MIDLANDS SURGICAL ANATOMY TEACHING SERIES

MSATS HANDOUT 2021/22

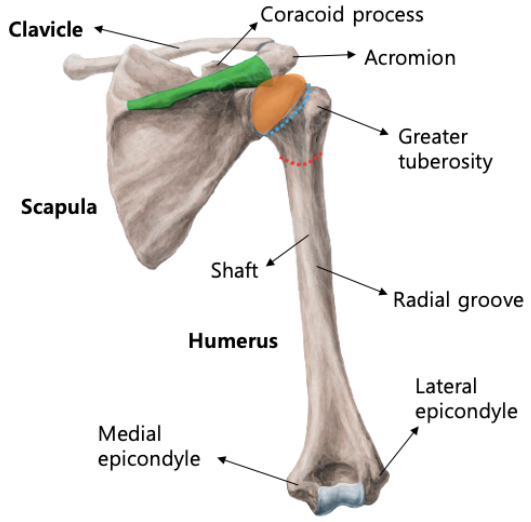
High Yield | Surgical Relevance | CPD Accredited

UPPER LIMB ANATOMY

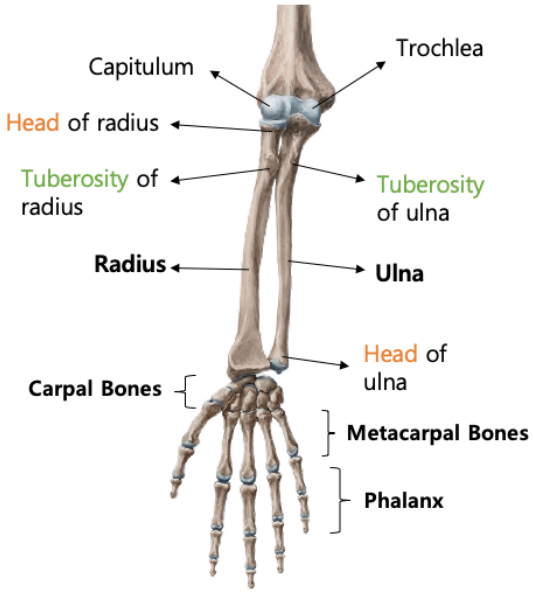
***Objectives**: Recall the bony anatomy of the upper limb, appreciate the position and function of the rotator cuff muscles, appreciate the muscular compartments of the upper limb, trace the course of important neurovascular structures of the upper limb & apply anatomical knowledge to the setting of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



