



Student Notes

ANATOMY

1st Edition

UPPER LIMB



Preface

Agam is a group of budding medicos, who are currently doing their under graduation in various Medical Colleges across Tamil Nadu and Pondicherry. The group was initiated on 18th November 2017, in the vision of uniting medicos for various social and professional causes.

We feel delighted to present you Agam Anatomy notes prepared by Agam Divide and Rule 2020 Team to guide our fellow medicos to prepare for university examinations.

This is a reference work of 2017 batch medical students from various colleges. The team took effort to refer many books and make them into simple notes. We are not the authors of the following work. The images used in the documents are not copyrighted by us and is obtained from various sources.

Dear readers, we request you to use this material as a reference note, or revision note, or recall notes. Please do not learn the topics for the 1st time from this material, as this contain just the required points, for revision.

Acknowledgement

On behalf of the team, Agam would like to thank all the doctors who taught us Anatomy. Agam would like to whole heartedly appreciate and thank everyone who contributed towards the making of this material. A special thanks to Srivardhany Bhaskar and M. Snaha, who took the responsibility of leading the team. The following are the name list of the team who worked together, to bring out the material in good form.

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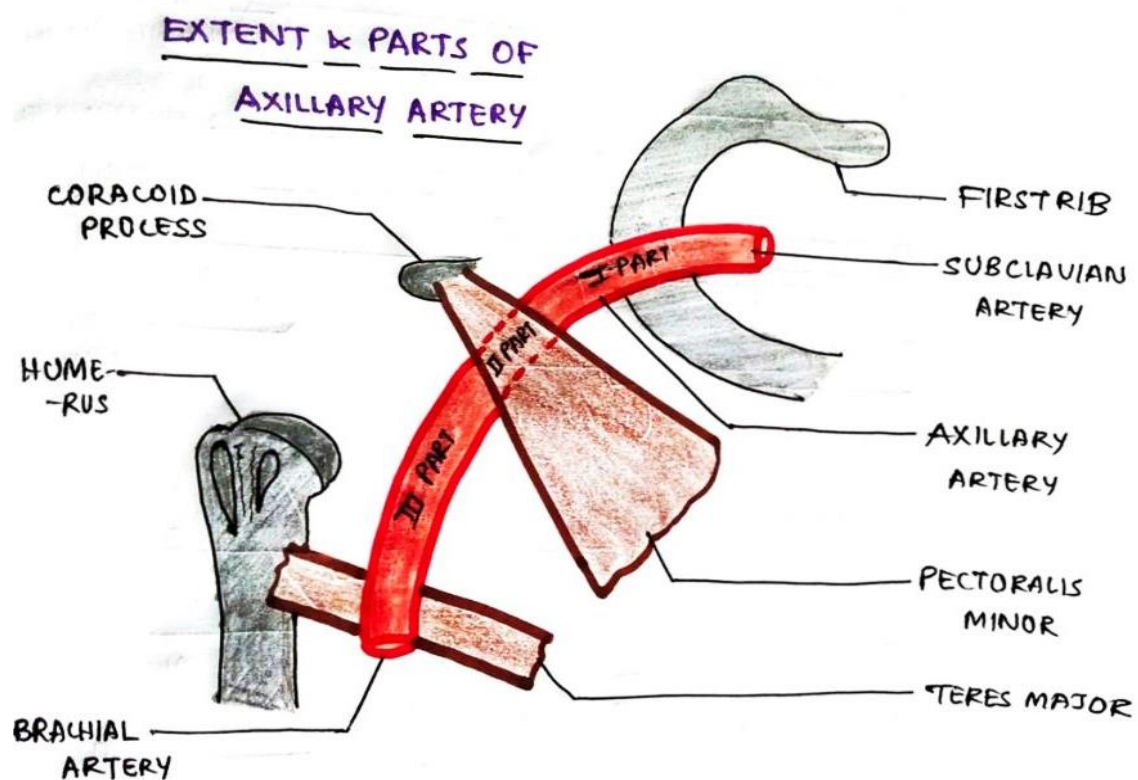
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1. . AXILLARY ARTERY

- **COMMENCEMENT** – upper border of first rib, continuation of subclavian artery
- **COURSE** – in axilla, runs along lateral wall nearer to anterior wall.
- In axilla – crossed superficially by pectoralis minor muscle

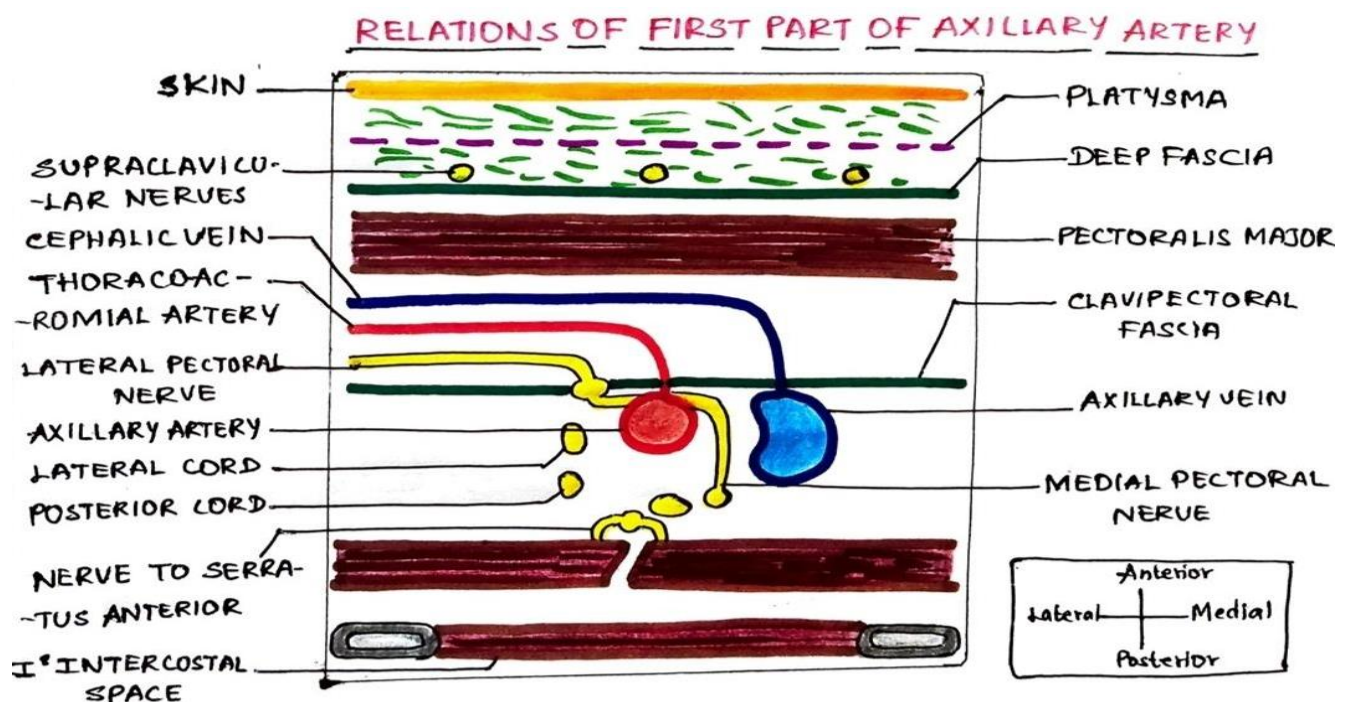
PARTS OF AXILLARY ARTERY:

- Pectoralis minor divides it into 3 parts
 1. **FIRST PART** – superior to muscle
 2. **SECOND PART** – posterior to muscle
 3. **THIRD PART** – inferior to muscle

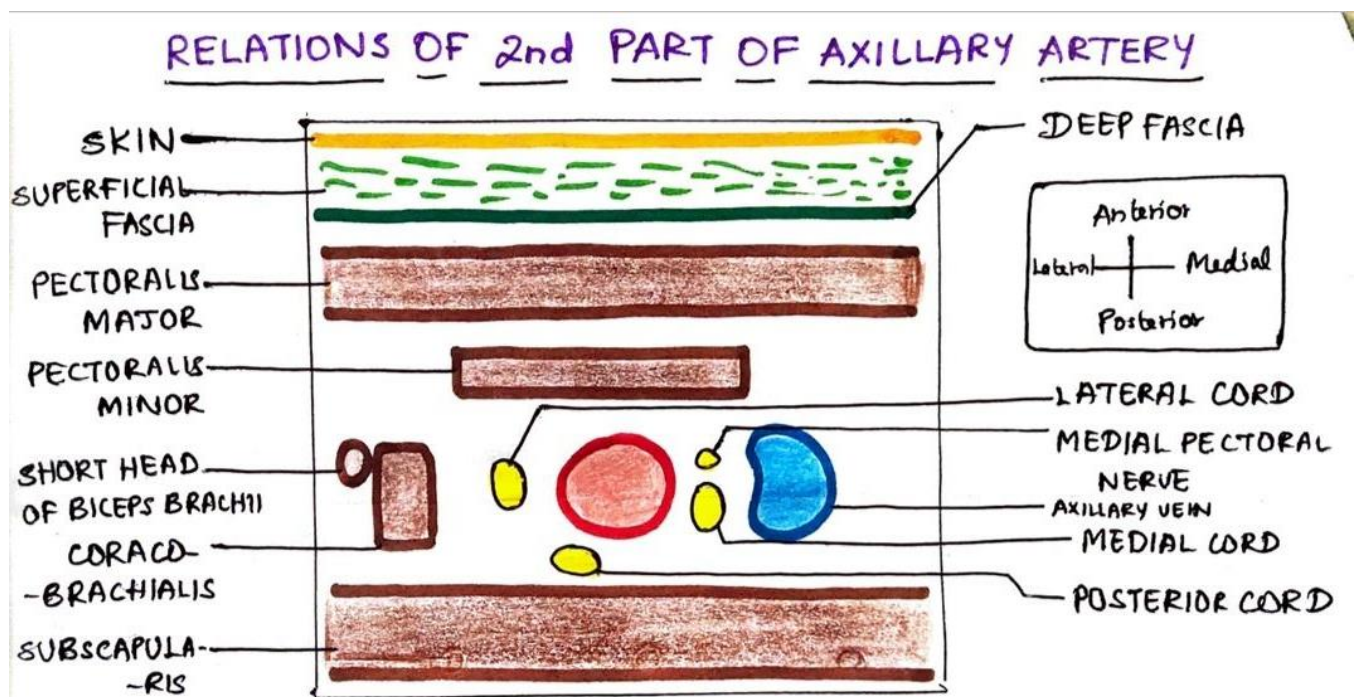


RELATIONS OF AXILLARY ARTERY:

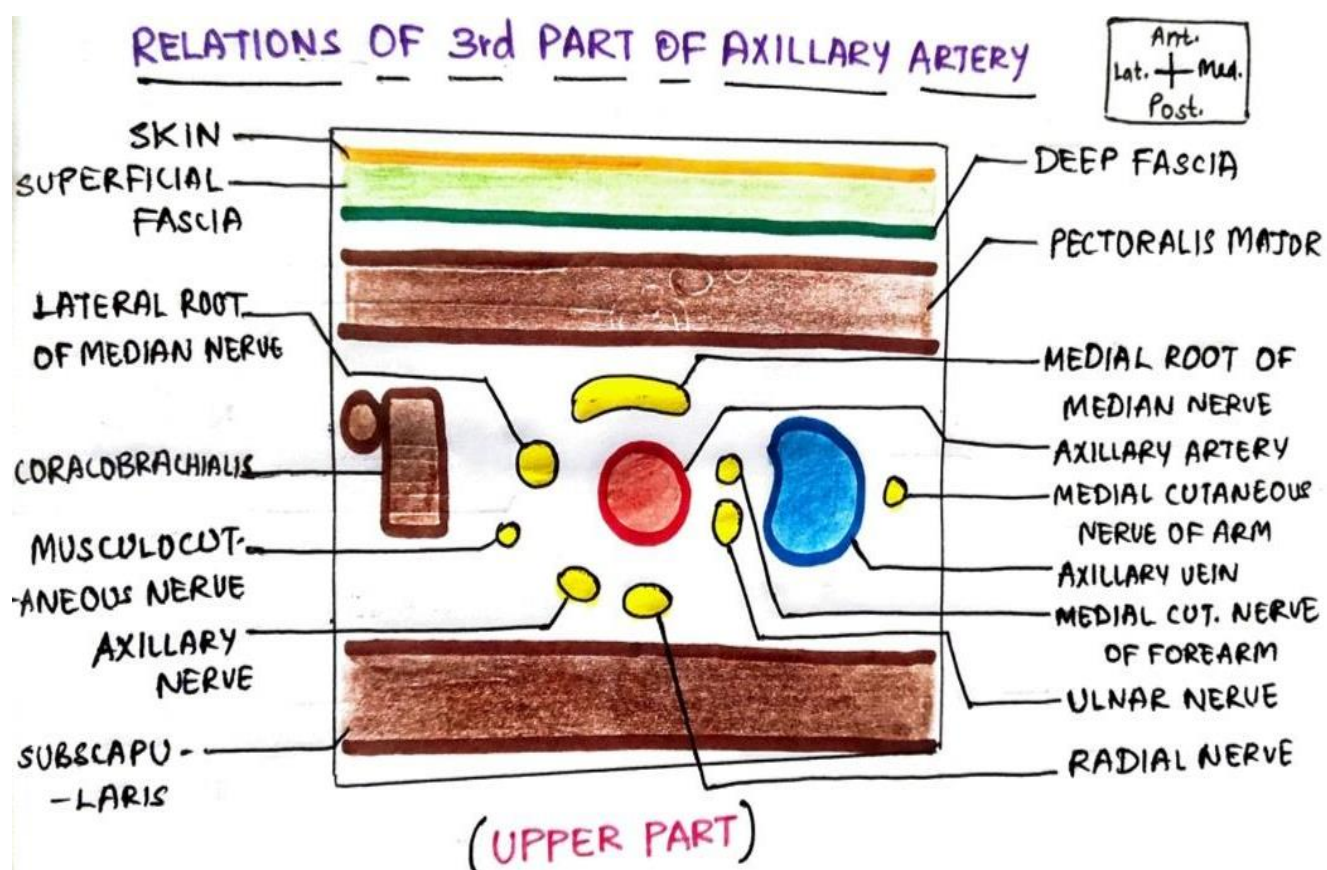
PART	ANTERIOR	POSTERIOR	MEDIAL	LATERAL
FIRST PART	● Skin, Superficial fascia, Deep fascia ● Pectoralis major (clavicular part) ● Clavicular fascia ● Loop of communication b/w lateral & medial pectoral nerves	● Medial cord of brachial plexus ● Serratus anterior (1st & 2nd div.) ● Nerve to serratus anterior	● Axillary vein	● Brachial plexus - lateral & posterior cords



PART	ANTERIOR	POSTERIOR	MEDIAL	LATERAL
SECOND PART	● Skin, superficial fascia, deep fascia ● Pectoralis major ● Pectoralis minor	● Brachial plexus - posterior cord ● Subscapularis	● Brachial plexus - medial cord ● Medial pectoral nerve ● Axillary vein	● Brachial plexus - lateral cord ● coracobrachialis



PART	ANTERIOR	POSTERIOR	MEDIAL	LATERAL
THIRD PART	● Skin, superficial fascia, deep fascia ● Pectoralis major (in upper part) ● Medial root of median nerve (in upper part)	● Radial nerve ● Axillary nerve (in upper part) ● Subscapularis (in upper part) ● Tendons of Latissimus dorsi & Teres major (in lower part)	● Axillary vein ● Medial cutaneous nerve of forearm & ulnar nerve ● Medial cutaneous nerve of arm	● Coracobrachialis ● Musculocutaneous nerve (in upper part) ● Lateral root of median nerve (in upper part) ● Trunk of median nerve (in lower part)





BRANCHES OF AXILLARY ARTERY:

- Six branches: one – from 1st part, two – from 2nd part, three – from 3rd part

1ST PART:

1. SUPERIOR THORACIC ARTERY (from first part)

- Arises near subclavius
- Passes b/w pectoral muscles
- Ends by supplying pectoral muscles

2ND PART:**2. THORACOACROMIAL ARTERY**

- Arises near pectoralis minor (upper border)
- Pierces clavipectoral fascia
- Gives 4 terminal branches – pectoral br., deltoid br., acromial br., clavicular br.

3. LATERAL THORACIC ARTERY

- Arises & runs along pectoralis minor (lower border)
- Closely related to ant. group of axillary lymph nodes
- In females, it gives lateral mammary branches to breast.

3RD PART:**4. SUBSCAPULAR ARTERY**

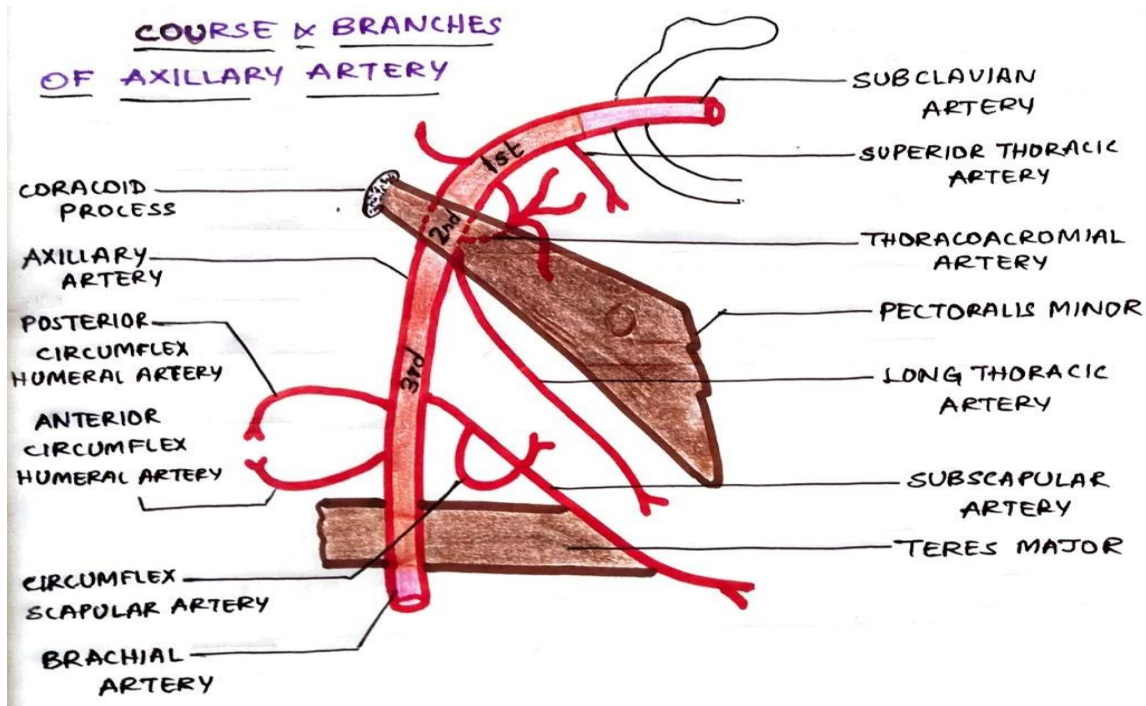
- Largest branch
- Runs along subscapularis (lower border)
- Ends near inferior angle of scapula
- Supplies – latissimus dorsi & serratus anterior
- Large branch – circumflex scapular

5. ANTERIOR CIRCUMFLEX HUMERAL ARTERY

- Arises at subscapularis (lower border)
- Anastomoses with posterior circumflex humeral
- Gives an ascending branch supplying head of humerus & shoulder joint

6. POSTERIOR CIRCUMFLEX HUMERAL ARTERY

- Arise at subscapularis (lower border)
- Supplies – shoulder joint, deltoid, muscles bounding quadrangular space
- Gives off descending branch (anastomose with ascending branch of profunda brachii)

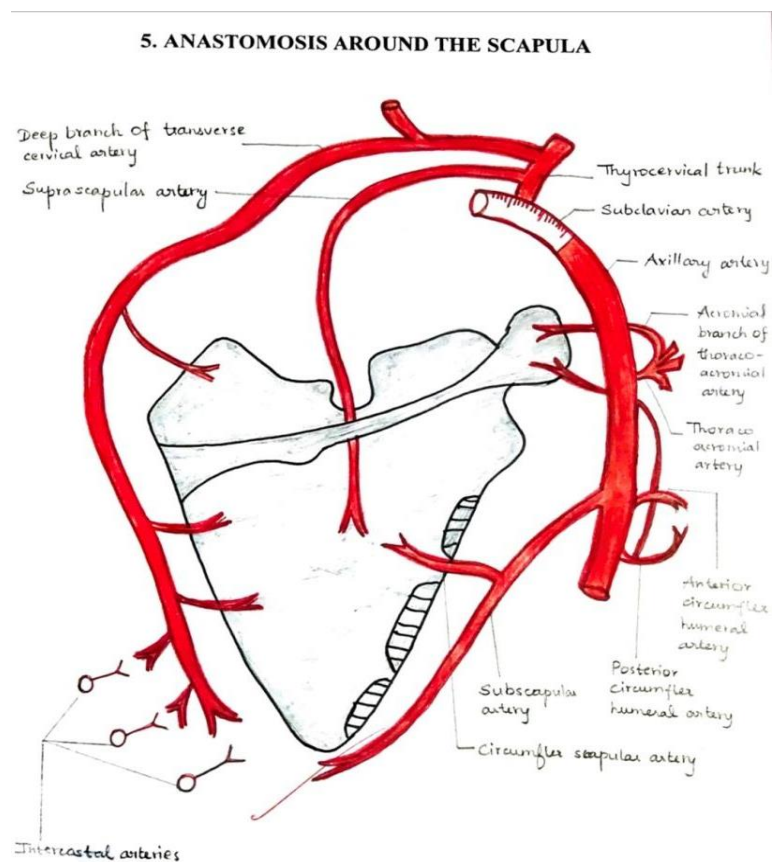


ANASTOMOSES AND COLLATERAL CIRCULATION:

- Branches of axillary artery anastomose with branches from - internal thoracic, intercostal, subscapular, deep branch of transverse cervical, profunda brachii arteries.

APPLIED ANATOMY:

- Axillary arterial pulsations
- Collateral circulation in blockage of proximal part of axillary artery.



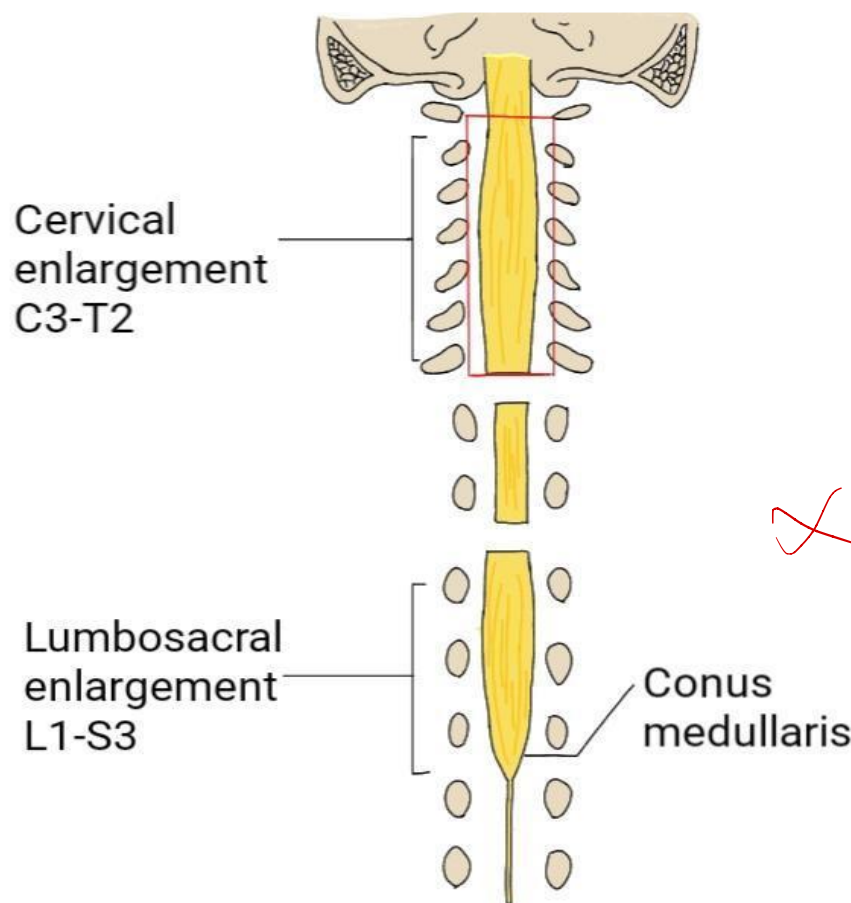
2. BRACHIAL PLEXUS

INTRODUCTION:

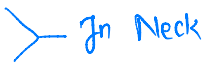
- This the plexus formed from cervical enlargement.
- To study the entire upper limb Nerve supply via it, the formation, its components and its nerve supply would help in understanding the nerves in an easy manner.

FORMATION:

- Cervical Enlargement of spinal cord gives Brachial Plexus.
- Root value-C5, C6, C7, C8; T1 from anterior primary Ramus Gives Brachial plexus.
- Little Contribution also from C4, T2 spinal Nerves.
- If Contribution from C4 is larger, T2 is absent it is called as **Pre-fixed Brachial Plexus**.
- If Contribution from T2 is larger and from C4 is absent it is called as **Post-fixed Brachial Plexus**.



COMPONENTS:

- 4 components of Brachial plexus
 - a. Roots 
 - b. Trunks
 - c. Divisions 
 - d. Cords 
- Cords end up in forming terminal branches

ROOTS:

- 5 Roots of Anterior Primary Ramus (C5-C8; T1) Located in Neck deep to scalenus anterior muscle

TRUNKS:

- Located in Neck- Occupying cleft between **scalenus medius** behind and **Scalenus anterior** in front
- ✓ Upper Trunk-Formed by C5, C6 Roots
- ✓ Middle Trunk-Root continues as Middle Trunk 
- ✓ Lower Trunk-C8, T1 Roots joined to form lower trunk

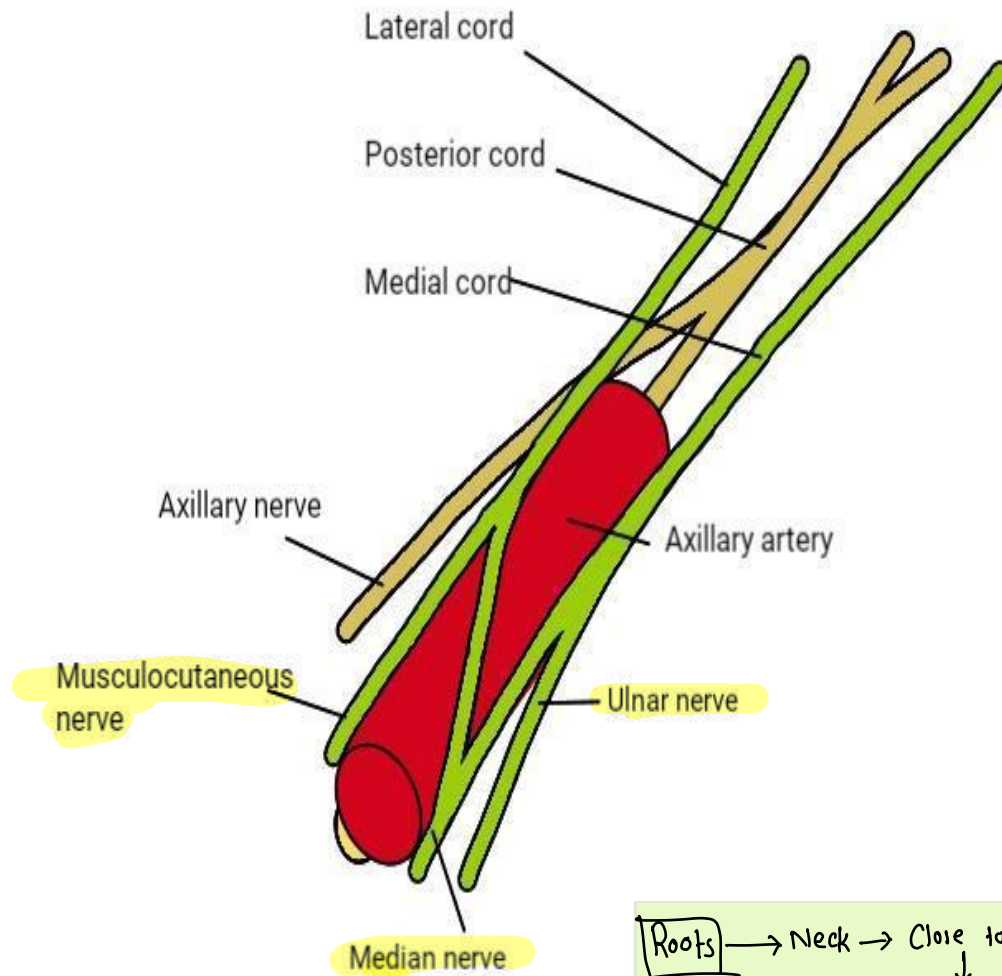
DIVISIONS:

- Each Trunk-Upper, Lower, Middle Trunk has anterior and Posterior Divisions located behind the clavicle.

CORDS:

- Present in **Axilla**
- **Formations**
 - a. **Lateral** - Anterior Divisions of Upper and Middle Trunk join to form the lateral cord
 - b. **Posterior**-Posterior Division of Upper, Middle, Lower Trunk joins to form Posterior cord
 - c. **Medial**-Anterior Division of Lower Trunk continues as Medial Cord (Ulnar Nerve)
- These Cords are named with respect to 2nd part of the Axillary artery.
- These Cords Continue in Axilla
 - ✓ a. **Lateral Cord**-Musculocutaneous Nerve
 - ✓ b. **Posterior Cord**-Radial Nerve
 - ✓ c. **Medial Cord**-Ulnar Nerve

Medial Nerve: Contributed by Lateral and Medial Cords in Midline



BRANCHES:

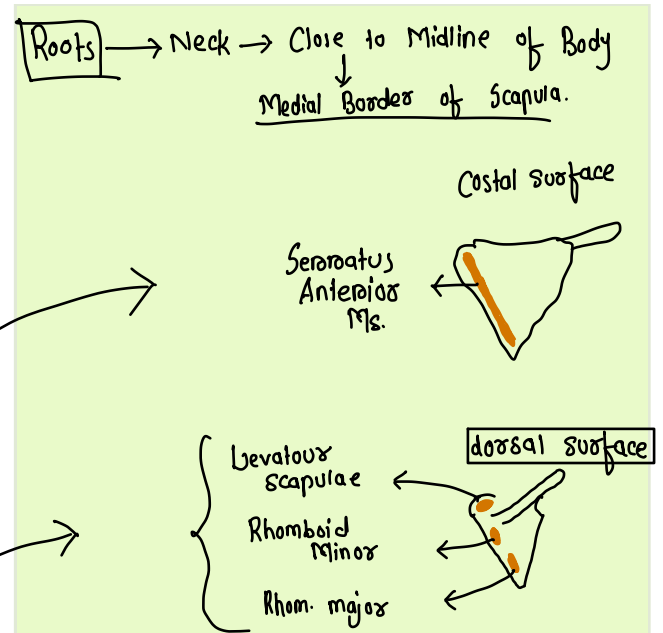
FROM ROOTS:

1. LONG THORACIC NERVE (C5, C6, C7)

- Directed by roots in neck.
- Supplies Serratus Anterior.

2. DORSAL SCAPULAR NERVE(C5)

- Present in neck region.
- Supplies Scapular muscles in neck.
- Directly from C5 Root.
- Additionally,
 - Contribution to phrenic Nerve (C5) supply diaphragm.
 - Branches by roots to supply scalene muscles and Longus Colli (C5-C8).



FROM TRUNKS (ONLY FROM UPPER TRUNK):

1. SUPRASCAPULAR NERVE (C5, C6)

- Supplies Scapular muscles

Supraspinatus Ms
Infraspinatus Ms

2. NERVE TO SUBCLAVIUS (C5, C6)

- Branches from Roots and Trunks are **Supraclavicular Branches of Brachial Plexus.**
- There are no specific branches from the divisions.

Subclavius Ms.

FROM CORDS:

A. FROM LATERAL CORD

(LML)

- Lateral Pectoral Nerve (C5-C7)
- Lateral root of Median Nerve (C5, C6, C7)
- Musculocutaneous Nerve (C5-C7)

B. FROM MEDIAL CORD

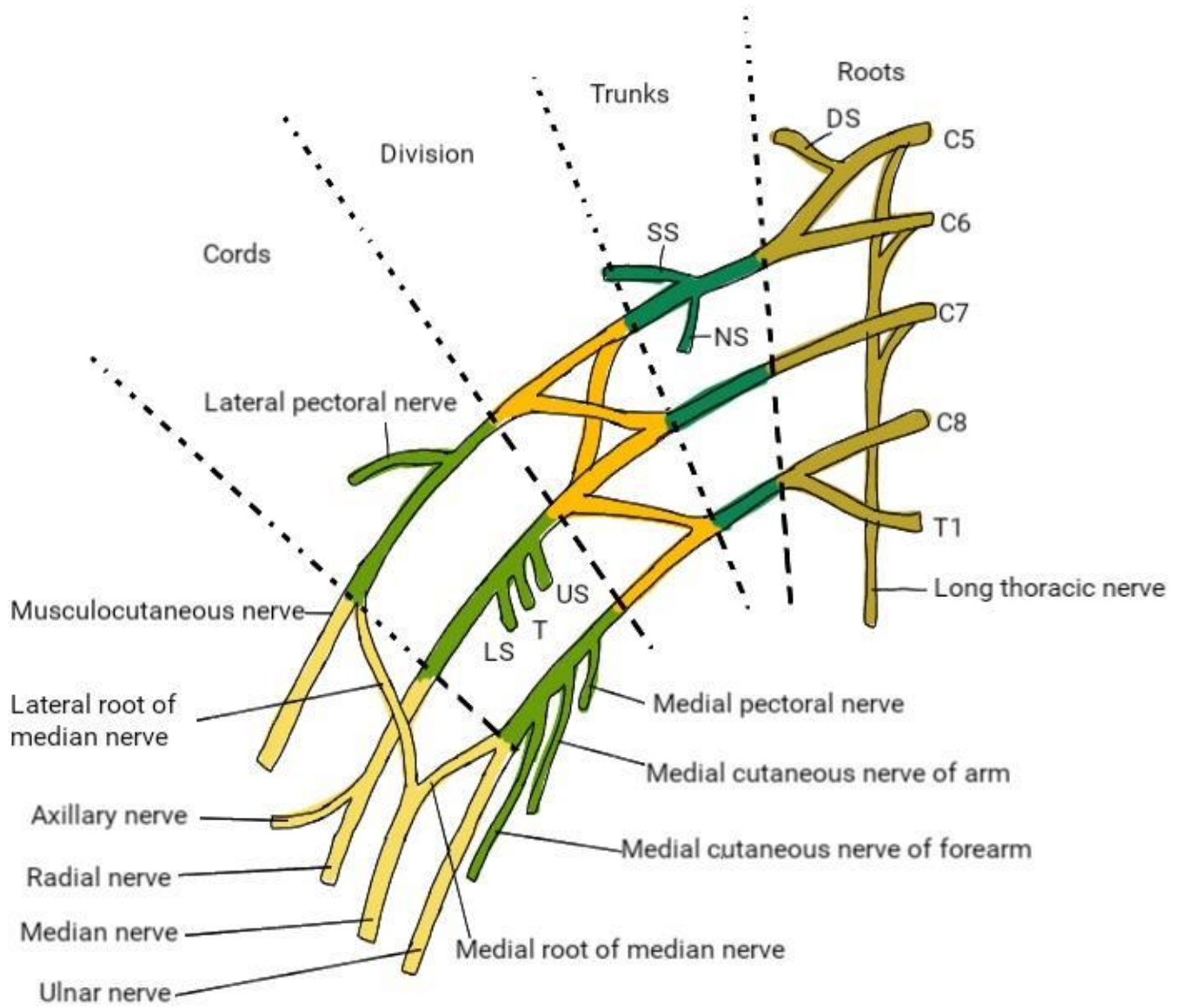
(MuU)

- Medial Pectoral Nerve (C8, T1)
- Medial Cutaneous nerve of Arm (C8, T1)
- Medial Cutaneous Nerve of Forearm (C8, T1)
- Medial Root of Median Nerve (C8, T1)
- Ulnar Nerve (C8, T1)

C. FROM POSTERIOR CORD

(ULNAR)

- Upper Subscapular Nerve (C5-C6) - supply Subscapularis
- Lower Subscapular Nerve (C5, C6) - Supply Subscapularis (Hybrid Muscle)
- Thoracodorsal Nerve / Nerve to Latissimus Dorsi (C6-C8) - Supply Latissimus Dorsi
- Axillary Nerve (C5, C6) - Supply Deltoid, Teres Minor
- Radial Nerve (C5-C8; T1) - Nerve of Extension - Present in Radial Groove (Nerve of Posterior Compartment)



APPLIED ANATOMY:

WINGING OF SCAPULA:

- Injury of Long Thoracic Nerve (Nerve to Serratus Anterior)

ERB'S PALSY

- It is an Upper Trunk Injury.
 1. Axillary Nerve-Total Injury.
 2. Musculocutaneous Nerve-Partial Injury - **coracobrachialis alone spared.**
 3. Radial Nerve-Partial Injury-Brachioradialis paralyzed.
 4. Suprascapular Nerve also injured.

