

Breast: - modified sweat gland; rudimentary in males

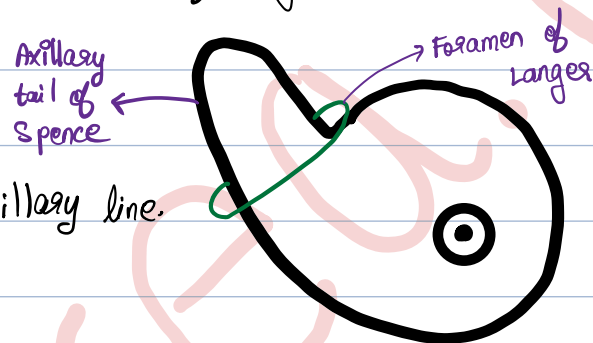
Situation & Extent:

- present in superficial fascia of pectoral region (except axillary tail of spence)
- Axillary tail of spence pierces the deep fascia through Foramen of Langer

vertically → 2nd to 6th rib

(Nipple in 4th intercostal space)

horizontally → from lateral border of sternum to mid-axillary line.

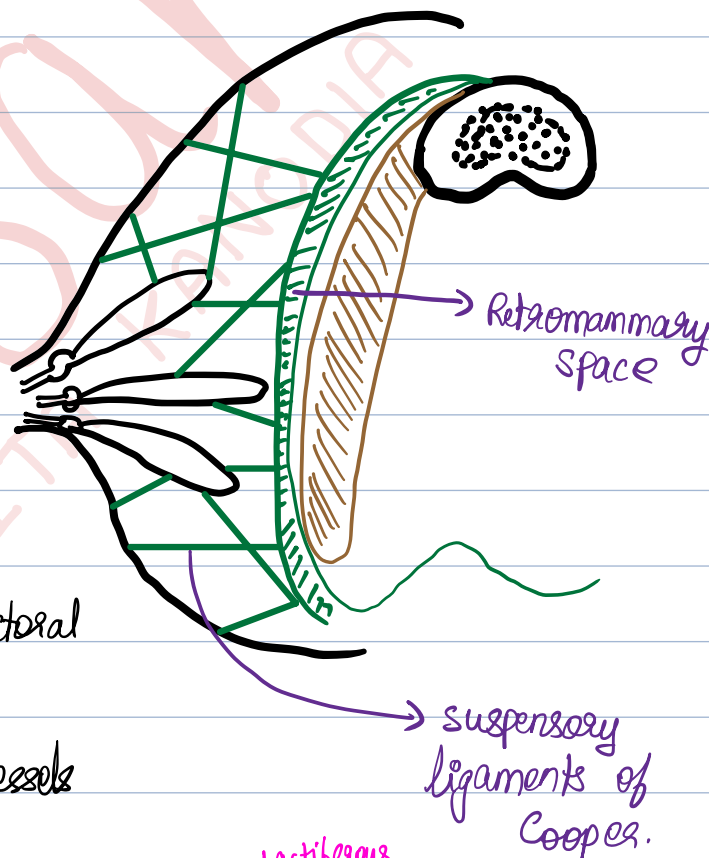


Relations:

Superficial → skin, superficial fascia

Deep → pectoral fascia

- pectoralis major
- serratus anterior
- external oblique muscles
- retromammary space



Retromammary Space:

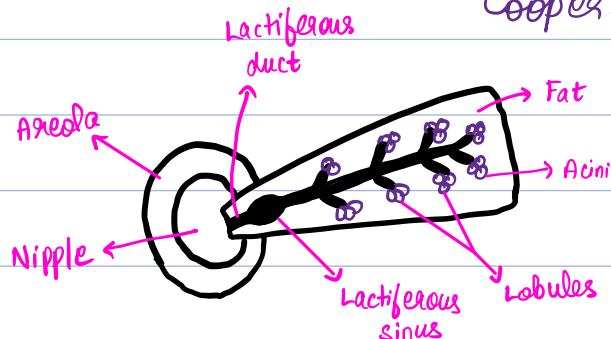
- allows free movement of breast on pectoral fascia
- traversed by lymph nodes & blood vessels
- breast prostheses are placed here.

Structure → skin
→ stroma
→ parenchyma (glandular tissue)

Skin:

Nipple → 4th intercostal space

- contains smooth muscle fibres (for erection during sexual arousal)
- very rich sensory innervation
- pierced by 10-15 lactiferous ducts



Areola → darkly pigmented area around the nipple

→ contains large number of modified sebaceous glands → prevent drying & cracking of nipple & areola

→ these are enlarged during pregnancy (especially at outer margin)

↳ Montgomery's tubercles (appear as small nodular elevations)

Stroma:

Fatty Stroma → present between septum & glands

→ distributed all over the breast except underneath nipple & areola

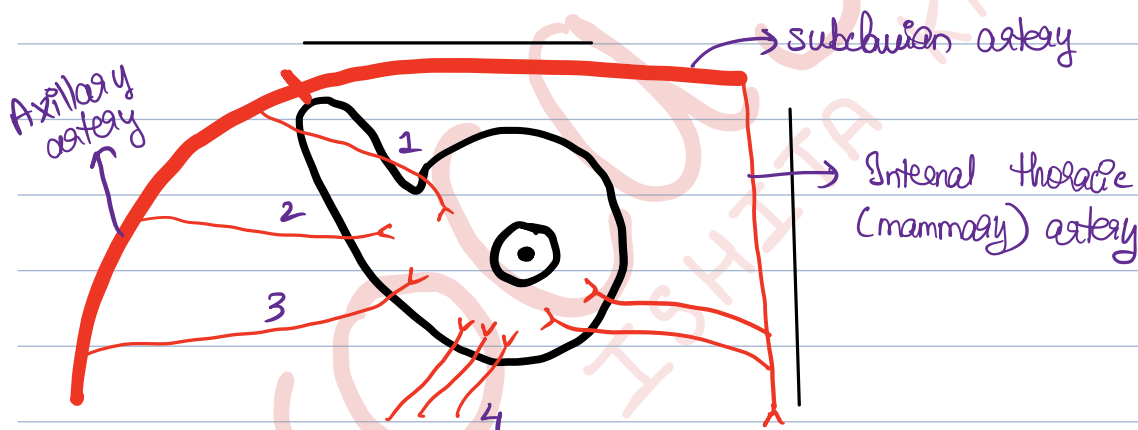
Fibrous Stroma → consists of fibrous septum extending from skin to clavipectoral fascia ⇒ Suspensory Ligaments
connect lactiferous ducts to dermis of overlying skin ← of Cooper

Loose connective tissue → consists of 10-15 lobes arranged in a radial fashion

→ each lobe is drained by a lactiferous duct via the lactiferous sinus (dilated portion of duct)

↳ for temporary storage of milk.

Arterial Supply:



1 = Superior thoracic artery

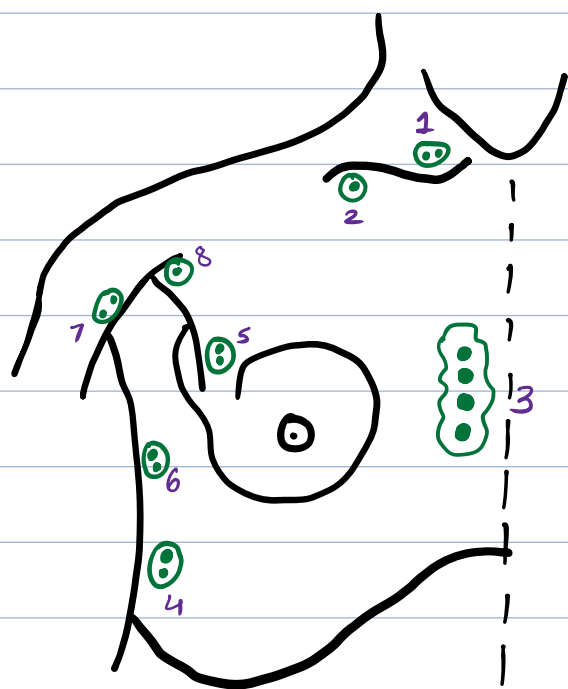
2 = Thoracoacromial trunk

3 = Lateral thoracic artery

4 = branches of intercostal arteries.

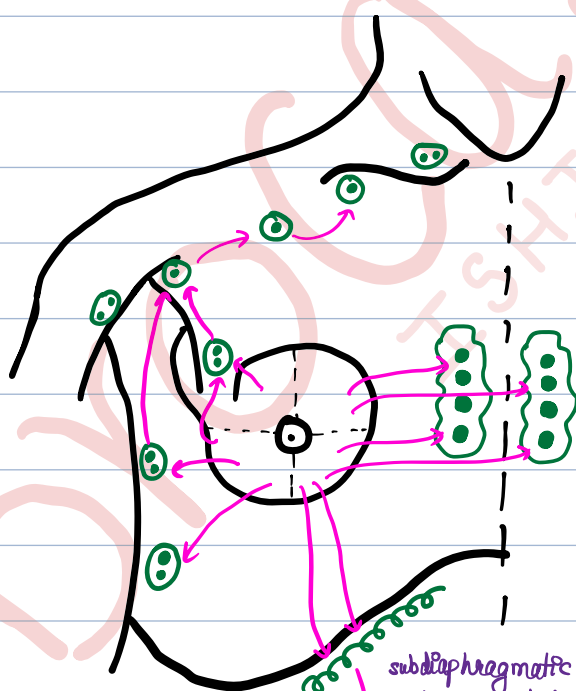
Veinous Drainage: veins run along the course of the corresponding arteries.

↳ posterior intercostal, internal thoracic, axillary vein.



- 1 = Supraclavicular
 - 2 = Apical $\Rightarrow$ Axillary
 - 3 = Internal mammary
 - 4 = Posterior intercostal
 - 5 = Anterior
 - 6 = Posterior
 - 7 = Lateral
 - 8 = Central
- Axillary

Axillary lymph nodes $\Rightarrow$ drain 70% of the lymph.



$\rightarrow$ superficial lymphatics drain skin except nipple & areola

$\rightarrow$ deep lymphatics drain parenchyma, nipple & areola

$\rightarrow$ Plexus of lymph vessels deep to areola is called subareolar plexus of Sappey which drains into anterior group of axillary lymph nodes

subphrenic & subperitoneal lymph plexuses

transcoelomic migration



$\Rightarrow$ secondary tumour in ovary called Krukenberg's tumour

Development of Breast: develops from an ectodermal thickening called milk line/ ridge of Schultz

- this line appears in the young embryo & extends from axilla to groin
- in humans, this ridge disappears except for its small part in the pectoral region.
- here it thickens, becomes depressed & gives off 15-20 solid cords (lobes)
- at birth, the depressed ectodermal thickening is raised to form nipple
- stroma develops from the surrounding mesoderm

Polythelia / Supernumerary Nipple: appears along the milk ridge & often mistaken for moles

Retracted / Inverted Nipple: nipple fails to develop from the ectodermal pit

- ↳ suckling of infant cannot take place & nipple is prone to infection

Polymastia: development of more than 1 breast along the milk line

Gynecomastia: development of breast in male, mainly at puberty

- ↳ usually bilateral & thought to occur due to hormonal imbalance.

Breast Carcinoma: one of the most common cancers in females

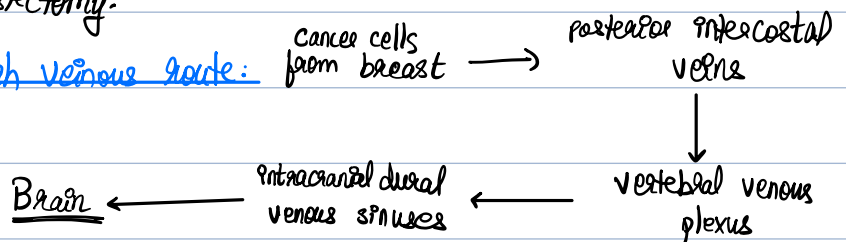
- arises from epithelial cells of lactiferous ducts
- 60% cases $\Rightarrow$ involvement of VL
- common between 40-60 years of age.

Clinical Presentation → painless hard lump

- breast becomes fixed & immobile $\Rightarrow$ due to infiltration of suspensory ligaments
- Retraction of skin $\Rightarrow$ infiltration of suspensory ligaments
- Retraction of nipple $\Rightarrow$ infiltration & fibrosis of lactiferous ducts.
- peau d'orange appearance (orange peel-like) of skin $\Rightarrow$ obstruction of superficial lymphatics

Treatment: classical operation of radical mastectomy.

Metastasis of Breast Carcinoma to Brain through venous route:



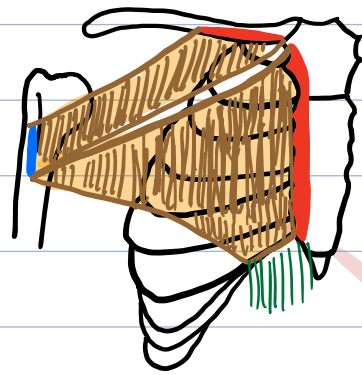
Pectoralis Major: largest muscle of pectoral region

Origin: clavicular head: medial half of anterior aspect of clavicle

Sternocostal head: - lateral half of anterior surface of sternum

- medial parts of 2nd to 6th costal cartilages

- aponeurosis of external oblique muscles of abdomen.



Insertion: inserted by a U-shaped (bilaminar) tendon on to lateral lip of bicipital groove / intertubercular sulcus of humerus.

(Twisting of the lower sternal fibers around the lower border of the same muscle $\Rightarrow$ forms rounded anterior axillary fold.

Nerve Supply: - Lateral pectoral N. (C5-C7)

- medial pectoral N. (C8-T1)

Actions: - clavicular head flexes the arm

- sternocostal head adducts & medially rotates the arm

Testing: - on lifting a heavy rod, clavicular head becomes prominent & while depressing the rod, sternocostal head becomes prominent.

Pectoralis Minor: small triangular muscle, deep to pectoralis major

Origin: 3rd, 4th, 5th ribs near their costal cartilages

Insertion: into medial border of coracoid process of scapula.

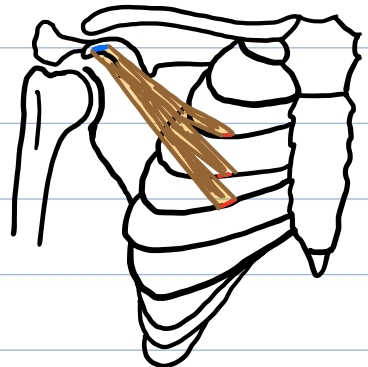
Nerve Supply: - Lateral pectoral N. (C5-C7)

- medial pectoral N. (C8-T1)

Actions: - assists the serratus anterior in protraction of scapula

- depresses the point of shoulder

- acts as an accessory muscle of respiration during forced inspiration



$\rightarrow$ key muscle of pectoral region as it divides axillary artery (which it crosses superficially) into 3 parts.

Subclavius:

Origin: 1st rib at costochondral junction

Insertion: into subclavian groove on inferior surface of middle third of clavicle

Nerve Supply: N. to subclavius

Action: stabilizes the clavicle by pulling it inferiorly & medially (during movement at shoulder joint)

Serratus Anterior: broad sheet of muscle

that clothes the side wall of the thorax

Origin: series of 8 digitations from upper 8 ribs

(First digitation arises from 1st & 2nd rib, all other digitations arise from their corresponding ribs)

Insertion: into costal surface of scapula along its medial border

Nerve Supply: N. to serratus anterior / Long thoracic N. / Bell's N.
(C5 - C7)

Actions: powerful protractor of scapula (Boxer's muscle)

→ Keeps medial/vertebral border of scapula in firm contact with chest wall

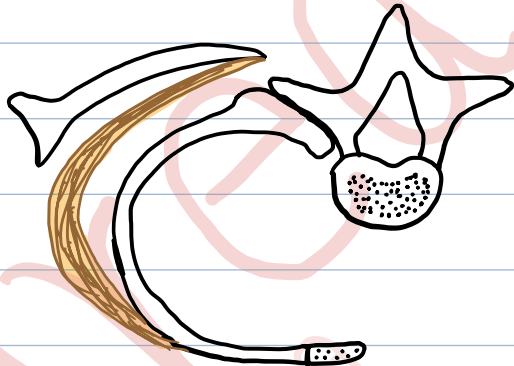
→ lower 4 digitations along with lower part of trapezius $\Rightarrow$ rotate the scapula laterally & upward during overhead abduction of arm ($> 90^\circ$).

Paralysis of Serratus Anterior / Winging of Scapula:

• following injury to long thoracic N. (stab injury / removal of breast tumor)

→ Protraction of scapula is weakened

→ inferior angle & medial border of scapula become unduly prominent (particularly when the patient pushes his hands against the wall) $\Rightarrow$ winging of scapula.



Clavipectoral Fascia: strong fascial sheet deep to clavicular head of pectoralis major

Extent:

Vertically: → from clavicle above to axillary fascia below

↳ splits into 2 laminae to enclose subclavius

↳ lower part splits to enclose pectoralis minor

↳ extends downwards as suspensory ligament of axilla which maintains the concavity of the axillary fascia

Medially: attached to first rib & costoclavicular ligament & blends with external intercostal membrane of upper two intercostal spaces

Laterally: attached to coracoid process & blends with coracoclavicular ligament.

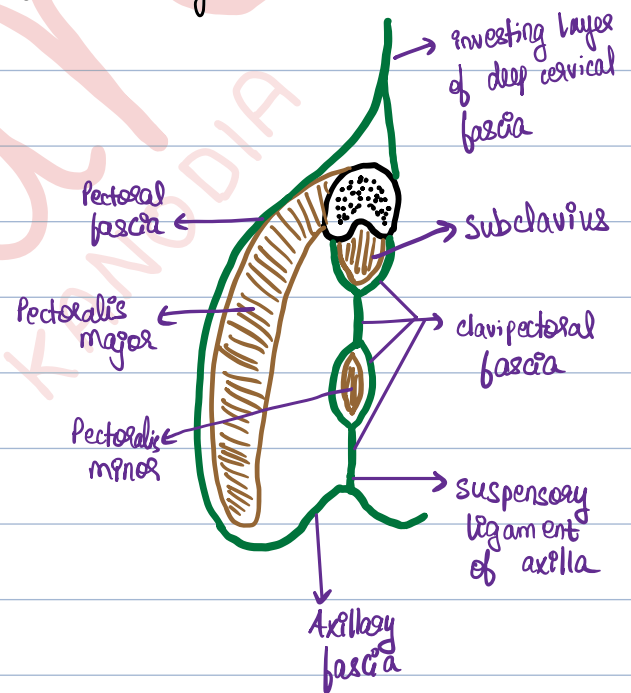
Structures Piercing:

(i) Thoraco-acromial artery

(ii) Lateral pectoral nerve

(iii) Lymphatics from breast to apical group of axillary lymph nodes

(iv) Cephalic vein



Axilla: pyramidal space containing brachial plexus, axillary vessels & lymph nodes embedded in fatty tissue.

Boundaries:

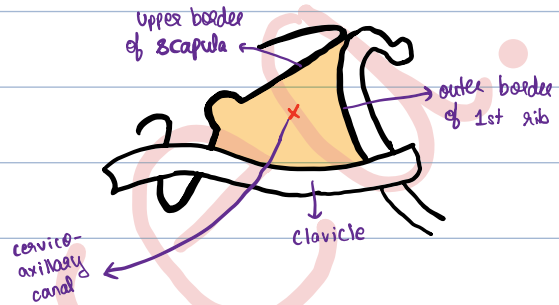
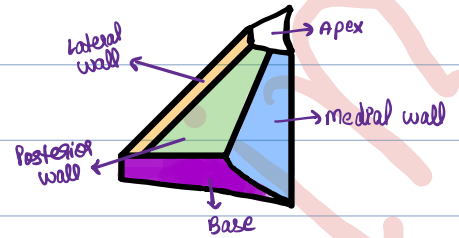
Apex / cervico-axillary canal: directed upwards & medially

→ Bound - in front by ⇒ clavicle

behind by ⇒ upper border of scapula

medially by ⇒ outer border of 1st rib

→ axillary vessels & brachial plexus pass from neck to axilla



Base / Floor: directed downward

↳ formed by axillary fascia

Bounded - in front by ⇒ anterior axillary fold (formed by lower border of pectoralis major)

- behind by ⇒ posterior axillary fold (formed by latissimus dorsi & teres major)

- medially by ⇒ lateral aspect of chest wall.

Anterior wall: pectoralis major & minor, subclavius

Posterior wall: subscapularis above & latissimus dorsi & teres major below

Medial wall: upper 4-5 ribs & corresponding intercostal spaces covered by serratus anterior

Lateral wall: tendon of biceps brachii in bicipital groove, coracobrachialis & short head of biceps.

Contents of Axilla: FA AA CAL

(i) fatty tissue

(ii) Axillary artery & its branches

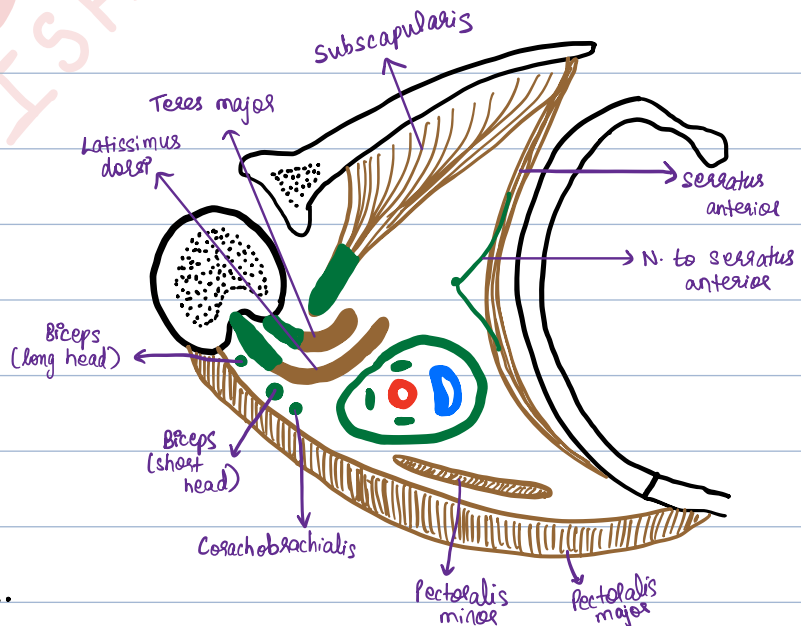
(iii) Axillary vein & its tributaries

(iv) Axillary lymph nodes

(v) Cords of brachial plexus

(vi) Axillary tail of Spence (of breast)

(vii) Long thoracic & intercostobrachial Ns.



