

# Forearm and hand

## Bones of the Forearm

- The forearm contains two bones: the **radius** and the **ulna**.

*Dr.sami 'ah algenabi*

**Radius** is the **lateral. bone of the forearm.**

Its proximal end articulates with humerus at elbow joint & with ulna at the proximal radioulnar joint.

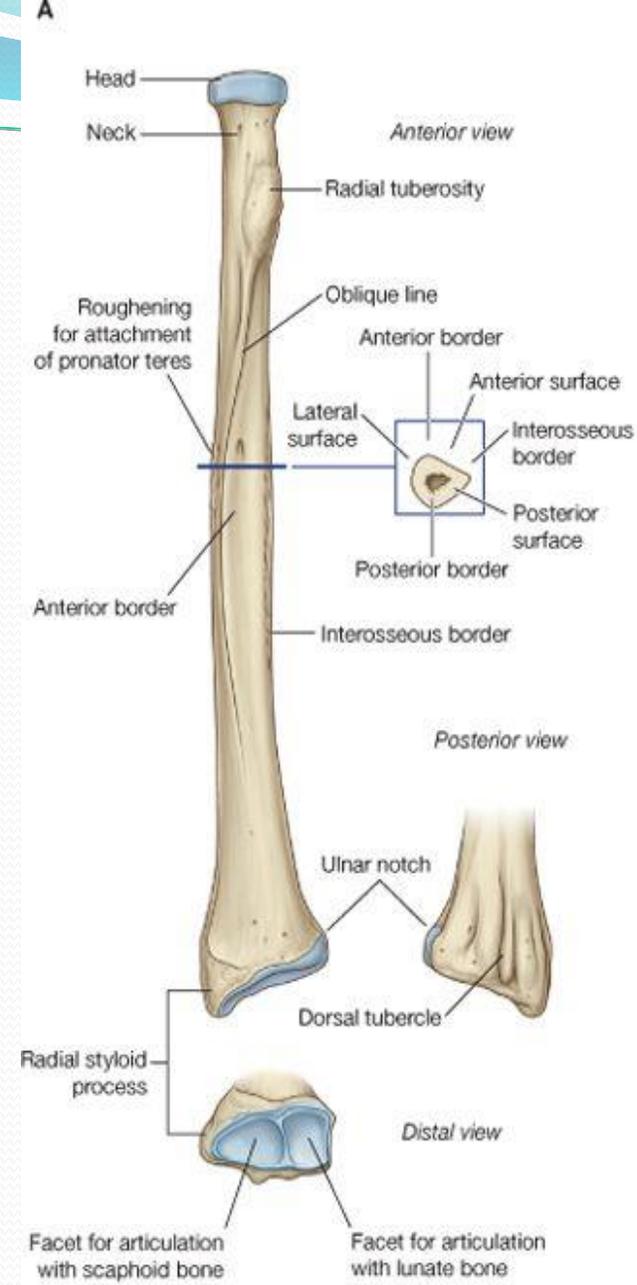
Its distal end articulates with the scaphoid & lunate bones of the hand at the wrist joint & with the ulna at the distal radioulnar joint.



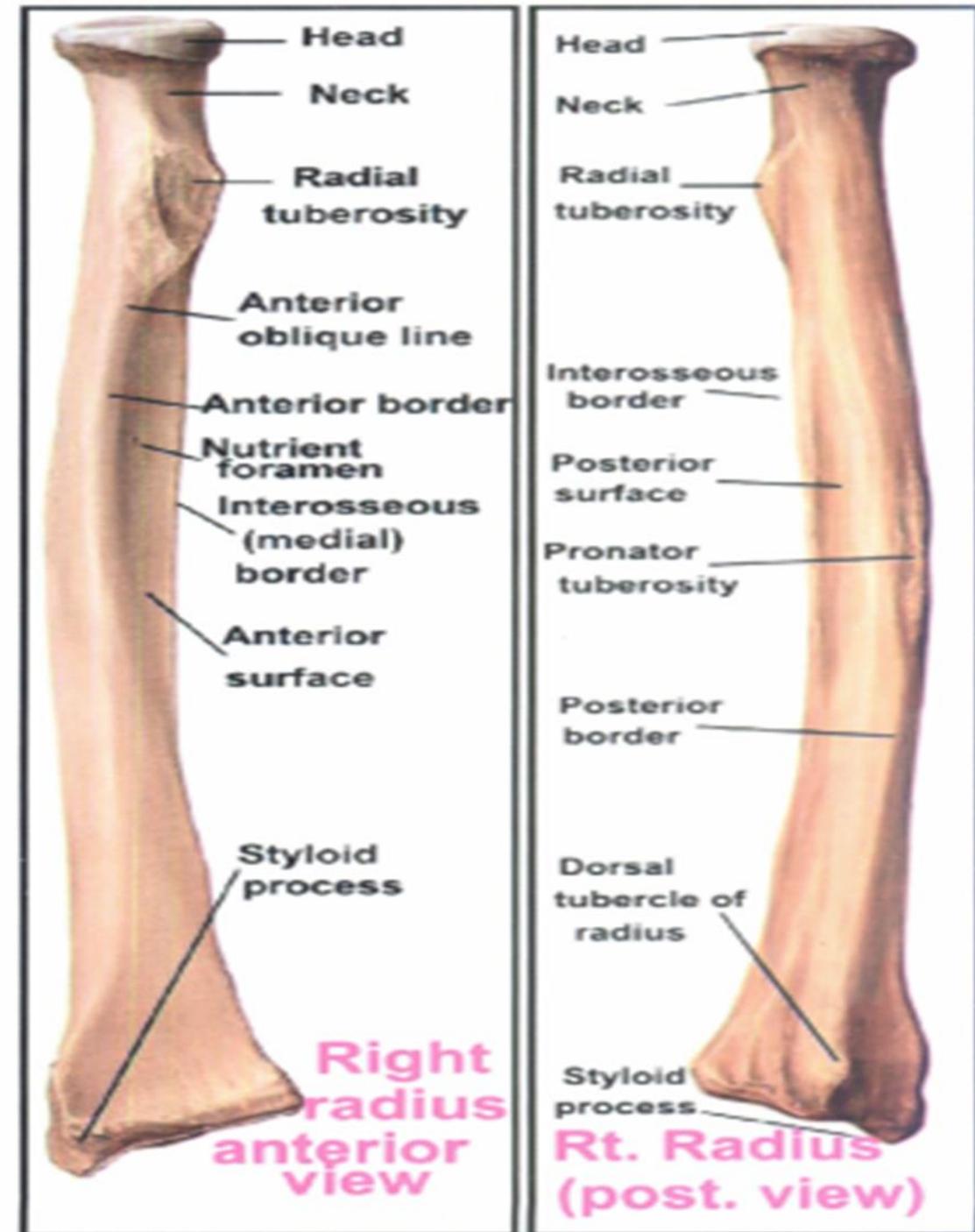
Proximal  
radioulnar  
joint

Distal  
radioulnar  
joint

- At the proximal end of the radius is the small circular **head**.
- The upper surface of the head is concave and articulates with the convex capitulum of the humerus.
- The circumference of the head articulates with the radial notch of the ulna.
- Below the head the bone is constricted to form the **neck**.
- Below the neck is the **bicipital tuberosity** for the insertion of the biceps muscle.



- The shaft of the radius, unlike that of the ulna, is wider below than above.
- It is prismatic in shape, slightly convex backward and laterally with 3 borders & 3 surfaces.
- **The anterior border** pass obliquely downwards laterally from radial tuberosity forming anterior oblique line,
- It has a sharp **interosseous border** medially for the attachment of the interosseous membrane that binds the radius and ulna together.
- **Posterior border** is well define in the middle third and continuous above as the posterior oblique line.
- **Anterior surface** is smooth & concave lies between anterior & interosseous borders.
- Posterior surface lies between posterior and interosseous borders
- Lateral surface is convex, lies between the anterior & posterior borders



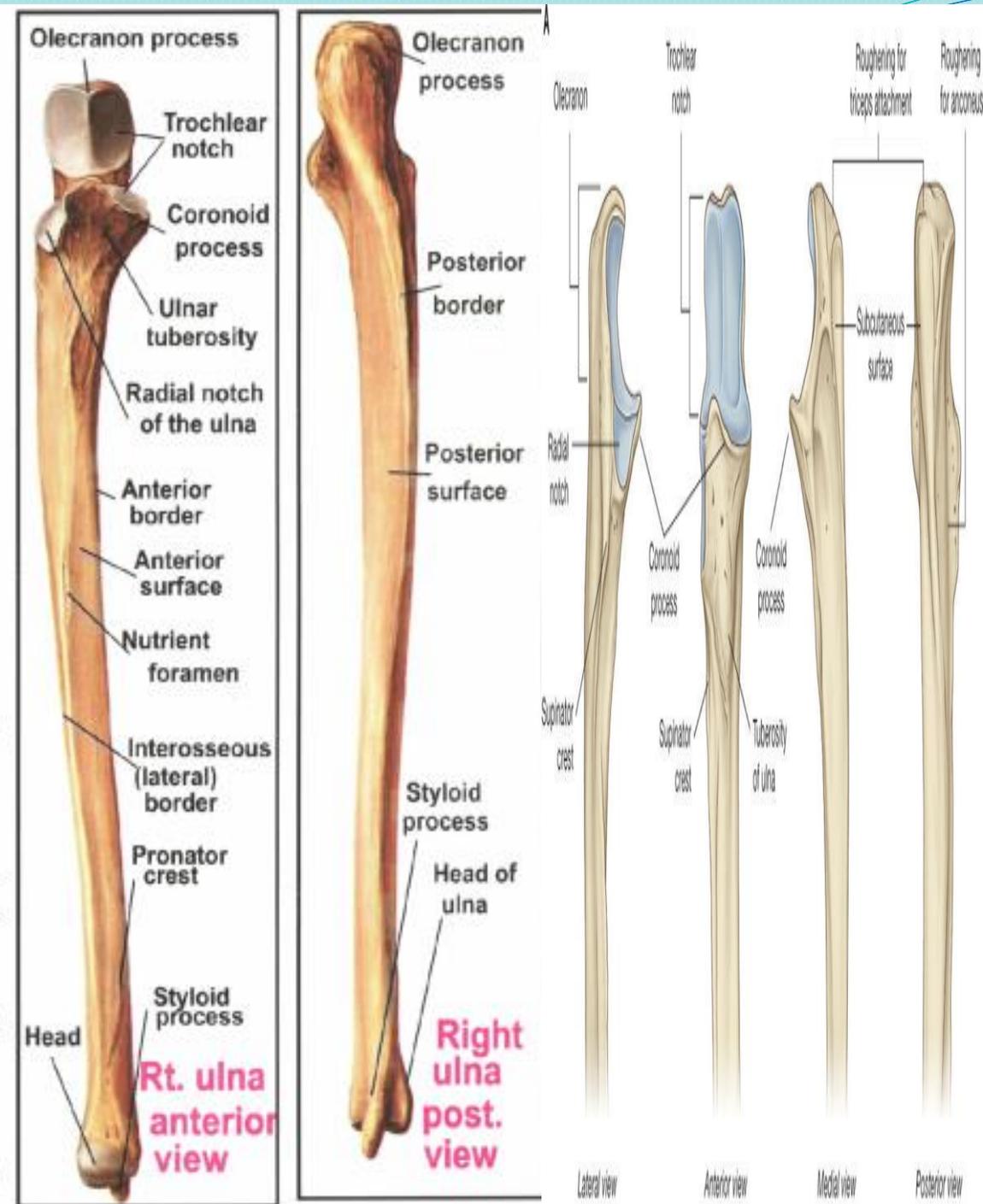
- The **pronator tubercle**, for the insertion of the pronator teres muscle, lies halfway down on its lateral side.
- Lower end of the radius has 5 surfaces
- **Anterior surface** is smooth & concave.
- **posterior aspect** has a small tubercle, the **dorsal tubercle of the radius**, which is grooved on its medial side by the tendon of the extensor pollicis longus.
- **Medial surface** is carries the **ulnar notch**, which articulates with the round head of the ulna.
- **Lateral surface** from which is the **styloid process**; projects downward distally (1.5 cm lower than the styloid process of the ulna thus the abduction less than adduction).
- **The inferior surface** articulates with the scaphoid and lunate bones.



Dorsal tubercle of radius

# Ulna

- The ulna is the medial bone of the forearm.
- Its proximal end articulates with the humerus at the elbow joint and with the head of the radius at the proximal radioulnar joint.
- Its distal end articulates with the radius at the distal radioulnar joint, but it is excluded from the wrist joint by the articular disc.
- The proximal end of the ulna is large and is known as the **olecranon process**; this forms the prominence of the elbow.
- It has a notch on its anterior surface, the **trochlear notch**, which articulates with the trochlea of the humerus.
- Below the trochlear notch is the triangular **coronoid process**, directed forward, which has on its lateral surface the **radial notch** for articulation with the head of the radius.



- **Shaft** of ulna tapers from above down & it has 3 borders & 3 surfaces:
- **Anterior border** is rounded, begins medial to ulnar tuberosity, ends below at the head
- **Lateral or interosseous border** is crest like and sharp give attachment of interosseous membrane.
- **Post. border** is rounded & subcutaneous & can be easily palpated throughout its length.
- Anterior surface is smooth & concave, lies between Ant. & Lat. Border
- Medial surface, lies between Ant. & poster. Borders.
- Posterior surface. Lies between Later. & post. borders
- Below radial notch lies **supinator crest** that gives origin to supinator muscle.
- The distal end of ulna forms the small rounded **head**, which has the **styloid process** projecting from its med. Aspect, it lies 1.5cm proximal to that of the radius.
- **Groove**: for extensor carpi ulnaris tendon lies between the head and the styloid process posteriorly

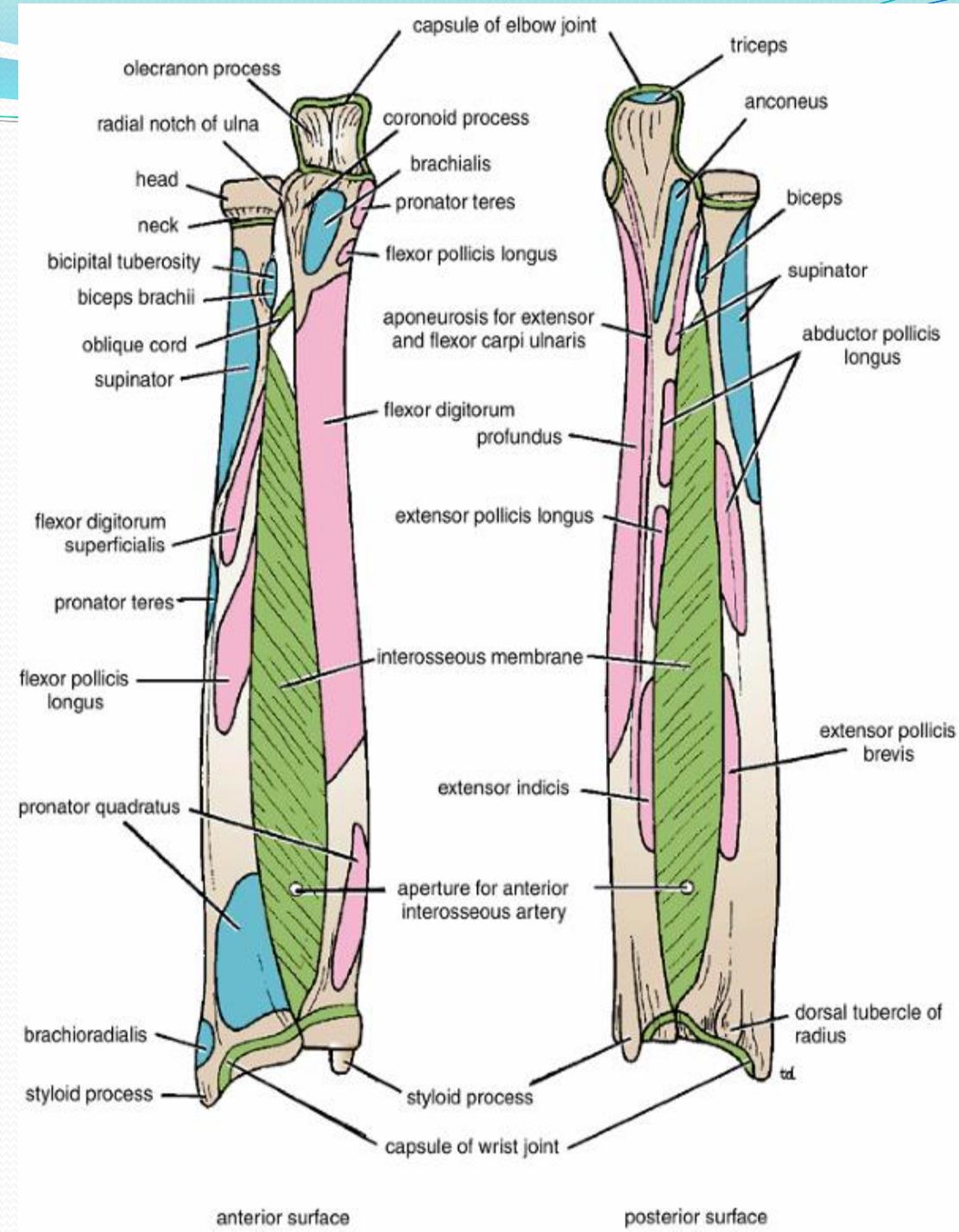


## Important landmarks for muscle

attachments include:

