



Brachial plexus & nerves of the upper limb.

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objects

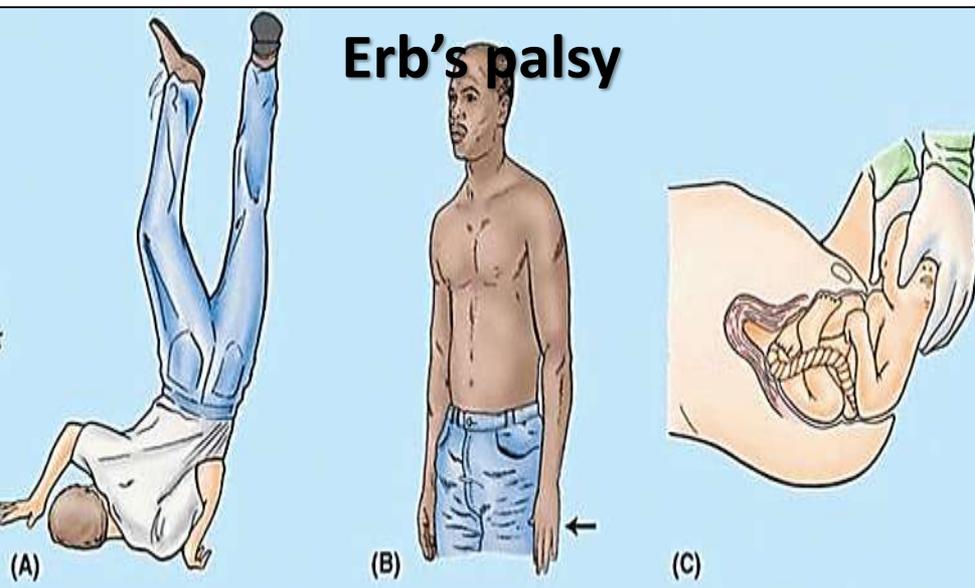
- 1-Make a list of contributing spinal nerves.
- 2-Discuss the general arrangement of this plexus.
- 3-Locate the plexus in the axilla and note important relations to blood vessels.
- 4-Make a list of local branches with short notes on its target organs.
- 5-Make a list of its terminal main branches.
- 6-Follow up each branch down to its target organs (myotomes and Dermatomes).

Injuries of brachial plexus: 3 types

1. Complete injury.

2. Upper trunk injury C5,6 (**Erb's palsy** or paralysis) ⇒ **Porter's (Waiter's) tips hand**.

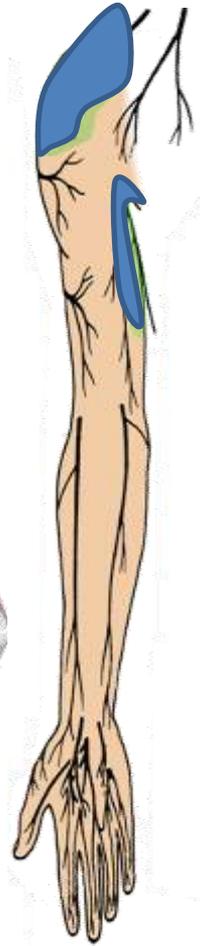
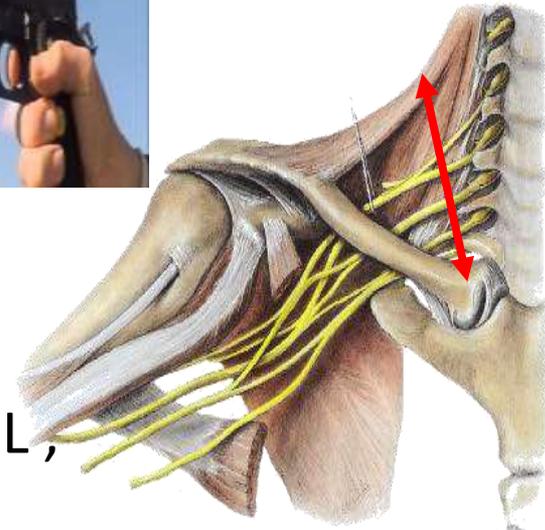
3. Lower trunk injury C8 T1 (**Klumpke's paralysis**) ⇒ **Complete claw hand** (also caused by combined lesion of both median & ulnar Ns.).



Brachial Plexus Injury

WHOLE PLEXUS

- **Cause:** gunshot wounds
- **Effects:**
 - **Motor** → Paralysis of whole UL, except
 - trapezius → spinal accessory and levator scapulae → C3,4
 - **Sensory** → Anesthesia whole UL, except
 - Skin over upper part of deltoid (lat. supraclavicular n.) → C3,4
 - Floor of axilla & upper medial side of arm (2nd intercostal n.) → T2

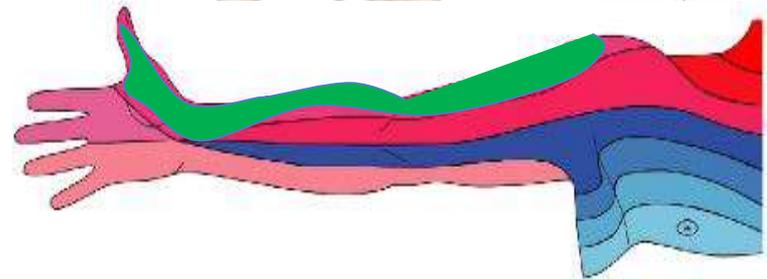
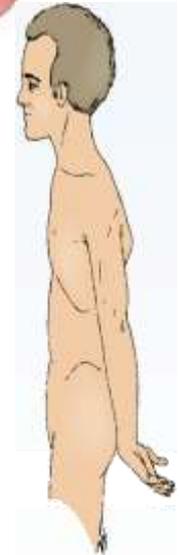
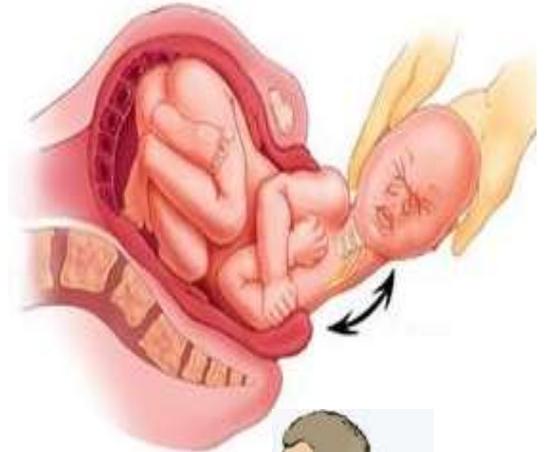
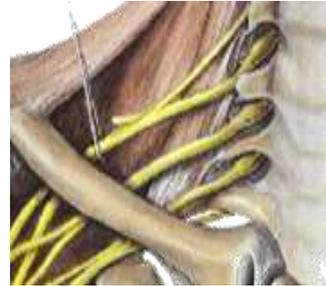


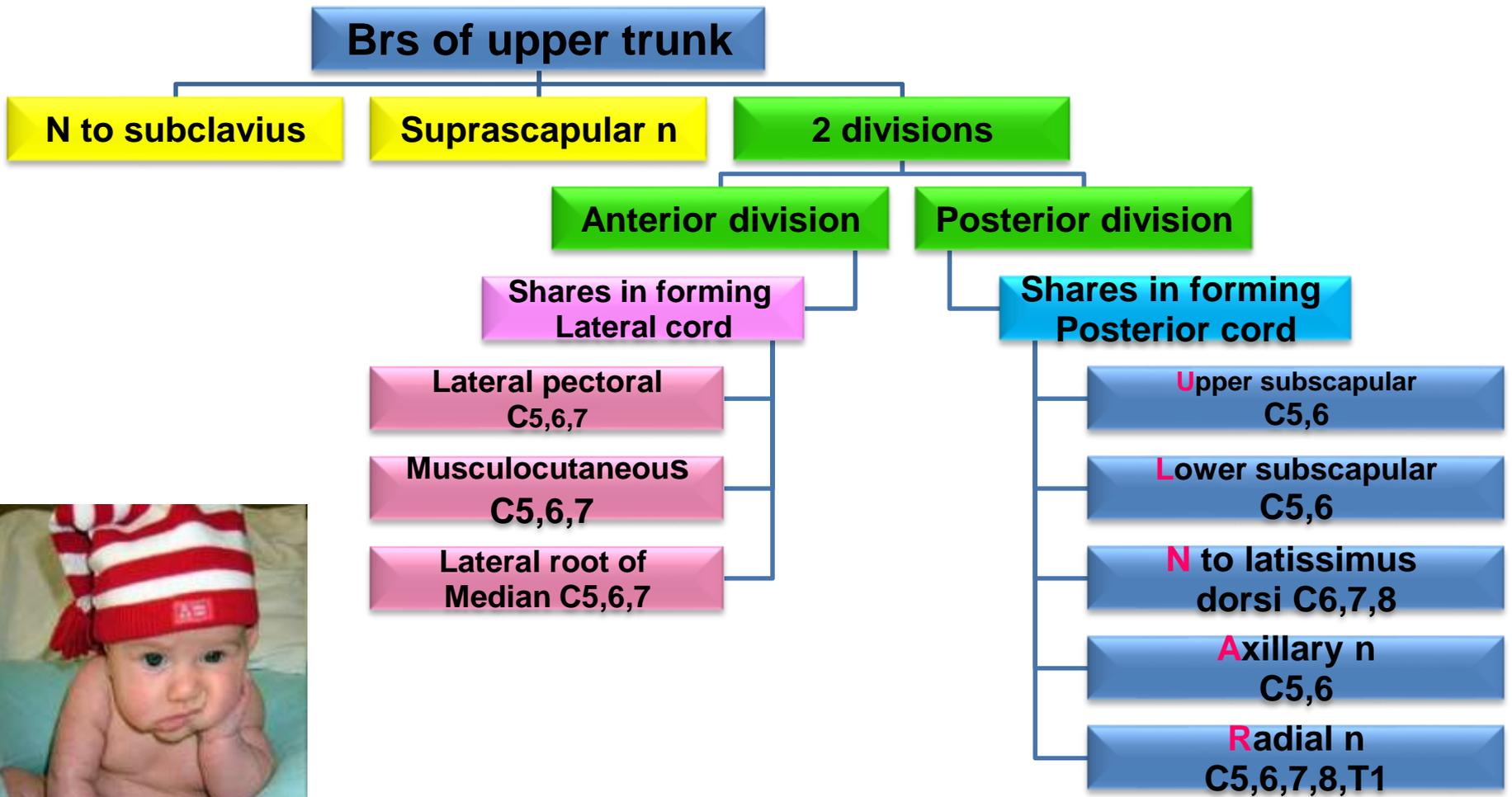
UPPER TRUNK LESION - C5,6 (ERB'S PARALYSIS)

Cause: difficult child birth

Effects:

- **Motor:** Upper limb is put in the following position :
 - **Arm** → adducted & medially rotated
 - **Forearm** → extended & pronated
 - **Wrist** → flexed
- **Sensory loss:** lat side of arm & forearm & hand
- **Deformity:** Waiter's tip position

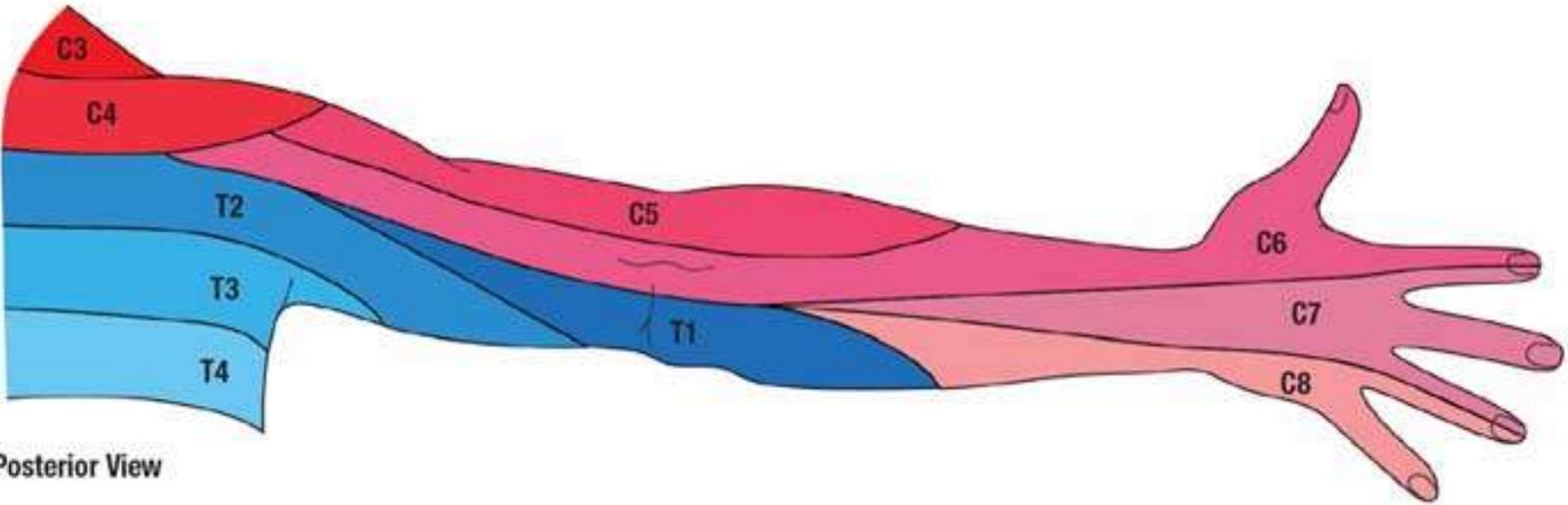
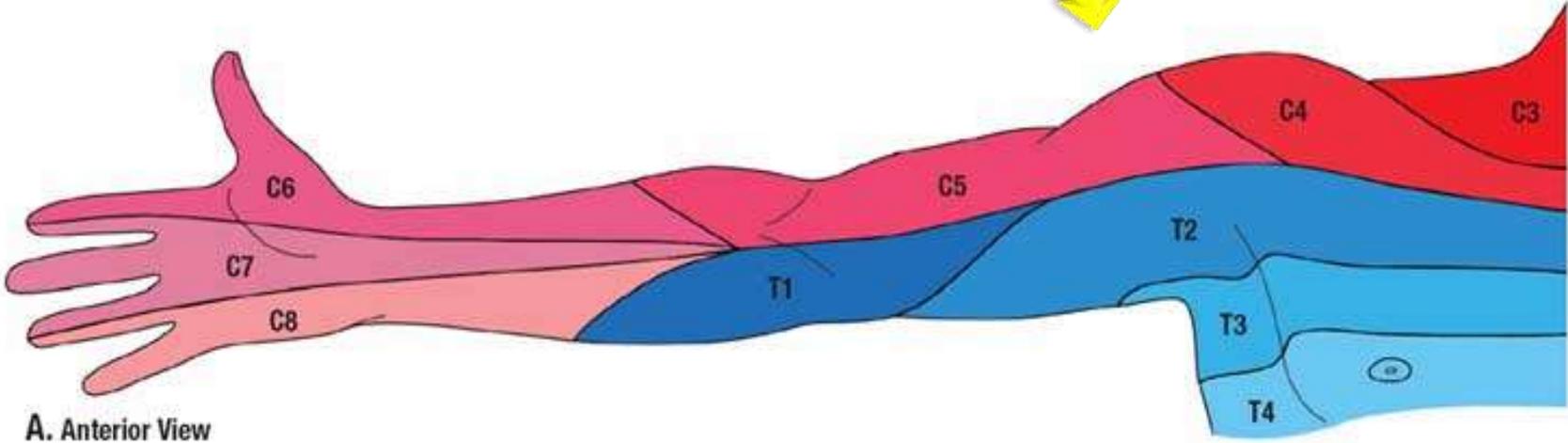




Muscles paralyzed and effect of paralysis:

1. Supraspinatus & deltoid **loss of abduction of the arm → the arm is adducted.**
2. Infraspinatus & teres minor **loss of lateral rotation of the arm → the arm is medially rotated.**
3. Brachialis & biceps brachii **loss of flexion at the elbow → the elbow is extended.**
4. Biceps, supinator & brachioradialis **loss of supination of the forearm → the forearm is pronated.**





