INTERNATIONAL SURGICAL ANATOMY TEACHING SERIES

ISATS HANDOUT 2023/24

Upper Limb

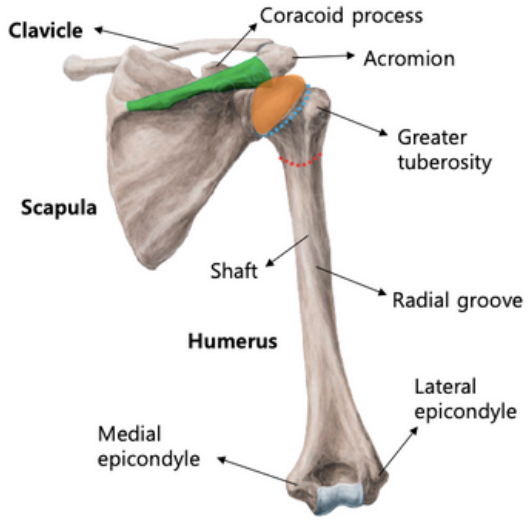
High Yield | Surgical Relevance | CPD Accredited

UPPER LIMB ANATOMY

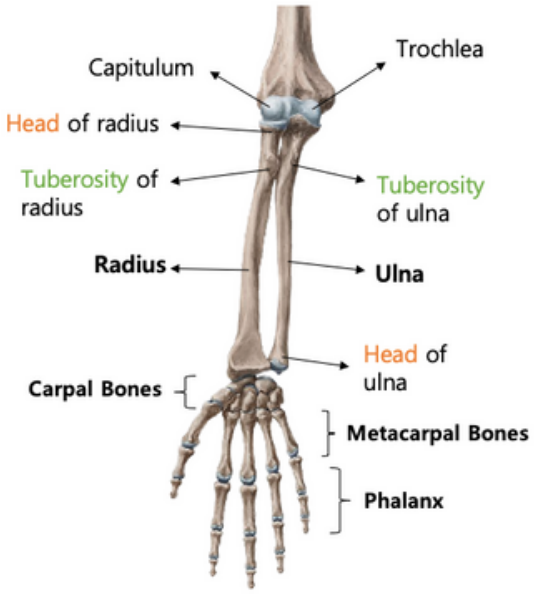
***Objectives**: Recall the bony anatomy of the upper limb, appreciate the position and function of the rotator cuff muscles, appreciate the muscular compartments of the upper limb, trace the course of important neurovascular structures of the upper limb & apply anatomical knowledge to the setting of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



