ANTERIOR POSTERIOR VIEW

- ***Demonstrates:*** Distal humerus, proximal ulna, proximal radius, and elbow joint.
- ***Measure:*** AP through the elbow at the epicondyles.
- ***kVp:*** 55 (50 to 60).
- ***Film Size:*** 10 × 12 inches (24 × 30 cm)



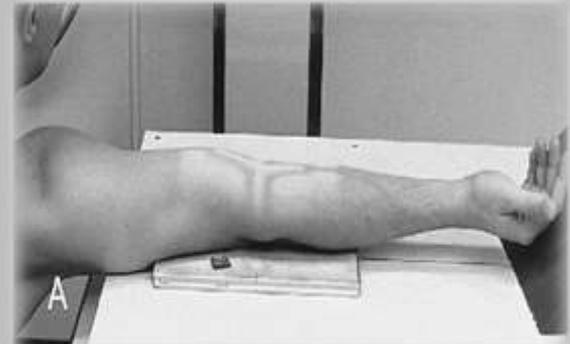
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➤ **Patient Position:** Seated, with body rotated away from the table. Apply a lead half apron for gonad protection.

➤ **Part Position:** Arm fully extended, and the hand supinated. If the elbow cannot be extended, two APs are done, one with the forearm on the film and the second with the humerus on the film.

➤ **CR:** To the elbow, between and 1 inch below the level of the epicondyles.

➤ **Breathing Instructions:** Suspended expiration.





❖ ***Demonstrates:*** Distal humerus, proximal ulna, proximal radius, and elbow joint.

❖ ***Measure:*** At the CR.

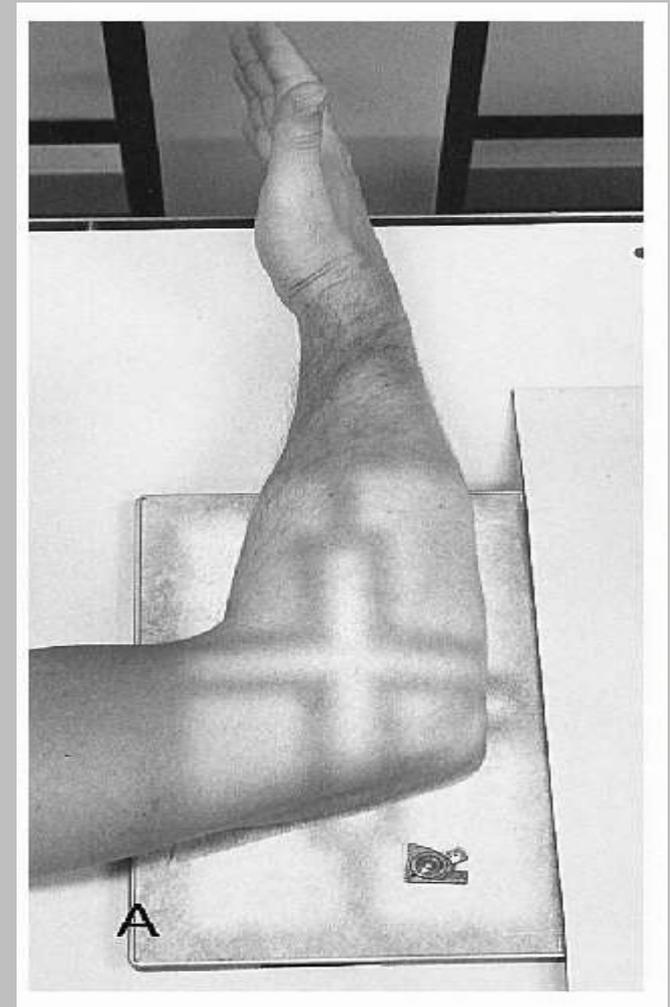
❖ ***kVp:*** 55 (50 to 60).

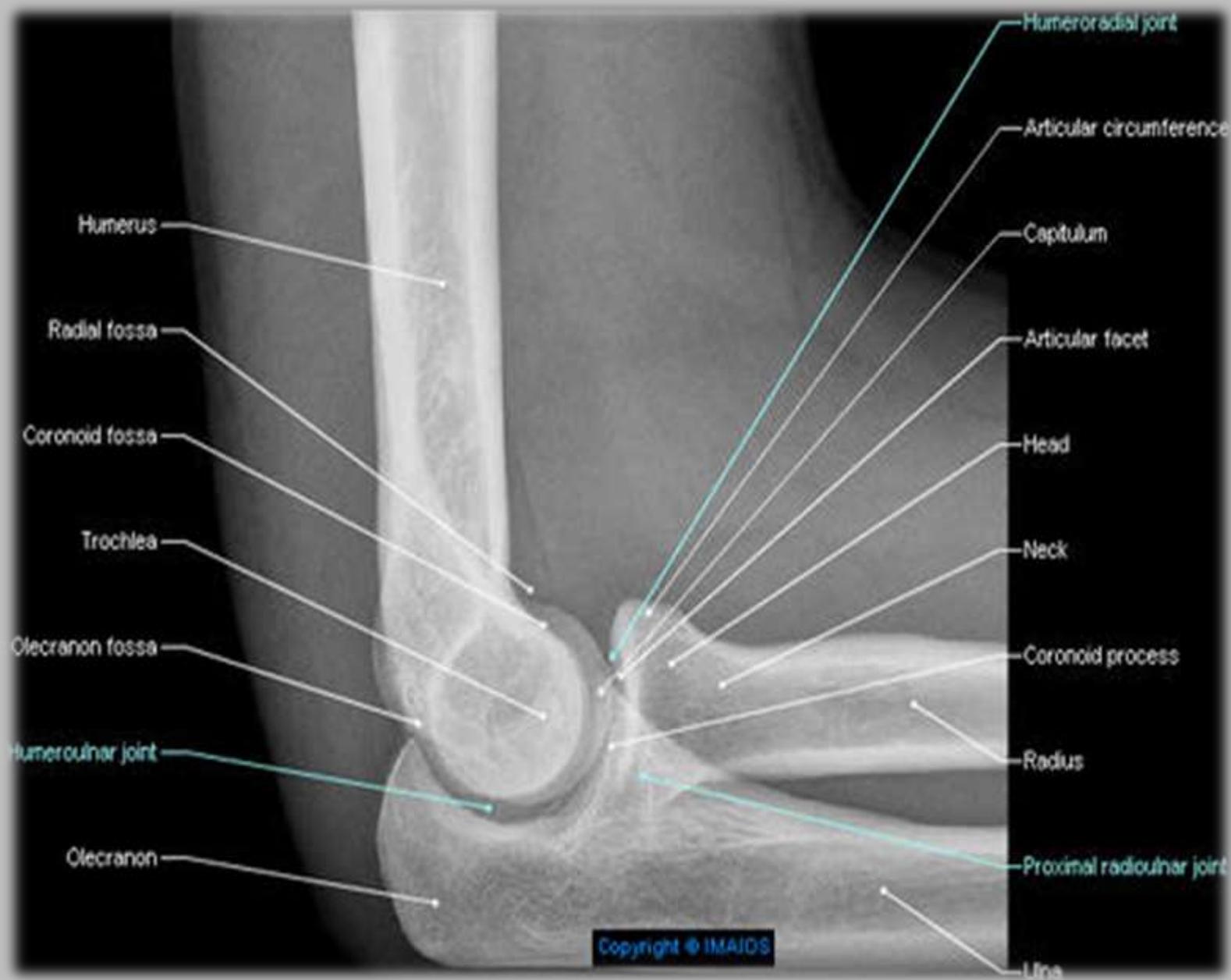
❖ ***Film Size:*** 10 × 12 inches (24 × 30 cm),