Sensory effects due to injury of C5,6

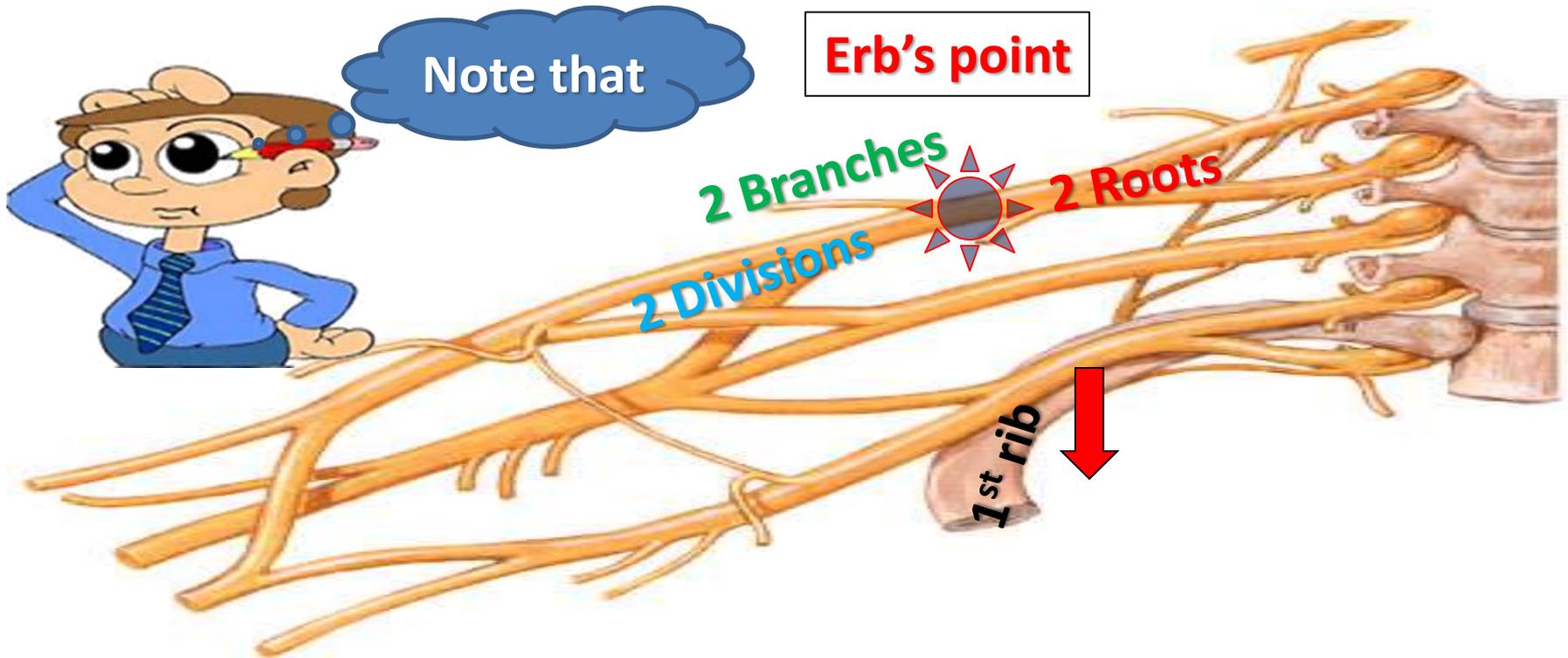
□ **Clinical anatomy:**

.**Erb's point**: A point on the upper trunk, where **6** nerves meet
⇒ Site of injury in Erb's paralysis (injury of upper trunk of brachial plexus).

.**Postfixed type of brachial plexus** ⇒ There may be nervous manifestations of lower trunk injury.

Note that

Erb's point



LOWER TRUNK LESION, C8 T1 (KLUMPKE'S PARALYSIS)

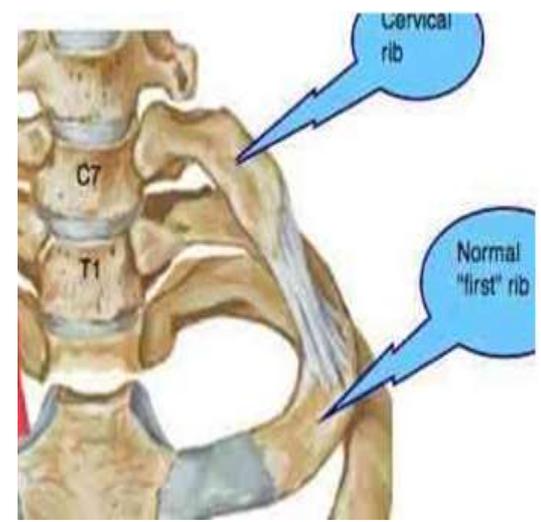
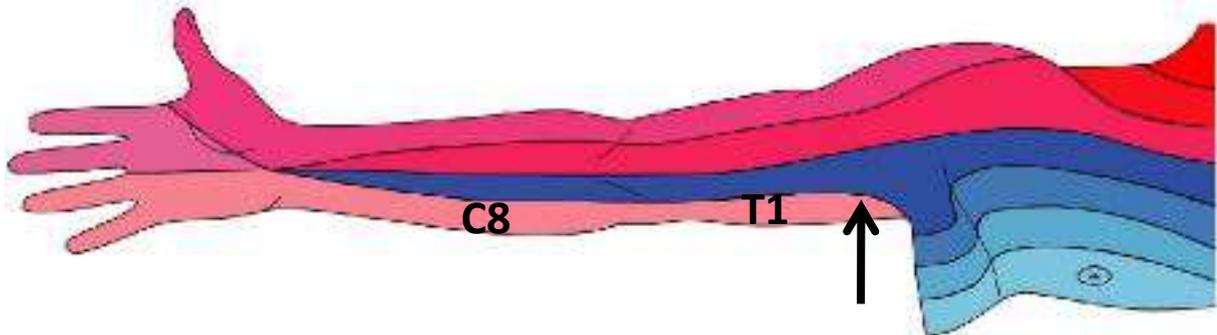
Cause: hyper abduction (as falling while hanging from a tree branch / traction on an abducted arm) or cervical rib

Effects:

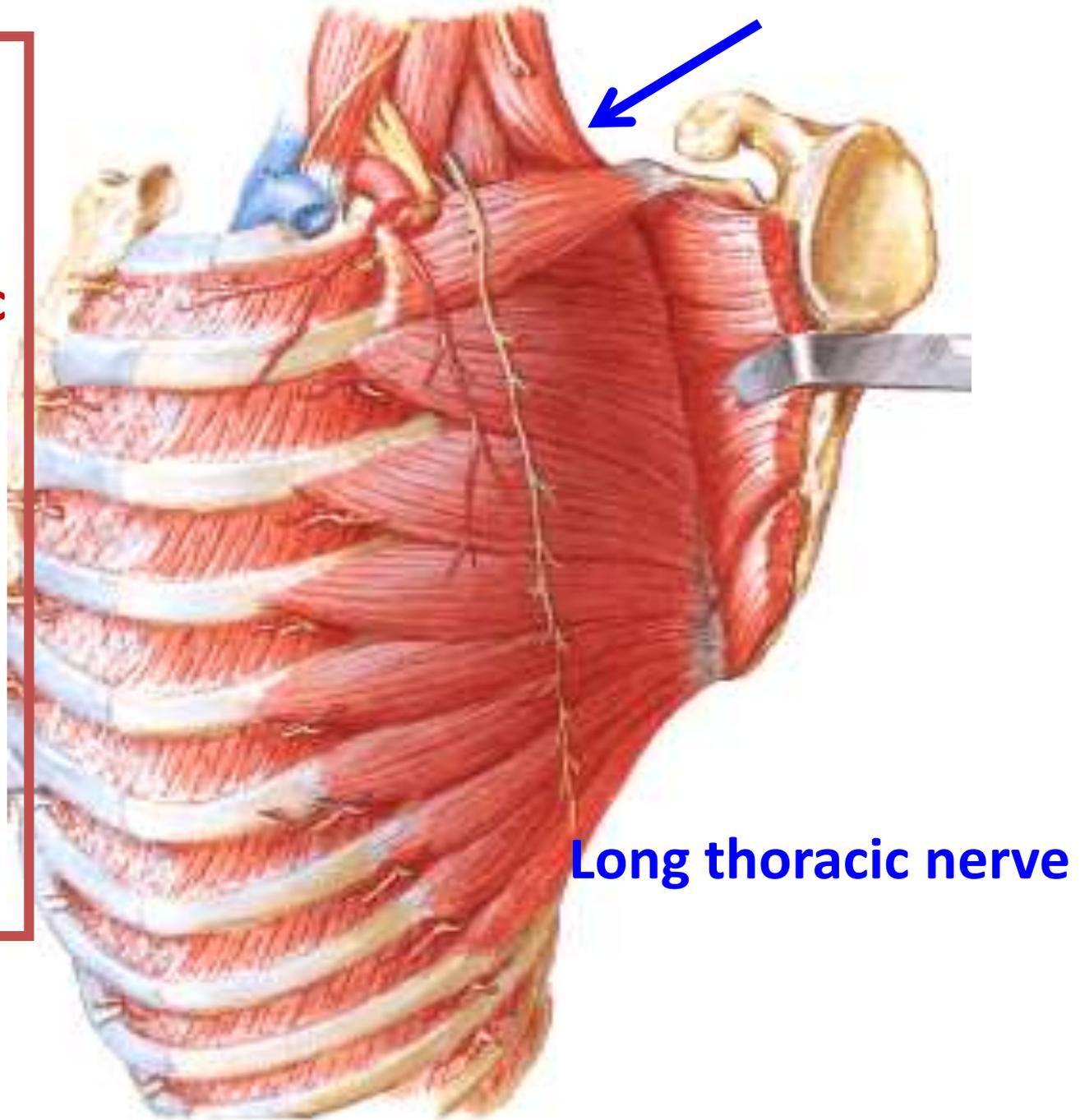
- **Motor:** Complete claw hand (intrinsic ms of hand)
- **Sensory Loss** : med side of arm, forearm & hand **T1** and **C8**.



MAYO
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- **Nerve to serratus anterior (long thoracic nerve) C5,6,7 from roots of BP**
- **Cause of injury: During radical mastectomy operations.**



- **Action of serratus anterior:**
- **1) Protraction & depression of the scapula**
- **2) With trapezius, produces upward rotation of scapula during raising the arm above the head**
- **3) Acting from its origin, it can elevate the ribs as in forced inspiration**



Applied Anatomy

- **Injury of long thoracic nerve** leads to paralysis of serratus anterior → **winging of the scapula** (prominence of medial border of scapula i.e. it does not become in contact with the thoracic wall)

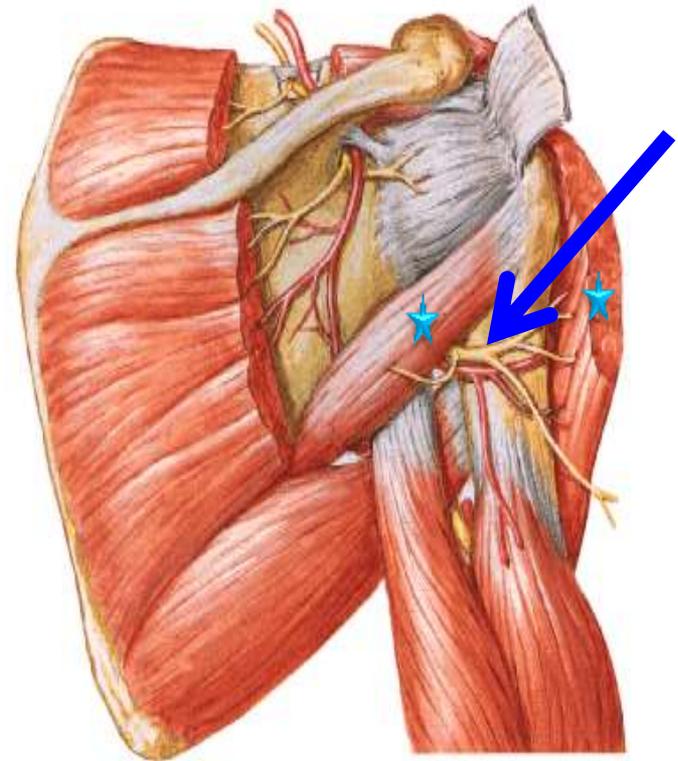


Right winged scapula

Axillary nerve injury

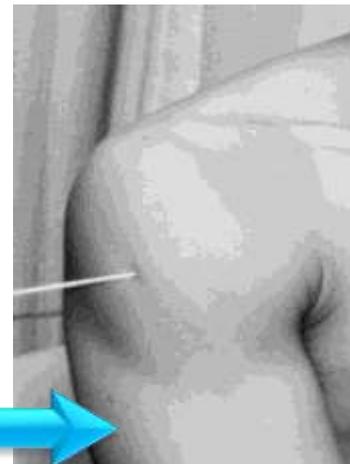
- Axillary nerve C5,6 supplies 2 muscles:
 1. Deltoid
 2. Teres minor
- Axillary nerve could be injured in **fractures of surgical neck of the humerus** or in **inferior dislocation of shoulder**

Scapulohumeral Dissection
Posterior View



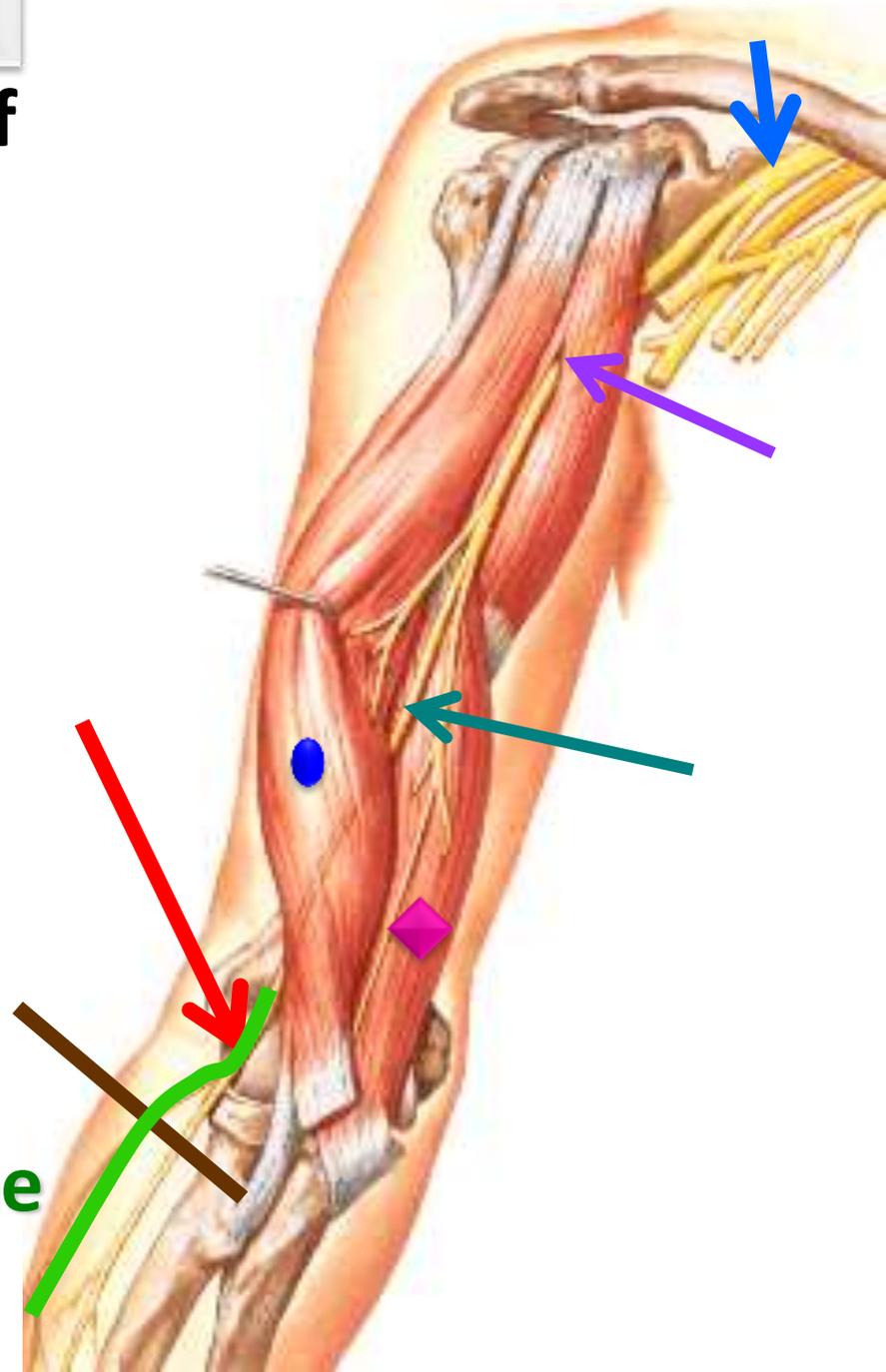
Results of axillary nerve injury

- Paralysis of **deltoid** & **teres minor** → **flat shoulder** & inability to abduct arm from 15° to 90°
- Loss of sensation over lower $\frac{1}{2}$ of deltoid
- Sensation over upper $\frac{1}{2}$ of deltoid is normal as it is supplied by
..... **lateral supraclavicular nerves C 3,4**



Musculocutaneous nerve:

- Branch from **lateral cord** of brachial plexus C5,6,7
- Enters arm by **piercing** coracobrachialis
- Runs downwards and laterally **between biceps** and **brachialis**
- Ends **lateral** to biceps tendon, by becoming the **lateral cutaneous nerve of the forearm**.