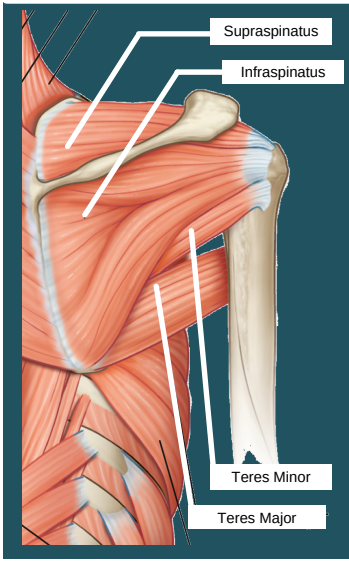
The Rotator Cuff

- 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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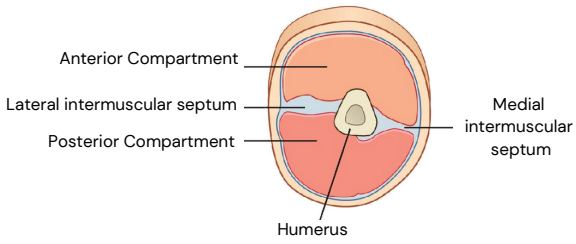
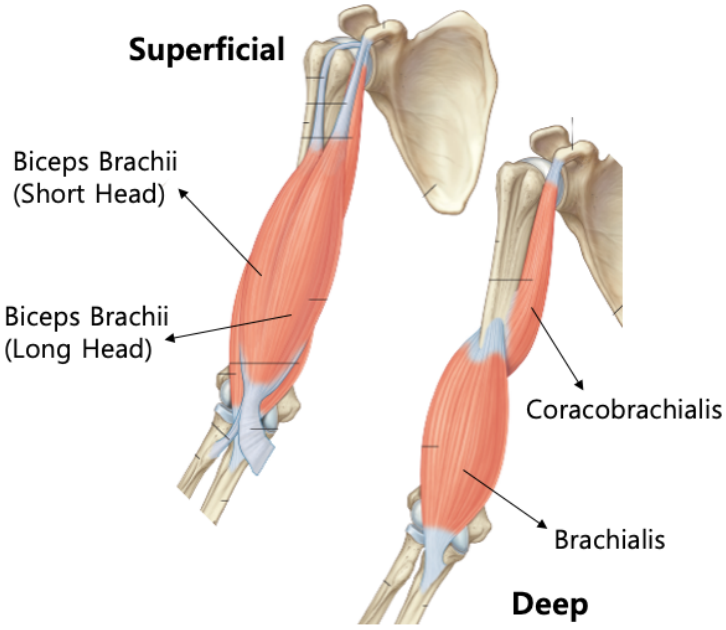
Compartments of the Arm

Overview

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



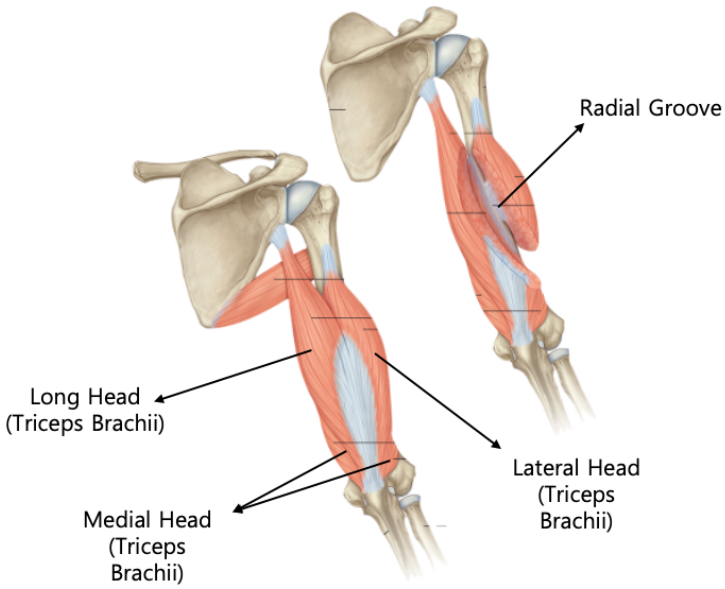
Anterior Compartment



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
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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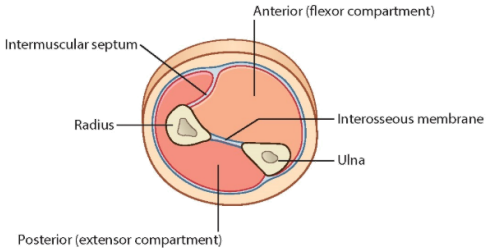
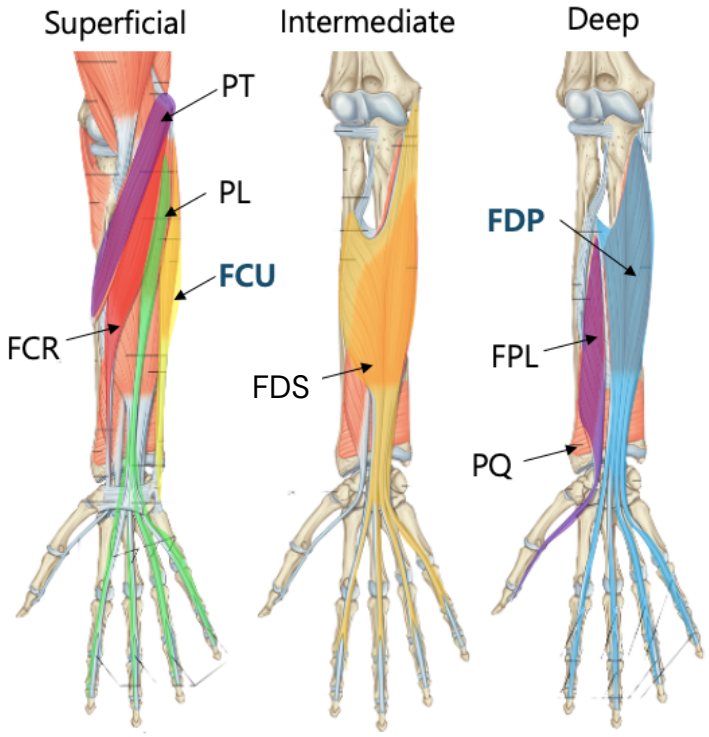
Compartments of the Forearm

