قال صلى الله عليه وسلم

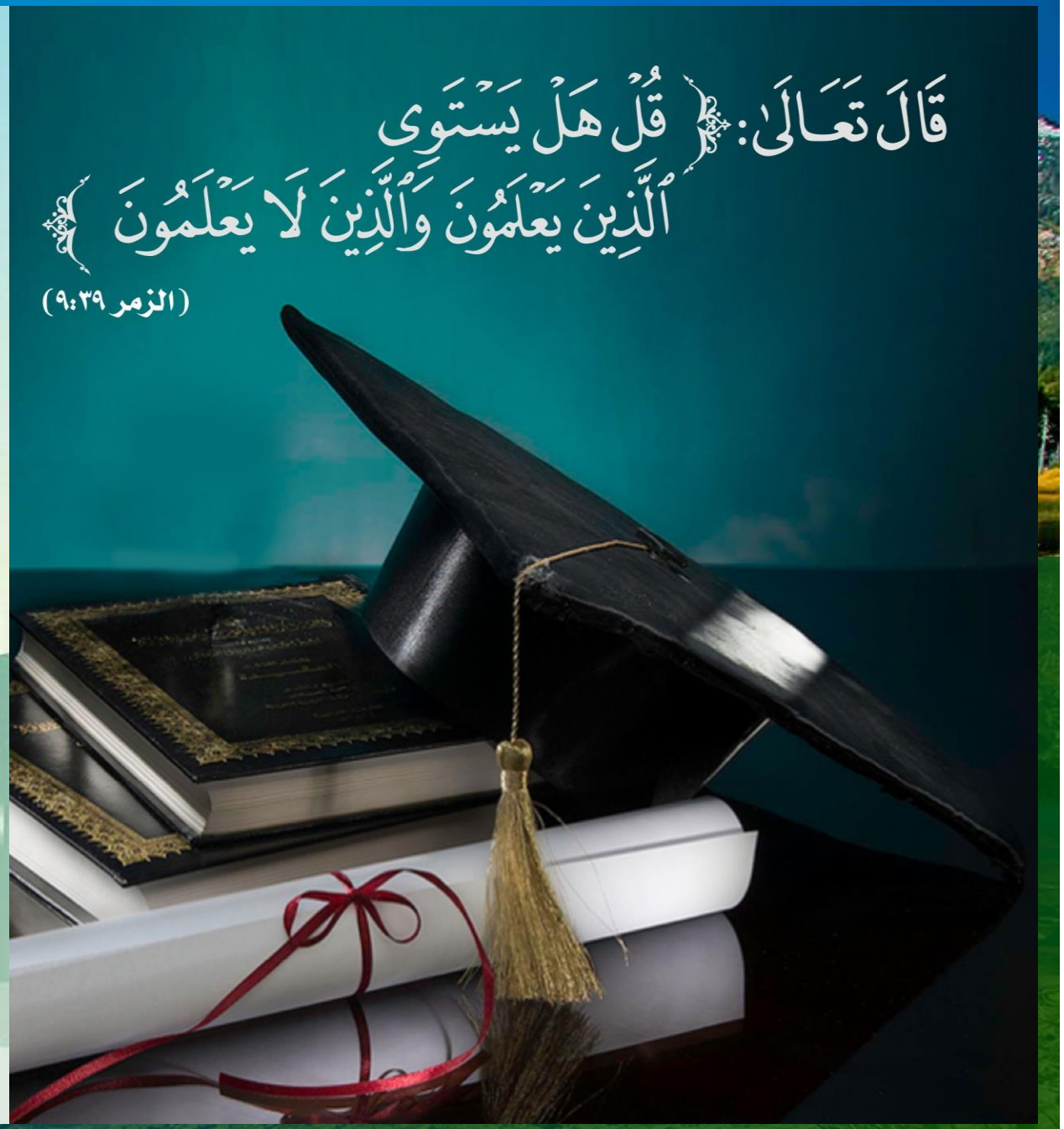
إنَّ اللَّهَ وملائِكتَهُ وأهلَ السَّماواتِ والأرضِ
حتَّى النَّملةَ في جُحرِها وحتَّى الحوتَ
ليصلُّونَ على

معلِّمِ النَّاسِ الخيرَ

رواه الترمذي وصححه الألباني

قَالَ تَعَالَىٰ: ﴿ قُلْ هَلْ يَسْتَوِي
ٱلَّذِينَ يَعْلَمُونَ وَٱلَّذِينَ لَا يَعْلَمُونَ ﴾

(الزمر ٣٩:٩)



Goniometric Measurements and Manual Muscle Testing for the Elbow and Forearm Complex

DR. REHAB SABER MAMOON

LECTURER OF PHYSICAL THERAPY, SVU

2) Elbow and Forearm Complex Ranges of Motion:-

	Flexion	Extension	Supination	Pronation
Articulation	Humeroulnar, Humeroradial	Humeroulnar, Humeroradial	Humeroradial, Superior radioulnar, Inferior radioulnar	Humeroradial, Superior radioulnar, Inferior radioulnar
Plane	Sagittal	Sagittal	Horizontal	Horizontal
Axis	Frontal	Frontal	Longitudinal	Longitudinal
Normal End Feel	Soft/hard/firm	Hard/firm	Firm	Hard/Firm
Normal Active Range of Motion	0–150 ° (0–140 °)	0 ° (0 °)	0–80–90 ° (0–80 °)	0–80–90 ° (0–80 °)

Normal Limiting Factors	Soft tissue apposition of the anterior forearm and upper arm; coronoid process contacting the coronoid fossa and the radial head contacting the radial fossa; tension in the posterior capsule and triceps	Olecranon process contacting the olecranon fossa; tension in the elbow flexors and anterior joint capsule and medial collateral ligament	Tension in the Pronator muscles, quadrate ligament, palmar radioulnar ligament of the inferior radioulnar joint, and oblique cord	Contact of the radius on the ulna; tension in the quadrate ligament, the dorsal radioulnar ligament of the inferior Radioulnar joint, the distal tract of the interosseous Membrane, supinator, and biceps brachii muscles with the elbow in extension

1) Elbow Flexion–Extension/ Hyperextension:-

***Start Position:** The patient is supine or sitting. The arm is in the anatomical position with the elbow in extension (0 °). A towel is placed under the distal end of the humerus to accommodate the ROM. Owing to biceps muscle tension, unusually muscular men may not be able to achieve 0°.

***Stabilization:** The therapist stabilizes the humerus.

***Goniometer Axis:** The axis is placed over the lateral epicondyle of the humerus.

***Stationary Arm:** Parallel to the longitudinal axis of the humerus, pointing toward the tip of the acromion process.

***Movable Arm:** Parallel to the longitudinal axis of the radius, pointing toward the styloid process of the radius.

*__End Position:__ From the start position of elbow extension, the forearm is moved in an anterior direction so that the hand approximates the shoulder to the limit of elbow flexion (150 °).

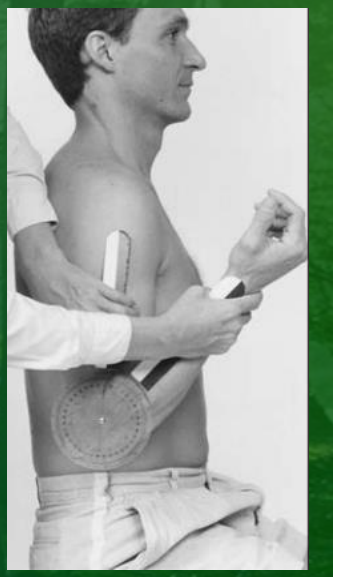
* __Extension/Hyperextension:__ The forearm is moved in a posterior direction to the limit of elbow extension (0 °)/ hyperextension (up to 15 °).

Start position for elbow flexion and extension.

End position for elbow flexion.

End position for elbow hyperextension.

Elbow extension



Elbow flexion.

2) Supination–Pronation:-

***Start Position:** The patient is sitting. The arm is at the side, and the elbow is flexed to 90° with the forearm in mid-position. A pencil is held in a tightly closed fist with the pencil protruding from the radial aspect of the hand, and the wrist in the neutral position. The fist is tightly closed to stabilize the fourth and fifth metacarpals, thus avoiding unwanted movement of the pencil as the test movements are performed.

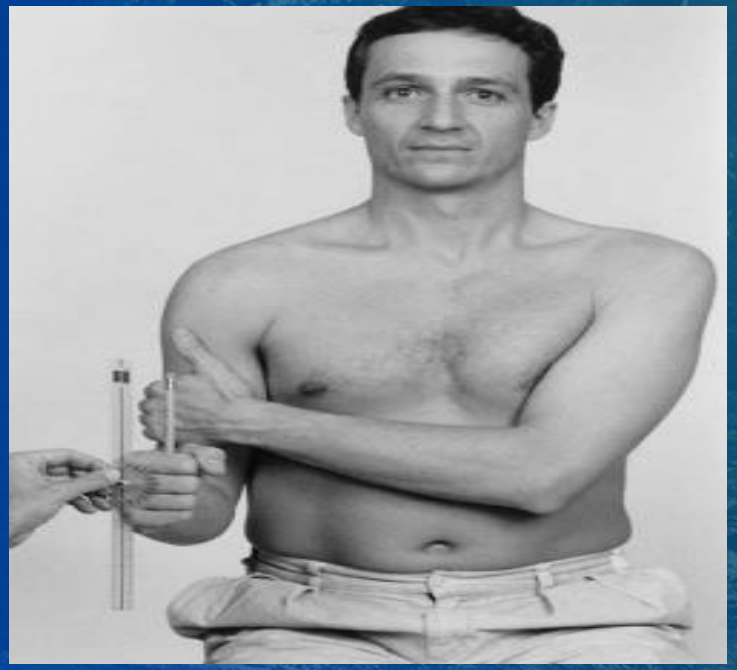
***Stabilization:** The patient stabilizes the humerus using the non-test hand.

