INTERNATIONAL SURGICAL ANATOMY TEACHING SERIES

ISATS HANDOUT 2025/26

Upper Limb

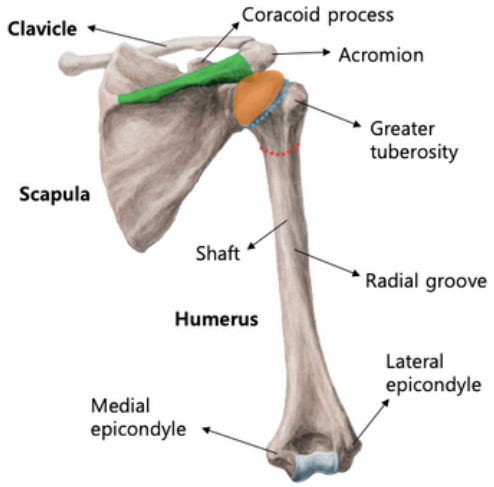
High Yield | Surgical Relevance | Approved for CPD Points

UPPER LIMB ANATOMY

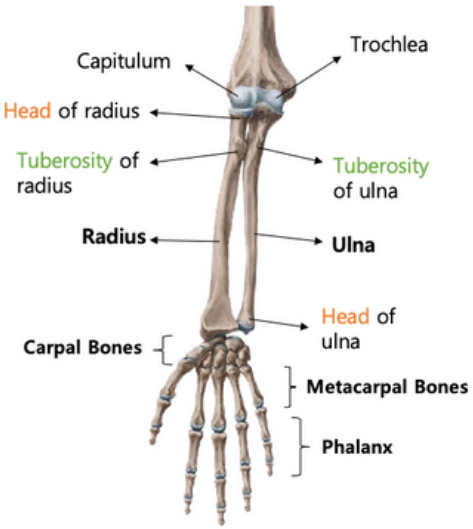
***Objectives**: Recall the bony anatomy of the upper limb, appreciate the position and function of the rotator cuff muscles, appreciate the muscular compartments of the upper limb, trace the course of important neurovascular structures of the upper limb & apply anatomical knowledge to the setting of trauma and orthopaedic surgery.*

Bony Anatomy

- Scapula (Triangular Flat Bone)
  - Bony articulations and muscular attachments
    - Glenoid Fossa
    - Acromion
    - Coracoid Process
    - Scapular Spine
- Humerus (Long Bone)
  - Surgical neck: Axillary Nerve and Posterior Circumflex Humeral Artery
  - Radial Groove: Radial Nerve and Profunda Brachii



- Radius and Ulna (Long Bones)
  - Hinge joint with the Humerus and a Pivot joint with each other (proximally)
  - Syndesmosis formed by Interosseous membrane
- Carpal Bones (Irregular Bones)
  - **S**o **L**ong **T**o **P**inky; **H**ere **C**omes **T**he **T**humb
- Metacarpals and Phalanges (Long Bones)



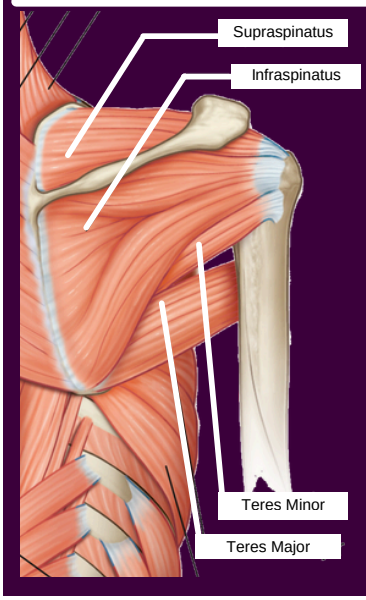
The Rotator Cuff

- Function: Muscles of Concavity Compression

- Supraspinatus: abduction of shoulder to 15°
- Infraspinatus: external rotation
- Subscapularis: internal rotation
- Teres Minor: external rotation + adduction
- Teres Major: internal rotation + extension

- 'The Cable' = intrinsic coordination of Supraspinatus, Infraspinatus and Subscapularis
  - Tendinous interweaving
  - Connects anterior with posterior

Is Teres Major a Rotator Cuff?



What is a rotator cuff?

