Systemic Module

PNS

"Anatomy"

Cervical and Brachial Plexuses

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The Spinal Nerves

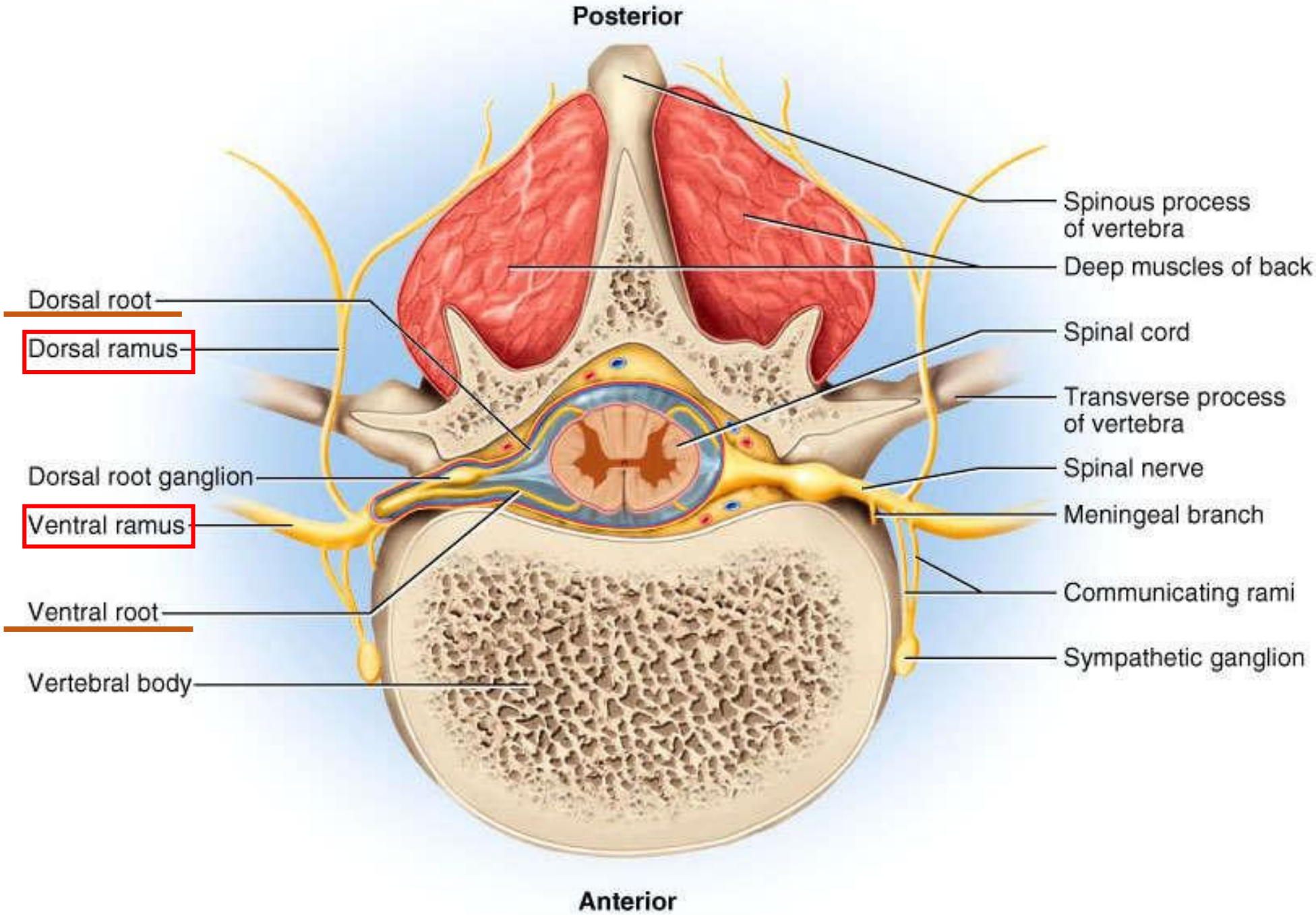
- 31 pairs connecting the spinal cord and various body regions.

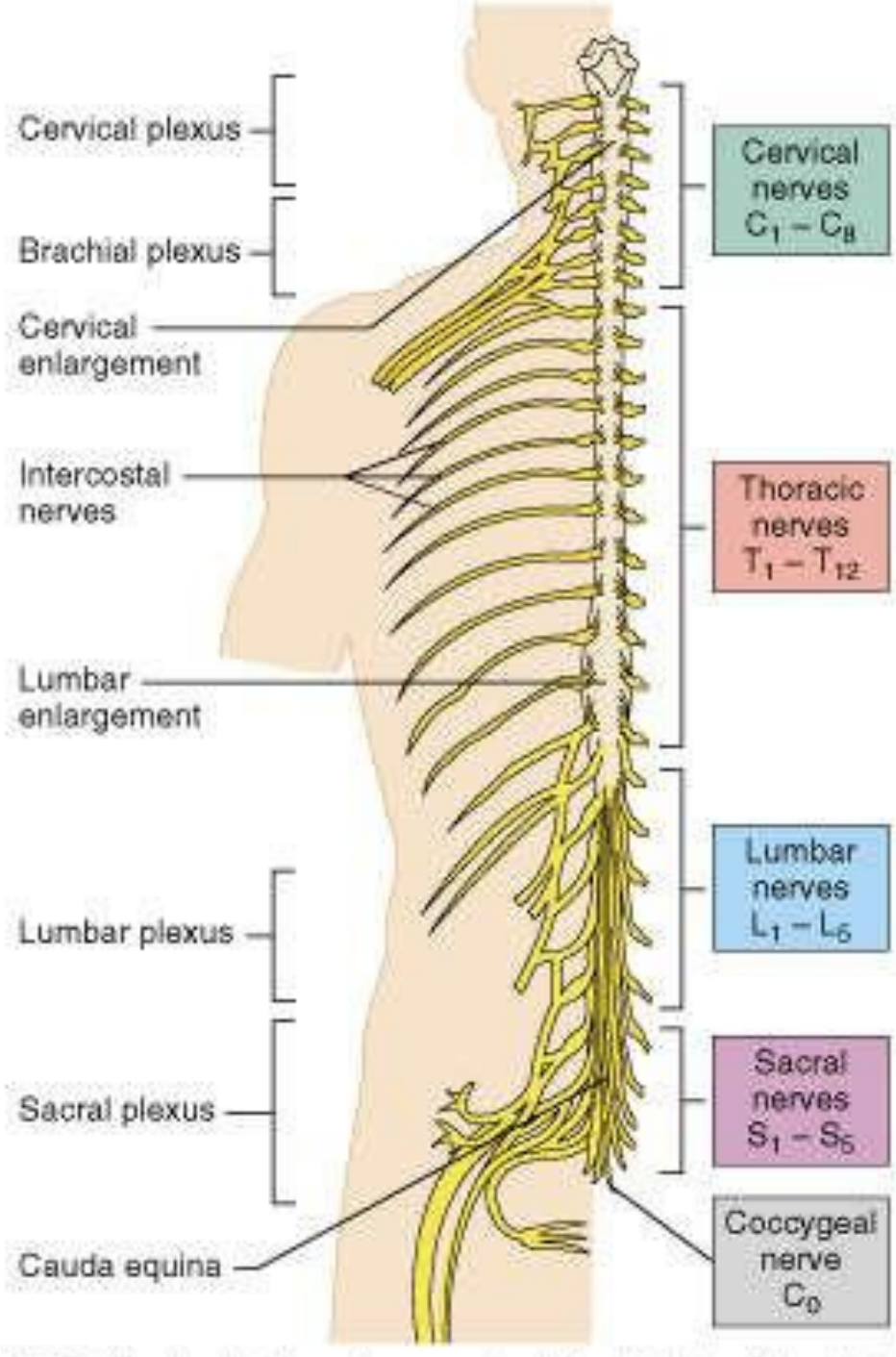
mixed nerves exiting at intervertebral foramen

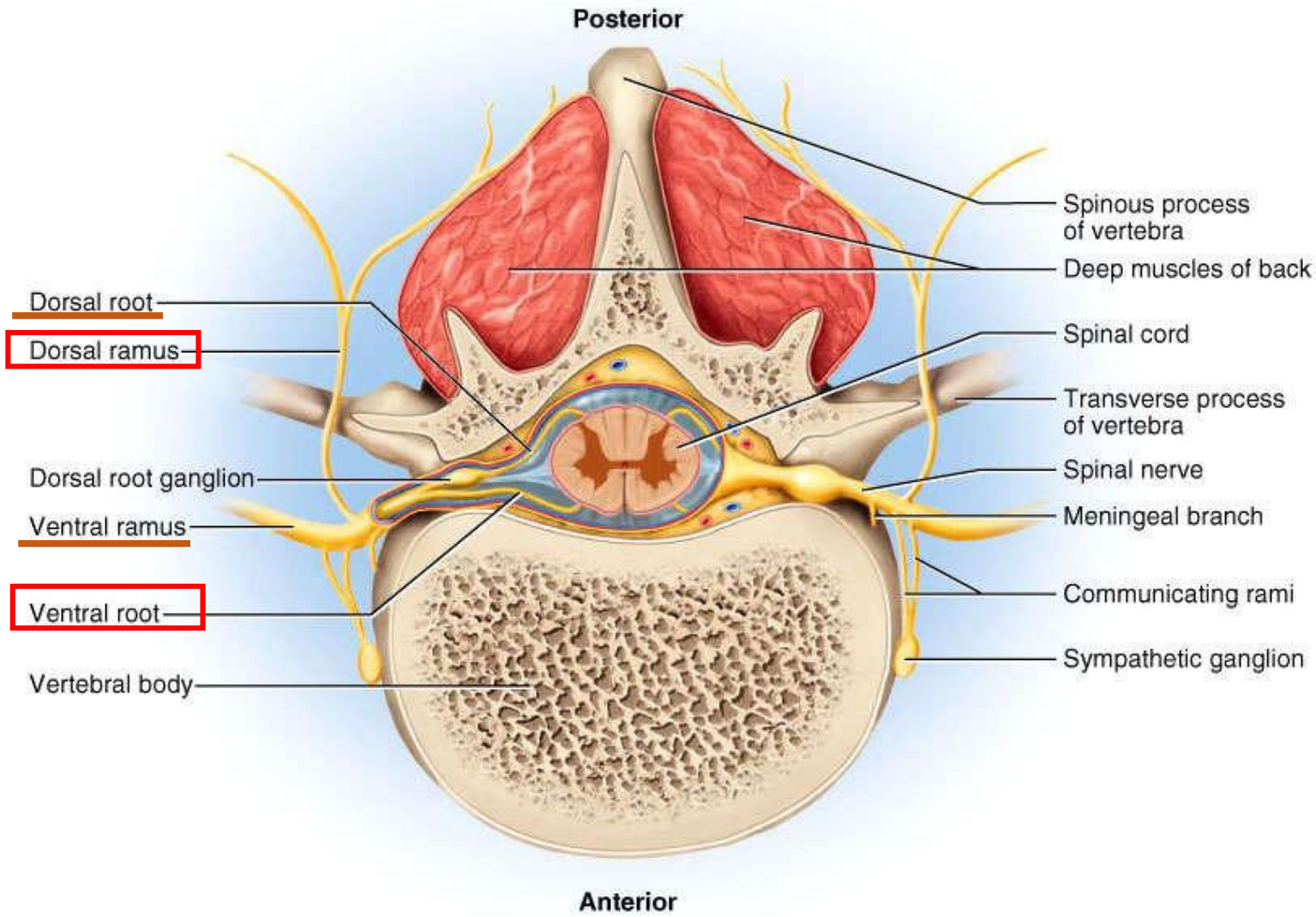
  - 8 cervical, 12 thoracic, 5 lumbar, 5 sacral and 1 coccygeal.

- **Proximal branches:**
  - Dorsal (posterior) root is sensory input to spinal cord
  - Ventral (anterior) root is motor output of spinal cord

- **Distal branches:**
  - Dorsal ramus supplies dorsal body muscle and skin
  - Ventral ramus to ventral skin and muscles and limbs
  - Meningeal branch to meninges, vertebrae and ligaments


Posterior
Spinous process of vertebra
Deep muscles of back
Dorsal root
Dorsal ramus
Spinal cord
Transverse process of vertebra
Dorsal root ganglion
Spinal nerve
Ventral ramus
Meningeal branch
Communicating rami
Ventral root
Sympathetic ganglion
Vertebral body
Anterior


Cervical plexus
Brachial plexus
Cervical enlargement
Intercostal nerves
Lumbar enlargement
Lumbar plexus
Sacral plexus
Cauda equina
Cervical nerves $C_1 - C_8$
Thoracic nerves $T_1 - T_{12}$
Lumbar nerves $L_1 - L_5$
Sacral nerves $S_1 - S_5$
Coccygeal nerve C_0


Posterior
Anterior
Dorsal root
Dorsal ramus
Dorsal root ganglion
Ventral ramus
Ventral root
Vertebral body
Spinous process of vertebra
Deep muscles of back
Spinal cord
Transverse process of vertebra
Spinal nerve
Meningeal branch
Communicating rami
Sympathetic ganglion

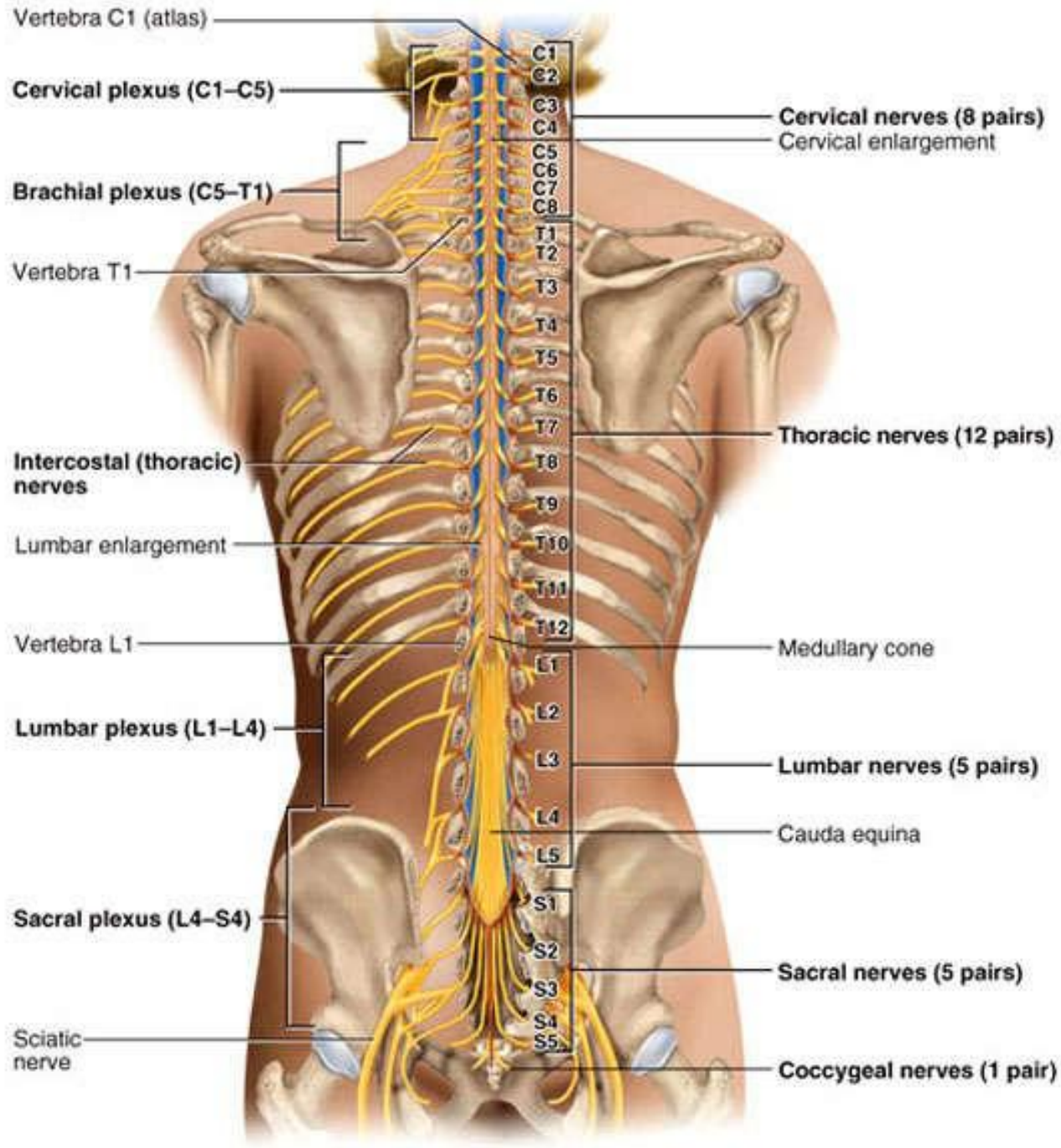
Nerve Plexuses

- The ventral (anterior) rami of spinal nerves (except for thoracic nerves T2-T12) do not go directly to the body structures they supply.

- They form networks on the both the left and right sides of the body by joining with various numbers of axons from anterior rami of adjacent nerves.

- Ventral rami branch and anastomose repeatedly to form **5 nerve plexuses**:

1. **Cervical plexus**
2. **Brachial plexus**
3. **Lumbar plexus**
4. **Sacral plexus**
5. **Coccygeal plexus**


Vertebra C1 (atlas)
Cervical plexus (C1–C5)
Brachial plexus (C5–T1)
Vertebra T1
Intercostal (thoracic) nerves
Lumbar enlargement
Vertebra L1
Lumbar plexus (L1–L4)
Sacral plexus (L4–S4)
Sciatic nerve
C1
C2
C3
C4
C5
C6
C7
C8
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
L3
L4
L5
S1
S2
S3
S4
S5
Cervical nerves (8 pairs)
Cervical enlargement
Thoracic nerves (12 pairs)
Medullary cone
Lumbar nerves (5 pairs)
Cauda equina
Sacral nerves (5 pairs)
Coccygeal nerves (1 pair)

CERVICAL PLEXUS

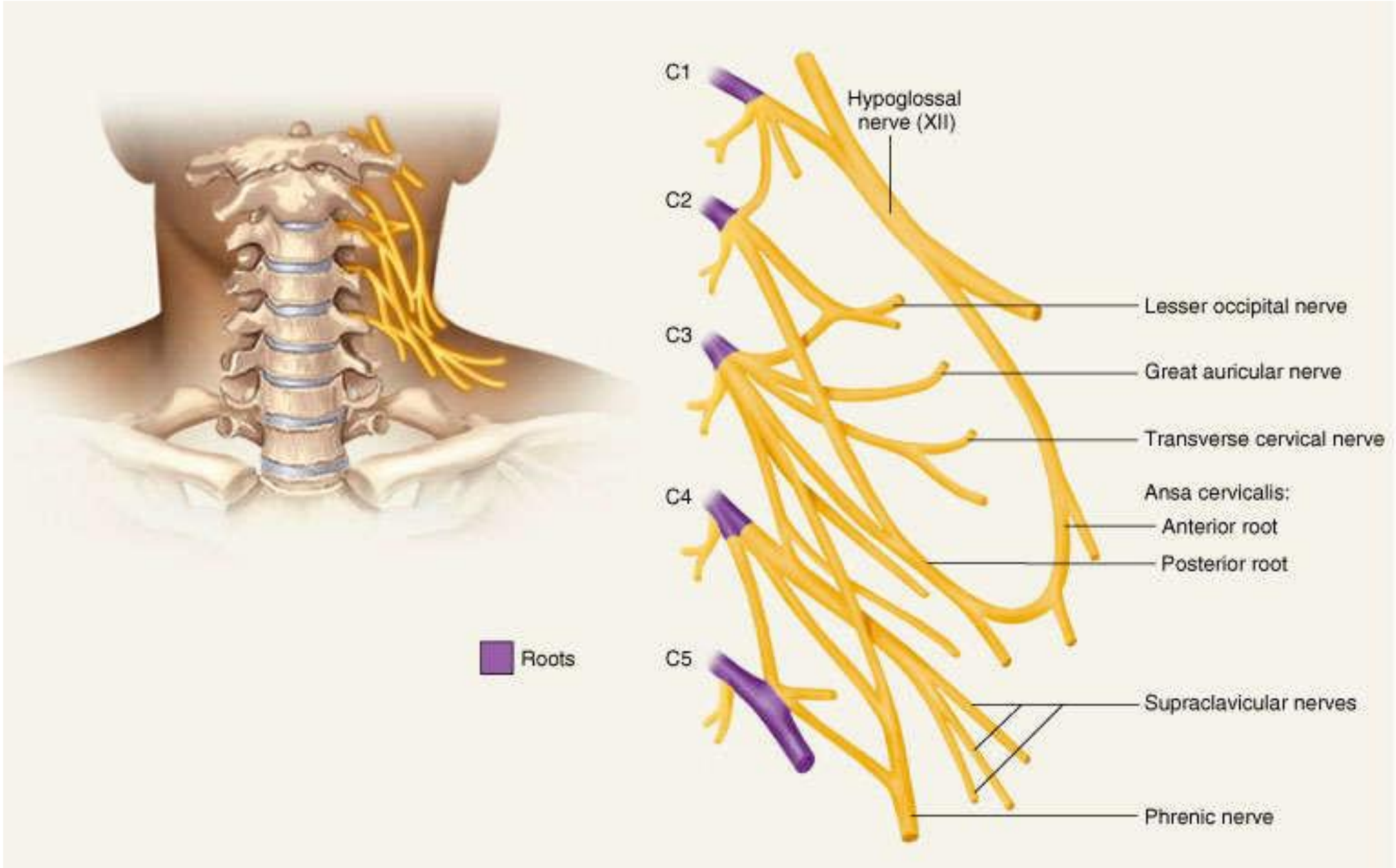
Cervical Plexus

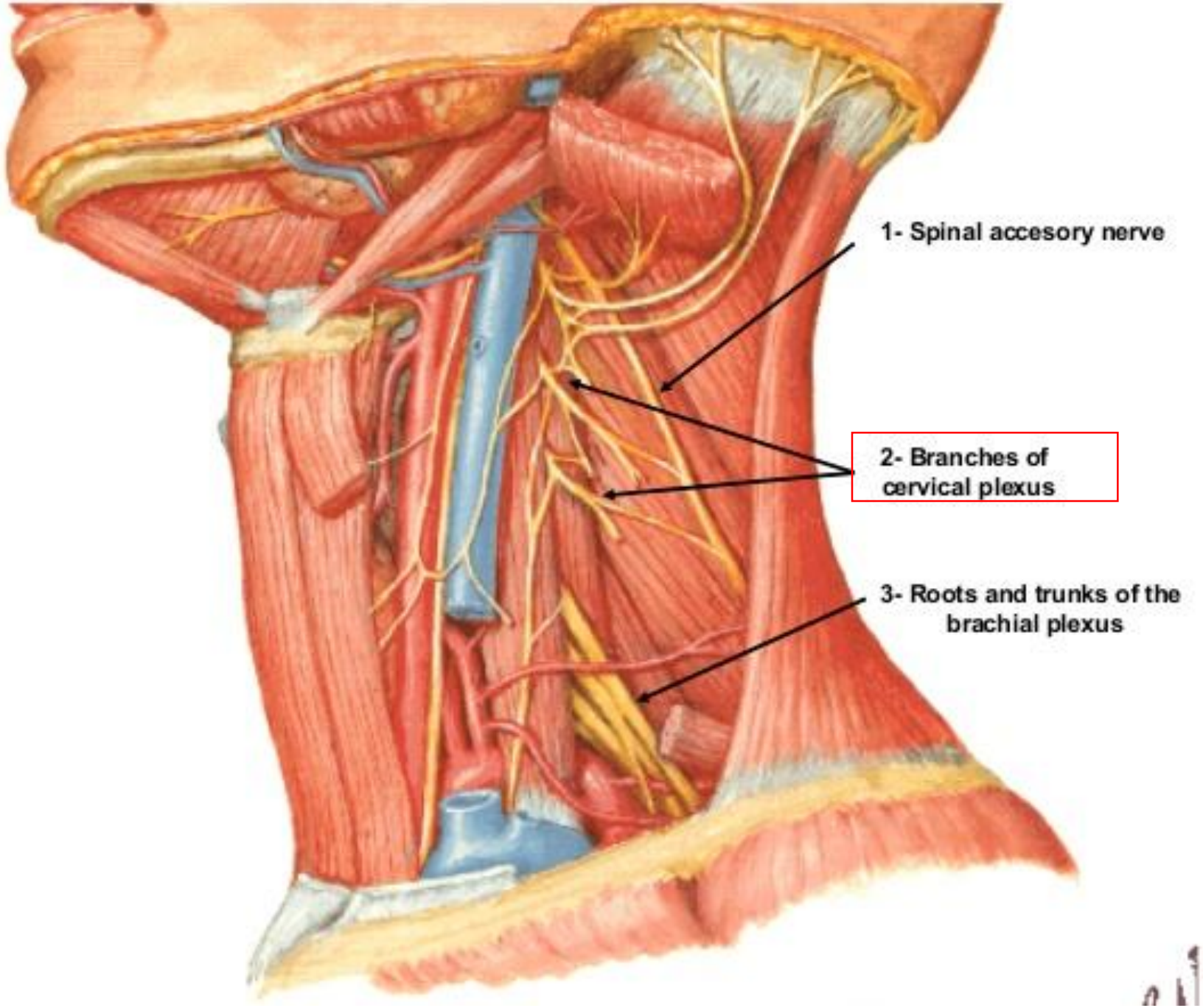
- Formed by the anterior (ventral) rami of the cervical nerves **C1-C4** with contribution **C5.**

- Supplies the **skin and muscles of the head, neck and superior part of the shoulders and chest**.

  - **Phrenic nerves** also arise from the cervical plexus and supply the diaphragm.

Cervical Plexus

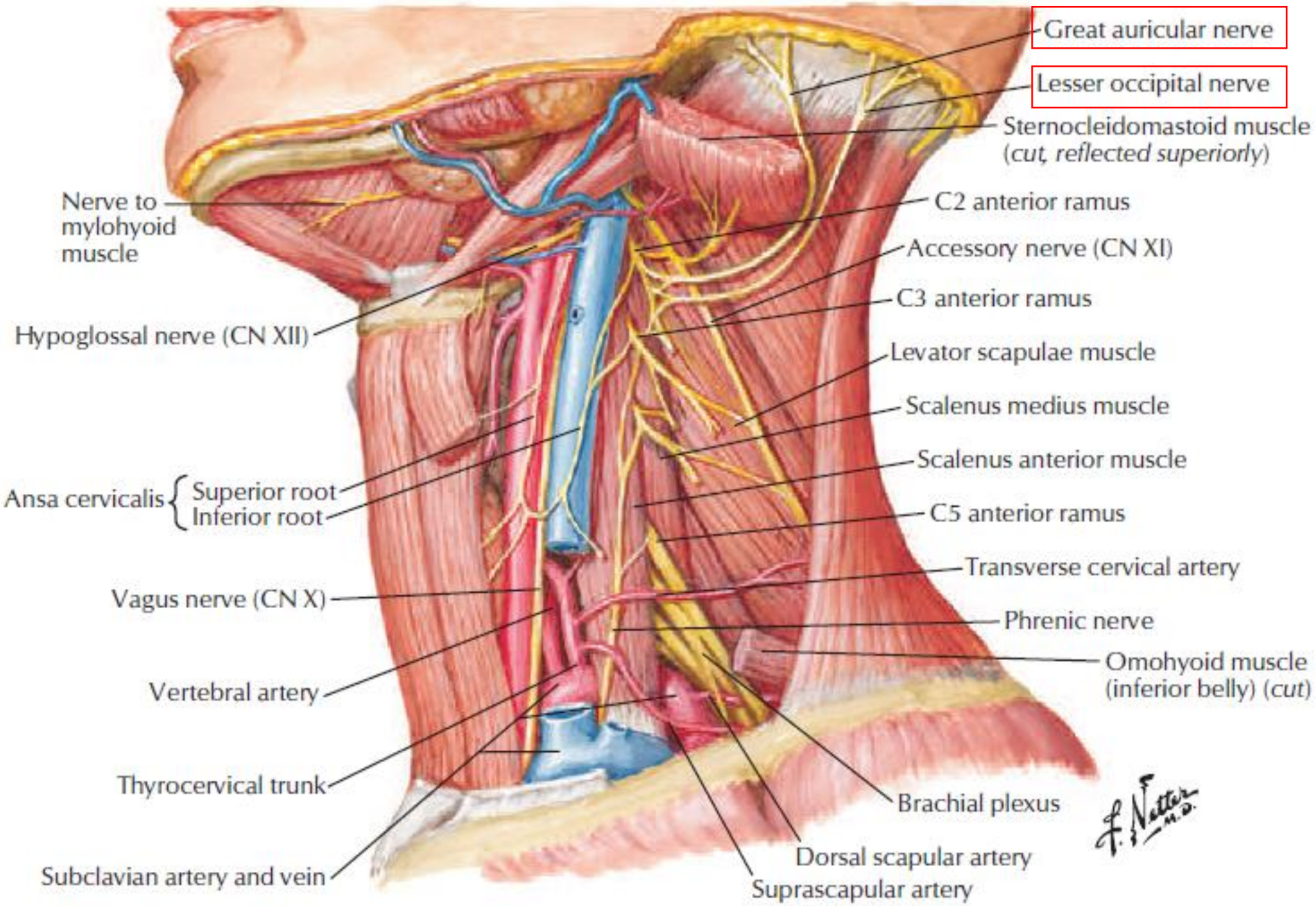



1- Spinal accesory nerve
2- Branches of cervical plexus
3- Roots and trunks of the brachial plexus

Terminal Branches

- **Superficial branches (Sensory):**

1. **Lesser occipital (C2)** – skin of scalp posterior and superior to auricle.
2. **Great auricular (C2-C3)** – skin anterior, inferior, and over ear and over parotid gland.
3. **Transverse cervical (C2-C3)** – skin over anterior aspect of neck.
4. **Supraclavicular (C3-C4)** – skin over superior portion of chest and shoulder.


Great auricular nerve
Lesser occipital nerve
Sternocleidomastoid muscle (*cut, reflected superiorly*)
Nerve to mylohyoid muscle
C2 anterior ramus
Accessory nerve (CN XI)
C3 anterior ramus
Hypoglossal nerve (CN XII)
Levator scapulae muscle
Scalenus medius muscle
Scalenus anterior muscle
Ansa cervicalis
Superior root
Inferior root
C5 anterior ramus
Transverse cervical artery
Vagus nerve (CN X)
Phrenic nerve
Omohyoid muscle (inferior belly) (*cut*)
Vertebral artery
Thyrocervical trunk
Brachial plexus
Dorsal scapular artery
Subclavian artery and vein
Suprascapular artery
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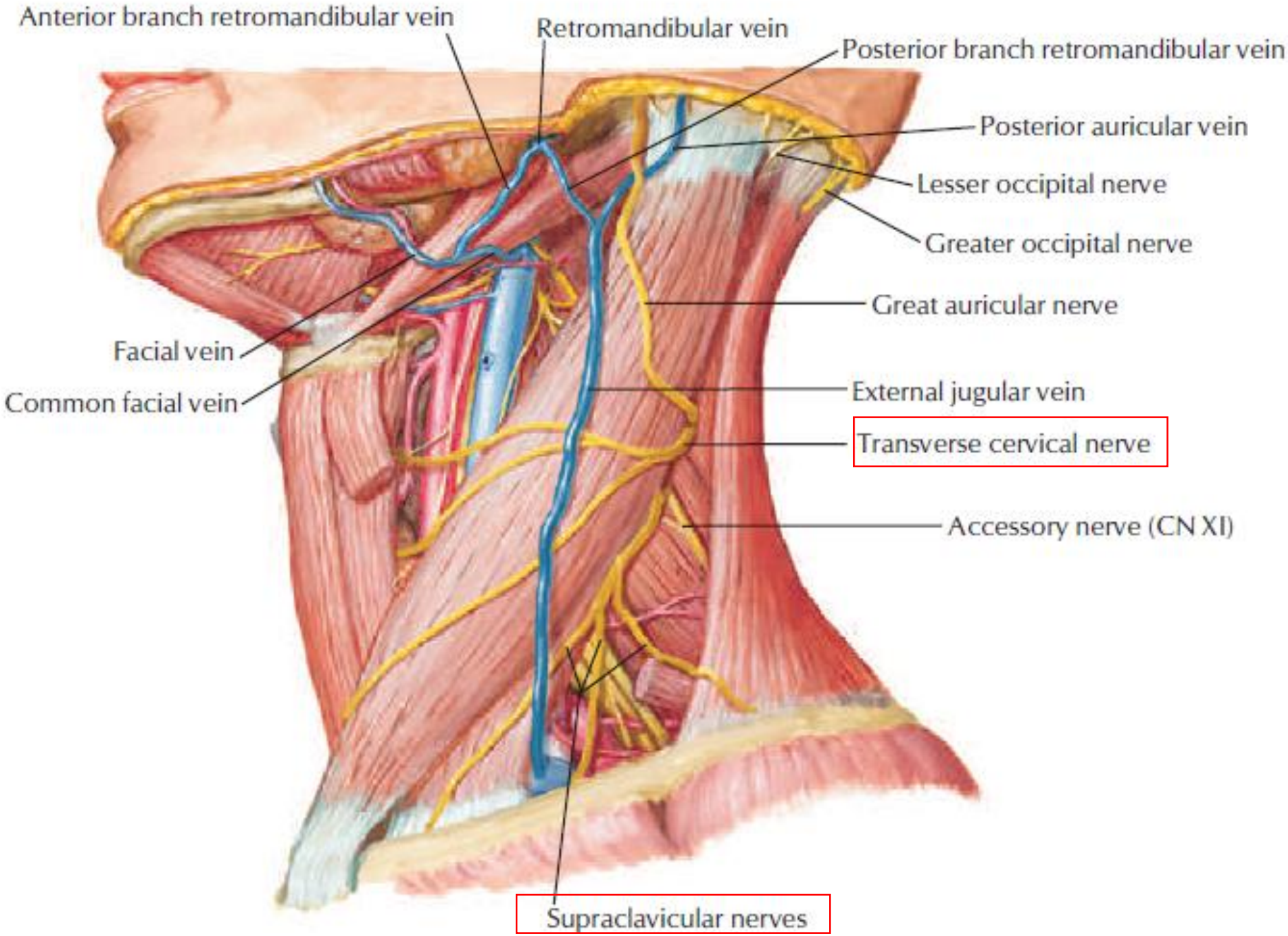
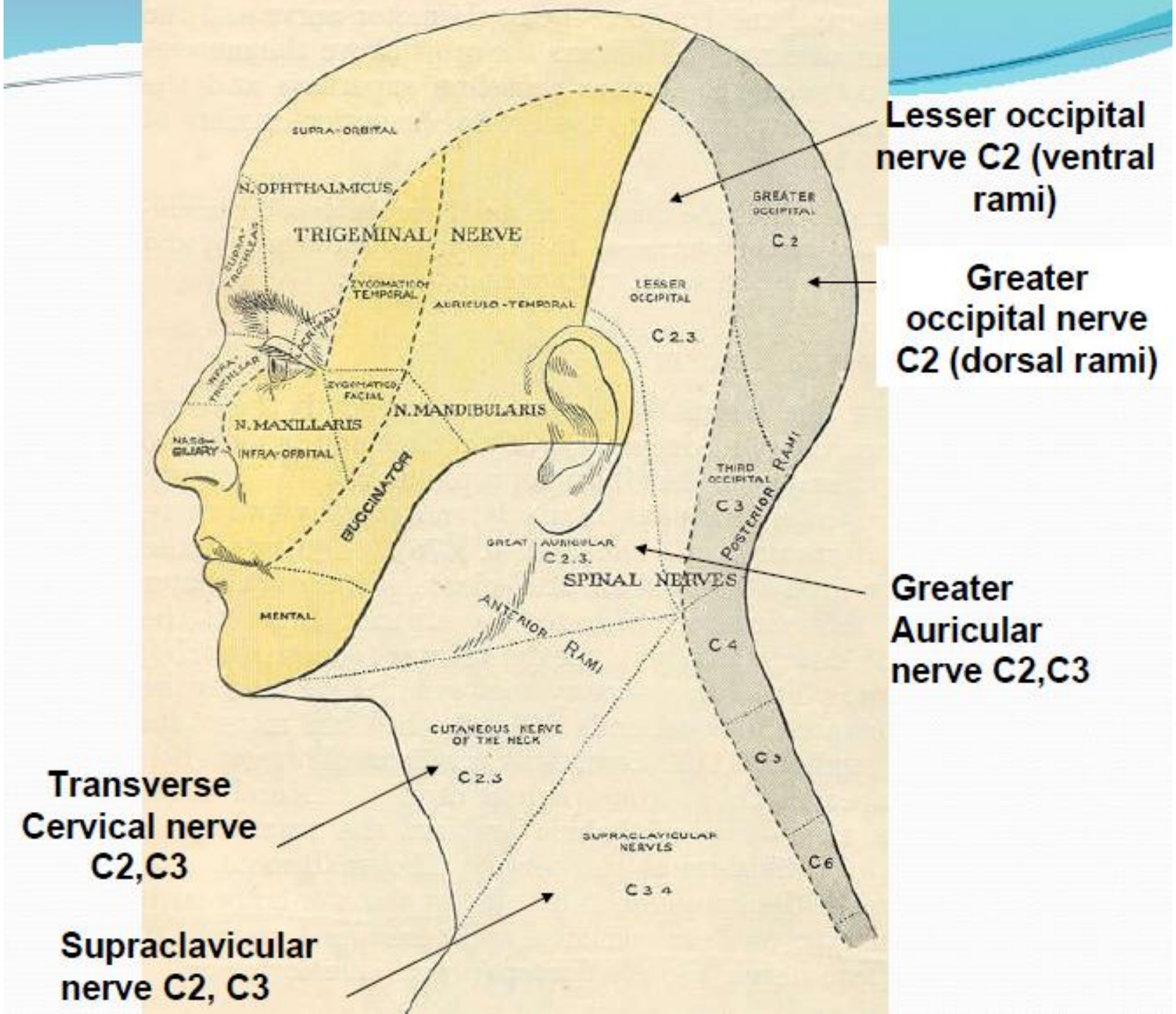

Anterior branch retromandibular vein
Retromandibular vein
Posterior branch retromandibular vein
Posterior auricular vein
Lesser occipital nerve
Greater occipital nerve
Great auricular nerve
Facial vein
Common facial vein
External jugular vein
Transverse cervical nerve
Accessory nerve (CN XI)
Supraclavicular nerves



Lesser occipital nerve C2 (ventral rami)

Greater occipital nerve C2 (dorsal rami)

