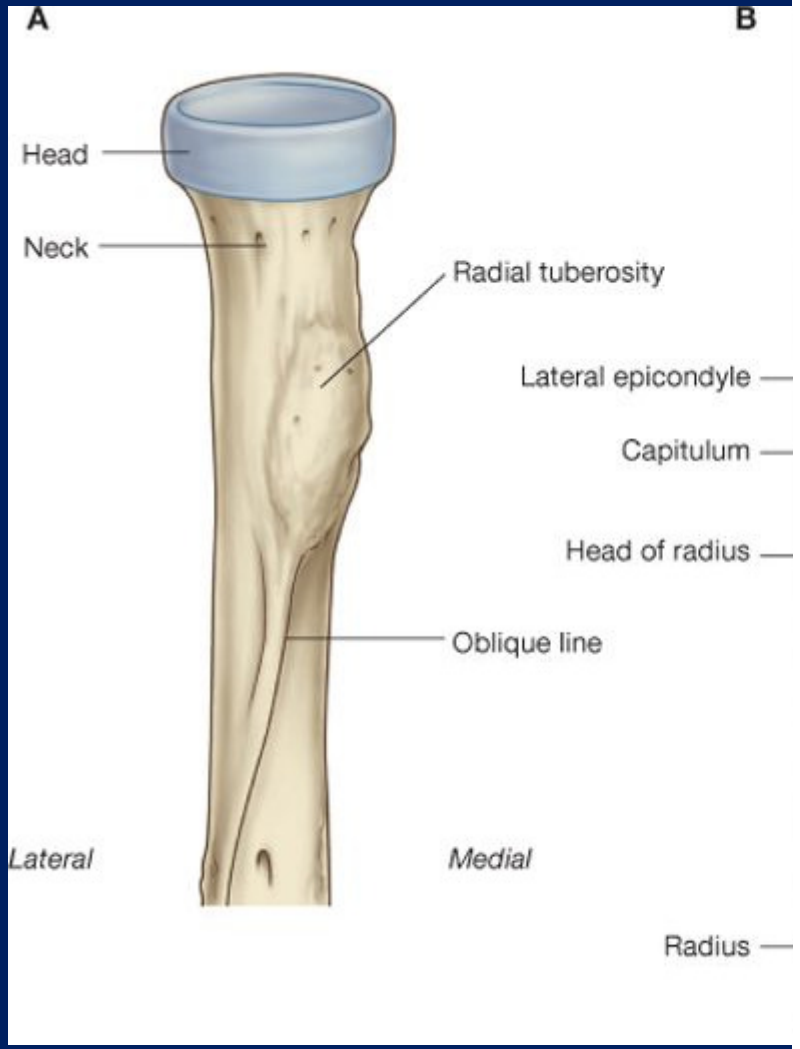
Forearm and Hand

Bones of the Forearm

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

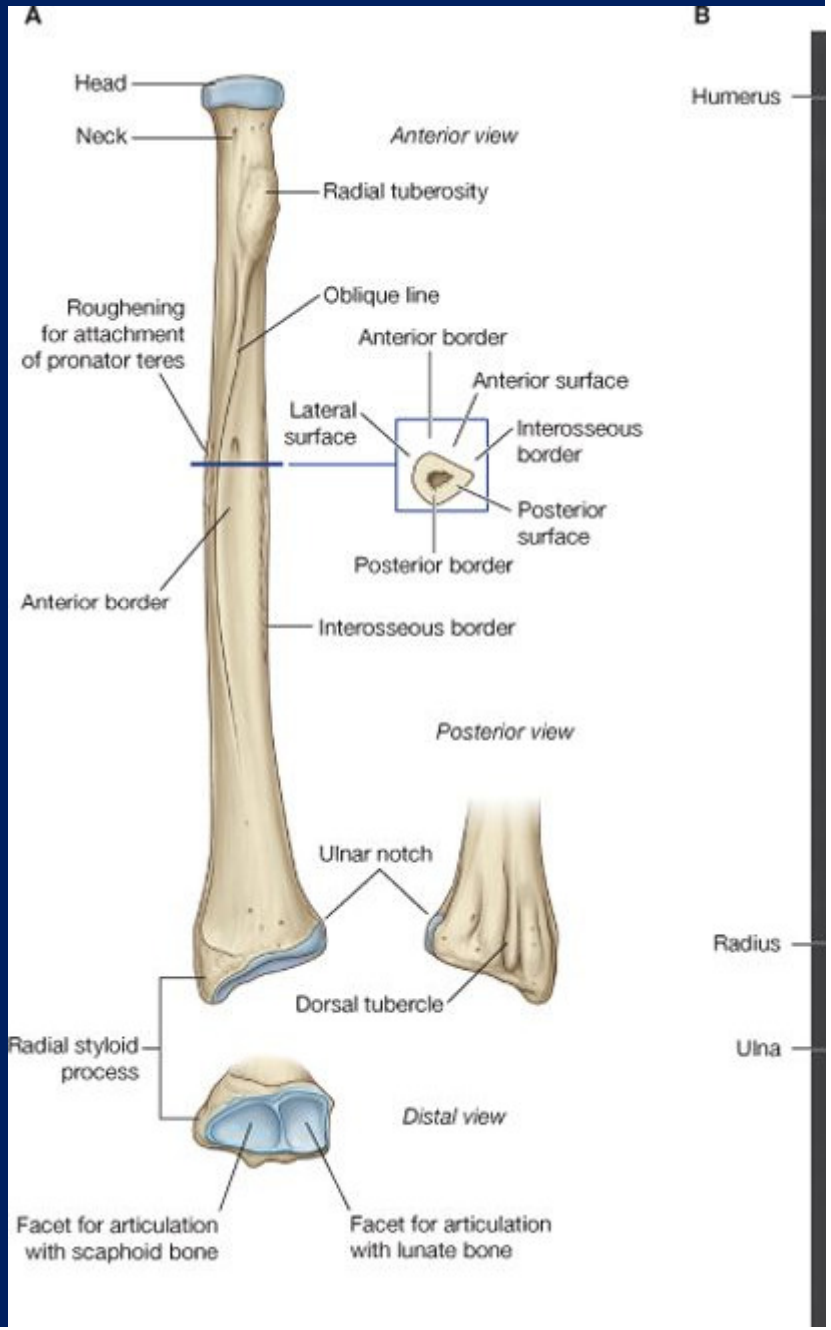
Radius

- The radius is the lateral bone of the forearm.
- Its proximal end articulates with the **humerus** at the elbow joint and with the **ulna** at the **proximal radioulnar joint**.
- Its distal end articulates with the **scaphoid and lunate** bones of the hand at the wrist joint and with the ulna at the **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.



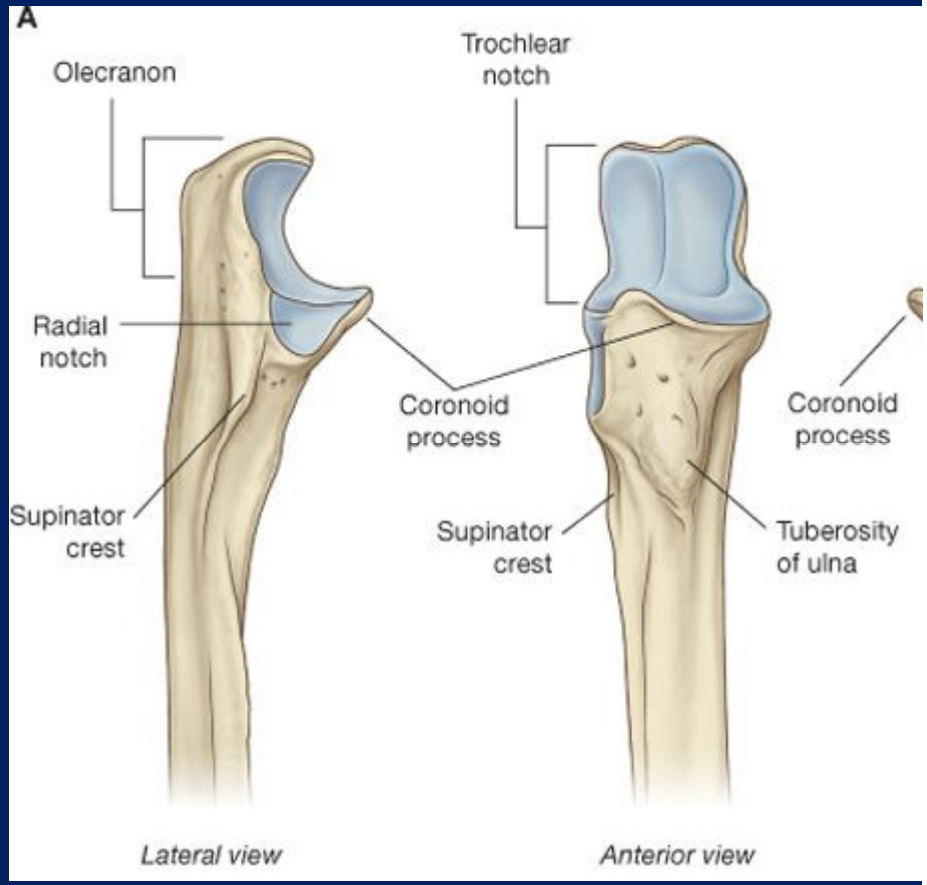
Radius

- The shaft has a sharp **interosseous border medially** for the attachment of the interosseous membrane that binds the radius and ulna together.
- The **pronator tubercle**, for the insertion of the pronator teres muscle, lies halfway down on its lateral side.
- At the distal end of the radius is the **styloid process**; this projects distally from its lateral margin.
- On the medial surface is the **ulnar notch**, which articulates with the round head of the ulna.
- The inferior articular surface articulates with the scaphoid and lunate bones.
- On the posterior aspect of the distal end is a small tubercle, the **dorsal tubercle**, which is grooved on its medial side by the tendon of the **extensor pollicis longus**.



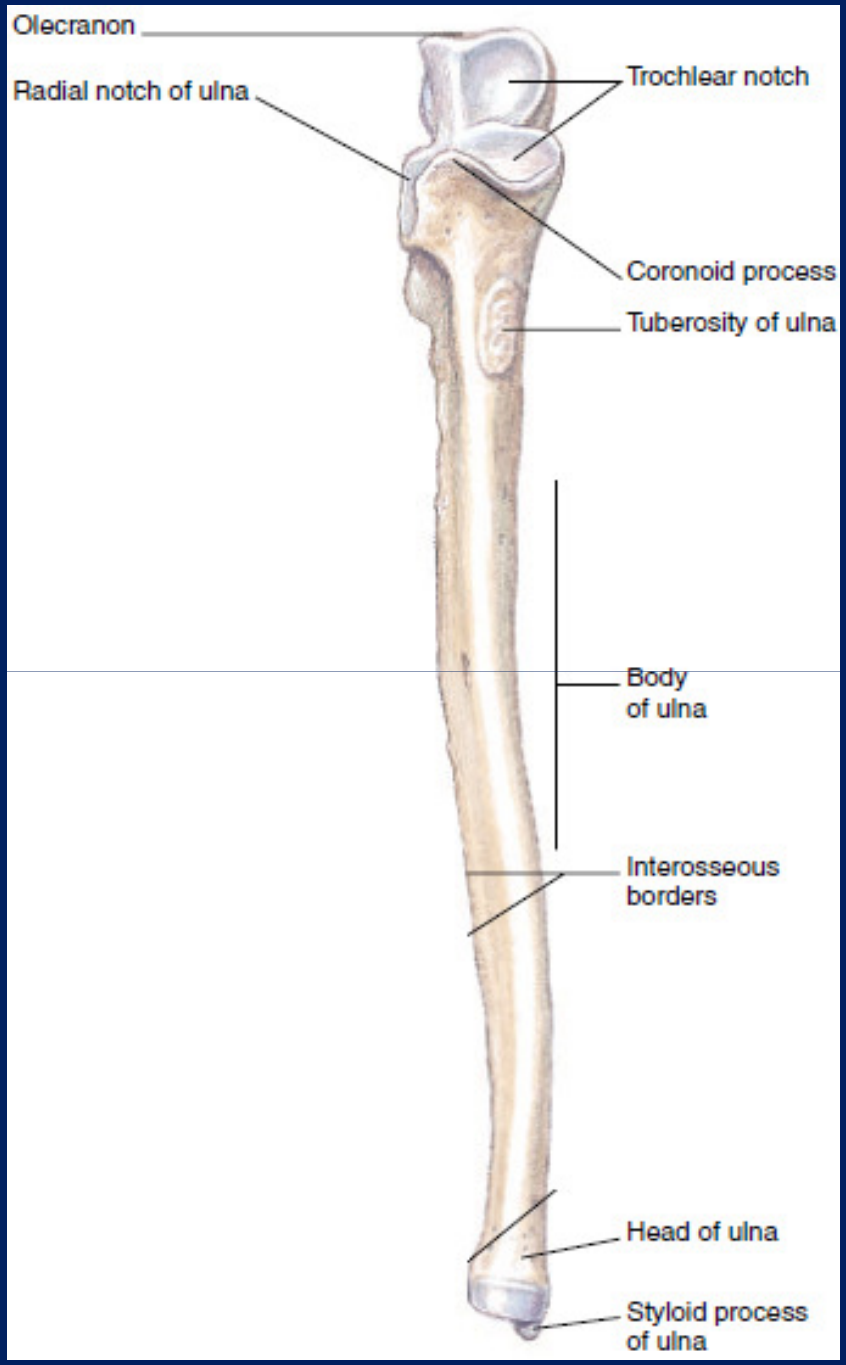
Ulna

- The ulna is the medial bone of 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**, which has on its lateral surface the **radial notch** for articulation with the head of the radius.



