NERVES OF UPPER LIMB

Brachial Plexus

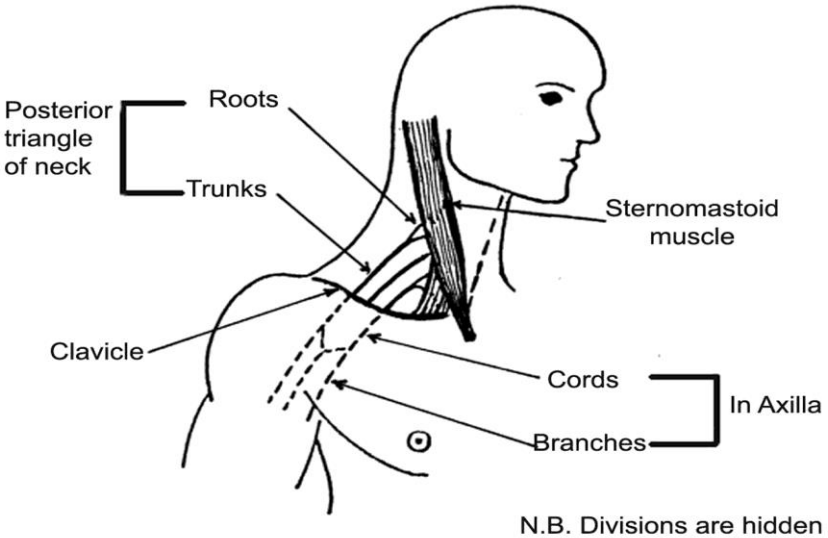
★ **F**ormed of ***roots***, ***trunks***, ***divisions*** and ***cords***:

- **The roots :** Formed of anterior rami of ***C5, 6, 7, 8 & T1***
- **The trunks:**
  - ♣ Upper trunk (C5,6).
  - ♣ middle trunk(C7).
  - ♣ lower trunk (C8, T1).
- **The divisions:** Each trunk divides into anterior & posterior divisions.
- **The cords:**
  - ♣ **Lateral cord** (upper 2 anterior divisions),
  - ♣ **Medial cord** (lower anterior divisions),
  - ♣ **Posterior cord** (3 posterior divisions).

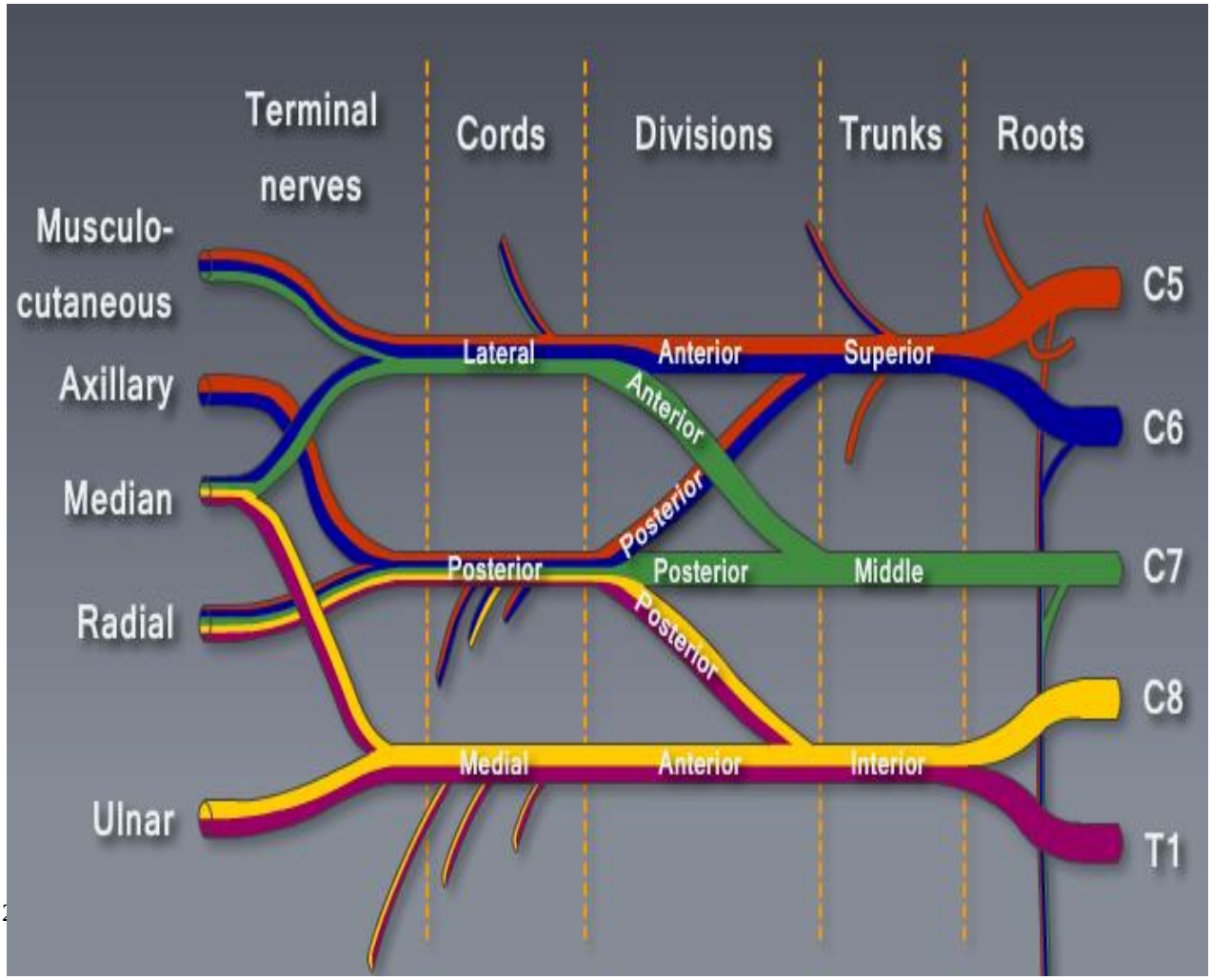
❖ **N.B: Lateral and medial cords supply the anterior aspect of upper limb while posterior cord supply the posterior aspect of upper limb.**

★ **Site:**

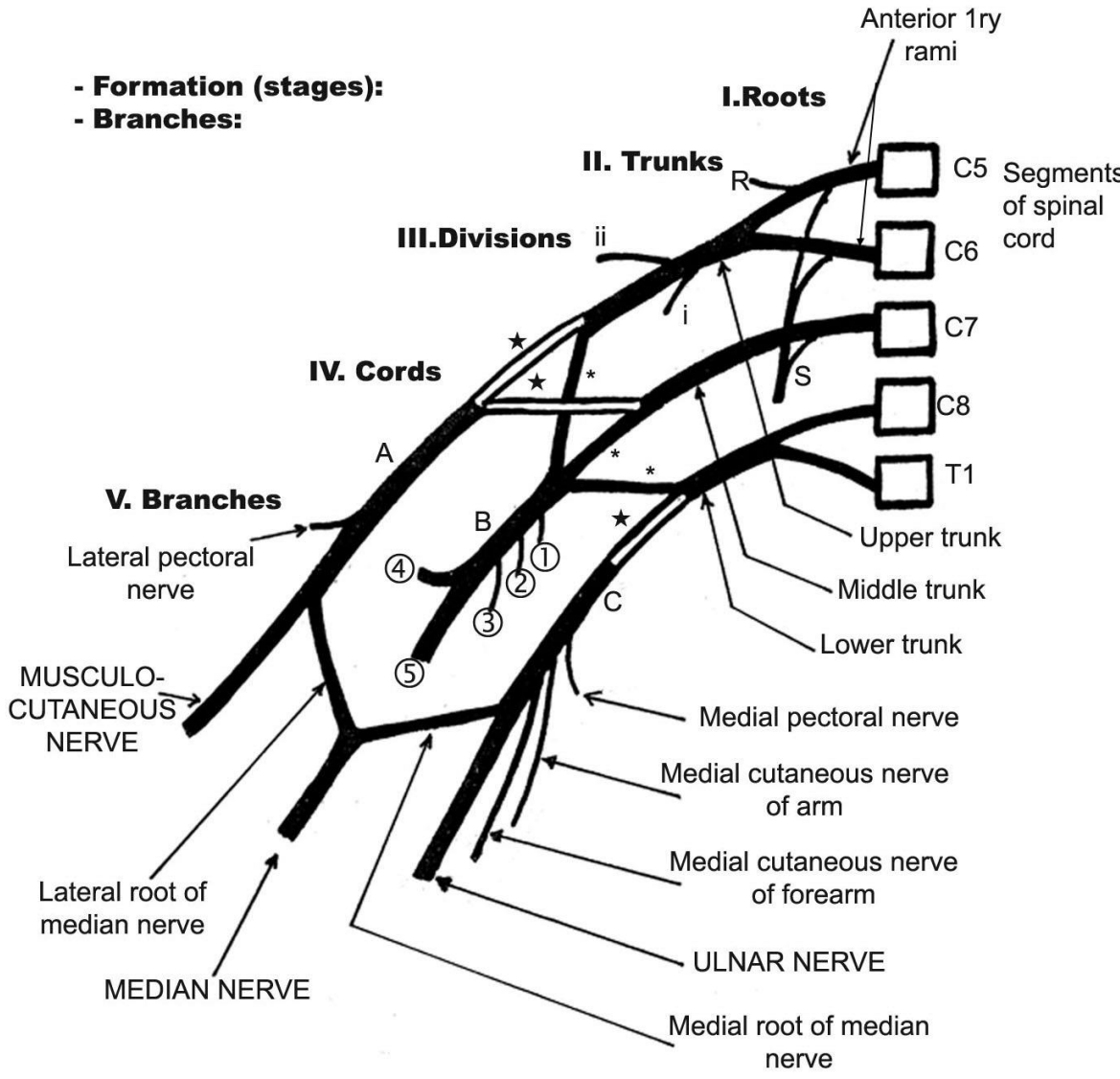
- Roots & trunks lie in **posterior triangle of neck**. The lower trunk passes in contact with the first rib .
- Divisions lie in the **apex of axilla** behind the middle 1/3 of clavicle.
- Cords and their branches lie in the **axilla.**



Site of Brachial plexus



BRACHIAL PLEXUS



A. Lateral cord
B. Posterior cord
C. Medial cord

★Anterior division
* Posterior division

i. Nerve to subclavius
ii. supra-scapular nerve

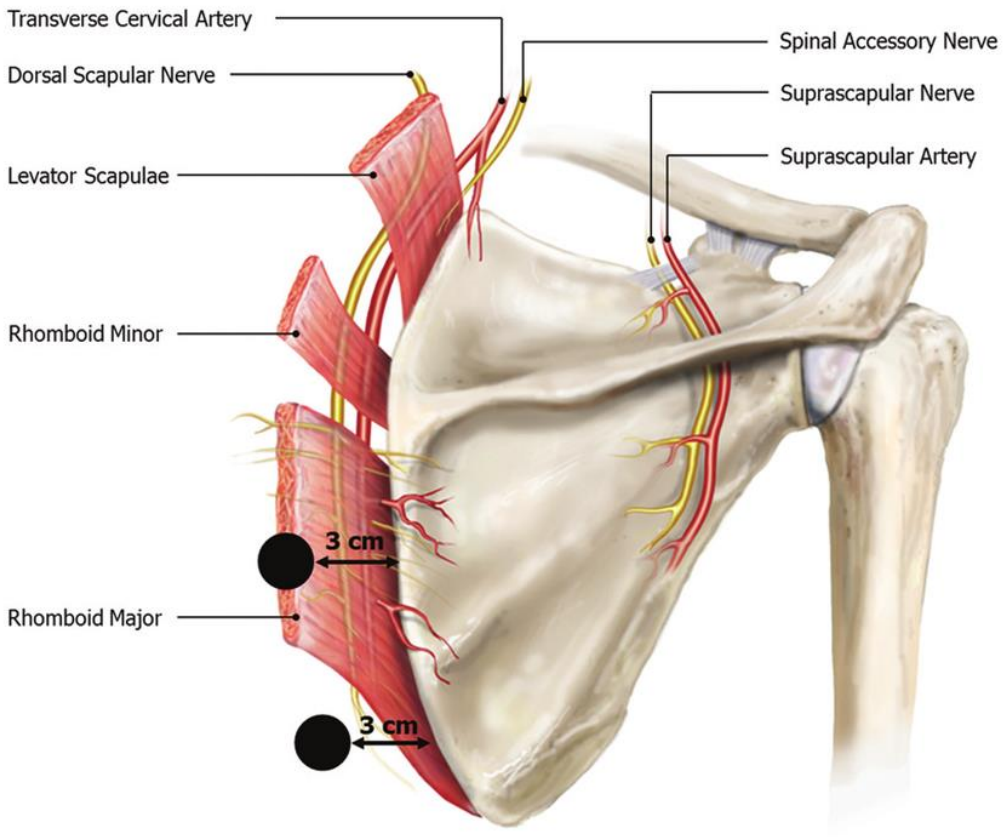
R. Nerve to rhomboids
S. Nerve to serratus anterior

① Upper subscapular nerve
② Nerve to latissimus dorsi
③ Lower subscapular nerve
④ AXILLARY NERVE
⑤ RADIAL NERVE

★ Branches of brachial plexus:

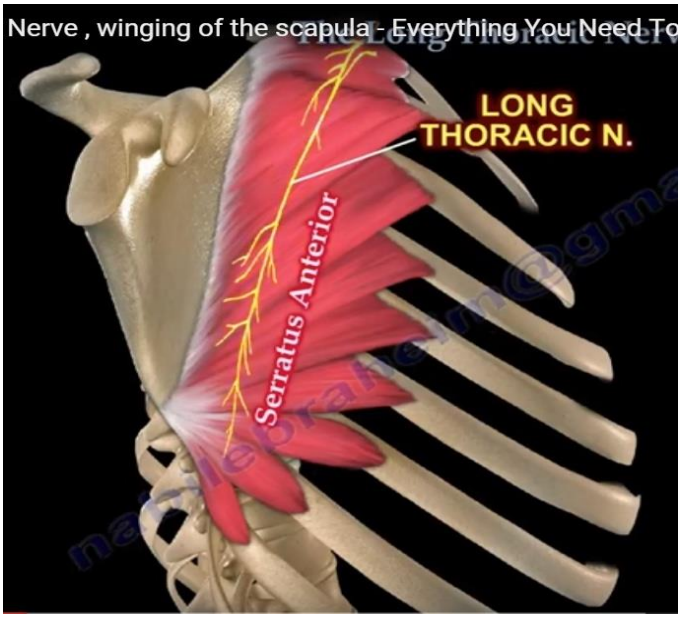
II. Branches of the Roots:

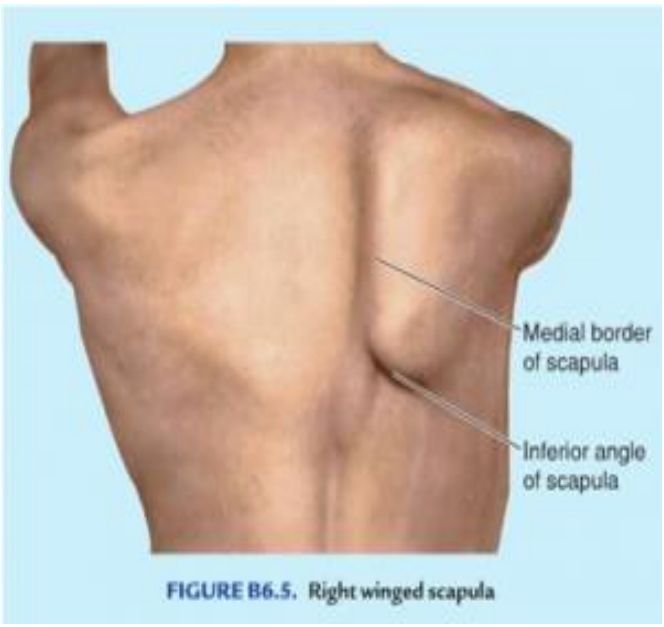
1. **Dorsal Scapular Nerve** (**Nerve to Rhomboids**): (C5)
   - Descends along medial border of scapula (with dorsal scapular artery) deep to levator scapulae and phomboids muscles, and supplying them.



2. Long Thoracic Nerve (Nerve to Serratus Anterior): (C5, 6 &7)

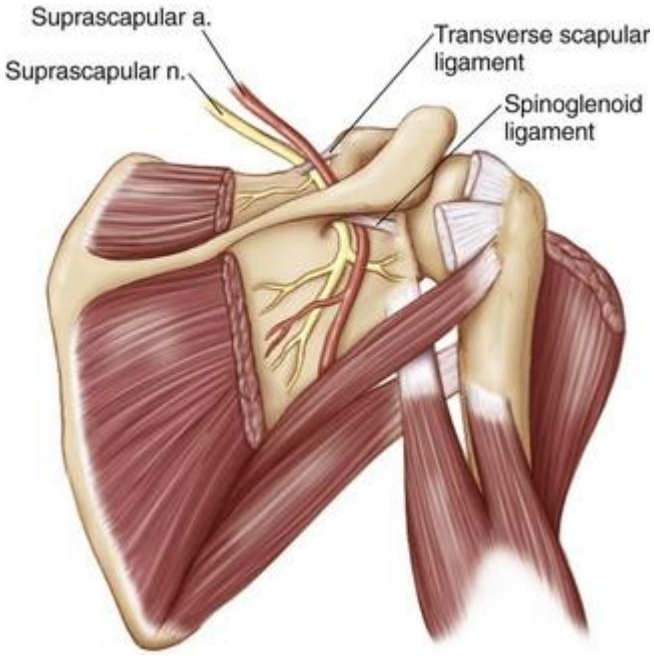
- Then it descends on the ***outer surface*** of serratus anterior muscle supplying it.
- **Applied anatomy** : its injury leading to ***winging*** of scapula .