- Can only be defined by naming involved muscles
- Functional similarity
  - Only Concave Compression
  - Should include Teres Major
- Neurovascular supply, Attachments and other Functions
  - Not shared

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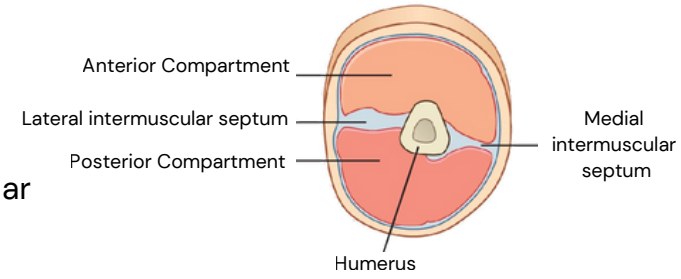
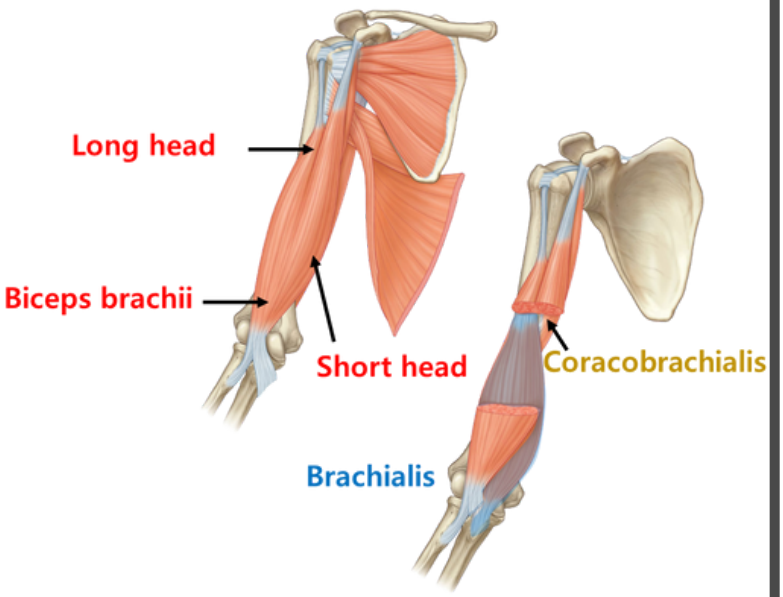
Compartments of the Arm

Overview



- Delineated by the Lateral and Medial Intermuscular septae
  - Lateral: fascia of deltoid → lateral epicondyle
  - Medial: fascia of teres major → medial epicondyle

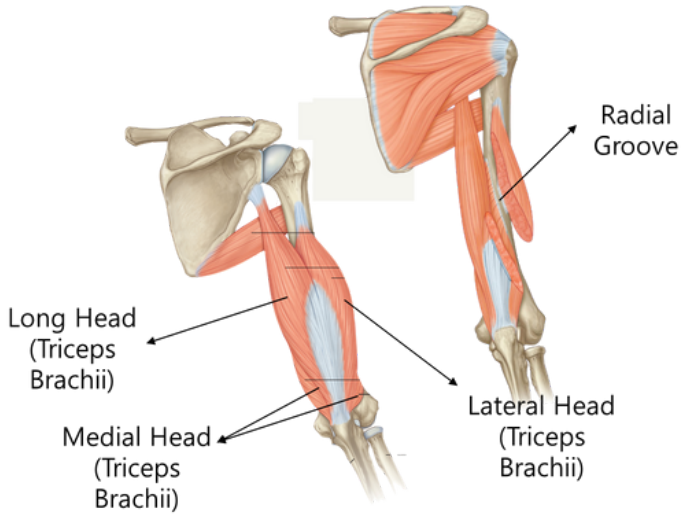
Anterior Compartment



Muscles	Function
Biceps Brachii (Short + Long)	Flexion (Elbow + Shoulder), Supination
Brachialis	Elbow flexion
Coracobrachialis	Shoulder flexion

- **Innervation**
  - Musculocutaneous nerve (C5,6,7)
- **Arterial Supply**
  - Variable branches of Brachial Artery

Posterior Compartment



Muscles	Function
Long Head of Triceps	Forced elbow extension + assisted shoulder extension and adduction
Medial Head of Triceps	Elbow extension
Lateral Head of Triceps	Forced elbow extension

- **Innervation**
  - Radial nerve (C6,7,8)
- **Arterial Supply**
  - Profunda Brachii

