ELBOW COMPLEX

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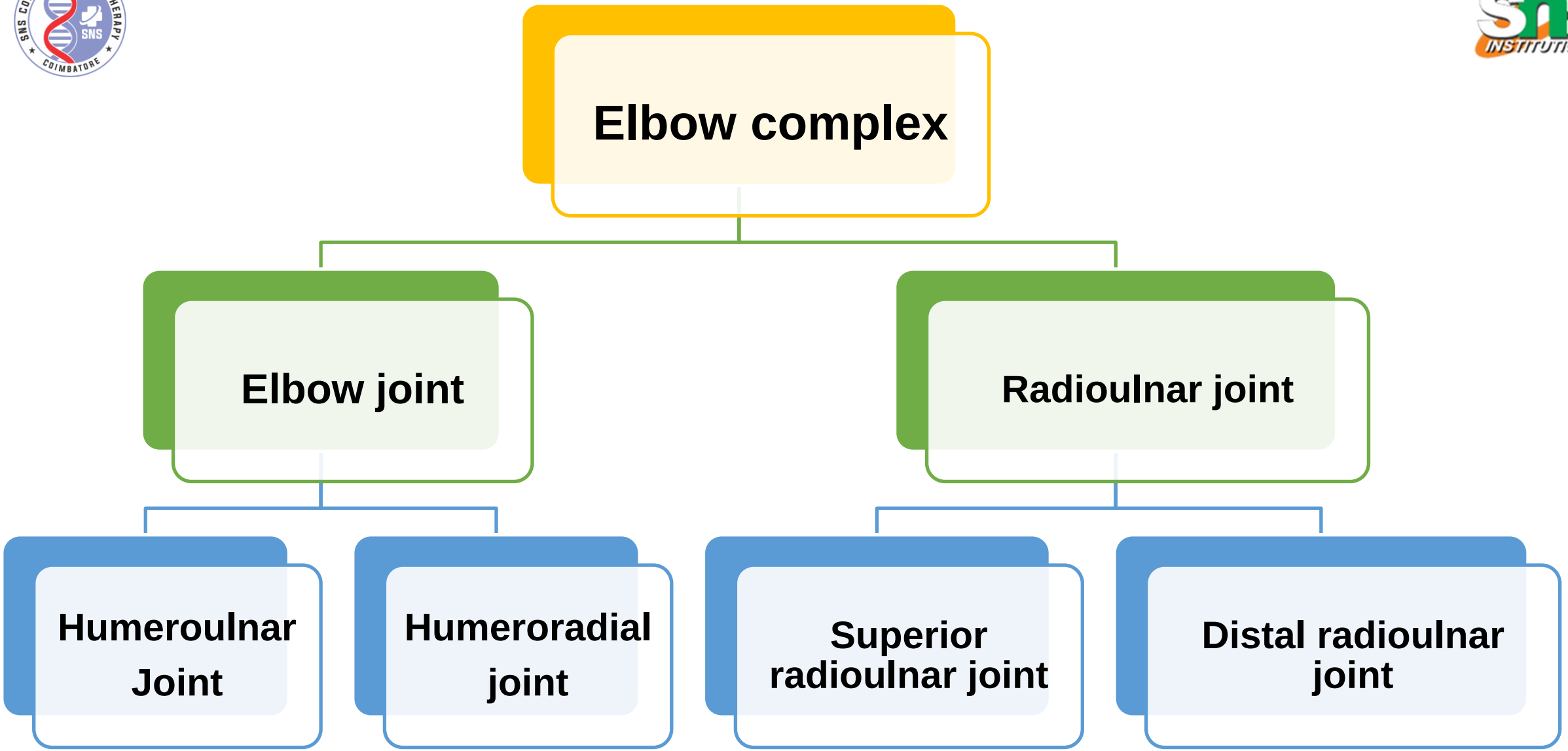
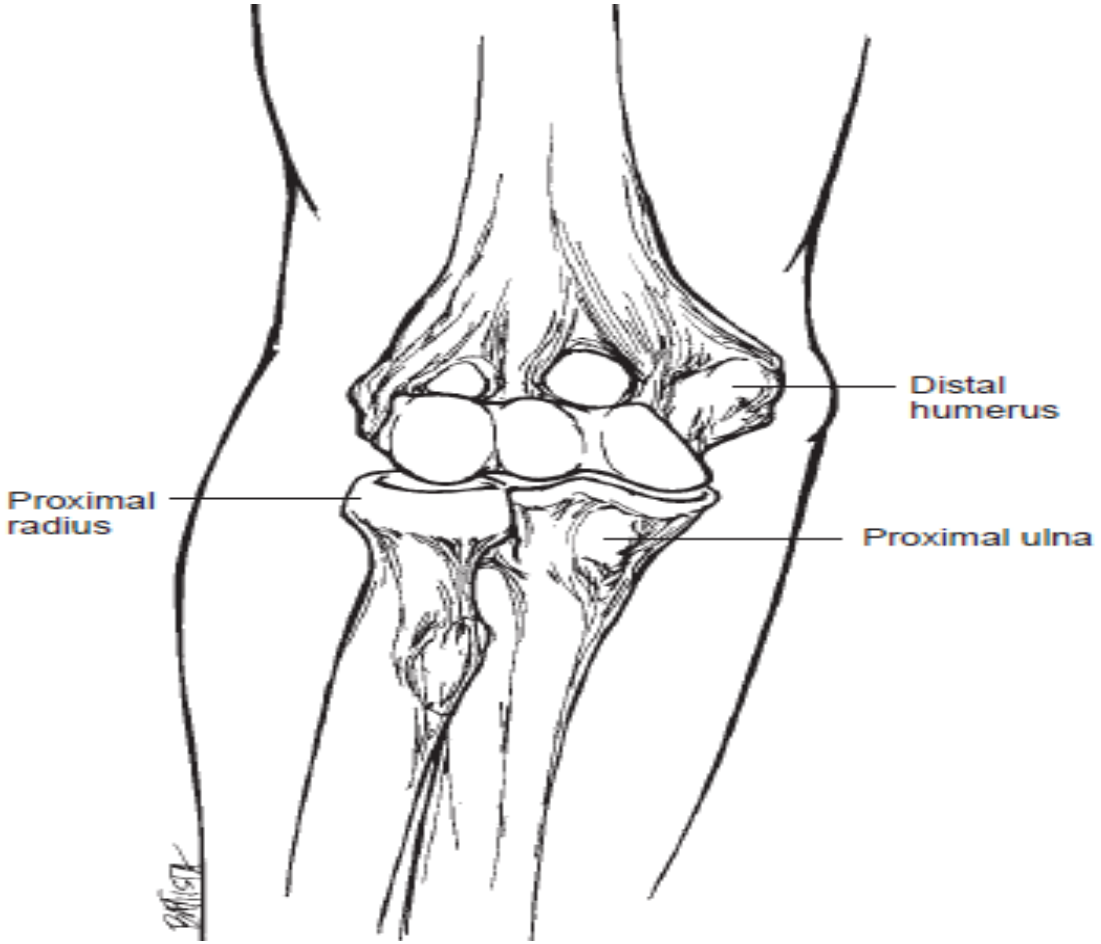
Assistant professor

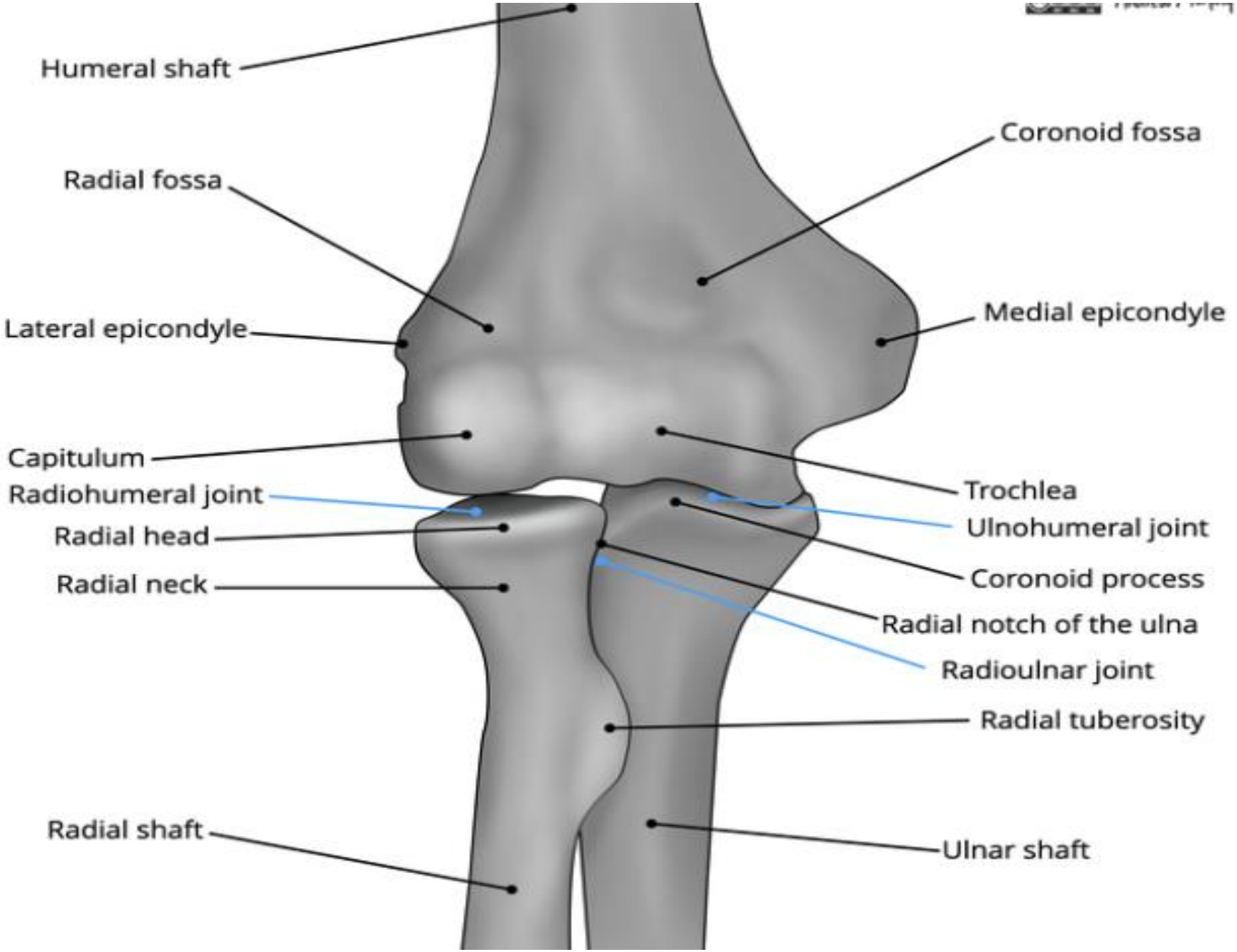
SNS COLLEGE OF PHYSIOTHERAPY


Elbow complex
Elbow joint
Radioulnar joint
Humeroulnar Joint
Humeroradial joint
Superior radioulnar joint
Distal radioulnar joint