Branches of musculocutaneous nerve:

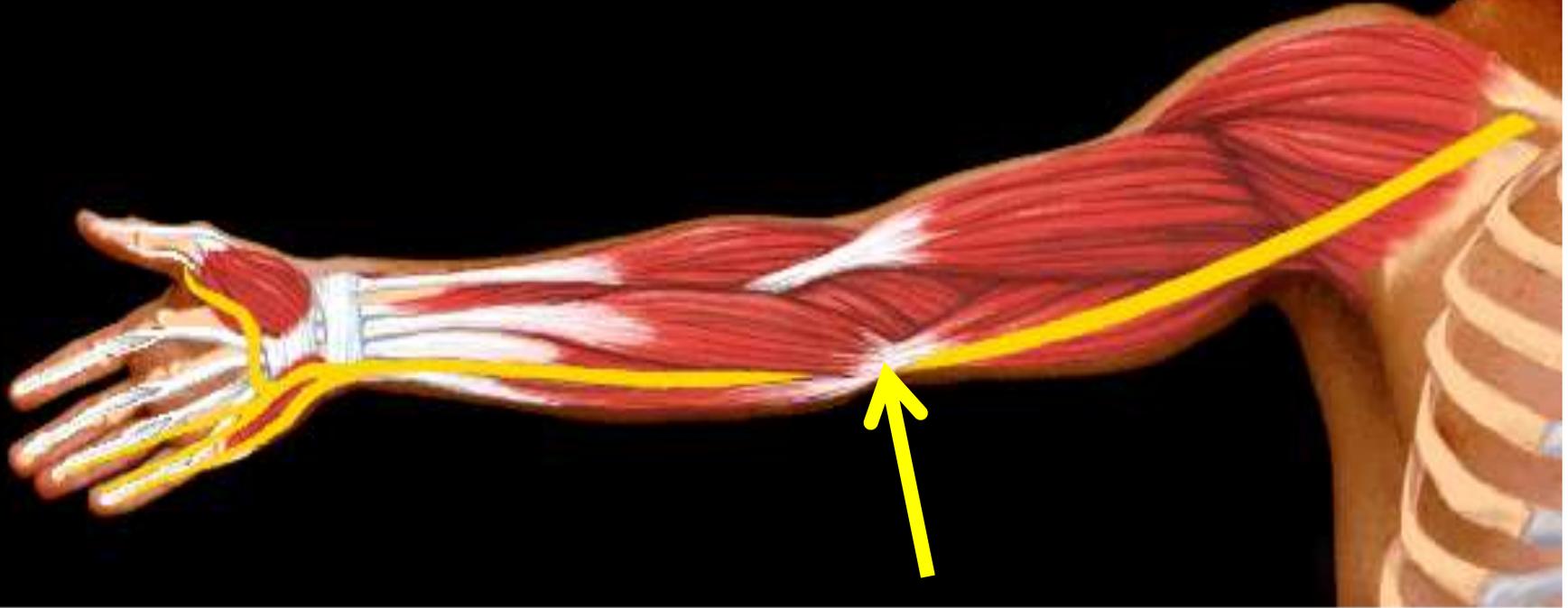
- **Muscular** : to the three muscles of the flexor compartment of the arm **BBC** {**Biceps**, **Brachialis** & **Coracobrachialis**}, except the lateral part of brachialis (by radial nerve)
- **Cutaneous**: **lateral cut. nerve of forearm** to skin of anterolateral aspect of forearm from elbow to wrist + skin over the **proximal** part of **thenar** eminence.



Musculocutaneous nerve is liable to injury in fractures of upper part of shaft of humerus or during repairs of these fractures. Its injury → weak flexion+ weak supination ??
Loss of sensation in area supplied by musculocutaneous n.