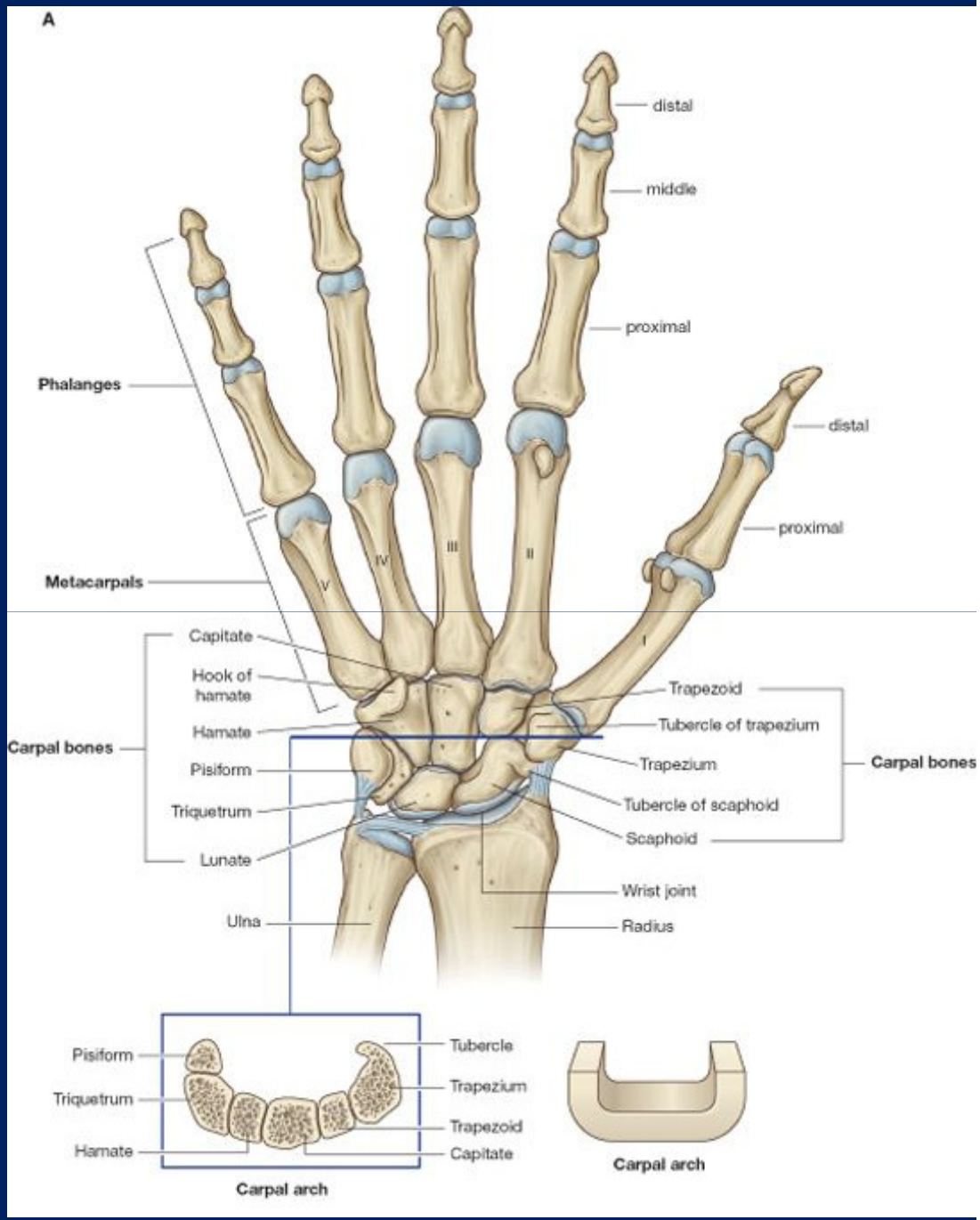
Ulna

The ***shaft*** **of the ulna** has a sharp **interosseous border** laterally for the attachment of the interosseous membrane. The posterior border is rounded and subcutaneous and can be easily palpated throughout its length. Below the radial notch is the **supinator crest** that gives origin to the supinator muscle. At the ***distal*** end of the ulna is the small rounded **head**, which has projecting from its medial aspect the styloid process.



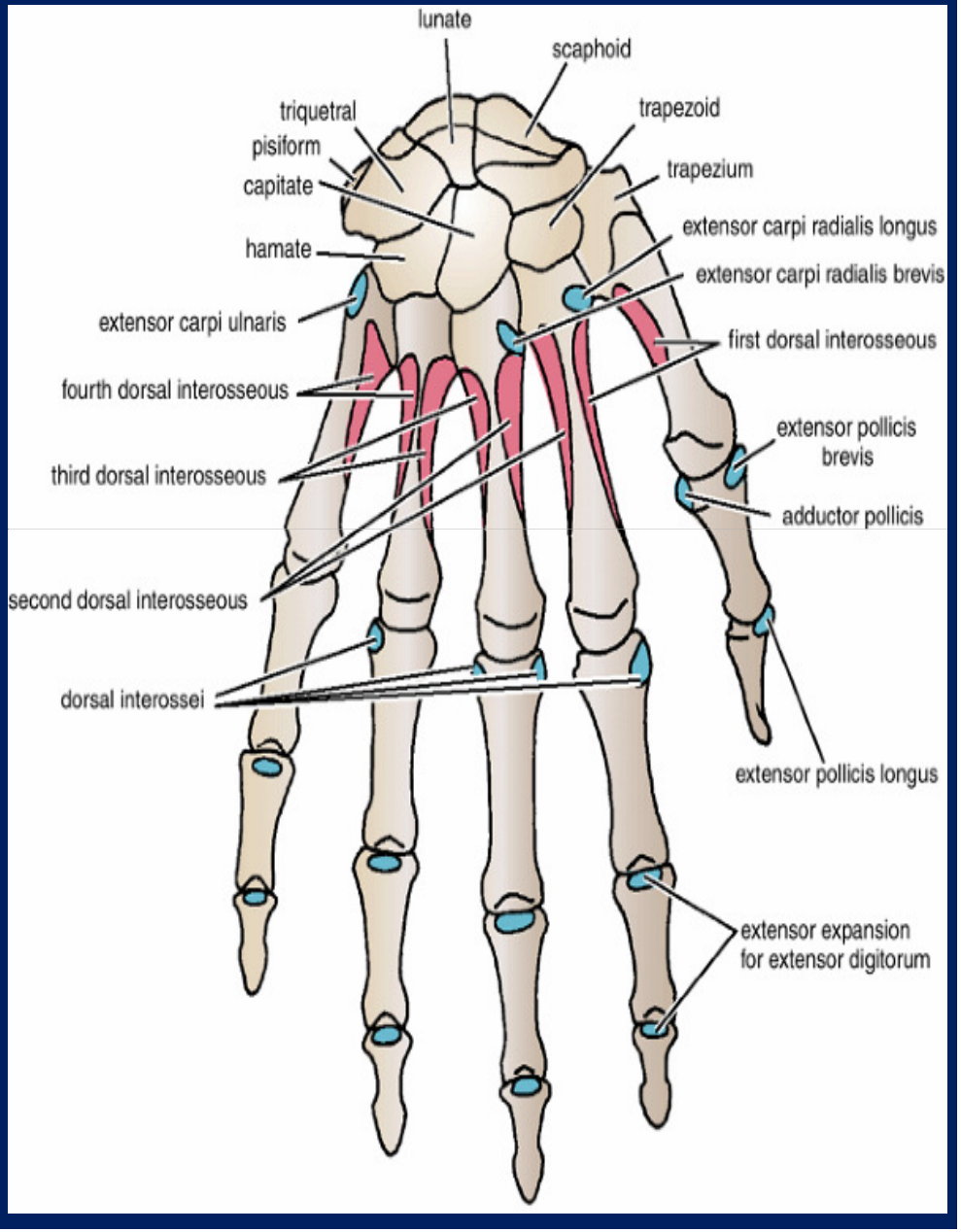
Bones of the Hand

- Carpal
- Metacarpal
- Phalanges



Carpal bones

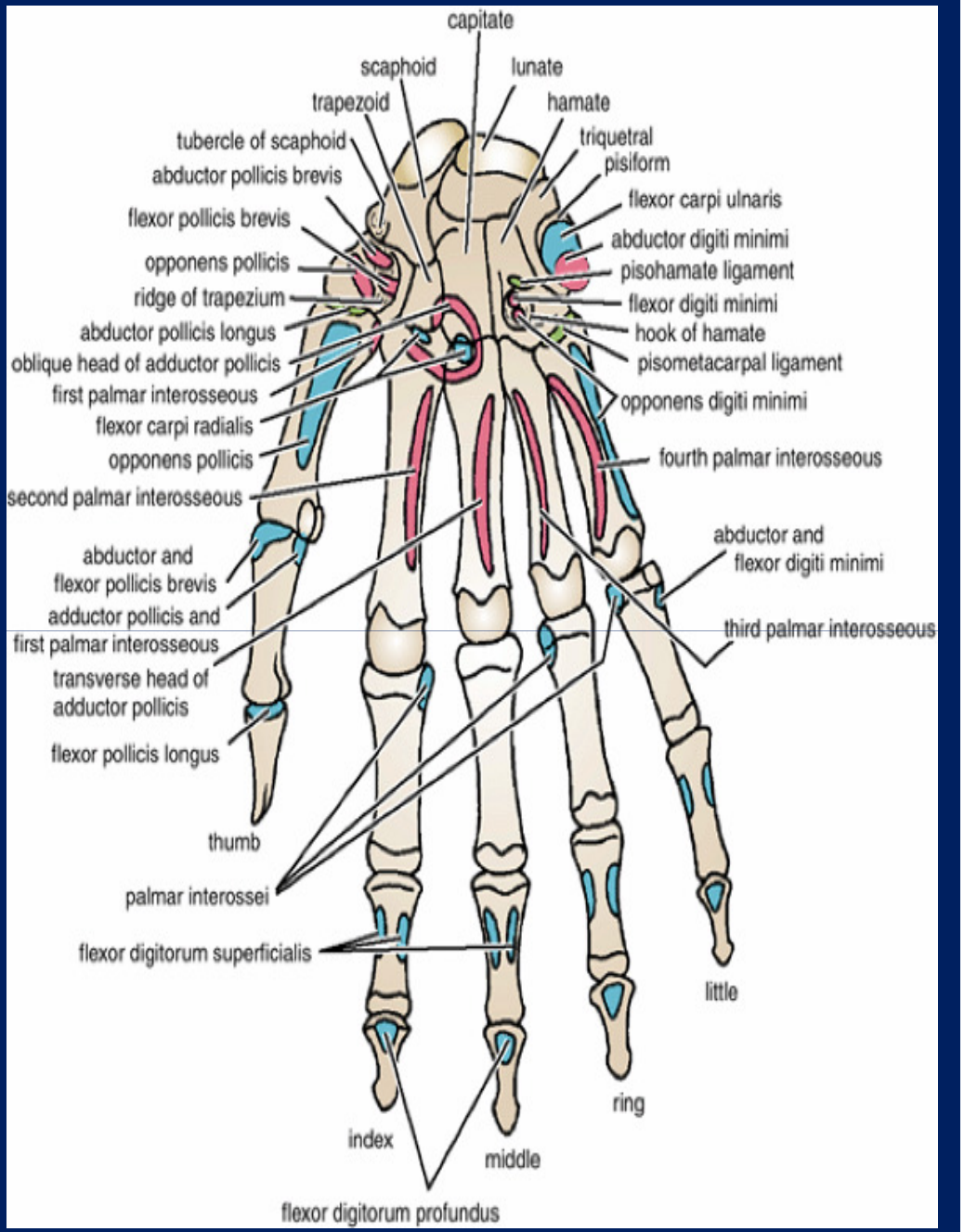
- There are eight carpal bones (two rows).
- The **proximal row** consists of (from lateral to medial) the **scaphoid, lunate, triquetral and pisiform bones**.
- The **distal row** consists of (from lateral to medial) the **trapezium, trapezoid, capitate and hamate bones**.
- Together, the bones of the 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 passage of the median nerve and flexor tendons of 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.
- **A detailed knowledge of bones of hand is unnecessary.**