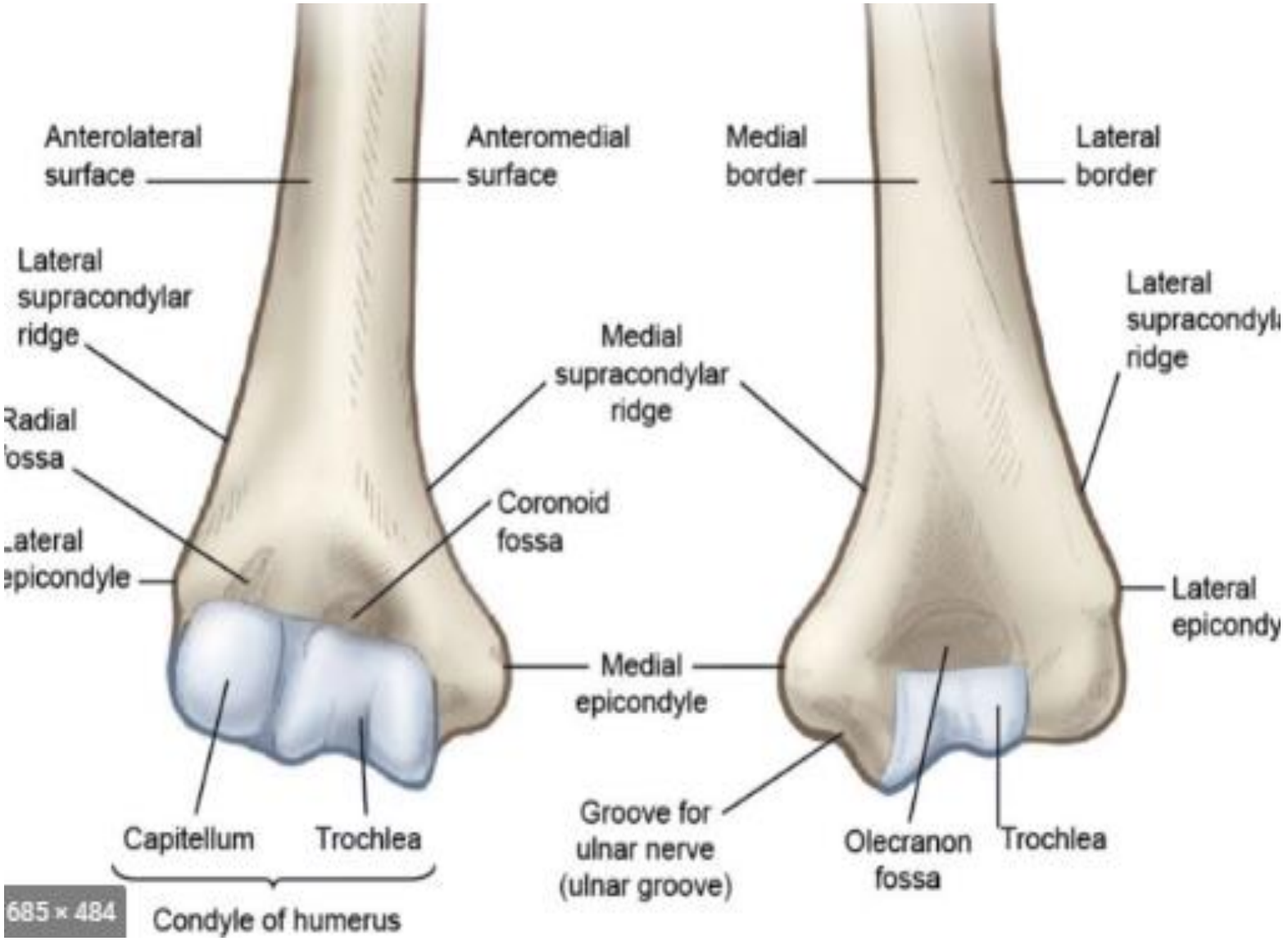
ELBOW JOINT: HUMEROULNAR AND HUMERORADIAL ARTICULATION

- **Modified or loose hinge joint**
- One degree of freedom is possible
- Movement allowed : Flexion and Extension
- A slit bit of axial rotation and side to side motion of the ulna occurs during flexion and extension and that's why elbow is considered to be a **modified or loose hinge joint**




Humeral shaft
Coronoid fossa
Radial fossa
Lateral epicondyle
Medial epicondyle
Capitulum
Trochlea
Radiohumeral joint
Ulnohumeral joint
Radial head
Coronoid process
Radial neck
Radial notch of the ulna
Radioulnar joint
Radial tuberosity
Radial shaft
Ulnar shaft

Bones forming elbow joints



ELBOW JOINT – HUMEROULNAR AND HUMERO RADIAL ARTICULATION

1. Articulating surface of humerus:

- Articular surface of distal humerus consist of trochlea and capitulum.
- **Trochlea**: hour glass shaped
- **Capitulum** : spherical shaped.
- These structures are situated between medial and lateral humeral epicondyles.
- **Trochlear groove**: divides trochlea in to medial and lateral portions.
- The medial portion of trochlea projects more distally than lateral side , which results in valgus angulation of forearm called **carrying angle**

- The depression above trochlea is called **coronoid fossa.**
- It receives coronoid process of ulna at the end of elbow flexion.
- **Capitulotrochlear groove** seperates the capitulum and trochlea.
- The depression just above the capitulum is called **radial fossa**, that receive head of radius in elbow flexion.
- Posterior aspect of distal humerus has a deep foosa called **olecranon fossa.**


radial notch of ulna
olecranon process
trochlear notch
head of radius
coronoid process
radius
ulna
styloid process
styloid process
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Articulating surface of ulna and radius

- The **articulating surface of the ulna** –trochlear notch(deep, concave surface).
- The proximal portion of notch is divided in to two unequal parts – trochlear ridge.
- The **radial articulating surface** of humeroradial joint –
- Head of radius.
- The radial head has a cup shaped concave surface called **fovea** , that is surrounded by a rim

Articulation between trochlea and trochlear notch of ulna:

- In **flexion**- trochlear ridge of ulna slides along the trochlear groove until the coronoid process reaches the coronoid fossa in full flexion.
- In normal resting position- only the sides of trochlea and trochlear notch is in contact.
- When arm is loaded (closed chain position)- the trochlea goes inside the trochlear notch.
- There is more joint approximation, contact area is expanded from side to center

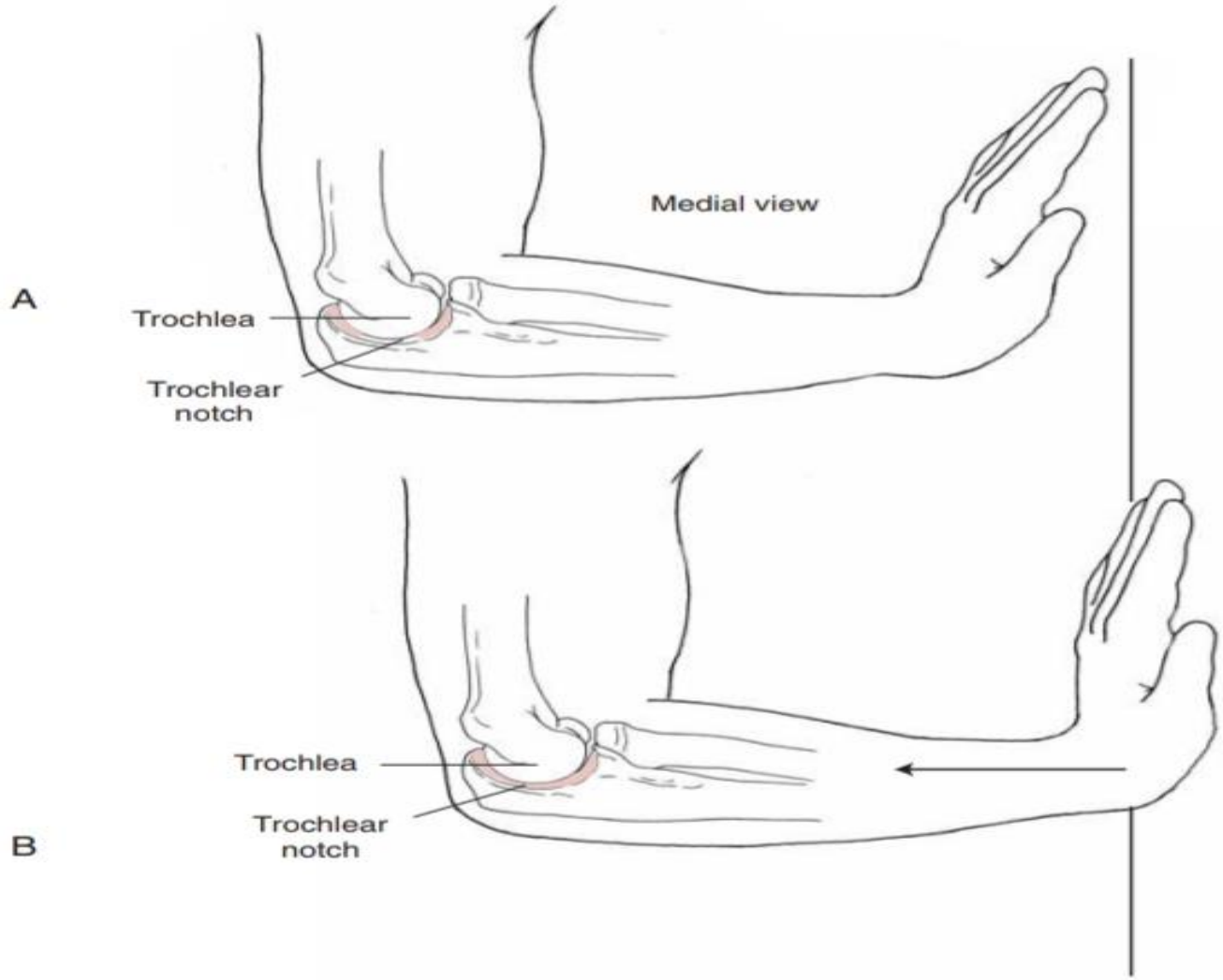


Figure 8–7 ■ **A.** No surface contact occurs between the trochlea and the center of the troclear notch from 30° to 120° of flexion. Contact is primarily on the sides of the notch under no-load conditions. **B.** Contact areas expand from the sides toward the center when a load is applied.

Articulation between radial head and capitulum:

- In flexion- the rim of radial head slides in the capitulotrochlear groove and enters the radial fossa.

Joint capsule

- Loose , weak anteriorly and posteriorly
- 3 joints(humeroulnar, humeroradial, superior radioulnar joint) are enclosed in a single capsule.
- Distally- capsule attaches margins of coronoid process of ulna
- Medially and laterally – capsule is continuous with medial and lateral collateral ligaments.
- Posteriorly- capsule is attached to the upper edge of olecranon process and medial epicondyle.

Ligaments

Medial collateral ligaments

- Also called ulnar collateral ligament
- Triangular in shape. The apex is attached to medial epicondyle of humerus and base to olecranon and coronoid process of ulna.