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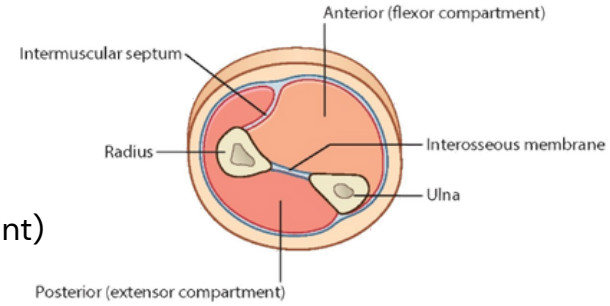
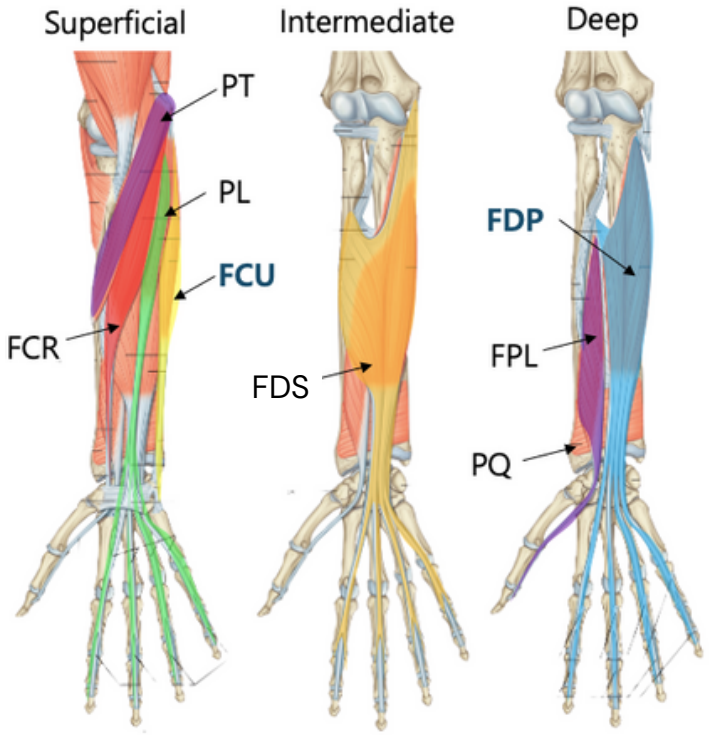
Compartments of the Forearm

Overview

- More defined than in the Arm
- Involve the Interosseous Membrane (syndesmosis joint)



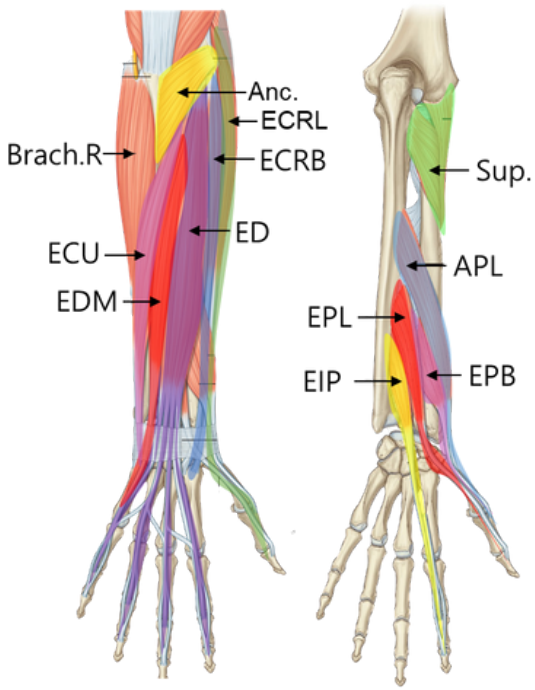
Anterior Compartment



FCR, flexor carpi radialis; **PT**, pronator teres; **PL**, palmaris longus; **FCU**, flexor carpi ulnaris; **FDS**, flexor digitorum superficialis; **FDP**, flexor digitorum profundus; **FPL**, flexor pollicis longus; **PQ**, pronator quadratus

- **Function**
  - Flexion of the wrist, MCP, PIP, DIP and thumb
  - Pronation (Pronator Teres and Quadratus)
- **Innervation**
  - Median Nerve - all except...
  - Ulnar Nerve - FCU and medial part of FDP
- **Arterial Supply**
  - Branches of the Radial and Ulnar arteries