CAUSES: Undue separation of head and Neck (Fall on shoulder, Birth Injury)

FEATURES: Policeman tip hand deformity (Sensory Loss on lateral aspect of upper limb)

POSITION:

- Shoulder-Abduction and Medial rotation
- Elbow-Extension
- Radioulnar Joint-Pronation

KLUMPKEY'S PALSY

- It is a Lower Trunk Injury
- Median Nerve, Ulnar Nerve, T1-Sympathetic fibers - Involved

CAUSES

- **Hyperabduction** of arm (Holding a branch while fall from tree)
- Birth Injury)

CLINICAL FEATURES:

- Claw Hand Deformity (Metacarpophalangeal Extension, Interphalangeal Flexion)
- Horner Syndrome (Ptosis due to paralysis of Superior Tarsal Muscle) - Miosis due to paralysis of Dilator Pupillae

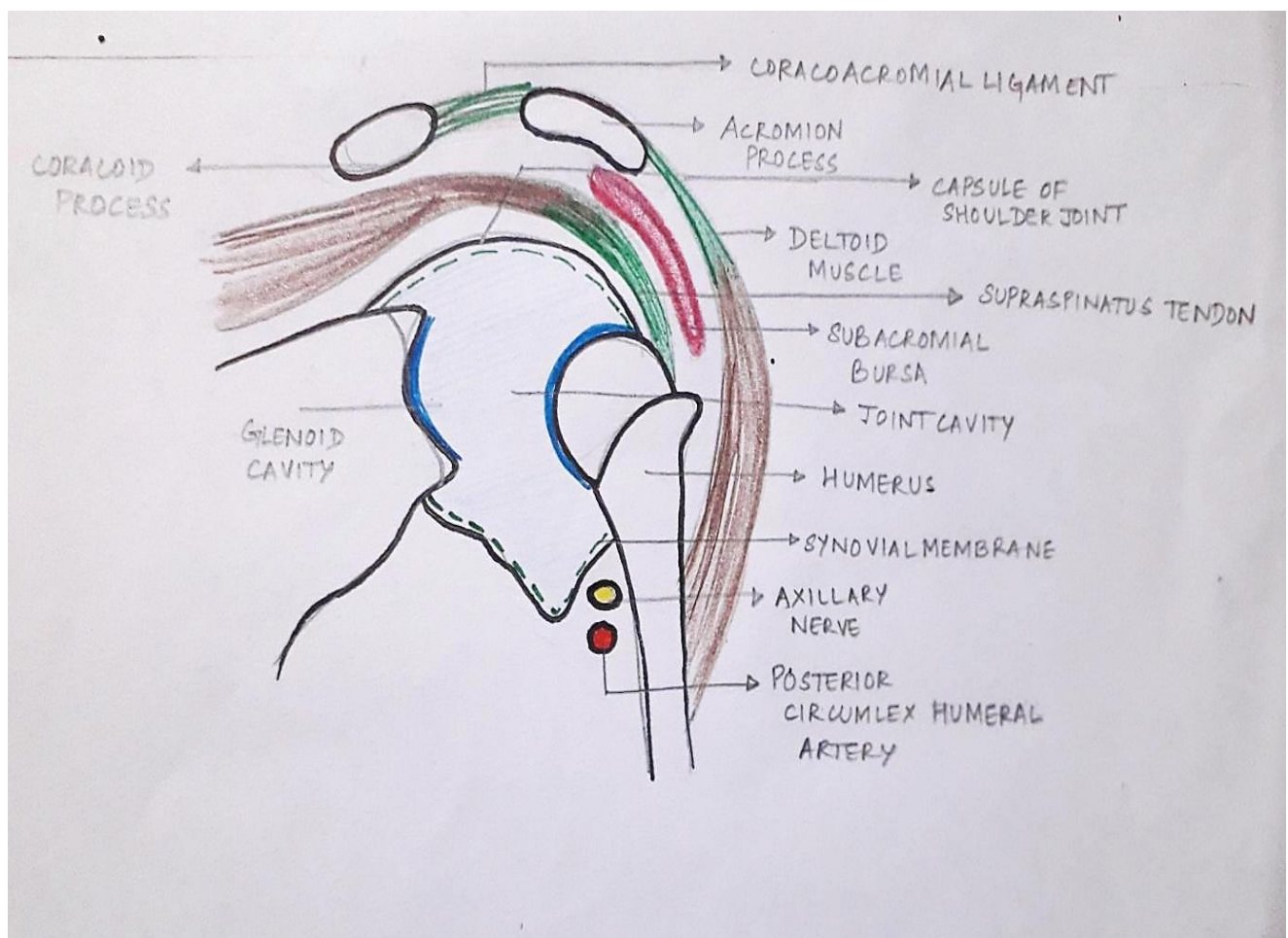
3. SHOULDER JOINT:

TYPE OF JOINT:

- Ball and socket type of synovial joint.

ARTICULAR SURFACES:

1. Head of humerus (1/3) - Rounded; Faces medially
2. Glenoid cavity of humerus: Shallow depression, faces laterally.



LIGAMENTS:

1. CAPSULAR LIGAMENT

- Encloses articular surfaces
- Extends between anatomical neck of humerus and glenoid cavity margins
- Encloses long head of biceps brachii tendon
- Joint cavity communicates with subscapular bursa and infraspinatus bursa

2. GLENOHUMERAL LIGAMENT

- Anterior thickening of fibrous capsule
- Defect causes anterior dislocation of shoulder joint.

3. CORACOHUMERAL LIGAMENT

- Extends between coracoid process of scapula and greater tubercle of humerus
- Degenerated part of pectoris minor

4. TRANSVERSE HUMERAL LIGAMENT

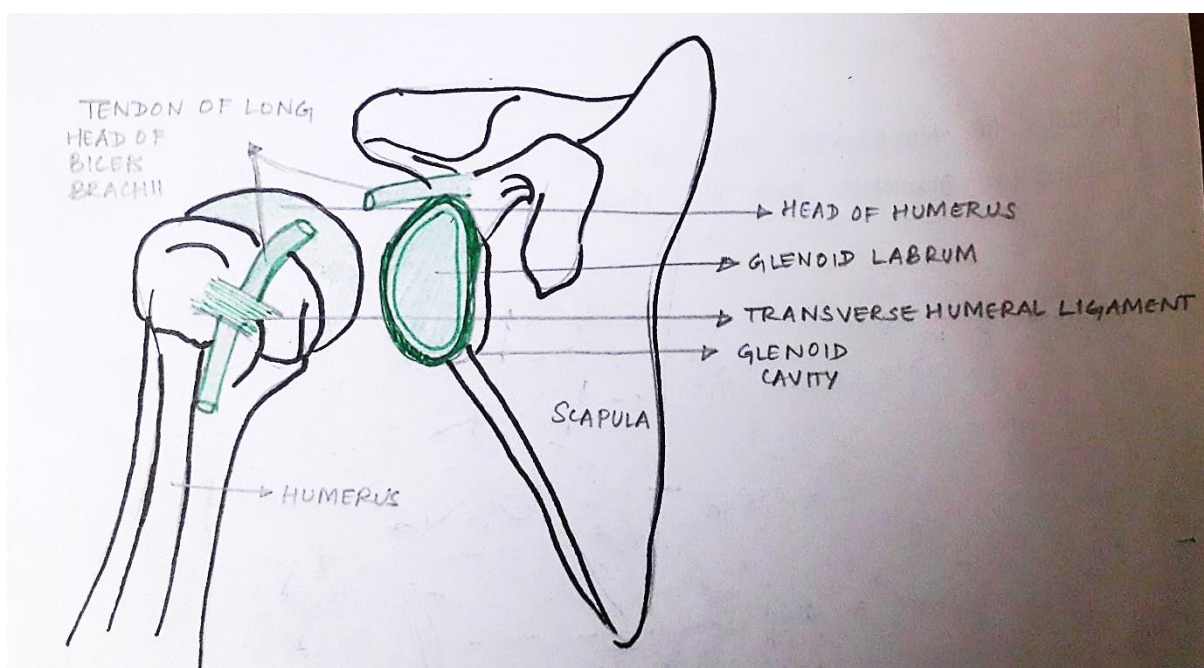
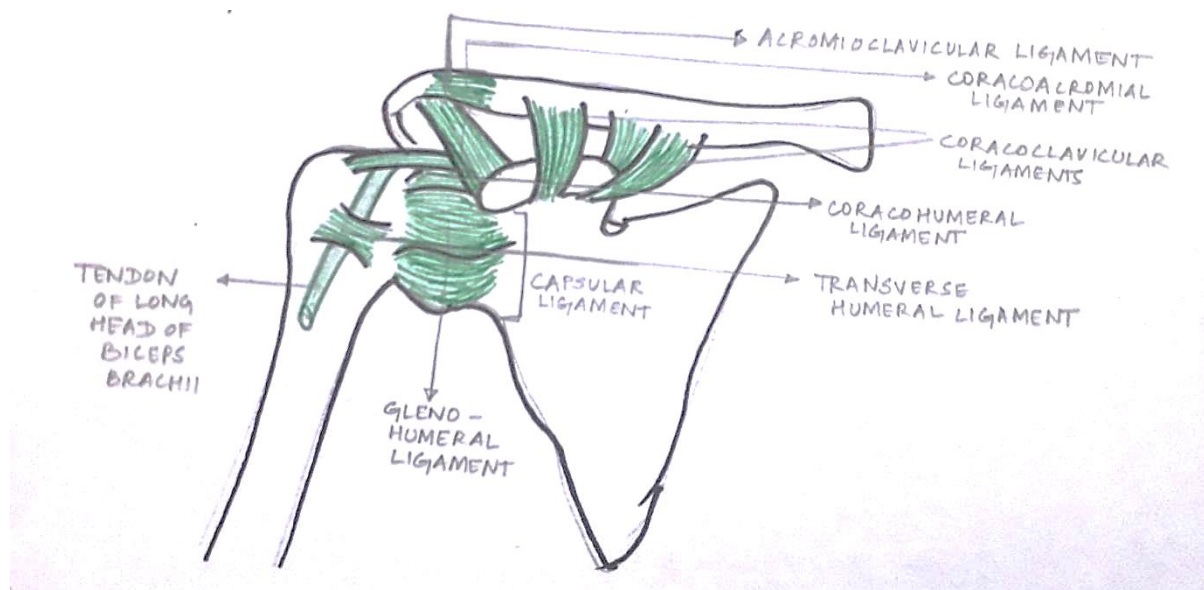
- Bridges bicipital groove
- Encloses biceps brachii tendon

5. CORACO ACROMIAL LIGAMENT

- Extends between coracoid process and acromial process of scapula
- Coracoid process + Coraco acromial ligament+ acromial process = Coraco acromial arch
- Prevents superior dislocation of shoulder joint

6. GLENOID LABRUM

- Fibrocartilage - Surrounds the margin of glenoid cavity
- Deepens glenoid cavity.



BURSAE:

1. SUBSCAPULAR BURSA:

- Lies below subscapular tendon.
- Communicates with joint cavity.

2. SUBACROMIAL BURSA:

- Lies between Coraco-acromial ligament above and supraspinatus below.
- Largest bursa and continues below deltoid as sub-deltoid bursa.

3. INFRASPINATUS BURSA:

- Lies below infraspinatus tendon.
- Communicates with joint cavity.

RELATIONS:

1. SUPERIOR:

- Coraco acromial arch
- Supraspinatus tendon
- Subacromial bursa
- Deltoid

2. INFERIOR:

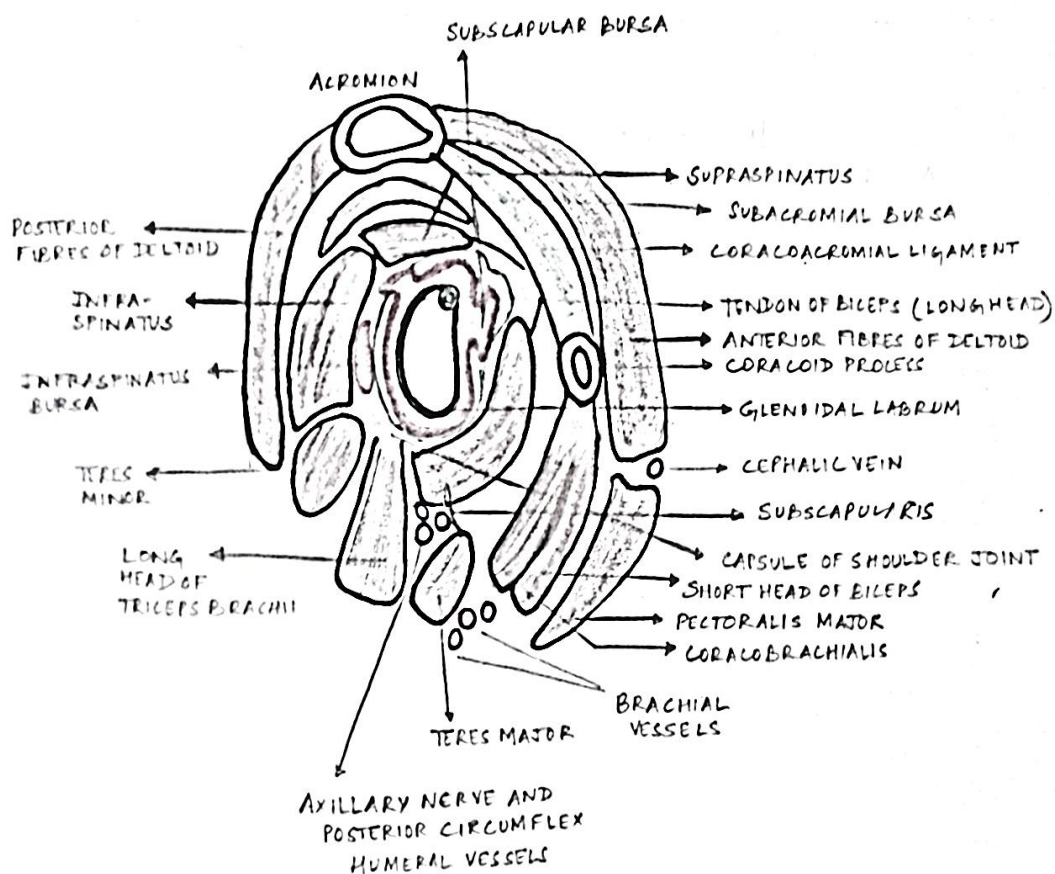
- Long head of triceps brachii
- Axillary nerve
- Posterior circumflex humeral vessels

3. ANTERIOR:

- Subscapularis
- Coracobrachialis
- Short head of biceps brachii
- Deltoid

4. POSTERIOR:

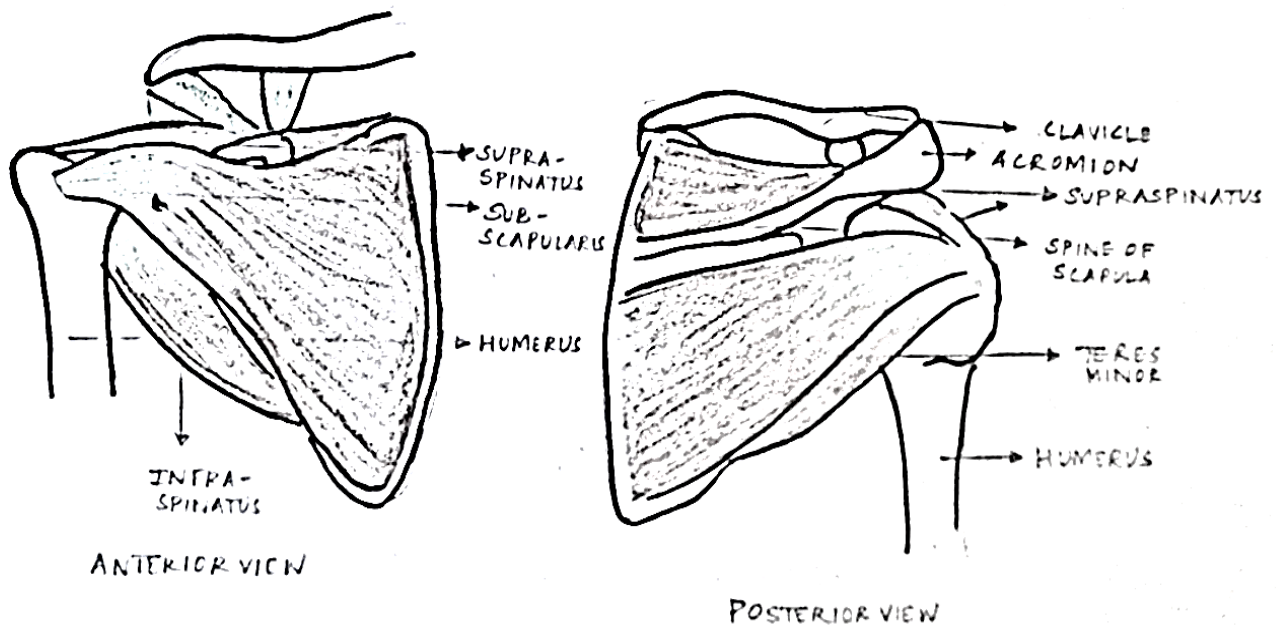
- Infraspinatus
- Teres minor
- Deltoid



ROTATOR CUFF/ MUSCULOTENDINOUS CUFF:

FORMATION:

- Formed by tendons of muscles surrounding shoulder joint
 - a. **S**uperior – Supraspinatus
 - b. **P**osterior – Infraspinatus; Teres minor
 - c. **I**nterior – Subscapularis
- Most important factor providing support to shoulder joint.
- **Deficient inferiorly** (Inferior dislocation of joint is more common).



MOVEMENTS:

- Multiaxial joint
- Most Mobile and least stable joint
- More prone to dislocation

MOVEMENTS	MUSCLES INVOLVED
FLEXION [Arm moves forwards; medially]	• Pectoralis Major • Deltoid (Anterior fibres) • Biceps brachii
EXTENSION [Arm moves backwards; laterally]	• Latissimus dorsi • Deltoid (Posterior fibres)
ADDUCTION [arm moves backwards; medially]	• Pectoralis major • Latissimus dorsi • Teres major
ABDUCTION [arm moves forwards; laterally]	• 0 - 15° Supraspinatus • 15 - 90° Deltoid (Lateral fibres) • 90 - 180° Serratus anterior, Trapezius
MEDIAL ROTATION [arm moves medially in semi-flexed position]	• Subscapularis • Deltoid (Anterior fibres)
LATERAL ROTATION [arm moves laterally in semi-flexed position]	• Infraspinatus • Teres minor • Deltoid (Posterior fibres)

NOTE*

- Deltoid muscle forms all relations for shoulder joint **except inferiorly**
- Deltoid causes all movements at shoulder joint **except adduction**

CIRCUMDUCTION - Combination of all movements of shoulder joint

SCAPULOHUMERAL RHYTHM -

- Abduction of shoulder joint is accompanied by lateral rotation of scapula
- Scapula and humerus move in ratio 1:2
- For every 15° abduction, scapular movement is 5° and humeral movement is 10°

CLINICAL ANATOMY:**DISLOCATION OF SHOULDER JOINT**

- More common - Inferior dislocation
- Rotator cuff deficit inferiorly
- Causes injury of axillary nerve - Deltoid and teres minor palsy

PAINFUL ARC SYNDROME / IMPINGEMENT SYNDROME

- Most common cause - Supraspinatus injury; Subacromial bursitis
- Painful abduction

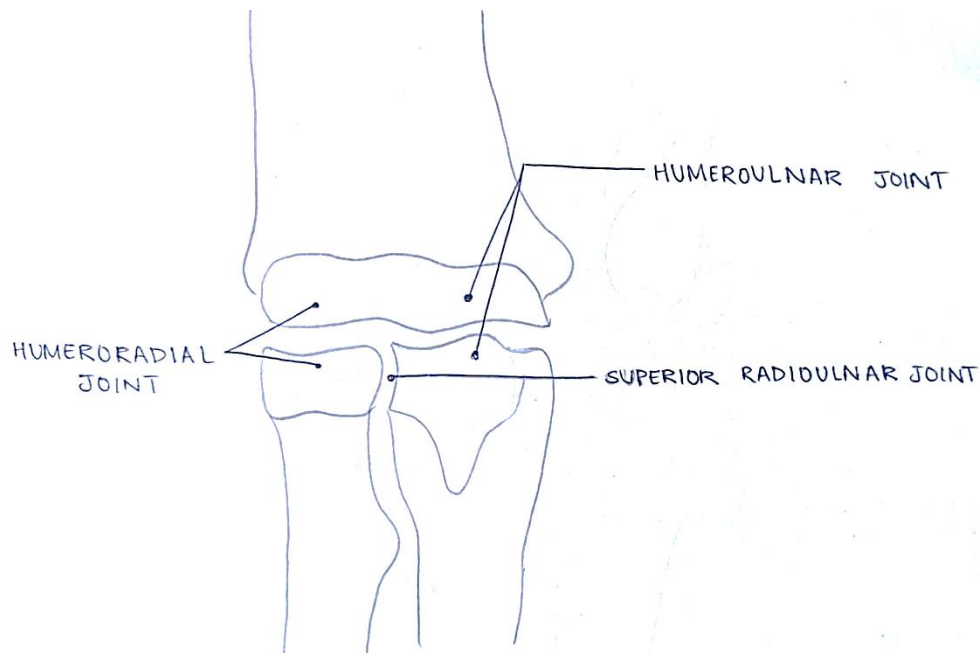
FROZEN SHOULDER

- Inflammation of rotator cuff tendons
- Painful movements

4. ELBOW JOINT:

INTRODUCTION:

- It's a hinge variety of synovial joint between the lower end of humerus and the upper end of ulna and radius bones.
- The elbow joint complex includes the humeroulnar, humeroradial and upper radioulnar joint.



ARTICULATION:

1. UPPER:

- Formed by the **capitulum** and the **trochlea** of the humerus.
- **Radial fossa** lies above the capitulum which articulates with the radial head during extreme flexion.
- **Coronoid fossa** lies above the trochlea which articulates with the coronoid process of the ulna during extreme flexion.

2. LOWER:

- Upper surface of the head of the radius articulates with the **capitulum**.
- Trochlear notch of the ulna articulates with the trochlea of the humerus.

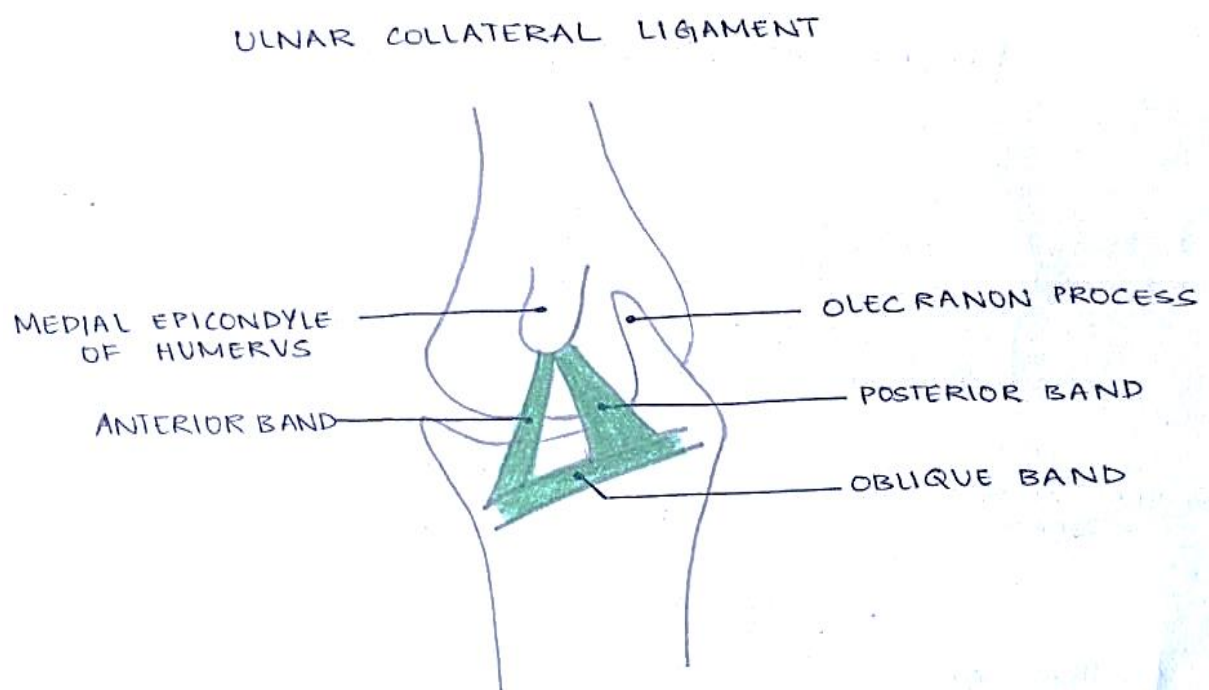
LIGAMENTS:

1. CAPSULAR LIGAMENT:

- Superiorly its attached to the lower end of humerus in such a way that the capitulum, trochlea, the radial fossa, the coronoid fossa and the olecranon fossa lies within it.
- Inferomedially, it is attached to the margin of the trochlear notch of the ulna except laterally
- Inferolaterally, it is attached to the annular ligament of the superior radioulnar joint.

2. THE ULNAR COLLATERAL LIGAMENT:

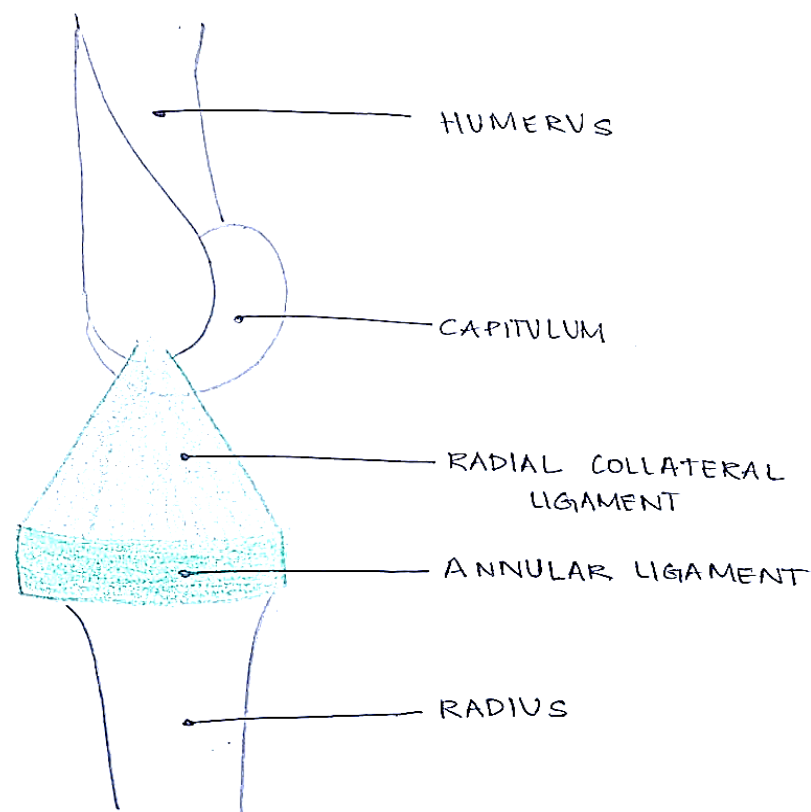
- It is triangular in shape.
- Its apex is attached to the medial epicondyle of the humerus, and its base to the ulna.
- The ligament has thick anterior and posterior bands.
- These are attached below to the coronoid process and the olecranon process respectively.
- Their lower ends are joined to each other by an oblique band which gives attachment to the thinner intermediate fibres of the ligament.
- The ligament is crossed by the ulnar nerve and it gives origin to the flexor digitorum.



3. THE RADIAL COLLATERAL LIGAMENT:

- It is a fan-shaped band extending from the lateral epicondyle to the annular ligament.
- It gives origin to the supinator and to the extensor carpi radialis brevis

RADIAL COLLATERAL LIGAMENT



RELATIONS:

1. ANTERIORLY:

- Brachialis, median nerve, brachial artery and tendon of biceps brachii. (Contents of cubital fossa)

2. POSTERIORLY:

- Triceps brachii and anconeus.

3. MEDIALY:

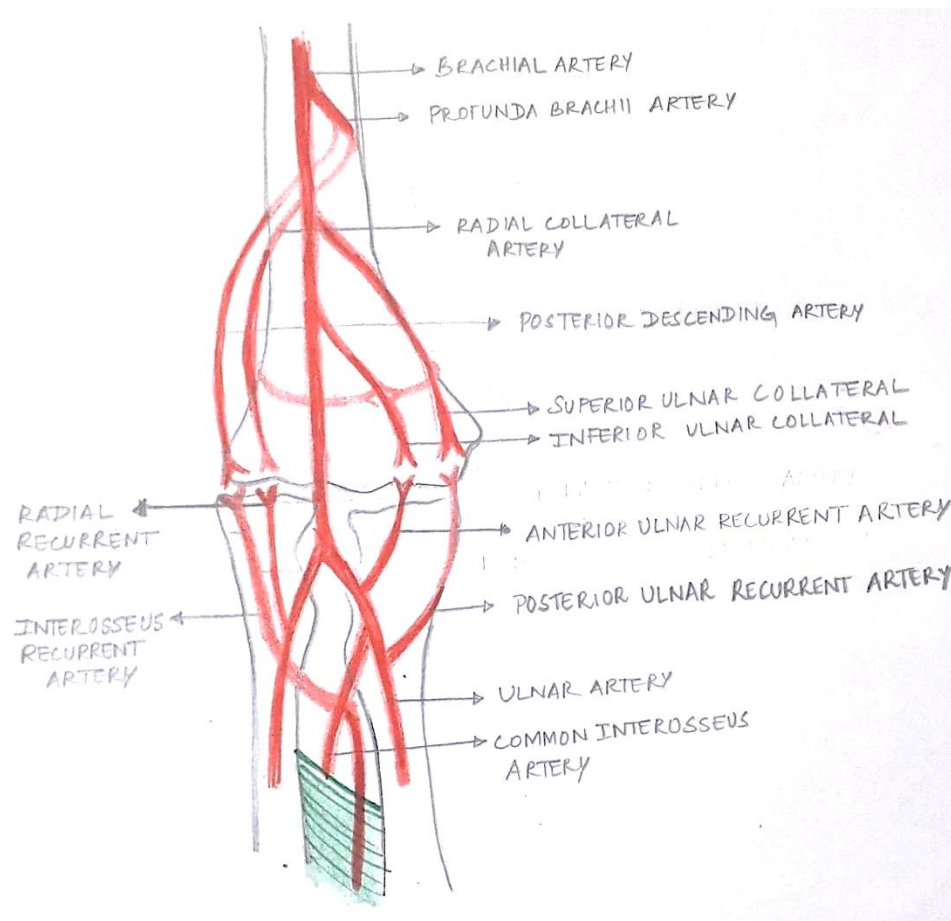
- Ulnar nerve, flexor carpi ulnaris and common flexors.

4. LATERALLY:

- Supinator, extensor carpi radialis brevis and other common extensors

BLOOD SUPPLY:

- From **anastomoses around the elbow joint**



NERVE SUPPLY:

- The joint receives branches from the following nerves.
 - Ulnar nerve.
 - Median nerve.
 - Radial nerve through branch to anconeus.
 - Musculocutaneous nerve through its branch to the brachialis.

MOVEMENTS:

FLEXION:

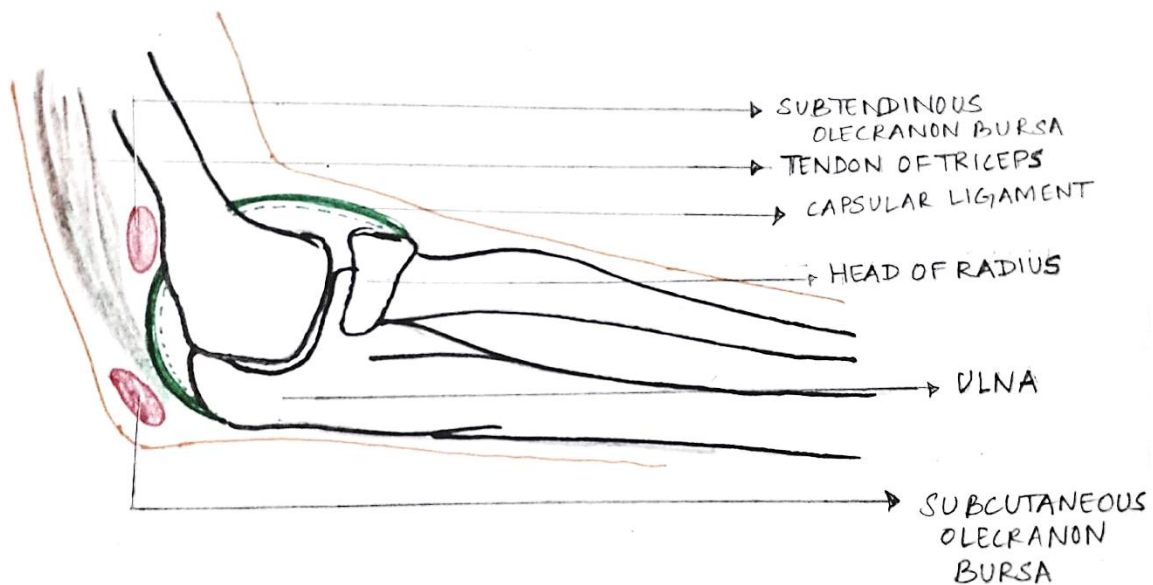
- Brachialis.
- Biceps brachii.
- Brachioradialis.