***Goniometer Axis:** The axis is placed over the head of the third metacarpal.

***Stationary Arm:** Perpendicular to the floor.

***Movable Arm:** Parallel to the pencil.

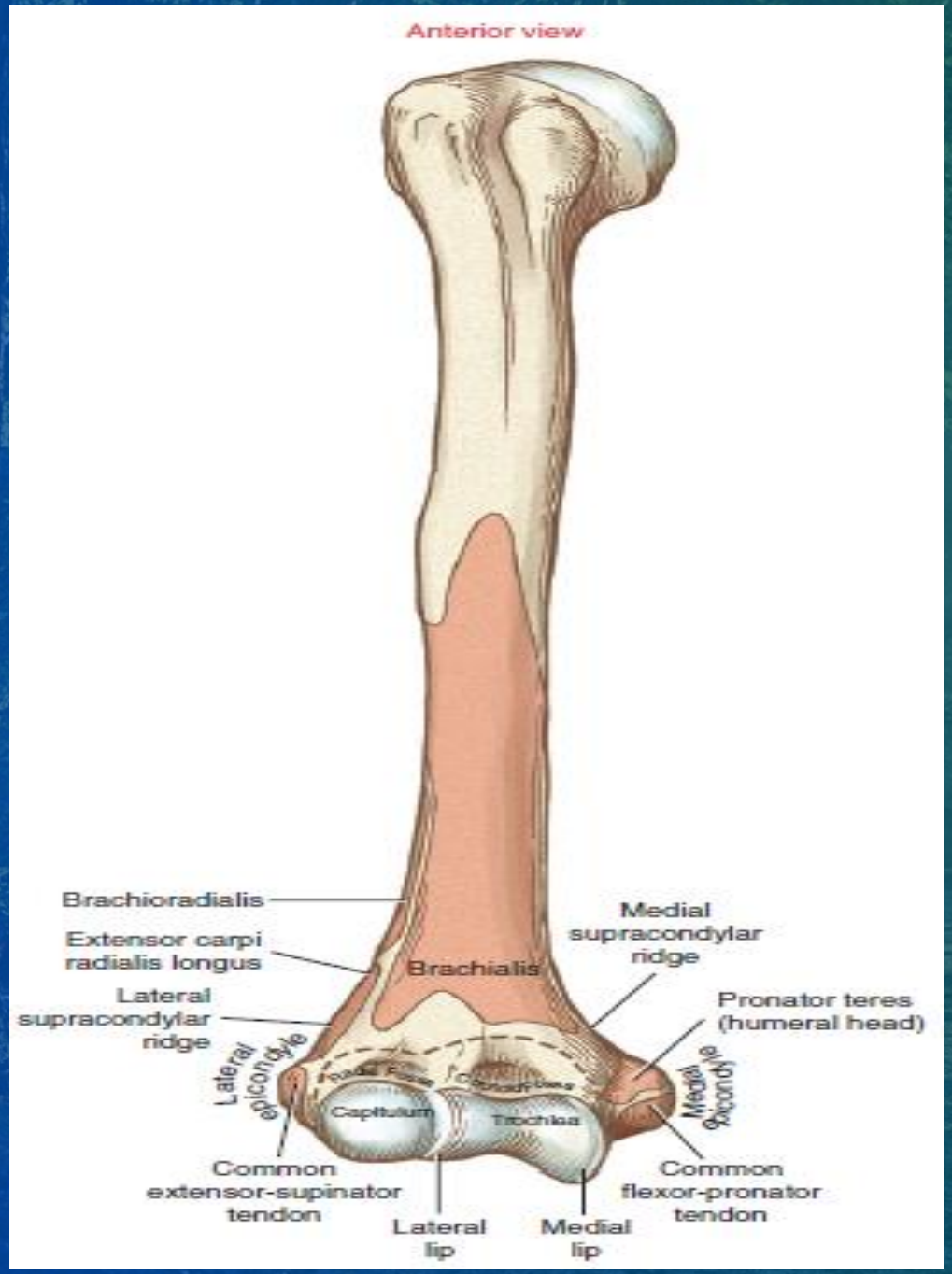
*__End Position:__ The forearm is rotated externally from mid-position so that the palm faces upward and toward the ceiling to the limit of forearm supination (80°to 90° from mid-position). The forearm is rotated internally so that the palm faces downward and toward the floor to the limit of forearm pronation (80 ° to 90 ° from mid-position).