- Has 3 parts:

ANTERIOR	POSTERIOR	TRANSVERSE
•Attaches from medial epicondyle of humerus to coronoid process of ulna.	•Attaches from medial epicondyle to coronoid and olecranon process.	•Attaches to olecranon to coronoid process
	•Limits excessive elbow extension .	
•Primary restraint to valgus stress	•Provides valgus stability	•Provides valgus stability

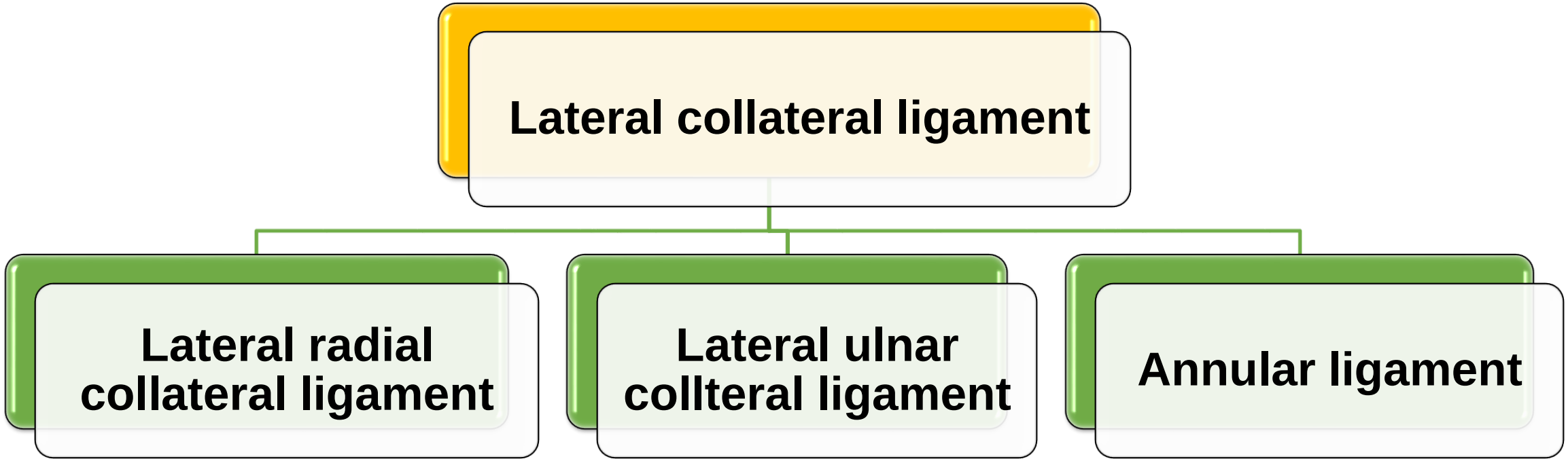
Functions

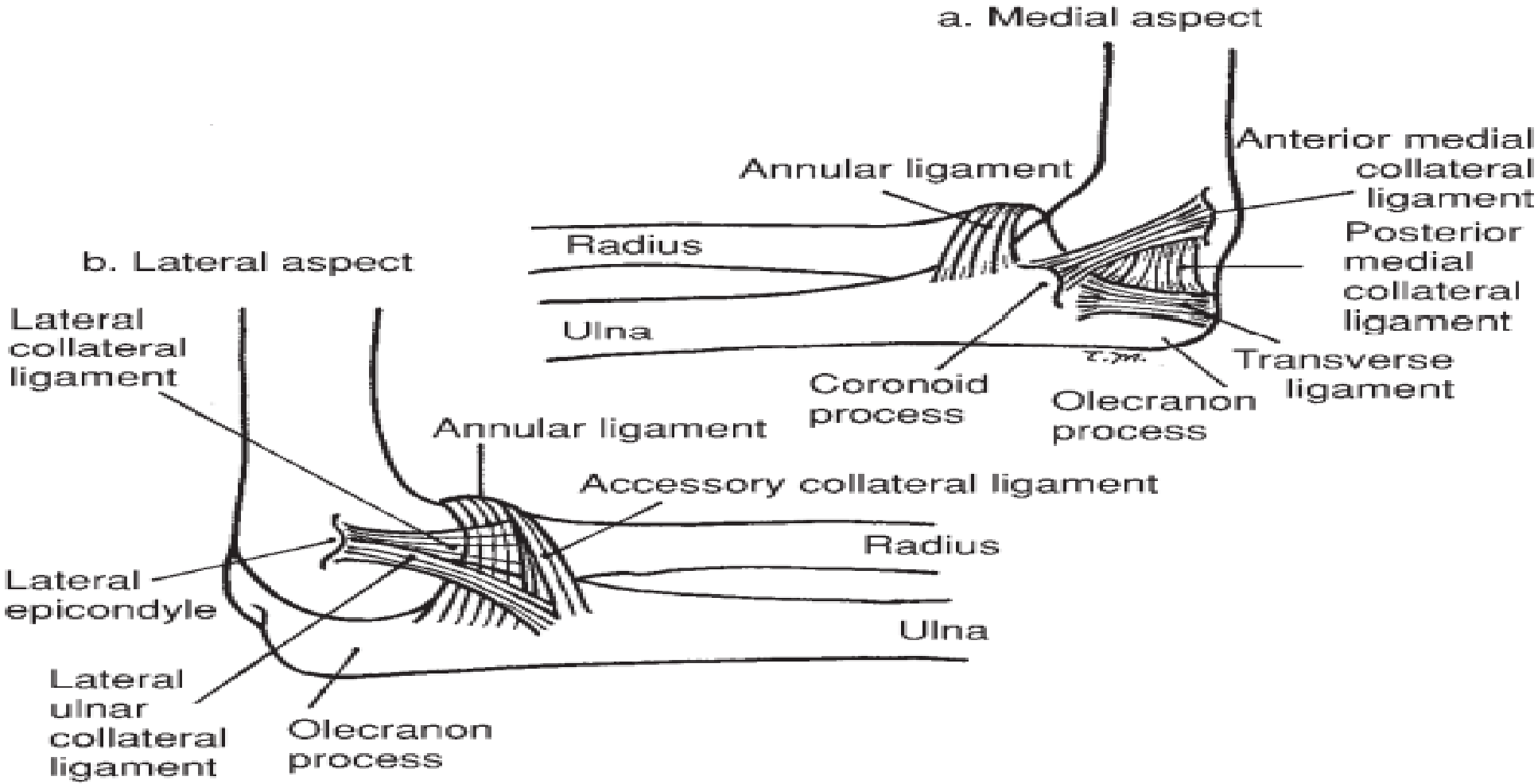
- Stabilize the elbow against valgus torque
- Limit the extension at the end of the extension ROM
- Guides joint motion throughout flexion ROM

- **Injury: Repeated valgus stress**
- **e.g: Back swing portion of pitching with shoulder external rotation and elbow flexion**

Lateral collateral ligaments

Also called radial collateral ligament.




a. Medial aspect
Annular ligament
Anterior medial collateral ligament
Radius
Posterior medial collateral ligament
Ulna
Transverse ligament
Coronoid process
Olecranon process
b. Lateral aspect
Lateral collateral ligament
Annular ligament
Accessory collateral ligament
Radius
Lateral epicondyle
Ulna
Lateral ulnar collateral ligament
Olecranon process

- **Lateral radial collateral ligament**
- Fan shaped structure.
- From the lateral epicondyle to the head of radius.

Functions:

- Provides reinforcement for the humeroradial articulation.
- Protection against varus stress.
- Provides resistance against longitudnal distraction of joint surfaces.

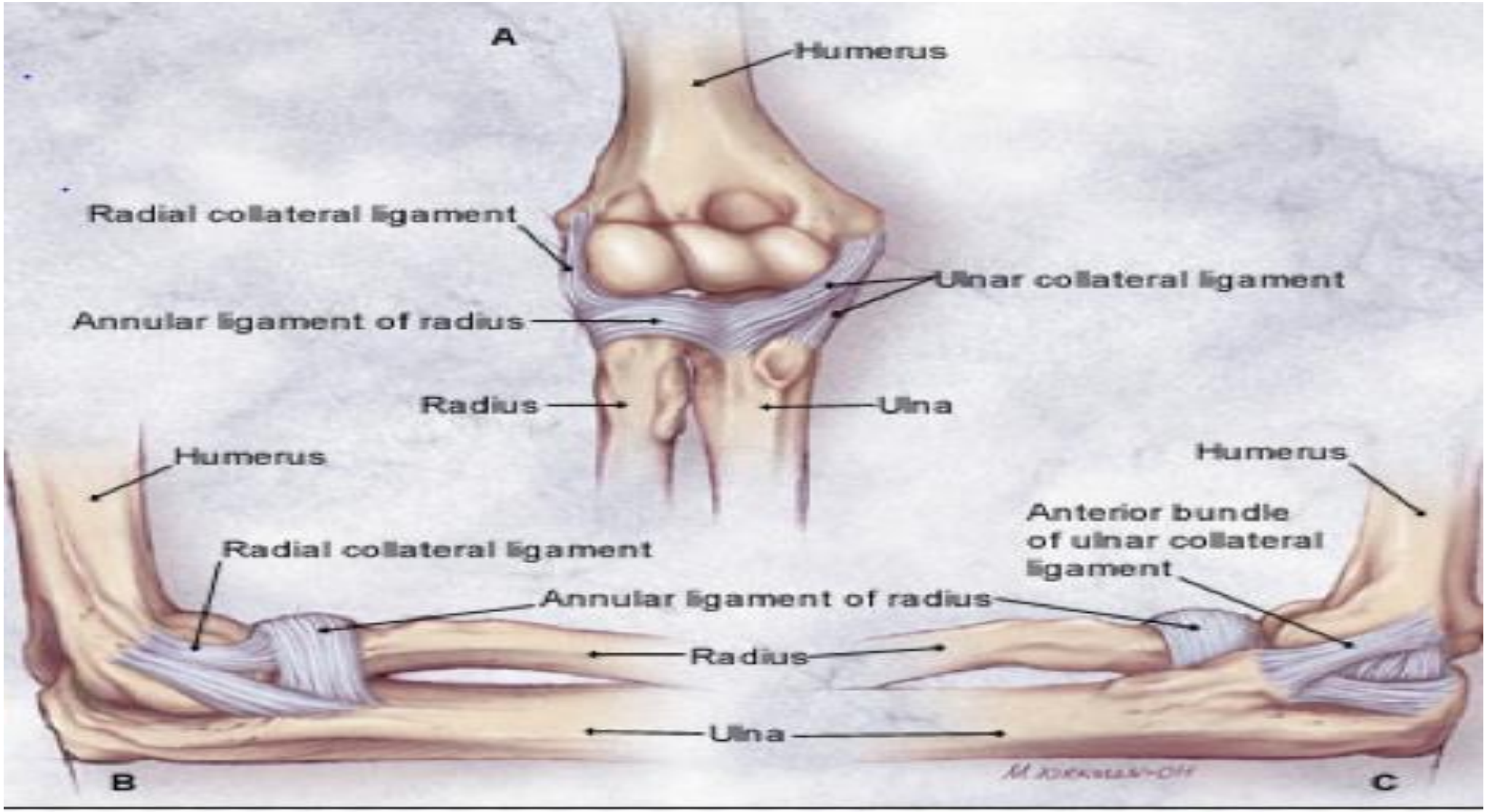
- Lateral radial collateral ligament: provides **primary soft tissue restraint** to combined varus and supination torque and the lateral ulnar collateral ligament and annular ligament are **secondary restraint.**
- Prevent subluxation of humero ulnar joint.