Posterior Compartment



Brach.R, brachioradialis; **ECU**, extensor carpi ulnaris; **EDM**, extensor digiti minimi; **Anc**, anconeus; **ED**, extensor digitorum; **ECRB**, extensor carpi radialis brevis; **ECRL**, extensor carpi radialis longus; **EPL**, extensor pollicis longus; **EIP**, extensor indicus (proprius); Sup, supinator; **EPB**, extensor pollicis brevis; **APL**, abductor pollicis longus

- **Function**
  - Extension of the wrist, MCP, PIP, DIP and thumb
  - Minor Supination (Supinator)
- **Innervation**
  - Radial Nerve + Posterior Interosseous Branch (Radial)
- **Arterial Supply**
  - Radial Artery Branches

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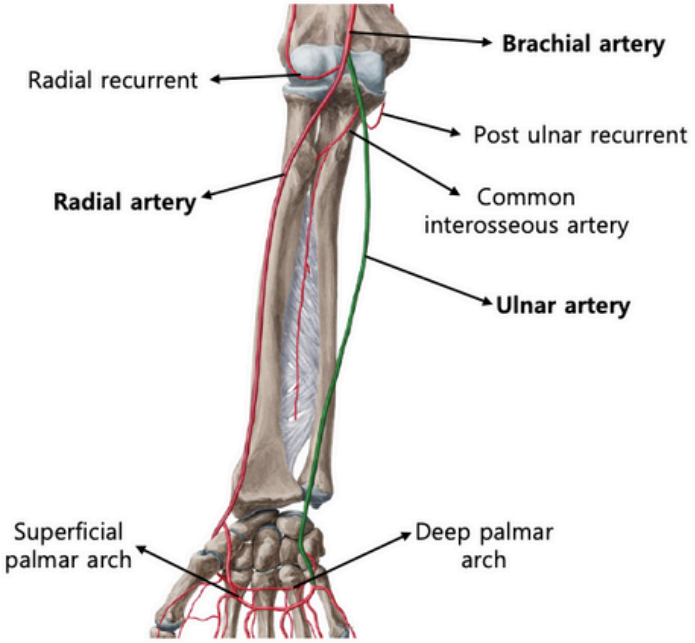
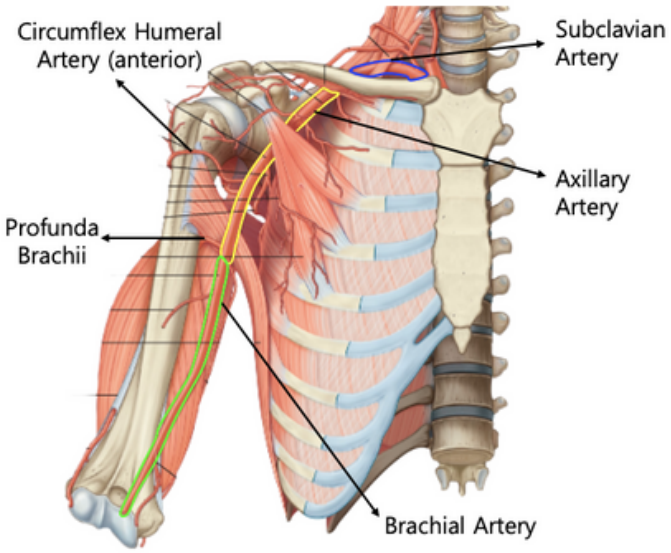
Brachial Artery

- Nomenclature - continuation of the Axillary Artery
- Begins: Inferior border of Teres Major
- Ends: ~1cm Distal to elbow (at bifurcation)





Course

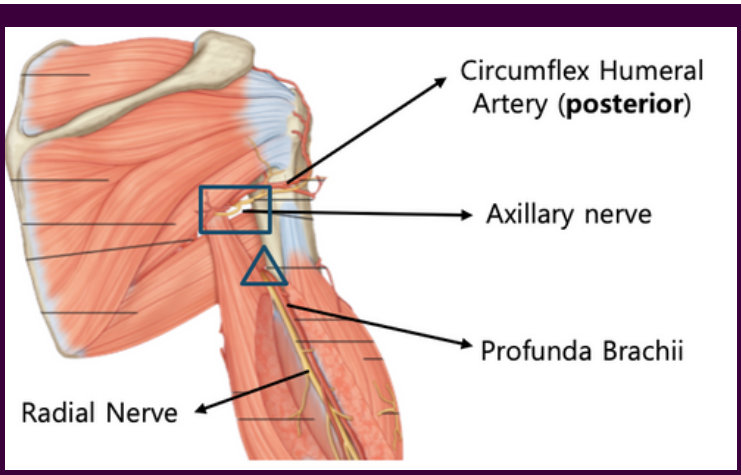
- Predominantly medial to humerus
- Crosses to mid-point between epicondyles
- Wholly superficial
- Bifurcates into radial and ulnar arteries within cubital fossa
- Radial artery - extends across posterior forearm.
  - Branches: radial recurrent a.
  - Hand – deep palmar arch
- Ulnar artery - extends across anteromedial forearm
  - Branches – common interosseous, posterior and anterior ulnar recurrent arteries
  - Hand - superficial palmar arch