EXTENSION:

- a. Triceps brachii.
- b. Anconeus.

BURSAE OF ELBOW JOINT:

1. **SUB TENDINOUS OLECRANON BURSA** between the tendon of triceps and capsular ligament.
2. **SUBCUTANEOUS OLECRANON BURSA** behind the posterior attachment of the capsular ligament
3. A bursa between biceps brachii and the radial tuberosity.



CARRYING ANGLE:

- Carrying angle is the angle between the long axis of arm and forearm when the arm is in fully extended position. The carrying angle prevents forearm hitting the hips while walking.
- Carrying angle is wider in females as compared to males due to wider pelvis of females.

CLINICAL ANATOMY:

- Distension of the elbow joint by an effusion occurs posteriorly because here the capsule is weak and the covering deep fascia is thin. **ASPIRATION** is done posteriorly on any side of the olecranon.
- Dislocation of the elbow is usually posterior, and is often associated with fracture of the coronoid process. The triangular relationship between the olecranon and the two humeral epicondyles is lost
- Subluxation of the head of the radius (pulled elbow) occurs in children when the forearm is suddenly pulled in pronation. The head of the radius slips out from the annular ligament.
- **TENNIS ELBOW**: Occurs in tennis players. Abrupt pronation with fully extended elbow may lead to pain and tenderness over the lateral epicondyle which gives attachment to common extensor origin. This is possibly due to:
 1. Sprain of radial collateral ligament.
 2. Tearing of fibres of the extensor carpi radialis brevis.
- **STUDENT'S (MINER'S) ELBOW** is characterized by effusion into the bursa over the subcutaneous posterior surface of the olecranon process. The bursa on the olecranon process gets inflamed
- **GOLFER'S ELBOW** is the microtrauma of medial epicondyle of humerus, occurs commonly in golf players, the common flexor origin undergoes repetitive strain and results in a painful condition on the medial side of the elbow.
- If carrying angle (normal is 13°) is more, the condition is cubitus valgus, ulnar nerve may get stretched leading to weakness of intrinsic muscles of hand. If the angle is less it is called **CUBITUS VARUS**.

5. BRACHIAL ARTERY:

INTRODUCTION:

- Main arterial supply of upper limb
- Present in the anterior compartment of the arm

COURSE:

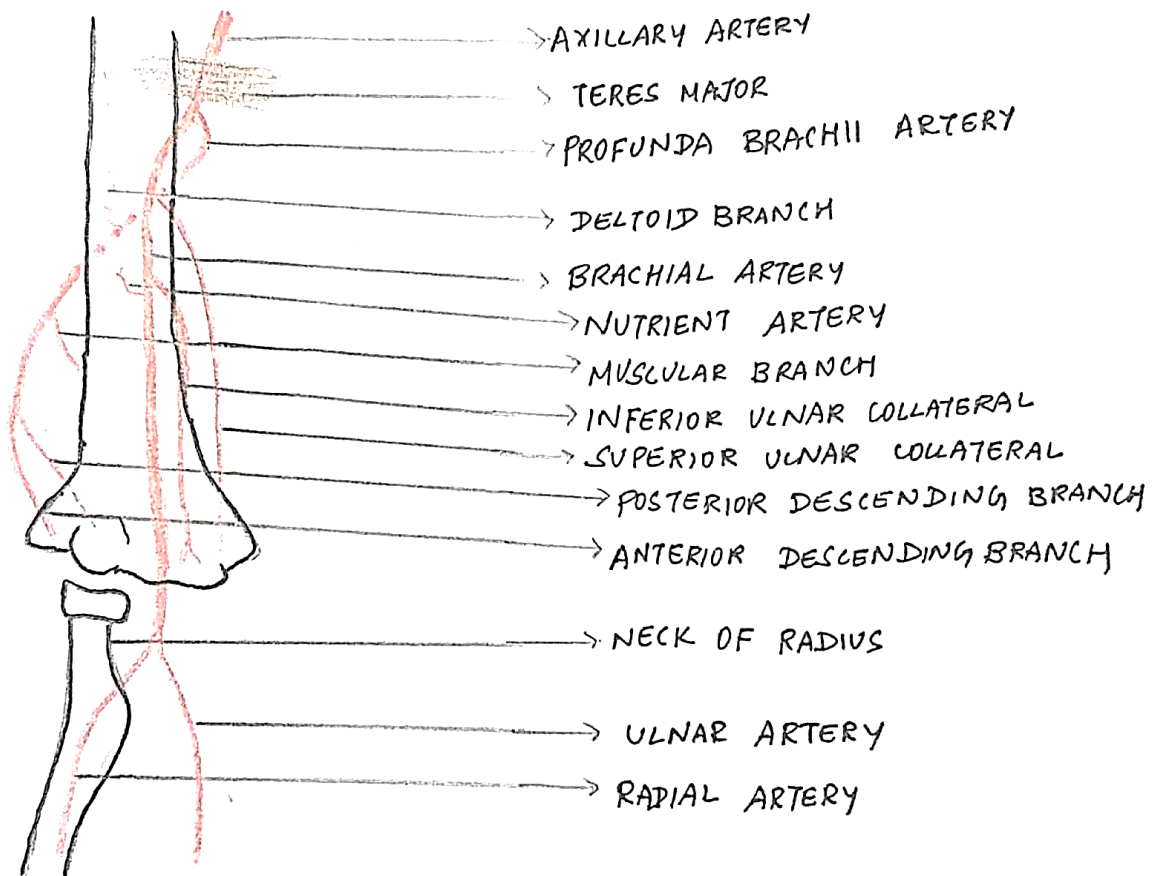
- Continuation of the axillary artery from the lower border of teres major
- Terminates at the level of neck of the radius by dividing into two terminal branches, radial and ulnar arteries
- The artery is superficial throughout its course, so it is easily accessible.

RELATIONS:

ANTERIOR	UPPER PART - Medial cutaneous nerve of forearm lies in front of it.
	MIDDLE PART - Median nerve crosses it from lateral to medial side.
	LOWER PART - Bicipital aponeurosis crosses it.
POSTERIOR	FROM ABOVE DOWN - long head of triceps, medial head of triceps, coracobrachialis, brachialis.
MEDIAL	UPPER PART - Ulnar nerve and basilic vein.
	LOWER PART - Median nerve.
LATERAL	UPPER PART - Median nerve, Coracobrachialis, Biceps.
	LOWER PART - Tendon of biceps.

DISTRIBUTION/BRANCHES:

1. **PROFUNDA BRACHII ARTERY**: It is the largest and the first branch. After arising from the posteromedial aspect of the brachial artery, it descends along with the radial nerve → lower triangular intermuscular space → spiral groove.
2. **SUPERIOR ULNAR COLLATERAL ARTERY**: It arises near the middle of the arm. It accompanies the ulnar nerve.
3. **INFERIOR ULNAR COLLATERAL ARTERY**: It arises near the lower end of the humerus. It will further divide into anterior and posterior branches.
4. **MUSCULAR BRANCHES**: To supply the muscles of the anterior compartment of the arm.
5. **NUTRIENT ARTERY**: It runs through the nutrient canal of the humerus. This is one of the events that occur at the level of insertion of the coracobrachialis.
6. **TERMINAL BRANCHES**: **Ulnar artery** and **Radial artery**. Of these, ulnar is larger and radial is smaller.



****Diagram showing the extent and branches of the brachial artery**

APPLIED ANATOMY:

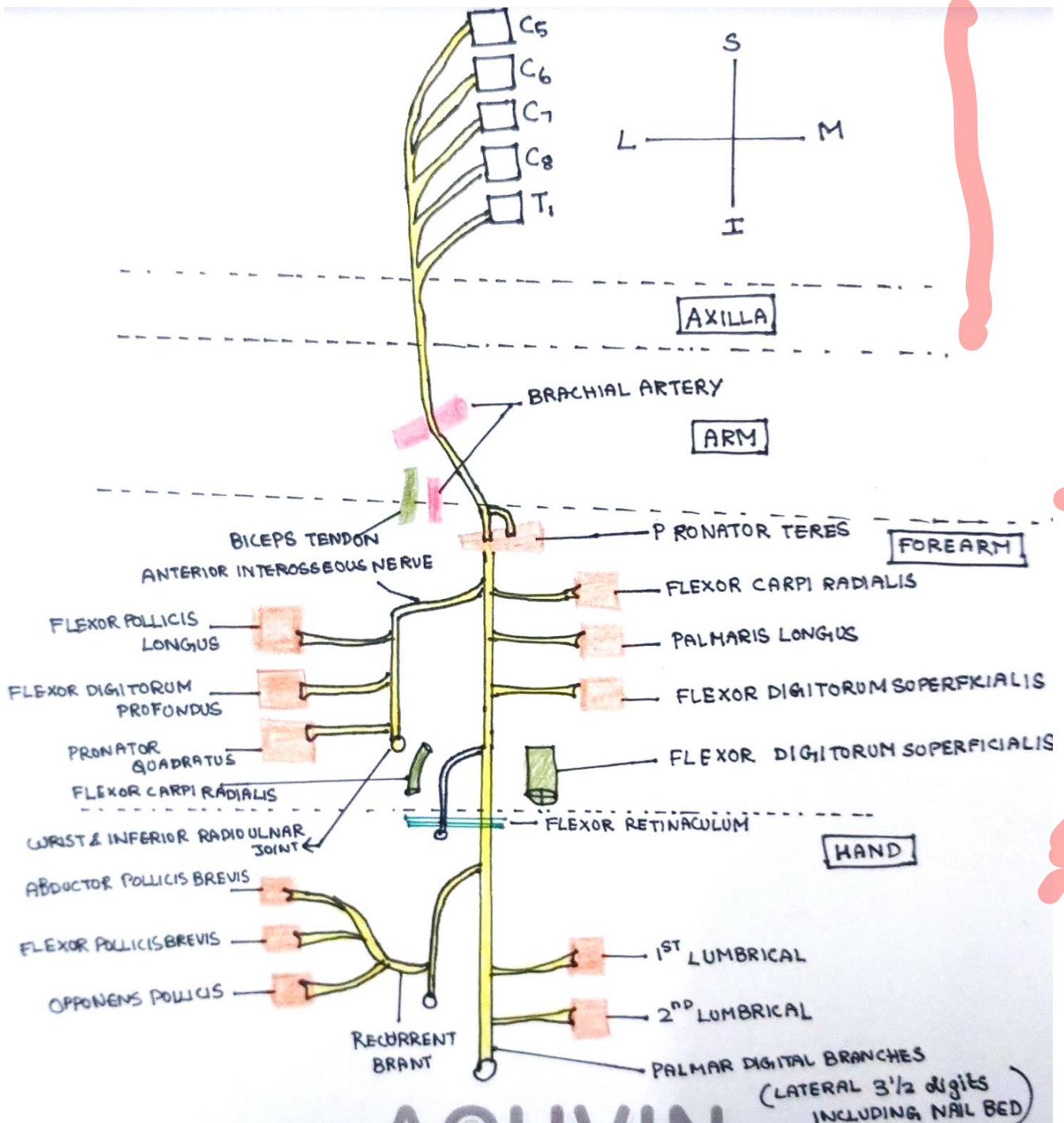
1. **BRACHIAL PULSE:** Since the brachial artery is superficial for most of its course, its pulse can be felt. In the cubital fossa, its pulsations can be felt medial to the tendon of biceps. These pulsations are auscultated for Korotkoff sounds while recording blood pressure.
2. **COMPRESSION OF BRACHIAL ARTERY:** To stop hemorrhages in the upper limb, the brachial artery is compressed against the shaft of the humerus at the level of insertion of the coracobrachialis.
3. **SUPRACONDYLAR FRACTURES OF THE HUMERAL SHAFT:** These are common in children after a fall on the elbow or on an extended hand and may cause posterior displacement of the distal fragment. This proximal bone fragment may injure the brachial artery. This may lead to Volkmann's ischemic contracture, where the flexors of the forearm are paralyzed due to ischemia.

SURFACE ANATOMY:

- Abduct the arm at right angles
- Mark a **point A** on the lower end of the lateral wall of the axilla, in front of the posterior axillary fold (lower end of the axillary artery).
- Mark a **point B** in the anterior midline of the forearm at the level of neck of the radius, medial to the tendon of biceps brachii.
- **Join all the points.** This is the surface marking of the brachial artery.

6. MEDIAN NERVE

FORMATION	LATERAL ROOT: C5 C6 C7 MEDIAL ROOT: C8 T1 of brachial plexus
COURSE	- Lies medial to brachial artery - Enters cubital fossa - Enters forearm - Lie between flexor digitorum superficialis and flexor digitorum profundus - Reaches the wrist - Lies deep and lateral to palmaris longus tendon - Passes deep to flexor retinaculum - Enters palm
RELATIONS	CUBITAL FOSSA
	● Medial-brachial artery ● Behind -bicipital aponeurosis ● Front - brachialis
	FOREARM
	● between 2 head pronator teres ● Crosses ulnar artery ● Passes beneath fibrous arch of flexor digitorum superficialis ● Runs deep to this muscle on surface of flexor digitorum profundus ● Accompanied by medial artery ● Lies between tendons of flexor carpi radialis and flexor digitorum superficialis ● Overlapped by tendon of palmaris longus ● Passes through flexor retinaculum
	CARPEL TUNNEL = then enters the palm
BRANCHES	- Muscular branches - Anterior interosseous branch - Palmar cutaneous branch - Articular branch - Vascular branch - Communicating branch
CLINICAL ASPECTS	- Carpel tunnel syndrome- positive Tinel and Phalen sign TINEL SIGN (percussion over the nerve elicits tingling sensations) PHALEN SIGN (flexing both wrists at 90 degree for 60 seconds)



7. RADIAL NERVE:

- Continuation of posterior cord of brachial plexus in the axilla
- It is the largest nerve of the brachial plexus

FORMATION/ROOT VALUE: C5, C6, C7, C8, and T1 of brachial plexus

COURSE AND RELATIONS:

A. IN THE AXILLA

- **ANTERIOR:** Third part of axillary artery
- **POSTERIOR:** Muscles forming posterior wall of axilla

B. IN THE ARM

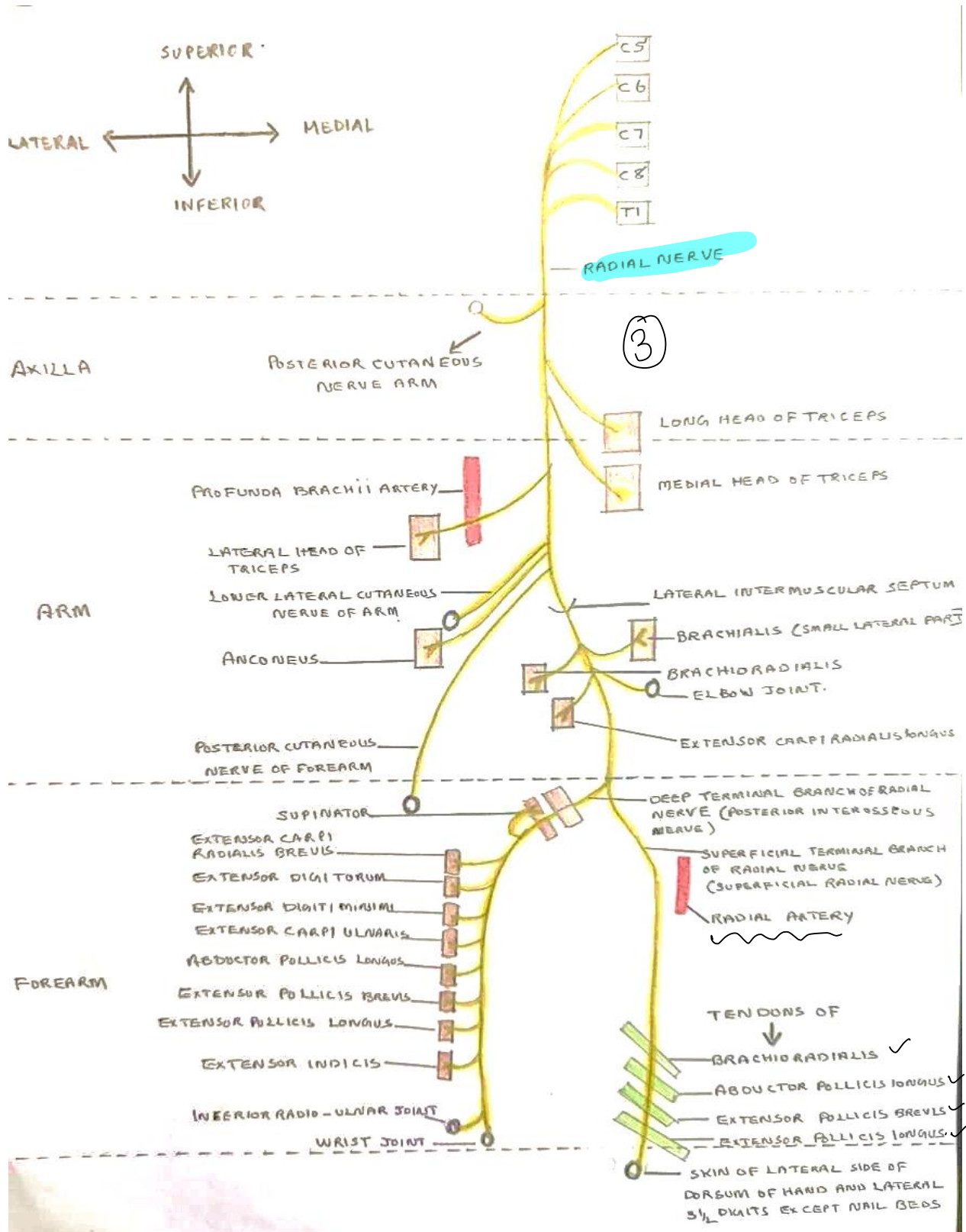
- It enters the arm at the lower border of the teres major.
- It passes between the long and medial heads of triceps to enter the lower triangular space, through which it reaches the spiral groove along with profunda brachii artery.

C. IN THE SPIRAL GROOVE

- The radial nerve in the spiral groove lies in direct contact with the humerus.
- At the lower end of the spiral groove, the radial nerve pierces the lateral muscular septum of the arm and enters the anterior compartment of the arm.
- It first descends between the brachialis and brachioradialis, and then between brachialis and extensor carpi radialis longus.
- At the level of lateral epicondyle of humerus, it terminates by dividing into superficial and deep branches in the lateral part of the cubital fossa
 - a. The *deep branch*; posterior interosseous nerve, in the cubital fossa
 - b. The *superficial branch* (superficial radial nerve) is sensory.
- It runs downwards over the supinator, pronator teres, and flexor digitorum superficialis deep to brachioradialis.
- About one-third of the way down the forearm (at about 7 cm above wrist), it passes posteriorly, emerging from under the tendon of brachioradialis, proximal to the styloid process of radius and then passes over the tendons of anatomical snuff-box.

D. IN THE HAND

- It terminates as cutaneous branches in the anatomical snuff box which provide sensory innervation to skin over the lateral part of the dorsum of hand and dorsal surfaces of lateral $3\frac{1}{2}$ digits proximal to the nail beds.



BRANCHES:

A. IN THE AXILLA

1. Posterior cutaneous nerve of arm (which provides sensory innervation to skin on the back of the arm up to the elbow).
2. Nerve to the long head of triceps.
3. Nerve to the medial head of triceps.

B. IN THE SPIRAL GROOVE

1. **LOWER LATERAL CUTANEOUS NERVE OF THE ARM**, which provides sensory innervation to the skin on the lateral surface of the arm up to the elbow.
2. **POSTERIOR CUTANEOUS NERVE OF THE FOREARM**, which provides sensory innervation to the skin down the middle of the back of the forearm up to the wrist.
3. **NERVE TO LATERAL HEAD OF TRICEPS.**
4. **NERVE TO MEDIAL HEAD OF TRICEPS.**
5. **NERVE TO ANCONEURUS**; it runs through the substance of medial head of triceps to reach the anconeus.

C. IN THE ANTERIOR COMPARTMENT OF ARM

Above the lateral epicondyle, it gives off the following three branches:

1. **NERVE TO BRACHIALIS** (small lateral part).
2. **NERVE TO BRACHIORADIALIS.**
3. **NERVE TO EXTENSOR CARPI RADIALIS LONGUS** (ECRL)

D. AT THE LEVEL OF LATERAL EPICONDYLE OF HUMERUS:

- Terminal superficial and deep branches in the lateral part of the cubital fossa.
- The **DEEP BRANCH (posterior interosseous nerve)** supplies 2 muscles in cubital fossa
 1. Extensor carpi radialis brevis
 2. Supinator
- After supplying these two muscles, it passes through the substance of supinator and enters the posterior compartment of the forearm and supplies all the extensor muscles of the forearm.
- Articular branches to the distal radio-ulnar, wrist, and carpal joints.
- The **SUPERFICIAL BRANCH (superficial radial nerve)** is sensory.
 - Terminates as cutaneous branches in anatomical snuff box

- Provide sensory innervation to skin over the lateral part of the dorsum of hand and dorsal surfaces of lateral 3½ digits proximal to the nail beds.

INJURIES TO THE RADIAL NERVE:

- The radial nerve may be injured at three sites:
 - A. In the axilla
 - B. In the spiral groove
 - C. At the elbow

A. INJURY OF RADIAL NERVE IN THE AXILLA:

- In the axilla the radial nerve may be injured by the pressure of the upper end of crutch (**crutch palsy**)

CHARACTERISTIC CLINICAL FEATURES:

MOTOR LOSS:

- Loss of extension of elbow—due to paralysis of triceps.
- Loss of extension of wrist—due to paralysis of wrist extensors. This causes wrist drop due to unopposed action of flexor muscles of the forearm
- Loss of extension of digits—due to paralysis of extensor digitorum, extensor indicis, extensor digiti minimi, and extensor pollicis longus.
- Loss of supination in extended elbow because supinator and brachioradialis are paralyzed but supination becomes possible in flexed elbow by the action of biceps brachii.

SENSORY LOSS:

- Sensory loss on small area of skin over the posterior surface of the lower part of the arm.
- Sensory loss along narrow strip on the back of forearm.
- Sensory loss on the lateral part of dorsum of hand at the base of thumb and dorsal surface of lateral 3½ digits.

(there is an isolated sensory loss on the dorsum of hand at the base of the thumb)

B. INJURY OF RADIAL NERVE IN THE RADIAL/SPIRAL GROOVE:

- In radial groove, the radial nerve may be injured due to:
 1. midshaft fracture of humerus
 2. inadvertently wrongly placed intramuscular injection
 3. direct pressure on radial nerve by a drunkard falling asleep with his one arm over the back of the chair **SATURDAY NIGHT PARALYSIS.**
- Injury to radial nerve occurs most commonly in the distal part of the groove beyond the origin of nerve to triceps and cutaneous nerves.

CLINICAL FEATURES:

MOTOR LOSS:

- Loss of extension of the wrist and fingers.
- **WRIST DROP.**
- Loss of supination
 - Extension of the elbow is possible but may have a little weakness because nerves to long and lateral heads of triceps arises in the axilla i.e., before the site of lesion.

C. INJURY OF RADIAL NERVE AT ELBOW: RADIAL TUNNEL SYNDROME:

- Entrapment neuropathy of the deep branch of radial nerve at elbow.
- Caused by compression of radial nerve by:
 - a. Fibrous bands, which can tether the radial nerve to the radio-humeral joint.
 - b. Sharp tendinous margin of extensor carpi radialis brevis.
 - c. Leash of vessels from the radial recurrent artery.
 - d. Arcade of Frohse, a fibro-aponeurotic proximal edge of the superficial part of the supinator muscle.

CHARACTERISTIC CLINICAL FEATURES:

- Loss of extension of the wrist and fingers but no wrist drop.
- Pain over the extensor aspect of the forearm.

8. ULNAR NERVE:

FORMATION:

- Arises from medial cord of brachial plexus C8 and T1 at the level of axilla
- Receives a contribution from ventral ramus of C7 which supplies flexor carpi ulnaris.

COURSE & RELATIONS:

- In axilla lies medial to 3rd part of axillary artery and lateral to axillary vein
- Enters arm as part of main neurovascular bundle & runs distally along medial side of brachial artery up to level of insertion of Coraco-brachialis
- Here pierces medial intermuscular septum and enters posterior compartment of arm and runs downwards to back of medial epicondyle, here it is lodged in a groove and easily palpated.
- **NO BRANCHES IN AXILLA & ARM.**
- Enters forearm by passing between two heads of (FCU) flexor carpi ulnaris, upper 1/3rd - vertically downwards under FCU, in lower 2/3rd superficial and lateral to FCU, here ulnar nerve and artery descend together where artery is in lateral side
- Enters palm by passing superficial to flexor retinaculum lying just lateral to pisiform, here it is covered by a fascial band (volar carpal ligament), the cavity formed by it is known as ulnar tunnel

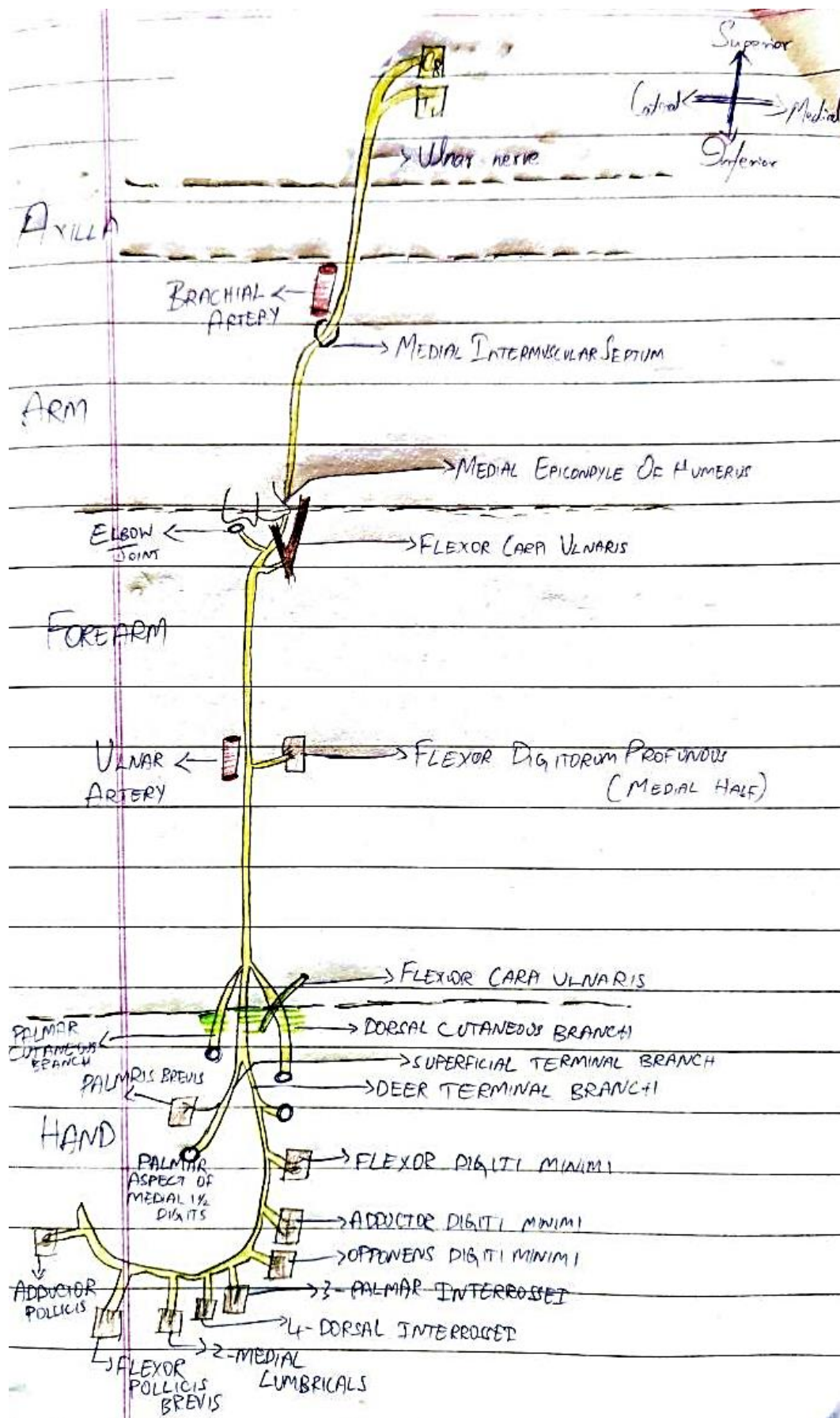
BRANCHES:

IN FOREARM:

- In proximal forearm, muscular branches to:
 - a. FCU
 - b. Medial half of flexor digitorum profundus (FDP)
- In mid fore- arm gives palmar cutaneous branch which enters palm superficial to flexor retinaculum and provides sensory supply to **skin above hypothenar eminence**
- In distal forearm, gives dorsal cutaneous branch that provides sensory innervation to skin over medial half of dorsum of hand and digital branches to medial 1½ finger.

IN PALM:

Just distal to pisiform, ulnar nerve divides to form superficial and deep terminal branches:



A. **SUPERFICIAL TERMINAL BRANCH:**

- Muscular branch to Palmaris brevis
- Digital branches to medial one and half digits including nail beds

B. **DEEP TERMINAL BRANCH:**

- Muscular branch to muscles of hypothenar eminence, medial two lumbricals, eight interossei, terminates by supplying adductor pollicis and occasionally deep head of flexor pollicis brevis.

EFFECTS OF INJURY:

A. **INJURY AT ELBOW:**

- It may be due to:
 - a. Fracture dislocation of medial epicondyle
 - b. Thickening of fibrous roof of cubital tunnel
 - c. Compression between FCU muscle
 - d. Valgus deformity of elbow (tardy or late ulnar nerve palsy)

CLINICAL FEATURES:

- Atrophy and flattening of hypothenar eminence
- Claw hand deformity affecting ring and little fingers; first phalanges are extended and middle & distal phalanges are flexed
- **NOT TRUE CLAW HAND**
- Loss of abduction and adduction of fingers
- Depression of interosseous spaces on dorsum of hand due to atrophy of interosseous muscles
- Loss of abduction in thumb
- Foment's sign is positive (patient asked to grasp a card between thumb and index finger on affected side and when examining doctor pulls the card; flexion of distal phalanx of thumb occurs due to paralysis of adductor pollicis)

B. **INJURY AT WRIST:**

- It may be due to:
 - a. Superficial position of ulnar nerve at this site makes it vulnerable to cuts and wounds
 - b. Compression in **GUYON'S CANAL/ PISOHAMTE'S TUNNEL**

CHARACTERISTIC CLINICAL FEATURES:

- Claw hand deformity affecting ring and little fingers but here FDP is not paralyzed, therefore marked flexion of distal interphalangeal joints
- This is also known as ulnar paradox since FDP is not paralyzed
- Loss of abduction and adduction in fingers
- Atrophy and flattening of hypothenar eminence
- **FOMENT'S SIGN IS POSITIVE**

9.MAMMARY GLANDS

- Modified apocrine gland present in the superficial fascia of pectoral region.
- Found in both males and females, but rudimentary in males throughout their life.
- Develops in females in puberty
- On rare occasions the breasts in males become enlarged, this condition is called gynecomastia.
- In females, they are accessory sex organs and produce milk for new born.

LOCATION:

- Breast lies in superficial fascia of the pectoral region.
- It is divided into four quadrants –
 - a. Upper medial
 - b. Upper lateral
 - c. Lower medial
 - d. Lower lateral
- Small extension from its upper lateral part called as **AXILLARY TAIL OF SPENCE** pierces deep fascia and extends into axilla.
- The aperture in the deep fascia through which axillary tail passes into axilla called the **FORAMEN OF LANGER**.
- **The axillary tail is the site of high percentage of breast tumor.**

SHAPE: hemispherical bulge

EXTENT:

- a. Vertically-2nd rib to 6th rib
- b. Horizontally- from lateral border of sternum to midaxillary line

RELATIONS:

- Structures from superficial to deep:
- **PECTORAL FASCIA**- deep fascia covering the anterior part of pectoralis major – breast lies on it.
- **THREE MUSCLES**
 - a. Pectoralis major
 - b. Serratus anterior

c. External oblique muscle of abdomen

- Breast is separated from pectoral fascia by loose areolar tissue called as **RETRO-MAMMARY SPACE** - enables normal breast to move freely over the pectoralis major muscle.

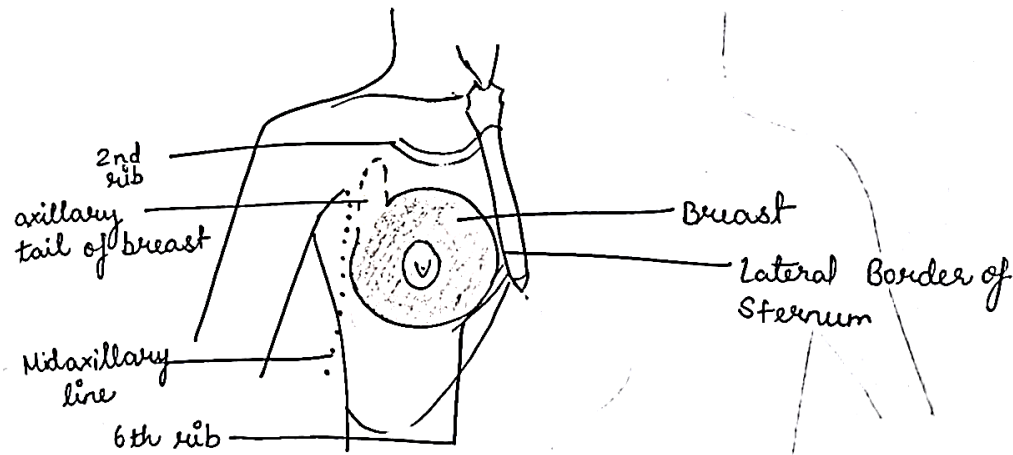


Fig: Location & Extent of Breast

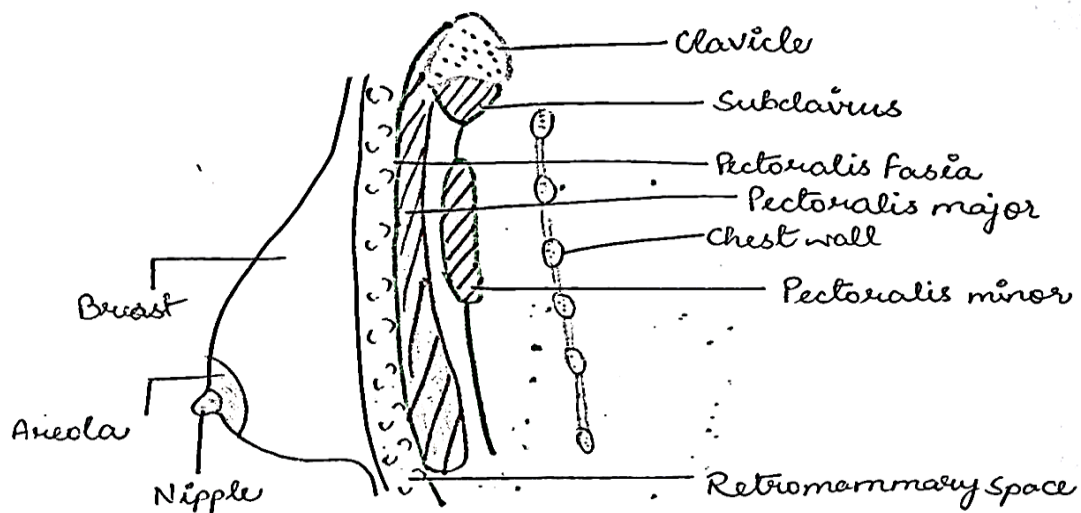


Fig: Deep Relations of Breast

- Breast consists of three components:

A. SKIN- covering the breast

a. **NIPPLE**

- It is a conical projection below the center of breast.
- It has smooth & longitudinal muscles and is richly innervated by sensory nerves.
- It is Sensitive to tactile stimulation.

b. **AREOLA**

- It is a circular area of pigmented skin around the base of nipple.
- It has modified sebaceous gland, produces oily secretion to lubricate the nipple and the areola.
- The sebaceous glands in the areola are enlarged during pregnancy and appear as nodular elevations called as **MONTGOMERY'S TUBERCLES**.