II. Branches of the Trunks: (only from the upper trunk) (**2 S**)

1. **Nerve to Subclavius** (C5 and 6) which gives also **articular branches** to supply sternoclavicular joint .
2. **Supra-scapular Nerve** (C5 and 6):
   - It passes through the supra-scapular ***foramen*** (below the supra-scapular ligament) to reach the ***supra-spinous fossa*** where it runs deep to and supplies ***supra-spinatus*** muscle.
   - Then it descends through the ***spino-glenoid notch*** to reach the ***infra-spinous fossa*** where it ends by supplying ***infra-spinatus*** muscle.
   - It gives also **articular branches** to supply the ***shoulder joint***.



III. Branches of the Cords:

A. Branches of Lateral Cord:

1. ***Musculo-cutaneous nerve*** (C5,6&7): is the **largest** branch.
2. Lateral root of median nerve (C5, 6 &7)
3. Lateral pectoral nerve (C5, 6 and 7): supply pectoralis major.

B. Branches of Medial Cord:

1. ***Ulnar nerve*** (C7,8 and T1): is the **largest** branch.
2. Medial root of median nerve (C8 and T1).
3. Medial pectoral nerve (C8 and T1): It pierces and supplies pectoralis minor and ends by supplying pectoralis major.
4. Medial cutaneous nerve of the arm (T1): Supplies the skin on the medial side of the lower half of the arm.
5. Medial cutaneous nerve of the forearm (C8 and T1):Supply the skin on medial side of the forearm to the wrist .

C. Branches of the Posterior Cord: Two terminal branches:

1. ***Radial nerve*** (C5,6,7,8 and T1), is the **larger**.

2. ***Axillary (circumflex) nerve*** (C5,6), is the smaller.
3. **Upper subscapular nerve** (C5 and 6): Supplies the upper part of the subscapularis muscle.
4. **Thoraco-dorsal nerve** (Nerve to Latissimus Dorsi): (C6,7&8)
   - Arises from the posterior cord between upper and lower subscapular nerves.
5. **Lower subscapular nerve** (C 5 and 6):
   - Supply the lower part of subscapularis muscle and teres major muscle.

Brachial Plexus Injuries

A- Upper trunk injury : (Erb's paralysis)

- **Cause:** Birth injury
- **Results**: Loss of C5 and 6 leading to:

1-Motor :

- ***Paralysis*** of the following muscles:
  - Abductor of shoulder :deltoid & supraspinatus .
  - Lateral rotators of shoulder : infraspinatous & teres minor.
  - Flexor of elbow :biceps & brachialis.
  - Supinator muscles
- This leading to combined **flat shoulder** and ***policeman or porter tip deformity*** (adduction of arm ,extension of elbow & pronation of forearm) .
- ***Wasting*** of scapular muscles , front of arm with flat shoulder .

2- Sensory loss over lower 1/2 of deltoid , lateral aspect of arm , lateral aspect of forearm , lateral aspect of hand & lateral 2 fingers .

Policeman or porter tip deformity

B- Lower trunk injury (Klumpke's paralysis)

- **Cause:** Birth injury
- **Results:** Loss of C8 and T1 leading to:

1- Motor : Paralysis and wasting of all intrinsic muscles of the hand leading to **complete claw hand** (paralysis of lumbricals & interossei).

2- Sensory loss over medial 2 fingers , medial 1/3 of hand , medial aspect of forearm and medial aspect of lower part of arm .

Axillary Nerve

(Circumflex nerve)

(C5&6)

* **It begins** in the axilla behind 3rd part of axillary artery as one of 2 terminal branches of posterior cord of brachial plexus.

* **Course, relation and termination :**

- It Passes backwards in the **quadrangular space** (accompanied by posterior circumflex humeral artery) .
- It turns **around the back of the surgical neck** just below shoulder joint where it gives an ***articular branch*** to the shoulder joint and then **ends by dividing into**:

1. Anterior division: This continues its course around the surgical neck to end near the anterior border of **deltoid** muscle, supplying its deep surface.

2. Posterior division: Gives a branch to teres minor and then curves around the posterior border of deltoid to become the **upper lateral cutaneous nerve** of the arm which supplies the skin over the lower half of the deltoid.

* **Branches:**
- **Muscular** (deltoid, teres minor),
- **Cutaneous** (upper lateral cutaneous nerve of arm).

* **Applied anatomy: Axillary nerve injury**

I. Cause: Axillary nerve injury is frequent in:

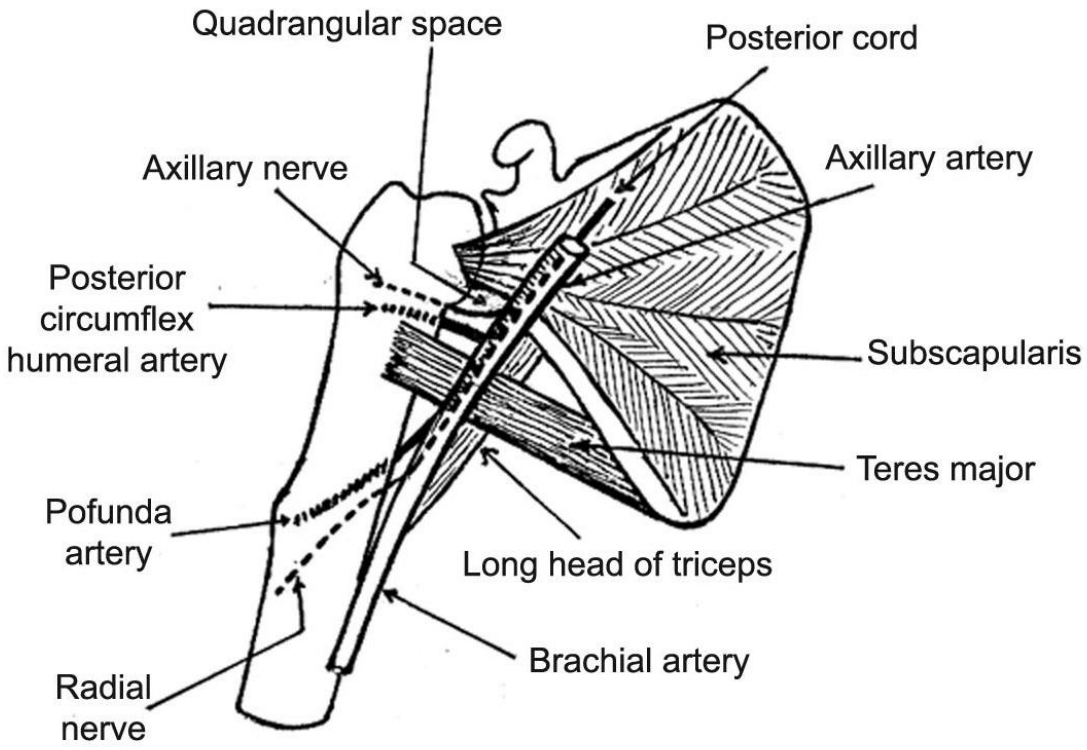
A. Dislocation of the shoulder joint.

B. Fracture surgical neck of humerus.

II. Results:

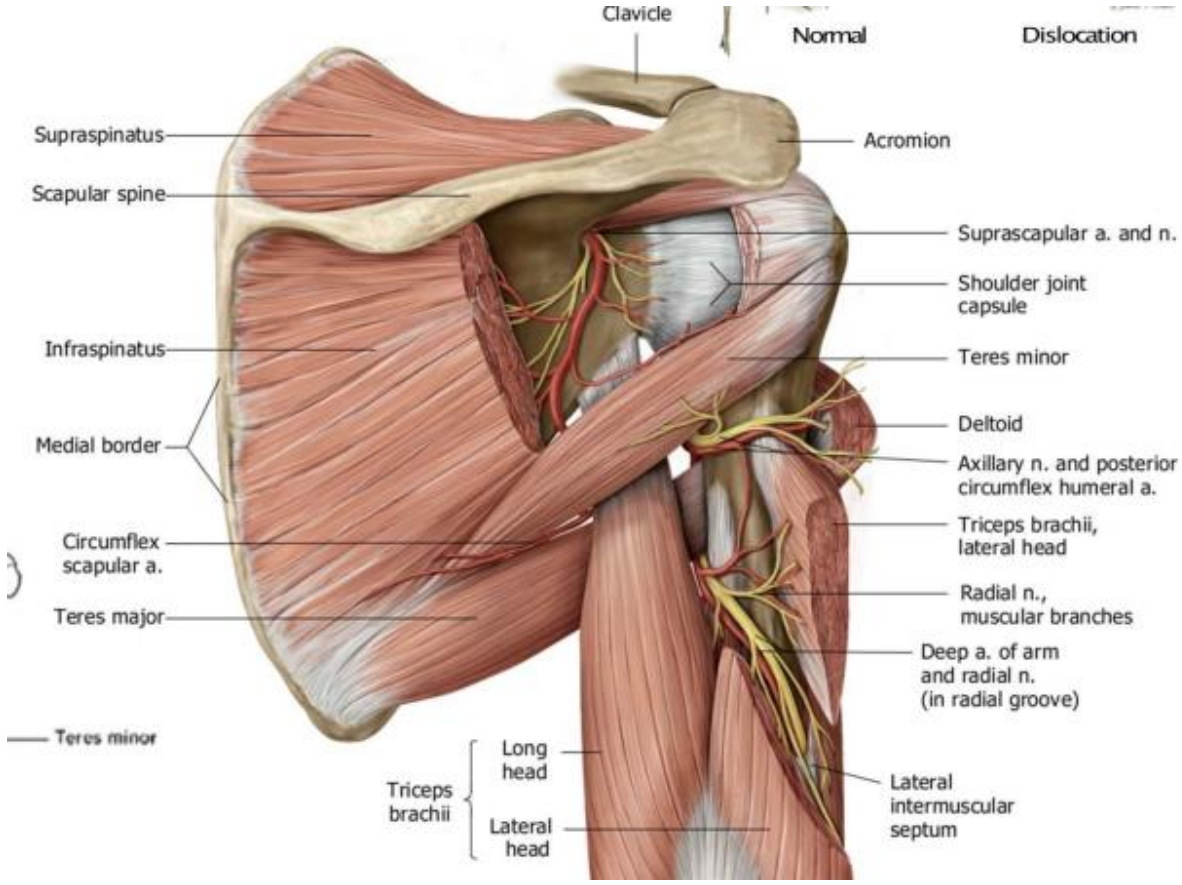
A. Sensory loss: in the skin covering the lower half of deltoid .

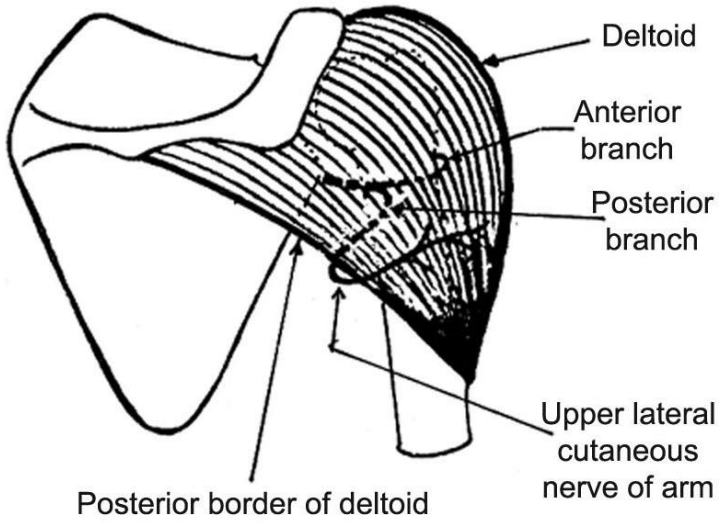
B. Motor loss: paralysis of teres minor & deltoid (loss of abduction of shoulder joint from 15 up to 90 degrees & ***flat shoulder***)



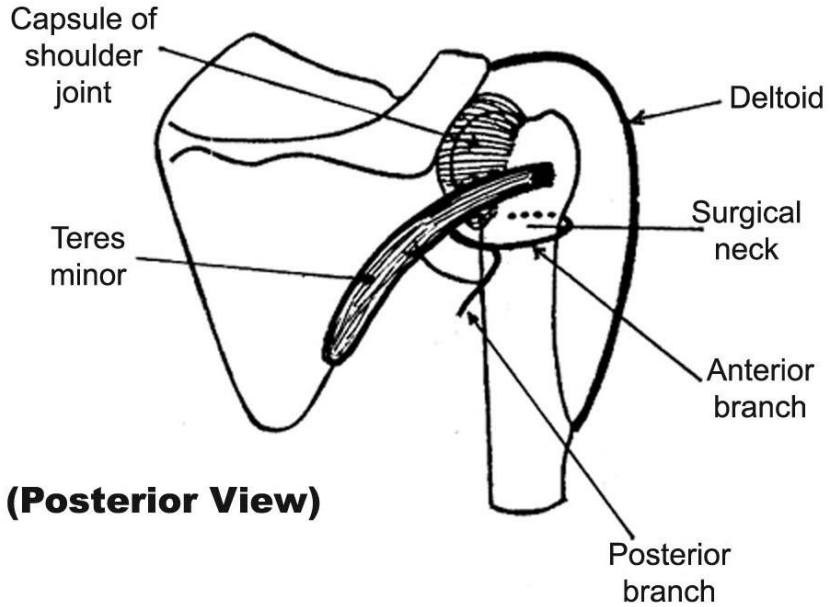
(Anterior View)

AXILLARY (CIRCUMFLEX) NERVE
(beginning, course and relations)


Clavicle
Normal
Dislocation
Supraspinatus
Acromion
Scapular spine
Suprascapular a. and n.
Shoulder joint capsule
Infraspinatus
Teres minor
Medial border
Deltoid
Axillary n. and posterior circumflex humeral a.
Triceps brachii, lateral head
Circumflex scapular a.
Radial n., muscular branches
Teres major
Deep a. of arm and radial n. (in radial groove)
Teres minor
Long head
Triceps brachii
Lateral head
Lateral intermuscular septum



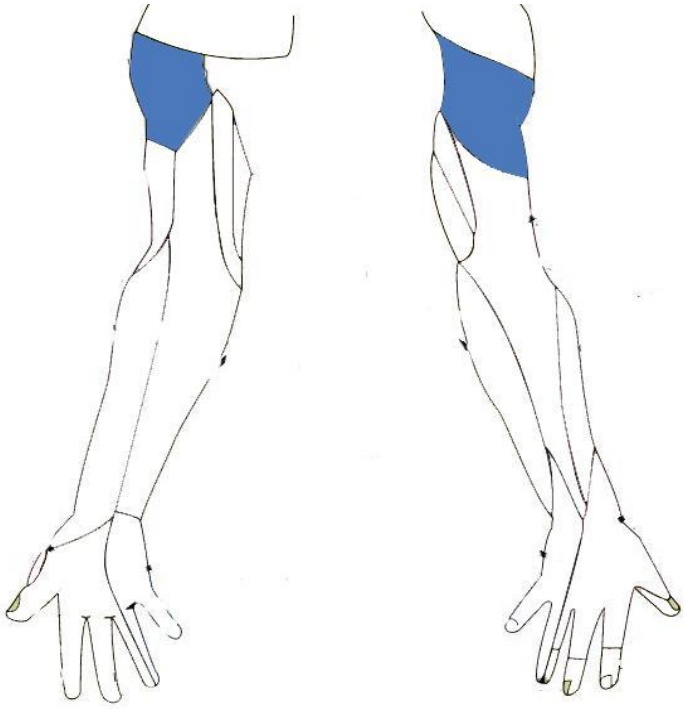
(Posterior view)



(Posterior View)

AXILLARY (CIRCUMFLEX) NERVE
(end)

Effect of Axillary Nerve Injury



Musculo-cutaneous nerve

(C 5,6,&7)

* **It begins** in the axilla, lateral to the 3rd part of axillary artery, as the largest branch of lateral cord of brachial plexus.

* **Course and relations :**

  - It **pierces** the coracobrachialis then descends obliquely downwards and laterally **between** brachialis & biceps.

* **Termination:** it ends one inch above the elbow by piercing the deep fascia at the lateral border of biceps muscle to continue as lateral cutaneous nerve of forearm.

* **Branches:**

  - **Muscular**: to coracobrachialis , biceps & medial part of brachialis i.e supply all muscles of front of the arm except lateral part of brachialis.
  - **Cutaneous:** it continues as lateral cutaneous nerve of forearm.