LATERAL VIEW



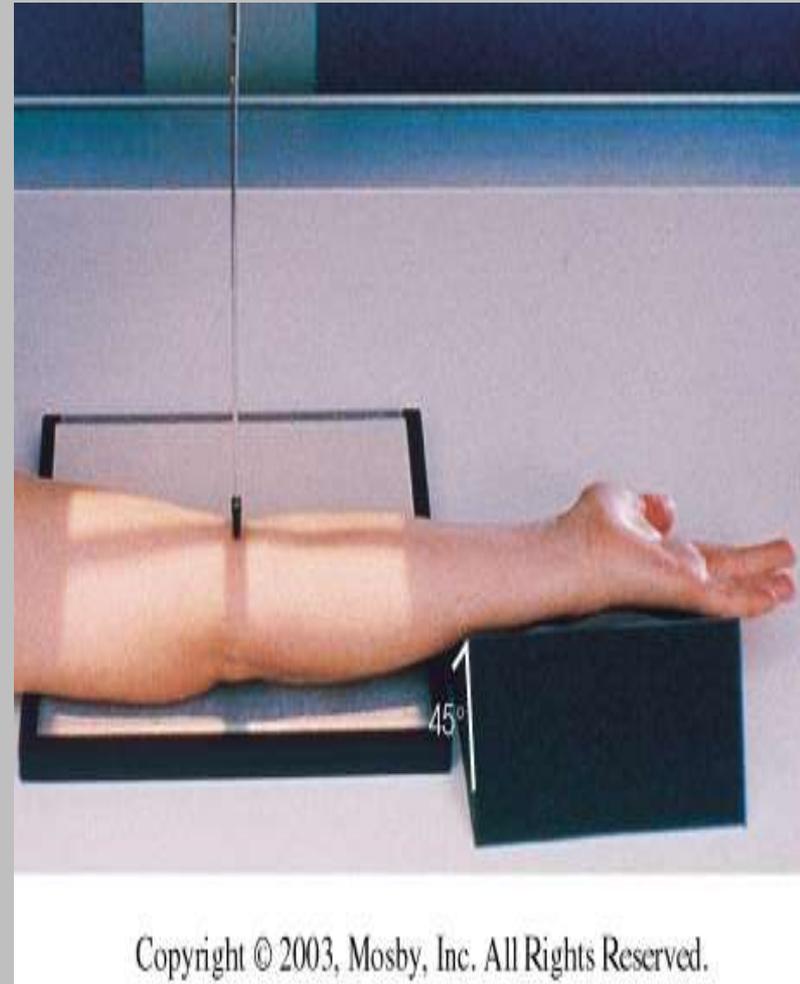
- **Patient Position:** Seated, with the body rotated away from the table. Apply a lead half apron for gonad protection.
- **Part Position:** Elbow flexed to 90° , with the ulnar surface of the forearm flat on the film. The hand is in the true lateral position. The humerus must also be parallel to the film plane, with the shoulder abducted to 90° .
- **CR:** Mid-elbow joint, just anterior to the lateral epicondyle.
- **Breathing Instructions:** Suspended expiration





LATERAL OBLIQUE VIEW

- **POSITIONING OF PATIENT**
- Extend the limb as in AP view
- Center the mid point of cassette to the elbow joint
- Rotate the hand laterally to place the posterior surface of elbow at an angle of 40 degree.
- Central ray perpendicular to elbow joint.
- Demonstrates FRACTURE of lateral epicondyle & radial head.



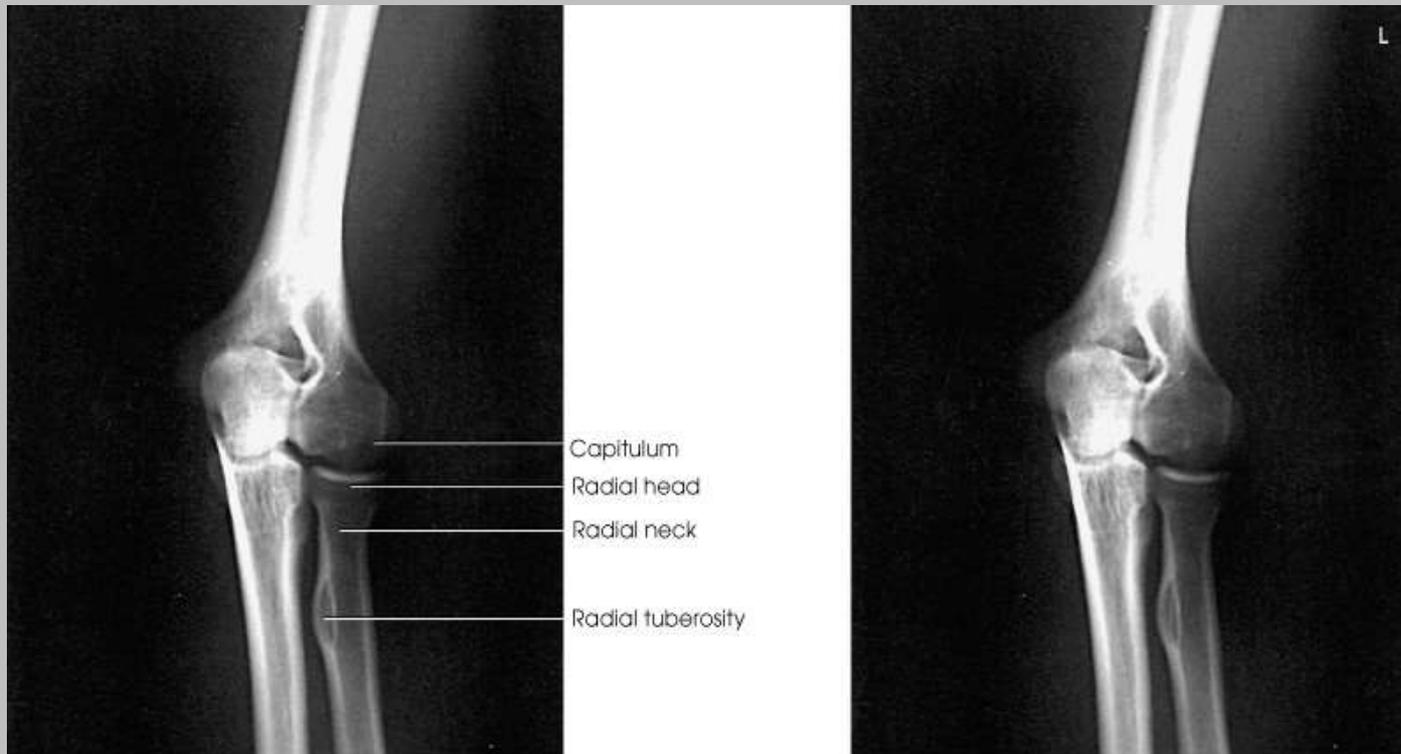
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STRUCTURE SHOWN