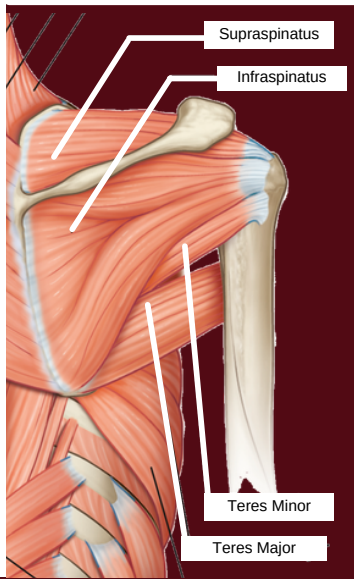
The Rotator Cuff

- 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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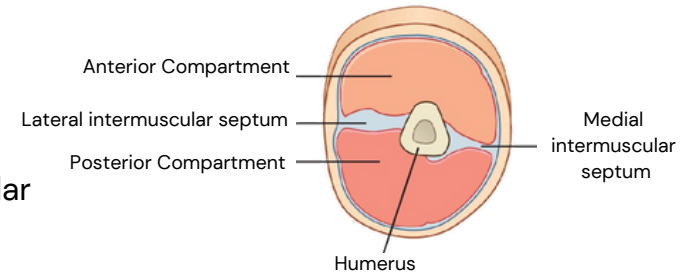
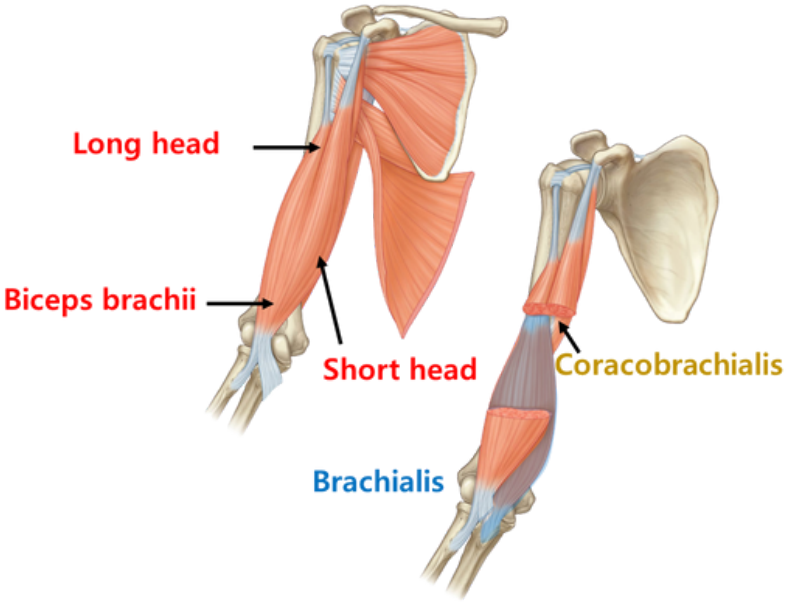
Compartments of the Arm

Overview



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

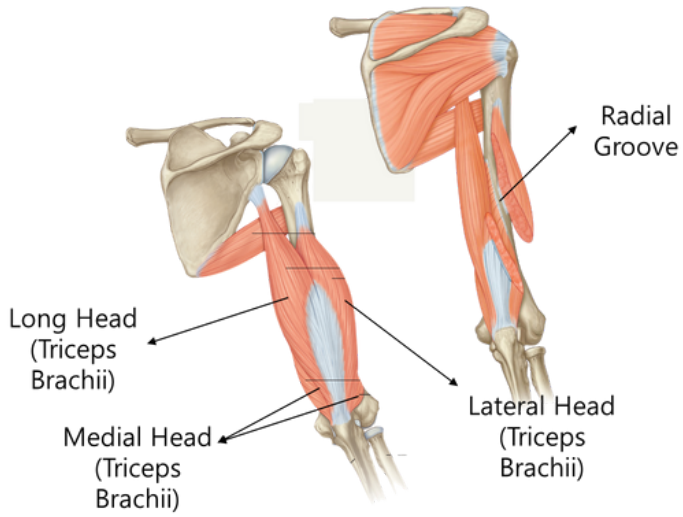
Anterior Compartment



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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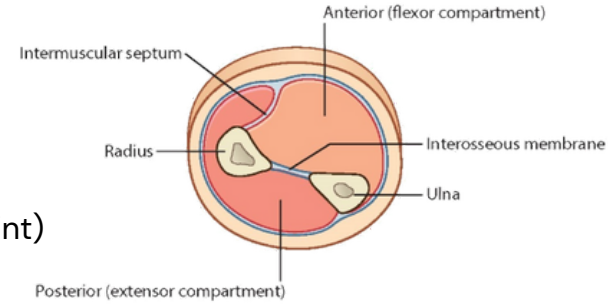
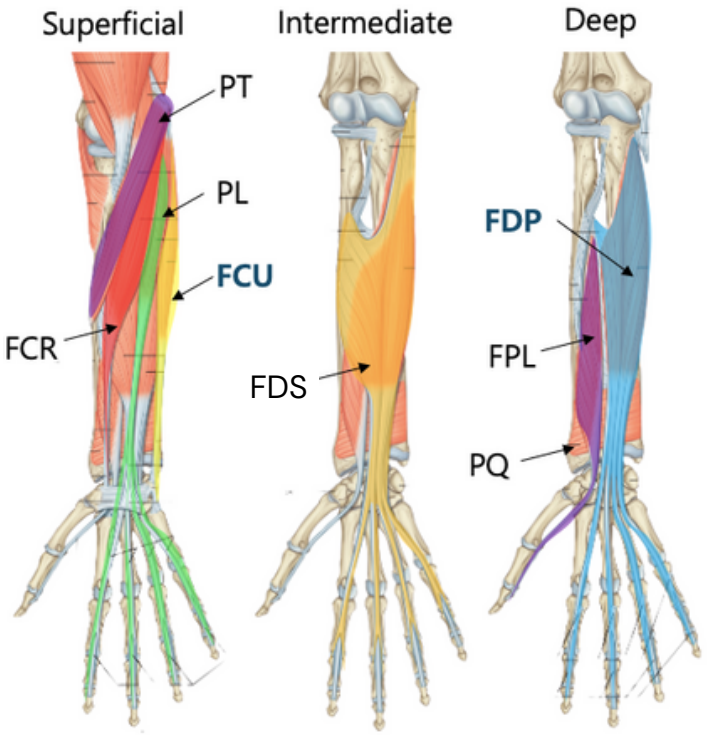
Compartments of the Forearm