B. STROMA

- It consists of connective tissue and fat.
- It forms supporting network of breast.
- The connective tissue condenses to form fibrous strand called **SUSPENSORY LIGAMENTS OF COOPER**. They connect dermis of overlying skin to the ducts of the breast & pectoral fascia.
- Fat forms main bulk of the gland

C. PARENCHYMA

- It secretes milk to feed the new-born.
- Has 15-20 lobes in radial fashion, each lobe is further divided into lobules that consist of a cluster of acini, each lobe is drained by a lactiferous tubule.
- Near its termination at nipple, lactiferous duct expands to form lactiferous sinus – reservoir of milk during lactation.

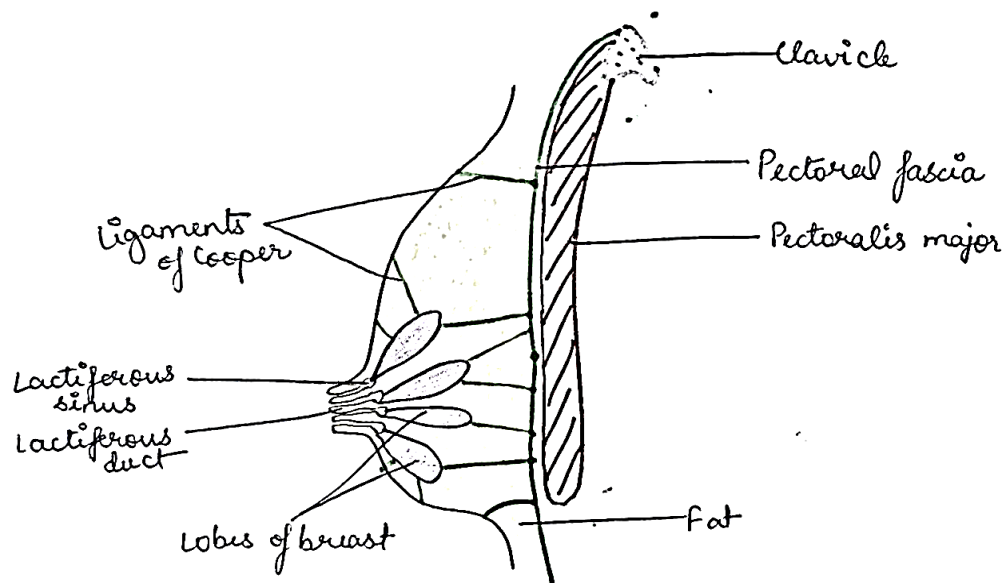


Fig: Structure of Breast

ARTERIAL SUPPLY:

- Breast is highly vascularized. Arteries supplying breast are:
 - INTERNAL THORACIC ARTERY** – branch of subclavian artery
 - LATERAL THORACIC ARTERY** – branch of axillary artery ➔ main blood supply of the breast. Also, superior thoracic and acromio-thoracic branches of axillary artery supply breast.
 - LATERAL BRANCHES OF POSTERIOR INTERCOSTAL ARTERY**

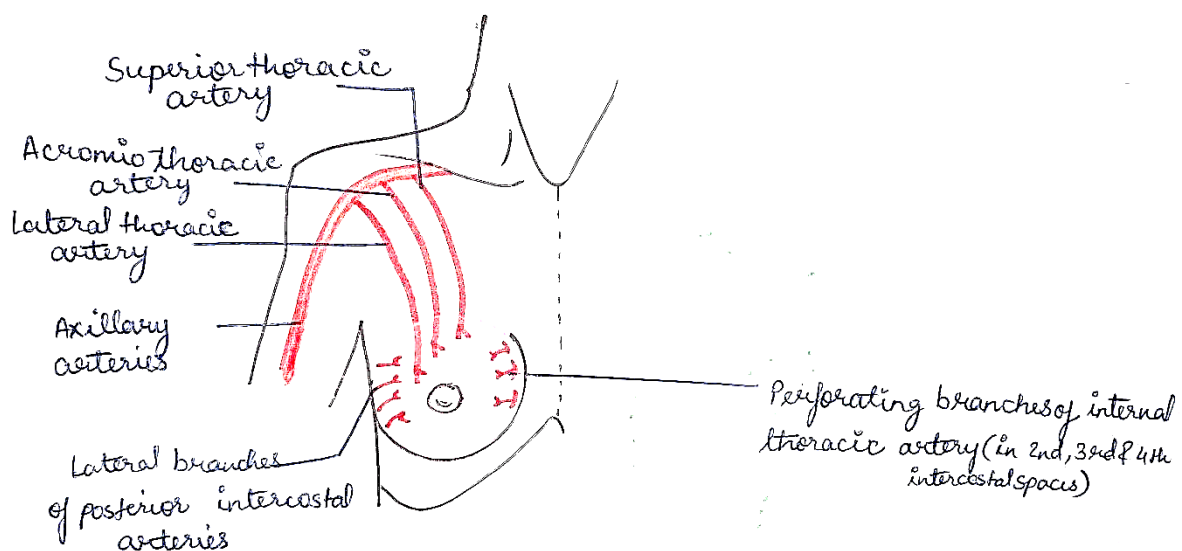


Fig: Arterial Supply of the Breast

VENOUS DRAINAGE:

1. **AXILLARY VEIN**
2. **INTERNAL THORACIC VEIN**
3. **POSTERIOR INTERCOSTAL VEINS**

- The superficial veins drain into internal thoracic vein and superficial veins of lower part of neck.
- Deep veins drain into internal thoracic, axillary and posterior intercostal vein.

NERVE SUPPLY:

- Primarily somatosensory.
- Derived from 4th to 6th intercostal nerves through their anterior and lateral cutaneous branches. These nerves convey sensory fibres to skin and autonomic fibres to smooth muscle and blood vessels
- These nerves don't control milk secretion. It is controlled by **HORMONE PROLACTIN**.

LYMPHATIC DRAINAGE

LYMPH NODES:

1. **AXILLARY LYMPH NODES**-in axilla – 4 groups:
 - a. Anterior/pectoral
 - b. Posterior
 - c. Central
 - d. Lateral
2. **INTERNAL MAMMARY NODES** -along internal thoracic vessels
3. **SUPRACLAVICULAR NODES**
4. **POSTERIOR INTERCOSTAL NODES**-lying in posterior parts of intercostal spaces in the front of the head of ribs.
5. **CEPHALIC** (deltopectoral) **NODES**- in deltopectoral groove.
6. Subdiaphragmatic and Sub-Peritoneal Lymph Plexuses

LYMPHATICS:

- Lymphatics draining the breast into two groups:
 - a. **SUPERFICIAL** - drains the skin of breast except nipple and areola
 - b. **DEEP** - drains parenchyma of breast, skin of nipple and areola is drained by lymph vessels called as **SUBAREOLAR PLEXUS OF SAPPEY**. Deep lymphatics drain into anterior group of axillary lymph node.
- Superficial lymphatics on one side communicate with those of other side. Therefore, malignancy of one side can become bilateral.
- **LYMPHATIC DRAINAGE OCCURS AS FOLLOWS:**
 1. **AXILLARY** and **PECTORAL GROUP OF LYMPH NODE** situated in deep and lower border of pectoralis minor drain the lateral quadrants.
 2. **INTERNAL MAMMARY LYMPH NODES** situated along with internal mammary artery drains the medial quadrants.
 3. Few other lymph nodes situated along with post. intercostal arteries drain into **POSTERIOR INTERCOSTAL NODES**.
 4. The few lymph vessel from lower medial quadrant pierces the abdominal wall and communicate with **SUB-PERITONEAL LYMPH PLEXUS**
 - From here, cancer cells migrate transcoelomically and get deposited on ovary producing secondary tumor called as **KRUKENBERG'S TUMOR**.
 5. Lymph vessels from deep surface of breast pierce pectoralis major and clavipectoral fascia to drain into **APICAL GROUP OF AXILLARY LYMPH NODES**.

****About 75% lymph nodes drain into axillary lymph nodes,**

****20% in internal mammary lymph nodes and**

****5% in posterior intercostal lymph nodes.**

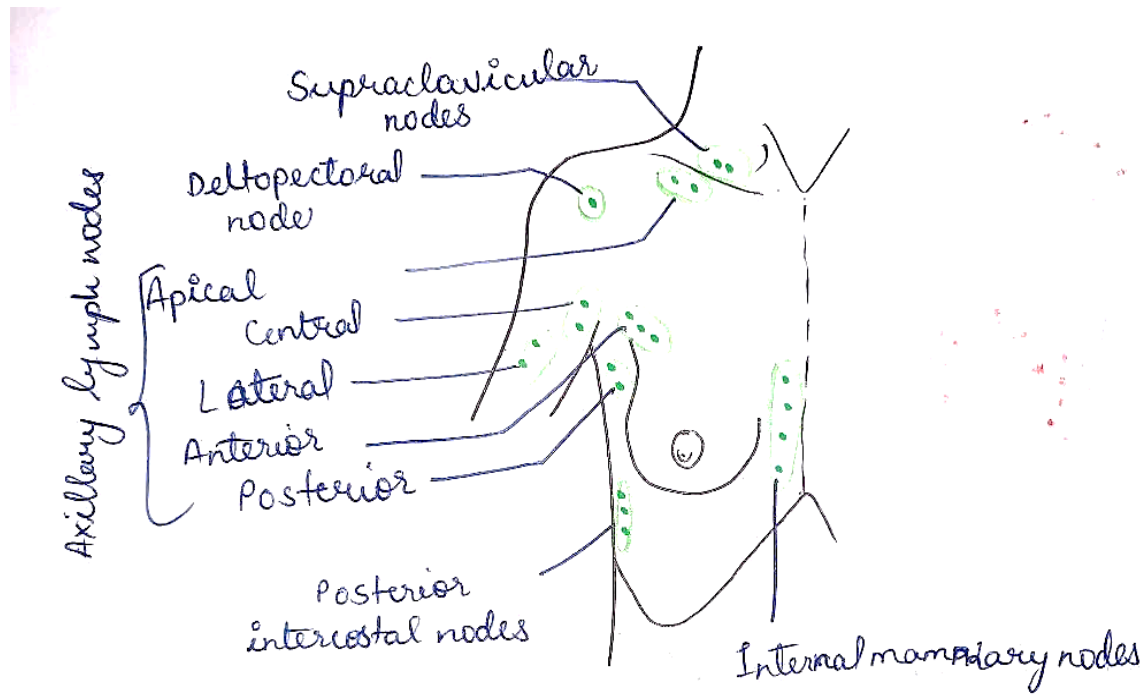


Fig: Lymph nodes of the Breast

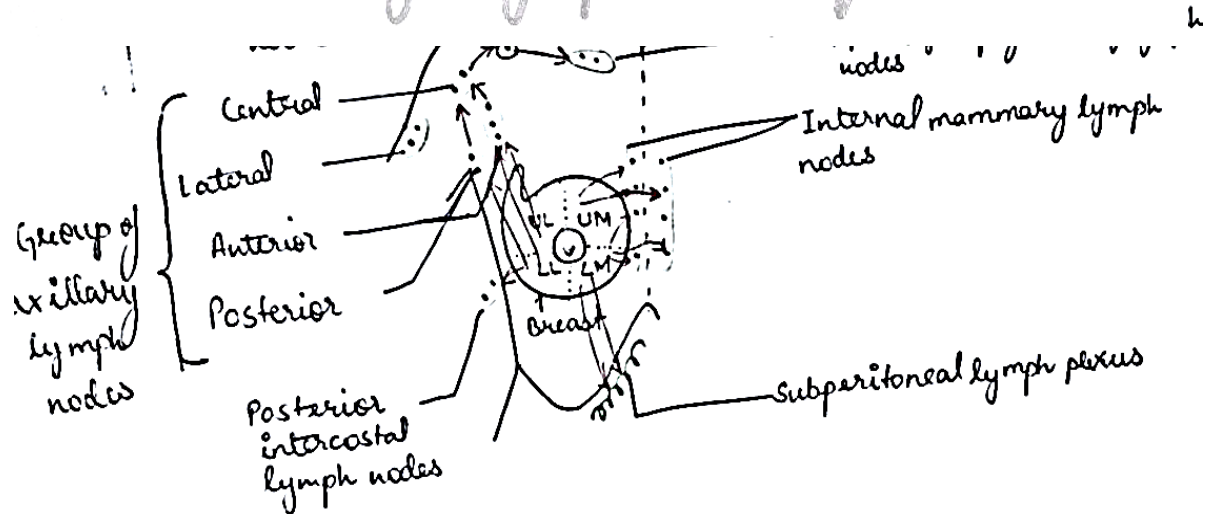


Fig: Lymphatic Drainage of Breast

CLINICAL CORRELATION

1. **BREAST CANCER** presents as
 - Painless hard lump
 - Breast becomes fixed and immobile due to infiltration of Suspensory Ligaments
 - Retraction of nipple due to infiltration & fibrosis of lactiferous ducts
 - **PEAU'D ORANGE APPEARANCE** of skin due to obstruction of superficial lymphatics.

2. **LYMPHATIC DRAINAGE OH BREAST** is important – metastasis of tumor cells of breast along lymph vessels to regional lymph nodes.

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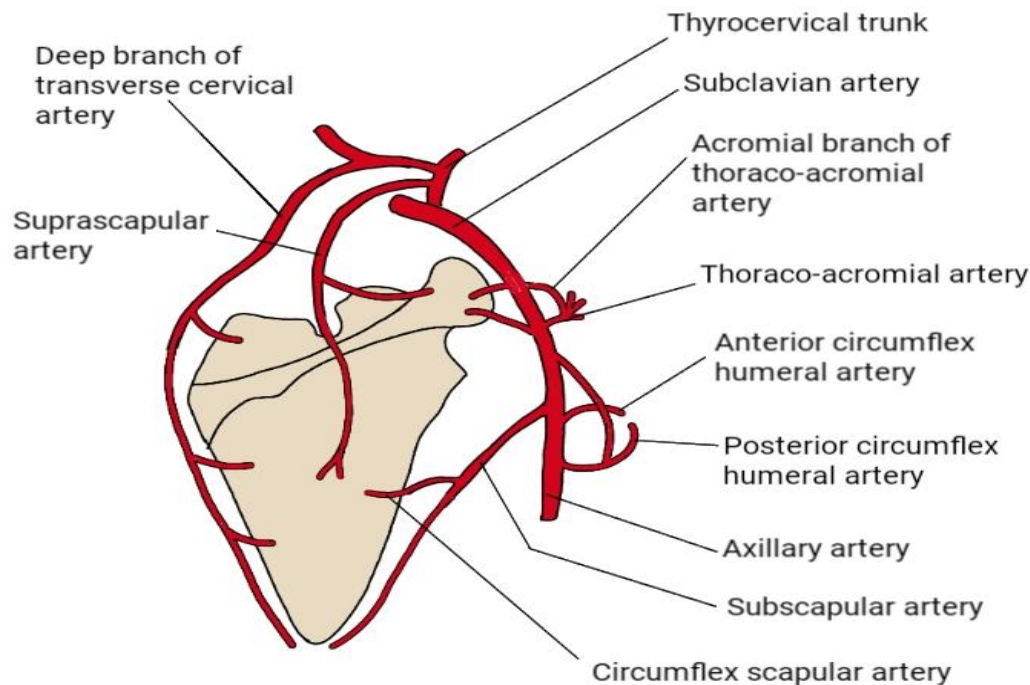
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1. ARTERIAL ANASTOMOSIS AROUND SCAPULA

- Principally formed between the branches of 1st part of the subclavian and the 3rd part of the axillary artery.



AROUND THE BODY OF SCAPULA	OVER THE ACROMION PROCESS
SUPRASCAPULAR ARTERY, a branch of the thyrocervical trunk from the 1st part of the subclavian artery. CIRCUMFLEX SCAPULAR ARTERY, a branch of subscapular artery from 3rd part of axillary artery. DEEP BRANCH OF TRANSVERSE CERVICAL ARTERY, a branch of the thyrocervical trunk.	ACROMIAL BRANCH OF THE THORACO-ACROMIAL ARTERY (2nd part of axillary artery) ACROMIAL BRANCH OF THE SUPRASCAPULAR ARTERY (1st part of subclavian artery) ACROMIAL BRANCH OF THE POSTERIOR CIRCUMFLEX HUMERAL ARTERY (3rd part of axillary artery)

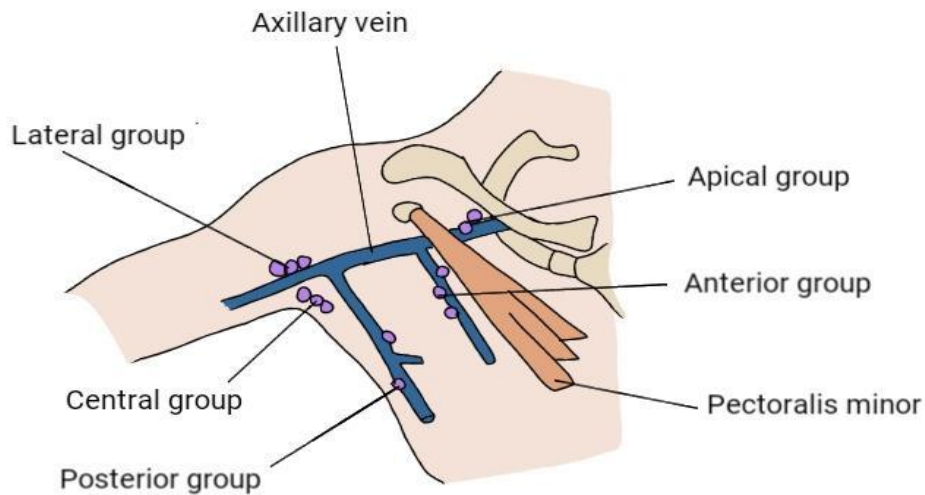
APPLIED ANATOMY:

- COLLATERAL CIRCULATION** ensures **ADEQUATE BLOOD SUPPLY TO THE UPPER LIMB** in case of blockage between third part of axillary artery and first part of axillary artery.

2. AXILLARY LYMPH NODES:

- Scattered in fibrofatty tissue of axilla
- 20-30 nodes
- 5 groups of axillary lymph nodes
 - I. ANTERIOR or PECTORAL GROUP
 - II. POSTERIOR or SCAPULAR GROUP
 - III. LATERAL GROUP
 - IV. CENTRAL GROUP
 - V. APICAL or INFRACLAVICULAR GROUP

GROUP	LOCATION	DRAINAGE
ANTERIOR OR PECTORAL GROUP	Lies along lateral thoracic vessels and lower border of pectoralis minor	<u>Receive lymph from</u> a. Upper half of anterior wall of trunk b. Major part of breast.
POSTERIOR OR SCAPULAR GROUP	Lies along the subscapular vessels on the posterior fold of axilla	<u>Receive lymph from</u> a. Upper half of posterior wall of trunk b. Axillary tail of breast
LATERAL GROUP	Lies along the upper part of humerus, medial to axillary vein	<u>Receive lymph from</u> a. Upper limb
CENTRAL GROUP	Lies in the fat of upper axilla	<u>Receive lymph from</u> a. Preceding groups b. Floor of axilla <u>Drain into</u> Apical group
APICAL OR INFRA- CLAVICULAR GROUP	Lies deep to clavipectoral fascia, along axillary vessels	<u>Receive lymph from</u> a. Central group(indirectly) b. Upper part of breast(directly) c. Thumb and it's web <u>Drain into</u> a. Subclavian lymph trunk on right side b. Thoracic duct on left side c. Also, to supraclavicular lymph nodes

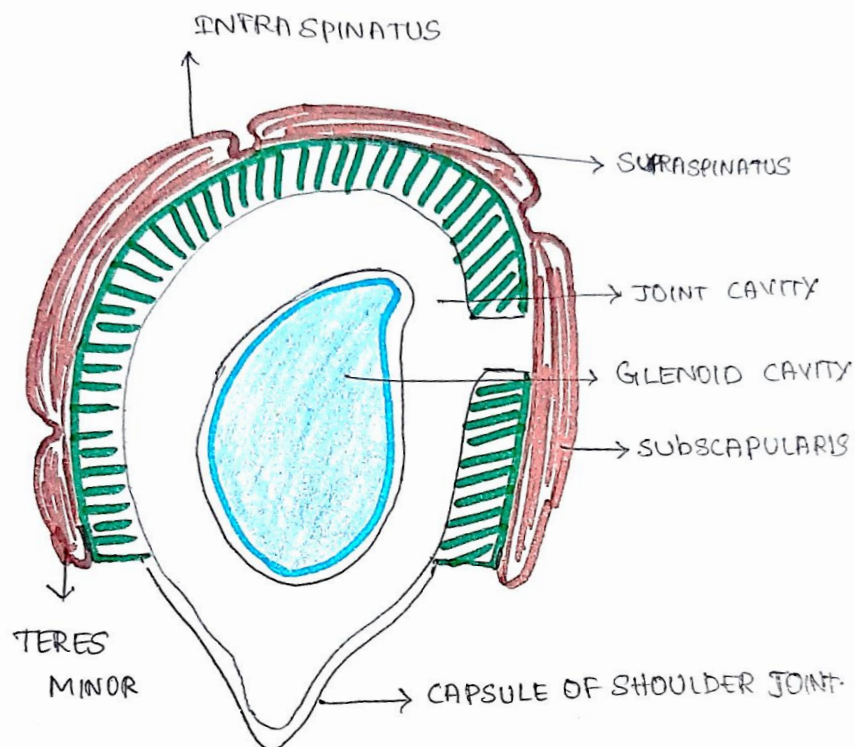


APPLIED ANATOMY:

- **PALPATION OF AXILLARY LYMPH NODES:** It is a part of clinical examination of the breast due to their involvement in breast cancer.
- The lymph node that first receive lymph from the area of the breast involved in cancer are termed as **SENTINEL LYMPH NODES**. These nodes are confirmed by injecting a radioactive substance into the affected area of the breast.
- **DRAINAGE OF AXILLARY ABSCESS:** incision in the floor of axilla – the most dependent part, Midway between anterior & posterior axillary folds nearer to medial wall to avoid injury to main vessels running along anterior, posterior & lateral walls of the axilla.

3. MUSCLOTENDINOUS CUFF (ROTATOR CUFF):

- Musculotendinous cuff of the shoulder is a fibrous sheath formed by four flattened tendons which blend with the capsule of the shoulder joint and strengthen it.
- The muscles which form the cuff arise from the scapula and are inserted into the lesser and greater tubercle of humerus.
- They are:
 - a. Subscapularis
 - b. Supraspinatus
 - c. Infraspinatus
 - d. Teres ~~Major~~ ^{Minor}
- Their tendons while crossing the shoulder joint, become flattened and blend with each other and also with the capsule of the joint.



IMPORTANCE:

- The cuff gives strength to the capsule of the shoulder joint all around except inferiority.
- Therefore, dislocation of humerus is common in anteroinferior direction.

ROTATOR CUFF DISORDERS:

- **CALCIFIC SUPRASPINATUS TENDINITIS** – Calcium deposits in supraspinatus tendon irritates overlying bursa leading to subacromial bursitis.
- Consequently, when the arm is abducted the inflamed bursa is caught between tendon & acromion impingement which causes severe pain. In most people, pain occurs during 60° - 120° of abduction known as painful arc syndrome.

4. MUSCULOCUTANEUS NERVE:

- Musculocutaneous nerve is named as it supplies muscle of front of forearm and skin of lateral side of the forearm.

ROOT VALUE:

- Ventral rami of C5 -C7 segments of spinal cord.

COURSE:

A. AXILLA AND ARM:

- It is a branch of lateral cord of brachial plexus, lies lateral to axillary artery and upper part of brachial artery.
- It supplies coracobrachialis, pierces the muscle to lie in the intermuscular septum between biceps brachii and brachialis muscles.

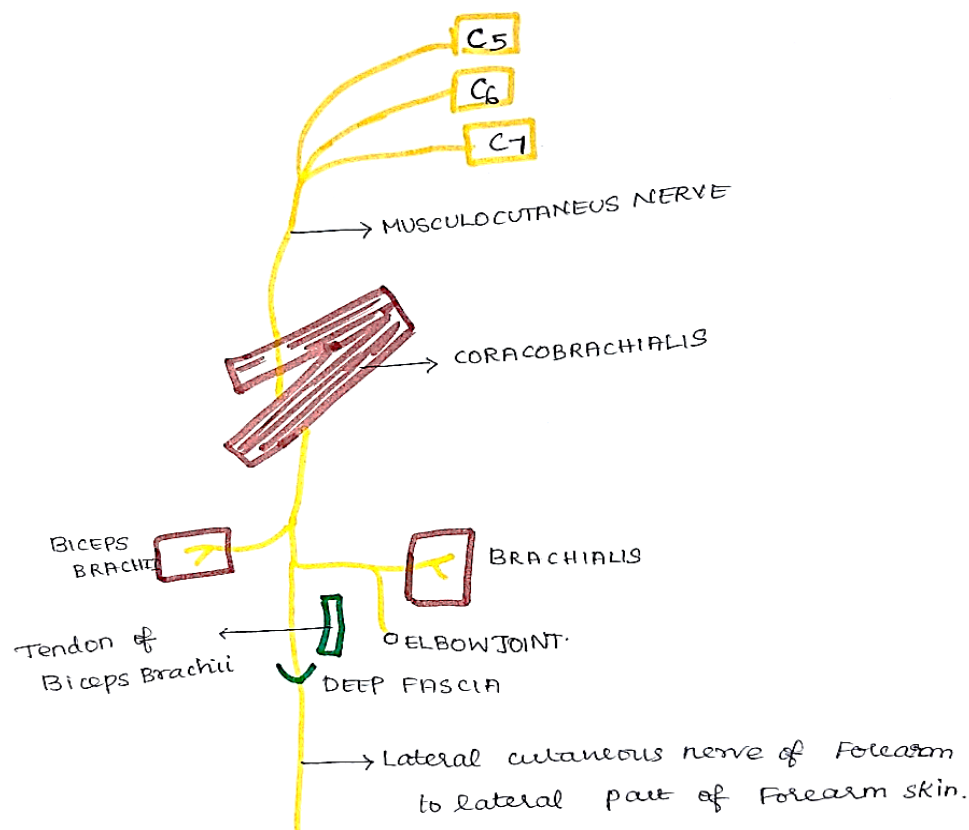
B. FOREARM:

- About 2.5 cm above the crease of elbow, it becomes cutaneous by piercing the deep fascia.
- The nerve is called the lateral cutaneous nerve of forearm which supplies the skin of forearm both on the front and back.

BRANCHES:

- **MUSCULAR** – Coraco-brachialis, long head and short head of biceps brachii and brachialis
- **CUTANEOUS**– lateral side of fore arm
- **ARTICULAR**–elbow joint

****MUSCULOCUTANEUS NERVE** innervations of arm are purely motor while that of forearm is purely sensory

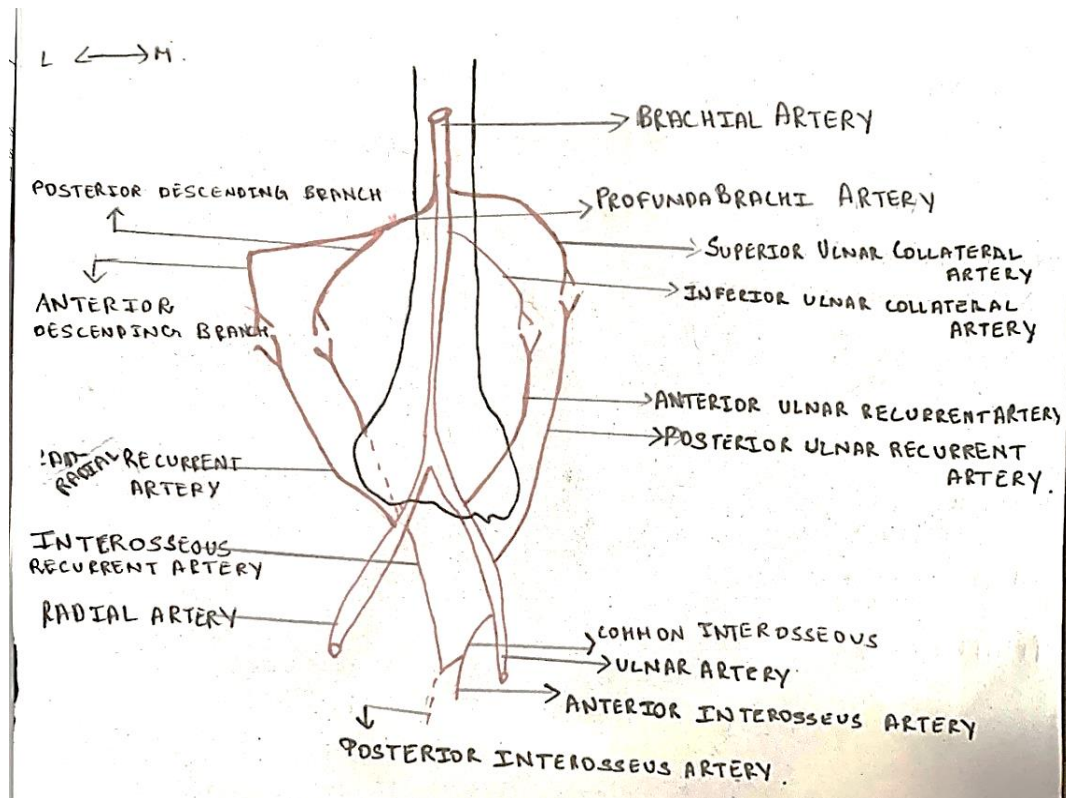


CLINICAL ANATOMY:

- This nerve is well protected within the axilla. So, injury is uncommon.
- If injured during any penetrating trauma, it leads to:
 - a. **MOTOR LOSS**: Paralysis of biceps brachii and brachialis & Coraco-brachialis
 - b. **SENSORY LOSS**: It is on the lateral side of forearm

5. ANASTOMOSIS AROUND ELBOW JOINT:

- Anastomosis around the elbow joint links the brachial artery with radial and ulnar arteries.



SITE OF ANATOMOSIS	ARTERIES INVOLVED
IN FRONT OF LATERAL EPICONDYLE	Anterior descending\radial collateral with radial recurrent arteries
BEHIND THE LATERAL EPICONDYLE	Posterior descending\middle collateral with interosseous arteries
IN FRONT OF MEDIAL EPICONDYLE	Inferior ulnar collateral with anterior ulnar recurrent arteries
BEHIND THE MEDIAL EPICONDYLE	Superior ulnar collateral with posterior ulnar recurrent arteries

CLINICAL ANATOMY:

- BRACHIAL PULSATATIONS** are felt in front of the elbow just medial to the tendon of biceps for recording the blood pressure.

6. CUBITAL FOSSA

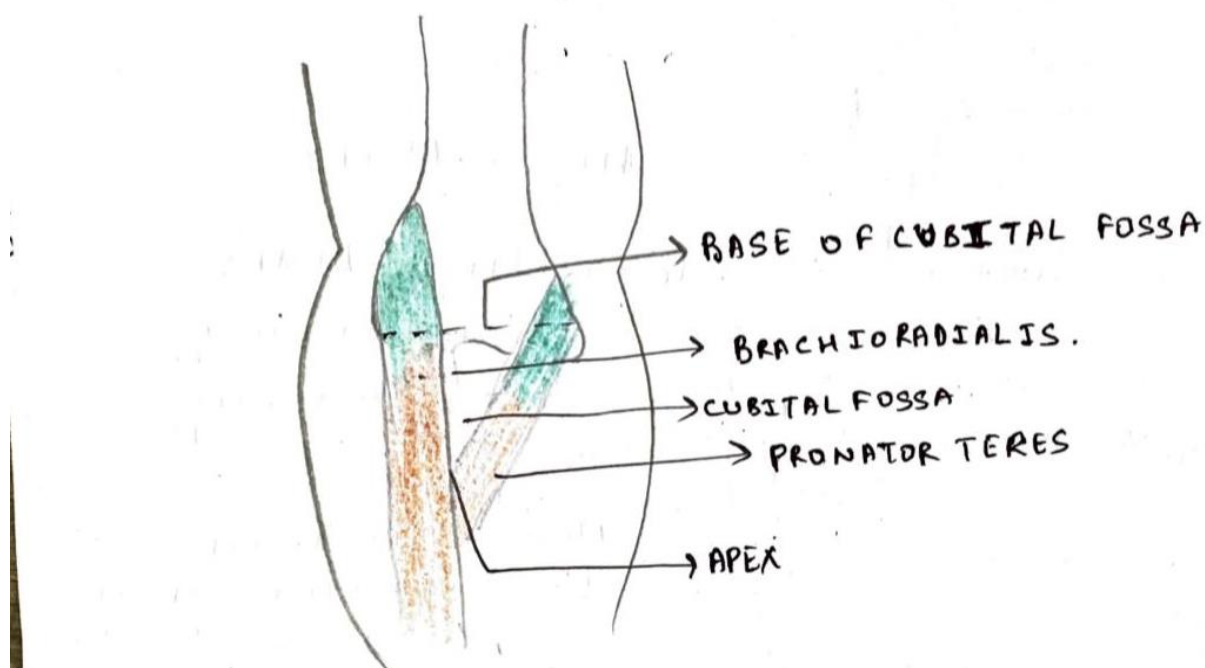
depression

- Cubital fossa is a triangular hollow situated on the front of the elbow.

BOUNDARIES:

- LATERALLY:** Medial border of brachioradialis
- MEDIALY:** Lateral border of pronator teres
- BASE:** Imaginary line joining the front of the two epicondyles of the humerus.
- APEX:** Meeting point of the lateral and medial boundaries. Here brachioradialis overlaps the pronator teres

BOUNDARIES OF RIGHT CUBITAL FOSSA.