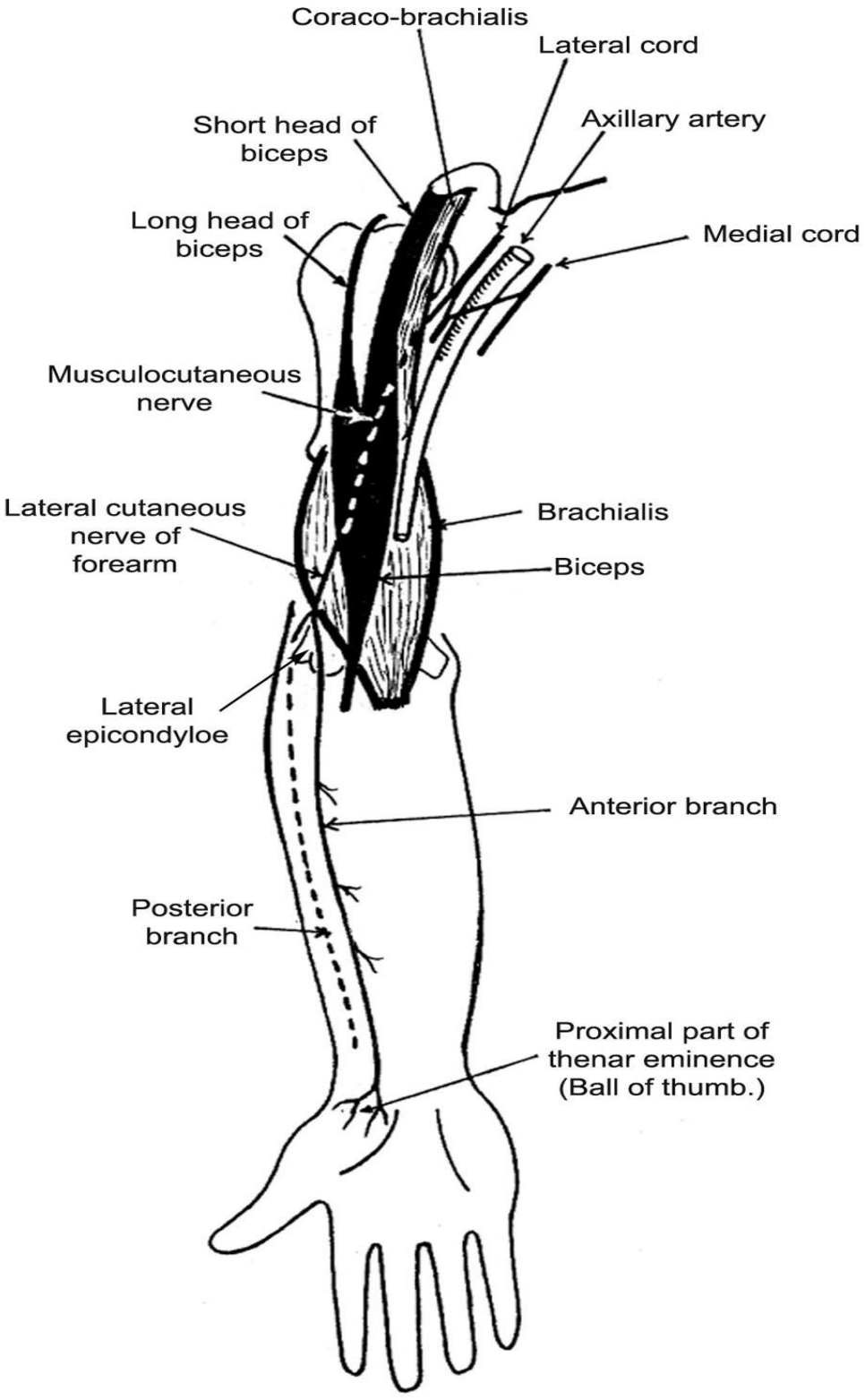
* **Applied anatomy:** Musculocutaneous **nerve injury.**

  I. Cause: Musculo-cutaneous nerve injury is rare as it is protected by muscles along its whole course.

  II. Results:

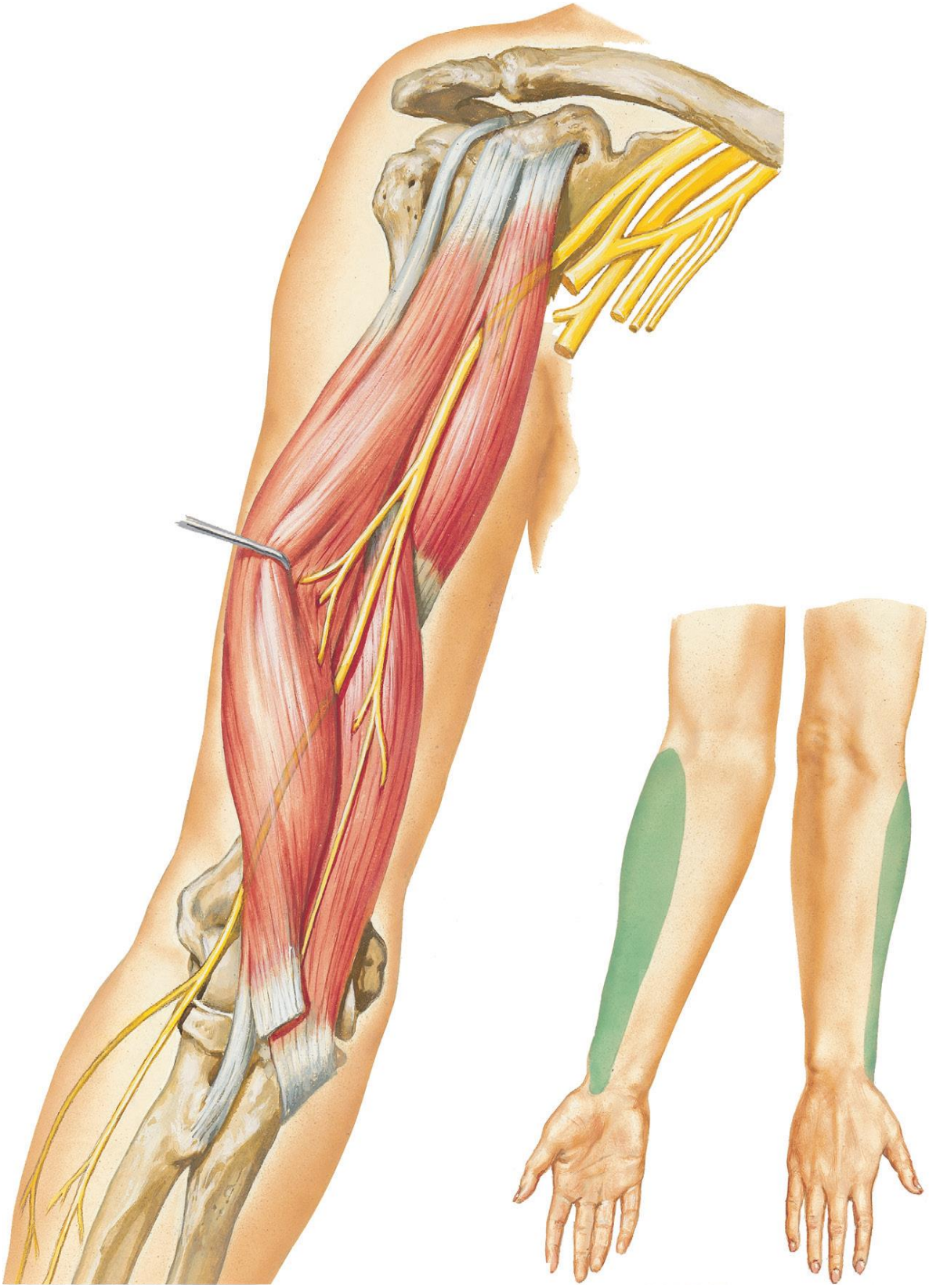
  A. Sensory Loss: loss of sensation in the skin of lateral aspect of forearm both anteriorly and posteriorly in addition to the proximal part of the thenar eminence).

  B. Motor Loss: Paralysis of muscules of front of arm



MUSCULOCUTANEOUS NERVE

Nerves of upper limbs



Radlal Nerve

(C5,6,7,8 &T1)

* **It begins** in the axilla behind 3rd part of axillary artery as the larger of two terminal branches of the posterior cord of brachial plexus.

* **Course and relations:**

- It **descends behind** the 3rd. part of axillary and upper part of brachial **artery** and in front of subscapularis , teres major latissimus dorsi (i.e posterior wall of axilla) and long head of triceps.
- It **passes** in the lower triangular space to reach the **spiral groove** with profunda brachii where they lie between the lateral & medial heads of triceps and in direct contact with middle 1/3 of humerus.
- **In the lower 1/3 of arm** it **pierces** the lateral intermuscular **septum** to reach the **front of arm** in the groove **between** brachialis & brachioradialis muscles.

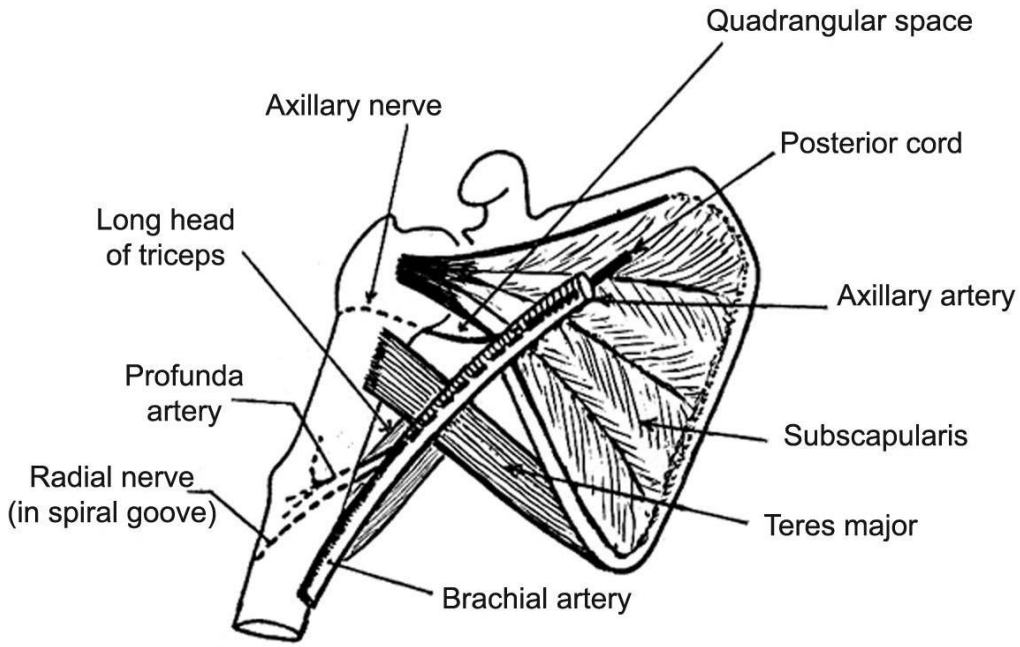
* **Termination**:

- It **ends** in front **lateral epicondyle** by giving deep terminal deep muscular terminal branch called ***posterior interosseous*** nerve and it continues as superficial terminal branch called ***superficial radial*** nerve.

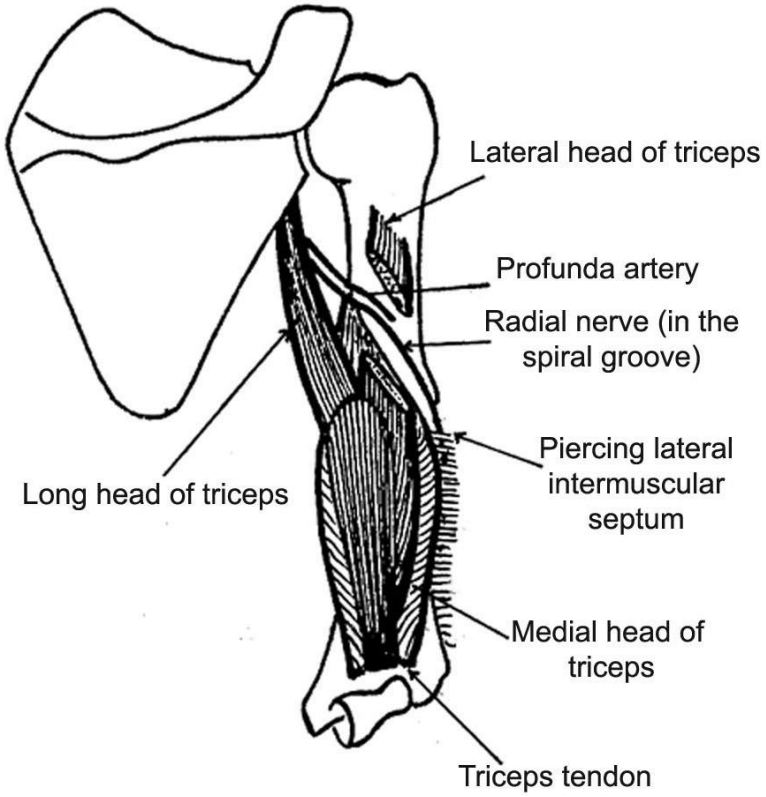
* **Branches:**

- **In axilla & medial aspect of arm** :
  - ***Muscular*** : to long & medial heads of triceps.
  - ***Cutaneous*** : posterior cutaneous nerve of arm.
- **In spiral groove**:
  - ***Muscular*** : to medial & lateral head of triceps and anconeus.
  - ***Cutaneous*** : lower lateral cutaneous nerve of arm & posterior cutaneous nerve of forearm.

- On lateral aspect of arm **between brachialis & brachioradialis**: supply lateral part of brachialis , brachioradialis & extensor carpi radials longus.
- **Posterior interosseous nerve**: (***pure motor***)
  - ♣ It **supplies** the extensor carpi radialis brevis & supinator then **pierces** the substance of supinator where it **winds around** the lateral aspect of radius and appears in the **back of forearm** just above the lower border of supinator muscle , to **supply** the remaining muscles of the extensors .
  - ♣ It **descends** in the back of forearm between the superficial & deep group of extensors where it is **accompanied** by posterior interosseous vessels .
  - ♣ It **supplies** to all muscles of back of forearm except brachioradialis , extensor carpi radials longus & anconeus.
- **Superficial radial nerve** : (***cutaneous***)
  - ♣ It **descends** on the lateral aspect of forearm **under cover** of brachioradialis , lateral to radial artery and **crossing** 4 muscle attached to radius (supinator , pronator teres , radial head of flexor digitorum superficialis & flexor pollicis longus).
  - ♣ 5 cm **above the wrist** it curves backwards to pass in the roof of anatomical **snuff-box** where it **ends** by dividing into 5 dorsal digital branches .
  - ♣ These branches **supply** the lateral 2/3 of dorsum of hand and dorsal aspect of proximal phalanges of lateral 3 1/2 of fingers.