Greater Auricular nerve C2,C3

Transverse Cervical nerve C2,C3

Supraclavicular nerve C2, C3

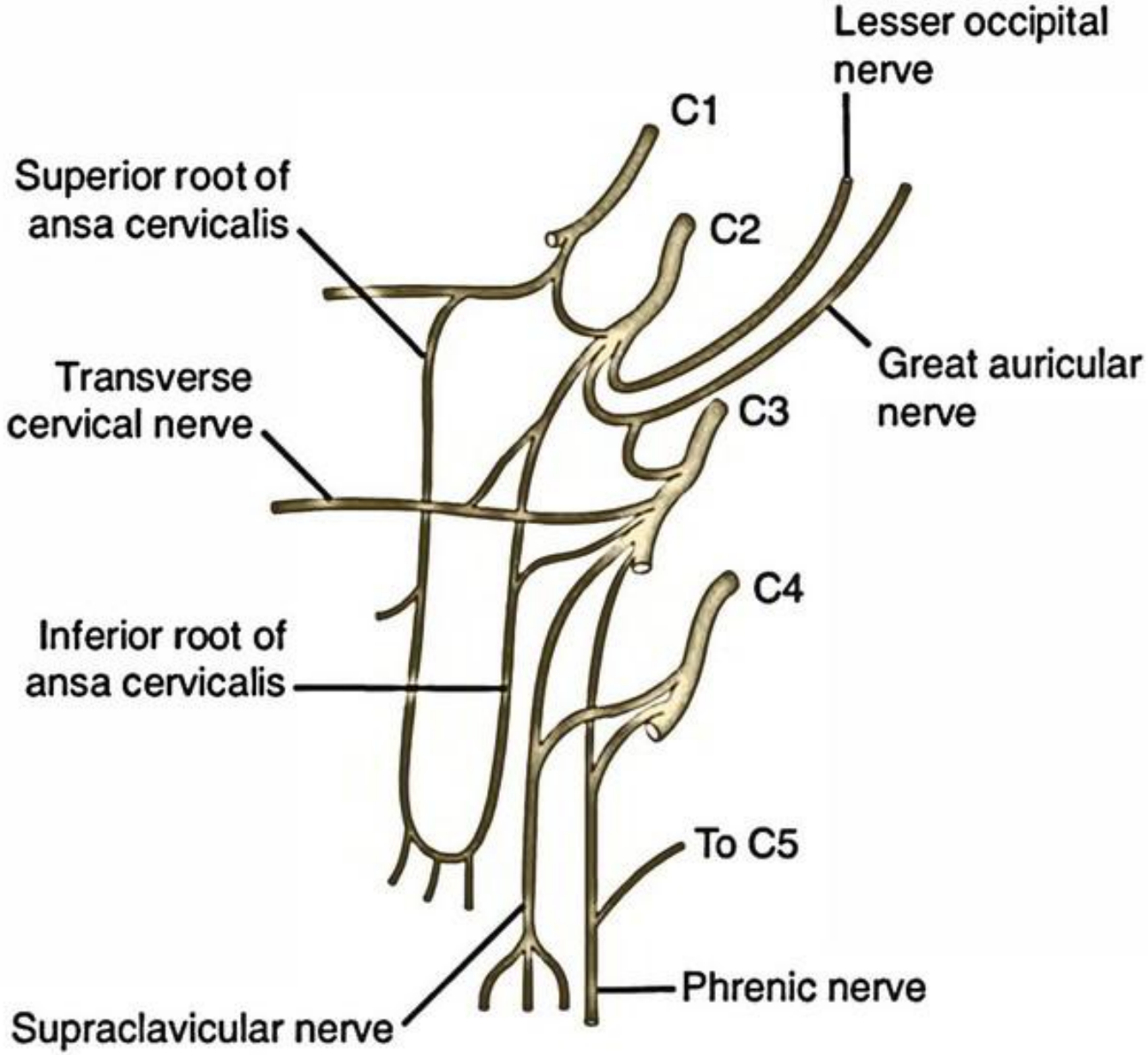
Terminal Branches

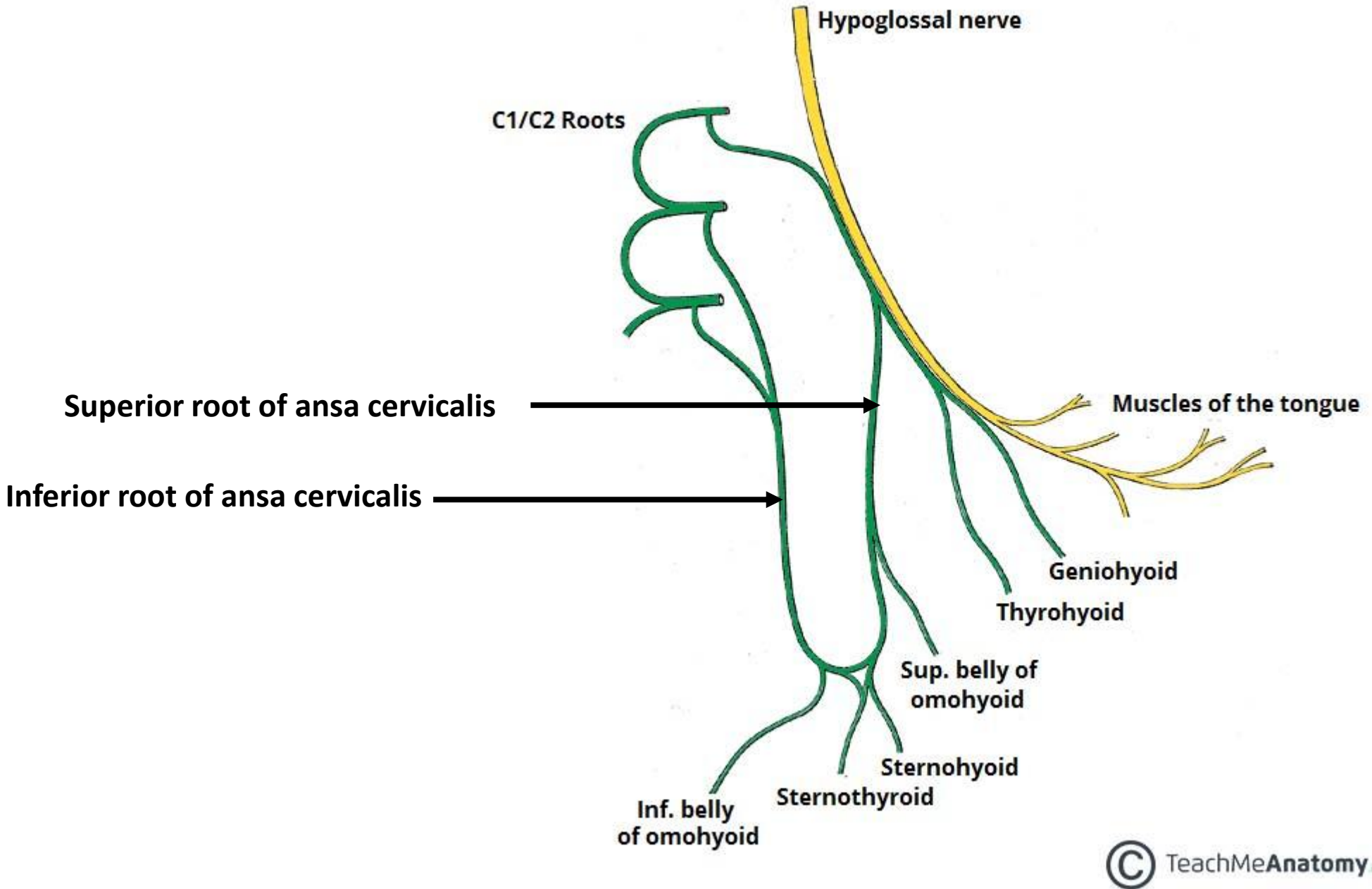
- **Deep Branches (Motor):**

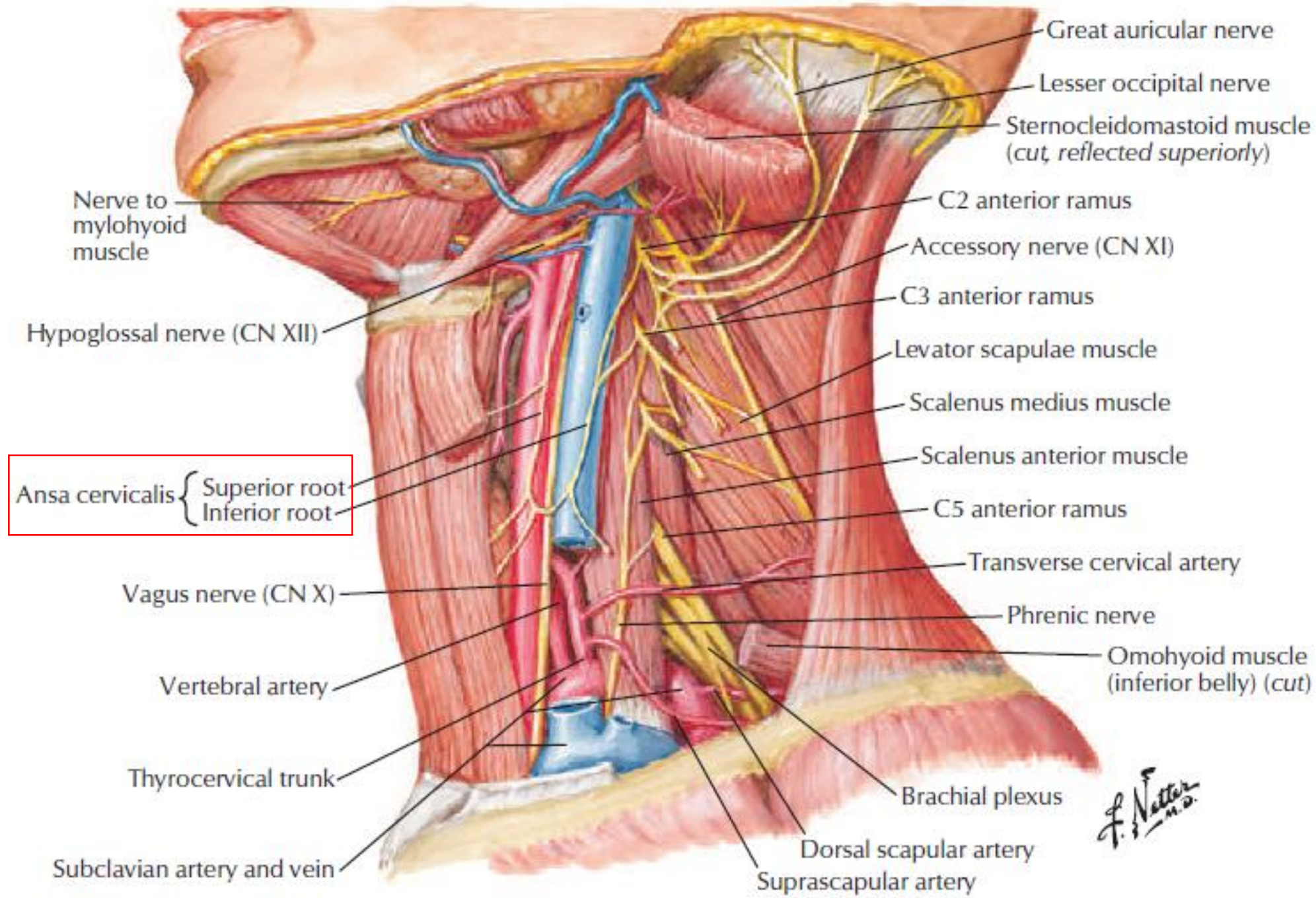
1. **Ansa cervicalis (C1-C3)** – (geniohyoid (C1 only), thyrohyoid (C1 only), sternothyroid, sternohyoid, omohyoid)

2. **Phrenic nerve (C3-C5)** innervates diaphragm and the pericardium.

3. **Segmental branches** – prevertebral muscles of the neck, levator scapulae and middle fiber of scalene.


Lesser occipital nerve
C1
Superior root of ansa cervicalis
C2
Great auricular nerve
Transverse cervical nerve
C3
C4
Inferior root of ansa cervicalis
To C5
Phrenic nerve
Supraclavicular nerve




Great auricular nerve
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Sternocleidomastoid muscle (*cut, reflected superiorly*)
Nerve to mylohyoid muscle
C2 anterior ramus
Accessory nerve (CN XI)
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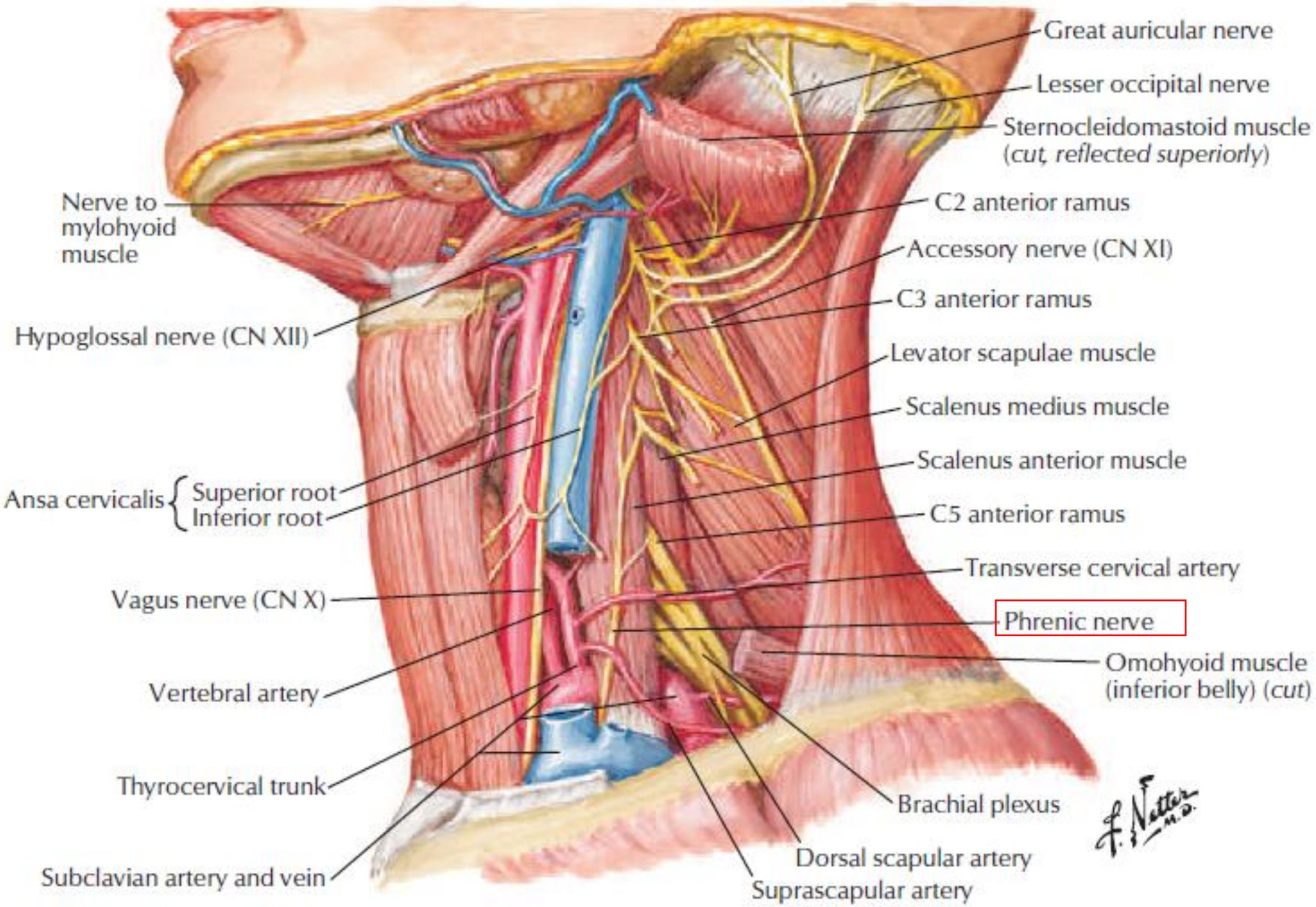
Levator scapulae muscle
Scalenus medius muscle
Ansa cervicalis
Superior root
Inferior root
Scalenus anterior muscle
C5 anterior ramus
Transverse cervical artery
Vagus nerve (CN X)
Phrenic nerve
Omohyoid muscle (inferior belly) (*cut*)
Vertebral artery
Thyrocervical trunk
Brachial plexus
Dorsal scapular artery
Subclavian artery and vein
Suprascapular artery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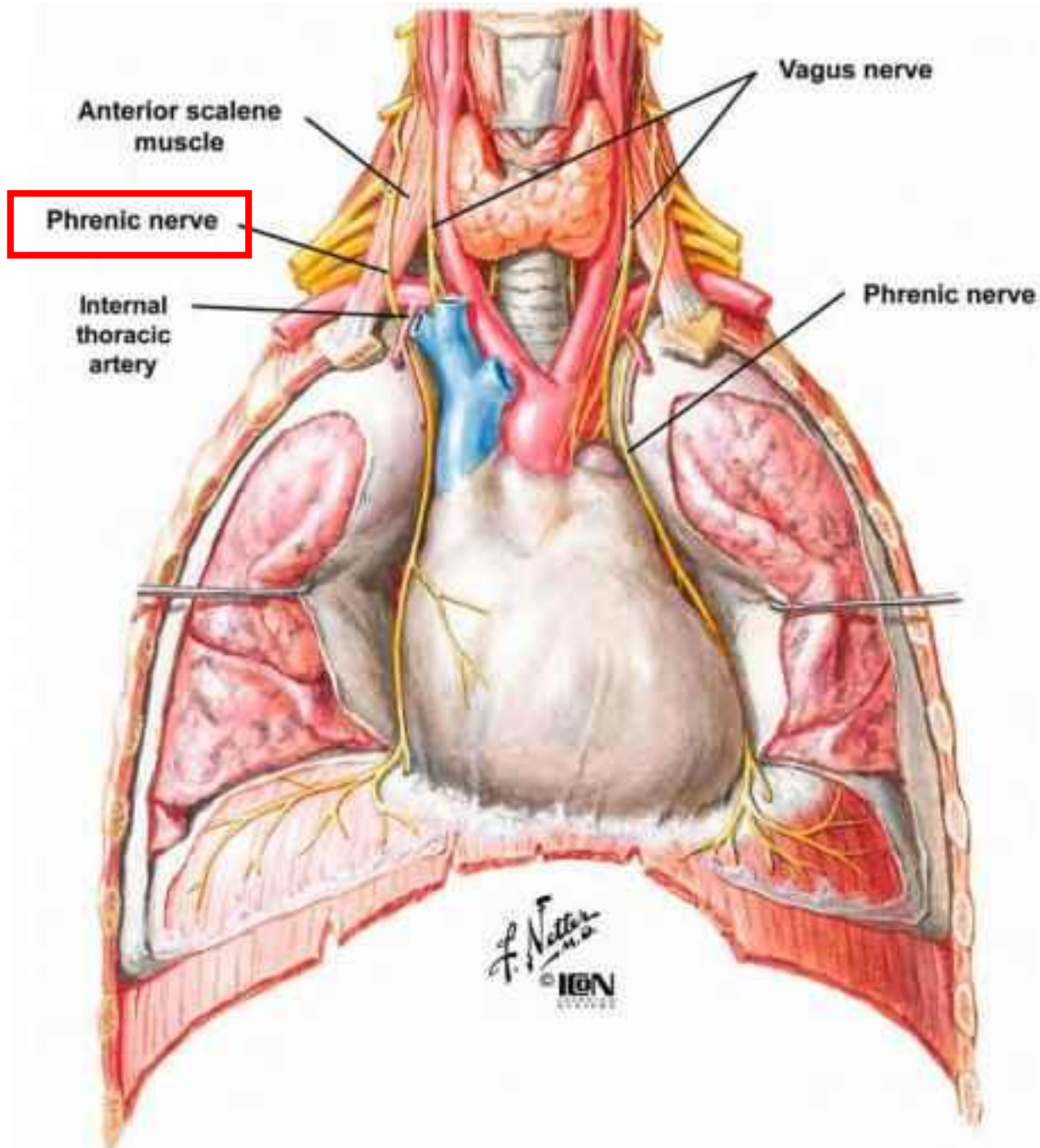
F. Netter M.D.


Anterior scalene muscle
Phrenic nerve
Internal thoracic artery
Vagus nerve
Phrenic nerve
F. Netter M.D.
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Brachial Plexus

Brachial Plexus

- The brachial plexus is a network of nerve fibers that ***supplies the skin and muscles of the upper limb.***

- The plexus is formed by the anterior rami (divisions) of cervical spinal nerves **C5-C8 and T1**.

- **Course:**

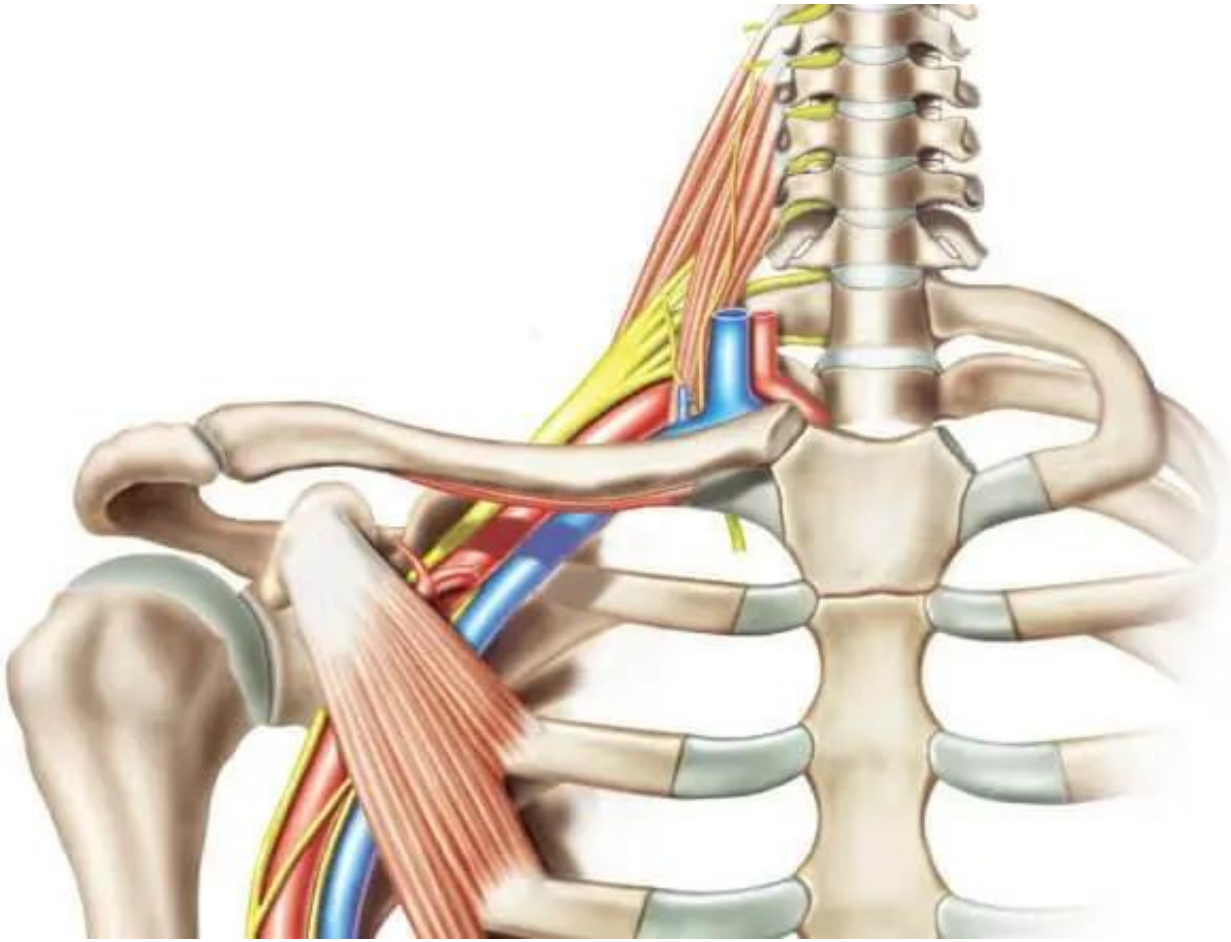
It begins in the root of the neck (in posterior triangle)

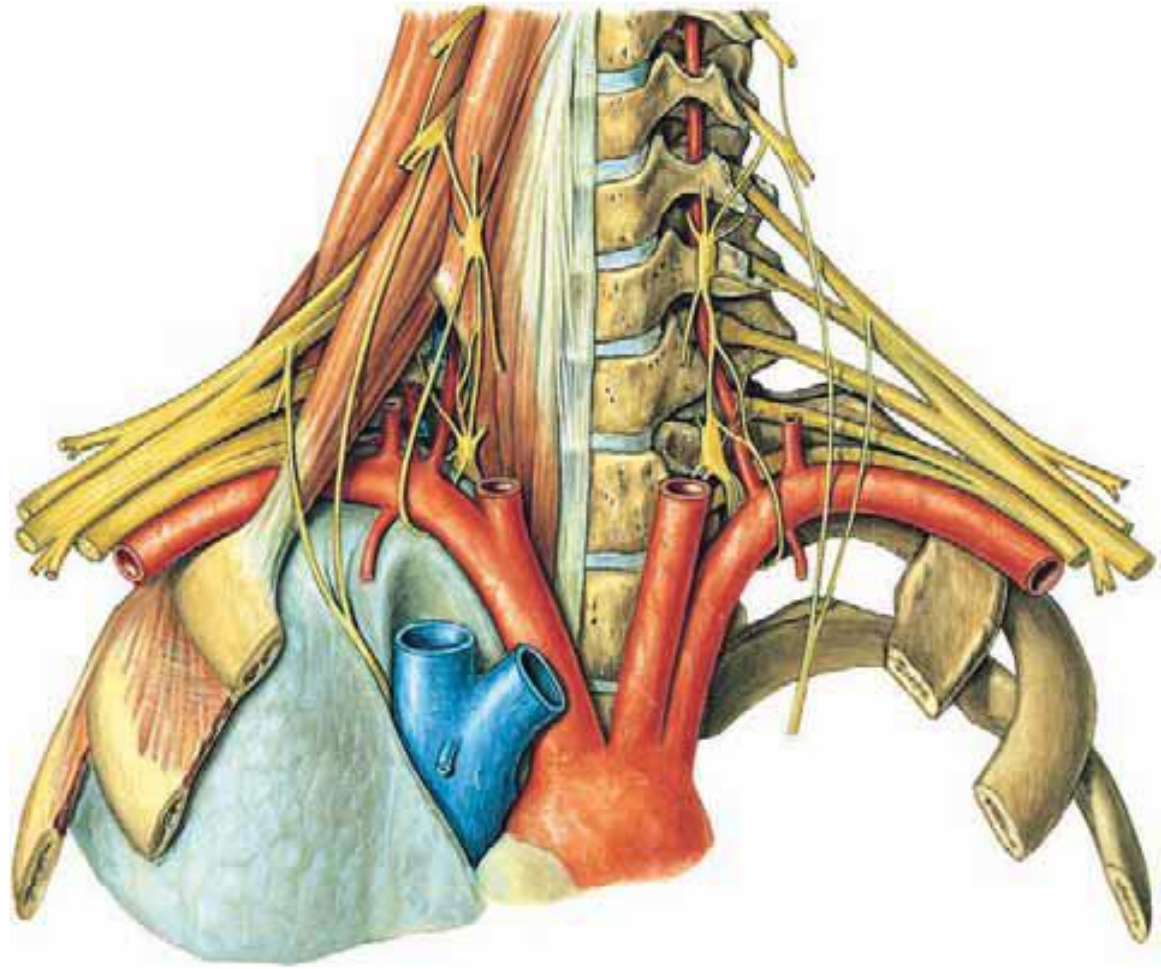
↓

Passes above the first rib posterior to the clavicle

↓

Then enter the axilla and into the arm.

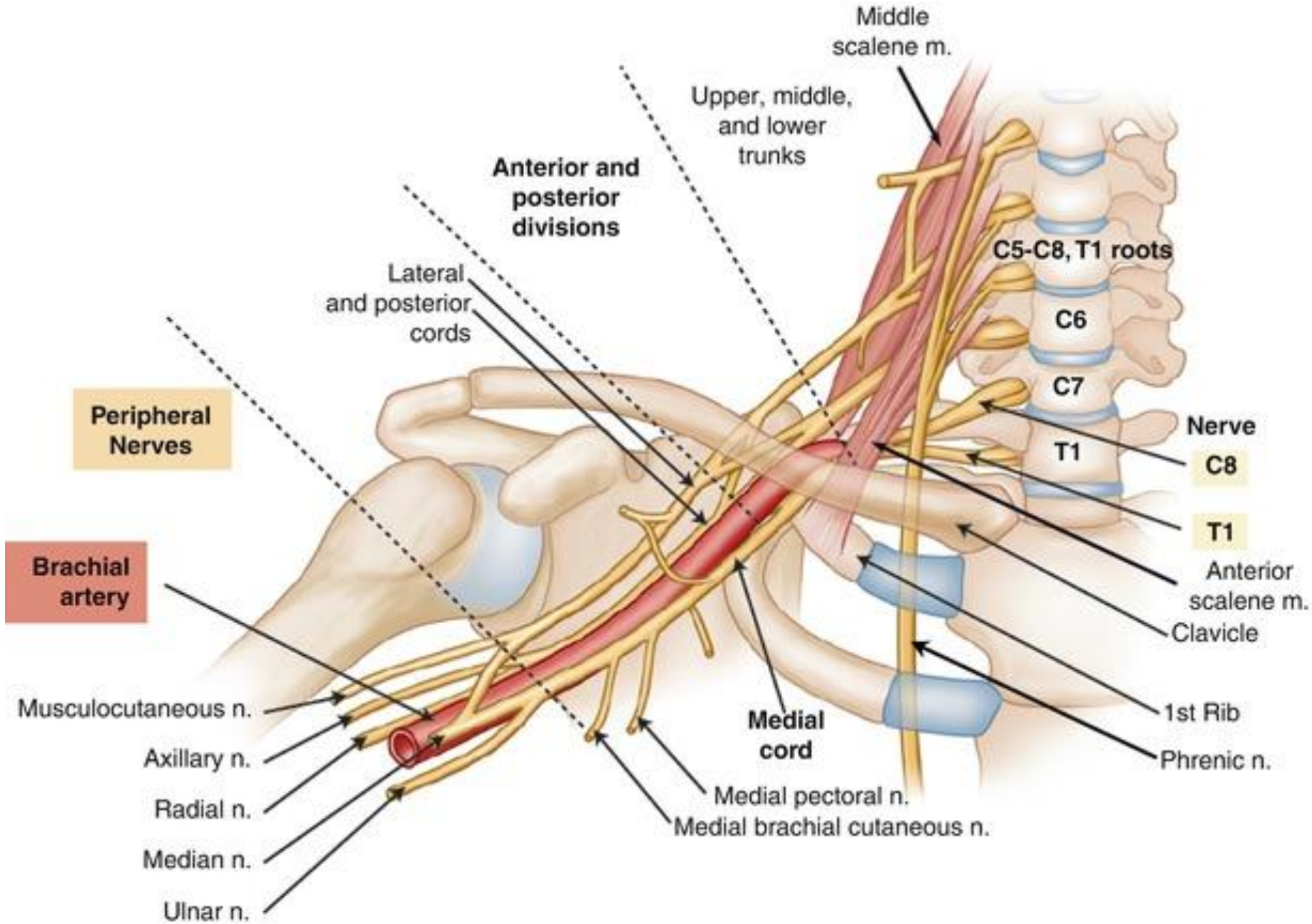




Brachial Plexus

- Five important nerves arise from brachial plexus are:

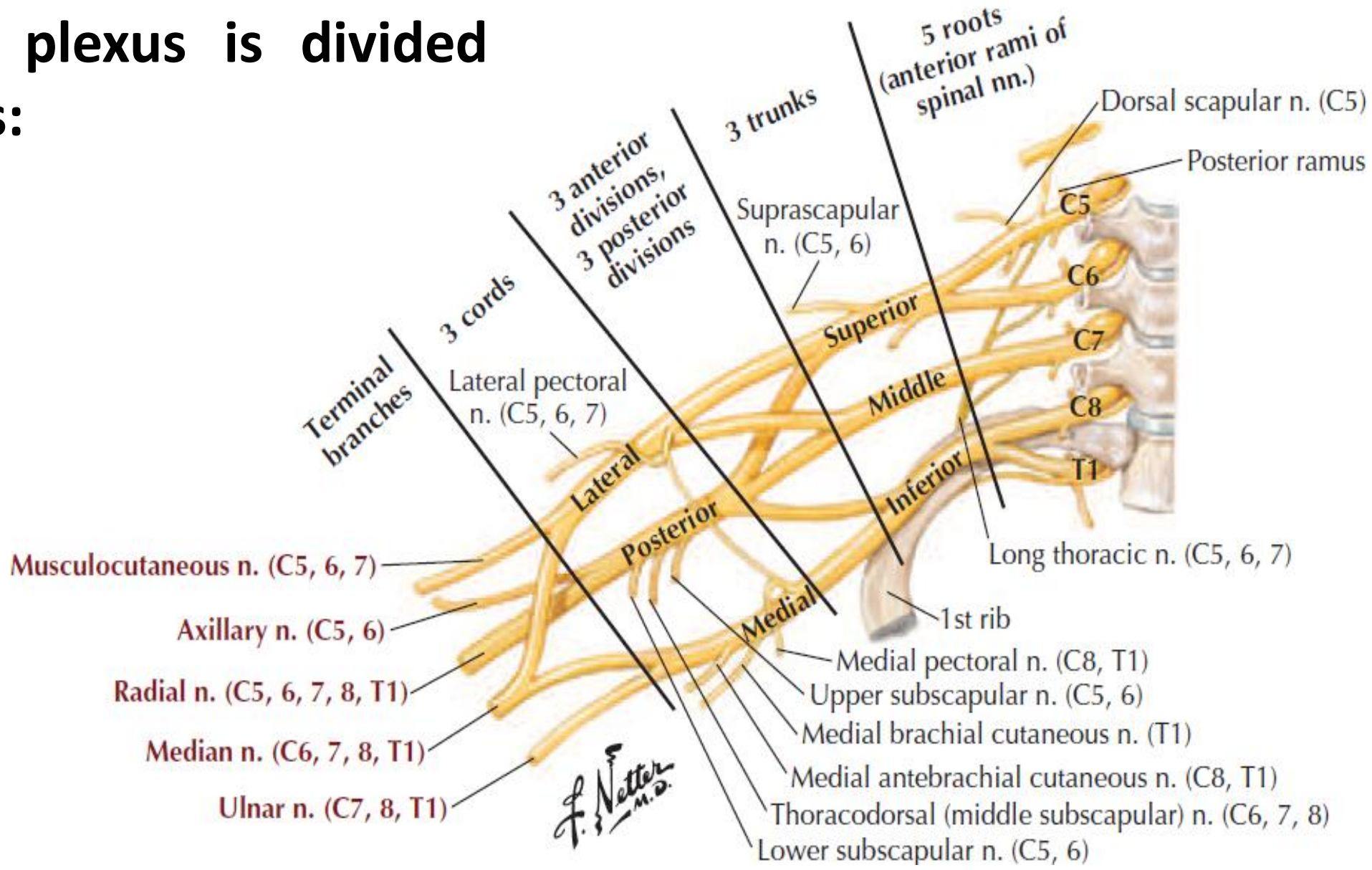
1. **Axillary nerve**
2. **Musculocutaneous nerve**
3. **Radial nerve**
4. **Median nerve**
5. **Ulnar nerve**


Middle scalene m.
Upper, middle, and lower trunks
Anterior and posterior divisions
Lateral and posterior cords
Peripheral Nerves
Brachial artery
C5-C8, T1 roots
C6
C7
T1
Nerve
C8
T1
Anterior scalene m.
Clavicle
1st Rib
Phrenic n.
Musculocutaneous n.
Axillary n.
Radial n.
Median n.
Ulnar n.
Medial cord
Medial pectoral n.
Medial brachial cutaneous n.

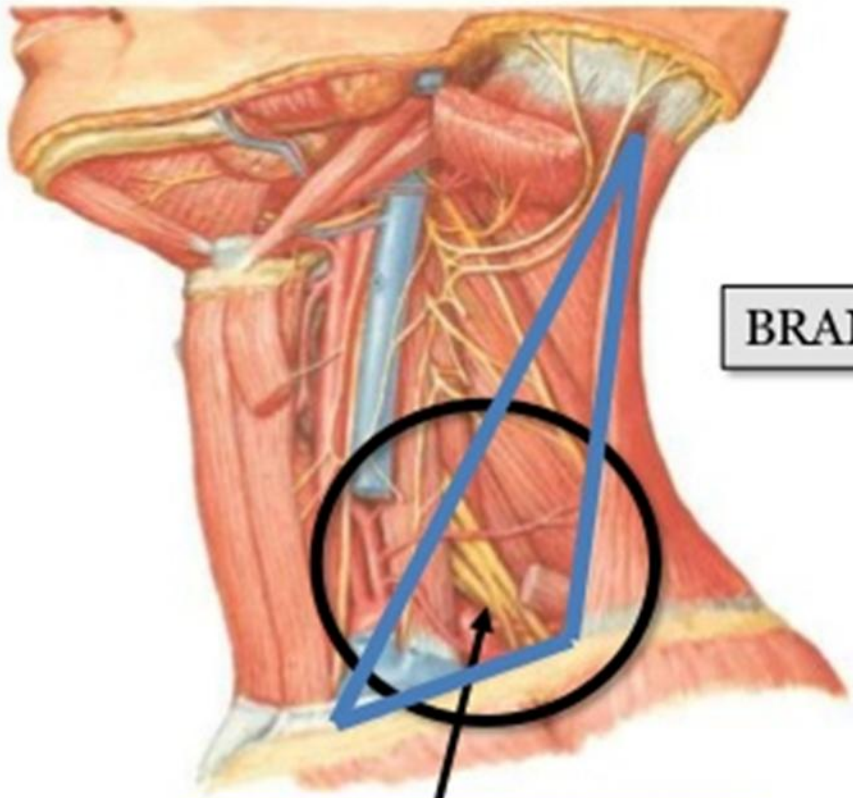
Parts of Brachial Plexus

- **The brachial plexus is divided into five parts:**

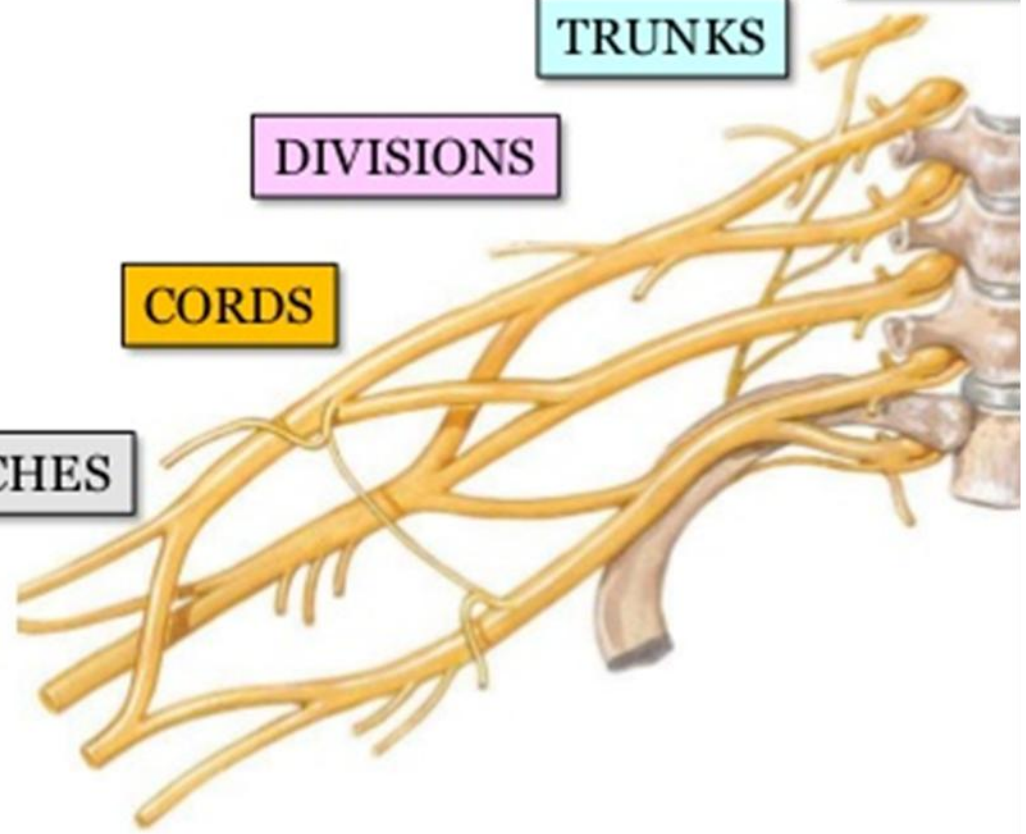
1. **Roots**
2. **Trunks**
3. **Divisions**
4. **Cords**
5. **Branches**



Lateral Cervical Region
(Posterior Triangle)