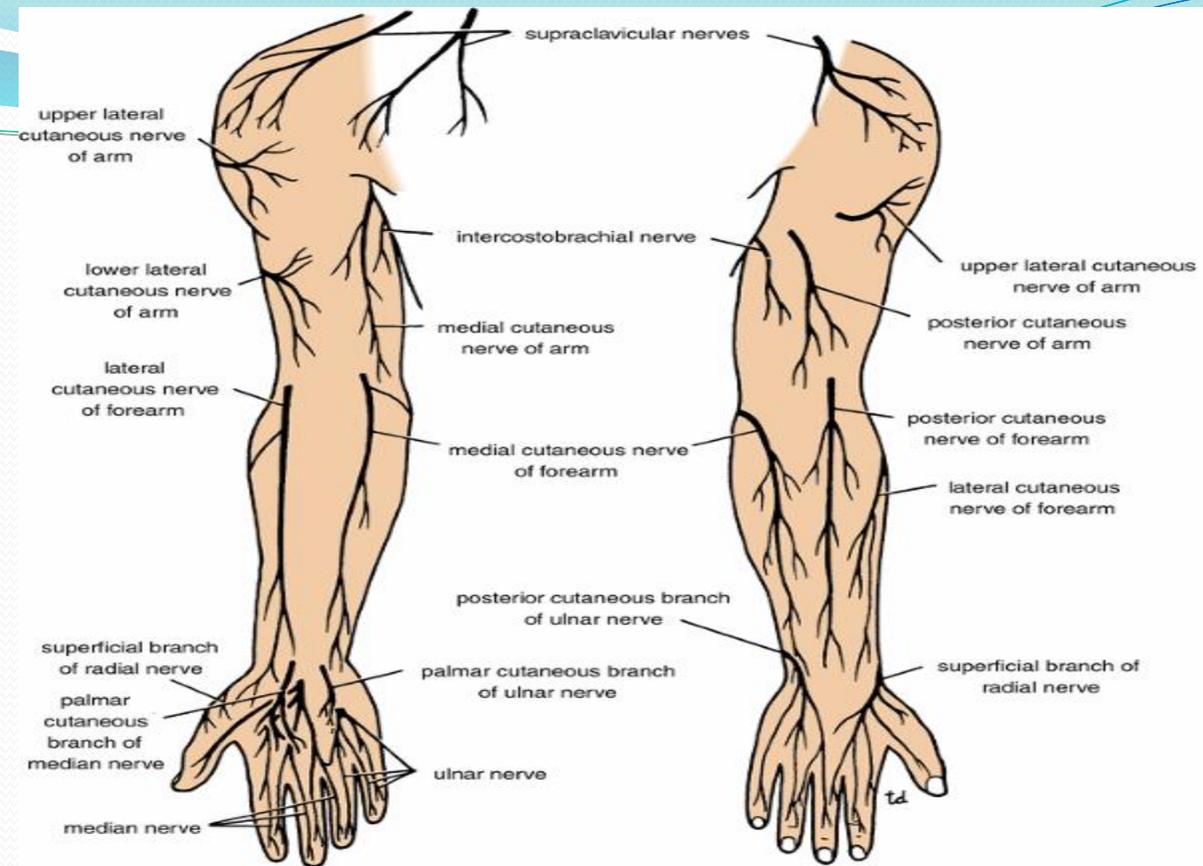
Biceps brachii, supinator, pronator teres, pronator quadratus and brachioradialis inserted to radius. Flexor digitorum superficialis, Flexor pollicis longus, Extensor pollicis brevis & Abductor pollicis longus origin from radius

Triceps, anconeus and brachialis inserted to ulna. Supinator, Abductor pollicis longus, Extensor pollicis longus, extensor indices & Flexor digitorum profunda origin from ulna



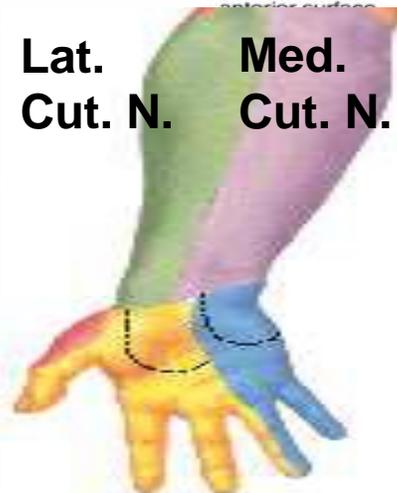
# SKIN of The Forearm

- The **sensory nerve supply** to the skin of the forearm is from the anterior and posterior branches of the **lateral cutaneous nerve of the forearm**, a continuation of the musculocutaneous nerve, and from the anterior and posterior branches of the **medial cutaneous nerve of the forearm**.
- A narrow strip of skin down the middle of the posterior surface of the forearm is supplied by the **posterior cutaneous nerve of the forearm**



anterior surface

Lat. Cut. N.      Med. Cut. N.



posterior surface

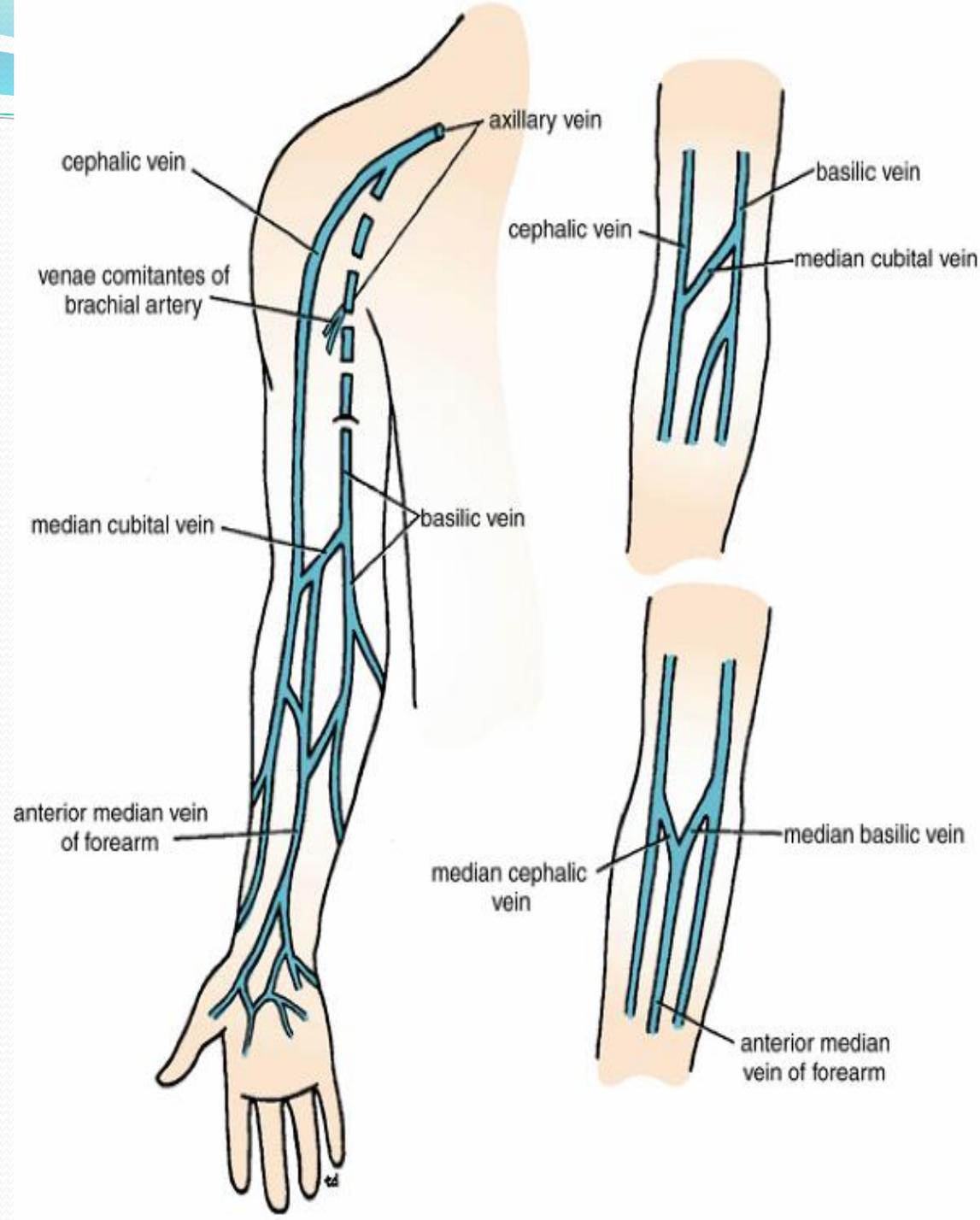
Post. Cut. N.



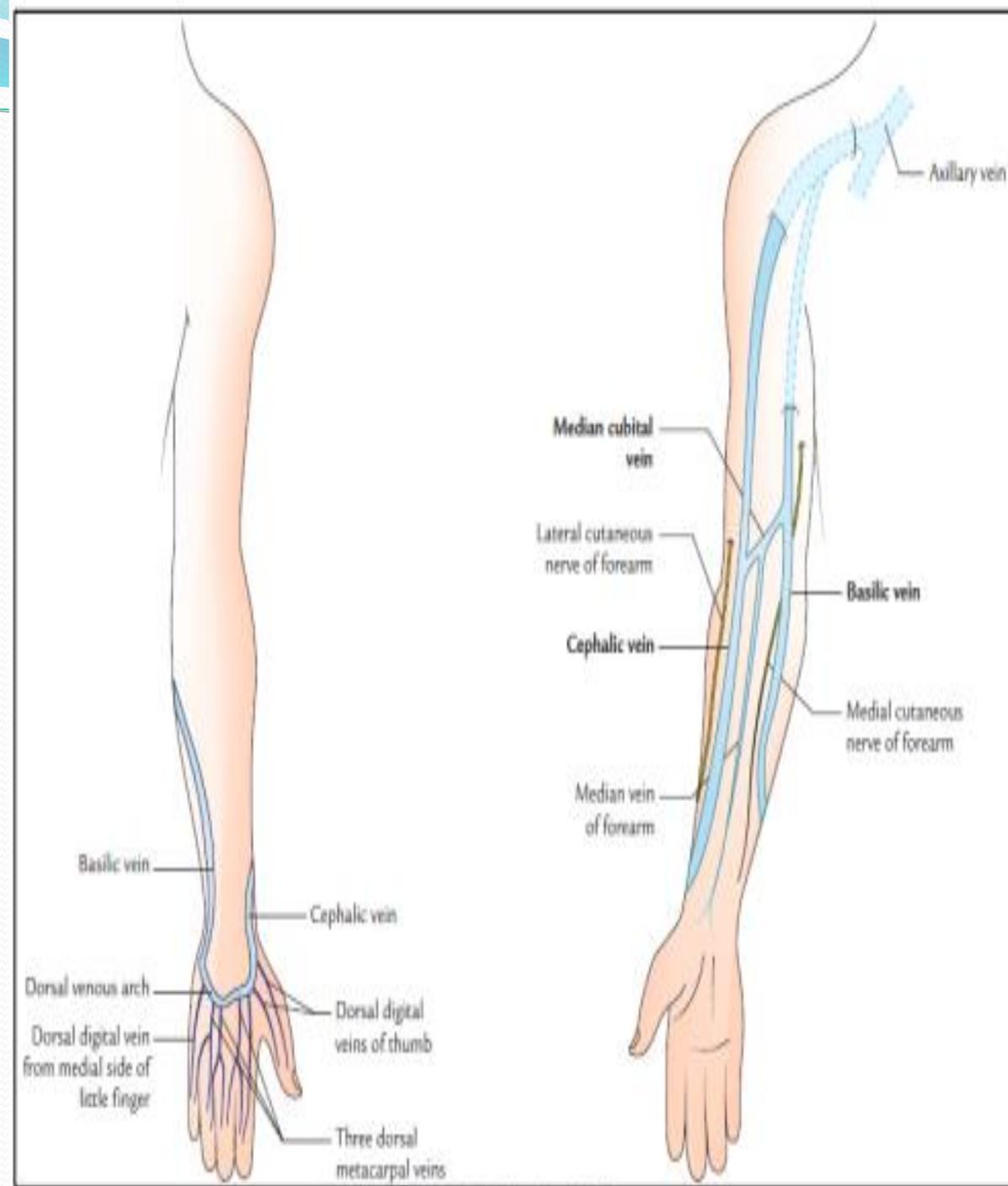
# superficial veins of the forearm

The **superficial veins of the forearm** lie in the superficial fascia.

- The **cephalic vein** arises from the lateral side of the dorsal venous arch on the back of the hand and winds around the lateral border of the forearm; it then ascends into the cubital fossa and up the front of the arm on the lateral side of the biceps. It terminates in the axillary vein in the deltopectoral triangle. As the cephalic vein passes up the upper limb, it receives a variable number of tributaries from the lateral and posterior surfaces of the limb.
- The **median cubital vein**, a branch of the cephalic vein in the cubital fossa, runs upward and medially and joins the **basilic vein**. In the cubital fossa, the median cubital vein crosses in front of the brachial artery and the median nerve, but it is separated from them by the bicipital aponeurosis.

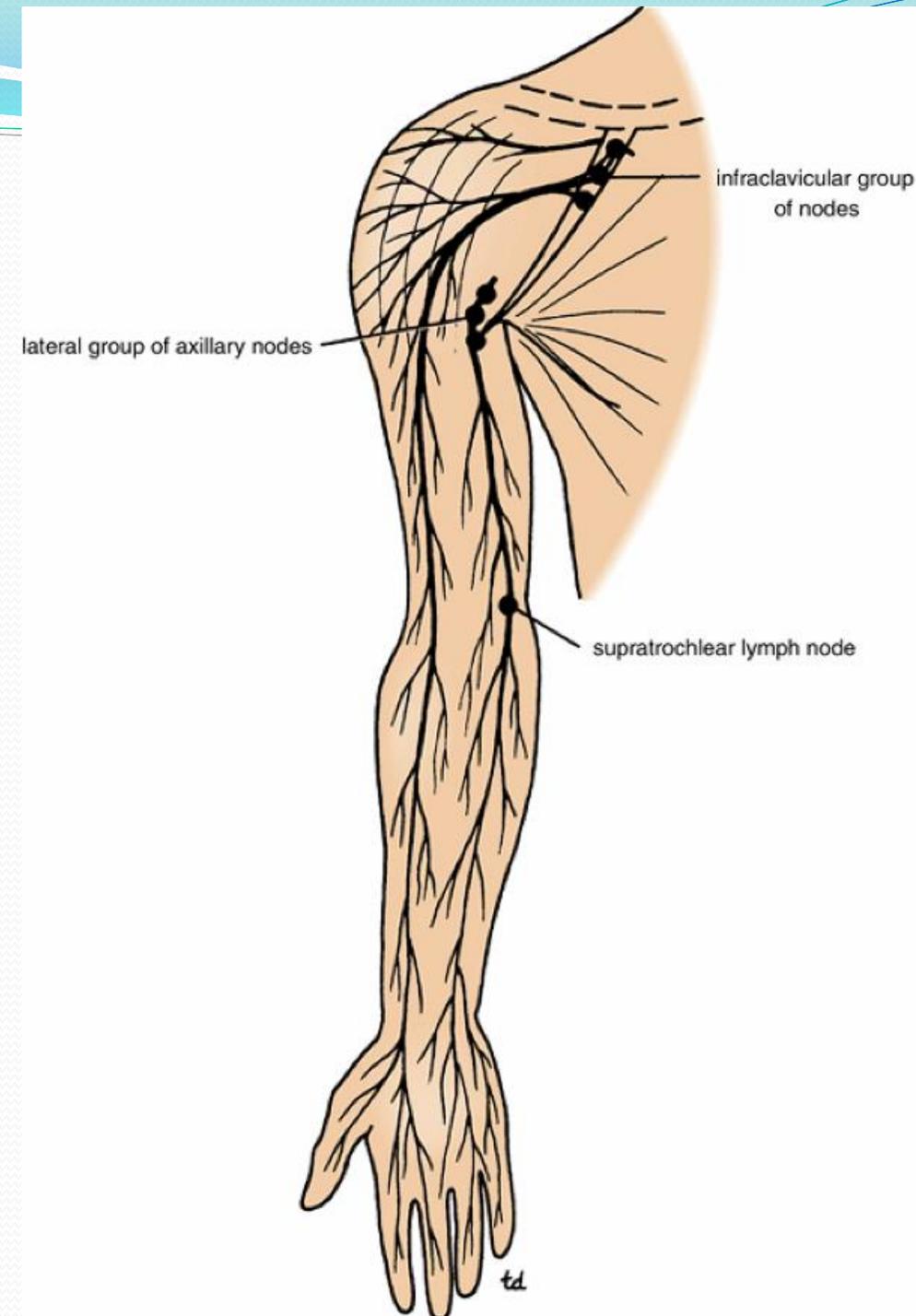


- The **basilic vein** arises from the medial side of the dorsal venous arch on the back of the hand and winds around the medial border of the forearm; it then ascends into the cubital fossa and up the front of the arm on the medial side of the biceps. Its termination, by joining the venae comitantes of the brachial artery to form the axillary vein. It receives the median cubital vein and a variable number of tributaries from the medial and posterior surfaces of the upper limb