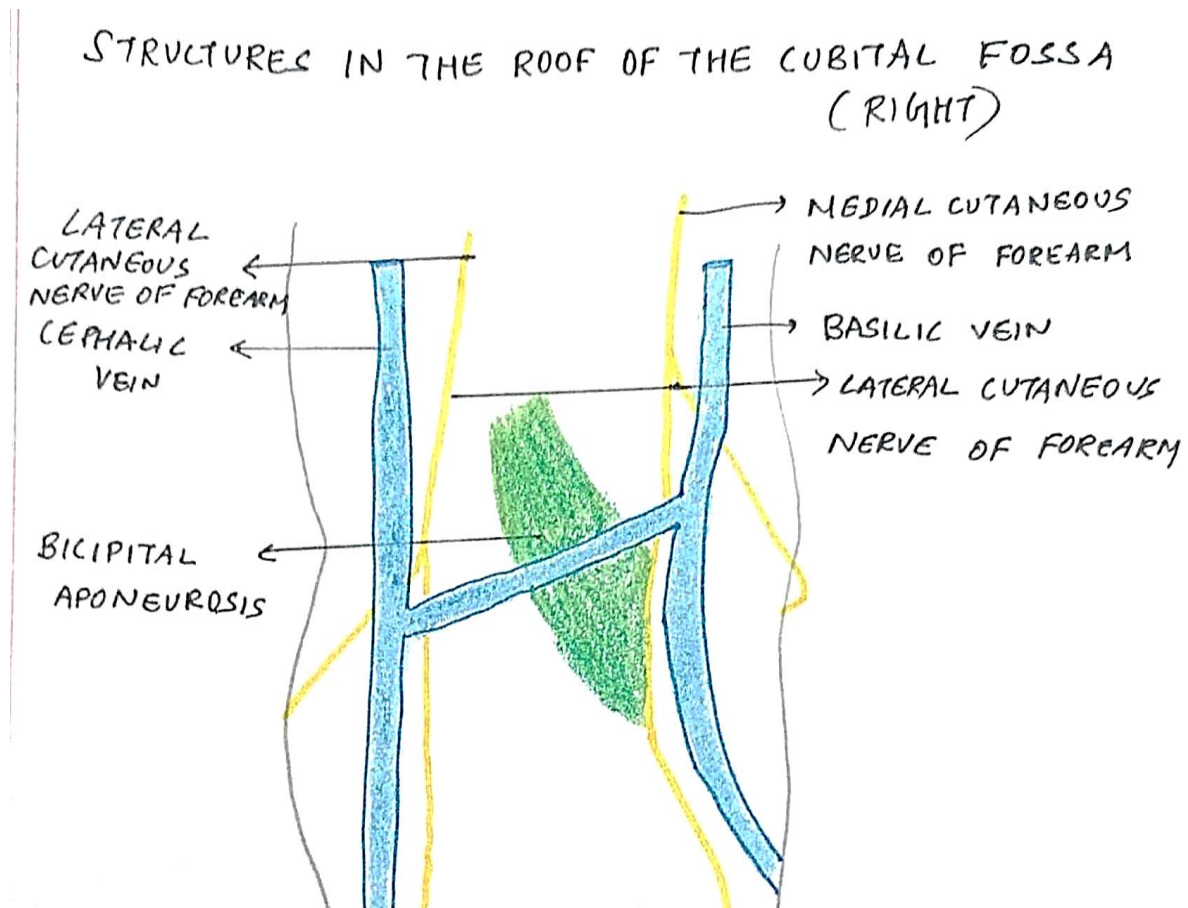


ROOF:

1. Skin
2. Superficial fascia containing median cubital vein
3. Deep fascia
4. Bicipital aponeurosis

FLOOR:

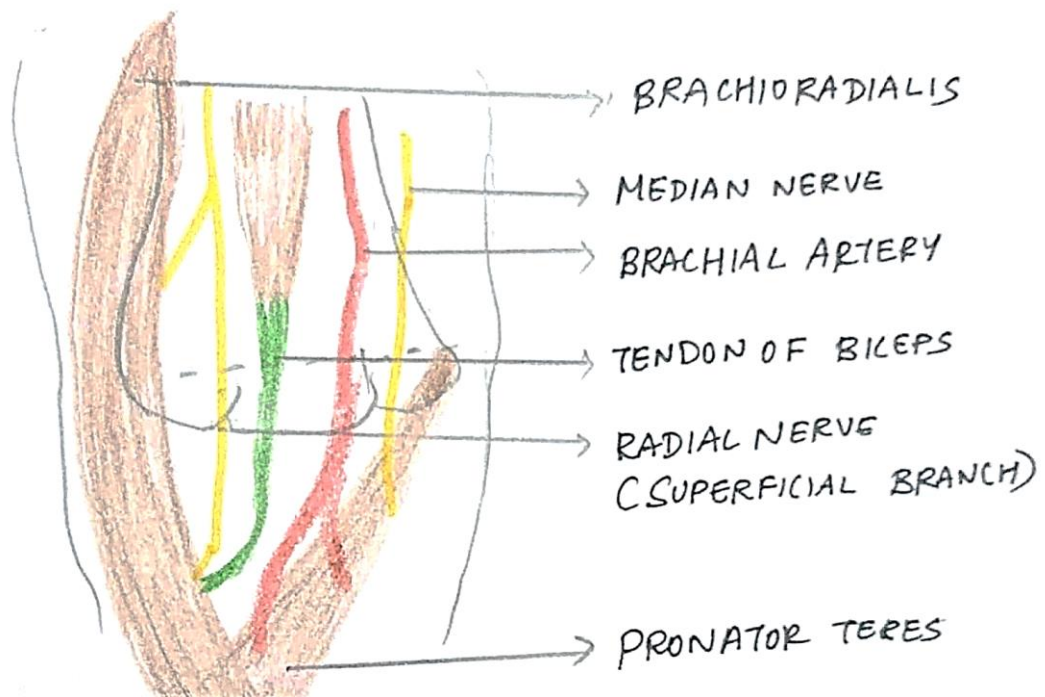
1. Brachialis (upper part)
2. Supinator (lower part)



CONTENTS:

1. **MEDIAN NERVE**: It leaves the fossa by passing between the two heads of pronator teres.
2. **BRACHIAL ARTERY**: It terminates in the fossa by dividing into radial and ulnar arteries. The radial artery is superficial and the ulnar artery is deep and passes deep to the pronator teres.
3. The tendon of **BICEP BRACHII**
4. **RADIAL NERVE**: It divides into superficial radial nerve and deep radial nerve (posterior interosseous nerve) at the level of lateral epicondyle. The latter disappears in supinator muscle.

CONTENTS OF RIGHT CUBITAL FOSSA



CLINICAL ANATOMY:

- The median cubital vein is the vein of choice for the intravenous injections and to get blood samples.
- The blood pressure is universally recorded by auscultating the brachial artery in front of the elbow.
- The anatomy of cubital fossa is important for dealing with the fracture around the elbow like supracondylar fracture of humerus

7. JOINTS OF DIGITS:

METACARPOPHALANGEAL JOINTS:

TYPE: Synovial joints of ellipsoid/ condylar variety

ARTICULAR SURFACES:

1. Proximal articular surface - Convex head of metacarpal
2. Distal articular surface - Shallow fossa on base of proximal phalanx

LIGAMENTS:

1. CAPSULAR LIGAMENT

- Thick in front & thin behind

2. PALMAR LIGAMENT

- Fibro-cartilaginous plate (volar plate)
- More firmly attached to phalanx than to metacarpal
- Ligaments of 2nd, 3rd, 4th & 5th MP joints join together to form deep transverse metacarpal ligament

3. MEDIAL & LATERAL COLLATERAL LIGAMENTS

- Cord-like, oblique fibrous bands present on each side of the joint
- Extends from head of metacarpal to base of joint
- Taut in flexion and relaxed in extension

MOVEMENTS AT FIRST JOINT AND MUSCLES PRODUCING IT:

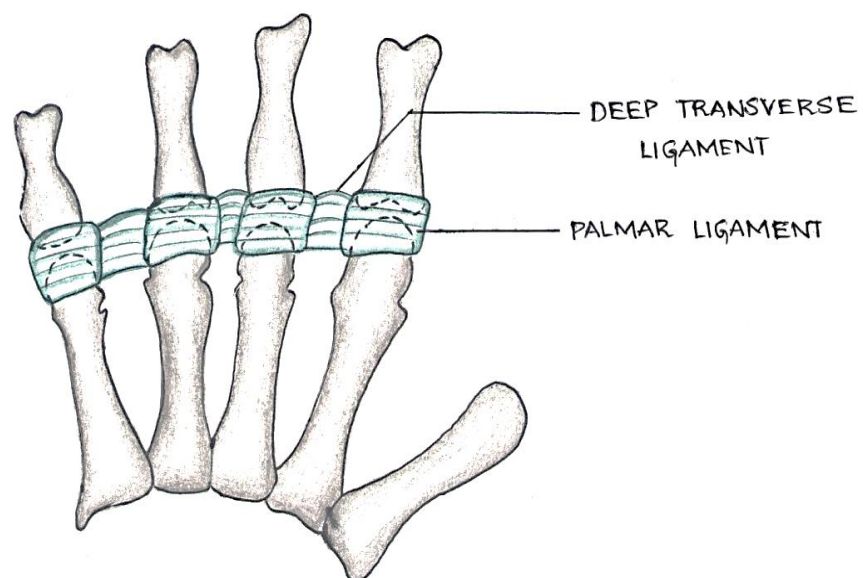
MOVEMENT	MUSCLES PRODUCING IT
FLEXION	Flexor Pollicis Longus, Flexor Pollicis Brevis
EXTENSION	Extensor Pollicis Longus, Extensor Pollicis Brevis
ABDUCTION	Abductor Pollicis Brevis
ADDUCTION	Adductor Pollicis

MOVEMENTS AT 2ND TO 5TH JOINT AND MUSCLES PRODUCING THEM:

MOVEMENT	MUSCLES PRODUCING IT
FLEXION	Interossei, Lumbricals
EXTENSION	Extensors of fingers
ABDUCTION	Dorsal interossei
ADDUCTION	Palmar interossei

MP JOINTS SHOWING PALMAR AND DEEP

TRANSVERSE LIGAMENTS



INTERPHALANGEAL JOINTS (PROXIMAL & DISTAL):

TYPE: Synovial joints of hinge variety

ARTICULAR SURFACES:

A. PROXIMAL INTERPHALANGEAL JOINT

1. Proximal articular surface - Head of proximal phalanx
2. Distal articular surface - Base of middle phalanx

B. DISTAL INTERPHALANGEAL JOINT

1. Proximal articular surface - Head of middle phalanx
2. Distal articular surface - Base of distal phalanx

LIGAMENTS:

- Similar to metacarpophalangeal joints
- One palmar fibrocartilaginous ligament,
- Two collateral bands running downwards and forwards

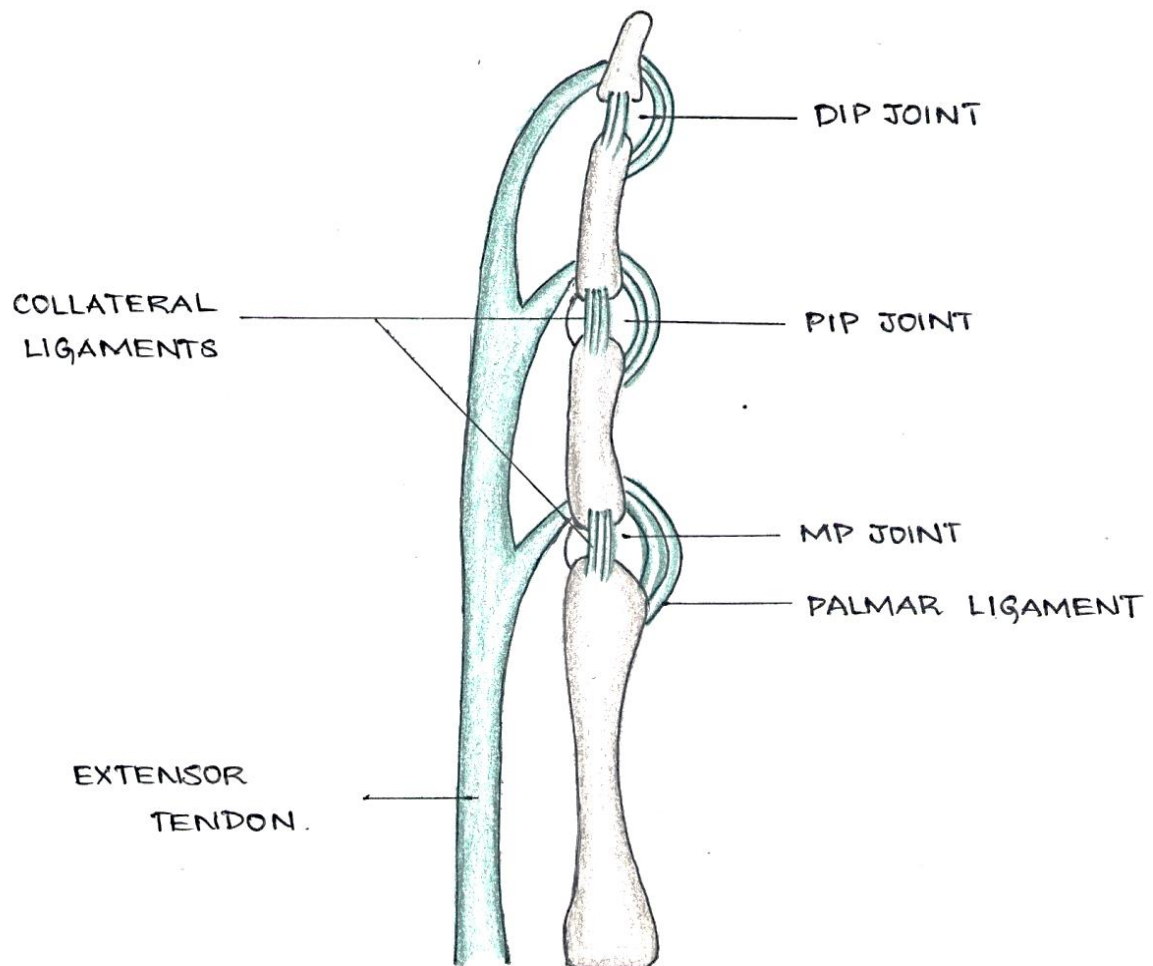
MOVEMENTS AT INTERPHALANGEAL JOINT OF THUMB:

MOVEMENT	MUSCLES PRODUCING IT
FLEXION	Flexor pollicis longus
EXTENSION	Extensor pollicis longus

MOVEMENTS AT SECOND TO FIFTH DIGITS:

MOVEMENT	MUSCLES PRODUCING IT
FLEXION	Proximal IP joint - Flexor digitorum superficialis Distal IP joint - Flexor digitorum profundus
EXTENSION	Interossei, Lumbricals

JOINTS OF DIGITS



8. SEGMENTAL INNERVATION OF THE MUSCLES OF THE UL:

- The knowledge of segmental values is of importance in the diagnosis of injuries to the nerve or to the spinal cord from which they arise.
- Proximal muscles of upper limb are supplied by proximal nerve roots forming brachial plexus and distal muscles by the distal or lower nerve roots.

SEGMENTAL INNERVATION OF MOVEMENTS:

1. SHOULDER

- **ABDUCTION** - Muscles supplied by C5 spinal segment
- **ADDUCTION** - Muscles supplied by C6, C7 spinal segments

2. ELBOW

- **FLEXION** - Muscles supplied by C5, C6 spinal segments
- **EXTENSION** - Muscles supplied by C7 spinal segment

3. RADIO-ULNAR JOINT

- **SUPINATION** - Muscles supplied by C6 spinal segment
- **PRONATION** - Muscles supplied by C6 spinal segment

4. WRIST

- **EXTENSION** - Muscles supplied by C6, C7 spinal segments
- **FLEXION** - Muscles supplied by C6, C7 spinal segments

5. INTERPHALANGEAL JOINT

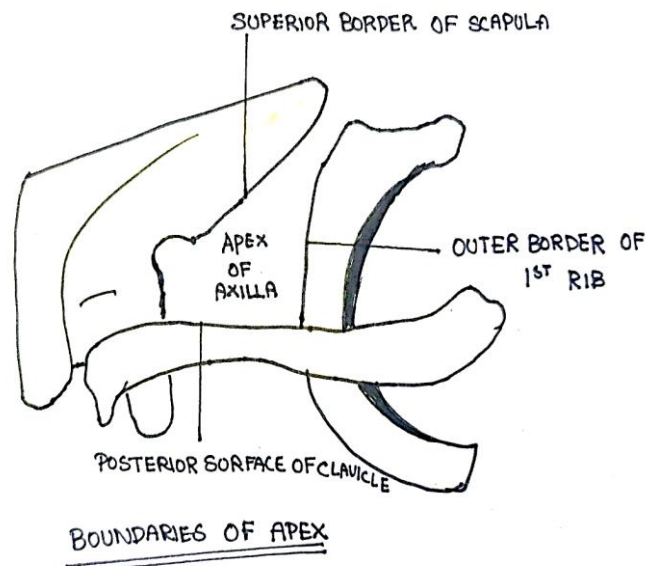
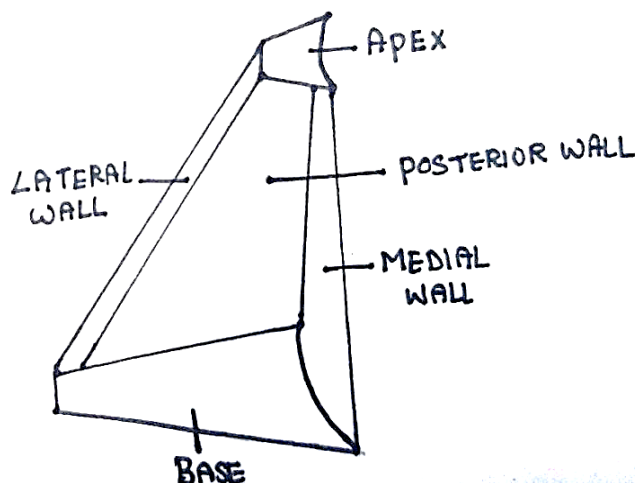
- **FLEXION** - Muscles supplied by C7, C8 spinal segments
- **EXTENSION** - Muscles supplied by C7, C8 spinal segments

SEGMENTAL INNERVATION OF MUSCLES:

SEGMENT	MUSCLES INNERVATED
C5	• Deltoid • Supraspinatus, infraspinatus, and teres minor • Rhomboideus major and minor • Coracobrachialis, biceps brachii, and brachialis • Brachioradialis and supinator
C6	• Pectoralis major and minor • Subscapularis, latissimus dorsi, and teres major • Serratus anterior • Triceps • Pronator teres and pronator quadratus
C7	• Extensors and flexors of wrist
C8	• Long flexors and extensors of fingers
T1	• Small muscles of hand

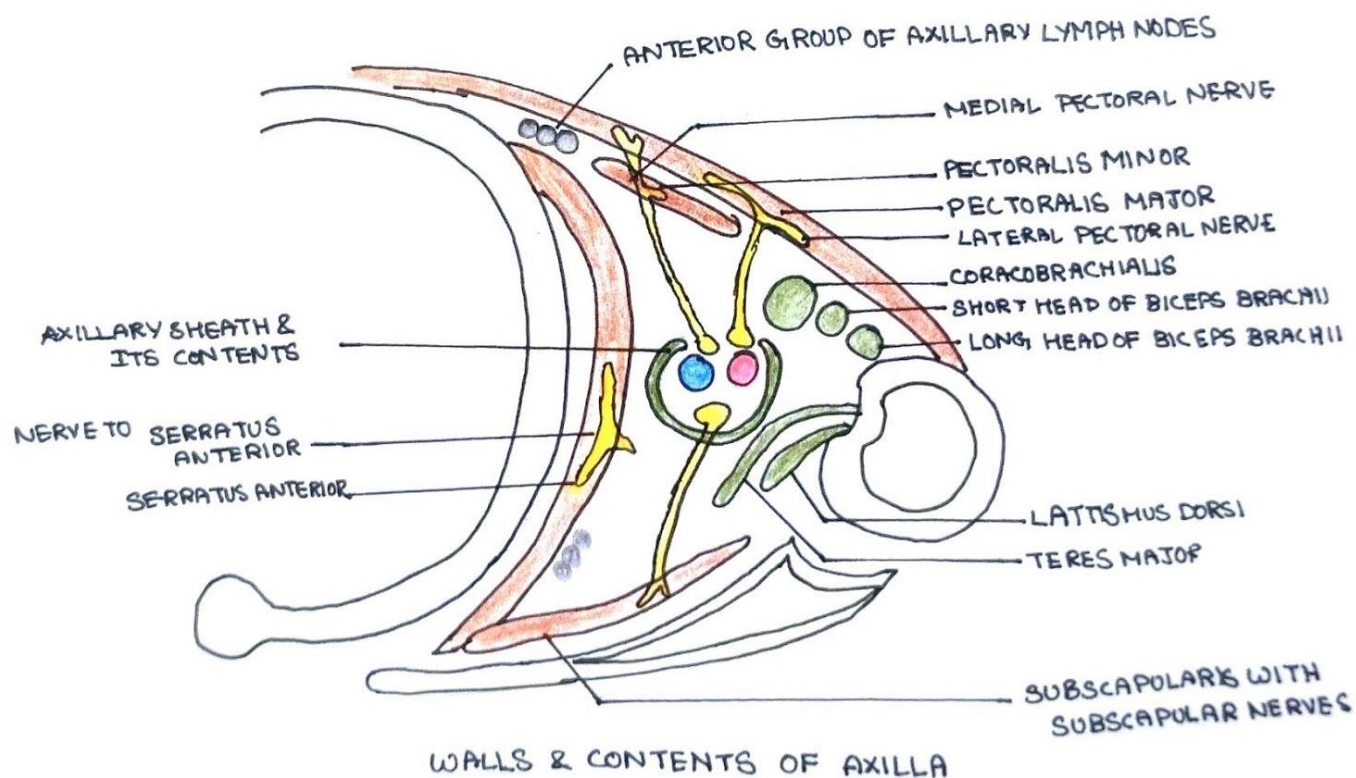
9. BOUNDARIES OF AXILLA:

APEX or CERVICOAXILLARY CANAL	ANTERIOR: posterior surface of clavicle POSTERIOR: superior border of the scapula and medial aspect of coracoid process MEDIAL: outer border of first rib
BASE or FLOOR	Skin, superficial fascia and axillary fascia
ANTERIOR WALL	Pectoralis major Clavipectoral fascia Pectoralis minor
POSTERIOR WALL	Subscapularis Teres major Latissimus dorsi
MEDIAL WALL	Upper 4 ribs with their intercostal muscles Upper part of serratus anterior
LATERAL WALL	Upper part of shaft of humerus in the region of bicipital groove Coracobrachialis Short head of biceps



CONTENTS OF AXILLA:

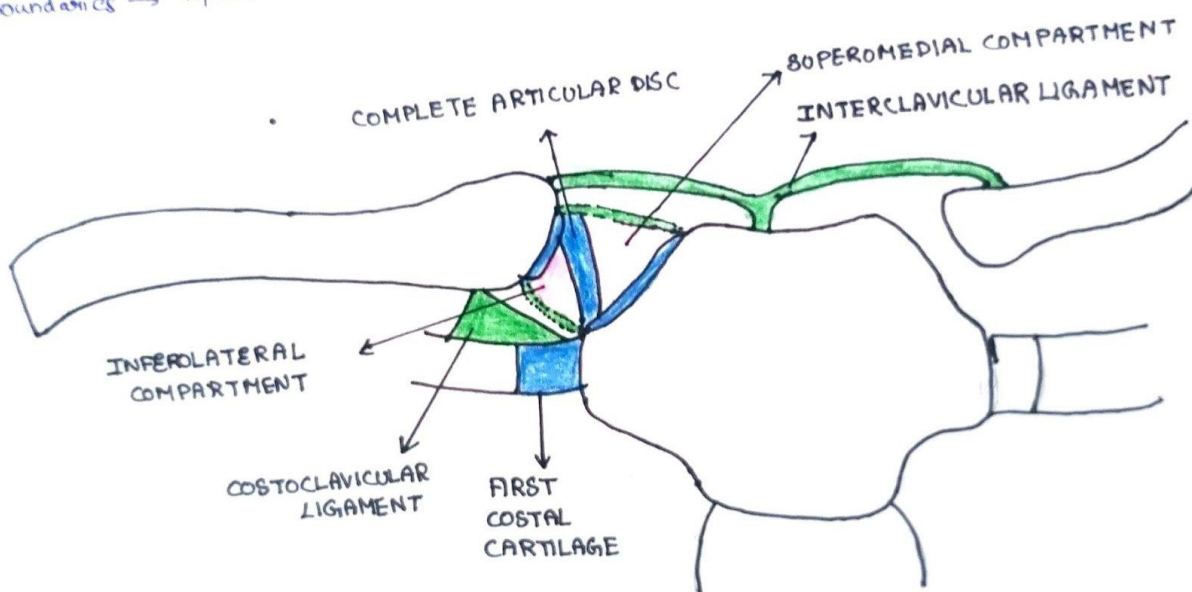
1. Axillary artery and its branches
2. Axillary vein and its tributaries
3. Infraclavicular part of brachial plexus
4. Axillary lymph nodes
5. Axillary fat
6. Long thoracic and intercostobrachial nerves



10. STERNOCLAVICULAR JOINT:

TYPE	Saddle type of synovial joint
ARTICULAR SURFACE	- Round head of clavicle - Shallow socket of superolateral angle of manubrium sterni
LIGAMENTS	- Anterior and posterior sternoclavicular ligament - Capsular ligament - Interclavicular ligament - Costoclavicular ligament
BLOODSUPPLY	- Internal thoracic - Suprascapular arteries
NERVE SUPPLY	Medial supraclavicular nerve
MOVEMENTS	- Elevation - Depression - Protraction - Retraction - Anterior and posterior rotation
ARTICULAR DISC	Present
CLINICAL ASPECTS	- Dislocation of joint - Transmission of weight of upper limb

boundaries → Apex.



11. ANATOMICAL EVENTS OCCURRING AT THE LEVEL OF INSERTION OF CORACOBRACHIALIS:

- Circular shaft of Humerus becomes triangular below this level.
- Brachial artery moves from medial aspect of arm to anterior aspect.
- Basilic vein pierces deep fascia of arm.
- Median nerve crosses in front of brachial artery from lateral to medial side.
- Radial nerve pierces lateral intermuscular septum to pass from posterior compartment to anterior compartment.
- Ulnar nerve pierces medial intermuscular septum to go into posterior compartment.
- Medial cutaneous nerve of arm and forearm pierces deep fascia.
- Nutrient artery pierces humerus.

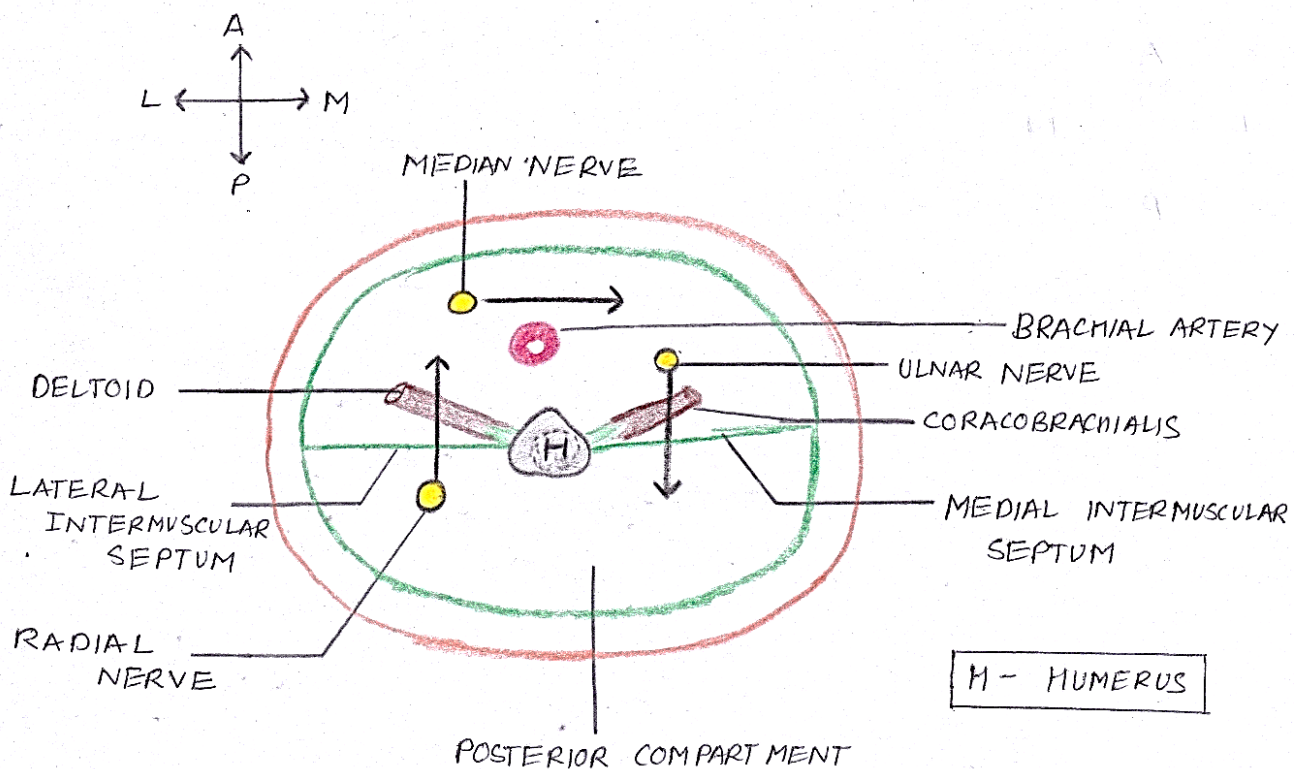


Figure: Anatomical EVENTS AT THE LEVEL OF -
- INSERTION OF CORACOBRACHIALIS

12. PROFUNDA BRACHII ARTERY- COURSE AND BRANCHES:

- Largest branch of brachial artery.

ORIGIN: Posteromedial aspect of brachial artery just below Teres major.

COURSE: Accompanies Radial nerve in the radial groove and terminates by dividing into anterior and posterior descending branches.

BRANCHES:

1. **DELTOID BRANCH** = Ascends between the long and lateral heads of triceps and anastomoses with descending branch of posterior circumflex humeral artery.
2. **NUTRIENT ARTERY** = Enters shaft of Humerus in radial groove.
3. **ANTERIOR DESCENDING ARTERY:** (A.K.A- Radial collateral) Smaller terminal branch. It accompanies radial nerve and anastomoses with the radial recurrent artery in front of lateral epicondyle.
4. **POSTERIOR DESCENDING ARTERY:** (A.K.A-Middle Collateral) Larger terminal branch. It descends behind shaft of Humerus and anastomoses with the interosseous recurrent artery behind the lateral epicondyle of Humerus.

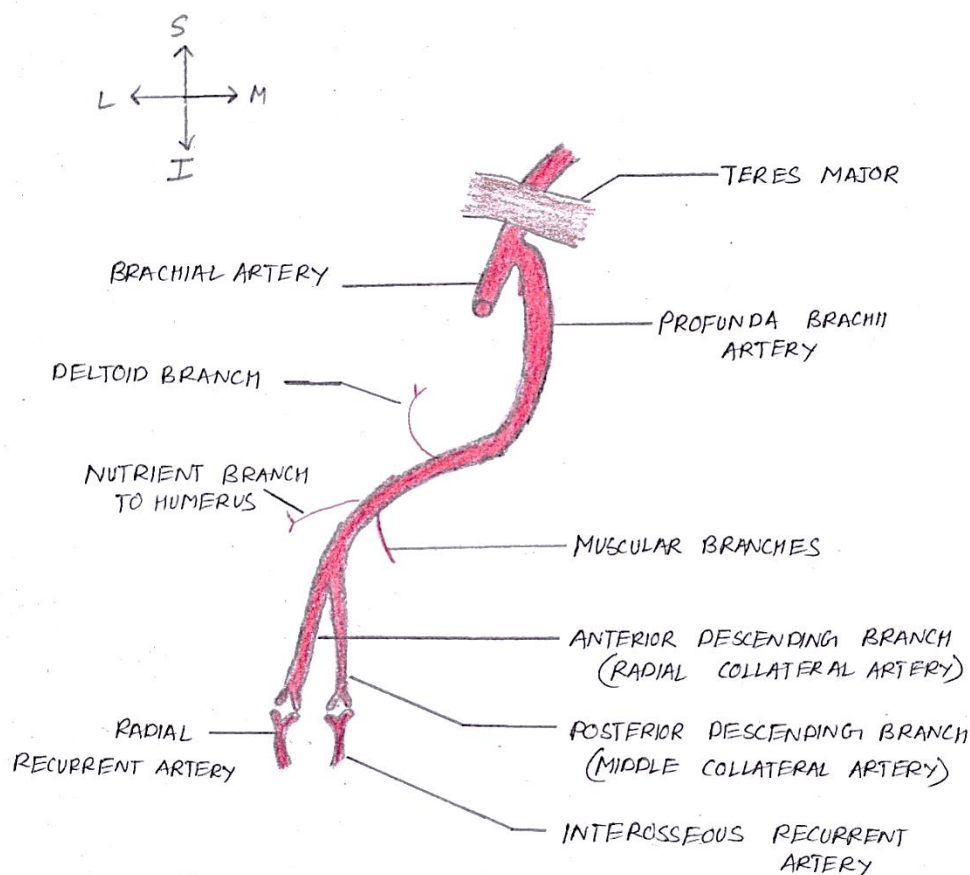


Figure: PROFUNDA BRACHII ARTERY ,

13. WRIST JOINT [RADIO CARPAL JOINT]:

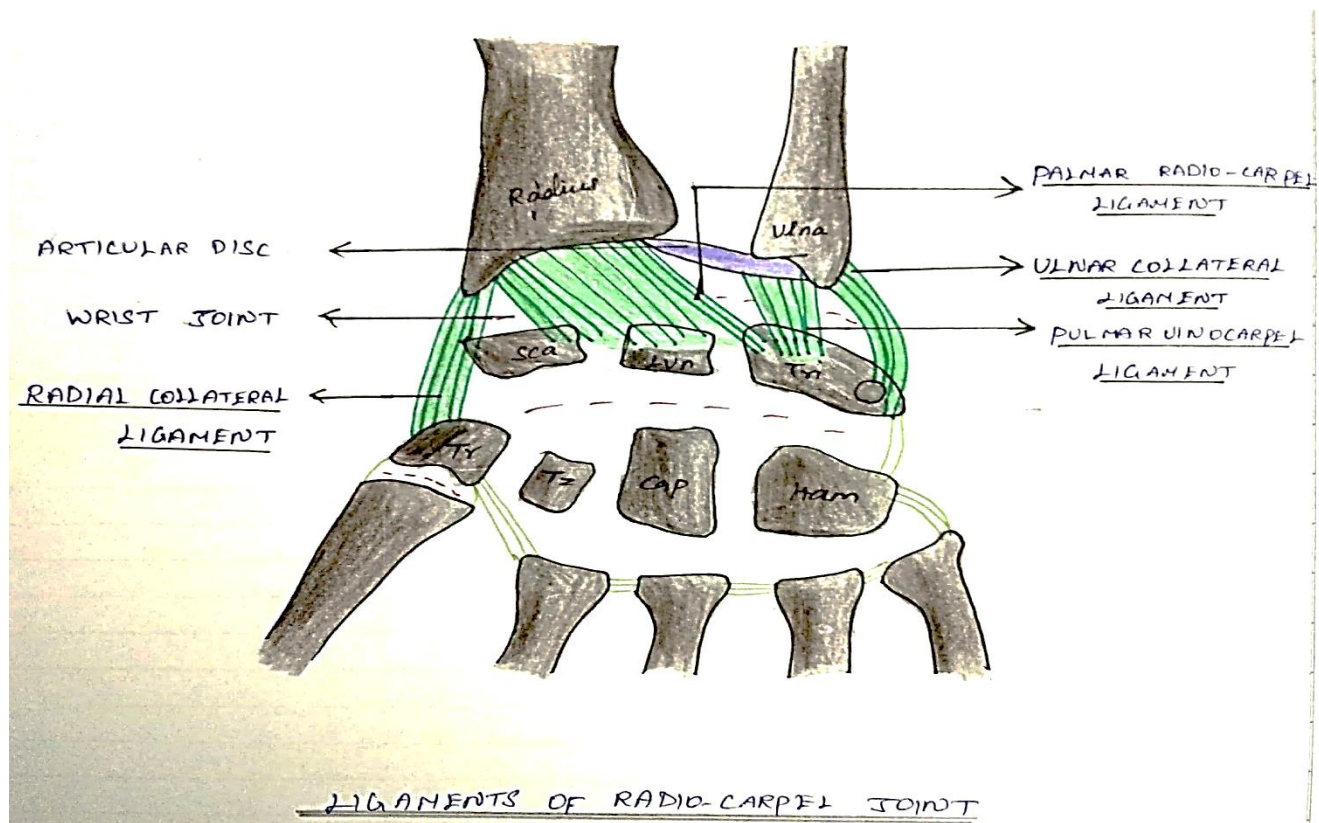
TYPE: Ellipsoid Joint

ARTICULAR SURFACES:

PROXIMAL SURFACE	DISTAL SURFACE
- Inferior surface of lower end of radius - Inferior surface of articular radio-ulnar joint disc of inferior	Proximal surfaces of scaphoid, lunate & triquetral

LIGAMENTS:

- There are 6 ligaments around wrist joint.