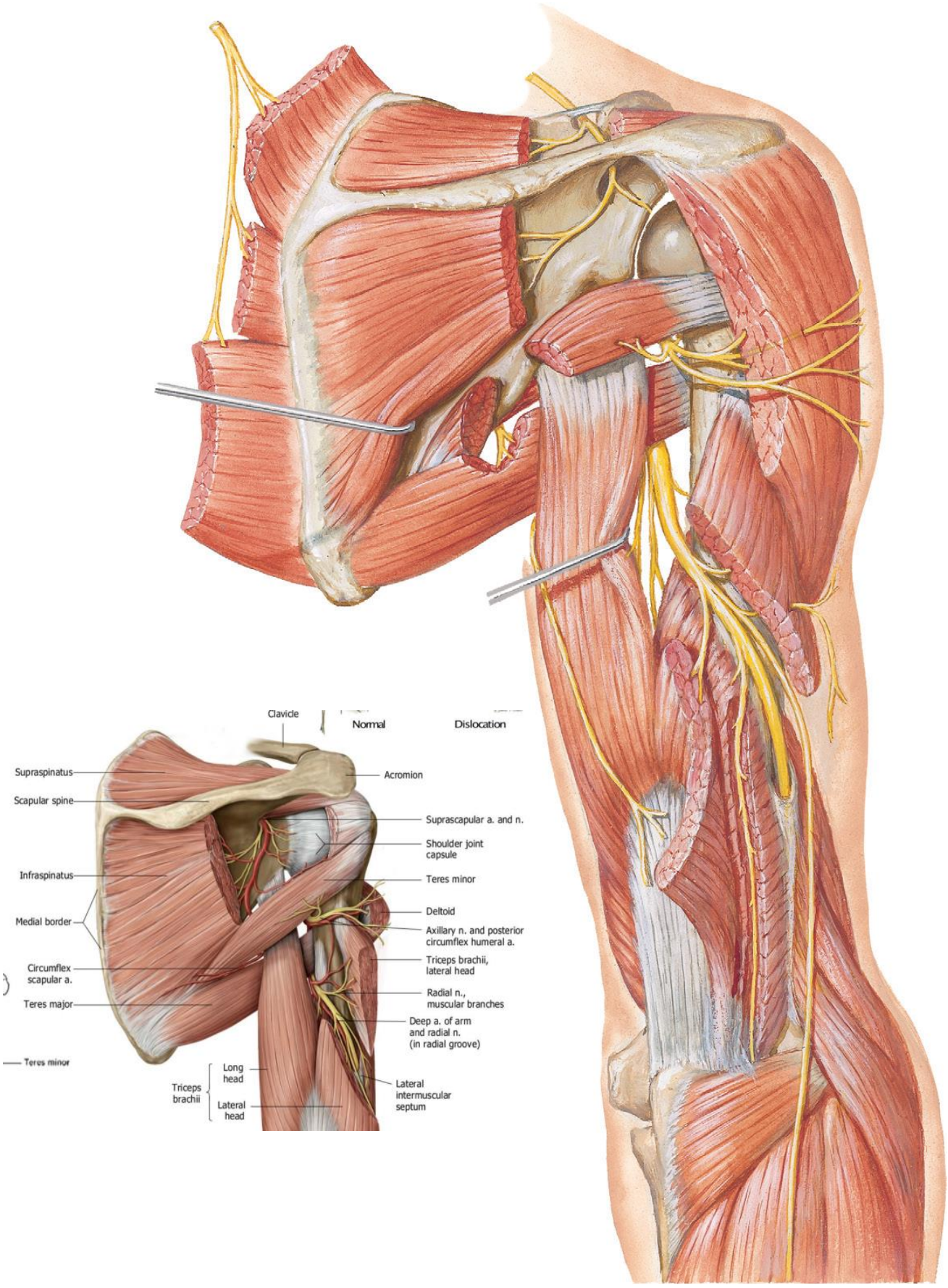


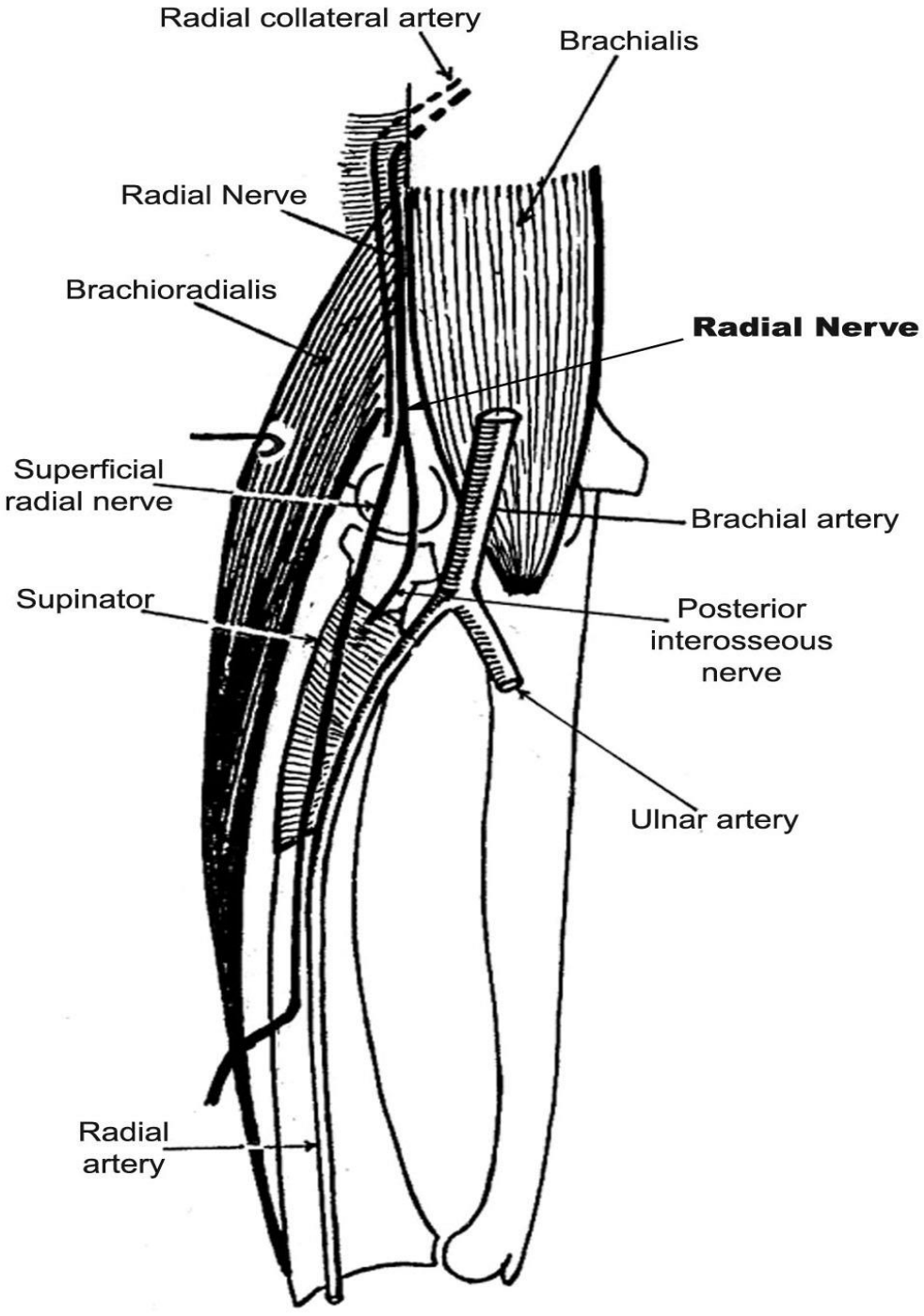
RADIAL NERVE
(in the axilla)



RADIAL NERVE
(in the spiral groove)

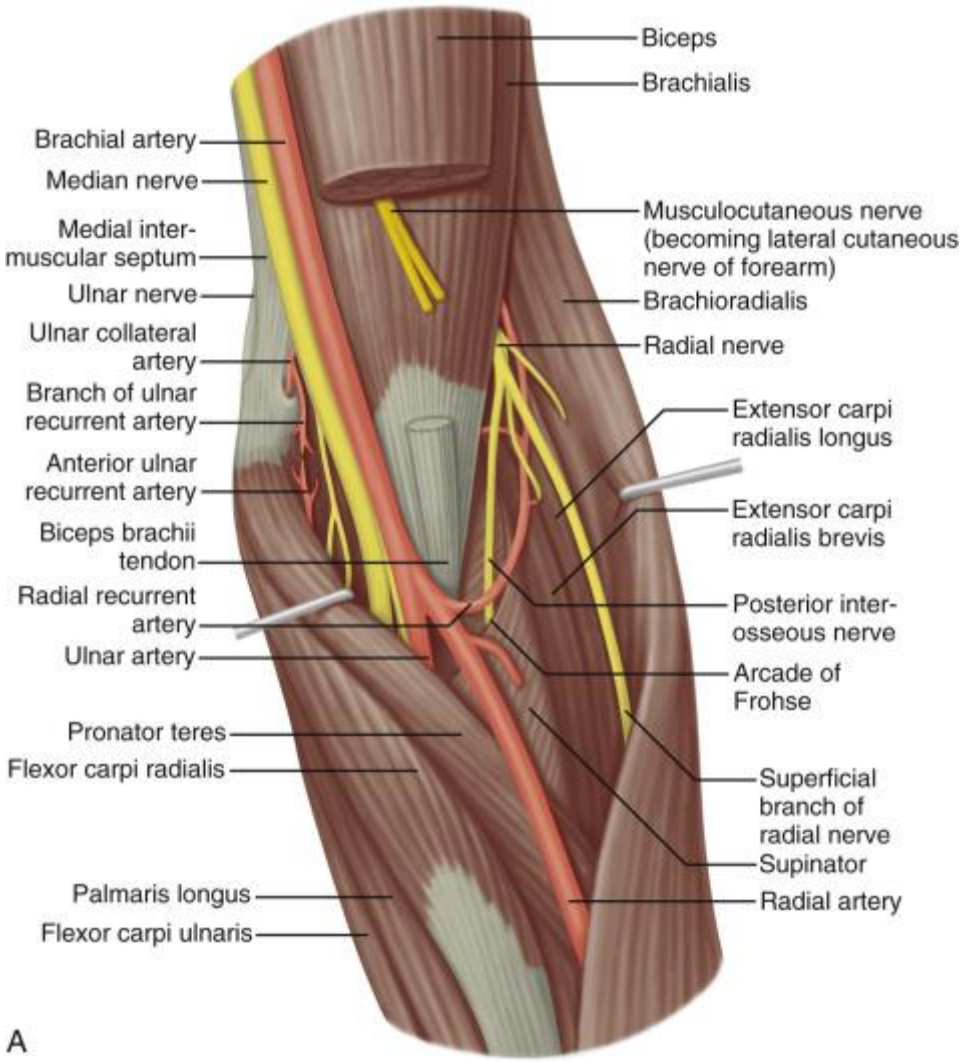
Nerves of upper limbs

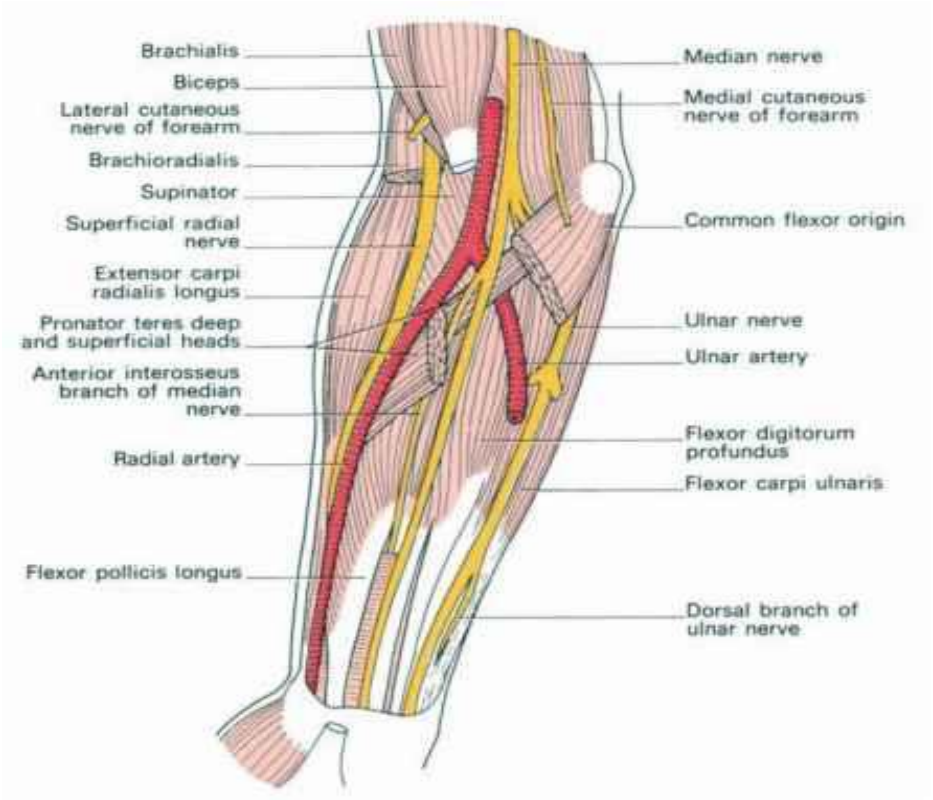




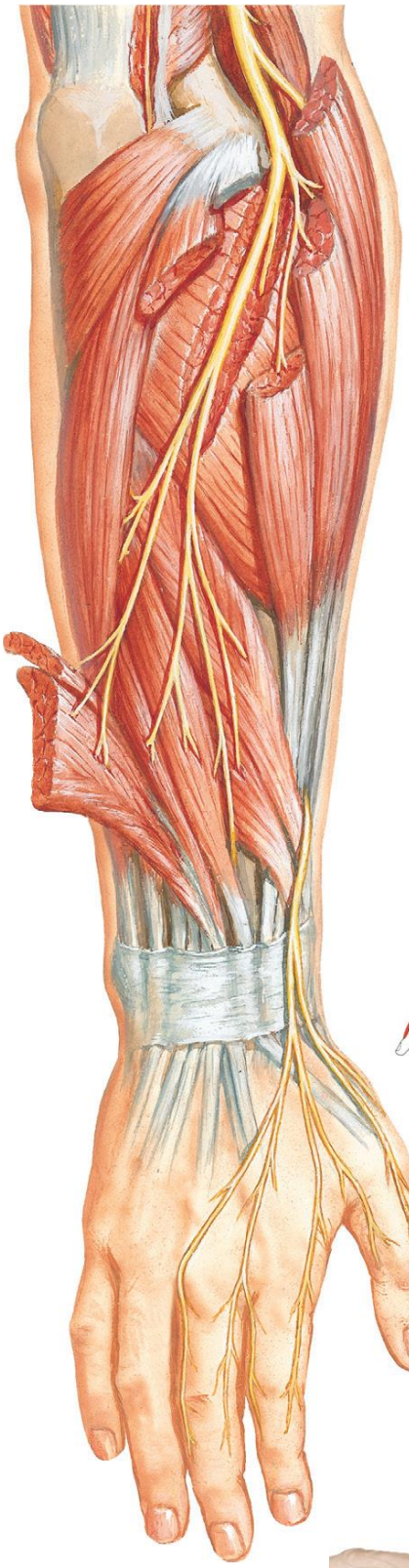
RADIAL NERVE
(in lower 1/3 of arm)

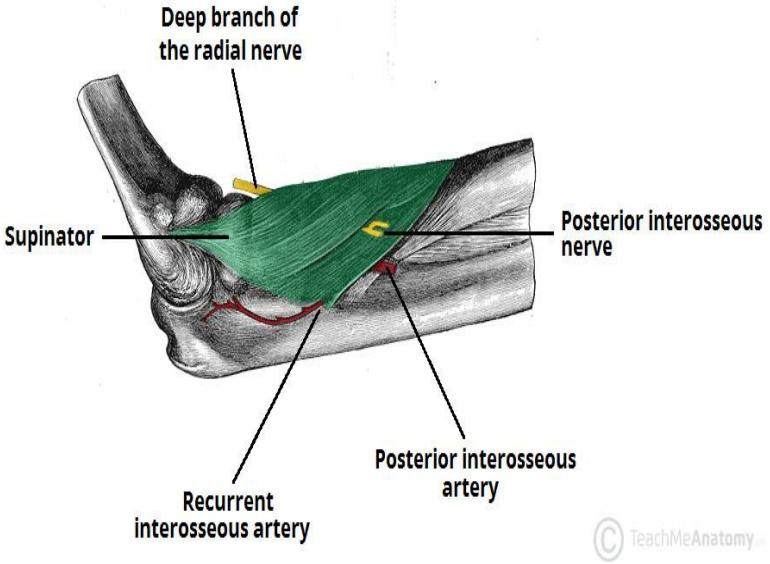
Nerves of upper limbs

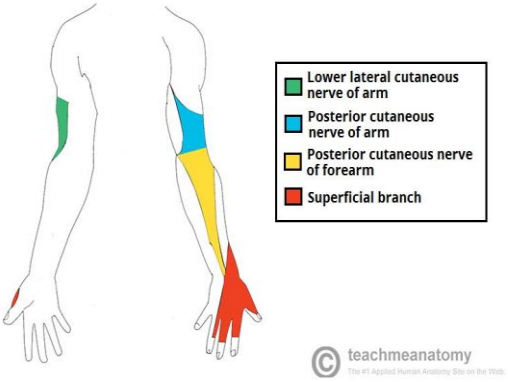


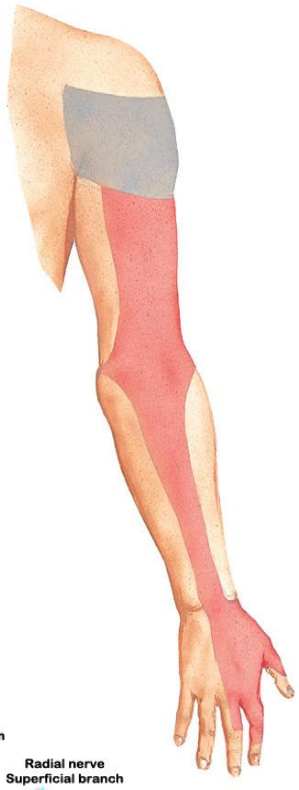


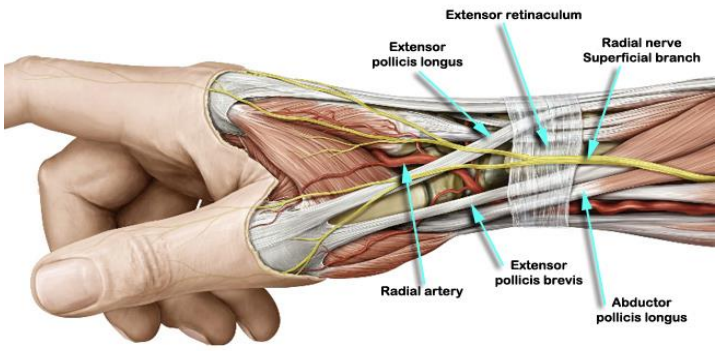
Nerves of upper limbs

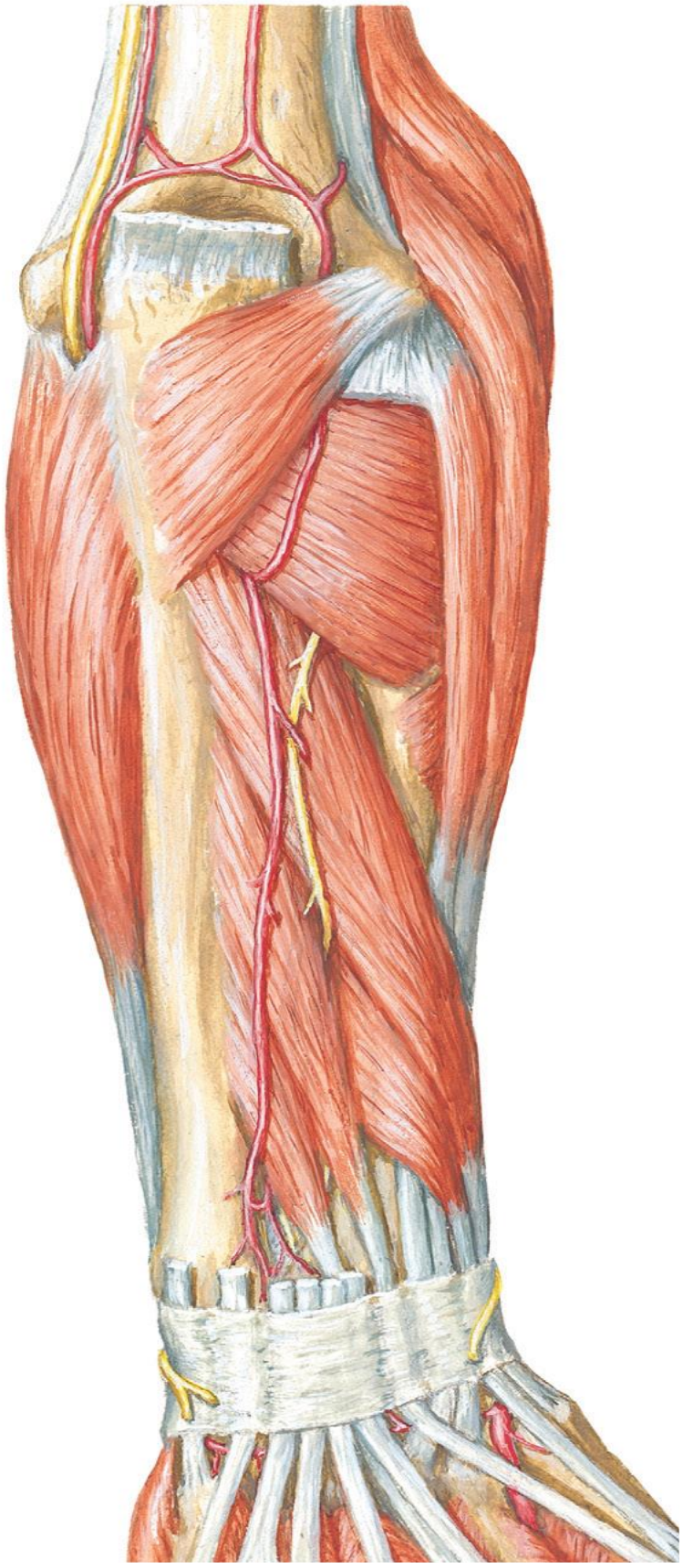












* Applied anatomy: Radial nerve injury

- **Causes:** Crutch palsy **,** Saturday night palsy, fracture shaft or supracondylar fracture of humerus.
- **Results:**

I) Injury at the level of axilla:

a-Motor loss:

- ♣ Atrophy of all muscules on the back of arm and back of forearm (mention).
- ♣ Loss of extension of elbow , wrist and fingers
- ♣ Loss of supination of extended elbow.
- ♣ Weak hand grip due to lack of fixation of elbow in extension.

b- Deformity: there is flexion of the elbow , pronation of forearm , wrist drop & fingers drop .

c- Sensory: Theoretically there is hypothesia in the area supplied by radial nerve (mention) but due to **overlapping by surrounding cutaneous nerves**, sensory loss is limited to a triangular area of skin on the dorsum of the hand between the 1st & 2nd metacarpal bones.