The Metacarpals and Phalanges

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

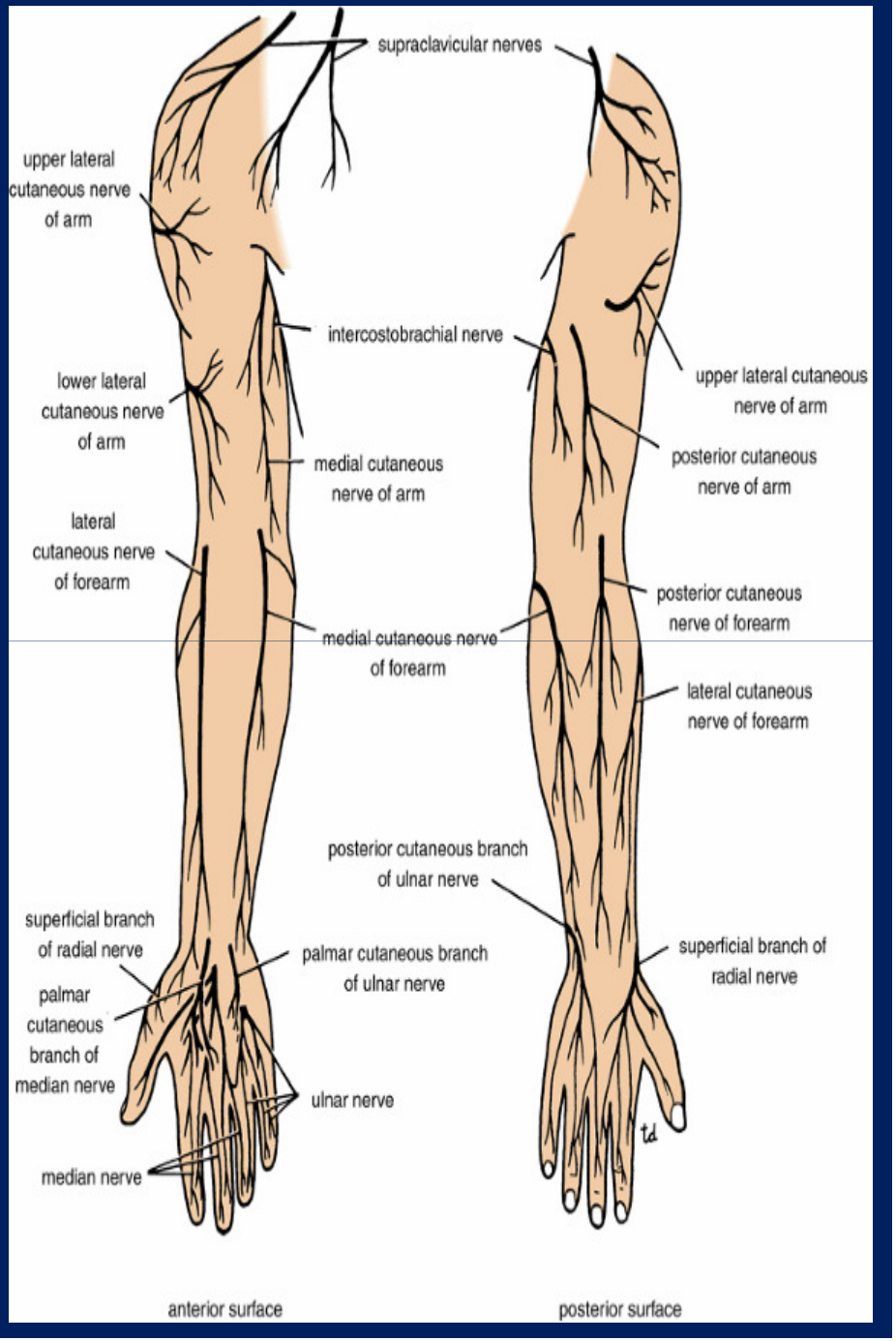
- The first metacarpal bone of the thumb is the shortest and most mobile.
- The **bases** of the metacarpal bones articulate with the distal row of the carpal bones .
- the **heads** which form the knuckles, articulate with proximal phalanges.
- The **shaft** of each metacarpal bone is slightly concave forward and is triangular in transverse section. Its surfaces are posterior, lateral and medial.
- There are **three phalanges** for each fingers but only **two** for the thumb.



Skin of the Forearm

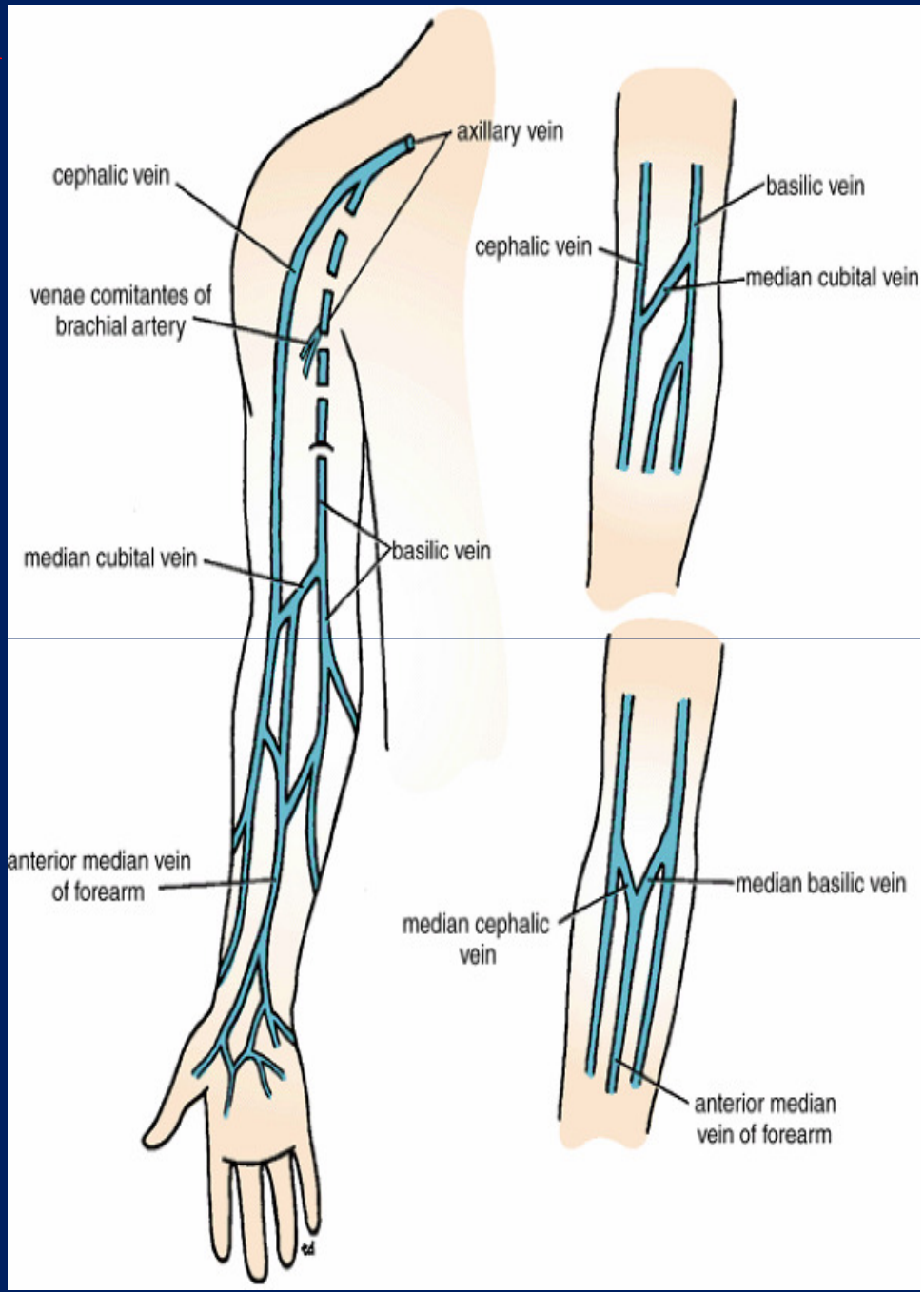
The **sensory nerve supply** to the skin of the forearm is from:-

- anterior and posterior branches of the **lateral cutaneous nerve of the forearm** a continuation of the musculocutaneous nerve .
- 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.



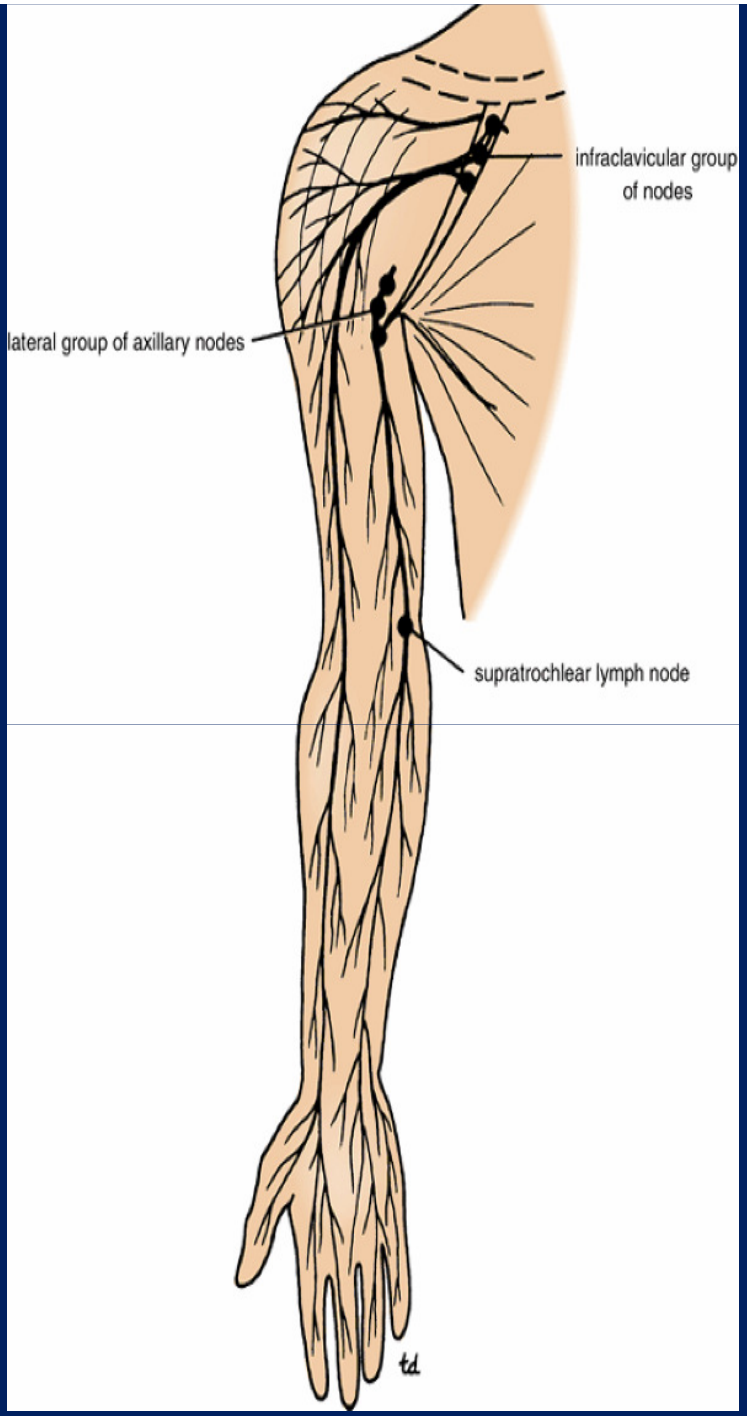
superficial veins of the forearm

- 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.