Overview

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



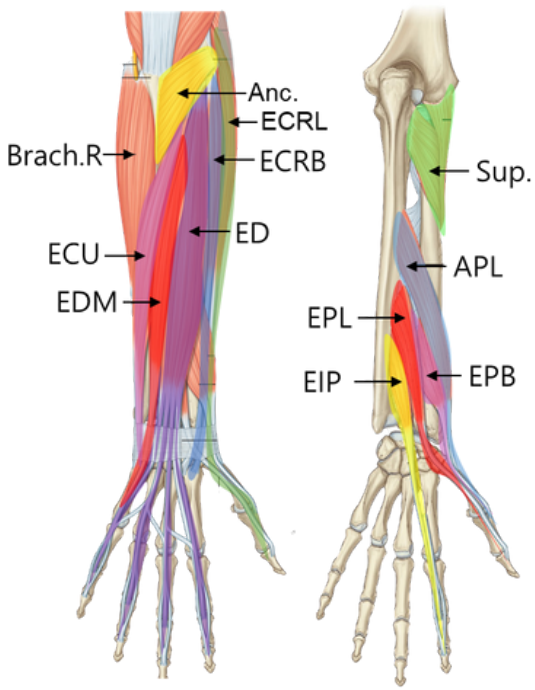
Anterior Compartment



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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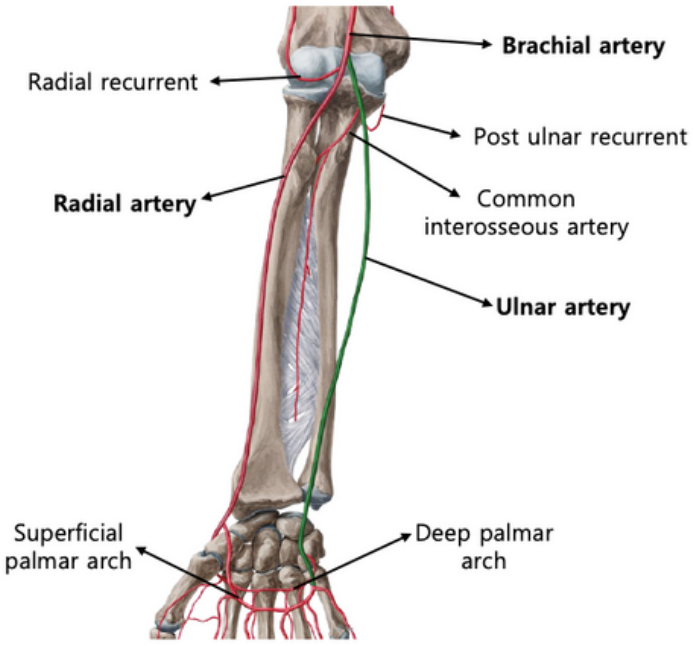
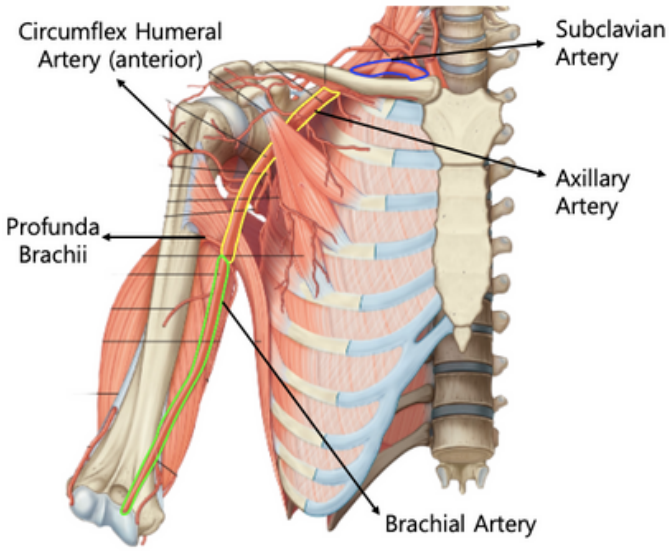
Brachial Artery