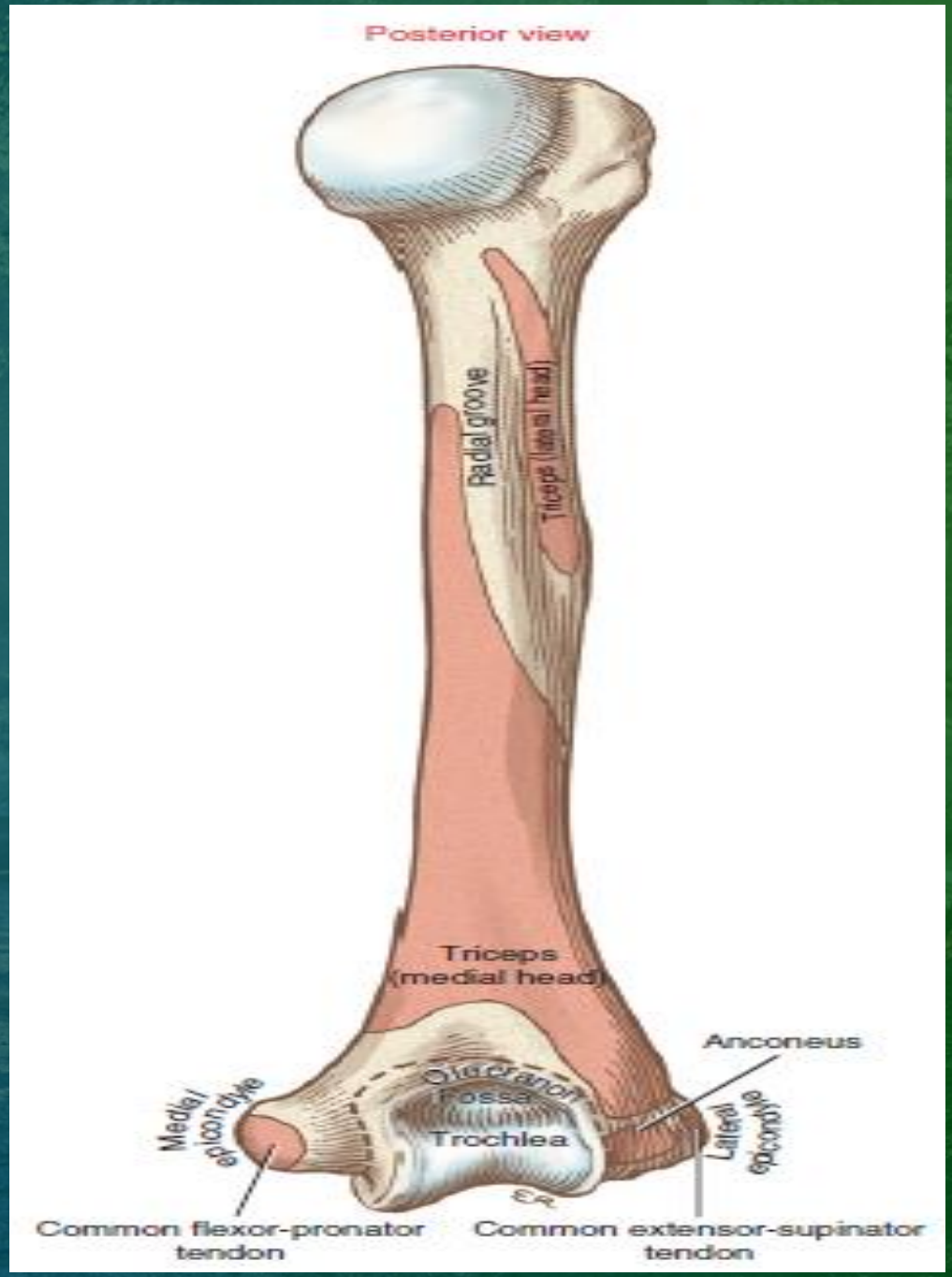


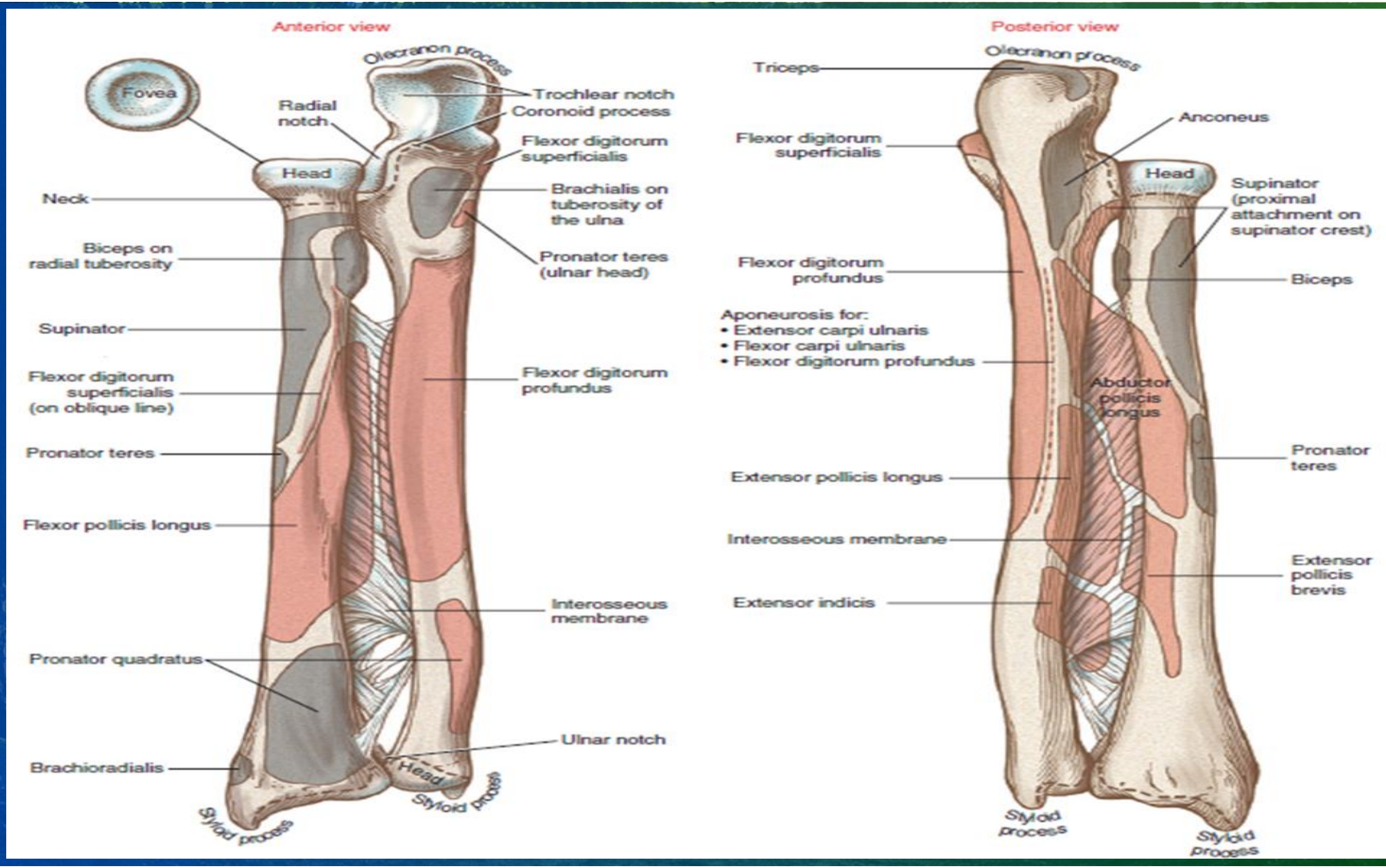
start position · supination and pronation.

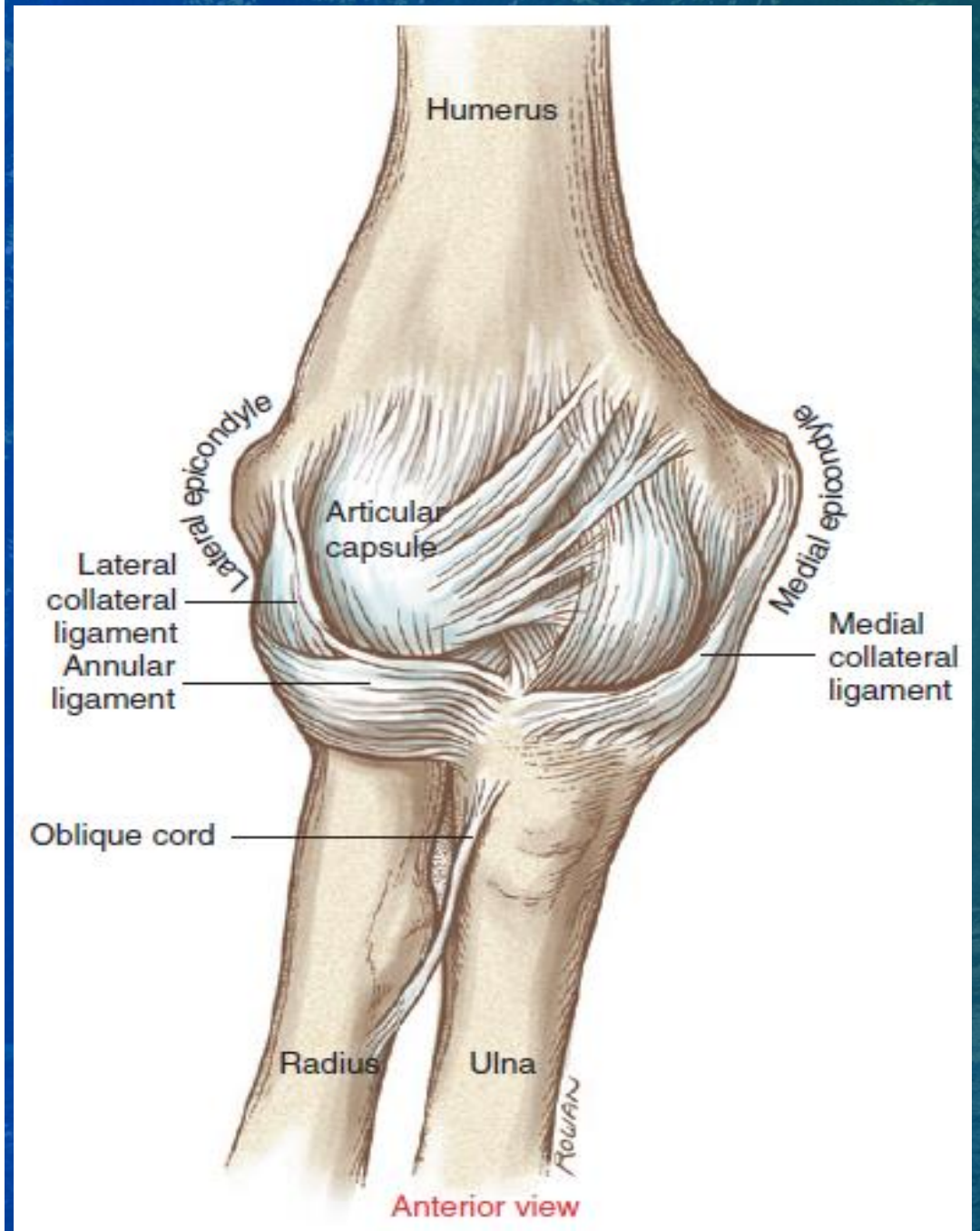
End position for Supination.

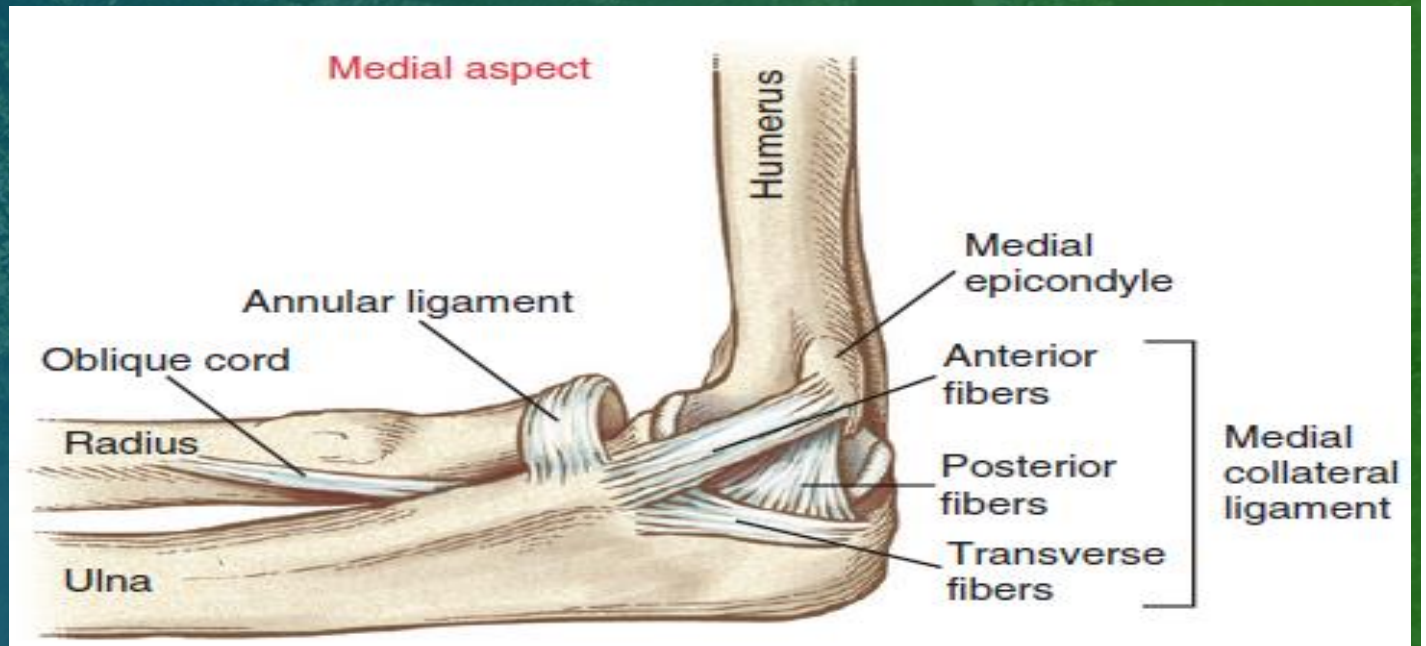
End position for Pronation.

