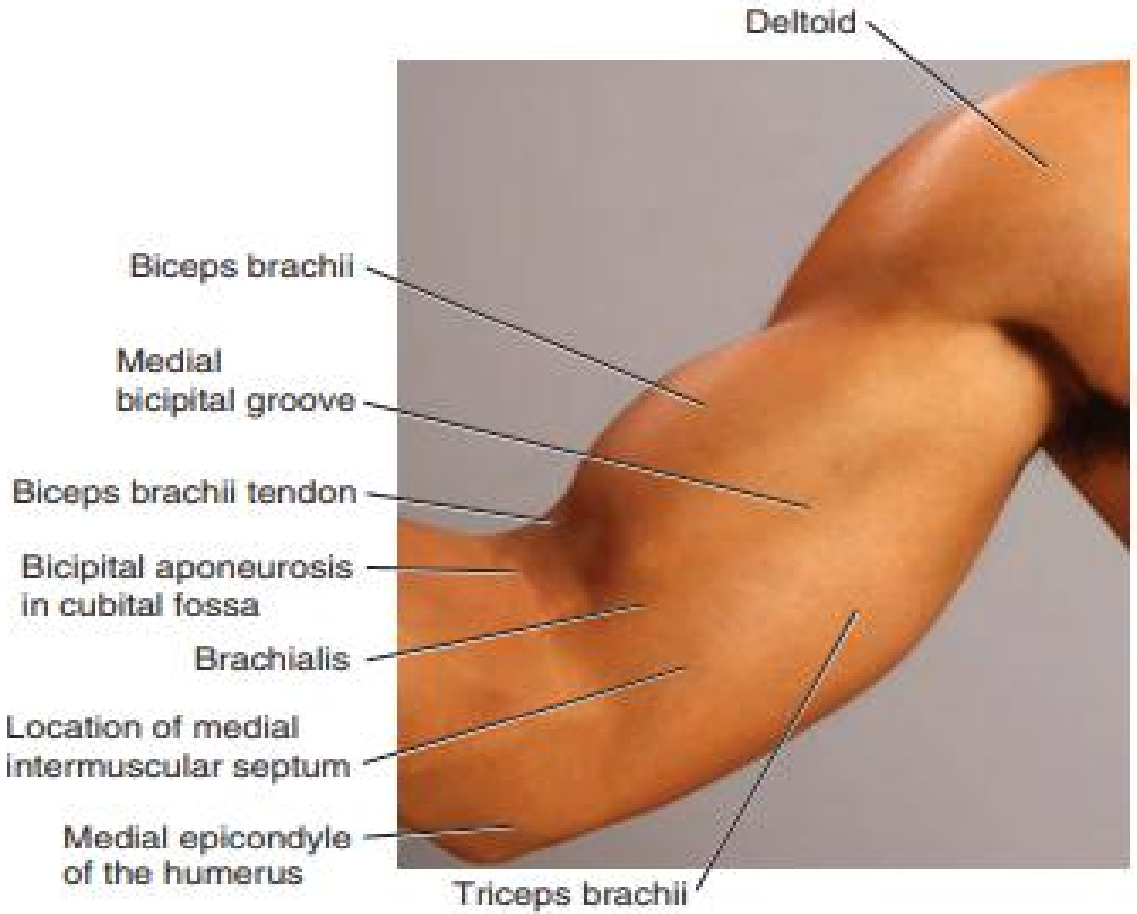
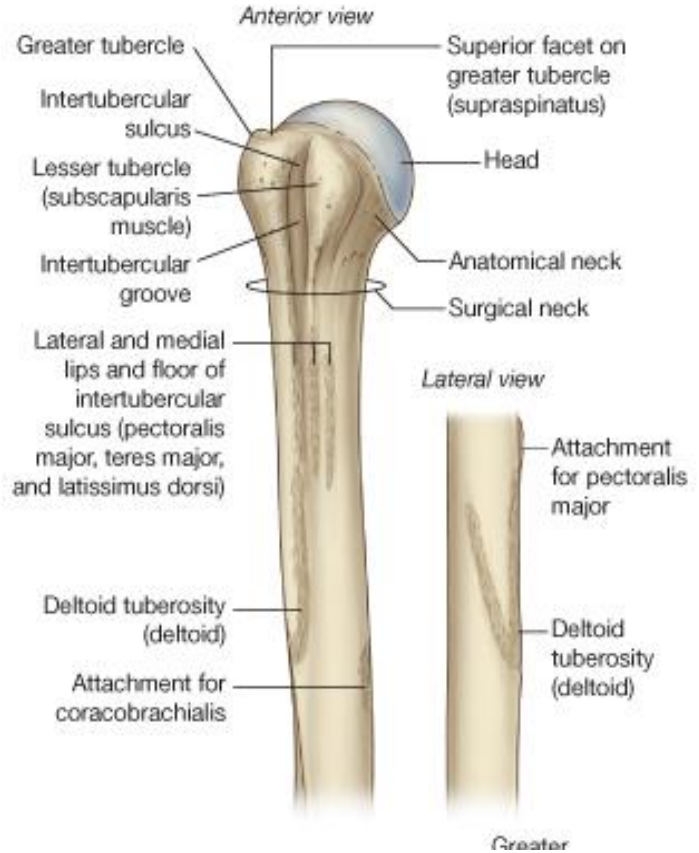
ARM

Dr G.O. Omotoso
Department of Anatomy
University of Ilorin


Deltoid
Biceps brachii
Medial
bicipital groove
Biceps brachii tendon
Bicipital aponeurosis
in cubital fossa
Brachialis
Location of medial
intermuscular septum
Medial epicondyle
of the humerus
Triceps brachii

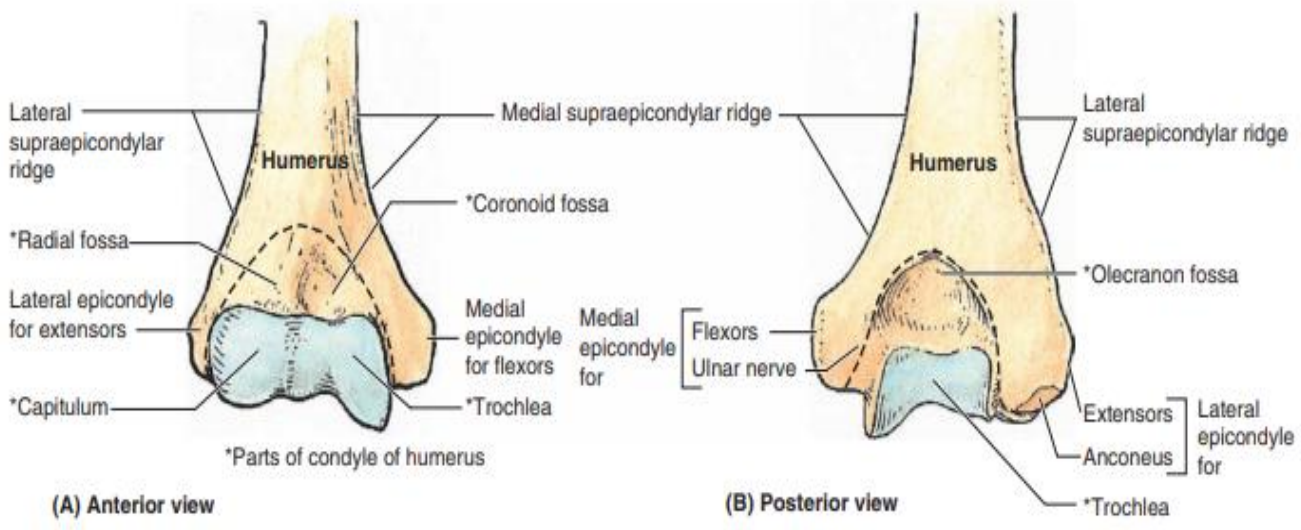
Humerus

- Largest bone of the upper limb
- Osteological features
  - Head
  - Anatomical neck: circumscribes head above tubercles
  - Surgical neck: below tubercles-common site of fracture
  - Greater and lesser tubercles
  - Intertubercular groove
  - The body of humerus has:
    - Deltoid tuberosity for attachment of deltoid muscle
    - Radial groove on posterior surface where radial nerve and deep brachial artery traverse
  - Medial and lateral supracondylar ridges: widening of humerus distally as sharp ridges on either side



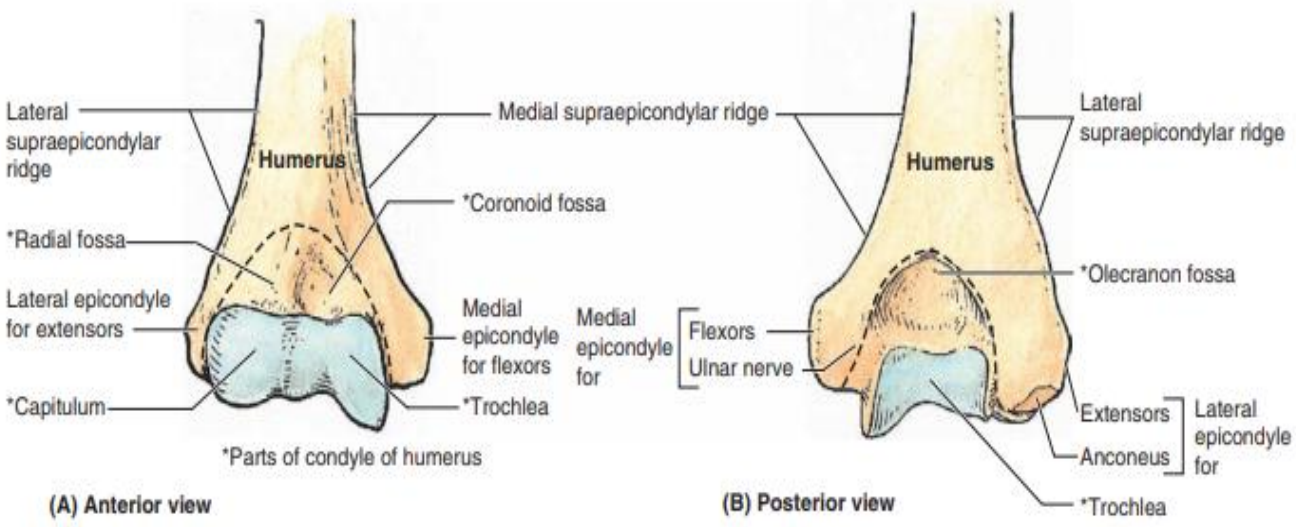
Humerus (cont'd)

- Medial epicondyle
  - Prominent medial extension at distal end
  - Common origin of forearm flexors; ulnar nerve posterior
- Lateral epicondyle
  - Prominent lateral extension at distal end
  - Common origin of forearm extensors; radial nerve posterior
- Condyle: distal end of humerus



Humerus (cont'd)

- Trochlea
  - Medial articular surface of condyle
  - For articulation with trochlear notch of ulna
- Capitulum
  - Lateral articular surface of condyle
  - For articulation with head of radius
- Coronoid fossa
  - Superior to trochlea
  - Receives coronoid process of ulna
- Olecranon fossae
  - Posterior distal end of humerus
  - Receives olecranon of ulna during full exte



Clinical anatomy

Fracture of the Humerus

- Fracture of the humerus is common at the surgical neck
- This fracture is common in elderly individuals with osteoporotic bone, falling on an outstretched arm
- The axillary nerve is vulnerable to damage at the surgical neck of humerus
- Direct blow to the arm may
  - Fracture humerus through its midshaft, with risk of injury to the radial nerve
  - Fracture humerus at distal end, risking damage to the median nerve

Fascia of the Arm

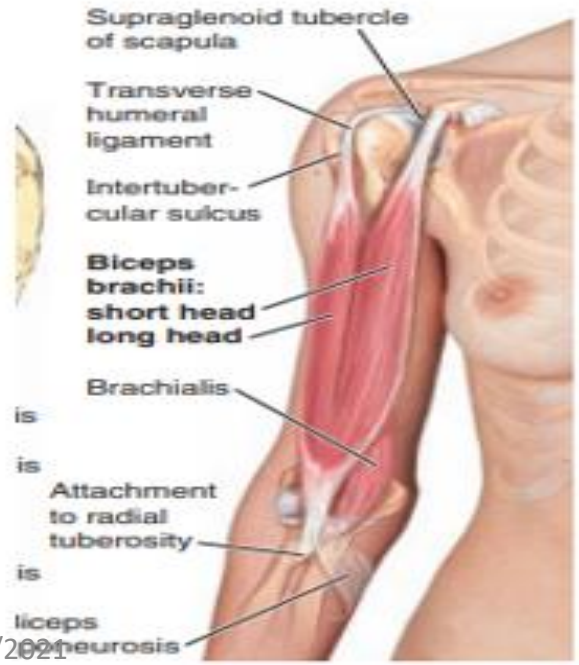
- Brachial fascia
  - Is a sleeve of deep fascia around the arm
  - It continues with the antebrachial fascia of the forearm
- Medial and lateral intermuscular septa
  - Extend from deep surface of brachial fascia to humerus
  - These septa divide arm into anterior (flexor) and posterior (extensor) compartments
  - Medial septum: medial lip of intertubercular sulcus (superiorly) → medial epicondyle
  - Lateral septum: lateral lip of intertubercular sulcus (superiorly) → lateral epicondyle