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





Course

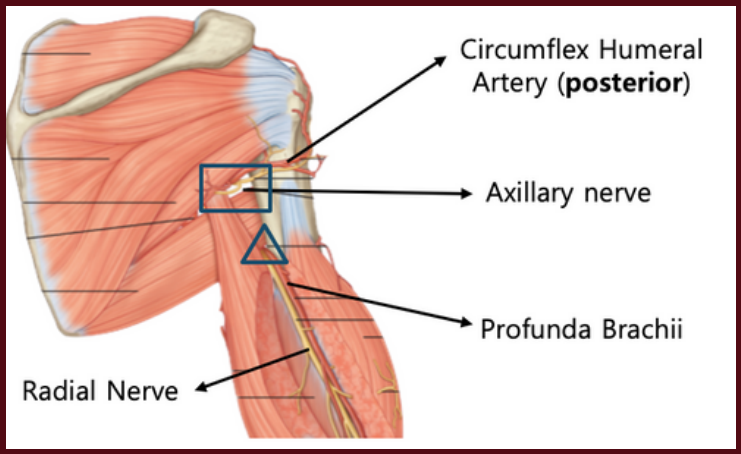
- Predominantly medial to humerus
- Crosses to mid-point between epicondyles
- Wholly superficial
- Bifurcates into radial and ulnar arteries within cubital fossa
- Radial artery - extends across posterior forearm.
  - Branches: radial recurrent a.
  - Hand – deep palmar arch
- Ulnar artery - extends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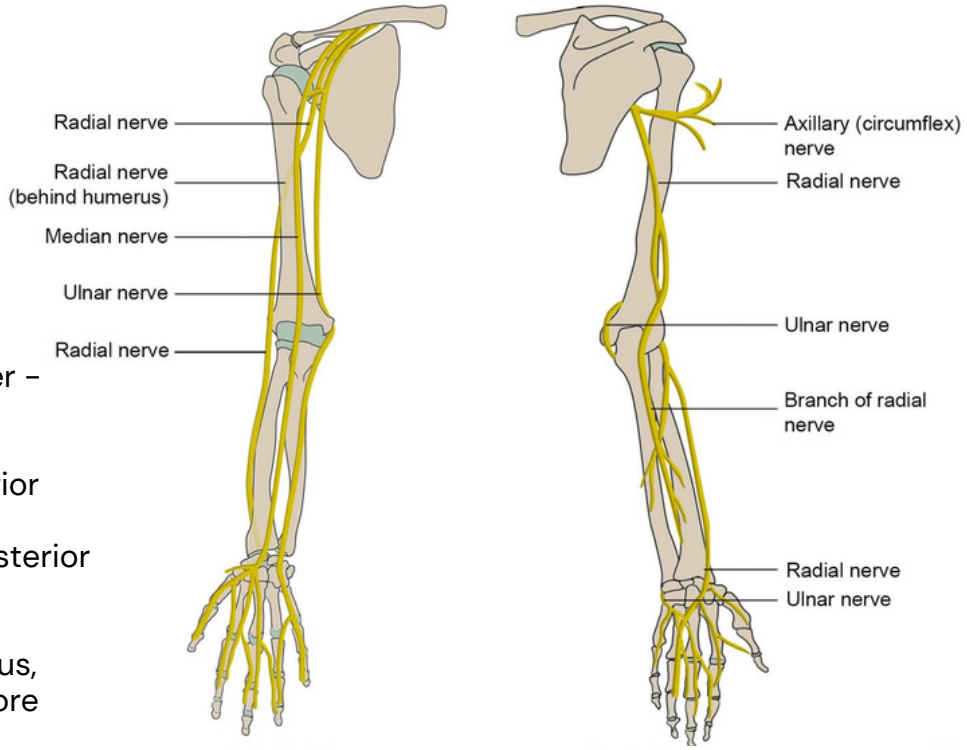
Brachial Plexus