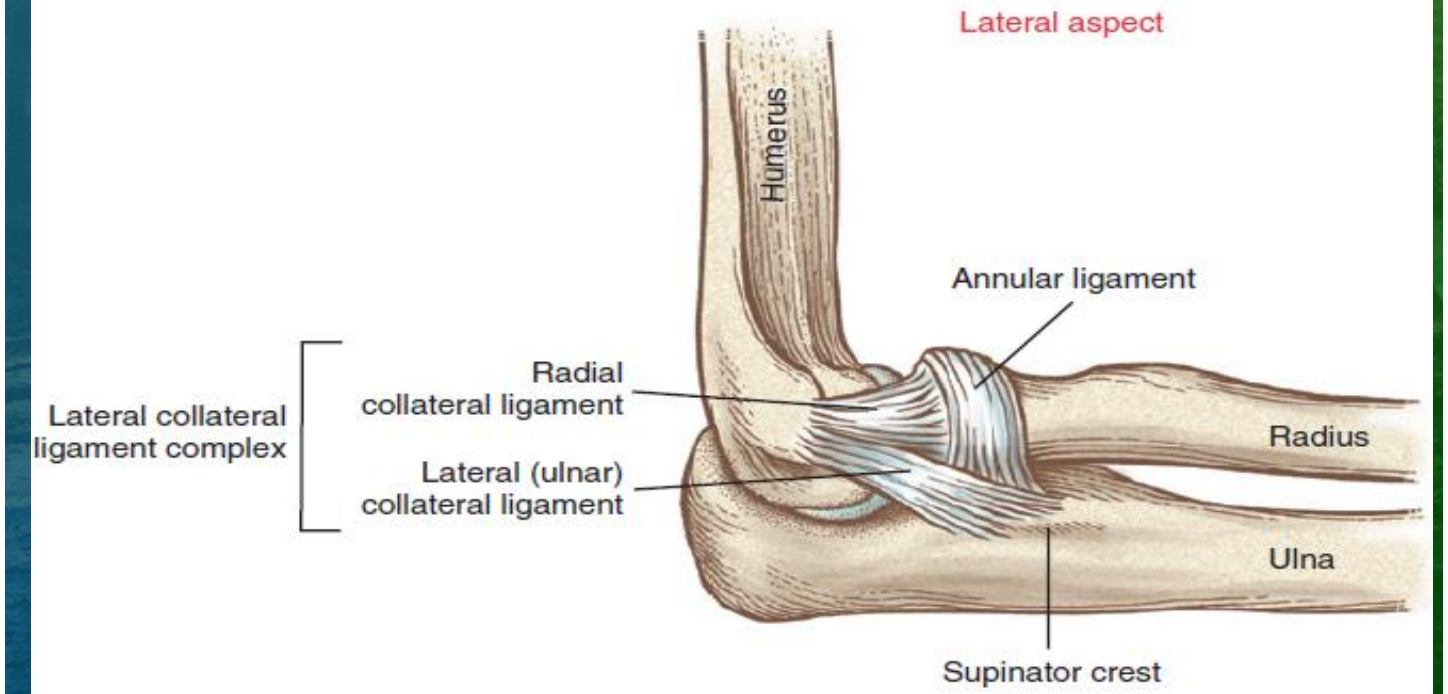

Anterior view
Brachioradialis
Extensor carpi radialis longus
Lateral supracondylar ridge
Lateral epicondyle
Brachialis
Medial supracondylar ridge
Pronator teres (humeral head)
Medial epicondyle
Capitulum
Trochlea
Common extensor-supinator tendon
Lateral lip
Medial lip
Common flexor-pronator tendon

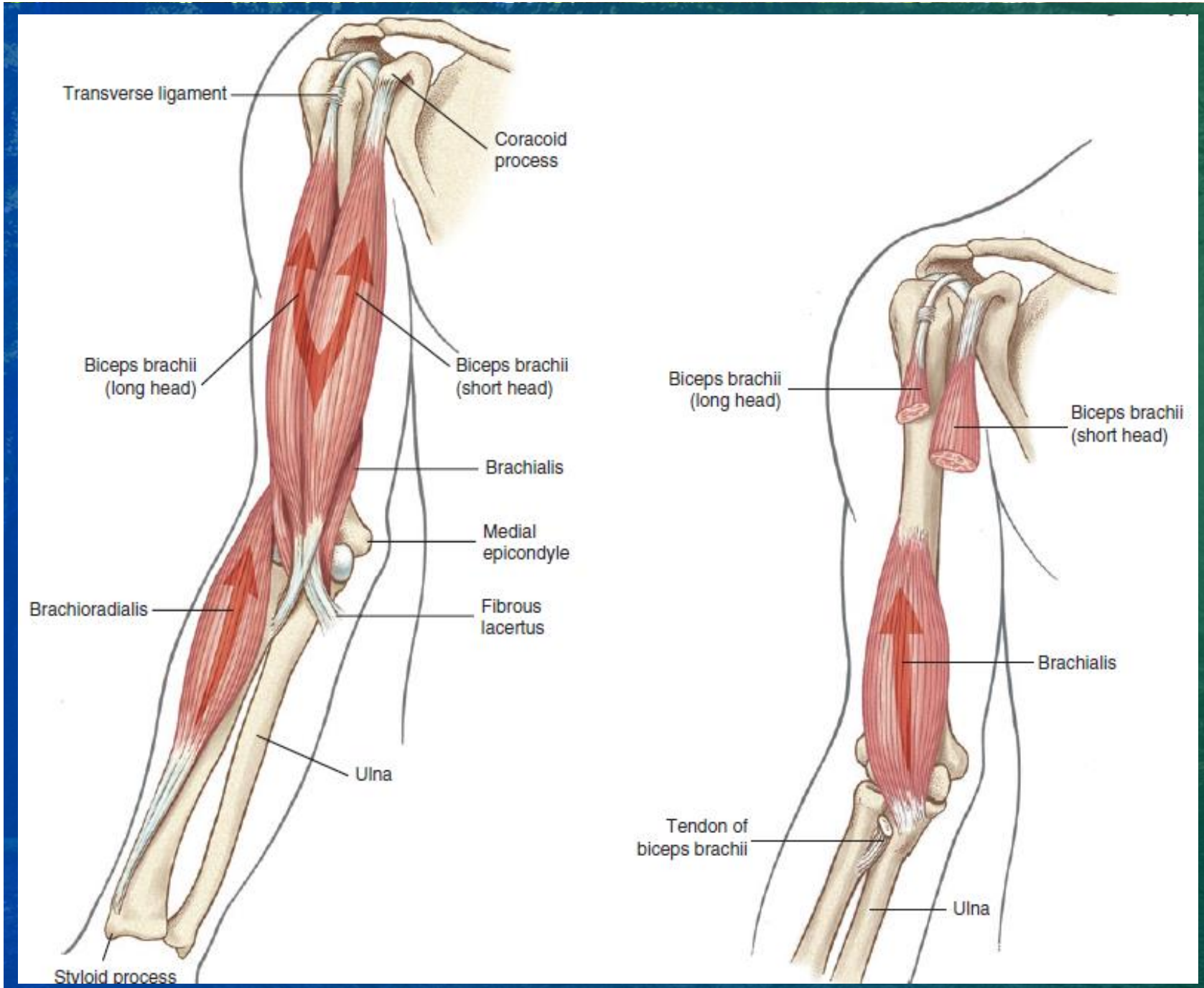

Posterior view
Radial groove
Triceps (lateral head)
Triceps (medial head)
Anconeus
Olecranon fossa
Trochlea
Medial epicondyle
Lateral epicondyle
Common flexor-pronator tendon
Common extensor-supinator tendon


Anterior view
Olecranon process
Fovea
Trochlear notch
Radial notch
Coronoid process
Flexor digitorum superficialis
Head
Neck
Brachialis on tuberosity of the ulna
Biceps on radial tuberosity
Pronator teres (ulnar head)
Supinator
Flexor digitorum profundus
Flexor digitorum superficialis (on oblique line)
Pronator teres
Flexor pollicis longus
Interosseous membrane
Pronator quadratus
Ulnar notch
Brachioradialis
Head
Styloid process
Styloid process
Posterior view
Olecranon process
Triceps
Anconeus
Flexor digitorum superficialis
Head
Supinator (proximal attachment on supinator crest)
Flexor digitorum profundus
Biceps
Aponeurosis for:
• Extensor carpi ulnaris
• Flexor carpi ulnaris
• Flexor digitorum profundus
Abductor pollicis longus
Pronator teres
Extensor pollicis longus
Interosseous membrane
Extensor pollicis brevis
Extensor indicis
Styloid process
Styloid process

