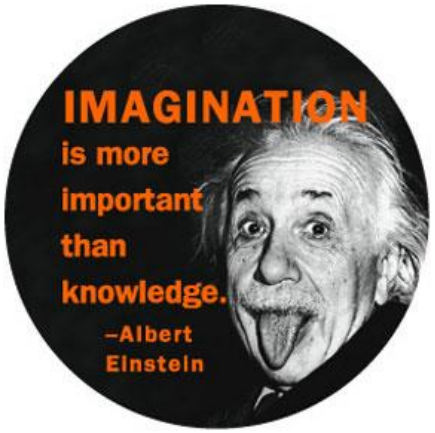



# AXILLA

# &

# BRACHIAL PLEXUS

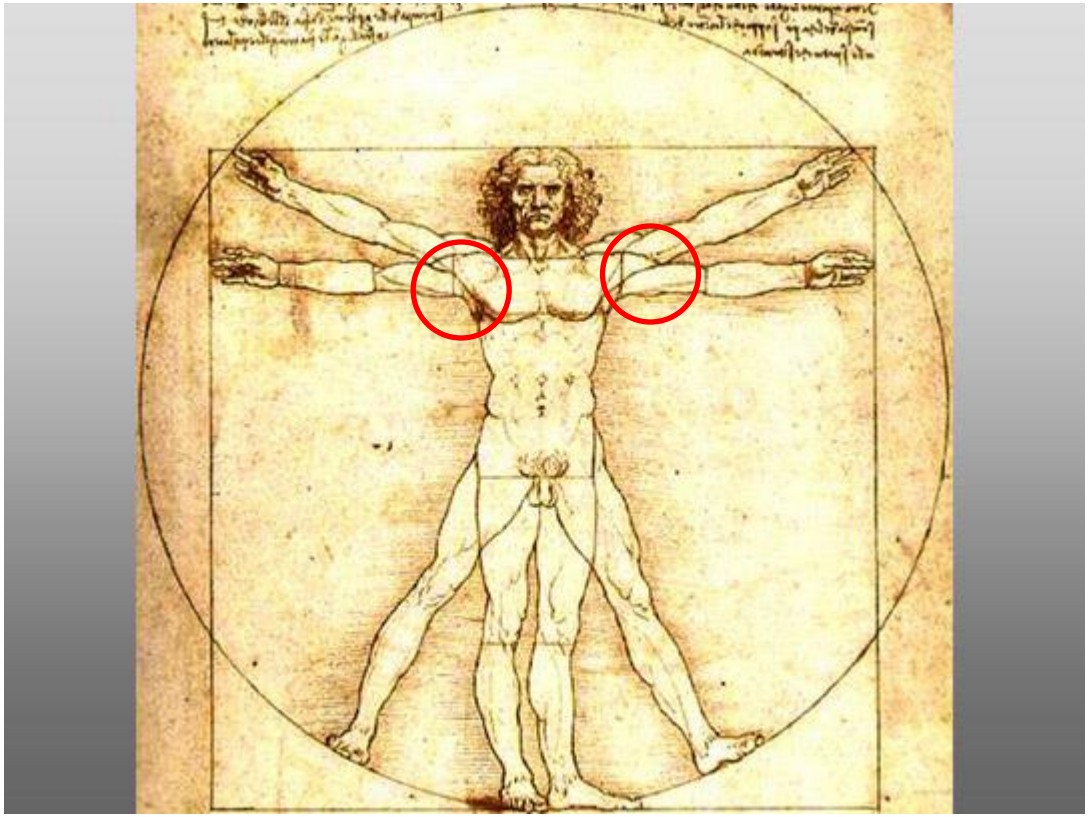
Kaan Yücel M.D., Ph.D

27.February.2014 Thursday

# AXILLA
## (ARMPIT)



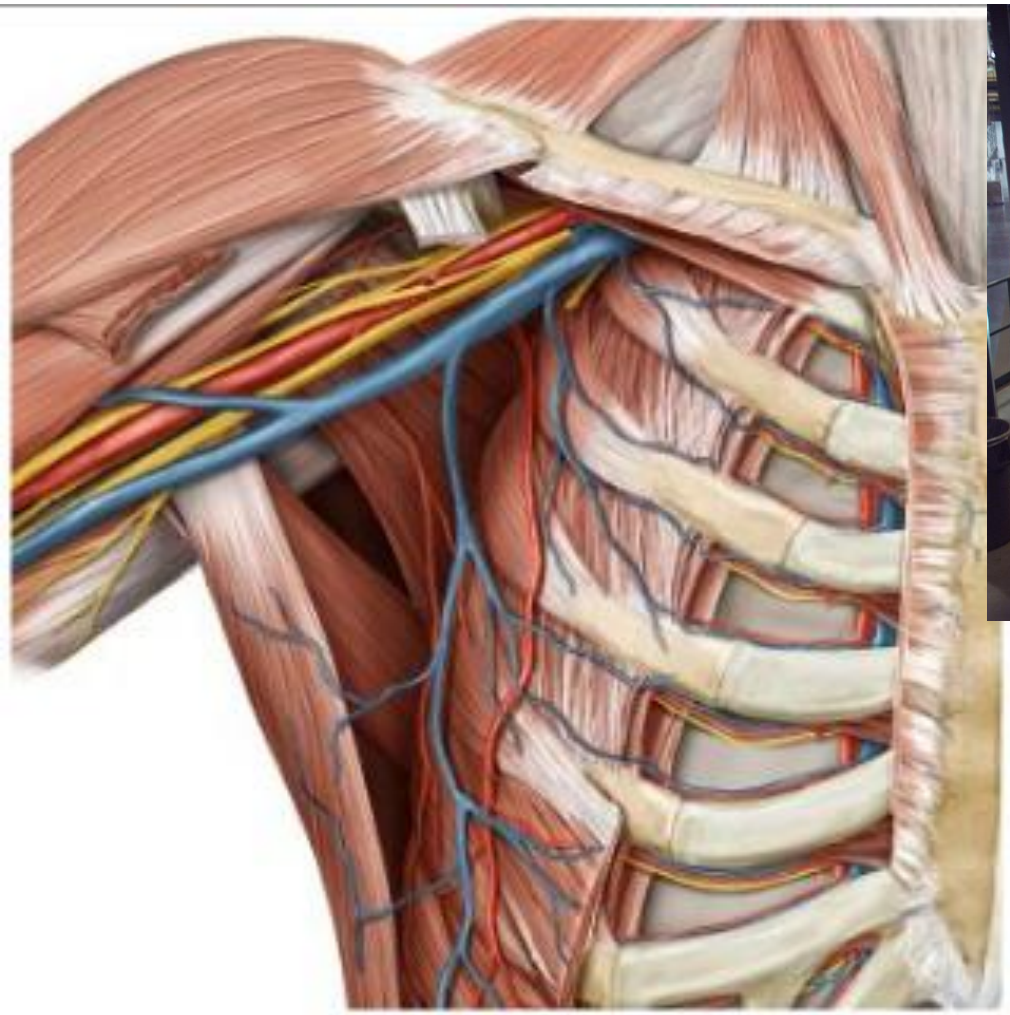
- Gateway to the upper limb
- An area of transition between the neck and the arm.



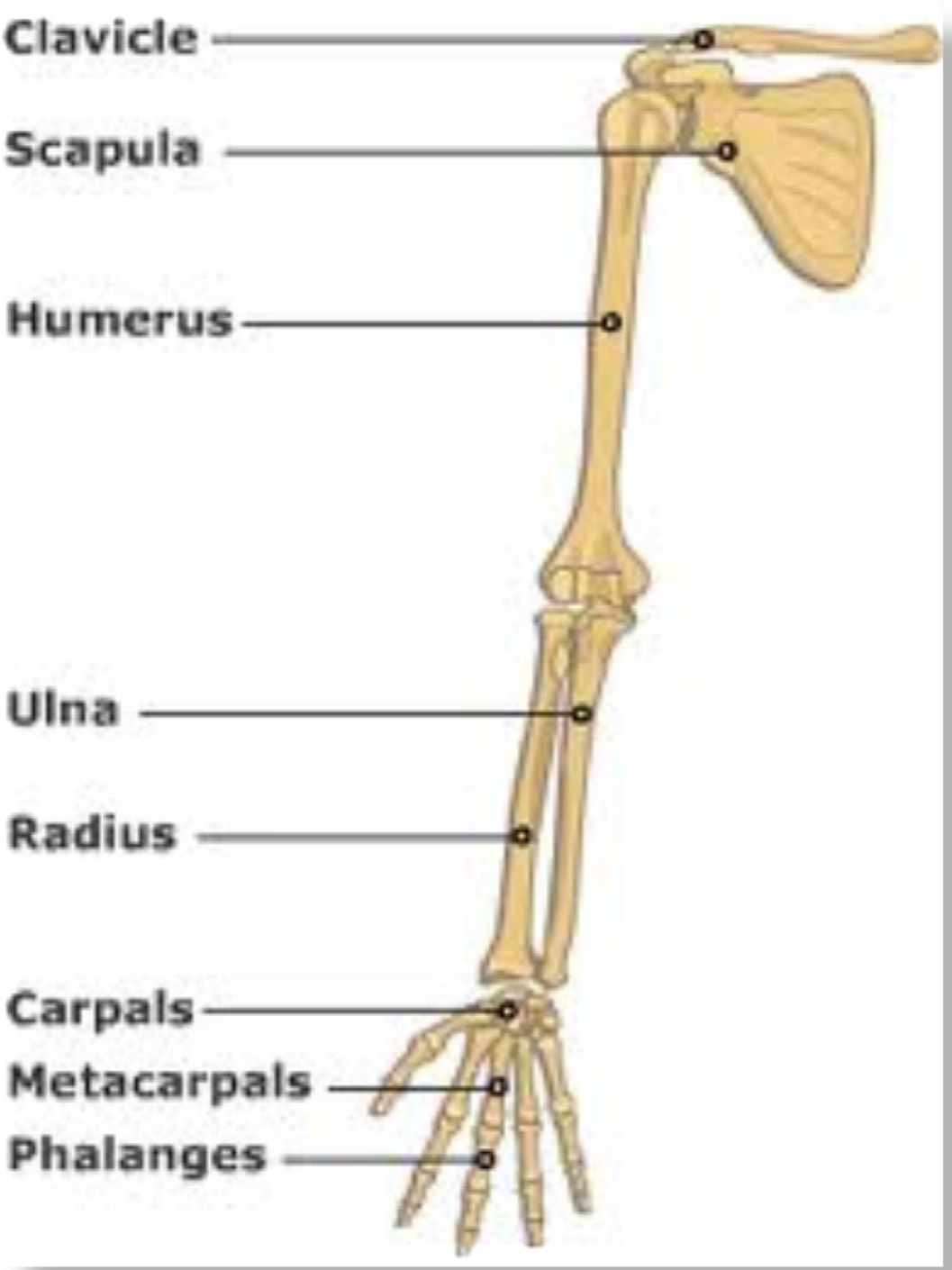
- Pyramidal space inferior to shoulder @ junction of arm & thorax

- **Distribution center** for the neurovascular structures that serve the upper limb.

*Protected by the adducted upper limb*.