- Oblique image of the elbow with radial head free of superimposition of ulna

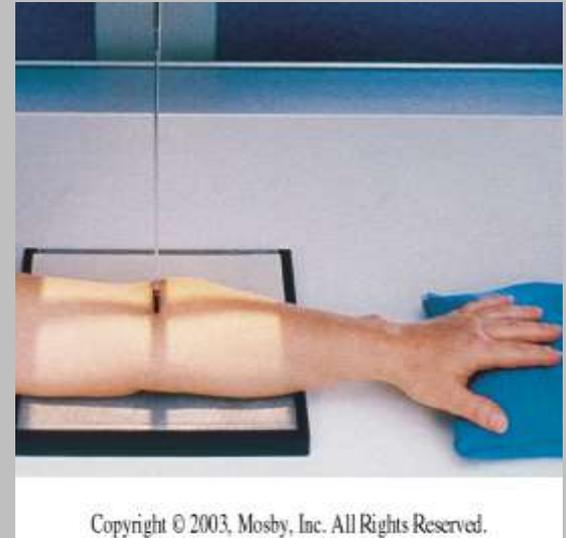
EVALUATION CRITERIA

- Radial head, Neck and tuberosity projected free of ulna
- Elbow joint should be open.



MEDIAL OBLIQUE VIEW

- **Synonyms:** AP Internal Oblique.
- **Demonstrates:** Distal humerus, proximal ulna, proximal radius, and elbow joint.
- **Measure:** At the CR.
- **kVp:** 55 (50 to 60).
- **Film Size:** 10 × 12 inches (24 × 30 cm)

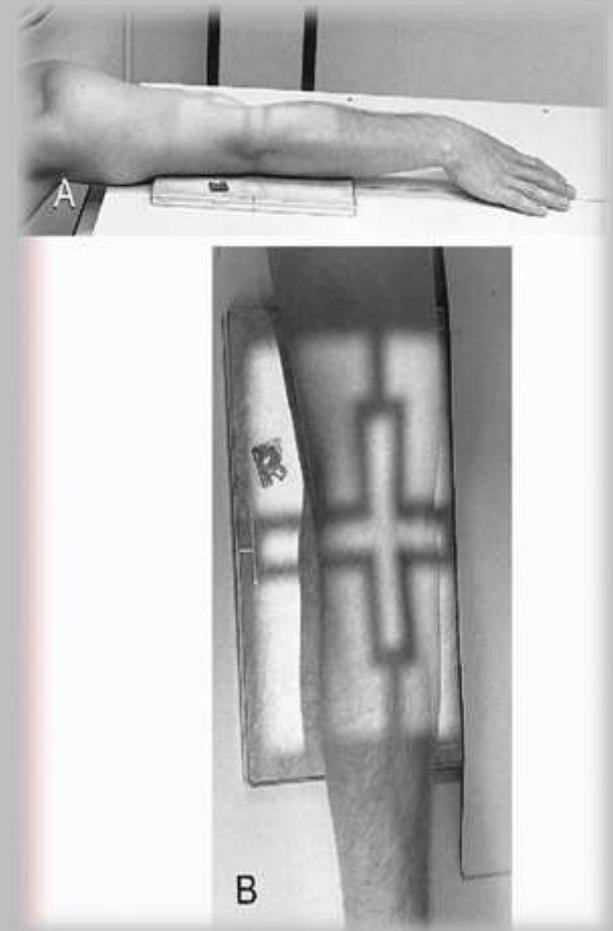


➤ ***Patient Position:*** Seated, with body rotated away from the table. Apply a lead half apron for gonad protection.

➤ ***Part Position:*** Arm fully extended and the forearm pronated.

➤ ***CR:*** 1 inch below the epicondyles.

➤ ***Breathing Instructions:*** Suspended expiration.





1. Shaft of the humerus.
2. Olecranon fossa, humerus.
3. Medial epicondyle, humerus.
4. Lateral epicondyle, humerus.
5. Supracondylar ridge.
6. Olecranon process, ulna.
7. Coronoid process, ulna.
8. Radial head.

**Major Lines in X-ray
joint.**

RADIOLOGICAL ANATOMIC CONSIDERATION

CARRYING ANGLE

- ❖ It is the angle at which the humerus and forearm articulate, with the elbow in full extension, and the palms facing forward.
- ❖ The carrying angle permits the arm to be swung without contacting the hips.

Normal values.