II) Injury at the level of spiral groove :

- ♣ As before but the long & medial head of triceps is intact therefore extension of elbow is maintained but weak.

III) Injury in the forearm :(Injury of superficial radial nerve)

- ♣ No motor manifestations and **only sensory loss .**

Ulnar Nerve

(C7, 8 & T1)

*** It begins** in the axilla as the largest branch of medial cord of brachial plexus .

*** Course and relations:**

- It **descends on medial aspect** of 3rd. part of axillary (between the artery and axillary vein) & upper part of brachial **artery** till the level of insertion of coracobrachialis.
- **It pierces** the medial intermuscular **septum** to reach the posterior compartment of arm to descend in front of medial head of triceps in company with ulnar collateral arteries.
- **It passes behind** the **medial epicondyle** with superior ulnar collateral artery.
- It **enters the medial aspect forearm** by passing **between** the 2 heads of flexor carpi ulnaris.
- **In upper 2/3 of forearm**: it lies deep **between** flexor carpi **ulnaris** (superficial to it) and medial part of flexor digitorum **profundus** (deep to it), **medial to ulnar artery**.
- **In the lower 1/3 of forearm:** it becomes **superficial between** the tendons of flexor carpi **ulnaris** & flexor digitorum **superficialis**.

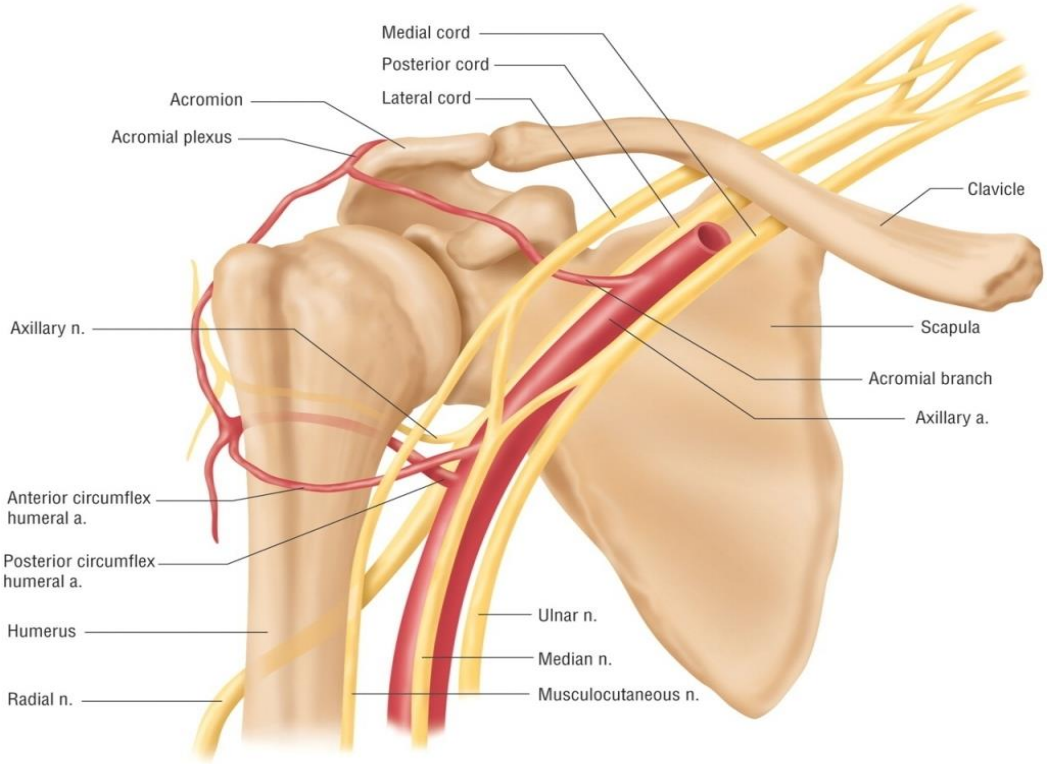
* **Termination**:It ends by entering the palm of hand **superficial** to flexor retinaculum where it divides into a **superficial cutaneous** branch and a **deep muscular** branch .

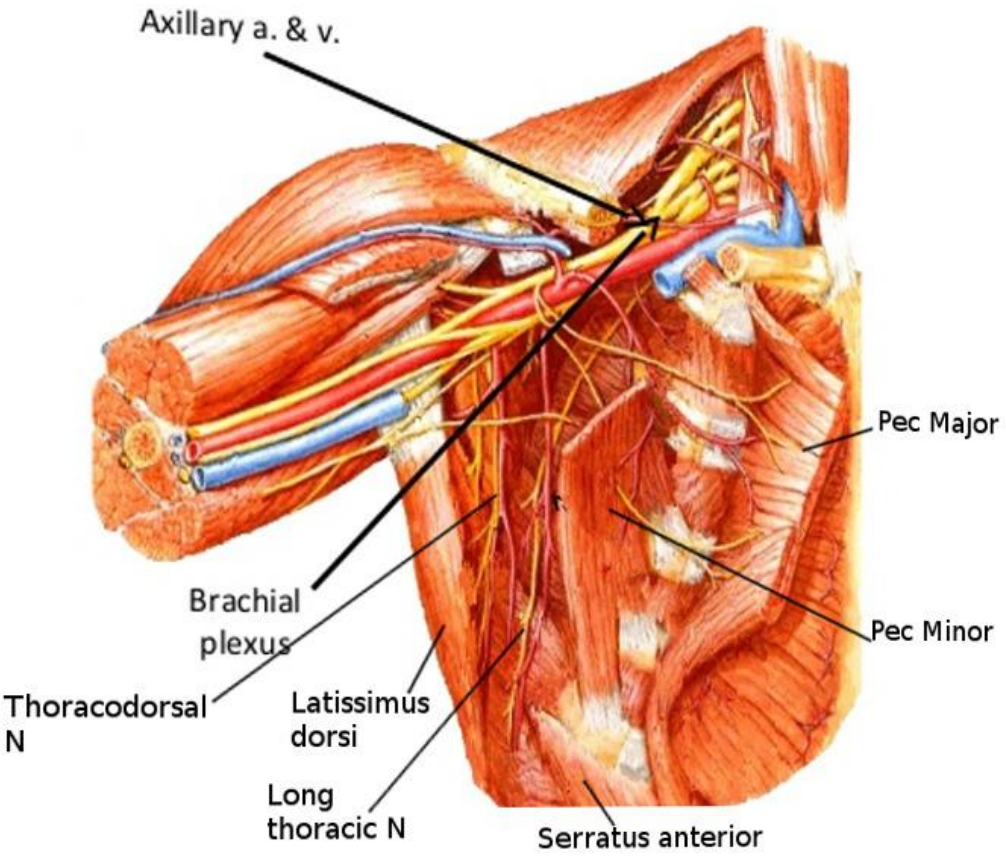
*** Branches:**

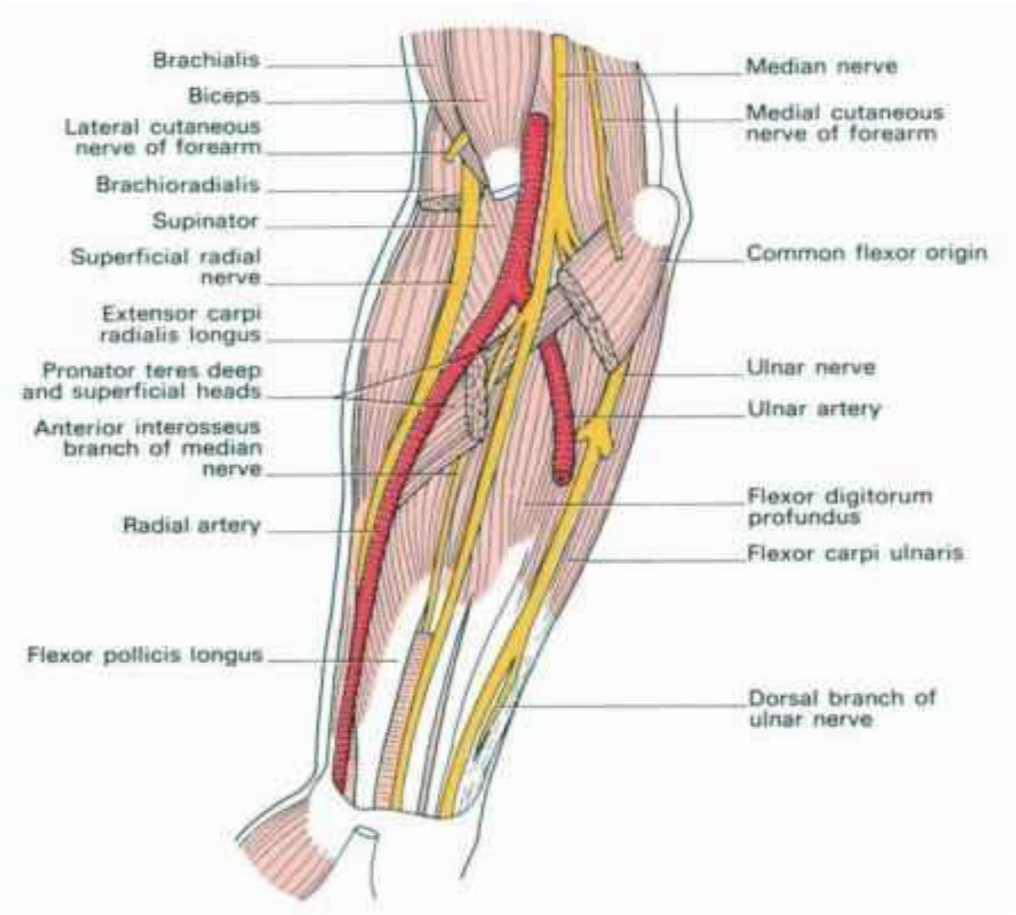
- **In axilla & arm**: No branches

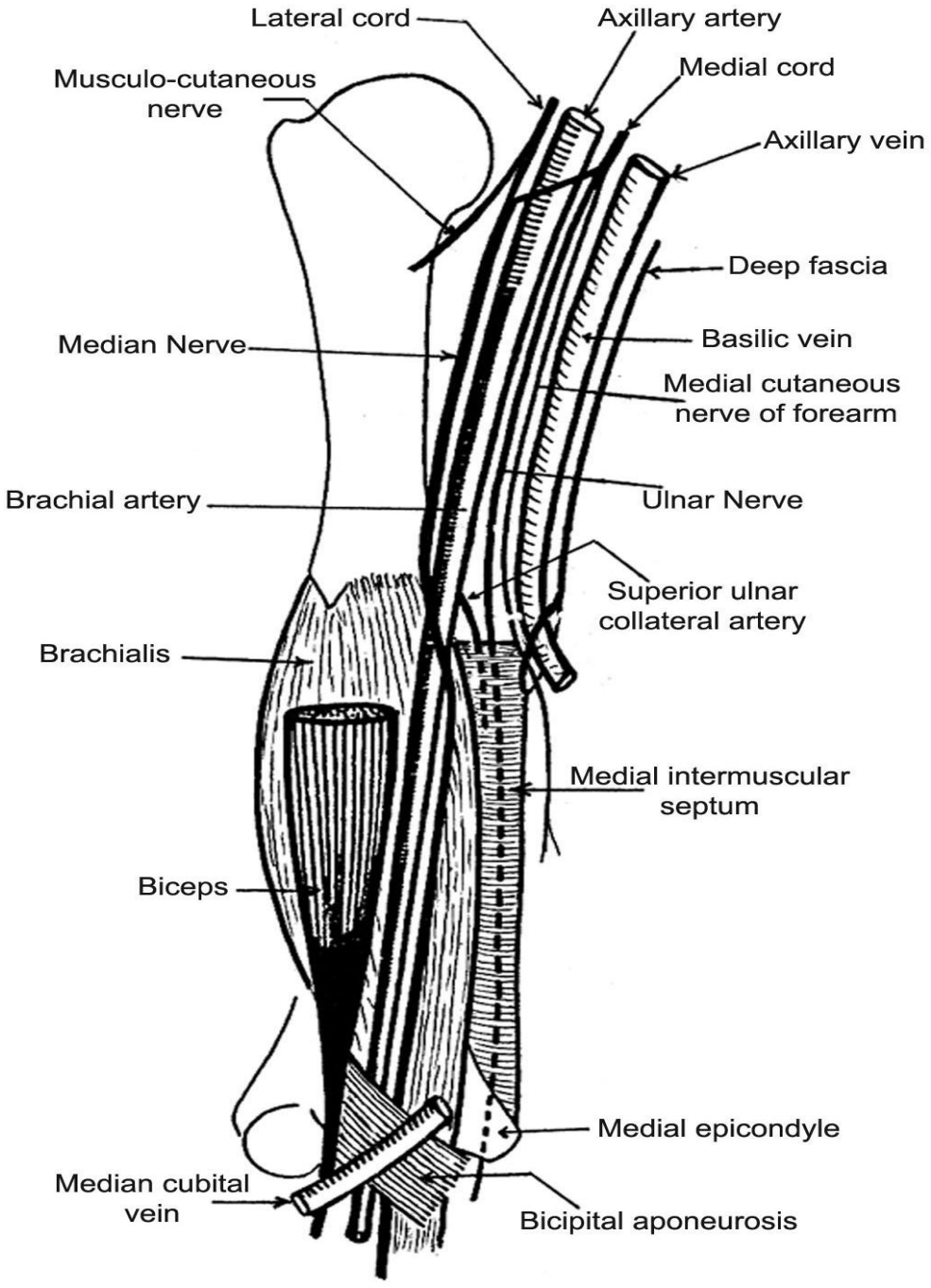
- **In forearm**:
  - **a) Muscular:** Flexor carpi ulnais & medial 1/2 of flexor digitorum profundus.
  - **b) Cutaneous :**
    1. **Palmar cutaneous branch:** Descend superficial to flexor retinaculum to supply **medial 1/3 of the palm.**
    2. **Dorsal cutaneous branch:** Supply the **medial 1/3** of the dorsum of hand and the dorsal aspect of medial **1 1/2 finger.**

- **In hand**:
  - a) **Deep branch**: Supply ms of hypothenar eminence, interossei, medial 2 lumbericals & adductor pollices.
  - b) **Superficial branch**: Supply palmar aspect of medial 1 1/2 fingers.