Muscles of the Arm

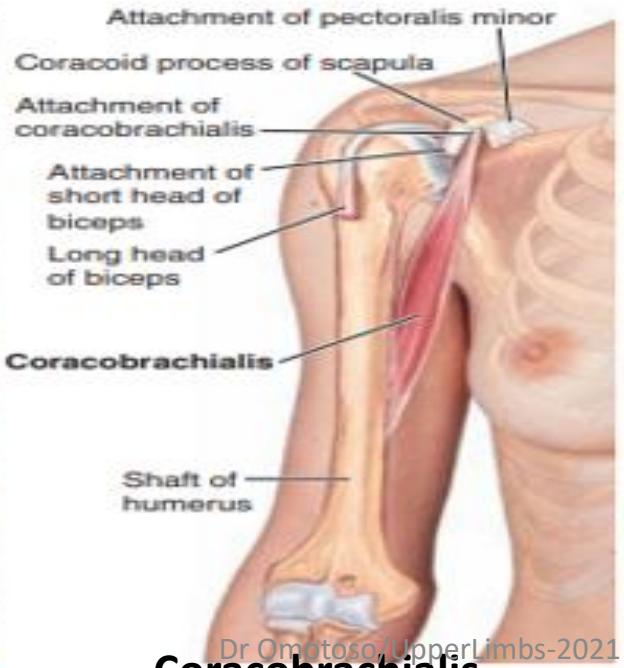
- **<u>Anterior (flexor) compartment</u>**
  1. Biceps brachii
     - Flexes and supinates
     - Continues distally as bicipital aponeurosis: triangular membrane from the biceps tendon across cubital fossa and blends with antebrachial fascia over the flexor muscles of the forearm
  2. Brachialis: main flexor of forearm
  3. Coracobrachialis
     - Flexes and adducts arm
     - Pierced by the musculocutaneous nerve

A Table Showing Attachments, Innervations and Actions of the muscles of anterior compartment of the arm

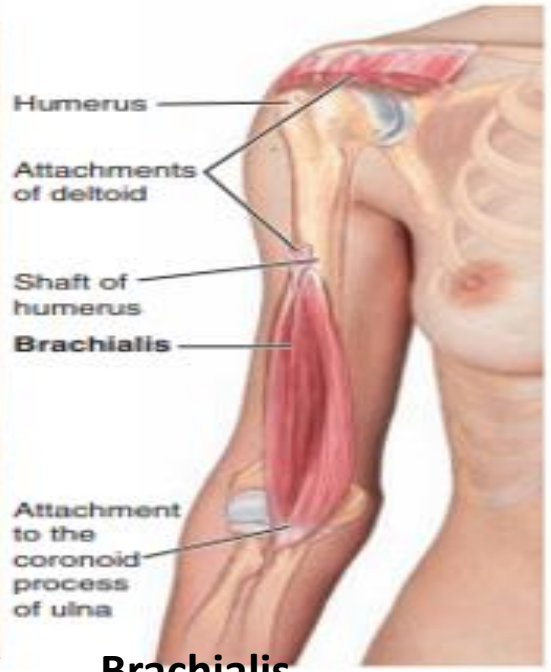
Muscle	Proximal Attachment	Distal Attachment	Innervation[a]	Muscle Action
Biceps brachii	Short head: tip of coracoid process of scapula Long head: supraglenoid tubercle of scapula	Tuberosity of radius and fascia of forearm via bicipital aponeurosis	Musculocutaneous nerve (C5, **C6**, C7)	Supinates forearm and, when it is supine, flexes forearm; short head resists dislocation of shoulder
Coracobrachialis	Tip of coracoid process of scapula	Middle third of medial surface of humerus		Helps flex and adduct arm; resists dislocation of shoulder
Brachialis	Distal half of anterior surface of humerus	Coronoid process and tuberosity ulna	Musculocutaneous nerve[b] (C5, C6) and radial nerve (C5, C7)	Flexes forearm in all positions



Biceps brachii



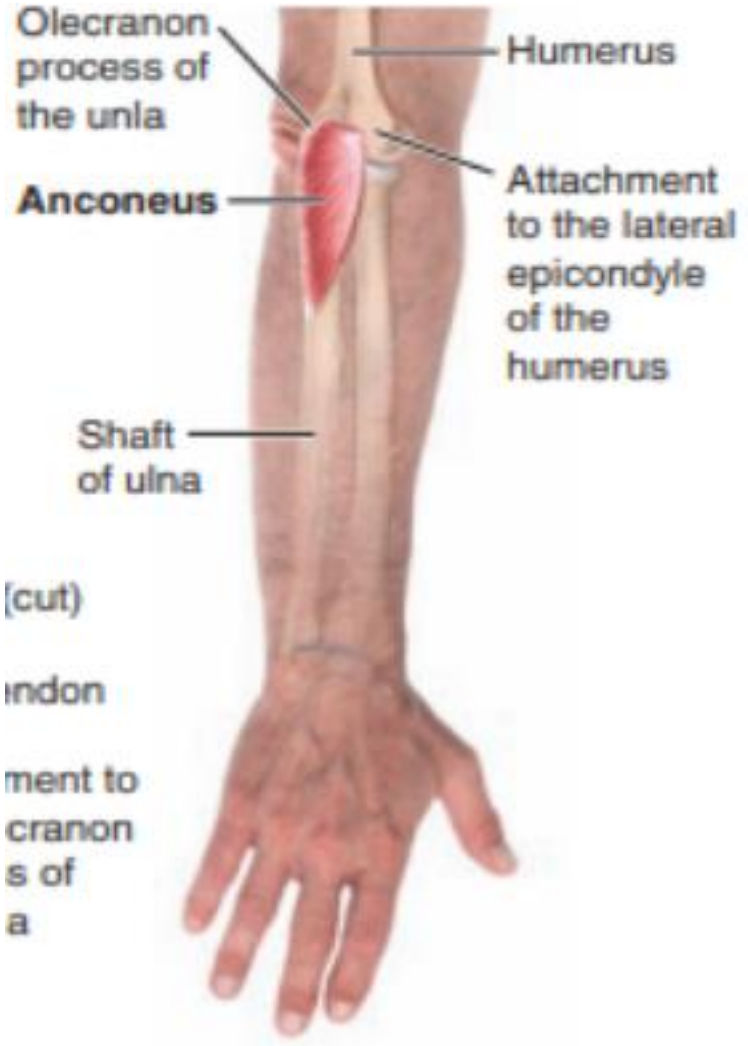
Coracobrachialis



Brachialis

Muscles of the Arm

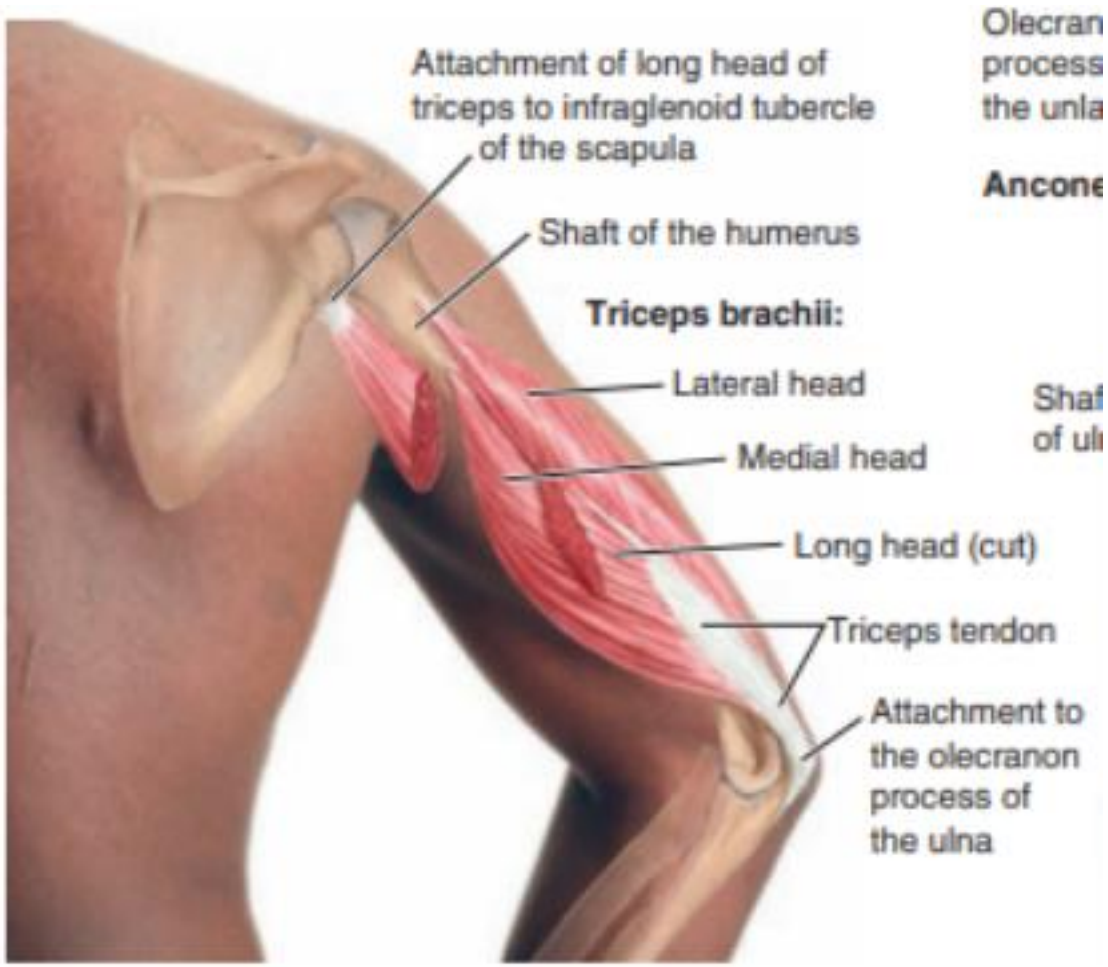
- **<u>Posterior (extensor) compartment</u>**
- **Anconeus**
  - extends arm, and resists adduction of the ulna during pronation
- Triceps brachii
  - Main extensor of arm
  - Stabilizes head of humerus in glenohumeral joint



Muscles of the Arm

- Posterior (extensor) compartment
- Anconeus: extends arm, and resists adduction of the ulna during pronation

- **Triceps brachii**
  - Main extensor of arm
  - Stabilizes head of humerus in glenohumeral joint



A Table Showing Attachments, Innervations and Actions of the muscles of posterior compartment of the arm

Muscle	Proximal Attachment	Distal Attachment	Innervation[a]	Muscle Action
Triceps brachii	Long head: infraglenoid tubercle of scapula Lateral head: posterior surface of humerus, superior to radial groove Medial head: posterior surface of humerus, inferior to radial groove	Proximal end of olecranon of ulna and fascia of forearm	Radial nerve (C6, **C7, C8**)	Chief extensor of forearm; long head resists dislocation of humerus; especially important during adduction
Anconeus	Lateral epicondyle of humerus	Lateral surface of olecranon and superior part of posterior surface of ulna	Radial nerve (C7, C8, T1)	Assists triceps in extending forearm; stabilizes elbow joint; may abduct ulna during pronation

Clinical anatomy

Rupture of the Biceps Brachii

- This produces "Popeye deformity" with muscle forming a ball in distal part of the anterior arm
- Tendon of long head has the highest rate of spontaneous rupture of any tendon in the body
- Rupture of the tendon on background of chronic tendonitis usually affects those older than 40
- Traumatic rupture may occur in younger individuals, but is rare