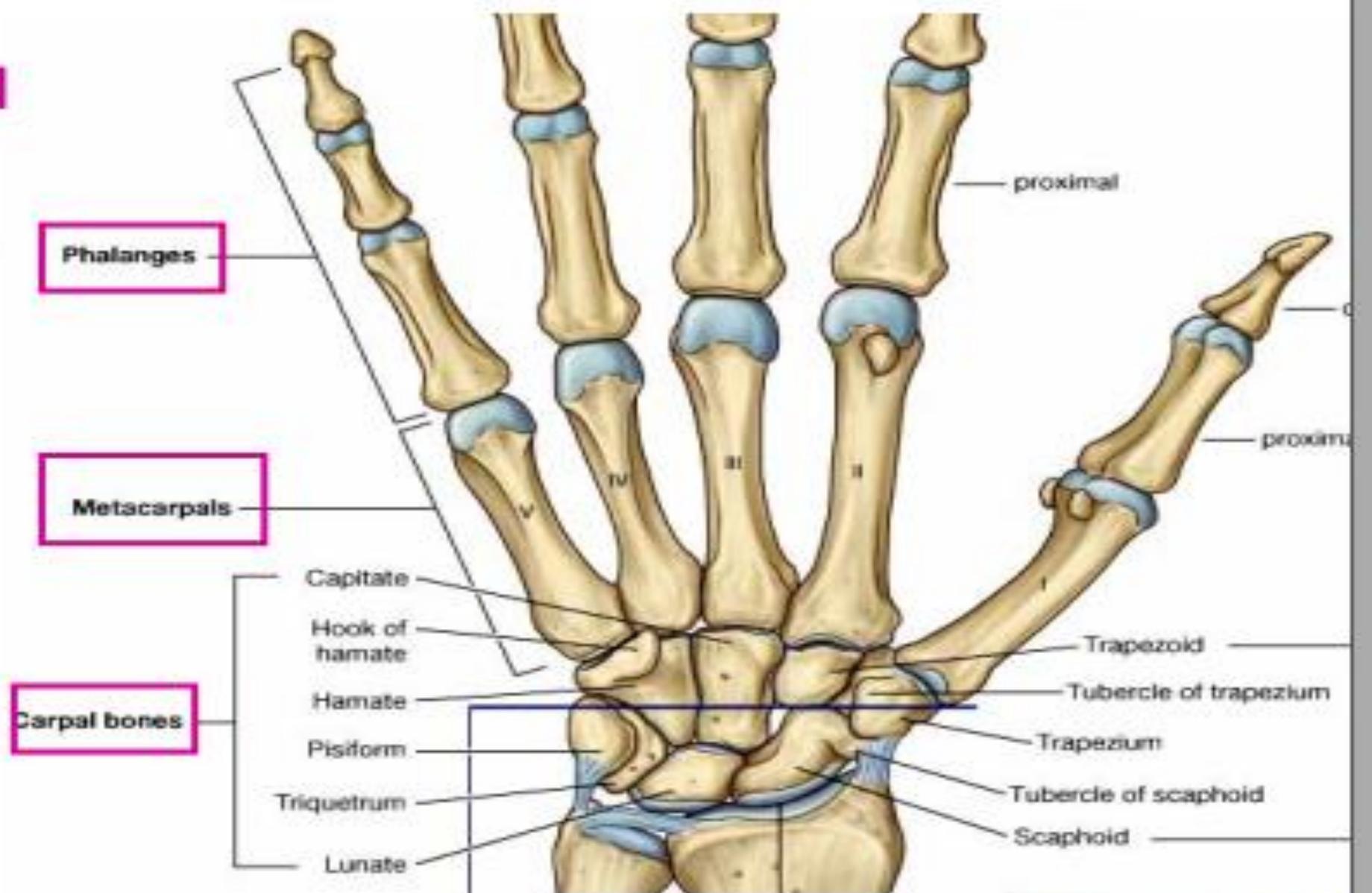
## The superficial lymph vessels

- From the thumb and lateral fingers and the lateral areas of the hand and forearm follow the **cephalic vein** to the **infraclavicular group of nodes**.
- Those from the medial fingers and the medial areas of the hand and forearm follow the **basilic vein** to the cubital fossa.
- Here, some of the vessels drain into the **supratrochlear lymph node**, whereas others bypass the node and accompany the basilic vein to the axilla, where they drain into the lateral group of axillary nodes.
- The efferent vessels from the supratrochlear node also drain into the lateral **axillary nodes**.



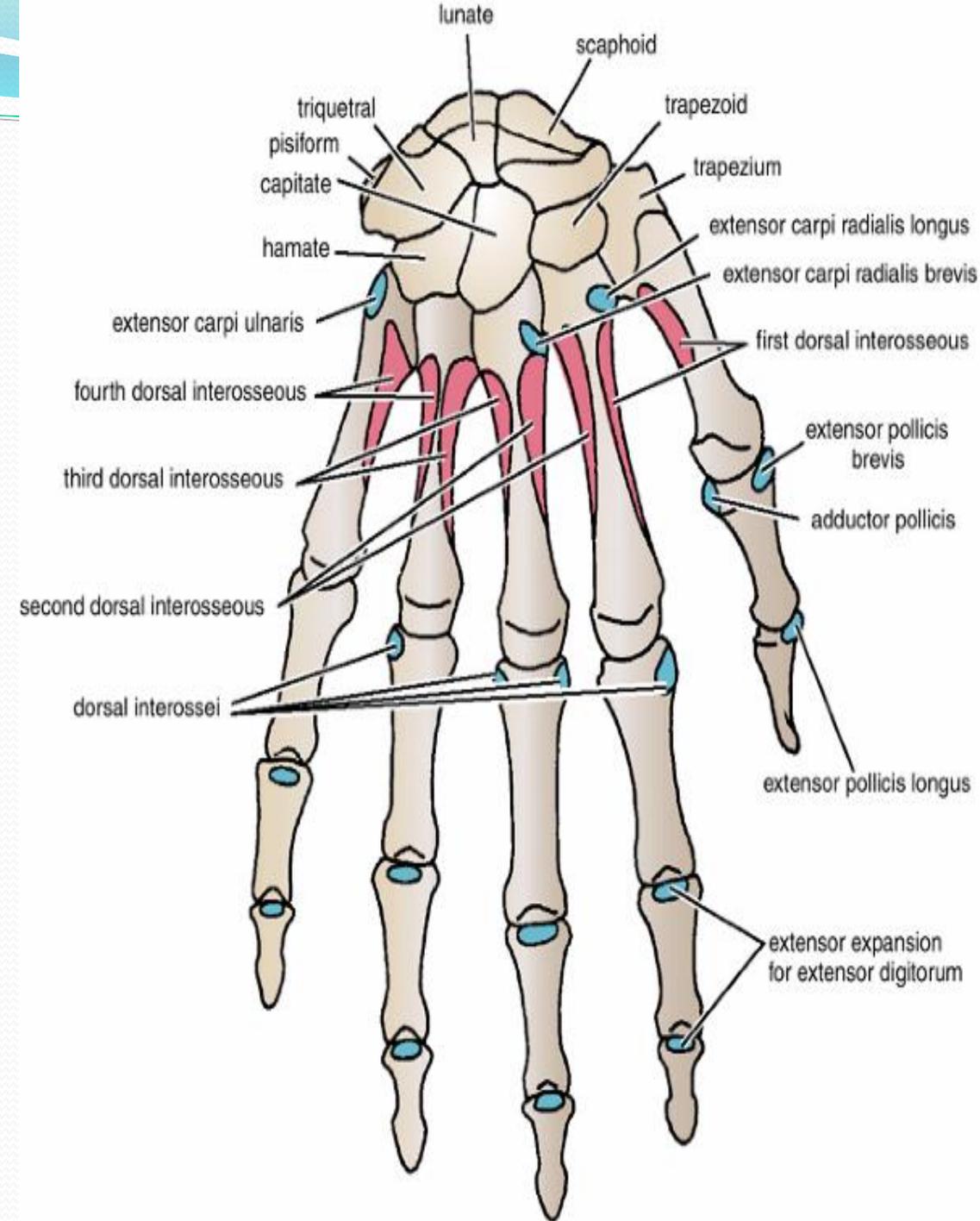
# Bones of Hand

- Carpal bones
- Metacarpals
- Phalanges



# Bones of the Hand

- There are eight carpal bones, made up of two rows of four.
- The **proximal row** consists of (from lateral to medial) the **scaphoid**, **lunate**, **triquetral**, and **pisiform** bones.
- The **distal row** consists of (from lateral to medial) the **trapezium**, **trapezoid**, **capitate**, and **hamate** bones.
- Together, the bones of the carpus present on their anterior surface a concavity, to the lateral and medial edges of which is attached a strong membranous band called the **flexor retinaculum**.
- In this manner, an osteofascial tunnel, the **carpal tunnel**, is formed for the passage of the median nerve and the flexor tendons of the fingers.
- The bones of the hand are cartilaginous at birth. The **capitate** begins to ossify during the first year, and the others begin to ossify at intervals thereafter until the 12th year, when all the bones are ossified.
- The position, shape, and size of the scaphoid bone, however, should be studied, because it is commonly fractured. The ridge of the **trapezium** and the hook of the hamate should be examined.



## Bones of proximal row:

**Scaphoid** is largest bone in proximal row, has boat shape and tubercle in distal part of palmer surface & has constricted waist at its middle so its easily fractured.

**Lunate** is crescent shape with anterior surface larger than the posterior so its easily dislocated anteriorly and compressing the median nerve

**Triquetral** is pyramidal shape

**The pisiform** smallest bone of proximal row, pear shape lies anterior to (*above*) the triquetrum, embedded in tendon of flexor carpi ulnaris.

## Bones of distal row

**The trapezium** is resemble four sided figure, has tubercle on its palmer surface lateral to groove of flexor carpi radialis

**Trapizoid** is resembles trapezium but smaller than it

**Capitate** largest of the carpal bones and most centrally in position.

**Hamate bone** has a hook projecting anteriorly and can be felt one finger distal to the pisiform bone.

The scaphoid and lunate articulate with the distal end of radius to form the wrist joint.

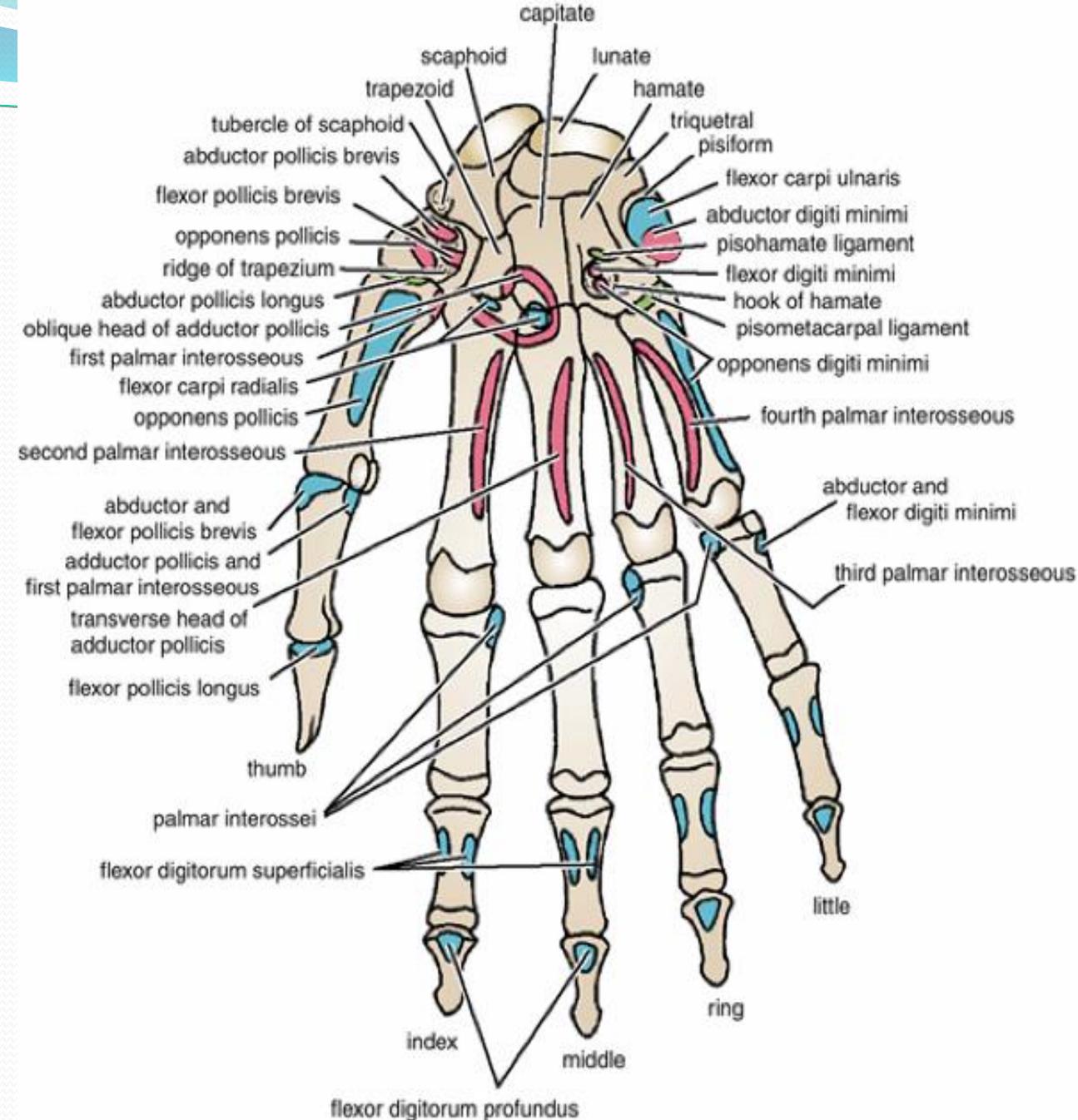
The bones of each row articulate with each other and with the bones of the other row at the **intercarpal joints**.



# The Metacarpals and Phalanges

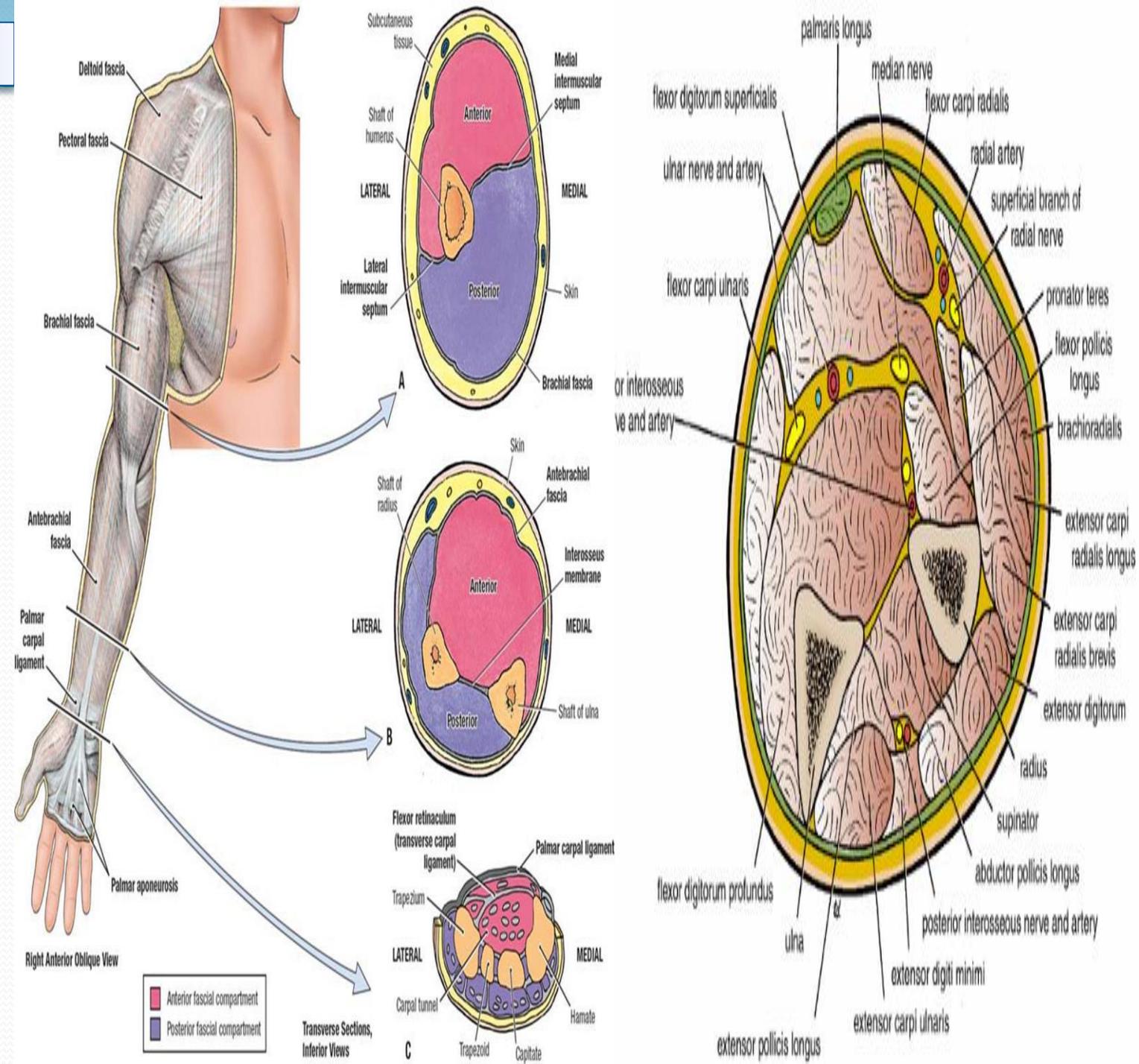
There are five metacarpal bones, each of which has a **base**, a **shaft**, and a **head**.