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**. 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**.

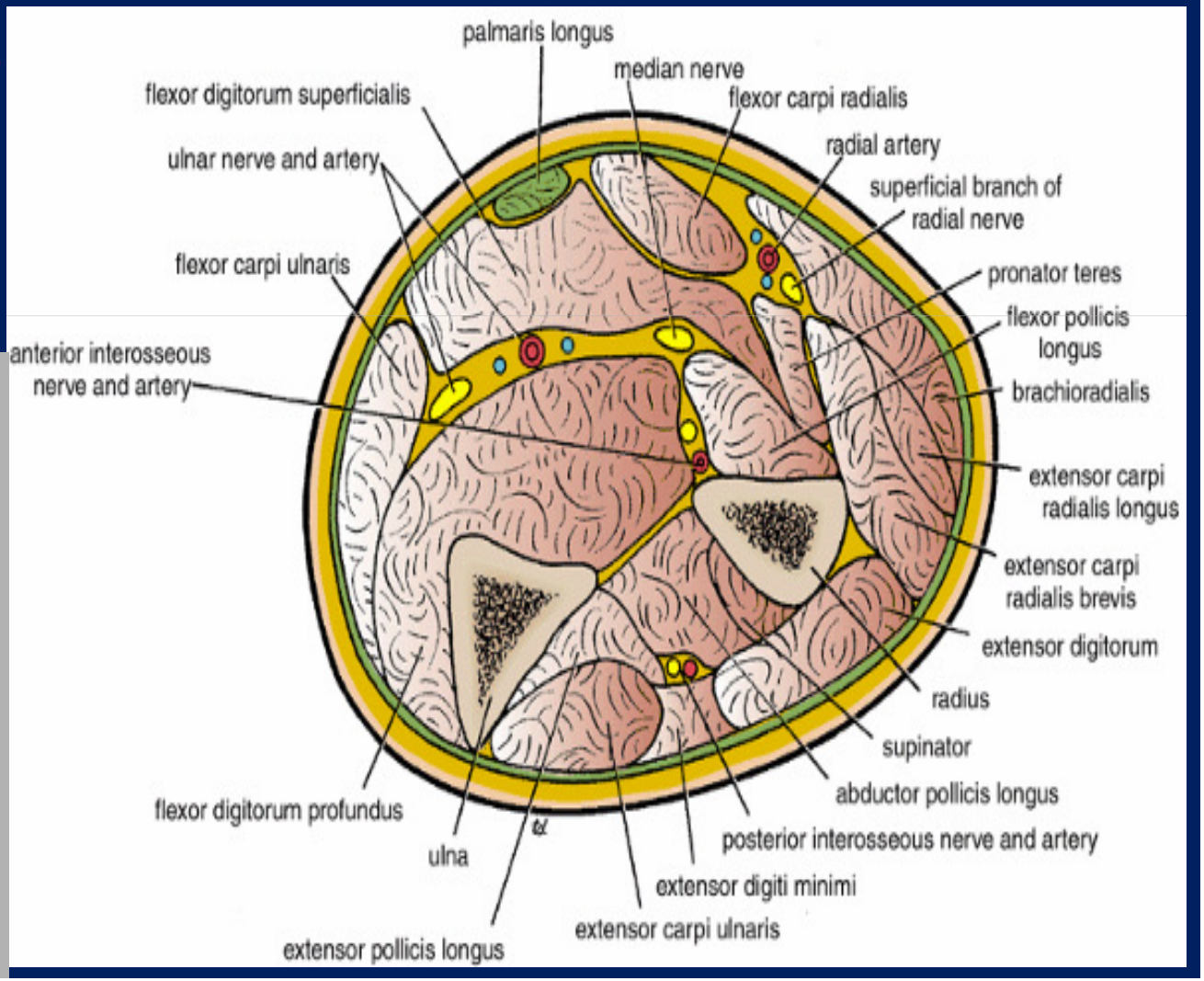


Fascial Compartments of the Forearm

Interosseous Membrane

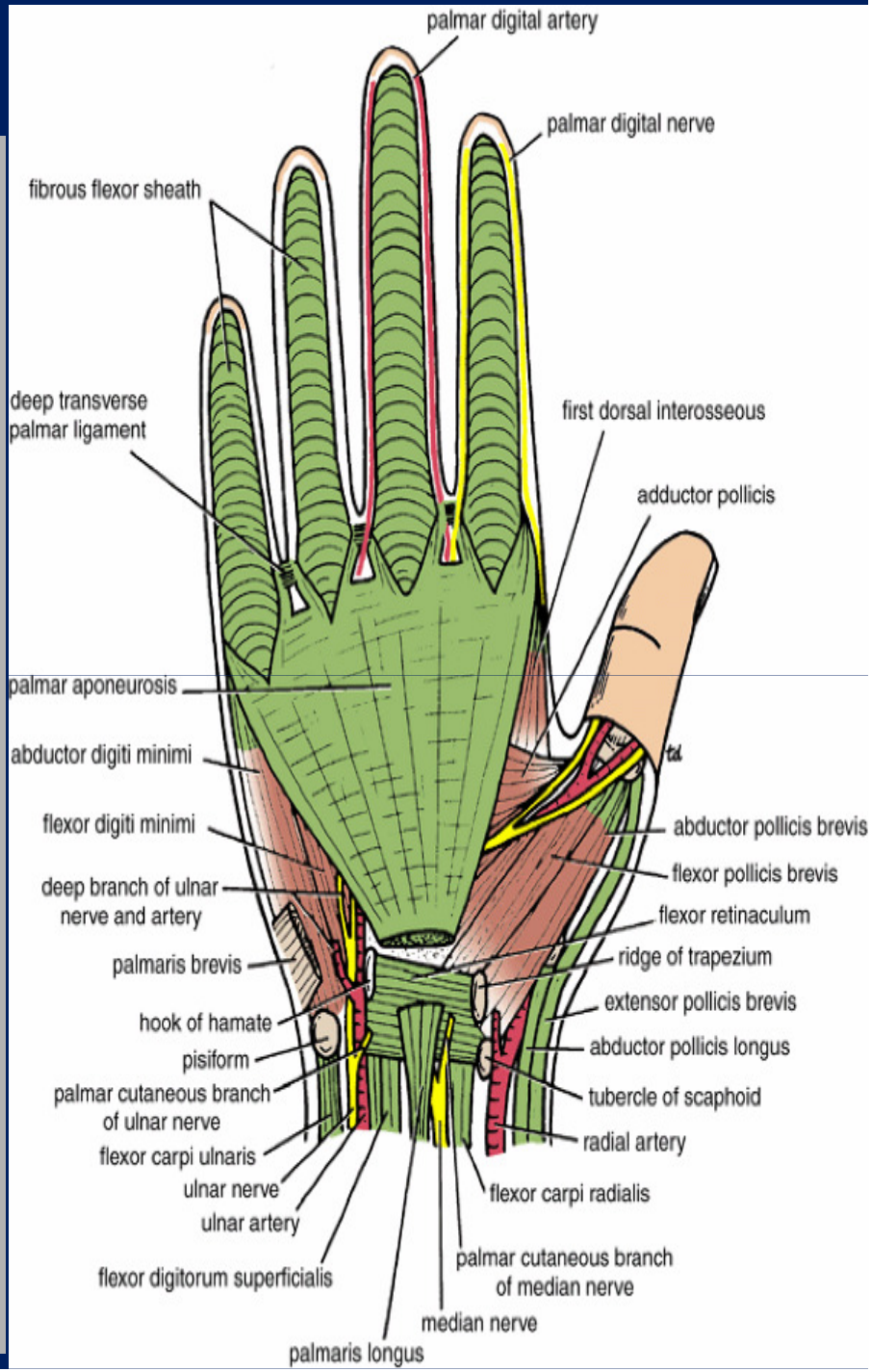
Flexor and Extensor Retinacula

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



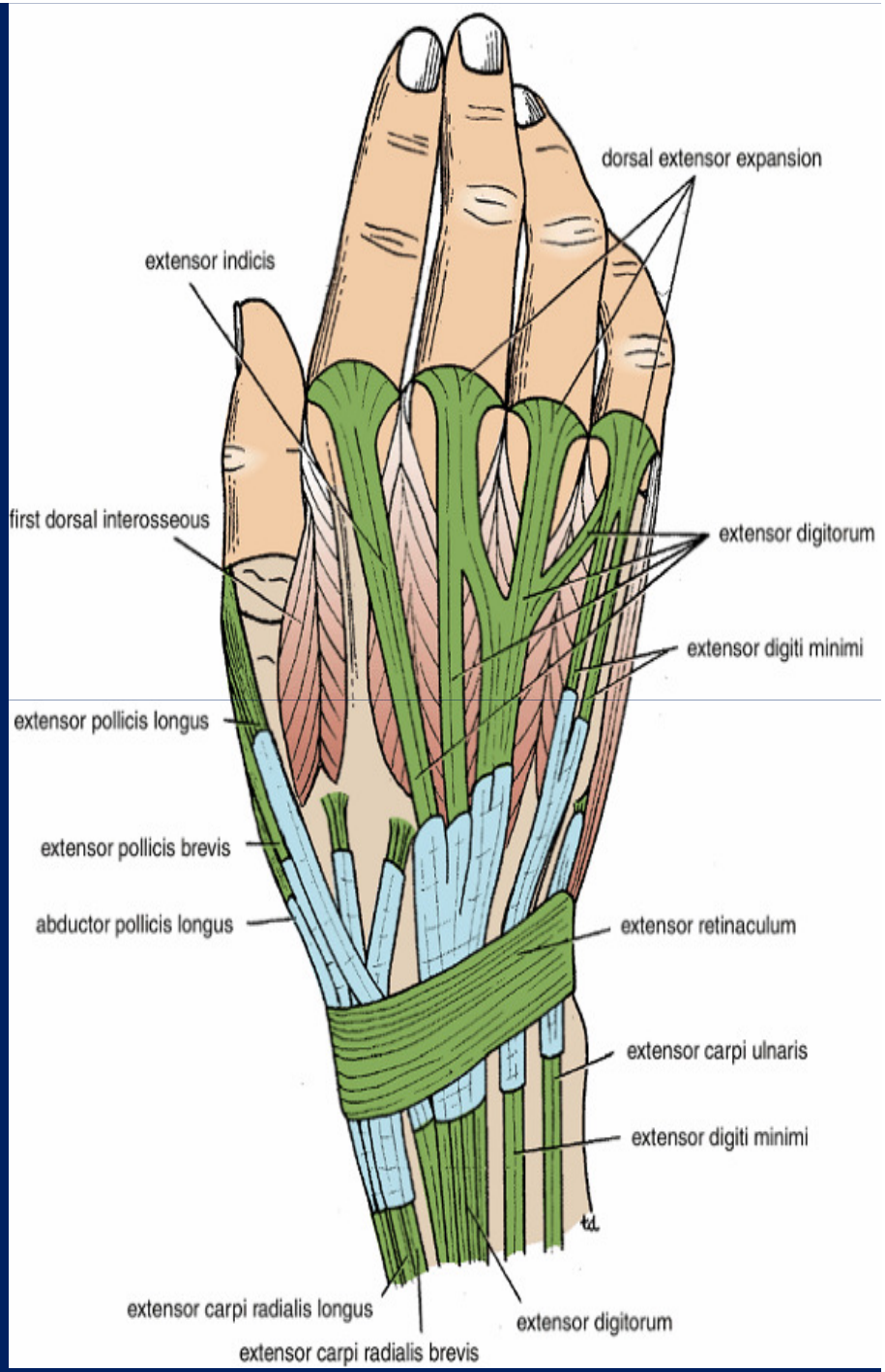
Flexor Retinaculum

- 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 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 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.