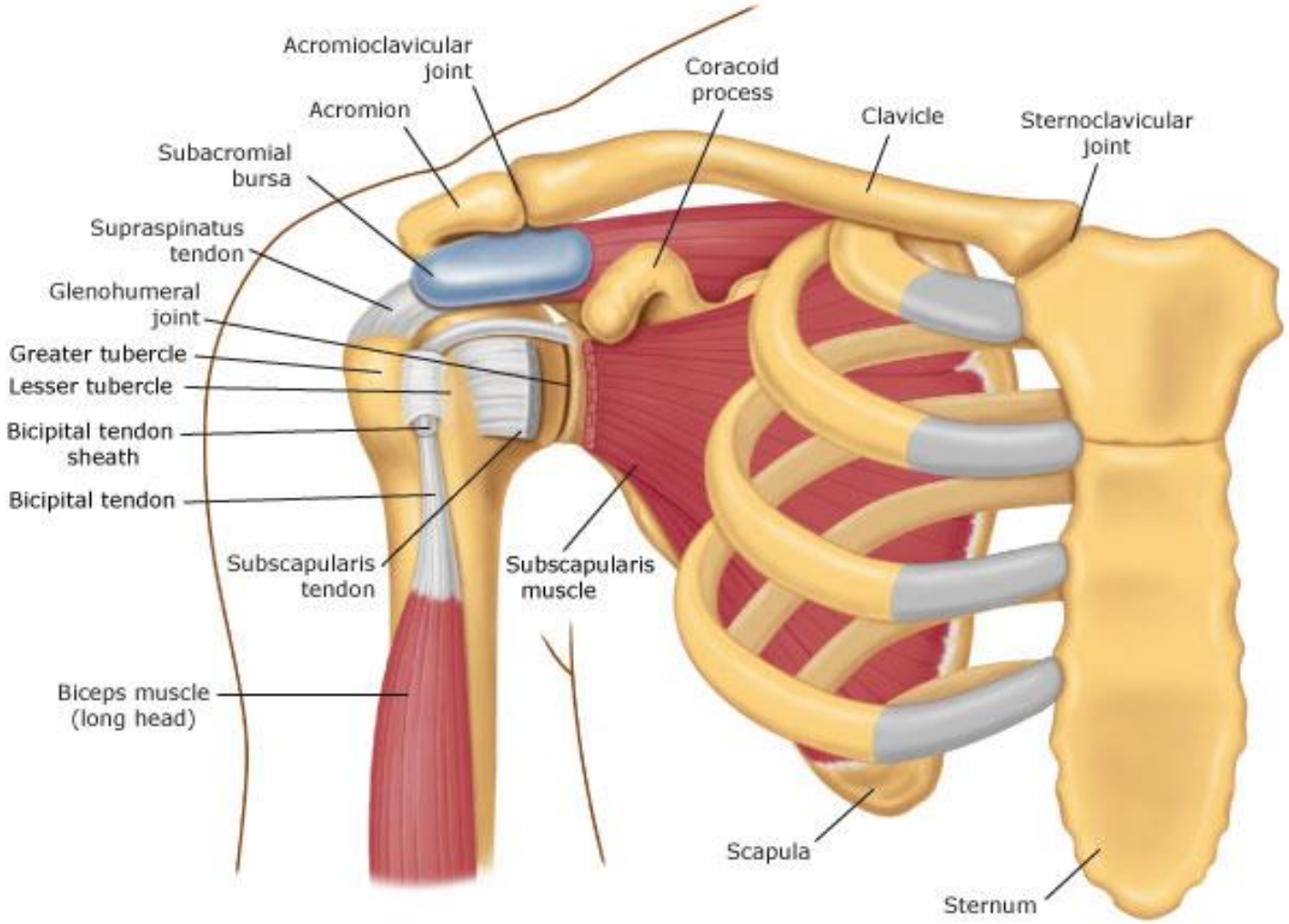


BLOOD COMES
**ARTERIES**
BLOOD GOES
**VEINS**
MUSCLES,VESSELS,
SWEAT GLANDS
INNERVATED
**NERVES**



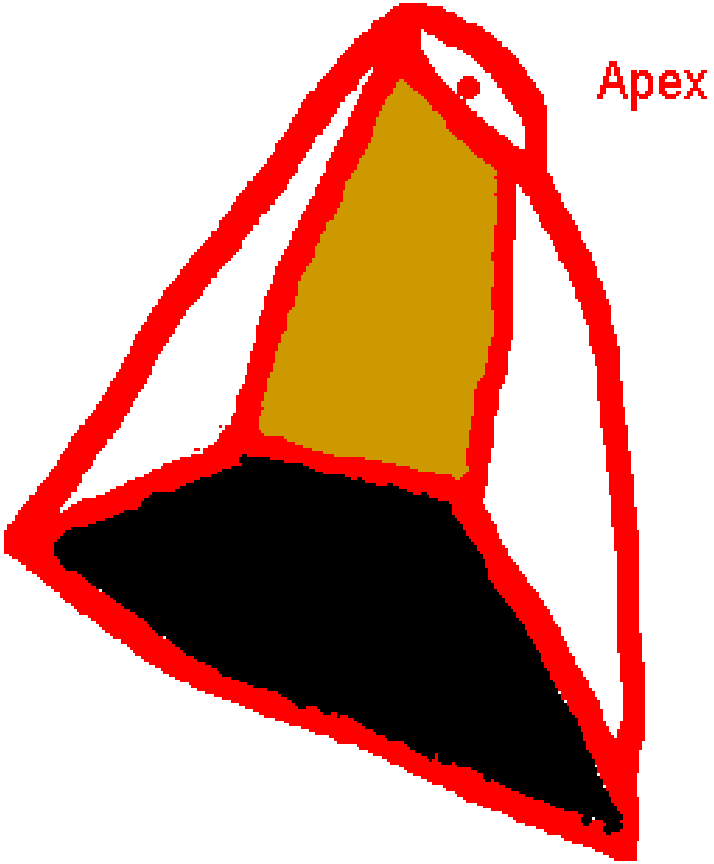
Axilla is formed by:

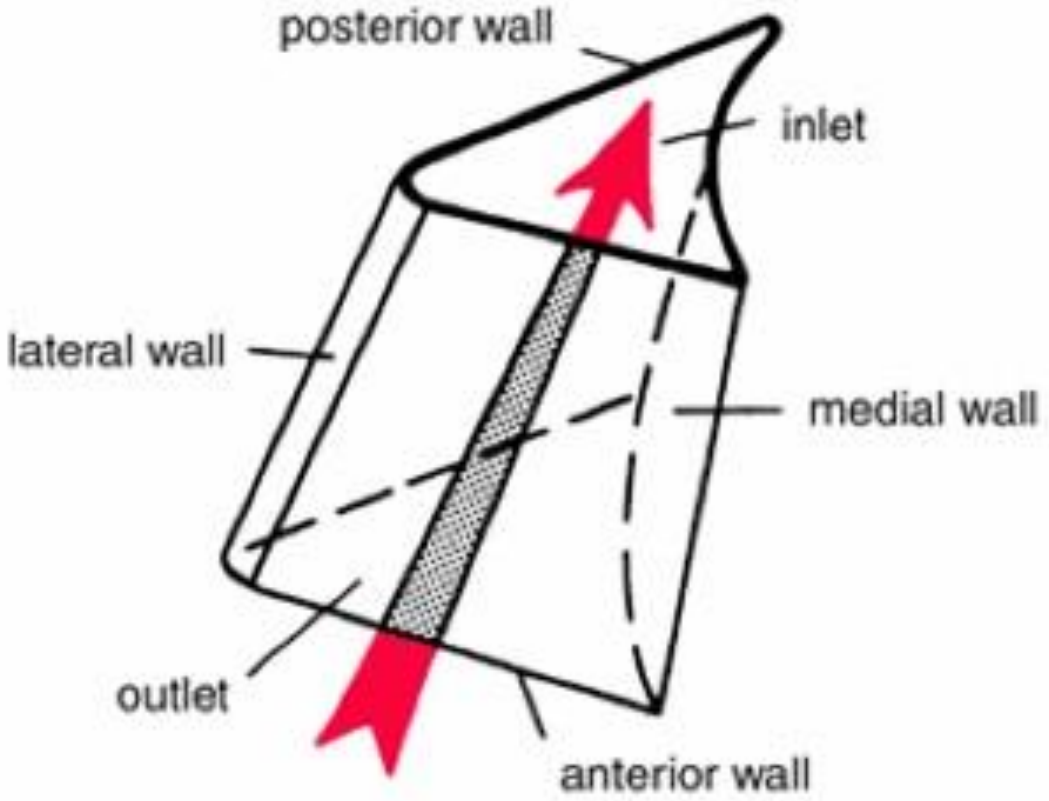
- ✓ **Clavicle**
- ✓ **Scapula**
- ✓ **Upper thoracic wall**
- ✓ **Humerus & related muscles**



Axilla is an irregularly shaped pyramidal space with:

- Four walls
- An inlet (apex)
- A floor (base)



# Axillary inlet (Apex)

## Cervico-axillary canal

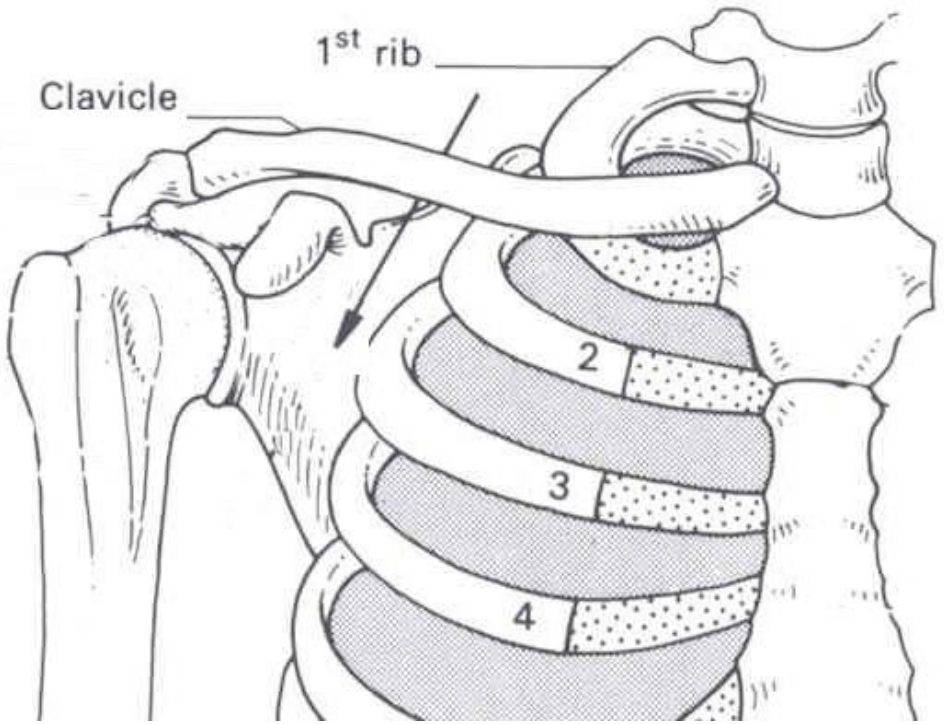
*passageway between neck and axilla*

bounded by:

1st rib

Clavicle

Superior edge of the scapula

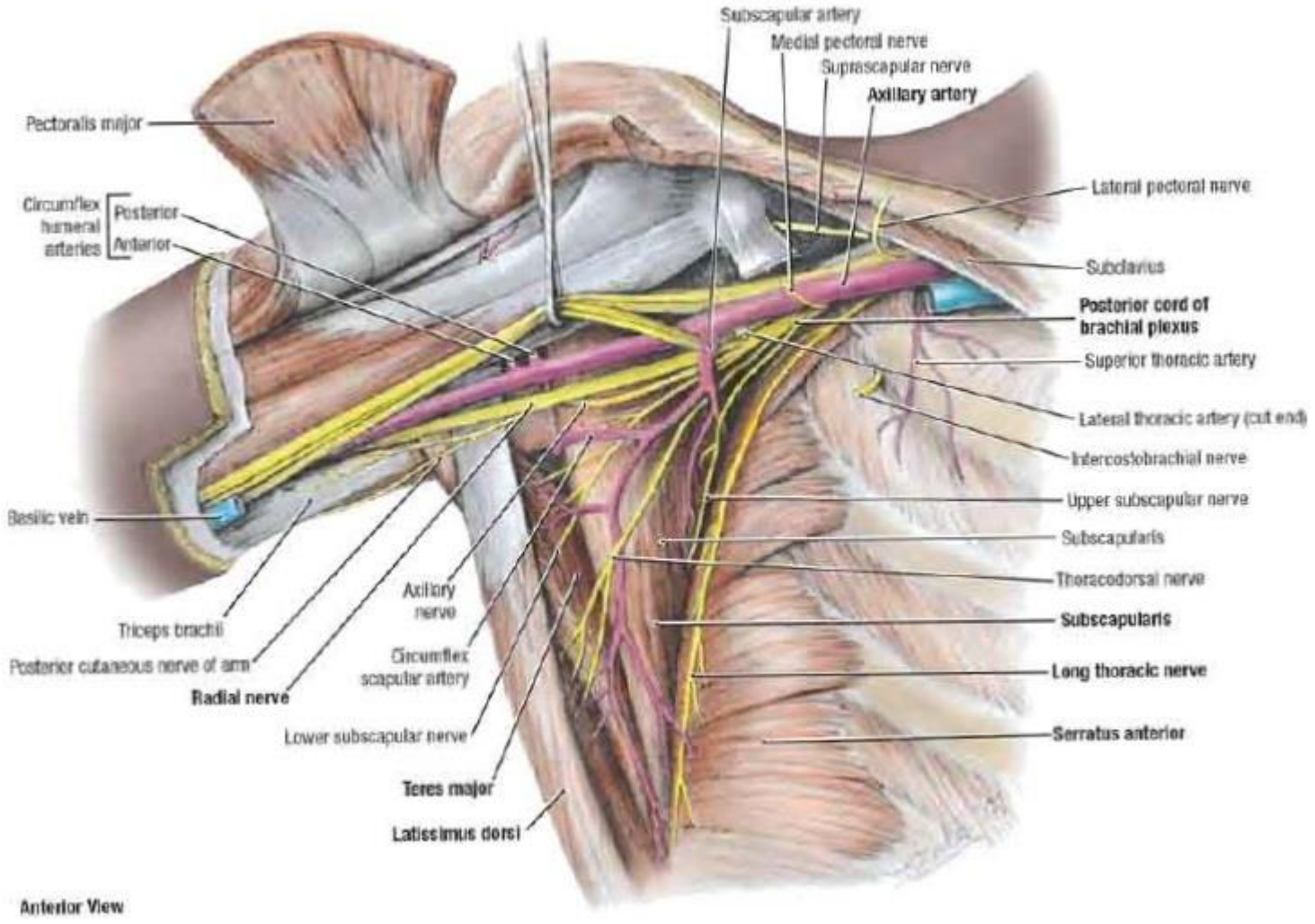



The arteries, veins, lymphatics, and nerves traverse this superior opening of the axilla to pass to or from the arm.

At the axillary inlet,

**A ➡ P**

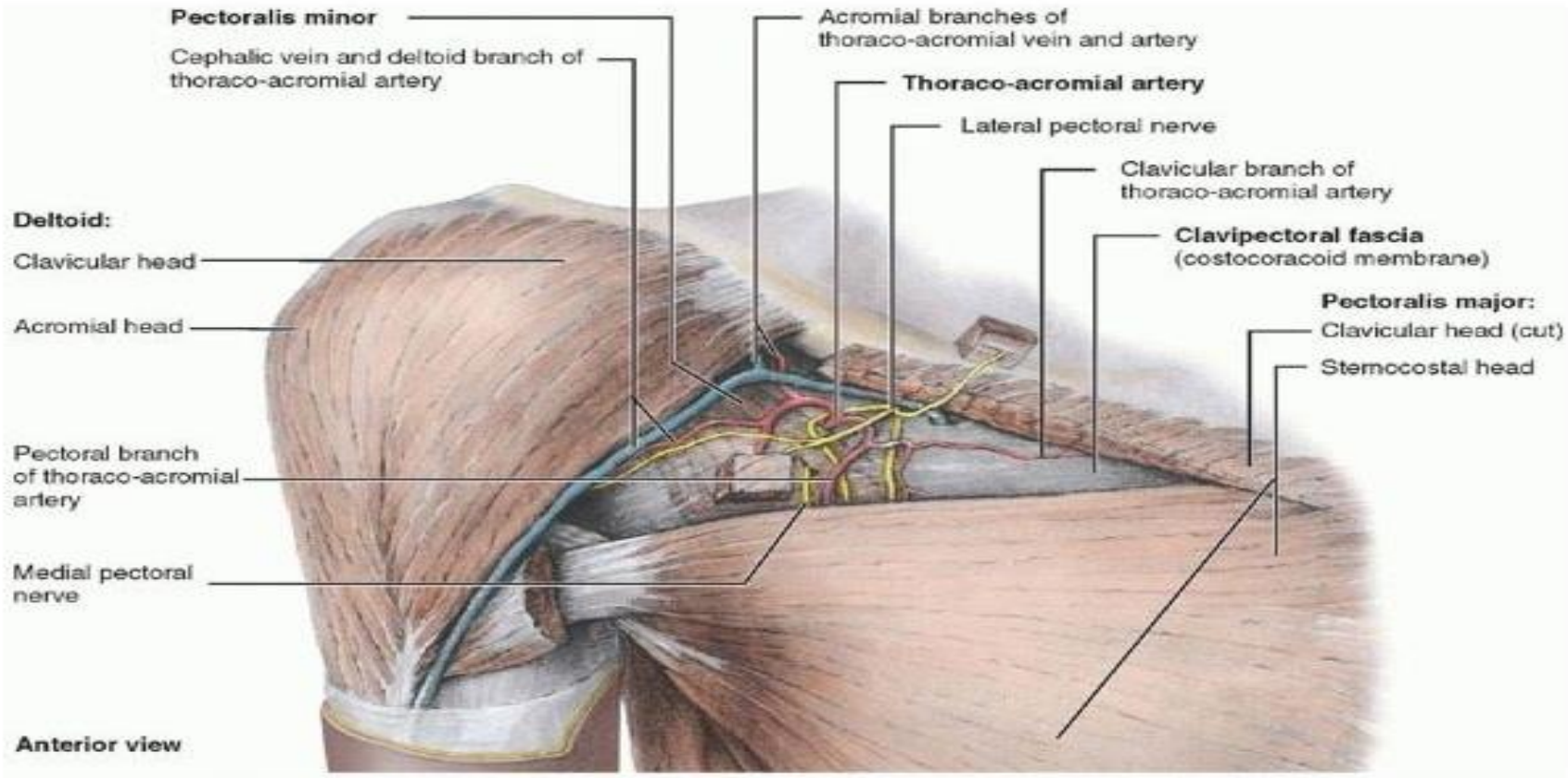
**Axillary vein- axillary artery--trunks of brachial plexus**

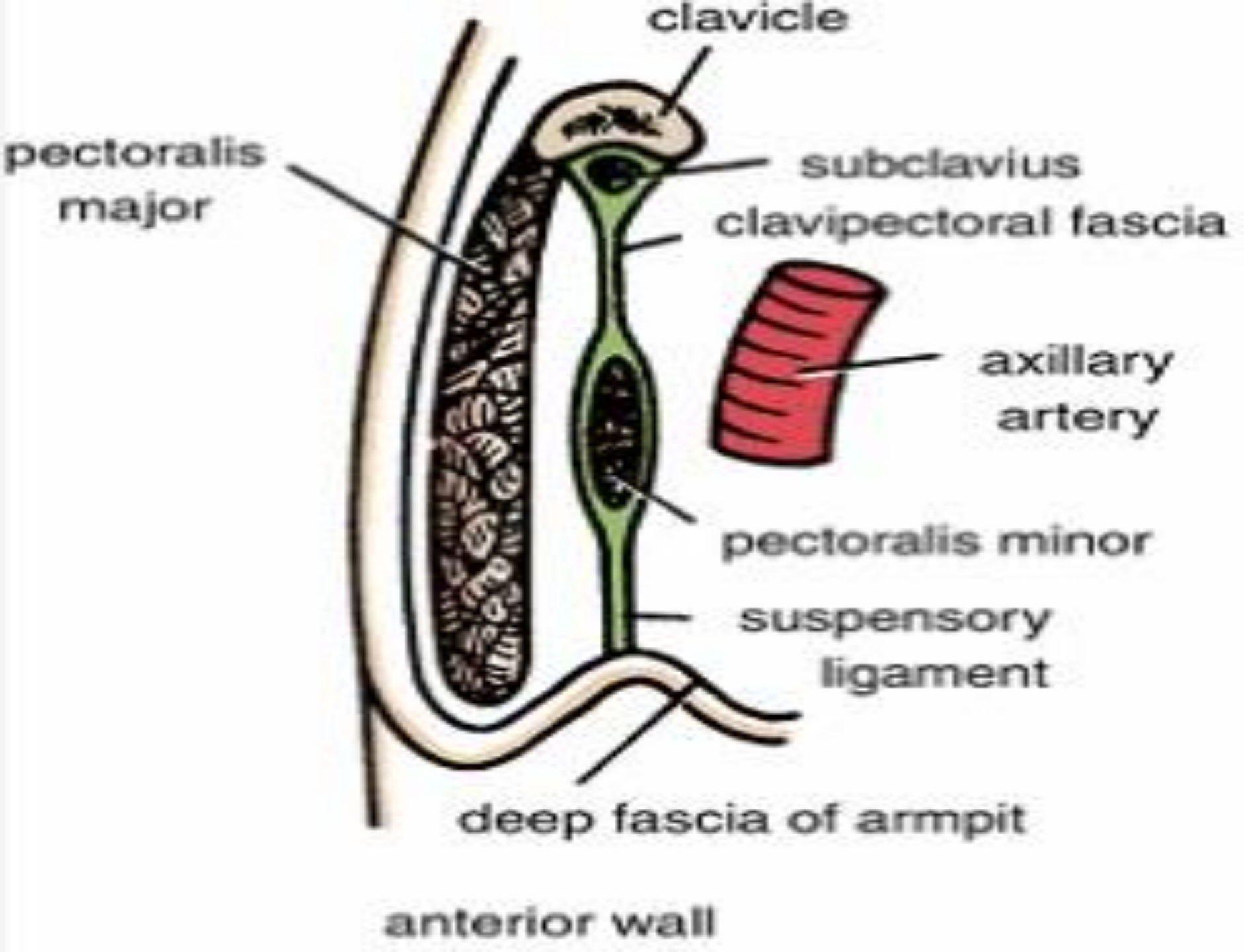


# Anterior wall

Formed by:

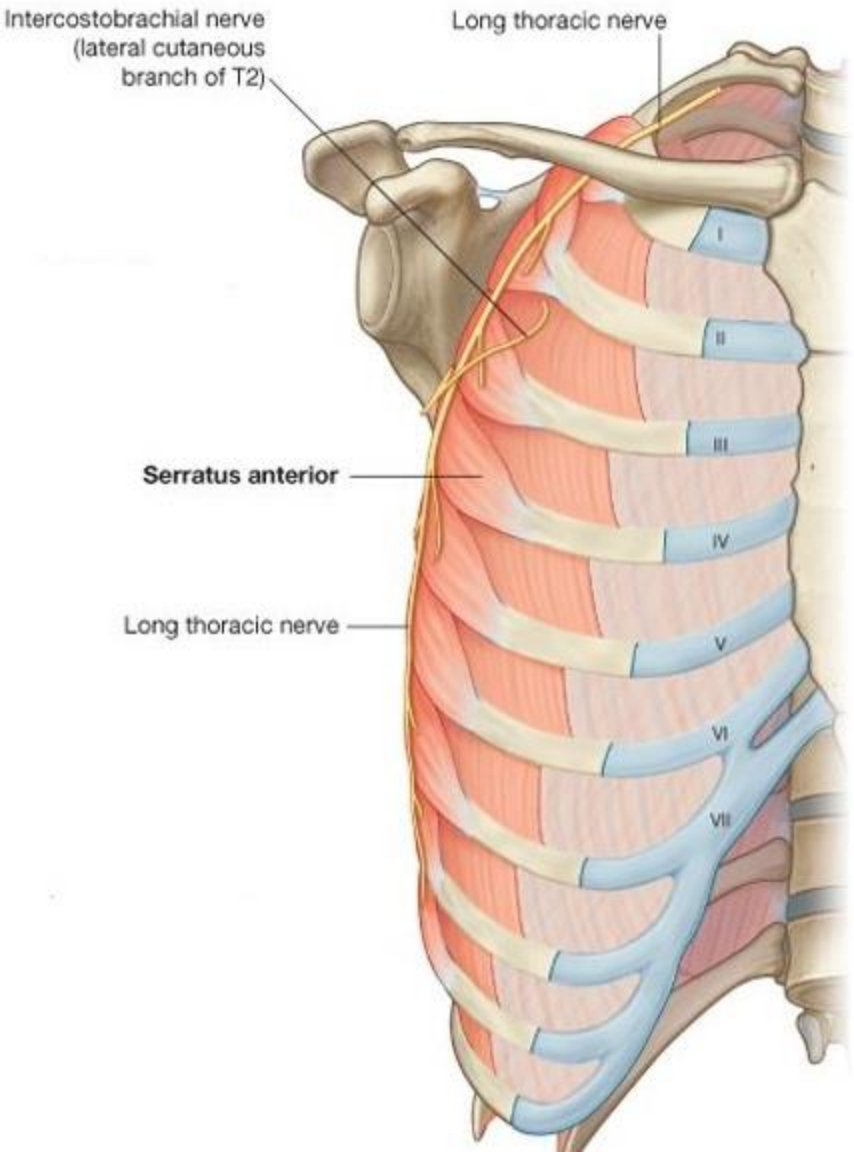
- lateral part of the **pectoralis major muscle**,
- underlying **pectoralis minor** & **subclavius muscles**,
- **clavipectoral fascia**




clavicle
pectoralis major
subclavius
clavipectoral fascia
axillary artery
pectoralis minor
suspensory ligament
deep fascia of armpit
anterior wall

# Medial wall

Formed by the thoracic wall (1st-4th ribs and intercostal muscles) & the overlying **serratus anterior**.



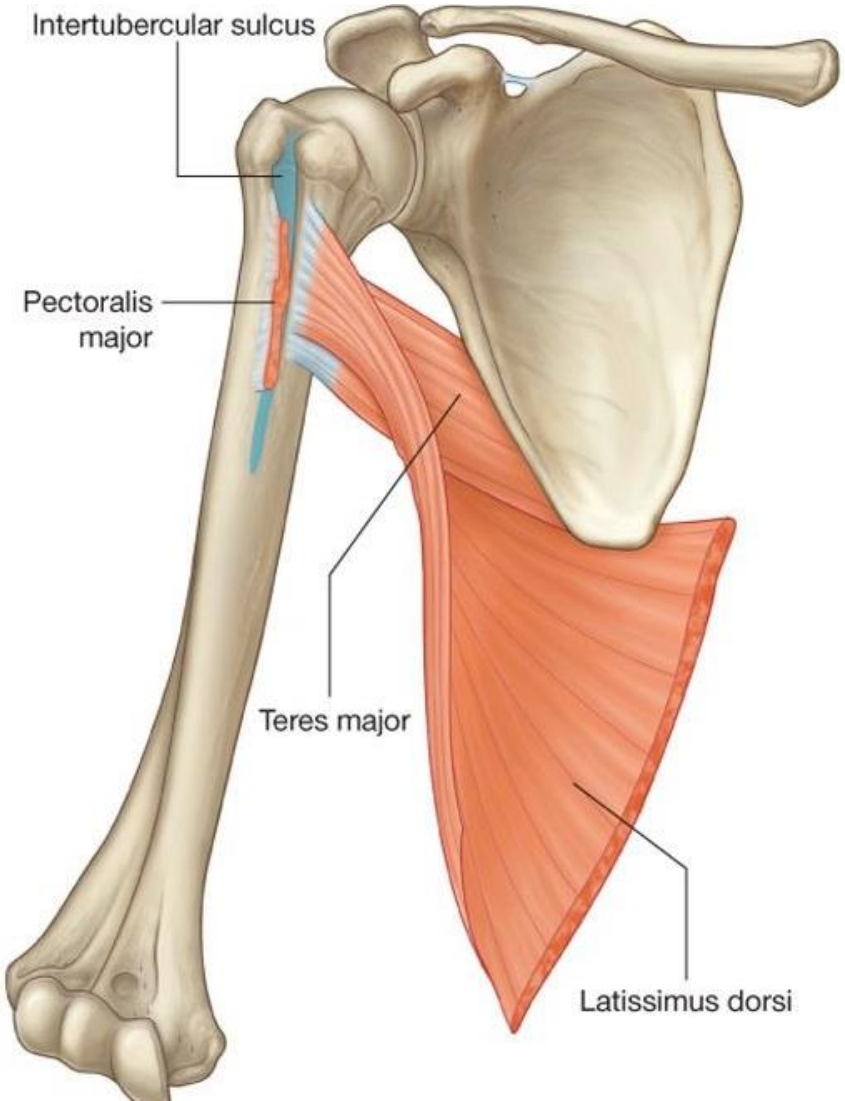

The only major structure that passes directly through the medial wall and into the axilla:

**intercostobrachial nerve**

*Lateral cutaneous branch of the second intercostal nerve (anterior ramus of T2)*

# Lateral wall

- A narrow bony wall formed by
- Intertubercular groove in the humerus

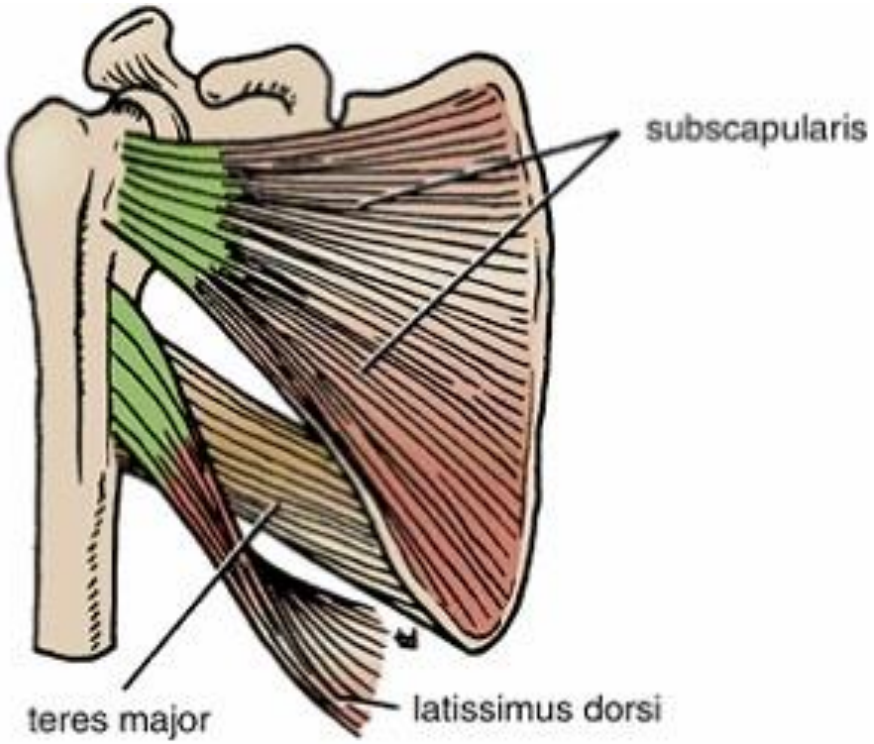


# Posterior wall

- Bone framework is formed by the costal surface of the scapula.