ULNAR NERVE C7,8,T1

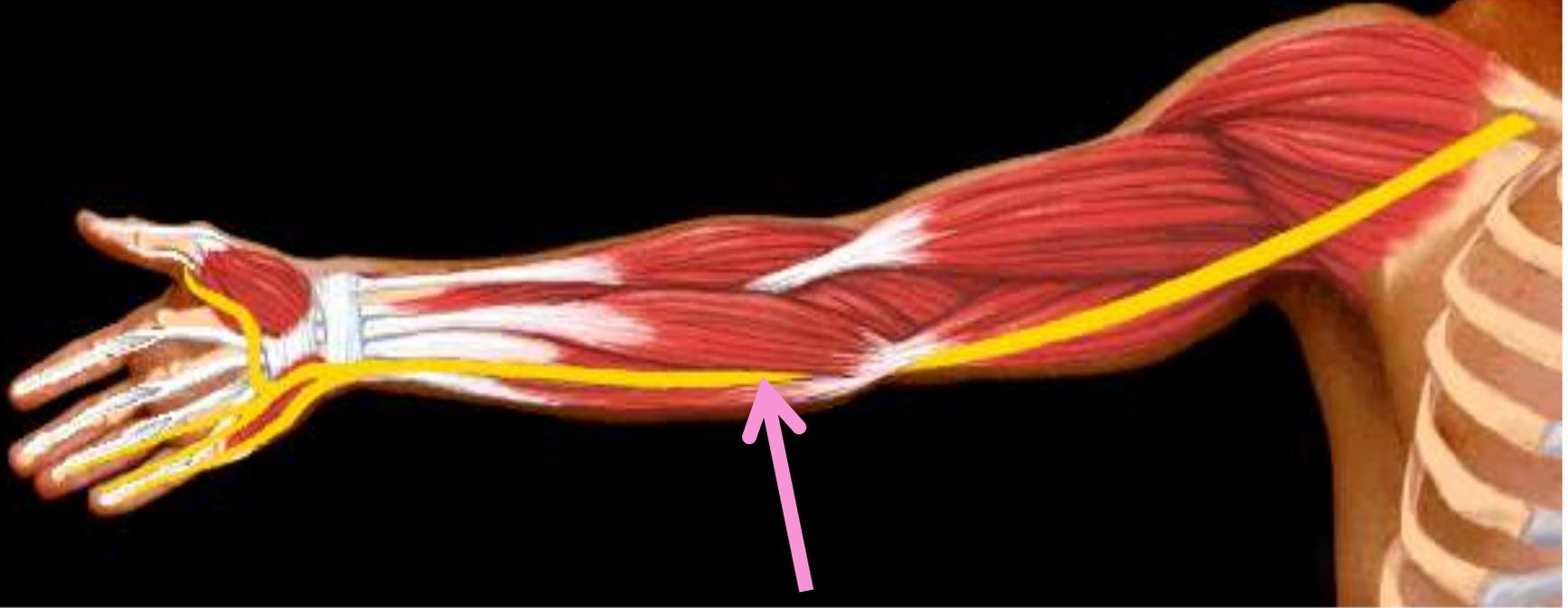
Ulnar Nerve Distribution



Ulnar nerve passes behind medial epicondyle of humerus

ULNAR NERVE C7,8,T1

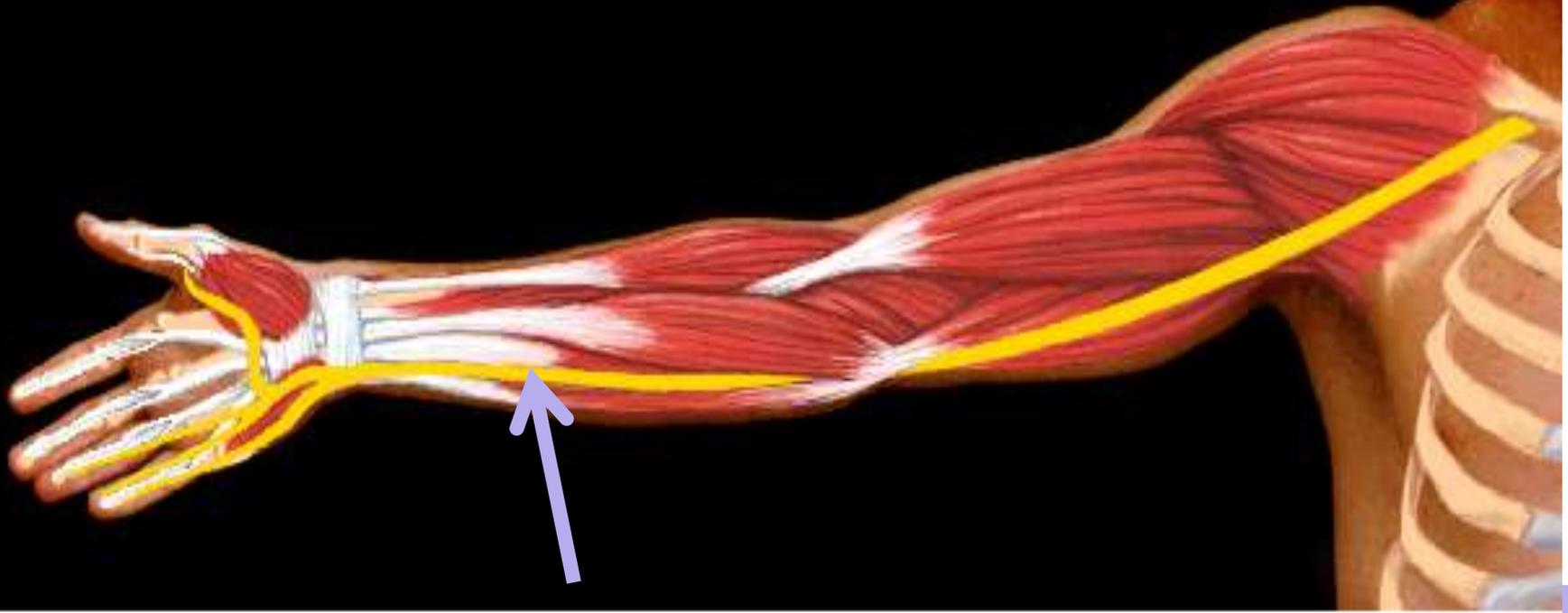
Ulnar Nerve Distribution



Ulnar nerve passes between 2 heads of flexor carpi ulnaris

ULNAR NERVE C7,8,T1

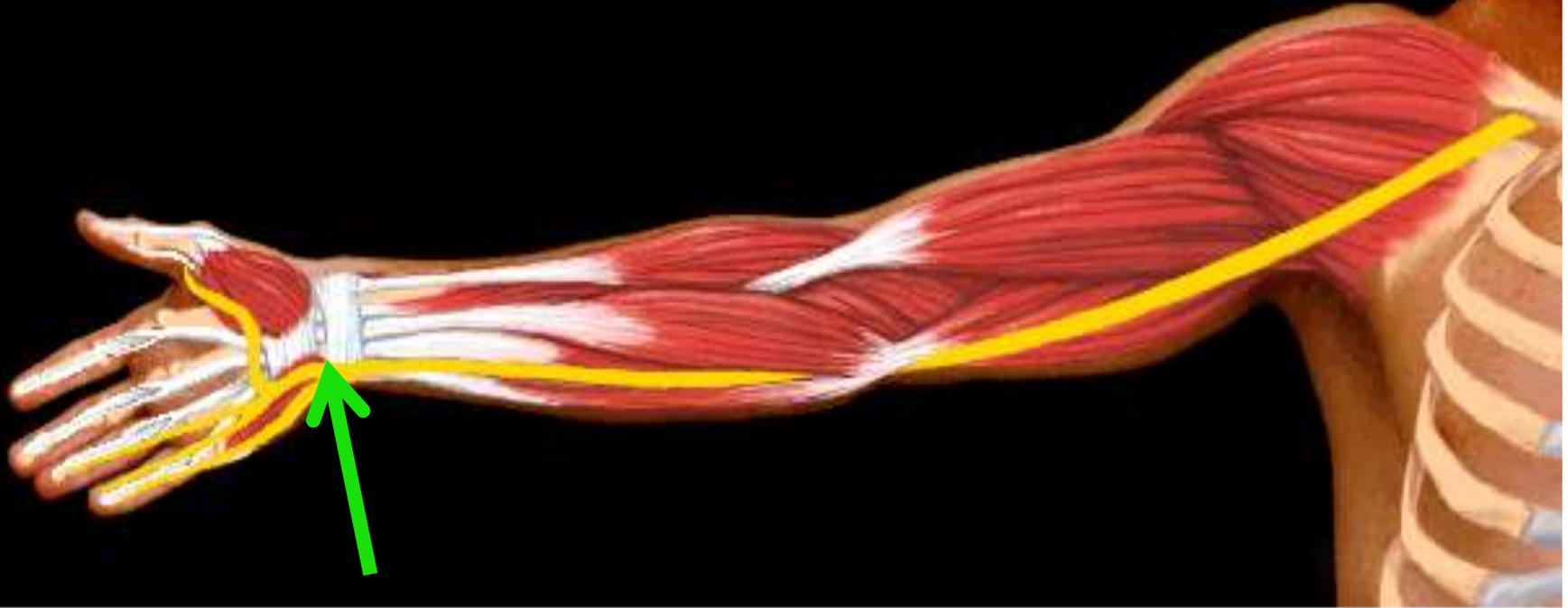
Ulnar Nerve Distribution



Ulnar nerve passes medial to ulnar artery

ULNAR NERVE C7,8,T1

Ulnar Nerve Distribution

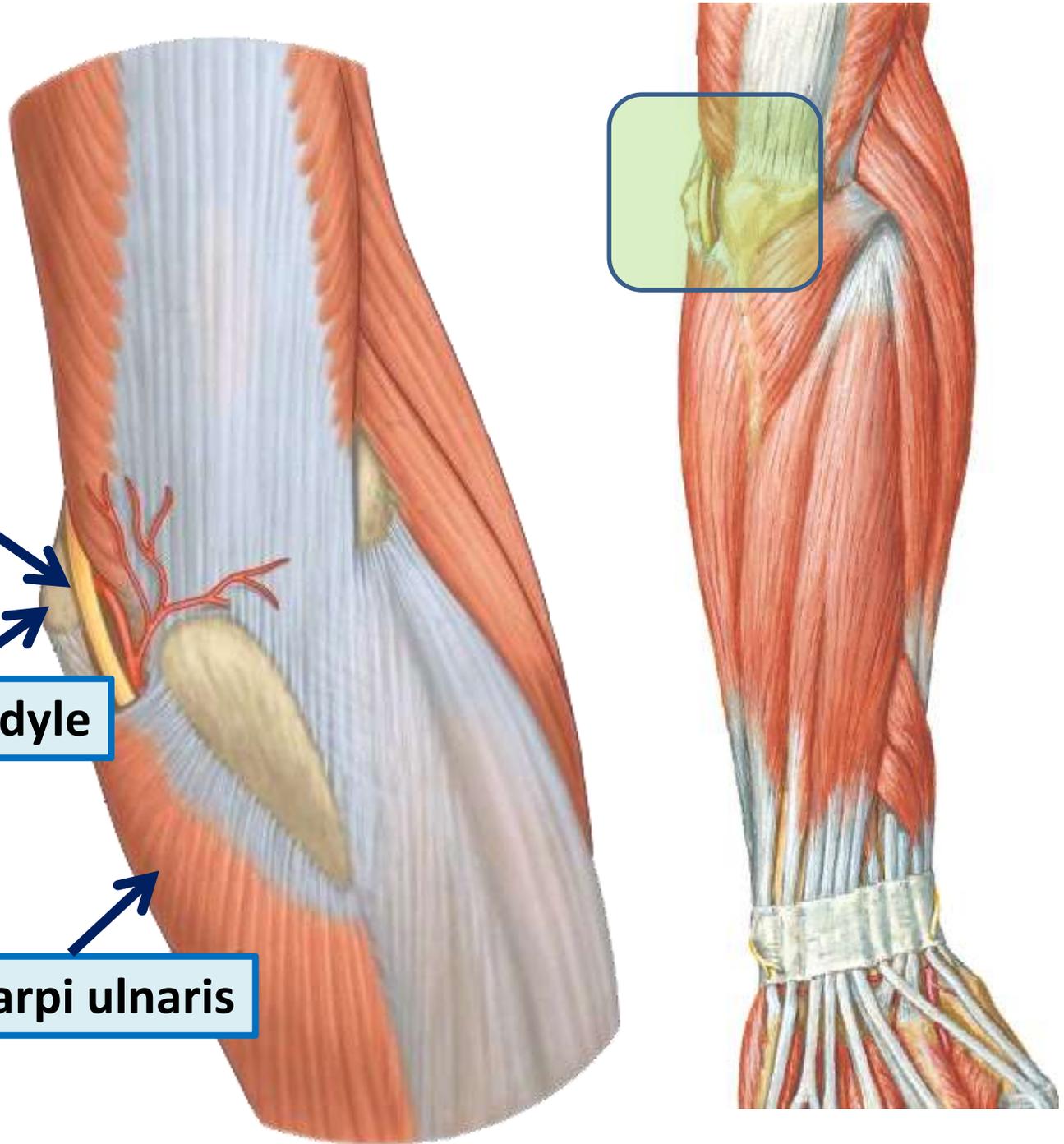


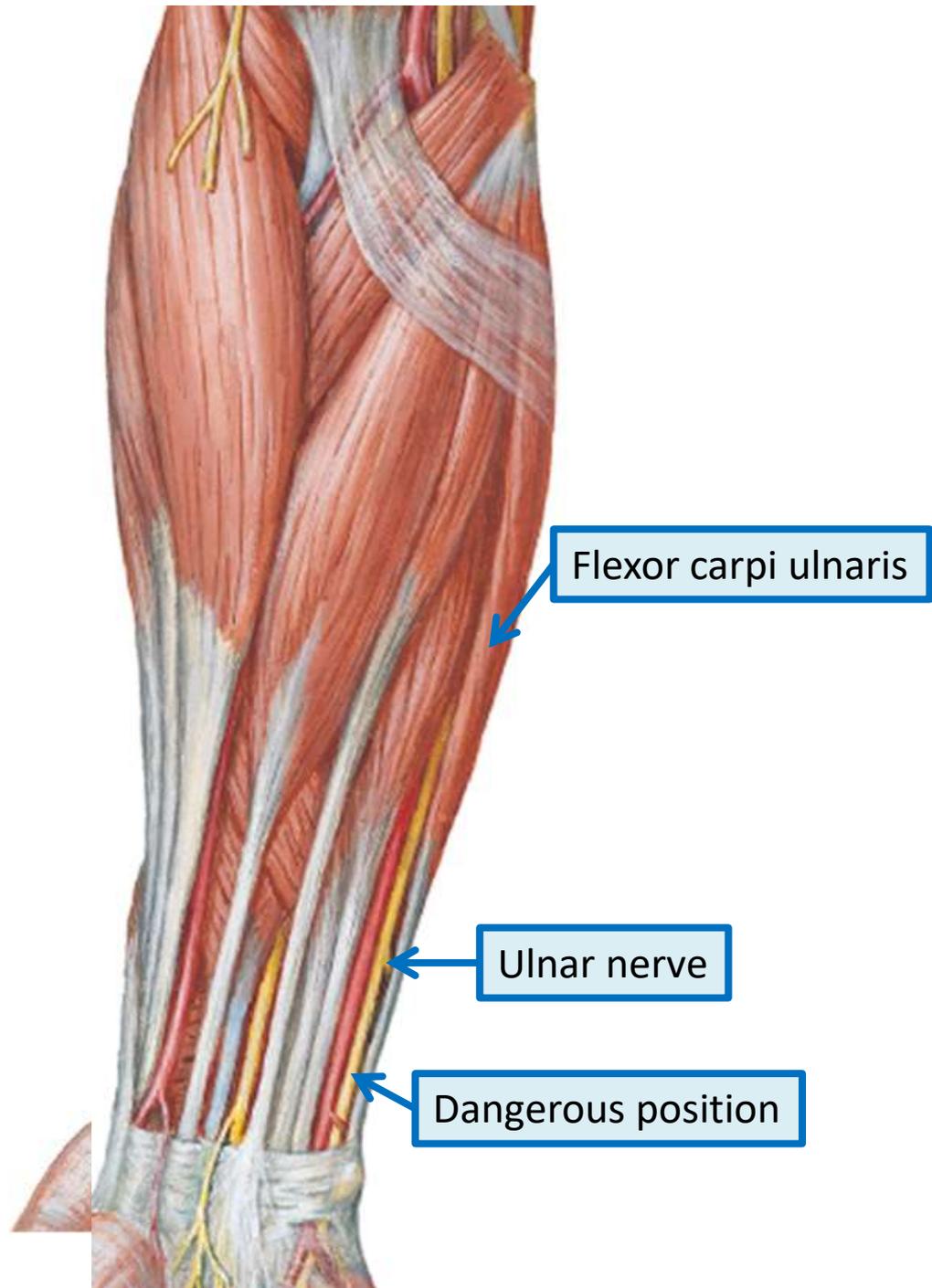
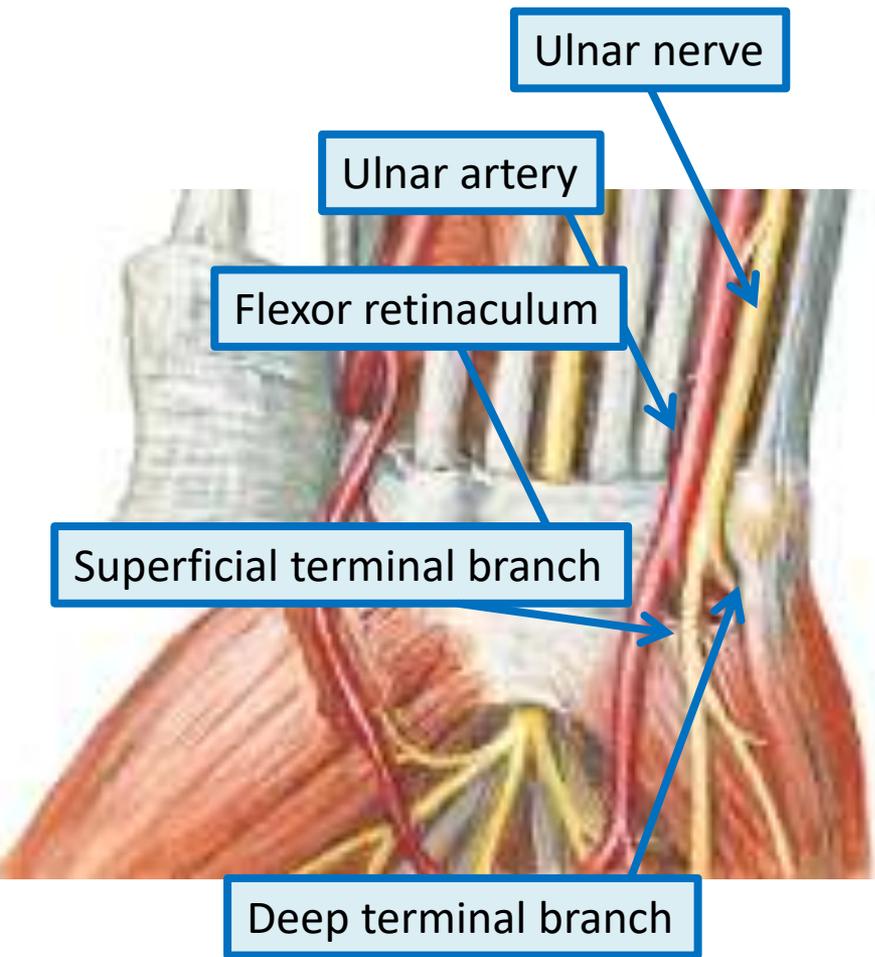
Ulnar nerve enters the hand superficial to the flexor retinaculum

Ulnar nerve

Medial epicondyle

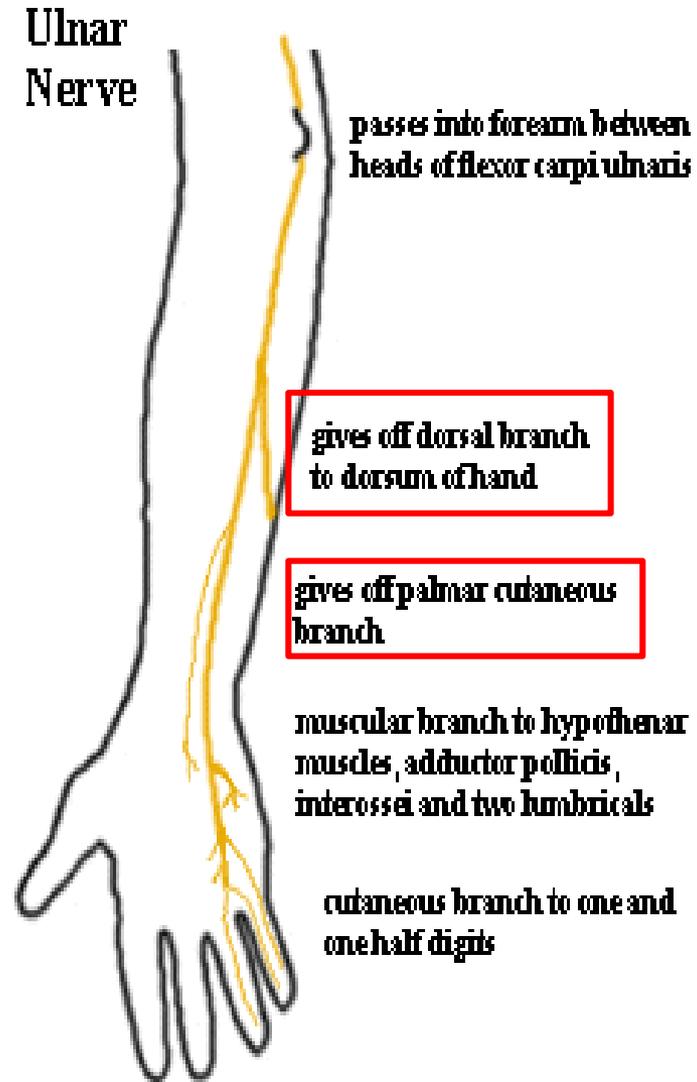
Flexor carpi ulnaris





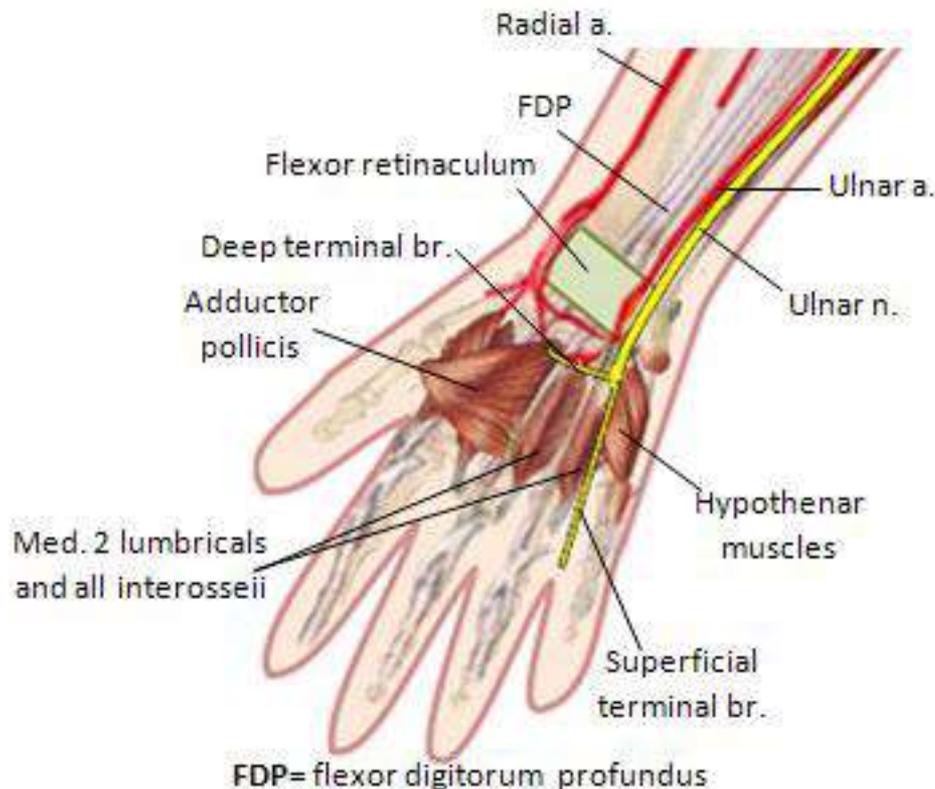
Branches of ulnar nerve in forearm:

1. Muscular:(one muscle and half) to flexor carpi ulnaris & medial ½ of flexor digitorum profundus
2. Cutaneous:
 - **Palmar** for skin of medial 1/3 of palm **only (not the front of the medial 1 ½ fingers)**
 - **Dorsal** branch for skin of medial 1/3 of dorsum of hand & dorsum of medial 1 ½ fingers



Branches of ulnar nerve in hand:

All muscles of the hand except thenar ms and the lateral 2 lumbricals ms) sensation of ventral surface of the medial one and half digit)



LESIONS OF ULNAR NERVE

1. At wrist

– Causes:

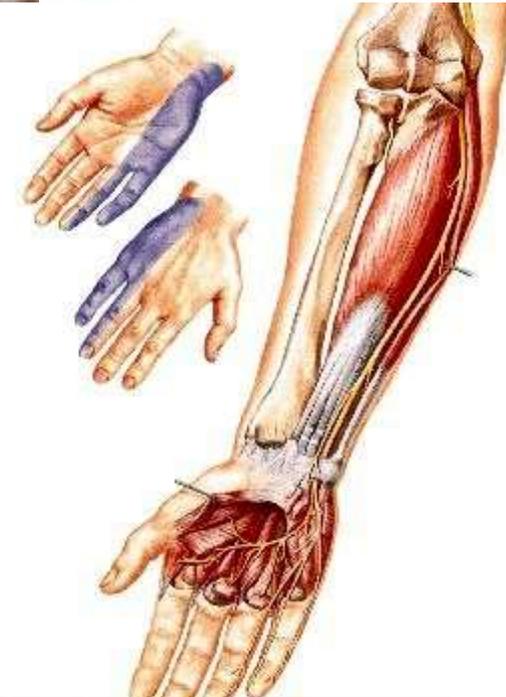
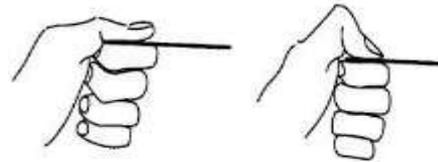
- Stab wound
- Entrapment (ulnar tunnel)

– Effects:

- **Paralysis** of all interossei & med. 2 lumbricals →
Partial claw hand (lat 2 lumbricals intact)
 - Loss of fingers abd. & add. (paper test)
 - Adductor pollicis → Froment's test
- **Anesthesia** in med. 1½ fingers (palmar surface)



Normal Froment's positive



2. At elbow

– Causes: fracture med. epicondyle

– Previous effects +

- Wrist flexion → weak + radial deviation (FCU)
- Clawing → Less apparent (**ulnar paradox** as med ½ FDP is paralyzed)
- Anesthesia on med. 1/3 of hand & med. 1½ fingers