Clinical anatomy

Biceps Tendonitis

- Is inflammation of the tendon of the long head of the biceps
- Tendon is susceptible to wear and tear as it moves back and forth within the intertubercular groove
- Inflammation also caused by repetitive microtrauma, seen in certain sports such as tennis

Arterial supply of the arm

Brachial artery

- It is the continuation of the axillary artery
- It ends in the cubital fossa by dividing into ulnar and radial arteries
- Lies anterior to triceps and brachialis throughout its course
- This artery is companied by median nerve, which crosses anteriorly to the artery and lies medially in cubital fossa

Branches:

- Many muscular branches
- Profunda brachii artery from medial aspect
- Superior and inferior ulnar collateral branches

Profunda brachii (deep artery of the arm)

- Accompanies radial artery in radial groove
- Divides into anterior and posterior descending branches to elbow

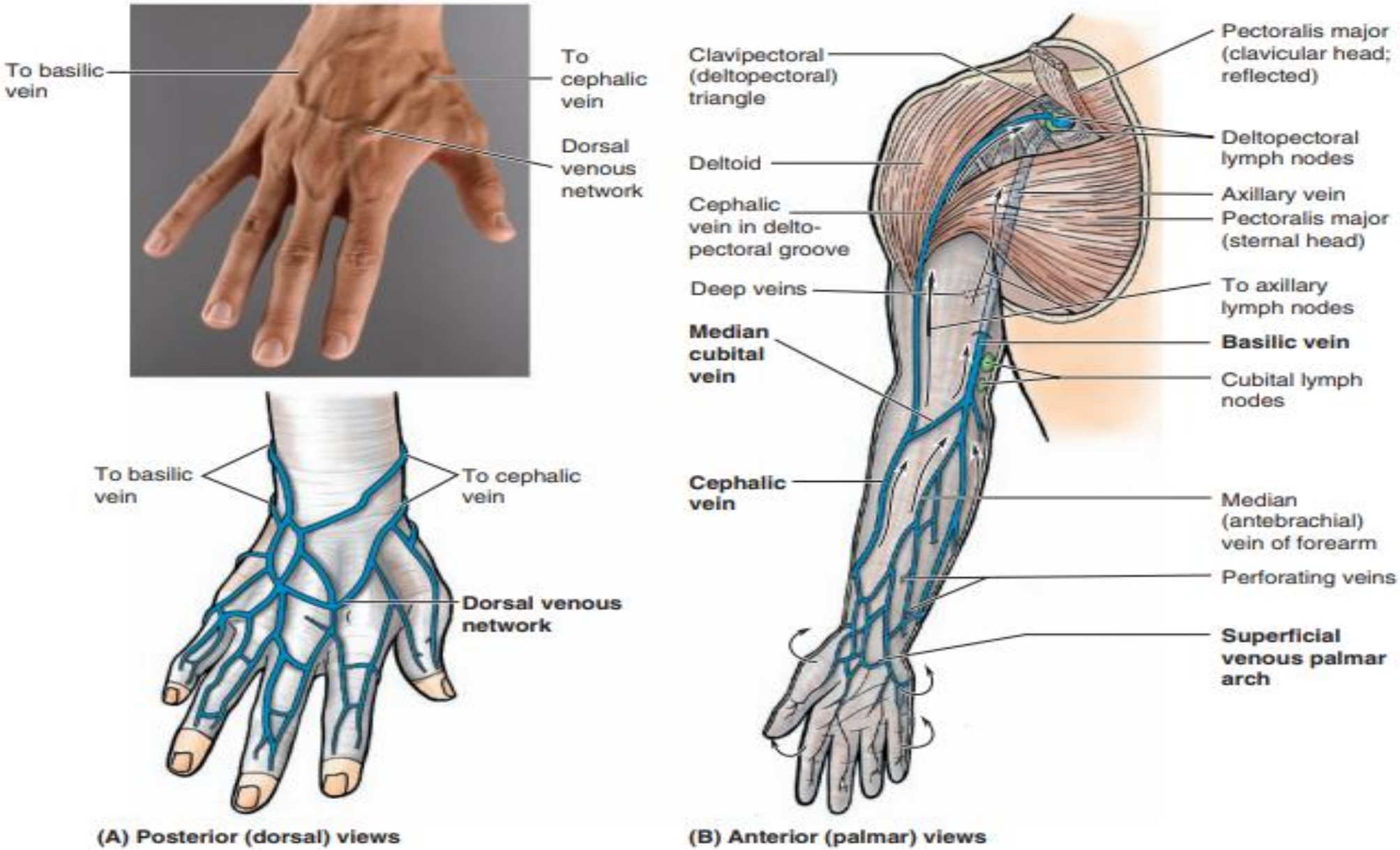
Venous Drainage of the Arm

A. Superficial veins of the arm (drain into axillary vein)

1. Cephalic vein
   - Lies on anterolateral surface of the arm
   - Enters groove between deltoid and pectoralis major (deltopectoral groove)
   - Then deltopectoral triangle
   - Empties into the axillary vein
2. Basilic vein
   - Medial side, inferior arm
   - Pierces deep fascia at junction of inferior and middle third of arm
   - Runs superiorly to axillary vein

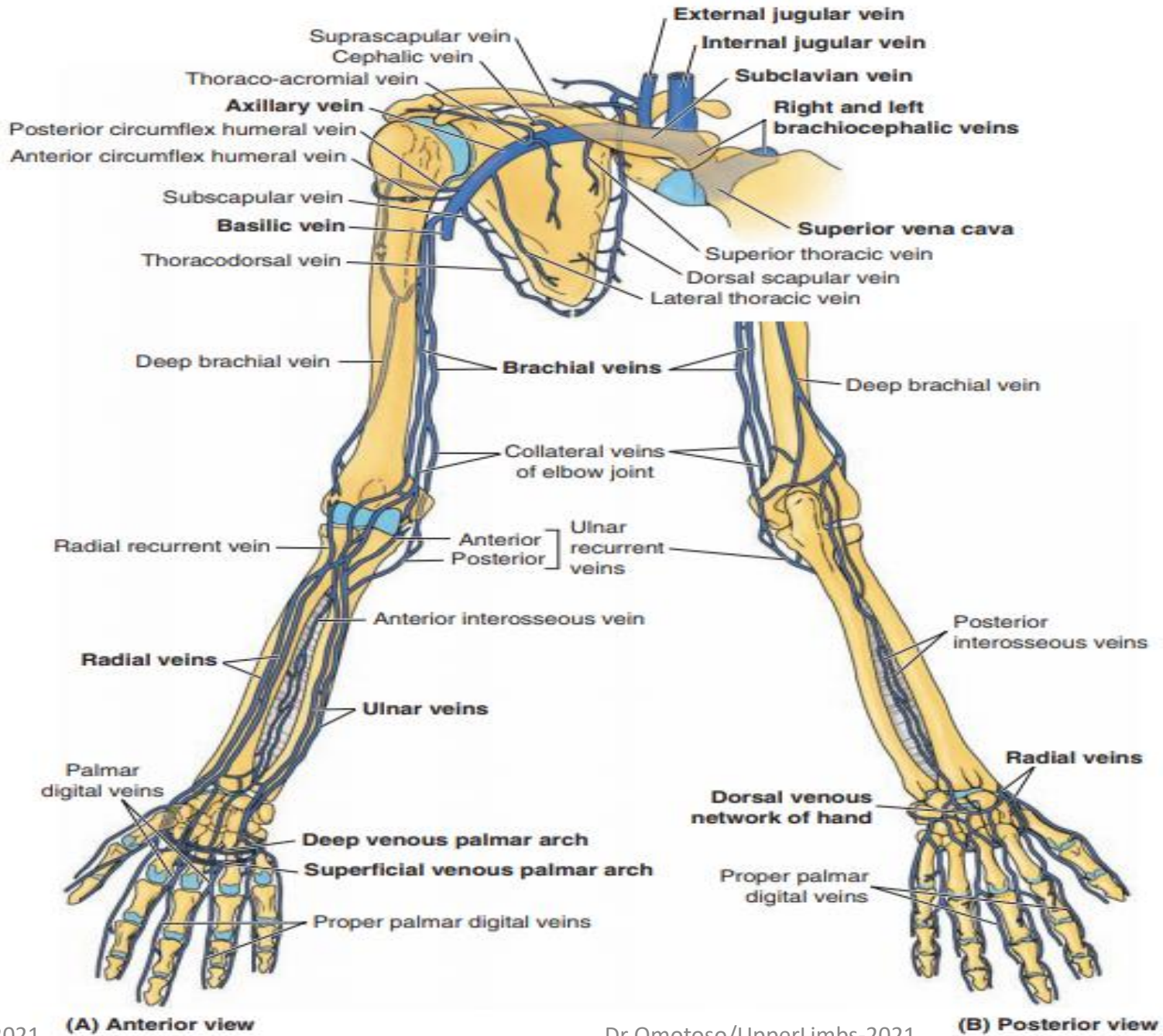
B. Deep veins of the arm

- Form at elbow from radial and ulnar veins
- Paired, accompany brachial artery (venae comitantes)
- Have valves
- Merge with basilic vein to form axillary vein



Superficial veins of the upper limb

Moore *et al.,* 2010



Deep veins of upper limb

Moore *et al.,* 2010

Cutaneous Nerves of Arm

Supraclavicular nerves (C4,C5):

Supply skin over shoulder

Superior lateral cutaneous nerve (C5,C6)

- Branch of axillary
- Supplies skin over upper lateral arm

Inferior lateral cutaneous nerve (C5,C6)

- Cutaneous branch of radial nerve
- Supplies skin over lower lateral arm

Cutaneous Nerves of Arm

Intercostobrachial nerve (T2)

- Lateral cutaneous branch of second intercostal nerve
- Supplies upper medial arm anteriorly and posteriorly

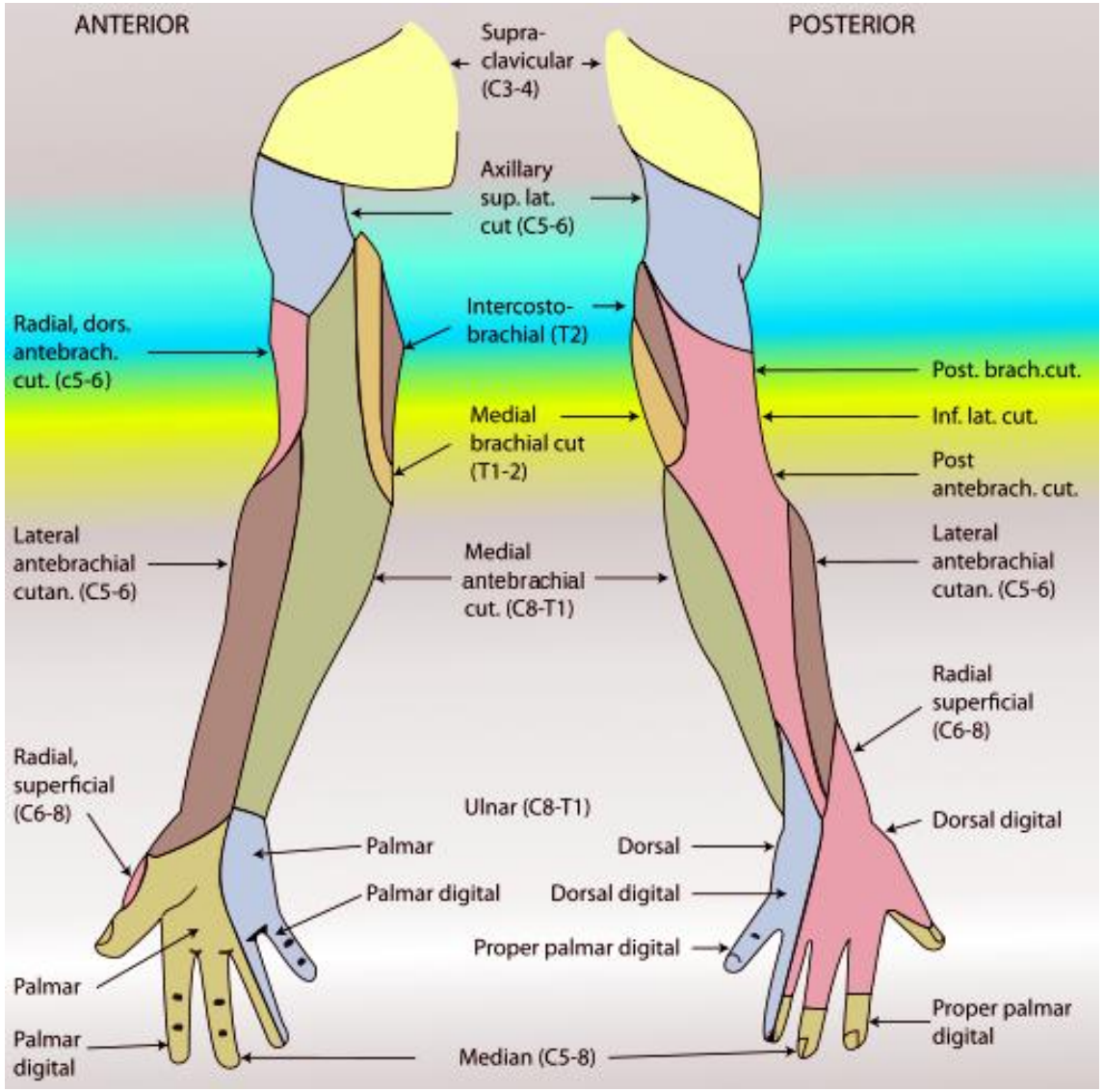
Medial brachial cutaneous (C8-T1)