Lateral ulnar collateral ligament:

- Provide stability against varus stress.
- Lateral support to elbow

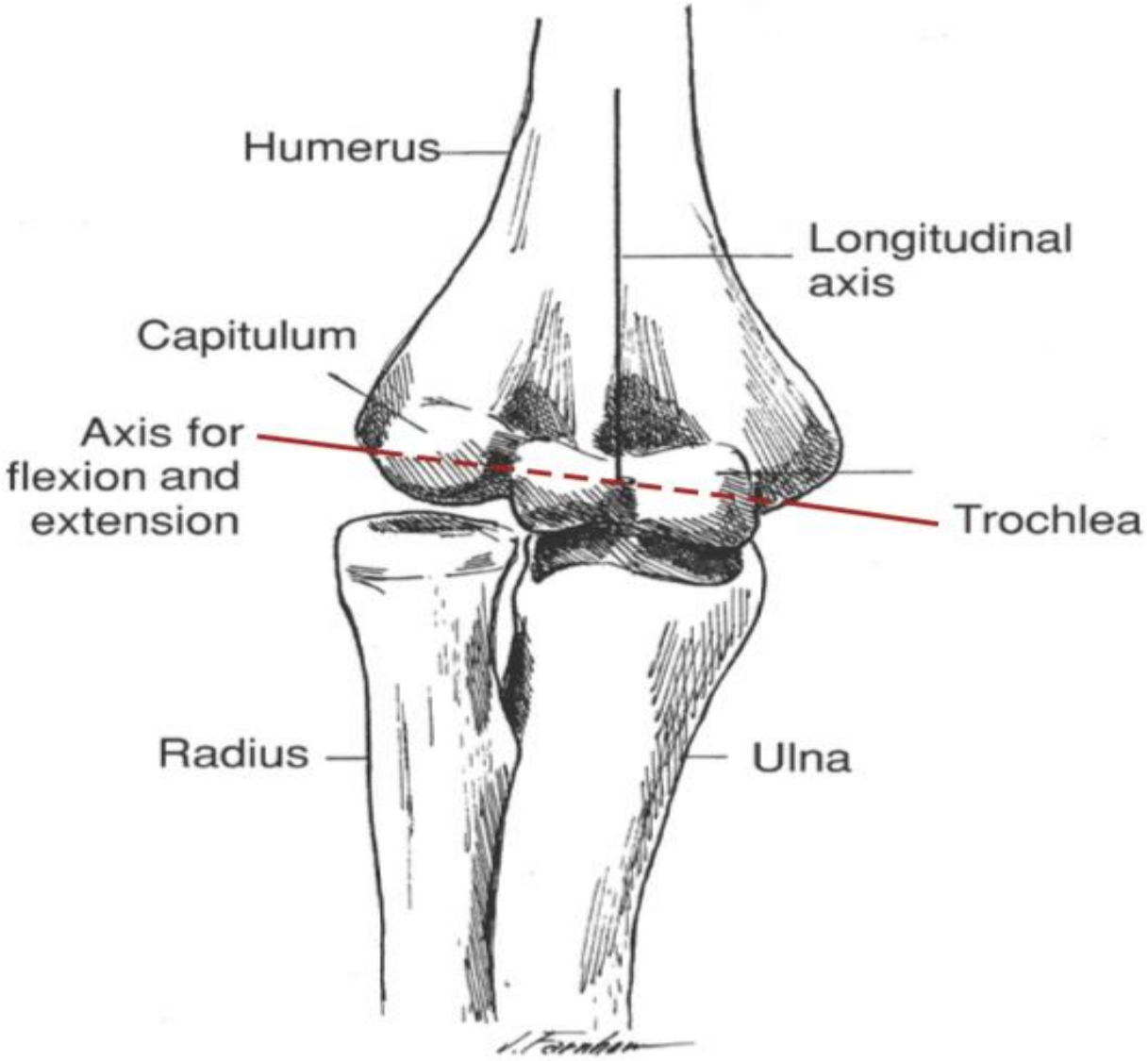
Annular ligament

- It surrounds radial head and attaches to the superior radioulnar joint.
- Plays an important role as primary stabilizing structure during forearm supination and pronation


A
Humerus
Radial collateral ligament
Ulnar collateral ligament
Annular ligament of radius
Radius
Ulna
Humerus
Humerus
Anterior bundle of ulnar collateral ligament
Radial collateral ligament
Annular ligament of radius
Radius
Ulna
B
C

Axis of motion

- Axis for flexion and extension -passes horizontally through the **center of the trochlea** and **capitulum**



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Motions of Elbow joint

- Elbow complex contains both hinge and pivot joint therefore it is described sometimes as '**trochoginglymus**' joint
- Motions of flexion and extension involves the humeral articulation.

Osteo kinematics:

flexion

- Plane : sagittal plane
- Axis : coronal axis
- Flexion-0-145 degree.
- During flexion in humeroulnar joint trochlea slides on trochlear notch until coronoid process reaches coronoid fossa
- In radial side radial head slides over capitulum and reaches radial fossa in full flexion

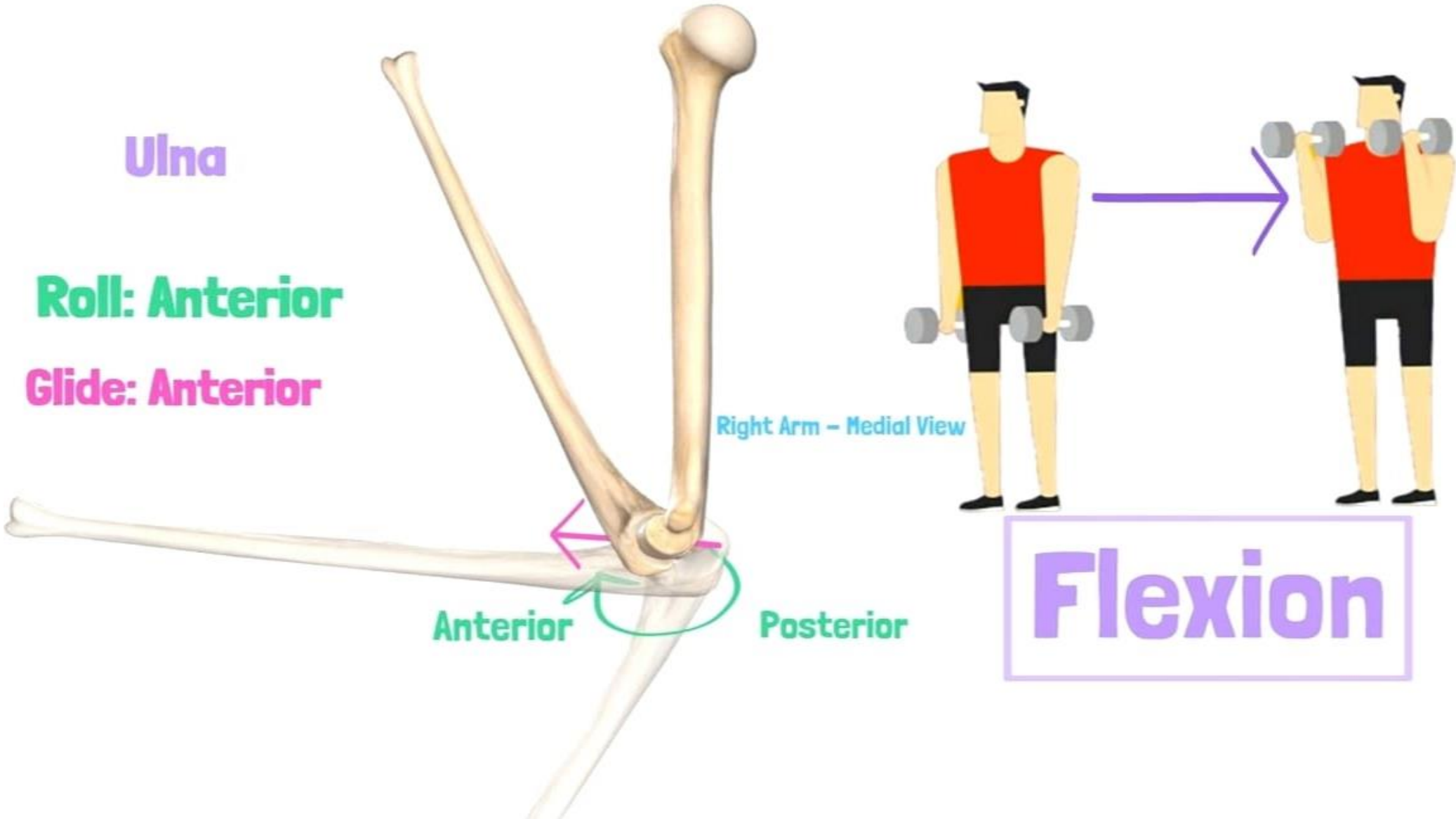
- **Flexion stops when coronoid process goes inside or sits in coronoid fossa-in ulnar side**
- **Radial side- radial head reaches radial fossa**
- The range of elbow flexion varies between individuals
- A range of almost 0-140 degree is normal
- It is accepted that most activities can be carried out with less than this and generally a range of flexion from **30 to 130** degree with 50 degrees of supination and pronation is felt to be sufficient to live without disability

Arthrokinematics-open kinectic chain

- Concave convex rule.
- Moving surface- trochlear fossa(concave)
- Non moving surface: trochlea(convex)
- Arthrokinematic movement occur in same direction to osteokinematic movement