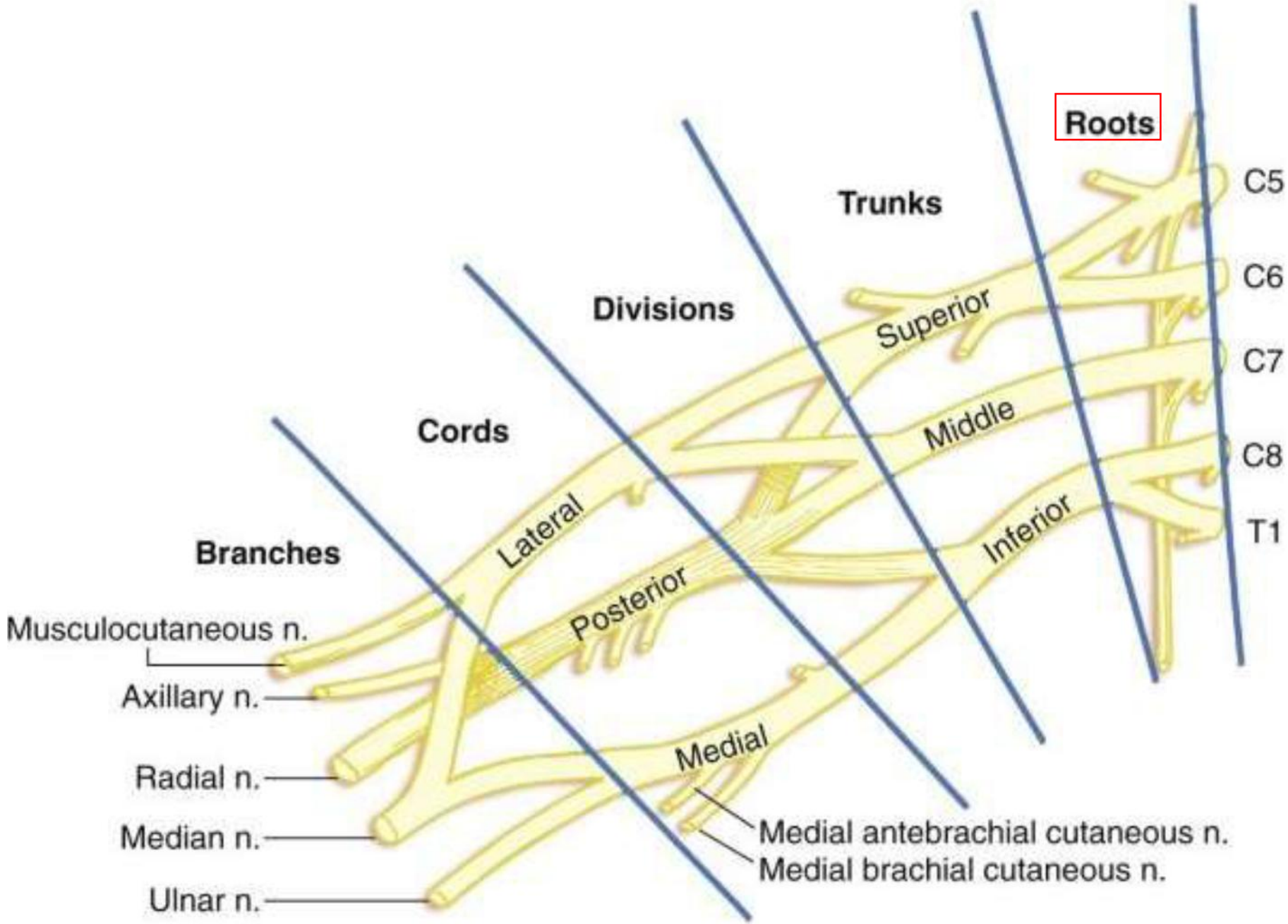
Brachial Plexus

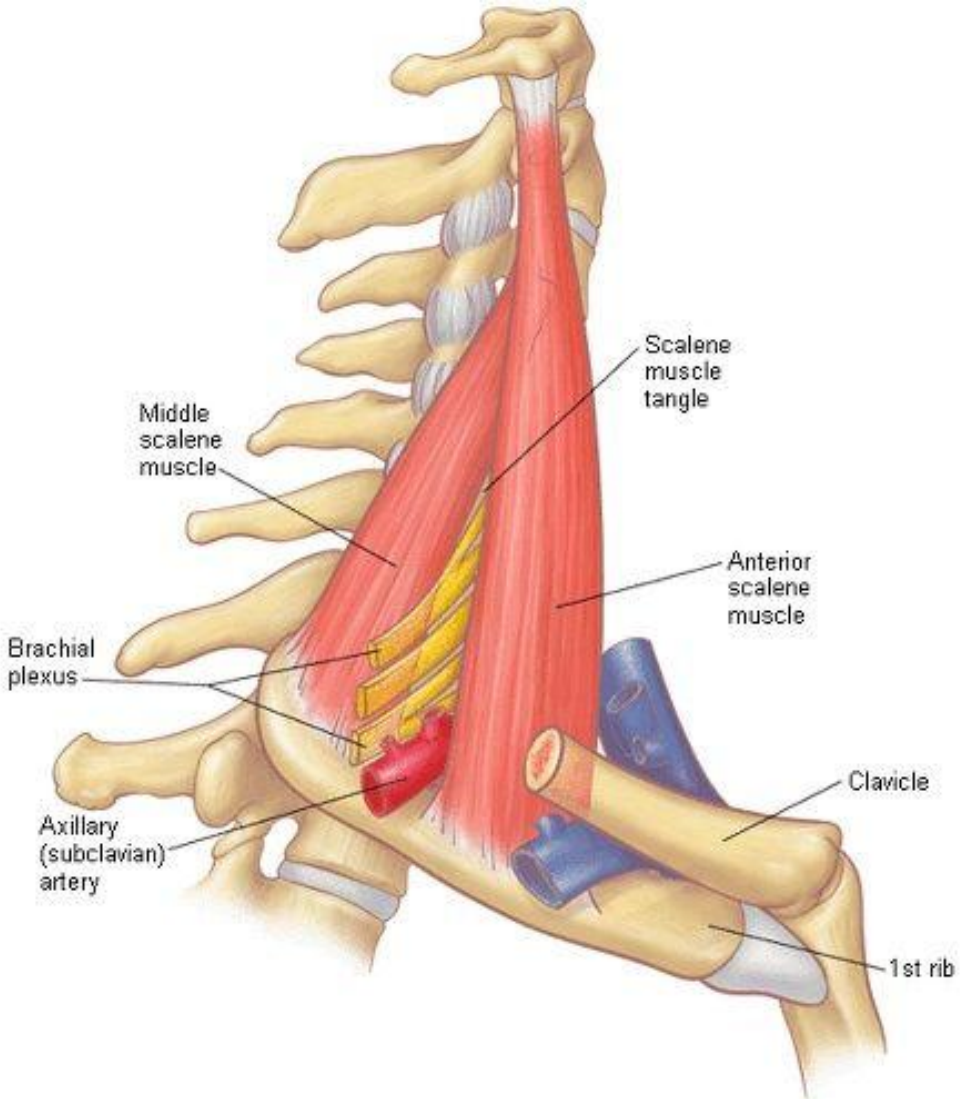


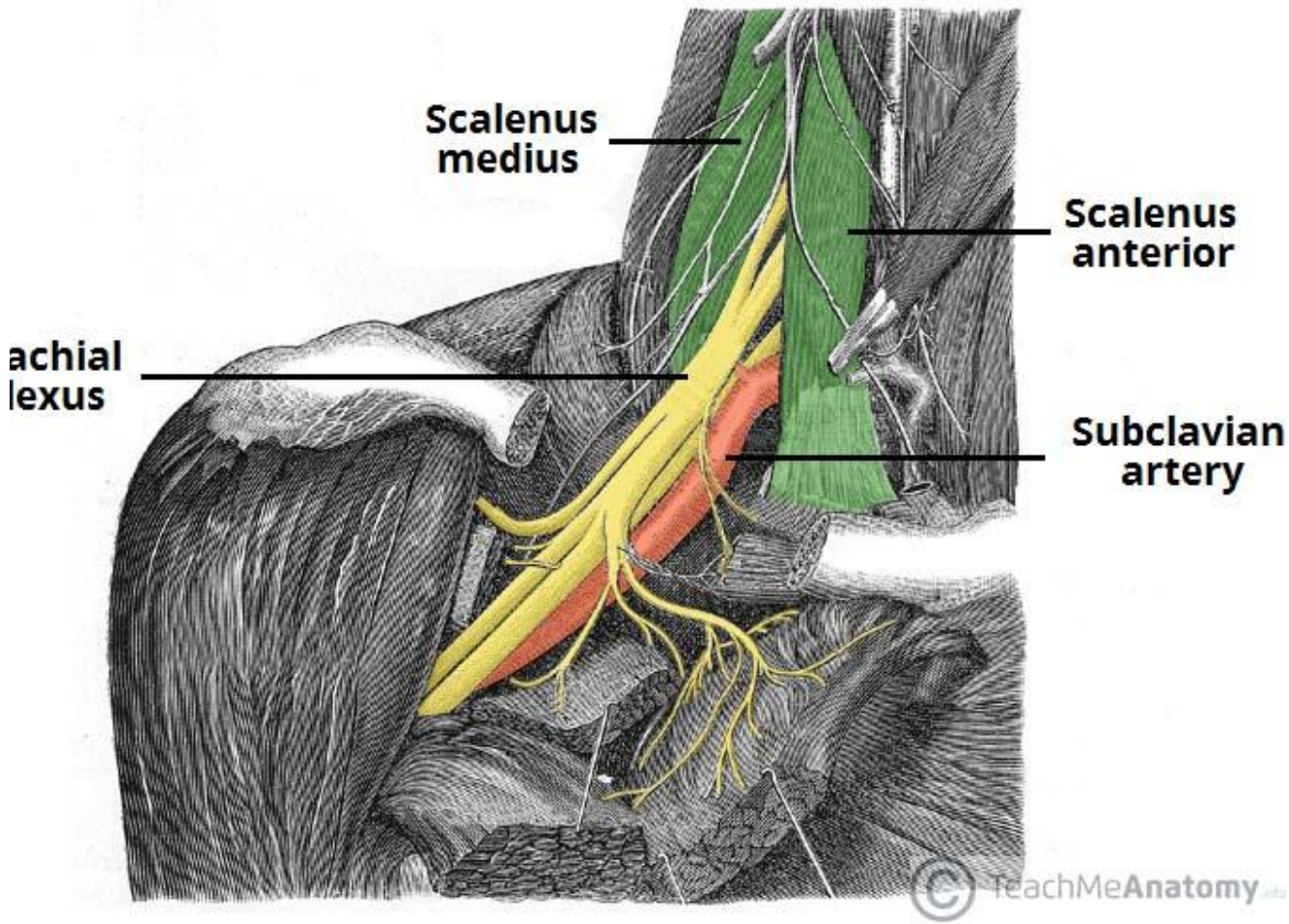
Roots

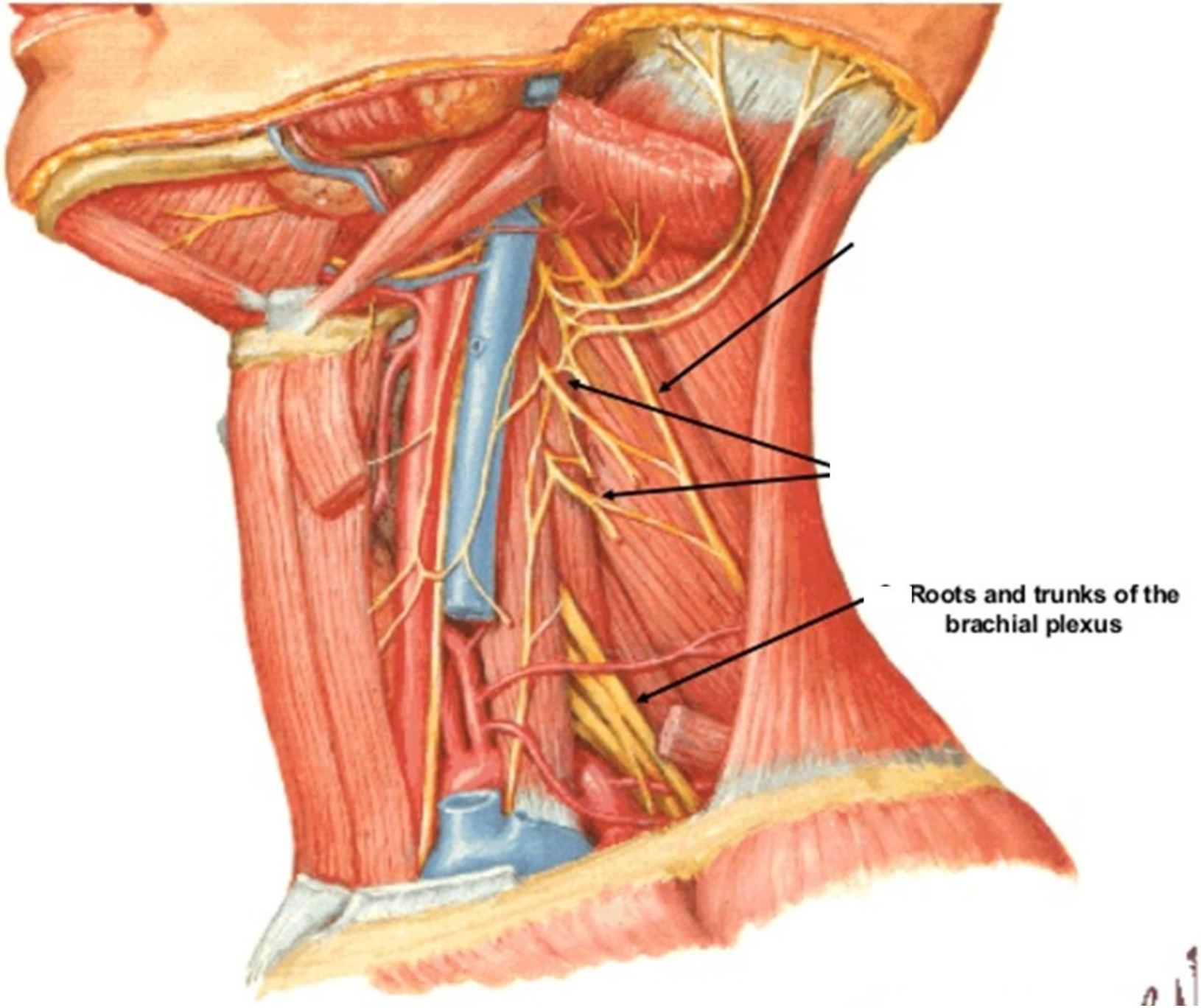
- The **Five Roots** are **the five ventral rami of spinal nerves C5 to T1.**

- The roots lie in the neck between *scalenus anterior* and *scalenus medius* muscles.


Roots
Trunks
Divisions
Cords
Branches
C5
C6
C7
C8
T1
Superior
Middle
Inferior
Lateral
Posterior
Medial
Musculocutaneous n.
Axillary n.
Radial n.
Median n.
Ulnar n.
Medial antebrachial cutaneous n.
Medial brachial cutaneous n.


Scalene muscle tangle
Middle scalene muscle
Anterior scalene muscle
Brachial plexus
Clavicle
Axillary (subclavian) artery
1st rib


Scalenus medius
Scalenus anterior
achial lexus
Subclavian artery
TeachMeAnatomy


Roots and trunks of the
brachial plexus

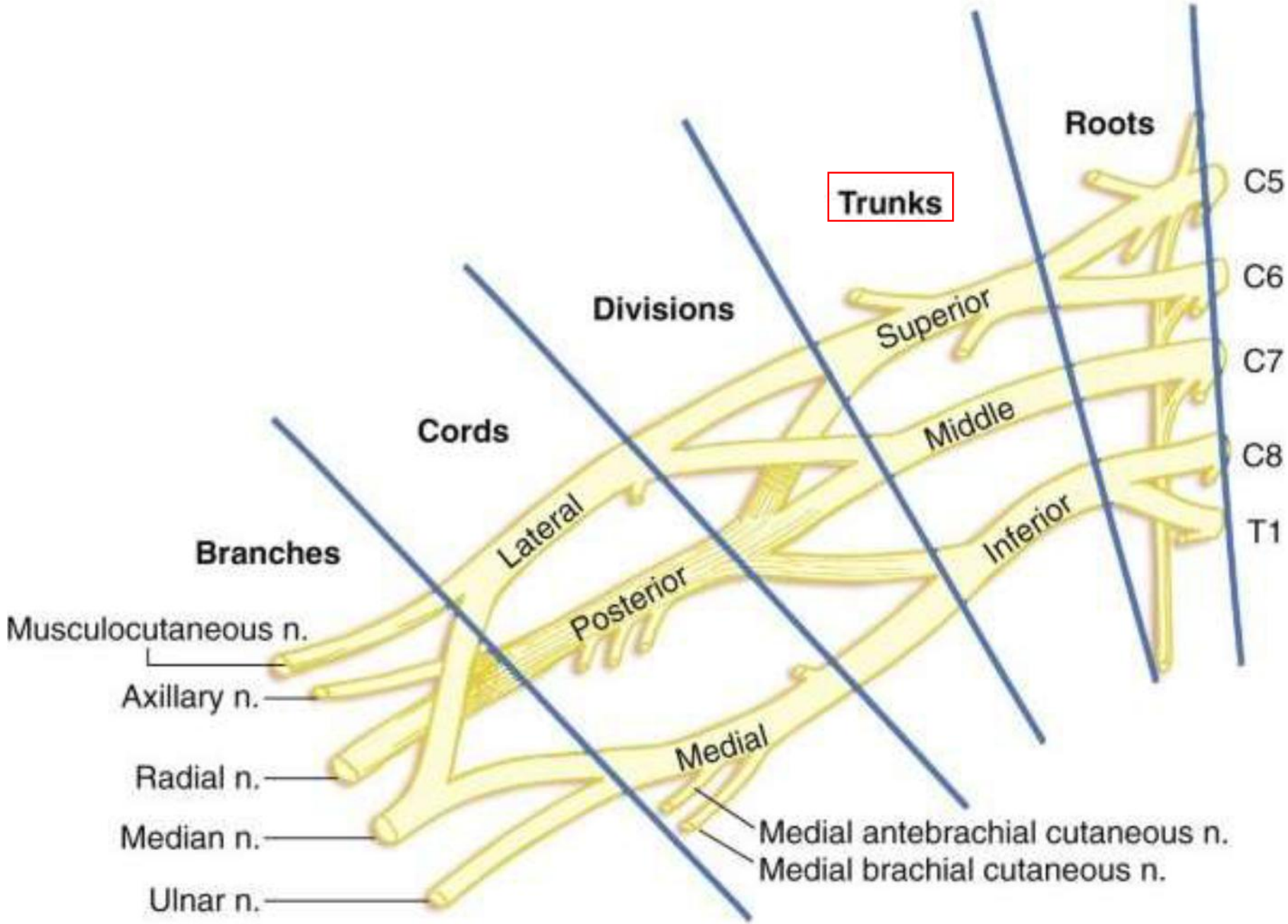
Trunks

- At the base of the neck, the roots of the brachial plexus converge to form **Three Trunks**.

- These structures are named by their relative anatomical location:

1. **Superior trunk** – a combination of **C5** and **C6** roots.
2. **Middle trunk** – continuation of **C7**.
3. **Inferior trunk** – combination of **C8** and **T1** roots.

- The trunks traverse laterally, crossing the posterior triangle of the neck.


Roots
Trunks
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Cords
Branches
C5
C6
C7
C8
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Superior
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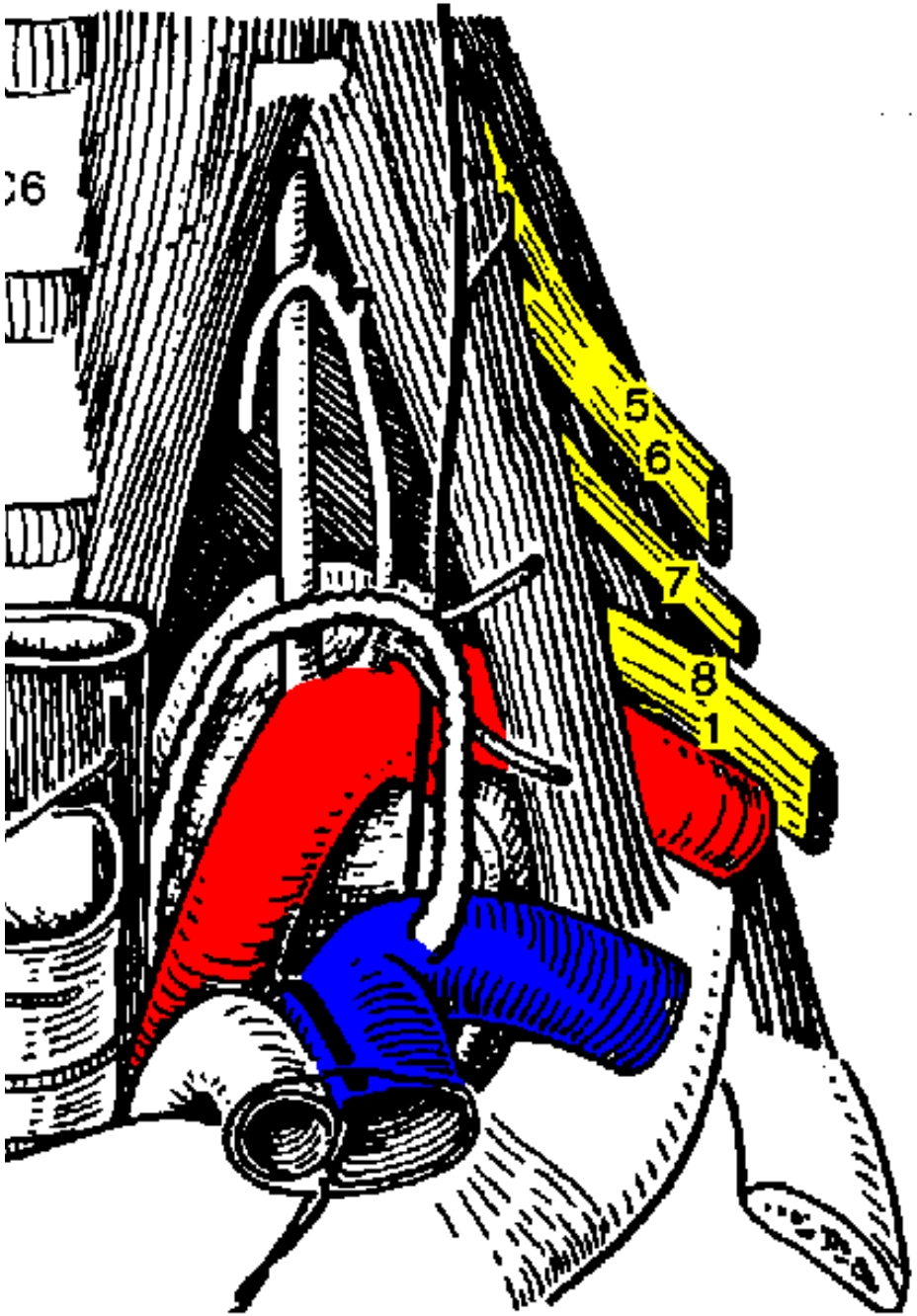
Musculocutaneous n.
Axillary n.
Radial n.
Median n.
Ulnar n.
Medial antebrachial cutaneous n.
Medial brachial cutaneous n.

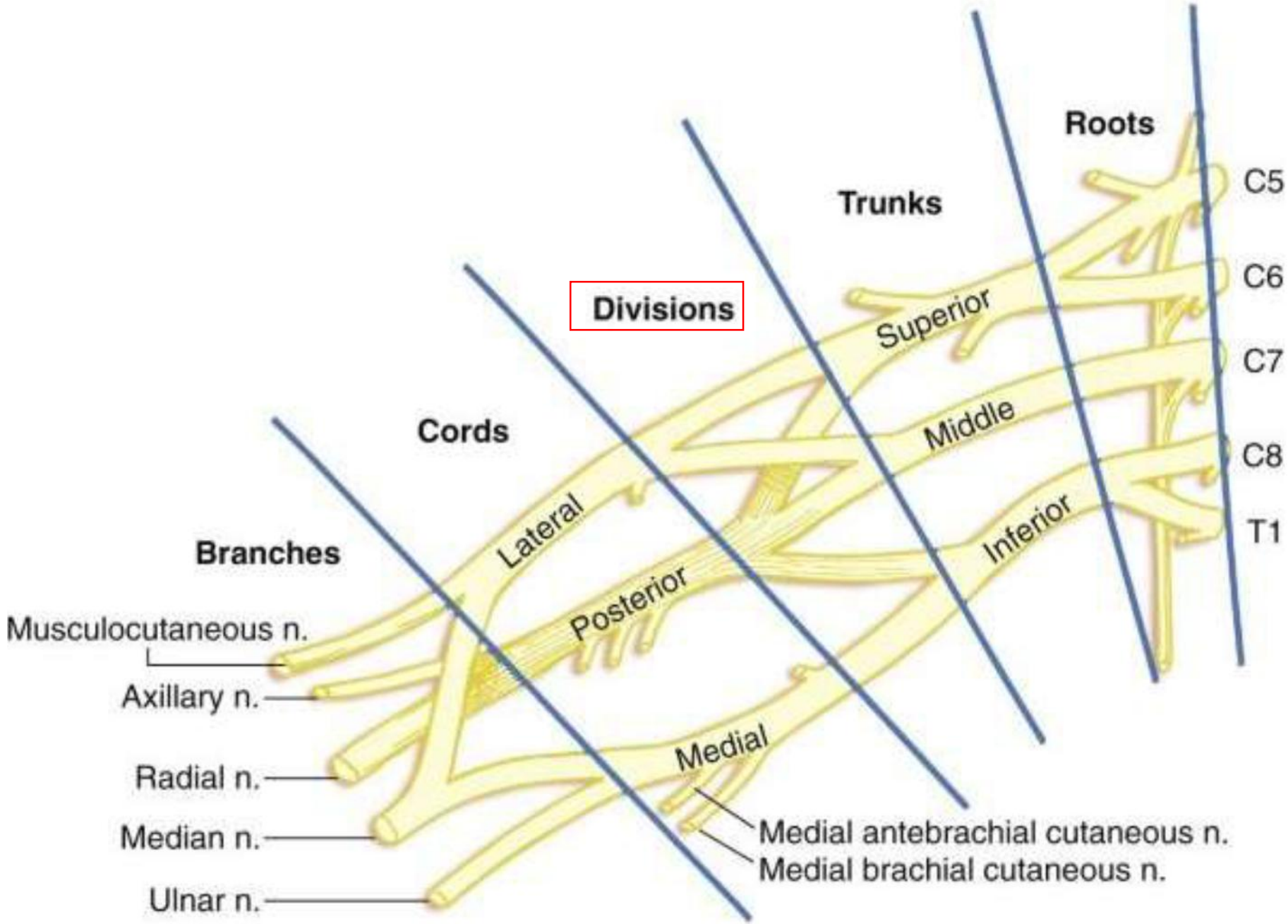


The inferior trunk lies on the first rib posterior to the subclavian artery

Divisions

- Each trunk splits into *two divisions* within the posterior triangle of the neck to form **Six Divisions**:
  - ***Three anterior divisions*** of the upper, middle and lower trunks
  - ***Three posterior divisions*** of the upper, middle, and lower trunks

- The anterior divisions usually supply flexor muscles of upper limb.
- The posterior divisions usually supply extensor muscles of upper limb.


Roots
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Posterior
Medial
Musculocutaneous n.
Axillary n.
Radial n.
Median n.
Ulnar n.
Medial antebrachial cutaneous n.
Medial brachial cutaneous n.

Cords

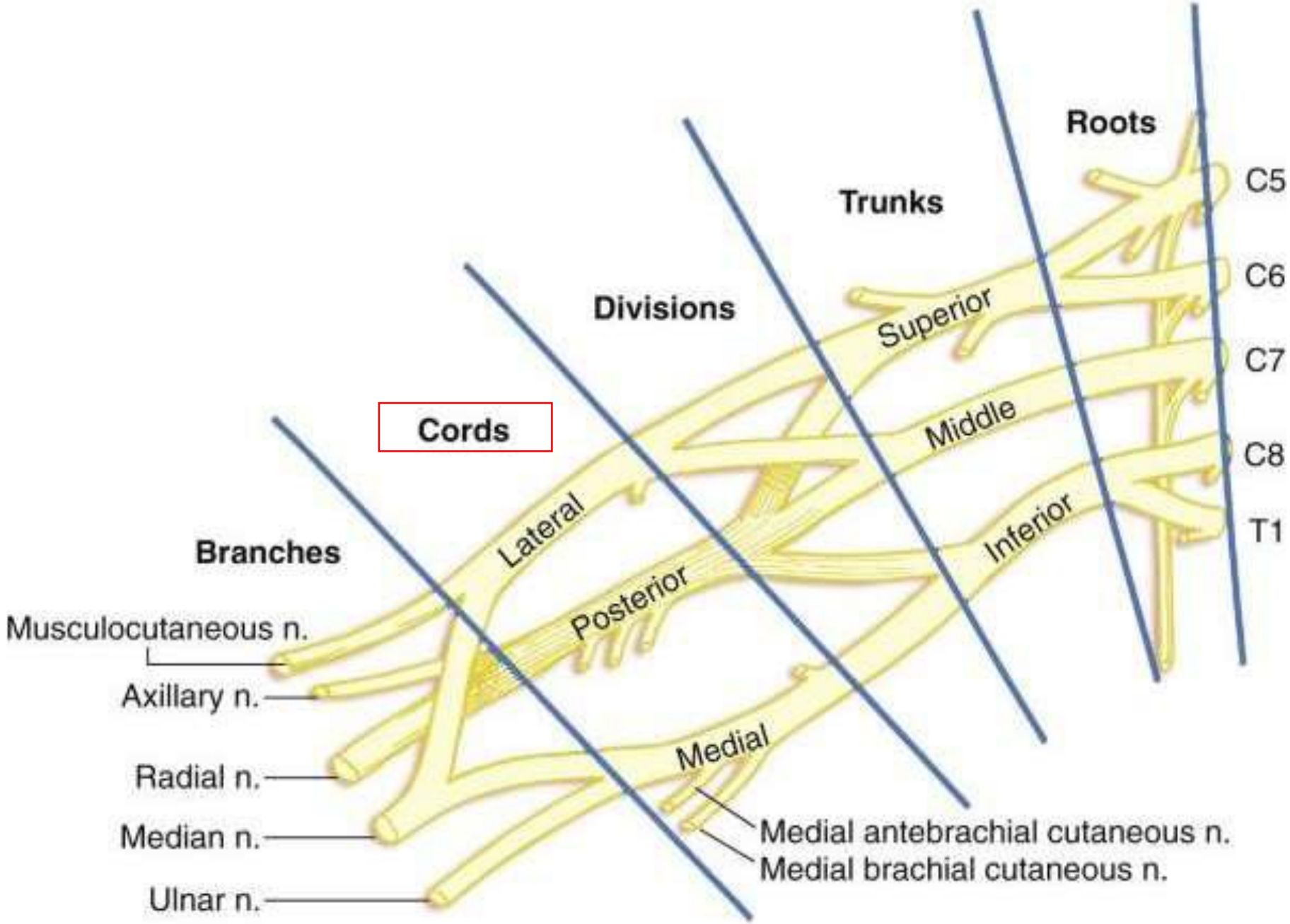
- Once the anterior and posterior divisions have entered the axilla, they combine together to form **Three Cords**.

- The cords are named by *their position in respect to the axillary artery*:

1. ***The posterior cord*** is formed from the three posterior divisions of the trunks.

2. ***The lateral cord*** is the anterior divisions from the upper and middle trunks.

3. ***The medial cord*** is simply a continuation of the anterior division of the lower trunk.


Roots
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C5
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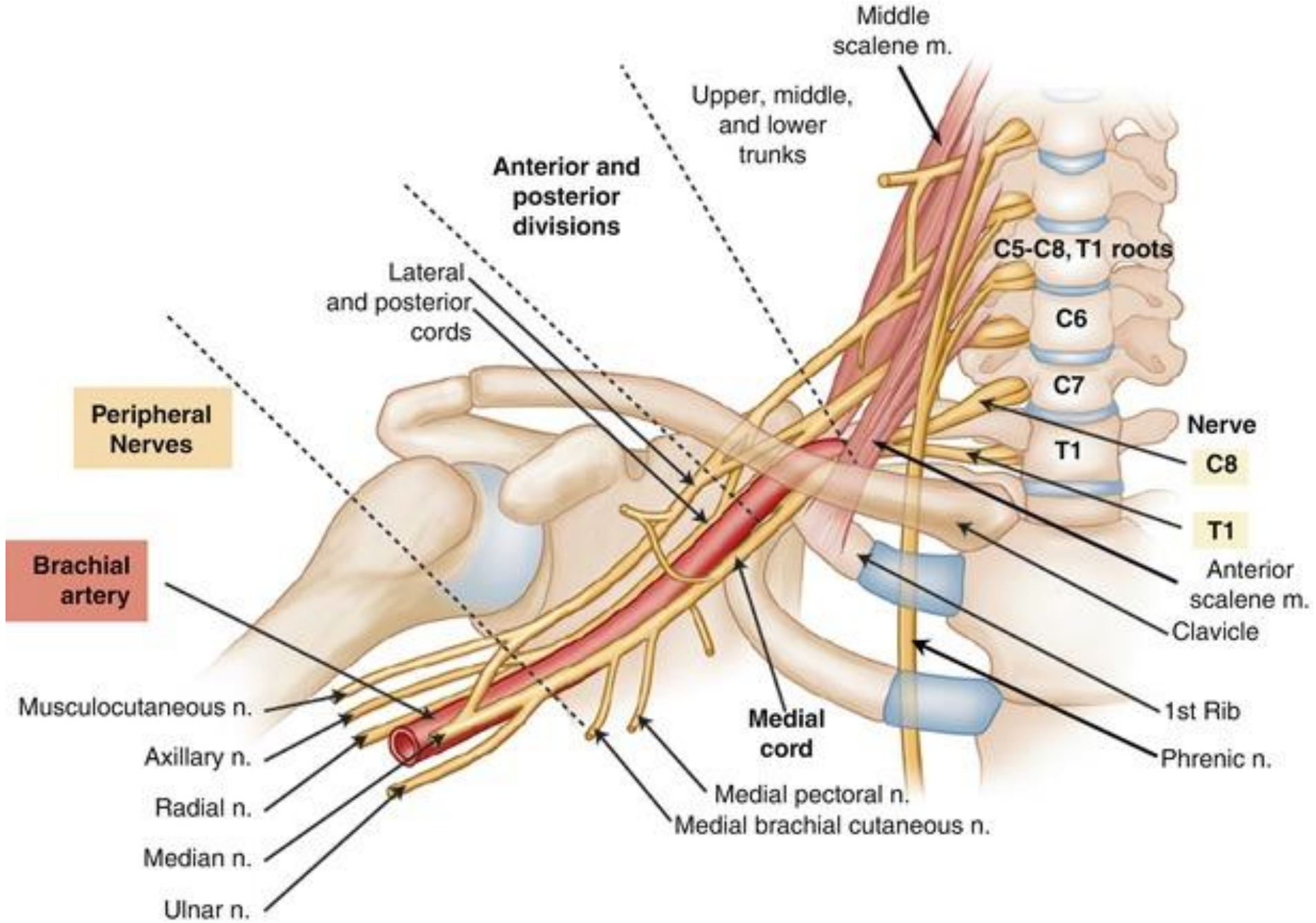
Middle scalene m.
Upper, middle, and lower trunks
Anterior and posterior divisions
Lateral and posterior cords
C5-C8, T1 roots
C6
C7
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Nerve
C8
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Brachial artery
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Clavicle
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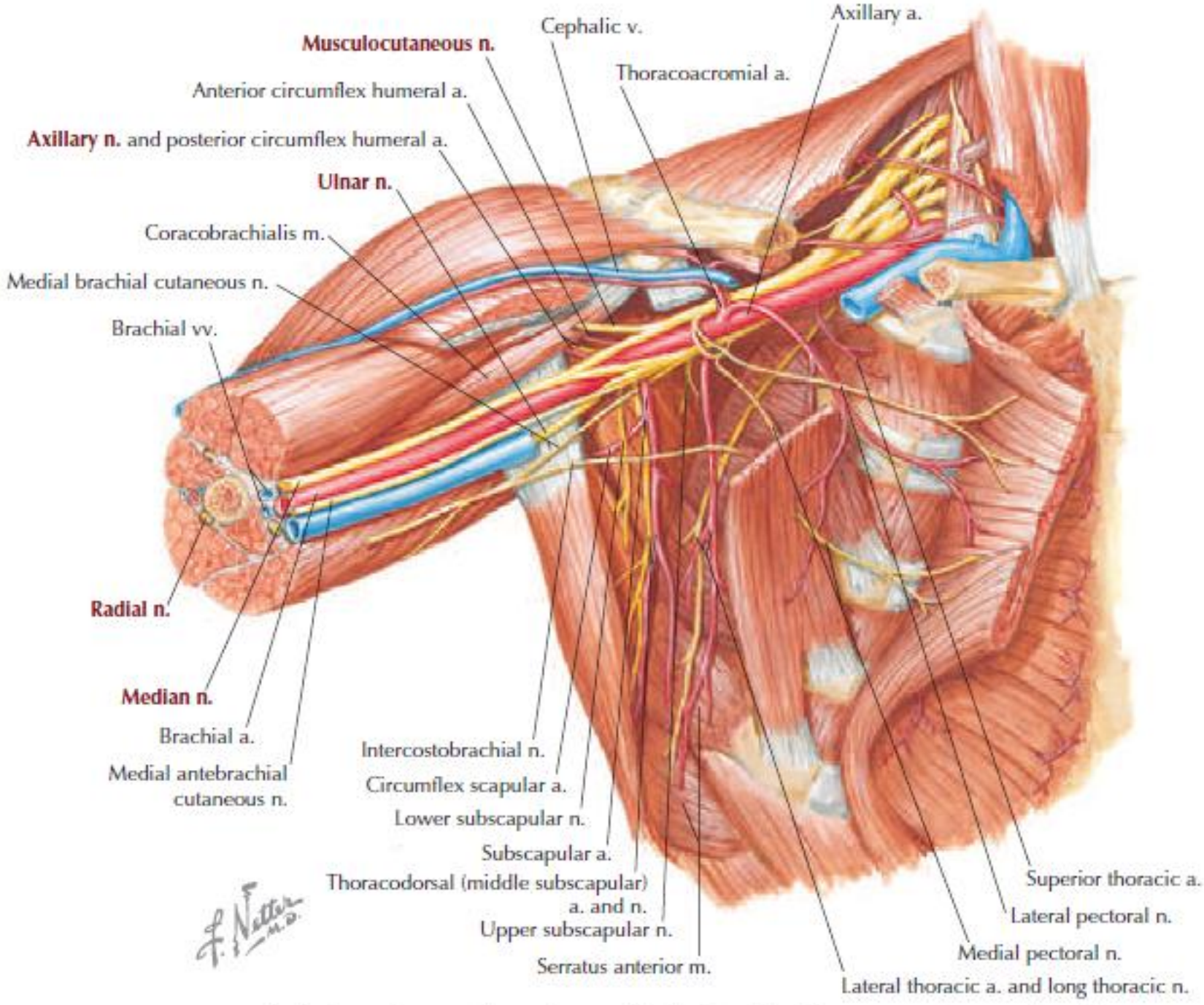
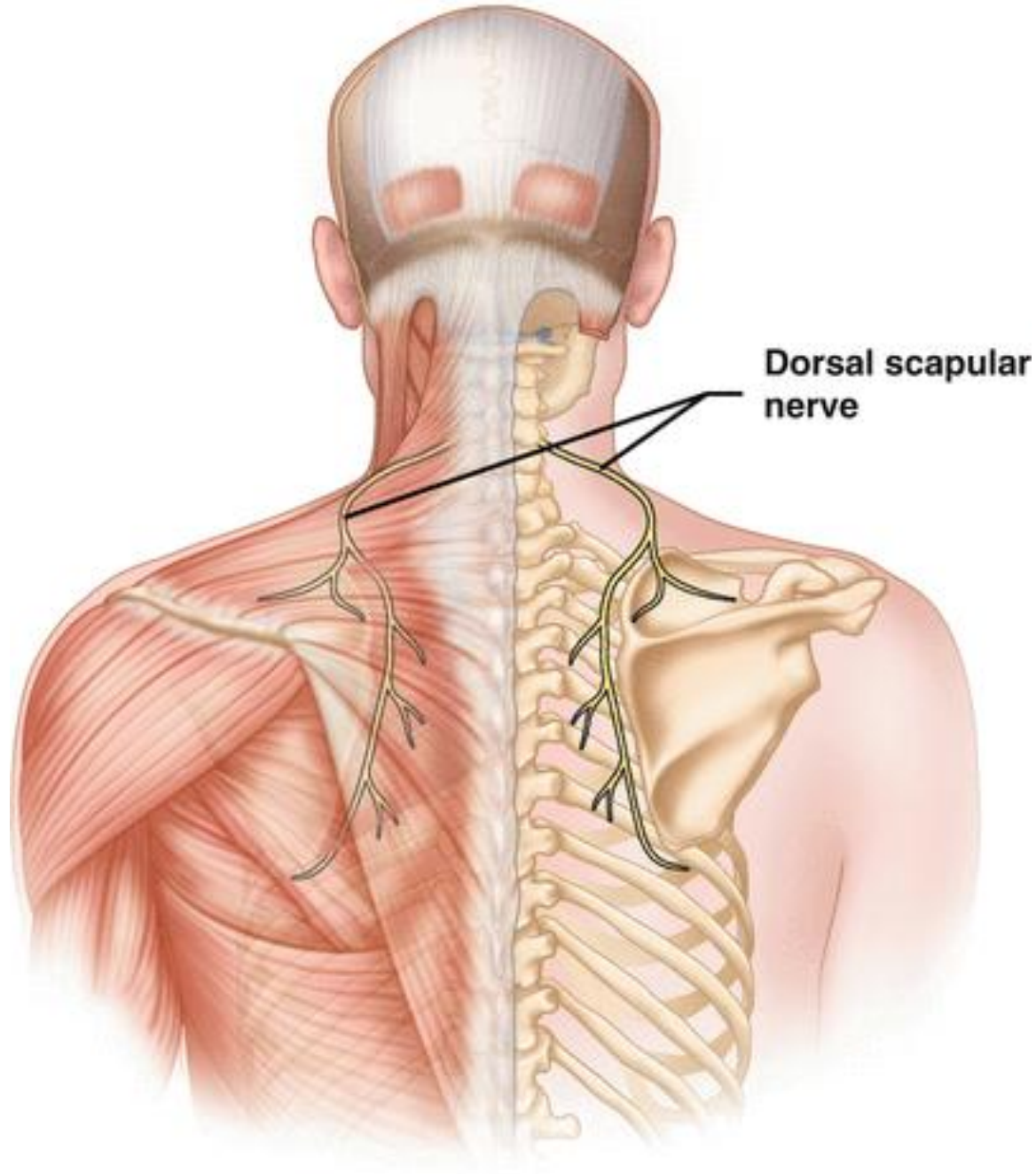
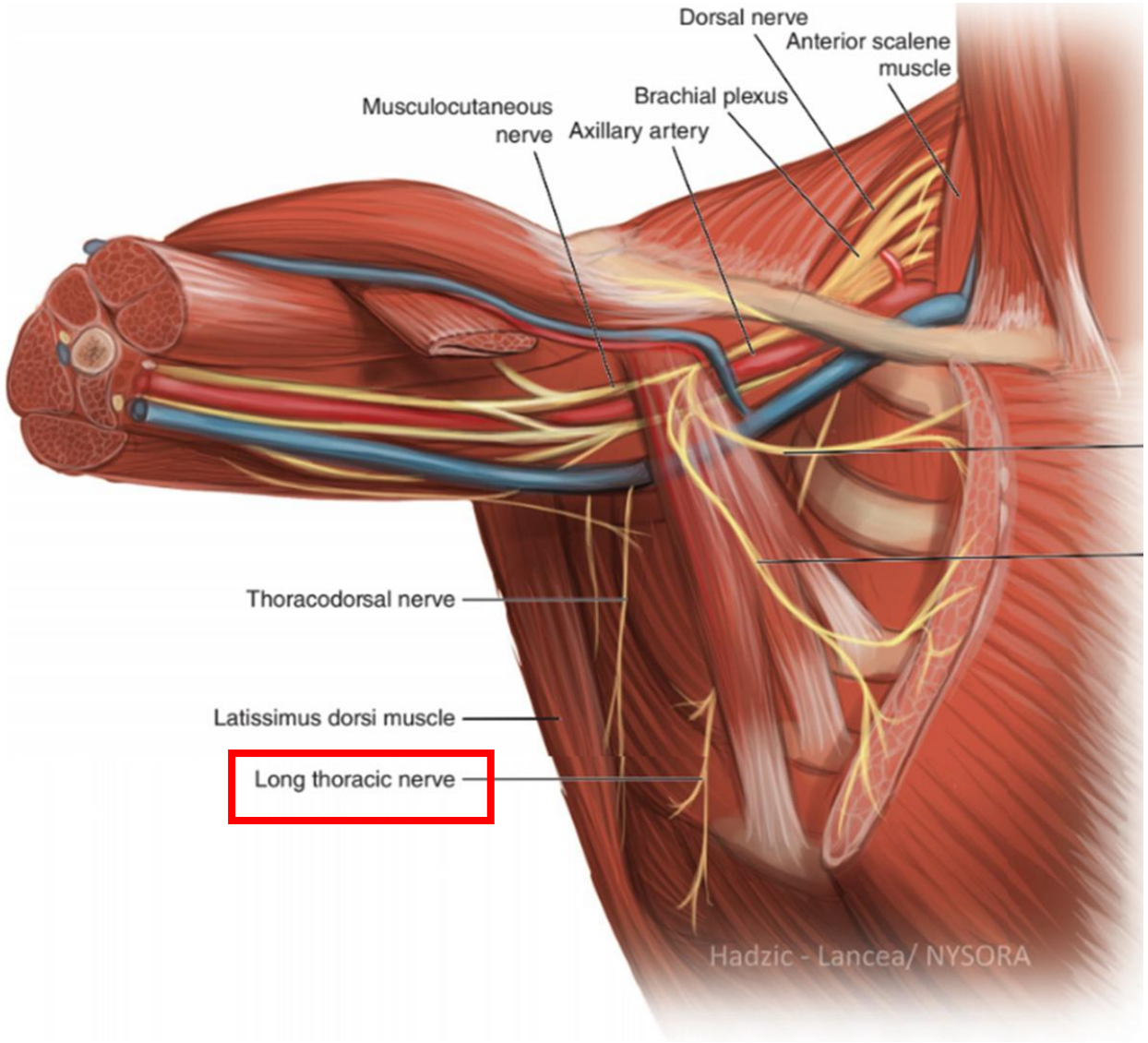

Musculocutaneous n.
Cephalic v.
Axillary a.
Thoracoacromial a.
Anterior circumflex humeral a.
Axillary n. and posterior circumflex humeral a.
Ulnar n.
Coracobrachialis m.
Medial brachial cutaneous n.
Brachial vv.
Radial n.
Median n.
Brachial a.
Medial antebrachial cutaneous n.
Intercostobrachial n.
Circumflex scapular a.
Lower subscapular n.
Subscapular a.
Thoracodorsal (middle subscapular) a. and n.
Upper subscapular n.
Serratus anterior m.
Superior thoracic a.
Lateral pectoral n.
Medial pectoral n.
Lateral thoracic a. and long thoracic n.