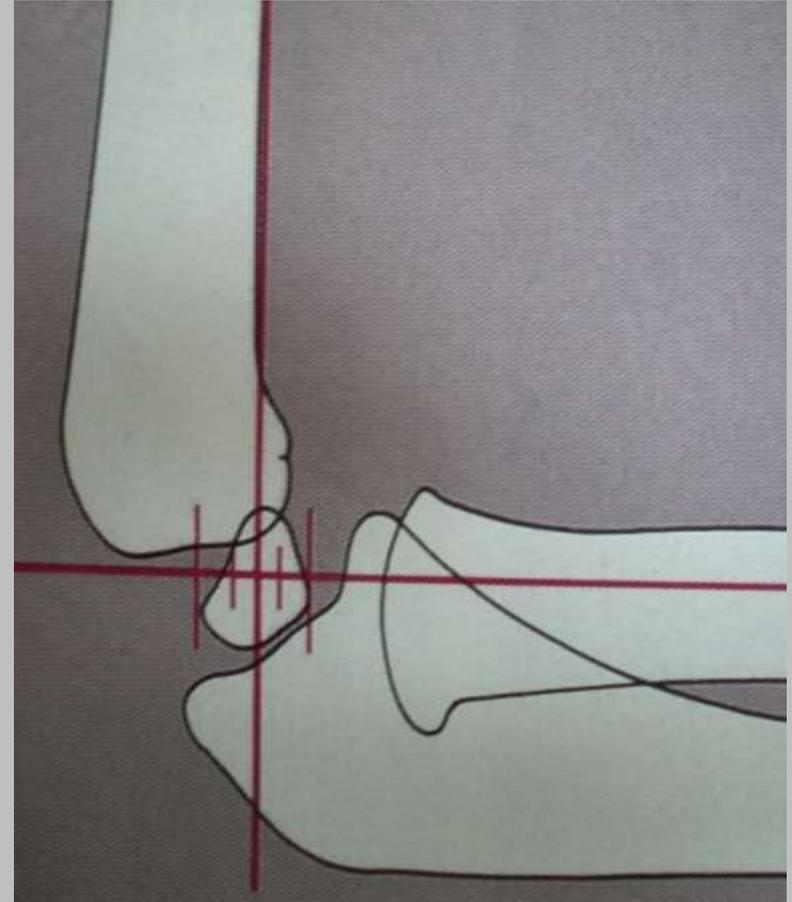
Males=15 deg

Female=20 deg



Land marks

- A line in the longitudinal axis of proximal end of radius passes to the centre of capitulum.
- A line in the Anterior cortex of distal end of humerus passes to the centre of capitulum
- Distruption from this indicates Fracture or Dislocation.



Fracture Classification.

- ❖ Approximately 6% of all fractures and dislocations involve the elbow.
- ❖ The frequency of injury at various sites around the elbow differ between adults and children

ADULTS

CHILDREN

LOCATION	INCIDENCE	LOCATION	INCIDENCE
RADIAL HEAD & NECK	50%	SUPRACONDYLAR	60%
OLECRANON	20%	LATERAL EPICONDYLE	15%
SUPRACONDYLAR	10%	MEDIAL EPICONDYLE	10%
FRACTURES - DISLOCATION	15%		

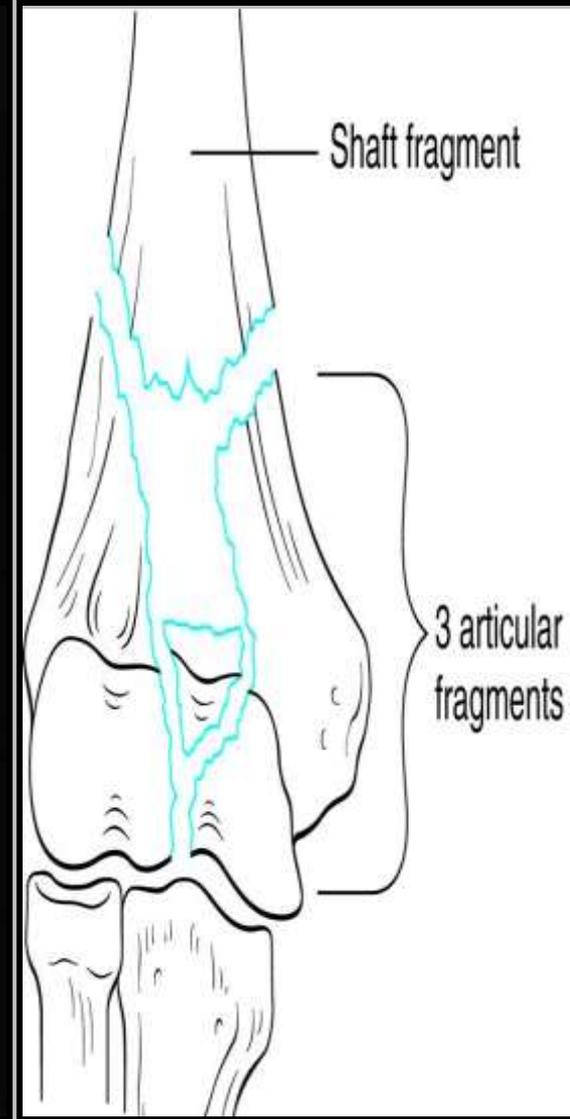
TRAUMA PROTOCOL

- X-ray :
- *AP view & Lateral View*
- *gentle traction x-ray help in: -*
 - *- accurate Diagnosis*
 - *-classification*
 - *- pre-operative planning*

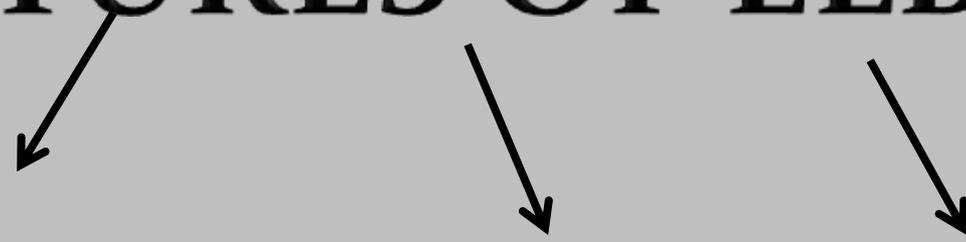
X-ray APV



Gentle traction Xray



FRACTURES OF ELBOW



❖ DISTAL HUMERUS: FRACTURES:

- ❖ SUPRACONDYLAR
- ❖ INTERCONDYLAR
- ❖ CONDYLAR
- ❖ EPICONDYLAR

❖ FRACTURES OF PROXIMAL ULNA:

- ❖ OLECRANON
FRACTURE
- ❖ CORONOID PROCESS
FRACTURE

❖ FRACTURES OF RADIUS:

- ❖ RADIAL HEAD
- ❖ RADIAL NECK

FRACTURES OF THE DISTAL HUMERUS

Extra-articular—Epicondylar, Supracondylar



avulsion of medial and/or lateral epicondyle



simple supracondylar fracture



comminuted supracondylar fracture

Intra-articular—Transcondylar



fracture of trochlea



fracture of capitellum

Intra-articular—Bicondylar, Intercondylar



Y-shaped bicondylar fracture



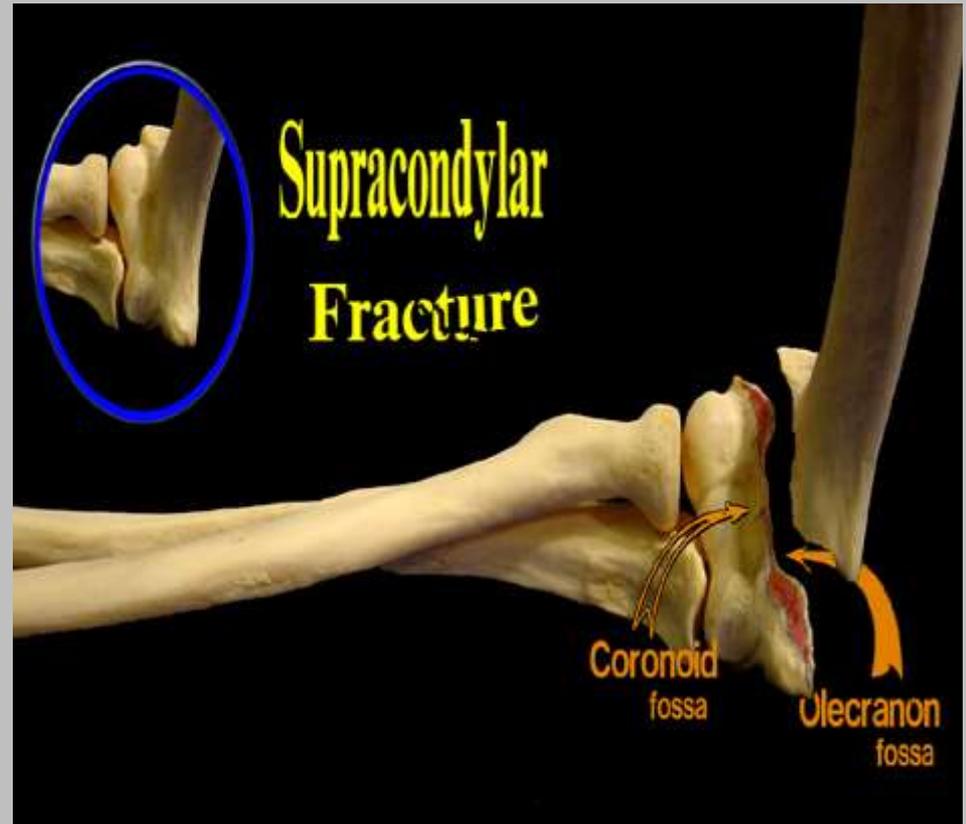
Y-shaped intercondylar fracture with supracondylar comminution



complex comminuted fracture

SUPRACONDYLAR FRACTURE

- ❖ This is the most common fracture to occur around the elbow in children (60%).
- ❖ Usually, the distal fracture fragment displaces posteriorly.



❖ The fracture line extends transversely or obliquely through the distal humerus above the condyles.



Intercondylar Fracture.

- The fracture line extends between the medial and lateral condyles and communicates with the supracondylar region.
- The resultant fracture line may take on a T or Y configuration.
- This type of fracture in adults accounts for at least 50% of distal humerus fractures.



➤ The transverse fracture line that passes through both humeral condyles is called a *transcondylar fracture*.

➤ A comminuted fracture of the distal humerus, usually with associated ulnar and radial fractures, may occur if an object is struck with the elbow protruding from a car window

Condylar Fracture.

- A single condyle may be sheared off owing to an angular force through the elbow.
- Fractures may occur along the articular surfaces of the capitellum and trochlea.
- The convex surface of the capitellum is particularly susceptible to compression and breakage .
- The radial head and capitellum are occasionally fractured simultaneously.



Epicondylar Fracture.

- Separation of the medial epicondyle is a common injury in sports in which strong throwing actions are performed, such as baseball.
- Epicondylar fractures are usually avulsive injuries from traction of the respective common flexor or extensor tendons and collateral ligaments on the medial or lateral epicondyles.



Fracture of capitulum.

- ❖ Mechanism:
- ❖ Head of radius impacted to capitulum → fracture.

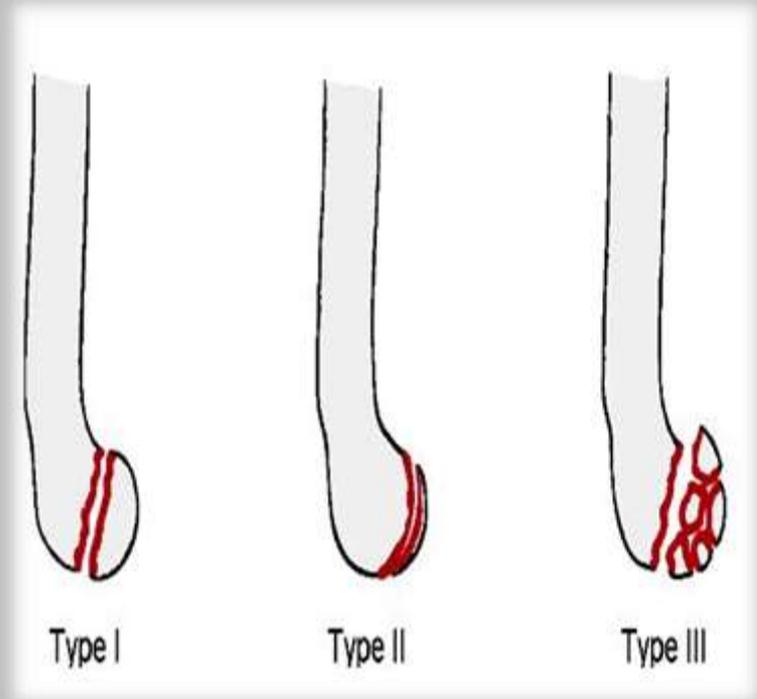


Classification:

❖ **Type I:** large fragment of bone and articular surface (involves trochlea) are fractured.

❖ **Type II:** small shell of bone and articular surface (not involves trochlea).

❖ **Type III:** comminuted fracture.