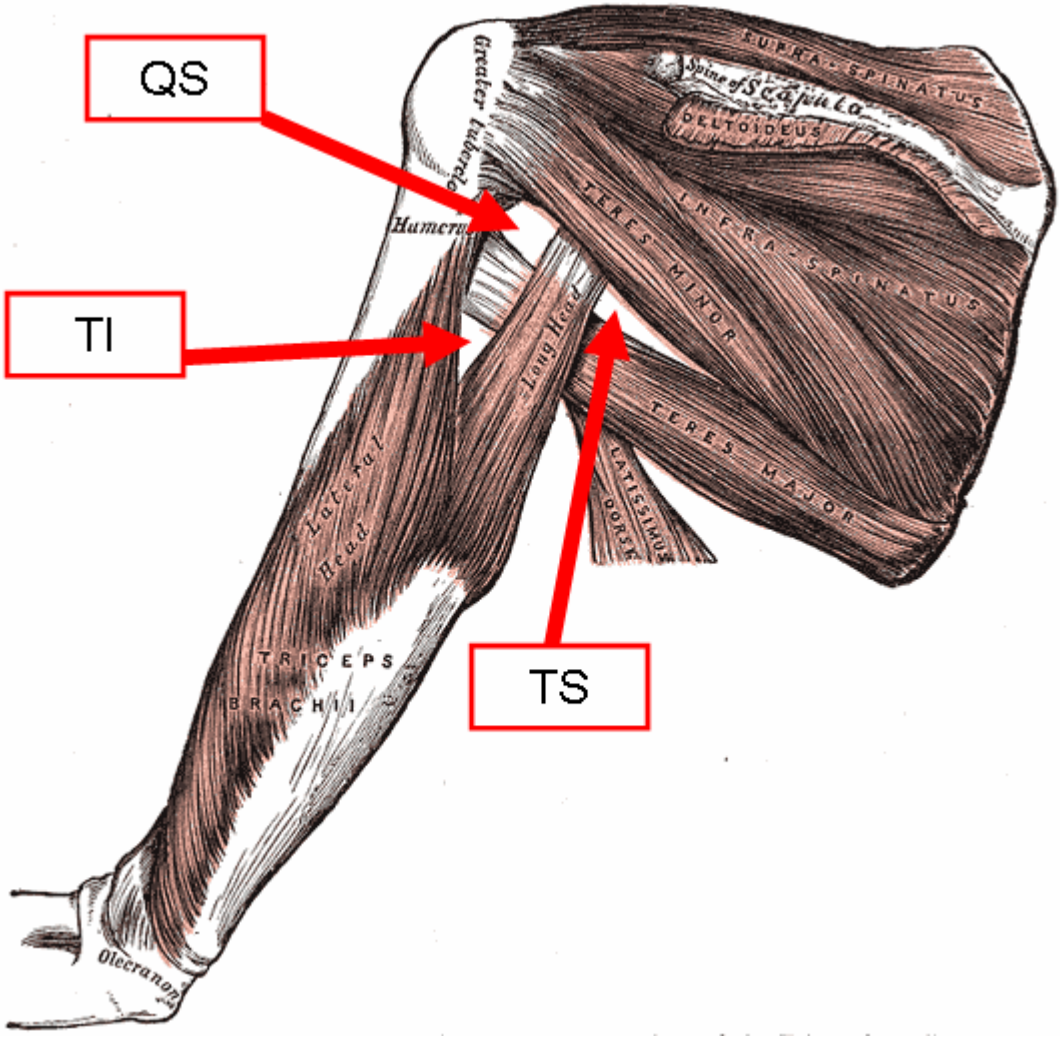
- Formed by

**scapula** & **subscapularis** on anterior surface
**teres major** & **latissimus dorsi**, inferiorly



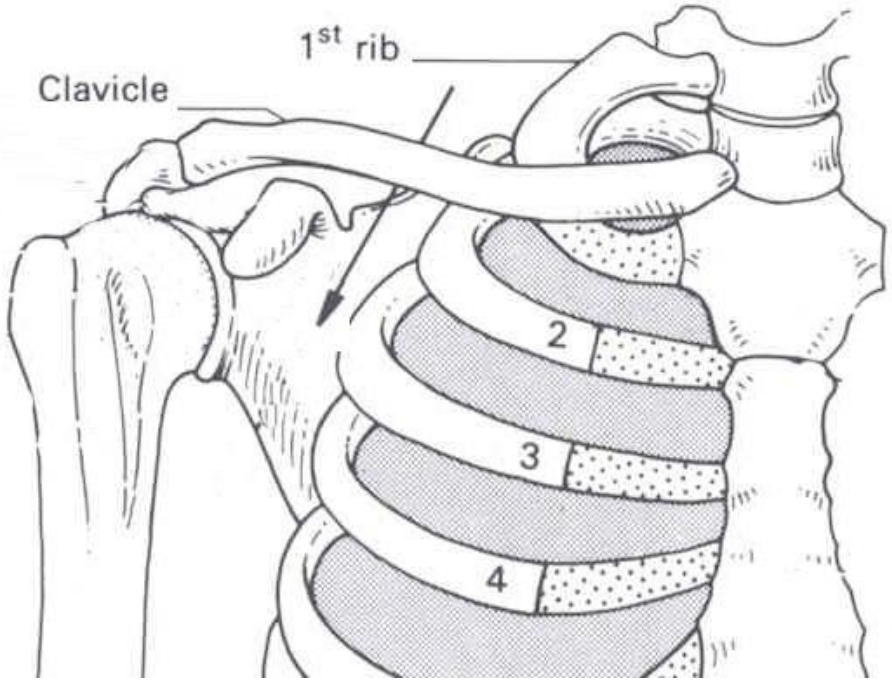

posterior wall

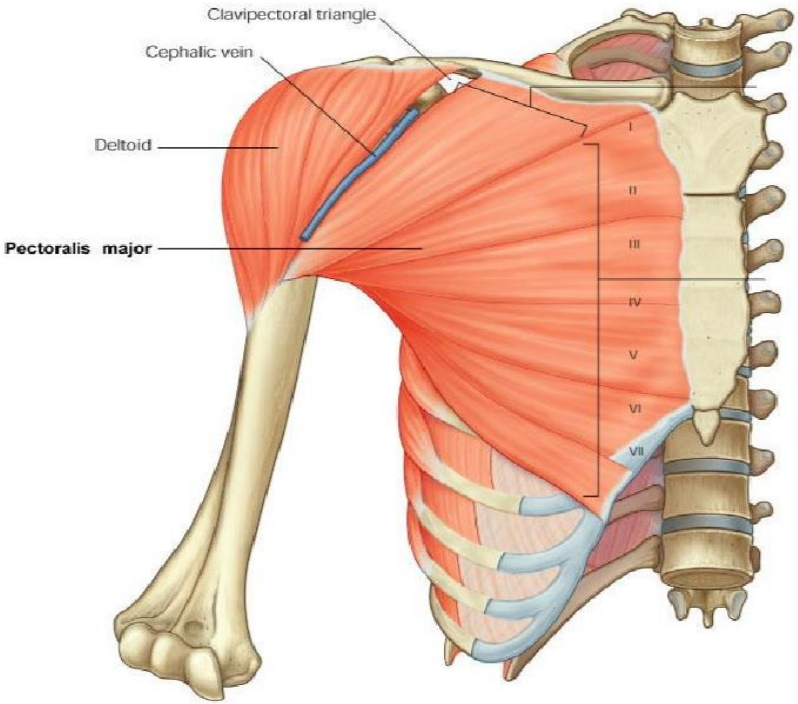
# Gateways in the posterior wall



From this distribution center, neurovascular structures pass

- **Superiorly** via cervico-axillary canal to (or from) the root of the neck.



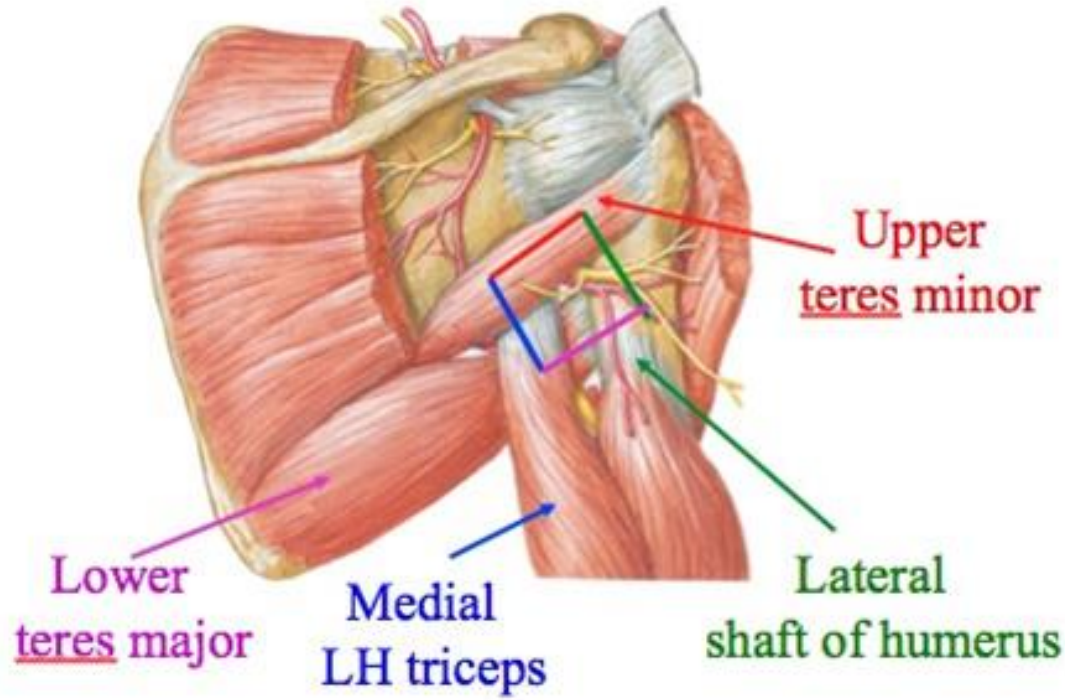



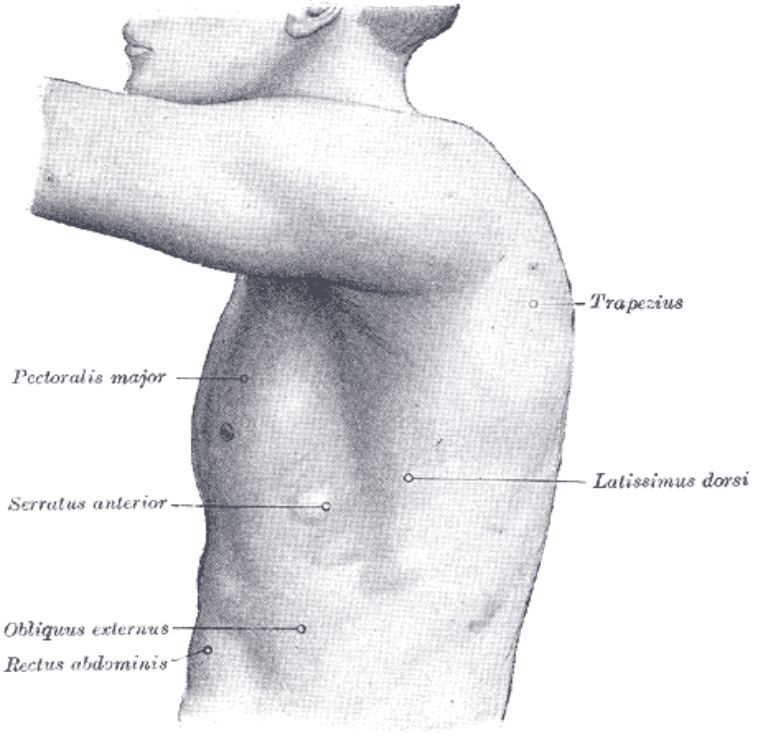

- **Anteriorly** via clavipectoral triangle to pectoral region.

- **Inferiorly & laterally** into limb itself.