Quadrangular Space

- Axillary Nerve
- Posterior Circumflex Humeral Artery

Triangular Interval

- Radial Nerve
- Profunda Brachii Artery



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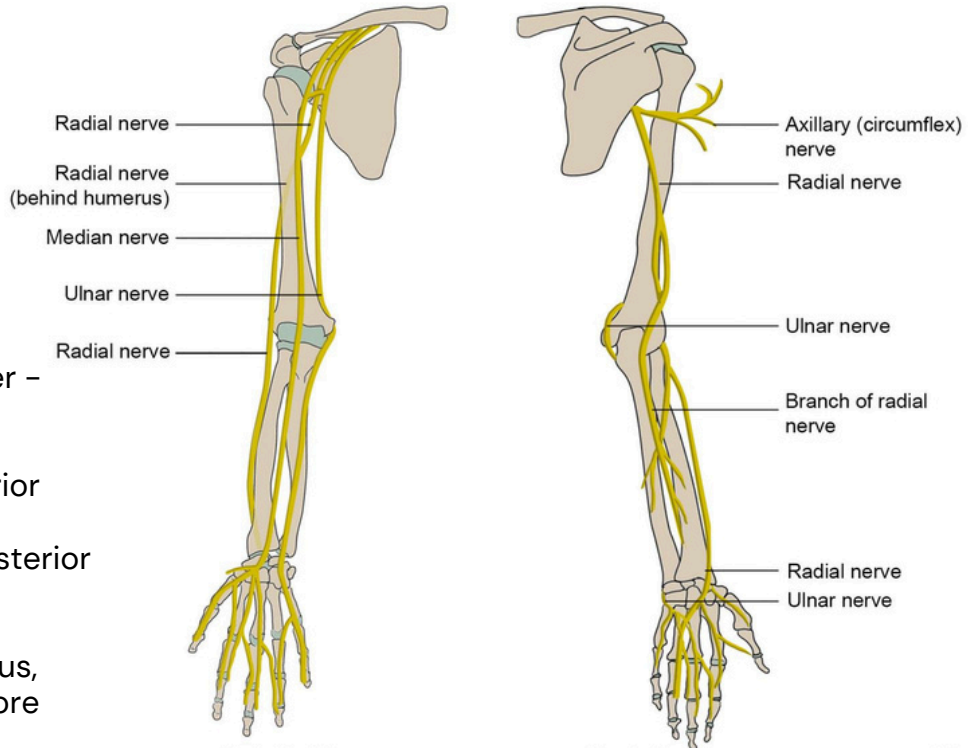
Brachial Plexus

- Roots, Trunks, Divisions, Cords, Branches **(Read That Damn Cadaver Book)**
  - Roots: C5-C8+T1 - (spinal foramina)
  - Trunks: Upper, Middle Lower - (scalenes)
  - Divisions: Anterior & Posterior
  - Cords: Lateral, Medial & Posterior - (axillary artery)
  - Branches: Musculocutaneous, Median, Radial & Ulnar + more



Median Nerve

- Lateral and Medial Cord combine over Brachial Artery
- Runs medial to Brachial Artery before crossing into cubital fossa
- Between heads of pronator teres → into anterior compartment (forearm)
- Between FDS and FDP
  - Gives off anterior interosseous branch
- Carpal tunnel
- Terminal Motor & Sensory branches in hand

Ulnar Nerve

- Medial Cord
- Pierces medial intermuscular septum (3/5 length of humerus) → enters posterior compartment (arm)
- Cubital Tunnel
- Enters anterior compartment (forearm) between heads of FCU
- Runs medial to FDP
- Guyon's canal
- Terminal Motor (FCU + 1/2 FDP) & Sensory (4th and 5th digits) branches in hand