CAPSULAR LIGAMENT:

- Fibrous covering of joint
- **ATTACHMENT:**
 - a. **ABOVE**- to the distal ends of radius, ulna
 - b. **BELOW**- to the proximal row of carpal bones
- Synovial membrane lines the inner surface of capsule

PALMAR RADIO-CARPAL LIGAMENT:

- It is formed by thickening of lateral part of fibrous capsule
- It extends from anterior margin of lower end of radius to anterior surface of scaphoid, lunate, triquetral

PALMAR ULNO-CARPAL LIGAMENT:

- It is formed by thickening of medial part of fibrous capsule.
- It extends from styloid process of ulna and adjoining articular disc to anterior surface of lunate and triquetral.

DORSAL RADIO CARPAL LIGAMENT:

- It extends from posterior margin of lower end of radius to dorsal surface of scaphoid, lunate, triquetral.

RADIAL COLLATERAL LIGAMENT:

- It extends from styloid process of radius to lateral aspect of scaphoid & trapezium

ULNAR COLLATERAL LIGAMENT:

- It extends from styloid process of radius to lateral aspect of scaphoid & trapezium

ULNAR COLLATERAL LIGAMENT:

It extends from styloid process of ulna to medial aspect of triquetral & pisiform bones

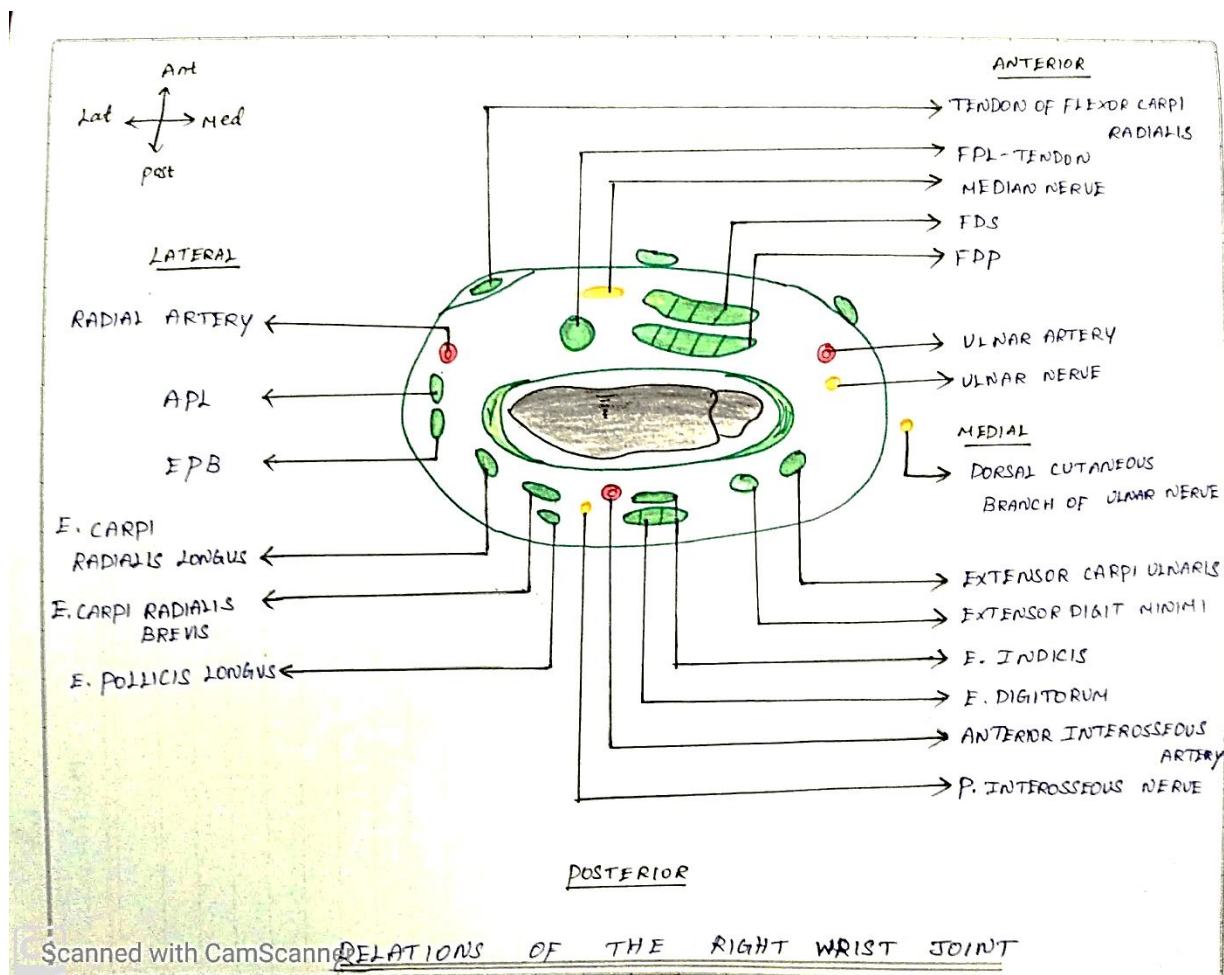
RELATIONS:

ANTERIOR:

- Tendon of flexor digitorum superficialis [FDS] and tendon of flexor digitorum profundus [FDP] associated with ulnar bursa.
- Tendon of flexor pollicis longus [FPL]
- Tendon of flexor carpi radialis
- Median nerve
- Ulnar nerve & vessels.

POSTERIOR:

- Extensor tendon of wrist and fingers
- Anterior interosseous artery
- Posterior interosseous nerve



LATERAL:

- Tendon of abductor pollicis longus [APL]
- Tendon of extensor pollicis brevis [EPB]
- Radial artery

MEDIAL:

- Dorsal cutaneous branch of ulnar nerve

MOVEMENTS:

- It is a biaxial joint
- It permits the following movements
 - a. FLEXION
 - b. EXTENSION
 - c. ABDUCTION
 - d. ADDUCTION
 - e. CIRCUMDUCTION.

CLINICAL ANATOMY:

- **GANGLION**: It is a non-tender cystic swelling due to mucoid degeneration of synovial sheath around the tendon.
- **ASPIRATION OF THE WRIST**: It is done by introducing needle posteriorly below the styloid process of radius.

14. FLEXOR RETINACULUM [TRANSVERSE CARPAL LIGAMENT]

SHAPE: Rectangular

FORMED BY: Thickening of deep fascia

- Bridges the carpal bones and forms an Osseo-fibrous tunnel called **CARPAL TUNNEL**.
- On either side it gives a slip.

SUPERFICIAL SLIP	DEEP SLIP
• On medial side	• On lateral side
• Ulnar nerve & vessels passes through it	• Tendon of flexor carpi radialis passes through it

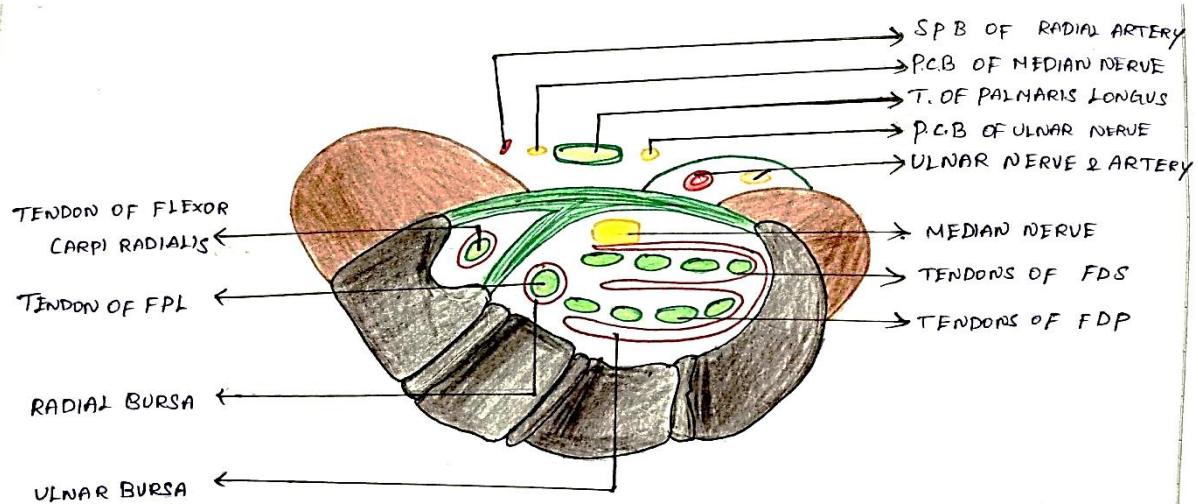
ATTACHMENT:

- **MEDIALY:** attached to pisiform & hook of hamate
- **LATERALLY:** attached to scaphoid & crest of trapezium.

RELATIONS:

STRUCTURES PASSING SUPERFICIALLY:

- Ulnar nerve
- Ulnar artery
- Palmar cutaneous branch of ulnar nerve
- Palmar cutaneous branch of median nerve
- Superficial palmar branch of radial artery
- Tendon of palmaris longus



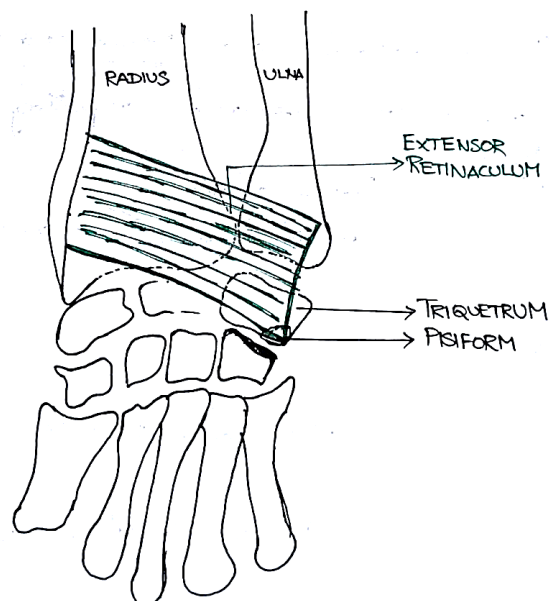
STRUCTURES PASSING DEEPLY [THROUGH CARPAL TUNNEL]:

- Tendon of flexor digitorum superficialis [FDS]
- Tendon of flexor digitorum profundus [FDP]
- Tendon of flexor pollicis longus [FPL]
- Median nerve

CLINICAL ANATOMY:

CARPAL TUNNEL SYNDROME:

- Compression of median nerve in carpal tunnel.
- Compression may due to wrist fracture, swelling or inflammation due to arthritis.



15. EXTENSOR RETINACULUM (DORSAL CARPAL LIGAMENT):

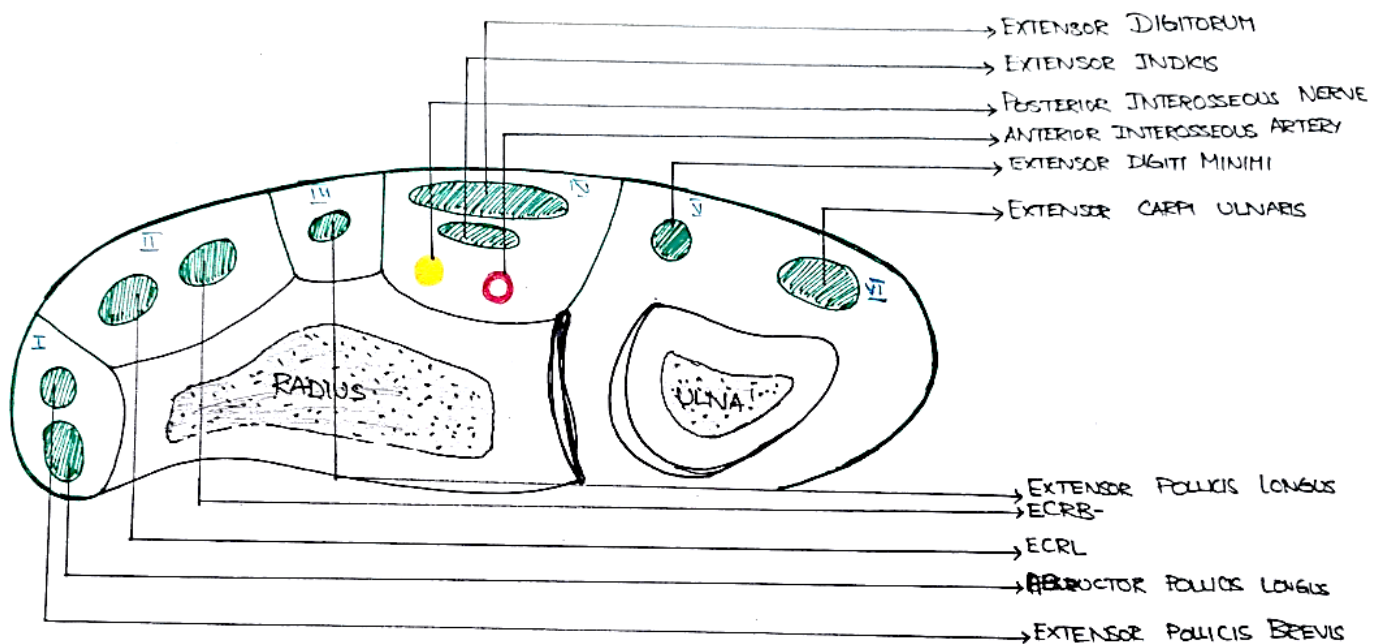
- Thickening of deep fascia to form strong fibrous band to retain tendon of long muscles in position.
- Prevents bow stringing during their action.
- Directed obliquely, medially and downwards.

ATTACHMENTS:

- LATERALLY** - Anterior border of radius
- MEDIALY** - Triquetral, pisiform and styloid process of ulna

COMPARTMENTS OF EXTENSOR RETINACULUM:

- From lateral to medial numbered as 1 to 6.
- Tendons enclosed within synovial sheaths traverse in their compartments accordingly.



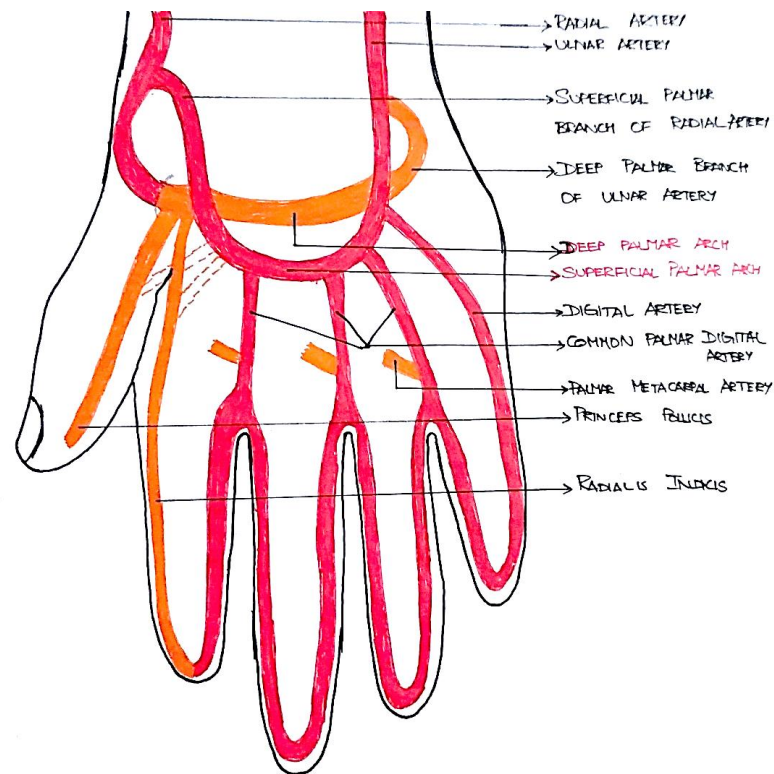
TRANSVERSE SECTION OF WRIST:

1. 1	ABDUCTOR POLLICIS LONGUS (APL) EXTENSOR POLLICIS BREVIS (EPB)	Thumb abduction Radial border of anatomical snuff box
2.	EXTENSOR CARPI RADIALIS LONGUS EXTENSOR CARPI RADIALIS BREVIS	Extension of wrist
3.	EXTENSOR POLLICIS LONGUS (EPL)	ULNAR border of anatomical snuff box
4.	EXTENSOR DIGITORUM (ED) EXTENSOR INDICIS (EI) POSTERIOR INTEROSSEOUS NERVE ANTERIOR INTEROSSEOUS ARTERY	Extension of medial 4 digits
5.	EXTENSOR DIGITI MINIMI (EDM)	Extension of little finger
6.	EXTENSOR CARPI ULNARIS (ECU)	Extension and adduction of wrist

IMPORTANT SPOTTER: ATTACHMENTS & COMPARTMENTS MAYBE SUB QUESTIONS.

16. PALMAR ARCHES:

SUPERFICIAL PALMAR ARCH	DEEP PALMAR ARCH
Direct continuation of ULNAR artery (superficial palmar branch of ulnar artery)	Direct continuation of RADIAL artery
<u>COURSE:</u> Enters palm, curves laterally behind palmar aponeurosis and in front of long flexor tendons.	<u>COURSE:</u> - Enters palm from dorsal aspect passing between 2 heads of first dorsal interosseous - Gives 2 branches : Radialis indicis, princeps pollicis - Then, passes between 2 heads of adductor pollicis.
- Completed laterally by anastomosing with any of these branches of RADIAL artery: - Superficial palmar branch of radial artery - Radialis indicis - Princeps pollicis	Completed medially by anastomosing with deep palmar branch of ULNAR artery
<u>BRANCHES:</u> 3 common palmar digital arteries 1 proper digital artery - Cutaneous branches to palm	<u>BRANCHES:</u> 3 palmar metacarpal arteries 3 perforating arteries - Recurrent branch
<u>RELATIONS:</u> - Superficial: Palmar aponeurosis - Deep: Long flexor tendons of FDS, FDP - Lumbricals - Digital branches of median and ulnar nerves	<u>RELATIONS:</u> - Superficial: Long flexor tendons, lumbricals - Deep: Proximal parts of shafts of metacarpal, interosseous muscles
<u>SURFACE ANATOMY:</u> Lies across center of palm at the level of distal border of fully extended thumb	<u>SURFACE ANATOMY:</u> Lies 1 cm proximal to superficial palmar arch



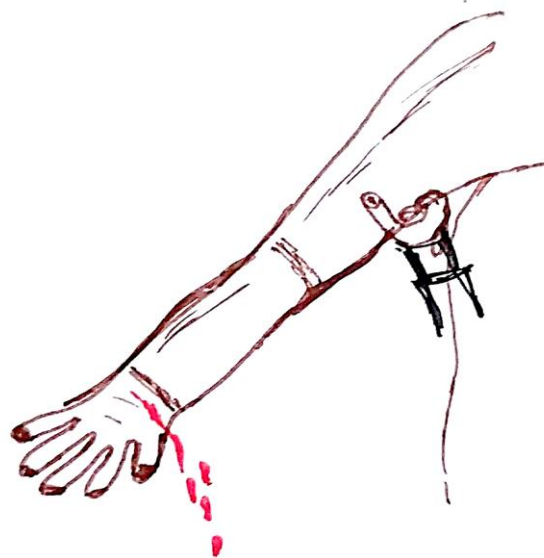
APPLIED ANATOMY:

LACERATION OF PALMAR ARTERIAL ARCH:

- Causes profuse and uncontrollable bleeding.

MOST EFFECTIVE METHOD TO CONTROL BLEEDING:

- Compression of BRACHIAL artery against



17. WINGING OF SCAPULA:

- Paralysis of serratus anterior produce winging of scapula (Wings of Heaven).
- Inferior angle and medial border of scapula more prominent.
- Paralysis of this muscle –serratus anterior due to injury to long thoracic nerve. (C5, C6, C7).
- This leads to protraction of scapula becomes weaken, arm cannot abduct beyond 90 degree.
- **CAUSES:**
 - A. Axillary node dissection after mastectomy
 - B. Stab wounds

SERRATUS ANTERIOR

ORIGIN	INSERTION	NERVE SUPPLY	CLINICALS
8 digitations from upper 8 ribs (Ribs 1-9)	• Muscle insert into costal surface of scapula • Superior angle of scapula ➤ medial border of scapula ➤ Inferior border of scapula	Long Thoracic Nerve	Paralysis of this muscle lead to winging of scapula

18. MEDIAL BORDER OF SCAPULA:

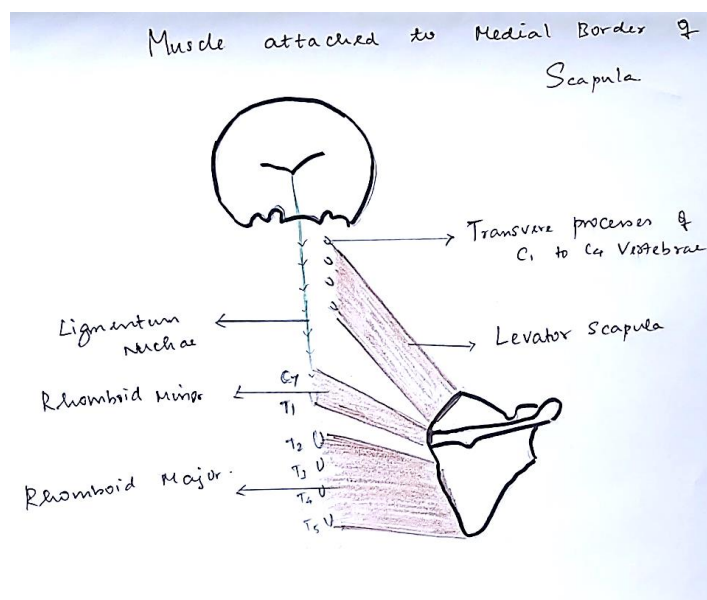
- Muscle attachment to medial border of scapula,
 - Levator scapula
 - Rhomboid major
 - Rhomboid minor

LEVATOR SCAPULAE:

ORIGIN	INSERTION	NERVE SUPPLY	ACTION
Transverse processes of C1-C4 Vertebrae	Medial border of scapula between the superior angle and root of spine	- Dorsal scapular nerve (C5) - C3 and C4 spinal nerve	Elevation of scapula and medial rotation.

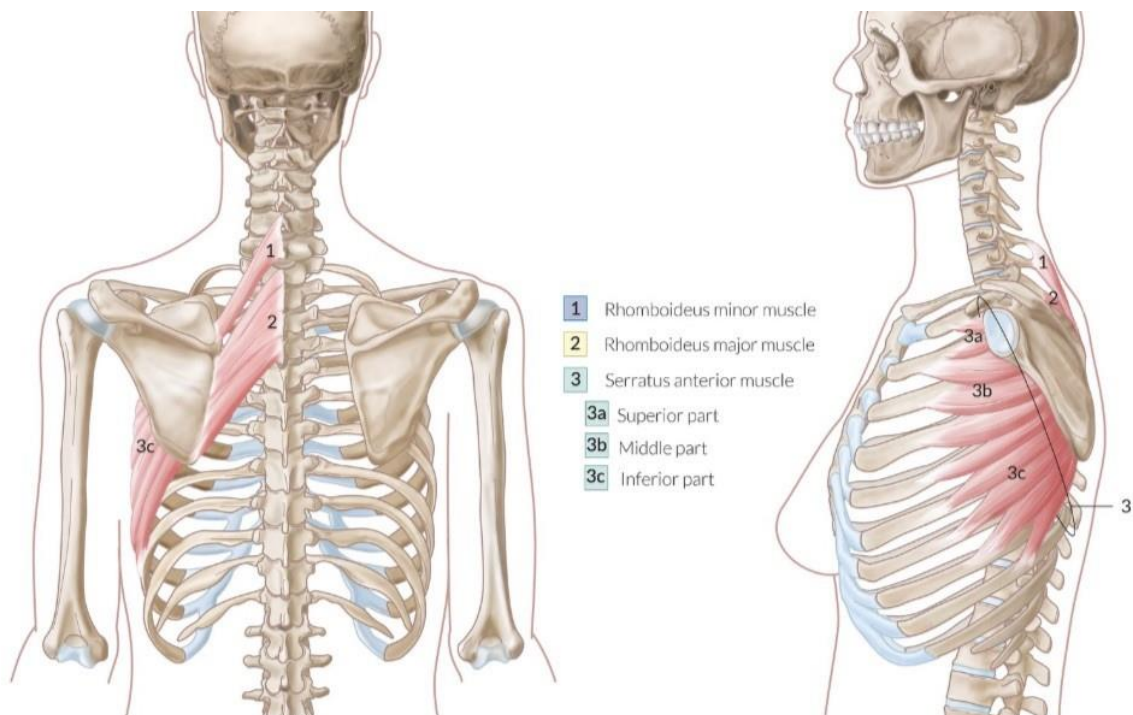
RHOMBOIDUS MAJOR:

ORIGIN	INSERTION	NERVE SUPPLY	ACTION
Spine of T2-T5 vertebrae.	Inferior part of medial border of scapula.	Dorsal scapular nerve (C5)	Retraction, medial rotation, elevation



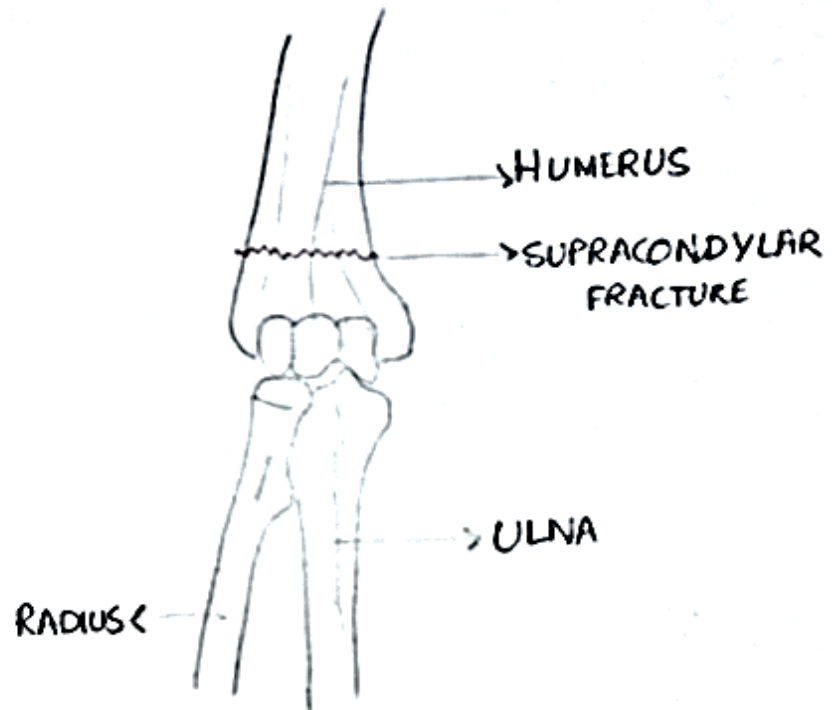
RHOMBOIDUS MINOR:

ORIGIN	INSERTION	NERVE	ACTION
- Lower part of ligmentum nuchae - Spine T2 –T5 vertebrae	Base of triangular area at root of spine of scapula	Dorsal scapular nerve (C5)	Retraction, elevation of scapula



19. SUPRACONDYLAR FRACTURE OF HUMERUS:

- Also called **MALGAIGNE'S FRACTURE**.
- It is a fracture of the distal humerus just above the elbow joint.
- The fracture is usually transverse or oblique and above the medial and lateral condyles and epicondyles.



MECHANISM OF INJURY:

EXTENSION TYPE:

- Fall on outstretched hand
- Elbow hyperextended
- Forearm-pronated or supinated

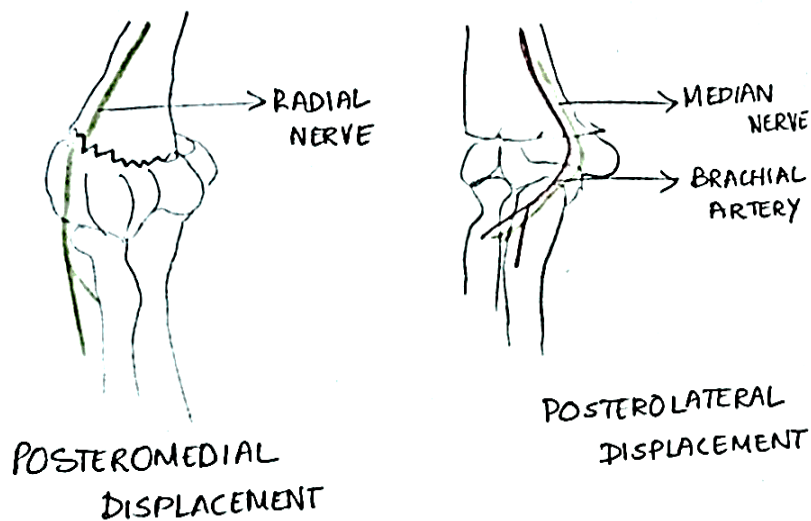
FLEXION TYPE:

- Fall directly on the elbow rather than out stretched hand

POSTEROMEDIAL DISPLACEMENT	POSTEROLATERAL DISPLACEMENT
• Fall with a forearm pronated, displaces the fragment poster medially. Medial displacement places the radial nerve at risk.	• Fall onto an outstretched supinated forearm, displaces the fragment poster laterally. Lateral displacement places the median nerve and brachial artery at risk.

CLINICAL SIGNS AND SYMPTOMS:

1. Pain and swelling
2. Tenderness in both condyles
3. Limited extension
4. S shaped deformity
5. Anterior pucker sign positive



CLINICAL CORRELATION:

- Rupture of brachial artery due to supracondylar fracture of humerus leads to Volkmann's ischemic contracture.

20. CARRYING ANGLE:

- It is an angle between the longitudinal axes of the arm and forearm
- Average angle:
 - a. For **FEMALES**: 20 (The wider carrying angle in females avoids rubbing of forearms with the wider female pelvis while carrying loads., for example buckets filled with water from one place to another.)
 - b. For **MALES**: 15 degrees.

IMPORTANCE:

- It increases progressively from childhood until 16 years.
- Epicondylar disease
- Surgical planning for elbow reconstruction.
- For Carrying objects.

FACTORS INFLUENCING CARRYING ANGLE:

- Elbow musculature/ligaments
- Forearm rotation
- Elbow flexion
- **Anatomical Factors**
 - Superior articular surface of the coronoid process of the ulna is placed obliquely to the long axis of the ulna.

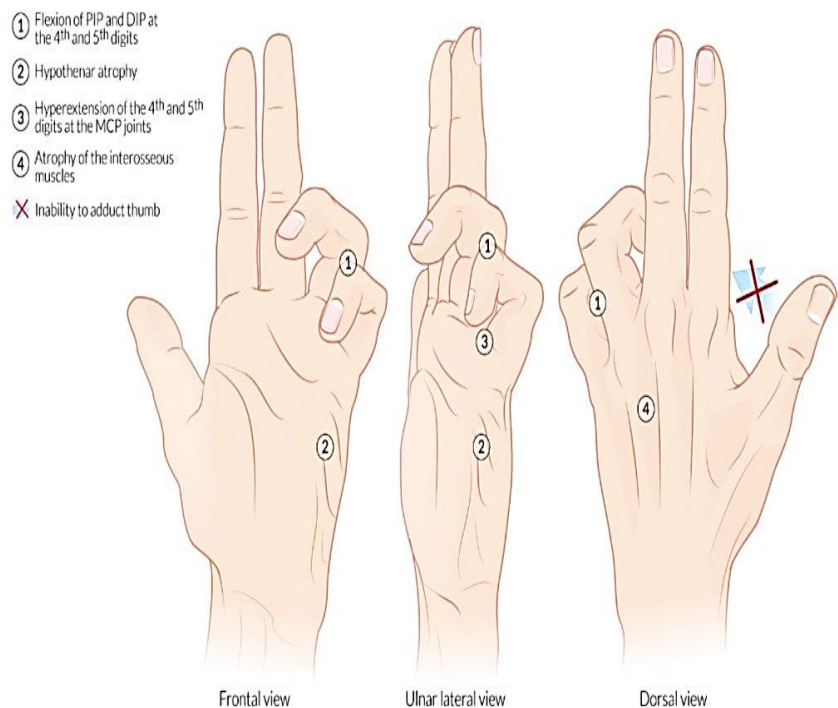


21. ULNAR CLAW HAND:

- Injury of Ulnar nerve at wrist causes Ulnar Claw Hand.
- The ulnar nerve supplies all the interossei, the 3rd and 4th lumbrical muscles, the hypothenar muscles, and the adductor pollicis.
- Atrophy of the interossei in chronic ulnar nerve palsy causes guttering of the intermetacarpal spaces and the 1st webbed space.
- The 4th and 5th joints are hyperextended at the MCP and flexed at the IP joints, resulting in an ulnar claw hand, which is caused by a paralysis of the 3rd and 4th lumbricals.

CAUSES:

- Ulnar nerve at wrist is superficial which makes it vulnerable to cuts and wounds.
- Compression in Guyon's canal.