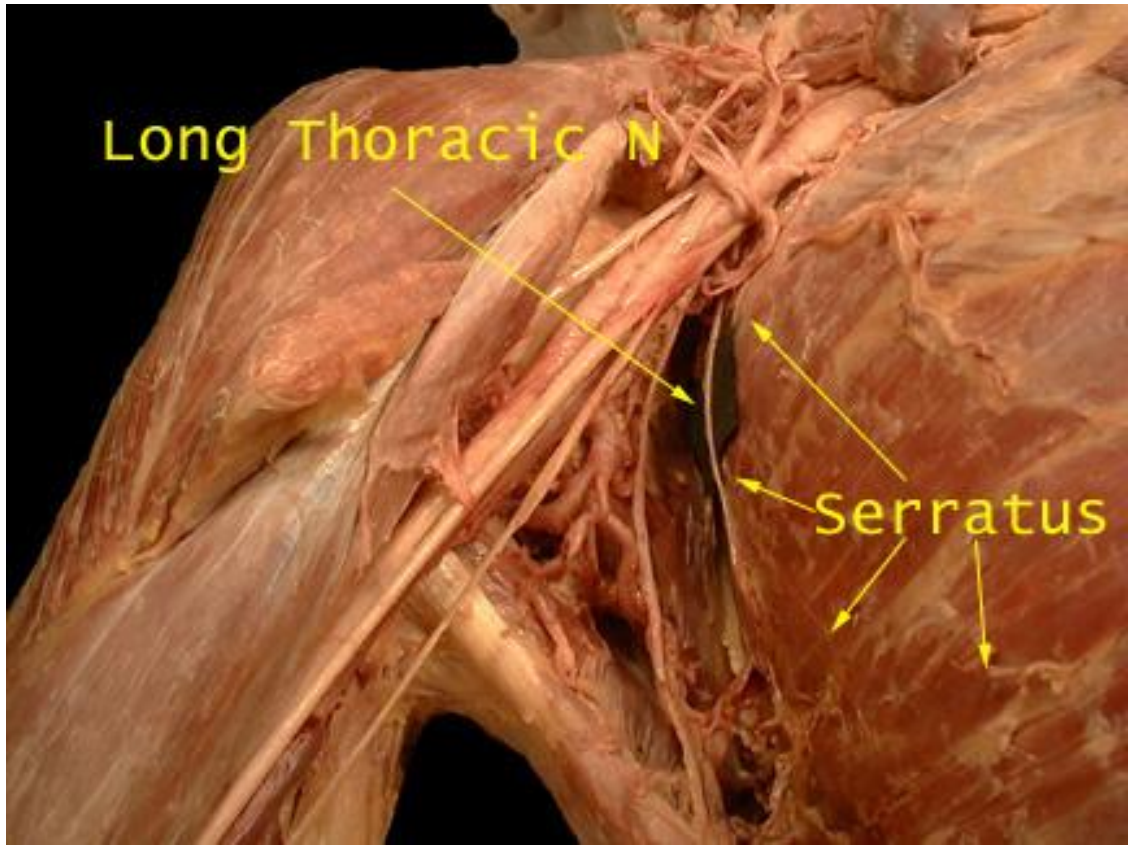
Branches of the Brachial Plexus

From the Roots

- **Dorsal Scapular Nerve** (C5)
  - Supply the Rhomboids muscles and levator scapula
- **Long Thoracic Nerve** (C 5,6,7)
  - Descends behind the brachial plexus and supplies serratus anterior muscle


Dorsal scapular
nerve

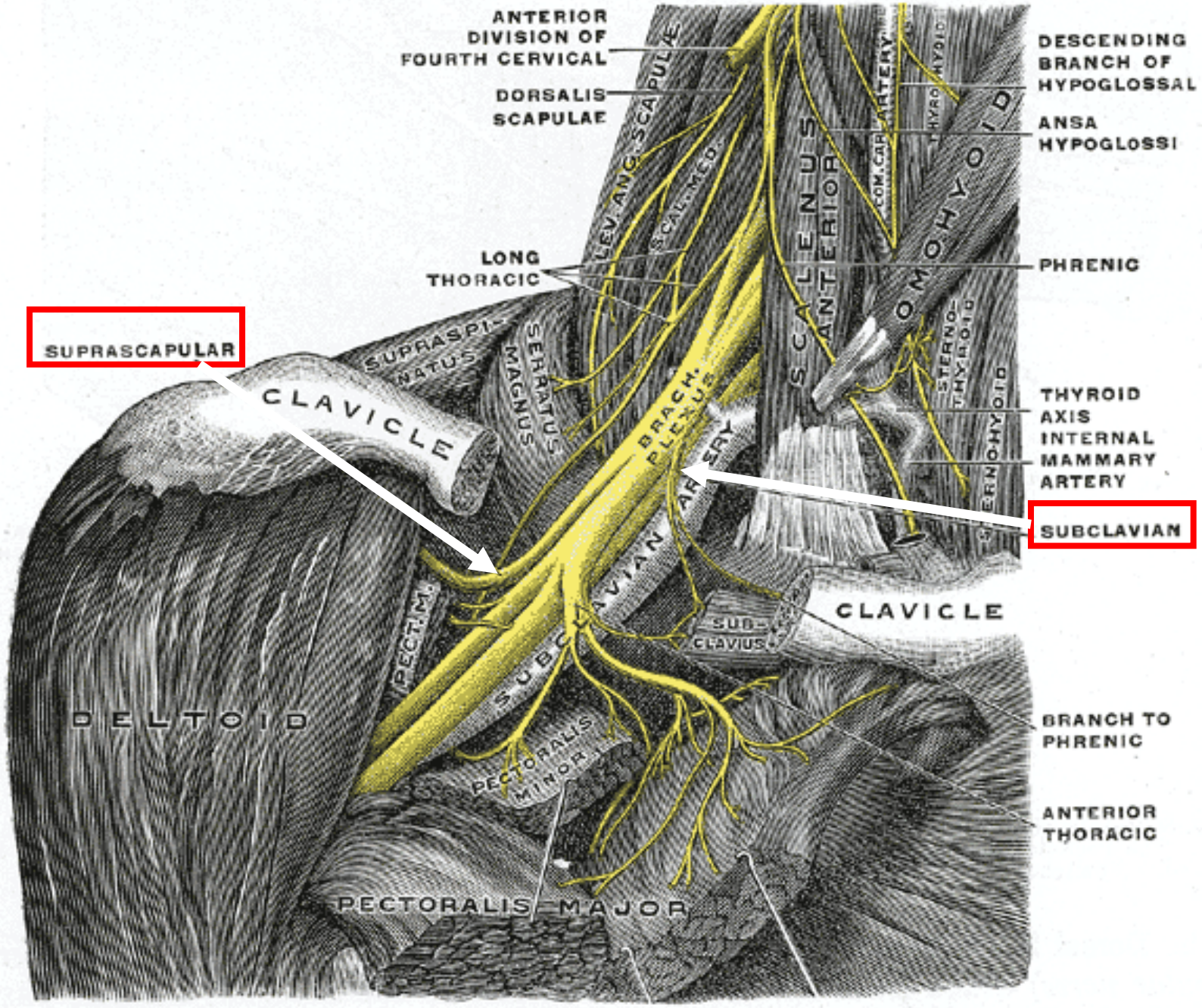

Dorsal nerve
Anterior scalene muscle
Brachial plexus
Musculocutaneous nerve
Axillary artery
Thoracodorsal nerve
Latissimus dorsi muscle
Long thoracic nerve
Hadzic - Lancea/ NYSORA


Long Thoracic N
Serratus

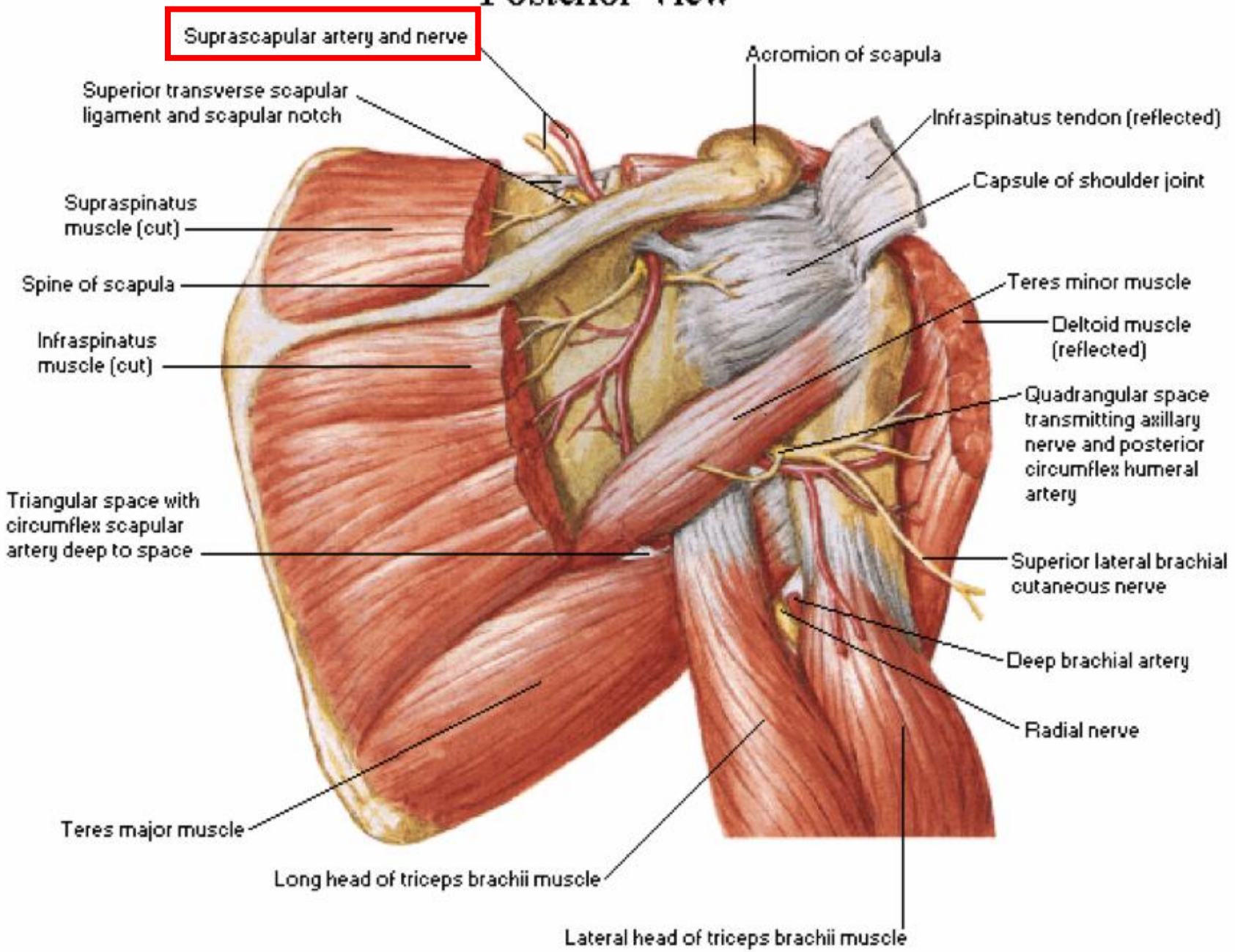
From the Upper Trunk

- **Nerve to subclavius muscle**

- **Suprascapular nerve**
  - Passes laterally across the neck, then through the *suprascapular notch* in the scapula to supply the supraspinatus and infraspinatus muscles.

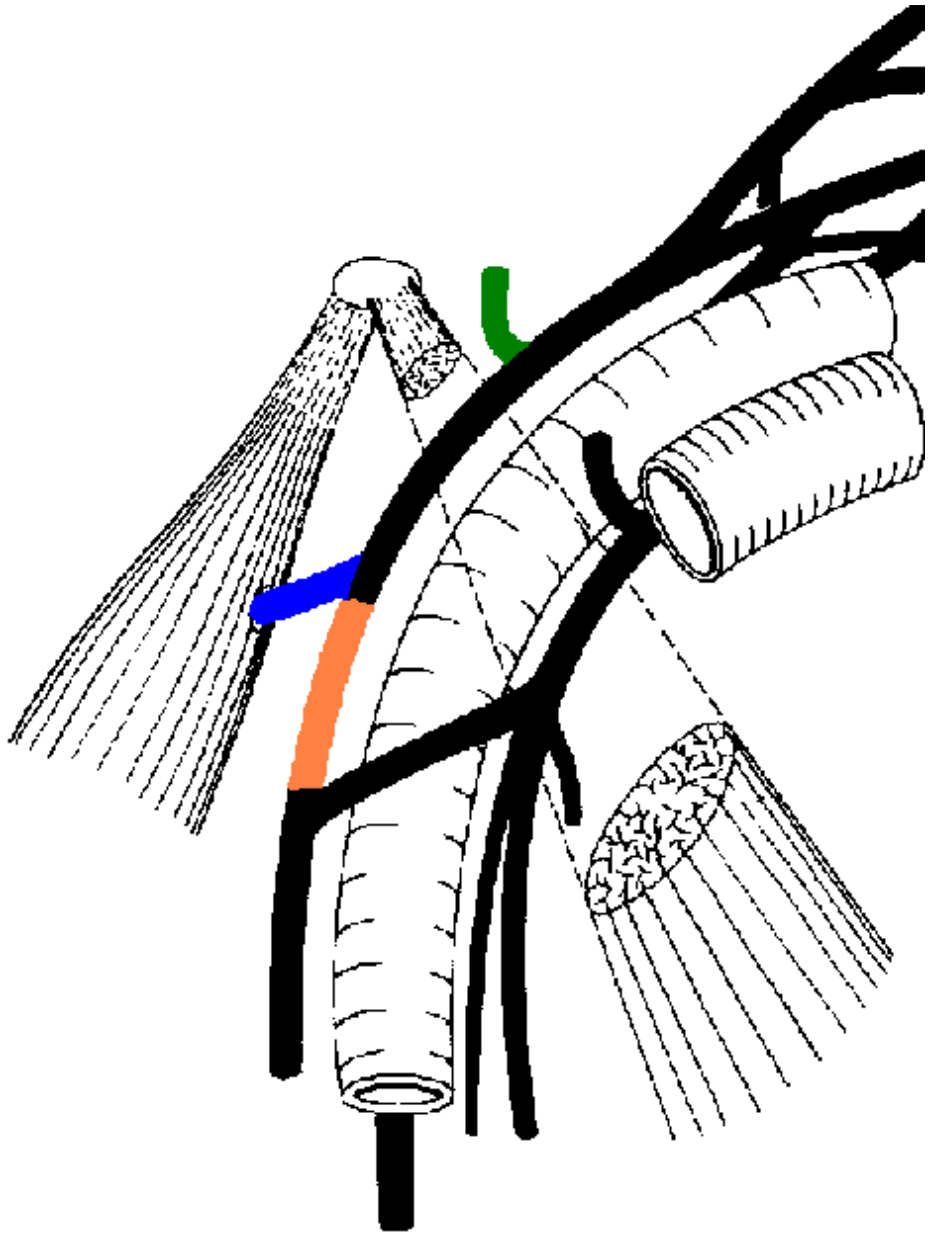

ANTERIOR DIVISION OF FOURTH CERVICAL
DORSALIS SCAPULAE
LONG THORACIC
SUPRASCAPULAR
DESCENDING BRANCH OF HYPOGLOSSAL
ANSA HYPOGLOSSI
PHRENIC
THYROID AXIS
INTERNAL MAMMARY ARTERY
SUBCLAVIAN
BRANCH TO PHRENIC
ANTERIOR THORACIC
CLAVICLE
CLAVICLE
DELTOID
PECTORALIS MAJOR
LEV. ANG. SCAPULAE
SCAL. MED.
SCALENUS ANTERIOR
COM. CAR. ARTERY
THYRO-HYOID
OMOHYOID
STERNO-THYROID
STERNO-HYOID
SUPRASPINATUS
SERRATUS MAGNUS
BRACH. PLEXUS
SUBCLAVIAN ARTERY
PECT. M.
SUB-CLAVIUS
PECTORALIS MINOR

Posterior View



Branches of the Lateral Cord

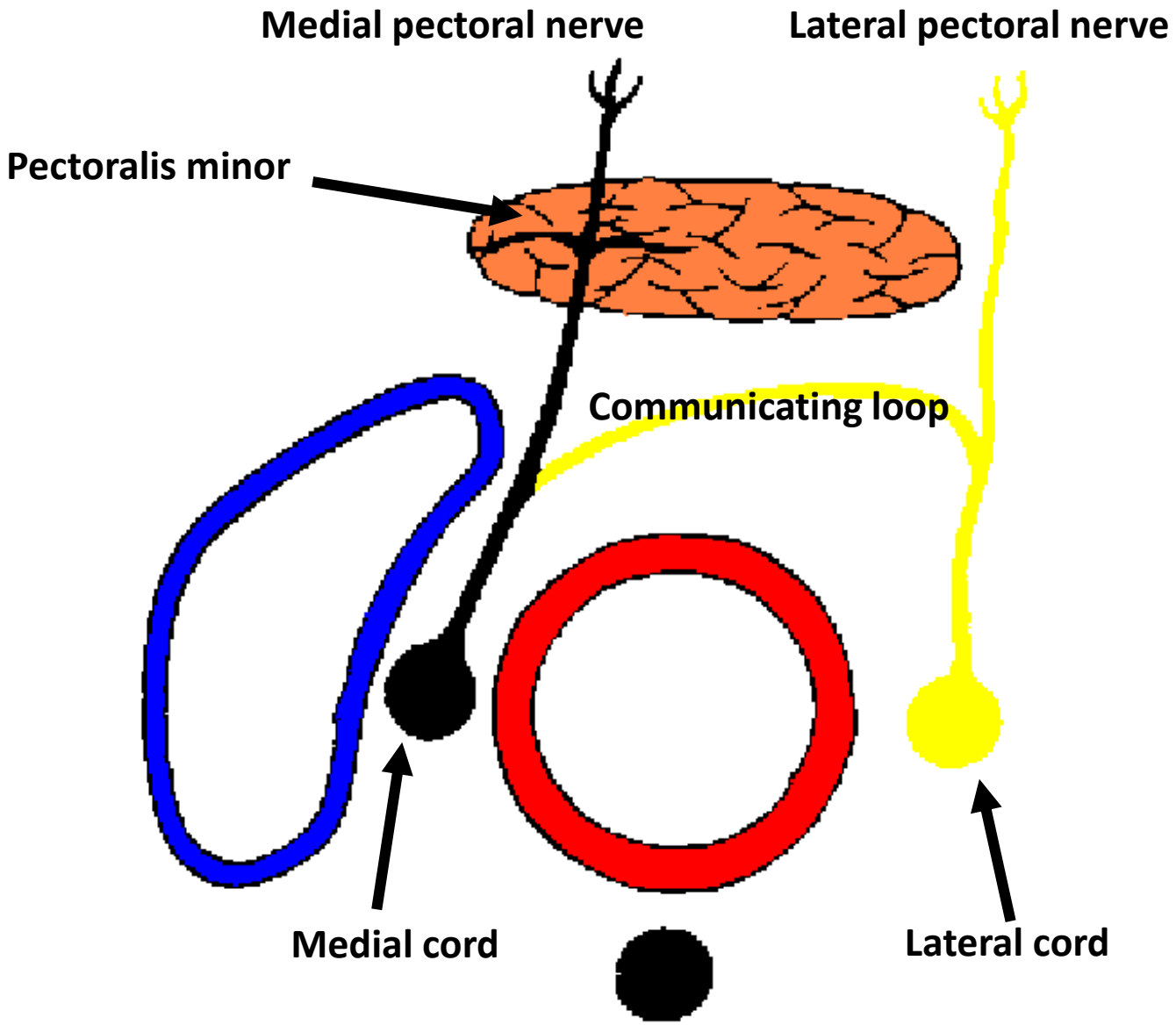
- The lateral cord has 3 branches: the **lateral pectoral nerve** and 2 terminal branches, the **musculocutaneous** and the **lateral root of the median nerve.**

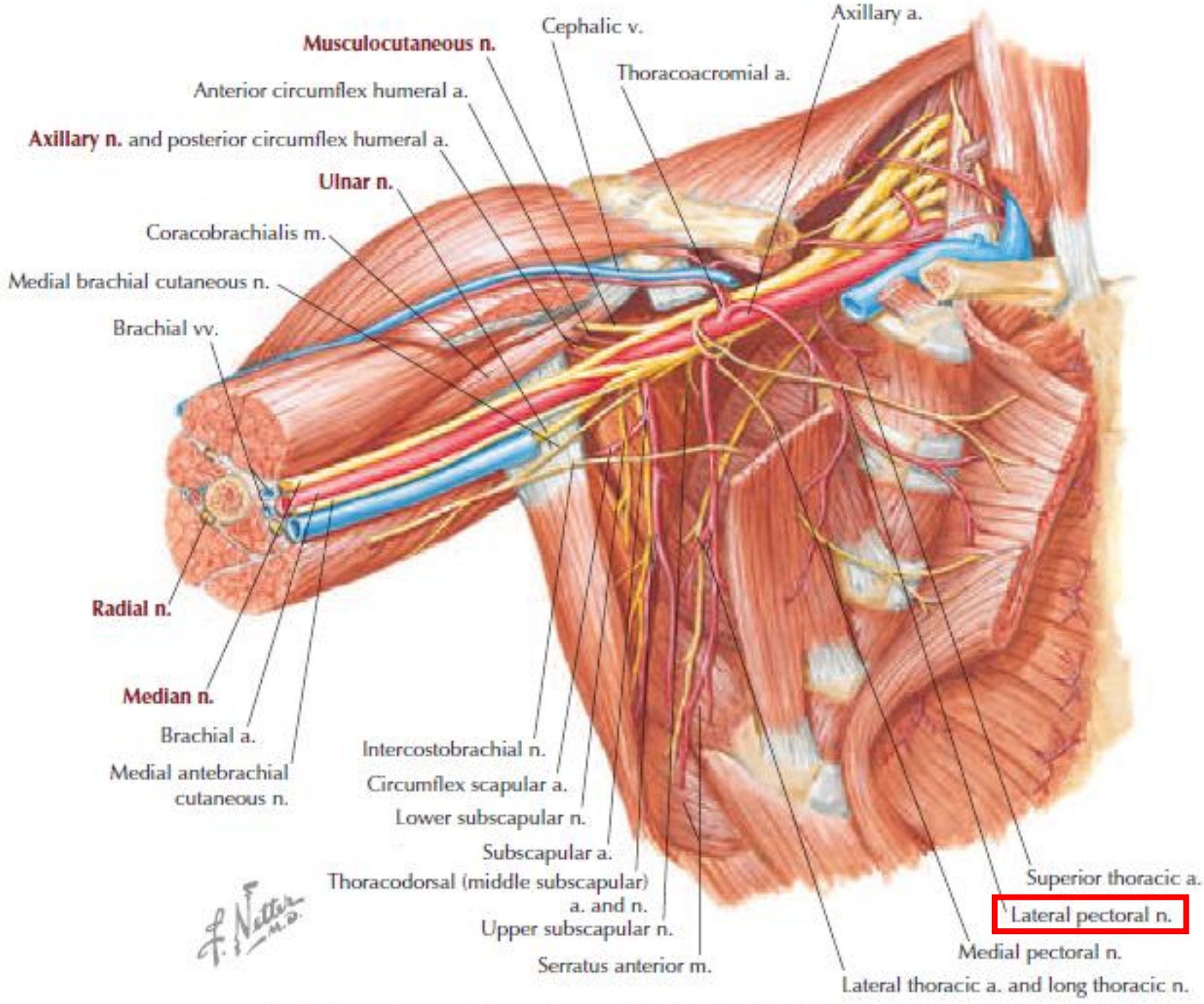


Lateral Pectoral Nerve

- The lateral pectoral nerve pierces the clavipectoral fascia to supply pectoralis major muscle.

- Sends a **communicating loop** to the medial pectoral nerve, through which it supplies pectoralis minor muscle


Medial pectoral nerve
Lateral pectoral nerve
Pectoralis minor
Communicating loop
Medial cord
Lateral cord


Musculocutaneous n.
Cephalic v.
Axillary a.
Thoracoacromial a.
Anterior circumflex humeral a.
Axillary n. and posterior circumflex humeral a.
Ulnar n.
Coracobrachialis m.
Medial brachial cutaneous n.
Brachial vv.
Radial n.
Median n.
Brachial a.
Medial antebrachial cutaneous n.
Intercostobrachial n.
Circumflex scapular a.
Lower subscapular n.
Subscapular a.
Thoracodorsal (middle subscapular) a. and n.
Upper subscapular n.
Serratus anterior m.
Superior thoracic a.
Lateral pectoral n.
Medial pectoral n.
Lateral thoracic a. and long thoracic n.

Musculocutaneous Nerve

- **Roots:** C5, C6, C7.

- **Course:**

Arises from the lateral cord of the brachial plexus.

↓

It runs downward and laterally, pierces the coracobrachialis muscle

↓

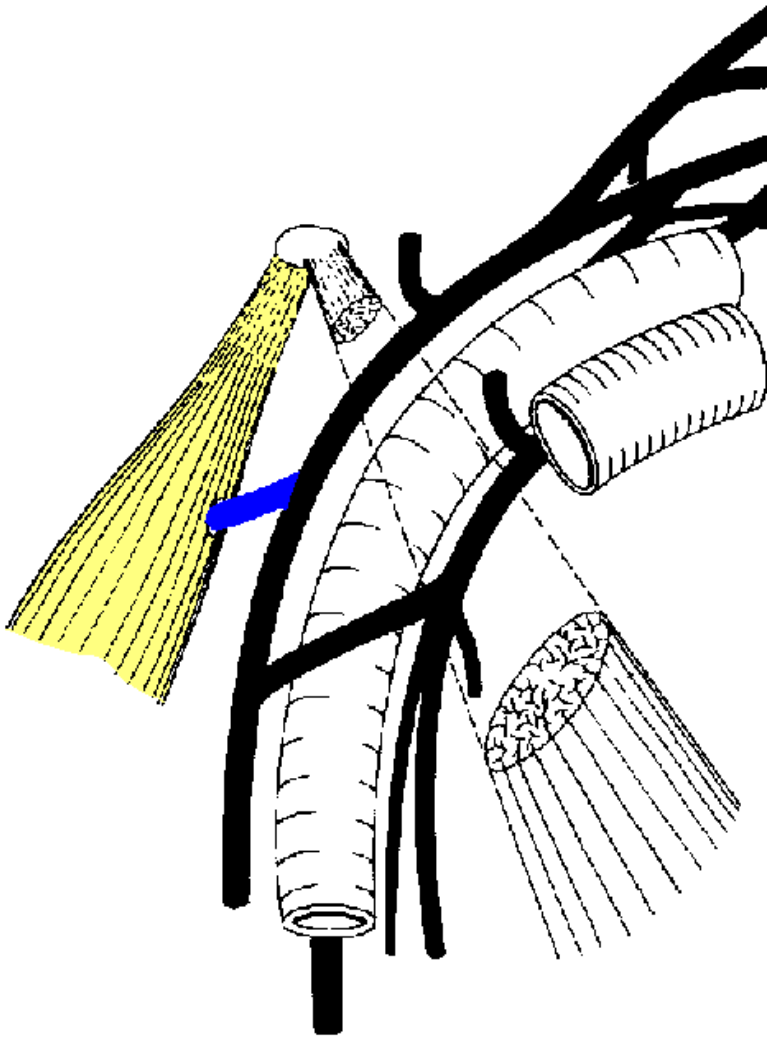
Then passes downward between the biceps and brachialis muscles

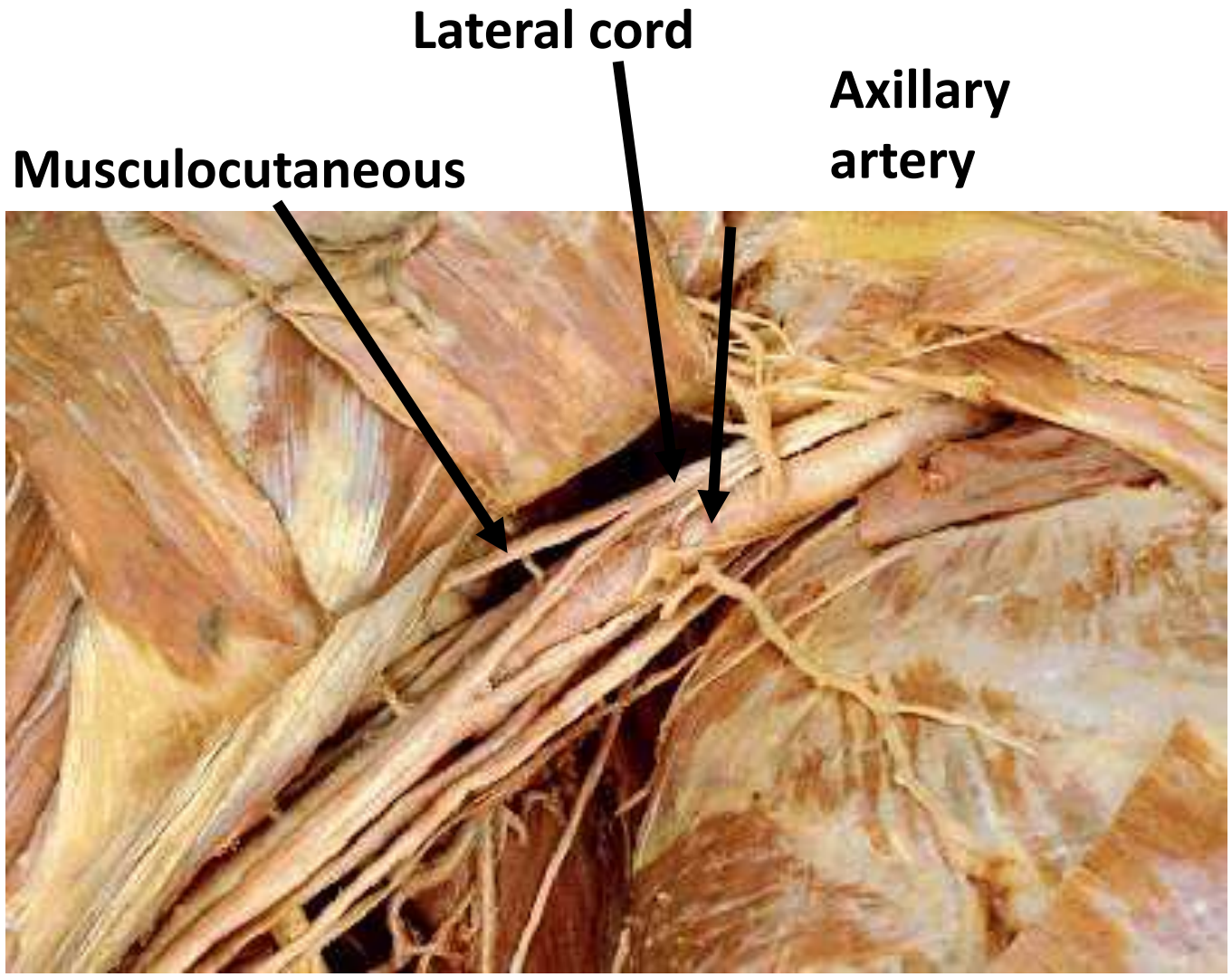
↓

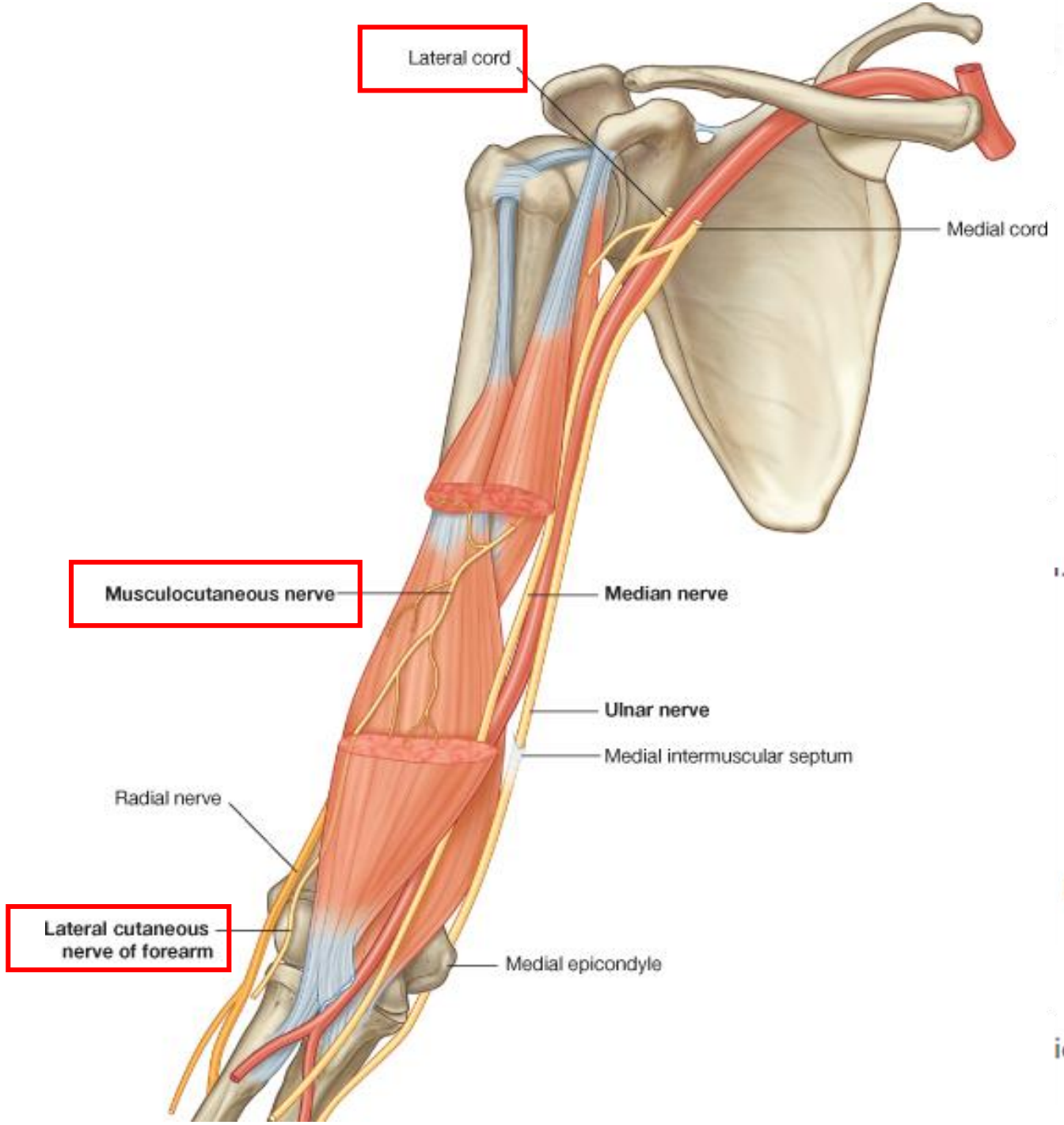
It appears at the lateral margin of the biceps tendon and pierces the deep fascia just above the elbow.

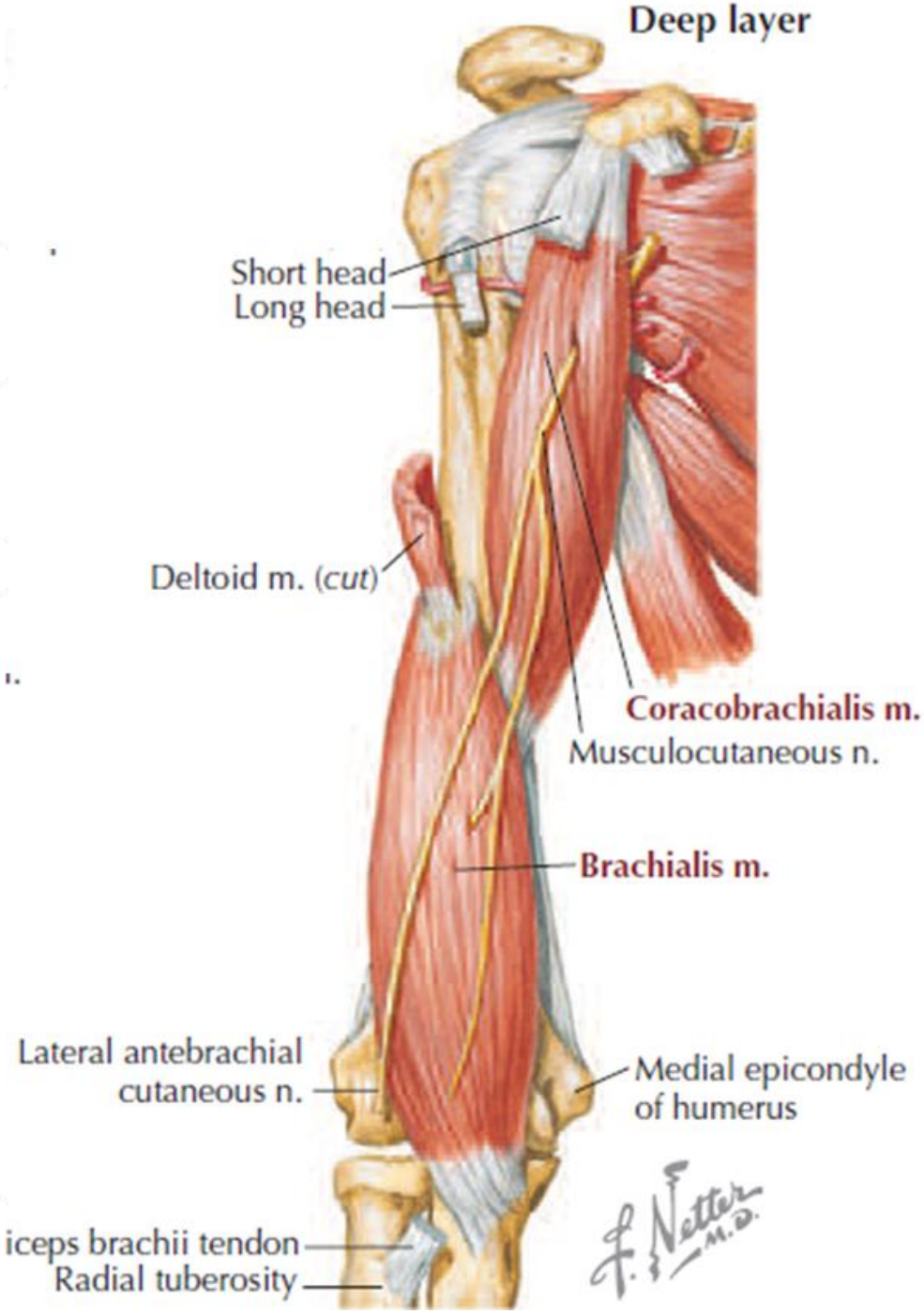
↓

runs down the lateral aspect of the forearm as the **lateral cutaneous nerve of the forearm**




Lateral cord
Axillary artery
Musculocutaneous


Lateral cord
Medial cord
Musculocutaneous nerve
Median nerve
Ulnar nerve
Medial intermuscular septum
Radial nerve
Lateral cutaneous nerve of forearm
Medial epicondyle


Deep layer
Short head
Long head
Deltoid m. (cut)
Coracobrachialis m.
Musculocutaneous n.
Brachialis m.
Lateral antebrachial cutaneous n.
Medial epicondyle of humerus
iceps brachii tendon
Radial tuberosity
F. Netter M.D.