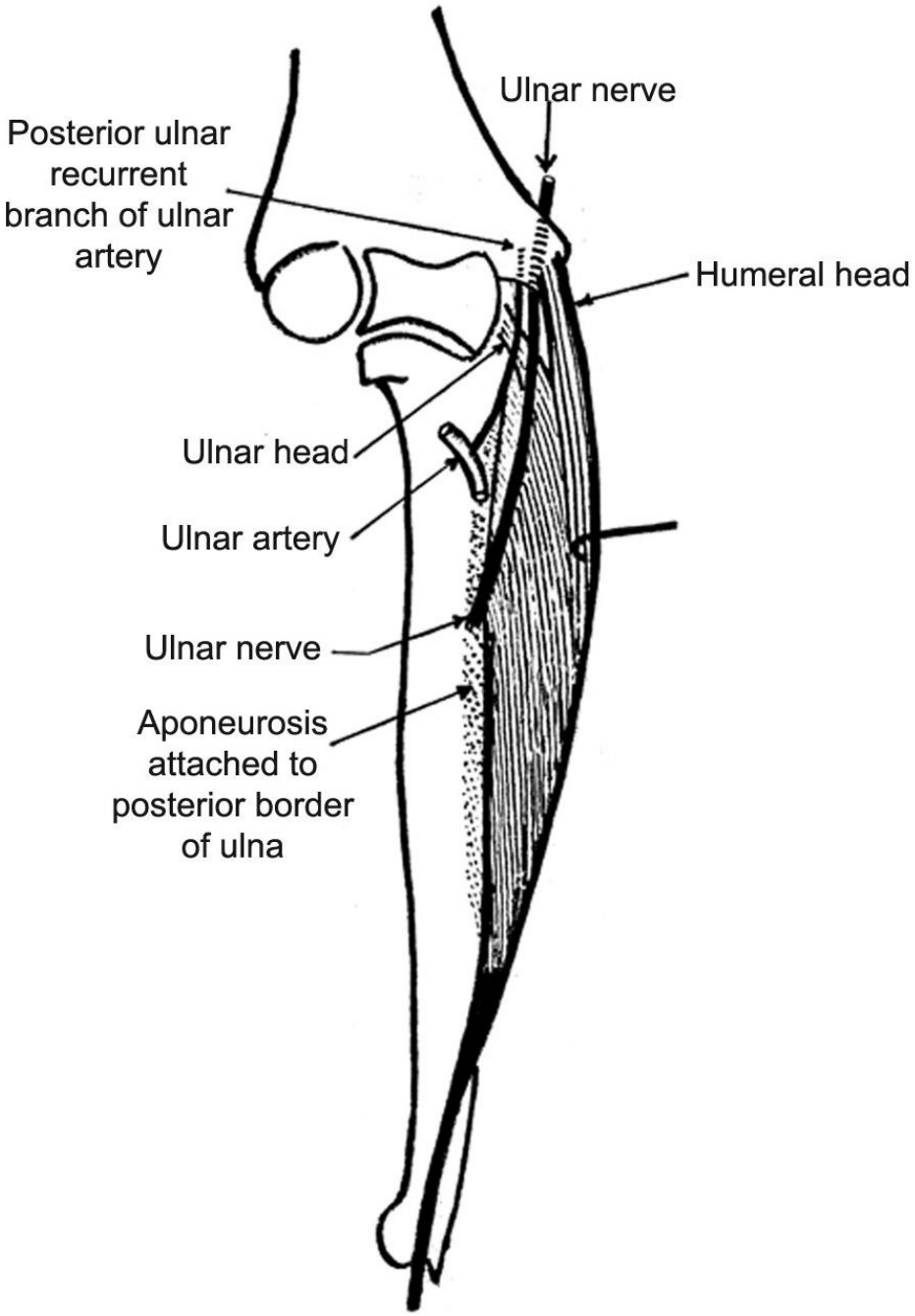



Axillary a. & v.
Pec Major
Brachial plexus
Pec Minor
Thoracodorsal N
Latissimus dorsi
Long thoracic N
Serratus anterior

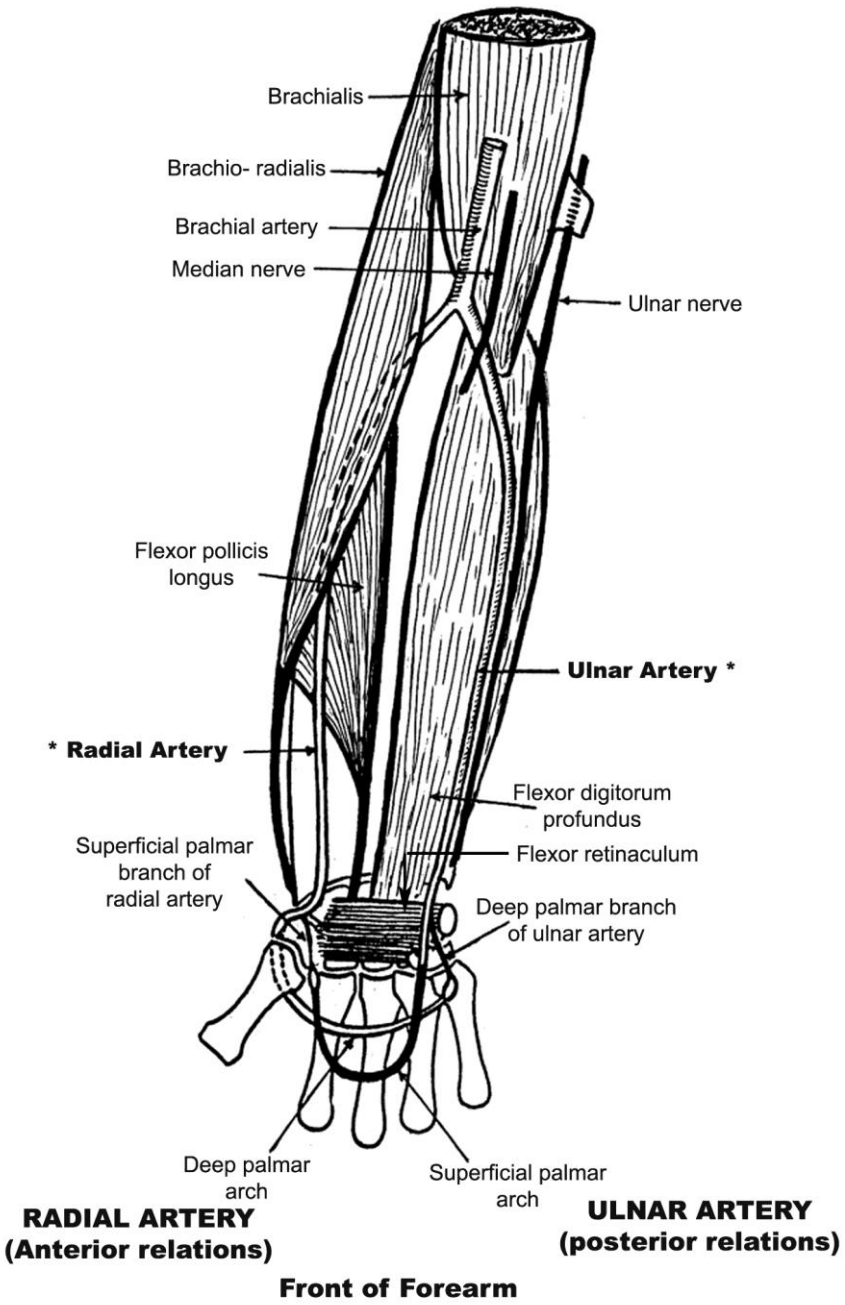

Brachialis
Biceps
Lateral cutaneous nerve of forearm
Brachioradialis
Supinator
Superficial radial nerve
Extensor carpi radialis longus
Pronator teres deep and superficial heads
Anterior interosseus branch of median nerve
Radial artery
Flexor pollicis longus
Median nerve
Medial cutaneous nerve of forearm
Common flexor origin
Ulnar nerve
Ulnar artery
Flexor digitorum profundus
Flexor carpi ulnaris
Dorsal branch of ulnar nerve

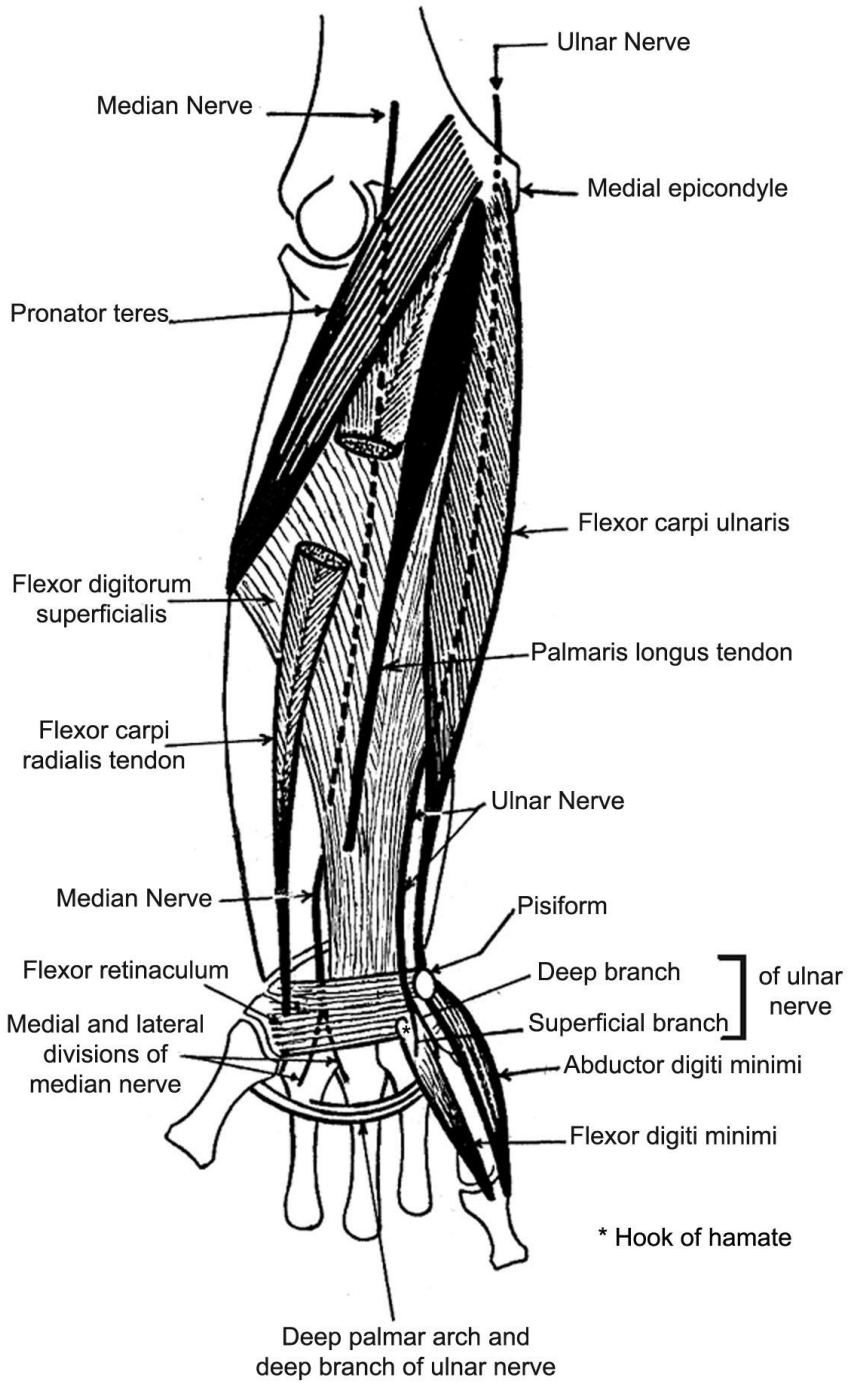


ULNAR AND MEDIAN NERVES IN THE ARM
(Course and Relations)

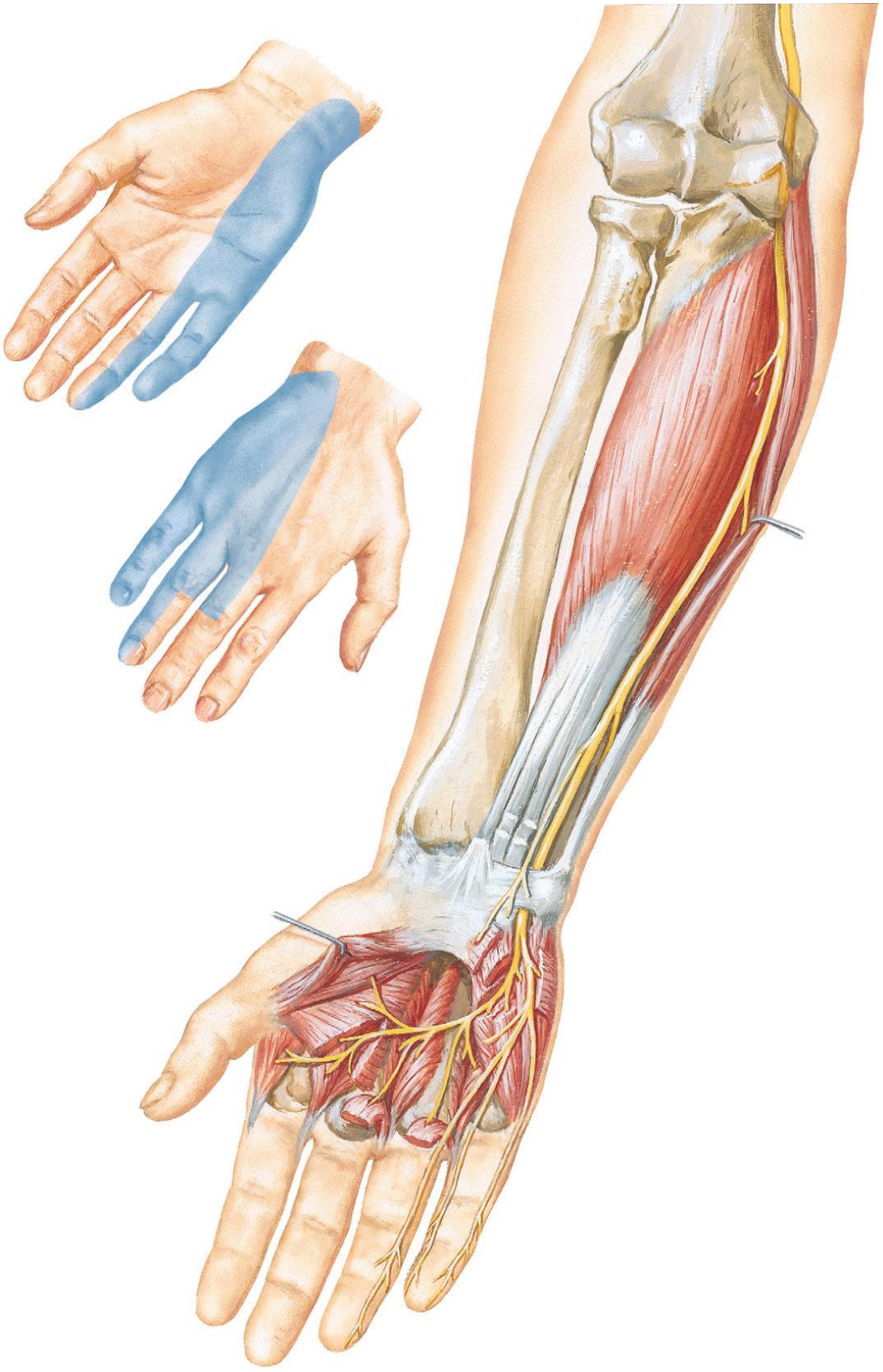


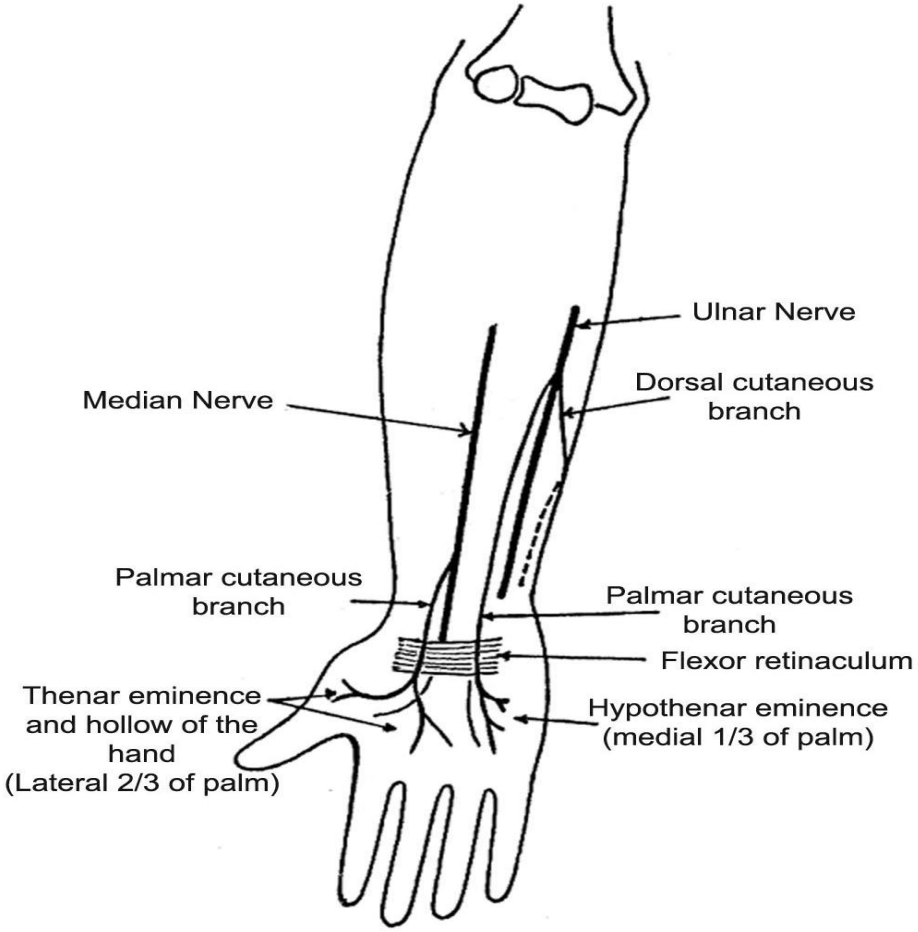
Flexor carpi ulnaris muscle and its relations


Brachialis
Brachio- radialis
Brachial artery
Median nerve
Ulnar nerve
Flexor pollicis longus
Ulnar Artery *
* Radial Artery
Flexor digitorum profundus
Superficial palmar branch of radial artery
Flexor retinaculum
Deep palmar branch of ulnar artery
Deep palmar arch
Superficial palmar arch
RADIAL ARTERY (Anterior relations)
ULNAR ARTERY (posterior relations)
Front of Forearm

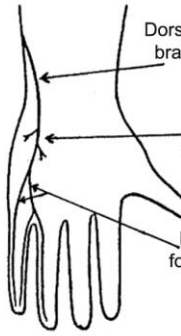


ULNAR AND MEDIAN NERVES IN THE FRONT OF FOREARM (Relations)

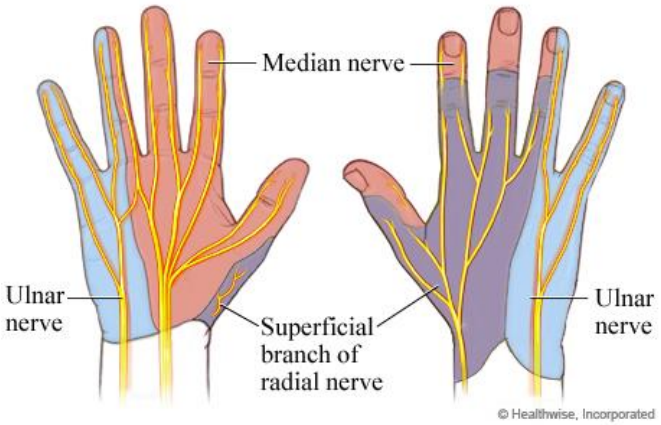




Ulnar and Median Nerves (Cutaneous branches)



Ulnar Nerve (Dorsal cutaneous branch)



* **Applied anatomy: ulnar nerve injury**

  ❖ **Cause:** Cut wound at wrist , supracondylar fracture or fracture medial epicondyle of humerus .