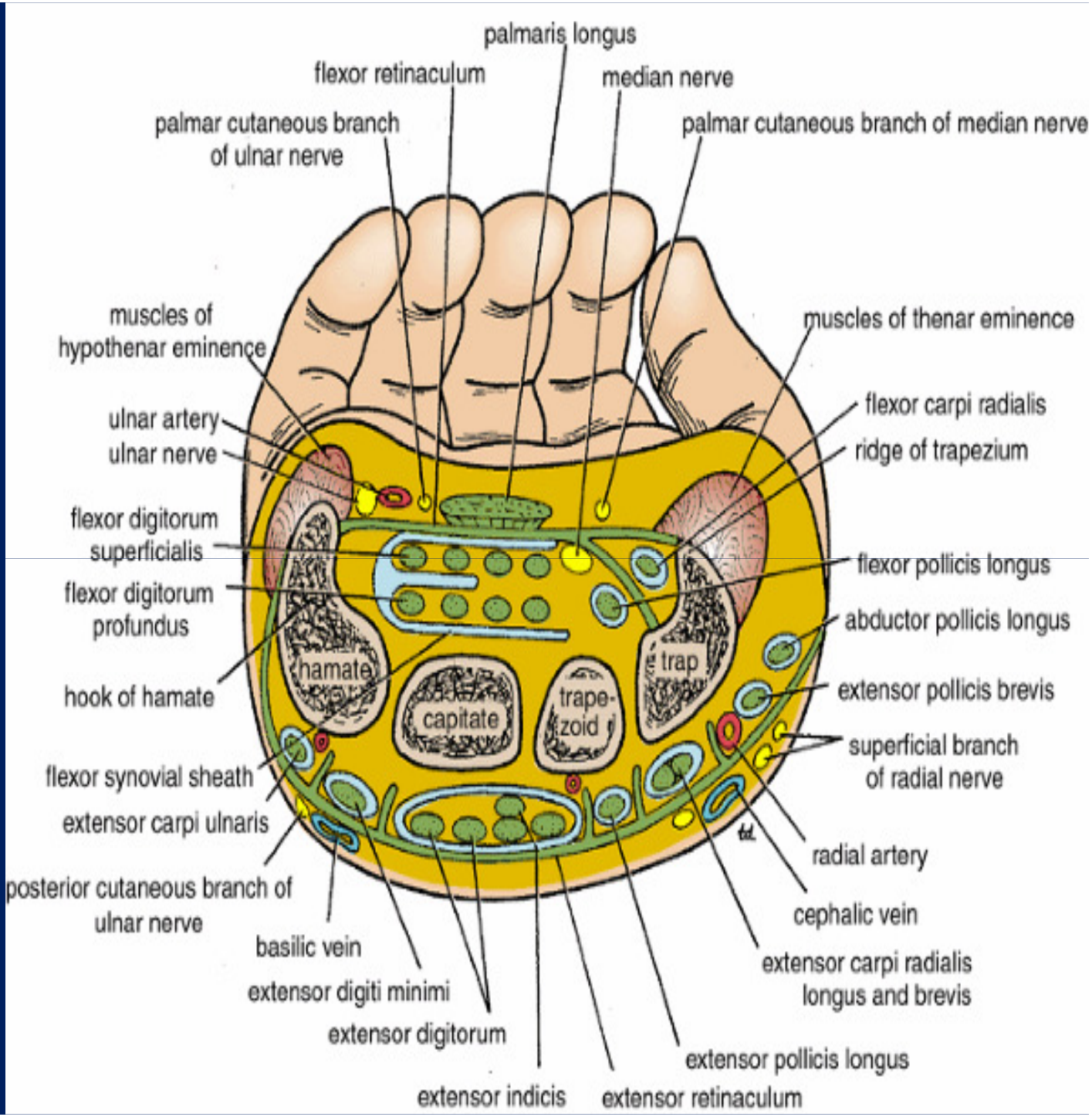
Extensor Retinaculum

- The extensor retinaculum is a thickening of deep fascia that stretches across the back of the wrist and holds the long extensor tendons in position.
- It converts the grooves on the posterior surface of the distal ends of the radius and ulna into six separate tunnels for the passage of the long extensor tendons.
- Each tunnel is lined with a synovial sheath, which extends above and below the retinaculum on the tendons.
- The retinaculum is attached medially to the pisiform bone and the hook of the hamate and laterally to the distal end of the radius.
- The upper and lower borders of the retinaculum are continuous with the deep fascia of the forearm and hand, respectively.



Carpal Tunnel

- The bones of the hand and the flexor retinaculum form the carpal tunnel.
- The median nerve lies in a restricted space between the tendons of the flexor digitorum superficialis and the flexor carpi radialis 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 ulnar nerve.

TABLE 9.6 Muscles of the Anterior Fascial Compartment of the Forearm

Muscle	Origin	Insertion	Nerve Supply	Nerve Roots*	Action
Pronator Teres					
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
Flexor Carpi Ulnaris					
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				

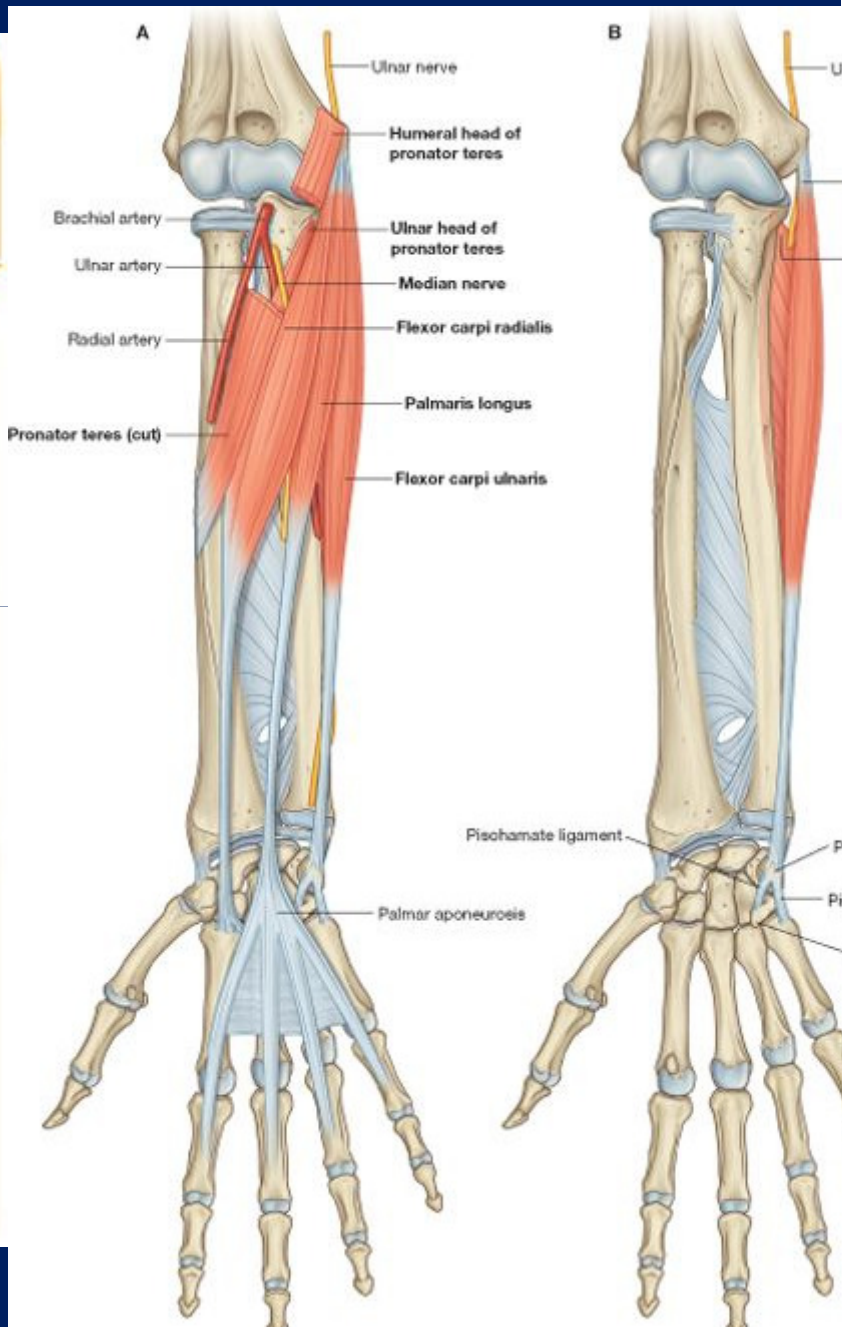
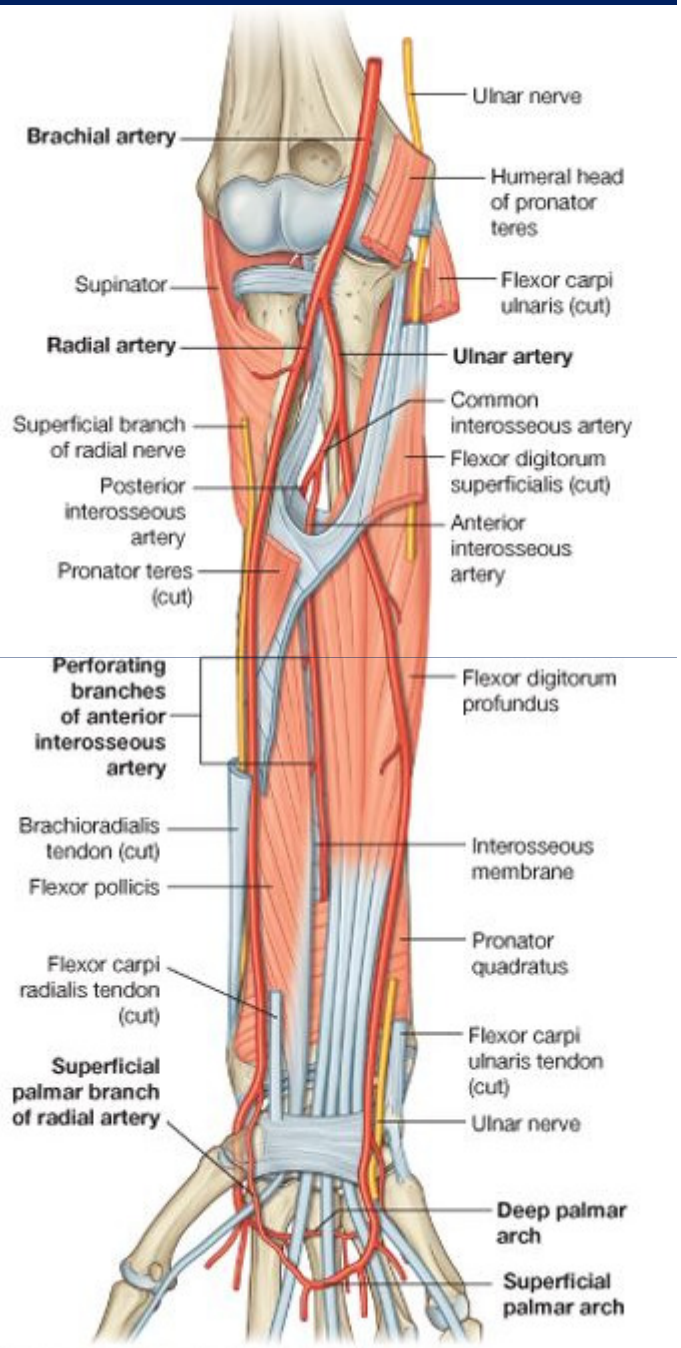