Radial Nerve

- Posterior cord → Triangular interval → enters posterior compartment
- Radial groove between attachments of the medial and lateral heads of triceps
- Perforates lateral intermuscular septum → enters anterior compartment (arm)
- Between brachioradialis and brachialis → divides into posterior interosseous + superficial radial nerve
- Superficial branch beneath brachioradialis → pierces deep fascia and runs over anatomical snuffbox
- Terminal Sensory branches in hand

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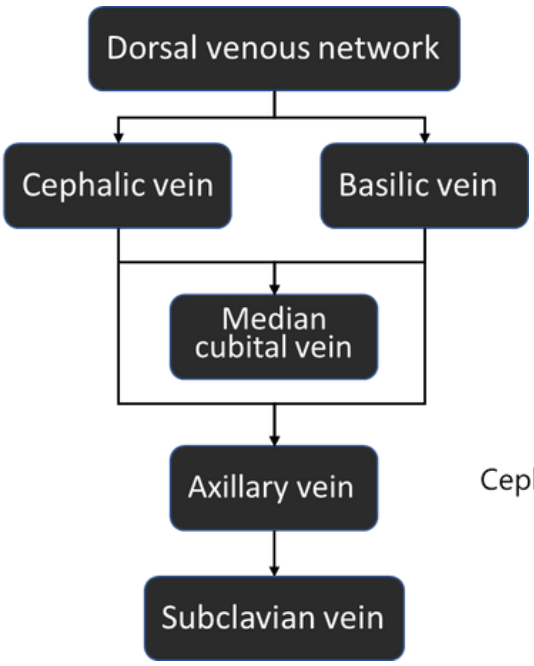
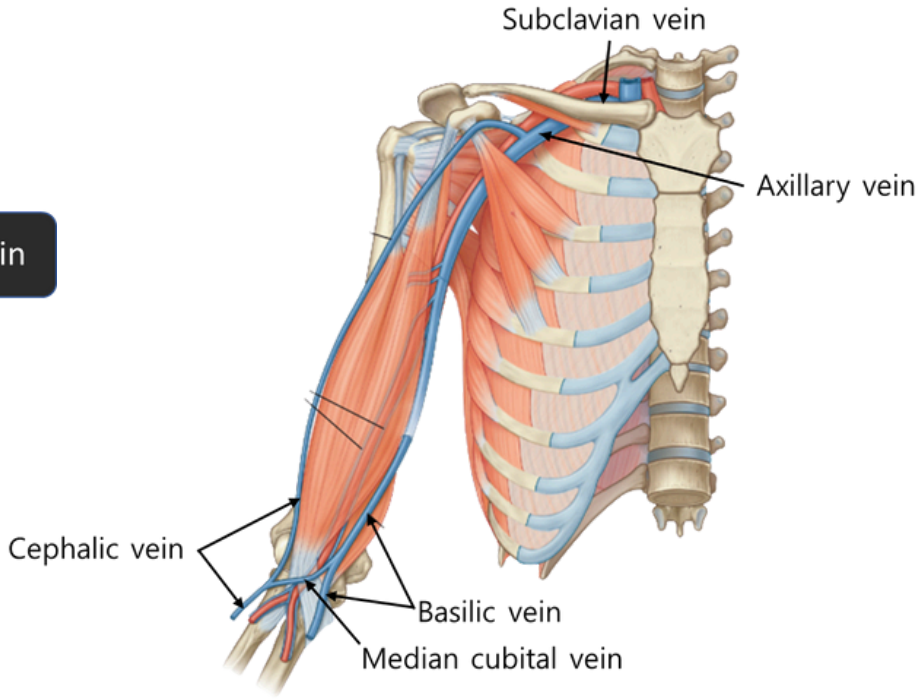
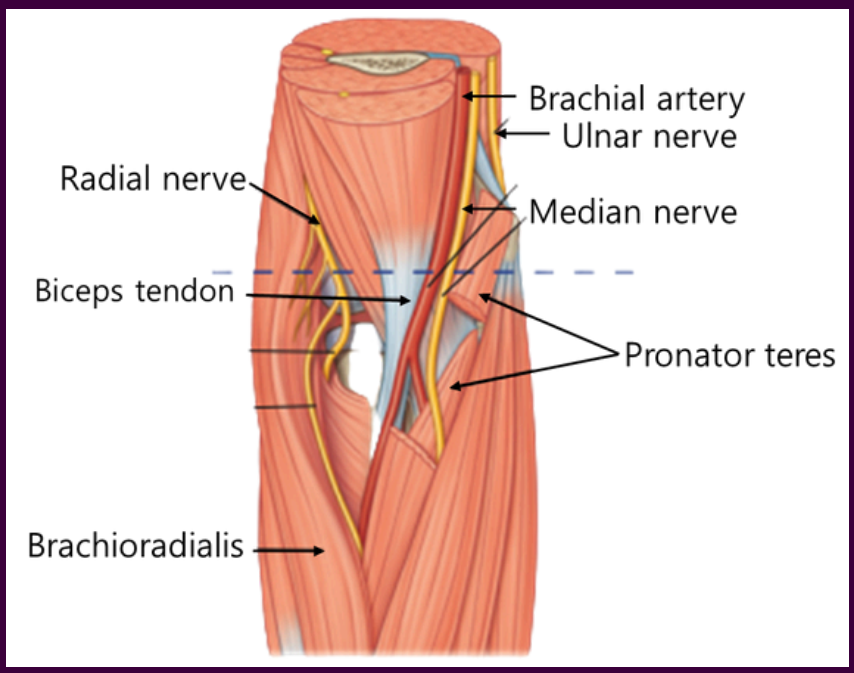
Venous drainage