Axillary Artery:

Origin: begins at outer border of first rib as continuation of subclavian artery

Termination: ends by becoming brachial artery at lower border of teres major

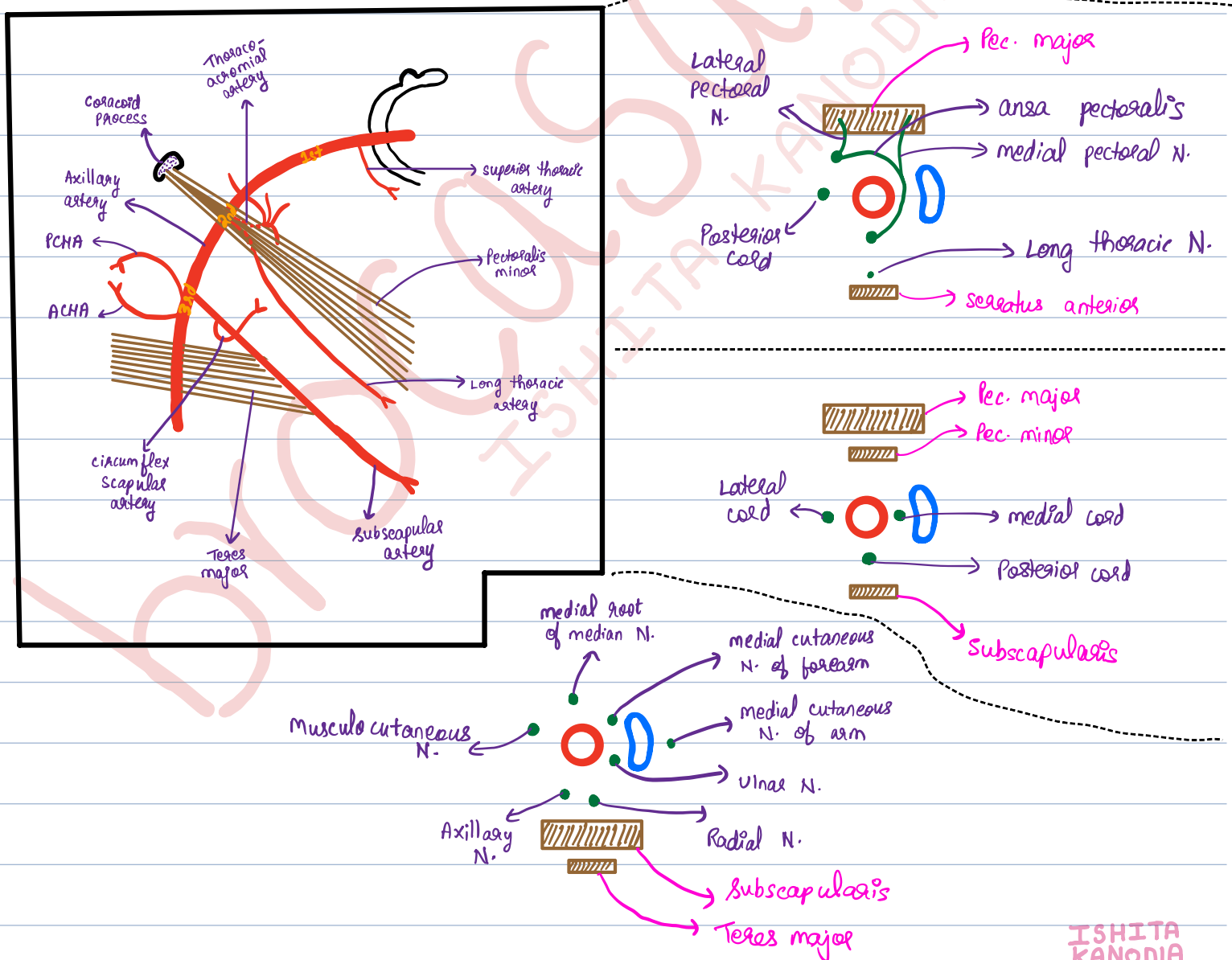
Course: Runs along lateral wall of axilla

↳ crossed on its superficial aspect by pectoralis minor which divides it into 3 parts —

- First part $\Rightarrow$ superior/proximal to muscle
- Second part $\Rightarrow$ posterior/deep to muscle
- Third part $\Rightarrow$ inferior/distal to muscle.

Relations: — Axillary vein lies medial to axillary artery through out its course.

$\rightarrow$ Relationship of cords of brachial plexus is different for different parts.



Branches:

I Superior Thoracic Artery: → arises near subclavius

II Thoraco-acromial artery: 4 branches (CAPP) — clavicular, acromial, deltoid, pectoral

[cadavers are dead people]
CAPP

Lateral thoracic artery: emerges & runs along inferior border of pectoralis minor

III Subscapular artery: largest branch — gives a large branch circumflex scapular artery

(ACHA) Anterior circumflex humeral artery: passes in front of surgical neck of humerus

(PCHA) Posterior circumflex humeral artery: passes behind surgical neck of humerus.

Axillary Vein: formed at lower border of teres major by union of basilic vein & venae comitantes of brachial artery

→ runs along medial side of axillary artery

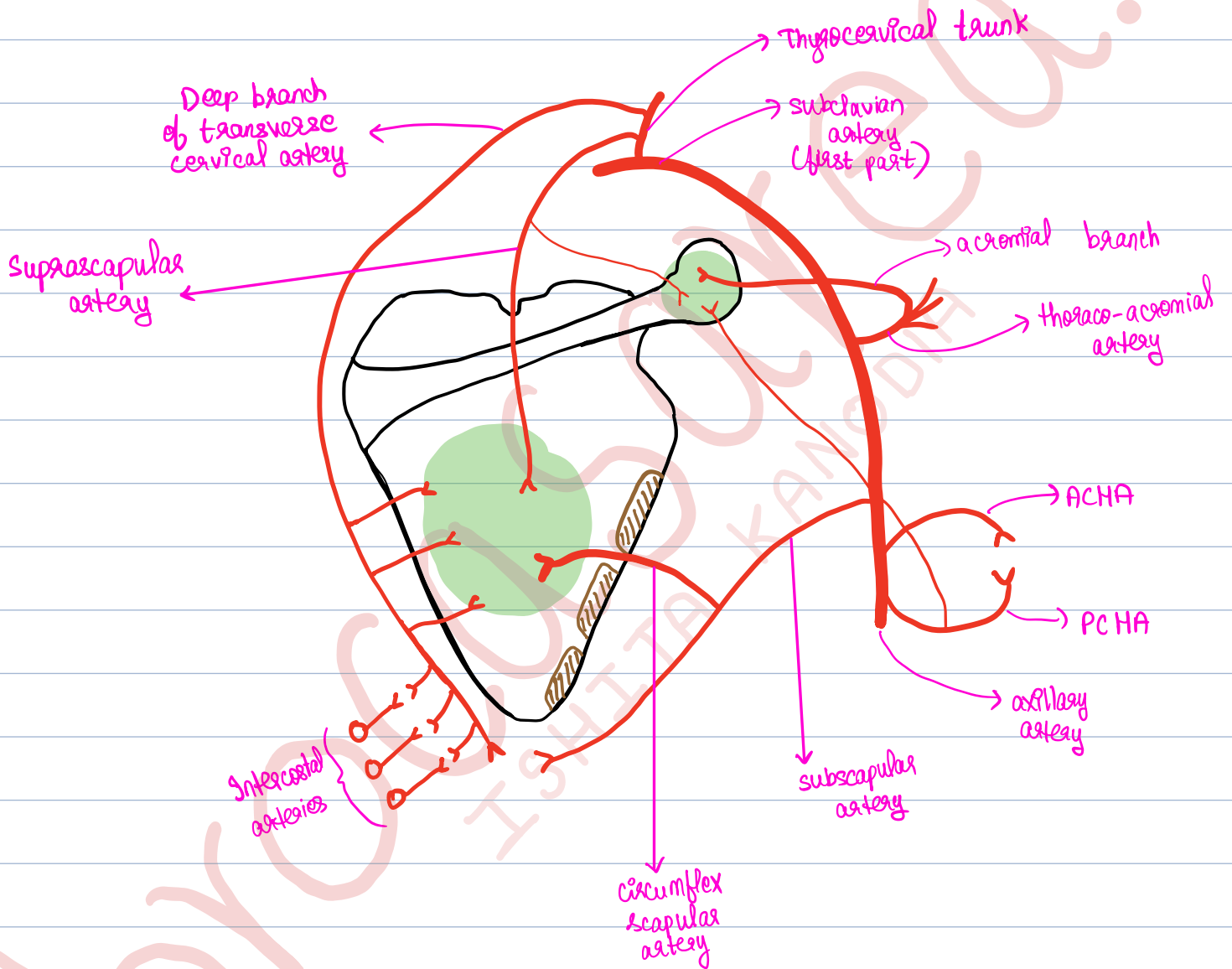
→ ends at outer border of first rib by becoming subclavian vein.

Tributaries: (i) veins which correspond to branches of axillary artery (lateral thoracic & subscapular vein)

(ii) Cephalic vein (after it pierces clavipectoral fascia)

Scapulae Anastomosis:

→ between 1st part of subclavian artery & third part of axillary artery



Brachial Plexus:

↳ anterior (ventral) rami of C5-C8, T1 with little contribution from C4 & T2.

Prefixed plexus: contribution from C4 is large & that from T2 is absent

Postfixed plexus: contribution from T2 is large & that from C4 is absent

Components:

- Roots
- Trunks
- Divisions
- Cords
- Branches

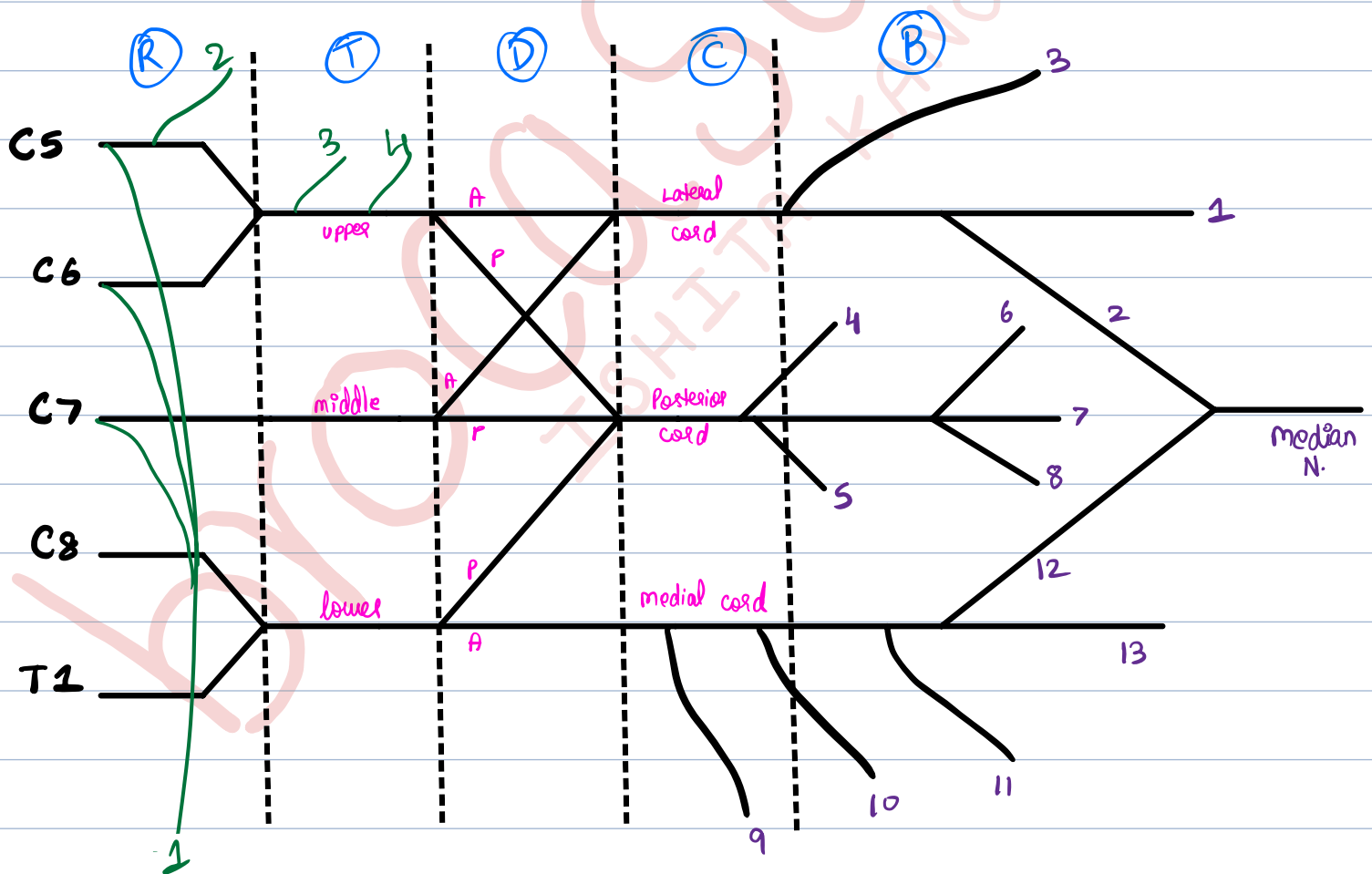
RTDCB → Remember to drink cold beer

Roots: in the neck, deep to scalenus anterior

Trunks: occupy the cleft between scalenus medius behind & scalenus anterior in front

Divisions: — Anterior & posterior ⇒ behind the clavicle.

Cords: Lateral, medial, posterior



Branches from Roots

1 = Long thoracic N. / N. to serratus anterior (C5 - C7)

2 = Dorsal scapular N. (C5)

Branches from Trunks: (upper trunk only)

3 = Suprascapular N. (C5, C6)

4 = N. to subclavius (C5, C6)

From Lateral Cord: ML²

1 = Musculocutaneous N. (C5 - C7)

2 = Lateral root of median N. (C5 - C7)

3 = Lateral pectoral N. (C5 - C7)

From Posterior Cord: ULNAR

4 = Upper subscapular N. (C5, C6)

5 = Lower subscapular N. (C5, C6)

6 = N. to Latissimus Dorsi / Thoraco-dorsal N. (C6 - C8)

7 = Axillary N. (C5, C6)

8 = Radial N. (C5 - C8, T1)

From Medial Cord: M4U

9 = Medial cutaneous N. of arm (C8, T1)

10 = Medial cutaneous N. of forearm (C8, T2)

11 = Medial pectoral N. (C8, T1)

12 = Medial root to Median N. (C8, T1)

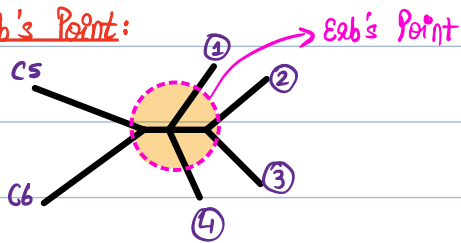
13 = Ulnar N. (C7, C8, T1)

Erb's Palsy:

→ upper plexus injury (brachial plexus)

→ # C5, C6

Erb's Point:



Causes: - physical injury during delivery of a newborn

- traumatic downward force on the upper arm & shoulder

Nerves involved: - Axillary N. ⇒ Deltoid # ⇒ Adducted shoulder

- Musculocutaneous N. ⇒ Biceps # ⇒ Extended elbow, pronated forearm

(No injury to coracobrachialis)

Police man's / waiter's / porter's tip hand.

Klumpke's Palsy: (Lower plexus injury)

→ injury to lower trunk of brachial plexus

→ C8, T1 #

Causes: sudden strong abduction

- birth injury

Nerves Involved: Median N. } supply intrinsic muscles of hand
Ulnar N. }

• extension at MCP joints

• flexion at IP joints

claw hand

Horner's Syndrome: ⇒ involvement of T1 #

⇒ loss of sympathetic function on the face

Signs - anhidrosis

- ptosis (drooping eyelids)

- miosis

- enophthalmos

- loss of ciliospinal reflex

Deltoid

Intro: three-in-one muscle

→ curved triangular muscle covering shoulder

→ forms rounded contour of shoulder

Origin: V shaped origin

Anterior unipennate part: upper surface & anterior border of lateral third of clavicle

Middle multipennate part: upper surface & lateral margin of acromion

Posterior unipennate part: lower lip of crest of spine of scapula

Insertion: short thick tendon inserted onto V-shaped deltoid tuberosity on lateral aspect of midshaft of humerus

Nerve Supply: axillary N. (C5, C6)

Actions:

Anterior (clavicular) fibres: flexes & medially rotates the arm

Posterior (spinous) fibres: extends & laterally rotates the arm.

Middle (acromial) fibres: strong abductors from 15° to 90° ($0 \rightarrow 15^\circ \Rightarrow$ supraspinatus)

Structures Under Cover:

Bones: upper end of humerus, coracoid process

Joints & Ligaments: glenohumeral (shoulder) joint, coracoacromial ligament

Bursae: subscapular, subacromial/subdeltoid, infraclavicular

Muscles: origin - long head & short head of biceps, coracobrachialis, long & lateral head of triceps

insertion - pectoralis major & minor, latissimus dorsi, subscapularis, supraspinatus, infraspinatus, teres minor

Vessels: anterior & posterior circumflex humeral vessels

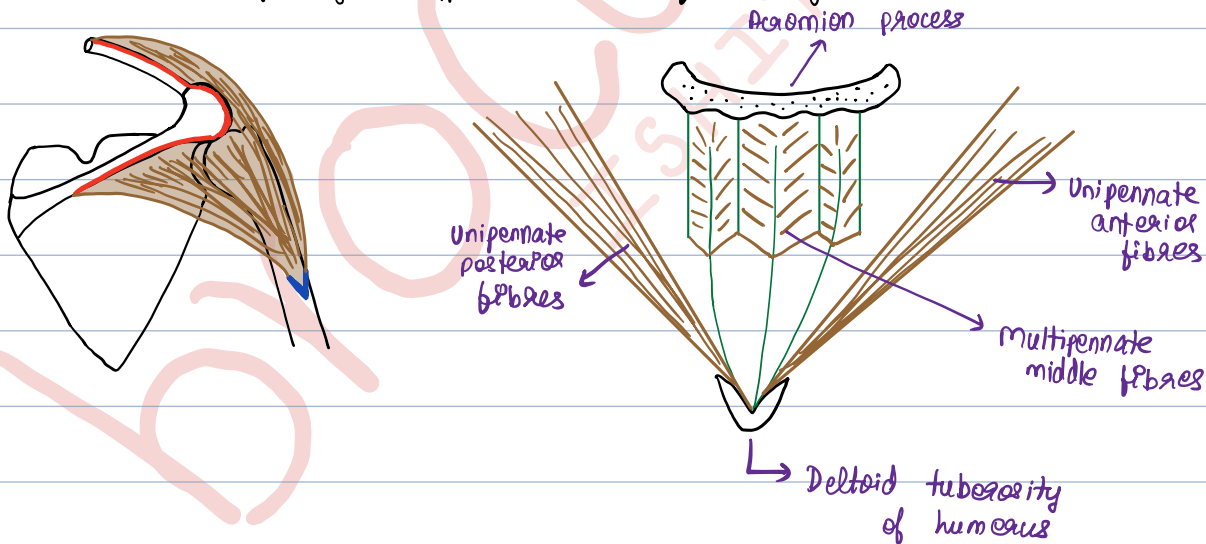
Nerves: Axillary N.

Spaces: Quadrangular & triangular subscapular intermuscular spaces.

Site of Intramuscular Injection: commonly given in lower half of deltoid to avoid injury to axillary N. which winds around surgical neck of humerus

→ given in middle fibres because they are bulky & avoid injury to any underlying structures

→ In clinical practice $\Rightarrow$ injection given in upper & outer quadrant of deltoid region.



Subscapular Intermuscular Spaces: one quadrangular, two triangular

Quadrangular Space:

Superior: lower border of teres minor

Inferior: upper border of teres major

Medial: lateral border of long head of triceps

Lateral: surgical neck of humerus

Contents: • Axillary N.

- posterior circumflex humeral vessels.

Upper Triangular Space:

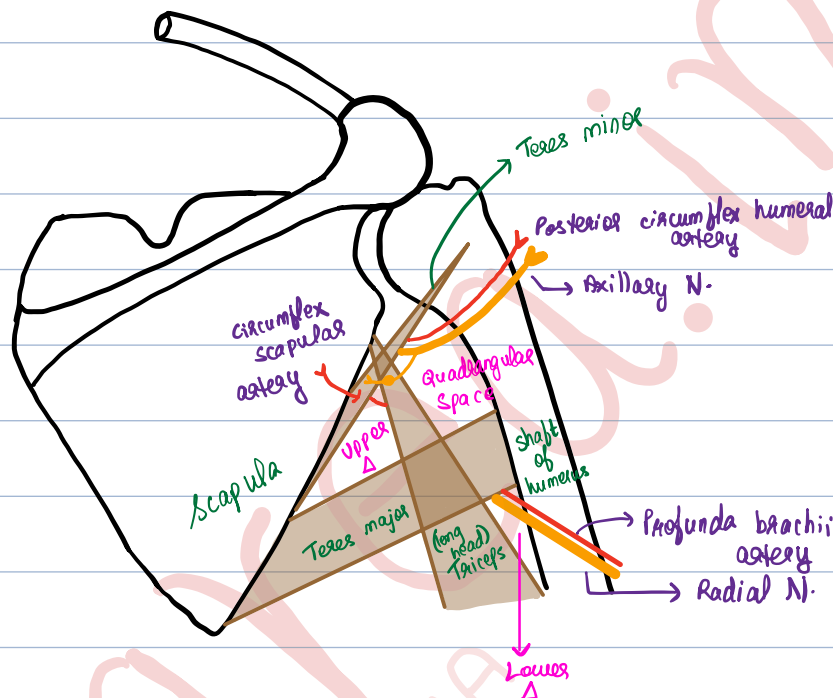
Superior: lower border of teres minor

Inferior: upper border of teres major

Apex: lateral border of scapula

Lateral: long head of triceps

Contents: • circumflex scapular artery



Lower Triangular Space:

Superior: lower border of teres major

Apex: meeting point of long head of triceps & shaft of humerus

Medial: long head of triceps

Lateral: shaft of humerus

Contents: • Radial N.

- profunda brachii artery & vein

Triangle of Auscultation:

→ gap in the musculature of the back of the thorax near the inferior angle of scapula

→ **Boundaries** ⇒ superior horizontal border of latissimus dorsi

⇒ medial border of scapula

⇒ inferolateral border of trapezius

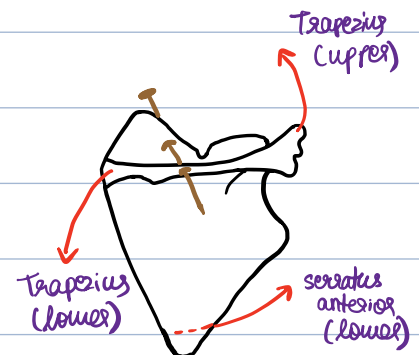
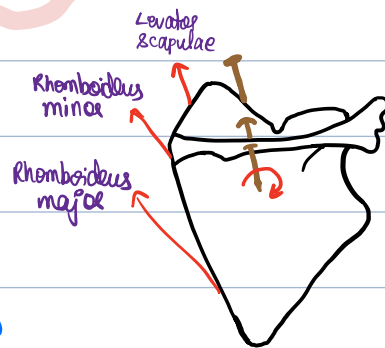
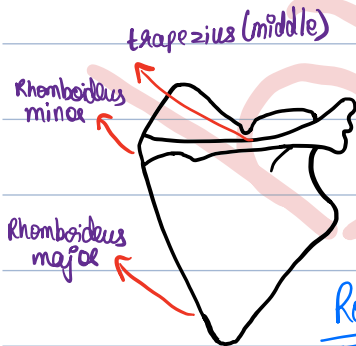
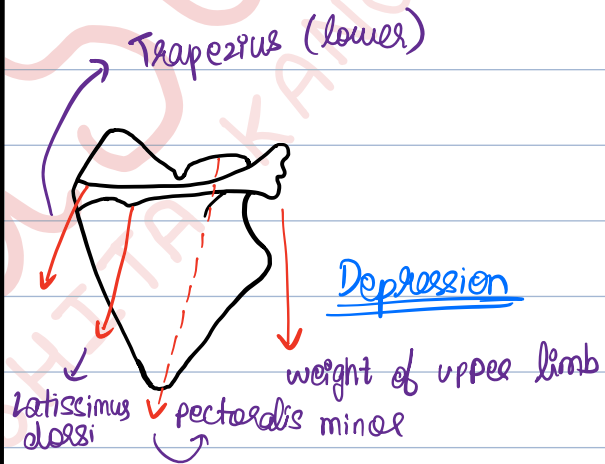
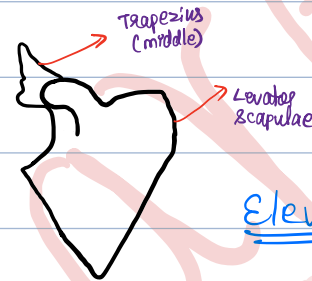
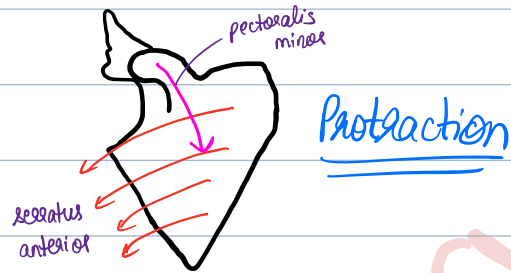
→ upper part of lower lobe of lung lies deep to this triangle.

→ sounds (during auscultation) are not muffled by the back muscles in this area

→ on protraction of scapula, triangle becomes more subcutaneous & can be auscultated.