TABLE 9.6 Muscles of the Anterior Fascial Compartment of the Forearm

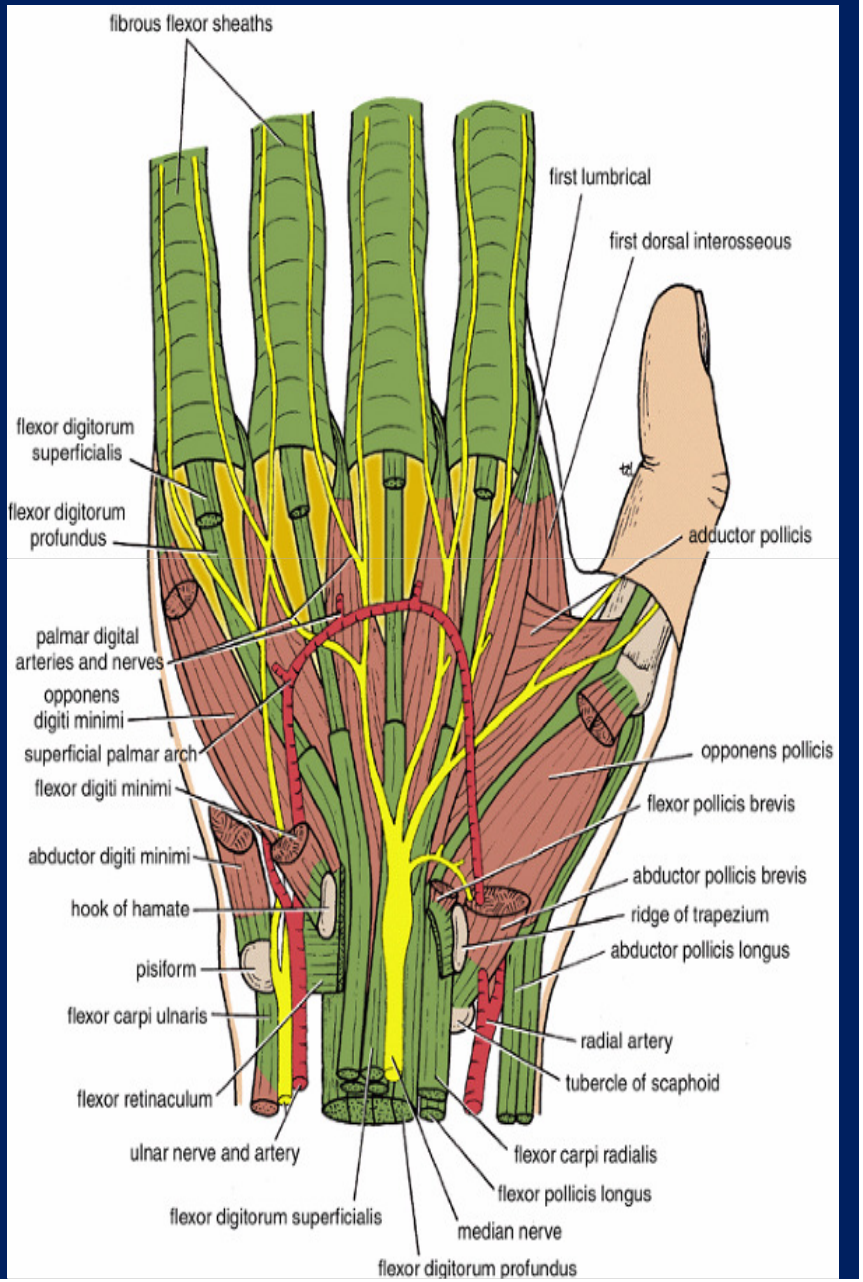
Muscle	Origin	Insertion	Nerve Supply	Nerve Roots*	Action
Flexor Digitorum Superficialis					
Humeroulnar head	Medial epicondyle of humerus; medial border of coronoid process of ulna	Middle phalanx of medial four fingers	Median nerve	C7, 8; T1	Flexes middle phalanx of fingers and assists in flexing proximal 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



Arteries of the Anterior Fascial Compartment of the Forearm

Ulnar Artery

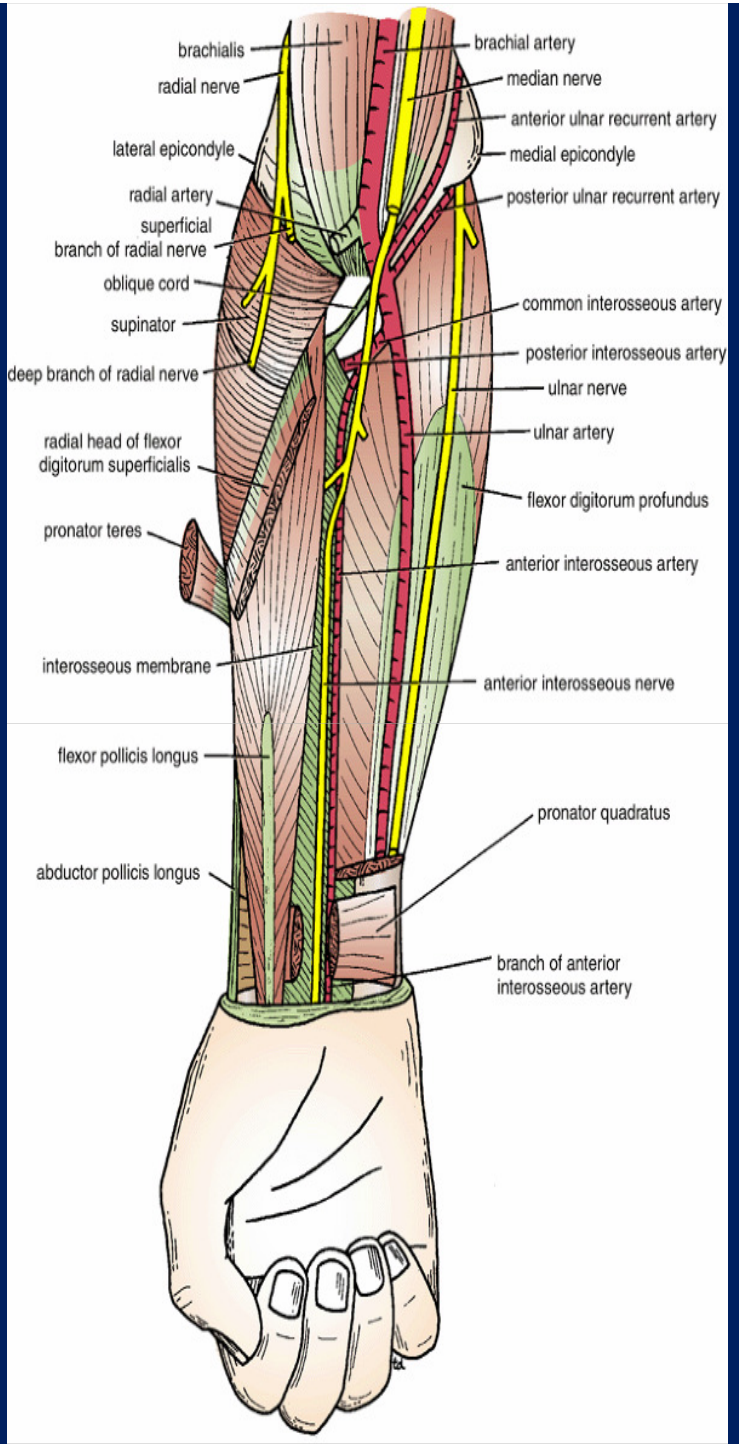
- The ulnar artery is the larger of the two terminal branches of the brachial artery.
- It begins in the cubital fossa at the level of the neck of the radius. It descends through the anterior compartment of the forearm and enters the palm in front of the flexor retinaculum in company with the ulnar nerve.
- It ends by forming the superficial palmar arch, often anastomosing with the superficial palmar branch of the radial artery.
- In the upper part of its course, the ulnar artery lies deep to most of the flexor muscles. Below, it becomes superficial and lies between the tendons of the flexor carpi ulnaris and the tendons of the flexor digitorum superficialis.
- In front of the flexor retinaculum, it lies just lateral to the pisiform bone and is covered only by skin and fascia (site for taking ulnar pulse).



Branches of the Ulnar Artery

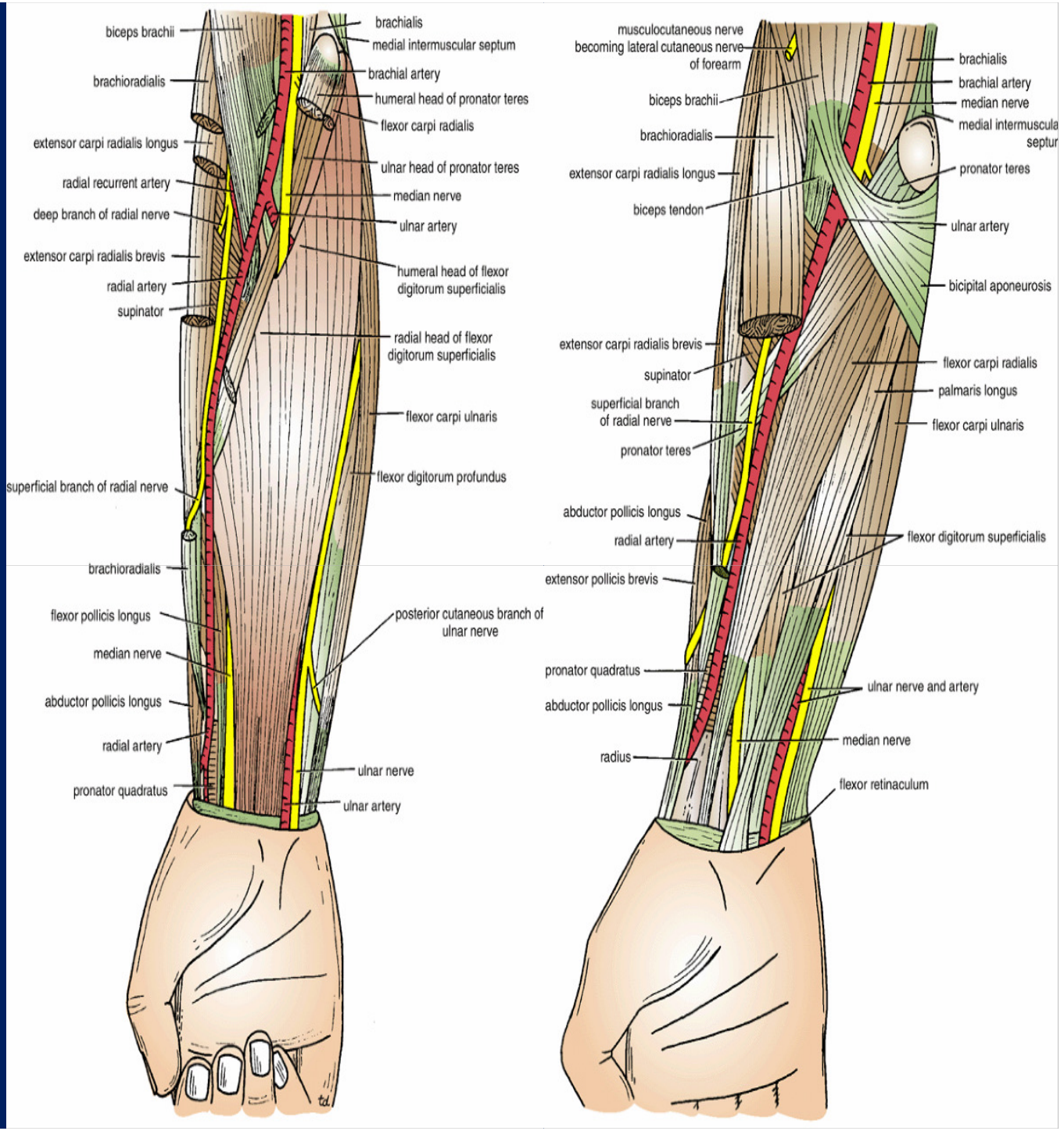
- Muscular branches to neighboring muscles
- Recurrent branches that take part in the arterial anastomosis around the elbow joint.
- Branches that take part in the arterial anastomosis around the wrist joint
- The common interosseous artery, which arises from the upper part of the ulnar artery and after 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.