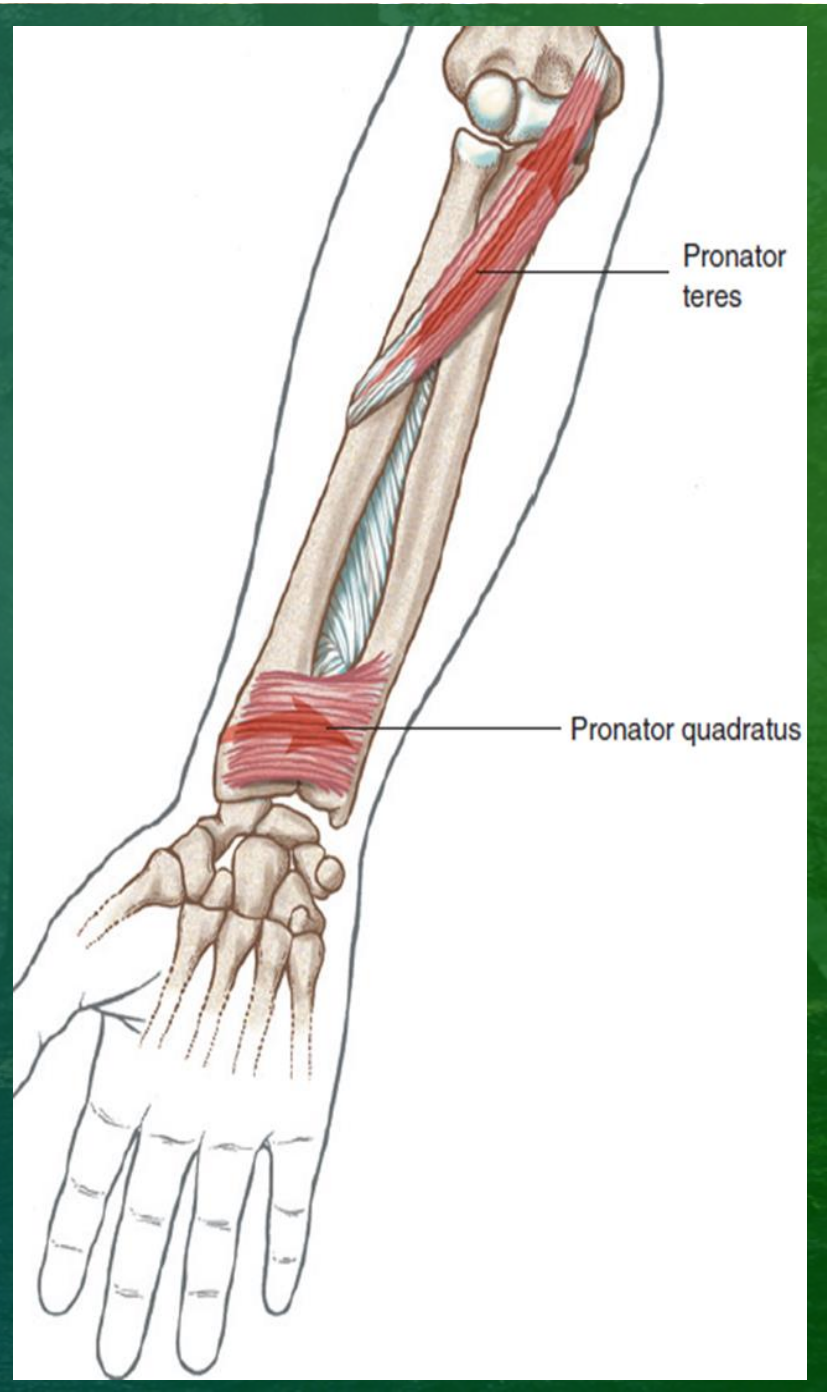

Humerus
Lateral epicondyle
Articular capsule
Medial epicondyle
Lateral collateral ligament
Annular ligament
Medial collateral ligament
Oblique cord
Radius
Ulna
Anterior view

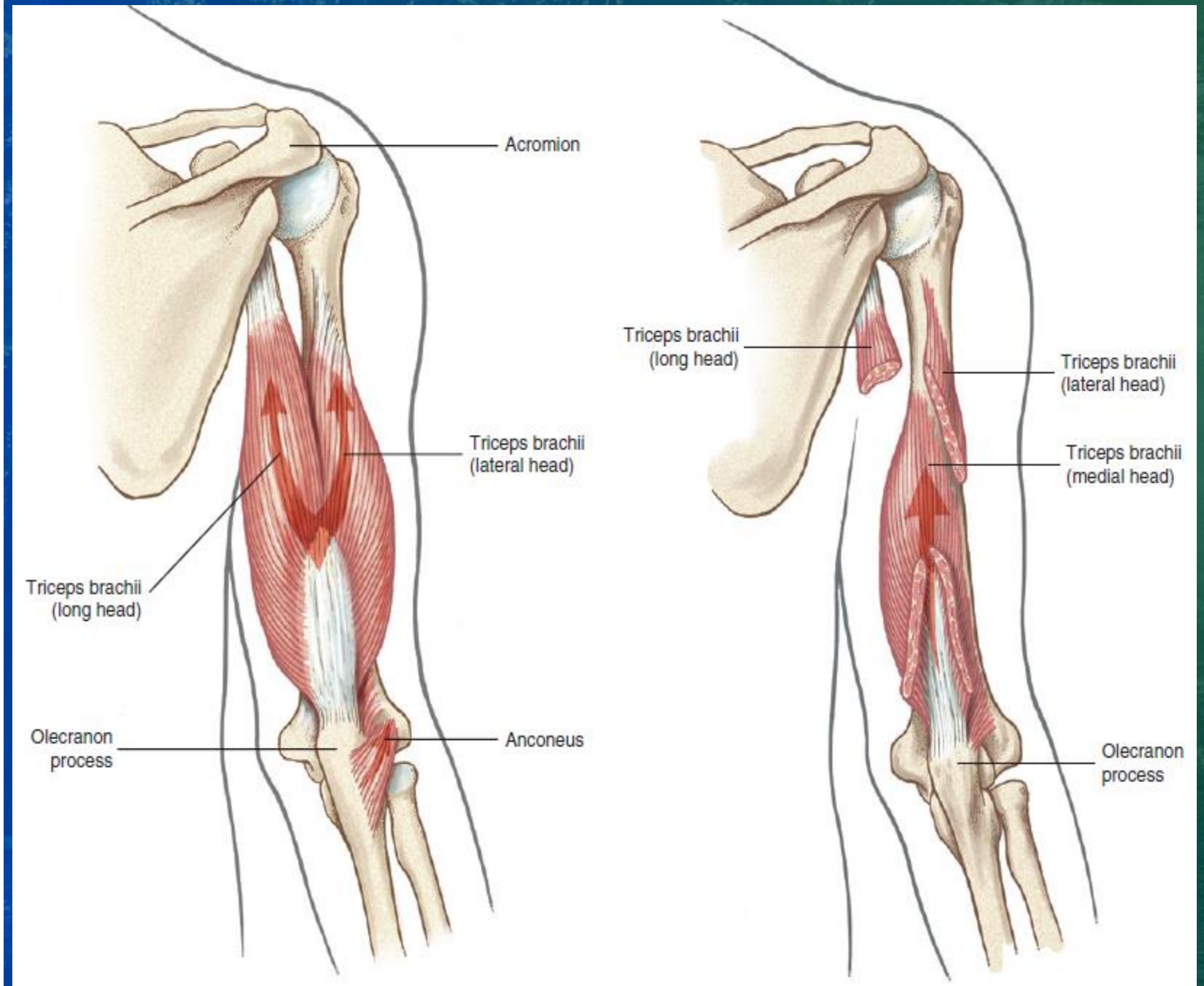

Medial aspect
Humerus
Medial epicondyle
Annular ligament
Oblique cord
Anterior fibers
Radius
Posterior fibers
Medial collateral ligament
Transverse fibers
Ulna


Lateral aspect
Humerus
Annular ligament
Radial collateral ligament
Lateral collateral ligament complex
Radius
Lateral (ulnar) collateral ligament
Ulna
Supinator crest