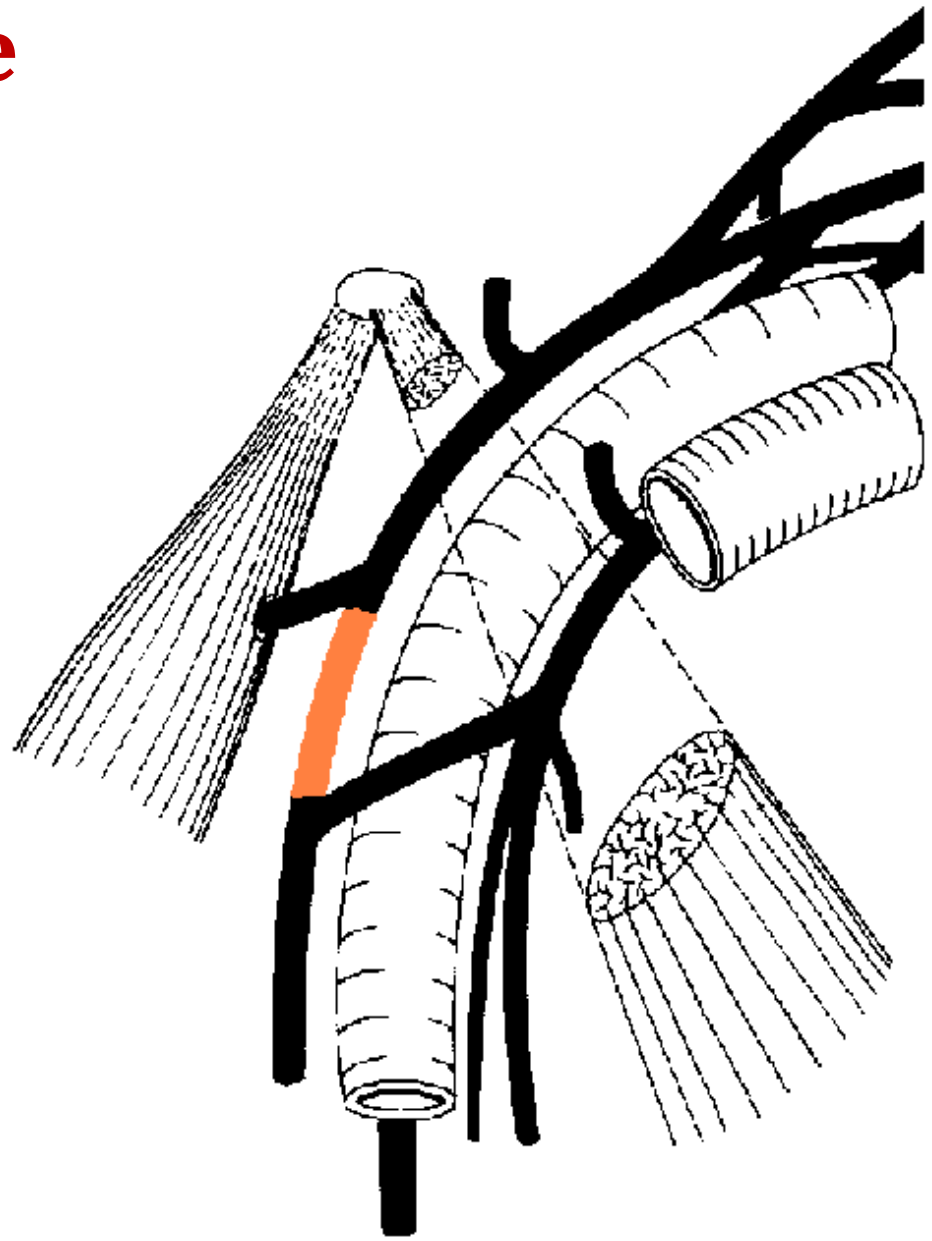
Contd..

- **Motor Functions:** Innervates the brachialis, biceps brachii and coracobrachialis muscles.

- **Sensory Functions:** the *lateral cutaneous branch of the forearm*, which innervates the lateral half of the anterior forearm, and a small lateral portion of the posterior forearm.

Lateral root of the median nerve

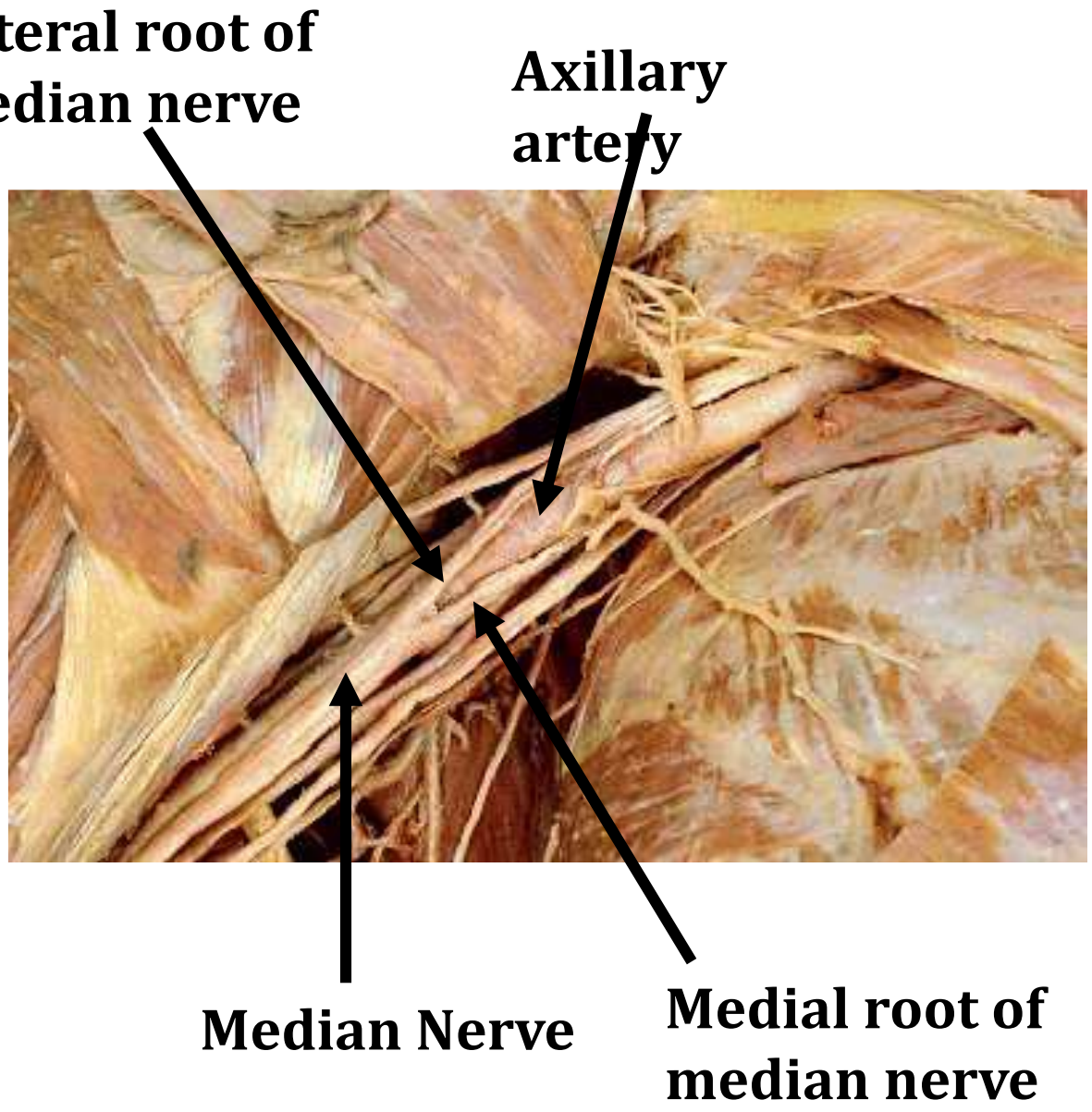
- The lateral root of the median nerve is the direct continuation of the lateral cord.



Median Nerve

- The median nerve arises by **medial and lateral roots** *from the corresponding cords* of the brachial plexus.

- **Nerve roots:** C6 – T1



Median Nerve - Anatomical Course

Median nerve enters the anterior compartment of arm at the lower border of teres major.

↓

In the arm, initially it lies lateral to the brachial artery, then crosses in front of the artery to reach its medial side.

↓

Enters the cubital fossa where it lies medial to the brachial artery.

↓

It leaves the cubital fossa by passing between the two heads of the pronator teres and gives off **anterior interosseous nerve**.

.

Contd..

In the forearm , the nerve travels between the flexor digitorum profundus and flexor digitorum superficialis muscles.

↓

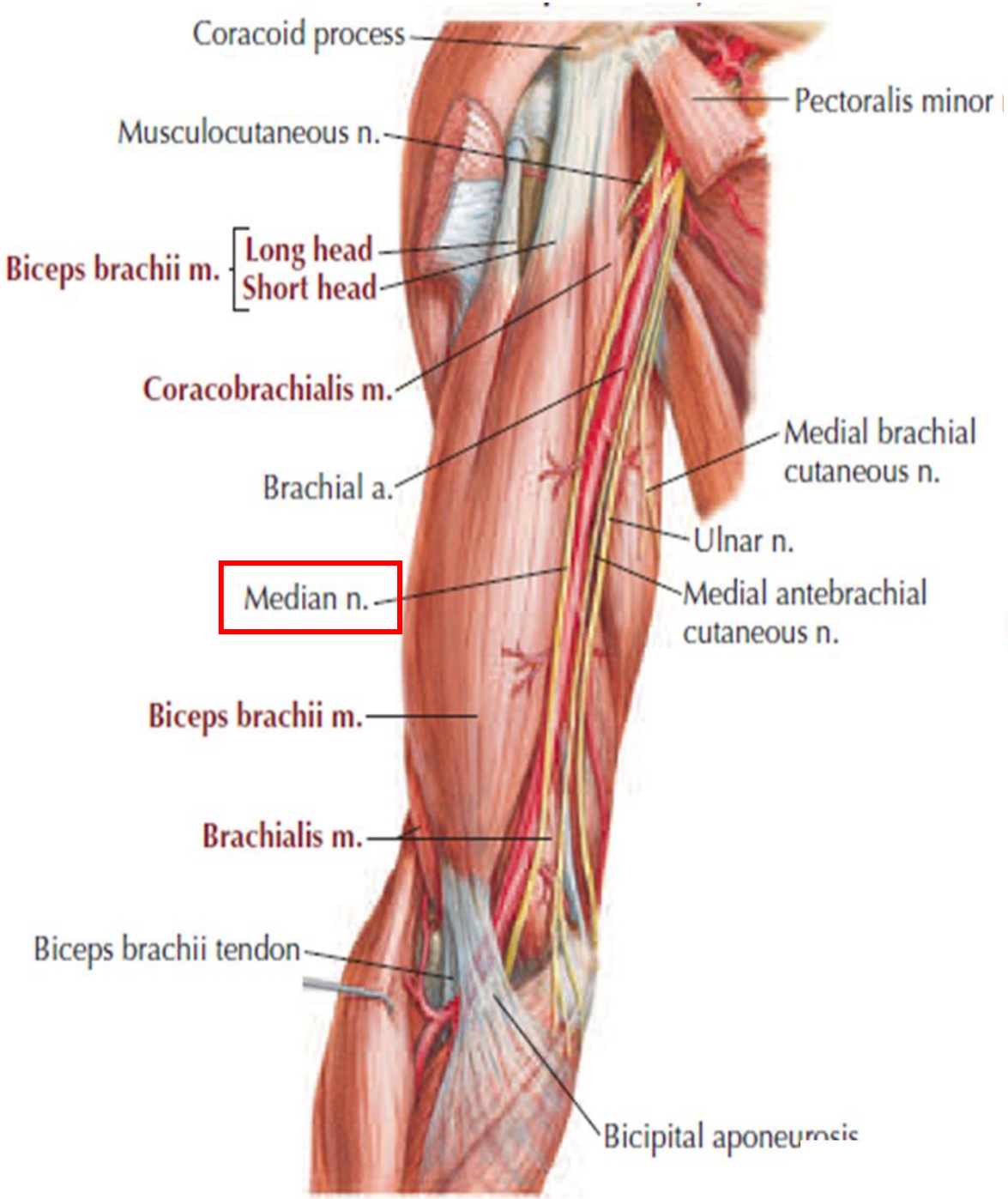
5 cm proximal to flexor retinaculum it becomes superficial and lies lateral to the tendons of flexor digitorum superficialis .

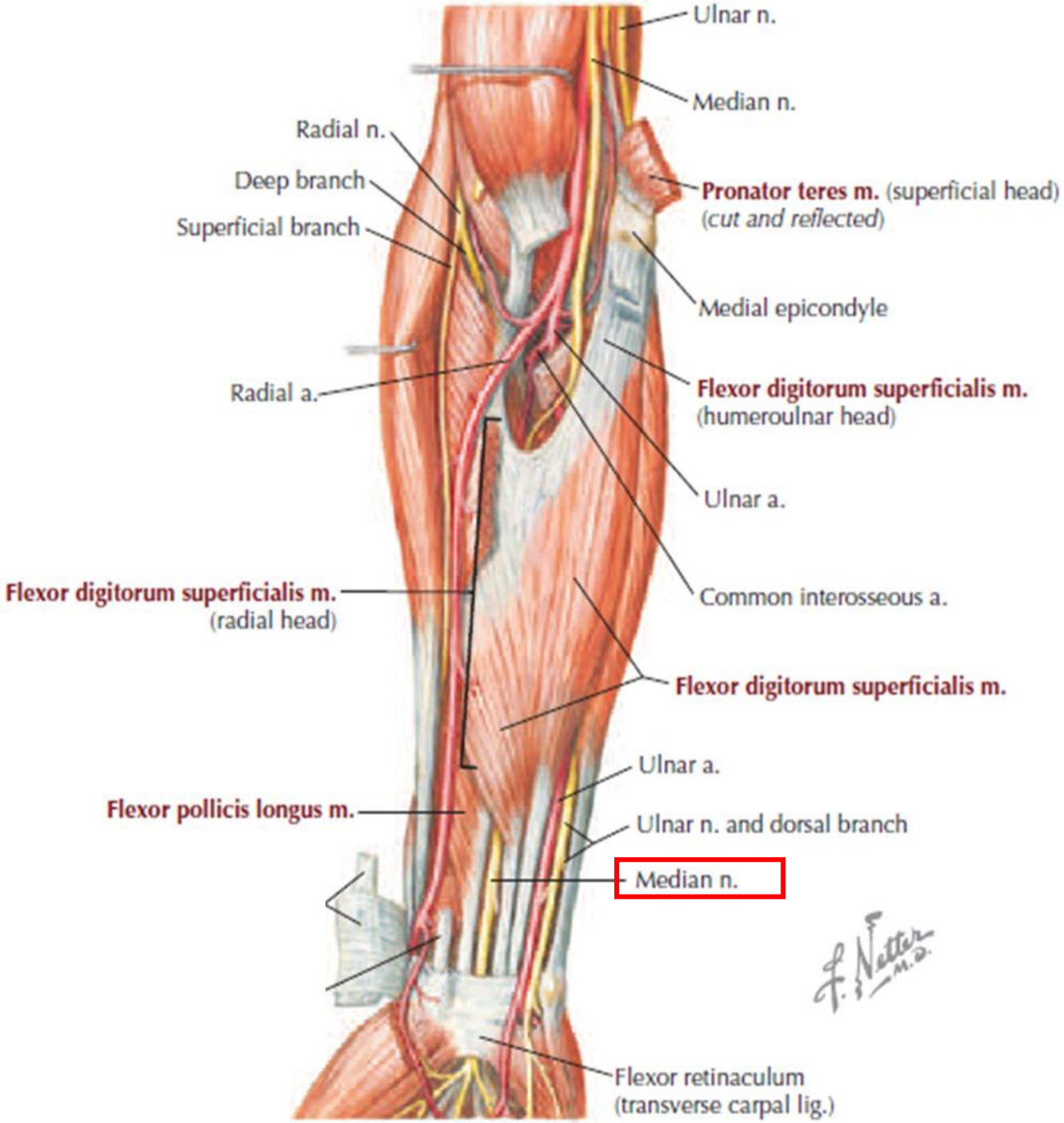
↓

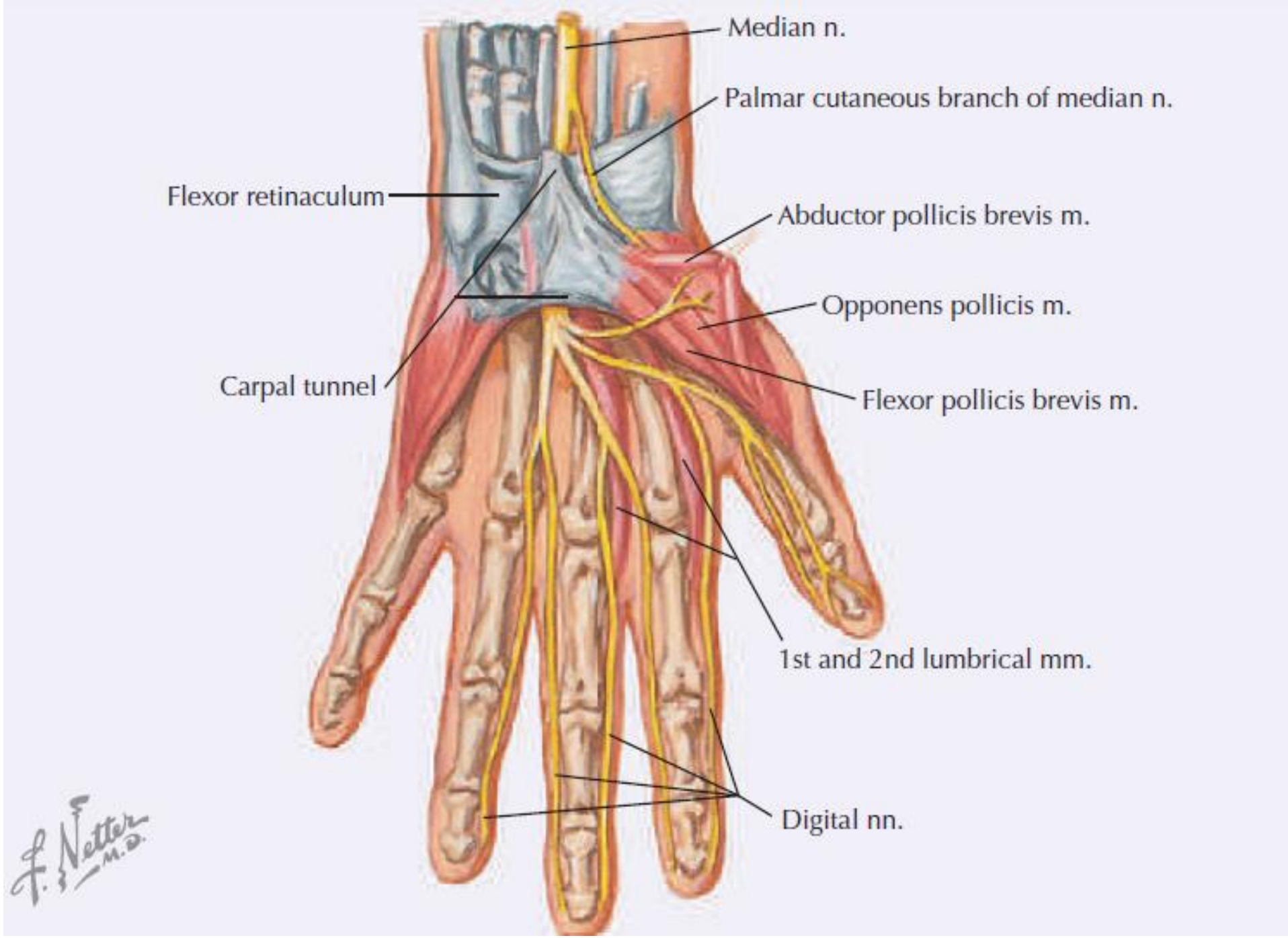
Before entering carpal tunnel, it gives off **palmar cutaneous branch** (passes superficial to flexor retinaculum).

↓

It then enters the palm through the carpal tunnel (deep to flexor retinaculum) and divides into **recurrent** and **palmar digital branches**.


Coracoid process
Pectoralis minor
Musculocutaneous n.
Biceps brachii m.
Long head
Short head
Coracobrachialis m.
Brachial a.
Medial brachial cutaneous n.
Ulnar n.
Median n.
Medial antebrachial cutaneous n.
Biceps brachii m.
Brachialis m.
Biceps brachii tendon
Bicipital aponeurosis


Ulnar n.
Median n.
Radial n.
Deep branch
Superficial branch
Pronator teres m. (superficial head)
(cut and reflected)
Medial epicondyle
Radial a.
Flexor digitorum superficialis m.
(humeroulnar head)
Ulnar a.
Flexor digitorum superficialis m.
(radial head)
Common interosseous a.
Flexor digitorum superficialis m.
Ulnar a.
Flexor pollicis longus m.
Ulnar n. and dorsal branch
Median n.
Flexor retinaculum
(transverse carpal lig.)
F. H. Netter M.D.


Median n.
Palmar cutaneous branch of median n.
Flexor retinaculum
Abductor pollicis brevis m.
Opponens pollicis m.
Carpal tunnel
Flexor pollicis brevis m.
1st and 2nd lumbrical mm.
Digital nn.
F. Netter M.D.

Median Nerve - Branches

- **In the axilla and arm:** no branches

- **In the cubital fossa:** Gives branches from its medial side to the all the superficial flexors (pronator teres, flexor carpi radialis, superficialis) of the forearm except flexor carpi ulnaris.

- **In the forearm:**
  - **Anterior interosseous branch** supplies 2 1/2 muscles: Flexor pollicis longus, Pronator quadrates Lateral half of the flexor digitorum profundus.

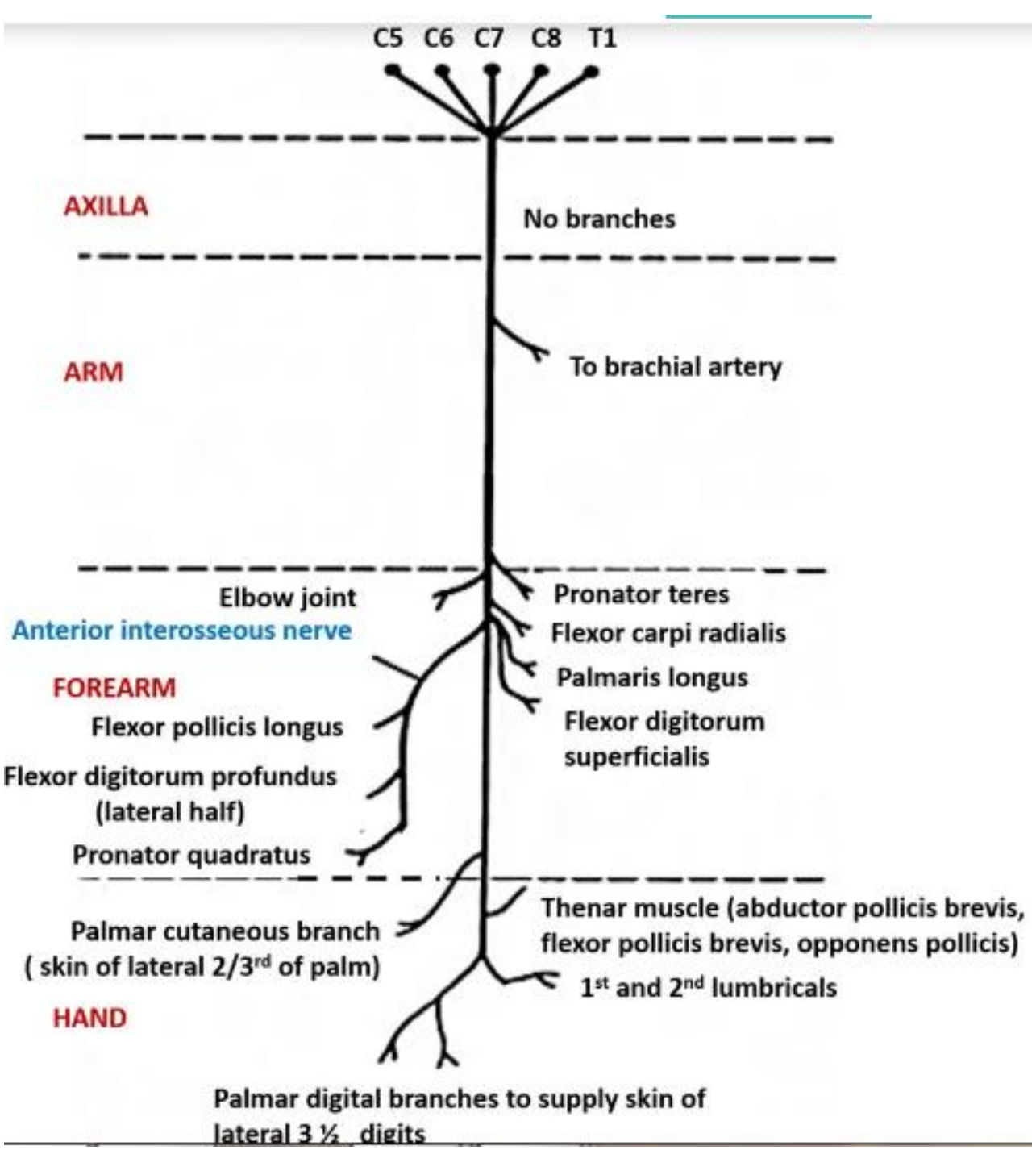
  - **Palmar cutaneous branch** (passes superficial to flexor retinaculum) which supplies skin over thenar eminence and lateral part of palm.

Contd..

- **In the palm:**
  - **Recurrent branch:** supplies thenar muscles (abductor pollicis brevis, flexor pollicis brevis and opponens pollicis).
  - **Palmar digital branch:** innervates the skin over the palmar surface and fingertips of the lateral three and half digits. Also innervates the lateral two lumbrical muscles.

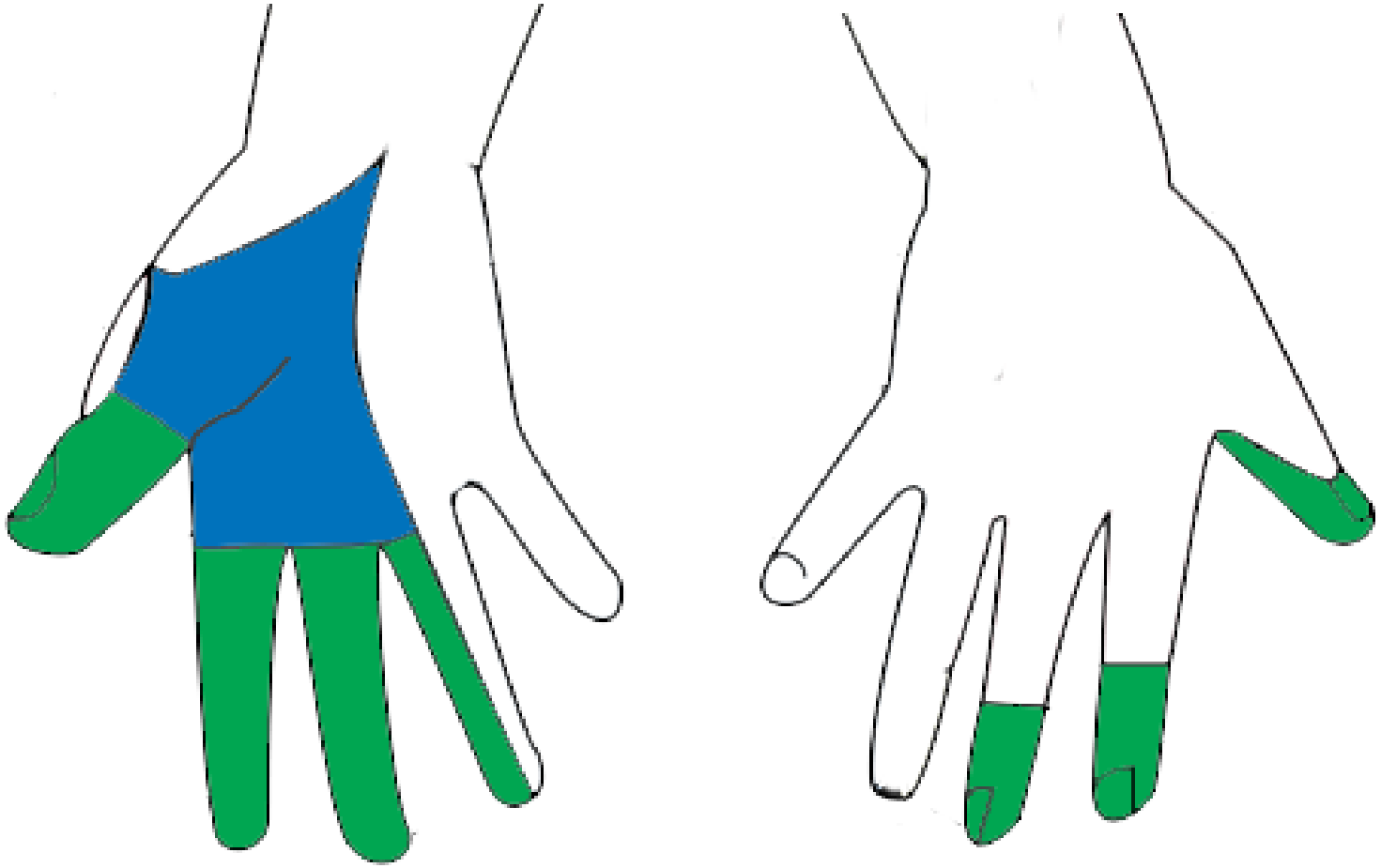
.

Median Nerve - Branches



Palmar cutaneous branch

Digital cutaneous branch

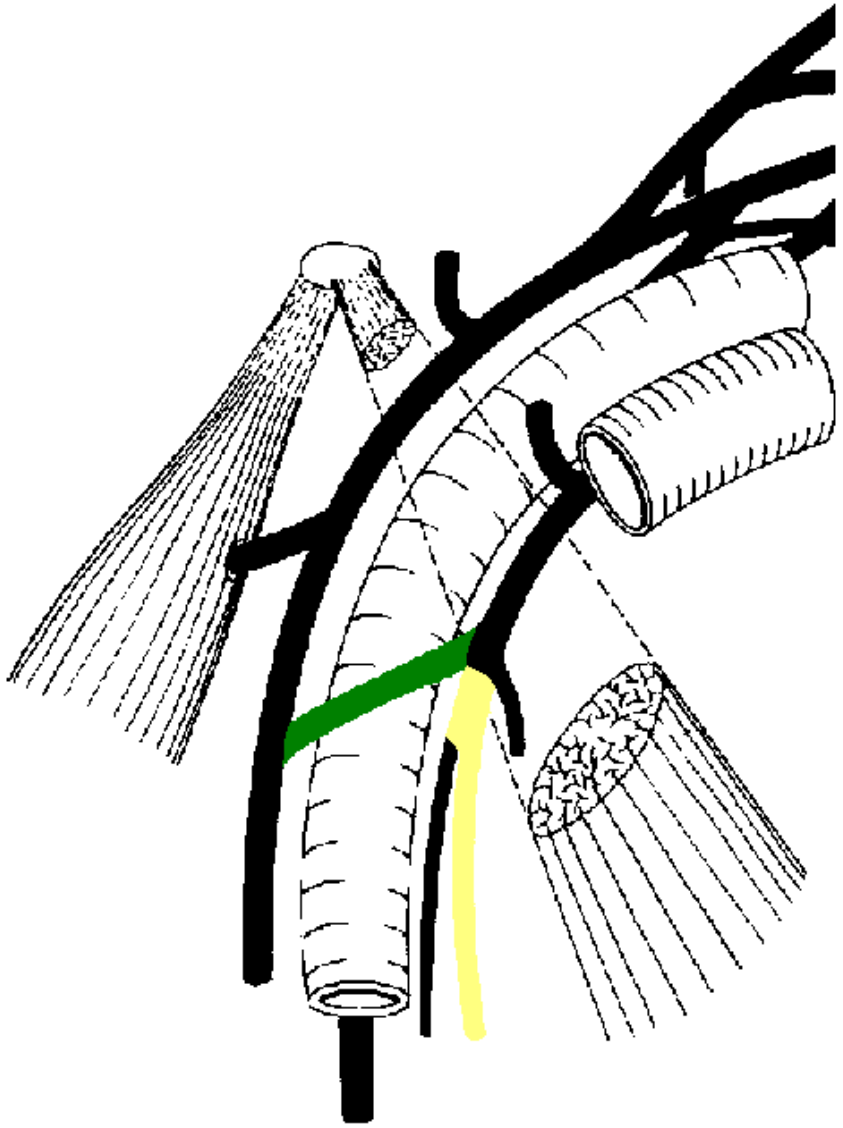


Palm

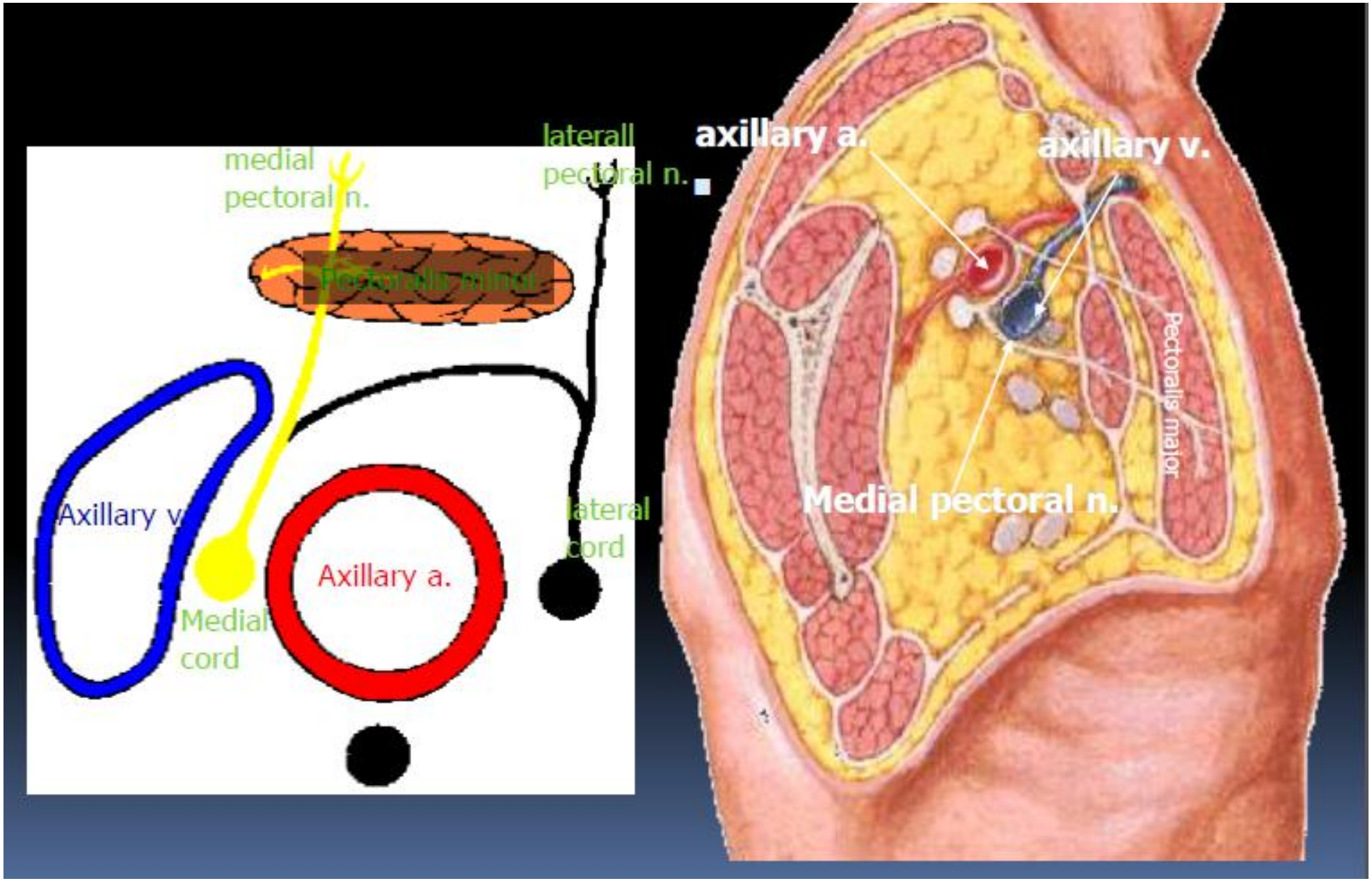
Dorsum

Branches of the Medial Cord

- The medial cord has **5 branches.**
- The **ulnar nerve** and **medial root of the median nerve** are its two terminal branches

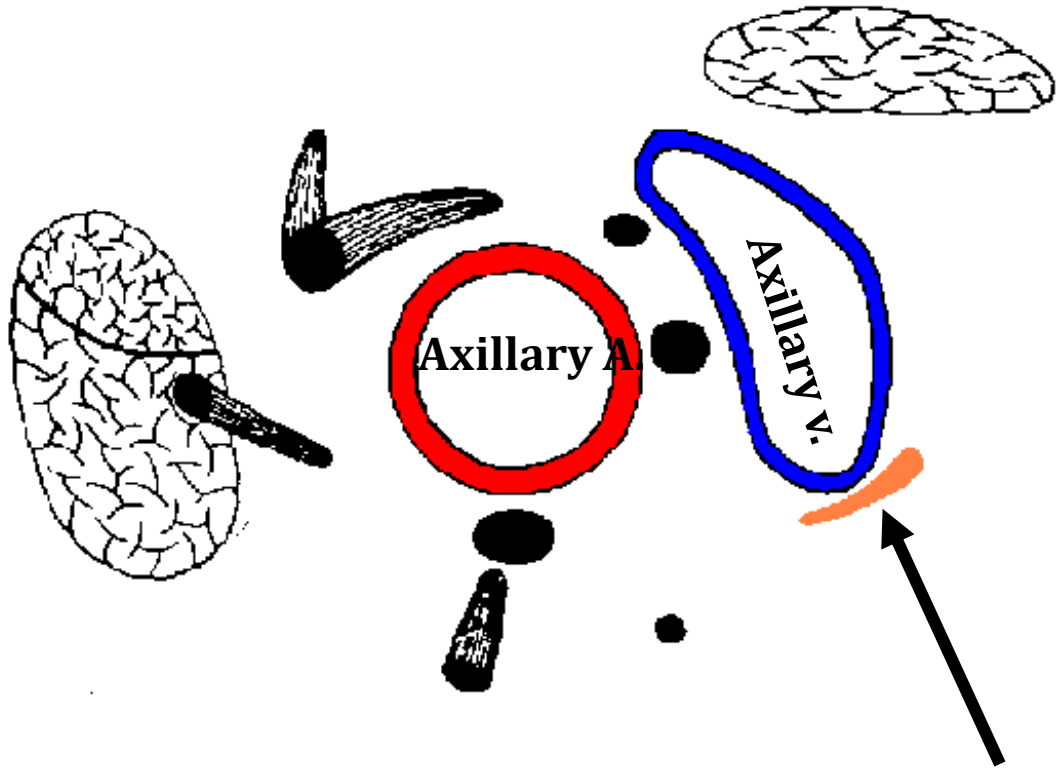


Medial pectoral nerve



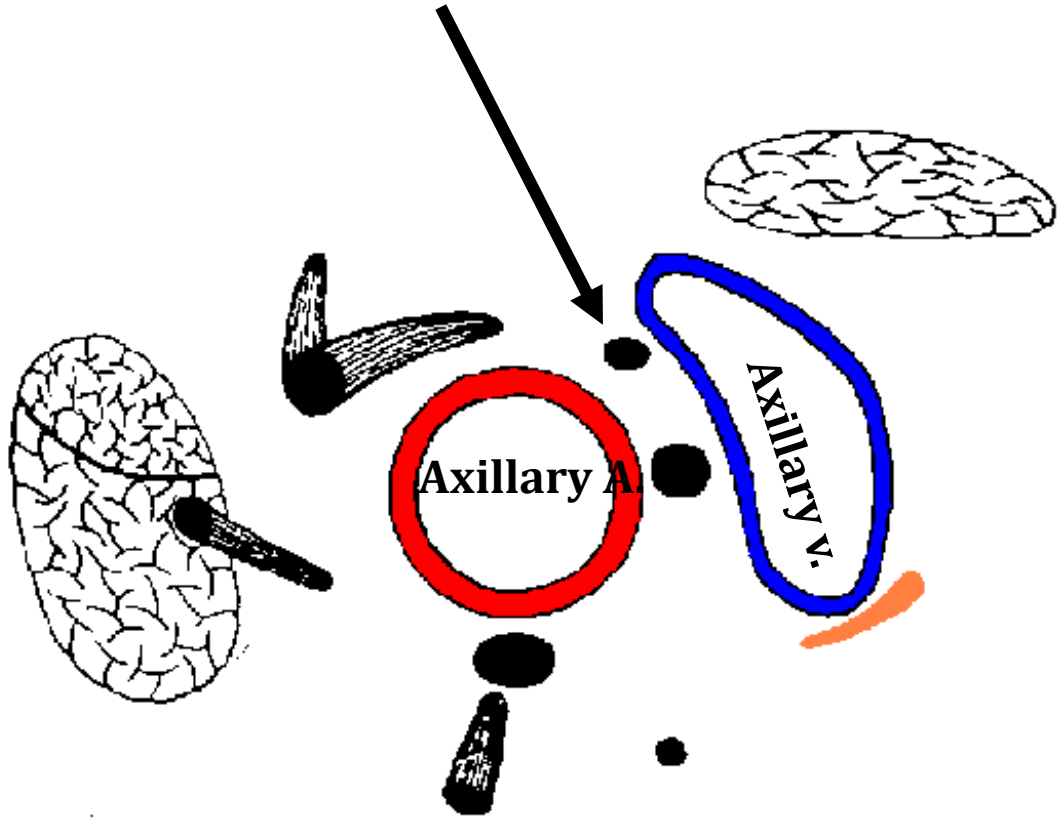
Medial cutaneous nerve of arm

- The medial cutaneous nerve of the arm, is a small nerve that runs medial to the axillary vein and **supplies the skin over the medial side and front of the arm.**