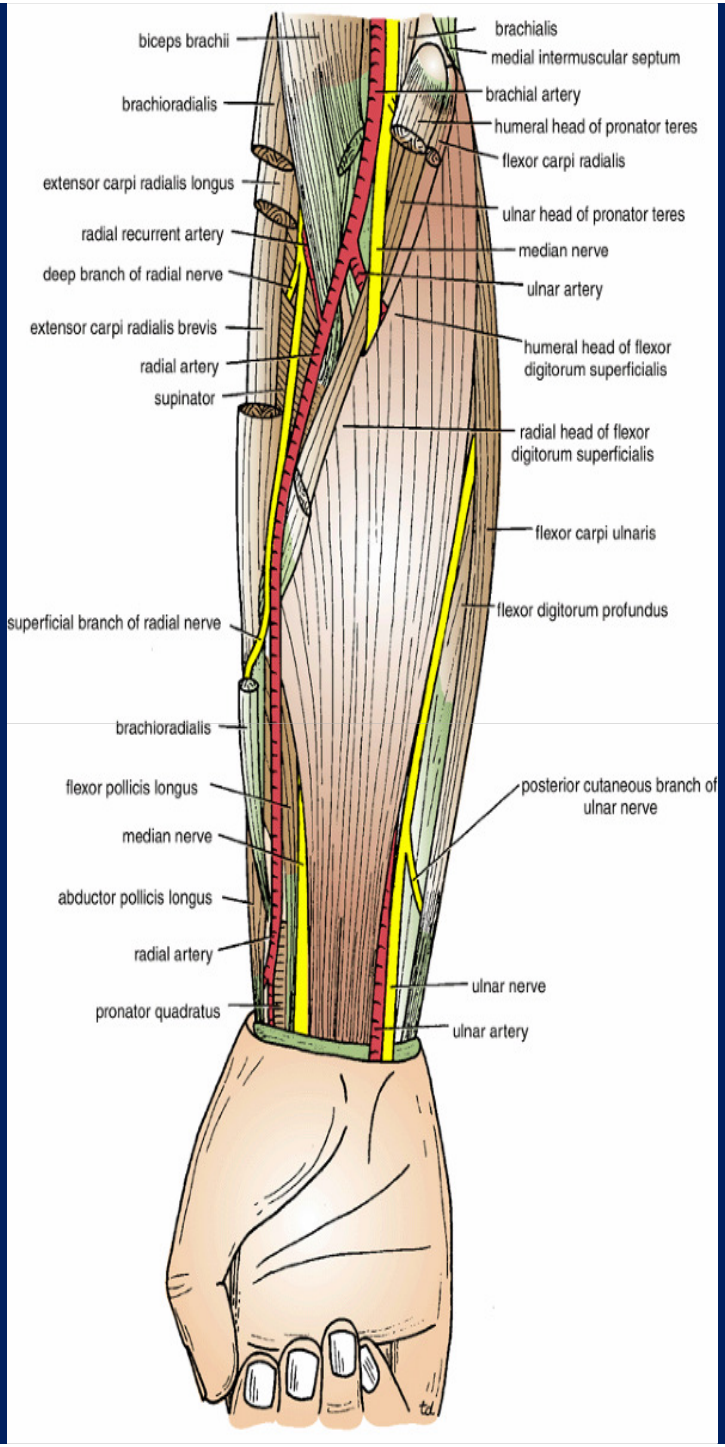
Radial Artery

- The radial artery is the smaller of the terminal branches of brachial artery.
- It begins in **cubital fossa**.
- 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(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.



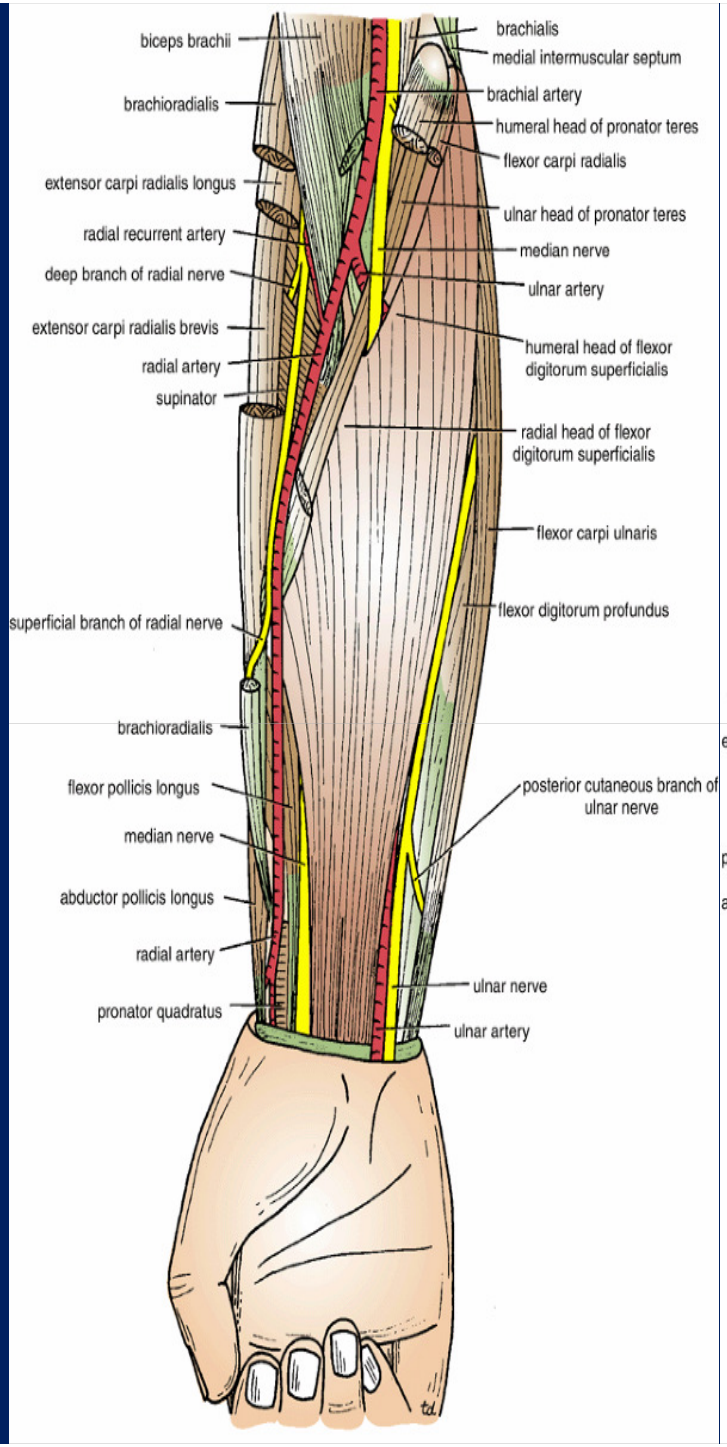
Branches of the Radial Artery in the Forearm

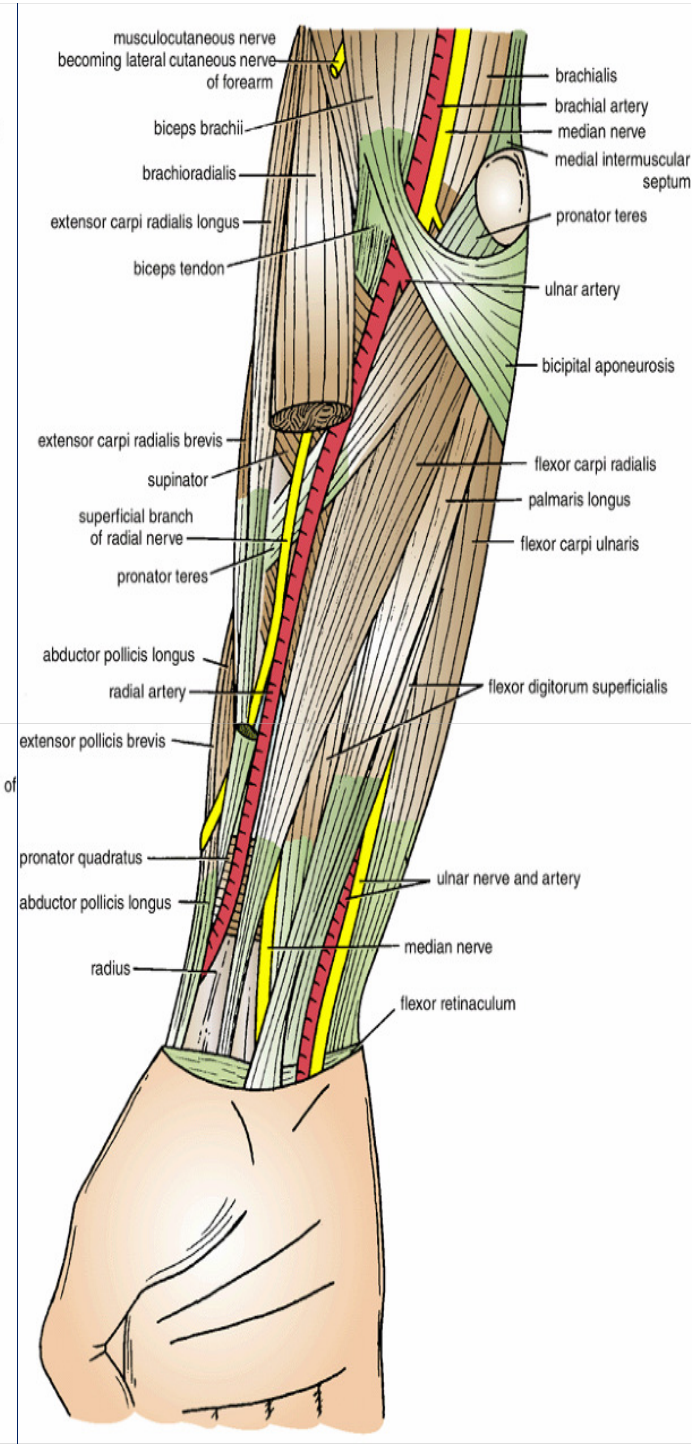
- **Muscular branches** to neighboring muscles
- **Recurrent branch**, which takes part in the arterial anastomosis around the elbow joint.
- **Superficial palmar branch**, which arises just above the wrist, enters the palm of the hand, and frequently joins the ulnar artery to form the **superficial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



Median Nerve

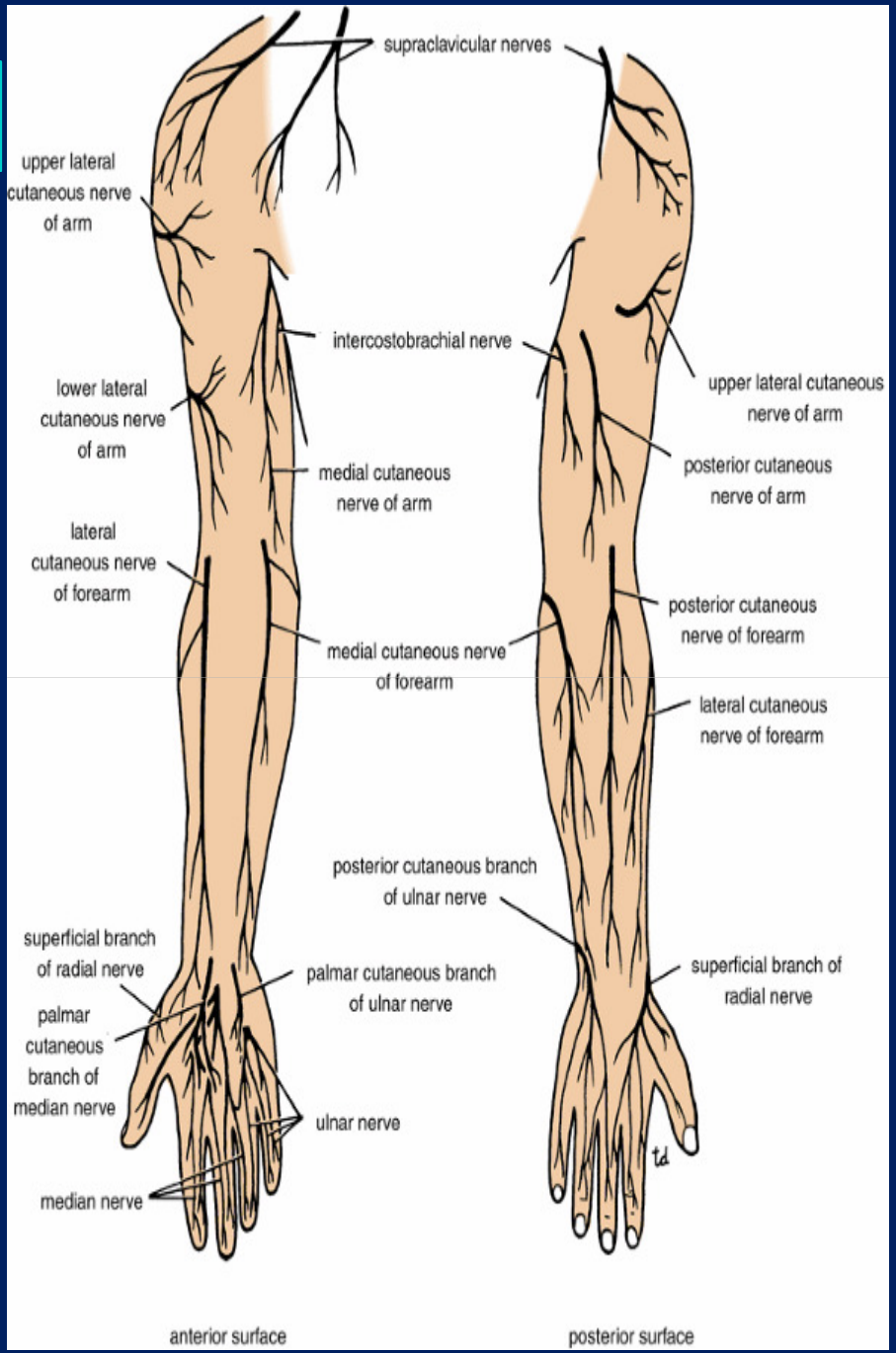
- The median nerve leaves the cubital fossa by passing between the two heads of the pronator teres.
- It continues downward behind the flexor digitorum superficialis and rests posteriorly on the flexor digitorum profundus.
- At the wrist, the median nerve emerges from the lateral border of the flexor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





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.