- Branch of brachial plexus
- Supplies lower anterior medial arm

Posterior brachial cutaneous nerve (C5-C8)

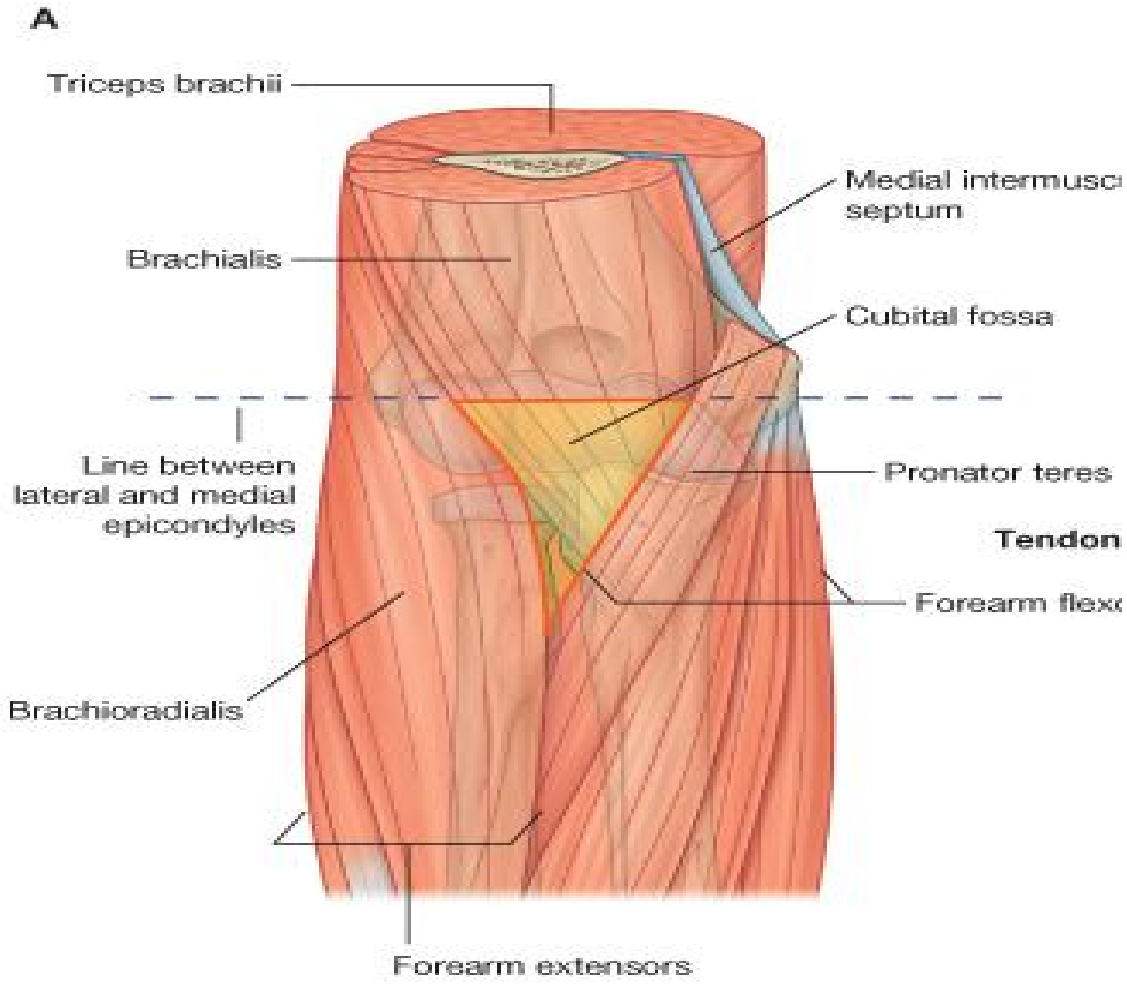
- Branch of radial nerve
- Supplies lower posterior medial arm

Dermatome of the Upper Limbs



CUBITAL FOSSA

Cubital Fossa

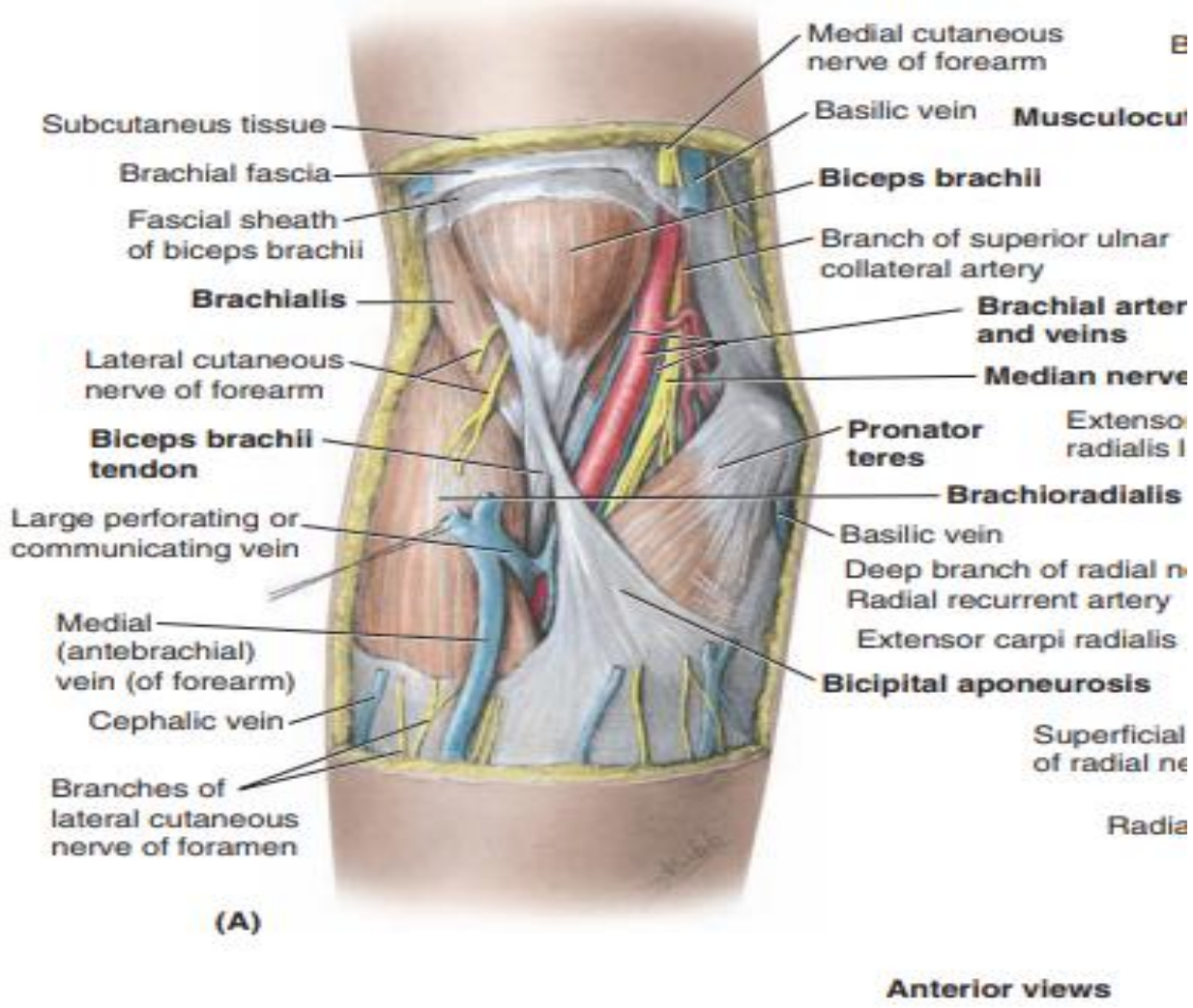


- Cubital fossa is a superficial triangular depression on the anterior aspect of the elbow.

Cubital Fossa

- **Boundaries**
  - Superiorly: (imaginary) line connecting the medial and lateral epicondyles (**base** of the fossa)
  - Medially: pronator teres muscle
  - Laterally: brachioradialis
  - **Apex**: meeting point of brachioradialis and pronator teres
  - Floor: brachialis and supinator muscles of arm and forearm
  - Roof: deep fascia, bicipital aponeurosis, subcutaneous tissue, and skin

Contents of Cubital Fossa

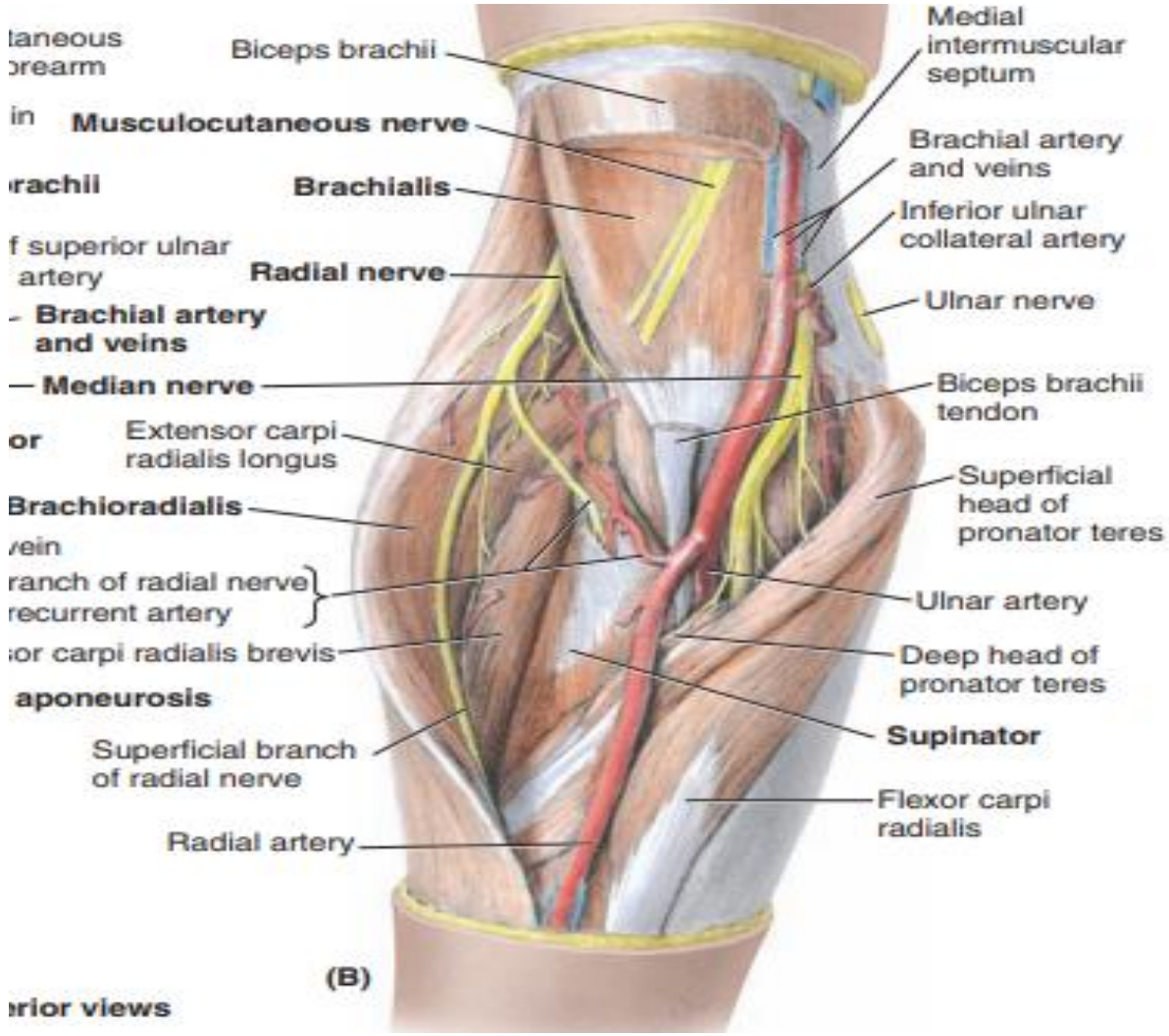


Dissections of cubital fossa. A. Superficial dissection. B. In this deep dissection, part of the biceps is excised and the cubital fossa is opened