Movements of Scapula:

Movement	Muscles
Protraction	→ Serratus anterior → Pectoralis minor
Retraction	→ Trapezius (middle fibres) → Rhomboides minor → Rhomboides major
Elevation	→ Trapezius (upper fibres) → Levator scapulae
Depression	→ Pectoralis minor → Trapezius (lower fibres) → Latissimus dorsi → weight of upper limb
medial rotation	→ Levator scapulae → Rhomboides minor → Rhomboides major
Lateral rotation	→ Trapezius (upper & lower) → Serratus anterior (lower)



Shoulder Joint - most mobile, most commonly dislocated

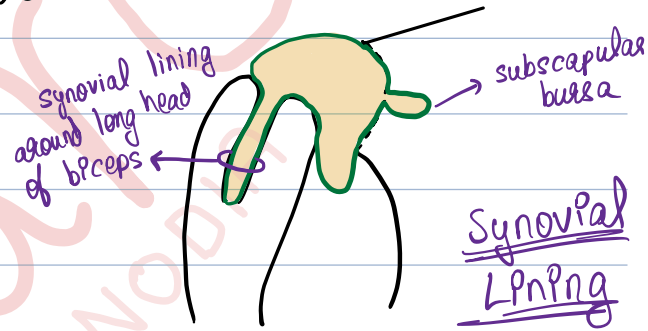
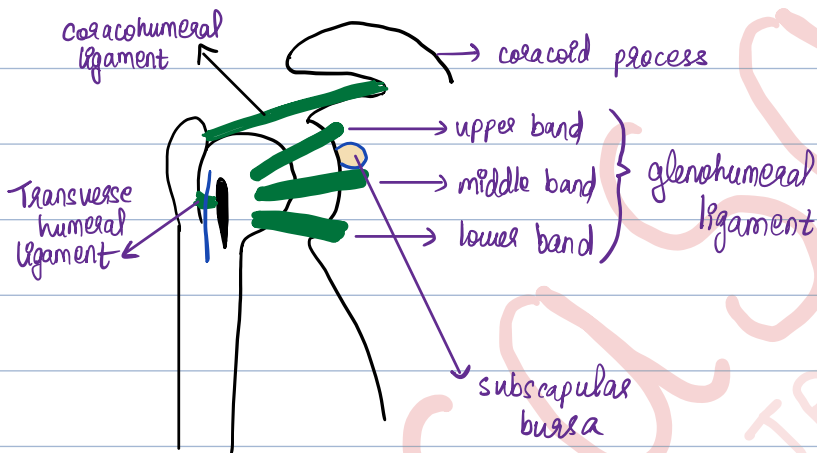
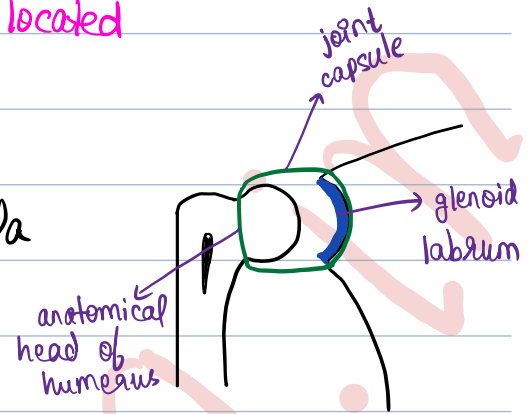
Type: ball & socket type of synovial joint

Articulating surfaces: - large round head of humerus
- relative shallow glenoid cavity of scapula

Ligaments:

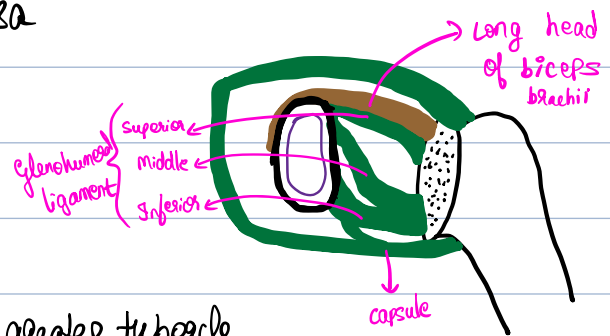
Capsular Ligament (Joint Capsule): Attachments -

- to the margin of glenoid cavity (outside glenoid labrum)
- to anatomical neck of humerus
- capsule is supported by rotator cuff muscles



Synovial Lining: Lines the inner surface of capsule except on articular surface
↳ extends as a tubular sheath around long head of biceps & deep to subscapularis muscle as subscapular bursa

Glenohumeral Ligament
→ upper band
→ middle band
→ lower band



Transverse humeral ligament - between lesser & greater tubercle

Coracohumeral ligament - from root of coracoid process
to greater tubercle

Additional Support: - coracoacromion arch (secondary socket of shoulder joint)
- Musculotendinous cuff / rotator cuff

Bursae:

Subscapular bursa: between tendon of subscapularis & neck of scapula

Subacromial bursa: between coracoacromial ligament above & supraspinatus tendon below (aka subdeltoid bursa)

Infraspinatus bursa: between tendon of infraspinatus & posterolateral aspect of joint capsule.

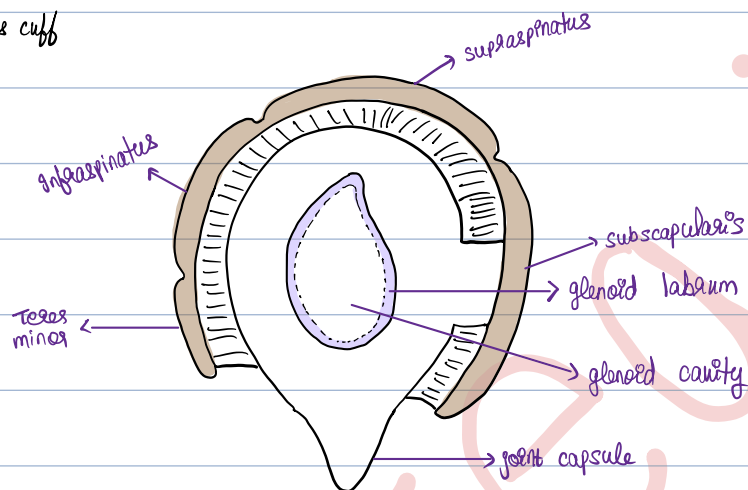
→ Bursae protect the tendons from friction against the bone

Stabilizing Factors: (i) Rotator cuff / musculotendinous cuff

(ii) Coracoacromial arch

(iii) Long head of biceps tendon

(iv) Glenoid labrum (deepens the shallow glenoid cavity to support large head of humerus)



Rotator cuff

Relations:

Superiorly: coracoacromial arch

subacromial bursa

supraspinatus

deltoid

Inferiorly: long head of triceps

axillary N.

posterior circumflex humeral vessels

Anteriorly: subscapularis

subscapular bursa

coracobrachialis

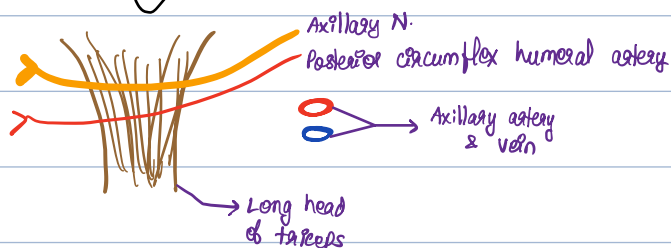
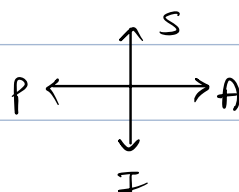
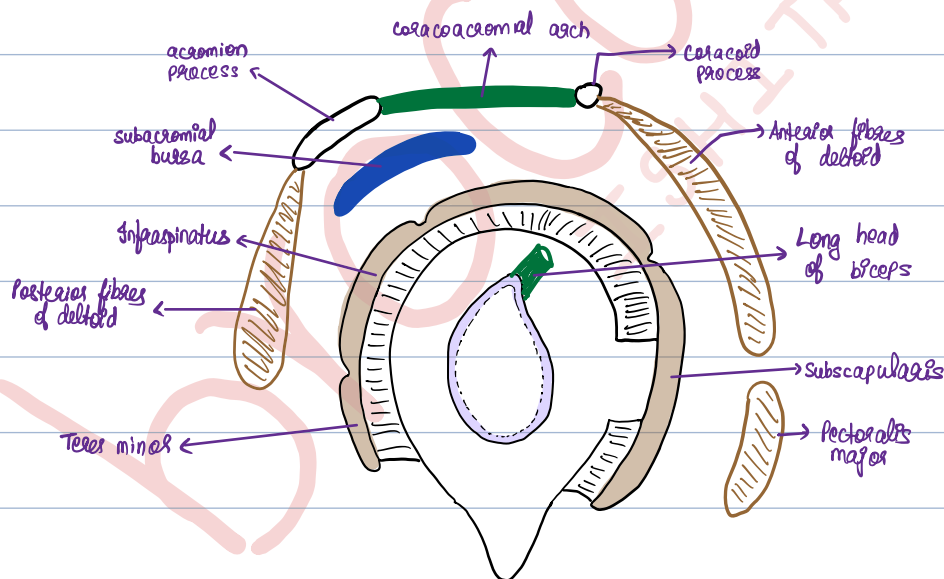
deltoid

short head of biceps

Posteriorly: infraspinatus

teres minor

deltoid.



Relations

Arterial supply:

- (i) Anterior & posterior circumflex humeral arteries
- (ii) Suprascapular artery
- (iii) Subscapular artery

Nerve Supply: (i) Axillary N.

(ii) Subscapular N.

Movements & Muscles:

Movement	Main Muscles	Accessory Muscles
Flexion	• clavicular head of pec. major • Deltoid (anterior fibres)	• short head of biceps • coracobrachialis
Extension	• Deltoid (posterior fibres) • Latissimus dorsi	• Long head of triceps • Teres major
Abduction	• 0 to $15^\circ \Rightarrow$ Supraspinatus • 15 to $90^\circ \Rightarrow$ Deltoid (middle fibres) • $> 90^\circ \Rightarrow$ serratus anterior & trapezius (upper & lower fibres)	
Adduction	• Pectoralis major (sternocostal fibres) • Latissimus dorsi	• Subscapularis • Teres major
Medial Rot.	• Subscapularis • Pectoralis major	• Latissimus dorsi • Teres major • Deltoid (anterior fibres)
Lateral Rot.	• Deltoid (posterior fibres) • Infraspinatus	• Teres minor

Clinical Aspects:

Dislocation of Shoulder Joint $\Rightarrow$ mostly occurs inferiorly $\because$ joint is least supported on this aspect

(Antero-inferior dislocation)

$\Rightarrow$ Presentation — hollow in front of the shoulder due to injury of axillary N. causing paralysis of deltoid.
— prominence of shoulder tip

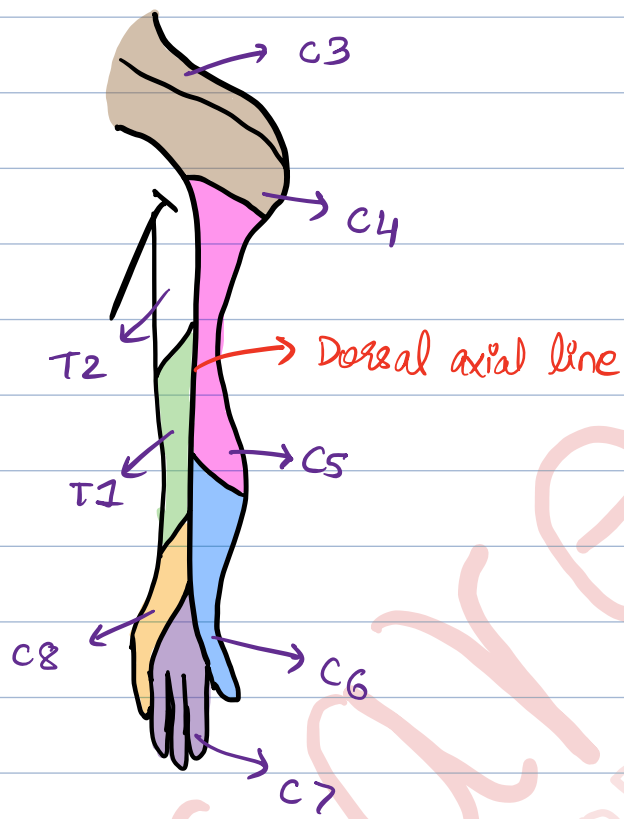
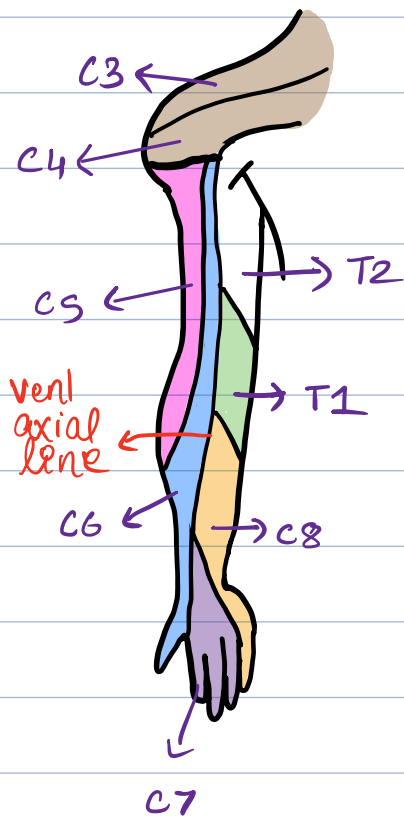
Frozen Shoulder (Adhesive Capsulitis) $\Rightarrow$ pain & uniform limitation of all movements of shoulder joint

$\Rightarrow$ occurs due to shrinkage of joint capsule in 40-60 y/o.

Subacromial Bursitis $\Rightarrow$ deposition of Ca in supraspinatus tendon (common); Ca deposition irritates overlying subacromial bursa

$\Rightarrow$ when arm is abducted, inflamed bursa is caught b/w tendon & acromion impingement which causes severe pain.

Dermatomes:



Cephalic Vein:

Origin: begins as a continuation of lateral end of dorsal venous arch



Course: crosses roof of anatomical snuff box



ascends along radial border of forearm



continues in front of elbow along lateral border of biceps



pierces deep fascia at lower border of pectoralis major



deltopectoral groove



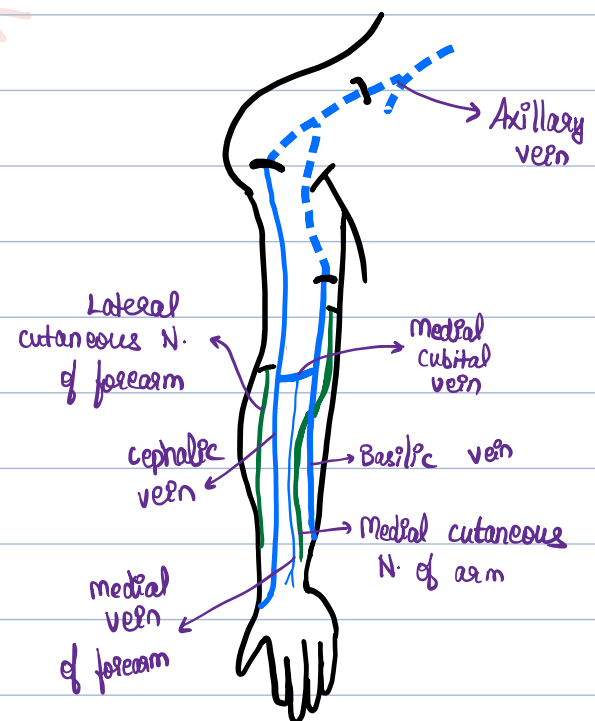
at infraclavicular fossa, pierces clavipectoral fascia



Termination: drains into axillary vein

Clinical Aspect:

- Cephalic vein is preferred for hemodialysis in patients with chronic renal failure (CRF), to remove waste products from blood.
- Cut-down of cephalic vein in deltopectoral groove is preferred when superior vena cava infusion is necessary.



Basilic Vein:

Origin: begins as continuation of medial end of dorsal venous arch



Course: runs along medial border of forearm



winds round the elbow & reaches anterior aspect



continues in front of elbow along medial side of biceps



pierces deep fascia at the middle of arm

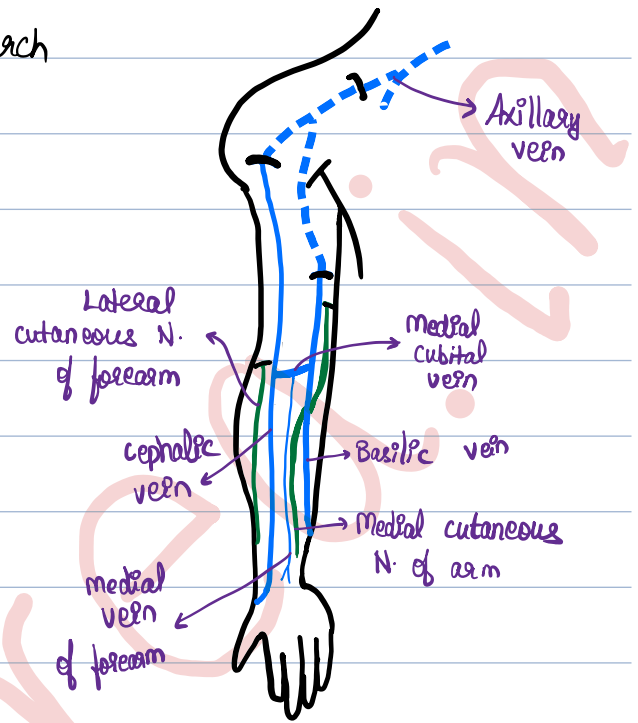


Termination:

unites with brachial vein & runs along medial side of brachial artery



becomes continuous with axillary vein at lower border of teres major



Clinical Aspect:

→ basilic vein is preferred for cardiac catheterization because:-

- diameter of basilic vein increases as it ascends from cubital fossa to axillary vein
- it is in direct line with axillary vein.

To enter the right atrium, path of catheter:

Basilic vein → Axillary vein → subclavian vein → brachiocephalic vein



right atrium of heart ← superior vena cava

Median Cubital Vein:

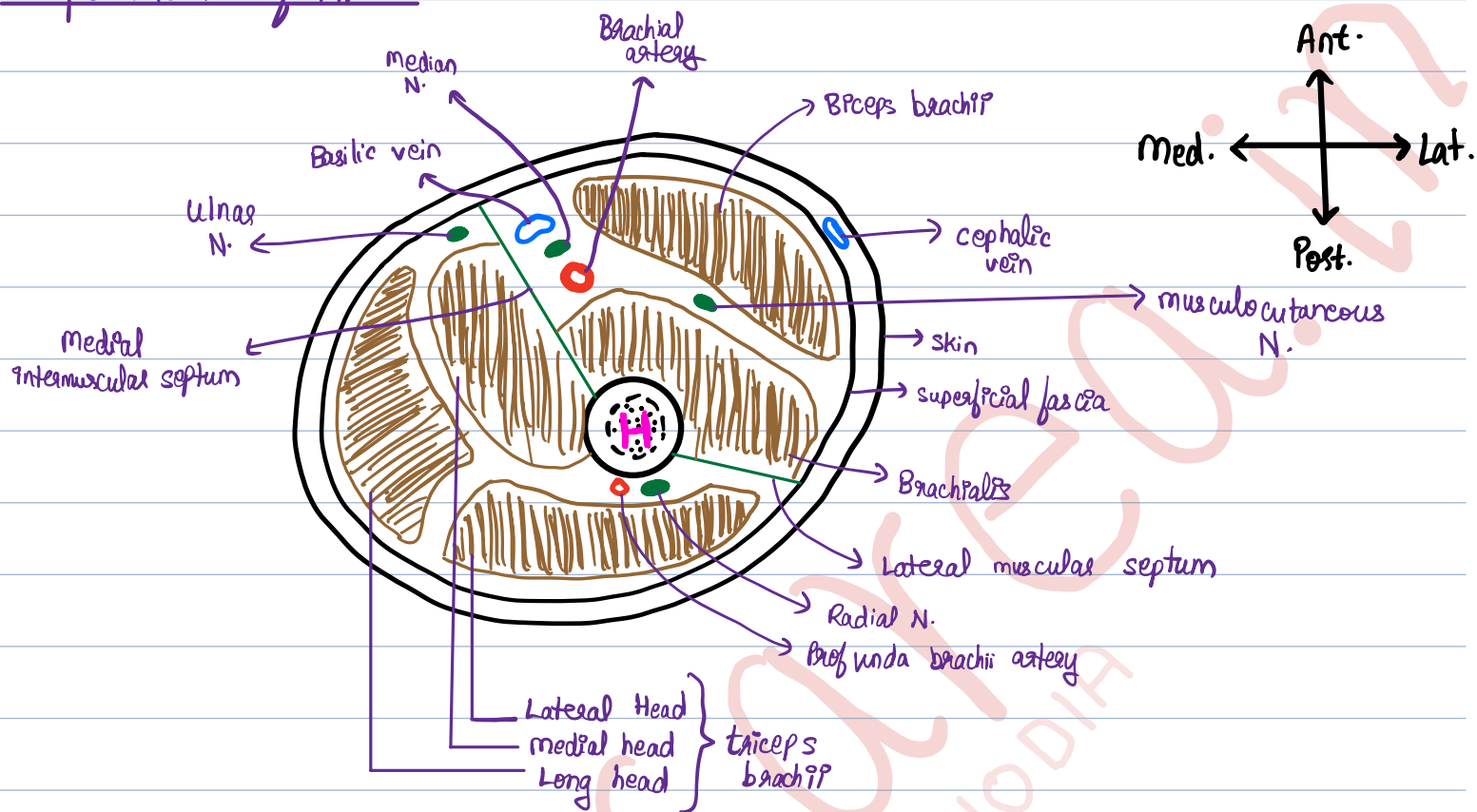
- communicating venous channel between cephalic & basilic veins
- begins from cephalic vein, 2.5 cm below elbow bend
- runs obliquely & medially
- ends in basilic vein, 2.5 cm above elbow bend.
- Important features:
 - separated from brachial artery by bicipital aponeurosis
 - communicates with deep veins through a perforator vein which pierces the bicipital aponeurosis.
 - receives median vein of forearm
 - shunts blood from cephalic vein to basilic vein.

Clinical Aspect:

Venepuncture In Cubital Fossa:

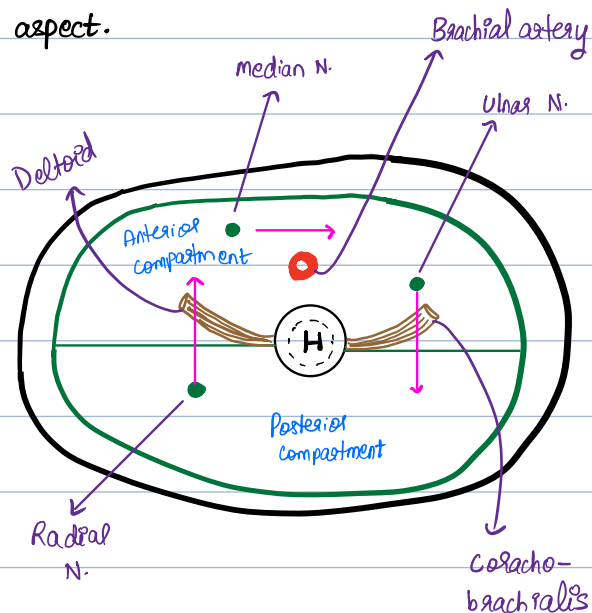
- veins in front of elbow (Cephalic, basilic & median cubital veins) are routinely used for giving intravenous injections & for withdrawing blood from patient/donor
- Median cubital vein is preferred because:
 - most superficial vein in the body, hence easy to access.
 - well supported by underlying bicipital aponeurosis
 - well anchored to the deep vein by a perforating vein, hence it does not slip during procedure.

Compartments of Arm:



Anatomical Events Occurring at level of insertion of Coracobrachialis:

- circular shaft of humerus becomes triangular below this level
- Brachial artery passes from medial side of arm to anterior aspect.
- Basilic vein pierces deep fascia
- Median N. crosses (in front of brachial artery) from lateral to medial side
- Radial N. pierces lateral intermuscular septum to pass from posterior to anterior compartment.
- Ulnar N. pierces medial intermuscular septum to pass from anterior to posterior compartment.
- Medial cutaneous N. of arm & forearm pierce deep fascia
- Nutrient artery pierces humerus.



Brachial Artery: main artery of arm

origin: begins at lower border of teres major as a continuation of axillary artery.

termination: in front of elbow at the level of neck of radius by dividing into radial & ulnar arteries.

Relations:

Anteriorly: Upper part - medial cutaneous N. of forearm lies in front of it

Middle part - crossed by Median N. from lateral to medial side.