From this distribution center, neurovascular structures pass

- **Posteriorly** via **quadrangular space** to scapular region

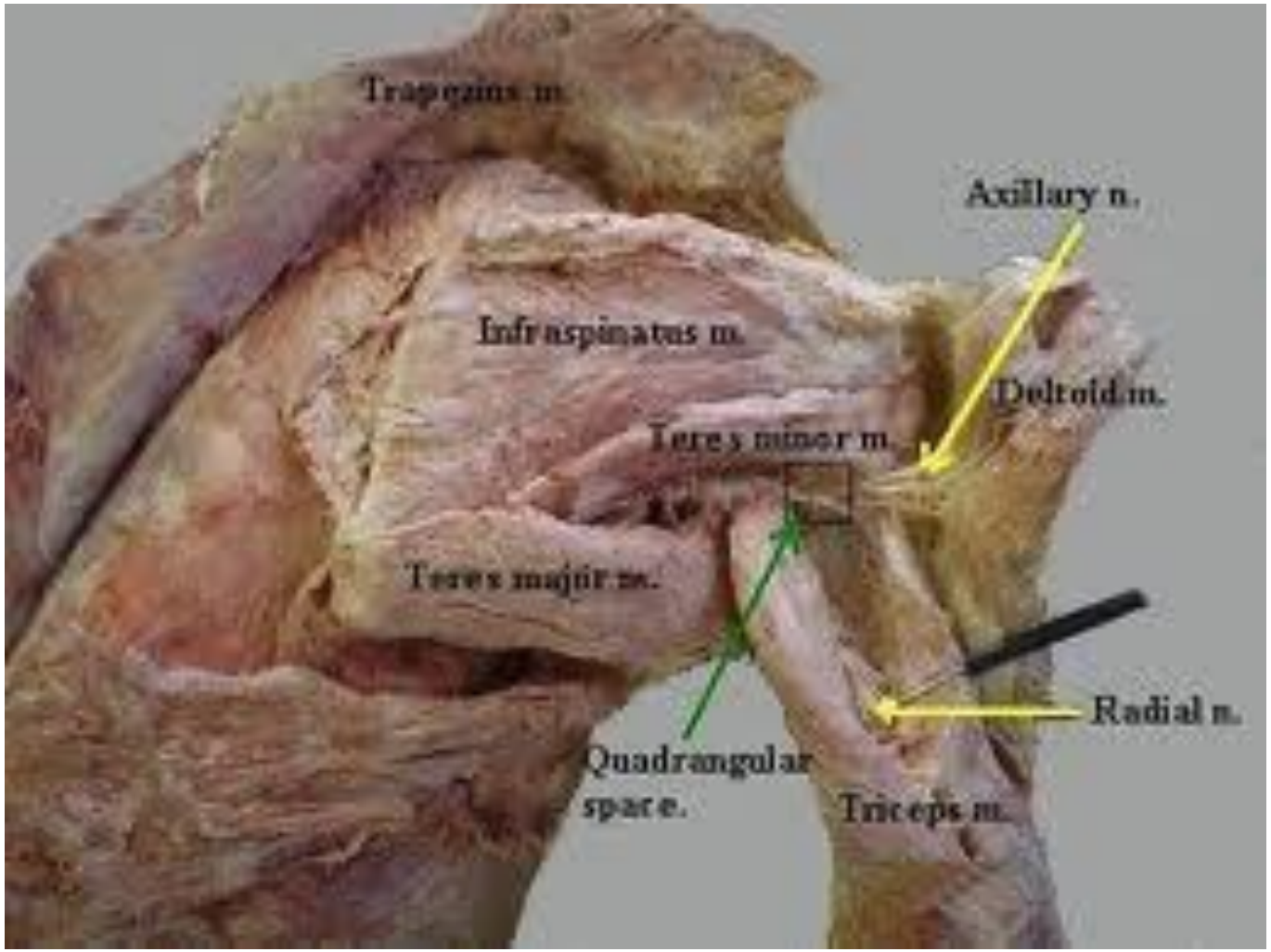



- **Inferiorly & medially** along the thoracic wall to the inferiorly placed axioappendicular muscles (serratus anterior and latissimus dorsi).

# Quadrangular space

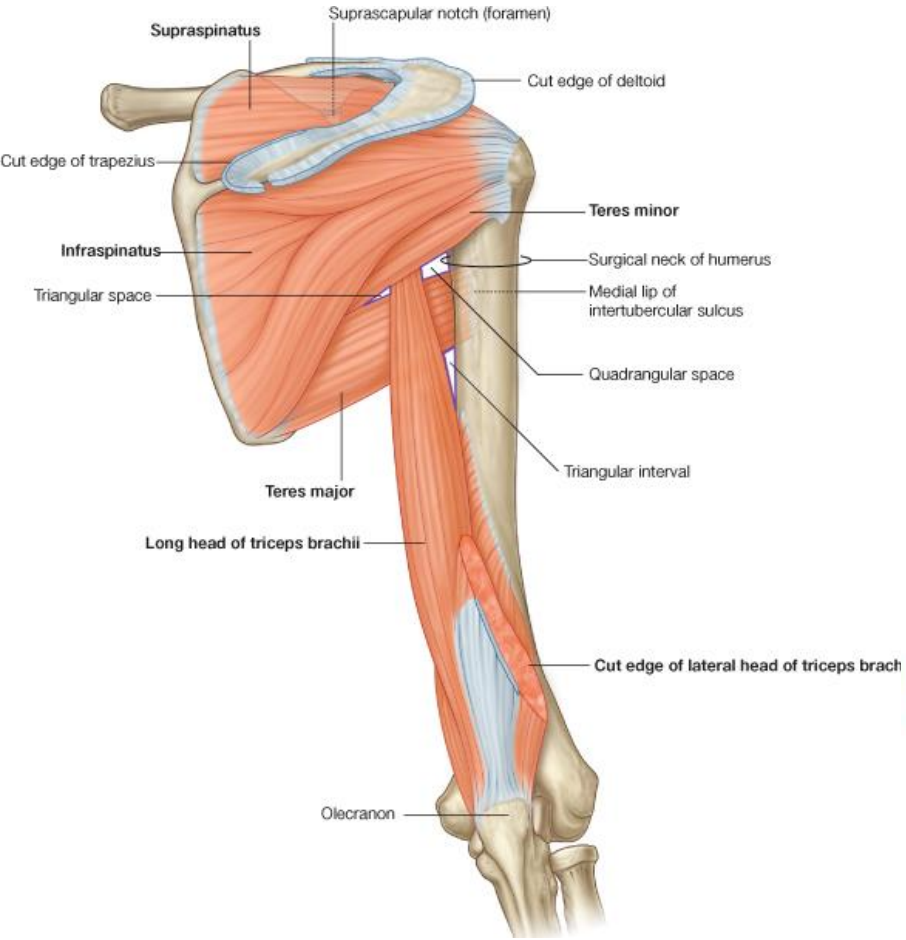
Passageway for nerves & vessels passing between the axilla and the more posterior scapular and deltoid regions.

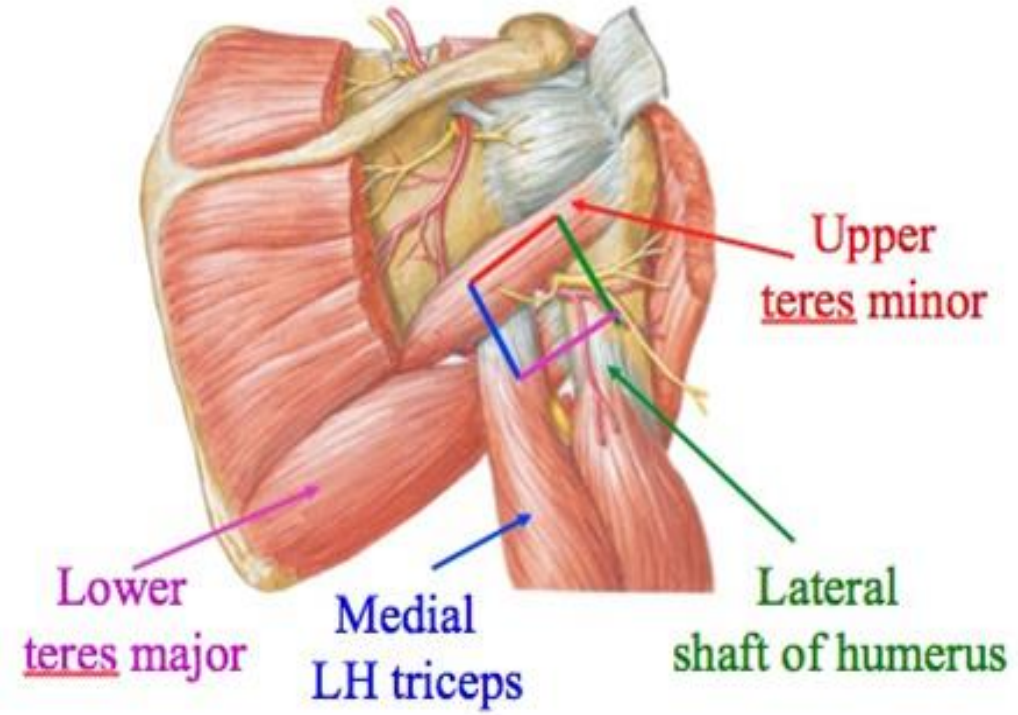


# Quadrangular space

Viewed from anteriorly, boundaries formed by:

- **Superior**: inferior margin of the subscapularis muscle
- **Lateral**: surgical neck of the humerus
- **Inferior**: superior margin of the teres major muscle
- **Medial**: lateral margin of the long head of triceps brachii