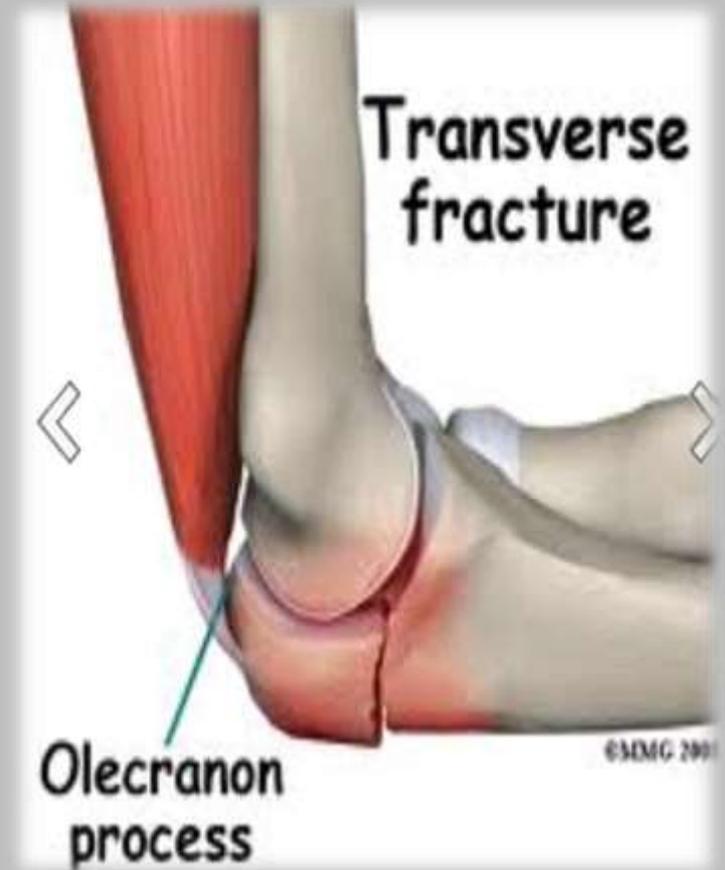
Fracture of capitulum



Fractures of the Proximal Ulna

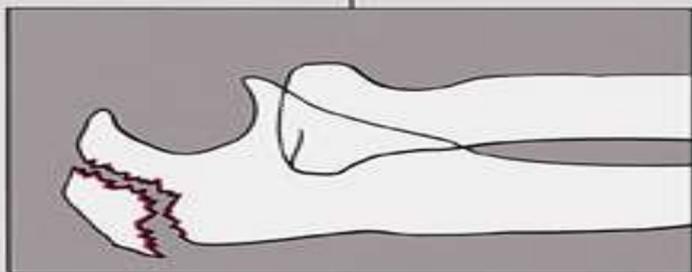
Olecranon fractures

- ❖ **Mechanism Of injury :**
- ❖ **Direct:** fall on the flexed elbow, and this frequently produces comminution and marked displacement of the major fragments
- ❖ **Indirect:** fall on the outstretched arm, produces an oblique or transverse fracture with minimal displacement
- ❖ **Imaging:** Well demonstrated on a lateral projection of the elbow.

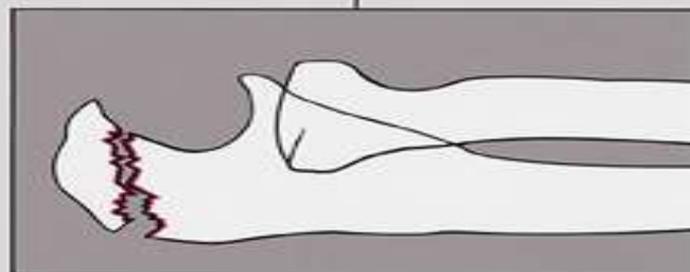


CLASSIFICATION OF OLECRANON FRACTURES

Type I

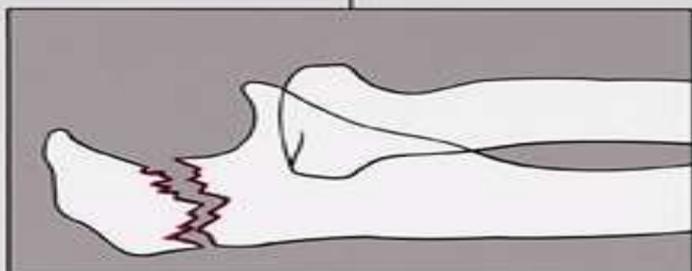


A

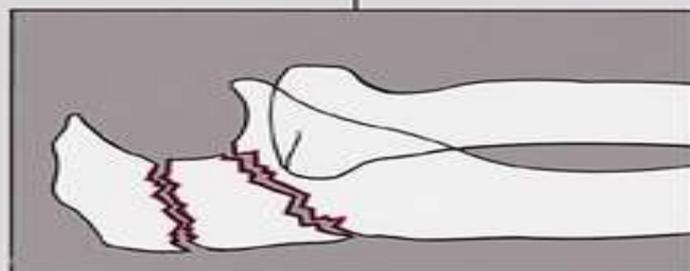


B

Type II

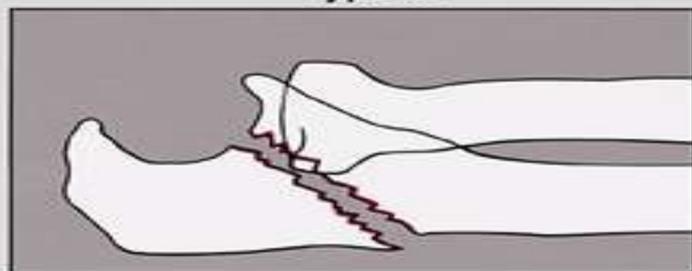


A



B

Type III



Avulsion #: small fragment



Coronoid fracture.

It indicates severe trauma to elbow.