Lower part - in cubital fossa; crossed by bicipital aponeurosis.

Posteriorly: From above downward → brachial artery lies on long head of triceps, medial head of triceps, coracobrachialis, brachialis

Medially: Upper part → ulnar N. & basilic vein; Lower part - median N.

Laterally: Upper part → median N., coracobrachialis, biceps; Lower part → tendon of biceps.

Branches: (i) muscular branches

(ii) profunda brachii artery

(iii) Nutrient artery to humerus

(iv) superior ulnar collateral artery

(v) inferior ulnar collateral (or supracondylar) artery

(vi) Radial & ulnar arteries (terminal branches)

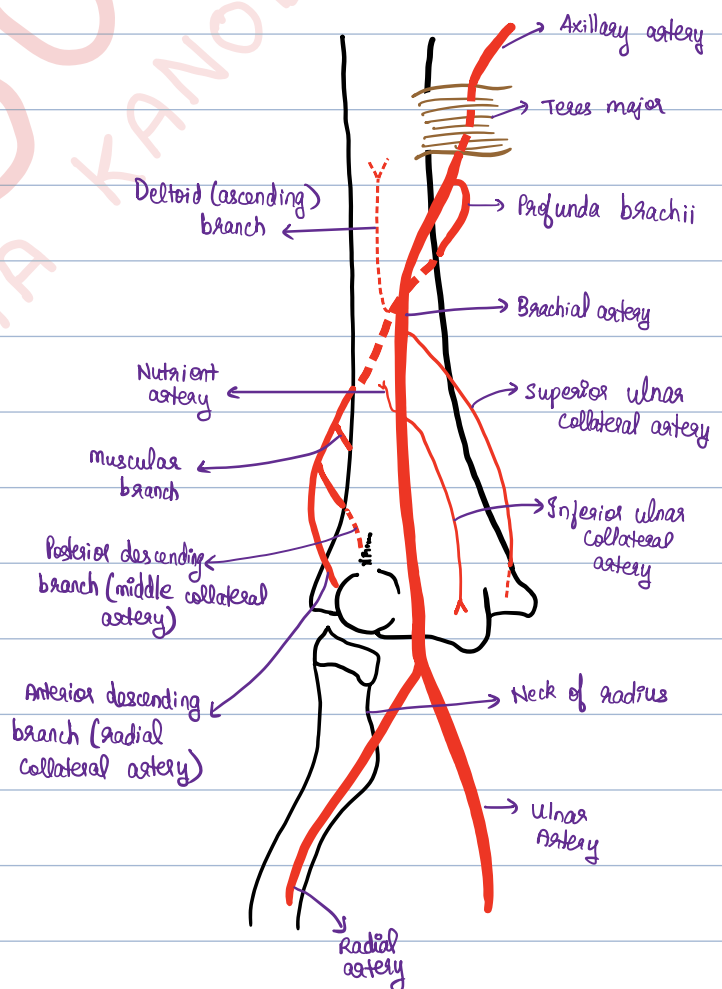
Clinical Aspect:

- Brachial pulse: commonly felt in cubital fossa medial to biceps tendon & its pulsations are auscultated for recording blood pressure.

- Rupture of Brachial artery: in supracondylar fracture of humerus, may lead to Volkmann's ischaemic contracture

- Brachial artery can be effectively compressed:

against shaft of humerus at level of insertion of coracobrachialis to stop haemorrhages in upper limb occurring from any artery distal to compression of brachial artery.



Anastomosis Around Elbow:

In front of ME:

- (i) Inferior ulnar collateral artery
- (ii) Anterior recurrent ulnar artery

Behind ME:

- (iii) Superior ulnar collateral artery
- (iv) Posterior recurrent ulnar artery

In front of LE:

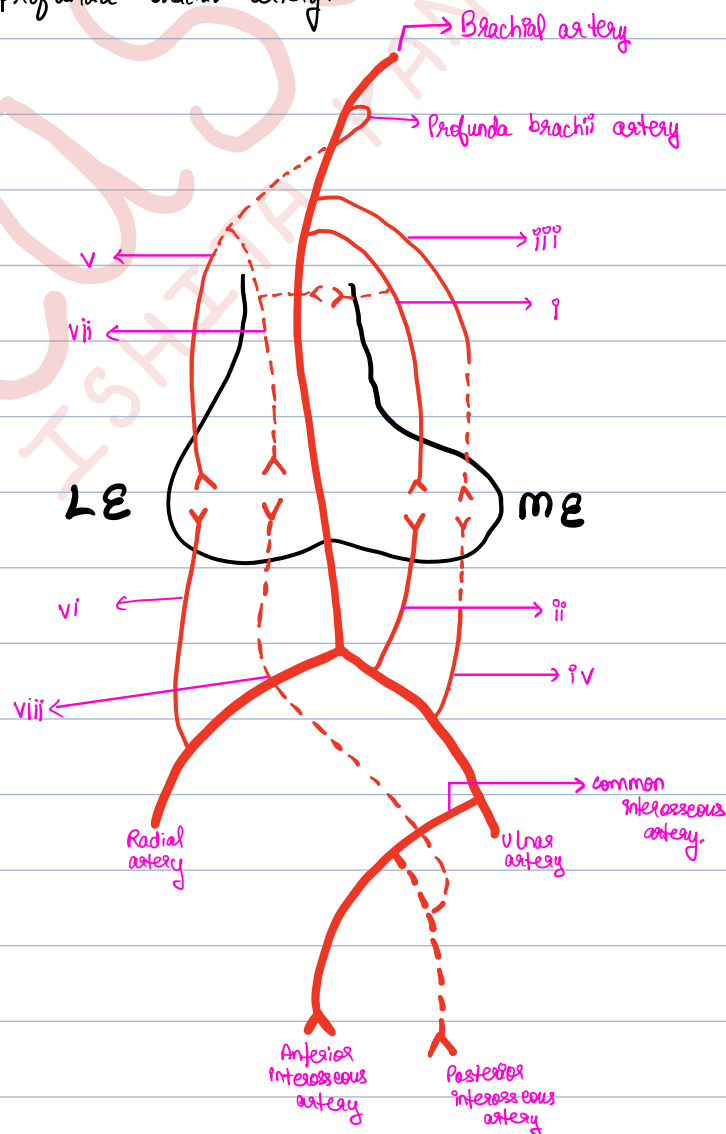
- (v) Anterior descending branch of profunda brachii artery
- (vi) Radial recurrent artery

Behind LE:

- (vii) Posterior descending branch of profunda brachii artery
- (viii) Recurrent interosseous artery (from posterior interosseous artery)

Behind the humerus, above the olecranon fossa:

- (i) Inferior ulnar collateral artery
- (ii) Posterior descending branch of profunda brachii artery.



Cubital Fossa:

- triangular hollow in front of elbow
- base is horizontal & directed upwards
- apex is directed downward
- homologous to lower half of popliteal fossa of lower limb

Boundaries:

Lateral: medial border of brachioradialis

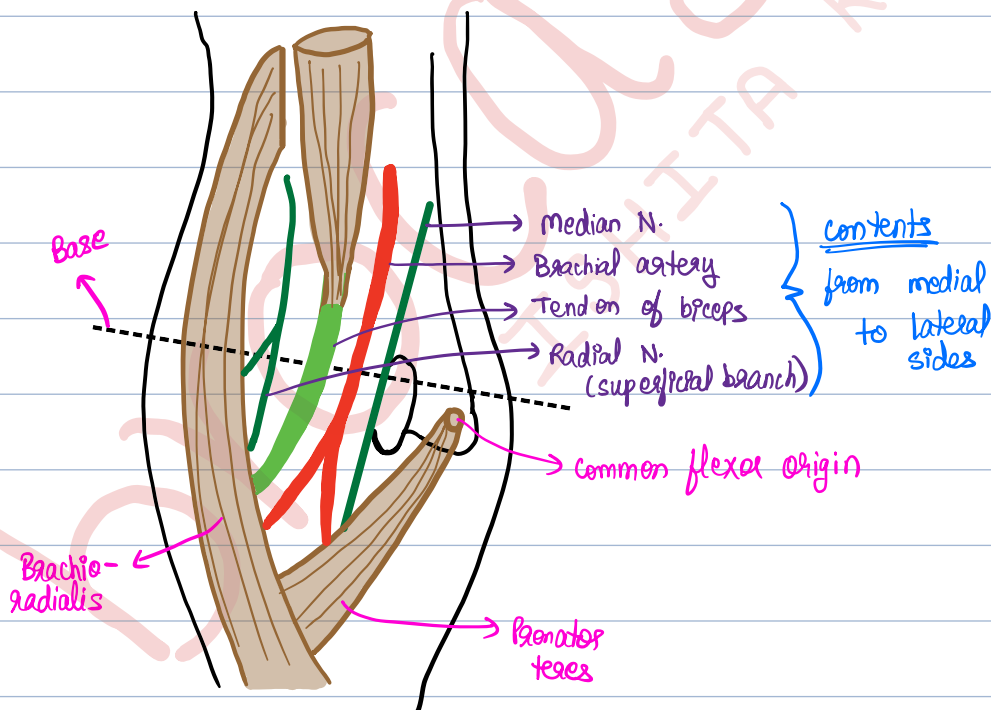
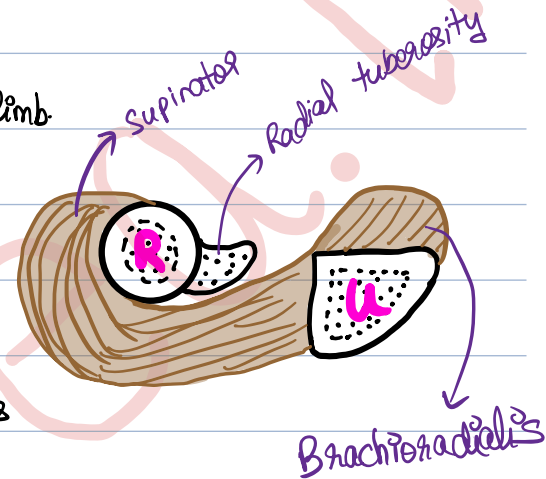
Medial: lateral border of pronator teres

Base: imaginary line joining front of 2 epicondyles of humerus

Apex: meeting point of brachioradialis & pronator teres

Floor: Brachialis in upper part; supinator in lower part

Roof: deep fascia of forearm with bicipital aponeurosis on medial side.



Contents:

Median N. → leaves the fossa by passing between 2 heads of pronator teres

Brachial Artery → terminates in the fossa at the level of neck of radius by dividing into radial & ulnar arteries

→ Radial artery is superficial & leaves the fossa at apex

→ Ulnar artery passes deep to pronator teres.

Biceps tendon: passes backward & laterally to be attached on radial tuberosity.

Radial N. → at level of lateral epicondyle, it divides into superficial radial N. & deep radial N. / posterior interosseous N.

Applied Aspect:

- Median cubital vein in this region, is the vein of choice for collecting blood samples & giving intravenous injections
- Brachial artery in this region, is easily located medial to biceps tendon & auscultated for recording BP.
- Used to deal with supracondylar fracture of humerus.

Ulnar Artery:

Origin: larger terminal branch of brachial artery in cubital fossa at level of neck of radius.



Course: runs downwards & reaches medial side of forearm midway between elbow & wrist



enters palm by passing superficial to flexor retinaculum, lateral to ulnar N.



terminates in hand by dividing into large superficial & small deep branches



Termination:

superficial branch continues as superficial palmar arch

Relations:

Upper Part: it lies deep to superficial flexor muscles

Lower Part: becomes superficial & lies between tendons of FCU & FDS

Anterior: upper part of ulnar artery is covered by 5 superficial muscles -

- (i) Pronator teres
- (ii) FCR
- (iii) Palmaris longus
- (iv) FDS
- (v) FCU

→ lower part of ulnar artery is covered by only skin & superficial & deep fasciae

Posterior: origin of ulnar artery lies on brachialis

→ remaining part of it lies on FDP

Medial: Ulnar N. & FCU

Lateral: FDS

Branches:

- Muscular branches
- Anterior & posterior ulnar recurrent arteries
- Common interosseous artery — divides into anterior & posterior interosseous arteries at upper border of interosseous membrane
- Anterior & posterior ulnar carpal branches — take part in formation of carpal arches
- Terminal branches (2) — superficial branch continues as superficial palmar arch
 - deep branch joins deep palmar arch.

Anterior Interosseous Artery: main source of supply to forearm along with PIA

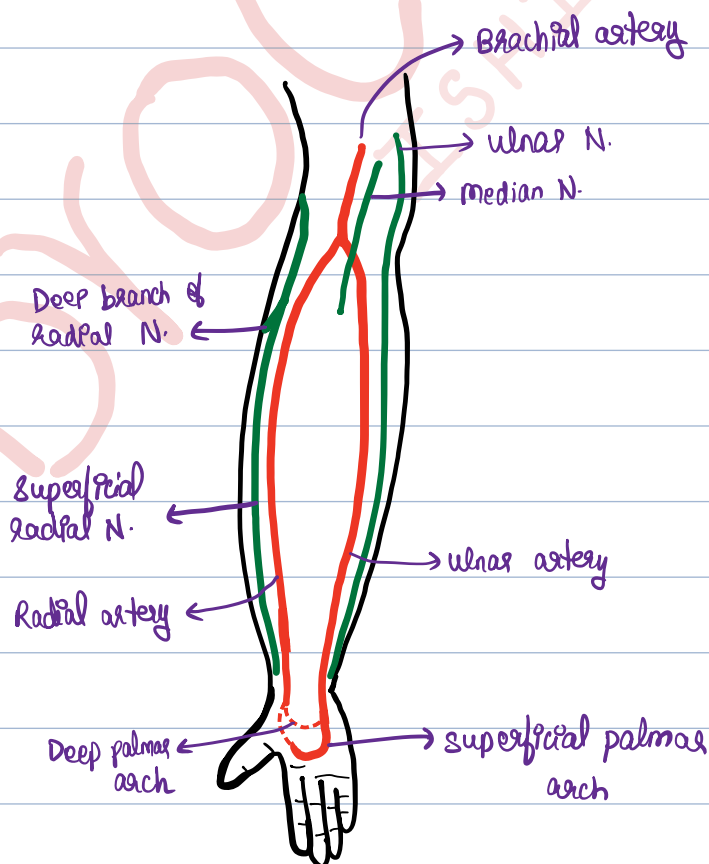
Origin: from common interosseous artery (branch of ulnar artery) at upper border of interosseous membrane

Course: descends in front of interosseous membrane along with anterior interosseous N. (branch of median N.)

pierces membrane at upper border of pronator quadratus to enter posterior compartment

Termination:

anastomoses with PIA & travels underneath extensor retinaculum to join dorsal carpal arch.



Radial Artery:

Origin: smaller terminal branch of brachial artery in cubital fossa at level of neck of radius

Course:

↓
lies beneath brachioradialis in upper part

↓
in lower part, lies on anterior surface of radius, covered only by skin & fascia

↓
leaves forearm by winding around lateral aspect of wrist to reach anatomical snuff box

↓
enters the palm by passing between two heads of 1st dorsal interosseous muscle
(in palm, it passes between 2 heads of adductor pollicis)

Termination:

↓
gives 2 branches - arteria radialis indicis & arteria princeps pollicis

↓
continues as deep palmar arch which is completed medially by anastomosing with deep palmar branch of ulnar artery.

Relations:

Anterior: upper part - overlapped by brachioradialis

lower part - covered by skin, superficial & deep fasciae

Posterior: Radial artery from above downwards lies on -

(i) biceps tendon

(ii) supinator

(iii) pronator teres

(iv) FDS

Branches:

(i) Muscular branches

(ii) Radial recurrent artery (anastomosis around elbow)

(iii) Palmar carpal branch

(iv) Superficial palmar branch

Applied Aspect:

Examination of Radial Pulse: felt on radial side of front of wrist

↳ while examining pulse, thumb should not be used as it has its own pulse

→ radial pulse is used for examining pulse rate

Volkman's ischaemic contracture (Ischaemic compartment syndrome):

→ sudden occlusion / laceration of brachial artery can cause paralysis of flexor muscles of forearm due to ischaemia within a few hours.

→ muscles can tolerate ischaemia upto 6 hours only

→ Thereafter, they undergo necrosis & fibrous tissue replaces necrotic tissue.

∴ there is permanent shortening of muscle, producing a flexor deformity:

- flexion of wrist
 - extension of MCP joints
 - flexion of IP joints
- } ⇒ loss of hand power

Posterior Interosseous Artery (PIA):

origin: from common interosseous artery (branch of ulnar artery) at upper border of interosseous membrane



Course: enters back of forearm by passing through a gap between oblique cord & upper margin of interosseous membrane



passes between supinator & adductor pollicis longus along with PIN.



becomes markedly reduced in lower part of forearm

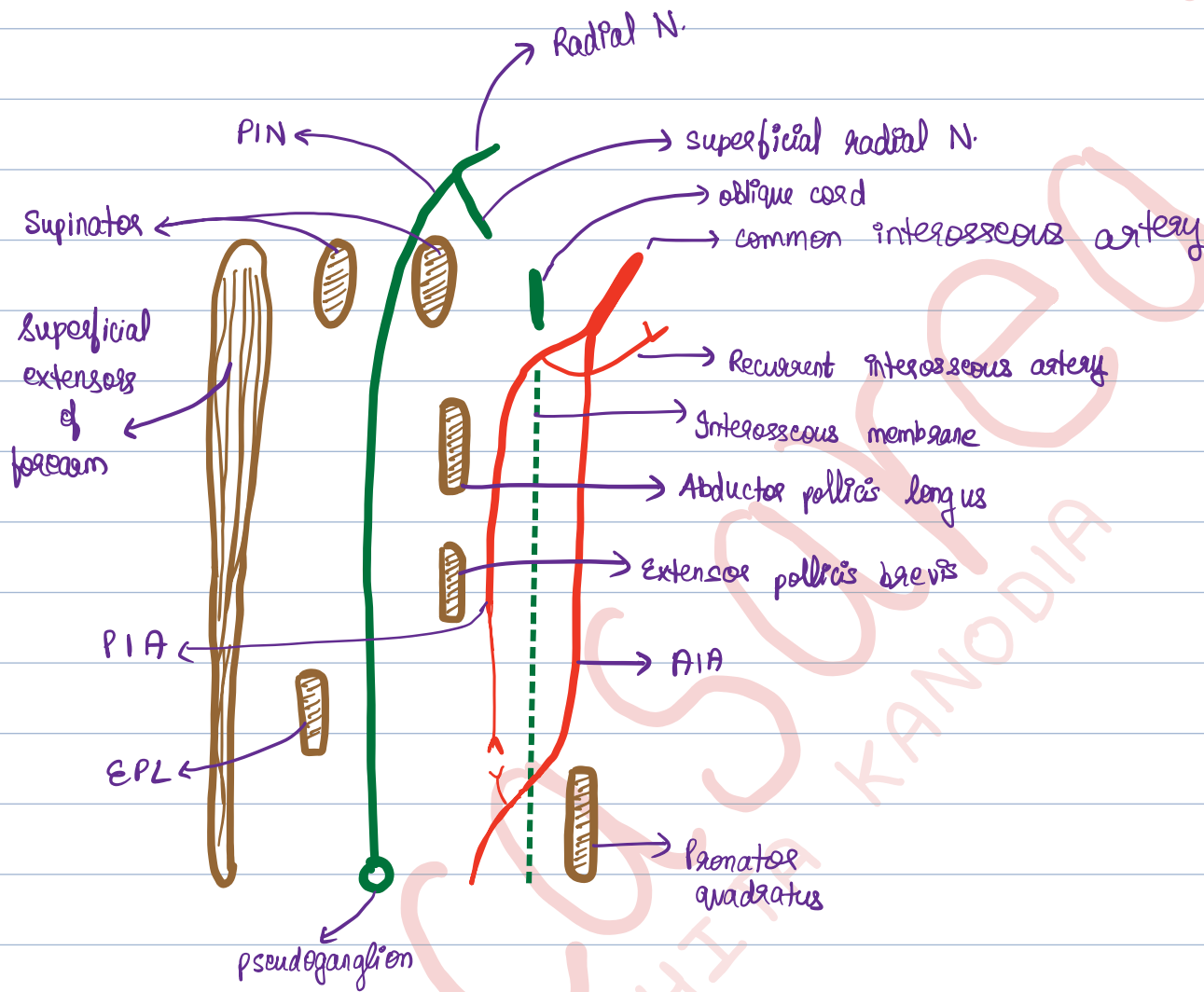


Termination:

ends by anastomosing with anterior interosseous artery in lower part of forearm.

Branches:

- Interosseous recurrent artery in cubital fossa (anastomosis around elbow joint)

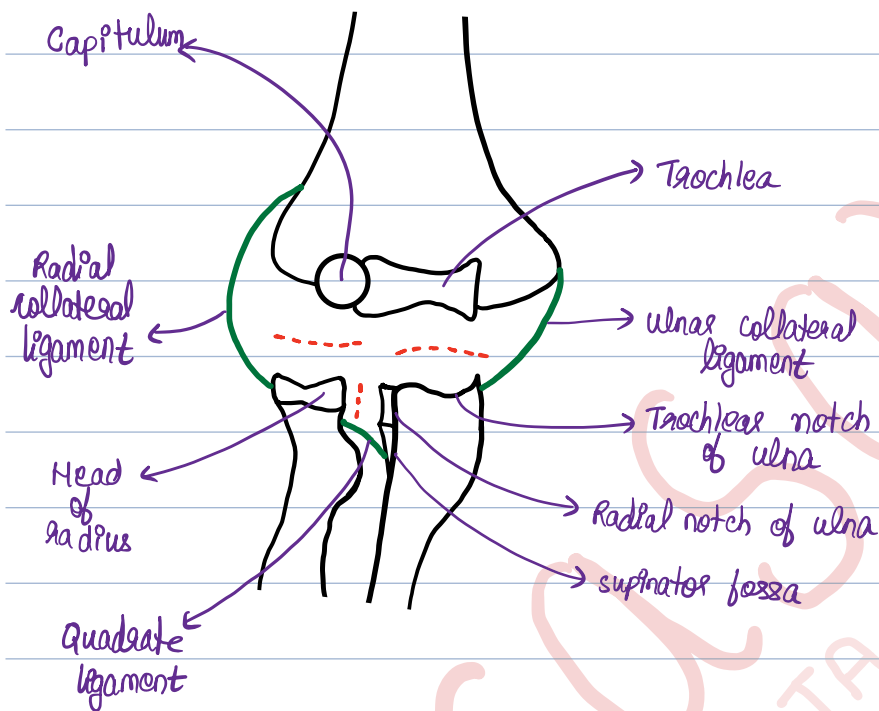


Elbow Joint:

Type: Hinge joint, synovial

Articulation:

- Humero-ulnar articulation $\Rightarrow$ between trochlea of humerus & trochlear notch of ulna
- Humero-radial articulation $\Rightarrow$ between capitulum of humerus & head of radius.