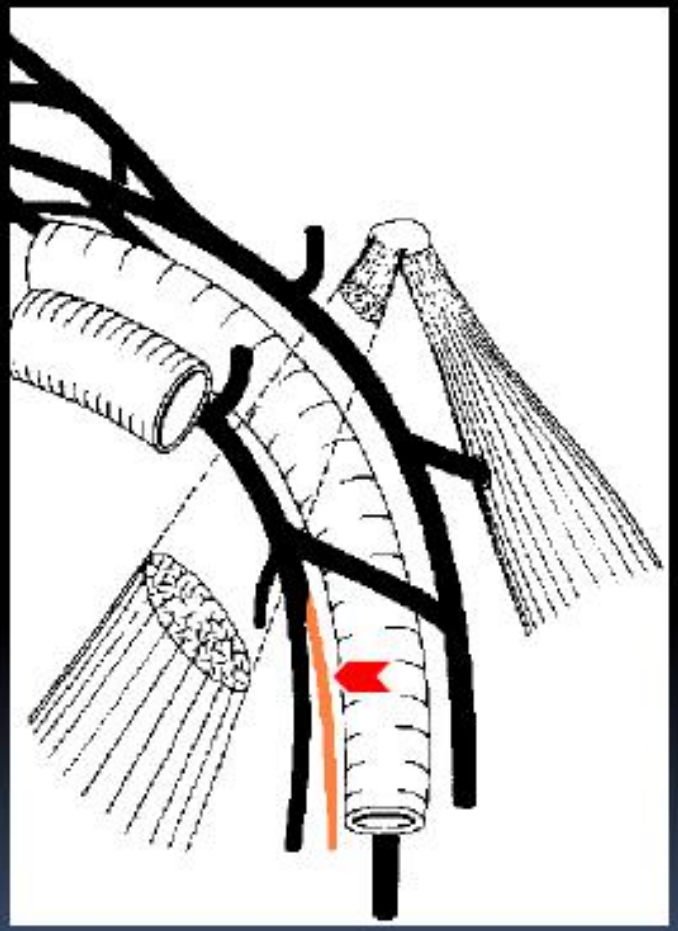


Medial cutaneous nerve of forearm

- runs between the axillary artery and vein and **supplies skin of the medial side of the forearm.**



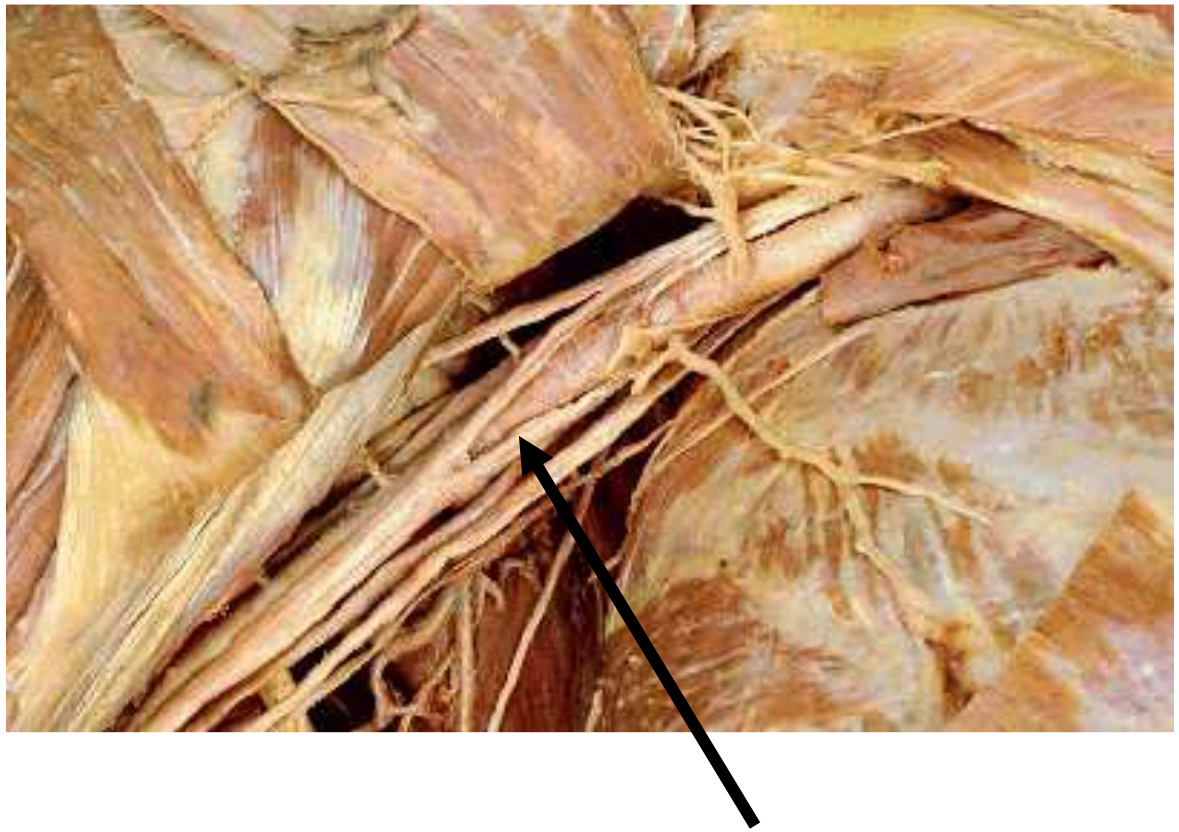
medial cutaneous nerve of the forearm



Runs between the axillary artery and vein superficial to the ulnar nerve

Medial root of the median nerve

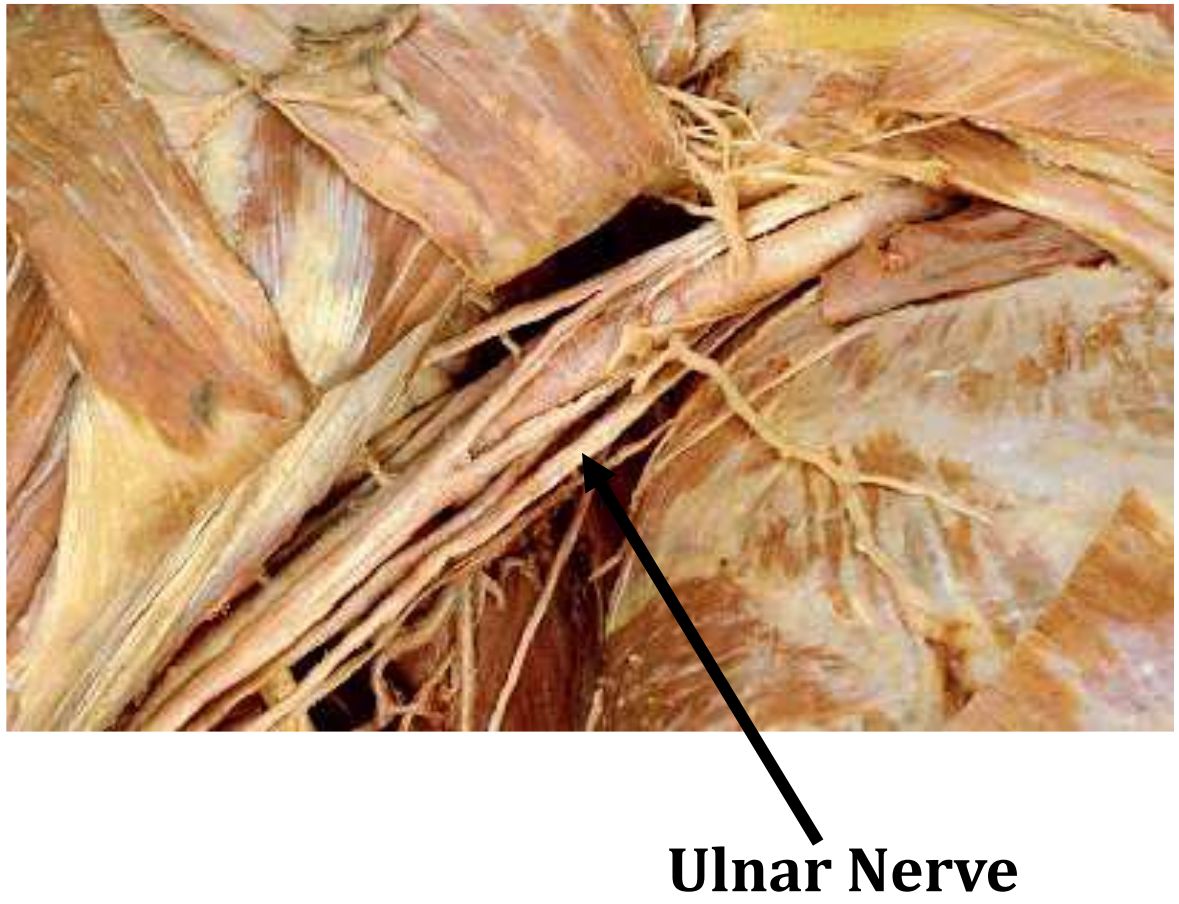
- Crosses the axillary artery to form the median nerve lateral to the artery.



Medial root of the median nerve

Ulnar Nerve

- Is the largest branch of the medial cord.
- **Roots:** C8-T1.
- Is mainly concerned with the innervation of the palm.



Ulnar Nerve - Anatomical Course

It leaves the axilla and enters the anterior compartment of arm along the medial side of the brachial artery.

↓

At the middle of the arm, it pierces the medial intermuscular septum to enter the posterior compartment of the arm and runs downwards to the back of the medial epicondyle of humerus.

↓

It enters the forearm by passing between the two heads of flexor carpi ulnaris

.

Contd.

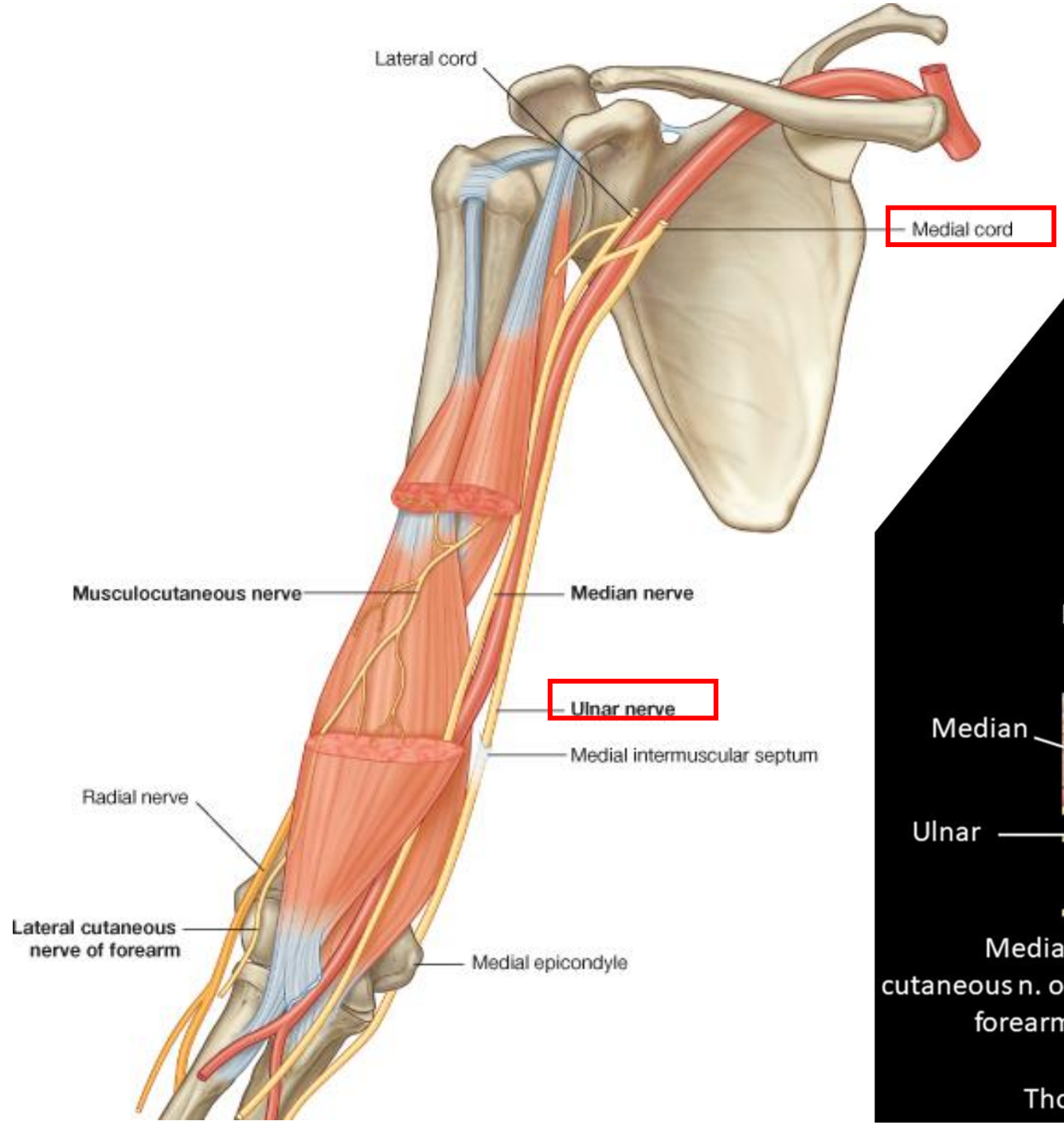
In the proximal 2/3rd of the forearm it runs deep to flexor carpi ulnaris and then it becomes superficial and lies lateral to flexor carpi ulnaris.

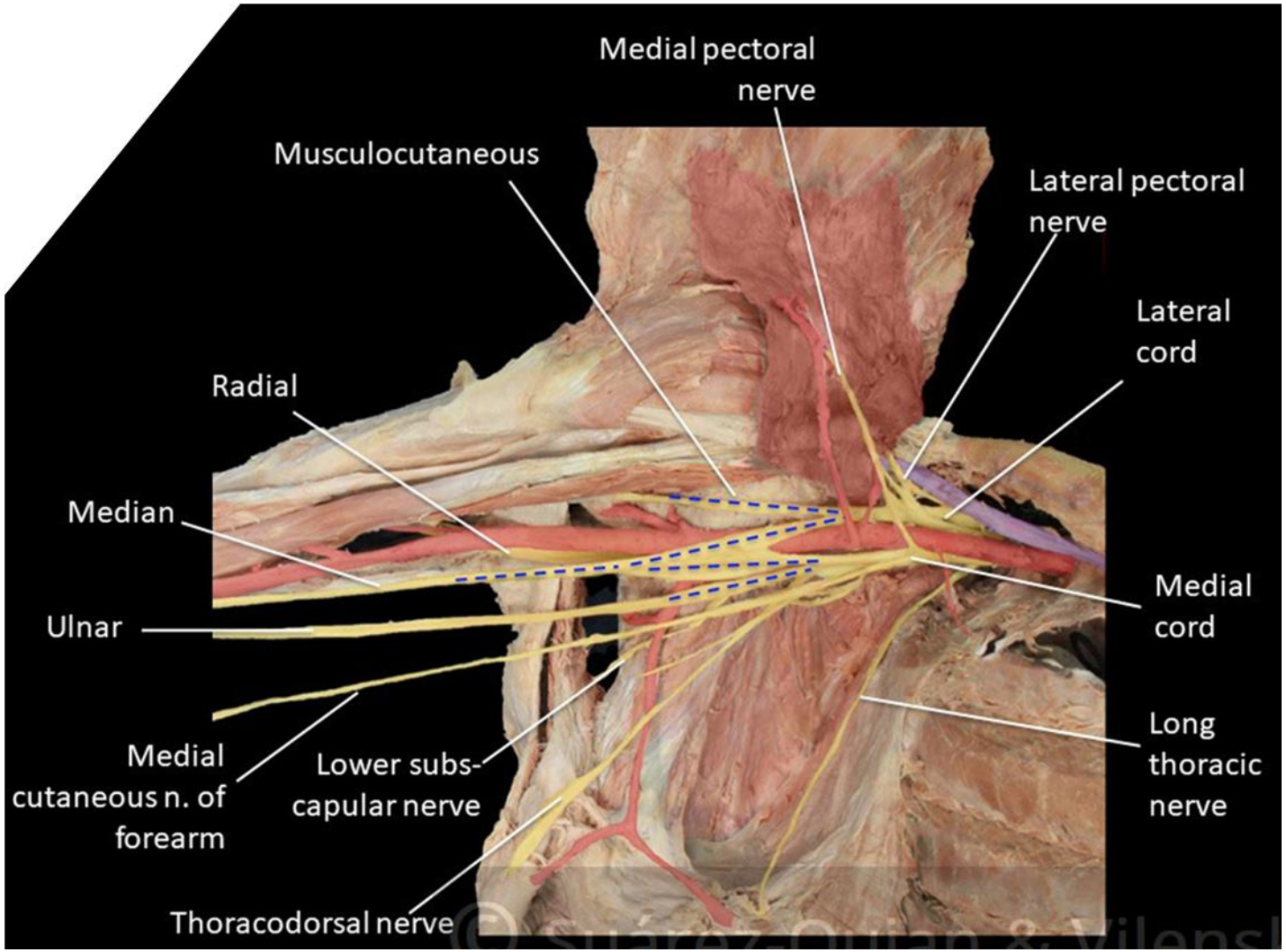
↓

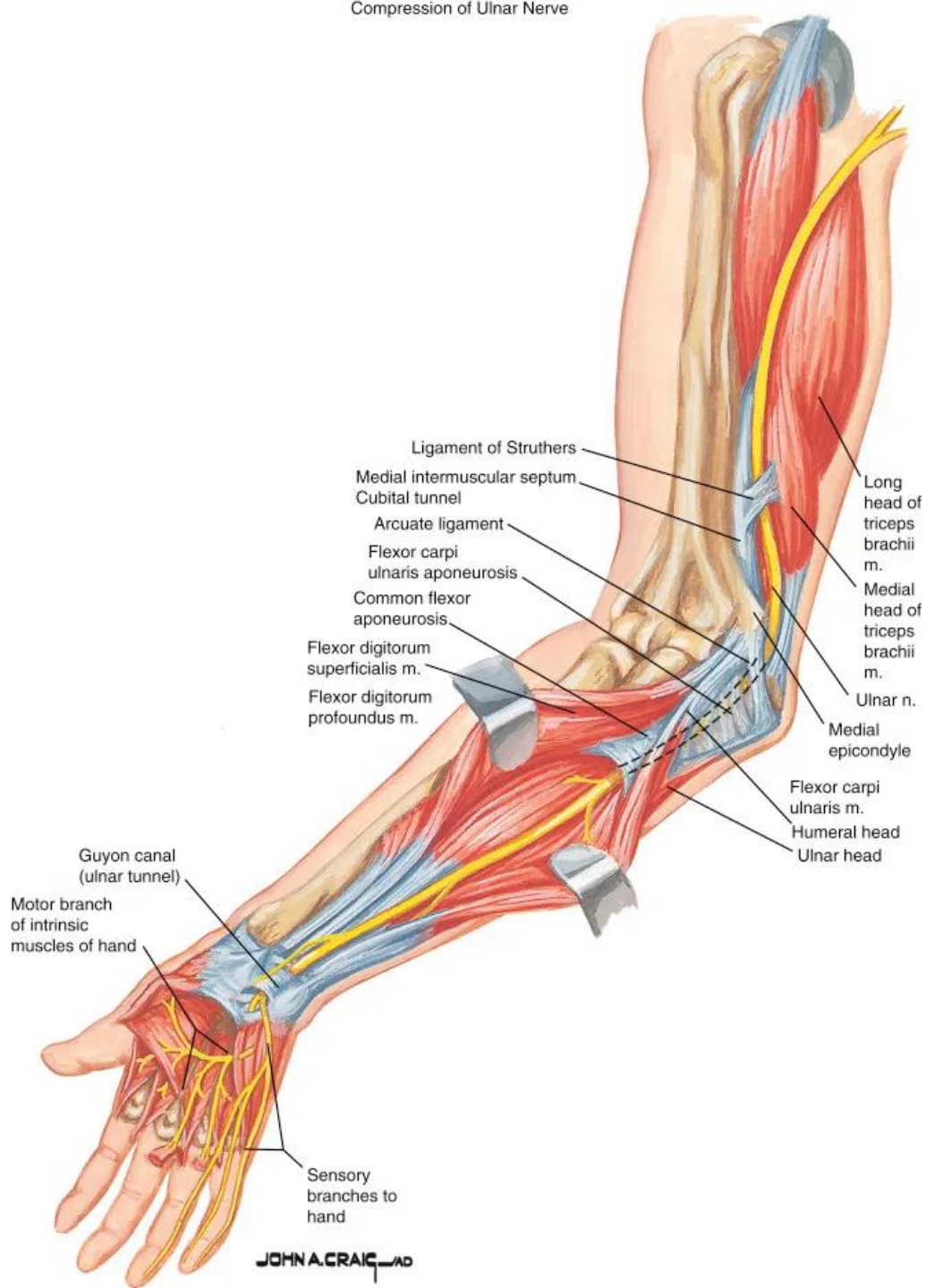
At the wrist, the nerve travel superficially to the flexor retinaculum and is medial to the ulnar artery.

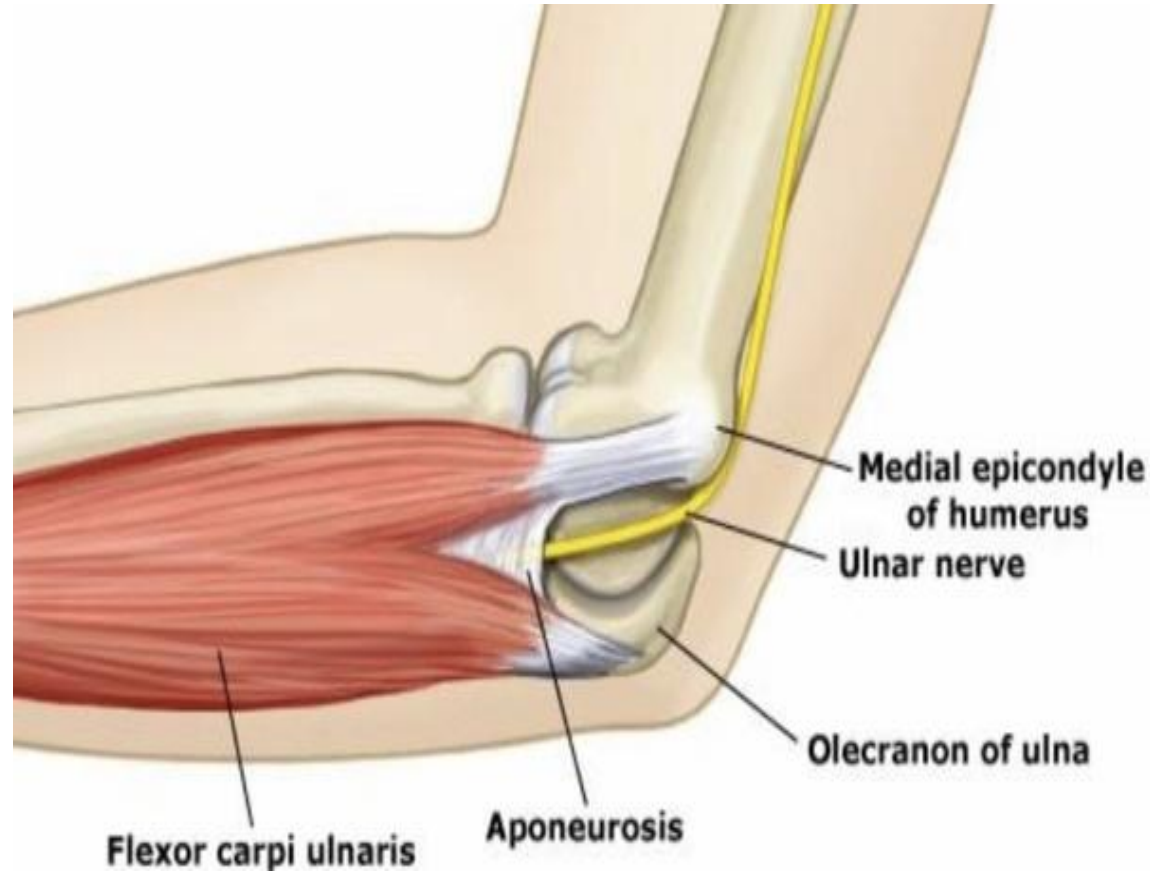
↓

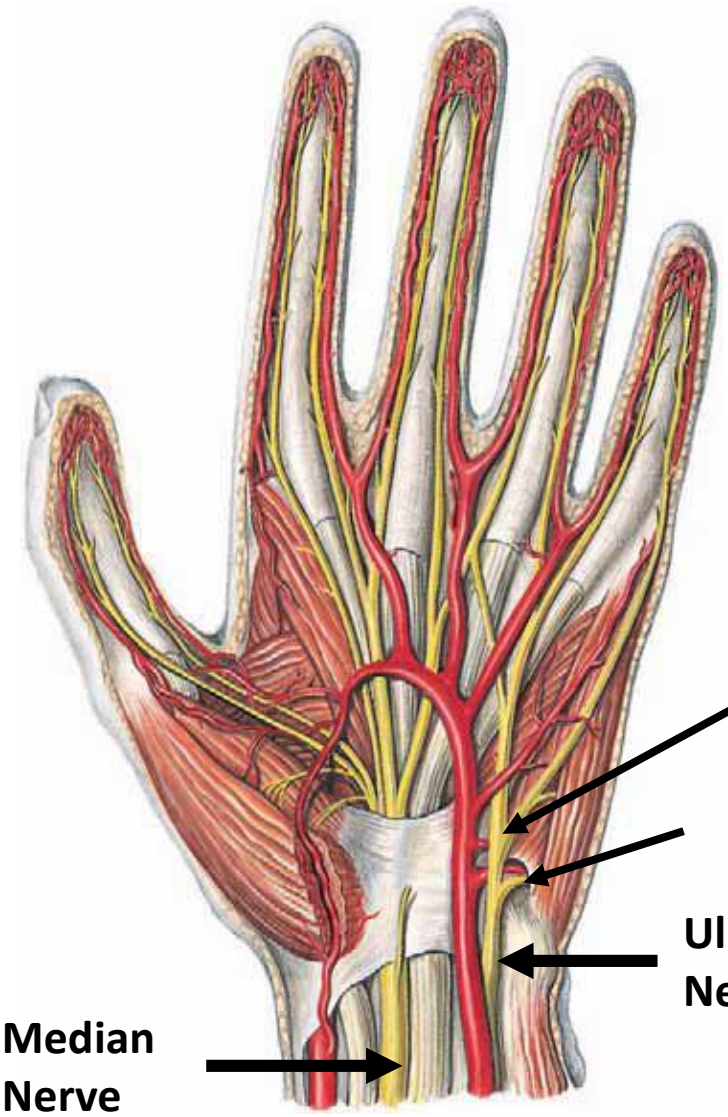
It enters the hand via the ulnar canal (Guyon's canal). In the hand, the nerve terminates by giving rise to **superficial** and **deep** branches.

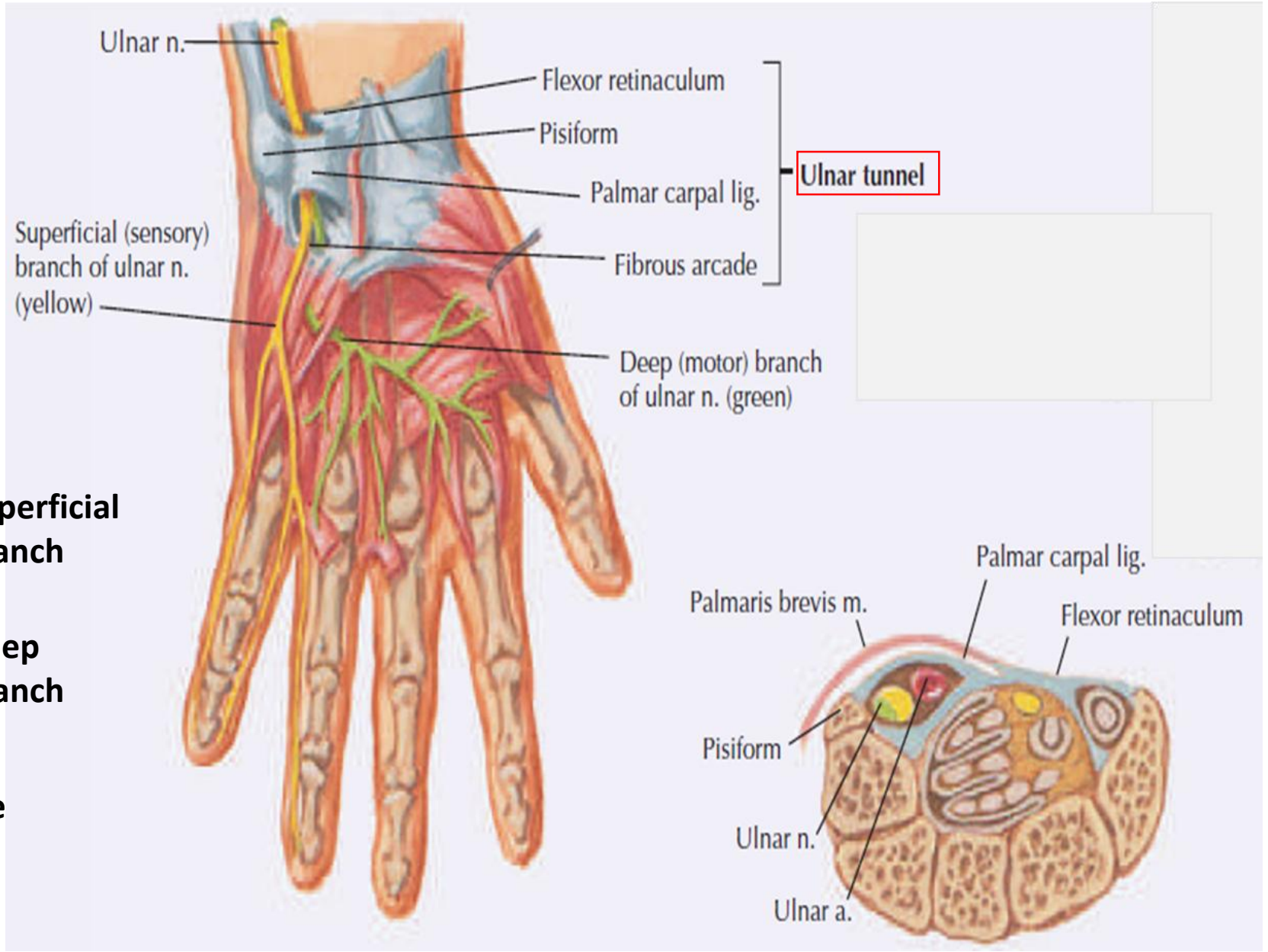

Lateral cord
Medial cord
Musculocutaneous nerve
Median nerve
Ulnar nerve
Medial intermuscular septum
Radial nerve
Lateral cutaneous nerve of forearm
Medial epicondyle


Medial pectoral nerve
Musculocutaneous
Lateral pectoral nerve
Lateral cord
Radial
Median
Ulnar
Medial cord
Medial cutaneous n. of forearm
Lower subs-capular nerve
Long thoracic nerve
Thoracodorsal nerve


Compression of Ulnar Nerve
Ligament of Struthers
Medial intermuscular septum
Cubital tunnel
Arcuate ligament
Flexor carpi ulnaris aponeurosis
Common flexor aponeurosis
Flexor digitorum superficialis m.
Flexor digitorum profoundus m.
Long head of triceps brachii m.
Medial head of triceps brachii m.
Ulnar n.
Medial epicondyle
Flexor carpi ulnaris m.
Humeral head
Ulnar head
Guyon canal (ulnar tunnel)
Motor branch of intrinsic muscles of hand
Sensory branches to hand
JOHN A. CRAIG, MD


Medial epicondyle of humerus
Ulnar nerve
Olecranon of ulna
Flexor carpi ulnaris
Aponeurosis


Superficial branch
Deep branch
Ulnar Nerve
Median Nerve


Ulnar n.
Flexor retinaculum
Pisiform
Palmar carpal lig.
Fibrous arcade
Ulnar tunnel
Superficial (sensory) branch of ulnar n. (yellow)
Deep (motor) branch of ulnar n. (green)
Palmar carpal lig.
Palmaris brevis m.
Flexor retinaculum
Pisiform
Ulnar n.
Ulnar a.

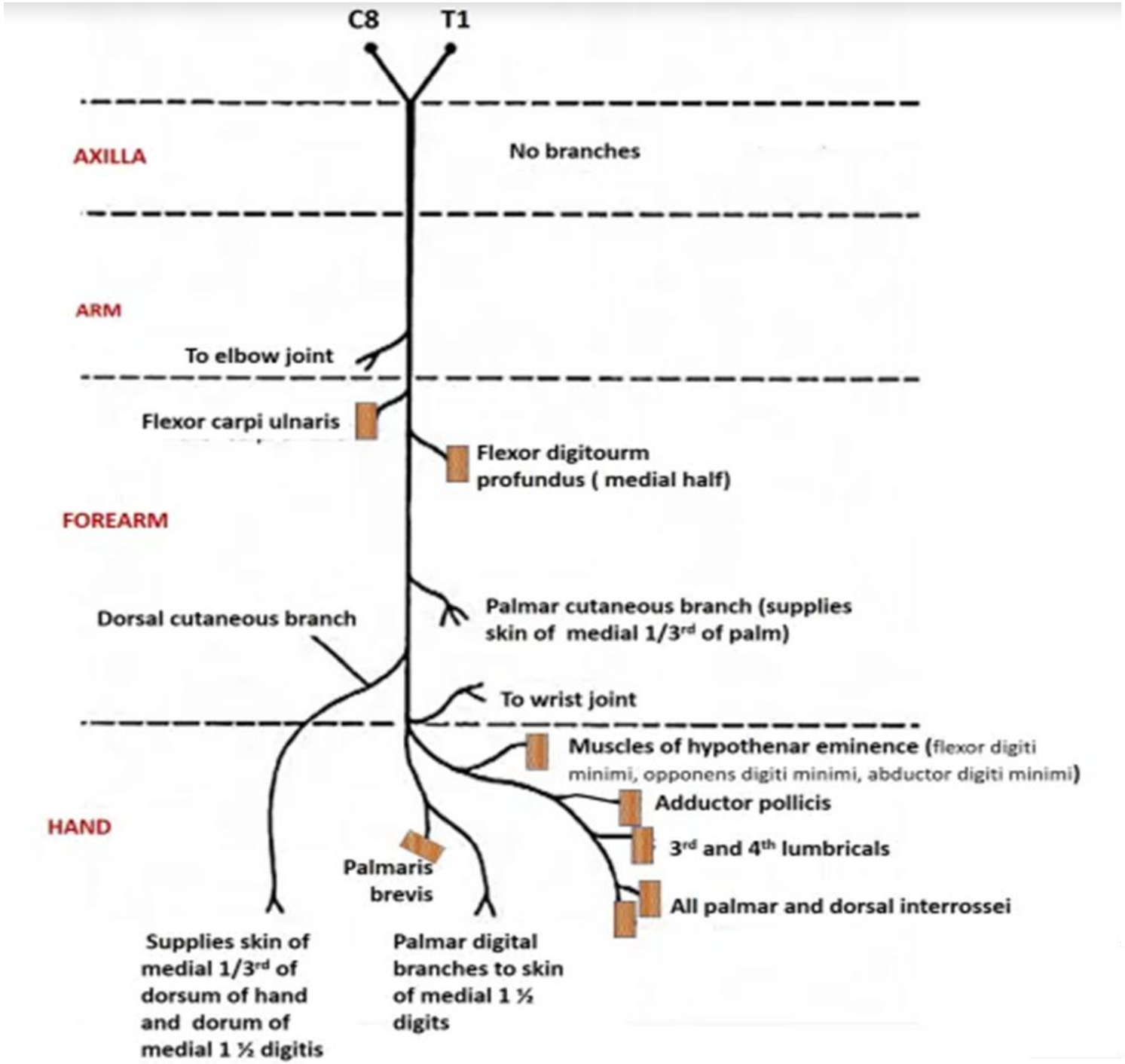
Ulnar Nerve - Branches

- **In the axilla:** no branches
- **In the arm:** branches to elbow joint
- **In the forearm:**
  - **Muscular branch –** innervates two muscles in the anterior compartment of the forearm (Flexor carpi ulnaris, Medial half of the flexor digitorum profundus).
  - **Palmar cutaneous branch –** innervates the medial half of palm.
  - **Dorsal cutaneous branch –** innervates the dorsal surface of the medial one and a half fingers, and the associated dorsal hand area.

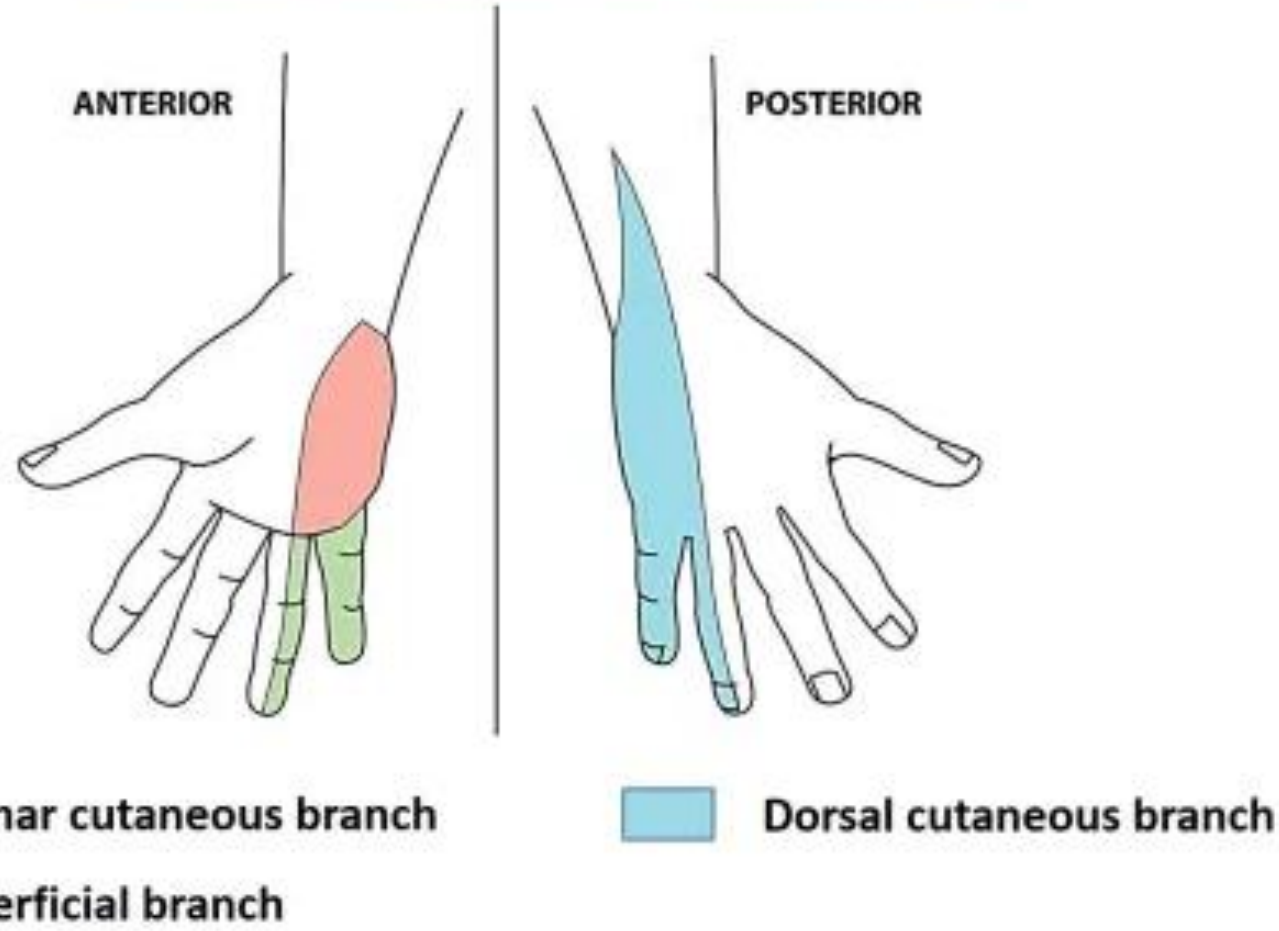
Contd..