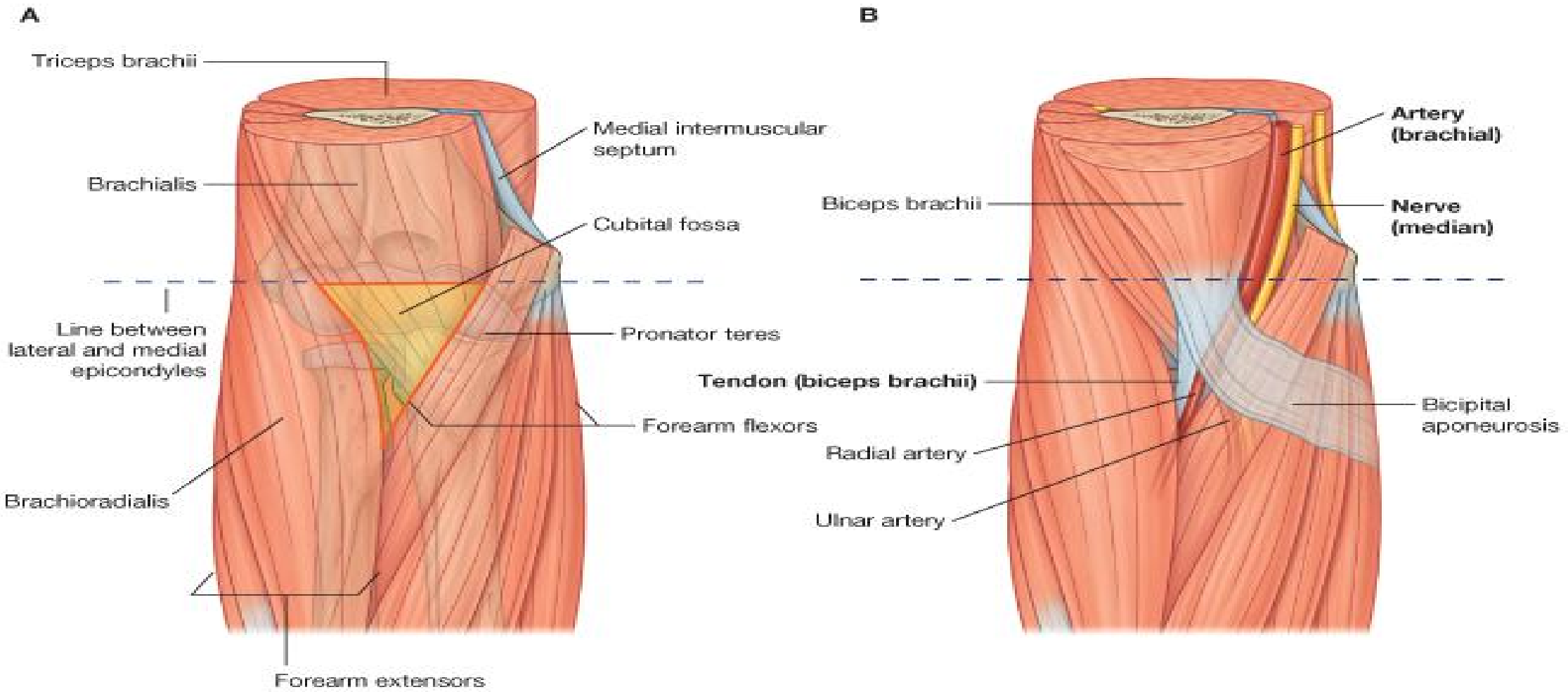
Contents of Cubital Fossa

- from medial to lateral:

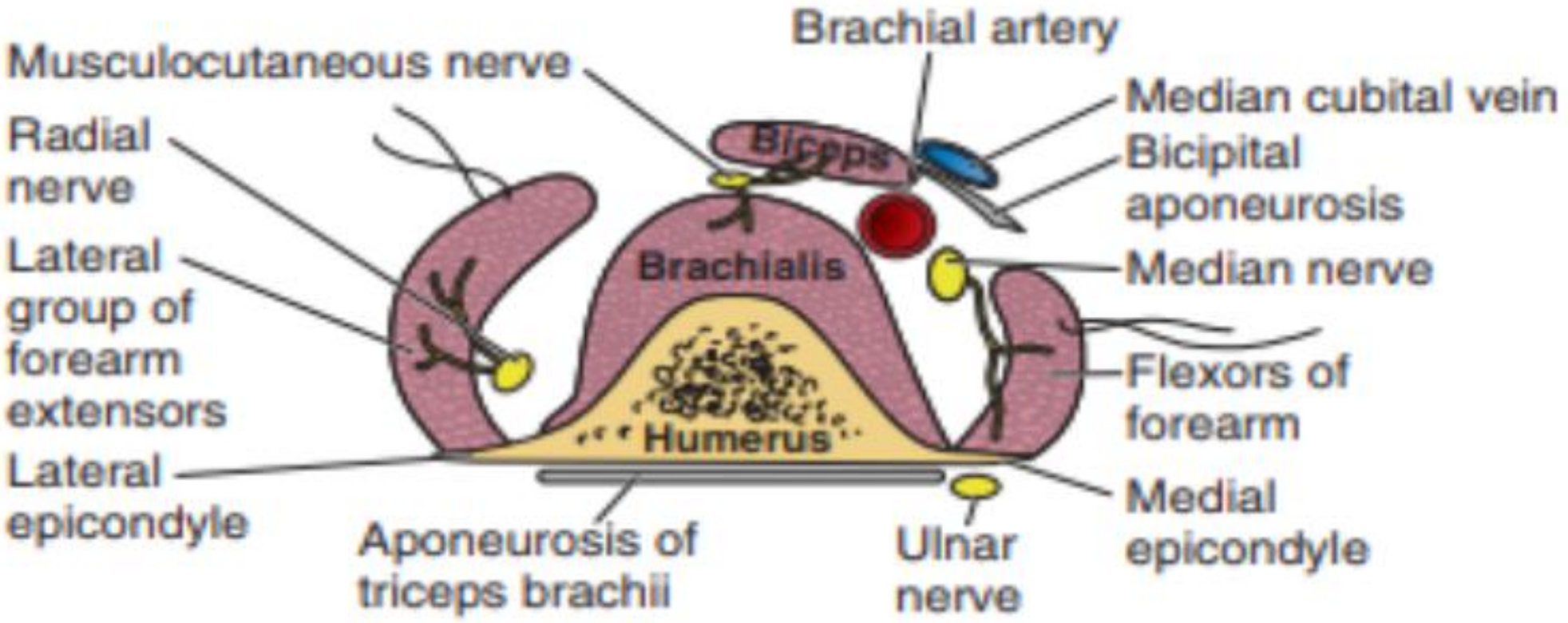
  - Median nerve
  - Brachial artery (terminal part)
  - Tendon of Biceps brachii
  - Radial nerve and its posterior interosseous branch
  - others:
  - Medial and lateral antebrachial cutaneous nerves (In subcutaneous connective tissue)
  - Basilic and cephalic veins
  - Median cubital vein
  - Deep and superficial branches of radial nerve (In floor of fossa)



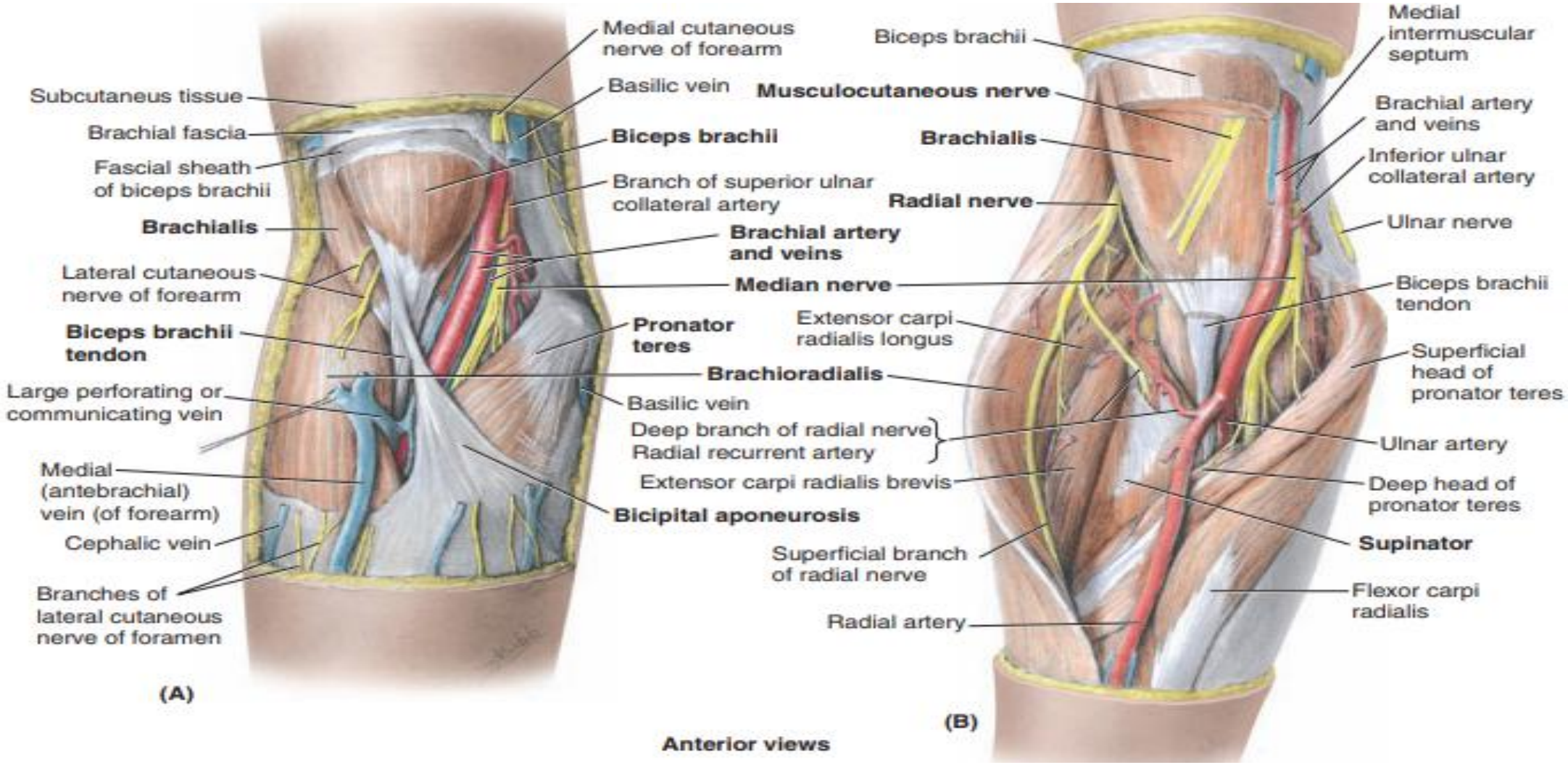
Dissections of cubital fossa. A. Superficial dissection. B. In this deep dissection, part of the biceps is excised and the cubital fossa is opened