Overview

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



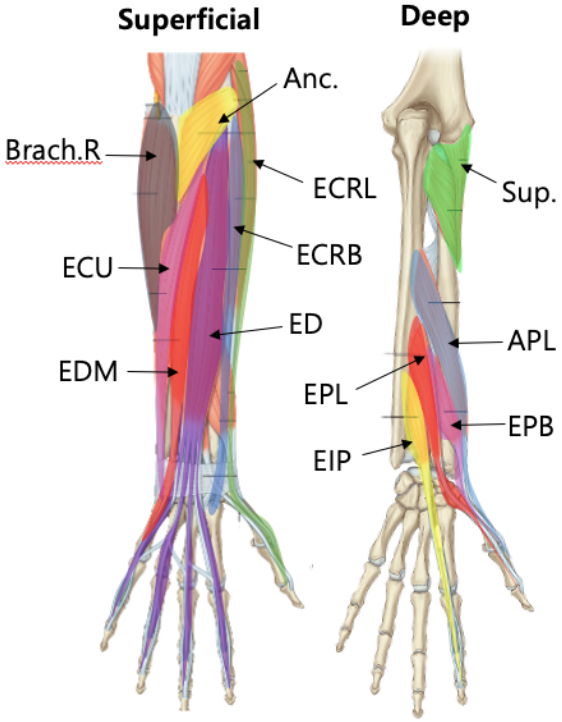
Anterior Compartment



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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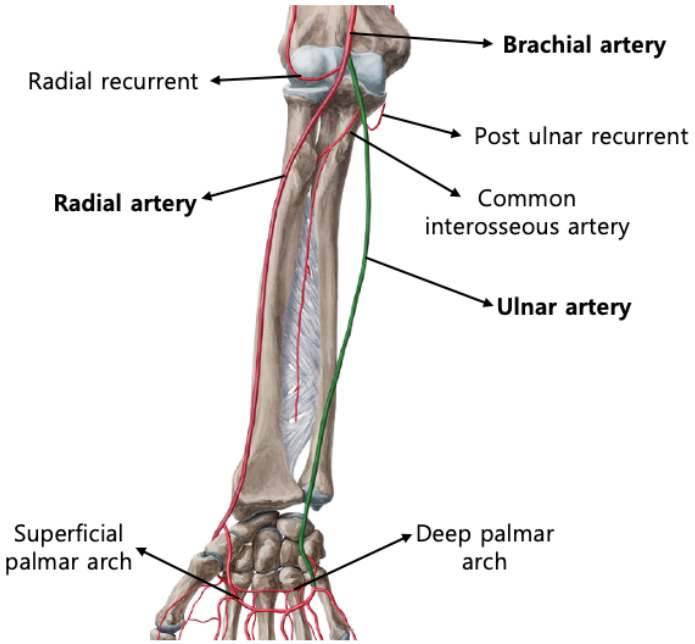
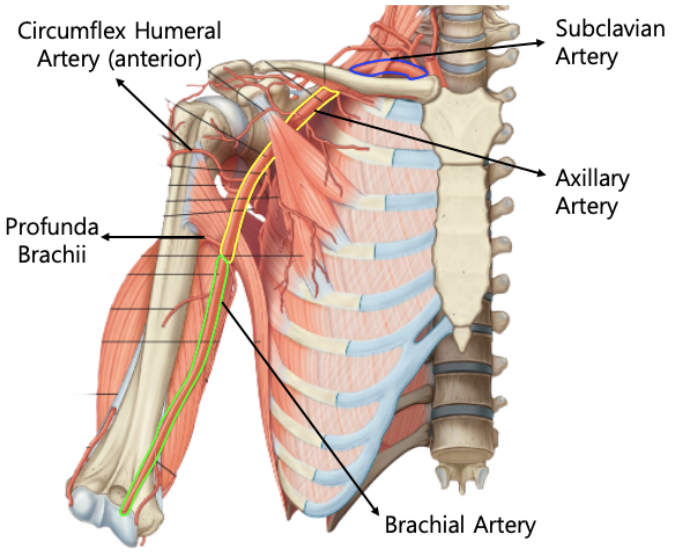
Brachial Artery