- **In the palm:**
  - **Superficial branch:**
    - Motor : nerve to Palmaris brevis
    - Sensory : innervates skin on the palmar surface of medial 1 1/2 digits
  - **Deep branch :** Purely motor, supplies following muscles:
    - Hypothenar muscles
    - Medial two lumbricals
    - All palmar and dorsal interossei
    - Adductor pollicis

Ulnar Nerve - Branches

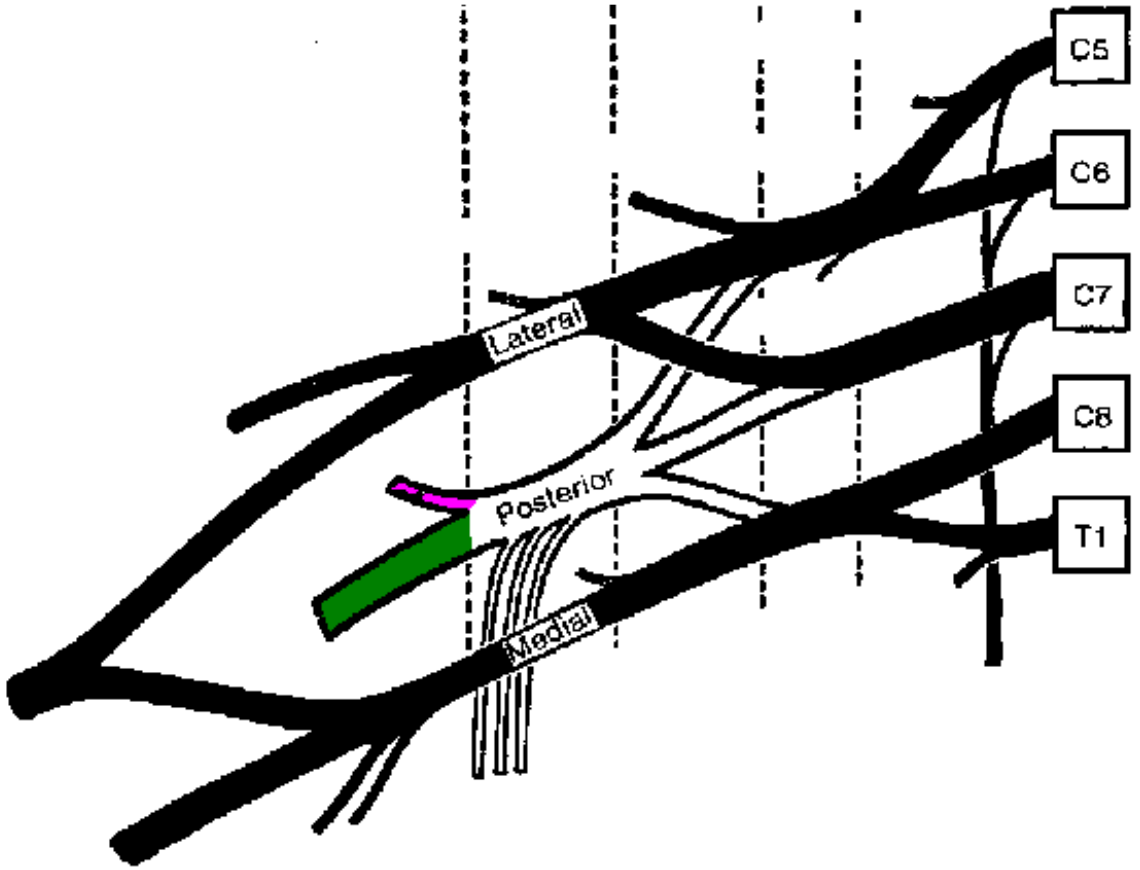


CUTANEOUS INNERVATION BY ULNAR NERVE



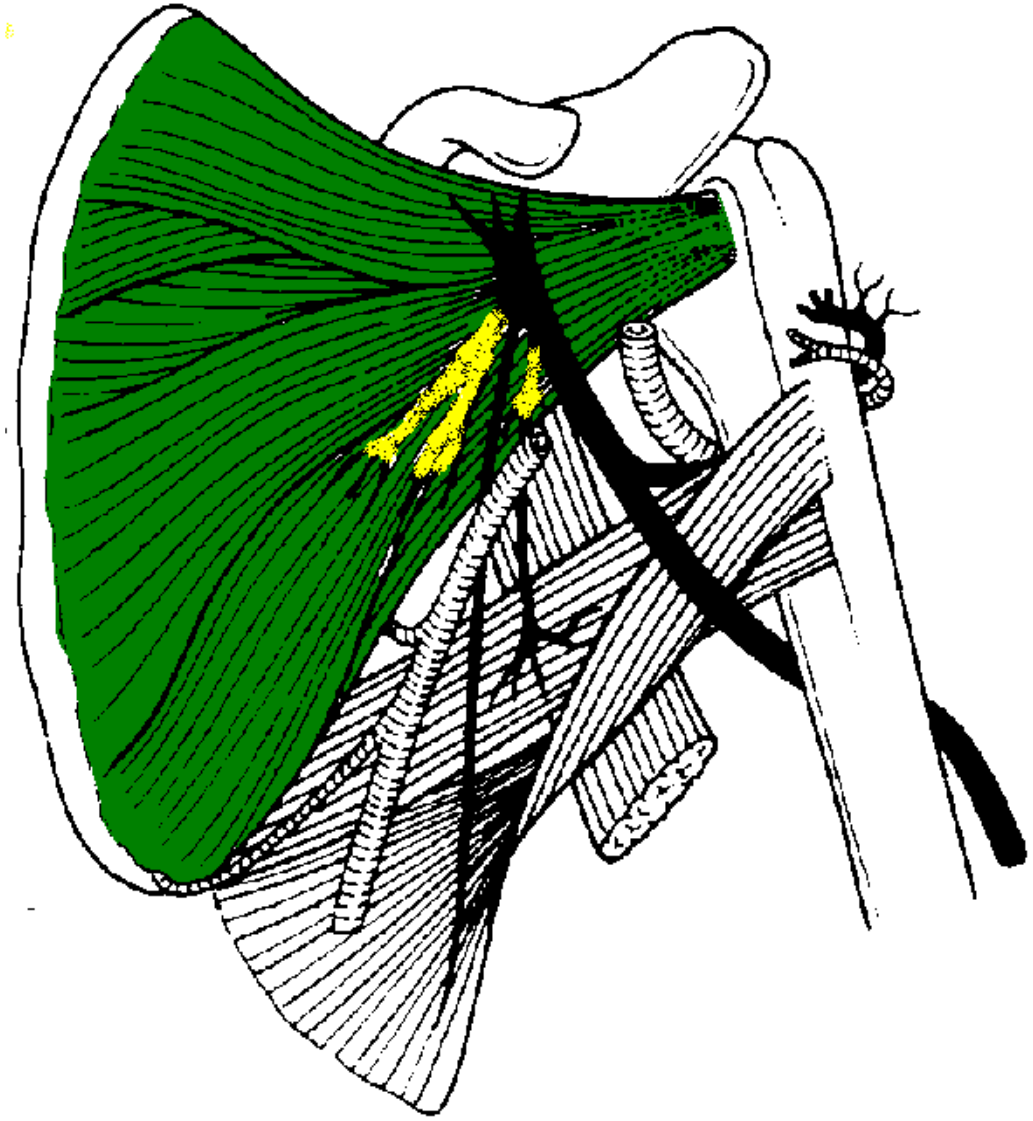
Branches of the Posterior Cord

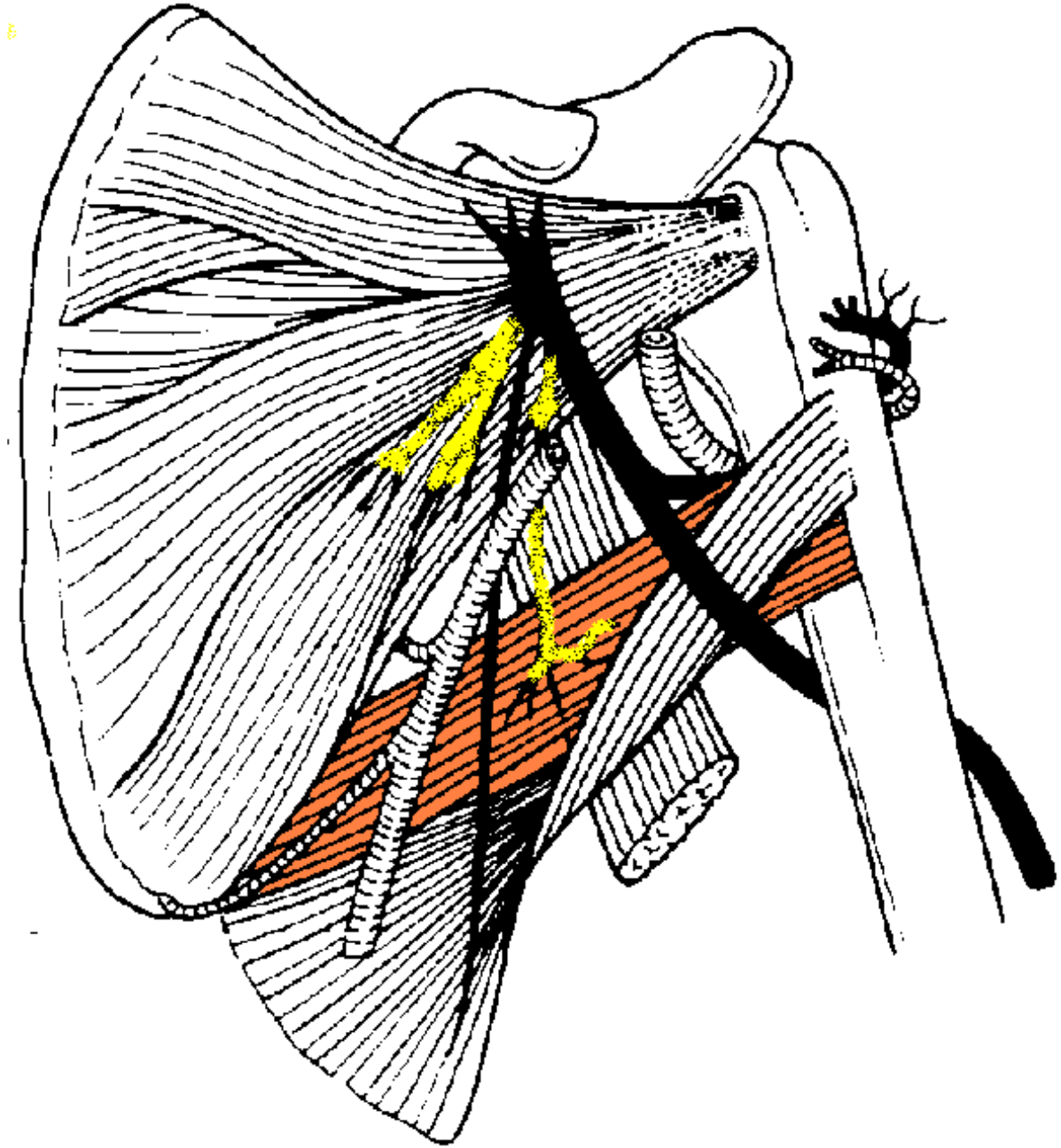
- The posterior cord of the brachial plexus has **5 branches.**
- The **axillary** and **radial nerves** are its 2 terminal branches.



Upper and Lower Subscapular Nerves

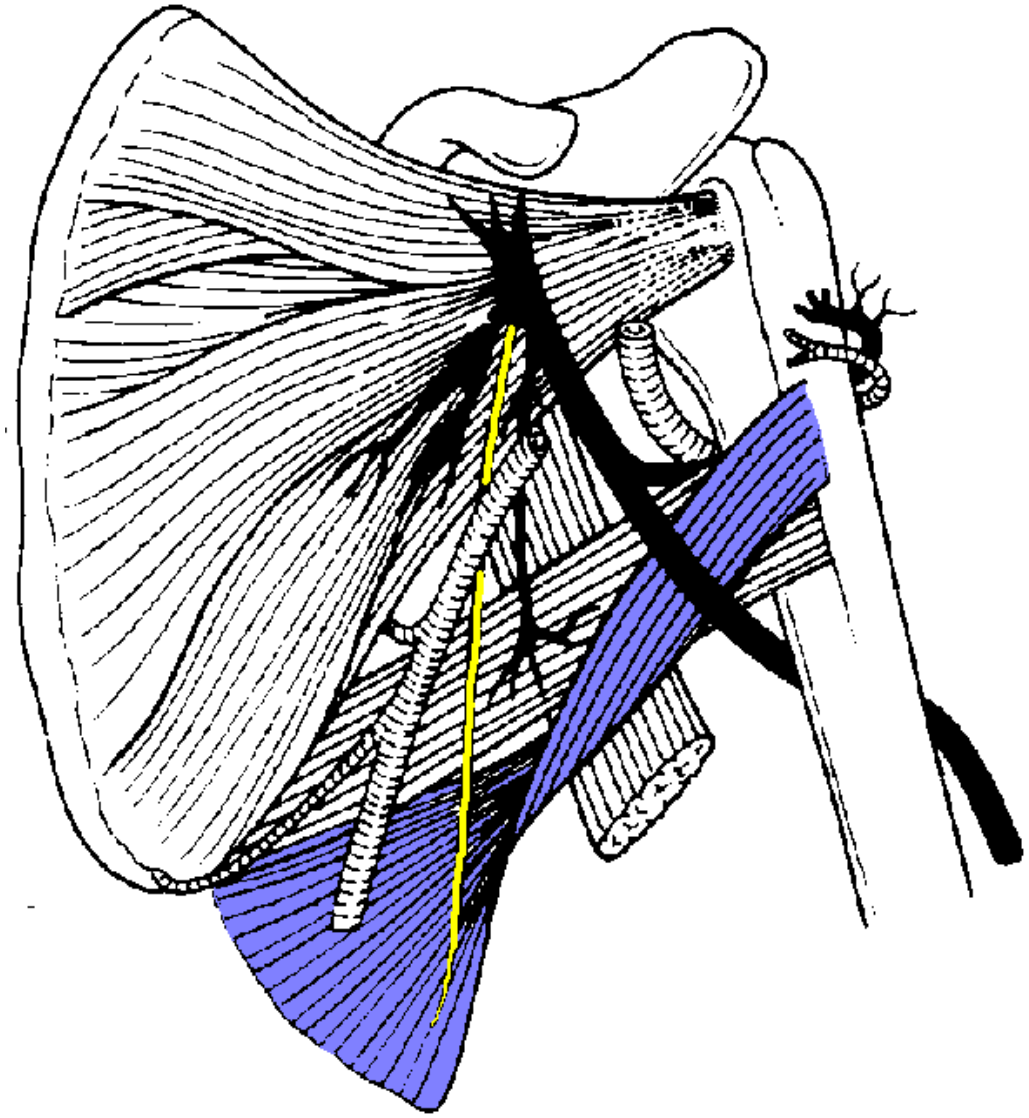
- The upper and lower subscapular nerves supply the upper and lower parts of subscapularis muscle.
- The lower subscapular nerve supplies teres major muscle in addition to subscapularis.

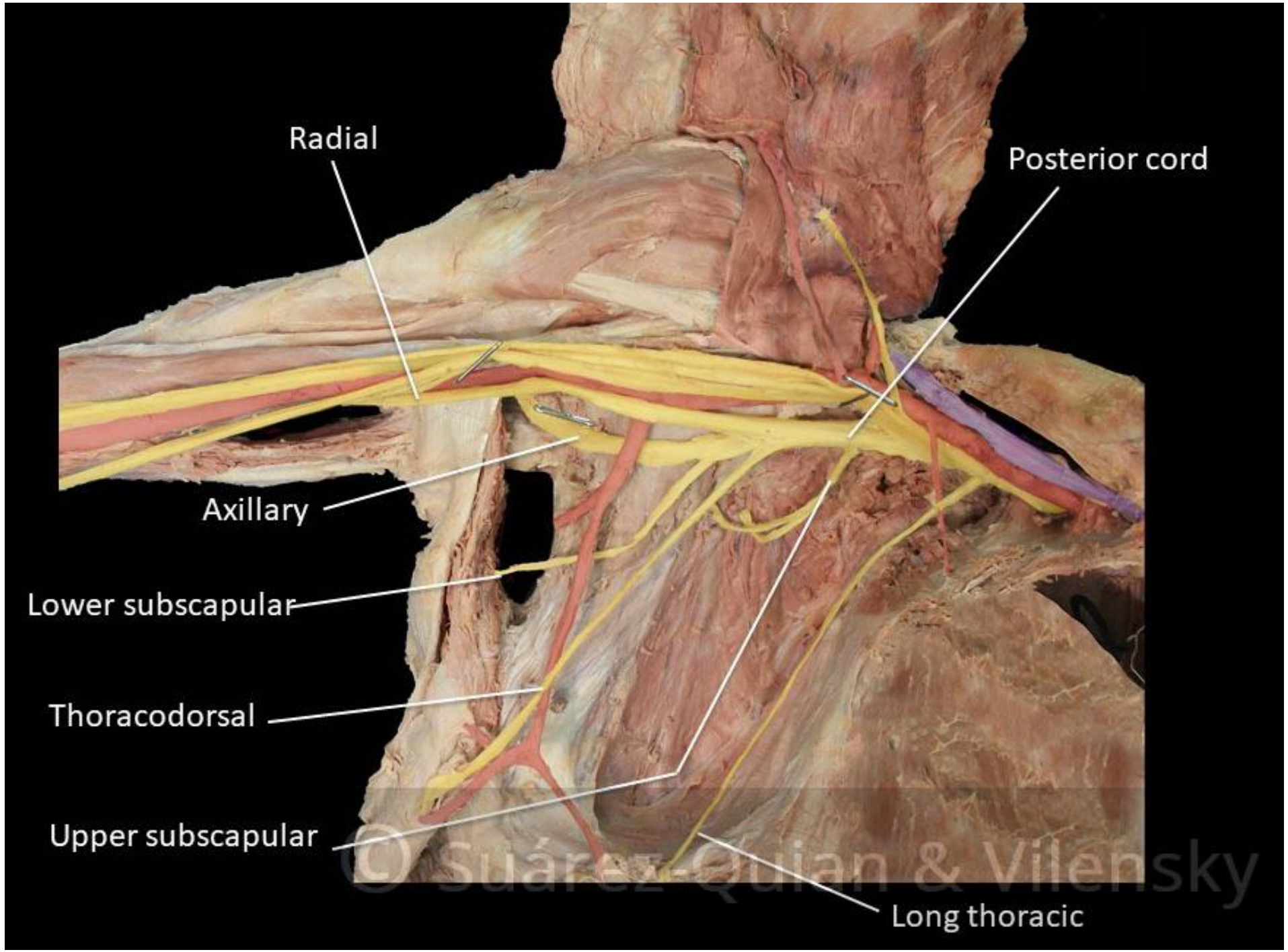




Thoracodorsal Nerve

- Runs between the subscapular nerves, it runs down on subscapularis towards latissimus dorsi which it supplies.




Radial
Posterior cord
Axillary
Lower subscapular
Thoracodorsal
Upper subscapular
Long thoracic
© Suárez-Quian & Vilensky

Axillary nerve

- **Roots:** C5 and C6.
- **Course:**

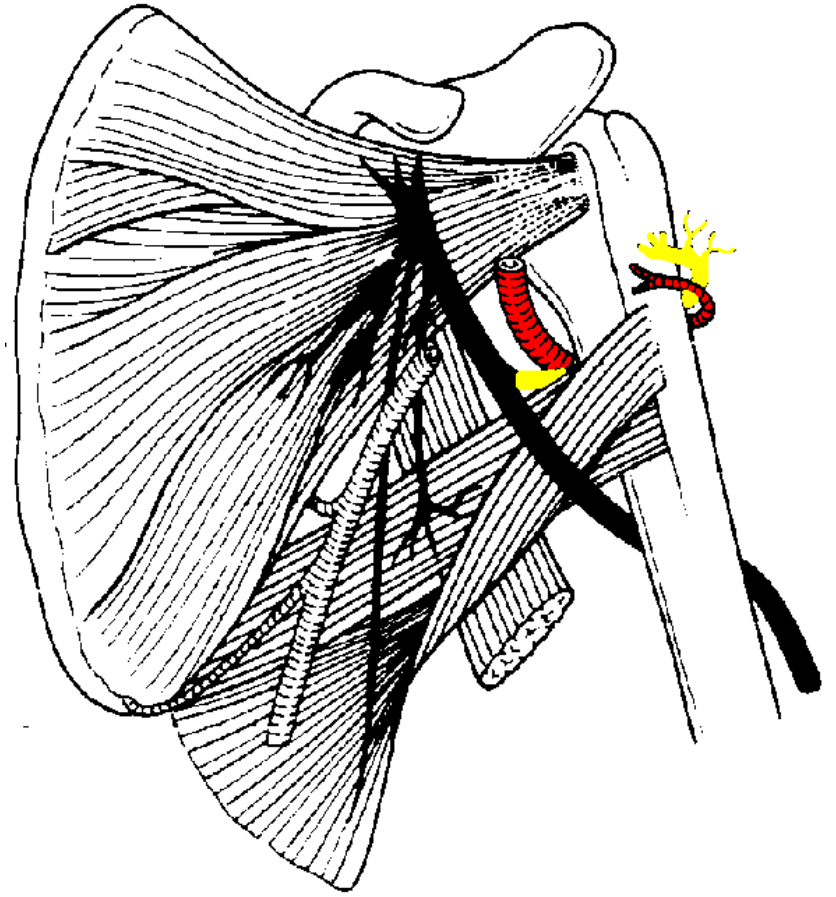
It arises from the posterior cord in the axilla

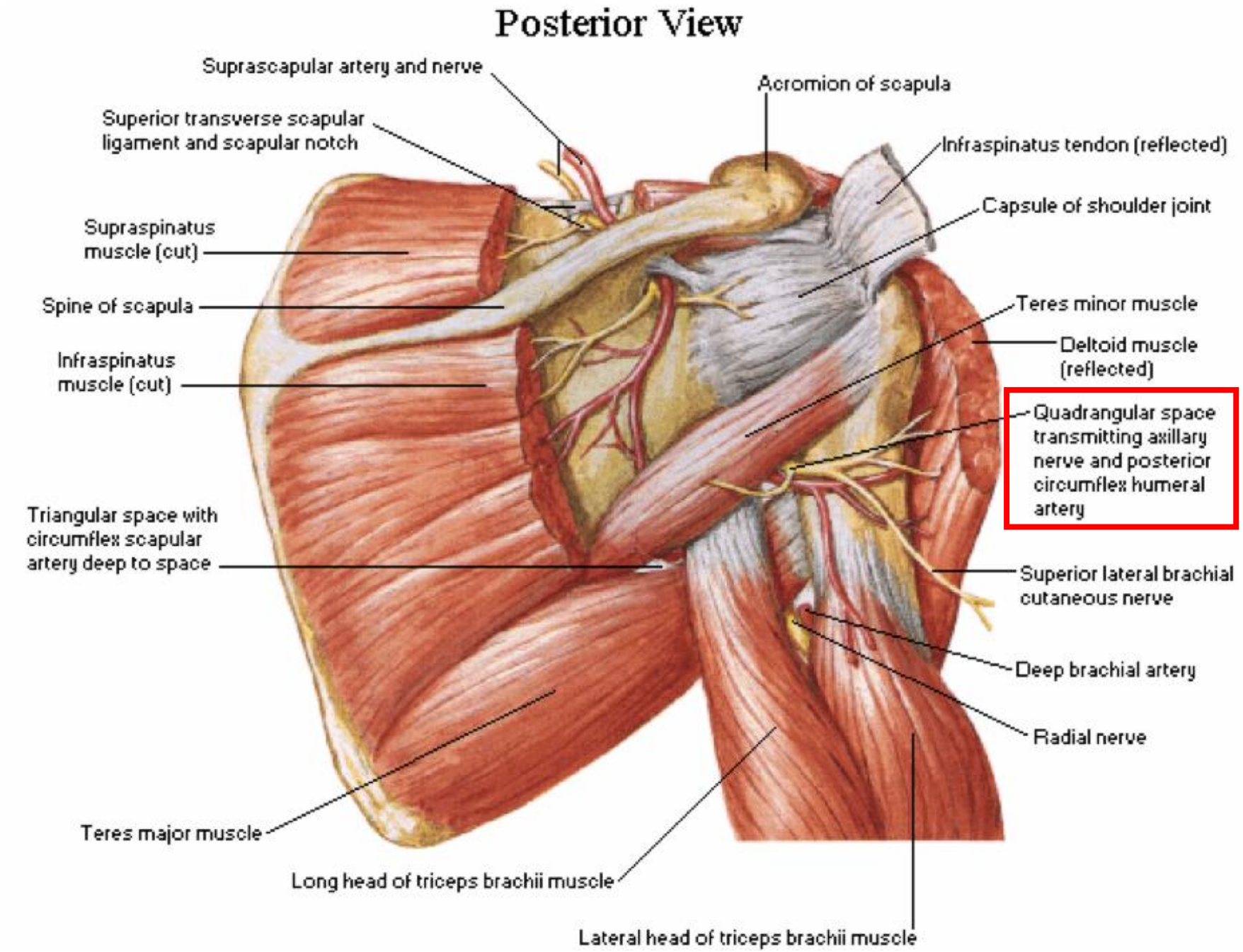
↓

Leaves the axilla through the ***quadrangular space*** accompanied by the posterior circumflex humeral vessels just below the capsule of the shoulder joint to which it sends an **articular branch**.

↓

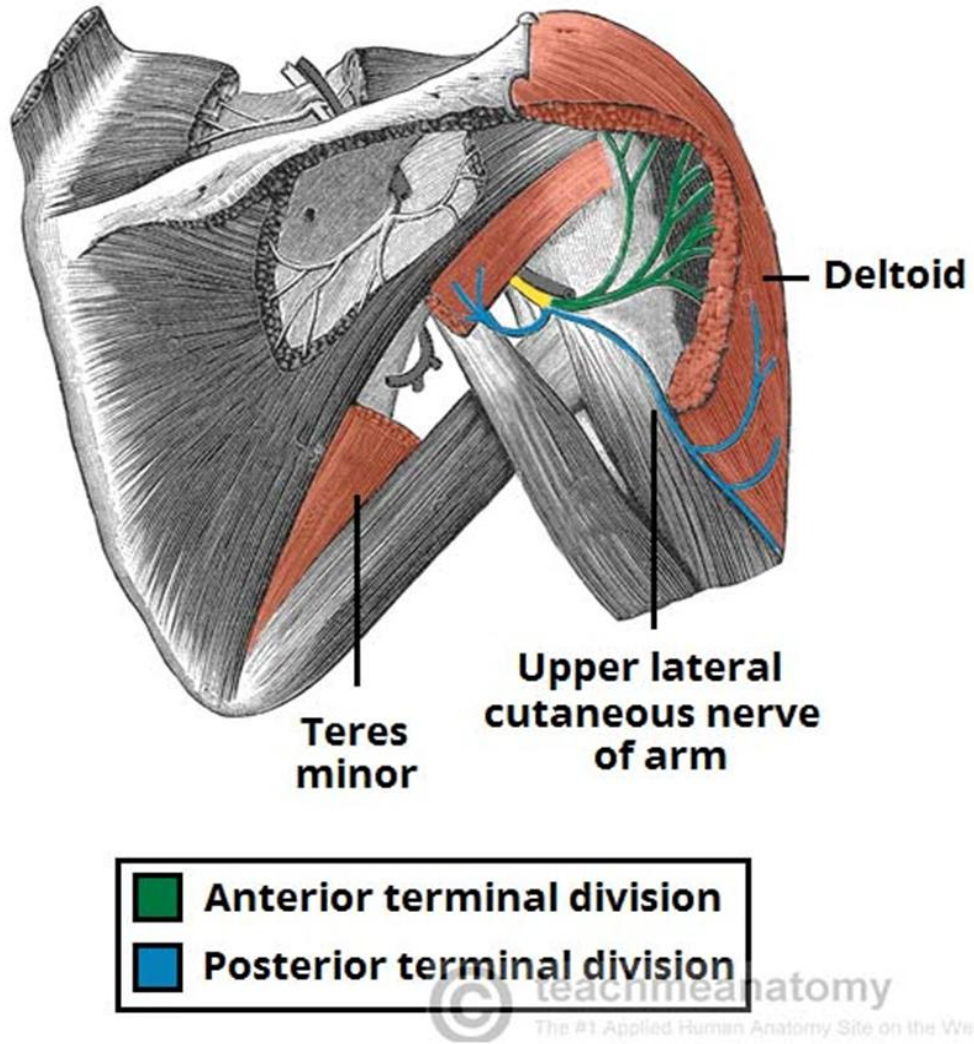
It then passes medially to the surgical neck of the humerus, where it divides into **anterior** and **posterior** terminal branches



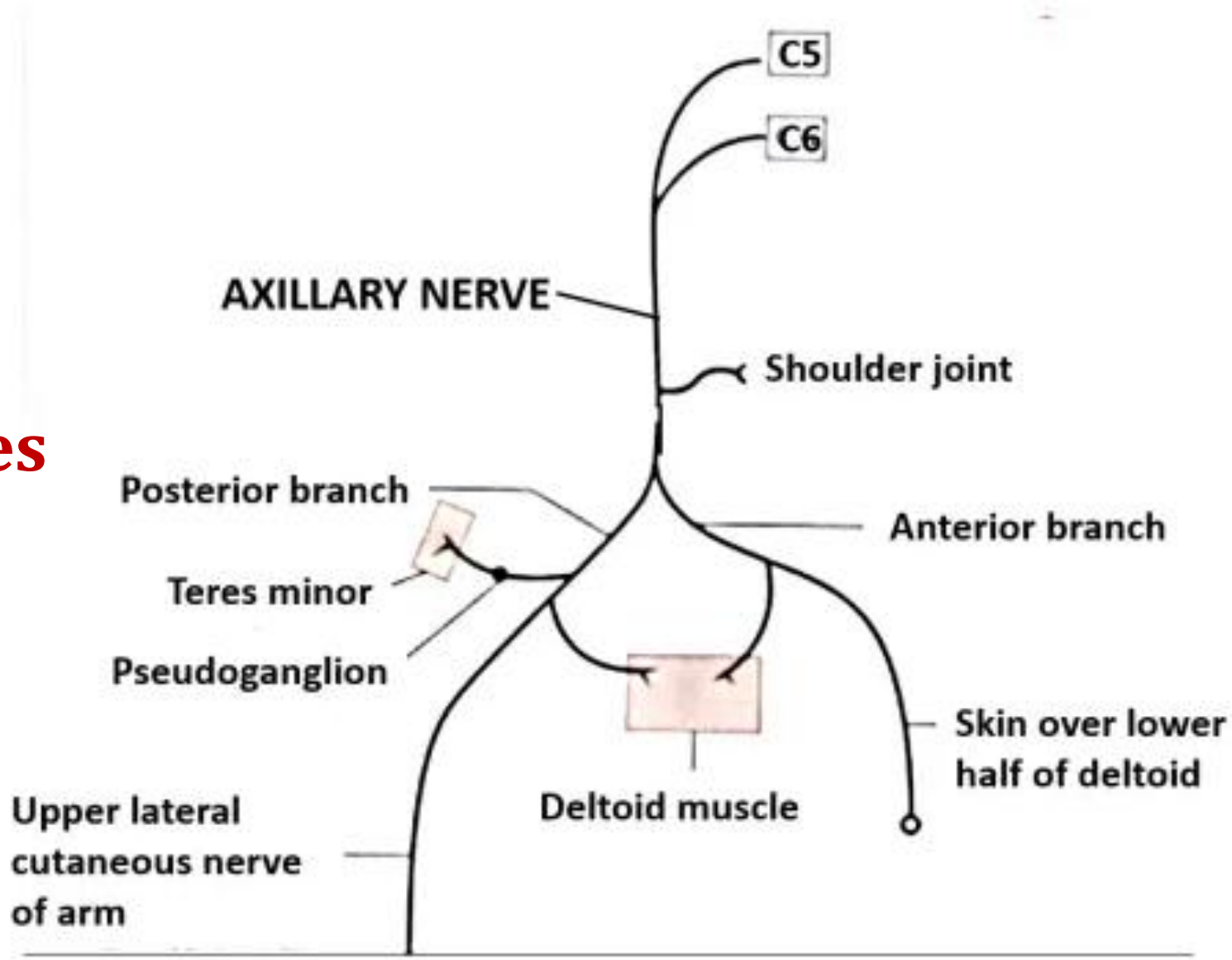

Posterior View
Suprascapular artery and nerve
Acromion of scapula
Superior transverse scapular ligament and scapular notch
Infraspinatus tendon (reflected)
Capsule of shoulder joint
Supraspinatus muscle (cut)
Spine of scapula
Teres minor muscle
Deltoid muscle (reflected)
Infraspinatus muscle (cut)
Quadrangular space transmitting axillary nerve and posterior circumflex humeral artery
Triangular space with circumflex scapular artery deep to space
Superior lateral brachial cutaneous nerve
Deep brachial artery
Radial nerve
Teres major muscle
Long head of triceps brachii muscle
Lateral head of triceps brachii muscle

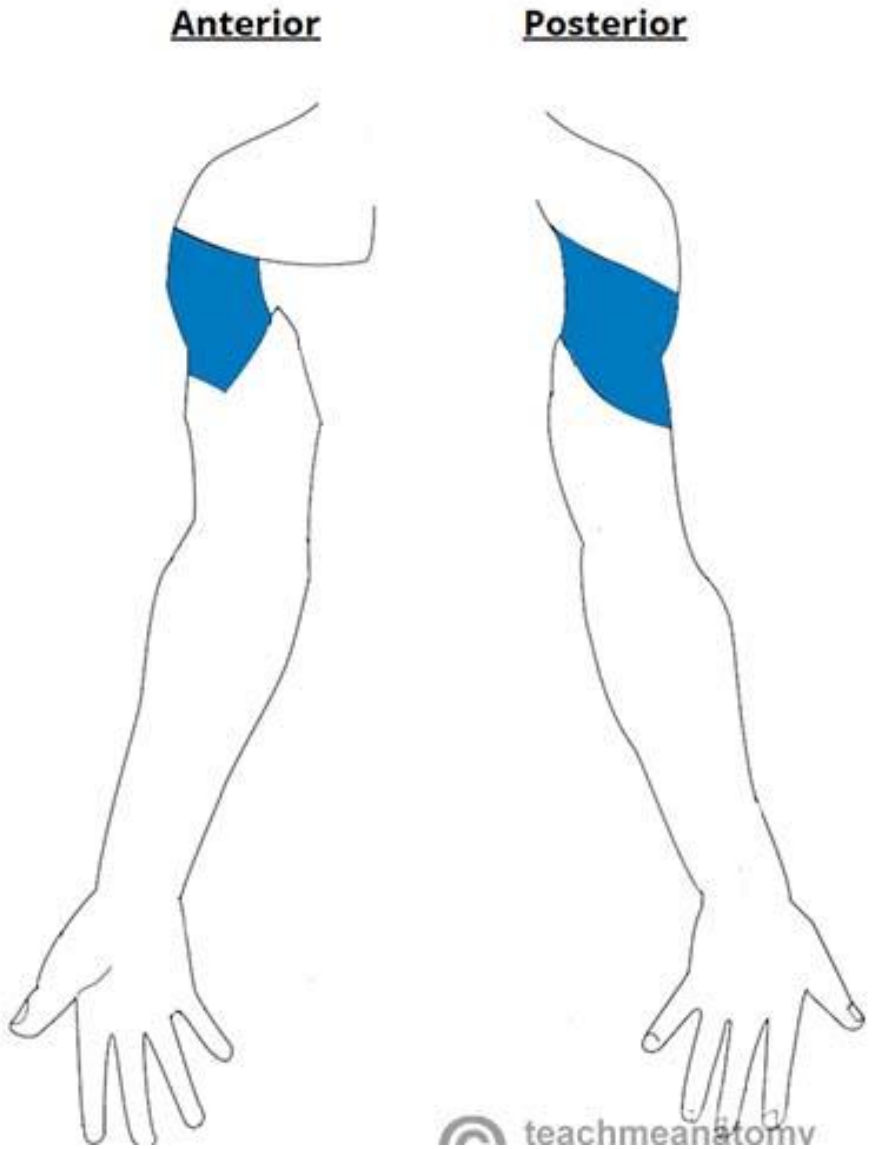
Axillary Nerve - Branches

- **Articular branch:** supplies the shoulder joint.
- **Posterior terminal branch:** after innervating to the posterior aspect of the deltoid muscle and teres minor. It continues as the ***upper lateral cutaneous nerve of the arm***. It innervates the skin over the inferior portion of the deltoid.
- **Anterior terminal branch:** winds around the surgical neck of the humerus and provides motor innervation to the anterior aspect of the deltoid muscle and supplies the skin over the anteroposterior part of the deltoid.



Axillary Nerve - Branches





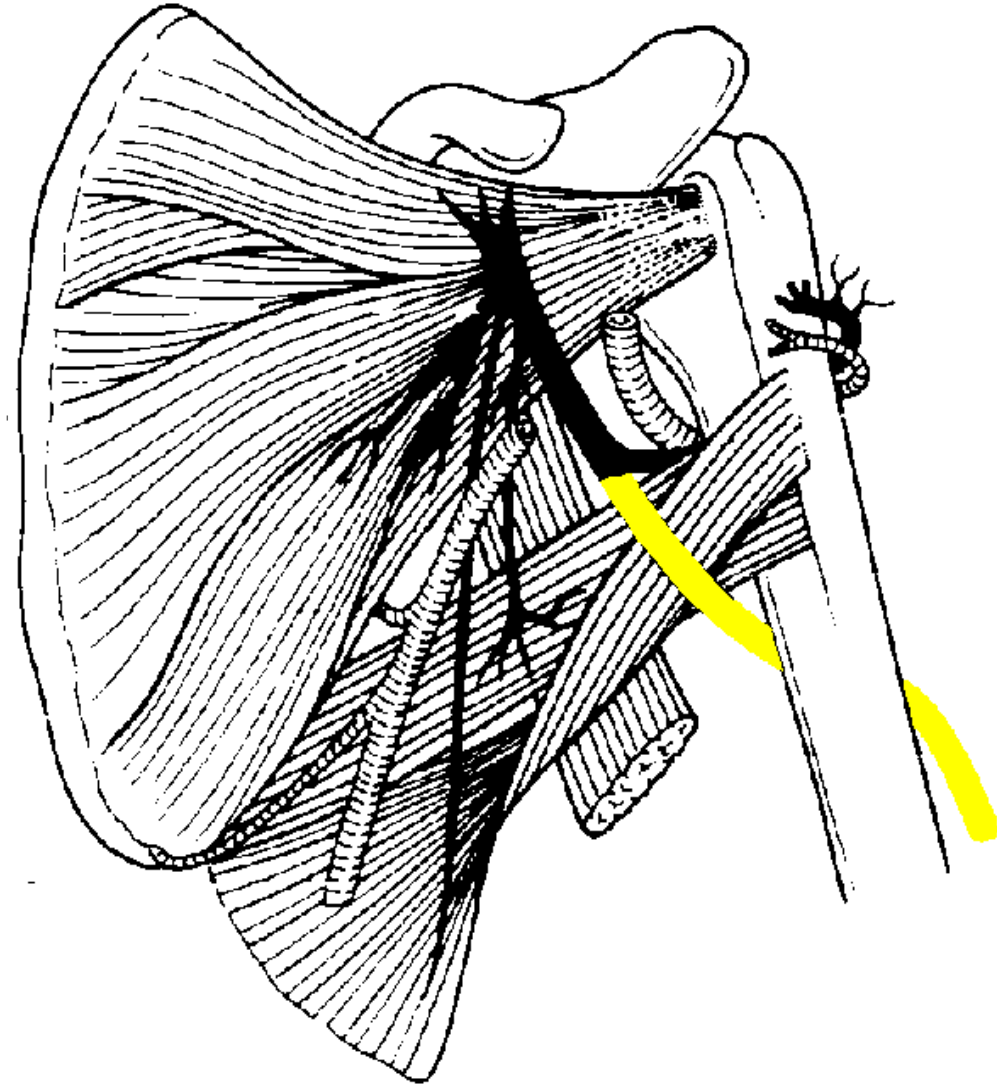
The sensory innervation of the axillary nerve. Known as the regimental badge area.

Radial nerve

- **Roots:** C5-T1.

- It leaves the axilla posteriorly through a triangular space between the humerus, teres major, and the long head of triceps

- The radial nerve provides the major nerve supply of the extensor muscles of the upper limb (arm and forearm).



Radial Nerve - Anatomical Course

It arises from the posterior cord in the axilla

↓

It enters the posterior compartment of arm at lower border of the teres major through the ***triangular interval.***

↓

It then lies in the spiral groove of humerus along with the profunda brachii vessels between the lateral and medial heads of triceps.

↓

At the lower end of the spiral groove, it pierces the lateral intermuscular septum to enter the anterior compartment of arm.

↓

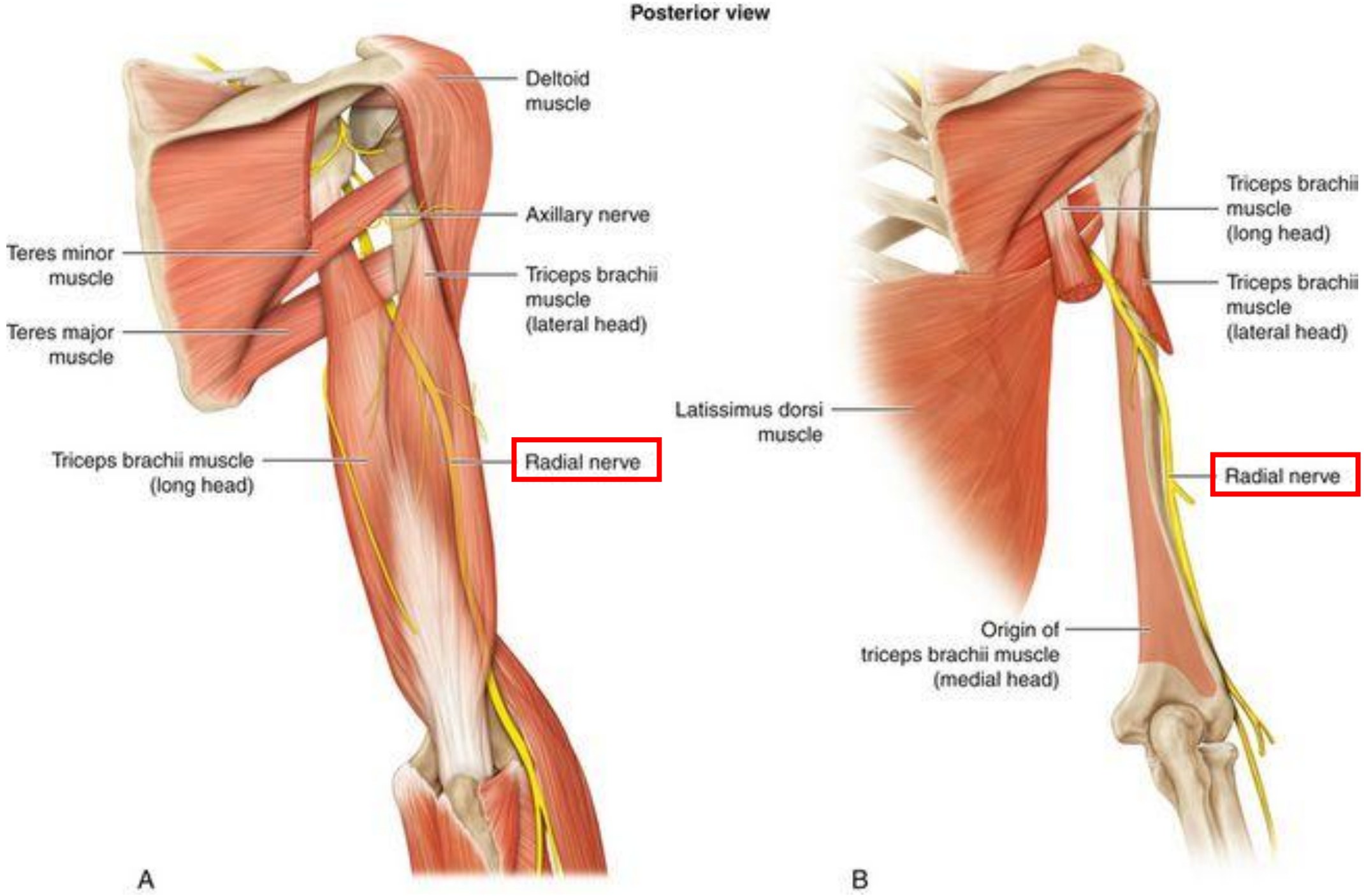
It then enters the cubital fossa and at the level of lateral epicondyle. it terminates by dividing into **superficial** and **deep** (posterior interosseous) branches.