Illustrative diagrams of cubital fossa and some of its contents

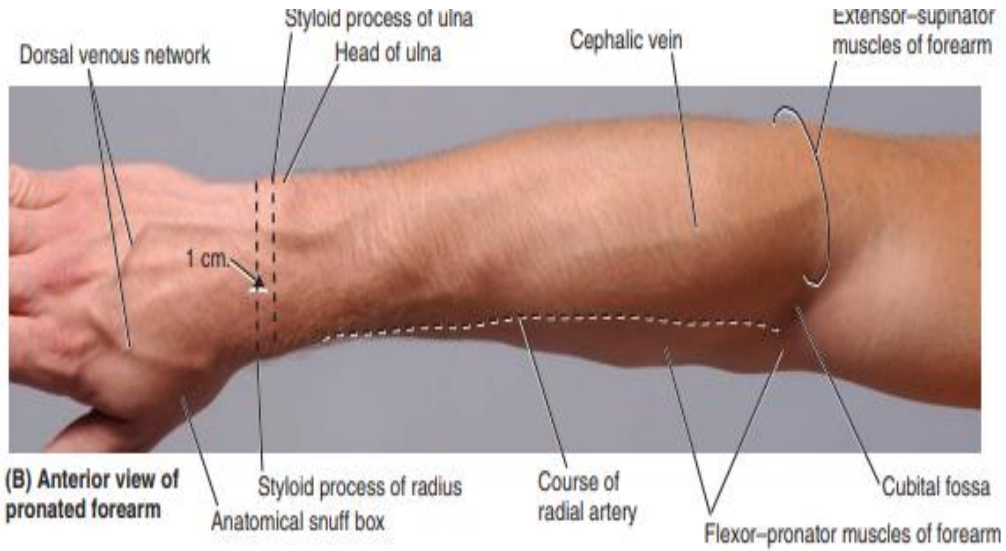


Cross section of cubital fossa



Dissections of cubital fossa. A. Superficial dissection. B. In this deep dissection, part of the biceps is excised and the cubital fossa is opened

Forearm


Dorsal venous network
Styloid process of ulna
Head of ulna
Cephalic vein
Extensor–supinator muscles of forearm
1 cm.
(B) Anterior view of pronated forearm
Anatomical snuff box
Styloid process of radius
Course of radial artery
Flexor–pronator muscles of forearm
Cubital fossa

Bones of the forearm

1. Ulna

- Stabilizing bone of the forearm
- Medial to and longer than radius

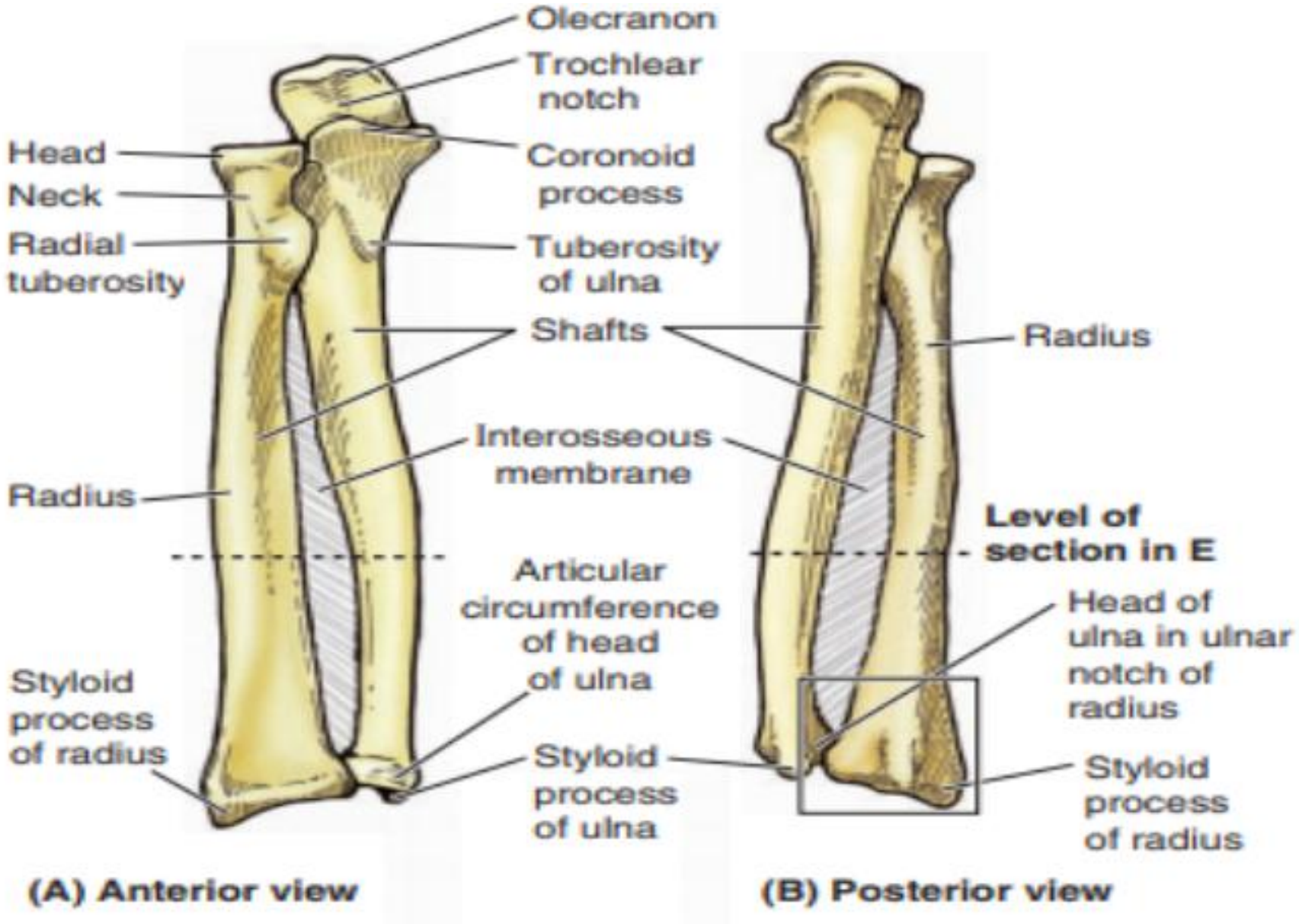
Osteological features

- Olecranon: projection of proximal posterior end
- Coronoid process: projection from proximal anterior end
- Trochlear notch: anterior surface of olecranon, articulates with trochlea of humerus
- Radial notch: rounded concavity on lateral side of coronoid process for radial head
- Ulnar tuberosity: inferior to coronoid process for attachment of brachialis muscle

Bones of the forearm

Osteological features of Ulna (continuation)

- Supinator crest: crest inferior to radial notch for attachment of supinator muscle
- Supinator fossa: concavity between supinator crest and coronoid process, for attachment of supinator muscle
- Body of Ulna: thicker proximally, tapering distally
- Head
- Styloid process: conical process from the head



Bones of the forearm (Ulna & Radius)

Bones of the forearm

2. Radius

- Lateral and shorter bone of the forearm
- Osteologic features
  - Head: is at proximal end, concave for articulation with capitulum of humerus
  - Neck: it is a constricted region between head and tuberosity
  - Radial tuberosity: oval protuberance below head and neck for attachment of biceps brachii
  - Body of radius: convex laterally and enlarging distally
  - Styloid process: projection from lateral aspect of distal end of radius
  - Dorsal tubercle: dorsal projection at distal end between groves for tendon of extensor carpi radialis longus and brevis and tendon of extensor pollicis longus
  - Ulnar notch: concavity on medial side of distal end for head of ulna

- Radius and ulna are connected by:
  - Interosseous membrane
  - Radioulnar joints (proximal and distal)

Muscles of the forearm

- The muscles of the forearm are divided into

1. The flexor muscles of the forearm: in the anterior (flexor–pronator) compartment of the forearm.

2. The extensor muscles of the forearm: in the posterior (extensor-supinator) compartment of the forearm.

  - These muscle groups are separated by the radius and ulna, and by the interosseous membrane that connects them.

Flexor Muscles of the forearm

- The flexor muscles are arranged in three layers or groups:

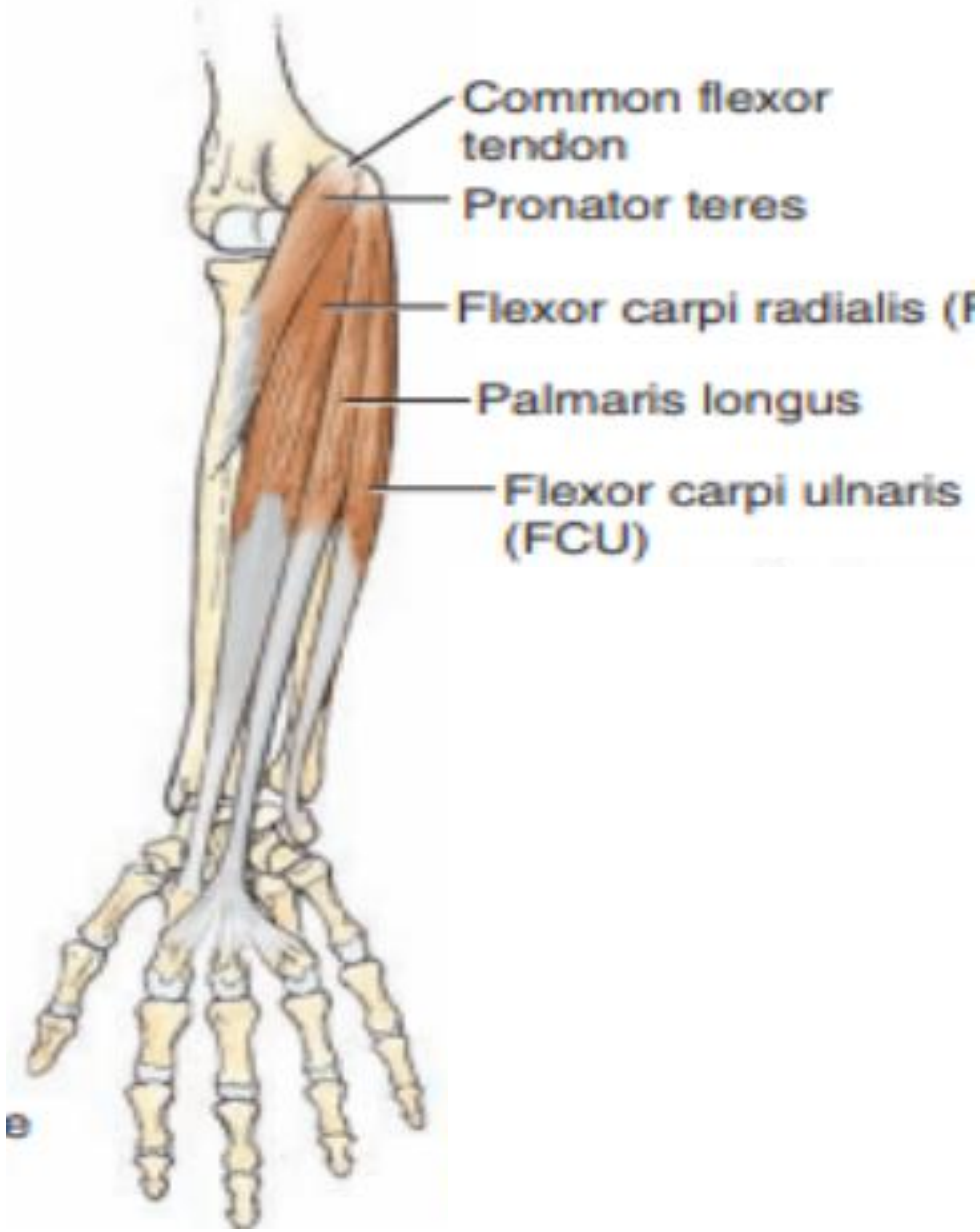
1. A superficial layer or group of four muscles
2. An intermediate layer, consisting of one muscle
3. A deep layer or group of three muscles

- The **tendons** of most flexor muscles are located on the anterior surface of the **wrist** and are held in place by the **palmar carpal ligament** and the **flexor retinaculum**.

Flexor Muscles of the Forearm

- **Superficial Layer**
- pronator teres
- flexor carpi radialis
- palmaris longus
- flexor carpi ulnaris

- These muscles are all attached proximally by a common flexor tendon to the medial epicondyle of the humerus, the common flexor attachment.