Mechanism of injury:

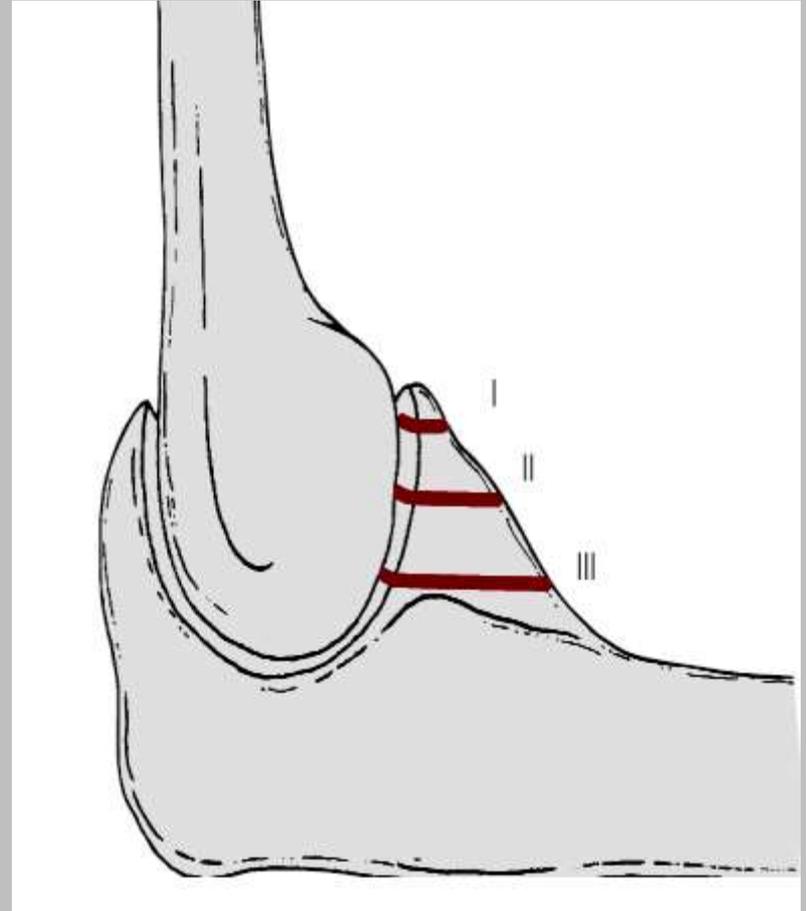
- Striking of trochlea in coronoid.
- avulsion (less common).



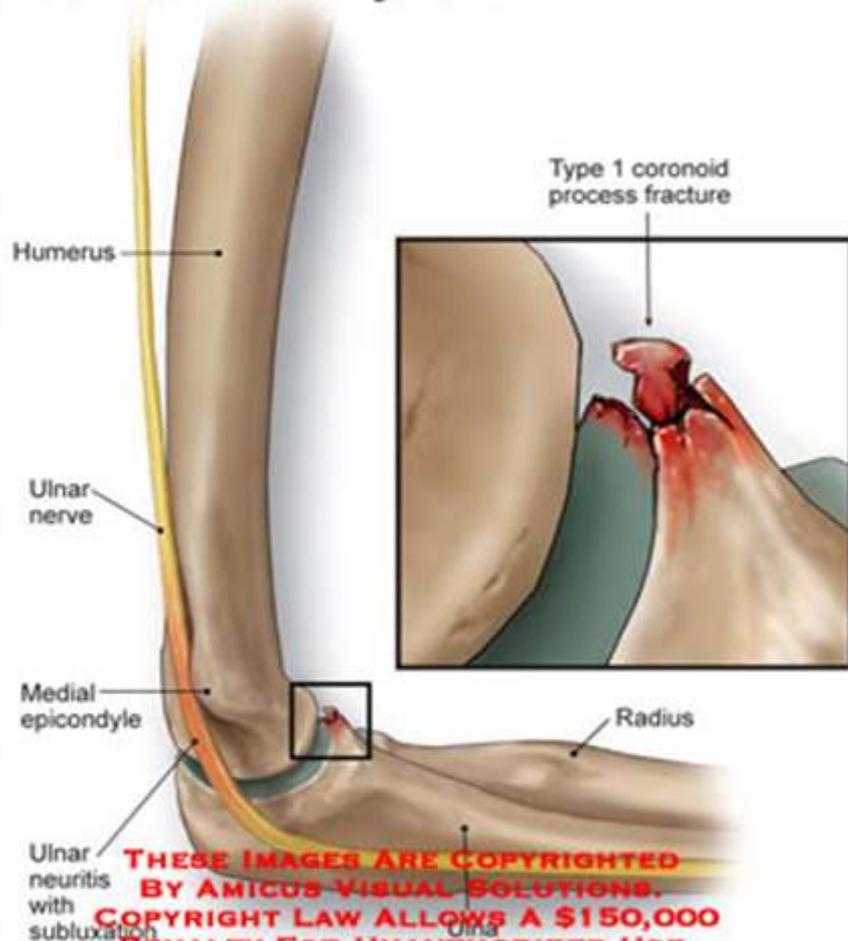
Classification

Classification:

- ❖ Type I: simple avulsion of tip.
- ❖ Type II: involve $<50\%$.
- ❖ Type III :involve $>50\%$.



's Left Elbow Injuries



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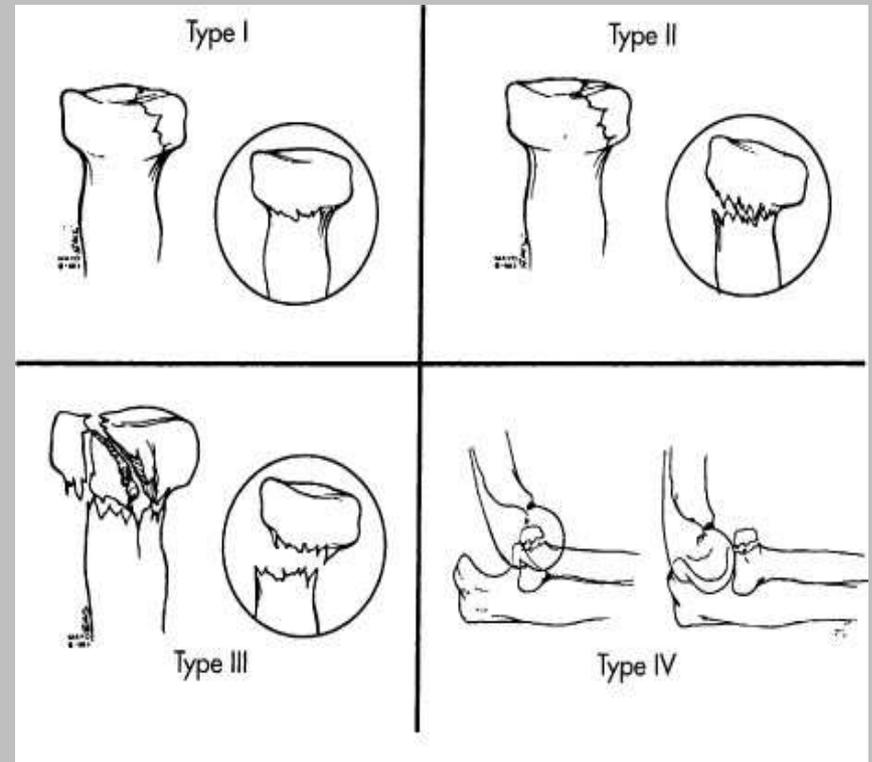
Fracture of radial head

- It is common in adults.
- **Mechanism of Injury:**
 - ❖ F.O.S.H while arm is pronated, head impacted in capitulum.