  ❖ **Results:**

  1. **Sensory loss:** in the area supplied by ulnar nerve (mention).
  2. **Motor loss:** paralysis & atrophy of muscles supplied by ulnar nerve (mention).
  3. **Disability and Deformity:** ***Partial claw hand*** (reverse of writing position due to paralysis of interossei and medial 2 lumbericals of little & ring fingers) .

  •This deformity is less sever when the injury occur at the level of elbow due to paralysis of medial ½ of flexor digitorum profundus (***ulnar paradox***) .

Median Nerve

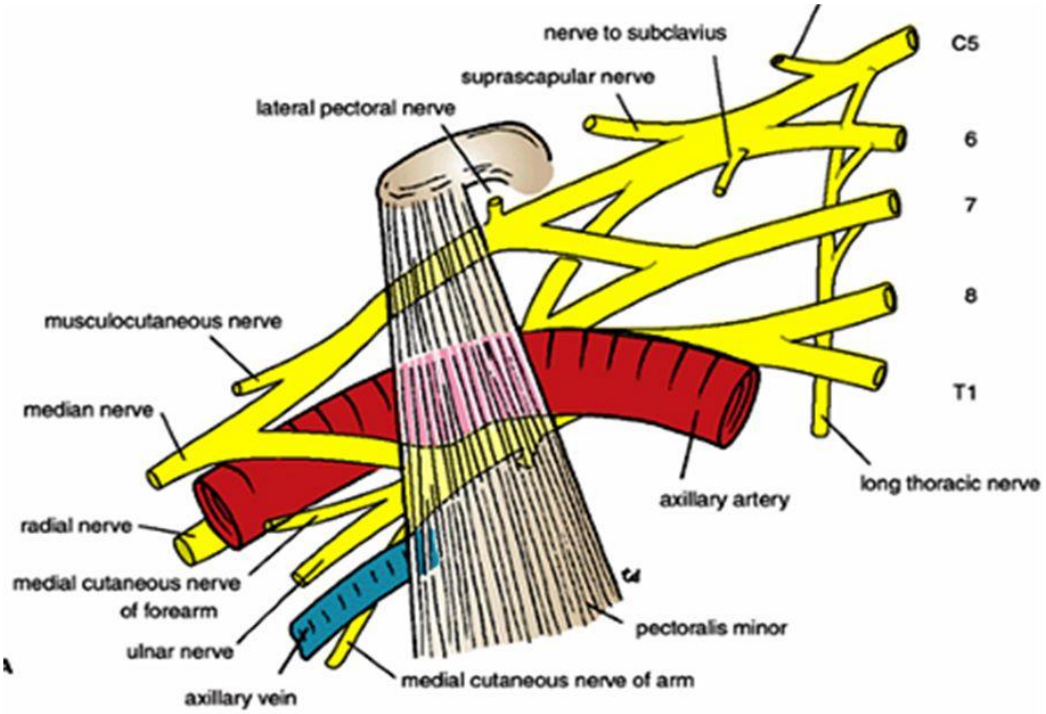
(C5,6,7,8 & T1)

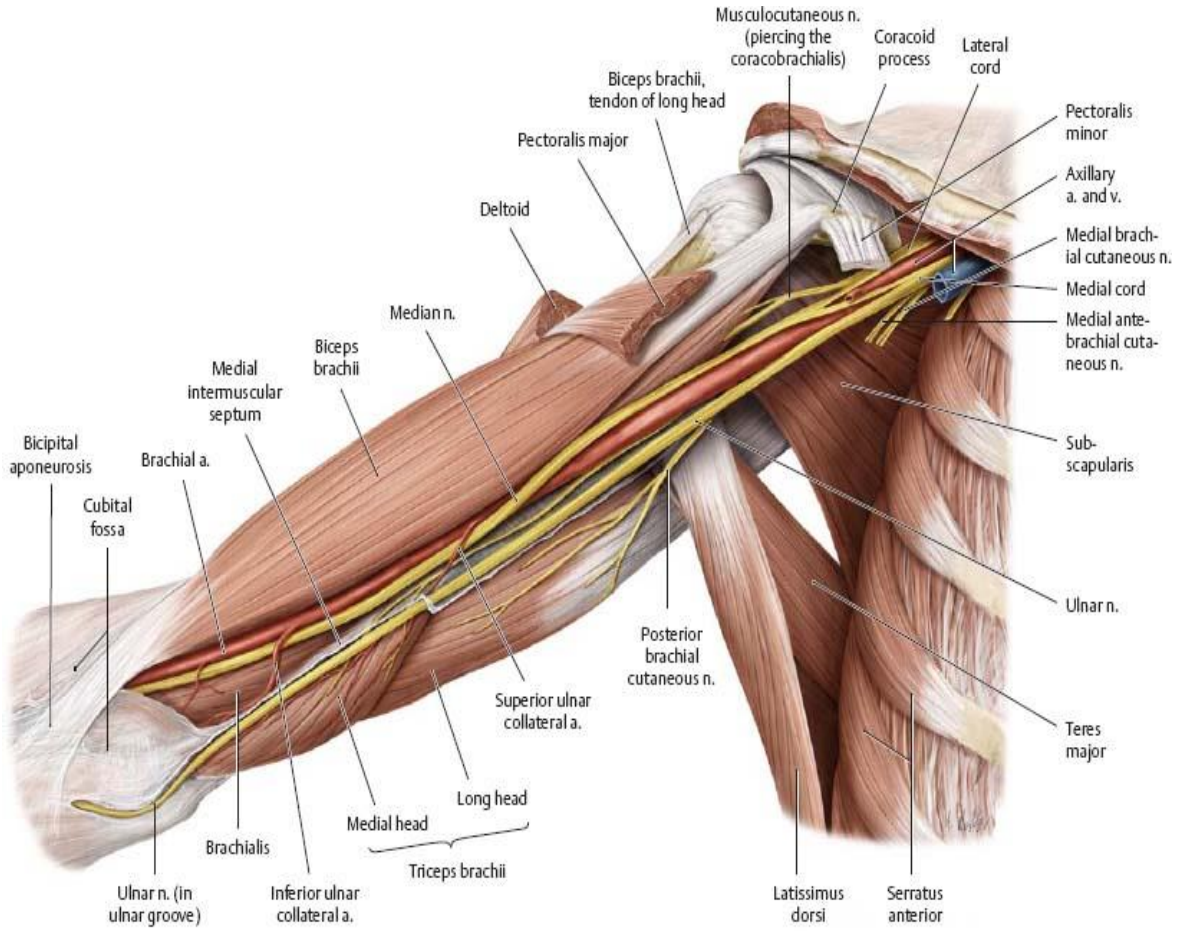
* **It begins** in the axilla by a medial root from the medial cord of brachial plexus and a lateral root from the lateral cord of brachial plexus .

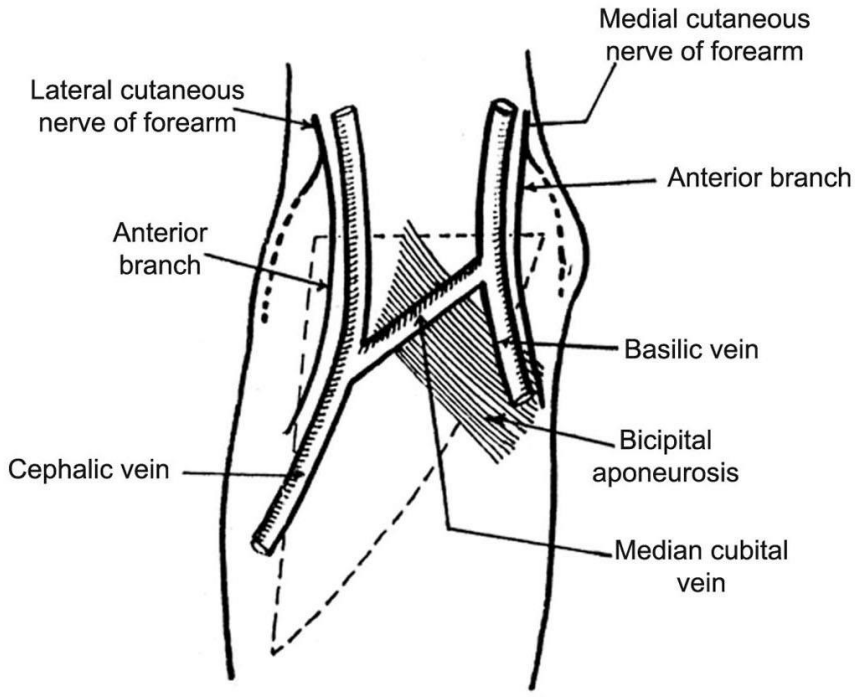
* **Course and relations :**
  - It **descends lateral** to 3rd. part of axillary & upper part of brachial **artery** till the middle of arm (level of insertion of coracobrachialis) where it ***crosses anterior to the brachial artery*** from lateral to medial .
  - It passes in **cubital fossa** medial to brachial artery , in front of brachialis tendon and deep to bicipital aponeurosis.
  - It **leaves the cubital fossa** by passing between the 2 heads of pronator teres separated from ulnar artery by the ulnar head of this muscle .
  - **In the upper 2/3 of forearm**: it passes in the middle of forearm and lies between flexor digitorum profundus (deep to it) & flexor digitorum superficialis (superficial to it).
  - **In lower 1/3 of forearm:** it becomes superficial between the tendons of flexor carpi radialis and flexor digitorum superficialis.
  - It pass just deep to the **flexor retinaculum** (through carpal tunnel) superficial to flexor digitorum superficialis .

* **Termination**: just after it emerges from the carpal tunnel ,it enters the hand where **it ends by** dividing into medial & lateral divisions.