- 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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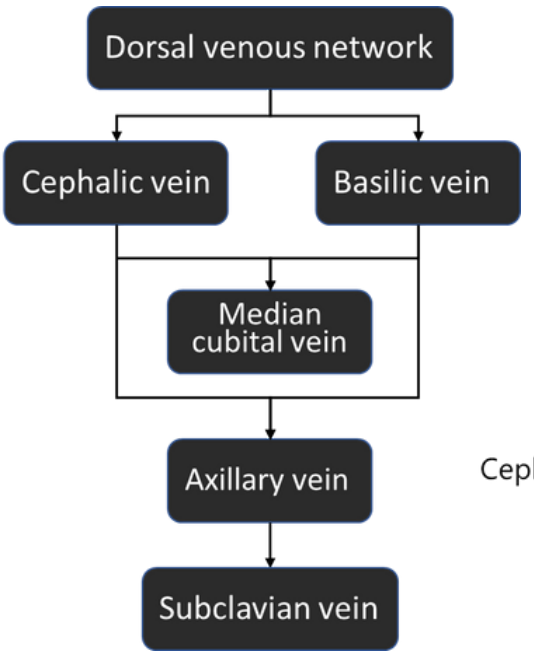
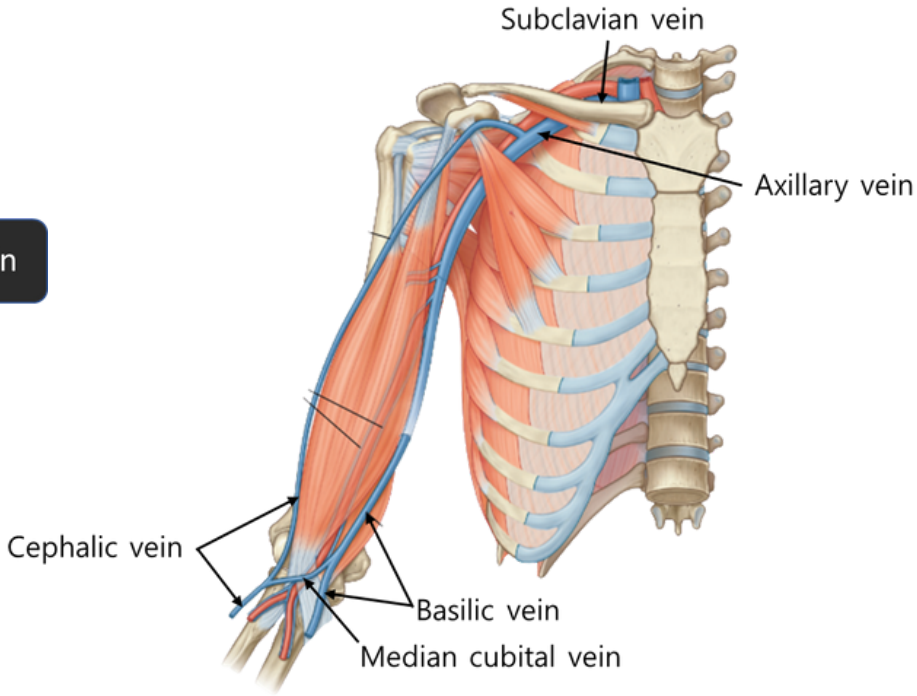
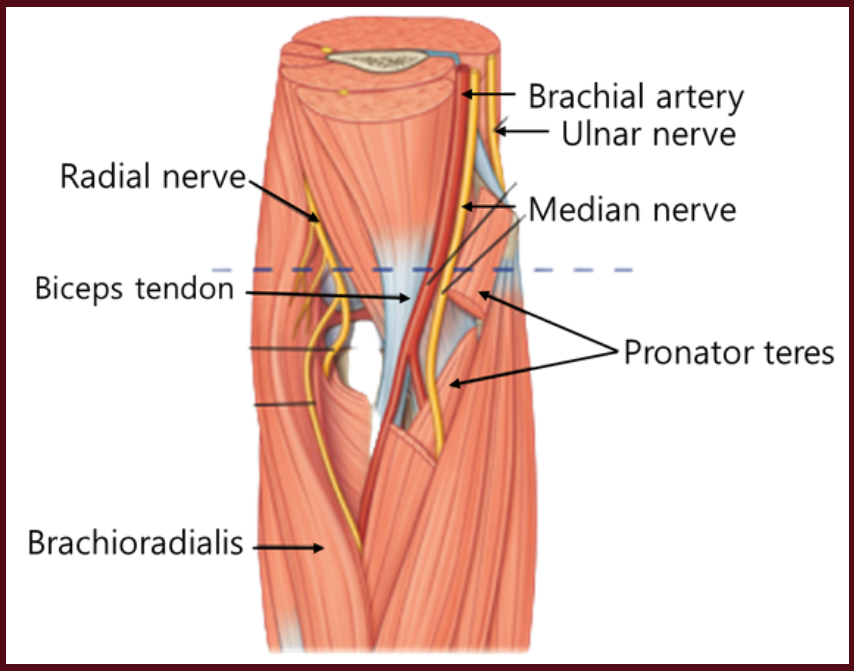
Venous drainage