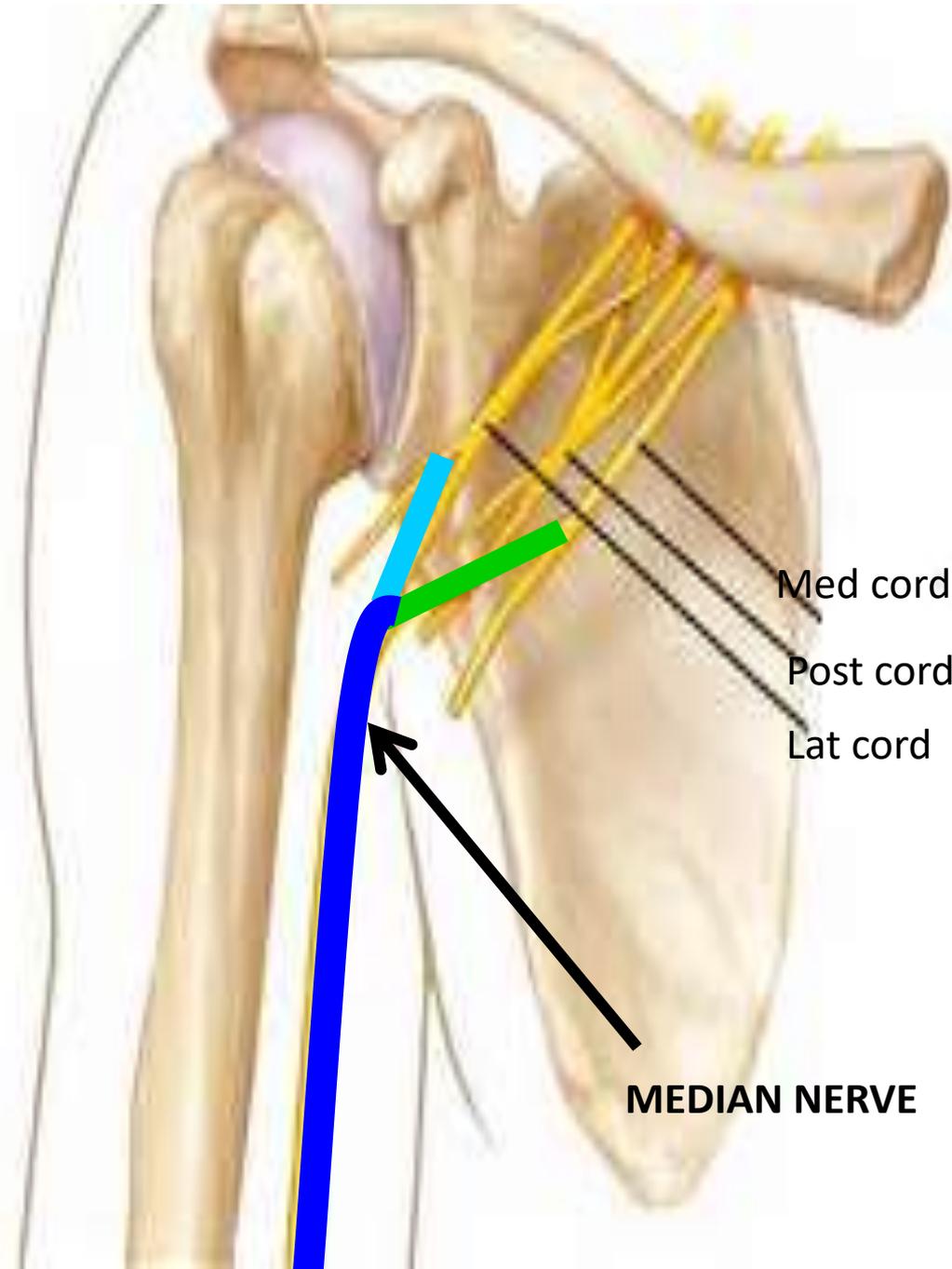


The Median Nerve (C5,6,7,8,T1):

➤ Origin:

Lateral root (C 5,6,7)
from lateral cord of BP

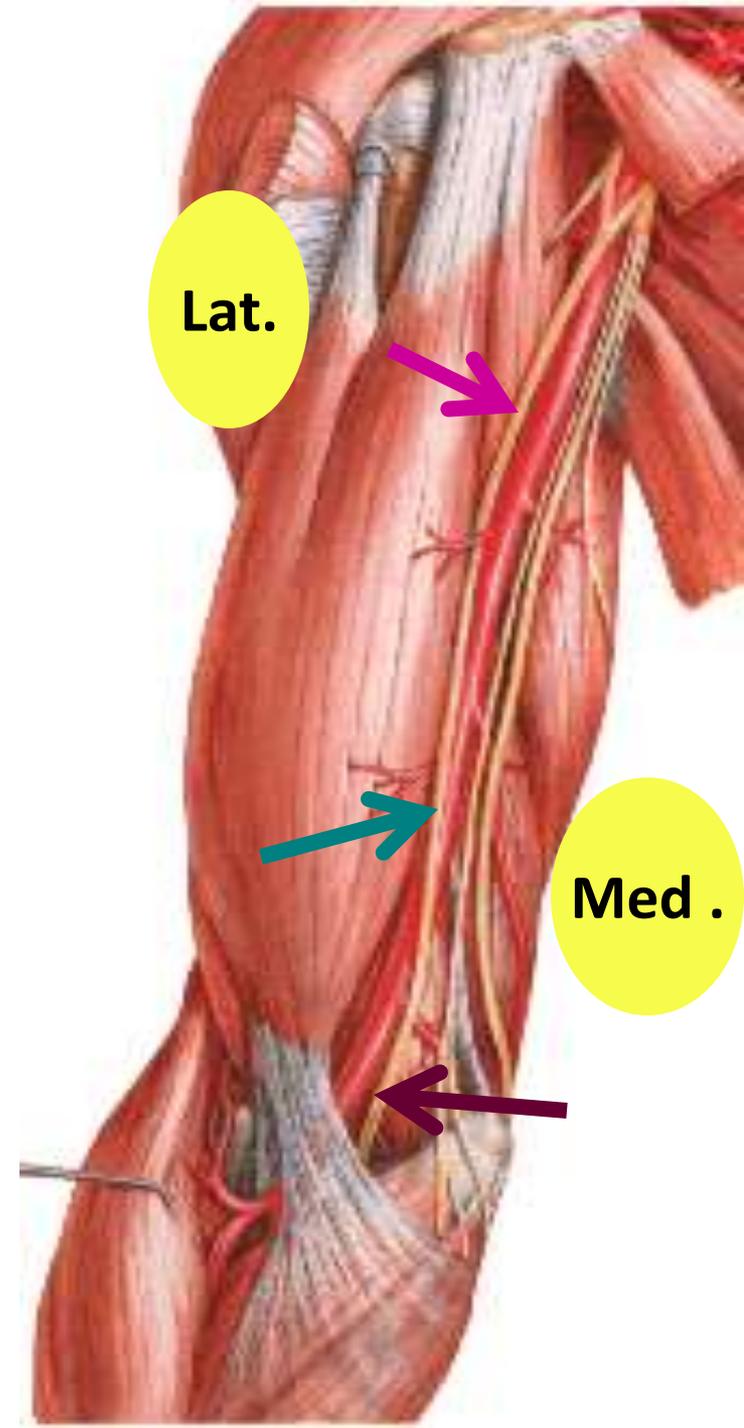
Medial root (C8,T1)
from medial cord of BP



In the Arm

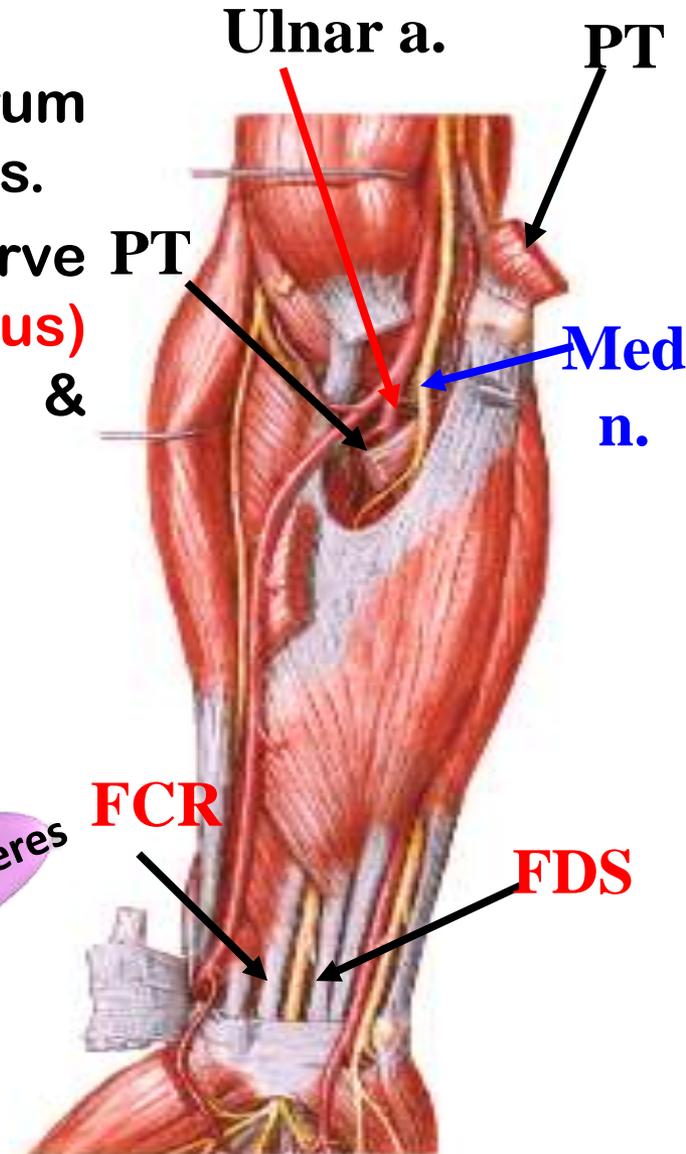
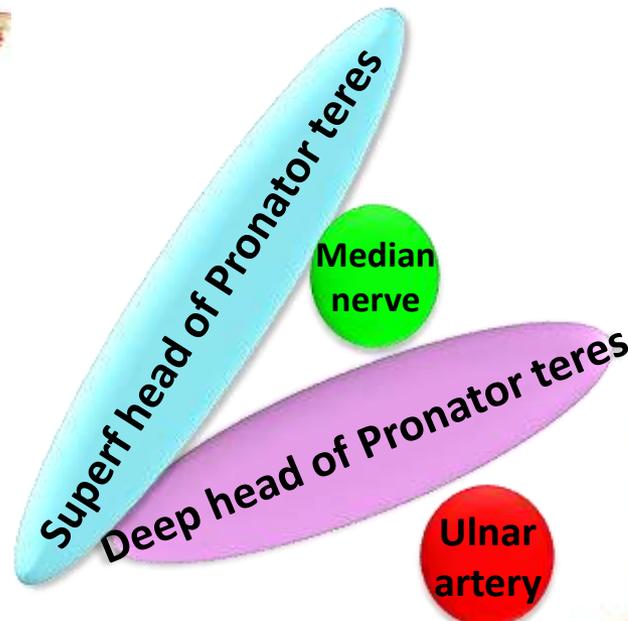
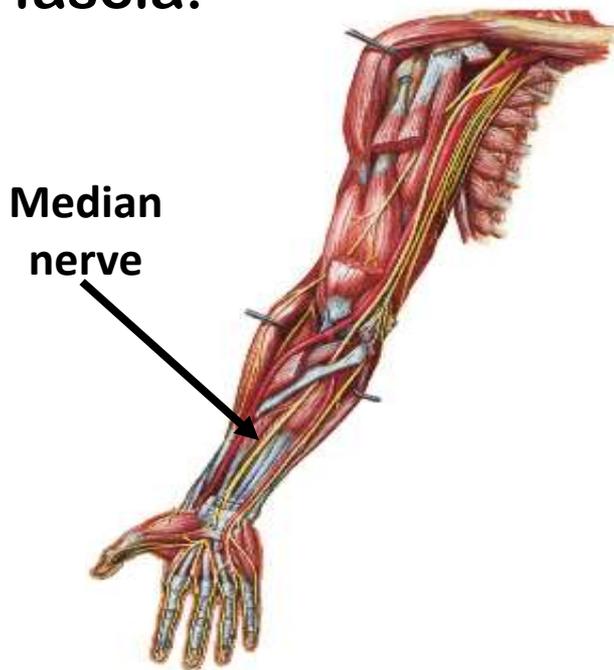
**Lat. → ant. → med. to
brachial artery**

**Median nerve gives no
branches in the arm**



In the Forearm

- ❑ It enters forearm between the 2 heads of pronator teres.
- ❑ It passes **between** flexor digitorum superficialis & flexor digitorum profundus.
- ❑ 2 inches above the wrist, median nerve winds to acquire a superficial (**dangerous**) position being covered only by skin & fascia.

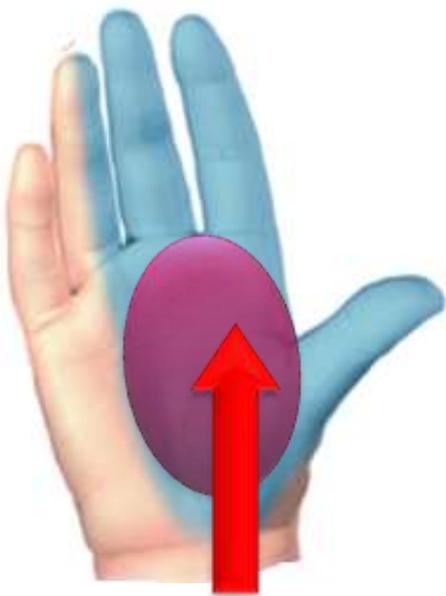


1. Muscular

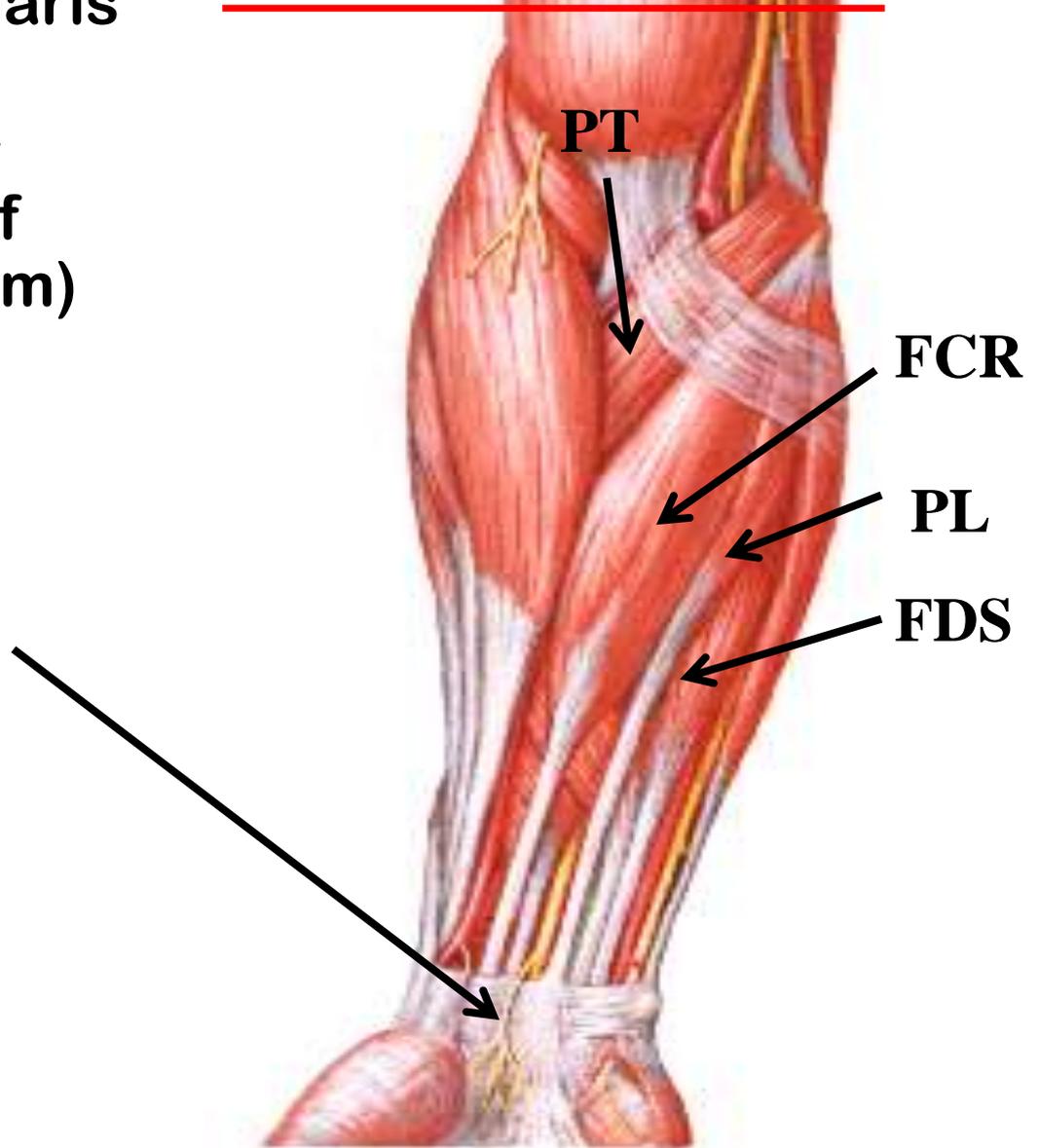
- All superficial flexor ms
Except Flexor carpi ulnaris

2. Palmar cutaneous

branch of median n for skin of the lateral 2/3 of the palm (hollow of palm)