Capsule: Attachments -

Above - medial epicondyle, upper margins of radial, coronoid, olecranon fossae, lateral epicondyle of humerus

Below - anterior & medial margins of coronoid process of ulna

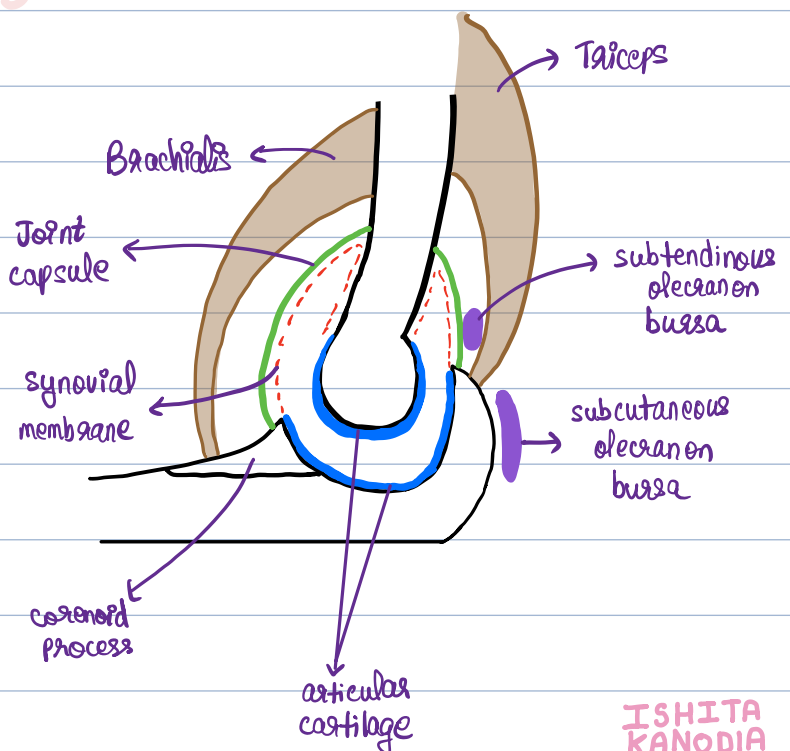
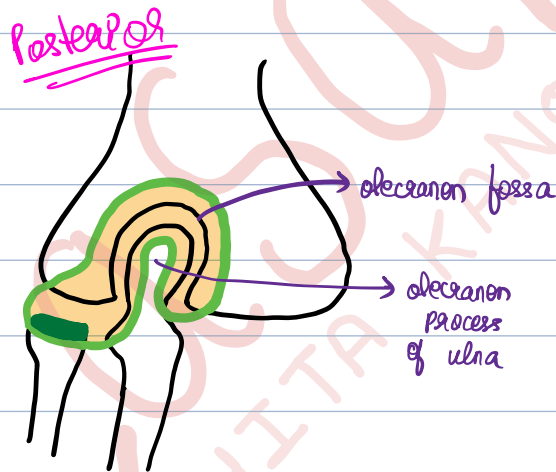
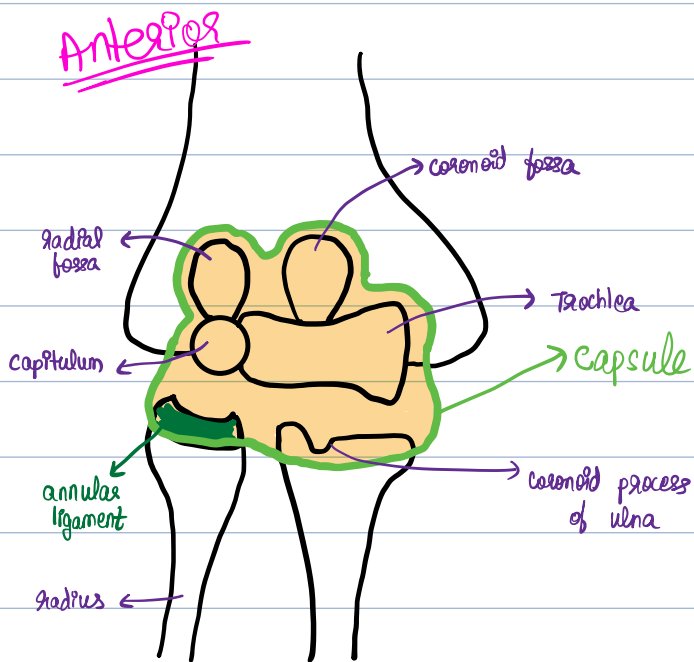
- upper margin of annular ligament

- upper & medial margin of olecranon process

(not attached to radius)

$\rightarrow$ to facilitate flexion & extension, anterior & posterior aspects of capsule are thinner than the sides

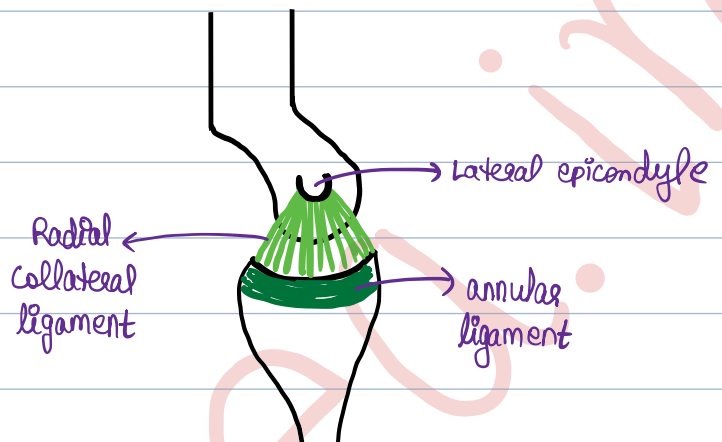
synovial lining of elbow joint is present along the capsule, except, it continues deep to annular ligament & reaches proximal radio-ulnar joint.



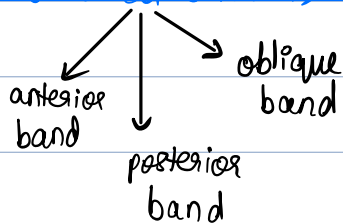
Ligaments:

Radial Collateral (Lateral) Ligament:

→ from lateral epicondyle of humerus to annular ligament on head of radius.



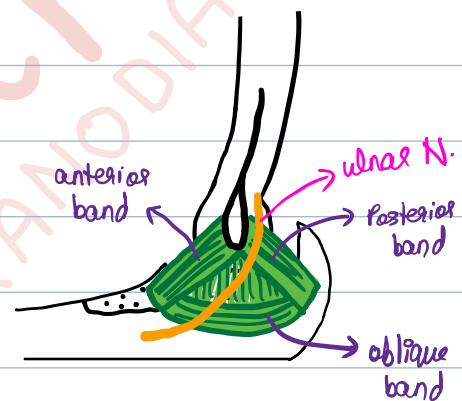
Ulnar Collateral (medial) Ligament:



Anterior band: from medial epicondyle to coronoid process

Posterior band: from medial epicondyle to olecranon process

Inferior/oblique band: between olecranon & coronoid process



Nerve Supply:

- (i) Median N.
- (ii) ulnar N.
- (iii) Radial N.
- (iv) Musculo-cutaneous N.

Blood Supply: arterial anastomoses around elbow joint by branches of brachial, radial & ulnar arteries.

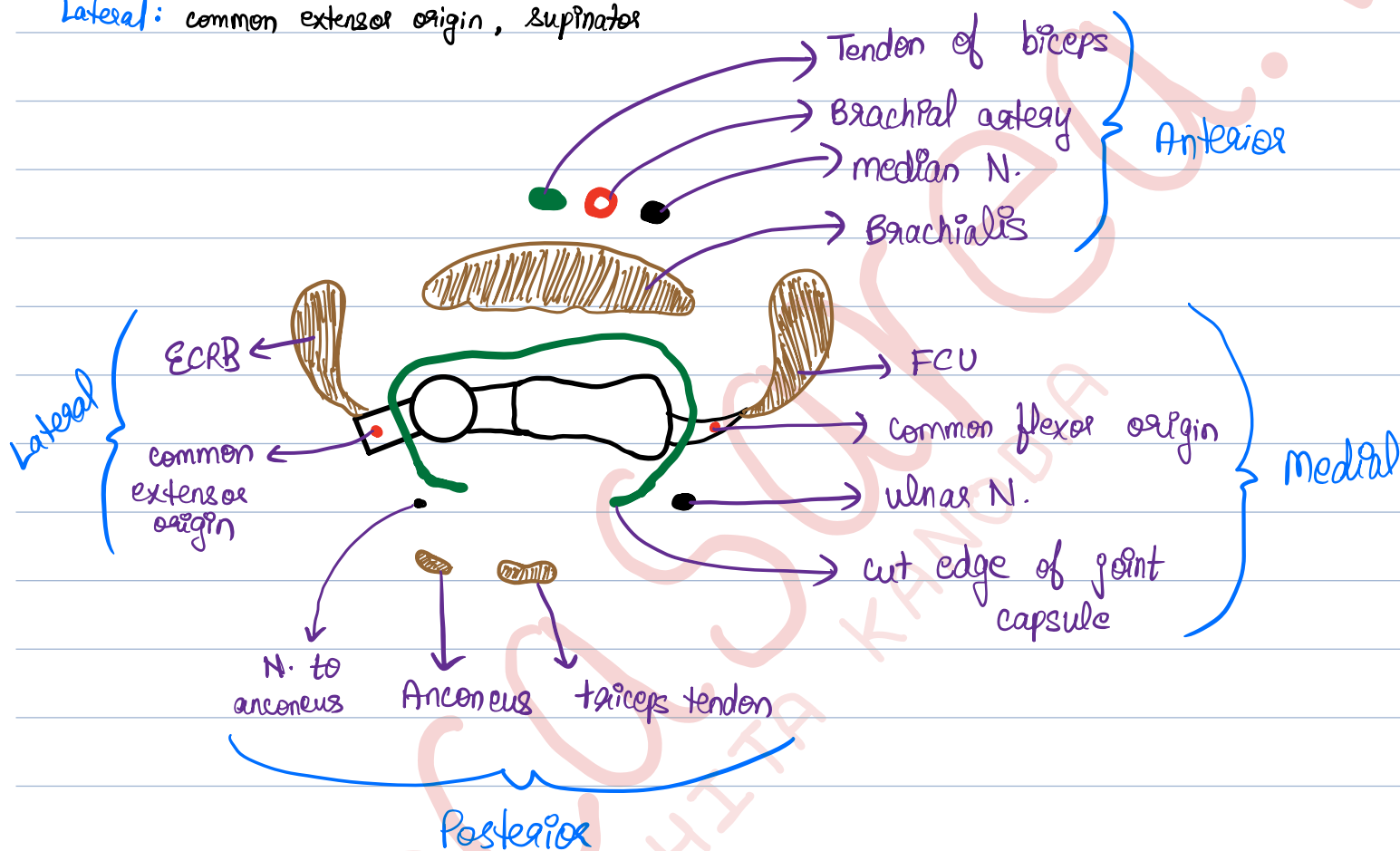
Relations:

Anterior: Brachialis, biceps tendon, brachial artery, median N. (boundaries & contents of cubital fossa)

Posterior: Triceps

Medial: common flexor origin, ulnar N.

Lateral: common extensor origin, supinator



Movements & Muscles:

Flexion: Brachialis

Biceps

Brachioradialis (weakest flexor)

Extension: Triceps

Anconeus

Related Bursae:

- (i) Subtendinous olecranon bursa
- (ii) Subcutaneous olecranon bursa
- (iii) Bicipitoradial bursa
- (iv) bursa separating biceps tendon from oblique cord.

Applied Aspect:

Dislocation: posterior dislocations are more common

→ occurs by falling on an outstretched hand.

Nursemaid's Elbow / Pulled Elbow (Subluxation of head of radius):

→ occurs in preschool children (1-3 y/o)

→ occurs when the forearm is suddenly pulled in pronation

→ head of radius comes out of the annular ligament & elbow is kept slightly flexed & pronated.

→ supinating the forearm causes severe pain.

→ reduction is achieved by supinating & extending the elbow & simultaneously applying direct pressure posteriorly on head of radius.

Tennis Elbow / Lateral Epicondylitis:

→ pain & tenderness over lateral epicondyle with pain during abrupt pronation

→ Causes — sprain of lateral collateral ligament

— tear of fibres of ECRB

— inflammation of bursa underneath the ECRB

— strain or tear of common extensor origin.

Golfer's Elbow / Medial Epicondylitis:

→ pain & tenderness over the medial epicondyle

→ Causes — strain or tear of common flexor origin with subsequent inflammation of medial epicondyle (due to repetitive use of superficial flexors of forearm as during playing golf).

Student's Elbow / Miner's Elbow:

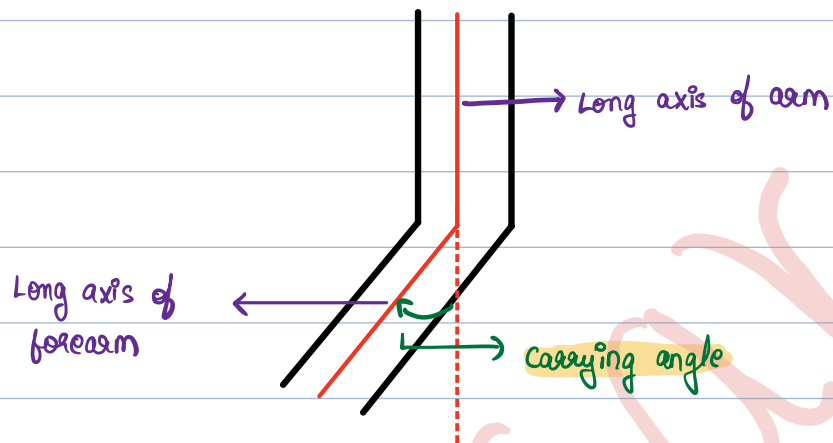
→ transverse axis of elbow joint is not transverse but is oblique being directed downwards & medially

→ this is because medial flange of trochlea lies 6mm below its lateral flange.

→ when elbow is extended, arm & forearm do not lie in a straight line, rather forearm is deviated slightly laterally.

→ angle of deviation of long axis of forearm from long axis of arm is called carrying angle.

- carrying angle disappears during pronation & full flexion of forearm.
- carrying angle varies from 5° to 15° & is more pronounced in females to avoid rubbing of forearms with the wider female pelvis while carrying loads.



Superior radio-ulnar joint: pivot type of synovial joint

- ↳ between circumference of radial head & fibro-osseous ring made by radial notch of ulna & annular ligament.
- Quadrate ligament → extends from neck of radius to upper part of supinator fossa of ulna (oblique cord)

Inferior (distal) radio-ulnar joint: pivot joint, synovial

- ↳ between convex head of ulna & ulnar notch of radius.

Interosseous membrane: fibrous sheet between interosseous borders of radius & ulna

- ↳ forms the middle radio-ulnar joint → syndesmosis type of fibrous joint.

Supination & Pronation:

Supination: radius & ulna lie parallel to each other

Pronation: rotation of lower end of radius along with articular disc on head of ulna (lower end of radius crosses in front of lower end of ulna).

— head of radius rotates within fibro-osseous ring formed by annular ligament & radial notch of ulna.

Supination: — Supinator

- biceps brachii supinates forearm while elbow is flexed
- brachioradialis supinates pronated forearm to midprone position.

Pronation: — Pronator teres

— Pronator quadratus

— Brachioradialis (pronates supinated forearm to midprone position)

→ Supination is more powerful than pronation because:

- it has antigravity movement
- performed by powerful muscles like biceps brachii compared to pronation (pronator teres & quadratus).

Flexor Retinaculum:

(Transverse Carpal Ligament)

→ strong fibrous band that bridges anterior concavity of carpus & converts it into osseofibrous tunnel called carpal tunnel.

→ rectangular

→ formed by thickening of deep fascia

Attachments:

Medially: pisiform & hook of hamate

Laterally: attached to tubercle of scaphoid & crest of trapezium

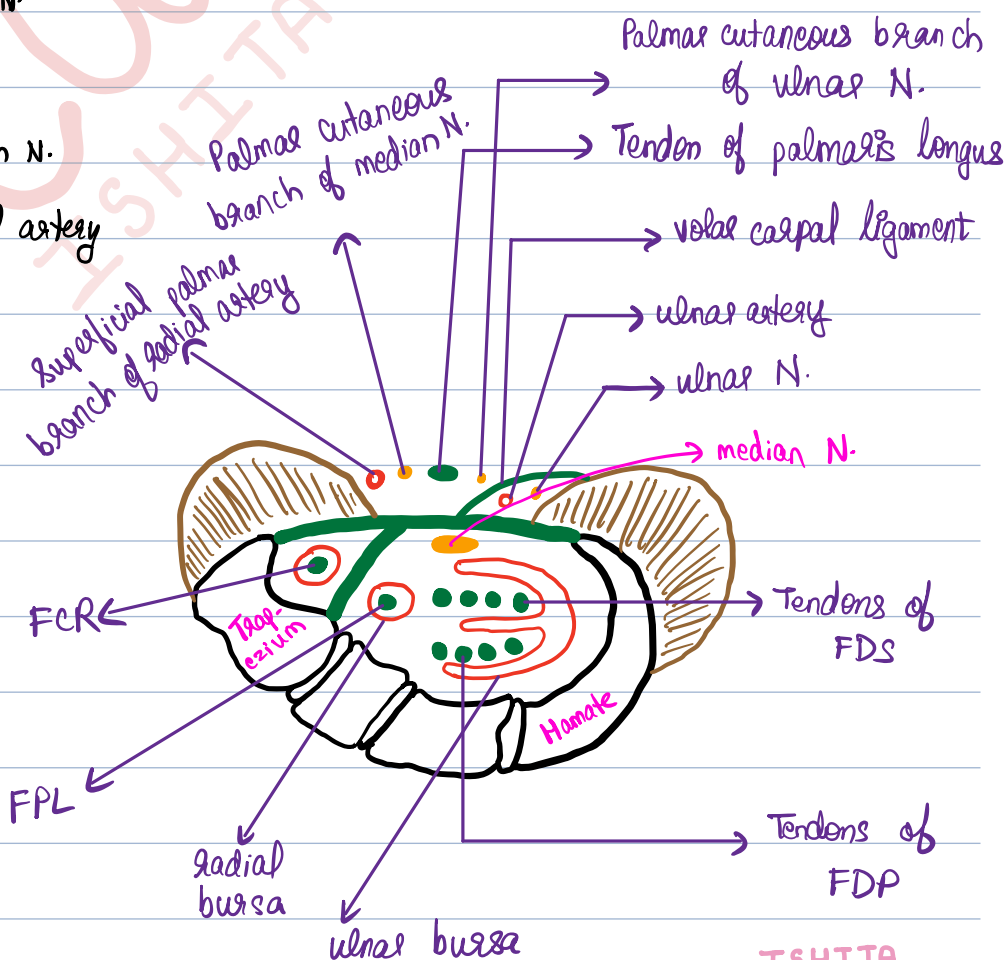
Structures Passing Superficial to Flexor Retinaculum:

From medial to lateral side:

- (i) Ulnar N.
- (ii) Ulnar artery
- (iii) Palmar cutaneous branch of ulnar N.
- (iv) Tendon of palmaris longus
- (v) Palmar cutaneous branch of median N.
- (vi) Superficial palmar branch of radial artery

Structures Passing Deep:

- (i) Tendon of FDS
- (ii) Tendon of FDP
- (iii) Tendon of FPL
- (iv) Median N.



Palmar Aponeurosis: (degenerated tendons of palmaris longus).

- deep fascia of palm is thin over the thenar & hypothenar eminences & thick in central part of palm where it forms palmar aponeurosis.
- covers long flexor tendons & superficial palmar arch.
- Apex is proximally.
Base is directed distally.

Features: Apex, Base, Medial border, Lateral border

Apex: blends with flexor retinaculum.

Base: proximal to heads of metacarpals, base divides into 4 longitudinal slips — one for each medial digit.

→ each slip further divides into 2 slips that blend with fibrous flexor sheaths

→ digital vessels & nerves of lumbricals emerge through intervals between the four longitudinal slips

Medial Border: continuous with deep fascia covering hypothenar muscles & gives origin to palmaris brevis.

Lateral Border: continuous with deep fascia covering thenar muscles

↳ Lateral palmar septum extends inwards from this edge to 1st metacarpal.

Functions: (i) helps to improve grip of hand by fixing the skin.

(ii) Protects underlying tendons, nerves & vessels.

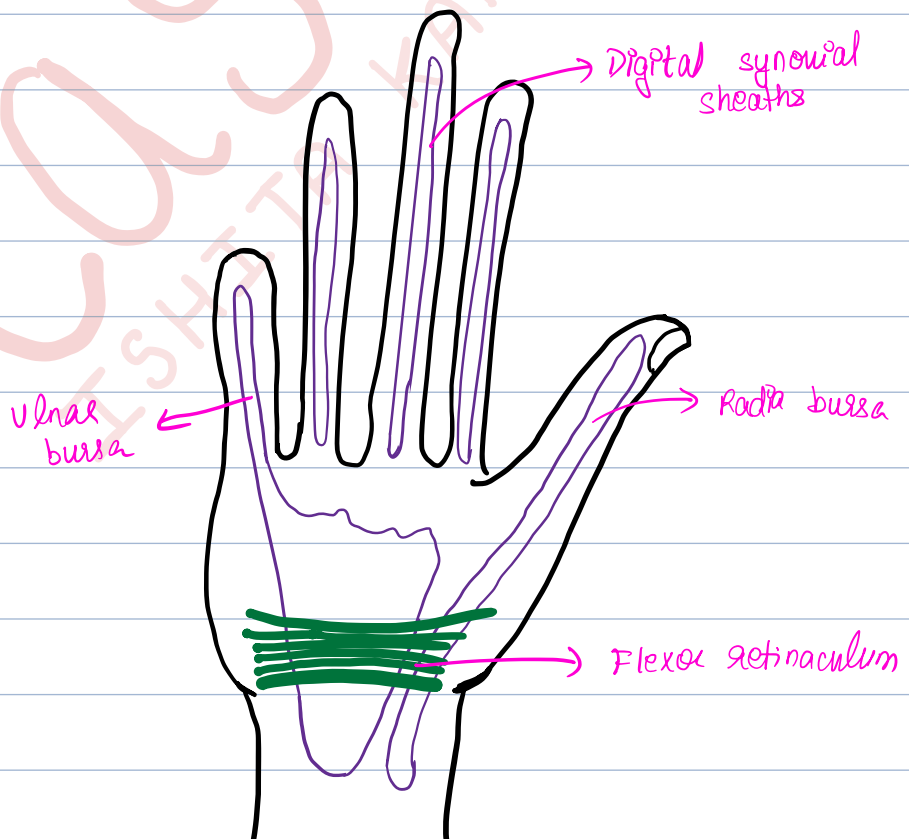
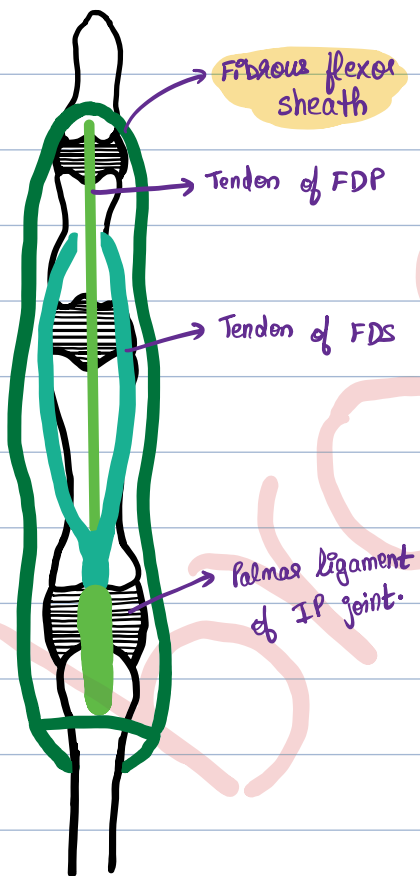
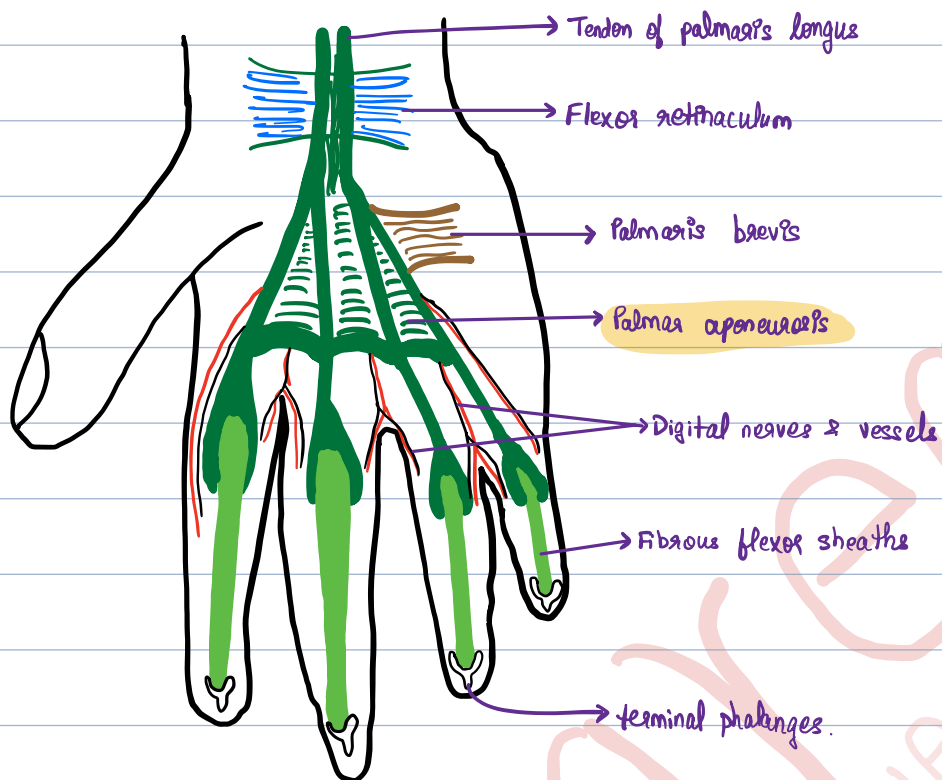
Dupuytren's contracture: progressive fibrosis in medial part of palmar aponeurosis.