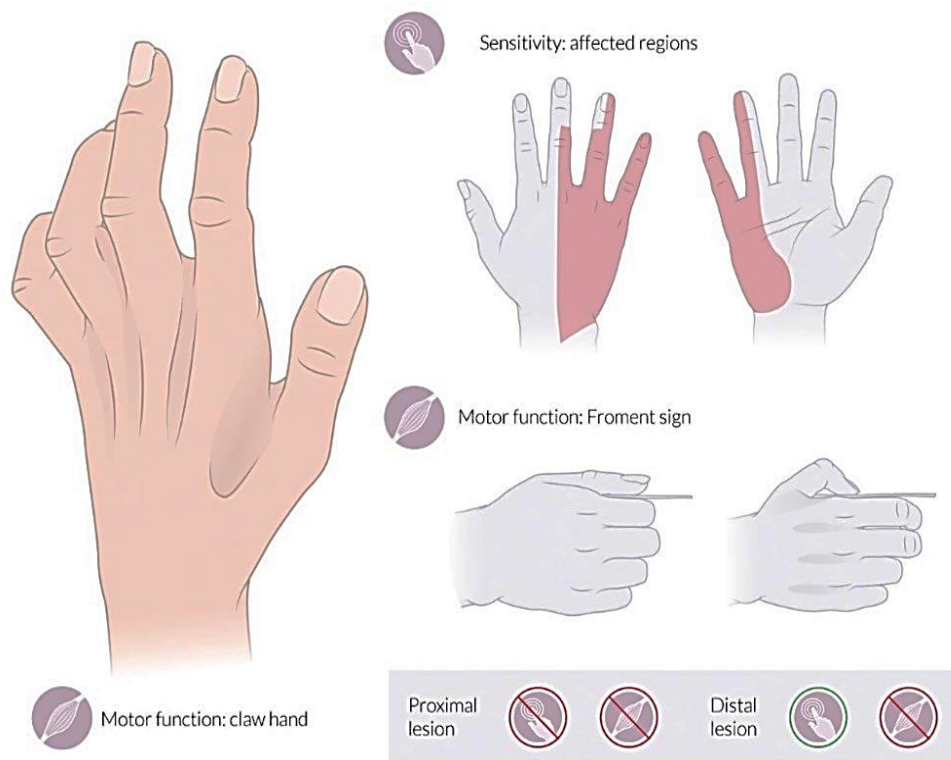
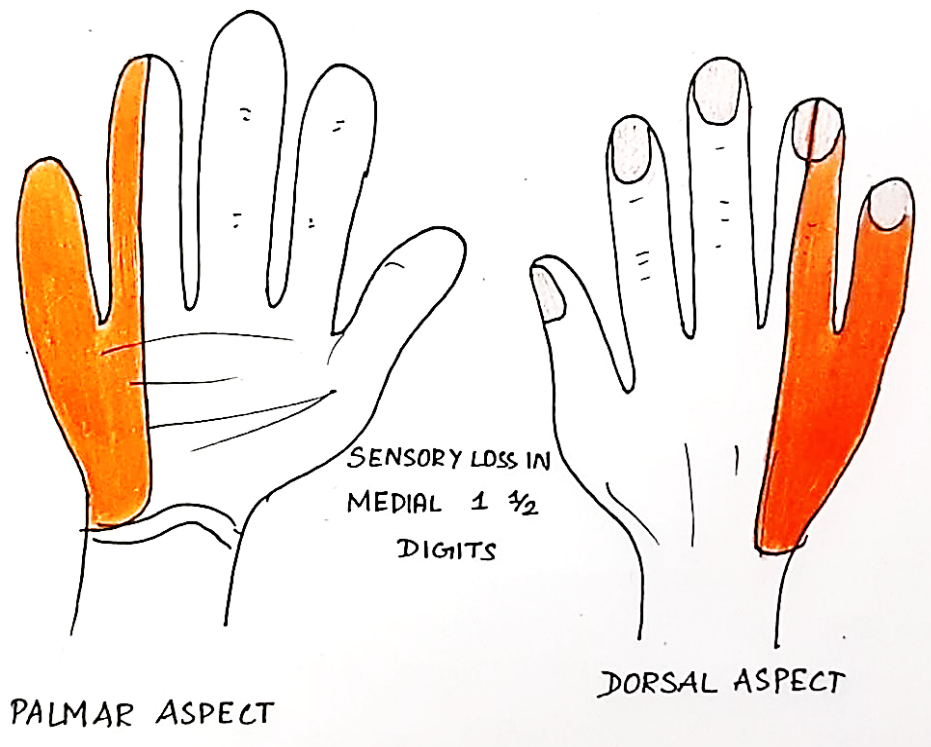


CLINICAL FEATURES OF ULNAR CLAW HAND:

- Hyperextension at metacarpophalangeal joints, flexion at the interphalangeal joints, involving ring and little finger more than middle and index finger.
- Claw hand deformity is more obvious in wrist lesions as Flexor Digitorum Profundus is not paralyzed, hence there is marked flexion at terminal phalanges.
- Atrophy and flattening of hypothenar eminence.
- Loss of adduction (2, 4, 5 digits).
- Loss of abduction (2, 3, 4 digits).
- Gutters seen in palm.
- Froment's sign positive.

- Sensory loss over medial 1 ½ digits in both palmar and dorsal aspect. [Injury of both ulnar and median nerve causes complete or true ulnar claw hand]

SENSORY LOSS IN HAND IN ULNAR NERVE INJURY



22. ANATOMICAL SNUFF BOX:

- Triangular depression at the base of thumb.
- Best seen in extended thumb.

BOUNDARIES:

ANTEROLATERALLY:

- Tendon of Abductor pollicis longus.
- Tendon of Extensor pollicis brevis.

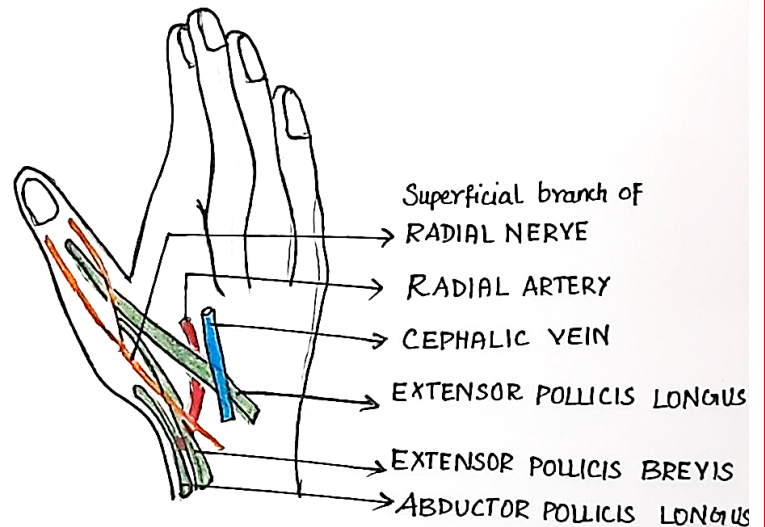
POSTEROMEDIALY:

- Tendon of Extensor pollicis longus.

STRUCTURES CROSSING THE ROOF:

- Cephalic vein (medial to lateral)
- Terminal branch of superficial radial nerve (lateral to medial)

ANATOMICAL SNUFF BOX.



CONTENT:

- Radial Artery.

APPLIED ASPECTS:

- Cephalic vein at roof of Anatomical snuffbox often used for giving intravenous fluids.
- Tenderness in anatomical snuff box indicates fracture of Scaphoid bone.
- Pulsations of radial artery can be felt in the anatomical snuff box.

23. EXTENSOR RETINACULUM:

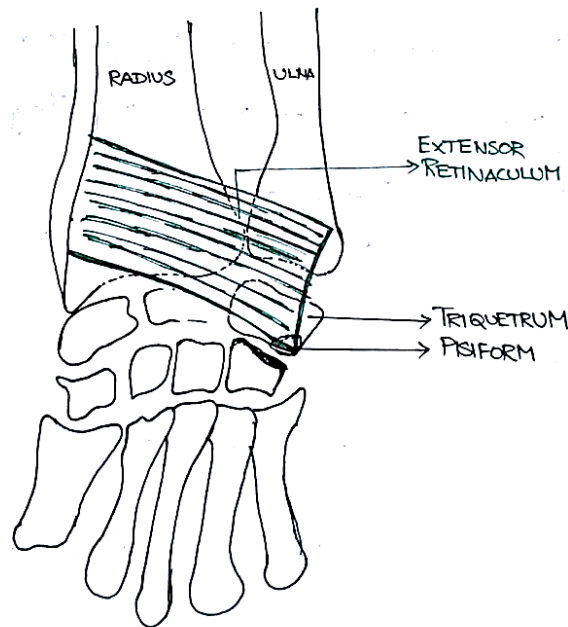
- It is the thickened deep fascia on the back of the wrist.
- It is an oblique band - directed downwards medially.
- It holds the tendons of extensor muscles in place.

ATTACHMENTS:

LATERALLY - lower part of sharp anterior border of radius

MEDIALY

- Styloid process of ulna
- Triquetrum
- Pisiform

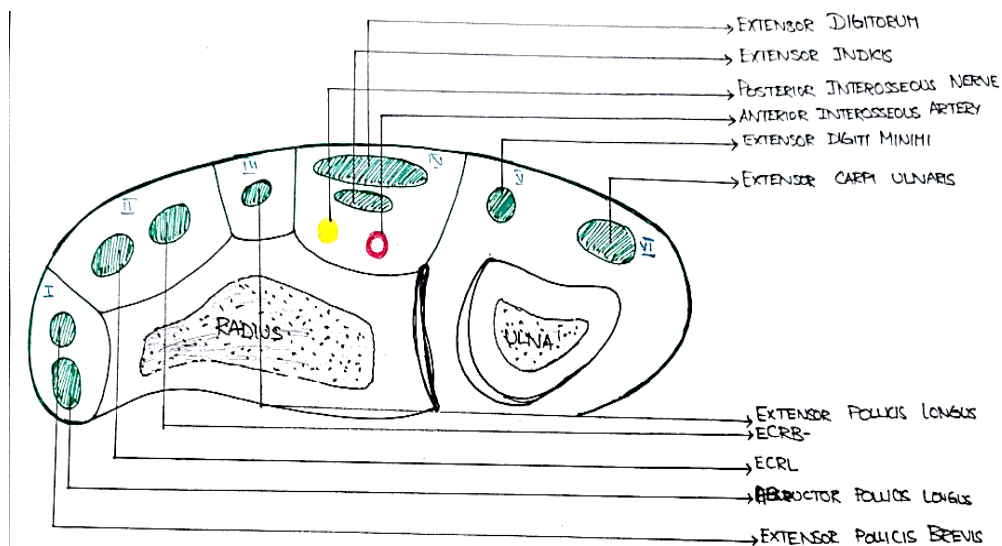


COMPARTMENTS:

- The retinaculum sends down septa which are attached to the posterior surface of lower end of radius.
- Thus 6 osseo-fascial compartments are formed.
- Each compartment is lined by synovial sheath which is reflected onto the contained tendons

COMPARTMENTS:

COMPARTMENTS	STRUCTURES PRESENT IN THE COMPARTMENTS
I	- Abductor pollicis Longus - Extensor pollicis brevis
II	- Extensor carpi radialis Longus - Extensor carpi radialis brevis
III	Extensor pollicis longus
IV	- Extensor digitorum - Extensor indicis - Posterior interosseous nerve - Anterior interosseous artery
V	Extensor digiti minimi
VI	Extensor carpi ulnaris

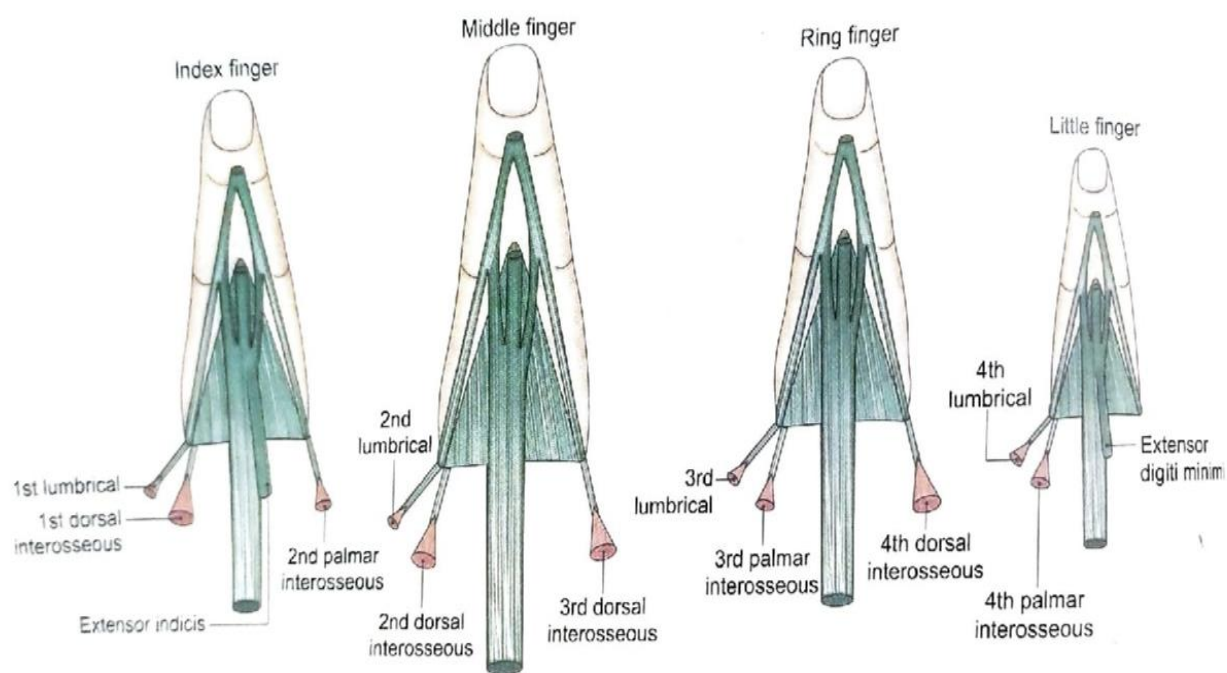


24. DORSAL DIGITAL / EXTENSOR EXPANSION:

- It is a small triangular aponeurosis covering the dorsum of proximal phalanx.
- This aponeurosis is related to the tendons of **extensor digitorum**.
- Its base is proximal and covers the metacarpophalangeal (MP) joint.
- Main tendon of extensor digitorum occupies the central part and is separated from the MP joint by a **bursa**.
- **Tendons of interossei and lumbrical** muscles join at posterolateral corners of extensor expansion.
- Corners are attached to **deep transverse metacarpal ligament**.
- **Wing tendons** - The point of attachment of interossei and lumbrical is often called wing tendon
- Near the **proximal interphalangeal joint** extensor tendon divides into **a central slip** and **2 collateral slips**.
- Central slip is inserted into the **dorsum of the base of the middle phalanx**.
- Collateral slips along with thick margin of extensor expansion are inserted into **the dorsum of base of distal phalanx**.
- Extensor expansion forms the dorsal part of fibrous capsule of metacarpophalangeal and interphalangeal joints.

MUSCLES INSERTED INTO DORSAL DIGITAL EXPANSION:

- **INDEX FINGER:** 1st dorsal interosseous, 2nd palmar interosseous, 1st lumbrical, extensor digitorum slip and extensor indicis.
- **MIDDLE FINGER:** 2nd and 3rd dorsal interossei, 2nd lumbrical, extensor digitorum slip.
- **RING FINGER:** 4th dorsal interosseous, 3rd palmar interosseous, 3rd lumbrical and extensor digitorum slip.
- **LITTLE FINGER:** 4th palmar interosseous, 4th lumbrical, extensor digitorum slip and extensor digiti minimi.



25. POSTERIOR INTEROSSEOUS NERVE:

- Posterior interosseous nerve is **motor and chief nerve of the back of the forearm**.

ORIGIN:

- It begins in the cubital fossa as one of the two terminal branches of **radial nerve** at the level of lateral epicondyle of humerus.

COURSE:

- PIN leaves cubital fossa by winding around lateral side of neck of radius in the substance of **supinator**.
- After emerging from supinator, it runs in fascial plane between superficial and deep extensor muscles.

At the lower border of extensor pollicis brevis, it passes deep to extensor pollicis

BRANCHES:

I. MUSCULAR BRANCHES:

- Before piercing supinator- extensor carpi radialis brevis and supinator
- While passing through supinator – supinator
- After emerging from supinator- extensor digitorum, extensor digiti minimi, extensor carpi ulnaris and all deep extensors.

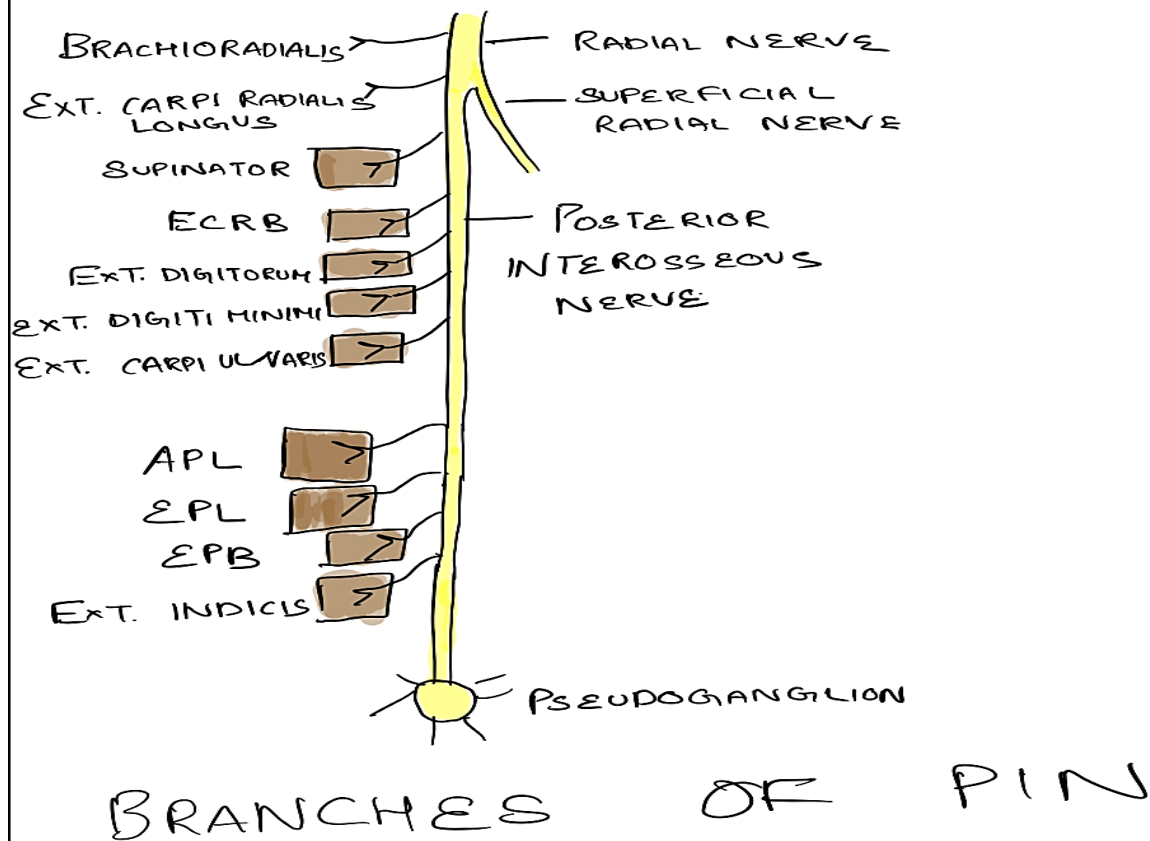
II. ARTICULAR BRANCHES TO

- Wrist
- Distal radio-ulnar
- Carpal joints

CLINICAL ANATOMY:

LESION OF POSTERIOR INTEROSSEOUS NERVE:

- **CAUSE:** Damaged during surgical exposure of head of radius in fracture of proximal end of radius.
- Wrist drop does not occur as extensor carpi radialis longus is spared which is supplied by radial nerve directly



26. POSTERIOR INTEROSSEOUS ARTERY

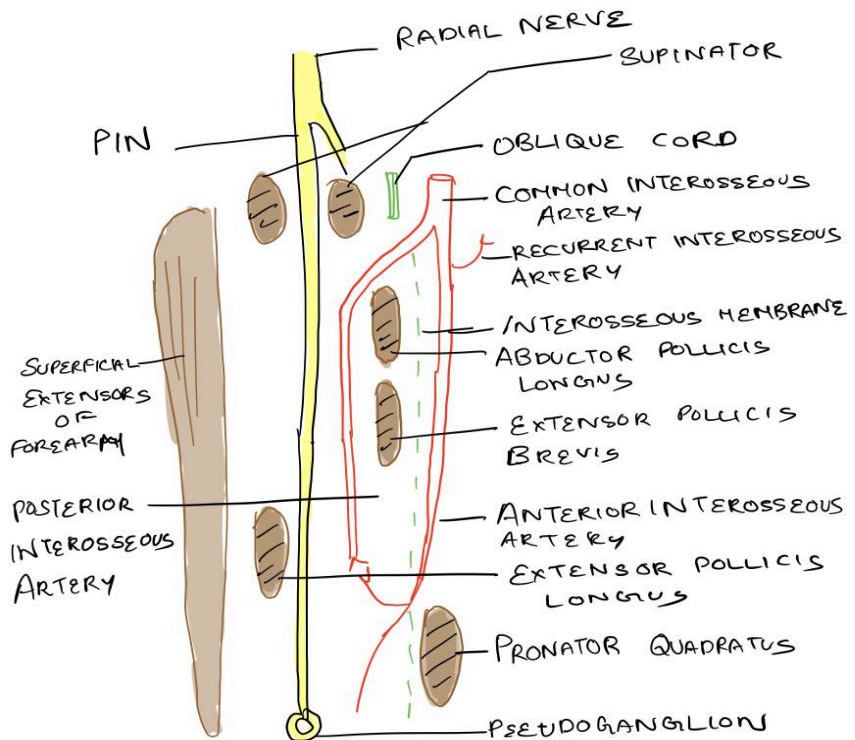
- Posterior interosseous artery is smaller terminal branch of the common interosseous artery from **ulnar artery**.

ORIGIN:

- It begins in cubital fossa, enters back of forearm by passing through the gap between oblique cord and upper margin of interosseous membrane.

COURSE:

- Posterior interosseous artery passes between supinator and abductor pollicis longus accompanying the posterior interosseous nerve.
- In lower part of forearm, it ends by anastomosing with anterior interosseous artery



COURSE & RELATIONS OF POSTERIOR INTEROSSEOUS ARTERY

BRANCHES:

- INTEROSSEOUS RECURRENT ARTERY** - Takes part in formation of anastomosis around elbow joint.
- MUSCULAR BRANCHES** to supinator, abductor pollicis Lingus, extensor muscles of forearm.

27. CEPHALIC VEIN:

- Cephalic vein is the preaxial limb of upper limb

FORMATION:

- Lateral end of dorsal venous arch

COURSE:

- It runs upwards through the roof of anatomical snuff box.
- Winds around the lateral border of distal part of forearm
- It continues upwards in front of the elbow and along the lateral border of biceps brachii.
- Pierces the deep fascia at the lower border of pectoralis major.
- Runs in the deltopectoral groove up to the infraclavicular fossa.
- It pierces the clavipectoral fascia and joins the axillary vein

AREA OF DRAINAGE:

- At the elbow, the greater part of blood is drained into basilic vein through median cubital vein and partly into deep veins through perforator vein.

RELATION:

- It is accompanied by Lateral cutaneous nerve of forearm & Terminal part of radial nerve.

TERMINATION:

- Drains into the axillary vein.

28. DELTOID:

ORIGIN:

1. Anterior border and adjoining surface of lateral one third of clavicle.
2. Lateral border of acromion where septa of origin are attached.
3. Lower lip of the crest of the spine of scapula.

INSERTION:

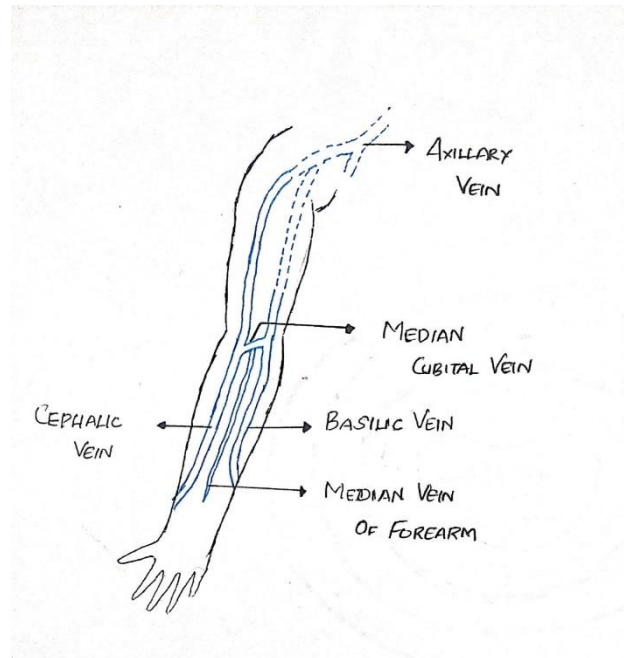
- Deltoid tuberosity of the humerus where three septa of insertion are attached.

NERVE SUPPLY:

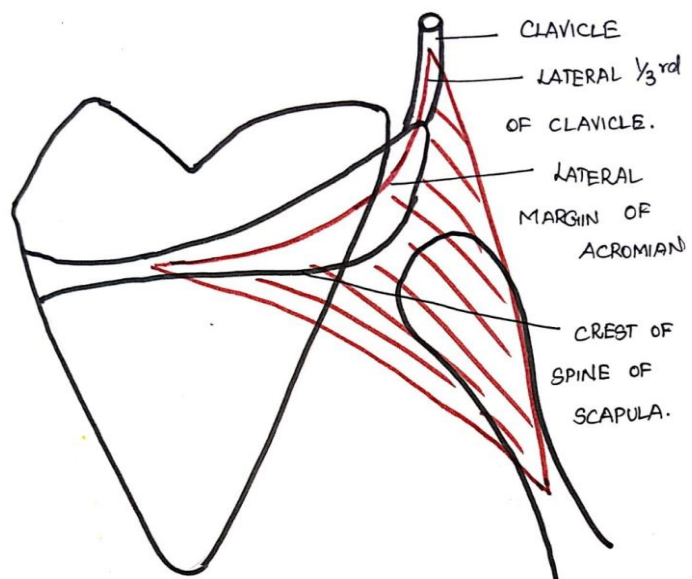
- Axillary nerve (C5, C6)

ACTIONS:

- Powerful abductors of arm at the shoulder joint from beginning to 90 degree.
- Anterior fibres are flexors and medial rotators of arm.
- Posterior fibres are extensors and lateral rotators of arm.



four
the



STRUCTURES UNDER COVER OF DELTOID:

BONES:

- Upper end of the humerus.
- Coracoid process.

MUSCLES INSERTION:

- Pectoralis minor on coracoid process.
- Supraspinatus, infraspinatus and teres minor on greater tubercle of the humerus.
- Subscapularis on lesser tubercle of humerus.
- Pectoralis major, teres major and latissimus dorsi on the
- Long head of triceps brachii from infraglenoid tubercle.
- Lateral head of triceps brachii from the upper part of posterior surface of humerus.
- Intertubercular sulcus of humerus.

MUSCLES ORIGIN:

- Coracobrachialis and short head of biceps brachii from coracoid process
- Long head of biceps brachii from the supraglenoid tubercle.

VESSELS:

- Anterior circumflex humeral.
- Posterior circumflex humeral.

NERVE:

- Axillary nerve

JOINTS AND LIGAMENTS:

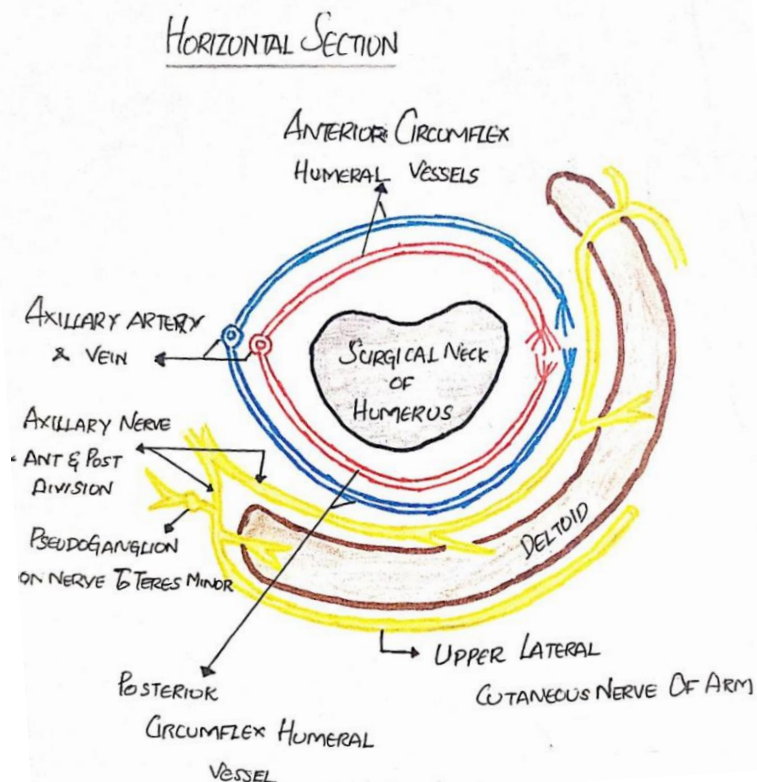
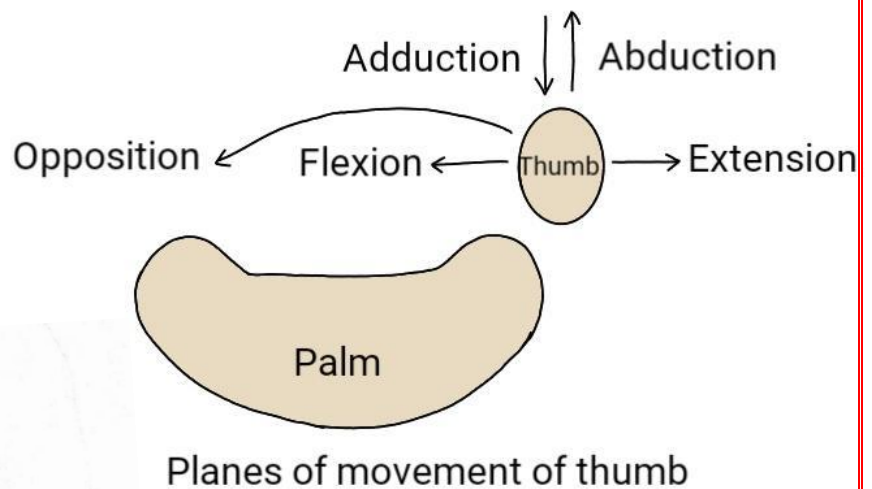
- Musculotendinous cuff of shoulder.
- Coracoacromial ligament.

BURSAE:

- Subacromial bursa and subdeltoid bursa.

CLINICAL ANATOMY:

- Intramuscular injection is often given in the deltoid. It should be given in the middle of the muscle to avoid injury to the axillary nerve.
- Axillary nerve may be damaged by dislocation of shoulder or by the fracture of surgical neck of humerus



29. MUSCLES CONTROLLING MOVEMENT OF THUMB:

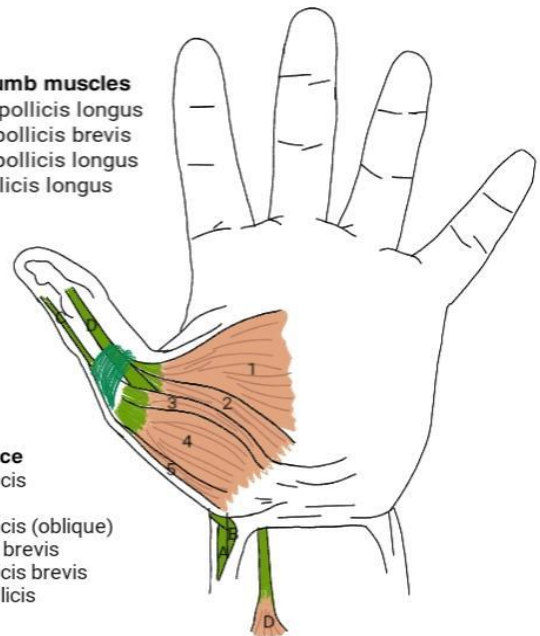
- The muscles controlling the movements of thumb are
 - a. Three muscles of thenar eminence: abductor pollicis brevis, flexor pollicis brevis, opponens pollicis
 - b. Adductor pollicis
 - c. First dorsal interossei

Extrinsic thumb muscles

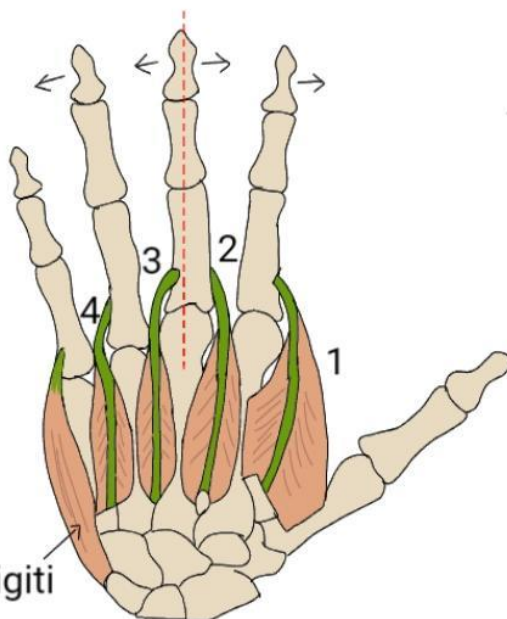
- A. Abductor pollicis longus
- B. Extensor pollicis brevis
- C. Extensor pollicis longus
- D. Flexor pollicis longus

Thenar eminence

1. Adductor pollicis (transverse)
2. Adductor pollicis (oblique)
3. Flexor pollicis brevis
4. Abductor pollicis brevis
5. Opponens pollicis



Axis of movement



Abductor digiti
minimi

MUSCLE	ORIGIN	INSERTION	NERVE SUPPLY	ACTION	TEST
ABDUCTOR POLLICIS BREVIS	Tubercle of scaphoid, crest of trapezium, flexor retinaculum	Base of proximal phalanx of thumb	Median nerve	Abduction of thumb	<u>PEN /PENCIL TEST:</u> lay the hand flat on table with palm directed upwards. The patient is unable to touch the pen/pencil held in front of palm
FLEXOR POLLICIS BREVIS	flexor retinaculum, crest of trapezium, capitate bones	Base of proximal phalanx of thumb	Median nerve	Flexes metacarpophalangeal joint of thumb	

MUSCLE	ORIGIN	INSERTION	NERVE SUPPLY	ACTION	TEST
OPPONENS POLLICIS	Flexor retinaculum , crest of trapezium	Lateral half of palmar surface of shaft of metacarpal bone of thumb	Median nerve	Pulls thumb medially and forward across palm (oppositi on)	Request the patient to touch the proximal phalanx of 2nd to 5th with tip of thumb.
ADDUCTOR POLLICIS	<u>OBLIQUE HEAD:</u> bases of 2nd and 3rd metacarpals <u>TRANS-VERSE HEAD:</u> shaft of 3 rd metacarpal	Base of proximal phalanx of thumb on its medial aspect	Deep branch of ulnar nerve	Adduction of thumb	<u>FORMENT'S SIGN OR BOOK TEST:</u> Ask the subject to grasp a book firmly between thumbs and other fingers of both the hands, the terminal phalanx of the thumb on paralyzed side becomes flexed at interphalangeal joint.
FIRST DORSAL INTEROSSEI	Adjacent sides of shaft of 1 st and 2 nd metacarpal	Via extensor expansion into dorsum of bases of distal phalanx of 2nd digit	Deep branch of ulnar nerve	Flex metacarp o phalangea l joint and extend interphala ngeal joint abduction	Ask the subject to abduct the thumb against resistance. As index finger is abducted one feels 1st dorsal interossei

30. APPLIED ASPECTS OF HAND

DUPUYTREN'S CONTRACTURE:

- This condition is due to inflammation involving the ulnar side of palmar aponeurosis. There is thickening and contraction of aponeurosis.
- As a result, the proximal phalanx and later the middle phalanx become flexed and cannot be straightened.
- The terminal phalanx remains unaffected. The ring finger is most commonly involved.