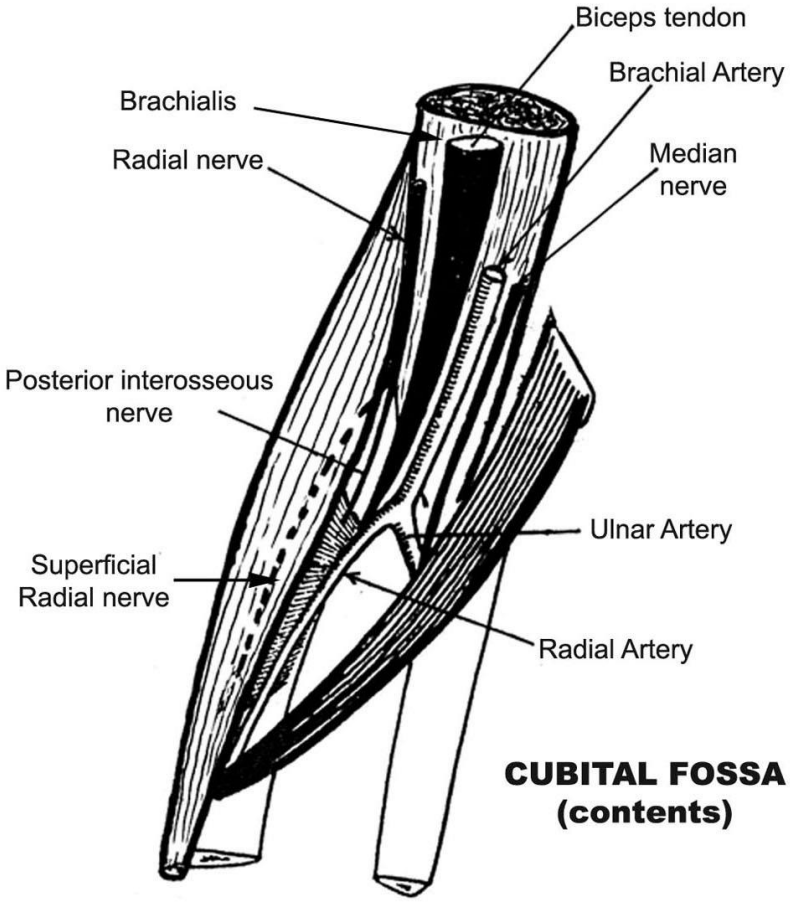
Relations of Brachial plexus



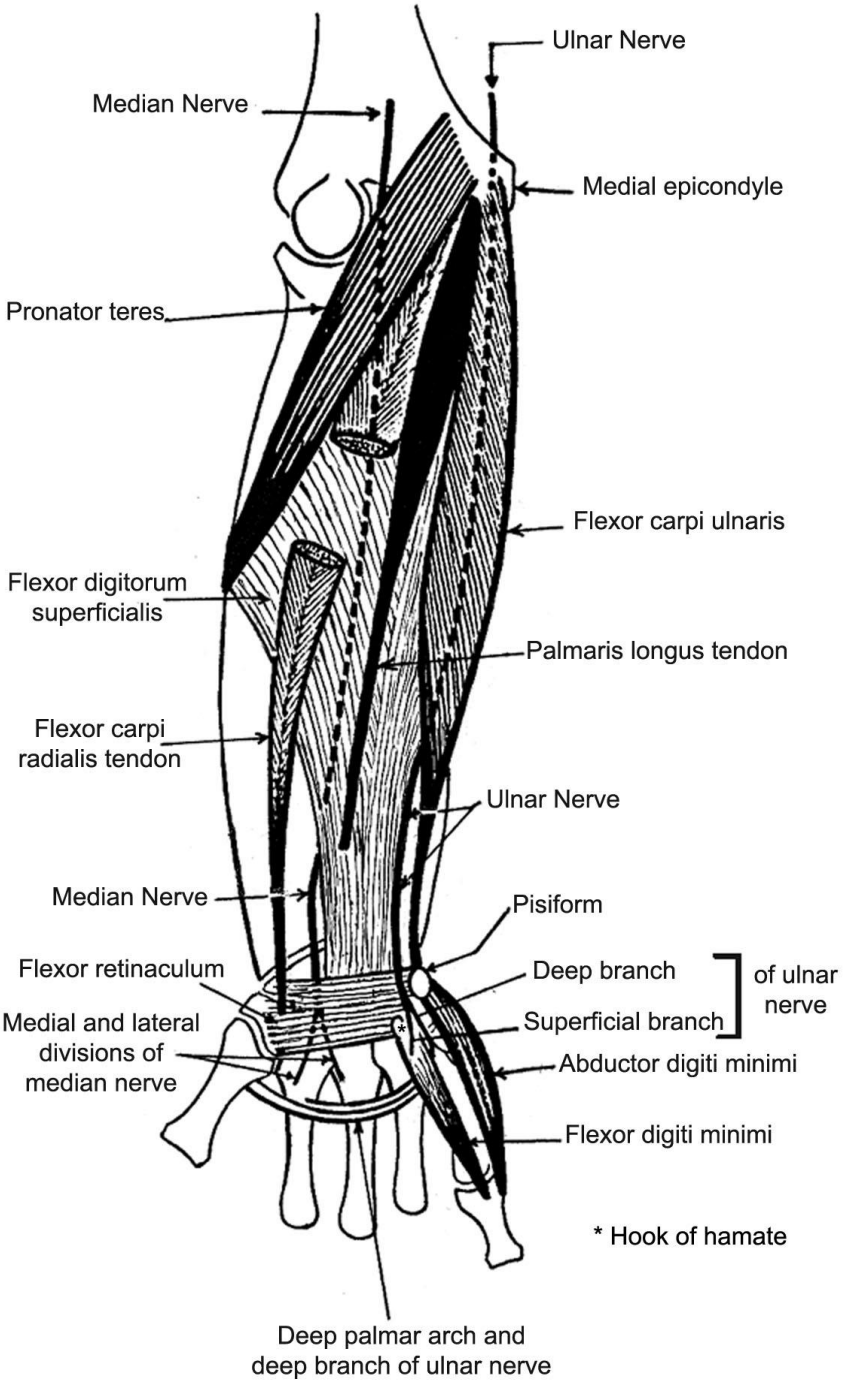




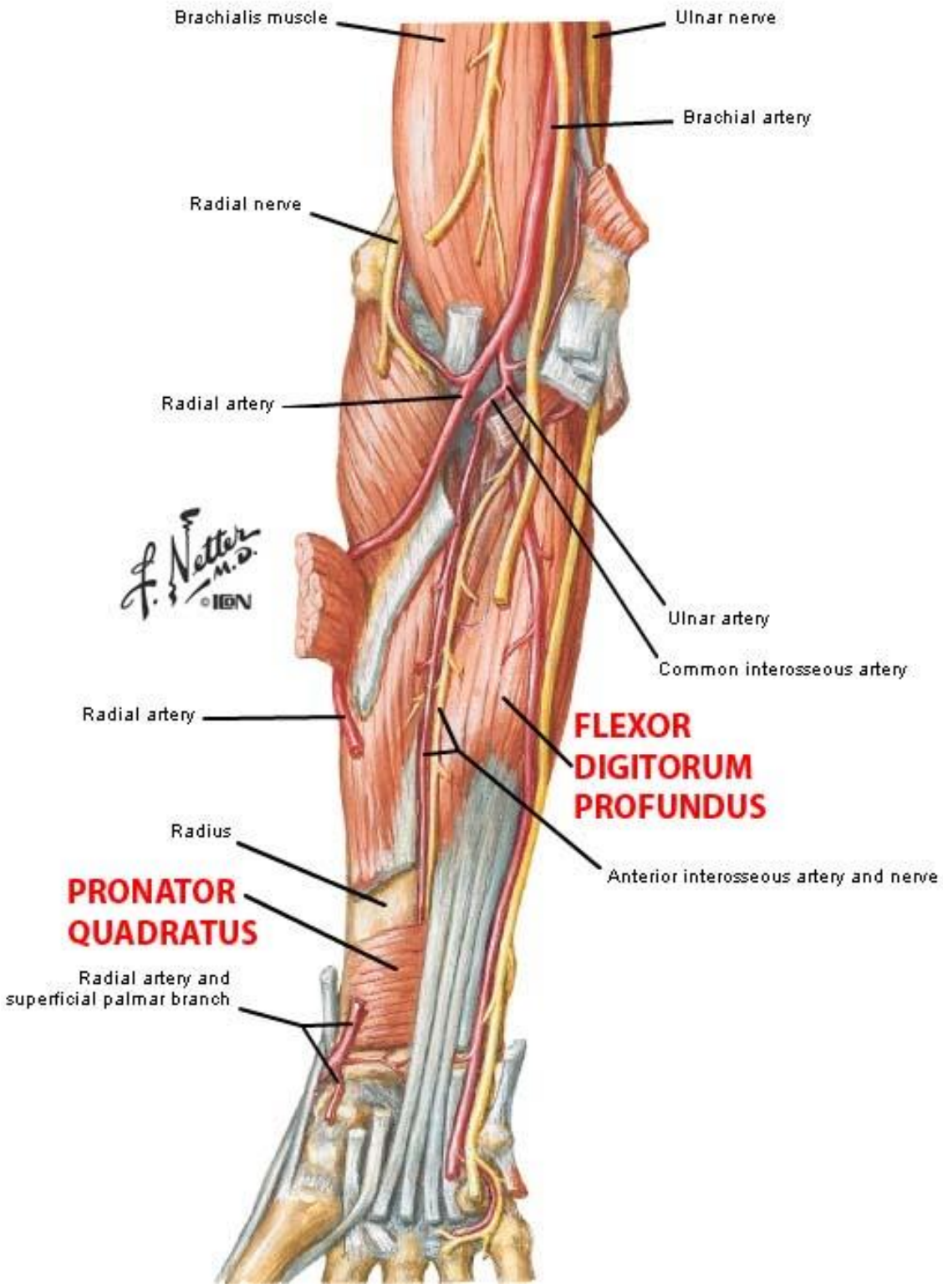
CUBITAL FOSSA
(Roof and its contents)



CUBITAL FOSSA
(contents)



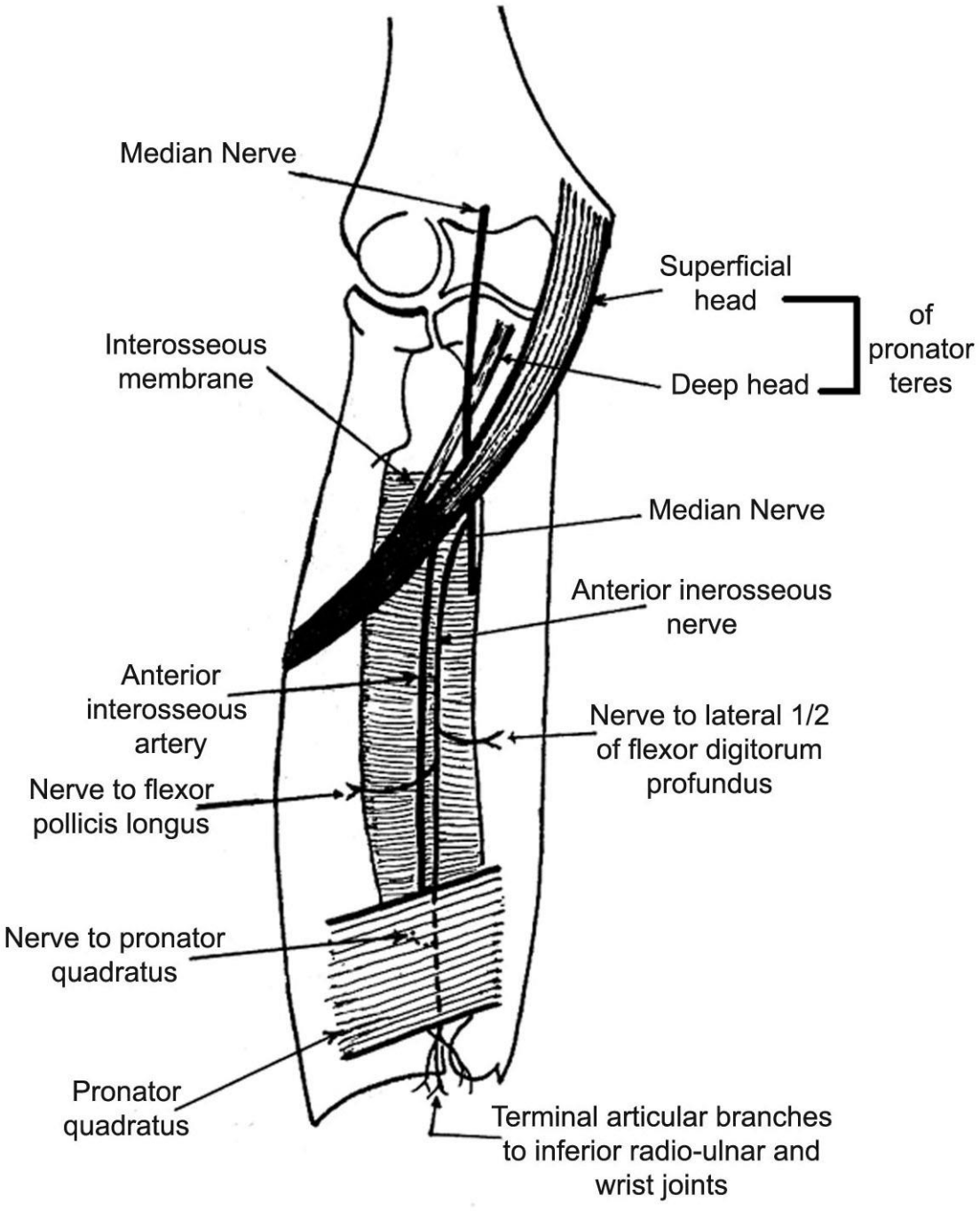
ULNAR AND MEDIAN NERVES IN THE FRONT OF FOREARM (Relations)



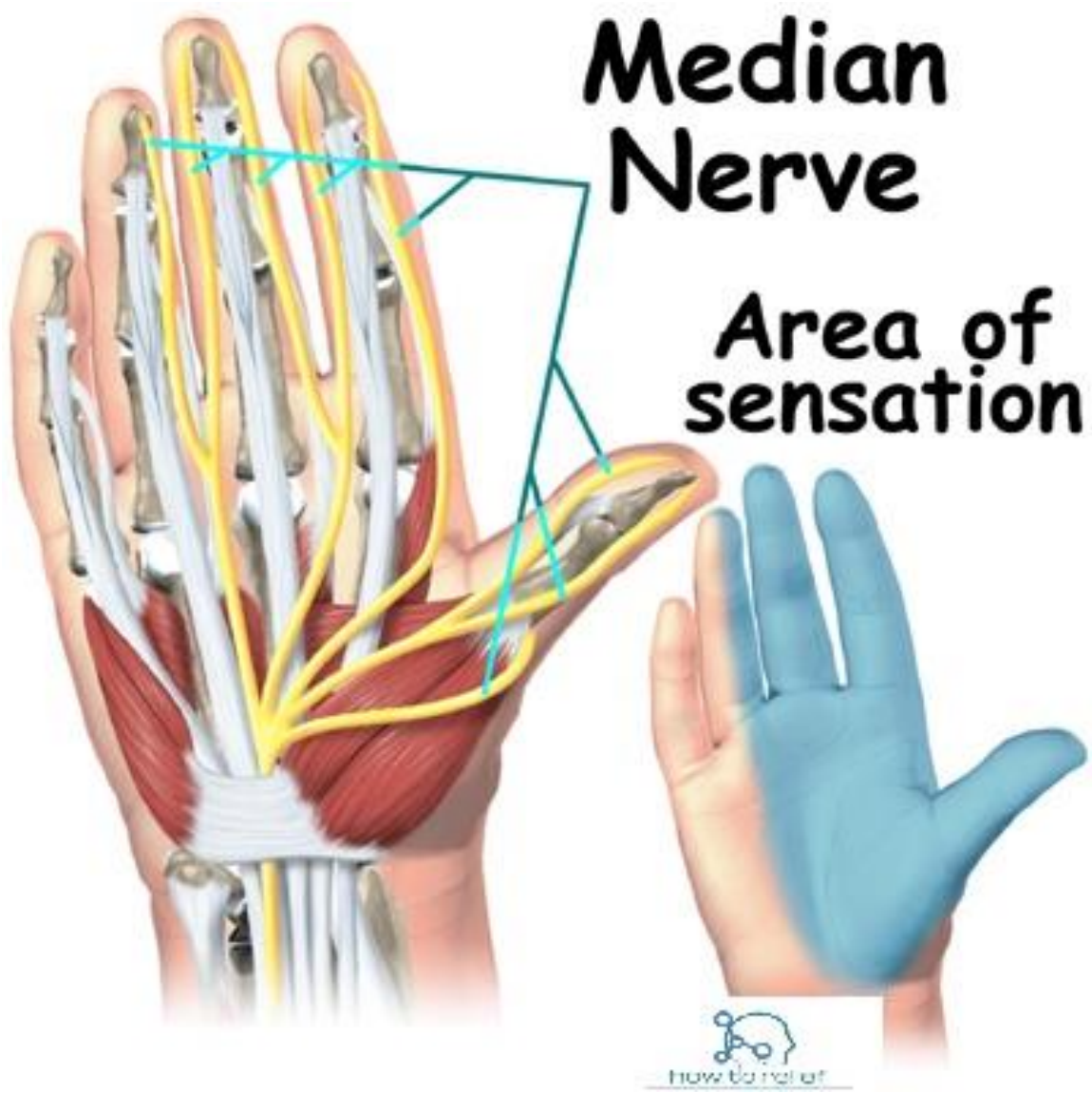
ULNAR AND MEDIAN NERVES IN THE FRONT OF FOREARM (Relations)

*** Branches:-**

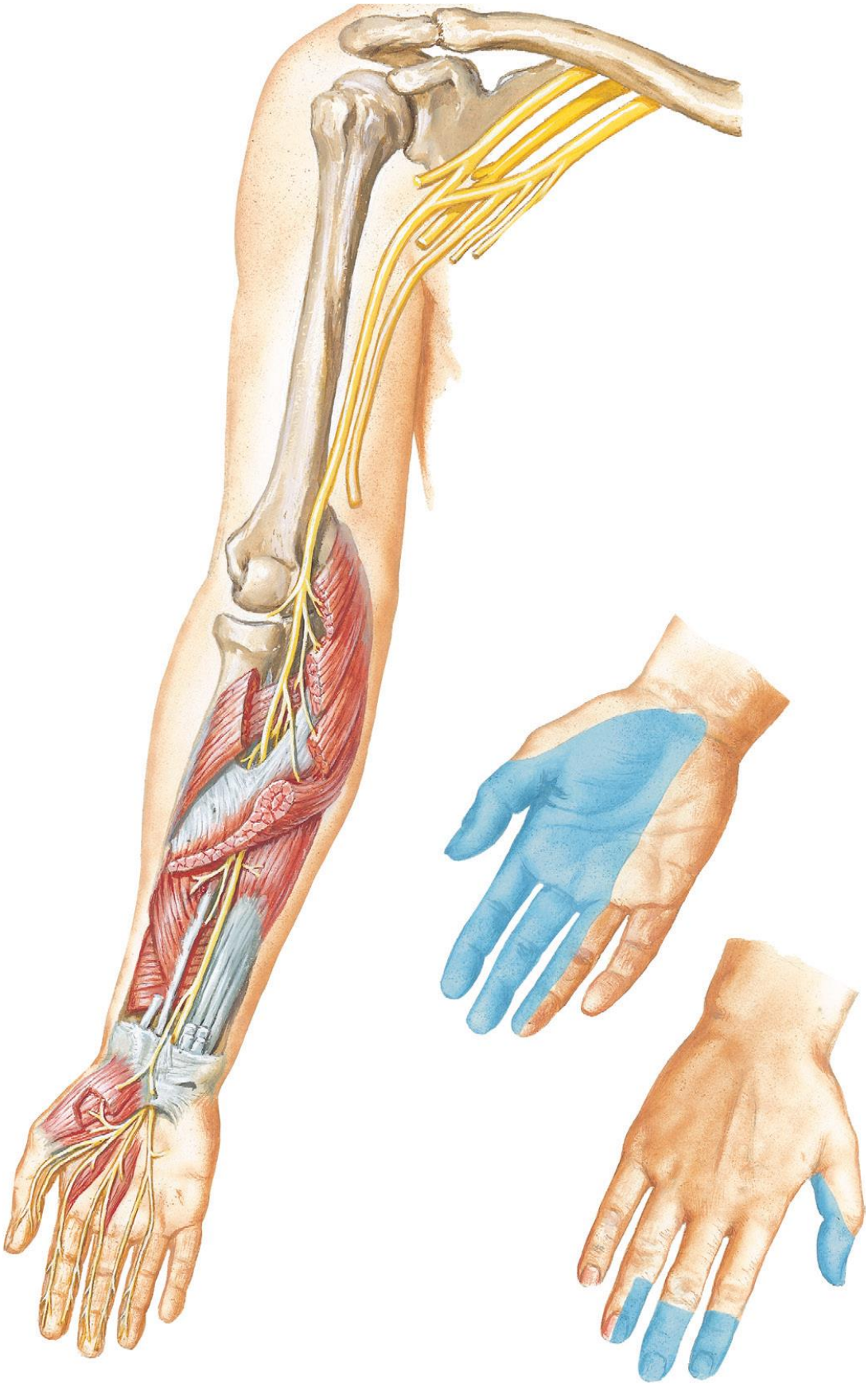
- **In axilla & arm**: No branches.
- **In forearm**:
  - **a) In the cubital fossa:**
    1-**Articular branches** to elbow joint and superior radio-ulnar joint .
    2- Muscular: superficial group of front of forearm **except** flexor carpi ulnaris.
  - **b) As it emerges from pronator teres it gives:**
    - **Anterior interosseous nerve** which descend in front of interosseous membrane accompanied with the anterior interosseous artery .
      - ♣ This nerve is related medially to flexor digitorum profundus and laterally to flexor pollicis longus and ends deep to pronator quadrates by supplying inferior radio-ulnar and wrist joints.
      - ♣ It supplies the deep group of front of forearm **except** medial 1/2 of flexor digit. Profundus .
  - **c) 5 cm above the flexor retinaculum it gives palmar cutaneous branch** which passes in front of flexor retinaculum to supply the skin of **lateral 2/3 of palm**.
- **In hand:**
  - **a) Muscular** : to lateral 2 lumbricals & 3 muscles of thenar eminence.
  - **b) Palmar digital cutaneous branches *:*** supply palmar aspect of **lateral 3 1/2 fingers** as well as the dorsal aspect of the distal & middle phalanges of these fingers .



Anterior Interosseous Nerve
(branch of Median Nerve)


Median
Nerve
Area of
sensation

Nerves of upper limbs



*** Applied anatomy: Median nerve injury .**

A. Cause: Supra-condylar fracture of the humerus , Colle's fracture of radius , cut wound at the wrist or Carpal tunnel syndrome (median nerve compression in the carpal tunnel due to oedema, myxoedema, tumors, teno-synovitis… etc.).

B. Results:

1. **Sensory loss:** in the skin supplied by median nerve (mention).
2. **Motor loss:** paralysis & atrophy of all muscles supplied by median nerve (mention)
3. **Deformity: Ape or Monkey's hand** (atrophy of thenar eminence with adduction and loss of opposition of the thumb).