- The first metacarpal bone of the thumb is the shortest and most mobile. It does not lie in the same plane as the others but occupies a more anterior position. It is also rotated medially through a right angle so that its extensor surface is directed laterally and not backward.
- The **bases** of the metacarpal bones articulate with the distal row of the carpal bones; the **heads**, which form the knuckles, articulate with the proximal phalanges.
- The **shaft** of each metacarpal bone is slightly concave forward and is triangular in transverse section. Its surfaces are posterior, lateral, and medial.
- There are three phalanges for each of the fingers but only two for the thumb.



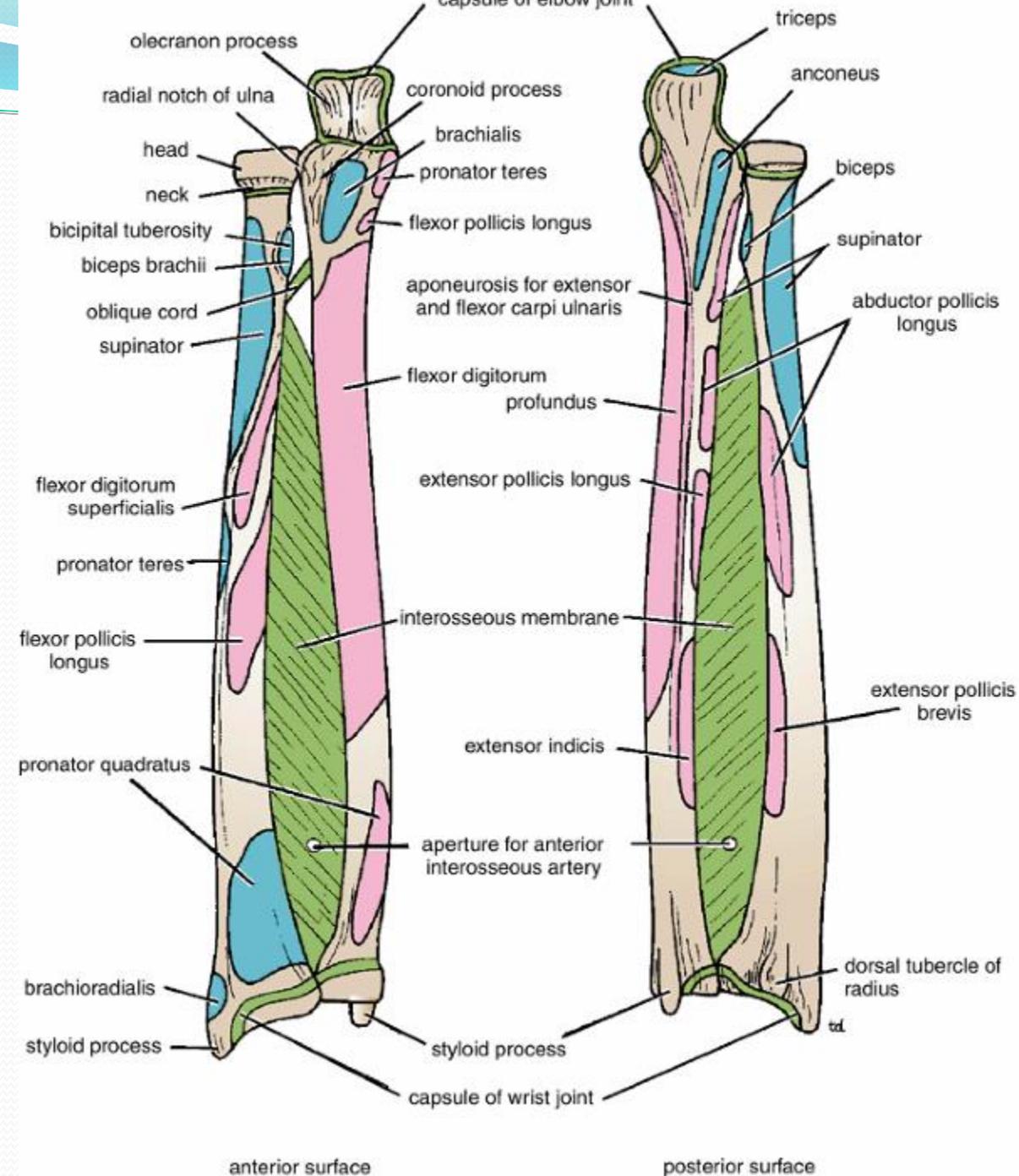
# Fascial Compartments of the Forearm

- The forearm is enclosed in a sheath of deep fascia, which is attached to the periosteum of the posterior subcutaneous border of the ulna.
- This fascial sheath, together with the interosseous membrane and fibrous intermuscular septa, divides the forearm into several compartments, each having its own muscles, nerves, and blood supply



# Interosseous Membrane

- The interosseous membrane is a strong membrane that unites the shafts of the radius and the ulna; it is attached to their interosseous borders.
- Its fibers run obliquely downward and medially so that a force applied to the lower end of the radius (e.g., falling on the outstretched hand) is transmitted from the radius to the ulna and from there to the humerus and scapula.
- The interosseous membrane provides attachment for neighboring muscles



## Contents of the Anterior Fascial Compartment of the Forearm

- **Muscles:** A **superficial group**, consisting of the pronator teres, the flexor carpi radialis, the palmaris longus, and the flexor carpi ulnaris; an **intermediate group** consisting of the flexor digitorum superficialis; and a **deep group** consisting of the flexor pollicis longus, the flexor digitorum profundus, and the pronator quadratus
- **Blood supply to the muscles:** Ulnar and radial arteries
- **Nerve supply to the muscles:** All the muscles are supplied by the median nerve and its branches, except the flexor carpi ulnaris and the medial part of the flexor digitorum profundus, which are supplied by the ulnar nerve

## FLEXOR GROUP

### These muscles: 8

- Act on the elbow & wrist joints and those of the fingers.
- Form fleshy masses in the proximal part and become tendinous in the distal part of the forearm.
- Arranged in three groups:

#### I-Superficial: 4

- Pronator teres
- Flexor carpi radialis
- Palmaris longus
- Flexor carpi ulnaris

#### II-Intermediate: 1

- Flexor digitorum superficialis

#### III- Deep: 3

- Flexor digitorum profundus
- Flexor pollicis longus
- Pronator quadratus



TABLE 9.6

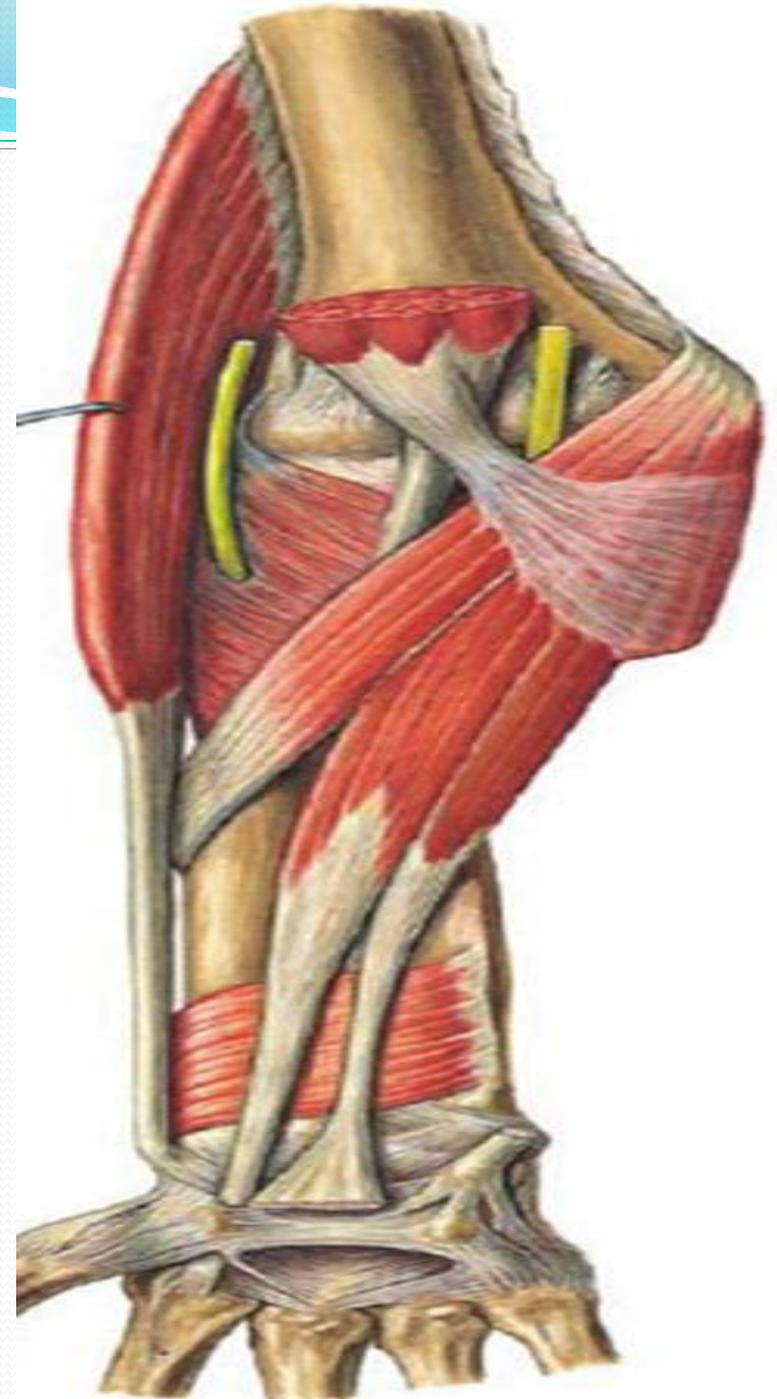
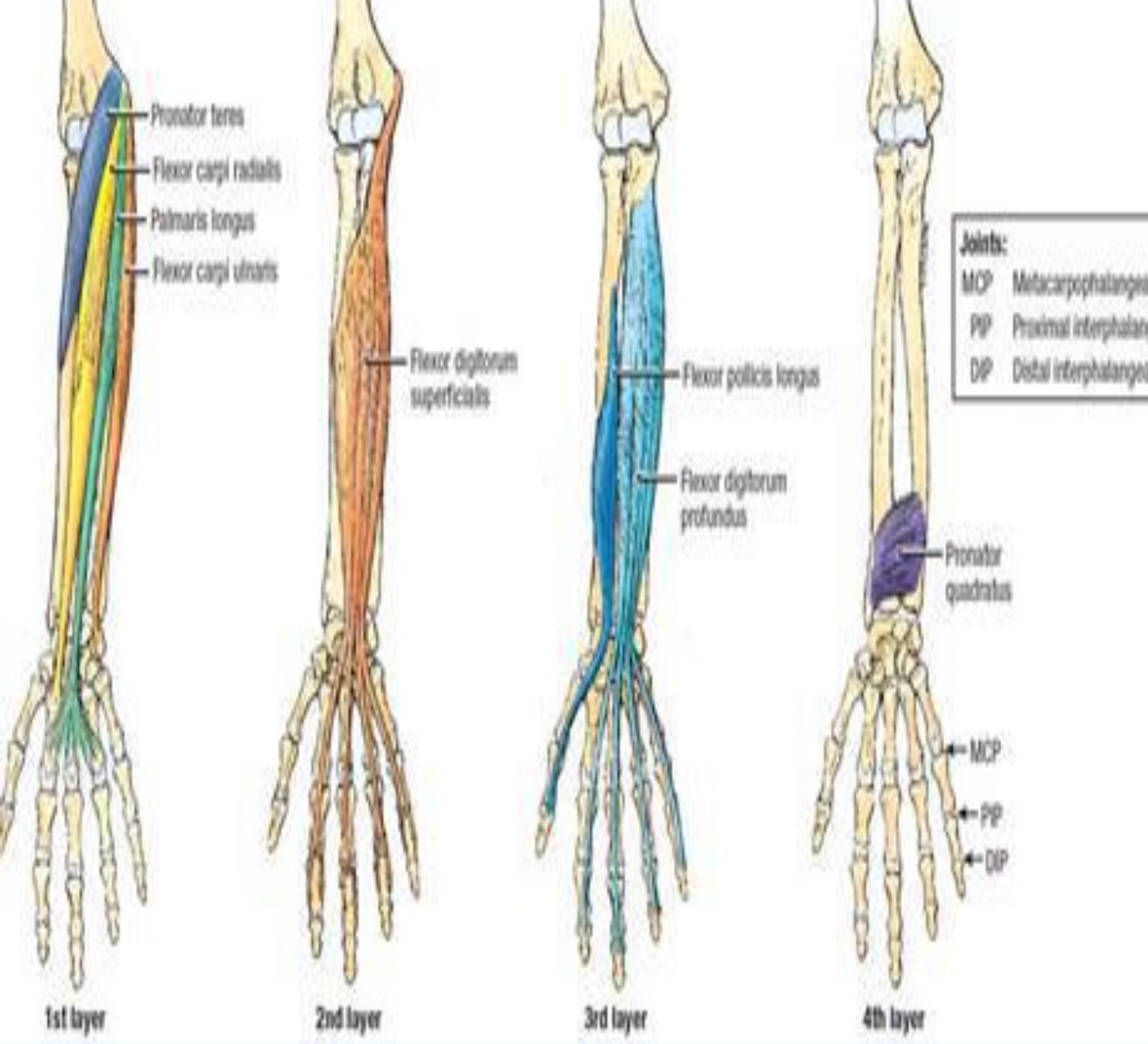
## Muscles of the Anterior Fascial Compartment of the Forearm

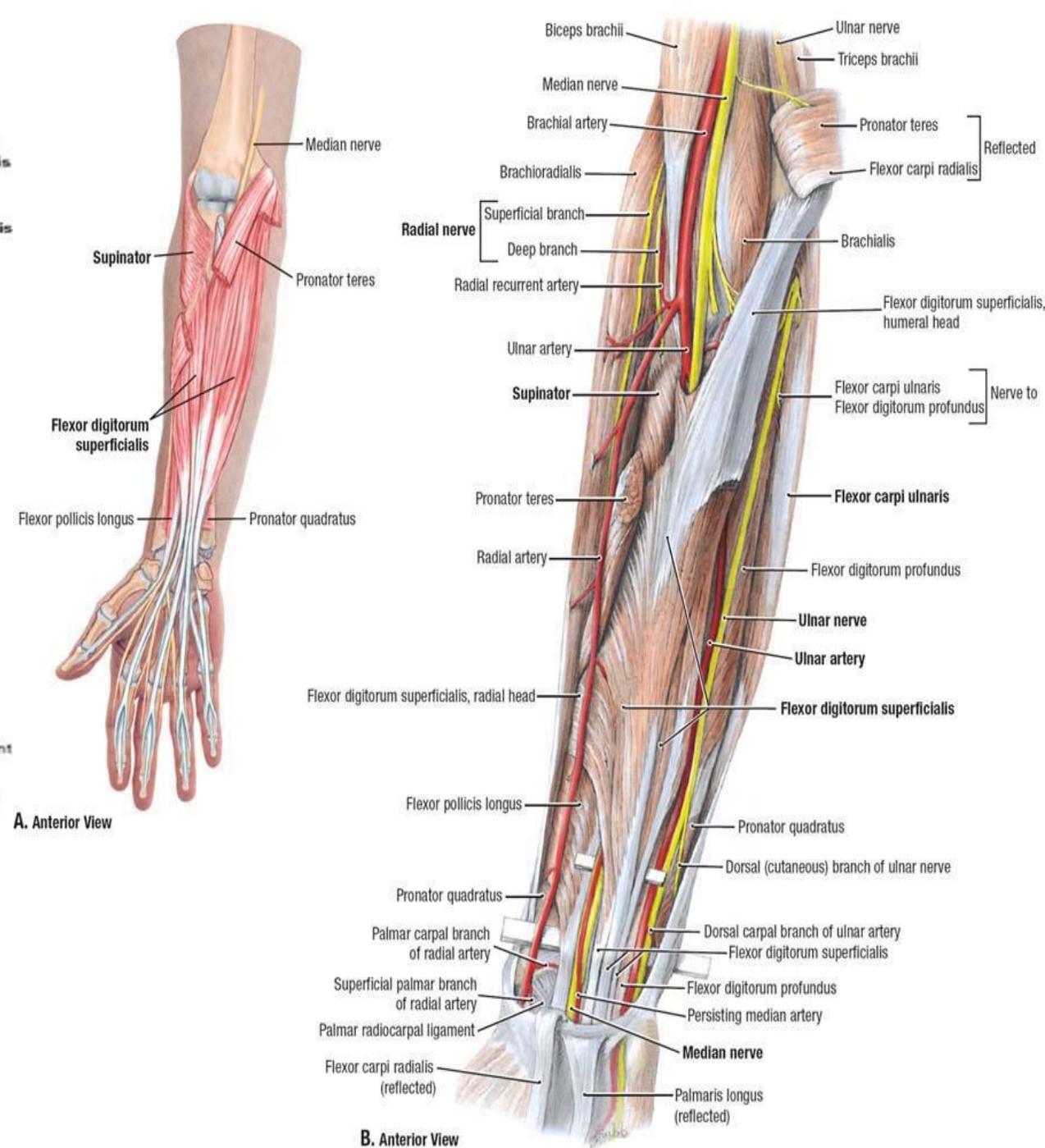
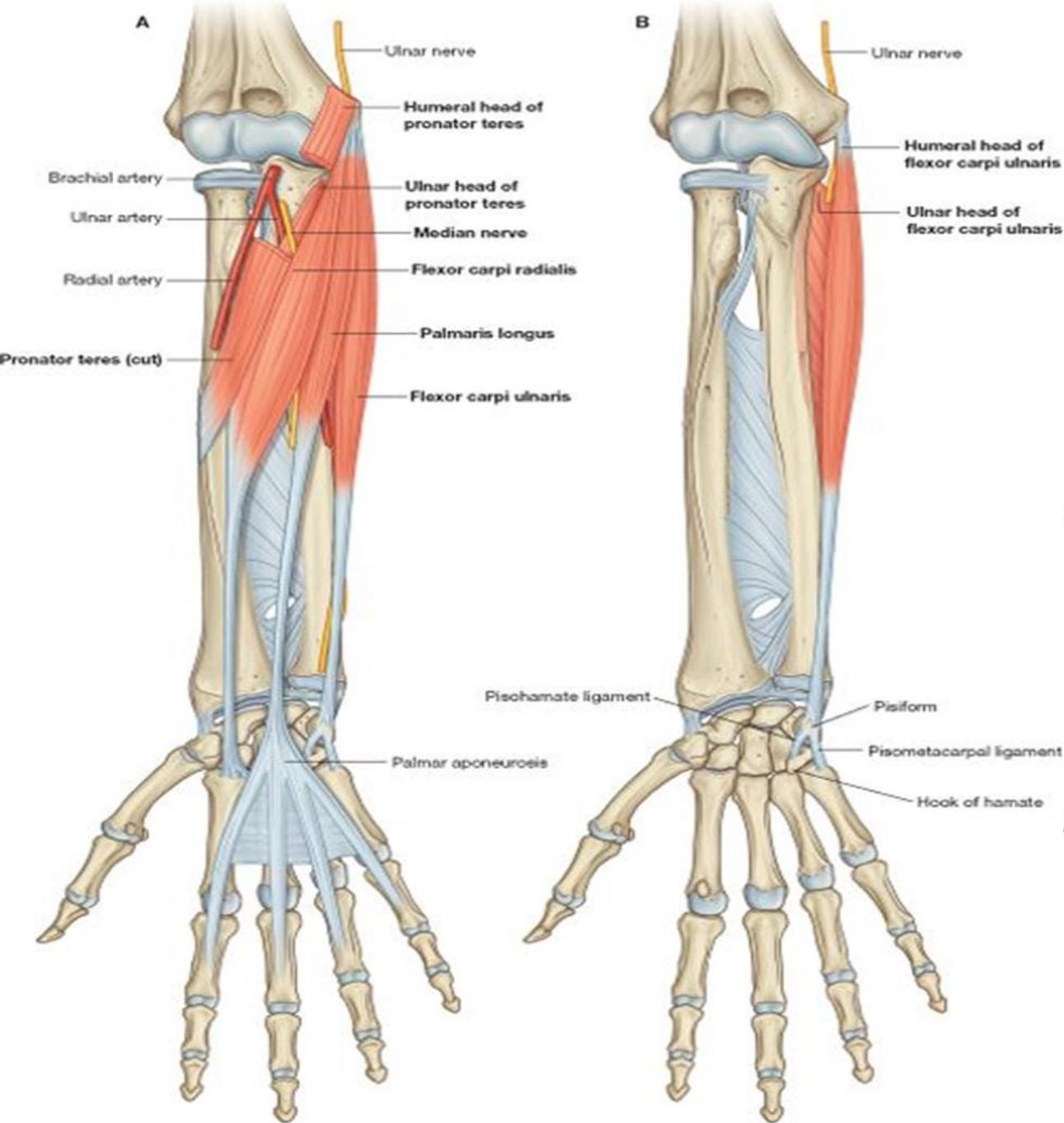
Muscle	Origin	Insertion	Nerve Supply	Nerve Roots <sup>a</sup>	Action
<b>Pronator Teres</b>					
Humeral head	Medial epicondyle of humerus	Lateral aspect of shaft of radius	Median nerve	C6, 7	Pronation and flexion of forearm
Ulnar head	Medial border of coronoid process of ulna				
Flexor carpi radialis	Medial epicondyle of humerus	Bases of second and third metacarpal bones	Median nerve	C6, 7	Flexes and abducts hand at wrist joint
Palmaris longus	Medial epicondyle of humerus	Flexor retinaculum and palmar aponeurosis	Median nerve	C7, 8	Flexes hand
<b>Flexor Carpi Ulnaris</b>					
Humeral head	Medial epicondyle of humerus	Pisiform bone, hook of the hamate, base at fifth metacarpal bone	Ulnar nerve	C8; T1	Flexes and adducts hand at wrist joint
Ulnar head	Medial aspect of olecranon process and posterior border of ulna				