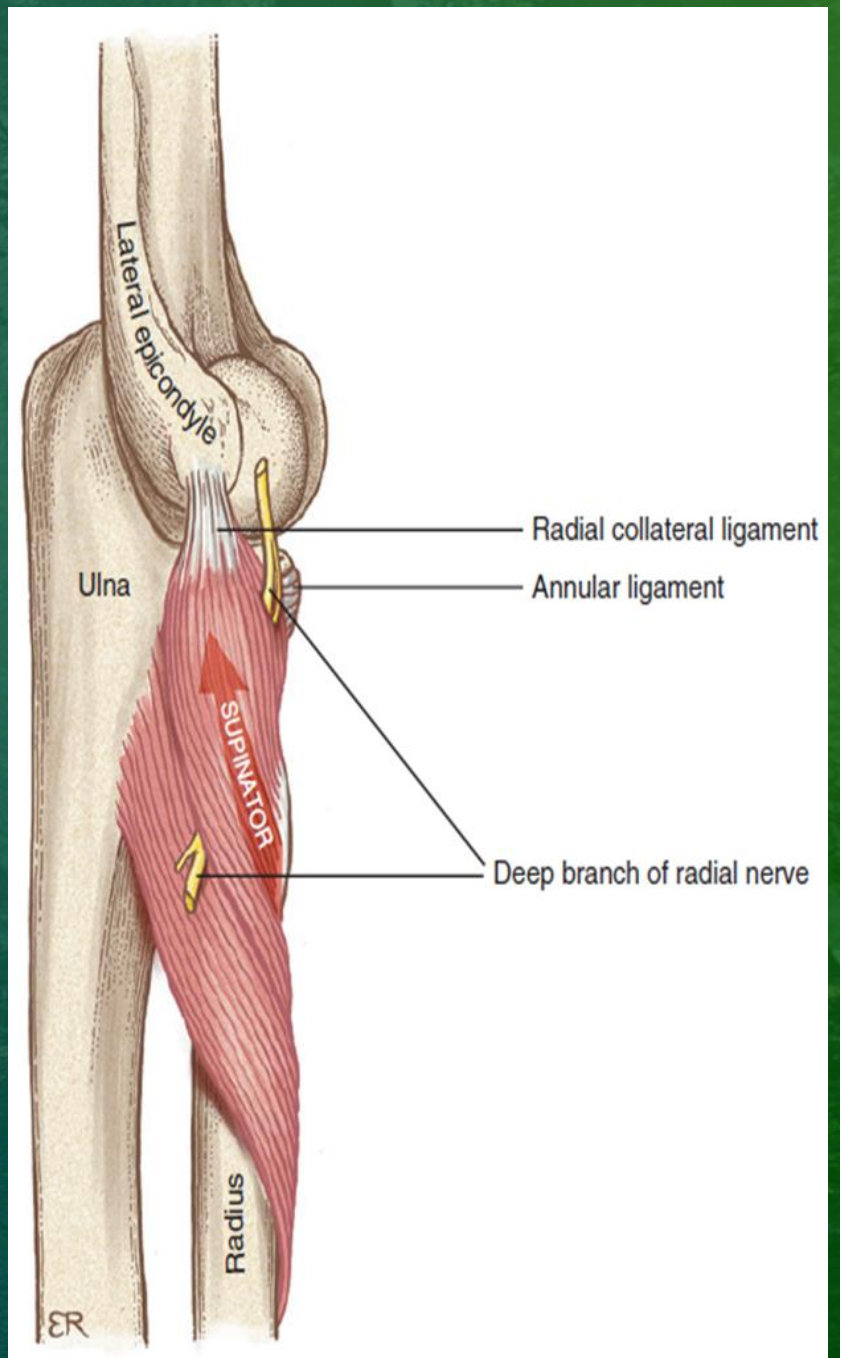

Transverse ligament
Coracoid process
Biceps brachii (long head)
Biceps brachii (short head)
Brachialis
Medial epicondyle
Brachioradialis
Fibrous lacertus
Ulna
Styloid process

Biceps brachii (long head)
Biceps brachii (short head)
Brachialis
Tendon of biceps brachii
Ulna


Pronator teres
Pronator quadratus


Acromion
Triceps brachii (lateral head)
Triceps brachii (long head)
Olecranon process
Anconeus

Triceps brachii (long head)
Triceps brachii (lateral head)
Triceps brachii (medial head)
Olecranon process


Lateral epicondyle
Radial collateral ligament
Annular ligament
Ulna
SUPINATOR
Deep branch of radial nerve
Radius
ER

Muscle	Primary Muscle Action	Muscle Origin	Muscle Insertion	Peripheral Nerve	Nerve Root
Biceps brachii	Elbow flexion and Forearm supination	a. Short head: apex of the coronoid process of the scapula b. Long head: supraglenoid tubercle of the scapula	a. Posterior aspect of the radial tuberosity b. Bicipital aponeurosis: deep fascia covering origins of the flexor muscles of the forearm	Musculocutaneous nerve	C5,6
Brachialis	Elbow flexion	Distal one-half of the anterior aspect of the humerus; medial and lateral intermuscular septa	Tuberosity of the ulna; rough impression on the anterior surface of the coronoid process	Musculocutaneous nerve and Radial nerve	C5,6 (7)
Brachio-radialis	Elbow flexion	Proximal two-thirds of the lateral supracondylar ridge of the humerus; lateral intermuscular septum	Lateral side of the distal end of the radius, just proximal to the styloid process	Radial nerve	C5,6

1) Elbow Flexion with Supination:-

*__Primary muscles:__ Biceps Brachii

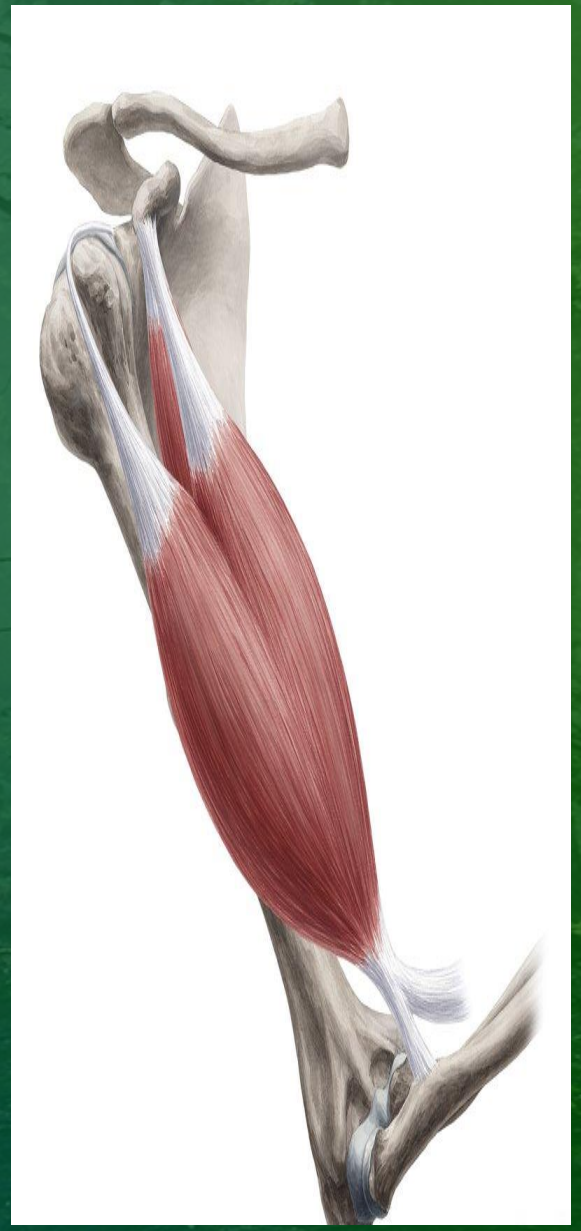
*__Accessory muscles:__ brachialis, brachioradialis, pronator teres, and extensor carpi radialis longus and brevis.

*__Against Gravity:__ __Start Position:__ The patient is supine or sitting. The arm is at the side, the elbow is extended, and the forearm is supinated.

*__Stabilization:__ The therapist stabilizes the humerus.

*__Movement:__ The patient flexes the elbow through full ROM.

*__Palpation:__ Anterior aspect of the antecubital fossa.



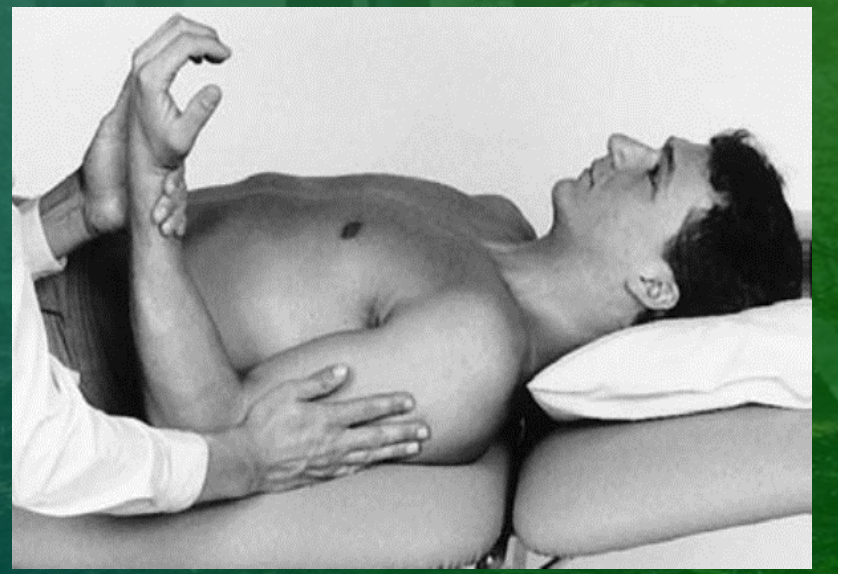
*__Substitute Movement:__ Brachialis may substitute for biceps brachii because it is an elbow flexor, irrespective of forearm positioning.

*__Resistance Location:__ Applied proximal to the wrist joint on the anterior aspect of the forearm.

*__Resistance Direction:__ Elbow extension.

Start position: biceps brachii.

Screen position: biceps brachii.



Resistance: biceps brachii.

*Gravity Eliminated: **Start Position:** The patient is sitting with the arm supported on a powder board. The shoulder is abducted to 90 °, the elbow is extended, and the forearm is supinated.

***Stabilization:** The therapist stabilizes the humerus.

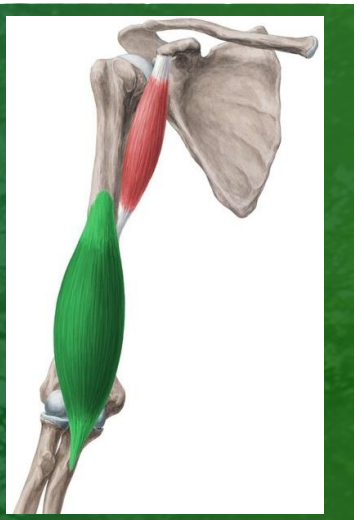
***End Position:** The patient flexes the elbow through full ROM.

***Substitute Movement:** Brachialis.

Start position: biceps brachii.

End position: biceps brachii.

2) Elbow Flexion with Pronation:-



*Primary muscles: Brachialis and Brachioradialis

*Accessory muscles: biceps brachii, pronator teres, and extensor carpi radialis longus and brevis.

*Against Gravity: Start Position: The patient is supine or sitting. The arm is at the side, the elbow is extended, and the forearm is in pronation.

*Stabilization: The therapist stabilizes the humerus.

*Movement: The patient flexes the elbow through full ROM.

*Palpation: -Brachialis: medial to biceps brachii tendon.
-Brachioradialis: anterolateral aspect of the forearm, just distal to the elbow crease. Because both muscles are active when the forearm is pronated, muscle contraction must be confirmed by palpation and/or observation.

*__Resistance Location:__ Applied proximal to the wrist joint on the posterior aspect of the forearm.

*__Resistance Direction:__ Elbow extension.