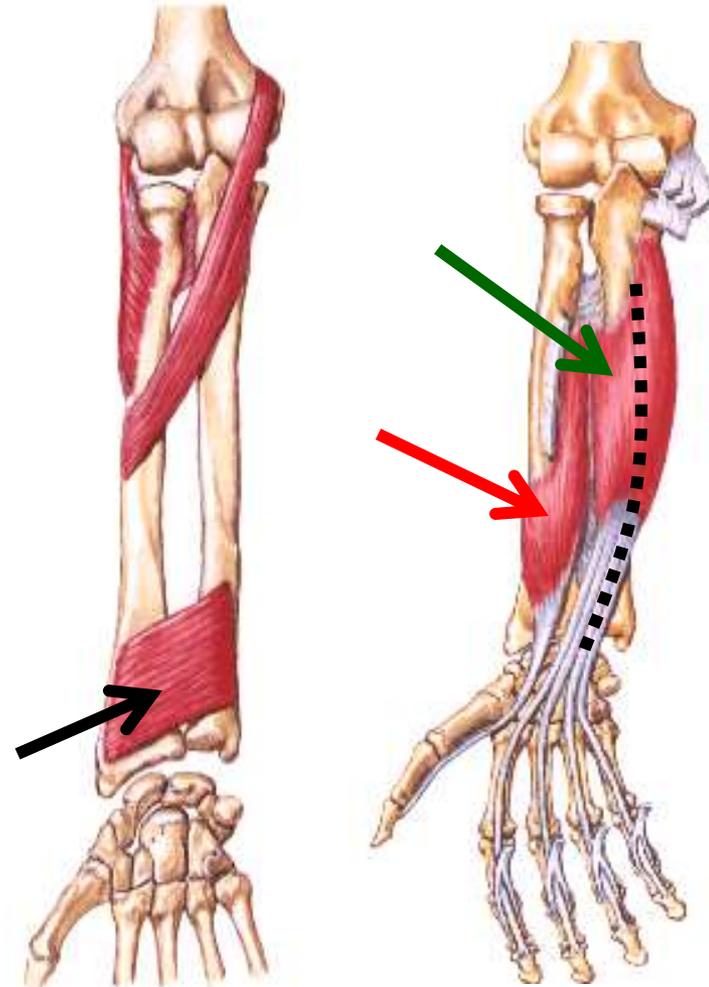
Branches of the median nerve in the Forearm



4. Anterior interosseous nerve supplies: (rest of deep muscles)

Muscular:

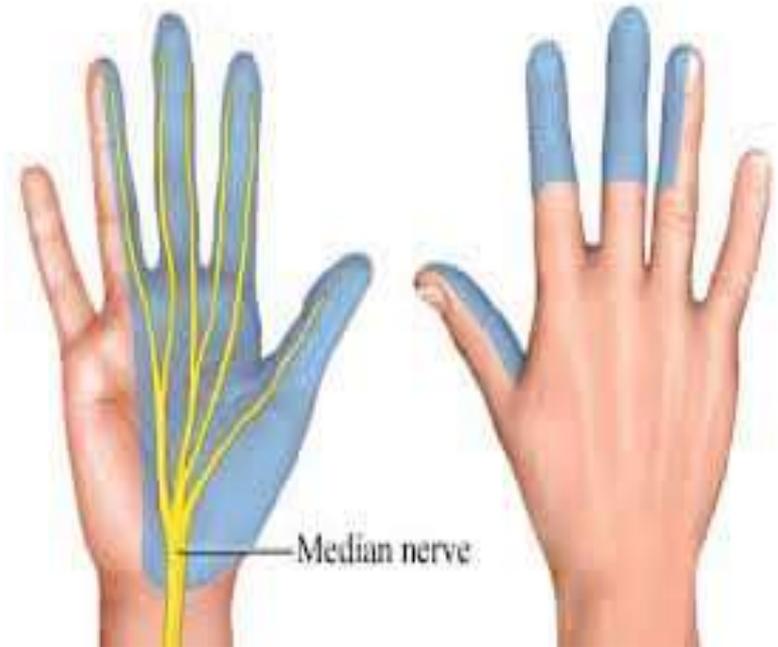
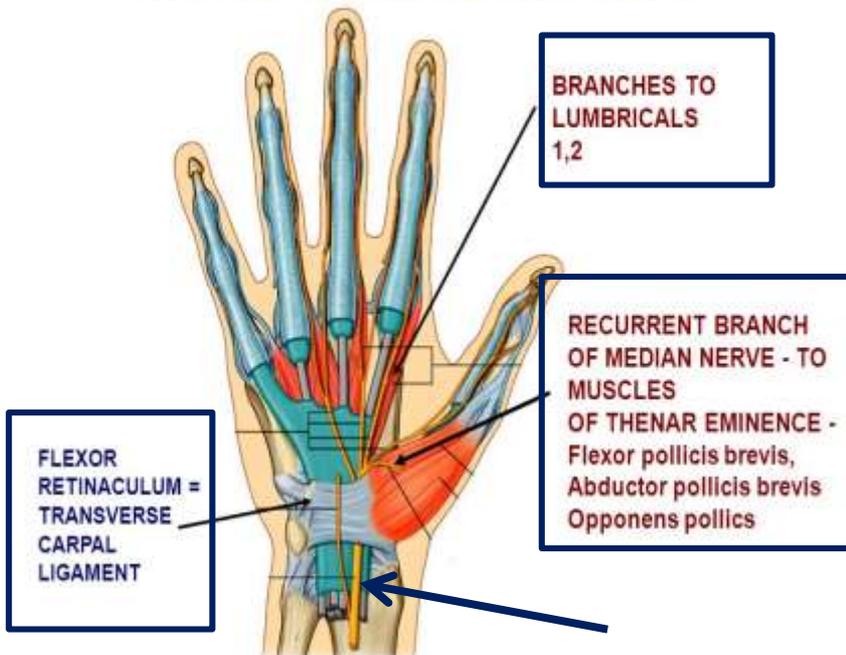
- **flexor pollicis longus,**
- **lateral 1/2 of flexor digitorum profundus**
- **pronator quadratus**



Median nerve in the Palm:

- Enters palm **deep** to flexor retinaculum
- Branches: **LOAF** (Lat 2 Lumbricals/ **OP/APB/FPB**)
- 1. **To 3 muscles** of thenar eminence + lateral 2 lumbricals
- 2. **To skin** of palmar aspect of lateral 3½ fingers & dorsum of terminal & middle phalanges

MOTOR BRANCHES OF MEDIAN NERVE TO MUSCLES OF HAND PASS THROUGH THE CARPAL TUNNEL



Median nerve

1. At elbow injury:

- Causes : Supracondylar fracture
 - Motor effect:
 - **Pronation** → lost (2 pronators)
 - **Wrist flexion** → weak + ulnar deviation (intact FCU)
 - **Fingers flexion** → ask patient to make fist → can't flex index and middle → Benediction (lat. ½ of FDP paralysis but med. ½ of FDP intact)
 - **Thumb flexion** → loss of (FPL+ Brevis)
 - **Paralysis of thenar eminence muscles** →
 - Flat thenar eminence,
 - Lost thumb opposition (counting test)
- Ape hand deformity.**



Ape Hand Deformity

■ Sensory effect:

Loss of sensation over the lateral 2/3 of the palm and the palmar surface of the lateral 3½ fingers and over their distal part on the dorsal surface.



Median nerve injury:

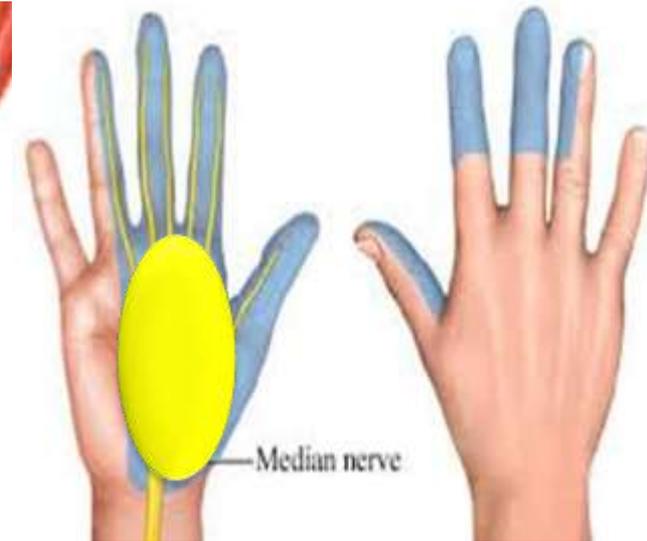
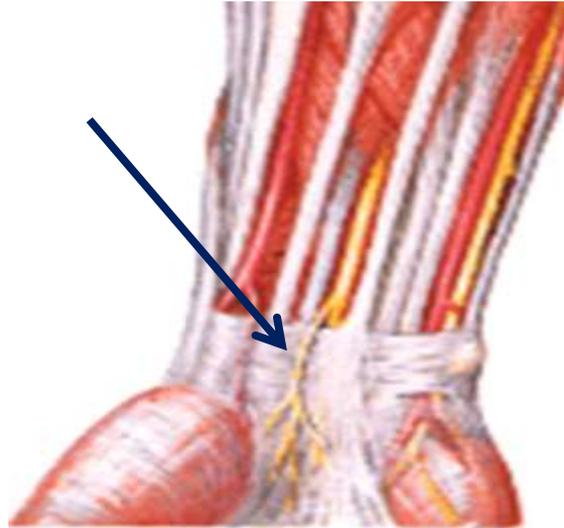
2. At wrist:

■ Causes

- carpal tunnel syndrome
- cut wounds (suicide)

■ Motor effects:

- **Paralysis** of thenar eminence muscles → Flat thenar eminence, lost thumb opposition and *Ape hand deformity*
- **Sensory loss** in lat. 3½ fingers [palmar surface & middle & distal phalanx dorsally].
- Sensation in hollow of palm is normal. **WHY?**



What is carpal tunnel syndrome?

Carpal tunnel syndrome: a pathological lesion which diminishes the size of the tunnel and compresses the median nerve.

●Causes:

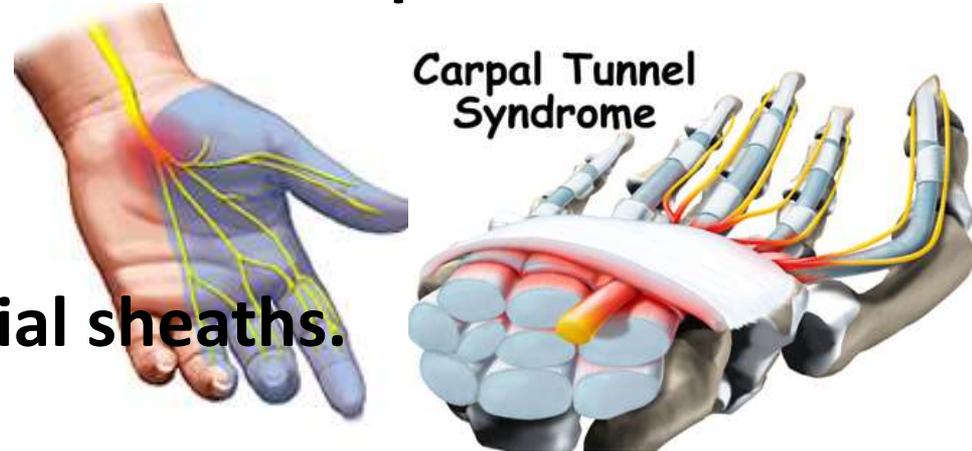
- 1- Arthritis in carpal bones.
- 2- Inflammation of the synovial sheaths.

●Results:

- 1- Burning pain i.e. pins & needles up to sensory loss along palmar surface of the lateral 3½ fingers but **sensation is normal in hollow of palm.**
- 3- Weakness and flattening of muscles of thenar eminence with ape hand deformity.

●Treatment:

longitudinal incision of the flexor retinaculum to relieve compression of the median **nerve**



Now Let's Summarize LESIONS OF MEDIAN NERVE

1. At wrist:

– Causes

- carpal tunnel syndrome
- cut wounds (suicide)

– Effects: “Ape hand”

- **Paralysis** of thenars →
 1. Flat thenar eminence
 2. Lost thumb opposition
 3. Weak thumb abduction & flexion
- **Sensory loss** in lat. 3½ fingers [palmar surface & middle & distal phalanges dorsally].



2. At elbow:

– Causes

- Supracondylar fracture

– Previous effects +

- Pronation → lost (2 pronators)
- Wrist flexion → weak + ulnar deviation (FCU intact)
- Fingers flexion → ask patient to make a fist → he can't flex index & middle due to paralysis of lat ½ of FDP → Benediction
- Thumb flexion → lost
- Sensory loss : lat. 2/3 of palm + lat. 3½ fingers [palmar surface & middle & distal phalanges dorsally].



Nerve Injured	Deformity
Long thoracic nerve	Winging of scapula
Axillary nerve	Flat shoulder
Median nerve	Ape hand
Ulnar nerve	Partial claw hand
Median and Ulnar	Complete claw hand
Upper trunk of BP (Erb's Paralysis)	Waiter's tip position
Lower trunk of BP (Klumpke's Paralysis)	Complete claw hand

Which of the following structures is most likely to be damaged in association with a fracture of the **medial epicondyle** of the humerus ?

- a) Radial artery
- b) Ulnar nerve
- c) Brachial artery
- d) Ulnar artery
- e) Median nerve

A female patient was operated for mastectomy. After the operation, she developed **winging of the scapula**. This could be due to injury of:

- a) Thoracodorsal nerve
- b) Long thoracic nerve
- c) Upper subscapular nerve
- d) Axillary nerve
- e) Medial pectoral nerve

Radial nerve
palsy



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Radial Nerve Injury

Origin of Radial Nerve

Root value:

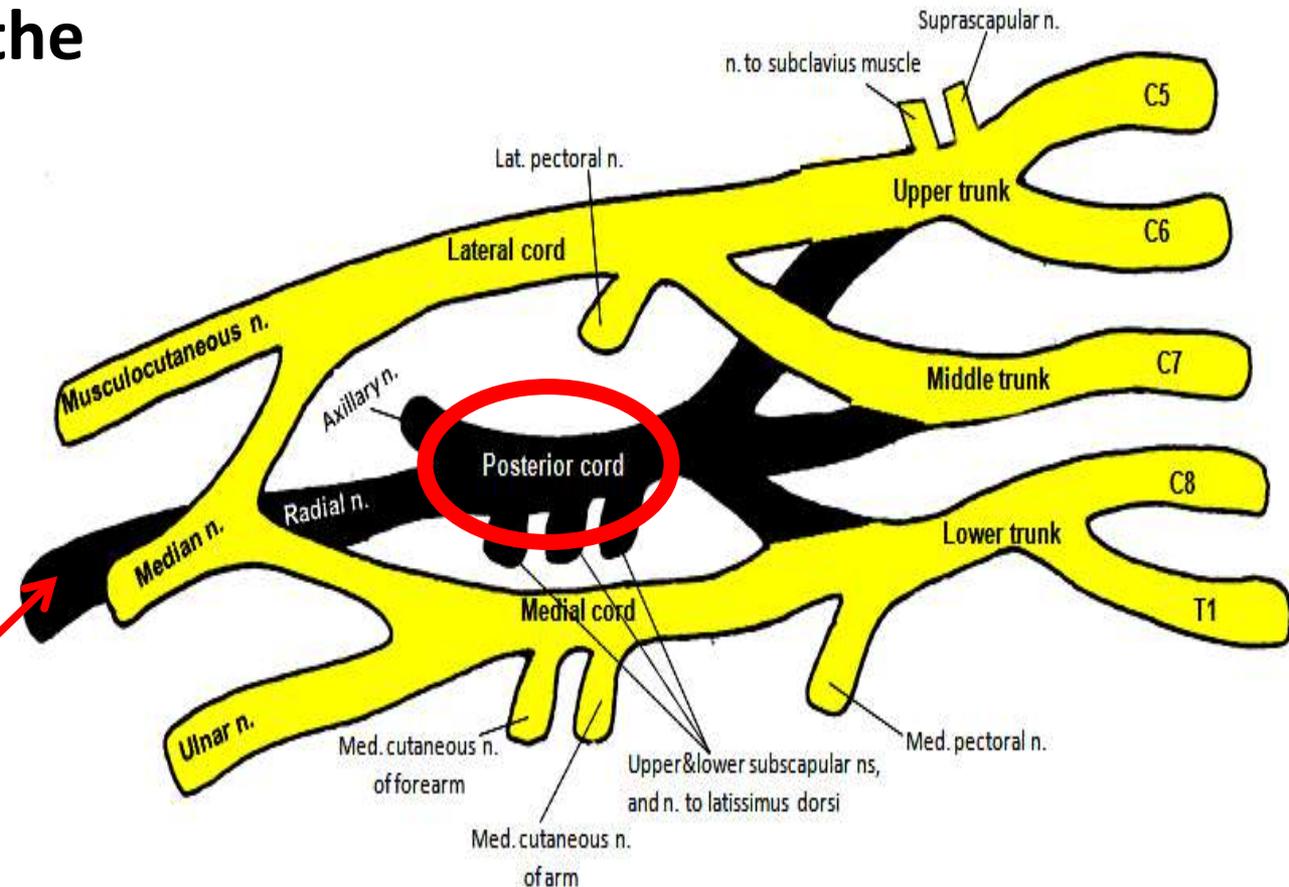
Ventral rami of C5,6,7,8 & T1.