Open kinematic chain

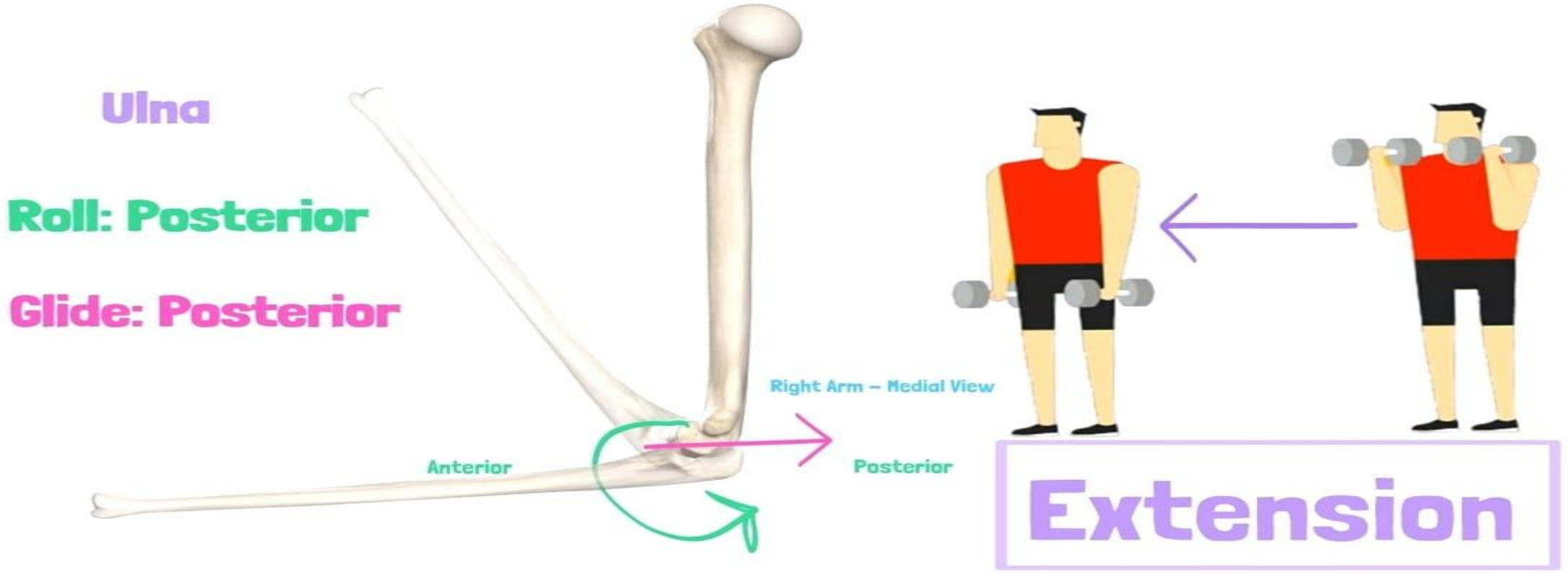
Osteokinematic movement	Arthrokinematic movement	Direction of arthrokinematic movement
Humeroulnar flexion	anterior gliding	Anterior roll
Humeroulnar extension	**Posterior glide**	**Posterior roll**
Humeroradial flexion	anterior gliding	Anterior roll
Humeroradial extension	**Posterior glide**	**Posterior roll**

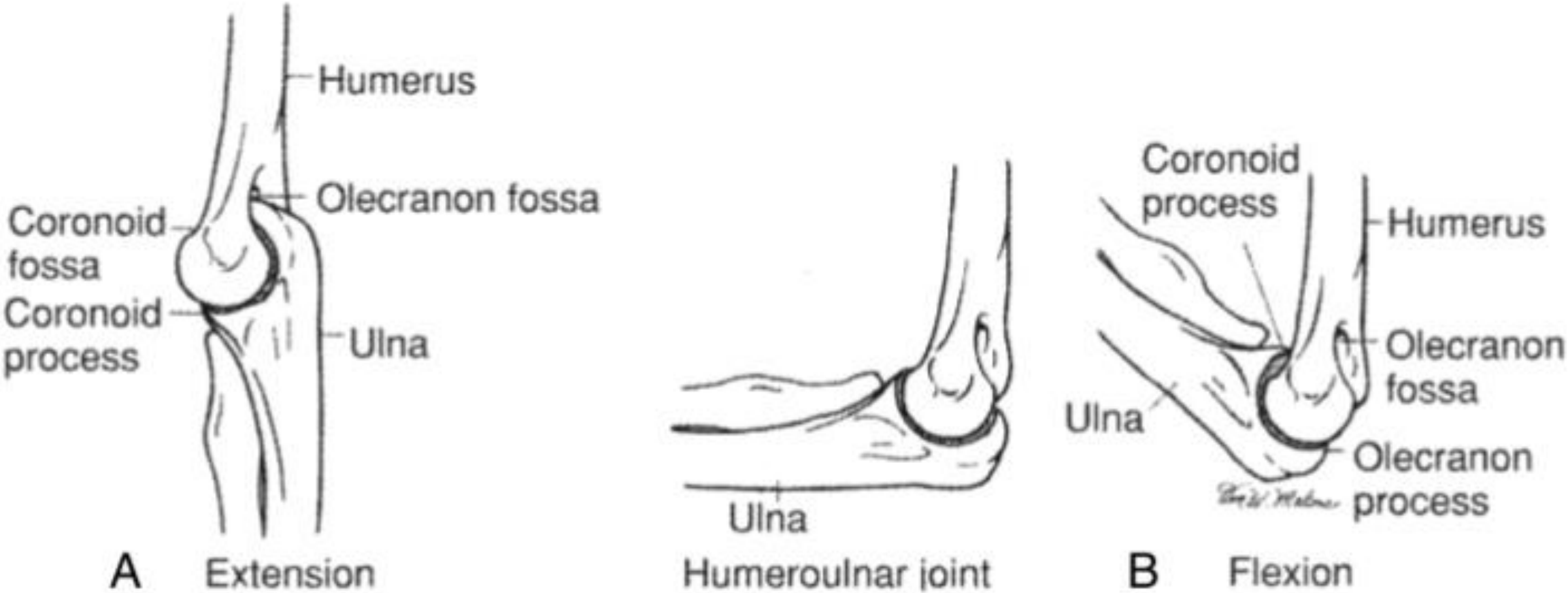

Ulna
Roll: Anterior
Glide: Anterior
Right Arm – Medial View
Anterior
Posterior
Flexion

Extension

- Plane : sagittal plane
- Axis : coronal axis
- Extension- 0-5 degree
- Extension stops when olecranon process sits on olecranon fossa
- In full extension there is no contact between radius and humerus articulation or capitulum therefore there is a joint gap between radial head with capitulum

Osteokinematic movement	Arthrokinematic movement	Direction of arthrokinematic movement
Humeroulnar Extension	Posterior glide	Posterior roll
Humeroradial extension	Posterior glide	Posterior roll





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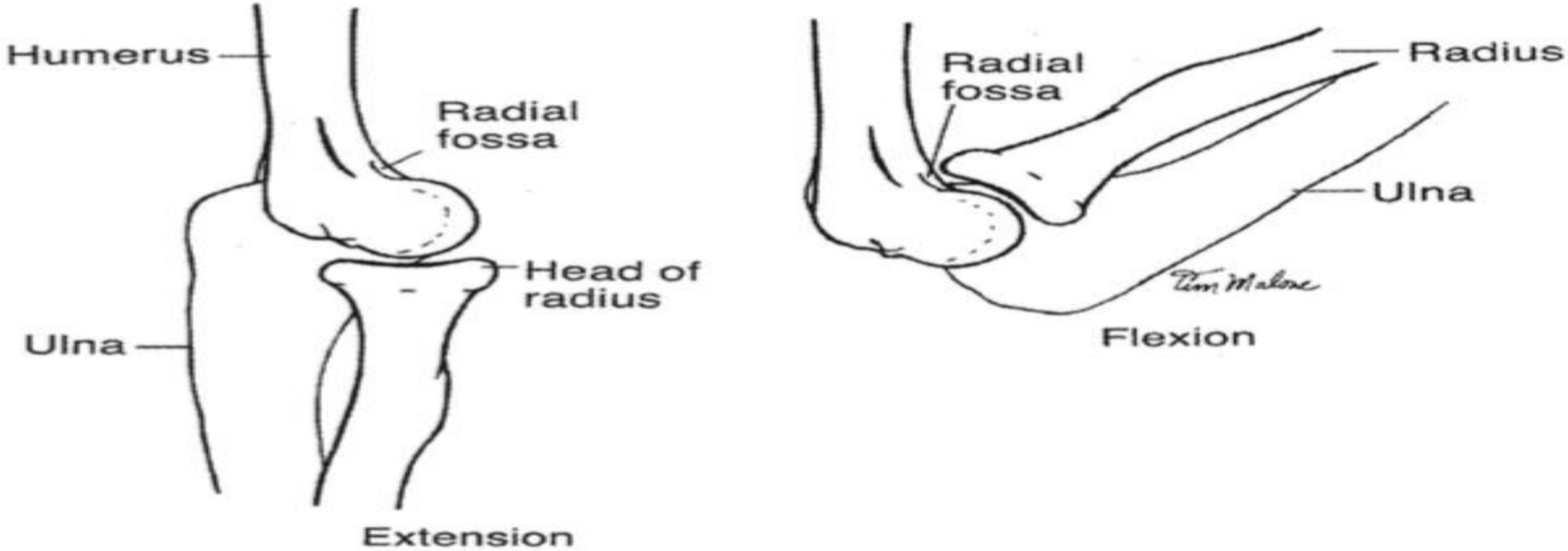
HUMERORADIAL JOINT