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





Course

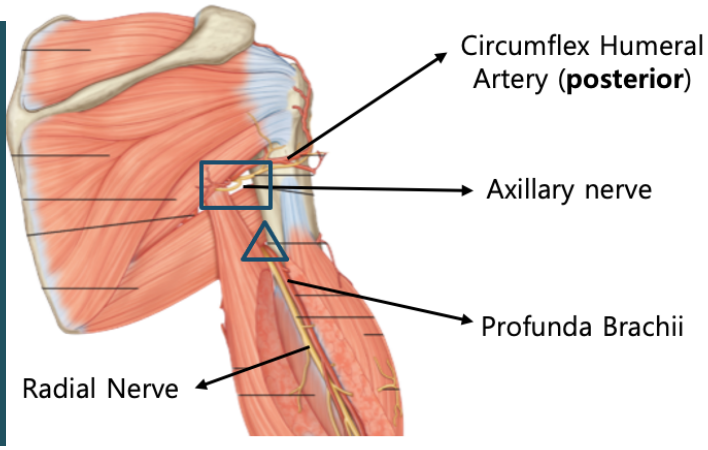
- Predominantly medial to humerus
- Crosses to mid-point between epicondyles
- Wholly superficial
- Bifurcates into radial and ulnar arteries within cubital fossa
- Radial artery - extends across posterior forearm.
  - Branches: radial recurrent a.
  - Hand – deep palmar arch
- Ulnar artery - extends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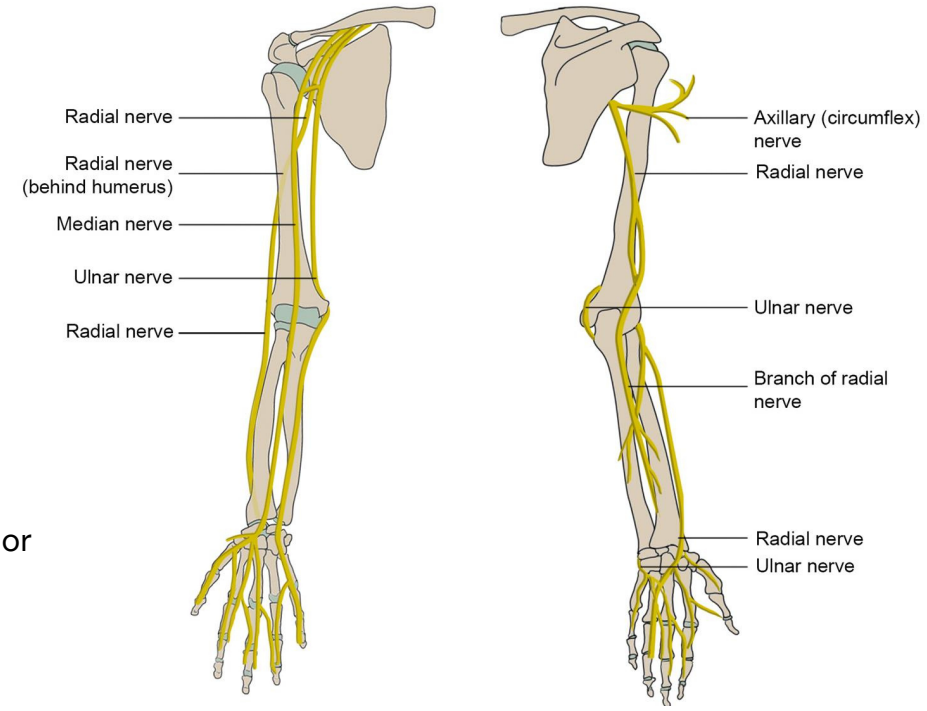
Brachial Plexus

- 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 & Sensory branches in hand