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

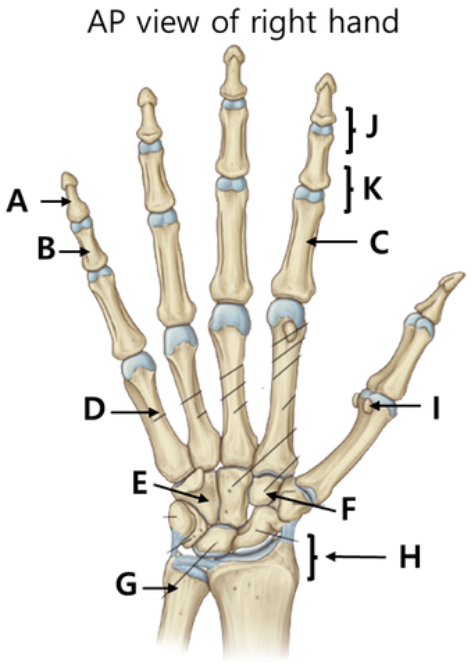
- **R**eally **N**eed **B**eer **T**o **B**e **A**t **M**y **N**icest
- Radial nerve, Biceps Tendon, Brachial Artery, Median Nerve
- Median cubital vein lies superficial to cubital fossa - separated by bicipital aponeurosis

UPPER LIMB ANATOMY

Test yourself

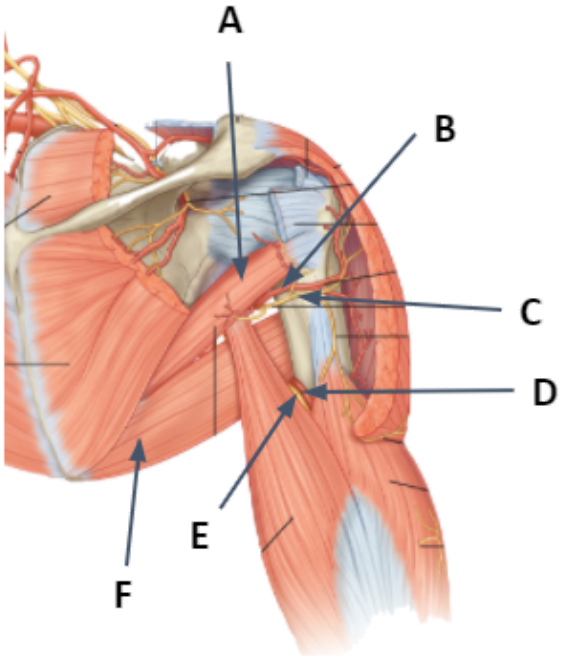
1) Label the bony anatomy and joints present in the hand:

- A .....
- B .....
- C .....
- D .....
- E .....
- F .....
- G .....
- H .....
- I .....
- J .....
- K .....