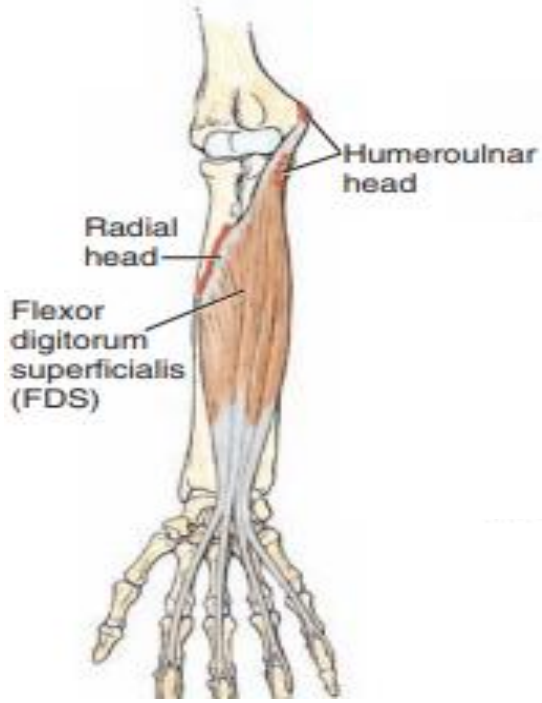
Flexor Muscles of the forearm

Muscle	Proximal Attachment	Distal Attachment	Innervation[a]	Main Action
Superficial (first) layer				
Pronator teres				
Ulnar head	Coronoid process	Middle of convexity of lateral surface of radius	Median nerve (C6, **C7**)	Pronates and flexes forearm (at elbow)
Humeral head	Medial epicondyle of humerus (common flexor origin)			
Flexor carpi radialis (FCR)		Base of 2nd metacarpal		Flexes and abducts hand (at wrist)
Palmaris longus		Distal half of flexor retinaculum and apex of palmar aponeurosis	Median nerve (C7, C8)	Flexes hand (at wrist) and tenses palmar aponeurosis
Flexor carpi ulnaris (FCU)				
Humeral head		Pisiform, hook of hamate, 5th metacarpal	Ulnar nerve (C7, **C8**)	Flexes and adducts hand (at wrist)
Ulnar head	Olecranon and posterior border (via aponeurosis)			

Flexor Muscles of the Forearm

Intermediate Layer

flexor digitorum superficialis

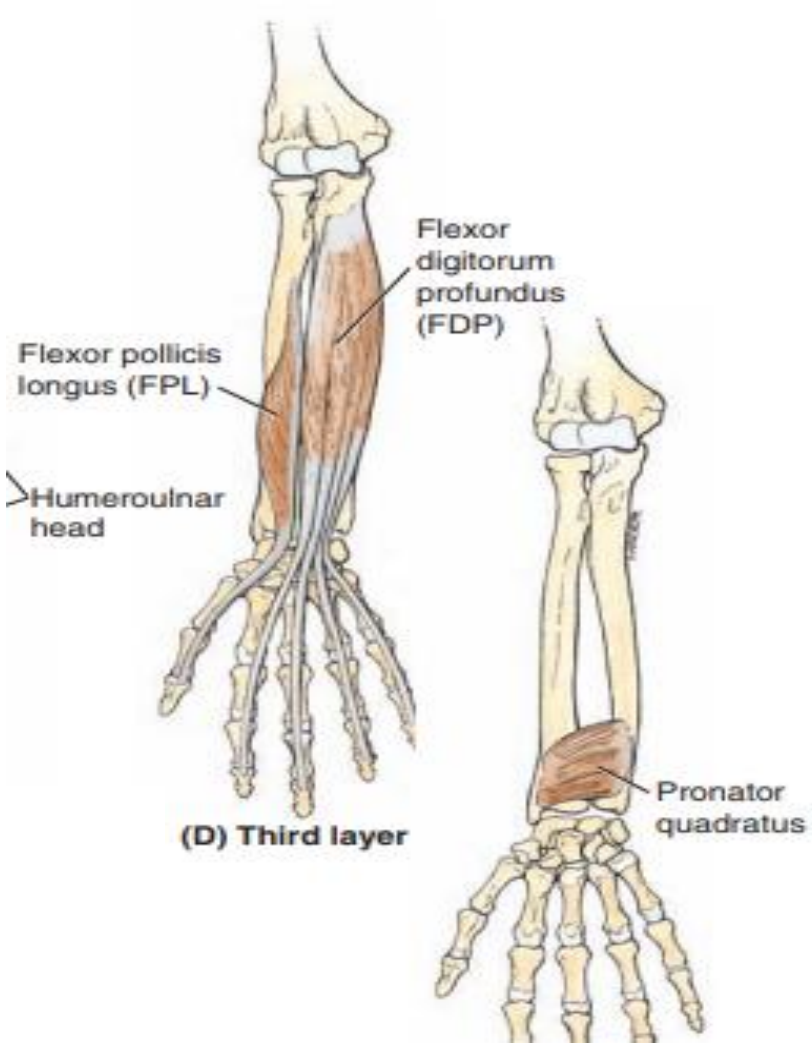


Muscle	Proximal Attachment	Distal Attachment	Innervation[a]	Main Action
Intermediate (second) layer				
Flexor digitorum superficialis (FDS)				
Humeroulnar head	Medial epicondyle (common flexor origin and coronoid process)	Shafts of middle phalanges of medial four digits	Median nerve (C7, C8, T1)	Flexes middle phalanges at proximal interphalangeal joints of middle four digits; acting more strongly, it also flexes proximal phalanges at metacarpophalangeal joints
Radial head	Superior half of anterior border			

Flexor Muscles of the forearm

Deep Layer

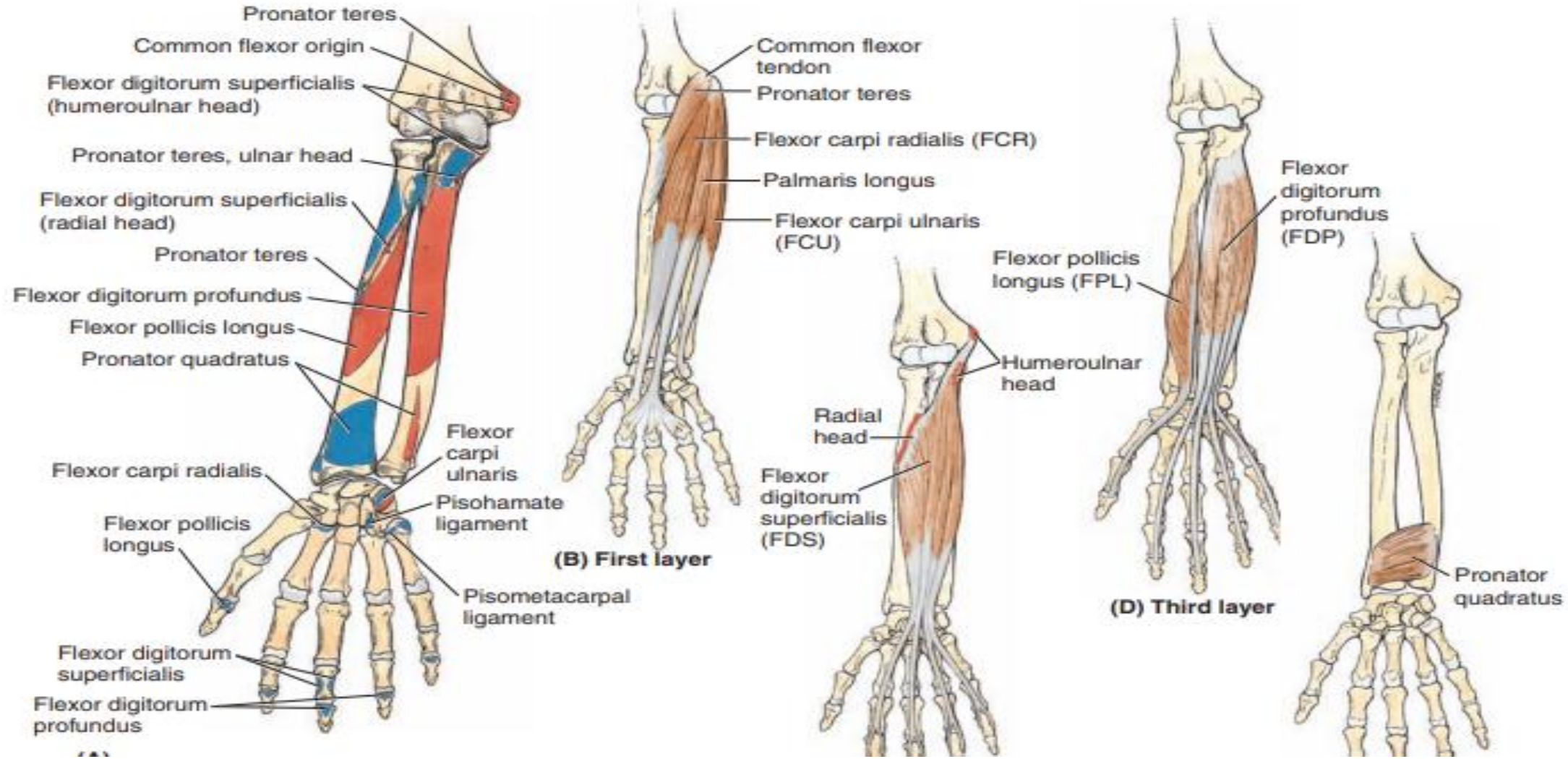
- flexor digitorum profundus
- flexor pollicis longus
- pronator quadratus



Flexor Muscles of the Forearm

Attachments, Innervations and Actions of the deep flexor muscles of the forearm

Deep (third) layer				
Flexor digitorum profundus (FDP)				
Medial part	Proximal three quarters of medial and anterior surfaces of ulna and interosseous membrane	Bases of distal phalanges of 4th and 5th digits	Ulnar nerve (C8, **T1**)	Flexes distal phalanges 4 and 5 at distal interphalangeal joints
Lateral part		Bases of distal phalanges of 2nd and 3rd digits	Anterior interosseous nerve, from median nerve (**C8**, T1)	Flexes distal phalanges 2 and 3 at distal interphalangeal joints
Flexor pollicis longus (FPL)	Anterior surface of radius and adjacent interosseous membrane	Base of distal phalanx of thumb		Flexes phalanges of 1st digit (thumb)
Pronator quadratus	Distal quarter of anterior surface of ulna	Distal quarter of anterior surface of radius		Pronates forearm; deep fibers bind radius and ulna together



Descriptive diagrams of flexor muscles of the forearm according to layers

Extensor Muscles of the forearm

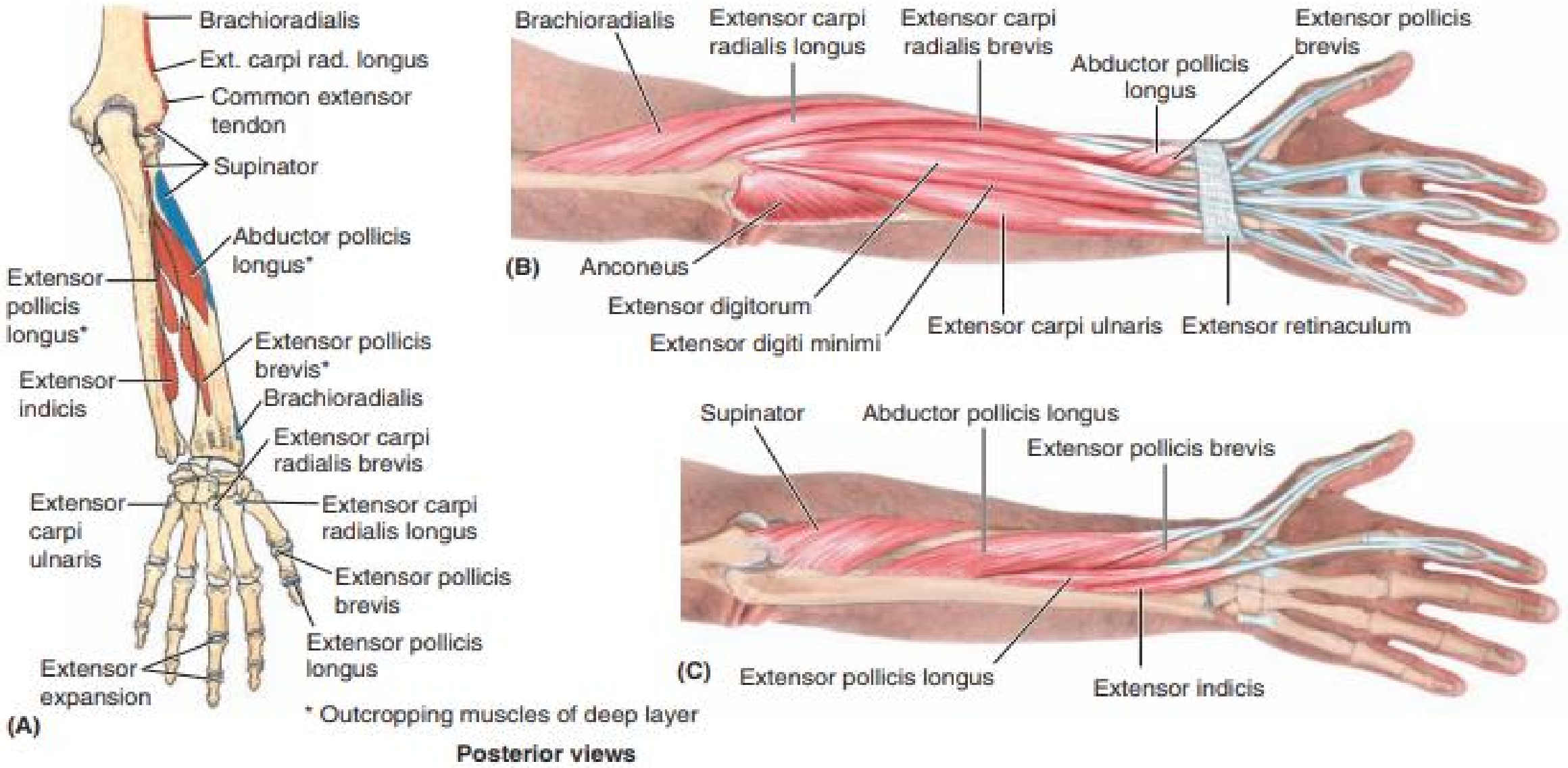
- These muscles can be organized physiologically into three functional groups:

1. Muscles that extend and abduct or adduct the hand at the wrist joint (extensor carpi radialis longus, extensor carpi radialis brevis, and extensor carpi ulnaris).
2. Muscles that extend the medial four fingers (extensor digitorum, extensor indicis, and extensor digiti minimi).
3. Muscles that extend or abduct the thumb (abductor pollicis longus, extensor pollicis brevis, and extensor pollicis longus).