TABLE 9.6

## Muscles of the Anterior Fascial Compartment of the Forearm

Muscle	Origin	Insertion	Nerve Supply	Nerve Roots <sup>a</sup>	Action
<b>Flexor Digitorum Superficialis</b>					
Humeroulnar head	Medial epicondyle of humerus; medial border of coronoid process of ulna	Middle phalanx of medial four fingers	Median nerve	C7, 8; T1	Flexes middle phalanx of fingers and assists in flexing proximal phalanx and hand
Radial head	Oblique line on anterior surface of shaft of radius				
Flexor pollicis longus	Anterior surface of shaft of radius	Distal phalanx of thumb	Anterior interosseous branch of median nerve	C8; T1	Flexes distal phalanx of thumb
Flexor digitorum profundus	Anteromedial surface of shaft of ulna	Distal phalanges of medial four fingers	Ulnar (medial half) and median (lateral half) nerves	C8; T1	Flexes distal phalanx of fingers; then assists in flexion of middle and proximal phalanges and wrist
Pronator quadratus	Anterior surface of shaft of ulna	Anterior surface of shaft of radius	Anterior interosseous branch of median nerve	C8; T1	Pronates forearm



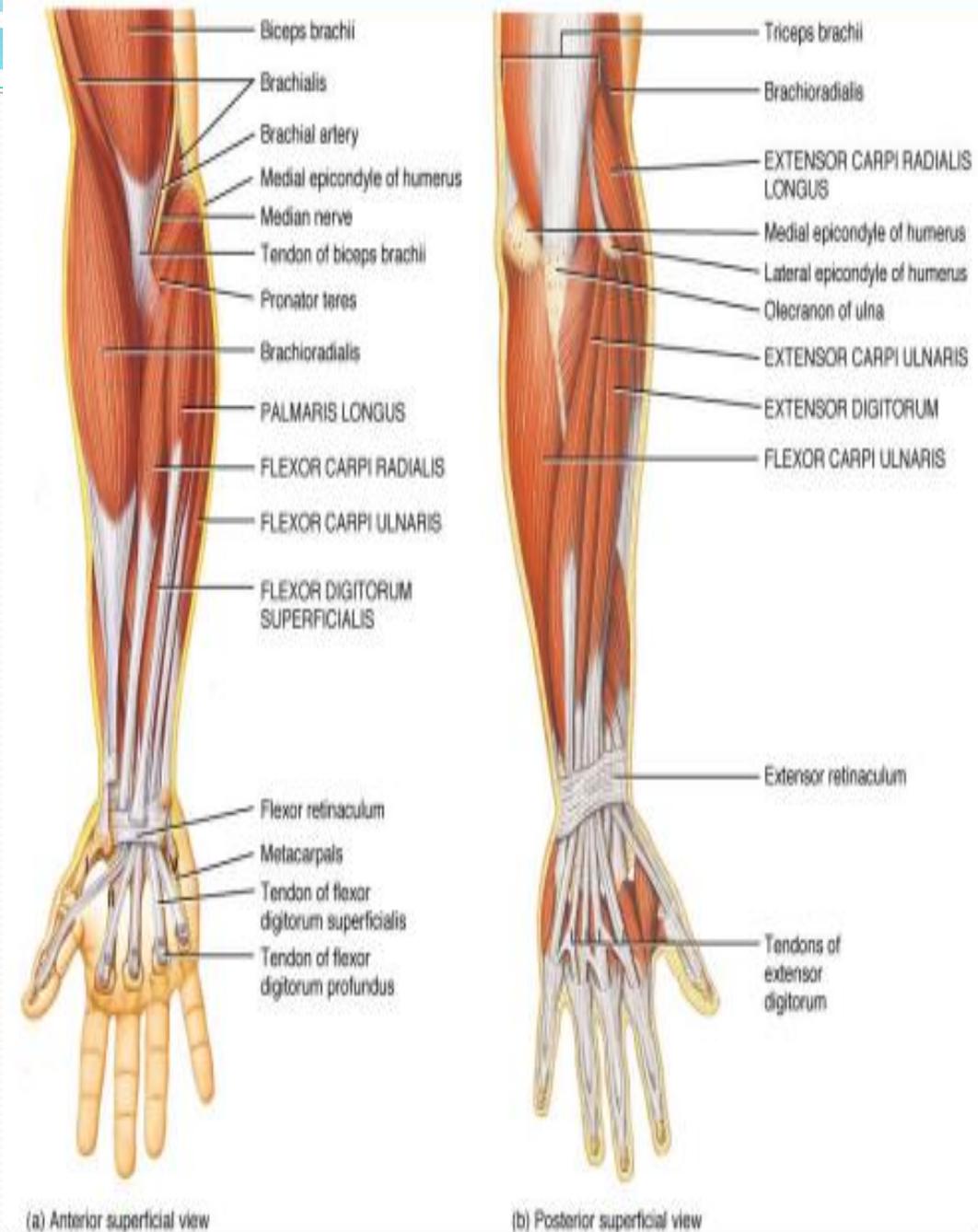


# Flexor and Extensor Retinacula

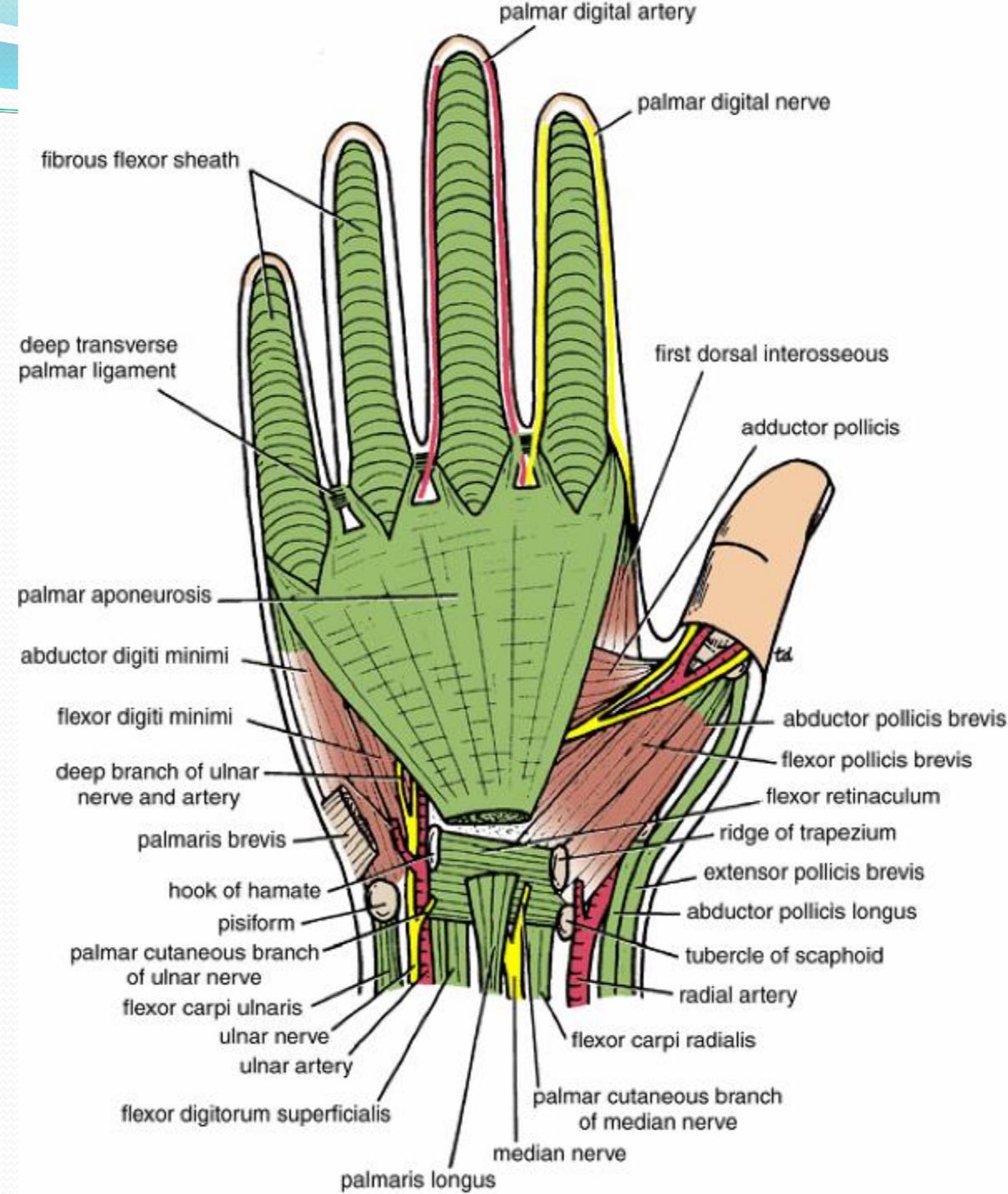
- **The flexor and extensor retinacula:** are strong bands of deep fascia that hold the long flexor and extensor tendons in position at the wrist.

## Flexor Retinaculum

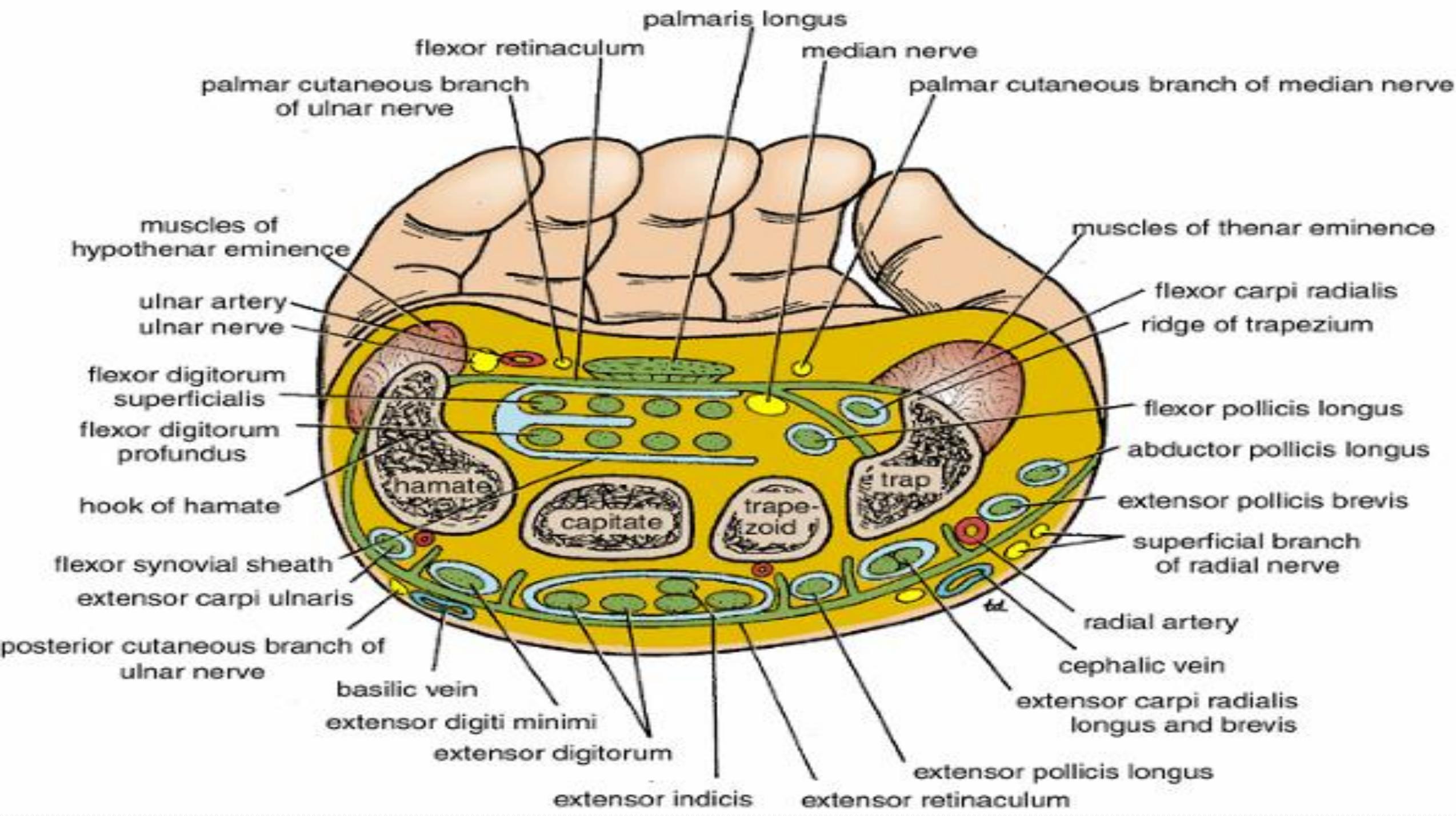
- The flexor retinaculum is a thickening of deep fascia that holds the long flexor tendons in position at the wrist.
- It stretches across the front of the wrist and converts the concave anterior surface of the hand into an osteofascial tunnel, the carpal tunnel, for the passage of the median nerve and the flexor tendons of the thumb and fingers.



- It is attached medially to the pisiform bone and the hook of the hamate and laterally to the tubercle of the scaphoid and the trapezium bones.
- The attachment to the trapezium consists of superficial and deep parts and forms a synovial-lined tunnel for passage of the tendon of the flexor carpi radialis.
- The upper border of the retinaculum corresponds to the distal transverse skin crease in front of the wrist and is continuous with the deep fascia of the forearm. The lower border is attached to the palmar aponeurosis.