Start position: brachialis and brachioradialis.

Screen position: brachialis and brachioradialis.

Resistance: brachialis and brachioradialis.

*Gravity Eliminated: Brachialis and Brachioradialis

*Start Position: The patient is sitting with the arm supported on a powder board. The shoulder is abducted to 90 °, the elbow is extended, and the forearm is pronated. An alternate position is side-lying.

*Stabilization: The therapist stabilizes the humerus.

*End Position: The patient flexes the elbow through full ROM.

Start position: brachialis and brachioradialis.

End position: brachialis and brachioradialis.

3) Elbow Extension:-

Muscle	Primary Muscle Action	Muscle Origin	Muscle Insertion	Peripheral Nerve	Nerve Root
Triceps brachii	Elbow extension	a. Long head: Infra-glenoid tubercle of the scapula b. Lateral head: posterolateral surface of the humerus between the radial groove and the insertion of teres minor; lateral intermuscular septum c. Medial head: posterior surface of the humerus below the radial groove between the trochlea of the humerus and the insertion of teres major; medial and lateral intermuscular septa	Posteriorly, on the proximal surface of the olecranon; some fibers Continue distally to blend with the Antebrachial fascia	Radial nerve	C6,7,8

2) Elbow Extension:-

*__Primary muscles:__ Triceps

*__Accessory muscles:__ anconeus

*__Against Gravity:__ __Start Position:__ The patient is supine. The shoulder is internally rotated and flexed to 90 °, the elbow is flexed, and the forearm is supinated.

*__Stabilization:__ The therapist stabilizes the humerus.

*__Movement:__ The patient extends the elbow through full ROM. Ensure the patient does not lock the elbow in full extension (i.e., the close-packed position).

*__Palpation:__ Just proximal to the olecranon process.

*__Resistance Location:__ Applied proximal to the wrist joint on the posterior aspect of the forearm.

*__Resistance Direction:__ Elbow flexion.

Start position: triceps.

Screen position: triceps.

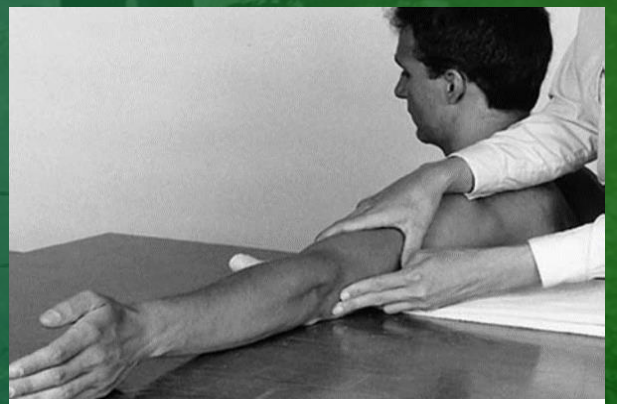
Resistance: triceps.

*Gravity Eliminated: Triceps

*Start Position: The patient is sitting with the arm supported on a powder board. The shoulder is abducted to 90°, the elbow is flexed, and the forearm is supinated.

Start position: triceps.

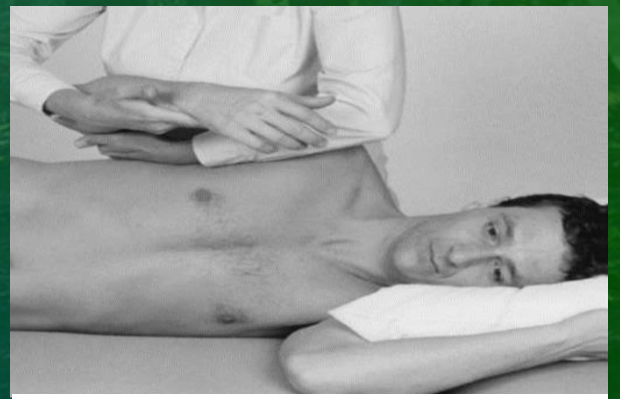
*Alternate Start Position: The patient is in a side-lying position. The therapist supports the weight of the upper limb.



End position: triceps.

*Stabilization: The therapist stabilizes the humerus.

*End Position: The patient extends the elbow through full ROM, avoiding the close-packed position.



Alternate start position.

*Substitute Movement: Scapular depression and shoulder external rotation, permitting gravity to complete the ROM.

*__Alternate Against Gravity:__ Triceps.

-This test is indicated if the patient has shoulder muscle weakness.

-The patient is prone.

-A towel is placed under the humerus for patient comfort during the application of stabilization and resistance.

-The shoulder is abducted, and the elbow is flexed with the forearm and hand hanging vertically over the edge of the plinth.

-The patient extends the elbow through the full ROM, avoiding the close-packed position.

-Resistance is applied proximal to the wrist joint on the posterior aspect of the Forearm.

Start position triceps.

Screen position: triceps.

Resistance: triceps.

4) Supination:-

Muscle	Primary Muscle Action	Muscle Origin	Muscle Insertion	Peripheral Nerve	Nerve Root
Supinator	Forearm Supination	Lateral epicondyle of the humerus; radial collateral ligament of the elbow joint; annular ligament of the superior radioulnar joint; from the supinator crest of the ulna and the posterior part of the depression anterior to it	Anterolateral and posterolateral surfaces of the proximal one-third of the radius	Posterior interosseous branch of radial	C6,7

4) Supination:-

* **Primary Muscles:** Supinator and Biceps Brachii.

*Against Gravity: **Start Position:** The patient is sitting. The arm is at the side, the elbow is flexed to 90 °, and the forearm is pronated.

***Stabilization:** The therapist stabilizes the humerus.

***Movement:** The patient supinates the forearm through full ROM. Because gravity assists supination beyond mid-position, slight resistance, equal to the weight of the forearm, may be applied by the therapist.

***Palpation:** -Biceps brachii: anterior aspect of the antecubital fossa.
-Supinator: posterior aspect of the forearm, distal to the head of the radius.

*__Substitute Movement:__ Shoulder external rotation, shoulder adduction, and ipsilateral trunk side flexion.

*__Resistance Location:__ Applied on the posterior surface of the distal end of the radius with counterpressure on the anterior aspect of the ulna.

*__Resistance Direction:__ Forearm pronation.

Start position: supinator and biceps brachii.

Screen position: supinator and biceps brachii.

Resistance: supinator and biceps brachii.

*Gravity Eliminated: Supinator and Biceps Brachii

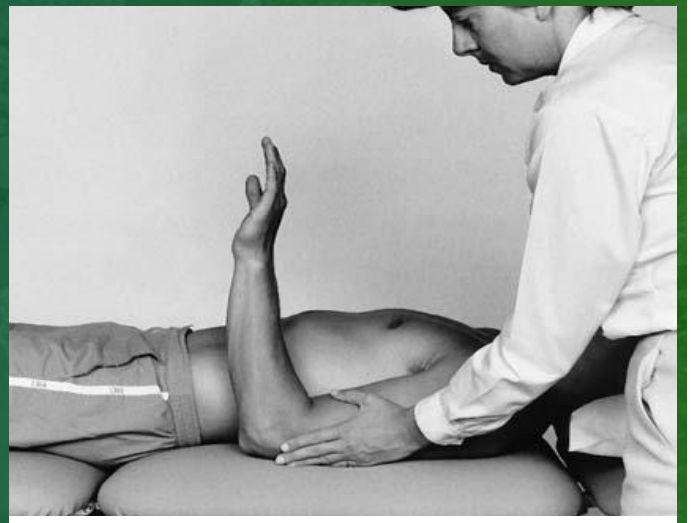
*Start Position: The patient is supine with the arm at the side, the elbow flexed to 90 °, and the forearm pronated.

*Alternate Start Position: The patient is sitting, the shoulder and the elbow are flexed to 90 °, and the forearm is pronated.

*Stabilization: The therapist stabilizes the humerus.

*End Position: The patient supinates the forearm through full ROM.

*Substitute Movement: Shoulder adduction and external rotation.



Start position: supinator and biceps brachii.

End position: supinator and biceps brachii.

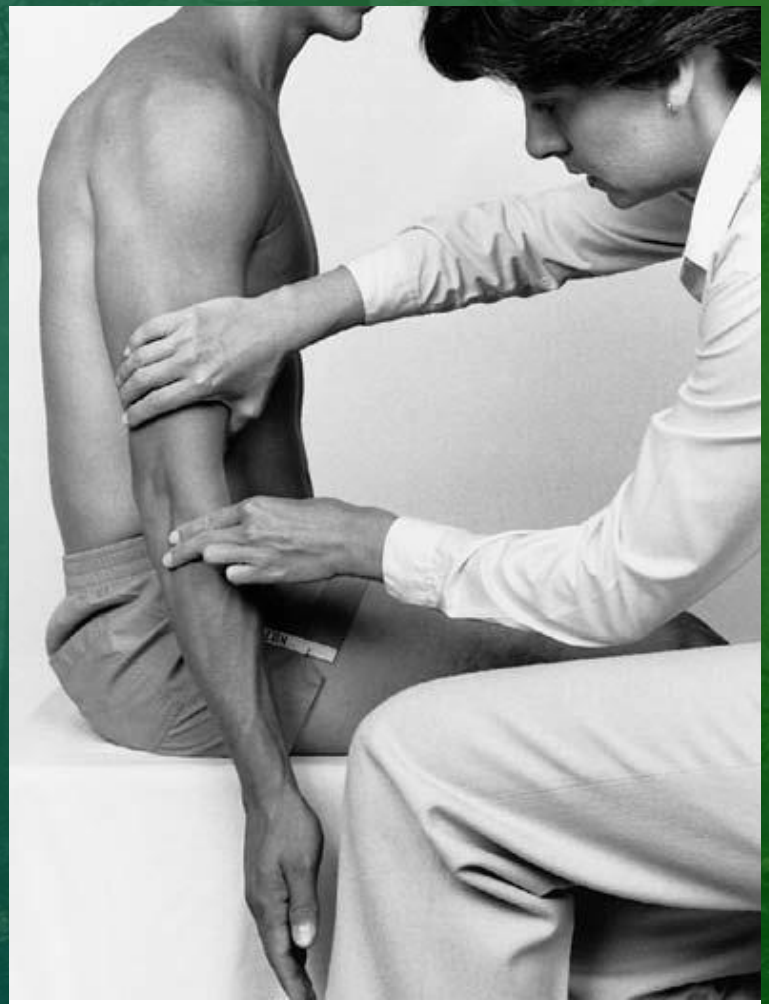
*Isolation of the Supinator muscle:

The biceps brachii does not supinate the forearm when the elbow is in extension and the movement is performed slowly and without resistance.