↳ medial part of palmar aponeurosis undergoes progressive thickening to form permanent contracture

→ flexion deformity of little & ring fingers

- proximal & middle phalanges are acutely flexed
- distal phalanges remain unaffected

→ surgical fasciectomy is required if hand function is grossly impaired.



Fibrous Flexor Sheath:

- deep fascia on anterior surface of each digit thickens
- Extends from head of metacarpal to base of distal phalanx.
- Attachments: attached to margins of phalanges & palmar ligaments of IP joints.
 - ↳ proximal end is open & continuous with distal slips of palmar aponeuroses
- distal end is attached to palmar surface of base of distal phalanx
- anterior surface of phalanges, the sheath & palmar ligaments of IP joints forms a blind osseofibrous tunnel through which pass long flexor tendons. (FDS & FDP)
[osseofibrous tunnel of thumb contains tendon of FPL]
- Function: hold the tendons in position during flexion of digits.

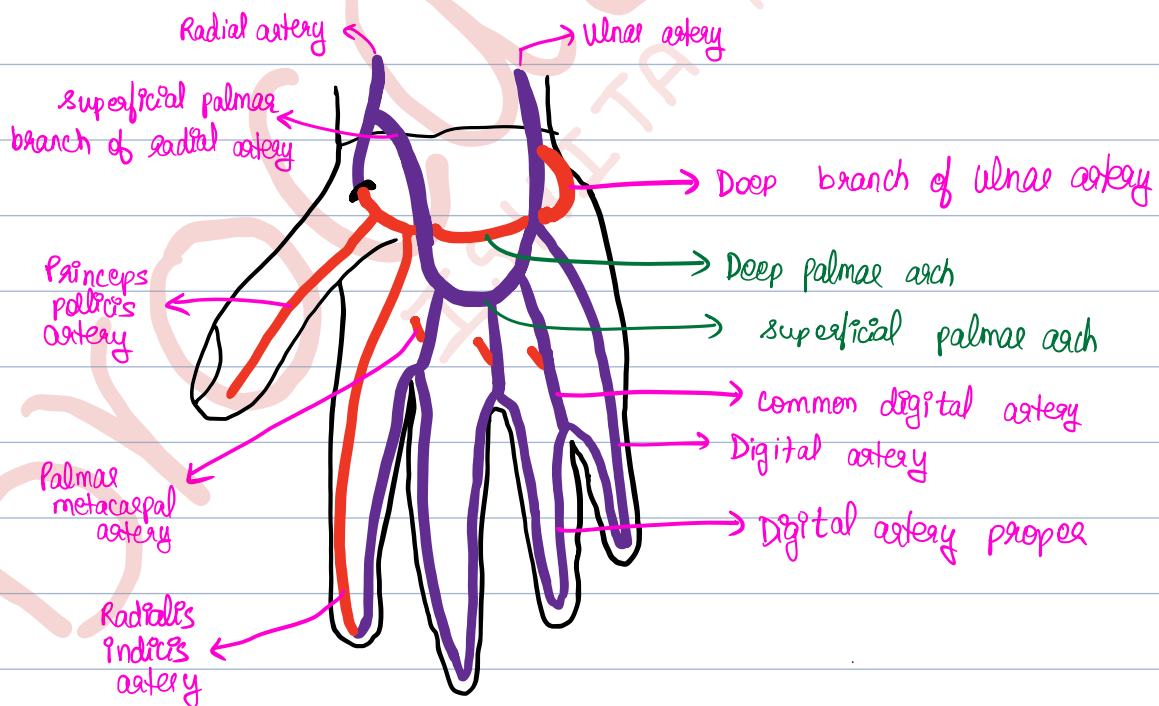
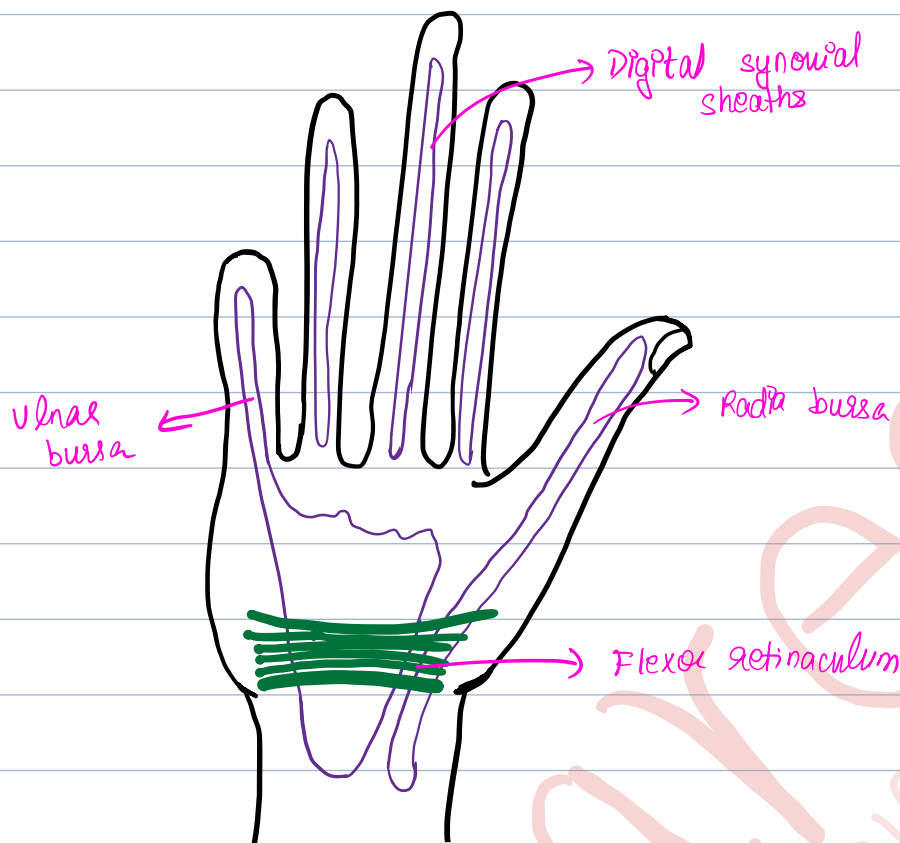
Ulnar Bursa: contains tendons of FDS & FDP

- Extent: extends into forearm, about a finger breadth proximal to flexor retinaculum
 - distally extends upto middle of shafts of metacarpal bones.
- Distal medial end of ulnar bursa is continuous with digital synovial sheath of little finger.

Radial Bursa: encloses tendon of FPL in thumb

- Extent: proximally, extends into forearm, about a finger breadth proximal to flexor retinaculum.
 - distally continuous with digital synovial sheath of thumb.

Digital Synovial sheath: extends from head of metacarpals to distal phalanges.



Superficial Palmar Arch:

- direct continuation of ulnar artery (superficial palmar branch of ulnar artery) beyond flexor retinaculum
- arch is completed laterally by anastomosing with:
 - (i) superficial palmar branch of radial artery
 - (ii) Radialis indicis artery
 - (iii) Princeps pollicis artery.

Branches:

- (i) 3 common palmar digital arteries (in interdigital clefts)



each divides into 2 proper digital arteries

(joined by palmar metacarpal arteries in interdigital cleft.

- (ii) one proper digital artery running along medial side of little finger.
- (iii) Cutaneous branches to palm.

Relations:

- FDS, FDP tendons
- Lumbricals
- Digital branches of medial & ulnar N.

Deep Palmar Arch:

- continuation of radial artery
- arch is completed medially by anastomosing with deep palmar branch of ulnar artery.

Branches:

- (i) Three palmar metacarpal arteries (which joint common digital arteries)
- (ii) Three perforating arteries (pass through 2nd, 3rd, 4th interosseous spaces to anastomose with dorsal metacarpal arteries.
- (iii) Recurrent branches

Relations:

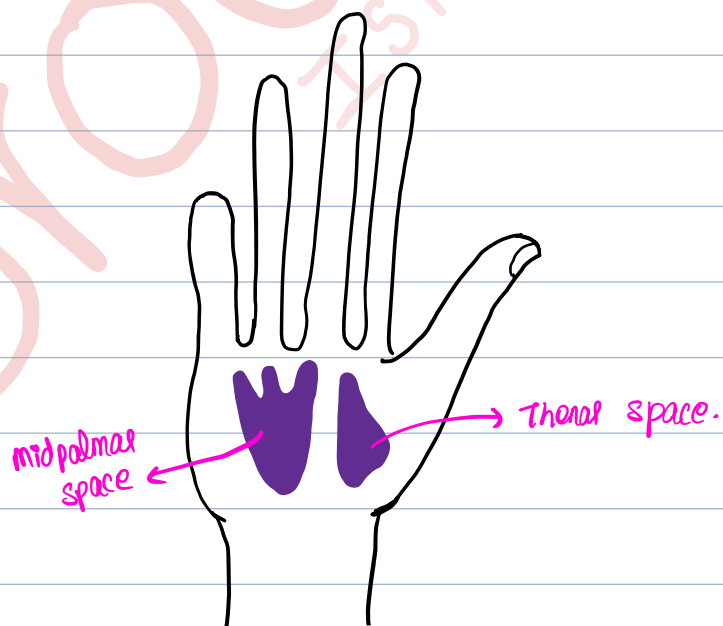
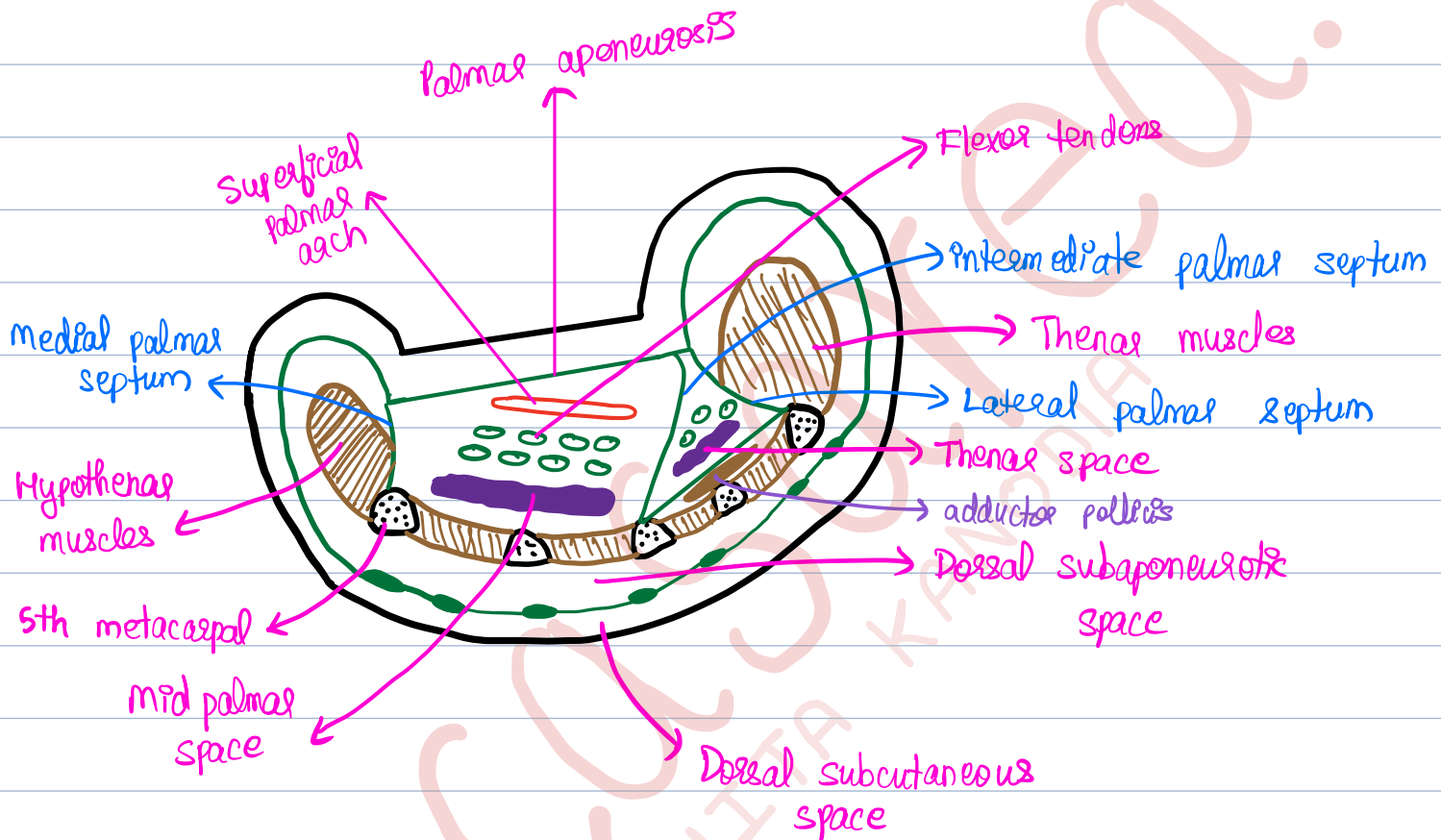
- Deep - interosseous muscles
- superficial - lumbricals.

Fascial Spaces of Hand:

- Palmar spaces** — midpalmar
— thenar
— pulp spaces of digits

- Dorsal spaces** — Dorsal subcutaneous space
— Dorsal subaponeurotic space.

Space of Perna

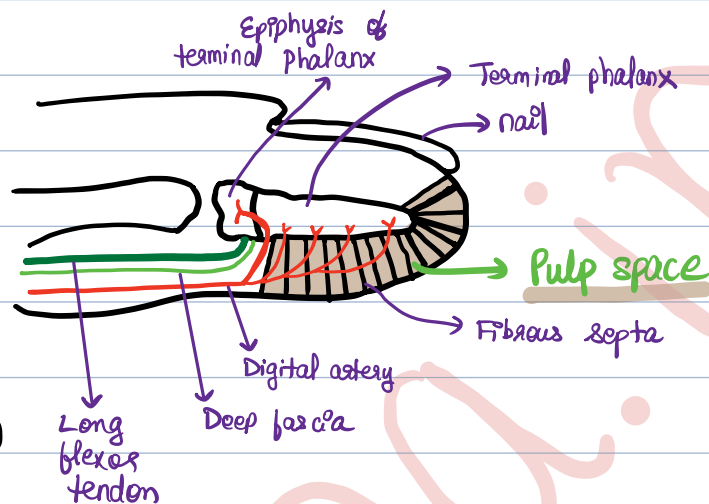


Pulp space of Digits:

Boundaries:

Superficial: skin & superficial fascia

Deep: distal two-third of terminal phalanx



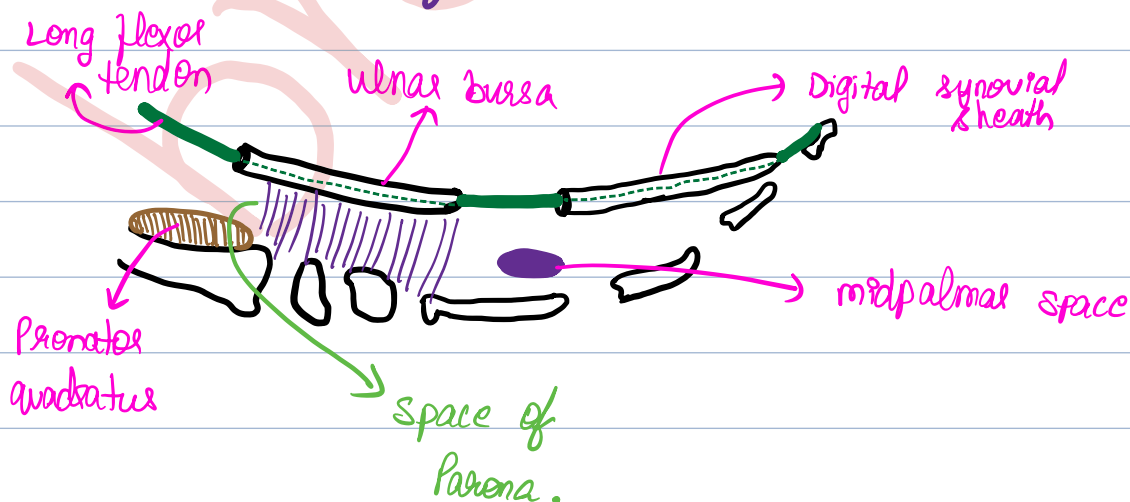
Features: space is traversed by numerous septa extending from skin to periosteum of terminal phalanx.

- digital artery supplies diaphysis of phalanx through this space.
(Epiphysis receives its blood supply proximal to pulp space)

Pulp space Infection:

- prone for infection (as it is the most exposed part of a digit)
- abscess in pulp space = whitlow/felon.
- rising tension in pulp space causes throbbing pain.
- pus from pulp space is drained by a lateral incision on front of the finger.
- if neglected, whitlow may lead to avascular necrosis of distal 4/5th of terminal phalanx due to occlusion of digital artery.
[Proximal 1/5th is not affected].

Forearm space of Parona:



Anatomical Snuff Box:-

- elongated triangular depression
- on lateral side of dorsum of hand (seen when thumb is hyperextended)

Boundaries:

Anterolaterally: APL, EPB

Posteromedially: EPL

Floor: scaphoid, trapezium

Roof: skin, superficial fascia.

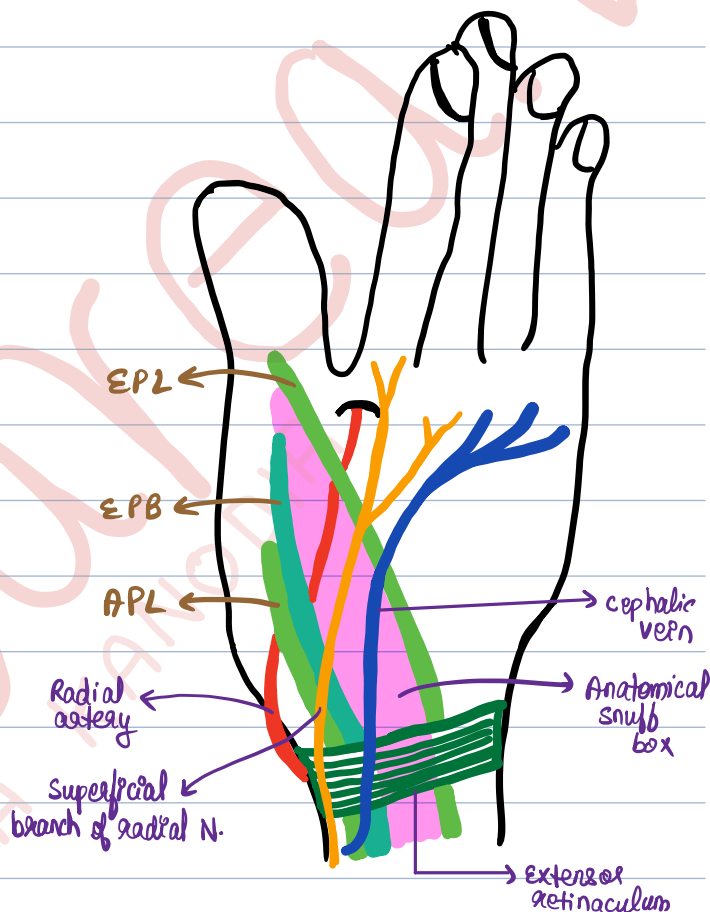
Contents: Radial artery

Structures Crossing Roof (Deep to Skin):

- cephalic vein
- terminal branches of superficial radial N.

Applied Aspect:

- pulsations of radial artery are felt in anatomical snuff box.
- tenderness in anatomical snuff box indicates fracture of scaphoid.
- cephalic vein at this site is often used for giving intravenous fluids.
- superficial branches of radial N. can be rolled over tendon of EPL.



Pectoral Region

- Pectoralis major } medial pectoral N. (C8, T1)
- Pectoralis minor } lateral pectoral N. (C5-C7)
- Subclavius - N. to subclavius (C5, C6)
- Serratus Anterior - Long Thoracic N. / Bell's N. (C5-C7)

Posterior Axio-Appendicular Muscles

- Trapezius - spinal part of accessory N. [ventral rami of C3 & C4 $\Rightarrow$ proprioceptive]
- Latissimus dorsi - Thoracodorsal N. (C6-C8)
- Levator scapulae - C3, C4; C5 through dorsal scapular N.
- Rhomboides major } dorsal scapular N. (C5)
- Rhomboides minor }

Scapulohumeral muscles

- Deltoid - Axillary N. (C5, C6)
- Supraspinatus - Suprascapular N. (C5, C6)
- Infraspinatus - Suprascapular N. (C5, C6)
- Teres major - lower subscapular N.
- Teres minor - Axillary N. (C5, C6) [possesses pseudoganglion]
- Subscapulars - upper & lower subscapular N.

Arm

- Biceps Brachii - musculocutaneous N. (C5-C7)
- Coracobrachialis - musculocutaneous N. (C5-C7) [Musculocutaneous N. $\Rightarrow$ pierces coracobrachialis]
- Brachialis - medial 2/3 $\Rightarrow$ musculocutaneous N.
Lateral 1/3 $\Rightarrow$ radial N.
- Triceps brachii - Radial N. (C7, C8)

Superficial Muscles of Anterior Forearm

Pronator Teres

Flexor carpi radialis

Palmaris longus

Flexor digitorum superficialis

} median N.

Flexor carpi ulnaris - ulnar N.

Deep Muscles of Anterior Forearm

Flexor Pollicis Longus - anterior interosseous N.

→ medial half ⇒ ulnar N.

Flexor digitorum profundus

→ lateral half ⇒ anterior interosseous N.

Pronator Quadratus - anterior interosseous N.

Superficial Muscles of Back of Forearm

Brachioradialis - Radial N.

(Posterior interosseous N. ⇒ process supinator)

ECRL - Radial N.

ECRB

ED

EDM

ECU

} Posterior interosseous N.

Anconeus - N. to anconeus (from radial N. in spiral groove)

Deep muscles of back of forearm

Supinator

APL

EPB

EPL

Extensor indicis

} Posterior interosseous N.

Thenar Muscles

Abductor Pollicis Brevis

Flexor Pollicis Brevis

Opponens pollicis

recurrent branch
of median N.

Hypothenar Muscles

Abductor Digiti minimi

Flexor digiti minimi

Opponens digiti minimi

deep branch
of Ulnar N.

Lumbricals

1st, 2nd - median N.