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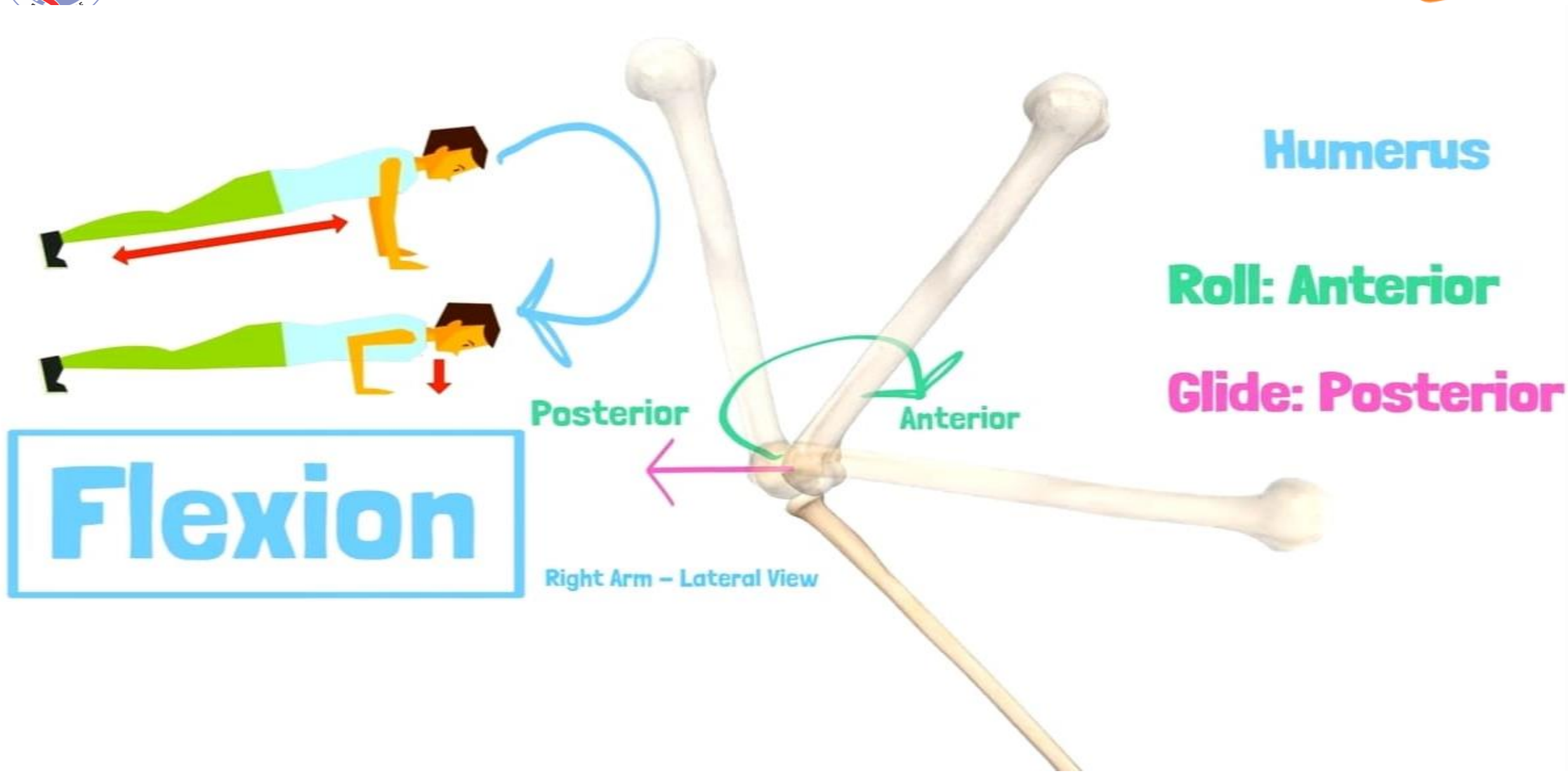
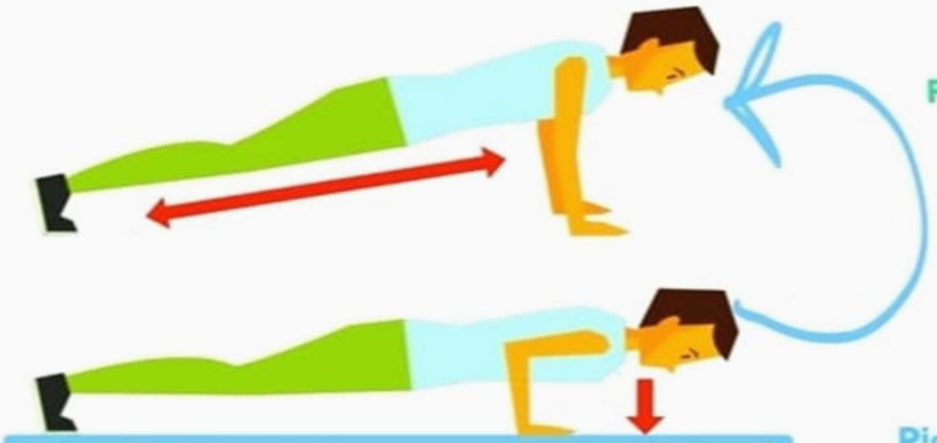
Arthrokinematic- closed kinetic c hain

- Concave convex rule.
- Moving surface: trochlea(convex)
- Non Moving surface- trochlear fossa(concave)
- Arthrokinematic movement occur in opposite direction to osteokinematic movement

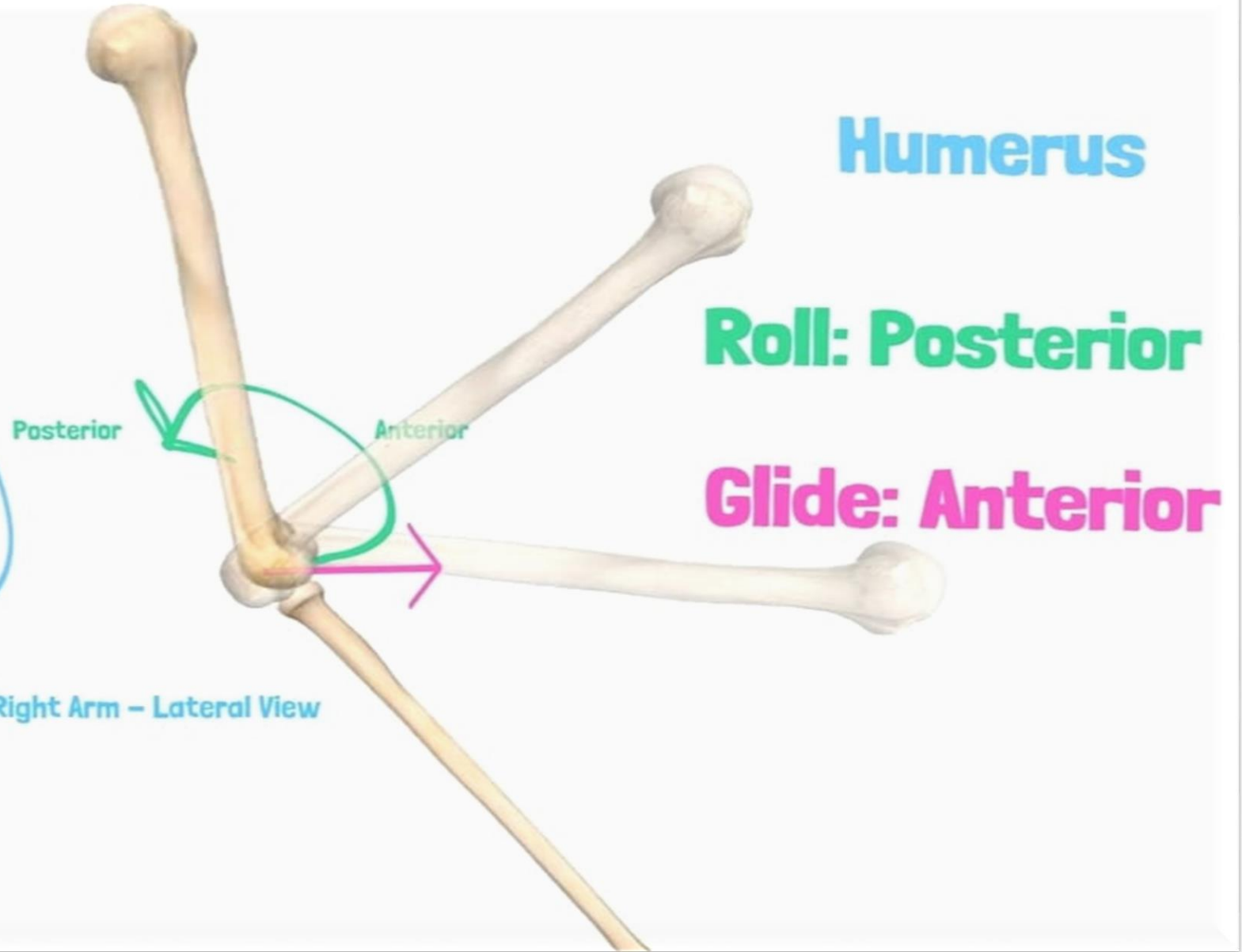
Closed kinematic chain

HUMERO ULNAR	
FLEXION	Roll- Anterior Glide- Posterior
EXTENSION	Roll- Posterior Glide-Anterior
HUMERO RADIAL	
FLEXION	Roll- Anterior Glide-Posterior
EXTENSION	Roll- Posterior Glide-Anterior


Humerus
Roll: Anterior
Glide: Posterior
Posterior
Anterior
Flexion
Right Arm – Lateral View



Extension



Humerus

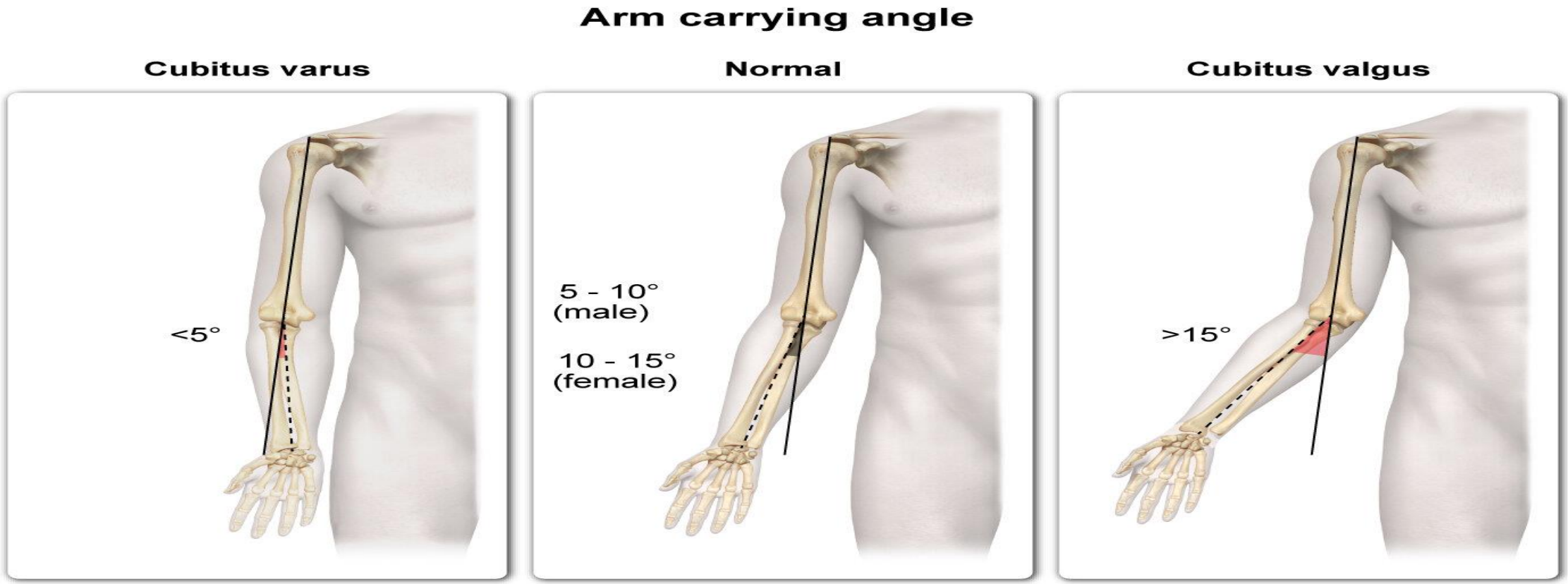
Roll: Posterior

Glide: Anterior

CARRYING ANGLE

Carrying angle

- Angle formed by the long axis of the humerus and ulna.



- Due to medial aspect of trochlea extends more distally
- With forearm supinated and elbow fully extended the forearm projects laterally about **15 degrees** relative to the humerus
- This natural angulation of the forearm within the frontal plane is called **carrying angle**
- It disappear during pronation and full flexion of elbow.