The extensor muscles of the forearm are organized anatomically into:

1. Superficial layer and,
2. Deep layer.

   - The extensor tendons are held in place in the wrist region by the extensor retinaculum to prevent bowstringing of the tendons when the hand is extended at the wrist joint



Descriptive diagrams of extensor muscles of the forearm

Extensor Muscles of the forearm

- **A Table Showing Attachments, Innervations and Actions of the superficial & deep extensor muscles of the forearm**

Muscle	Proximal Attachment	Distal Attachment	Innervation[a]	Main Action
Superficial layer				
Brachioradialis	Proximal two thirds of supraepicondylar ridge of humerus	Lateral surface of distal end of radius proximal to styloid process	Radial nerve (C5, **C6**, C7)	Relatively weak flexion of forearm; maximal when forearm is in mid-pronated position
Extensor carpi radialis longus (ECRL)	Lateral supraepicondylar ridge of humerus	Dorsal aspect of base of 2nd metacarpal	Radial nerve (C6, C7)	Extend and abduct hand at the wrist joint; ECRL active during fist clenching
Extensor carpi radialis brevis (ECRB)	Lateral epicondyle of humerus (common extensor origin)	Dorsal aspect of base of 3rd metacarpal	Deep branch of radial nerve (**C7**, C8)	
Extensor digitorum		Extensor expansions of medial four digits		Extends medial four digits primarily at metacarpophalangeal joints, secondarily at interphalangeal joints
Extensor digiti minimi (EDM)		Extensor expansion of 5th digit		Extends 5th digit primarily at meta-carpophalangeal joint, secondarily at interphalangeal joint
Extensor carpi ulnaris (ECU)	Lateral epicondyle of humerus; posterior border of ulna via a shared aponeurosis	Dorsal aspect of base of 5th metacarpal		Extends and adducts hand at wrist joint (also active during fist clenching)
Deep layer				
Supinator	Lateral epicondyle of humerus; radial collateral and anular ligaments; supinator fossa; crest of ulna	Lateral, posterior, and anterior surfaces of proximal third of radius	Deep branch of radial nerve (C7, **C8**)	Supinates forearm; rotates radius to turn palm anteriorly or superiorly (if elbow is flexed)
Extensor indicis	Posterior surface of distal third of ulna and interosseous membrane	Extensor expansion of 2nd digit	Posterior interosseous nerve (**C7**, C8), continuation of deep branch of radial nerve	Extends 2nd digit (enabling its independent extension); helps extend hand at wrist

Arterial supply of the forearm

1. Ulnar artery

- Larger of two terminal branches of brachial artery
- Begins medial to biceps tendon and descends through anterior compartment deep to pronator teres
- Branches
  - Anterior ulnar recurrent
  - Posterior ulnar recurrent
  - Common interosseus, which branches into:
    - Anterior interosseus artery
    - Posterior interosseus artery
  - Muscular branches to muscles of medial side of forearm
  - Branches to the hand

Arterial supply of the forearm

2. Radial artery

- Begins in cubital fossa at neck of radius
- Passes distally deep to brachioradialis muscle
- Palpable throughout lateral forearm (best felt at the wrist)
- Branches
  - Supplies flexor and extensor muscles on lateral side of forearm
  - Radial recurrent artery
  - Branches to the hand

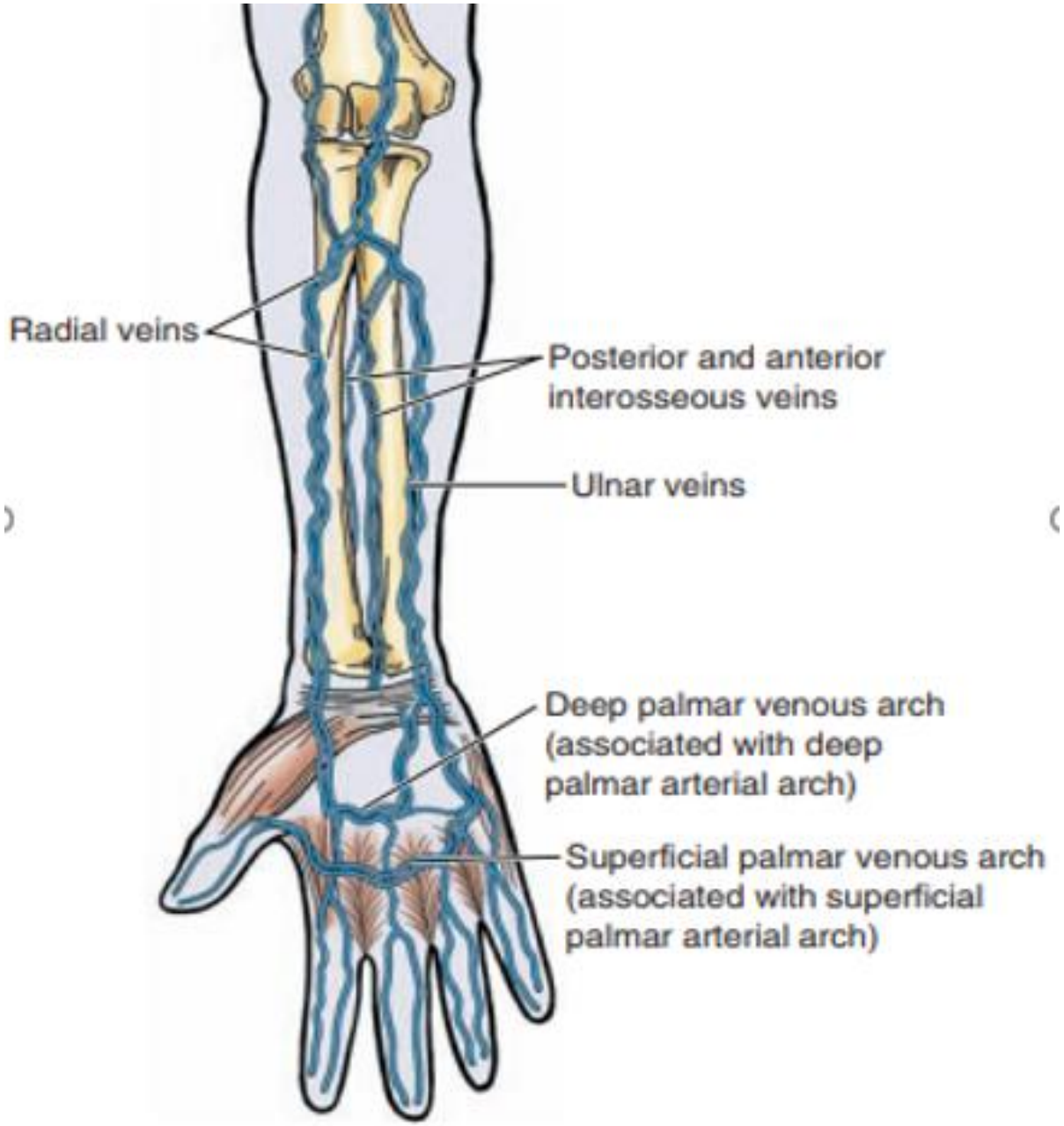
Venous Drainage of the forearm

A. Superficial veins of forearm

- Basilic vein ascends posteromedially on forearm
- Cephalic vein ascends on lateral border of forearm
- Median cubital vein connects cephalic and basilic over cubital fossa

B. Deep veins of forearm

- Paired radial and ulnar veins and interosseus veins accompany arteries of same name
- All communicate with superficial veins and median cubital vein



Illustrative diagram showing deep veins of the forearm and hand

Nerves of the forearm

- The nerves of the forearm are the median, ulnar, and radial.
- The median nerve is the principal nerve of the anterior (flexor– pronator) compartment of the forearm.
- Although the radial nerve appears in the cubital region, it soon enters the posterior (extensor–supinator) compartment of the forearm.
- Besides the cutaneous branches, there are only two nerves of the anterior aspect of the forearm: the median and ulnar nerves. The named nerves of the forearm

Nerves of the forearm (median nerve)

- The median nerve and its branches.

Nerve	Origin	Course in Forearm
Median	By union of lateral root of median nerve (C6 and C7, from lateral cord of brachial plexus) with medial root (C8 and T1) from medial cord)	Enters cubital fossa medial to brachial artery; exits by passing between heads of pronator teres; descends in fascial plane between flexors digitorum superficialis and profundus; runs deep to palmaris longus tendon as it approaches flexor retinaculum to traverse carpal tunnel
Anterior interosseous	Median nerve in distal part of cubital fossa	Descends on anterior aspect of interosseous membrane with artery of same name, between FDP and FPL, to pass deep to pronator quadratus
Palmar cutaneous branch of median nerve	Median nerve of middle to distal forearm, proximal to flexor retinaculum	Passes superficial to flexor reticulum to reach skin of central palm

FPL= Flexor Pollicis Longus
FDP= Flexor Digitorum Profundus

Nerves of the forearm (Ulnar nerve)

- The Ulnar nerve and its branches.

Nerve	Origin	Course in Forearm
Ulnar	Larger terminal branch of medial cord of brachial plexus (C8 and T1, often receives fibers from C7)	Enters forearm by passing between heads of flexor carpi ulnaris, after passing posterior to medial epicondyle of humerus; descends forearm between FCU and FDP; becomes superficial in distal forearm
Palmar cutaneous branch of ulnar nerve	Ulnar nerve near middle of forearm	Descends anterior to ulnar artery; perforates deep fascia in distal forearm; runs in subcutaneous tissue to palmar skin medial to axis of 4th digit
Dorsal cutaneous branch of ulnar nerve	Ulnar nerve in distal half of forearm	Passes posteroinferiorly between ulna and flexor carpi ulnaris; enters subcutaneous tissue to supply skin of dorsum medial to axis of 4th digit

FCU= Flexor Carpi Ulnaris

FDP= Flexor Digitorum Profundus

Nerves of the forearm (Radial nerve)

- The Radial nerve and its branches.

Nerve	Origin	Course in Forearm
Radial	Larger terminal branch of posterior cord of brachial plexus (C5–T1)	Enters cubital fossa between brachioradialis and brachialis; anterior to lateral epicondyle divides into terminal superficial and deep branches
Posterior cutaneous nerve of forearm	Radial nerve, as it traverses radial groove of posterior humerus	Perforates lateral head of triceps; descends along lateral side of arm and posterior aspect of forearm to wrist
Superficial branch of radial nerve	Sensory terminal branch of radial nerve, in cubital fossa	Descends between pronator teres and brachioradialis, emerging from latter to arborize over anatomical snuff box and supply skin of dorsum lateral to axis of 4th digit
Deep branch of radial/posterior interosseous nerve	Motor terminal branch of radial nerve, in cubital fossa	Deep branch exits cubital fossa winding around neck of radius, penetrating and supplying supinator; emerges in posterior compartment of forearm as posterior interosseous; descends on membrane with artery of same name