Fracture of radial head

- **Mason Classification of radial head:**
 - ❖ Type I: undisplaced.
 - ❖ Type II: displaced.
 - ❖ Type III: Comminuted.
 - ❖ Type IV: # associated with posterior elbow dislocation & coronoid fracture.





Radial Neck Fracture

- ❖ The most common radial neck fracture is an impaction at the junction of the head and neck.
- ❖ The only sign may be a sharpened angle on the anterior surface, best depicted on the lateral projection.
- ❖ Complete fractures will be readily seen as a transverse lucent line with varying degrees of displacement.



Anteroposterior View



Lateral View



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Fat-pad sign

- It is the clear depiction of displaced humeral capsular fat pads.
- In the normal elbow a layer of fat (*fat pad*) lies between the synovial and fibrous layers of both the anterior and posterior joint capsule.
- In the lateral projection of the normal elbow, the anterior fat pad is seen as an obliquely oriented radiolucency.



- When acute intracapsular swelling is present from any origin, the anterior fat pad is elevated to be oriented horizontally, and the posterior fat pad becomes visible (fat-pad sign)
- the posterior fat pad, when visible, is the most reliable sign of intra-articular effusion.



Dislocation of elbow joint.

- Form 20% of joint dislocation (after shoulder & finger)
- classification: posterior [most common 80%]
 - ant. - med. - lat. - divergent. [rare].

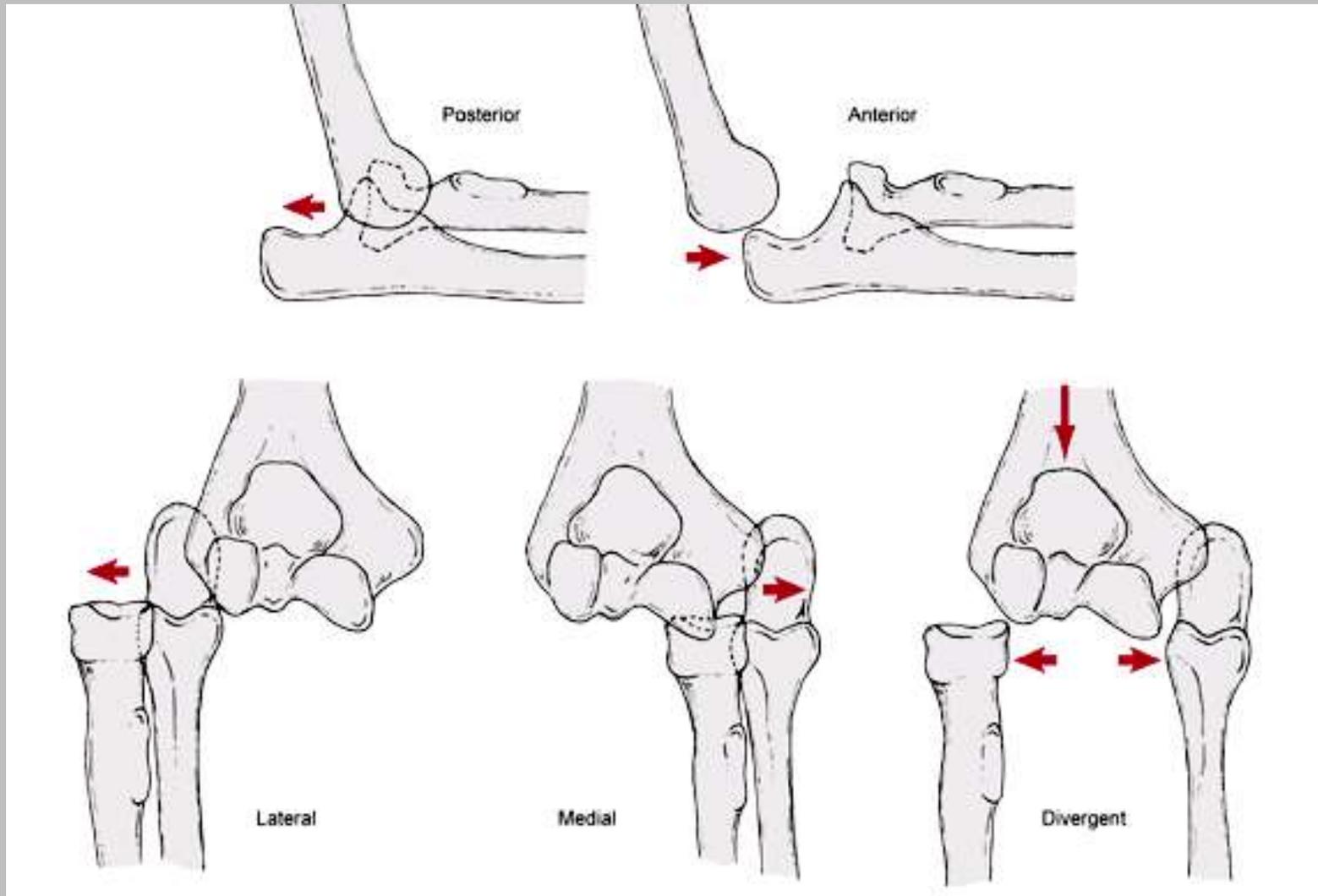
posterior or post.lat. dislocation :

mech of injury. : FOSH while elbow extended.

Diagnosis: -Clinically it may be associated with neurovascular injury

(median & ulnar n. & brachial artery.)

Classification Of Dislocation.



Posterior elbow dislocation.



Tennis Elbow

- “Tennis elbow” - common problem usually involving extensor digitorum muscle near its origin on lateral epicondyle
 - known lateral epicondylitis
 - associated with gripping & lifting activities

Medial Epicondylitis

- Somewhat less common
- Also known as golfer's elbow
- Associated with medial wrist flexor & pronator group near their origin on medial epicondyle.
- Involves muscles which cross elbow but act primarily on wrist & hand

THE END