(continuation of the posterior cord)

Posterior cord

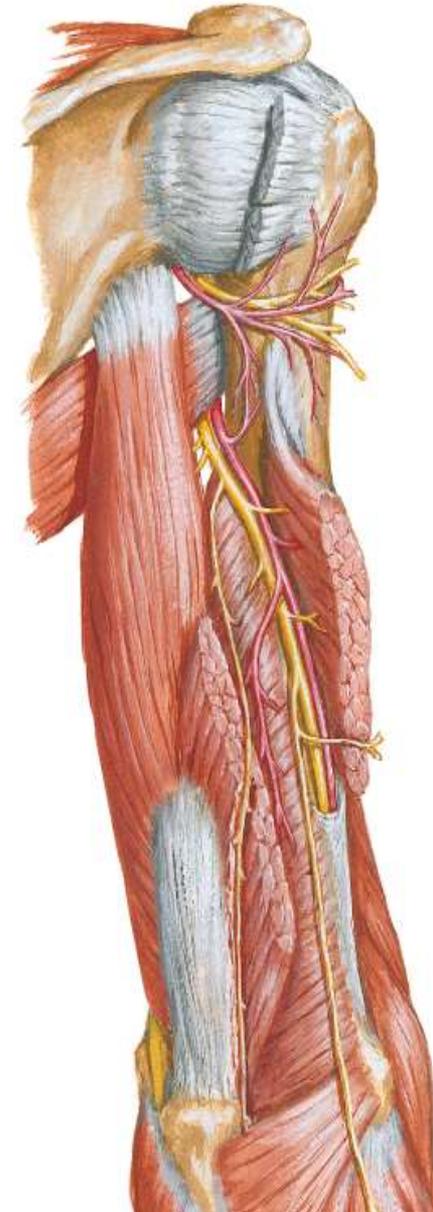
C_{5,6,7,8}, T₁

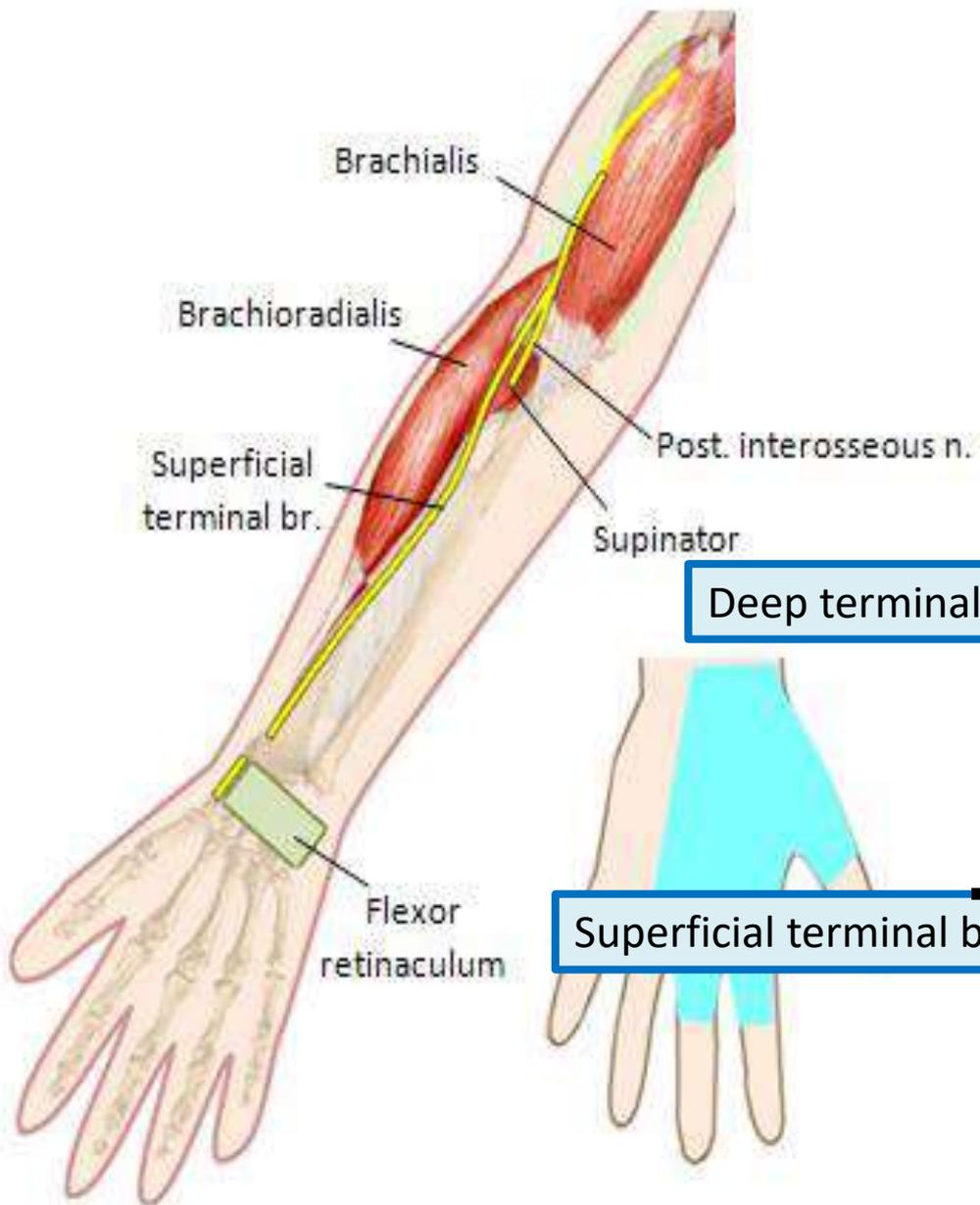
Radial Nerve



Let's revise the anatomy of the radial nerve

1. In Axilla
2. In lower triangular space
3. In spiral groove
4. Ends in front of lateral epicondyle of humerus by dividing into:
 - a) Superficial terminal branch → runs lateral to radial artery in forearm undercover of brachioradialis
 - b) Deep terminal branch (Posterior interosseous) → pierces supinator and supplies extensors of forearm **Except 3** supplied by Radial n (BR /ECRL/Anconeus)

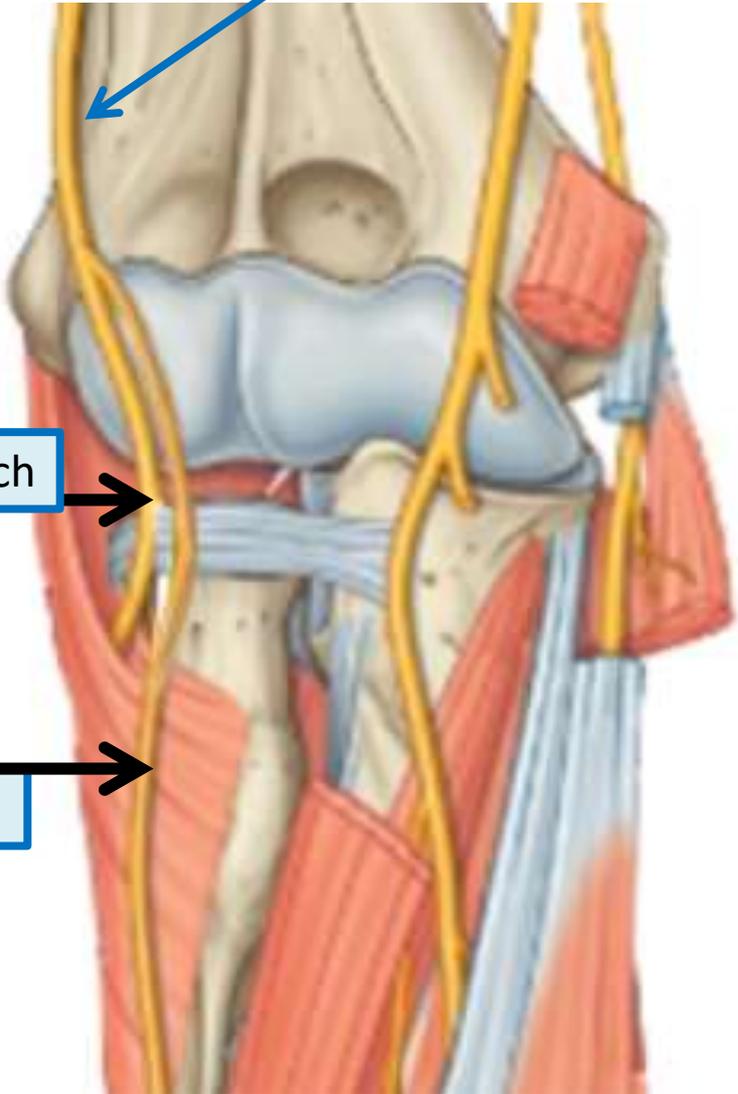


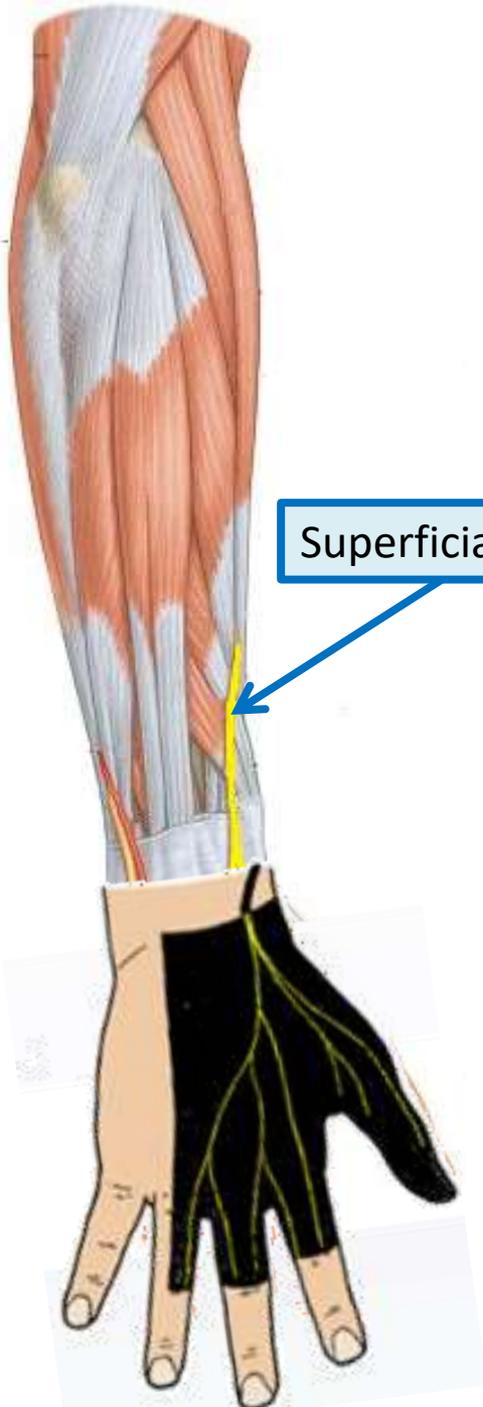


Radial n.

Deep terminal branch

Superficial terminal branch





Superficial terminal branch

Deep terminal branch =
Posterior interosseous n.



Branches In

Axilla (Long head
of triceps & Medial
of triceps +)

Branches in Spiral groove

(Lateral head & Medial head of
triceps +)

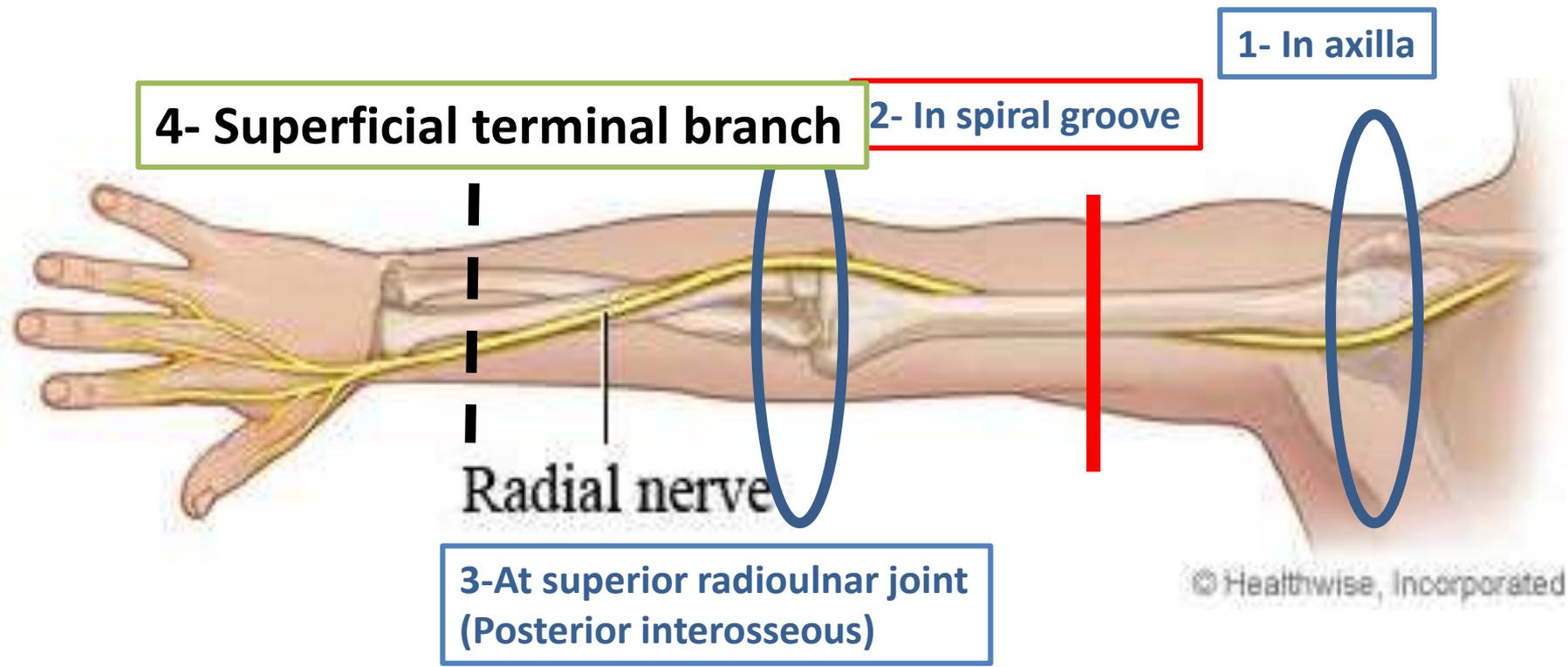
Branches in Groove between

**Brachialis &
brachioradialis**

(Exceptions → lat part
brachialis+
brachioradialis+
anconeus+ ECRL)

**Terminal branches
of Radial Nerve
(Superficial & Deep
terminal brs)**

We will discuss injury of the radial nerve



Injury of radial nerve

In axilla

- Cause of injury

(Crutch Palsy).

(Saturday night's palsy or sleep palsy).