RADIAL PULSATION:

- The radial artery is used for feeling pulse at wrist.
- The pulsation can be felt well in this situation because of presence of flat radius

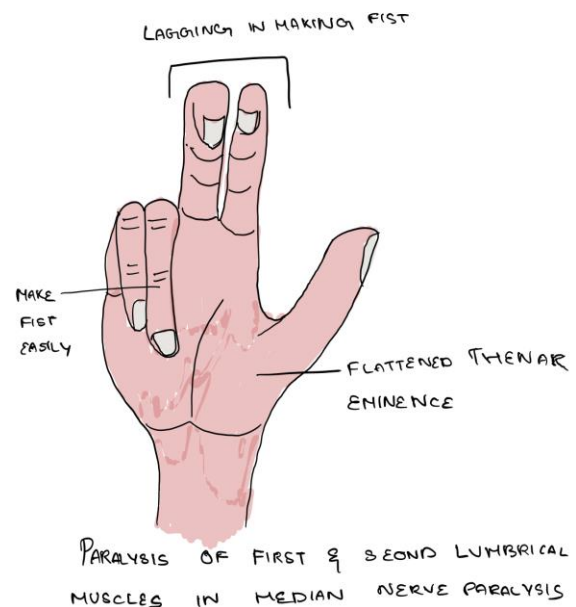
ULNAR CLAW HAND:

- Due to ulnar nerve lesion at wrist hyper-extension at metacarpo phalangeal joints and flexion at interphalangeal joints, involving ring and little fingers- more than index and middle fingers.
- Sensory loss in medial $\frac{1}{3}$ of palm and medial 1 and $\frac{1}{2}$ of fingers including nail beds, medial half of dorsum of hand.
- Skin with sensory loss is drier and warmer due to loss of sympathetic supply and arteriolar dilation respectively.



CARPAL TUNNEL SYNDROME:

- Compression of median nerve in carpal tunnel at wrist.
- Wasting of thenar eminence (ape like hand)
- Hypoesthesia to light touch palmar aspect of lateral 3 and ½ digits.
- **FORMENT'S SIGN** positive.
- **PAPER HOLDING TEST**: unable to hold.
- **MOTOR CHANGES**: ape thumb deformity - loss of opposition of thumb.
- **SENSORY CHANGES**: loss of sensation on lateral 3 ½ digits.
- **VASOMOTOR CHANGES**: skin areas are warmer and drier.
- **TROPHIC CHANGES**: Long standing cases of paralysis lead to dry and scaly skin.
- The nails crack easily with atrophy of pulp of fingers.
- Both in male and female between age of 25 and 70.
- Intermittent attacks of pain in distribution of median nerve.
- More common due to excessive working in computer.
- Phalen's test positive.
- Complete claw hand present.



31. CLINICAL ANATOMY OF PALMAR SPACES

- A number of fascial spaces in the region of hand are formed due to arrangement of fasciae and fascial septa.
- Palmar spaces include:
 - a. Midpalmar space
 - b. Thenar space
 - c. Pulp space of the fingers

MID-PALMAR SPACE:

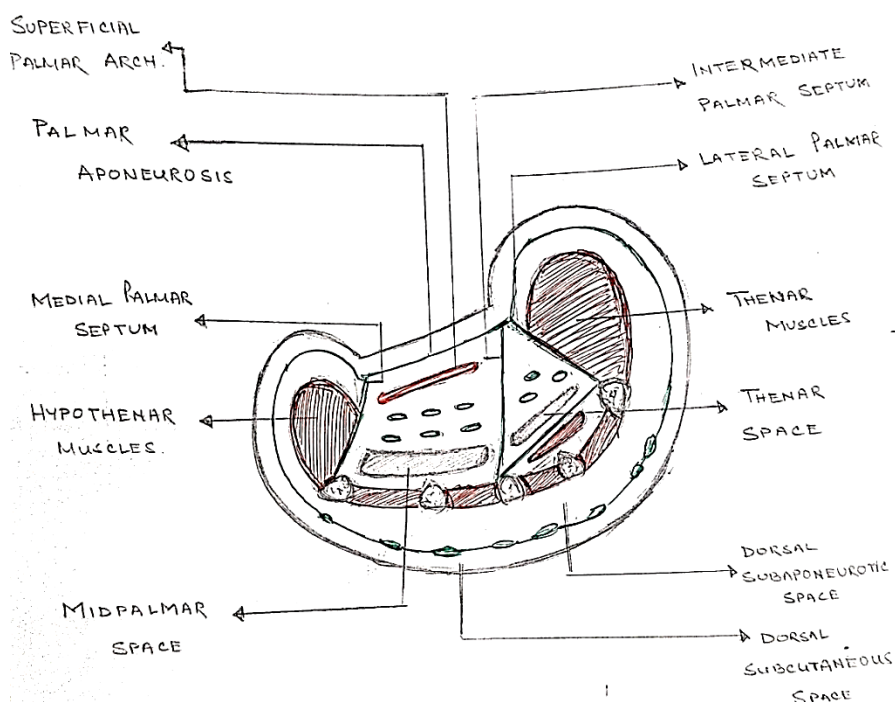
- Primarily infected by puncture wounds.
- May be involved secondarily due to infection spreading from digital synovial sheaths of flexor tendons.
- Pus can be drained by an incision into 3rd or 4th web space, depending on where the pus points.

THENAR SPACE:

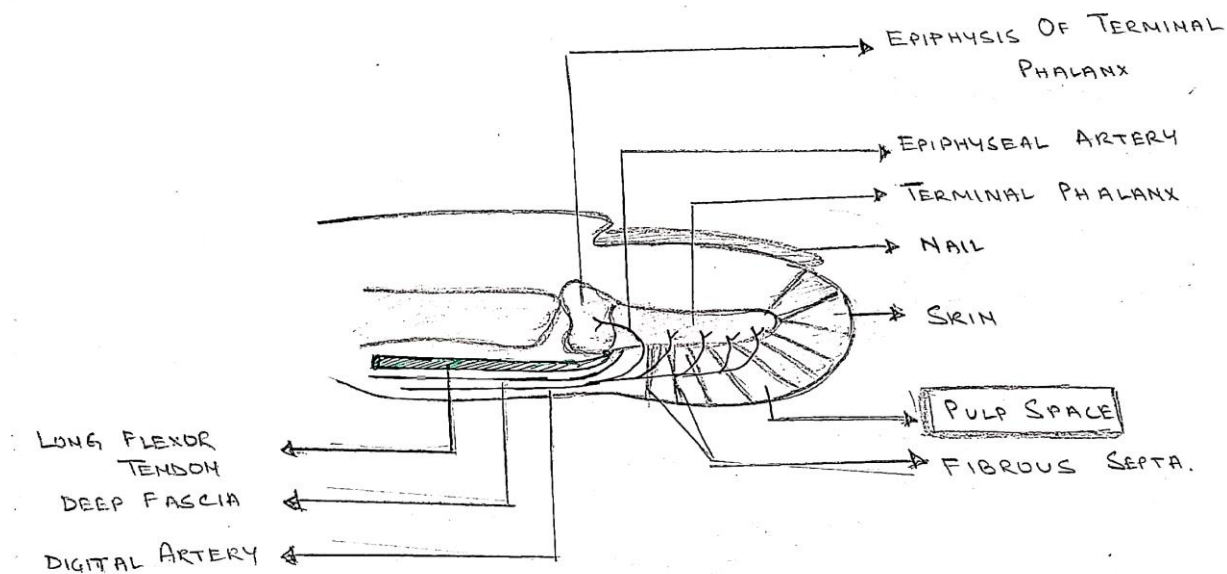
- Primarily infected by puncture wounds.
- May be involved secondarily due to infection spreading from digital synovial sheath of index finger.
- Pus can be drained by an incision in the 1st web space, depending on where the pus points.

PULP SPACE:

- The infection of pulp space called **WHITLOW**.
- Increasing tension in the space gives rise to severe throbbing pain.



- Infections can be drained by a lateral incision which opens all compartments and prevents damage to the tactile tissue in front of finger.
- If neglected it can produce necrosis of distal 4/5th of the phalanx due to occlusion of digital artery by the tension.
- The complete regeneration is possible because the proximal epiphyseal portion of phalanx remains unaffected.

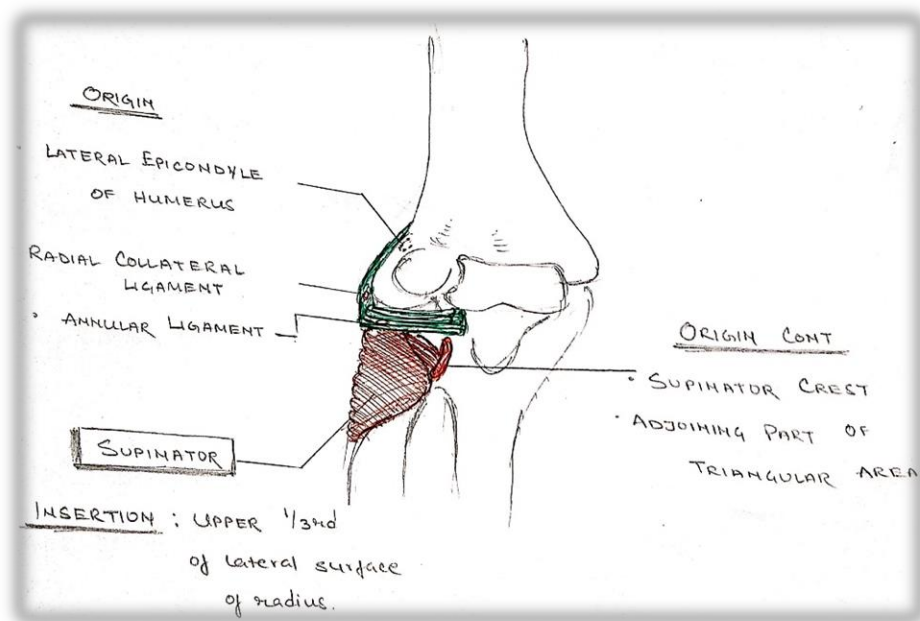


32. SUPINATOR MUSCLE:

- The supinator muscle is located in the posterior compartment of the forearm.

STRUCTURE:

- The supinator is a broad muscle in the superior and posterior compartment of the forearm
- It curves around the upper third of the radius and consists of two layers of fibres.
- In between these layers lies the deep branch of the radial nerve.



ORIGIN:

- The two layers of fibres originate in common from:
 - lateral epicondyle of humerus
 - annular ligament of superior radioulnar joint
 - supinator crest of ulnar and depression behind it
- The superficial layer of fibres has a tendinous origin and surround the upper part of the radius.
- The deeper layer of fibres encircles the neck of the radius above the radial tuberosity.

INSERTION:

- Neck and whole shaft of upper 1/3rd of radius

INNERVATION:

- Deep branch of the radial nerve

FUNCTION:

- Supination of forearm when elbow is extended

CLINICAL RELEVANCE:

- **SUPINATOR ENTRAPMENT SYNDROME** (or posterior interosseous nerve syndrome).
- The entrapment and compression of Posterior interosseous nerve between the fibres of supinator muscle could potentially result in selective paralysis of the muscles served by this nerve.
- Possible causes are - compression by various soft-tissue masses surrounding the nerve, and stress caused by repetitive supination and pronation.

ASSESSMENT:

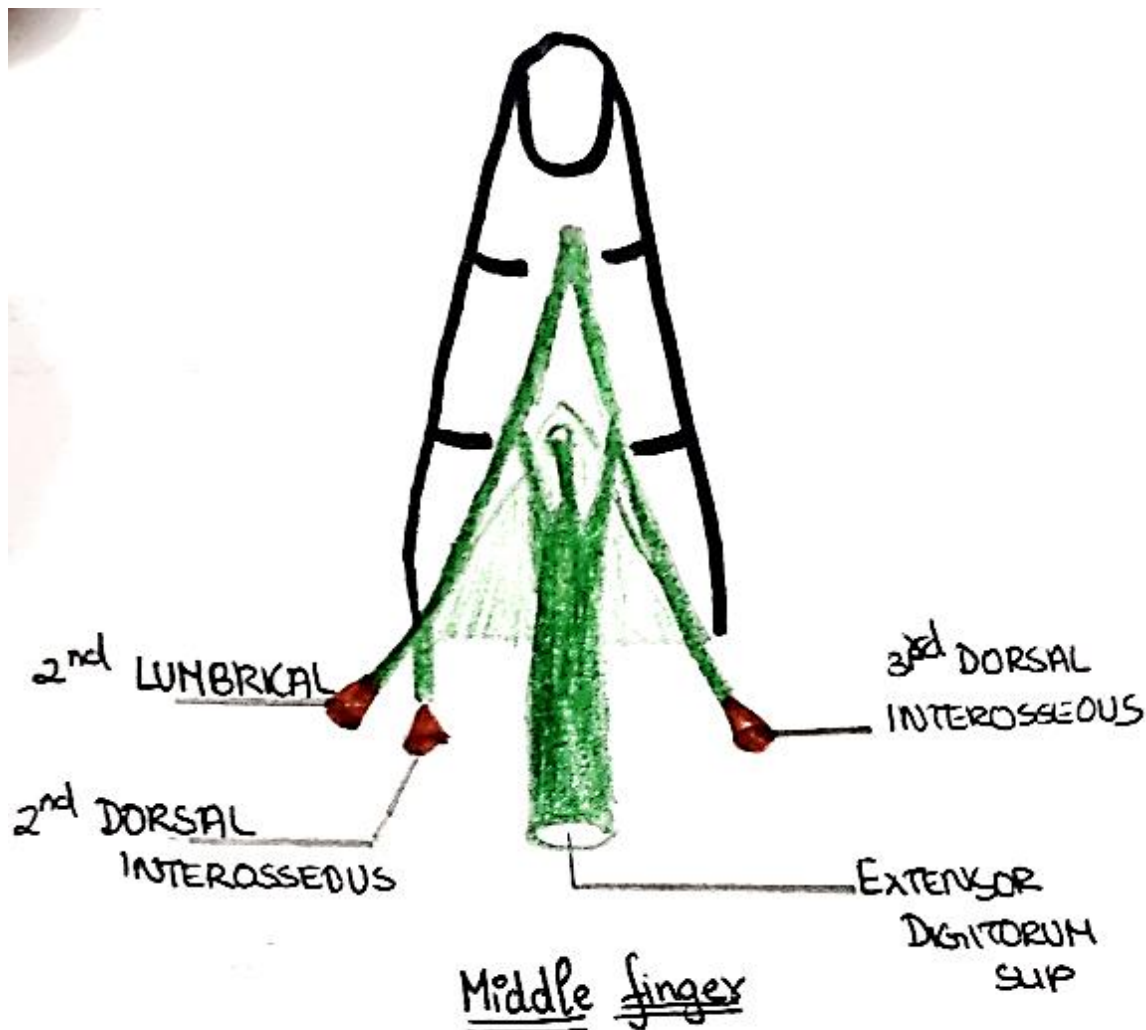
- Place the patient's arm and elbow in extended position with the forearm in mid-position.
- Actively resist supination and palpate along the posterior part of the proximal third of the radius.

33. EXTENSOR EXPANSION OF MIDDLE FINGER:

- Also called **DORSAL DIGITAL EXPANSION**
- Small triangular Aponeurosis, covering the dorsum of proximal phalanx.

PARTS:

1. **BASE:** Covers metacarpophalangeal joint
 2. **CENTRAL PART:** formed by main part of extensor digitorum tendon. It is separated from the joint by a bursa
 3. **POSTEROLATERAL CORNERS:** are joined by tendons of interossei (proximal) and lumbrical (distal). The points of attachments of these tendons are called '**WING TENDONS**'.
 4. **CORNERS:** are attached to deep transverse metacarpal ligament.
- Near the proximal interphalangeal joint:



- **EXTENSOR TENDON** divides into
 - Central slip, inserted in to the dorsum of base of middle phalanx
 - 2 collateral slips, inserted into the dorsum of base of terminal phalanx
- **Retinacular or link ligament:**
 - Extends from the side of proximal phalanx, form its fibrous flexor sheath, to margins of extensor expansion to reach the base of distal phalanx.
- **THE MUSCLES INSERTED:**

<u>FINGER</u>	INTEROSSEI	LUMBRICAL	OTHERS
MIDDLE	2,3 dorsal	2 nd	Extensor dig slip

CLINICALS:

- Button hole deformity
- Mallet/cricketers/basketball finger

34. MIDPALMAR SPACES:

SHAPE: triangle

SITUATION: under the inner half of the hollow of the palm

EXTENT:

- a. **PROXIMAL** –distal margin of flexor retinaculum
- b. **DISTAL** –distal palmar crease

COMMUNICATIONS:

- a. **PROXIMAL** –forearm space of parona
- b. **DISTAL** –fascial sheaths of 3rd, 4th lumbricals

BOUNDARIES:

ANTERIOR: flexor tendons of

- i. 3rd, 4th, 5th digits
- ii. 2nd, 3rd, 4th lumbricals
- iii. Palmar aponeurosis

POSTERIOR – fascia covering interossei and metacarpals

MEDIAL – medial palmar septum

LATERAL – intermediate palmar septum

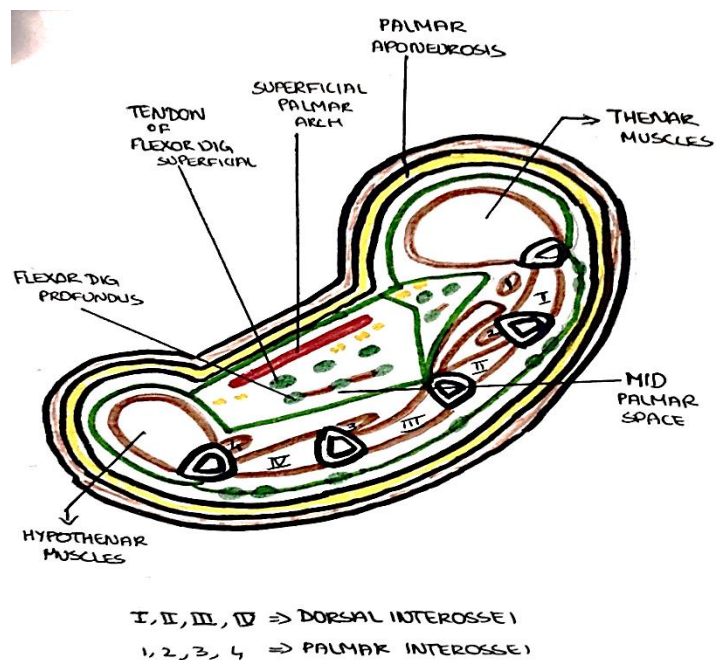
DRAINAGE:

- Incision in either 3rd or 4th web space

CLINICALS:

INFECTION OF MIDPALMAR SPACE:

- Inlet for infection-ulnar bursa
- Outlet for infection-lumbricals canal



35. FINE MOVEMENTS OF FINGERS:

- Fine movements are carried out by **INTRINSIC MUSCLES** of the hand, especially the *short muscles* (i.e., lumbricals, interossei muscles) of hand.
- The muscles are:

Table 9.5: Attachments of small muscles of the hand

Name		Origin	Insertion
Muscles of thenar eminence			
Abductor pollicis brevis (Fig. 9.20)	1st layer	Tubercle of scaphoid, trapezium, flexor retinaculum	Base of proximal phalanx of thumb
Flexor pollicis brevis		Flexor retinaculum, trapezoid and capitate bones	Base of proximal phalanx of thumb
Opponens pollicis	3rd layer	Flexor retinaculum	Lateral half of palmar surface of the shaft of metacarpal bone of thumb
Adductor of thumb			
Adductor pollicis	3rd layer	Oblique head: Bases of 2nd–3rd metacarpals; transverse head: Shaft of 3rd metacarpal	Base of proximal phalanx of thumb on its medial aspect
Muscle of medial side of palm			
Palmaris brevis		Flexor retinaculum	Skin of palm on medial side
Muscles of hypothenar eminence			
Abductor digiti minimi	1st layer	Pisiform bone	Base of proximal phalanx of little finger
Flexor digiti minimi		Flexor retinaculum	Base of proximal phalanx of little finger
Opponens digiti minimi	3rd layer	Flexor retinaculum	Medial border of fifth metacarpal bone
Lumbricals (Fig. 9.21)			
Lumbricals (4)	2nd layer	1st Lateral side of tendon of flexor digitorum profundus of 2nd digit	Via extensor expansion into dorsum of bases of distal phalanges
Arise from 4 tendons of flexor digitorum profundus	2nd layer	2nd Lateral side of same tendon of 3rd digit	
		3rd Adjacent sides of same tendons of 3rd and 4th digits	
		4th Adjacent sides of same tendons of 4th and 5th digits	
Palmar interossei			
Palmar (4) (Fig. 9.24b)	4th layer	1st Medial side of base of 1st metacarpal	Medial side of base of proximal phalanx of thumb or 1st digit
		2nd Medial side of 2nd metacarpal	Via extensor expansion into dorsum of bases of distal phalanges of 2nd, 4th and 5th digits
		3rd Lateral side of 4th metacarpal	
		4th Lateral side of 5th metacarpal	
Dorsal interossei			
Dorsal (4) (Fig. 9.24a)	4th layer	1st Adjacent sides of 1st and 2nd metacarpals	Via extensor expansion into dorsum of bases of distal phalanges of 2nd, 3rd, 3rd and 4th digits
		2nd Adjacent sides of 2nd and 3rd metacarpals	
		3rd Adjacent sides of 3rd and 4th metacarpals	
		4th Adjacent sides of 4th and 5th metacarpals	

Table 9.6: Nerve supply and actions of small muscles of the hand

<i>Muscle</i>	<i>Nerve supply</i>	<i>Actions</i>
Muscles of thenar eminence		
Abductor pollicis brevis (Fig. 9.20)	Median nerve	Abduction of thumb
Flexor pollicis brevis	Median nerve	Flexes metacarpophalangeal joint of thumb
Opponens pollicis	Median nerve	Pulls thumb medially and forward across palm (opposes thumb towards the fingers)
Adductor of thumb		
Adductor pollicis	Deep branch of ulnar nerve which ends in this muscle	Adduction of thumb
Muscle of medial side of palm		
Palmaris brevis	Superficial branch of ulnar nerve	Wrinkles skin to improve grip of palm
Muscles of hypothenar eminences		
Abductor digiti minimi	Deep branch of ulnar nerve	Abducts little finger
Flexor digiti minimi	Deep branch of ulnar nerve	Flexes little finger
Opponens digiti minimi	Deep branch of ulnar nerve	Pulls fifth metacarpal forward as in cupping the palm
Lumbricals (Fig. 9.21)		
Lumbricals (4)	First and second, i.e. lateral two by median nerve; third and fourth by deep branch of ulnar nerve	Flex metacarpophalangeal joints, extend interphalangeal joints of 2nd–5th digits
Palmar interossei		
Palmar (4) (Fig. 9.24b)	Deep branch of ulnar nerve	Palmar interossei adduct fingers towards centre of third digit or middle finger
Dorsal interossei		
Dorsal (4) (Figs 9.23 and 9.24a)	Deep branch of ulnar nerve	Dorsal interossei abduct fingers from centre of third digit. Both palmar and dorsal interossei flex the metacarpophalangeal joints and extend the interphalangeal joints

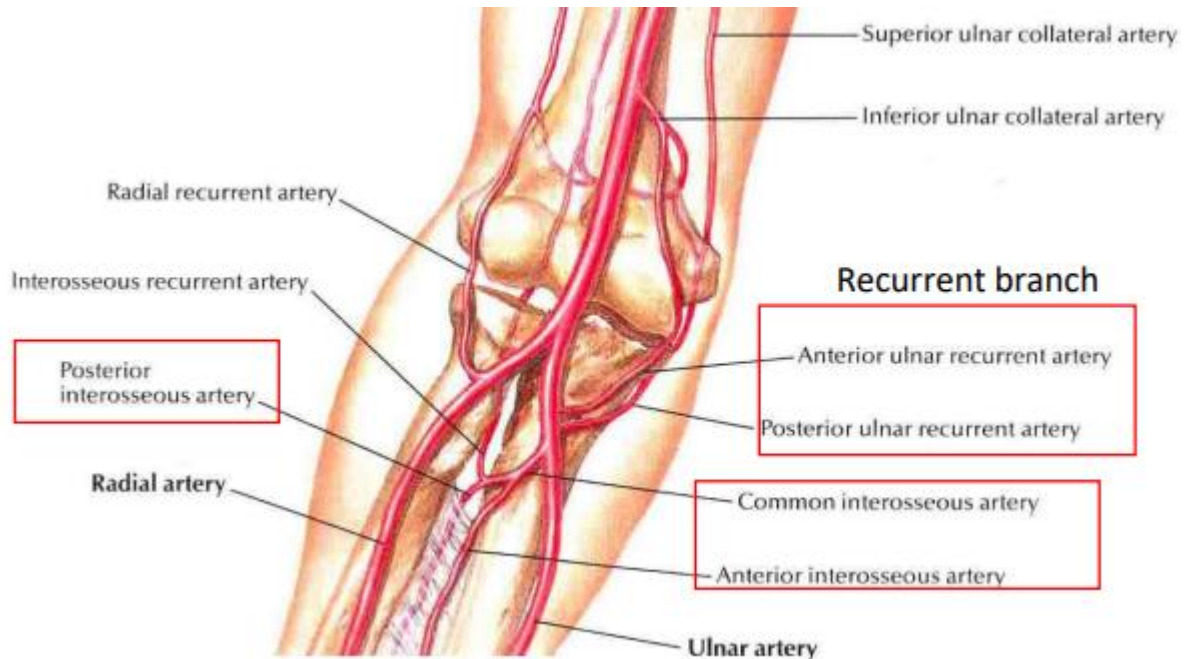
APPLIED ANATOMY:

- The ulnar nerve is also known as the '**MUSICIAN'S NERVE**' because it controls fine movements of the fingers
- The ulnar nerve controls fine movements of the fingers through its extensive motor distribution to the short muscles of the hand.
- Ulnar nerve lesion at wrist produces '**ULNAR CLAW HAND**'.
- Compression of median nerve in the carpal tunnel causes '**CARPAL TUNNEL SYNDROME**'. It causes wasting of thenar eminence leads to ape like hand.
- Lesion to the radial nerve at the wrist region causes weak extension of wrist, metacarpophalangeal, and interphalangeal joints.

36. ANTERIOR INTEROSSEOUS ARTERY

ORIGIN:

- The ulnar artery gives off a common interosseous branch which again divides into anterior and posterior interosseous branches near the upper border of interosseous membrane.



COURSE:

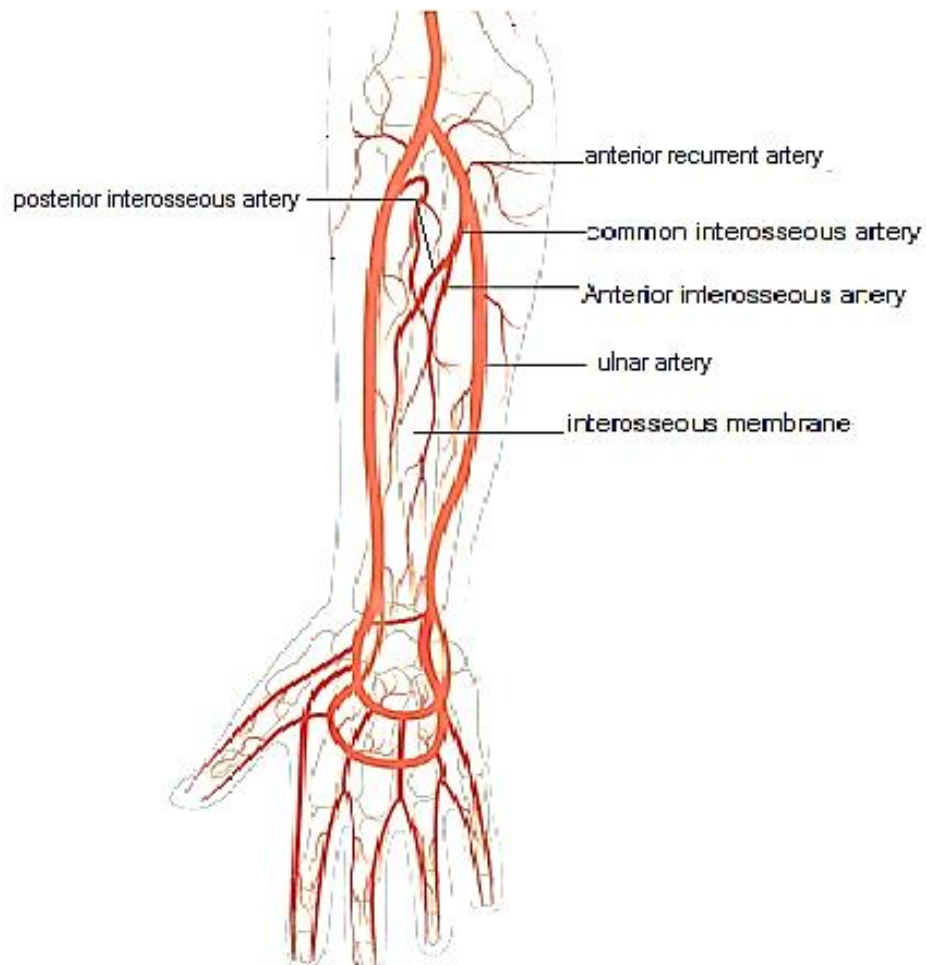
- It passes down the forearm on anterior aspect of the interosseous membrane.
- It is accompanied by the anterior interosseous nerve.
- It descends between the flexor digitorum profundus and flexor pollicis longus muscles.
- At the upper border of the pronator quadratus muscle, it pierces the interosseous membrane and reaches the back of the forearm, where it anastomoses with the posterior interosseous artery.

BRANCHES

- The anterior interosseous artery gives muscular branches to the deep muscles of front of forearm.
- Nutrient arteries to radius and ulna.
- A median artery which accompanies the median nerve.

TERMINATION:

- It terminates by anastomosing with dorsal carpal arch.



37. THENAR SPACE OF HAND:

The arrangement of fascia and fascial septa in hands is such that many spaces are formed like thenar space of hand

FEATURES:

SHAPE – Triangular

SITUATION – under the outer half of the hollow palm

EXTENT:

- a. **PROXIMAL** – Distal margin of flexor retinaculum
- b. **DISTAL** – Proximal transverse palmar crease

COMMUNICATIONS:

- a. **PROXIMAL** – Forearm space of Parona.
- b. **DISTAL** – Fascial sheath of first lumbrical

BOUNDARIES:

ANTERIOR:

- Short muscles of thumb
- Flexor tendons of the index finger
- First lumbrical
- Palmar aponeurosis

POSTERIOR: Transverse head of adductor pollicis

LATERAL: Tendon of flexor pollicis longus and lateral palmar septum

MEDIAL: Intermediate palmar septum

CONTENTS:

- Short muscles of thumb
- Palmar aponeurosis
- Flexor tendons of index finger with first lumbricals
- Transverse head of adductor policis
- Flexor pollicis longus tendon

APPLIED ANATOMY:

- This space is of surgical importance as they may become infected and distended with pus.
- Incision to drain the pus: Incise in the first web posteriorly

THENAR MUSCLES:

ABDUCTOR POLLICIS BREVIS:

ORIGIN – Tubercle of scaphoid and Crest of trapezium and Flexor retinaculum

INSERTION – Base of proximal phalanx of thumb in its lateral side

NERVE SUPPLY – Median nerve

ACTION – Abduction of thumb

FLEXOR POLLICIS BREVIS: Arises by two heads.

ORIGIN – Superficial head: Flexor retinaculum & Crest of trapezium

DEEP: Capitate and trapezoid bone

INSERTION – base of proximal phalanx of thumb on its lateral side

NERVE SUPPLY – Median nerve

ACTION – Flexes metacarpal joint of thumb.

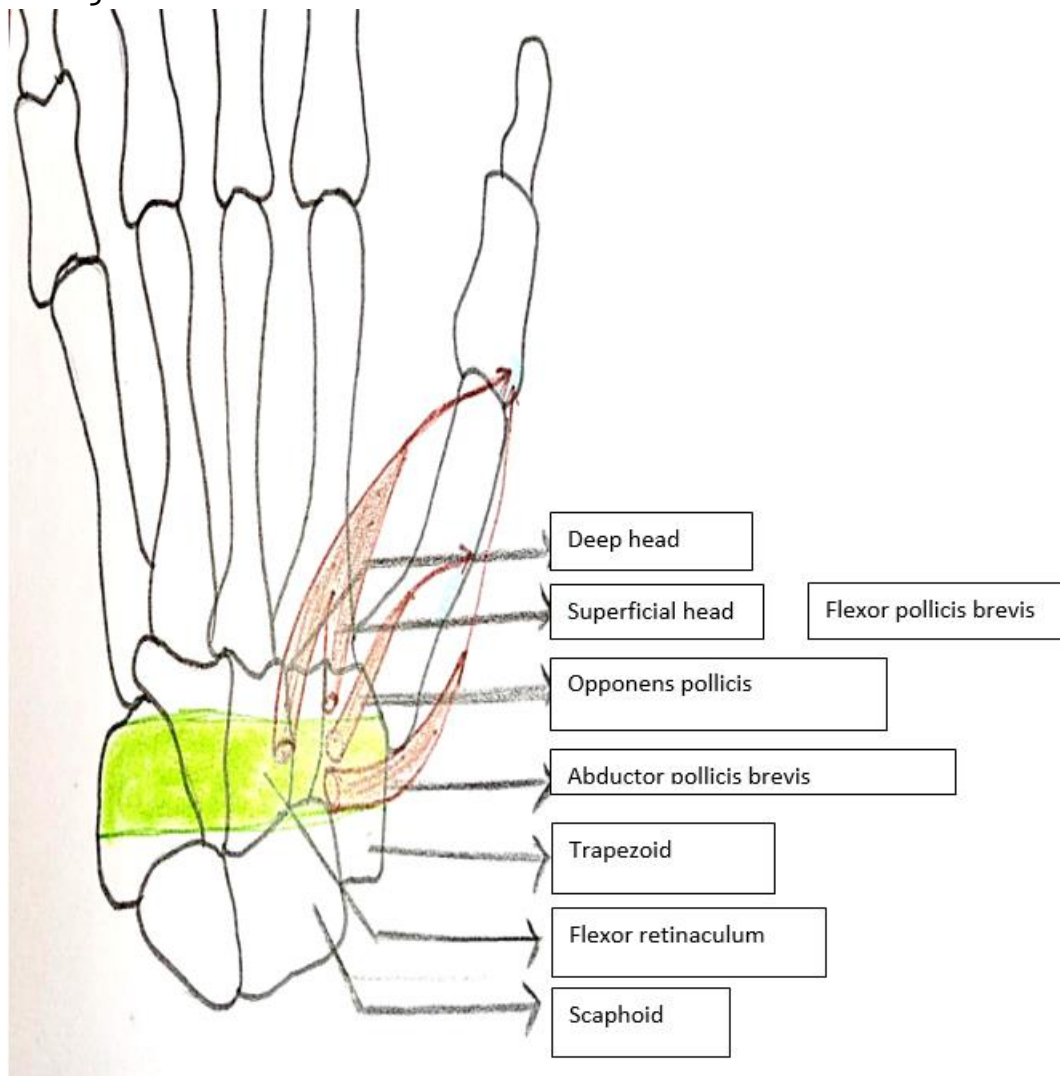
OPPONENS POLLICIS:

ORIGIN - Flexor retinaculum and Crest of trapezium

INSERTION - Base of proximal phalanx of thumb on its medial aspect

NERVE SUPPLY - Median nerve

ACTION - Pulls thumb medially and forward across palm, that is opposing thumb towards the finger



APPLIED ANATOMY:

- Damage to median nerve impairs the action of thenar muscles as thenar muscles are solely supplied by median nerve.