Cubital fossa

- Superior border: Imaginary line across medial and lateral epicondyle
- Lateral border: Brachioradialis
- Medial border: Pronator teres
- Floor: Brachialis and supinator
- Roof: Bicipital aponeurosis



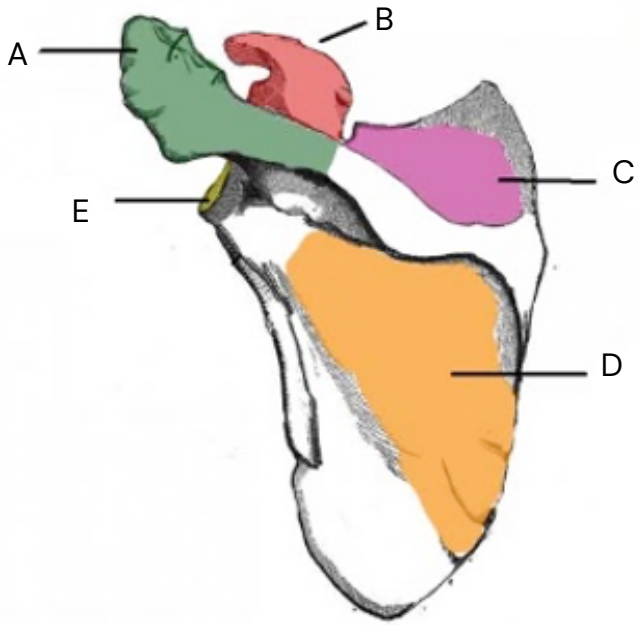
Content

- **R**eally **N**eed **B**eer **T**o **B**e **A**t **M**y **N**icest
- Radial nerve, Biceps Tendon, Brachial Artery, Median Nerve
- Median cubital vein lies superficial to cubital fossa – separated by bicipital aponeurosis

UPPER LIMB ANATOMY

Test yourself

1) Label the components of the scapula:



A)

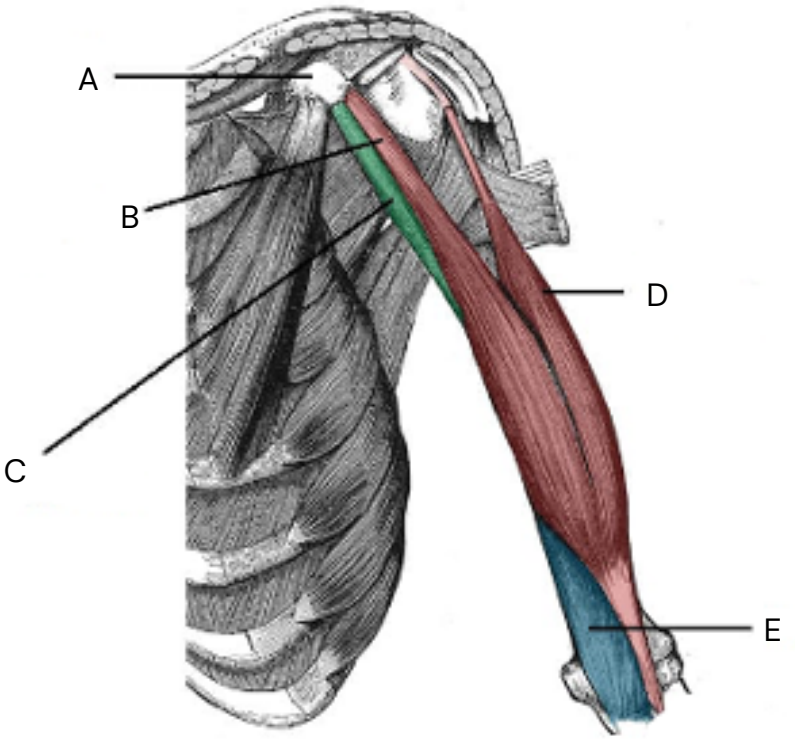
B)