Fracture & dislocation of the proximal end of



Injury of radial nerve in axilla

Motor effects:

- Paralysis of triceps and anconeus → *(loss of extension of elbow) however elbow can be extended by gravity*
- Paralysis of brachioradialis and supinator → *(weakness of supination but it is not lost ?) → biceps can supinate*
- Paralysis of long extensors of wrist and fingers → *(wrist drop and fingers drop).*

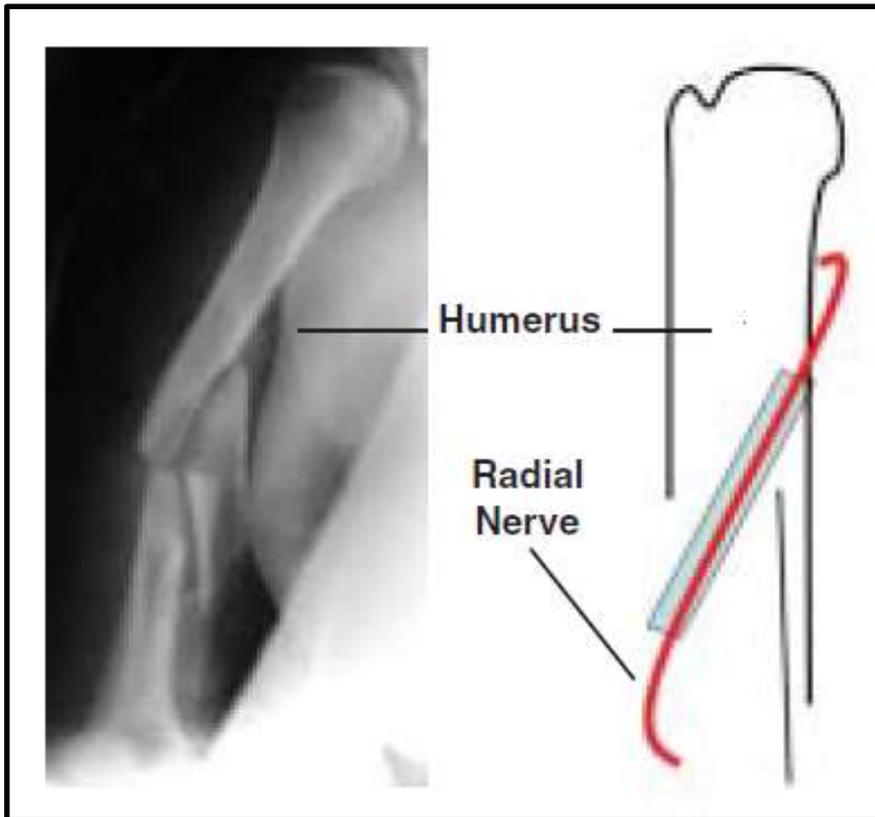
This leads to the deformity
known as **wrist drop & finger
drop** .



Injury of radial nerve in spiral groove

Causes of injury:

1- Fracture of the middle of the shaft of the humerus.



2-Using a tourniquet to the arm for a long time.



Injury of radial nerve in spiral groove

Motor effects:

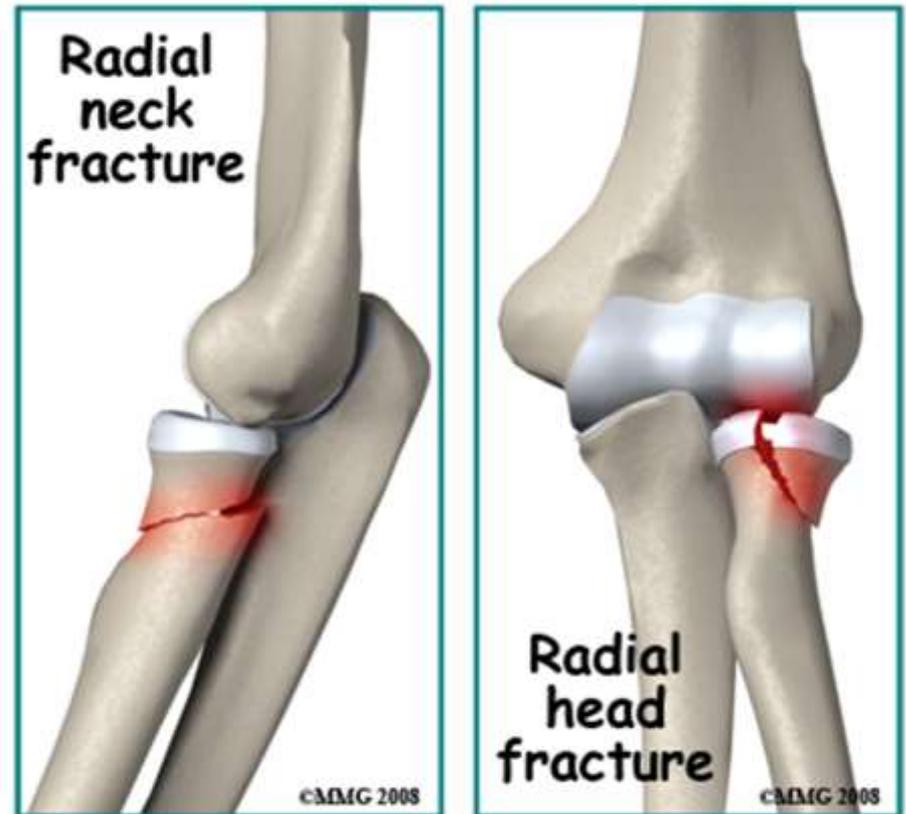
- Paralysis of brachioradialis and supinator →
(weakness of supination but it is not lost)
- Paralysis of long extensors of wrist and fingers → *(wrist drop and fingers drop).*
- Triceps is not paralyzed

Lesion at superior radioulnar joint

→ Injury of deep branch of radial nerve
(posterior interosseous nerve)

Causes of injury

- 1- Fracture of proximal end of radius.
- 2- Dislocation of head of radius.



Injury of deep branch of radial nerve (posterior interosseous nerve)

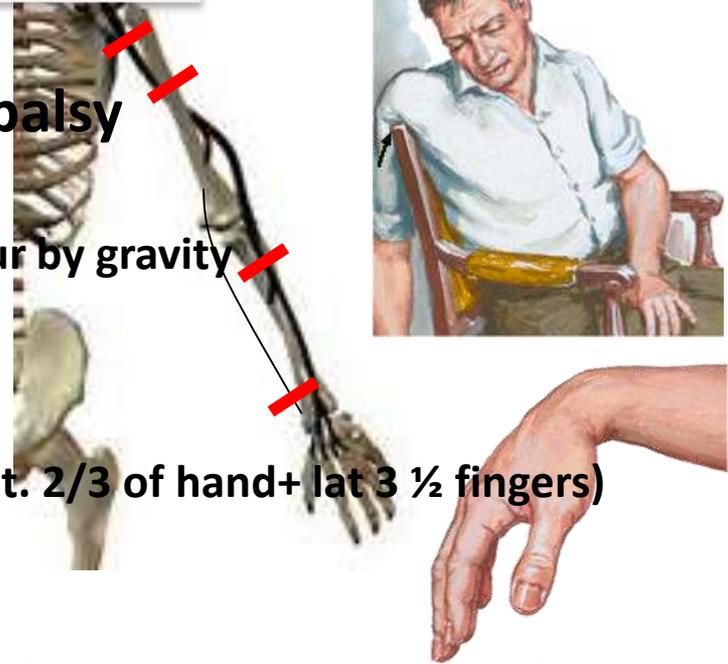
Motor effects:

- Paralysis of muscles of the back of forearm , except brachioradialis, extensor carpi radialis longus and anconeus → *(finger drop)*.
- Extensor carpi radialis longus can produce extension of the wrist → *(no wrist drop)*.

LESIONS OF RADIAL NERVE

- In axilla

- **Cause:** crutch palsy - Saturday night palsy
- **Effects**
 - Total loss of elbow extension however it can occur by gravity
 - Wrist drop & finger drop
 - Sensory loss at:
 - Back of arm & forearm
 - Lower lat. aspect of arm + dorsum of (lat. 2/3 of hand + lat 3 ½ fingers)



- In spiral groove

- **Causes:** midshaft fracture humerus
- **Effects:** wrist drop & finger drop but there is extension of elbow since triceps received its nerve supply

- Injury of post. interosseous n

- **Cause:** fracture neck of radius
- **Effects:** finger drop but no wrist drop since ECRL received its ns

- Injury of superficial terminal br of radial n

- **Cause:** stab wound
- **Effect:** anesthesia over dorsum of (lat 2/3 of hand & lat. 3 ½ fingers)



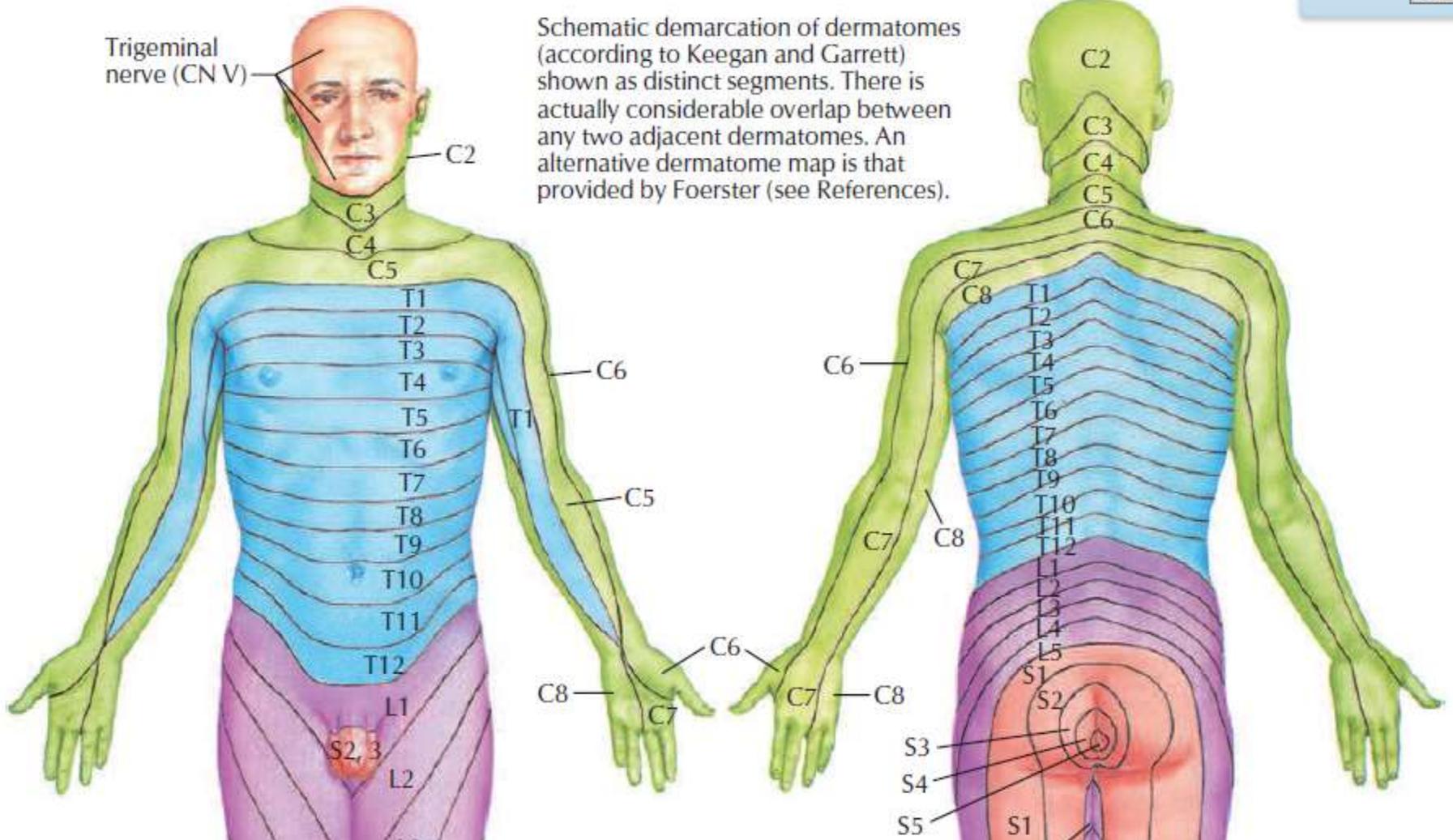
Dermatome : an area of the skin supplied by nerves from a single spinal root

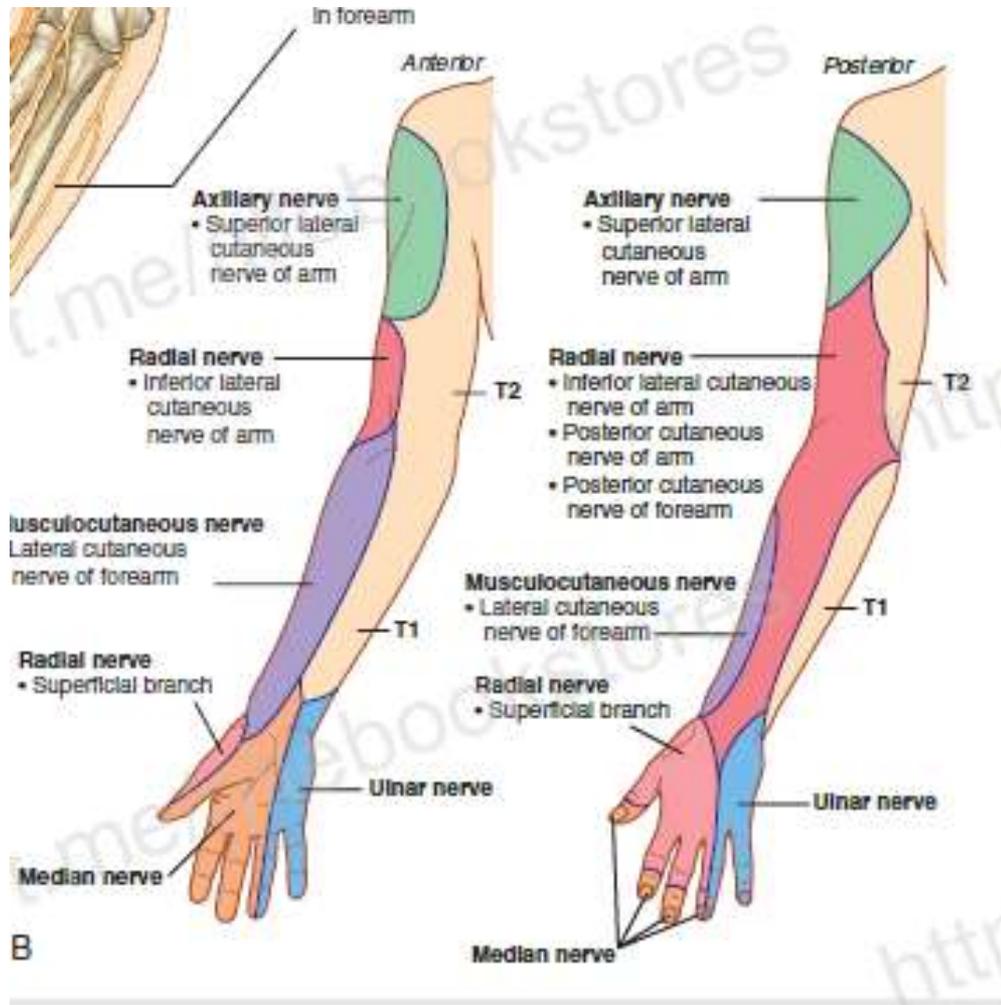
dermatome

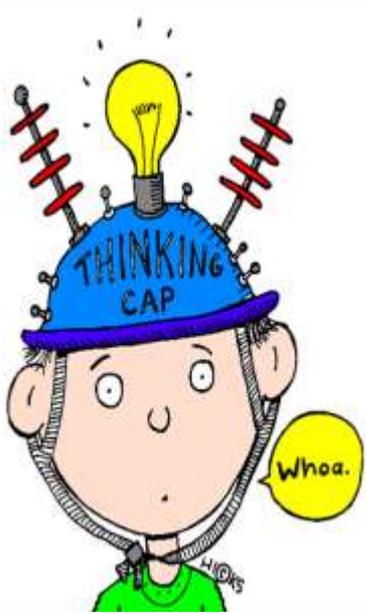
Prev

Trigeminal nerve (CN V)

Schematic demarcation of dermatomes (according to Keegan and Garrett) shown as distinct segments. There is actually considerable overlap between any two adjacent dermatomes. An alternative dermatome map is that provided by Foerster (see References).







- How can you differentiate median, ulnar & radial nerve injuries by testing the **thumb movement only**?
- With 3 **pin pricks** how can you differentiate median, ulnar & radial nerve injuries?

**Radial
Nerve**



**What is the nerve likely
to be injured in this
X RAY ?
(Midshaft fracture)**

The thumb action that could be totally affected by a radial nerve lesion is:

- A. abduction
- B. adduction
- C. extension
- D. flexion
- E. opposition

Complete claw hand is a deformity caused by injury of the following pair of nerves:

- A. Radial & ulnar nerves
- B. Ulnar & median nerves
- C. Anterior interosseous & Posterior interosseous nerves
- D. Radial & median nerves
- E. Musculocutaneous & median nerves



Thank you