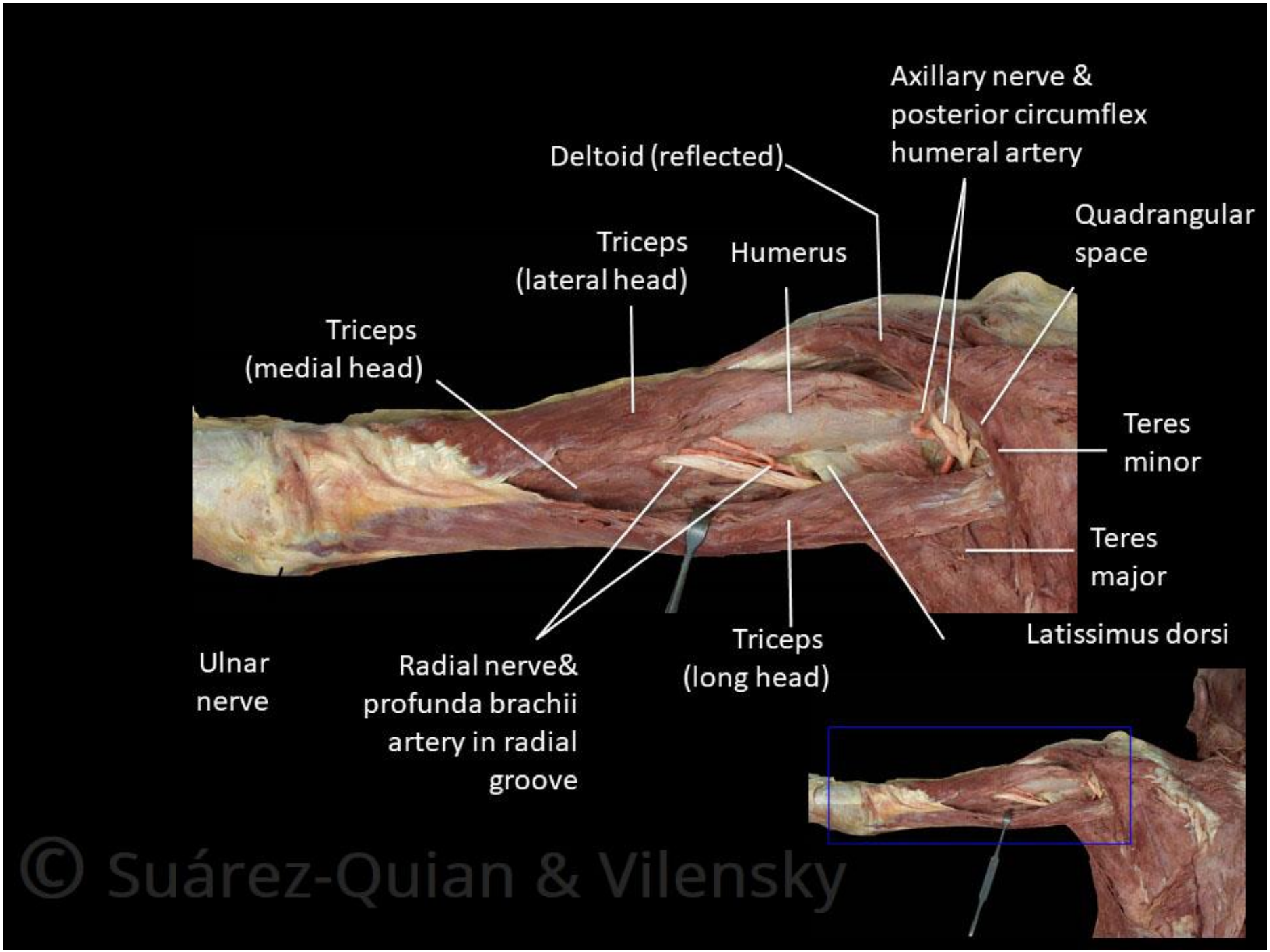
Cond.

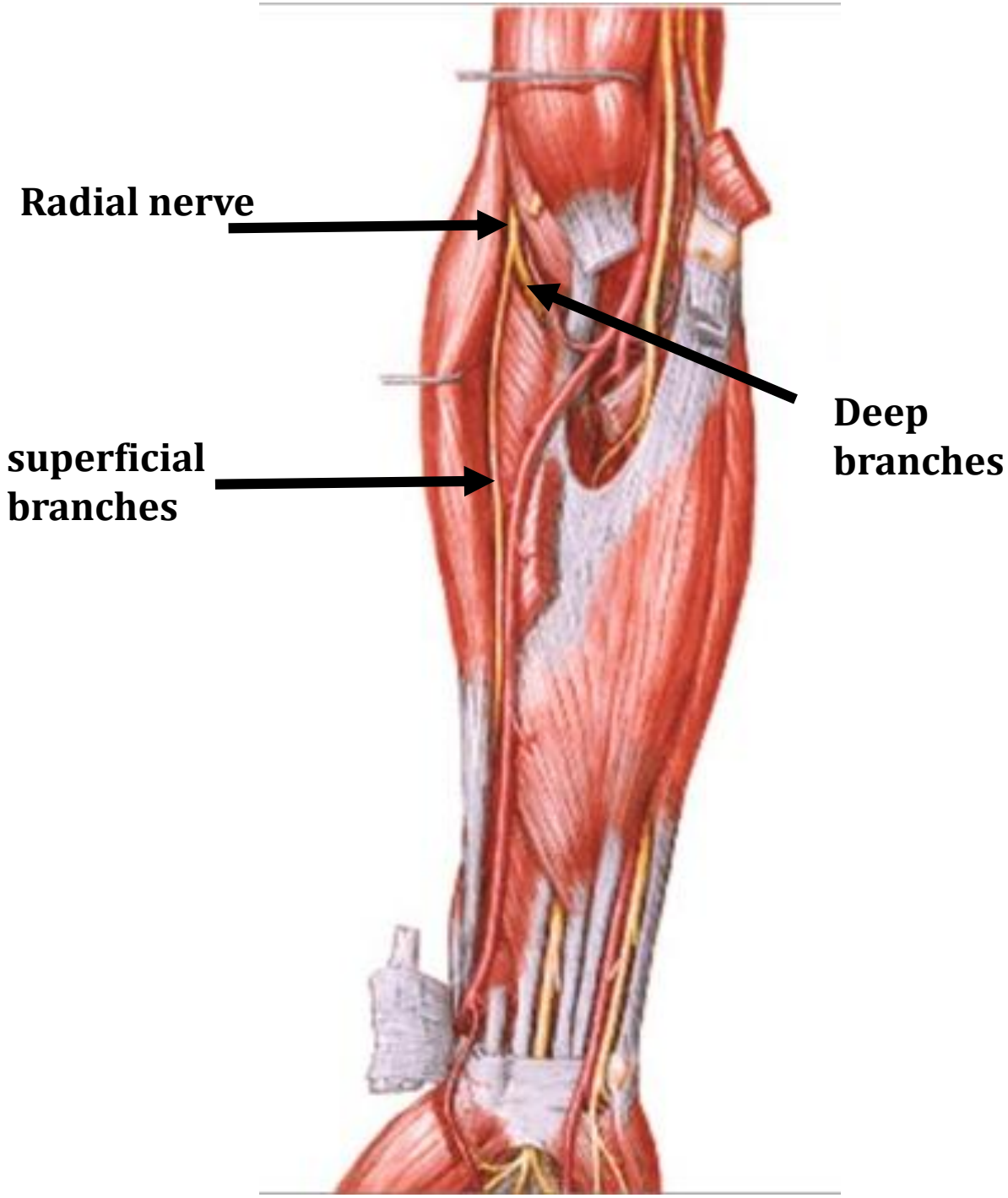
- **The superficial branch** enters the forearm and runs deep to brachioradialis.

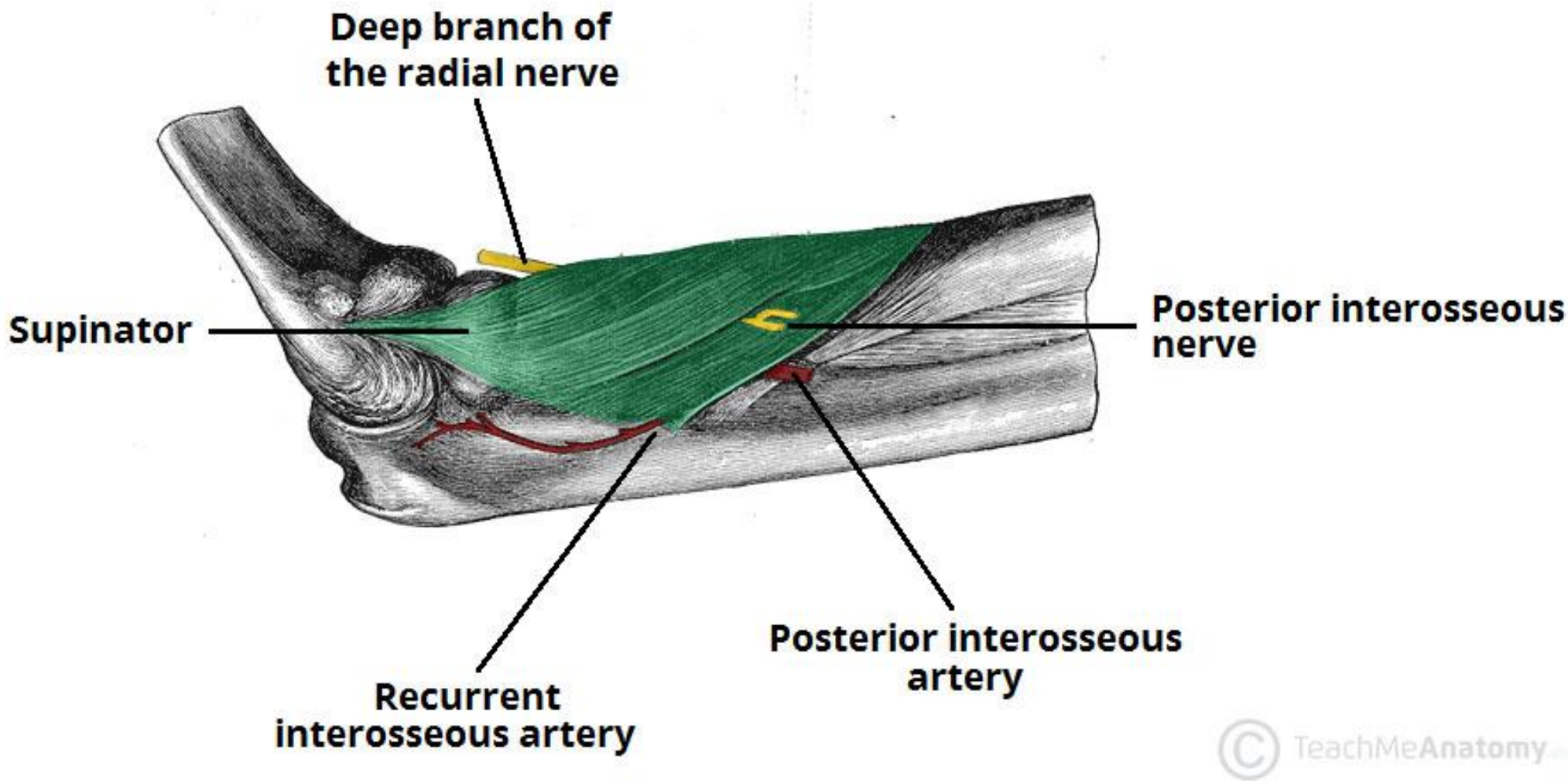
  - In the lower 1/3rd of the forearm it winds around the lateral aspect of radius to reach the anatomical snuff box on the dorsum of hand.
  - It terminates by dividing into ***digital branches***.

- **The deep (posterior interosseous nerve) branch** leaves the cubital fossa by *passing through the supinator to enter the posterior compartment of forearm*.


Posterior view
Deltoid muscle
Axillary nerve
Teres minor muscle
Triceps brachii muscle (lateral head)
Teres major muscle
Triceps brachii muscle (long head)
Radial nerve
A
Triceps brachii muscle (long head)
Triceps brachii muscle (lateral head)
Latissimus dorsi muscle
Radial nerve
Origin of triceps brachii muscle (medial head)
B


Axillary nerve &
posterior circumflex
humeral artery
Deltoid (reflected)
Quadrangular
space
Triceps
(lateral head)
Humerus
Triceps
(medial head)
Teres
minor
Teres
major
Latissimus dorsi
Triceps
(long head)
Ulnar
nerve
Radial nerve&
profunda brachii
artery in radial
groove
© Suárez-Quian & Vilensky


Radial nerve
superficial branches
Deep branches



Radial Nerve – Branches of Motor Functions

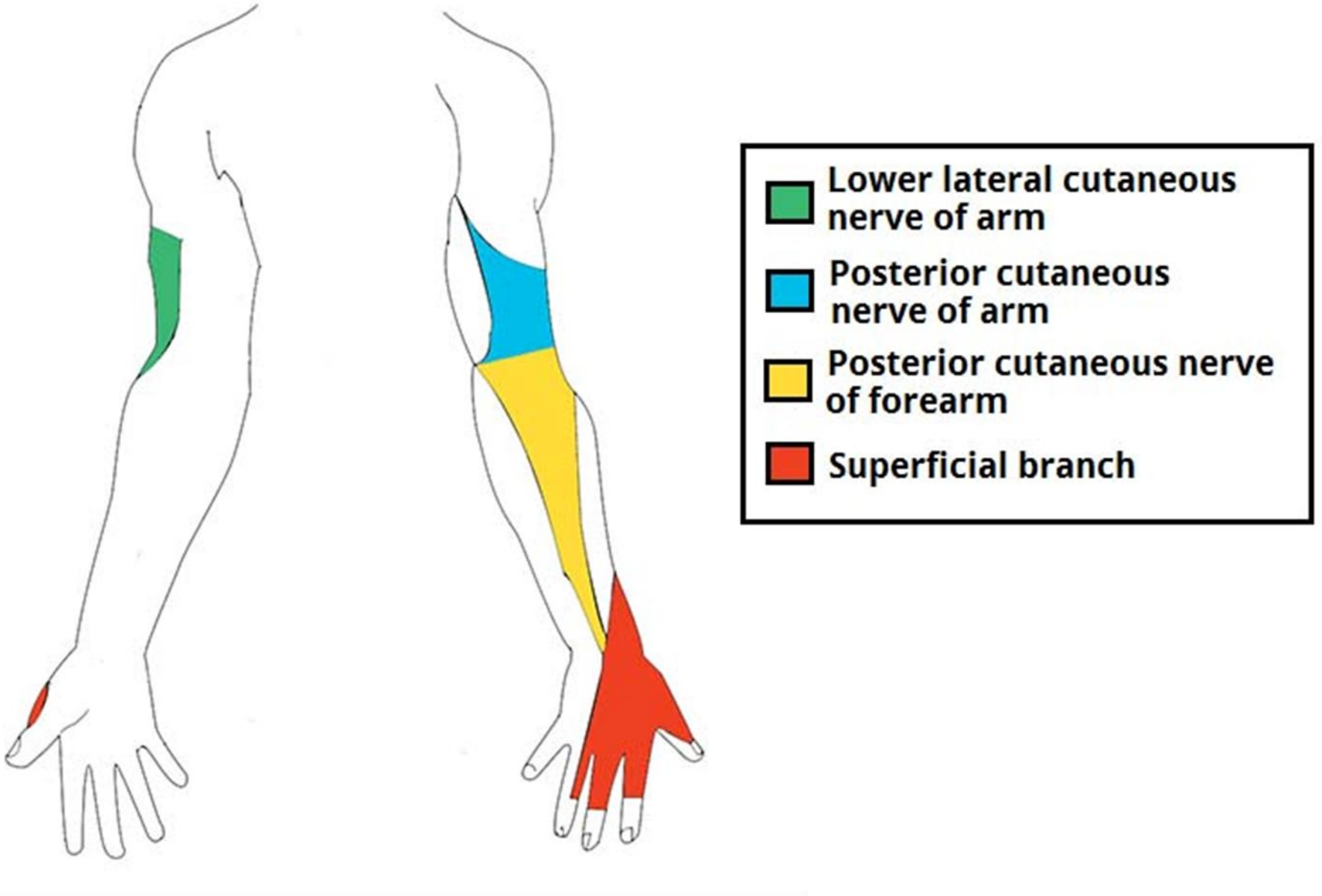
- **In the arm:**
  - It innervates the three heads of the triceps brachii**.**
  - It also gives rise to branches that supply the brachioradialis and extensor carpi radialis longus (muscles of the posterior forearm).

- **In the forearm:**
  - **The deep (posterior interosseous nerve) branch** innervates the remaining muscles of the posterior forearm.

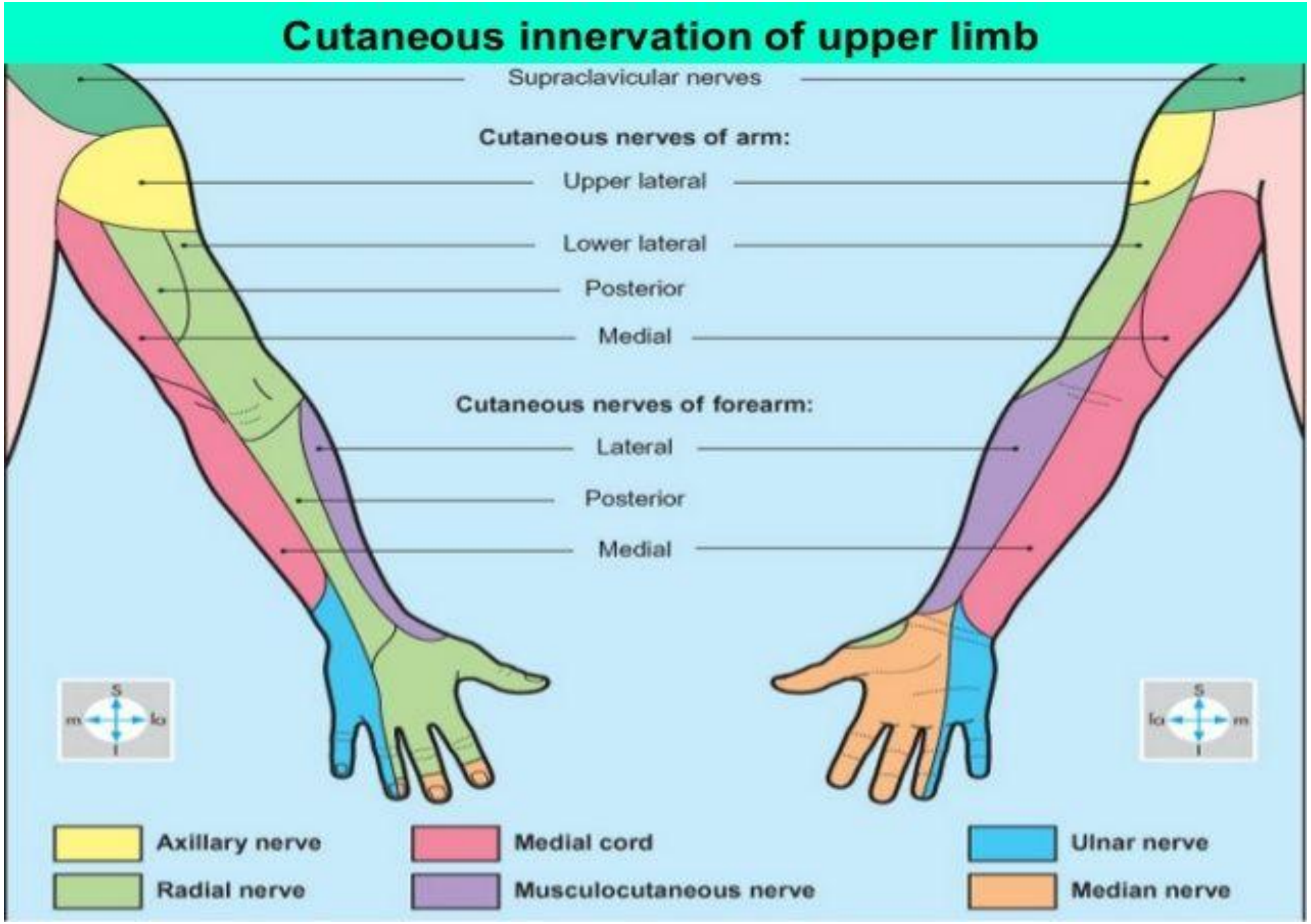
Radial Nerve – Branches of Sensory Functions

- **In the arm:**
  - **Lower lateral cutaneous nerve of arm:** innervates the lateral aspect of the arm, inferior to the insertion of the deltoid muscle.
  - **Posterior cutaneous nerve of arm:** innervates the posterior surface of the arm.
  - **Posterior cutaneous nerve of forearm:** innervates a strip of skin down the middle of the posterior forearm.
- **In the forearm:**
  - **The superficial branch:** innervates the dorsal surface of the lateral three and half digits and the associated area on the dorsum of the hand.

Radial Nerve – Sensory Functions



Cutaneous innervation of upper limb



Clinical Anatomy

Injury to the Brachial Plexus

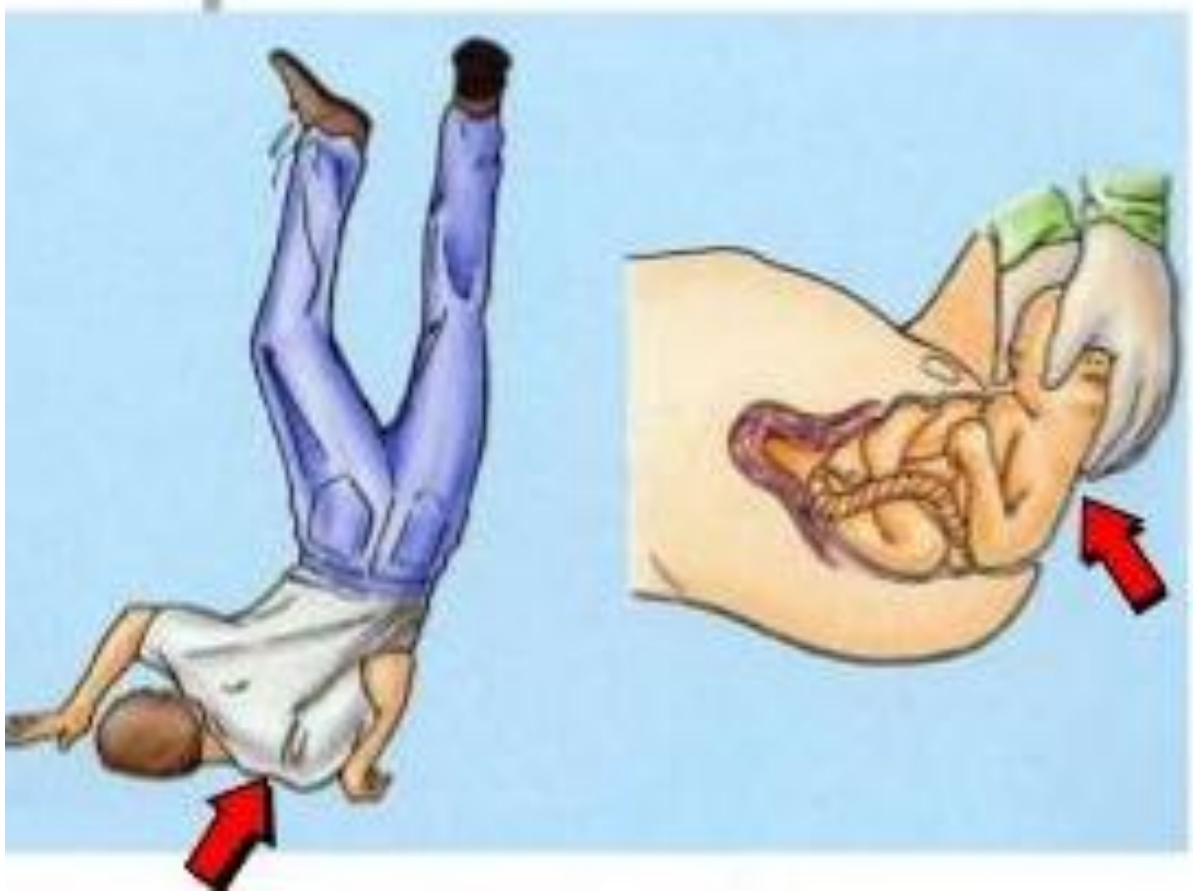
- **There are two major types of injuries that can affect the brachial plexus:**

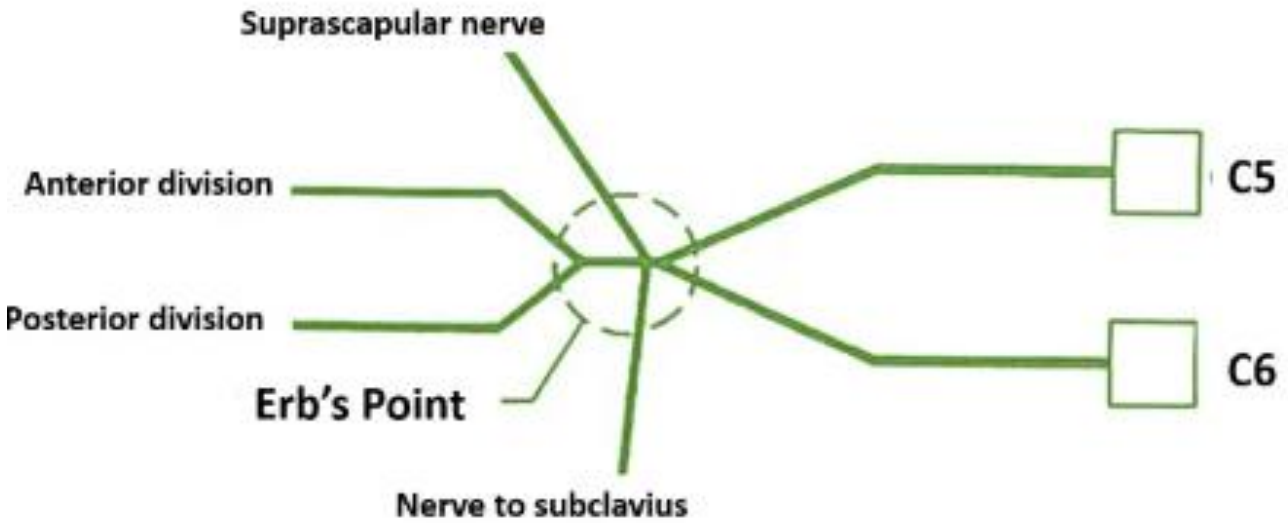
1. An upper brachial plexus injury affects the superior roots – **Erb's Palsy**

2. A lower brachial plexus injury affects the inferior roots - **Klumpke's Palsy**

Upper Brachial Plexus Injury – Erb's Palsy

- **Site of lesion**: The nerve roots of **C5 and C6** (upper trunk).
- Commonly occurs as a result of an *excessive increase in the angle between the neck and shoulder, which stretches (or even tears) the nerve roots of C5 and C6.*
  - It can occur as a result of a **difficult birth** or **shoulder trauma**
- **Nerves affected: musculocutaneous**, **axillary**, **suprascapular** and **nerve to subclavius.**




Suprascapular nerve
Anterior division
Posterior division
Erb's Point
Nerve to subclavius
C5
C6

Signs of Erb's Palsy:

- **Sensory loss:** There is loss of sensations from the skin over the lower part of the deltoid (supplied by axillary nerve).

- **Motor loss:** The muscles paralyzed are supraspinatus, deltoid, infraspinatus, teres minor, biceps brachii, brachialis, brachioradialis and supinator.

- **Position of upper limb:**

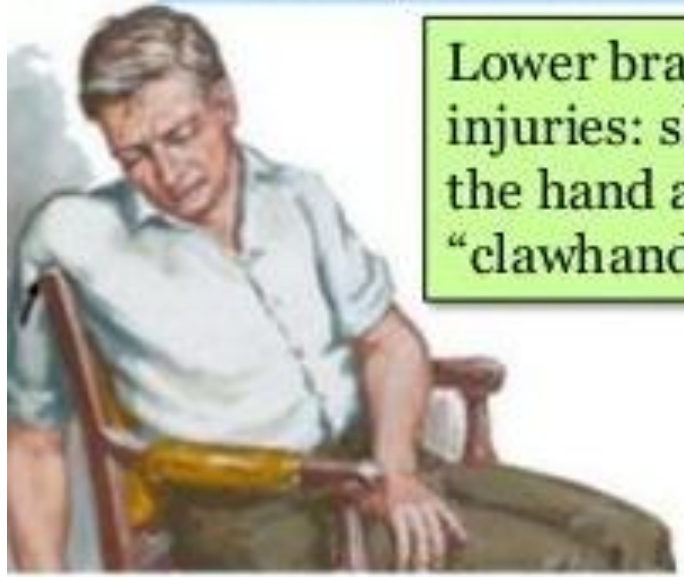
  - The arm is adducted and medially rotated.
  - The forearm is extended and pronated.

➢ This is position is known as **'waiter's tip'**

waiter's tip hand

Lower Brachial Plexus Injury - Klumpke's Palsy

- Site of lesion: The nerve roots of **C8 and T1** (lower trunk).
- Results from *excessive abduction of the arm*.
  - It has a much lower incidence than Erb's palsy.
- **Nerves affected: ulnar** and **median nerves.**



Lower brachial plexus injuries: short muscles of the hand are affected > “clawhand”

Signs of Klumpke's Palsy:

- **Sensory loss:** Loss of sensations from a narrow zone along the medial side of hand and forearm.
- **Motor loss:** the intrinsic muscles of the hand are paralyzed.
  - Hyperextension at metacarpophalangeal joints
  - Flexion at interphalangeal joints.
- **Position of the hand:** the complete **"Claw hand".**

Complete “Claw hand”

Axillary Nerve Injury

- **The axillary nerve may get injured due to:**
  - Inferior dislocation of head of humerus.
  - Fracture of surgical neck of humerus.
  - Improper use of crutches.
- **The injury to axillary nerve results in:**
  - Impaired abduction of shoulder joint due to paralysis of deltoid muscle.
  - Loss of rounded contour of shoulder ***(flat shoulder deformity).***
  - Loss of sensation over the lower half of the deltoid.

Radial Nerve Injury

- **In the Axilla**
  - The axillary nerve may get injured due to:
    - **Dislocation of head of humerus.**
    - **Fracture of the proximal humerus.**
    - **Improper use of crutches.**
  - **Motor functions:** *muscles in posterior compartment of arm and forearm are affected*. The patient is ***unable to extend at the forearm***, wrist and fingers. Unopposed flexion of wrist occurs, known as ***wrist-drop***.
  - **Sensory functions:** *all four cutaneous branches of the radial nerve are affected*. There will be a ***loss of sensation over the lateral and posterior arm, posterior forearm, and dorsal surface of the lateral three and a half digits***.

Radial Nerve Injury

- **In the Radial Groove**

  - The axillary nerve may get injured due to **damage with a fracture of the humeral shaft**

  - **Motor functions:** The triceps brachii may be weakened but is not paralysed (branches to the long and lateral heads of the triceps arise proximal to the radial groove). *Muscles of the posterior forearm are affected*. The patient is unable to extend at the wrist and fingers. Unopposed flexion of wrist occurs, known as ***wrist-drop***.

  - **Sensory functions:** the cutaneous branches to the arm and forearm have already arisen. *The superficial branch of the radial nerve will be damaged*, resulting in ***sensory loss to the dorsal surface of the lateral three and half digits and the associated area on the dorsum of the hand***.

Ulnar Nerve Injury

- **At elbow:** due to **fracture of medial epicondyle** or **entrapment between the two heads of flexor carpi ulnaris.**
  - Injury at this site results in:
    - **Partial claw hand** affects little and ring fingers.
    - Flattening of hypothenar eminence
    - Loss of abduction and adduction of fingers, due to paralysis of palmar and dorsal interossei.
    - Adduction of the thumb is impaired (due to paralysis of adductor pollicis).
    - Loss of sensation over the palmar and dorsal surface of medial 1/3rd of hand and medial 1 ½ digits.

Ulnar Nerve Injury

- **At wrist:** its superficial position makes it vulnerable to **cuts and wounds at the wrist.**
  - Injury at this site results in:
    - **Partial claw hand** affecting little and ring fingers.
    - Loss of abduction and adduction of fingers.
    - Adduction of the thumb is impaired
    - Loss of sensation over the palmar surface of medial 1 ***1/2*** digits (??)

Partial claw hand

Median Nerve Injury

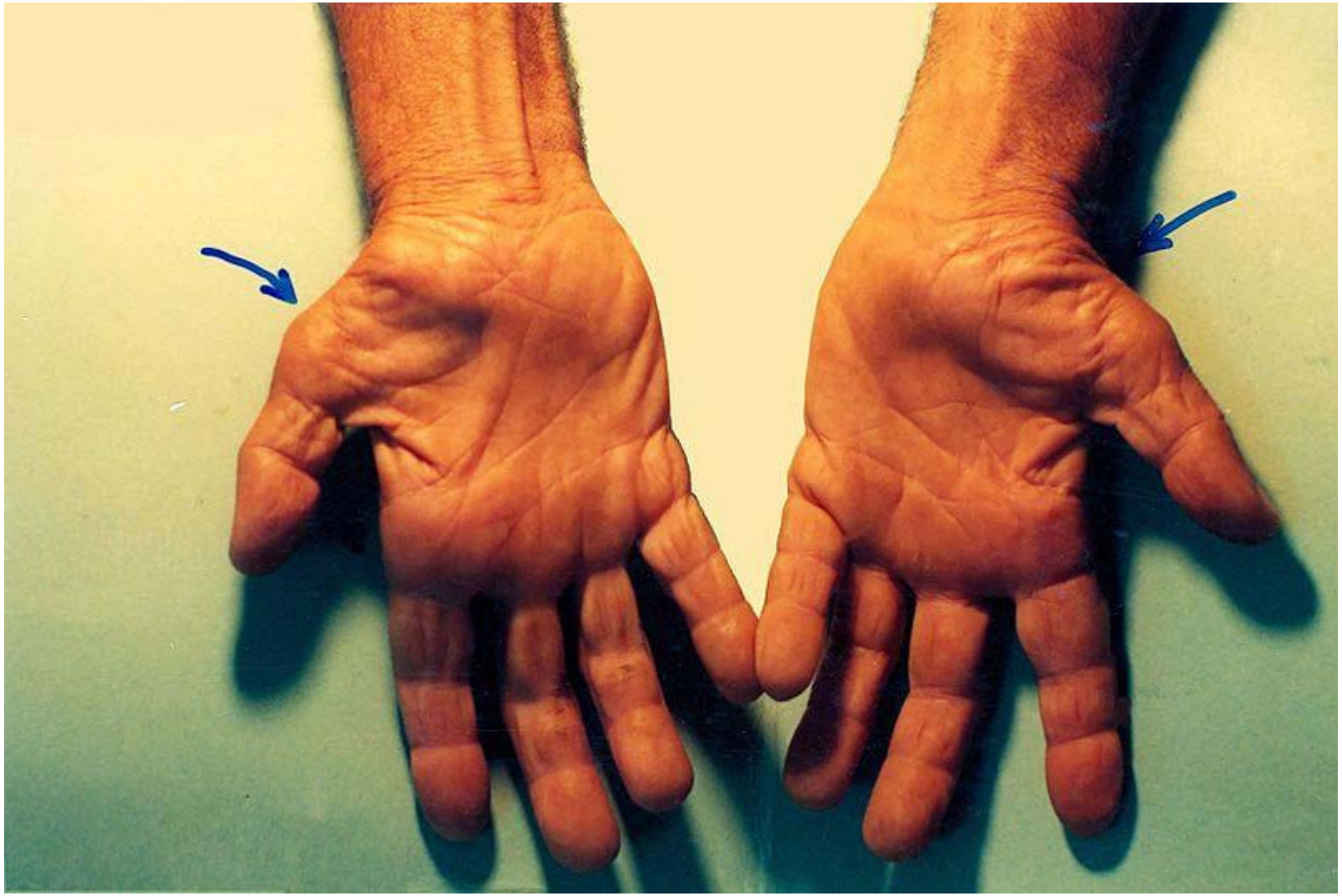
- **At the elbow:** due to **supracondylar fracture of humerus** OR **entrapment of nerve between the two heads of pronator teres** (pronator syndrome).

  - Injury to median nerve at this site results in:
    - Loss of forearm pronation.
    - Weakened flexion at wrist.
    - Thenar eminence is flattened
    - **Ape thumb deformity:** Thumb is laterally rotated and adducted. Opposition of thumb is not possible.
    - **Benediction Attitude:** Index and middle fingers lag behind while making the fist due to paralysis of 1st and 2nd lumbricals
    - Sensory loss over the lateral half of the palm and lateral 3 ½ digits.

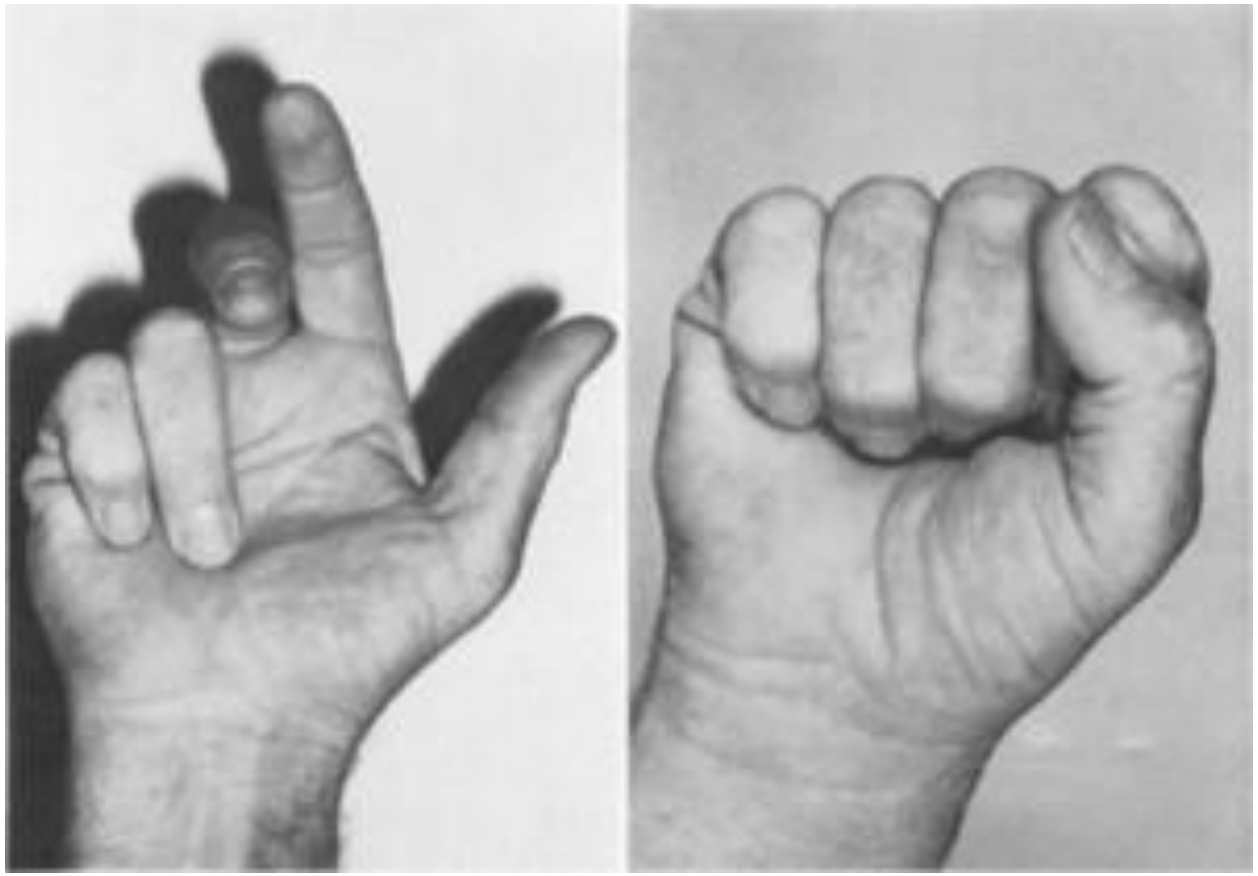
Median Nerve Injury

- **Carpal Tunnel Syndrome:** due to **compression of the median nerve in the carpal tunnel.**
  - Clinical features:
    - Numbness, tingling, and pain in the distribution of the median nerve. Importantly, the palm is usually spared (why ?)
    - Thenar eminence is flattened
    - Ape thumb deformity
    - Index and middle fingers lag behind while making the fist due to paralysis of 1st and 2nd lumbricals (Benediction Attitude).

Ape thumb deformity



Benediction Attitude



Thank You

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