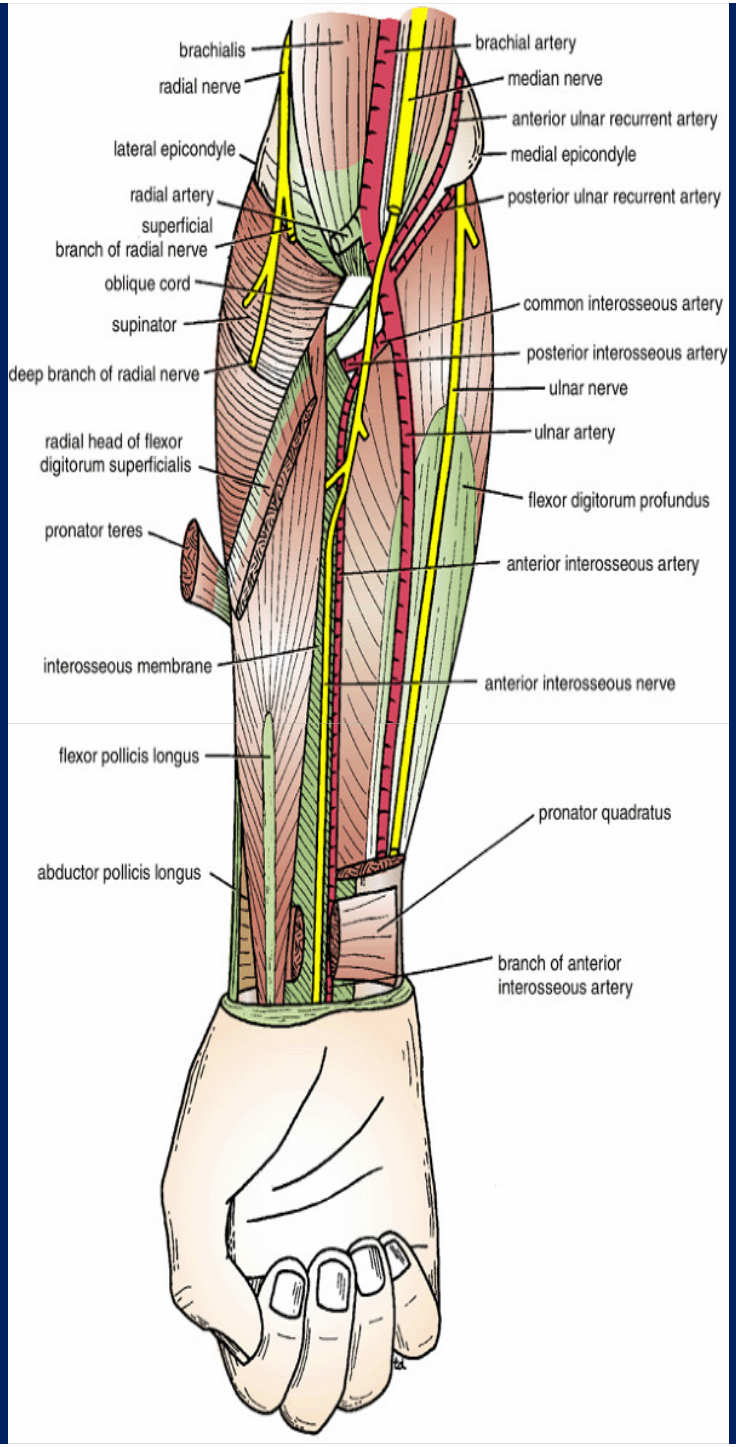


Anterior Interosseous Nerve

- 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.

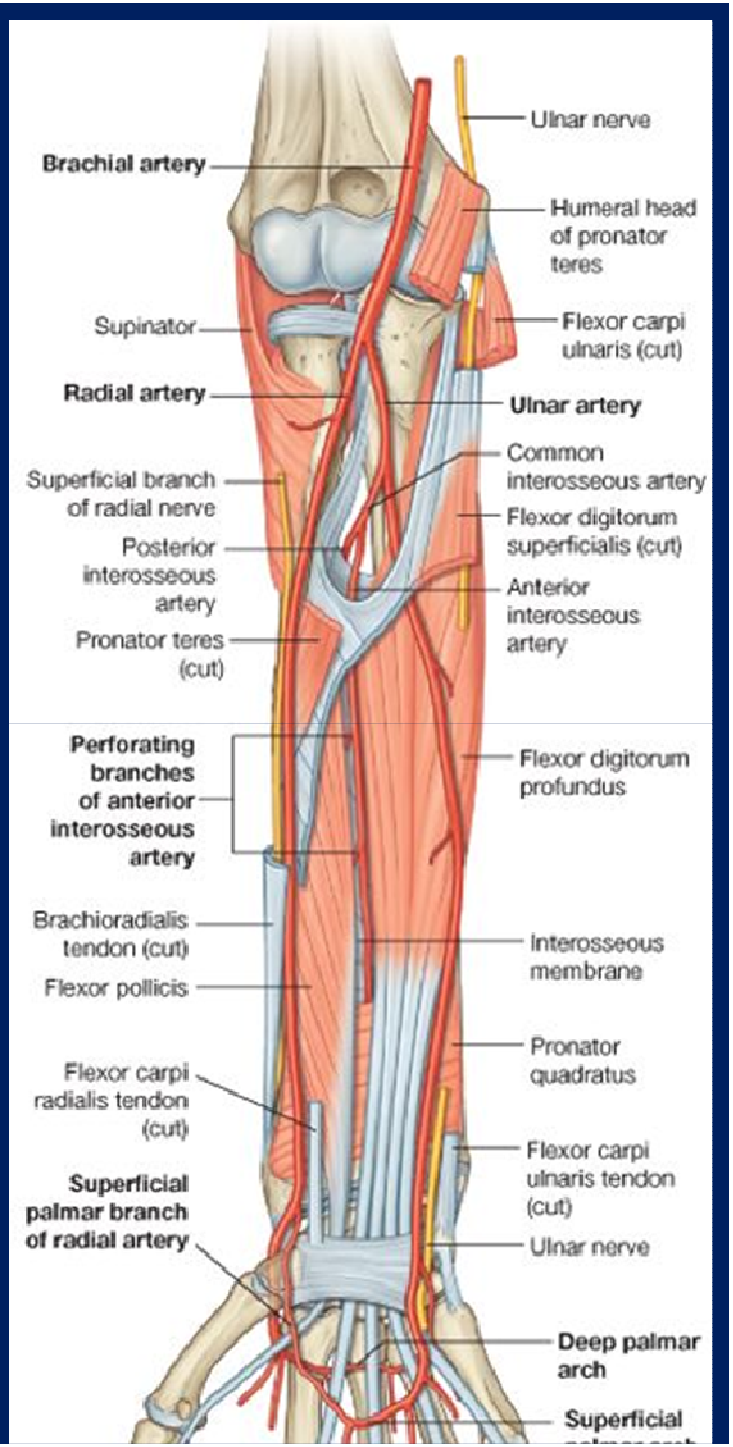


Ulnar Nerve

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 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 flexor carpi ulnaris and flexor digitorum superficialis muscles.

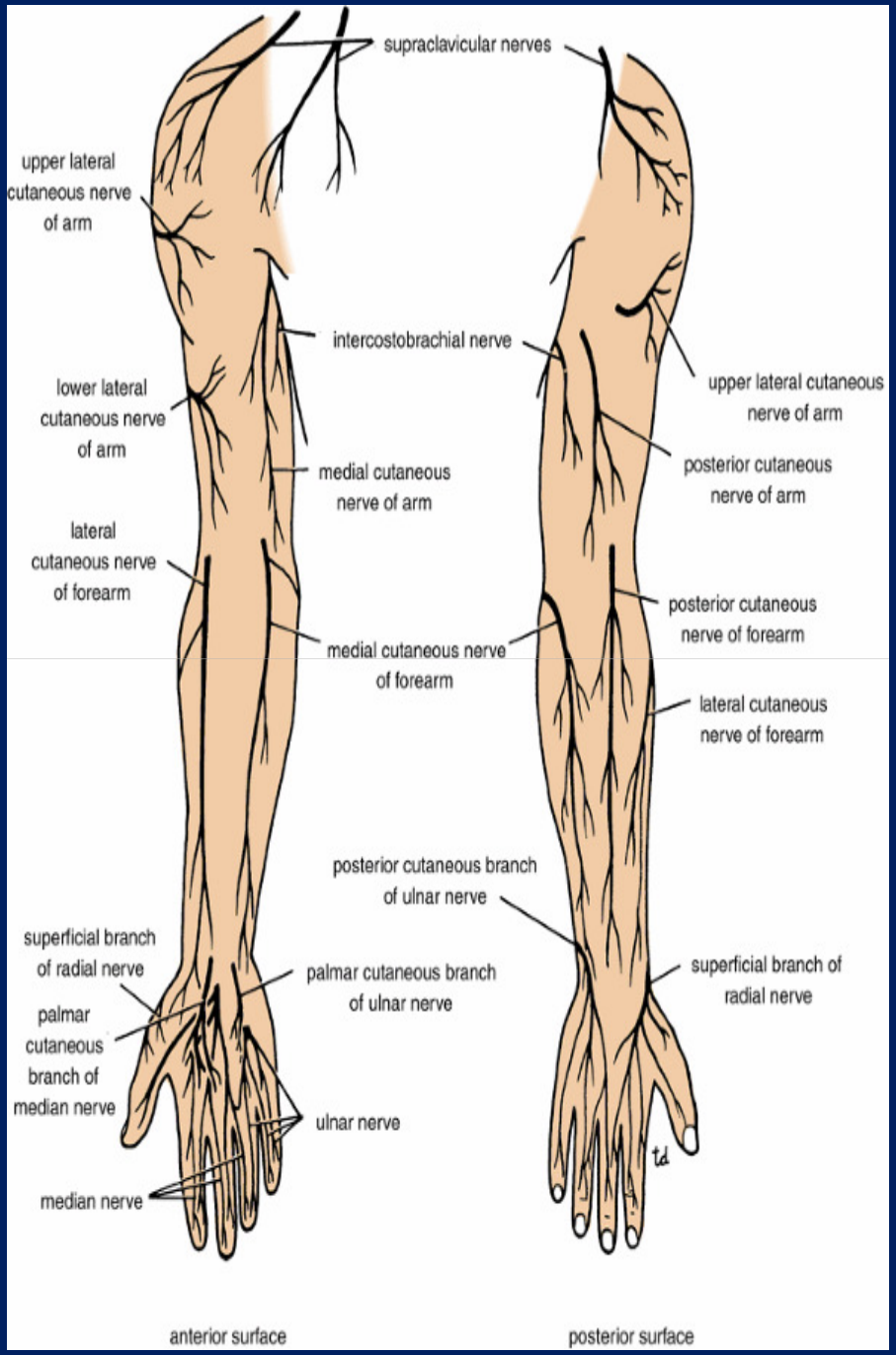
The ulnar nerve **enters the palm** of the hand by passing **in front of the flexor retinaculum and lateral to the pisiform bone** .

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 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 is distributed on the posterior surface of the hand and fingers.



Thank You & Good Luck