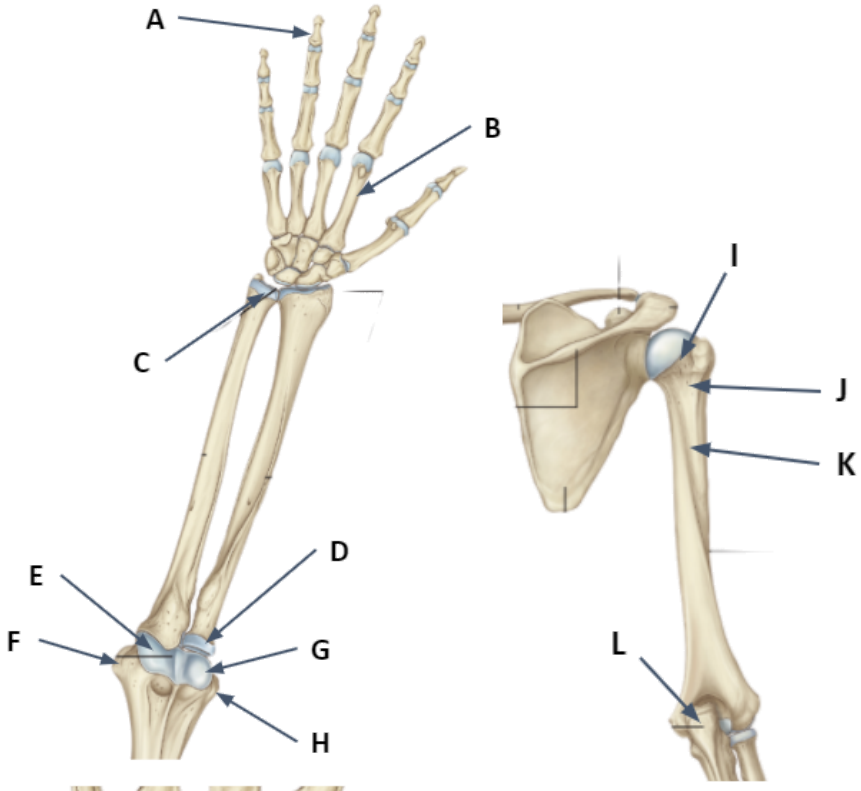
Radial Nerve

- 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

UPPER LIMB ANATOMY

Test yourself...

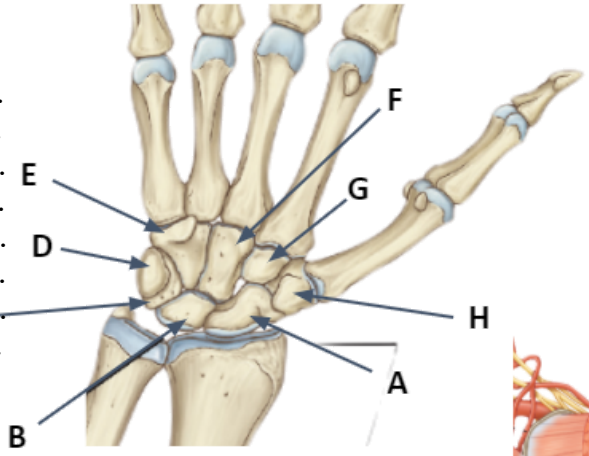
1) Label the structures...



Long Bones of the Arm

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

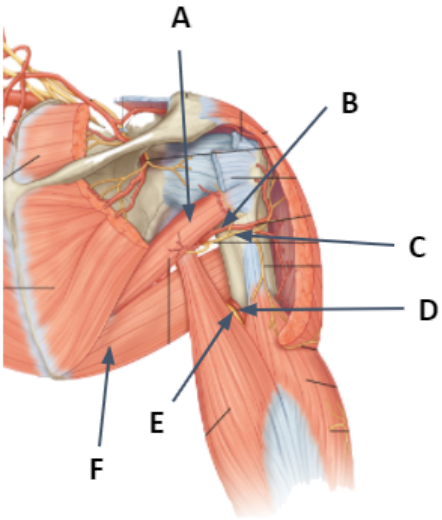
2) Label:



Carpal bones

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

3) Label:



Spaces of Posterior Arm

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

UPPER LIMB ANATOMY

Test yourself...