- Carrying angle is more in **females** than the males.
- This is because end of ulna angulates more and medial flange of trochlea grows longer in shorter person than in taller person

- The functional use of carrying angle results from the combination of shoulder lateral rotation, elbow extension, and forearm supination- which helps a person to carry bucket or load in one hand.
- That helps to avoid contact between the carried load and lowerlimb.
- Increasing in the carrying angle is called **cubitus valgus**
- Decreasing in carrying angle is known as **cubitus varus**

Cubitus varus

Normal

Cubitus valgus

Mobility and stability

Factors affecting elbow joint range of motion:

- ✓ **Type of motion- active or passive**: active range is less than passive due to bulk of the muscle.
- **Active range- 135-145 degree**
- **Passive range – 150-160**
- ✓ **BMI:** high BMI limit elbow range of motion

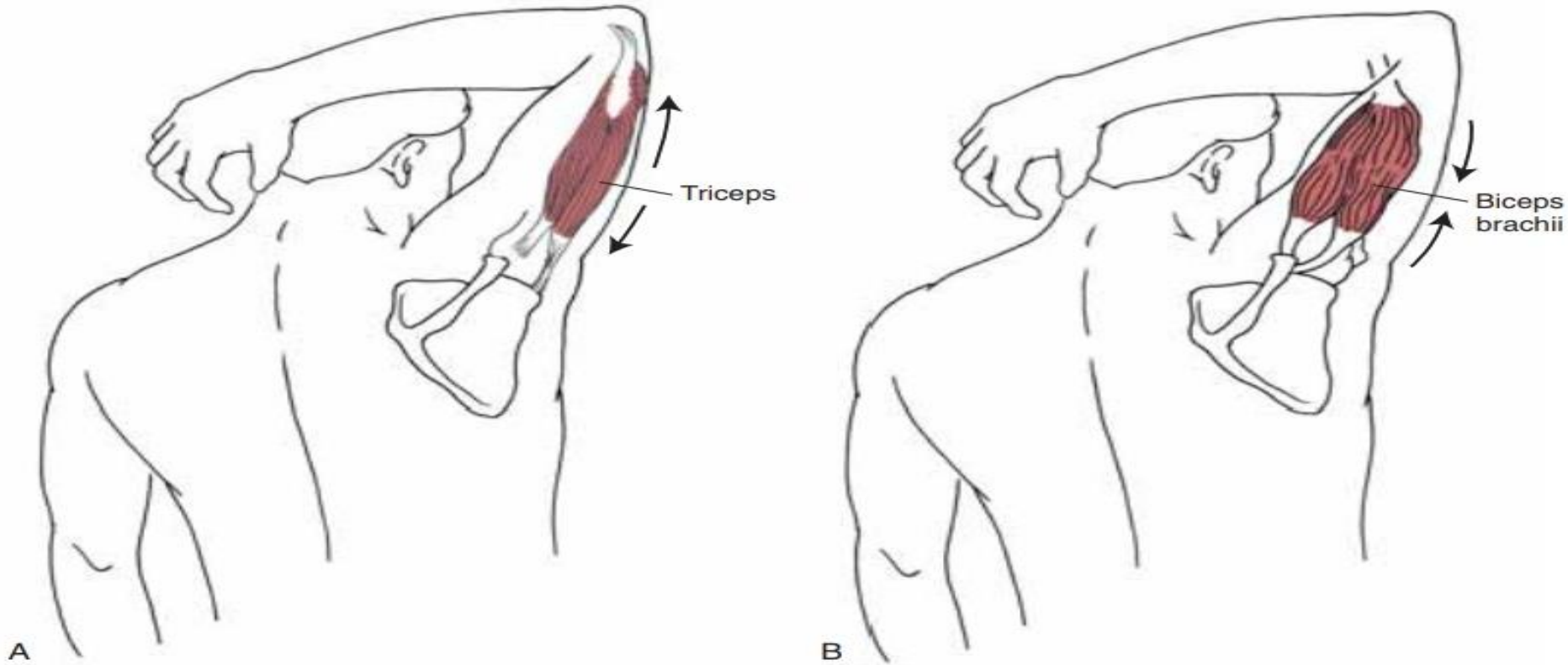
- ✓ **Position of forearm- pronation or supination,**
- When forearm is pronated or neutral the range of motion is less than when forearm is supinated.
- ✓ **Position of shoulder:**
- May affect range of motion available at elbow joint. because of two joint muscle cross shoulder and elbow

- **Biceps and triceps brachi** – limit the range of motion at elbow.

- **When a 2 joint muscle is stretched efficiently at one joint it is very hard for that muscle to stretch at another joint- passive insufficiency.**

- Passive tension in triceps brachi limit full elbow flexion when shoulder is simultaneously moved in to flexion.
- Triceps is completely stretched at shoulder joint, so it is very hard for triceps to stretch at elbow joint.

- **Biceps brachi:**
- Active tension in biceps brachi may decrease elbow joint flexion as it is efficiently produce maximum tension at shoulder joint when shoulder and elbow is simultaneously flexed- **Active insufficiency**(Because bicpes is contracted at shoulder joint, it is difficult to produce active contraction at elbow joint)



▲ **Figure 8–16** ■ **A.** Passive tension in the long head of the biceps brachii may limit elbow flexion. **B.** Passive tension in the long head of the biceps brachii may limit elbow extension.

Mechanics of muscle activities

- **Elbow flexor muscles**
- Biceps brachii
- Brachialis
- Brachio radialis
- **Elbow extensors**
- Triceps
- Anconeus

Biceps brachii

- It is a fusiform muscle with two head.
- It attached to both elbow and shoulder joint.
- **MOBILITY MUSCLE**
- The contraction of biceps brachii will affect the glenohumeral, humeroulnar and humeroradial articulation.
- Small physiological cross sectional area (PCSA)

- The **moment arm** of biceps largest between **80 to 100 degrees of elbow flexion** , therefore produce **greater torque in this range**
- The moment arm gets smaller in elbow extension. So Biceps is less effective as an elbow flexor when the elbow is fully extended, than when the elbow is flexed at 90 degree.

- The moment arm of biceps is small when elbow is in full extension. The muscle force is translatory and towards joint compression.
- When elbow is flexed beyond 100 degree the translatory component of muscle force is directed away from the joint and act as distracting force.

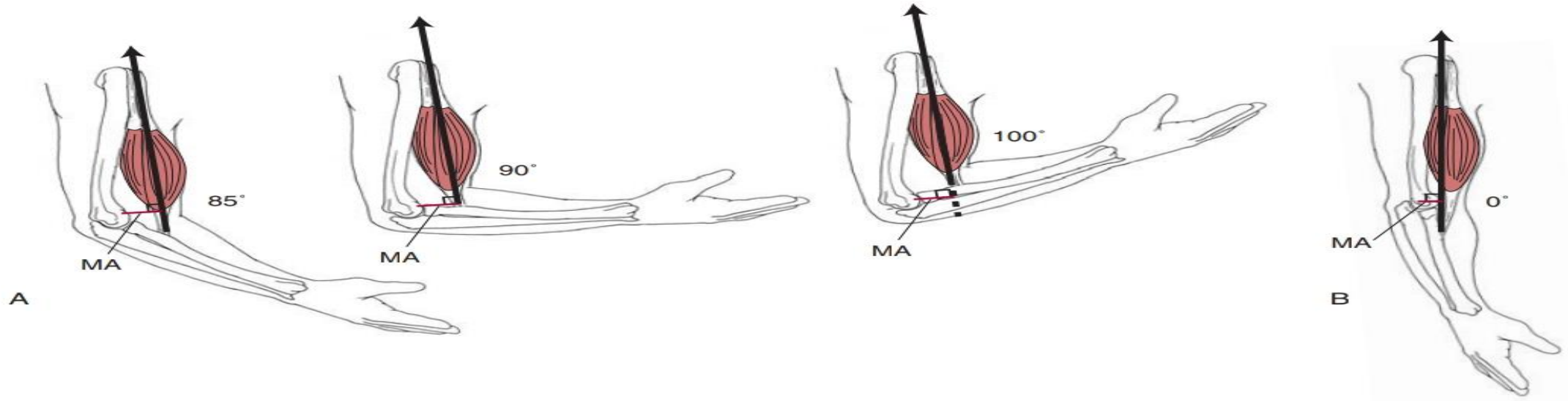
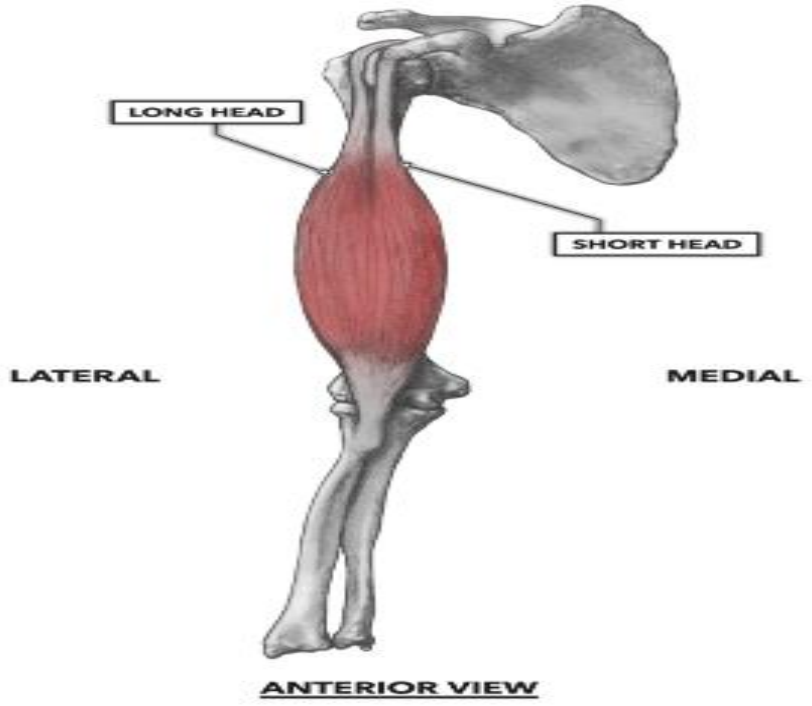


Figure 8–18 ■ A. Moment arm of the biceps at 85° to 100° of elbow flexion. **B.** Moment arm of the biceps at full extension.