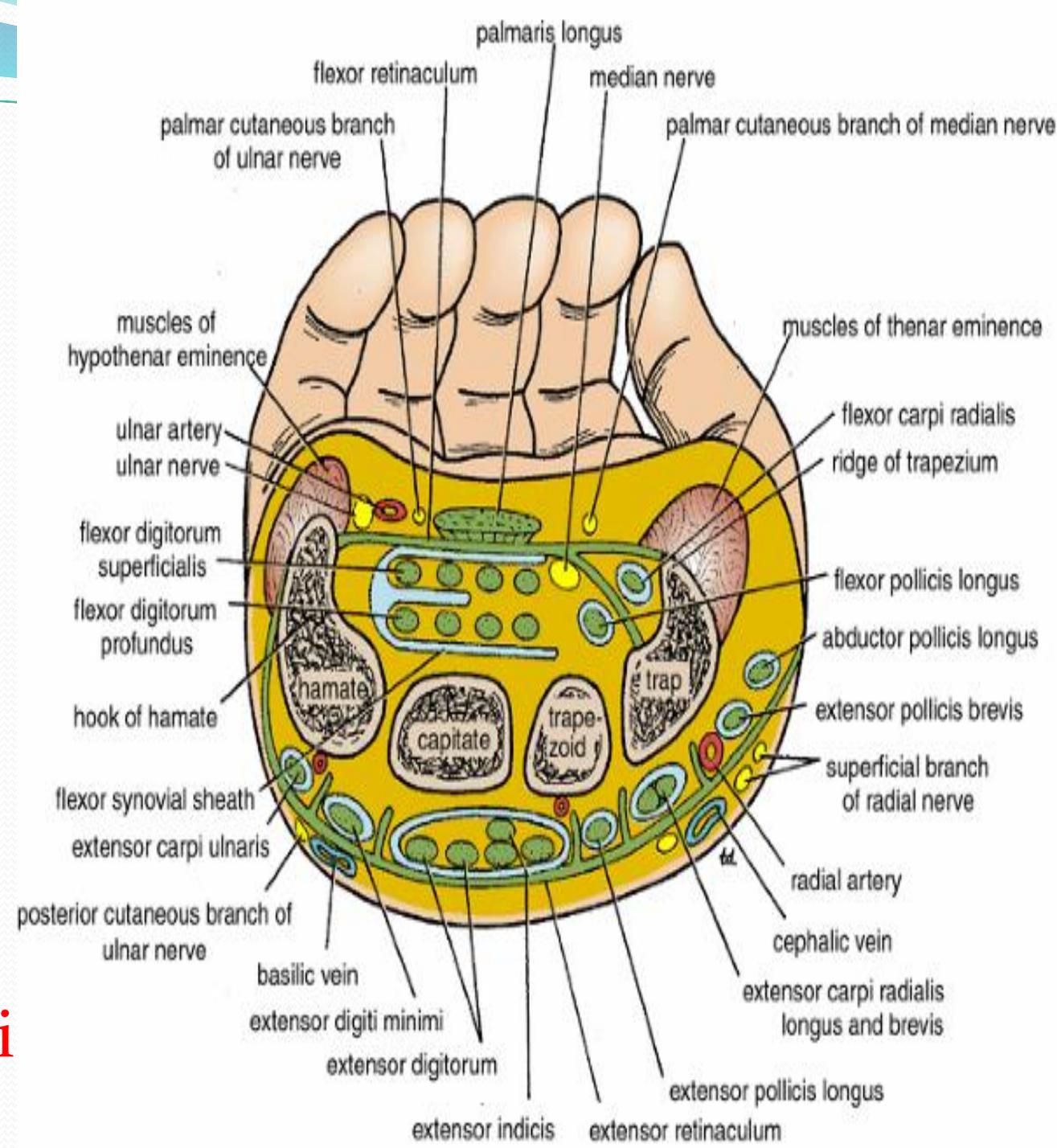


- Structures passing anterior (superficial) to the flexor retinaculum; from medial to lateral: Ulnar nerve → Ulnar artery → Palmar cutaneous branch of the ulnar nerve → Palmaris longus tendon → Palmar cutaneous branch of the median nerve
- Structures passing posterior (deep) to the flexor retinaculum; from medial to lateral: The 8 tendons of flexor digitorum superficialis (anteriorly) and flexor digitorum profundus (posterior four) → Median nerve → Flexor pollicis longus tendon → Flexor carpi radialis tendon (in its own separate tunnel).



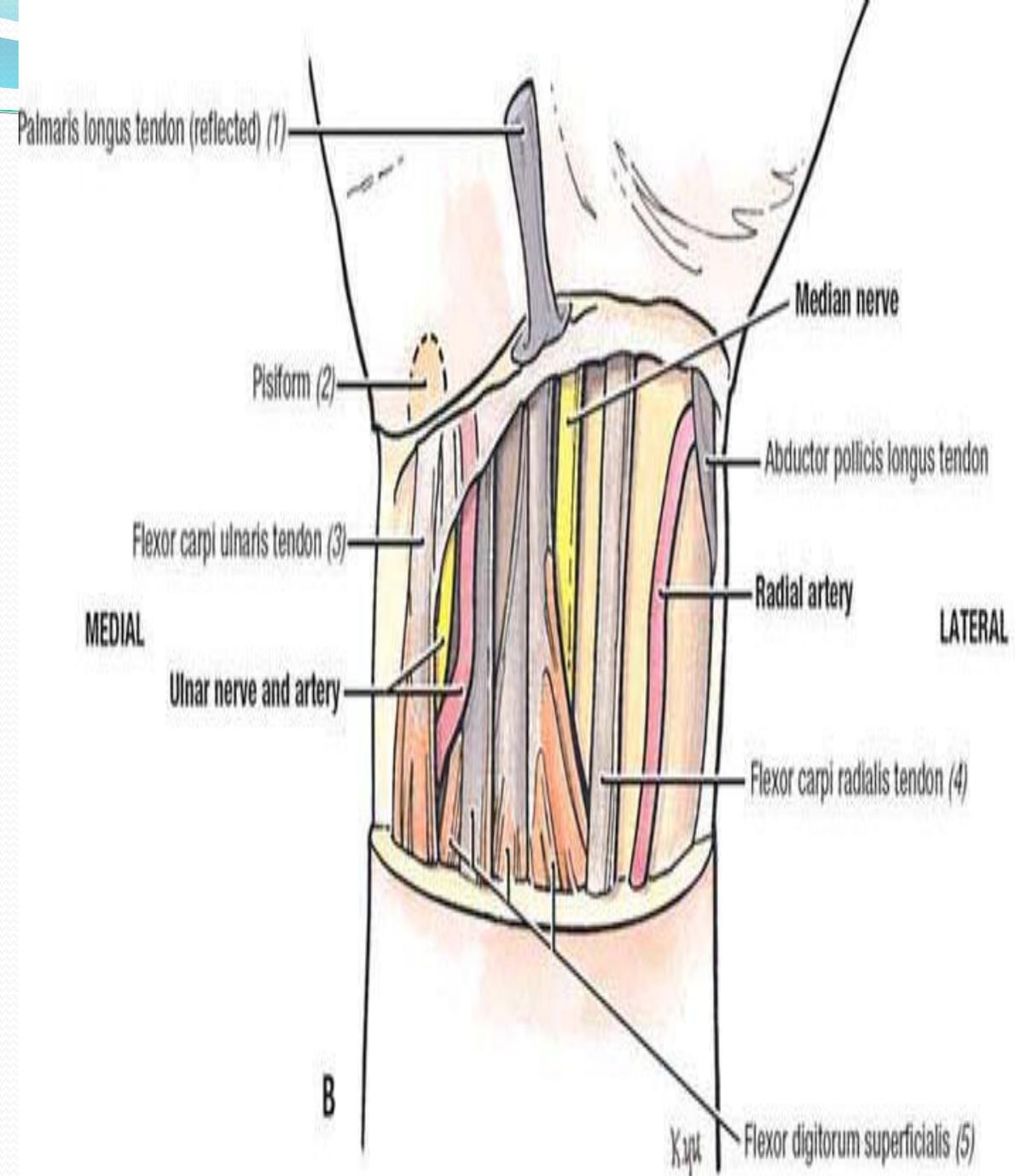
# Carpal Tunnel

- The space between concave anterior surface of carpal bones & flexor retinaculum form the carpal tunnel. It is contain the structures deep to flexor retinaculum
- The median **nerve** lies in a restricted space between the tendons of the **flexor digitorum superficialis** and the **flexor carpi radialis** muscles.



# Carpal tunnel syndrome

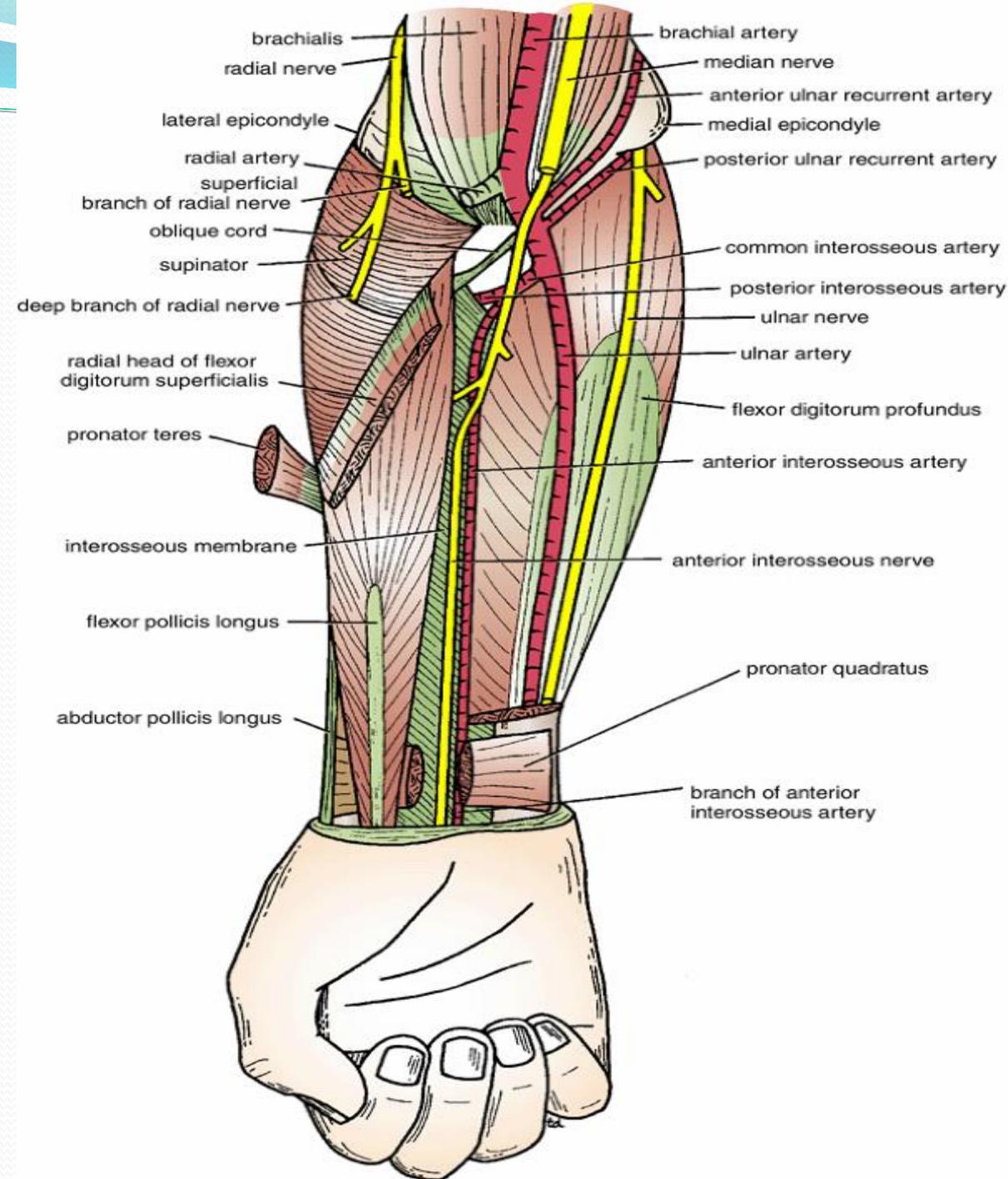
- In the tightly crowded flexor tunnel the median nerve can be compressed, especially by
  - 1- inflammation swelling of the synovial sheaths.
  - 2- Dislocation of lunate bone
  - 3- Thickness of flexor retinaculum by rheumatoid arthritis
- The symptoms include wasting and weakness of the thenar muscles (with loss of power of opposition of the thumb) and anaesthesia over three and a half digits on the thumb side of the hand. There is no anaesthesia over the thenar eminence itself (supplied by the palmar branch of the median nerve, or occasionally by the lateral cutaneous nerve of the forearm). Surgical division of the retinaculum relieves the pressure.





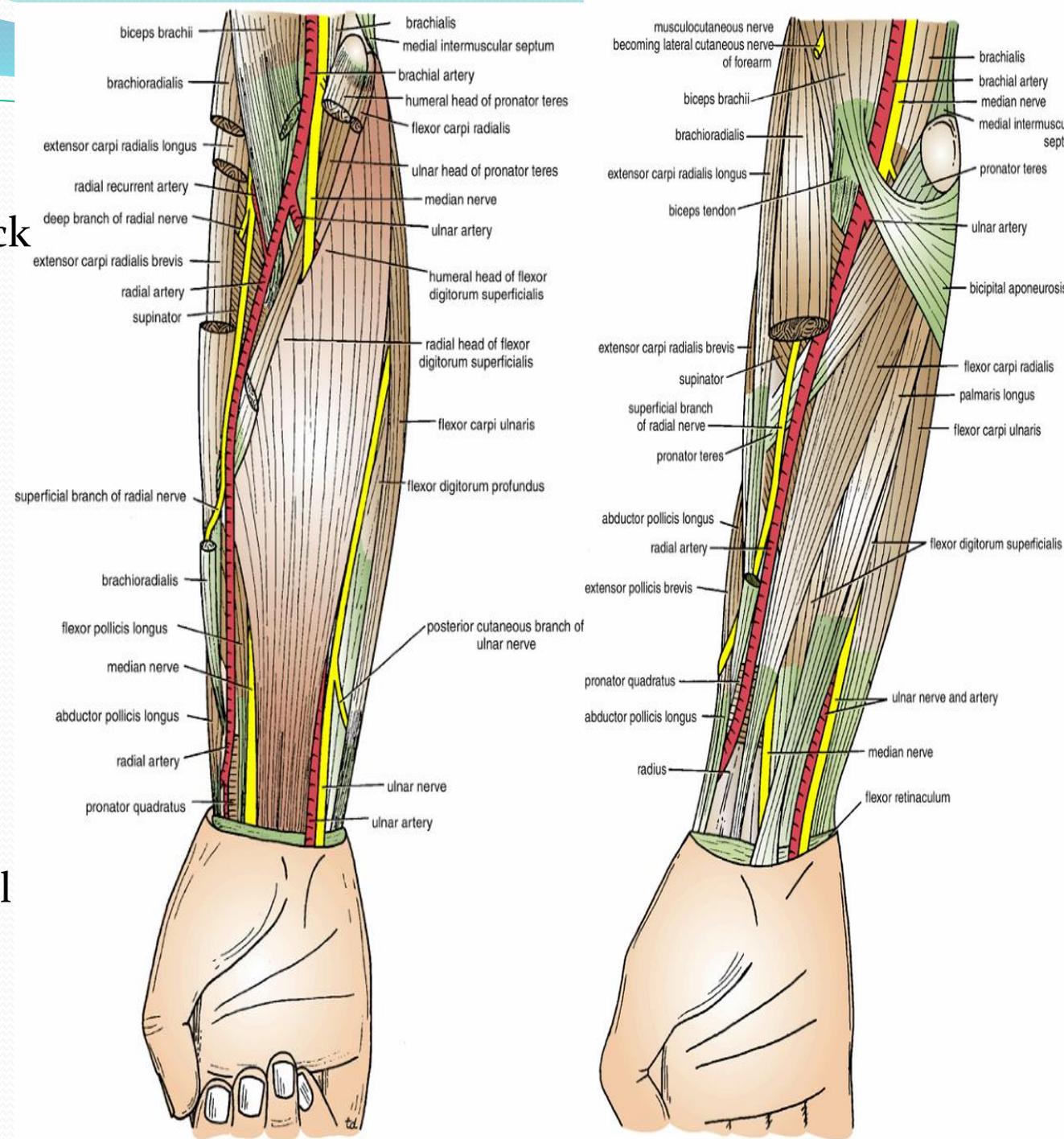
# Branches of the Ulnar Artery

- **Muscular branches** to neighboring muscles
- **Recurrent branches** that take part in the arterial anastomosis around the elbow joint.
- **Branches that take part in the arterial anastomosis** around the wrist joint
- The **common interosseous artery**, which arises from the upper part of the ulnar artery and after a brief course divides into the **anterior** and **posterior interosseous arteries**. The interosseous arteries are distributed to the muscles lying in front of and behind the interosseous membrane; they provide nutrient arteries to the radius and ulna bone.