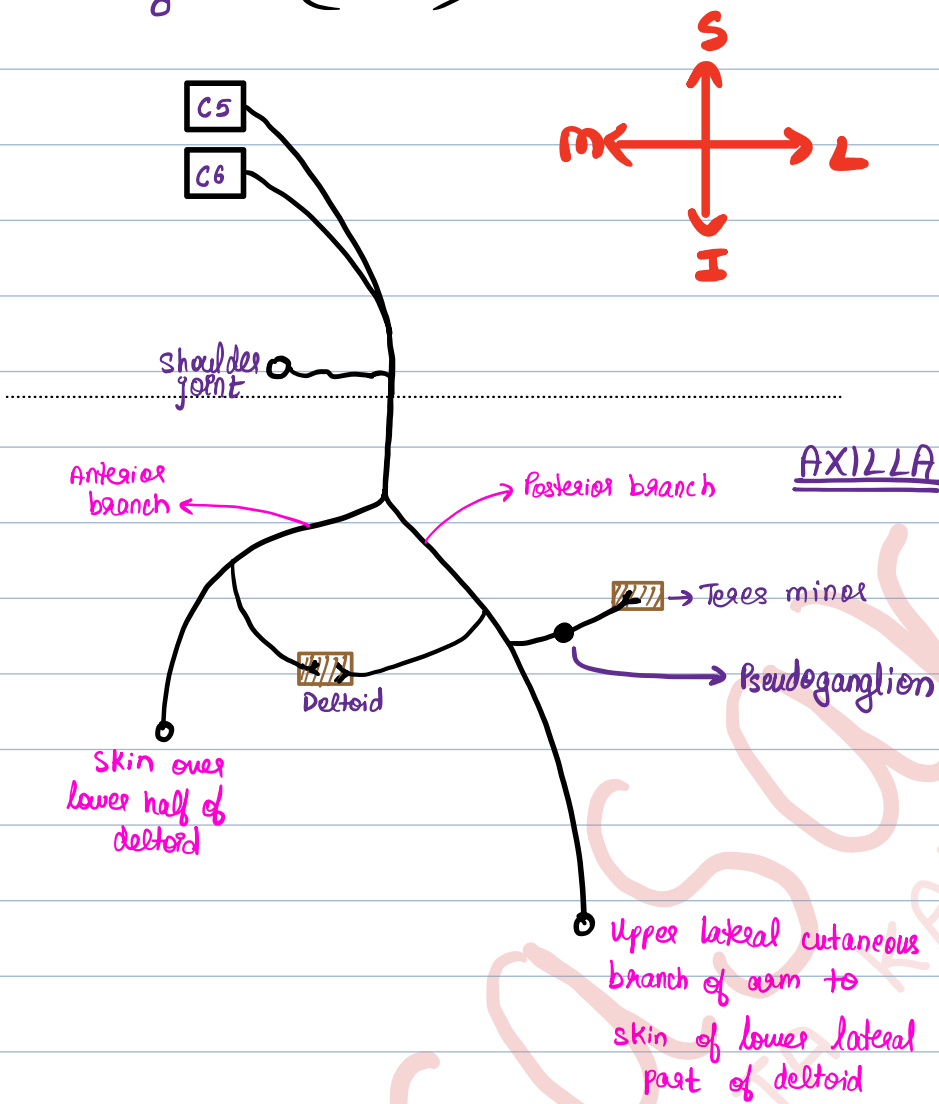
3rd, 4th - deep branch of Ulnar N.

Palmar Interossei

Dorsal Interossei

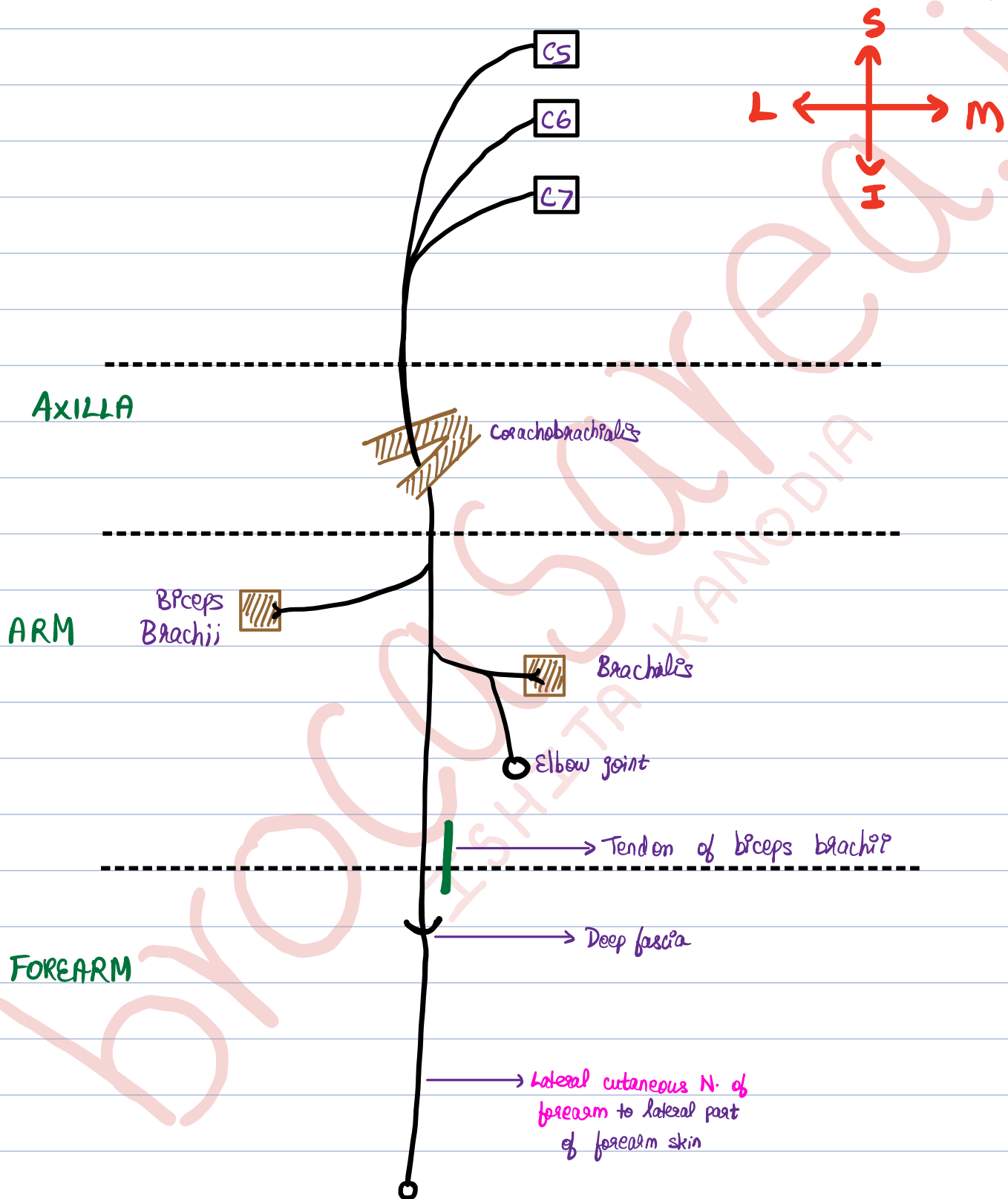
deep branch
of ulnar N.

Axillary N.: (C5, C6)



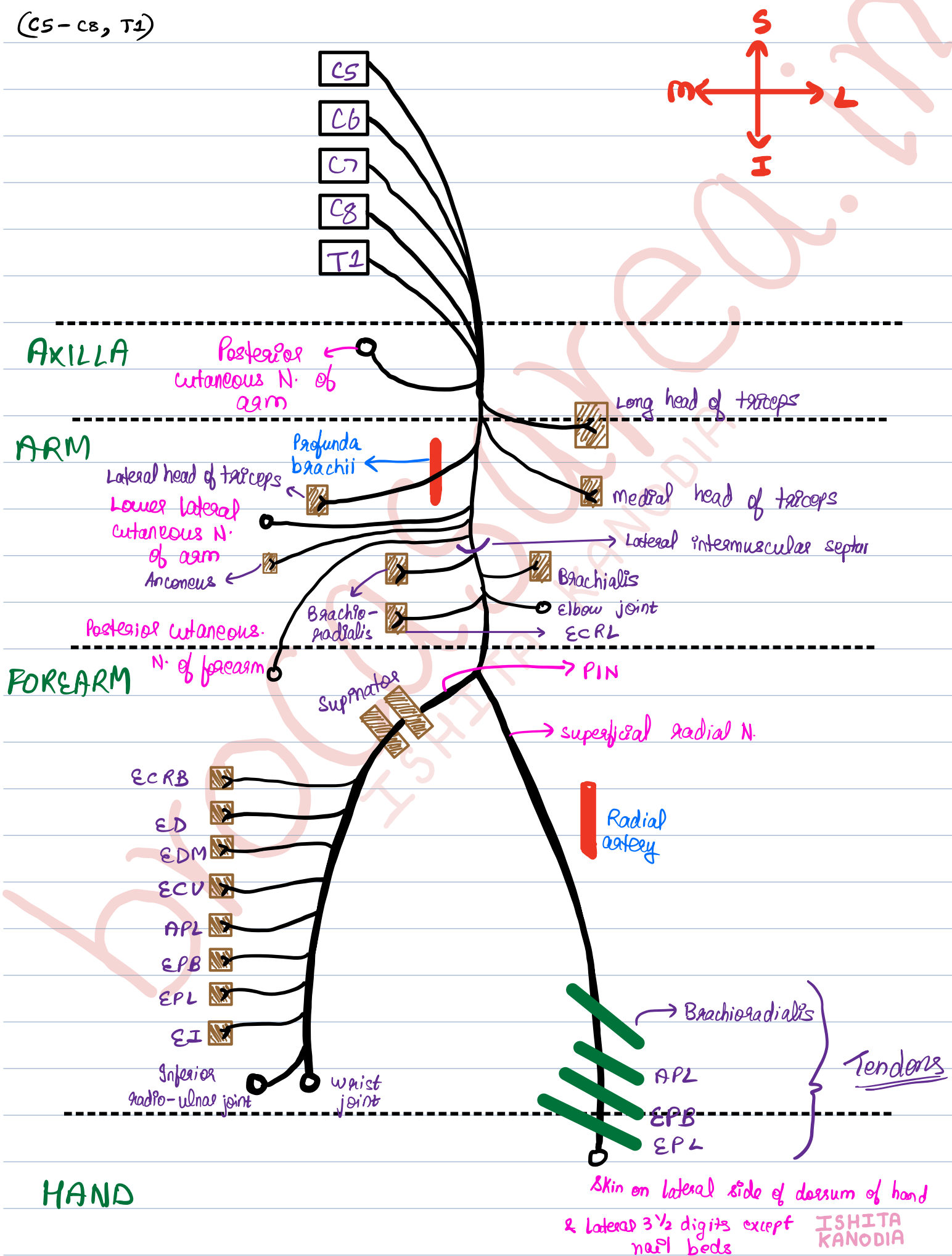
Musculocutaneous N.:

(C5, C6, C7)



Radial N.:

(C5 - C8, T1)



Radial Nerve Injuries:

In axilla: Crutch palsy

Motor loss: Loss of extension of elbow (# triceps)

- Loss of extension of wrist (wrist drop - due to unopposed action of flexors of forearm)
- loss of extension of digits (# = ED, EI, EDM, EPL)
- loss of supination in extended elbow (# = Brachioradialis, supinator)

Sensory loss: skin over posterior surface of lower part of arm

- along narrow strip on the back of forearm
- lateral part of dorsum of hand & base of thumb (except nail beds).

In radial groove: Saturday Night Paralysis / midshaft fracture of humerus / wrongly placed IM injection.

Features: wrist drop

- loss of extension of wrist & fingers
- loss of supination in extended arm
- sensory loss over dorsum of hand.

At Elbow: Radial tunnel Syndrome

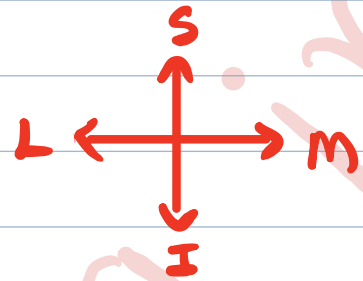
Features: loss of extension of wrist & fingers. NO WRIST DROP

- Pain over the extensor aspect of forearm

Median N.:

(C5 - C8, T1)

ISHITA
KANODIA

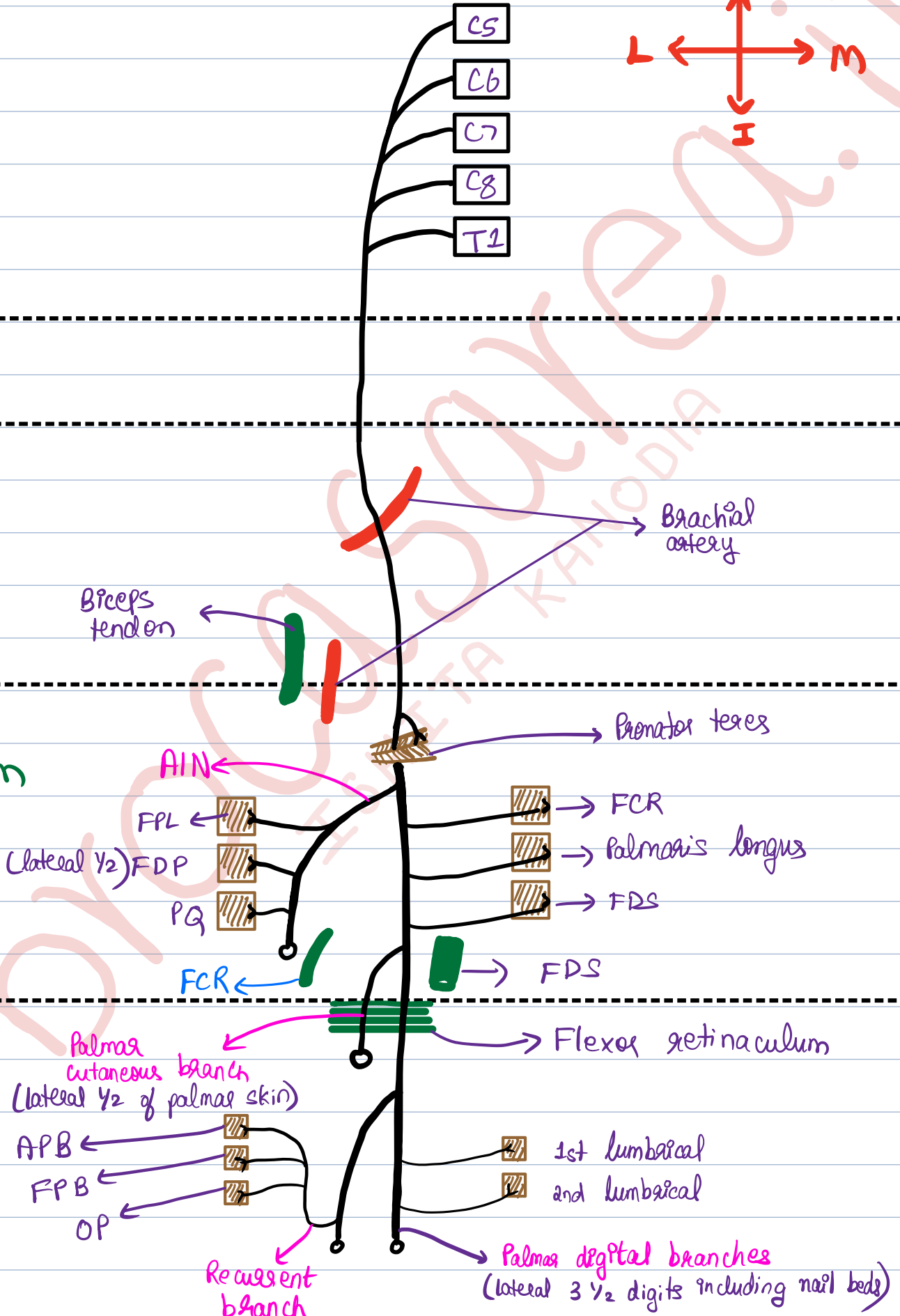


AXILLA

ARM

FOREARM

HAND



Injury of Median N. at Elbow:

Causes: Supracondylar fracture

- application of tight tourniquet during venipuncture
- entrapment of nerve between 2 heads of pronator teres

Clinical features: - loss of pronation (pronator teres #)

- wrist flexion is weak (flexors of forearm #, except medial half of FDP & FCU)
- adduction of wrist (FCR #; unopposed action of FCU & medial 1/2 of FDP)
- flexion at IP joints of index & middle fingers $\Rightarrow$ not possible

Benediction deformity of hand

- when patient tries to make fist, index & middle fingers remain straight (superficial, deep flexors #)
[loss of flexion at PIP & DIP] of these digits
- loss of flexion of terminal phalanx of thumb (FPL #)

Ape-thumb deformity

- thenar eminence is flattened (thenar muscles #)
- thumb is laterally rotated & adducted (adductor pollicis = normal)
- loss of sensation in lateral half of palm & lateral 3 1/2 digits & dorsal aspect of same digits.

Carpal Tunnel Syndrome: median N. is injured in carpal tunnel due to its compression

Causes - tenosynovitis of flexor tendons (idiopathic)

- myxedema (deficiency of thyroxine)
- fluid retention in pregnancy
- fracture dislocation of lunate
- osteoarthritis of wrist

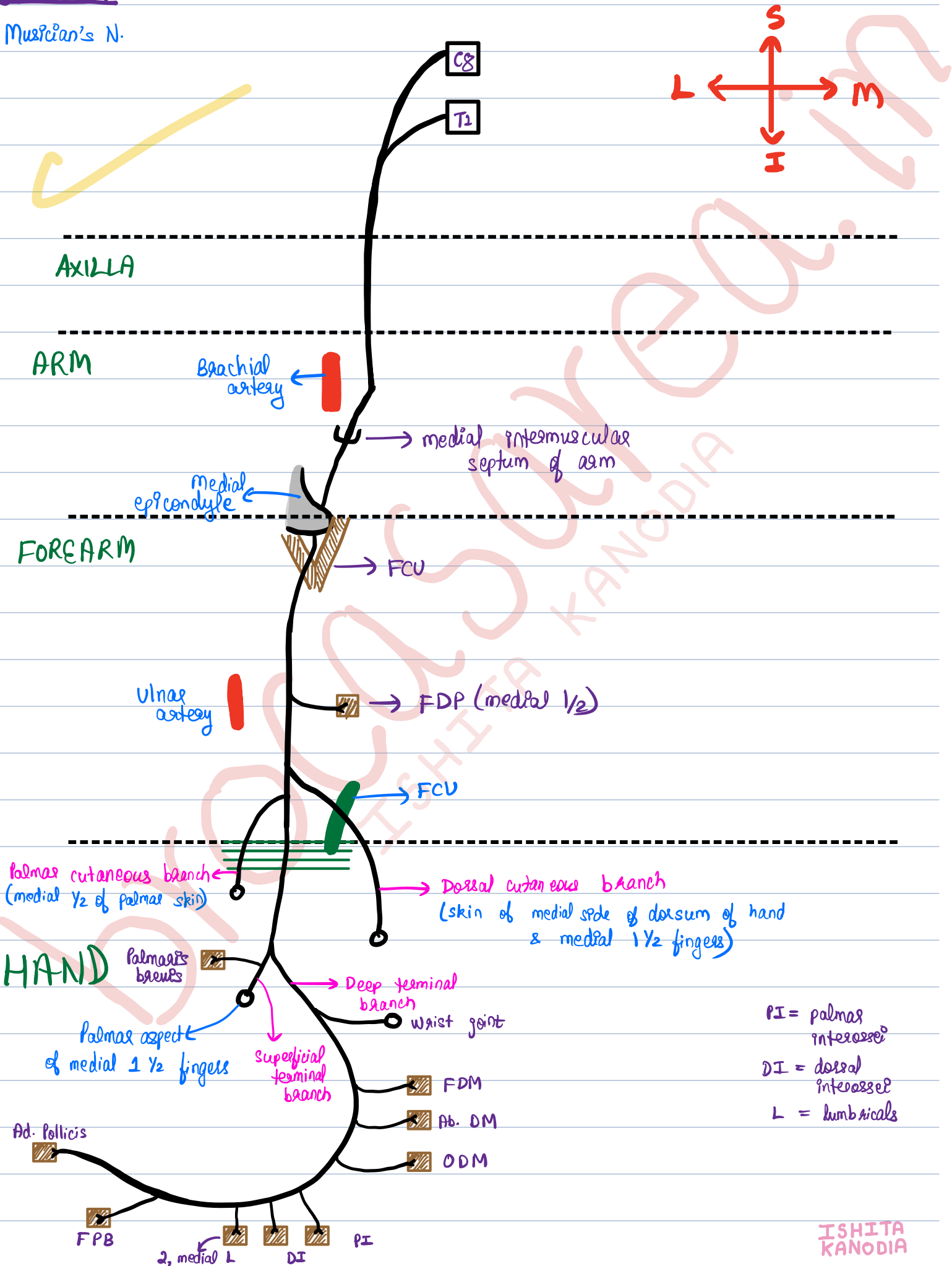
Clinical Features - feeling of burning / 'pins & needles' along lateral 3 1/2 digits, especially at night

- no sensory loss of thenar eminence ($\because$ it is supplied by palmar cutaneous branch of median N. which passes superficial to flexor retinaculum)
- weakness of thenar muscles
- Ape thumb deformity (if left untreated)
- Positive Tinel's Sign & Phalen's test
- reduced conduction velocity in median N. (< 30 m/s)

Tinel's sign $\Rightarrow$ percussion over flexor retinaculum reproduces patient's symptoms
Phalen's test $\Rightarrow$ flexion of both wrists against each other for 1 min. reproduces patient's symptoms.

Ulnar N.

Musician's N.



Injury of Ulnar N. at Elbow

Causes - fracture dislocation of medial epicondyle

- thickening of fibrous roof of cubital tunnel (cubital tunnel syndrome)
- compression between 2 heads of FCU
- valgus deformity of elbow (early or late ulnar N. palsy)

Clinical features - atrophy & flattening of hypothenar eminence

- Claw hand deformity $\Rightarrow$ affecting ring & little fingers

$\Rightarrow$ first phalanges of these digits are extended & middle & distal phalanges are flexed

$\Rightarrow$ Not true claw hand.

- Loss of abduction & adduction of fingers
- Loss of adduction of thumb
- Hollowing of skin in first web space on dorsum of hand
- loss of sensation over palmar & dorsal surfaces of medial third of hand & medial $1\frac{1}{2}$ fingers
- Positive Forment's sign.

Forment's sign $\Rightarrow$ patient is asked to grasp a card between his thumb & index fingers on affected side

$\Rightarrow$ examining doctor pulls it

$\Rightarrow$ flexion of distal phalanx of thumb occurs (adductor pollicis #) = positive Forment's sign.

Injury of Ulnar N. at Wrist - due to cuts/wounds or compression in Guyon's canal/pisohamate tunnel

Clinical features

- claw hand deformity (ulnar claw hand) but it is more pronounced (ulnar paradox) because FDP is not paralyzed
 $\therefore$ there is marked flexion of DIP joints
- atrophy & flattening of hypothenar eminence
- loss of abduction & adduction of fingers
- Positive Forment's sign.

Complete claw hand - due to combined lesions of median & ulnar N. at elbow

- hyperextension of wrist & MP joints
- flexion of IP joints.

Surface Marking

Axillary Artery:

↳ Abduct arm at right angle

a = midpoint of clavicle

b = lower end of lateral wall of axilla (just in front of posterior axillary fold)

Brachial artery:

↳ Abduct arm at right angle

a = midpoint of clavicle

b = lower end of lateral wall of axilla (just in front of posterior axillary fold)

c = in anterior midline of forearm at level of neck of radius, medial to biceps tendon

Radial Artery:

a = at level of neck of radius, medial to biceps tendon

b = in front of distal forearm, on lateral side (at the site of radial pulse)

Ulnar Artery:

a = at level of neck of radius, medial to biceps tendon

c = medial border of forearm at junction of upper $\frac{1}{3}$ & lower $\frac{2}{3}$

d = lateral to pisiform bone

Superficial palmar arch:

a = lateral side of pisiform bone

b = medial to hook of hamate

c = centre of palm at level of distal border of extended thumb

d = on distal border of thenar eminence in line with cleft between index & middle fingers

Deep Palmar Arch:

e = distal to hook of hamate

f = at proximal end of first intermetacarpal space.

Cephalic Vein, Basilic Vein, Medial Cubital Vein:

↳ Follow origin, course, termination as mentioned before

Axillary Nerve:

a = acromion process

b = insertion of deltoid

c = 2cm above midpoint between 'a' & 'b'.

Draw curved horizontal line from 'c'.

Radial Nerve:

a = lateral wall of axilla

b = junction of upper $\frac{1}{3}$ & lower $\frac{2}{3}$ of line joining insertion of deltoid & lateral epicondyle

c = in front of elbow, at level of lateral epicondyle, lateral to biceps tendon

d = at junction of upper $\frac{2}{3}$ & lower $\frac{1}{3}$ of lateral border of forearm

e = distal part of anatomical snuff box

Posterior Interosseous N.

f = c

g = junction of upper $\frac{1}{3}$ & lower $\frac{2}{3}$ of line joining posterior aspect of radial head & Lister's tubercle of radius

h = 1cm medial to Lister's tubercle on the back.

Ulnar Nerve:

a = lower end of lateral wall of axilla

b = middle of medial border of arm

c = on the back of medial epicondyle on ulnar N. which can be rolled here with the fingers

d = just lateral to pronator bone

(In lower $\frac{2}{3}$ of forearm, ulnar N. lies medial to ulnar artery & lateral to FCU tendon)

Median Nerve:

- Mark brachial artery
- Now mark median N. lateral to brachial artery in upper half & medial to artery in lower half of arm
- a = in midline at bend of elbow (at level of neck of radius)
- b = in front of wrist, 1cm medial to FCR tendon.