MCQ 1
If the Posterior Cord of the Brachial Plexus is damaged, which muscle would most likely be affected?

A. Brachialis
B. Flexor Digitorum Profundus
C. Deltoid
D. Flexor Carpi Ulnaris
E. Pectoralis Minor

MCQ 2
The Teres Major is considered a Rotator Cuff by some because it...

A. Produces Concave Compression
B. Contributes to 'The Cable'
C. Assists Extension
D. Contributes to the Fibrous capsule of shoulder
E. Attaches to the Scapula

MCQ 3
The Structures that Border the Quadrangular Space are...

A. Teres Minor, Humerus, Long Head of Triceps, Infrapinatus
B. Subscapularis, Scapula, Humerus, Teres Major
C. Long Head of Triceps, Humerus, Teres Major
D. Axillary Nerve, Posterior Circumflex Humeral Artery
E. Teres Minor, Humerus, Teres Major, Long Head of Triceps

MCQ 4
Abduction of the wrist involves which muscles?

A. Flexor Carpi Ulnaris + Ulnar Extensors
B. Flexor Carpi Radialis + Radial Extensors
C. Extensor Carpi Radialis Longus + Extensor Carpi Radialis Brevis
D. Brachioradialis + Flexor Carpi Radialis
E. Brachialis + Radial Extensors

MCQ 5
3/5 down the length of the Humerus, the Ulnar Nerve pierces which fascial structure?

A. Medial Intermuscular Septum
B. Anterior Compartment of the Forearm
C. Posterior Compartment of the Forearm
D. Cubital Tunnel
E. Lateral Intermuscular Septum

MCQ 6
Which 2 main branch nerves run in the Anterior Compartment of the Forearm?

A. Ulnar + Radial
B. Median + Radial
C. Musculoskeletal + Medial
D. Ulnar + Median
E. Posterior Interosseous + Anterior Interosseous

UPPER LIMB ANATOMY

Test yourself...

OSCE Station - Case Based Discussion

A 22 year old man attends A&E after being assaulted by one individual with a baseball bat. He received a series of blows followed by a direct strike to his right arm before someone was able to intervene. He is taken for an X-ray that reveals a segmental transverse fracture of the midshaft of the humerus requiring open fixation. After the operation, you follow up the young man and ask him to hold out his hands. You notice that when pronated, his whole hand drops at the wrist with bent fingers and he is unable to lift his fingers to the sky. Extension of his elbow is present but weak compared to the unaffected limb.

Q1. Which nerve is likely affected in this case?

Q2. Why was this nerve particularly at risk from this type of injury?

Q3. Can you think of any instances where a different nerve of the Upper Limb may be injured?

Q4. In which compartment is the weakness found in this patient?

Q5. What are the indications for open or closed fixation? (i.e. surgery or not)

Q6. What other mechanisms might cause a midshaft humerus fracture and how would the fracture differ?

Answers
1) A- Distal Phalanx, B- Metacarpal, C- Head of Ulna, D- Head of Radius, E- Trochlea, F- Medial Epicondyle, G- Capitulum, H- Lateral Epicondyle, I- Anatomical Neck of Humerus, J- Surgical Neck of Humerus, K- Radial Groove, L- Olecranon
2.) A- Scaphoid, B- Lunate, C- Triquetrum, D- Pisiform, E- Hamate, F- Capitate, G- Trapezoid, H- Trapezium
3.) A- Teres Minor, B- Posterior Circumflex Humeral Artery, C- Axillary Nerve, D- Profunda Brachii, E- Radial Nerve, F- Teres Major

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

OSCE
1 - Radial Nerve
2 - The radial nerve has a tortuous path closely associated to the Humerus (radial groove) putting it at risk of injury from fracture and surgery
3 - Axillary Nerve - shoulder dislocation/Median Nerve - carpal tunnel release/Ulnar Nerve - Elbow trauma or superficial laceration/ All - entrapment neuropathies
4 - Posterior compartment of Arm (partial), Posterior compartment of Forearm (total)
5 - Most humeral shaft fractures can be managed conservatively with immobilisation and splinting, even when there is mild displacement. When displacement is severe, segmental or there is vascular compromise, open reduction is recommended.