- Functions of the biceps affected by the position of the shoulder(because muscle crosses both joints)
- **When full flexion of elbow is attempted with the full flexion of shoulder, the ability of muscle to generate torque is diminished.**
- **Active during concentric , isometric contraction and during slow supination**



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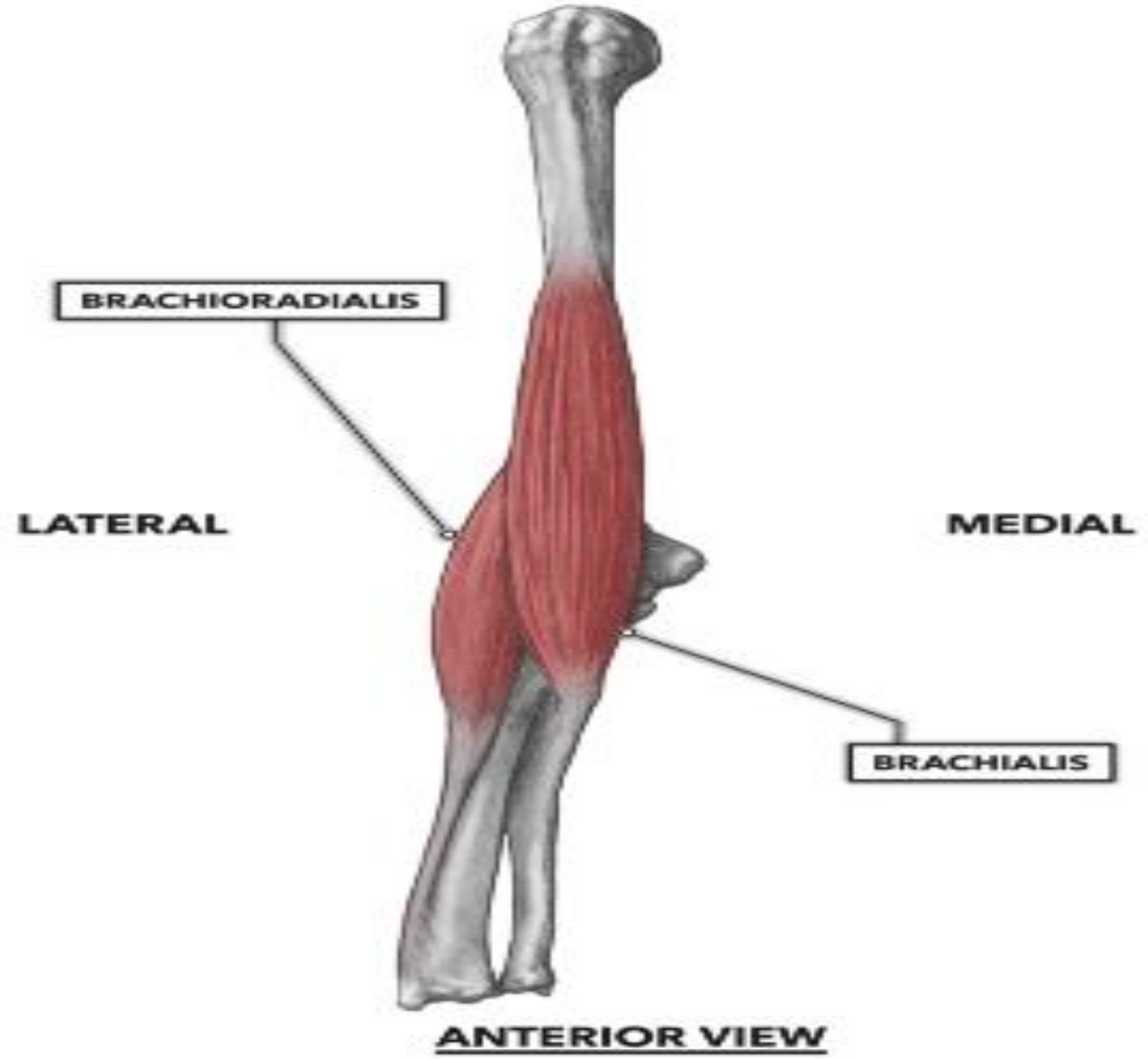
Brachialis

- The brachialis is considered to be a **mobility muscle** because its insertion is close to the elbow joint axis
- Being a **one-joint muscle** it **is not affected by the position of the shoulder**
- Because the brachialis is inserted on the ulna, it is unaffected by changes in the forearm position brought about by rotation of the radius .
- Large PCSA
- Moment arm is greatest at **100 degree elbow flexion** so torque is greatest at this range
- It also is active in all types of contractions **(isometric, concentric, and eccentric) during slow and fast motions.**

Brachioradialis

- The brachioradialis is inserted at a distance from the joint axis, and therefore the largest component of muscle force goes toward compression of the joint surfaces and hence toward stability
- **STABILITY MUSCLE**
- The brachioradialis does not cross the shoulder and therefore is unaffected by the position of the shoulder.
- Peak moment arm occur at 100-120 degree of elbow flexion.
- The position of the elbow joint was found to affect brachioradialis muscle activity only during voluntary maximum eccentric contractions

- Brachioradialis shows no electrical activity during eccentric flexor activity when the motion is performed slowly with the forearm supinated
- In an EMG experiment on the effects of forearm motion on muscle activity when elbows in 90 degree of flexion while pronating and supinating the forearm, the brachioradialis showed high levels of activity during rapid alternating supination/pronation motions.
- Higher levels of activity were noted when the forearm was pronated than when it was supinated



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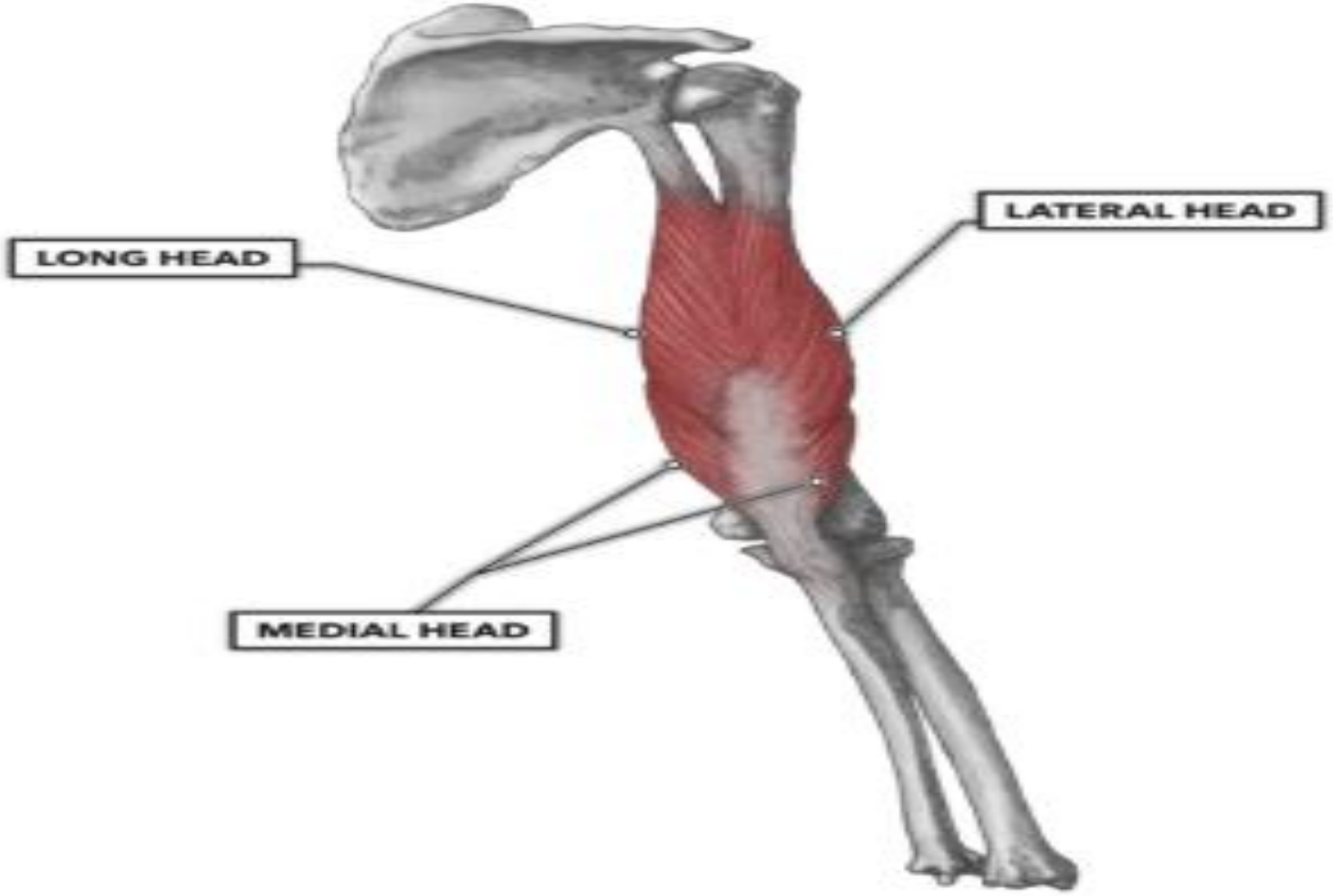
Elbow extensors

- **TRICEPS**
- Three heads – long head, medial head and lateral head
- Activity of **the long head of the triceps is affected by changing shoulder joint positions because the long head crosses both** the shoulder and the elbow.
- The long head's ability to produce **torque may diminish when full elbow extension is attempted with the shoulder in hyperextension**

- The medial and lateral heads of the triceps, being one-joint muscles, are **not affected by the position of the shoulder**
- The medial head is active in unresisted active elbow extension
- but all three heads are active when heavy resistance is given to extension or when quick extension of the elbow is attempted in the gravity assisted position.
- Maximum isometric torque generation is at a position of **90 degrees of elbow flexion**



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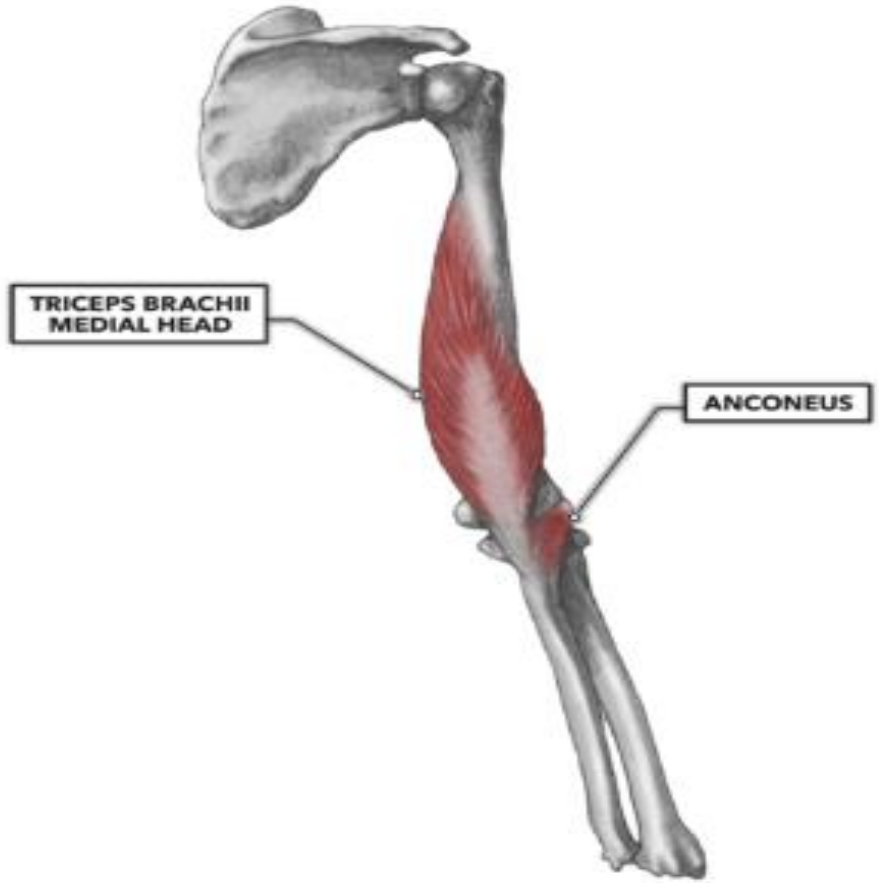
Anconeus

- Assists in elbow extension
- Apparently also acts as a stabilizer during supination and pronation.


TRICEPS BRACHII
MEDIAL HEAD
ANCONEUS

Thank you