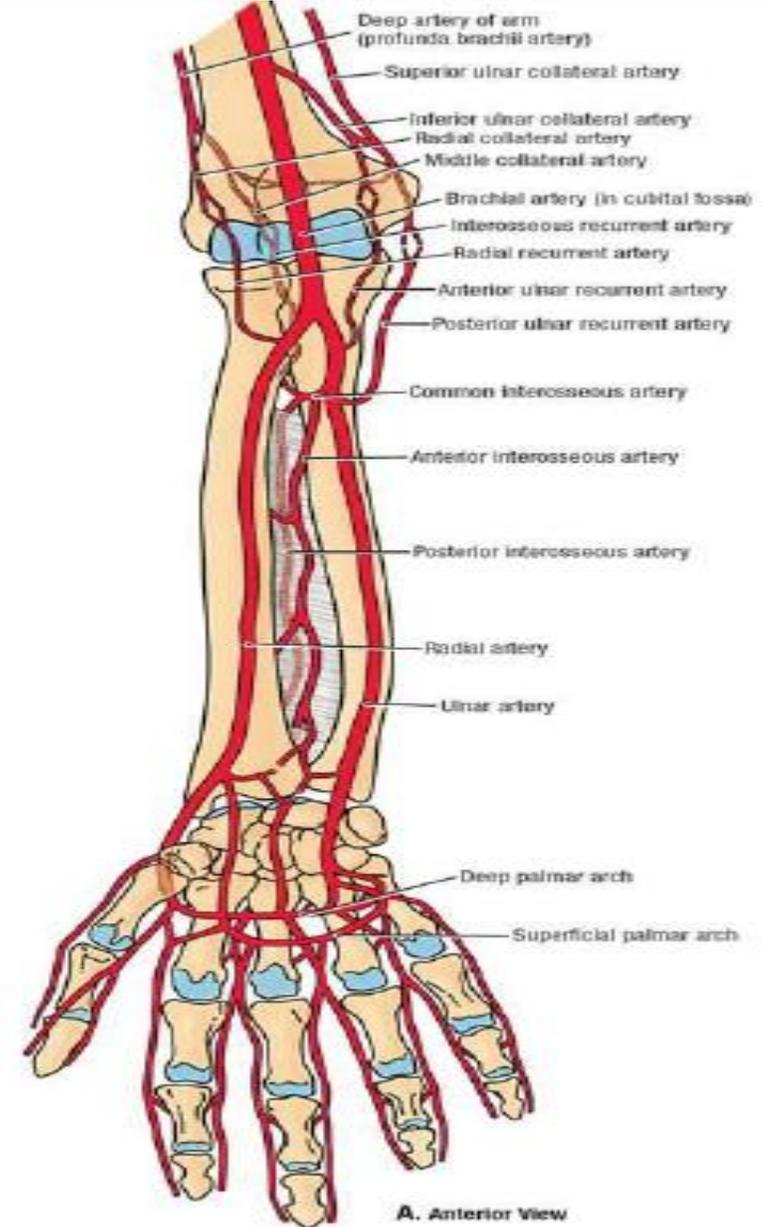
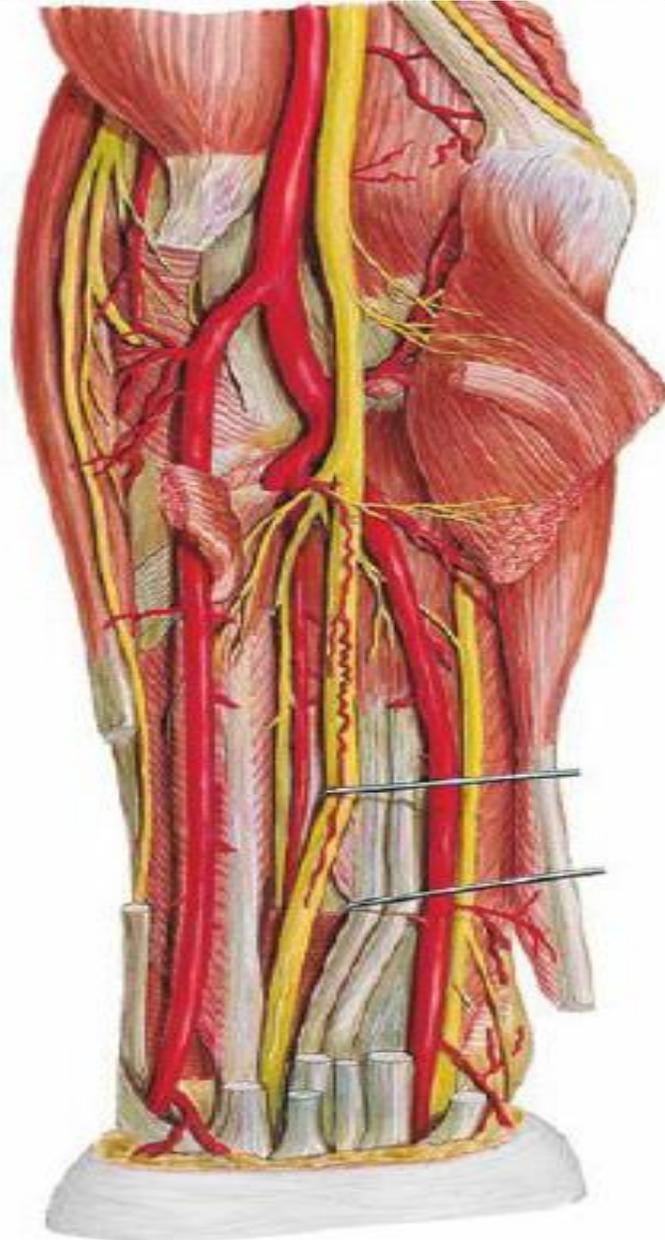
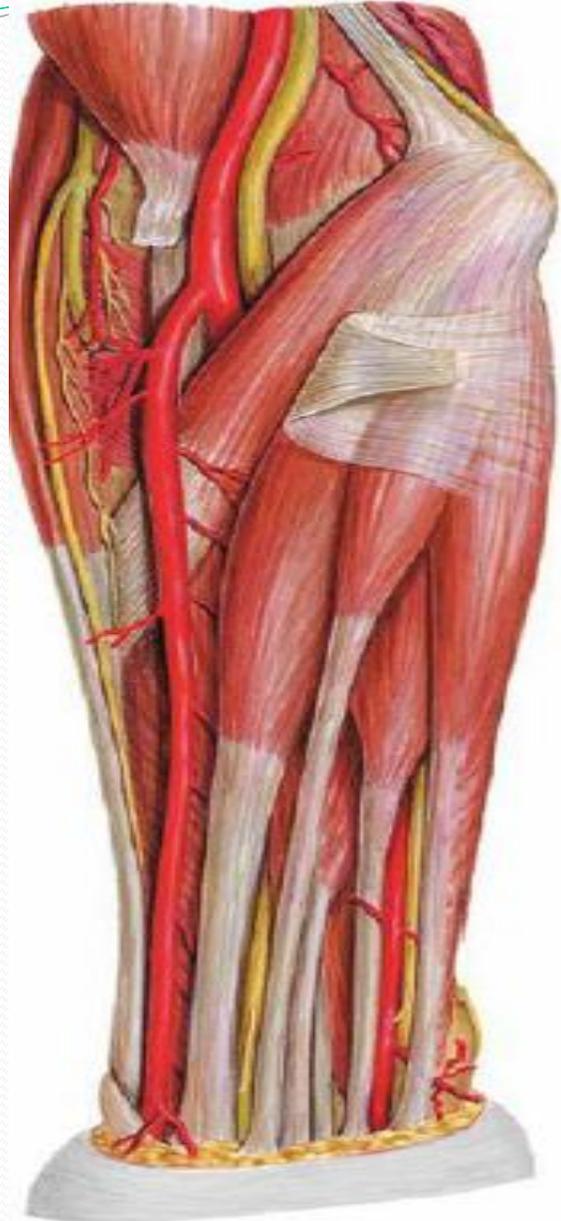


# Radial Artery

- The radial artery is the smaller of the terminal branches of the brachial artery.
- It begins in the cubital fossa at the level of the neck of the radius.
- It passes downward and laterally, beneath the brachioradialis muscle and resting on the deep muscles of the forearm. In the middle third of its course, the superficial branch of the radial nerve lies on its lateral side.
- In the distal part of the forearm, the radial artery lies on the anterior surface of the radius and is covered only by skin and fascia.
- Here, the artery has the tendon of brachioradialis on its lateral side and the tendon of flexor carpi radialis on its medial side (site for taking the radial pulse).
- The radial artery leaves the forearm by winding around the lateral aspect of the wrist to reach the posterior surface of the hand.

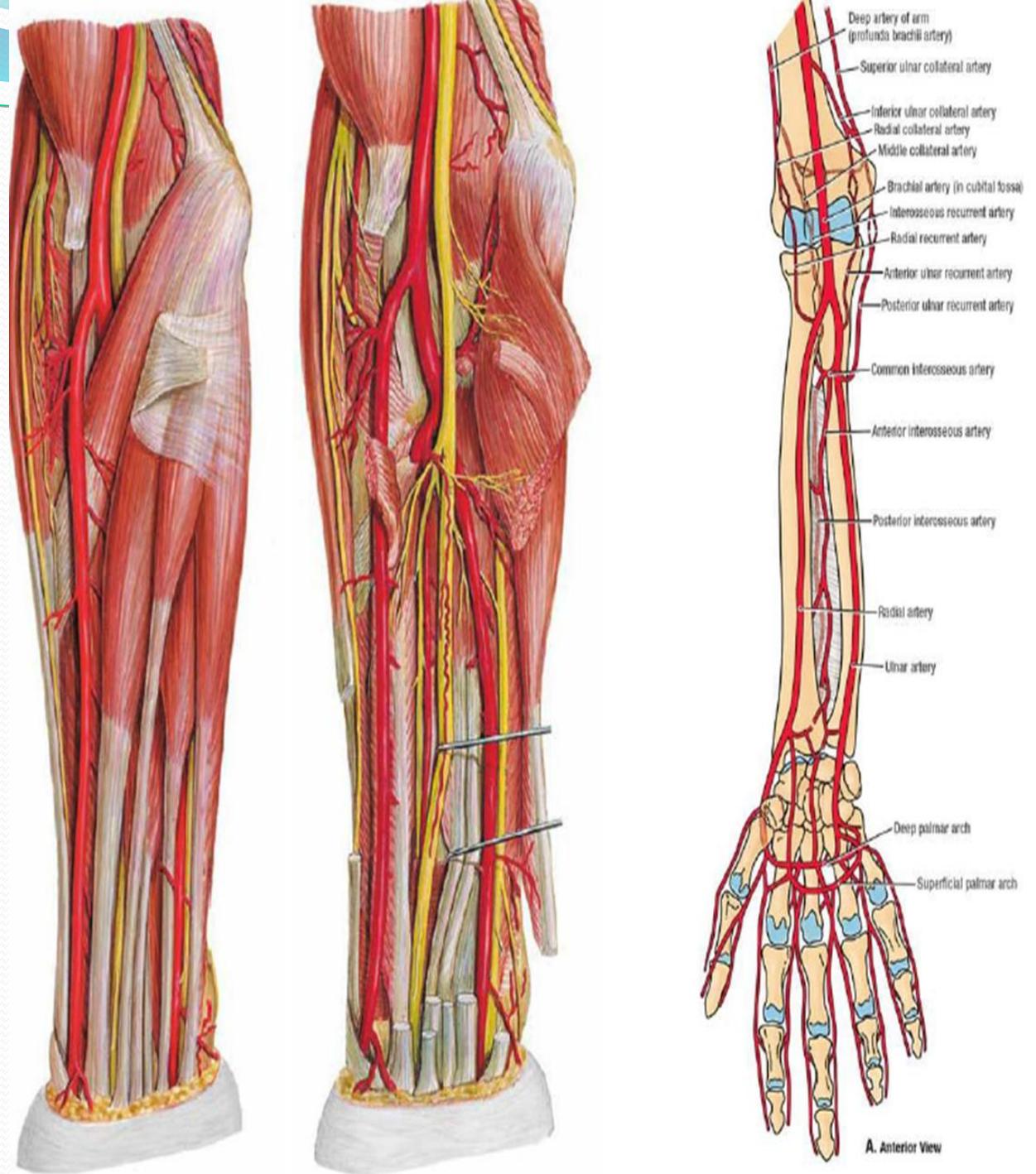


# Branches of ulnar and radial arteries



## Branches of the Radial Artery in the Forearm

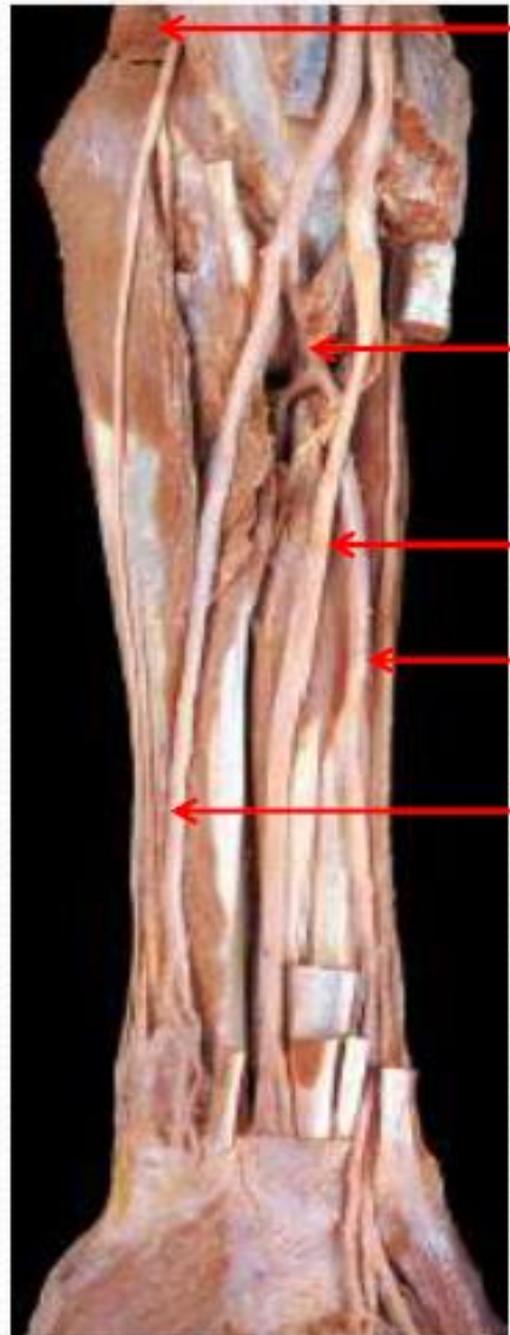
- **Muscular branches** to neighboring muscles
- **Recurrent branch**, which takes part in the arterial anastomosis around the elbow joint.
- **Superficial palmar branch**, which arises just above the wrist, enters the palm of the hand, and frequently joins the ulnar artery to form the **superficial palmar arch**.



# Nerves of the Anterior Fascial Compartment of the Forearm

## Median Nerve

- The **median nerve** leaves the cubital fossa by passing between the **two heads** of the **pronator teres**.
- It continues downward behind the **flexor digitorum superficialis** and rests posteriorly on the **flexor digitorum profundus**.
- At the wrist, the median nerve emerges from the lateral border of the **flexor digitorum superficialis** muscle and lies behind the tendon of the **palmaris longus**.
- It enters the palm by passing behind the **flexor retinaculum**