***Start Position:** The patient is sitting, the arm is at the side, the elbow is extended, and the forearm is pronated.

***Stabilization:** The therapist stabilizes the humerus.

***Movement:** The patient supinates the forearm through full ROM. The therapist palpates the supinator muscle during the Movement.



Clinical test for isolation of supinator.

*__Alternate Start Position:__ Using this test position, the biceps brachii is placed in a maximally shortened position, that is, a position of active insufficiency. In this position, the biceps is put on slack and no longer has the ability to develop effective tension, thus isolating the Supinator muscle.

*__Start Position:__ The patient is supine, the shoulder is flexed 90 °, the elbow is fully flexed, and the forearm is pronated.

*__Stabilization:__ The therapist stabilizes the humerus.

*__Movement:__ The patient slowly supinates the forearm. The therapist palpates the supinator during the movement. In the presence of supinator muscle weakness, the patient will be unable to maintain the forearm in the fully supinated position using the biceps alone.

Muscle	Primary Muscle Action	Muscle Origin	Muscle Insertion	Peripheral Nerve	Nerve Root
Pronator teres	Forearm pronation	a. Humeral head: just proximal to the medial epicondyle; common forearm flexor muscle tendon b. Ulnar head: medial side of the coronoid process of the ulna	Midway along the lateral surface of the radial shaft	Median	C6 7
Pronator quadratus	Forearm pronation	Distal one-fourth of the anterior surface of the shaft of the ulna	Distal one-fourth of the anterior border and surface of the shaft of the radius; triangular area proximal to the ulnar notch of the radius	Anterior interosseous branch of median	C7 8

5) Pronation:-

*__Primary Muscles:__ Pronator Teres and Pronator Quadratus.

*__Against Gravity:__ __Start Position:__ The patient is sitting. The arm is at the side, the elbow is flexed to 90 °, and the forearm is supinated.

*__Stabilization:__ The therapist stabilizes the humerus.

*__Movement:__ The patient pronates the forearm through full ROM. Because gravity assists pronation beyond mid-position, slight resistance, equal to the weight of the forearm, may be applied by the therapist.

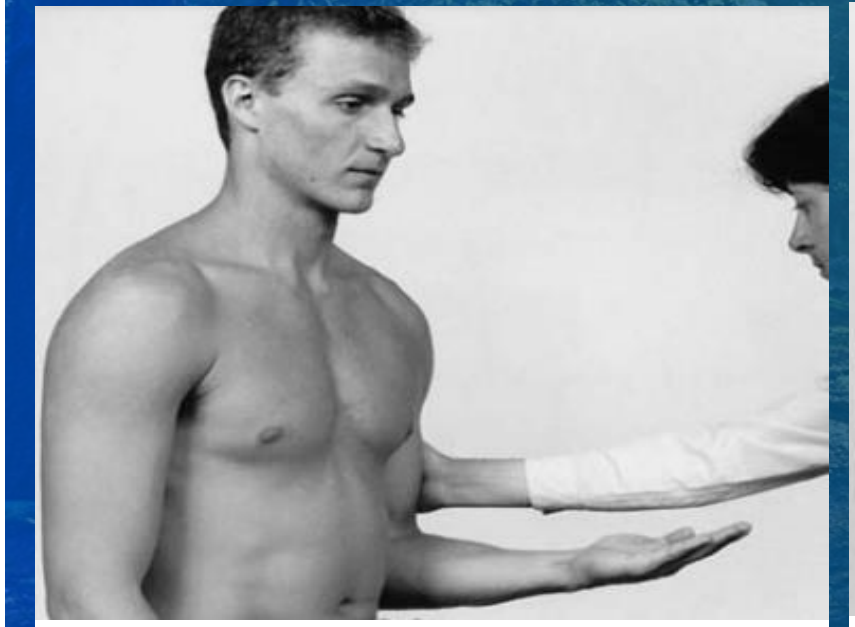
*__Palpation:__ -Pronator teres: proximal one-third of the anterior surface of the forearm on a diagonal line from the medial epicondyle of the humerus to the middle of the lateral border of the radius.

-Pronator quadratus: too deep to palpate.

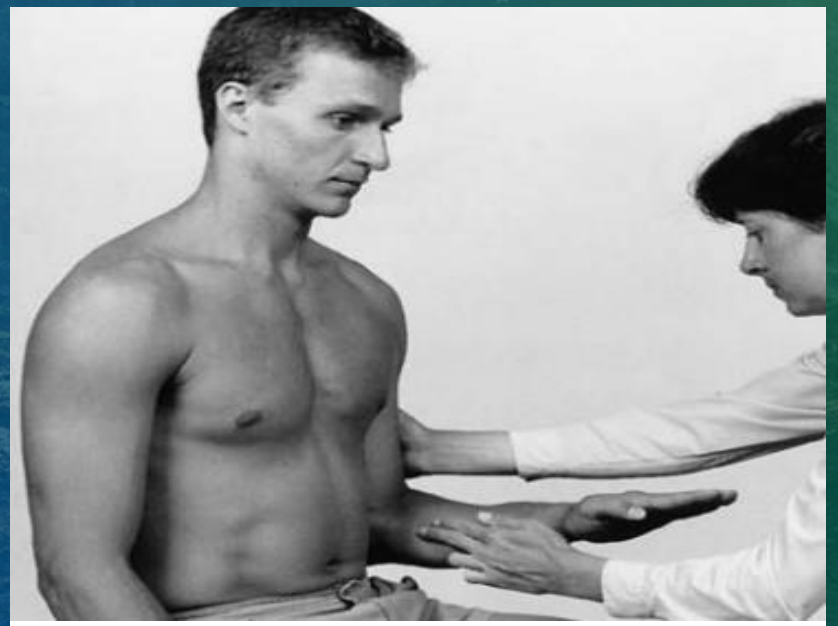
*__Substitute Movement:__ Shoulder abduction and internal rotation, and contralateral trunk side flexion.

*__Resistance Location:__ Applied on the anterior surface of the distal end of the radius with counterpressure on the posterior aspect of the ulna.

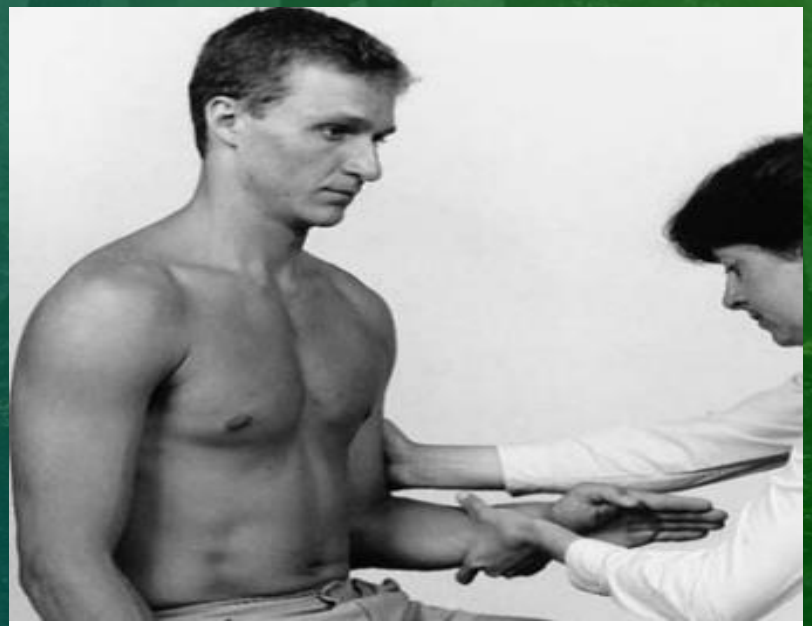
*__Resistance Direction:__ Forearm supination.



Start position: pronator teres and pronator quadratus.



Screen position: pronator teres and pronator quadratus.



Resistance: pronator teres and pronator quadratus.

*__Gravity eliminated:__ Pronator Teres and Pronator Quadratus.

*__Start Position:__ The patient is supine with the arm at the side, the elbow flexed to 90 °, and the forearm supinated.

*__Stabilization:__ The therapist stabilizes the humerus.

*__End position:__ The patient pronates the forearm through full ROM’

*__Substitute movement:__ Shoulder abduction and internal rotation.


Start position: pronator teres and pronator quadratus.


End position: pronator teres and pronator quadratus.


Thanks


سُبْحَانَكَ اللَّهُمَّ وَبِحَمْدِكَ
أَشْهَدُ أَنْ لَا إِلَهَ إِلَّا أَنْتَ
أَسْتَغْفِرُكَ وَأَتُوبُ إِلَيْكَ