C)

D)

E)

2) Label the muscles of the anterior compartment of the arm:



A)

B)

C)

D)

E)

UPPER LIMB ANATOMY

Test yourself

MCQ 1

Injury to which component of the brachial plexus would affect the function of the ulnar nerve?

A. Superior trunk
B. Middle trunk
C. Medial cord
D. Lateral cord
E. Lateral trunk

MCQ 2

A 32 year old male presents to ED with pain in the hand after punching a wall. Which metacarpal is most likely to be fractured?

A.First
B. Second
C. Third
D. Fourth
E. Fifth

MCQ 3

A 42-year-old construction worker presents after falling onto his outstretched hand. On examination, he is unable to oppose his thumb and has numbness over the lateral three-and-a-half fingers. Which nerve is most likely injured?

A. Radial nerve
B. Median nerve
C. Ulnar nerve
D. Musculocutaneous nerve
E. Axillary nerve

MCQ 4

A newborn is delivered with difficulty . Shortly after birth, the infant's right arm hangs limp by the side, adducted and internally rotated, with the forearm extended and pronated ("waiter's tip" posture). Which part of the brachial plexus is most likely injured?

A. C5–C6 nerve roots
B. C7 nerve root
C. C8–T1 nerve roots
D. Posterior cord
E. Long thoracic nerve

MCQ 5

Which of the following bony landmarks is not part of an articulating surface in the elbow joint?

A. Trochlea
B. Radial head
C. Capitulum
D. Radial tuberosity
E. Trochlear notch

MCQ 6

A transplant surgeon is performing an arteriovenous fistula within the antecubital fossa of the arm. Which structure lies immediately lateral to the brachial artery in this area?

A. Radial nerve
B. Biceps tendon
C. Median nerve
D. Median cubital vein
E. Ulnar nerve

UPPER LIMB ANATOMY

Test yourself

OSCE Station - Case Based Discussion

You are the junior doctor in the emergency department.

A 7-year-old boy is brought in by his parents after falling off a swing onto his outstretched hand.
On arrival, the child is crying with severe pain, holding his elbow. There is visible swelling and deformity around the distal humerus. He refuses to move the elbow.

X-ray shows a displaced supracondylar fracture

Q1. What radiological features would you look for in a supracondylar fracture?

Q2. How do you assess vascular status in this child?

Q3. Which nerve is most commonly injured in a supracondylar fracture?

Q4. What is Volkmann's ischemic contracture?

Q5. How is this fracture initially managed?

Q6. What is the classification system for these type of fractures?

Answers
Labels

1. **A)** Acromion **B)** Coracoid **C)** Supraspinatus fossa **D)** Infraspinatus fossa **E)** Glenoid fossa
2. **A)** Coracoid process **B)** Short head bicep **C)** coracobrachialis **D)** Biceps brachaii long head **E)** Brachialis

MCQs: 1) C, **2)** E, **3)** B, **4)** A, **5)** D, **6)** B

OSCEs
1. Posterior fat pad sign, Displacement of distal fragment
2. Check brachial, radial, and ulnar pulses, capillary refill time, skin temperature, and color of the hand
3. Anterior interosseous nerve (branch of median nerve) in extension type fractures, ulnar nerve in flexion type fracture
4. A complication of supracondylar fractures which cause a permanent flexion deformity of the hand and wrist due to ischemia and fibrosis of forearm muscles following untreated compartment syndrome.
5. Immobilisation in above-elbow backslab, analgesia, neurovascular monitoring
6. Gartland classification