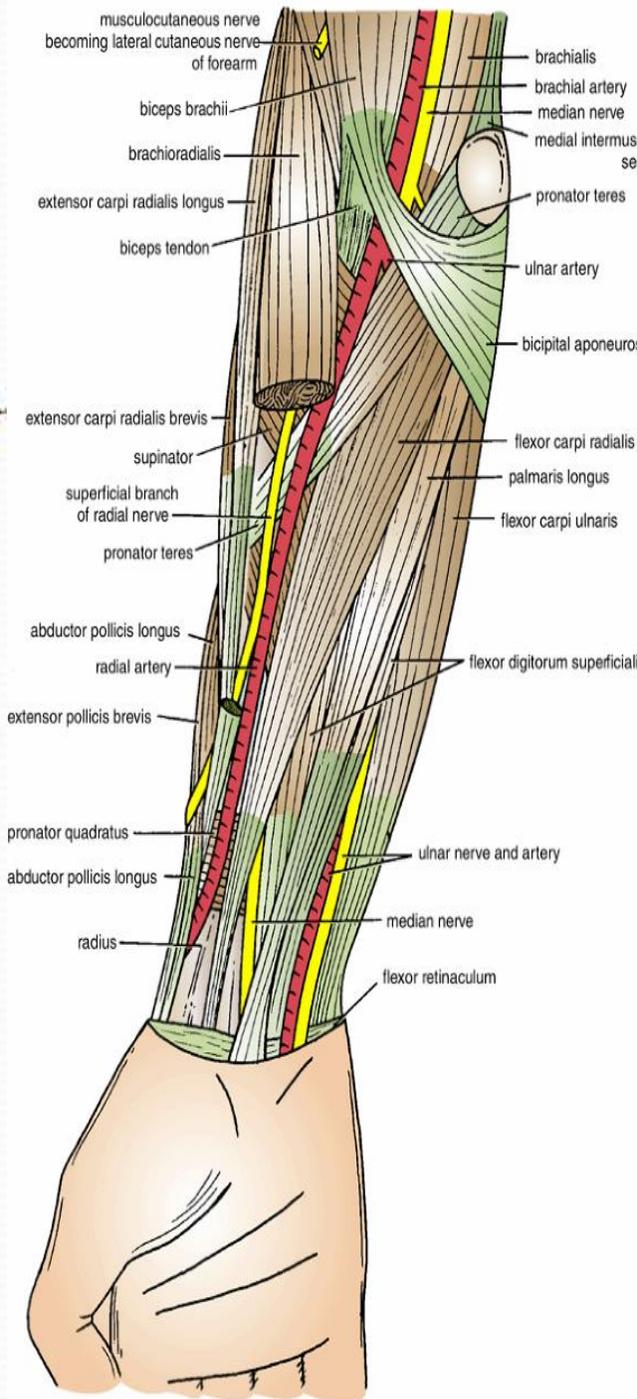
**Brachio-radialis**

**Common I. A.**

**Median n.**

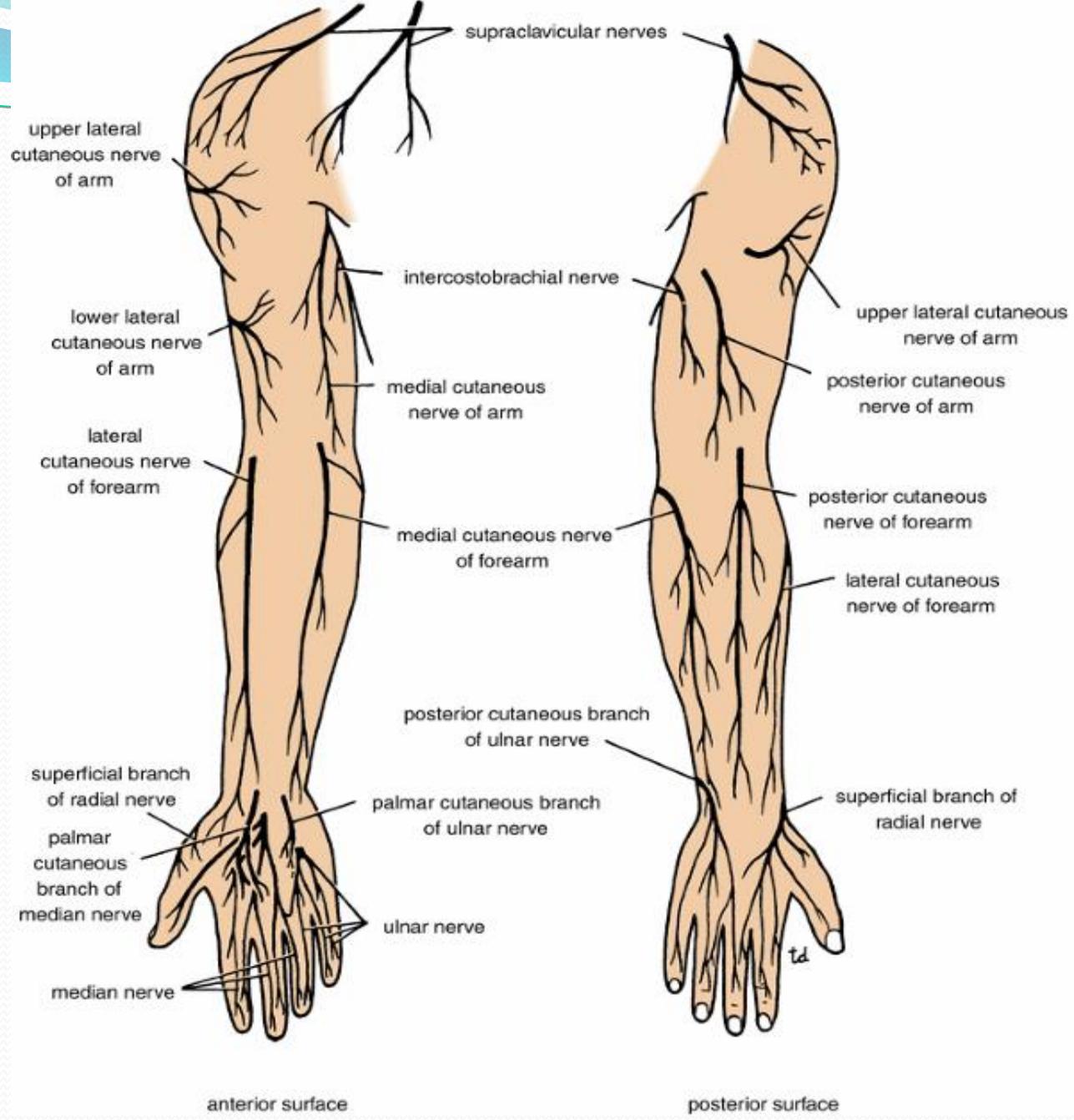
**Ulnar a.**

**Radial a.**



# Branches of the Median Nerve

- **Muscular branches** in the cubital fossa to the pronator teres, the flexor carpi radialis, the palmaris longus, and the flexor digitorum superficialis.
- **Articular branches** to the elbow joint
- **Anterior interosseous nerve**
- **Palmar cutaneous branch.** This arises in the lower part of the forearm and is distributed to the skin over the lateral part of the palm.

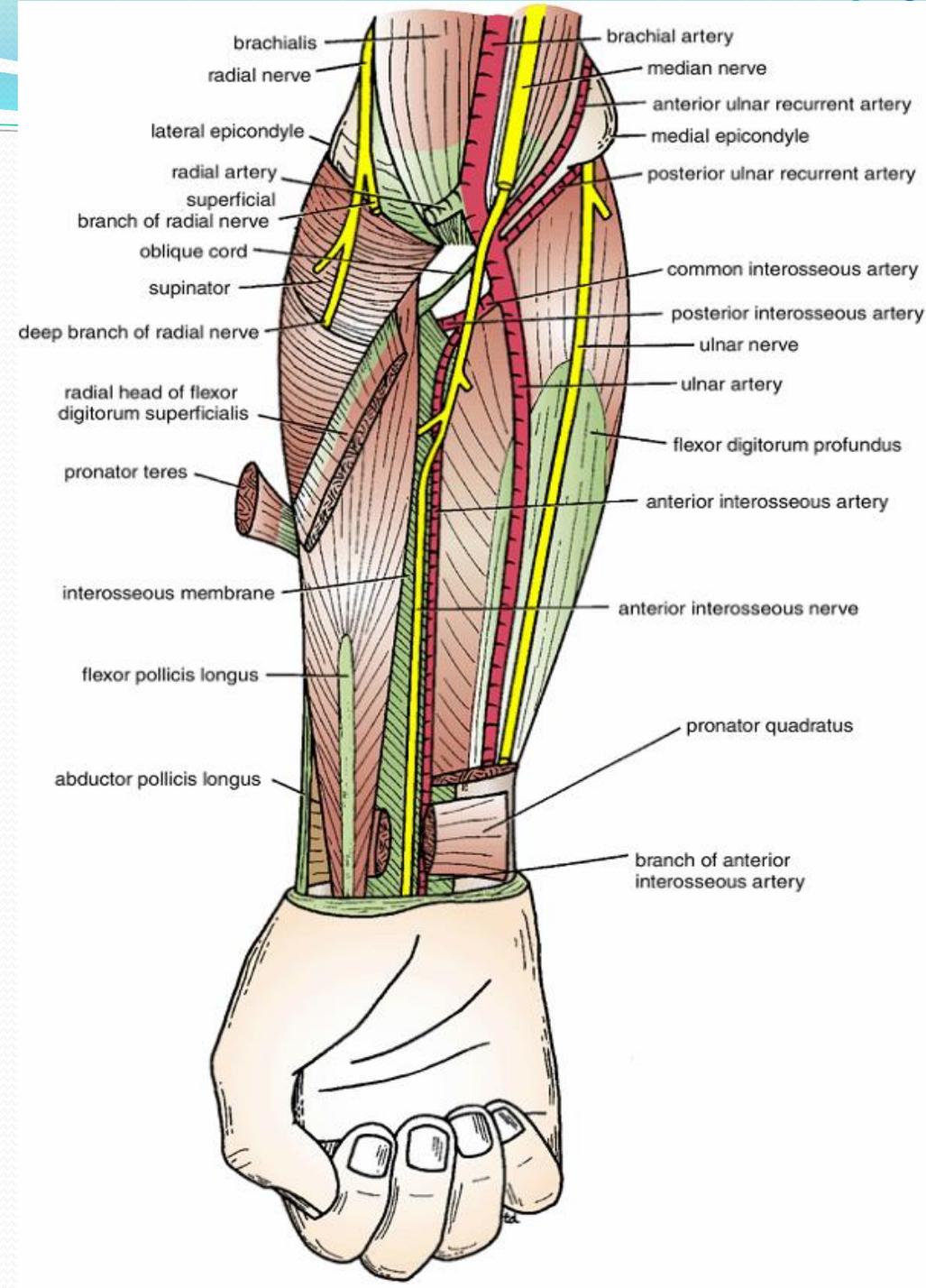


# Anterior Interosseous Nerve

- The **anterior interosseous nerve** arises from the **median nerve** as it emerges from between the two heads of the pronator teres.
- It passes downward on the anterior surface of the interosseous membrane, between the flexor pollicis longus and the flexor digitorum profundus.
- It ends on the anterior surface of the carpus.

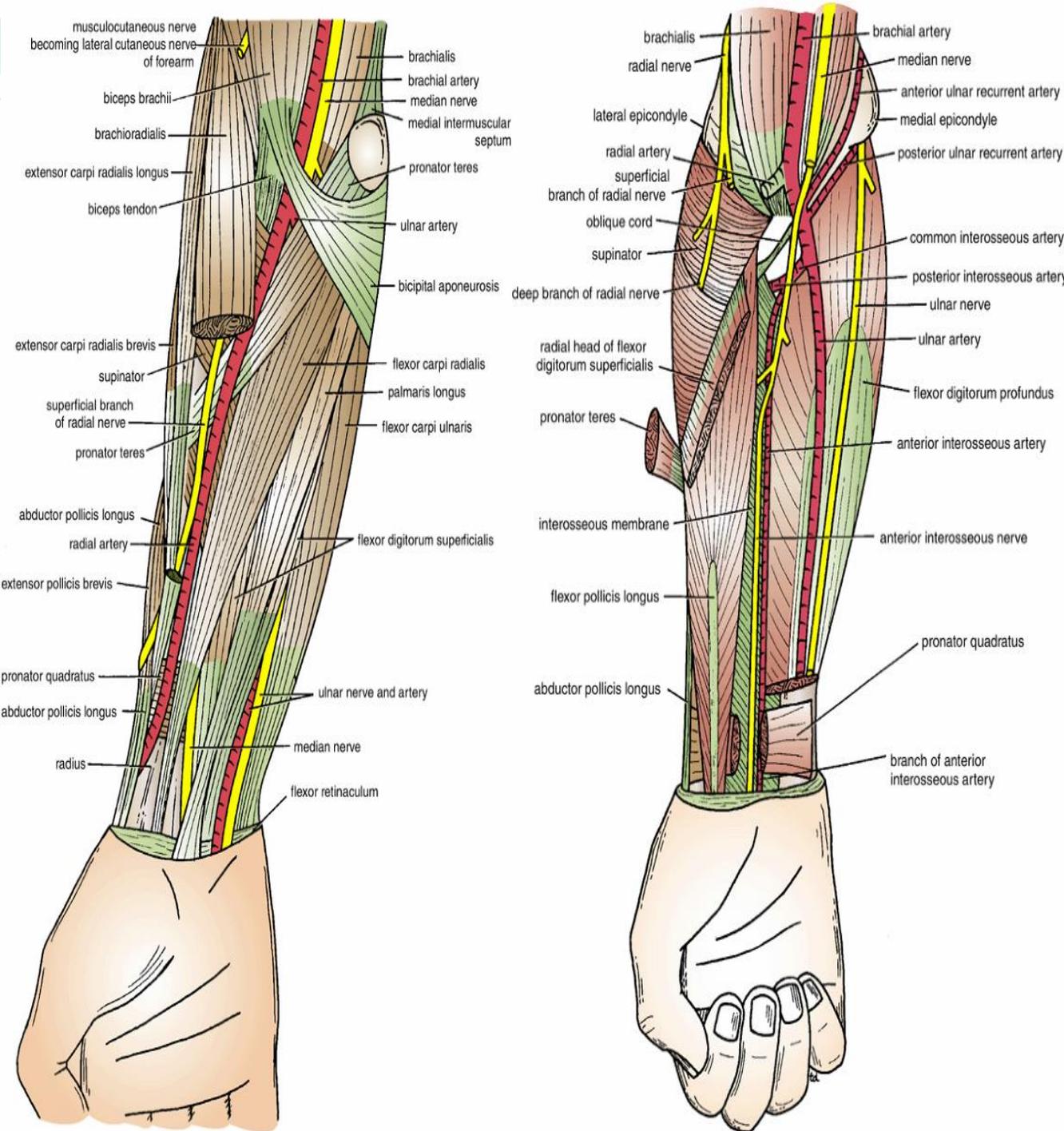
## Branches

- **Muscular branches** to the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus
- **Articular branches** to the wrist and distal radioulnar joints. It also supplies the joints of the hand.



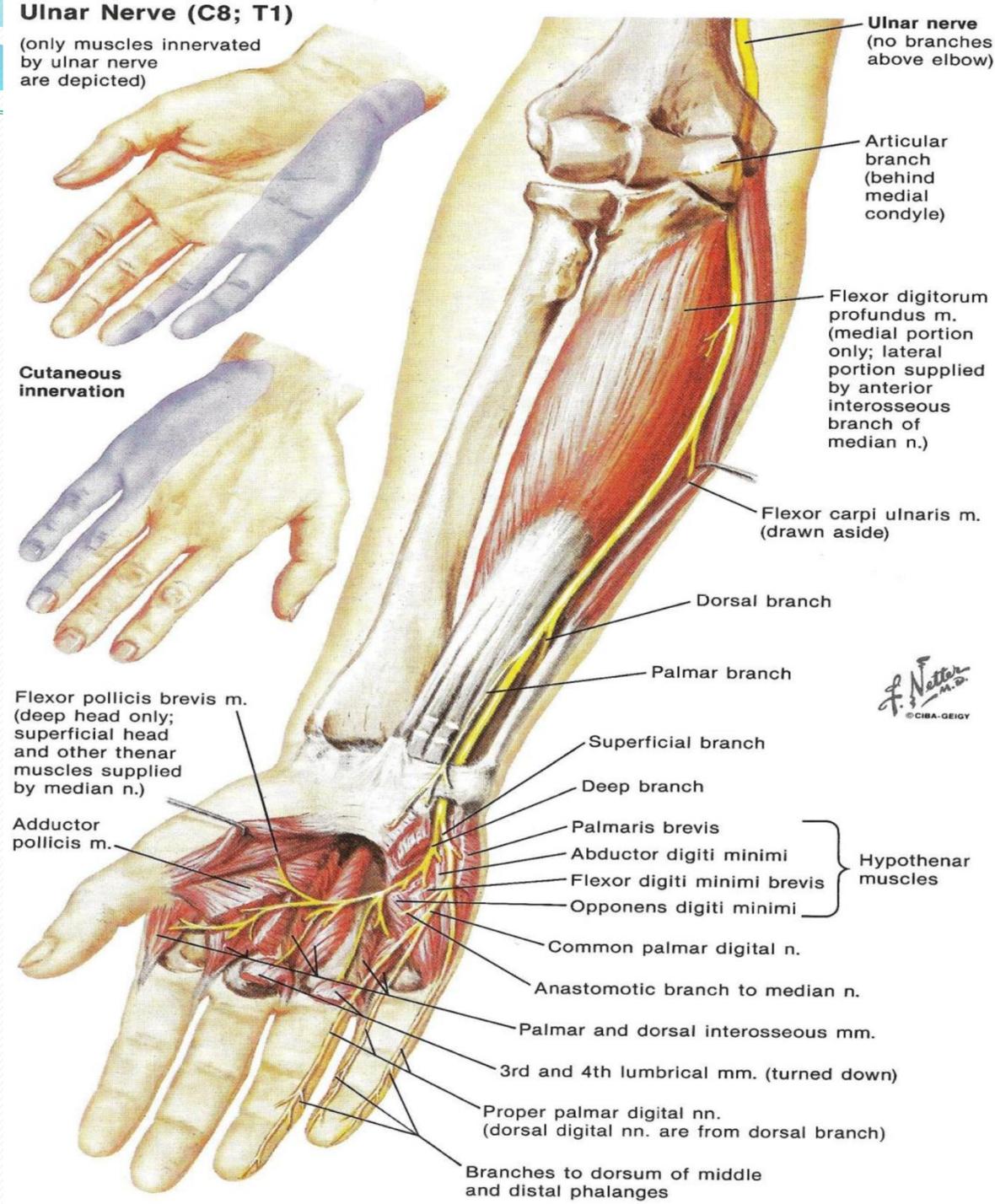
# Ulnar Nerve

- The ulnar nerve passes from behind the medial epicondyle of the humerus, crosses the medial ligament of the elbow joint, and enters the front of the forearm by passing between the two heads of the flexor carpi ulnaris.
- It then runs down the forearm between the flexor carpi ulnaris and the flexor digitorum profundus muscles.
- In the distal two thirds of the forearm, the ulnar artery lies on the lateral side of the ulnar nerve.
- At the wrist, the ulnar nerve becomes superficial and lies between the tendons of the flexor carpi ulnaris and flexor digitorum superficialis muscles.
- The ulnar nerve enters the palm of the hand by passing **in front of** the flexor retinaculum and lateral to the pisiform bone; here it has the ulnar artery lateral to it.



# Branch of the Ulnar Nerves

- **Muscular branches** to the flexor carpi ulnaris and to the medial half of the flexor digitorum profundus.
- **Articular branches** to the elbow joint
- The **palmar cutaneous branch** is a small branch that arises in the middle of the forearm and supplies the skin over the hypothenar eminence.
- The **dorsal posterior cutaneous branch** is a large branch that arises in the distal third of the forearm.
- It passes medially between the tendon of the flexor carpi ulnaris and the ulna and is distributed on the posterior surface of the hand and fingers.



Thank You & Good Luck