2) Label the muscles and neurovasculature of the posterior arm:

- A .....
- B .....
- C .....
- D .....
- E .....
- F .....



UPPER LIMB ANATOMY

Test yourself

MCQ 1

A 22-year-old male was assaulted with a 20 cm chef knife resulting in a posterior-to-anterior shoulder injury. The trauma surgeon attempts to assess any vascular injury intraoperatively. Which blood vessel courses the quadrangular space?

A. Anterior humeral circumflex artery
B. Posterior humeral circumflex artery
C. Profunda brachii artery
D. Axillary artery
E. Axillary vein

MCQ 3

A 55-year-old female is admitted to A&E having experienced a fall on an outstretched arm. Examination reveals a non-tender forearm but the rest of the upper limb is internally rotated with loss of sensation below the deltoid. What nerve is likely damaged?

A. Medial cutaneous nerve
B. Diagonal band of broca
C. Radial nerve
D. Axillary nerve
E. Ulnar nerve

MCQ 5

Which of the following muscles does the median nerve NOT provide innervation to?

A. Flexor digitorum superficialis
B. Flexor carpi radialis
C. Flexor carpi ulnaris
D. Palmaris longus
E. Flexor pollicis longus

MCQ 2

Which structure is not in the cubital fossa?

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

MCQ 4

A FY1 is tasked with perfoming an arterial blood gas for a patient with a suspicion of diabetic ketoacidosis. To establish the patency and connection of the anastomosis between the radial and ulnar arteries, what clinical assessment should be employed?

A. Allen's test
B. Auscultate brachial artery
C. Sonography of axilla
D. Grip strength test
E. Tilt table test

MCQ 6

Which of the following statement regarding the brachial plexus is false?

A. The plexus originates from nerve roots C5 to T1
B. The radial and ulnar nerves arise from the posterior cord of the plexus
C. The brachial plexus courses around the brachial artery
D. There are 5 terminal nerve branches of the brachial plexus
E. Damage to the ulnar and median nerves results in wrist drop

UPPER LIMB ANATOMY

Test yourself

OSCE Station - Case Based Discussion

A 55 year old man tripped over the curb and landed heavily with his hands stretched out. His palms contacted the ground and he has been in pain on the base of his thumb since then. It has been 2 weeks since the accident and his pain is getting worse. He has no other injuries and no other significant details in his history. When you examine him, the pain is in his anatomical snuffbox.

Q1. What are the boundaries of the anatomical snuffbox?

Q2. What bone is most likely do have been damaged in this presentation?

Q3. Considering the anatomy of this injury, why may the patient's pain be getting worse?

Q4. How will this patient be managed surgically?

Q5. What is a serious complication of this injury if left untreated?

Q6. If this patient's X-Ray demonstrated no fracture, what imaging modality would be preferred next and why?

Answers
Labels
1. A – Distal phalanx, B – Middle phalanx, C – Proximal phalanx, D – Metacarpal, E – Hamate, F – Trapezoid, G – Ulna, H – Radial styloid process
2. A – Teres Minor, B – Posterior Circumflex Humeral Artery, C- Axillary Nerve, D- Profunda Brachii, E- Radial Nerve, F- Teres Major
MCQs
B, C, D, A, C, E
OSCEs
1. Tendon of extensor pollicis longus, tendons of extensor pollicil brevis and abductor pollicis longus & the styloid process of radius 2. Scaphoid 3. Retrograde blood supply has been damaged leading to avascular necrosis of the proximal half of the scaphoid 4. ORIF, some pts may only require conservative fixation (casting) 5. Avascular necrosis causing loss of stability of the proximal carpal row requiring fusion of the wrist 6. MRI of wrist. Higher sensitivity and specificity than CT + can demonstrate any soft tissue injuries