Flexor Retinaculum:

- Mark —
- pronator
 - tubercle of scaphoid
 - crest of trapezium
 - hook of hamate
- join these points

HAND

- ① Thenar muscles : 4 muscles
- ② Hypothenar muscles : 4 muscles
- ③ Lumbricals : 4 muscles
- ④ Interossei : 8 muscles

① THENAR MUSCLES

- a) Abductor pollicis brevis
 - b) Flexor pollicis brevis
 - c) Opponens pollicis
 - d) Adductor pollicis
- Medial Nerve
- ulnar Nerve

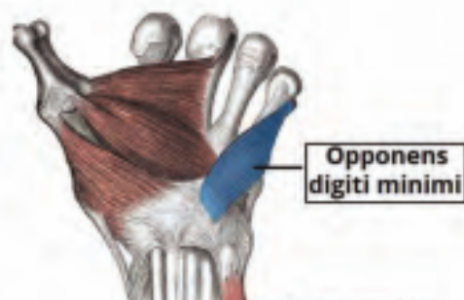
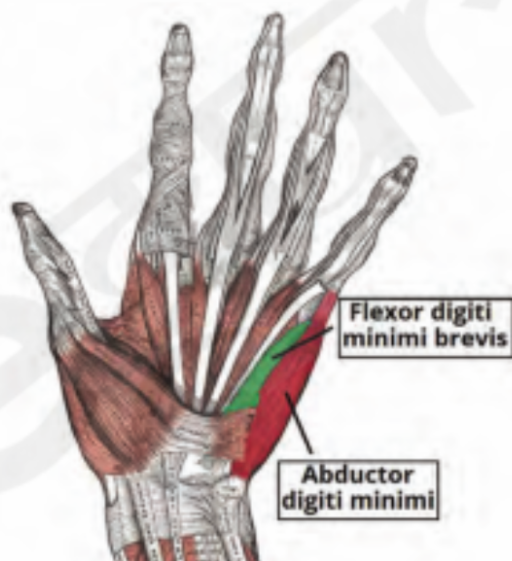
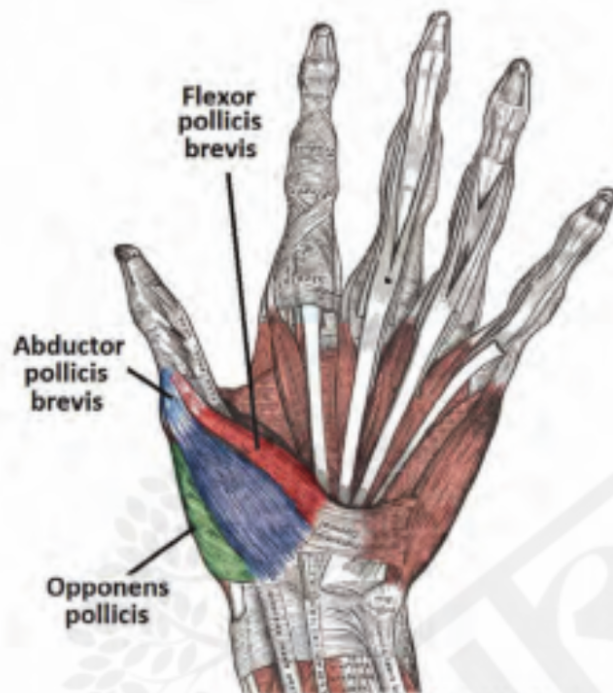
* Movement of thumb completely lost in Median Nerve injury at Carpal tunnel → **opposition**

* Function of thumb completely lost in Ulnar Nerve injury is → **Adduction**

* Function of thumb completely lost in Radial Nerve injury is → **Extension.**

* Movement of thumb can be used to test all long nerves of upper limb.

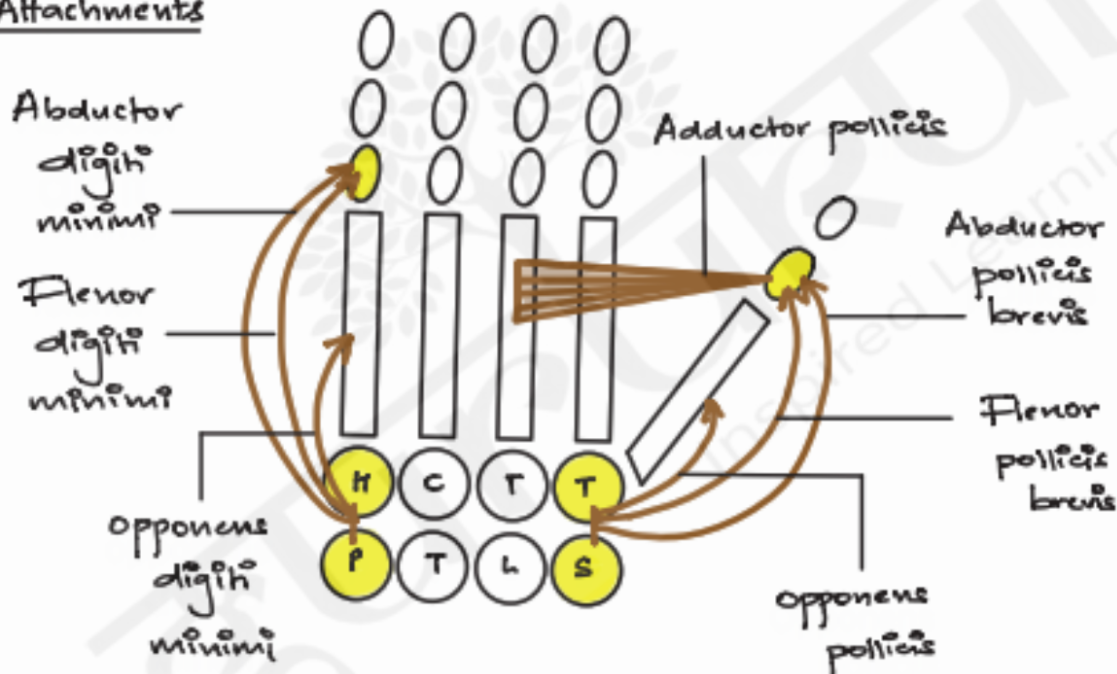
* Inability to flex the interphalangeal joint of thumb is due to flexor pollicis longus involvement supplied by anterior interosseous Nerve.



HYPOTHENAR MUSCLES

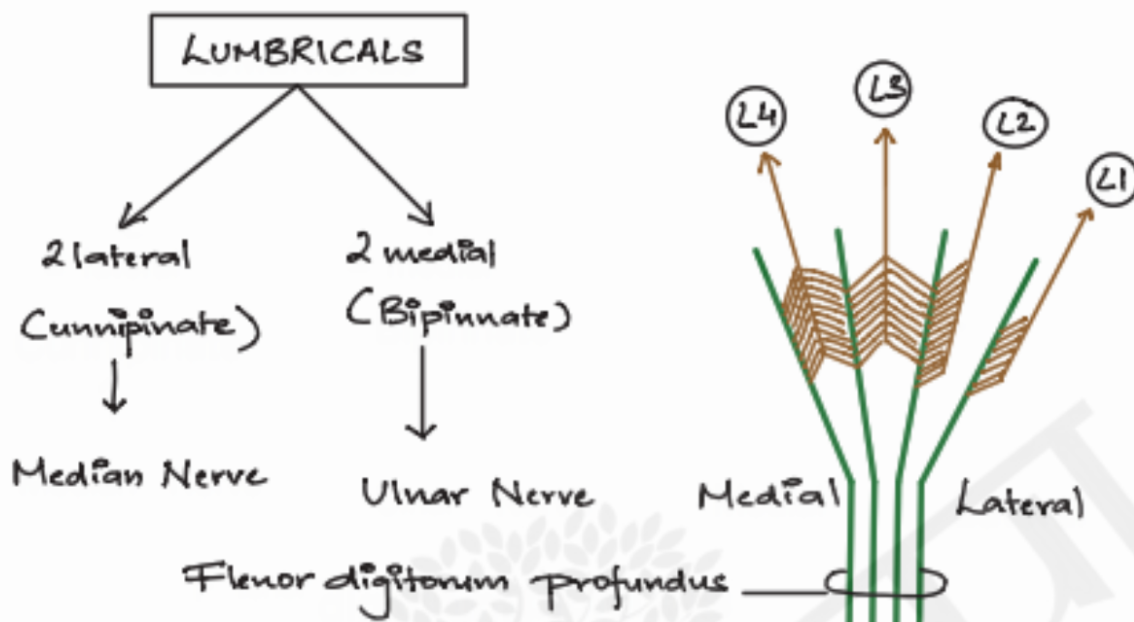
- a.) Flexor digiti minimi
 - b.) Abductor digiti minimi
 - c.) Opponens digiti minimi
 - d.) Palmaris brevis (Subcutaneous muscle)
- Supplied by ulnar Nerve

Attachments



* In case of Bennett's fracture → opposition of thumb is impaired.

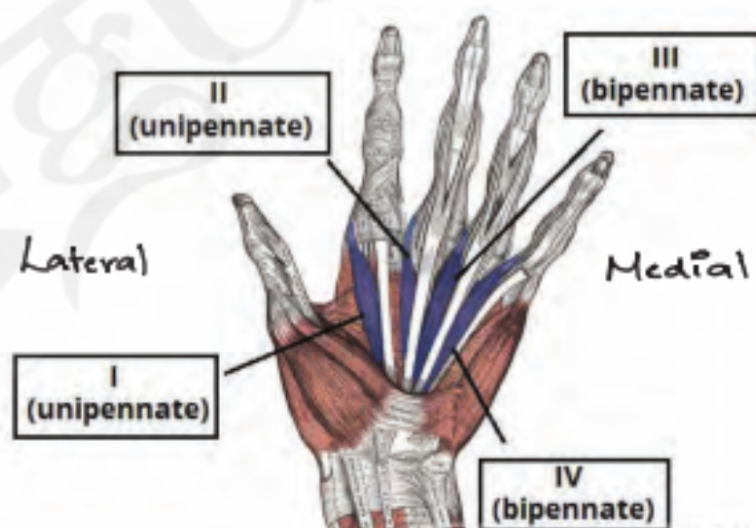
* Only thenar muscle, not muscle of thenar eminence – Adductor Pollicis



Common insertion → dorsal digital expansion

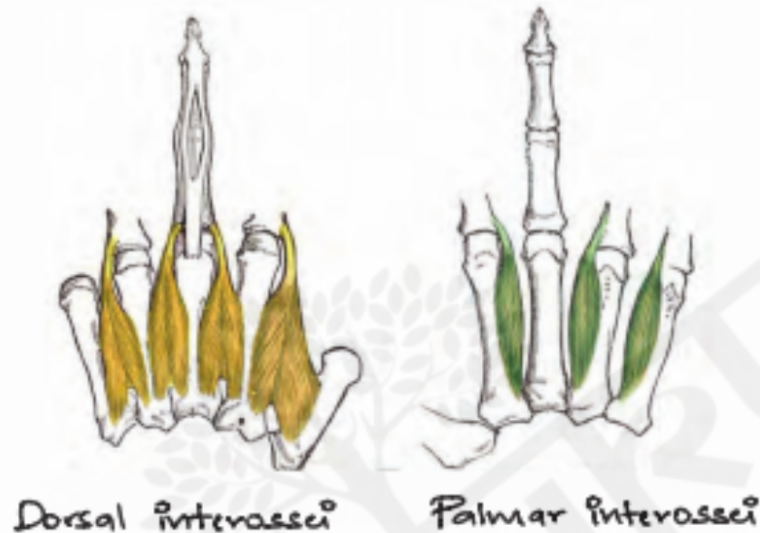
Common function for lumbricals & interossei

Flexion at metacarpophalangeal Joints
& extension at interphalangeal Joints



INTEROSSEI

- a) Palmar interossei (4) — unipinnate
b) Dorsal interossei (4) — Bipinnate
- Supplied by
ulnar Nerve



Mnemonic : P-AD — Palmar — Adduction
D-AB — Dorsal — Abduction

- * Dorsal interossei are absent on thumb and little finger
- * Palmar interossei are absent on middle finger.

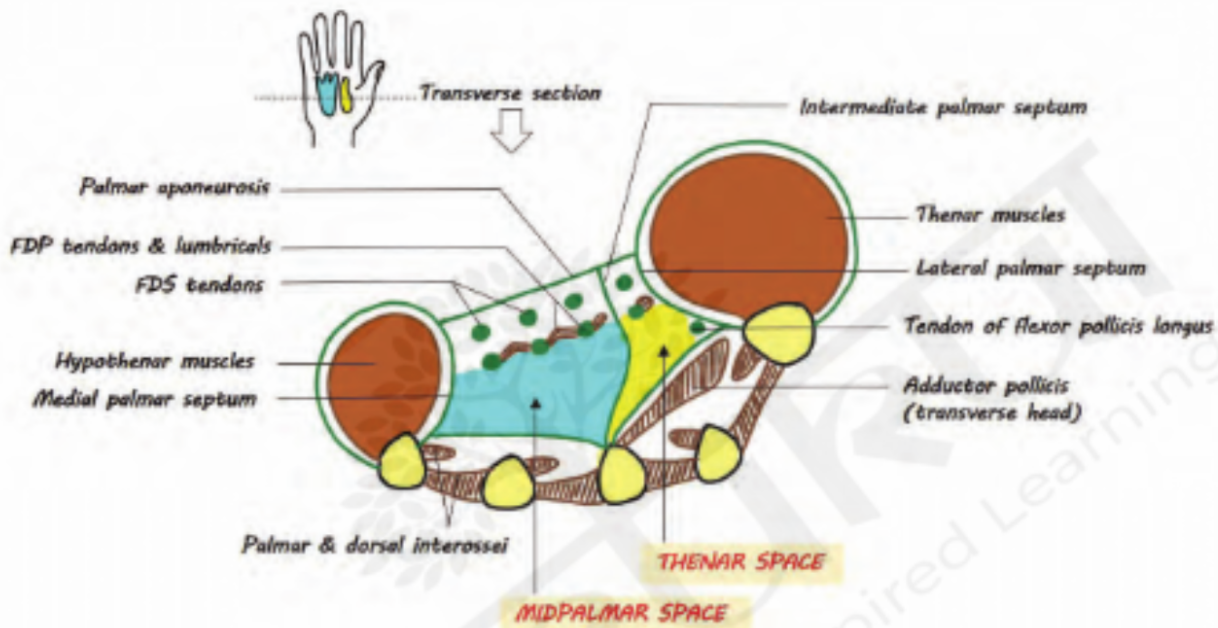
★ All adductors, interossei and bipinnate muscles of hand and foot are always supplied by Dominant nerve of that region.

Upper limb — Ulnar Nerve

Lower limb — Lateral plantar Nerve

SPACES IN HAND

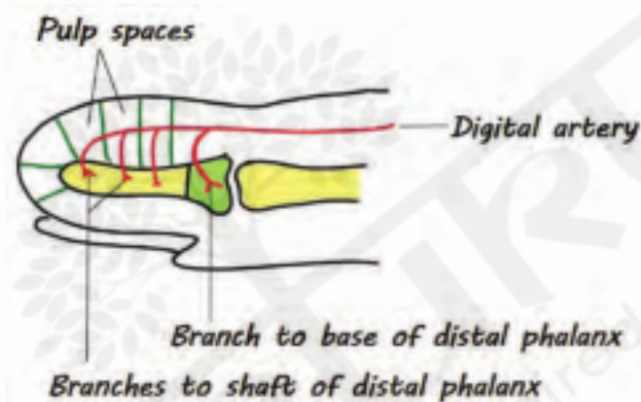
- 1) Thenar space
- 2) Midpalmar space
- 3) Pulp space
- 4) Parona space (in forearm)



- * Thenar muscles communicate with the fascial sheath of 1st Lumbrical.
- * Midpalmar space communicates with the fascial sheath of 2nd, 3rd and 4th Lumbrical.
- * Infections of thenar space can be drained by incising 1st web space.
- * Midpalmar space infections incise 3rd and 4th web space
- * Midpalmar space communicates proximally to forearm space of parona.

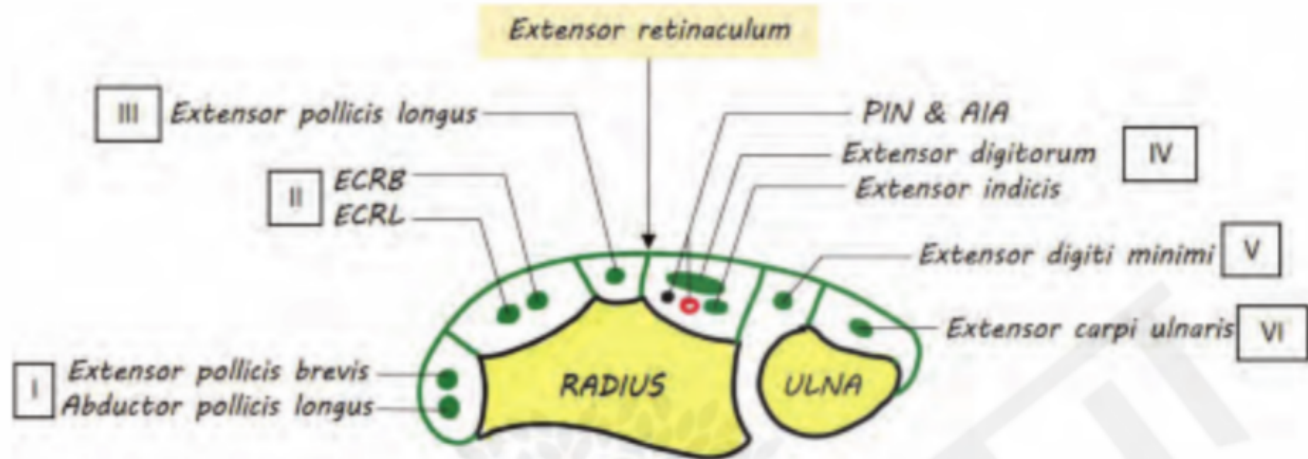
- * Space of Parona : It is a fascial space between flexor digitorum profundus and pronator quadratus.
 - It extends proximally till the oblique line of radius.

PULP SPACE



- * Whitlow - Avascular Necrosis of distal $\frac{4}{5}$ th of distal phalanx.

EXTENSOR RETINACULUM



- I - Extensor pollicis brevis
Extensor pollicis Longus
- II - Extensor carpi radialis longus
Extensor carpi radialis Brevis
- III - Extensor pollicis longus
- IV - Extensor digitorum
Extensor Indices
Posterior Interosseous Nerve
Anterior Interosseous Artery
- V - Extensor digiti minimi
Extensor carpi ulnaris

LAQ-19**Describe wrist joint (radio carpal) under**

1. Bones taking part
2. Classification
3. Ligaments
4. Relations
5. Movements
6. Blood supply
7. Nerve supply
8. Applied anatomy.

1. Bones taking part :**A. Proximally :**

- a. Distal articular surface of the radius and
- b. Articular disc of inferior radio-ulnar joint.

B. Distally :

- a. Scaphoid, lunate, triquetral bone and
- b. Interosseous ligament.

2. Classification :

- A. Structural : Compound, biaxial, ellipsoid, type of synovial joint.
- B. Functional : Diarthrosis.

b. Midcarpal
Table 1.27 : The table showing muscles bringing different movements.

Movements	Range of movements	Main joint at which movements take place	Muscles bringing movements	Accessory muscles
A. Flexion	85°	Mid carpal	Flexor carpi radialis and flexor carpi ulnaris	Flexor digitorum superficialis, Flexor digitorum profundus, Flexor pollicis longus.
B. Extension	60°	Radiocarpal (wrist)	Extensor carpi radialis longus and brevis, Extensor carpi ulnaris	Extensor digitorum, Extensor indicis, Extensor pollicis longus, Extensor digiti minimi.
C. Abduction (Abduction is restricted than the adduction)	15°	Midcarpal	Abductor pollicis longus	Flexor carpi radialis, Extensor carpi radialis longus and brevis
D. Adduction	45°	Radio carpal	Flexor carpi ulnaris and Extensor carpi ulnaris	
E. Circumduction	Combination of flexion, extension, adduction and abduction			

8. Applied anatomy :

- A. Colles fracture (Dinner fork deformity)
- It is due to fall on outstretched hand,
 - It involves distal end of radius,
 - Here fracture is transverse,
 - Force displaces the lower segment upwards and backwards and
 - Distal articular surface is inclined posteriorly.

- d. Force displaces the lower segment upwards and backwards and
e. Distal articular surface is inclined posteriorly.

Distal fragment of radius overrides rest of bone

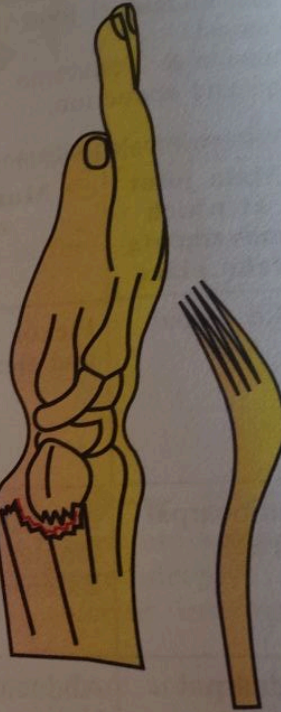


Fig. 1.61 : Colles fracture of distal radius.

B. Smiths fracture; it is reverse of Colles fracture :

- It is produced by fall on the back of hand.
- Here distal fragment is displaced forward and upward.

- Classification :**
1. A. Structurally : Biaxial, saddle variety of synovial joint.
B. Functionally : Diarthrosis.
 2. **Articular surfaces :**
A. Distal surface of trapezium.
B. Proximal surface of base of first metacarpal.
 3. **Ligament :**
A. Capsular ligament : Surrounds the joint. It is thickest, dorsally and laterally.
B. Lateral ligament : Broad band, which thickens capsule.
C. Anterior ligament.
D. Posterior ligament.

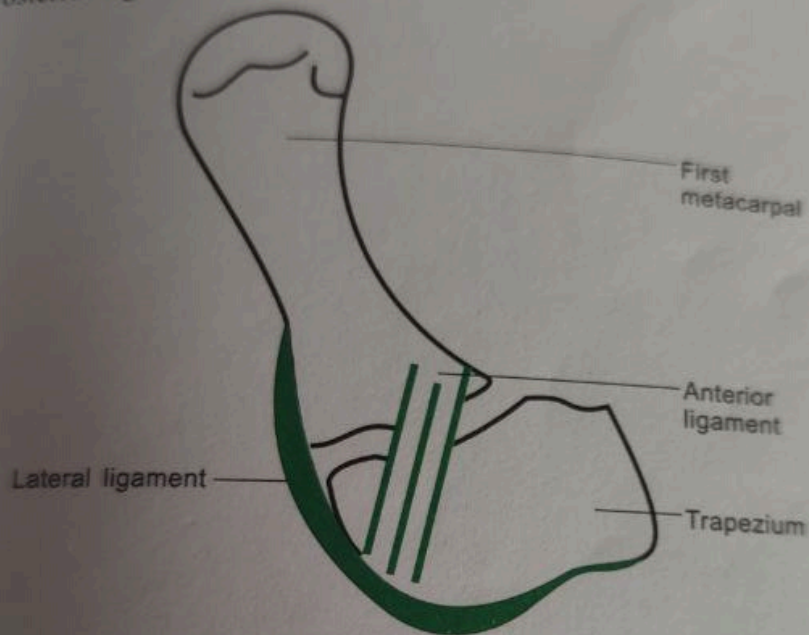


Fig. 1.62 : Carpo-metacarpal joint of thumb.

- 4. Relations :**
- A. Anterior : Muscles of thenar eminence.
 - B. Dorsally : Long and short extensor of thumb.
 - C. Medially : First dorsal interossei muscle.
 - D. Laterally : Abductor pollicis longus.
- 5. Nerve supply :** Median Nerve.
- 6. Movements :** Flexion and extension are parallel to the plane of palm. Abduction and adduction movements are perpendicular to the plane of palm. Opposition is adduction with medial rotation.
- A. Flexion : Flexor pollicis brevis.
 - B. Extension : Abductor pollicis longus. Extensor pollicis brevis.
 - C. Abduction : Abductor pollicis brevis. Abductor pollicis longus.
 - D. Adduction : Adductor pollicis.
 - E. Opposition : Opponens pollicis.