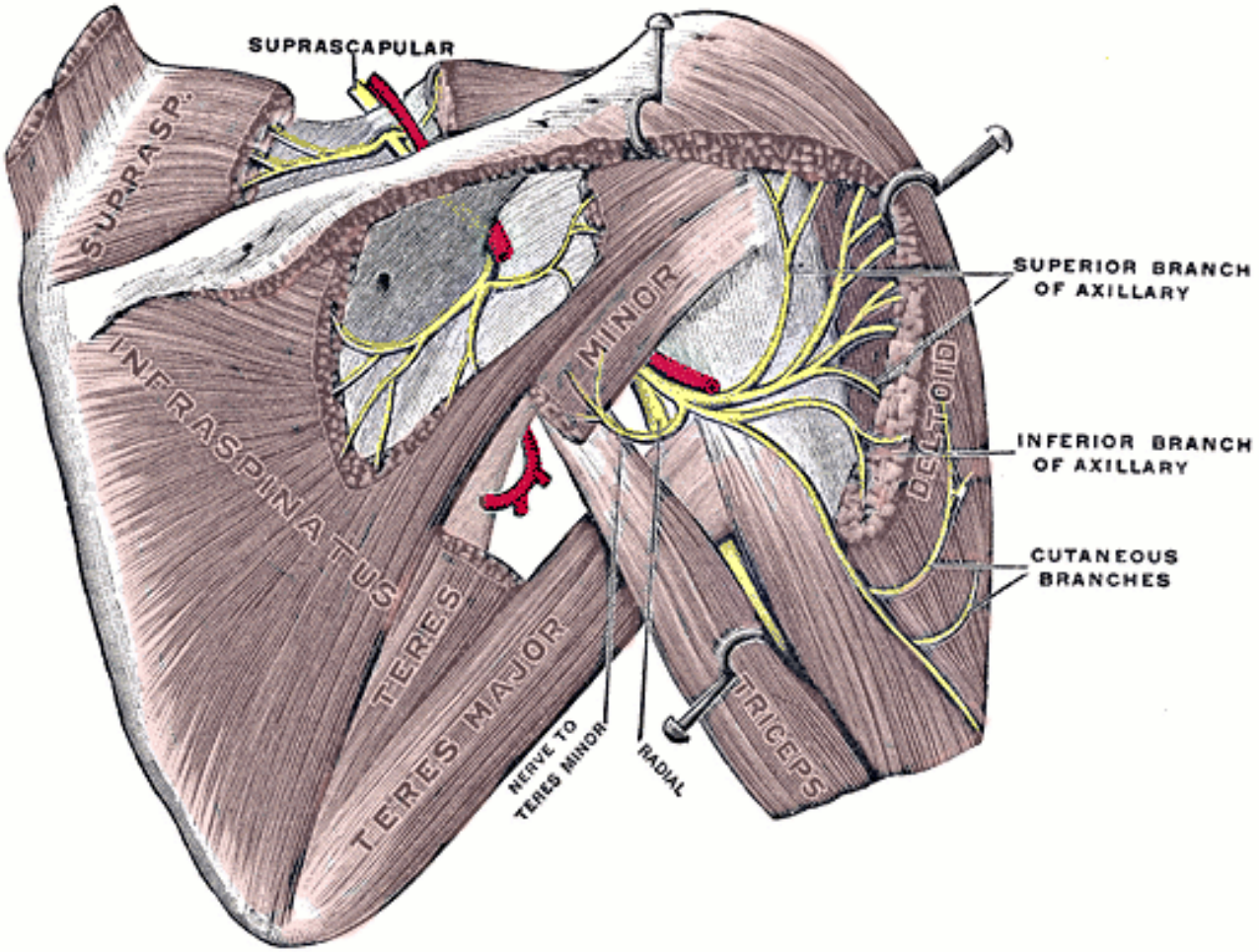


# Quadrangular space

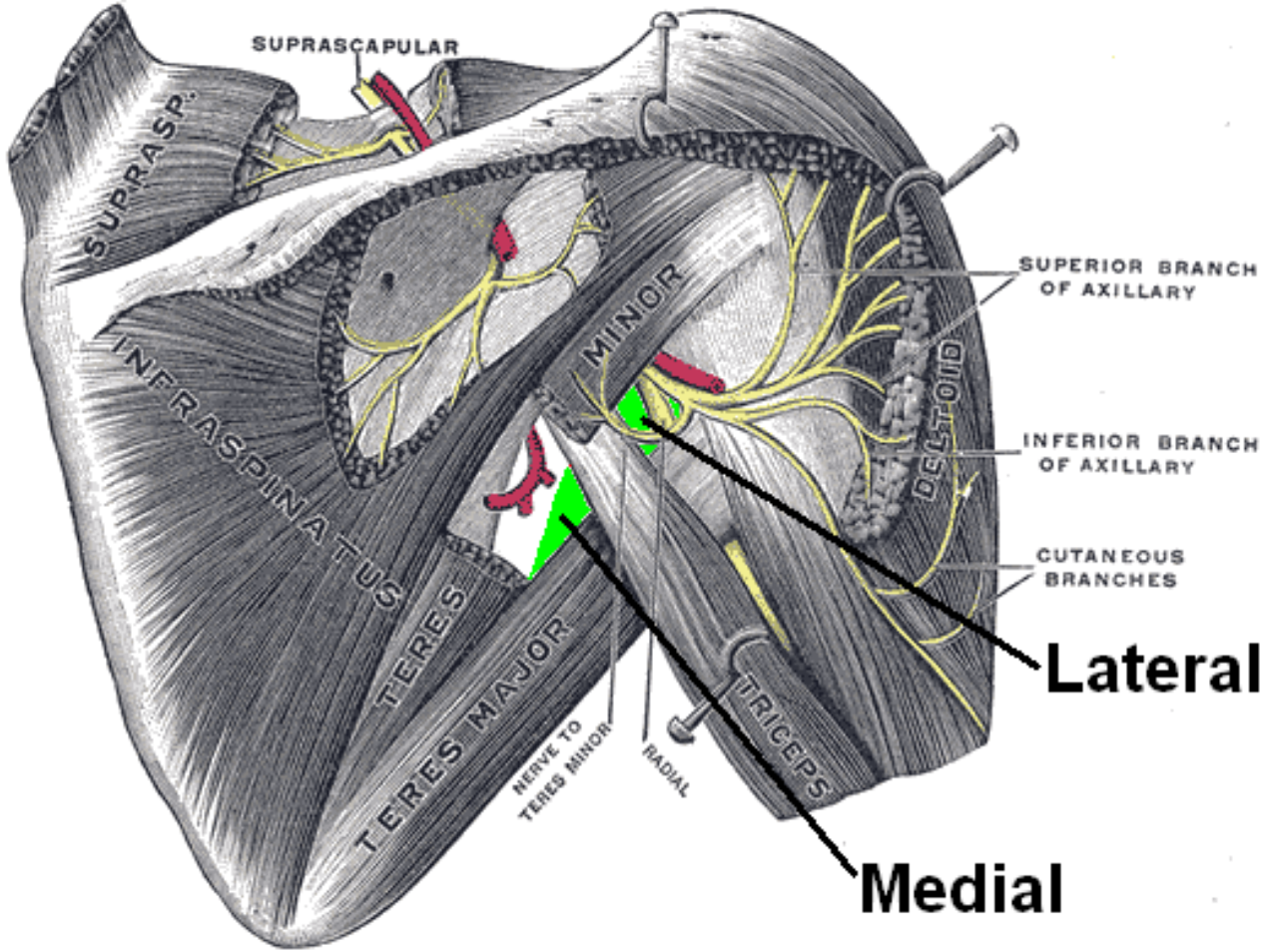
Structures passing through:

- **Axillary nerve**
- **Posterior circumflex humeral artery** & **vein**



# Triangular space

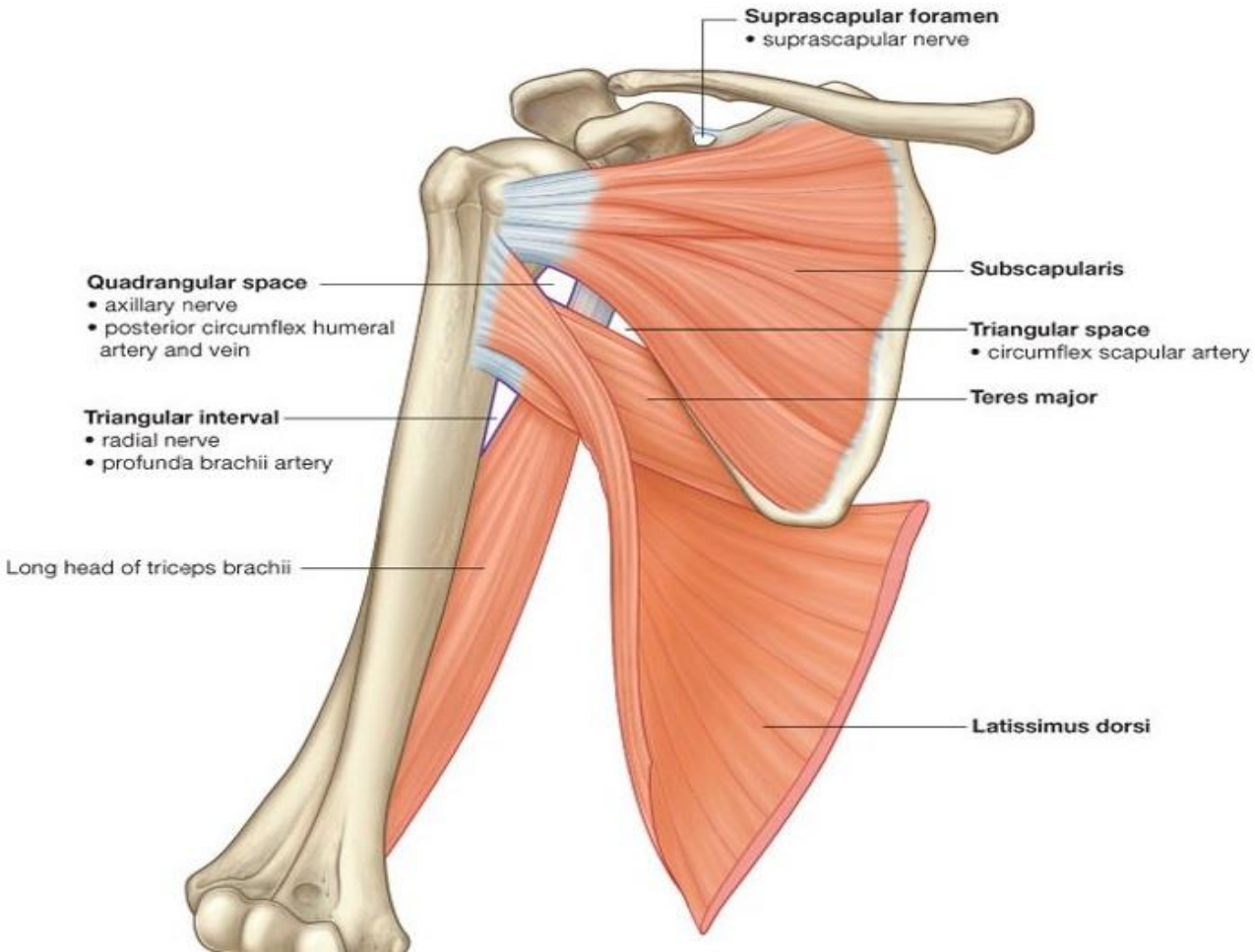
Area of communication
between axilla and posterior scapular region



# Triangular space [Medial triangular space]

Viewed from anteriorly, formed by:

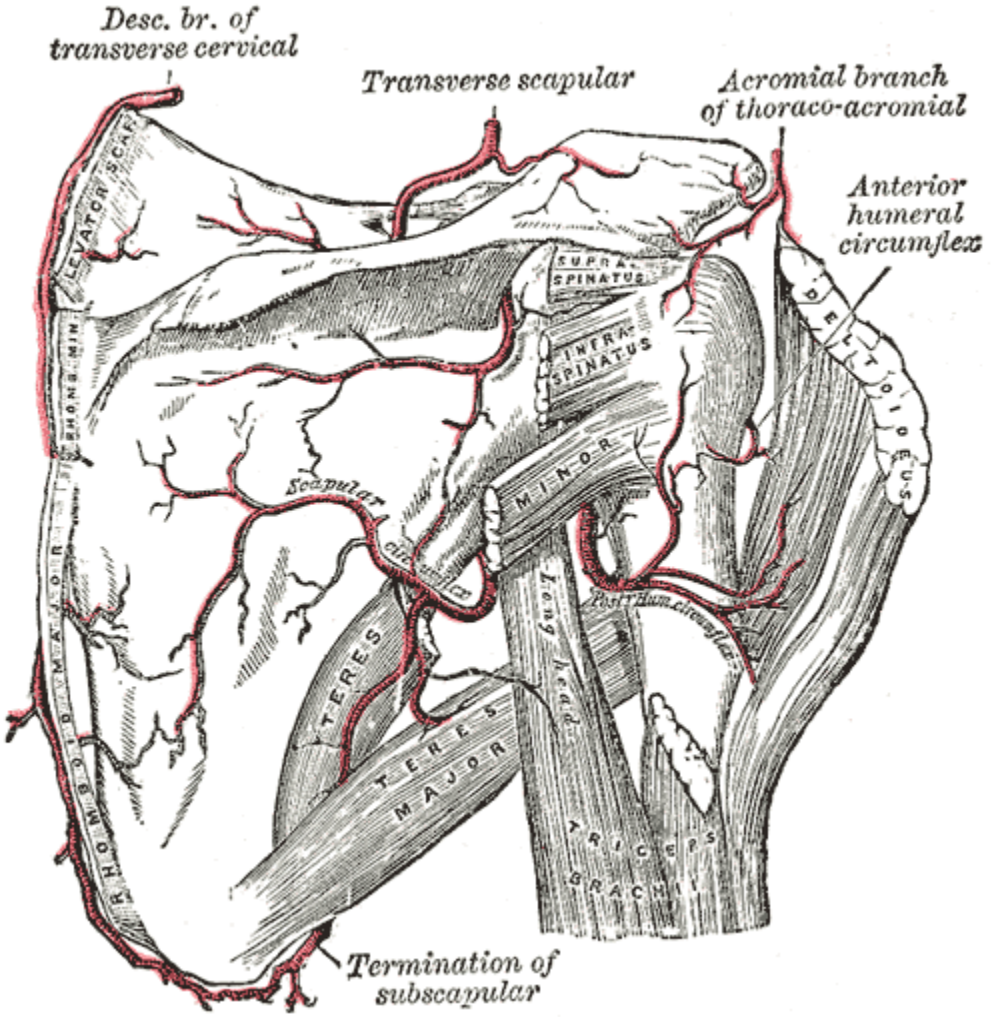
- medial margin of the **long head of the triceps brachii**
- superior margin of the **teres major muscle**
- inferior margin of the **subscapularis muscle**



# Triangular space

Structures passing through:

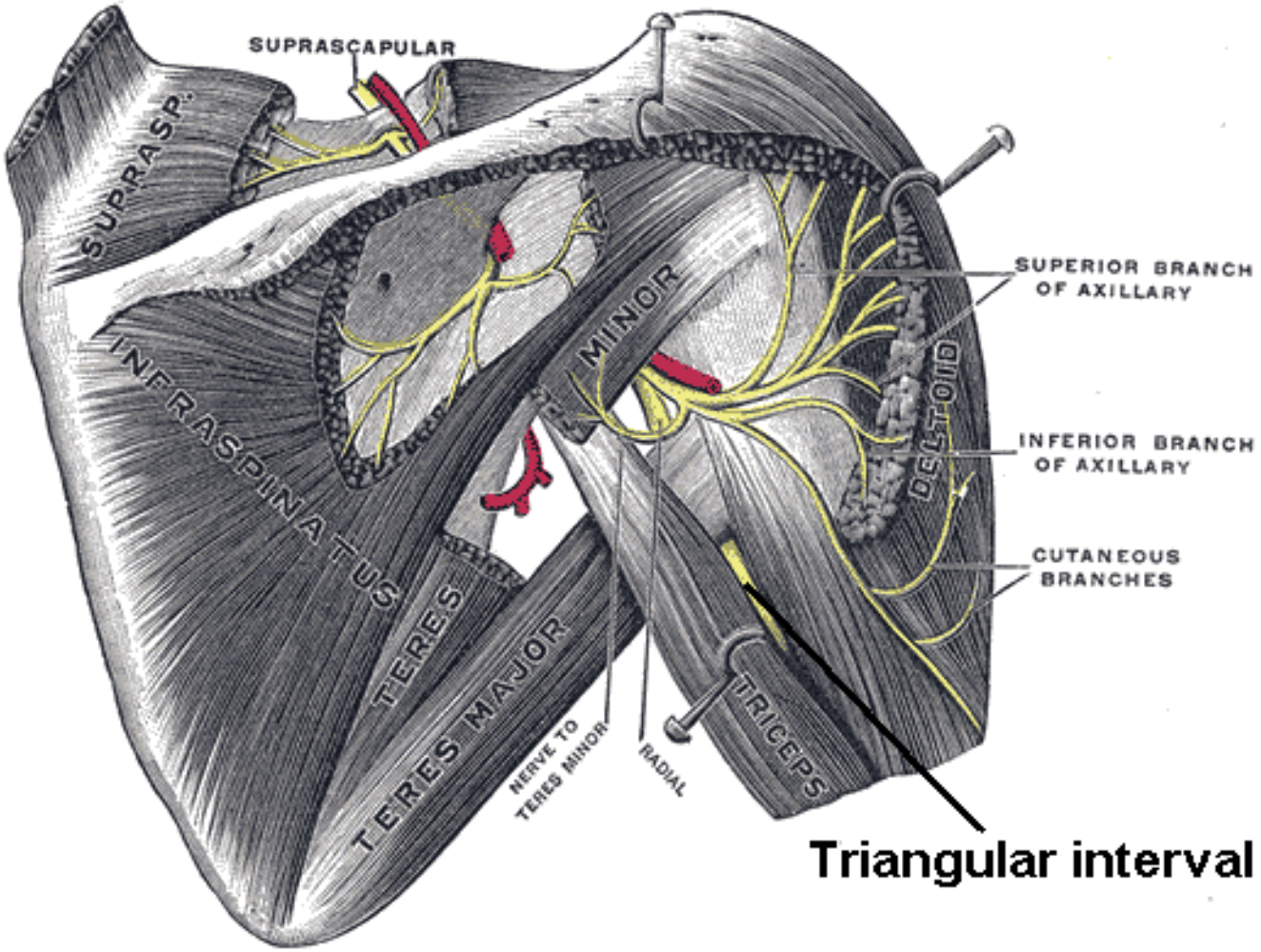
**Circumflex scapular artery** & **vein**



# Triangular interval [Lateral triangular space]

formed by:

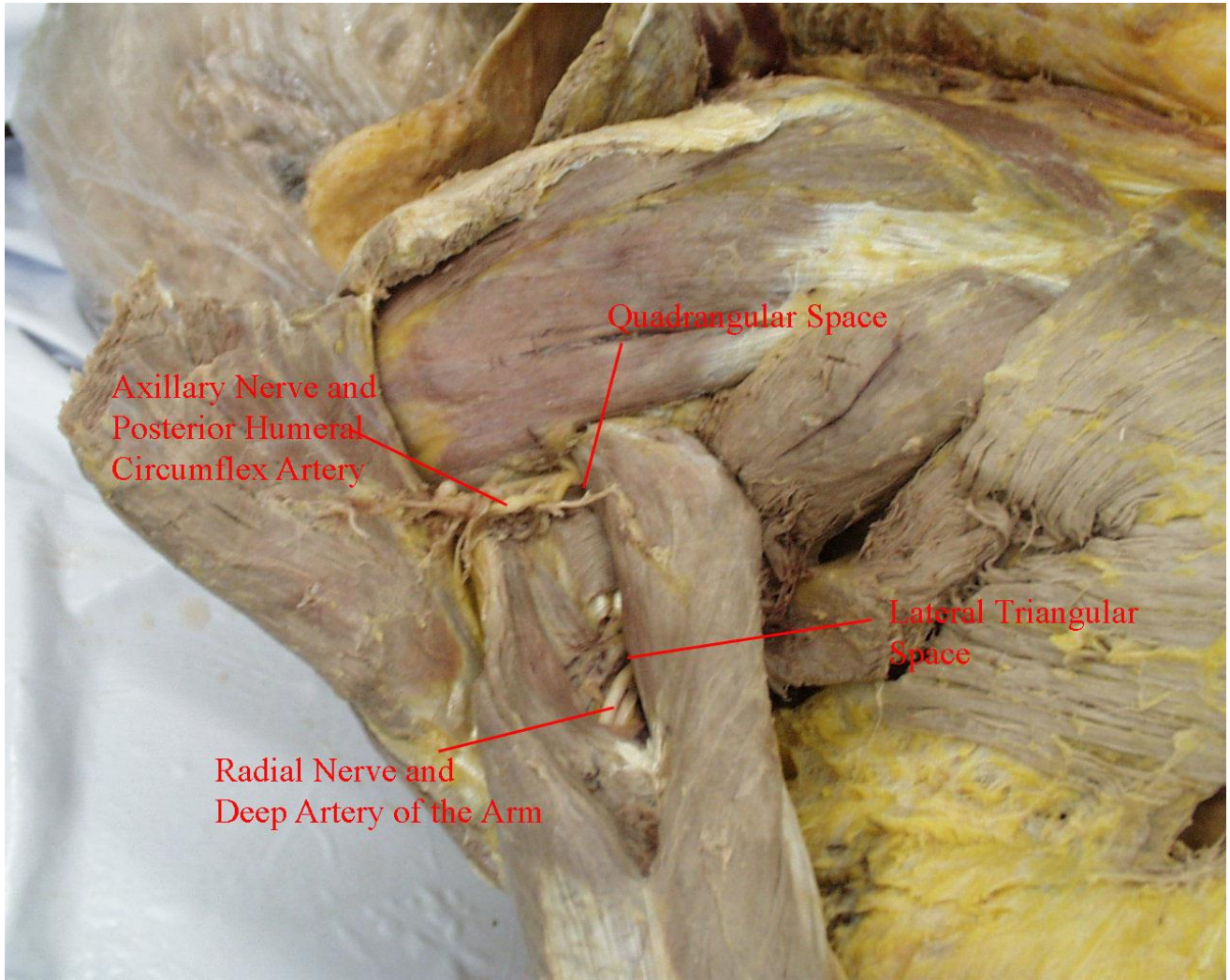
- lateral margin of the **long head of the triceps brachii**
- shaft of the humerus
- inferior margin of the **teres major muscle**

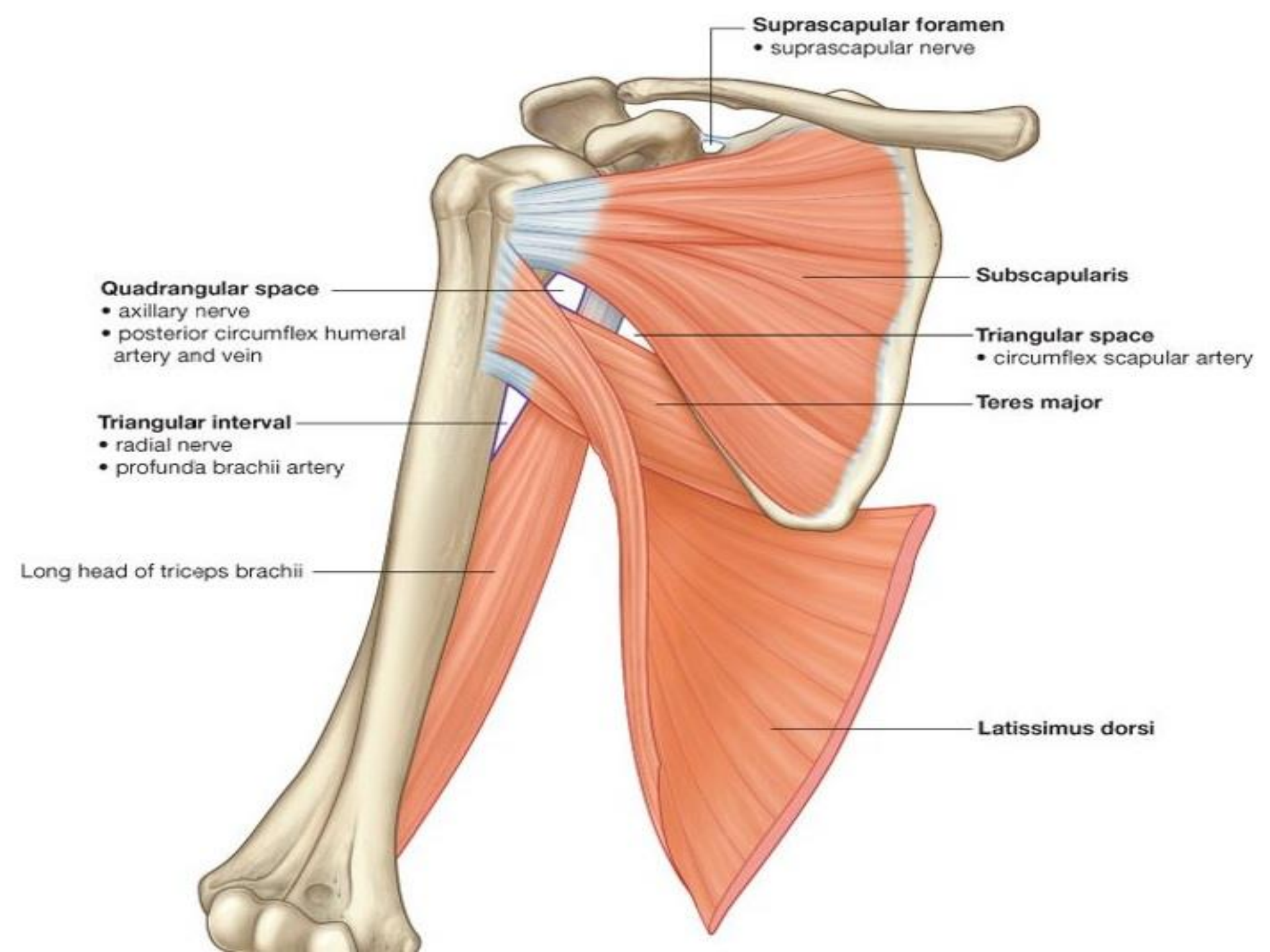


# Triangular interval

Structures passing through

**Radial nerve** **&** **profunda brachii artery** (deep artery of arm) **& associated veins**




Suprascapular foramen
• suprascapular nerve
Quadrangular space
• axillary nerve
• posterior circumflex humeral artery and vein
Triangular interval
• radial nerve
• profunda brachii artery
Long head of triceps brachii
Subscapularis
Triangular space
• circumflex scapular artery
Teres major
Latissimus dorsi

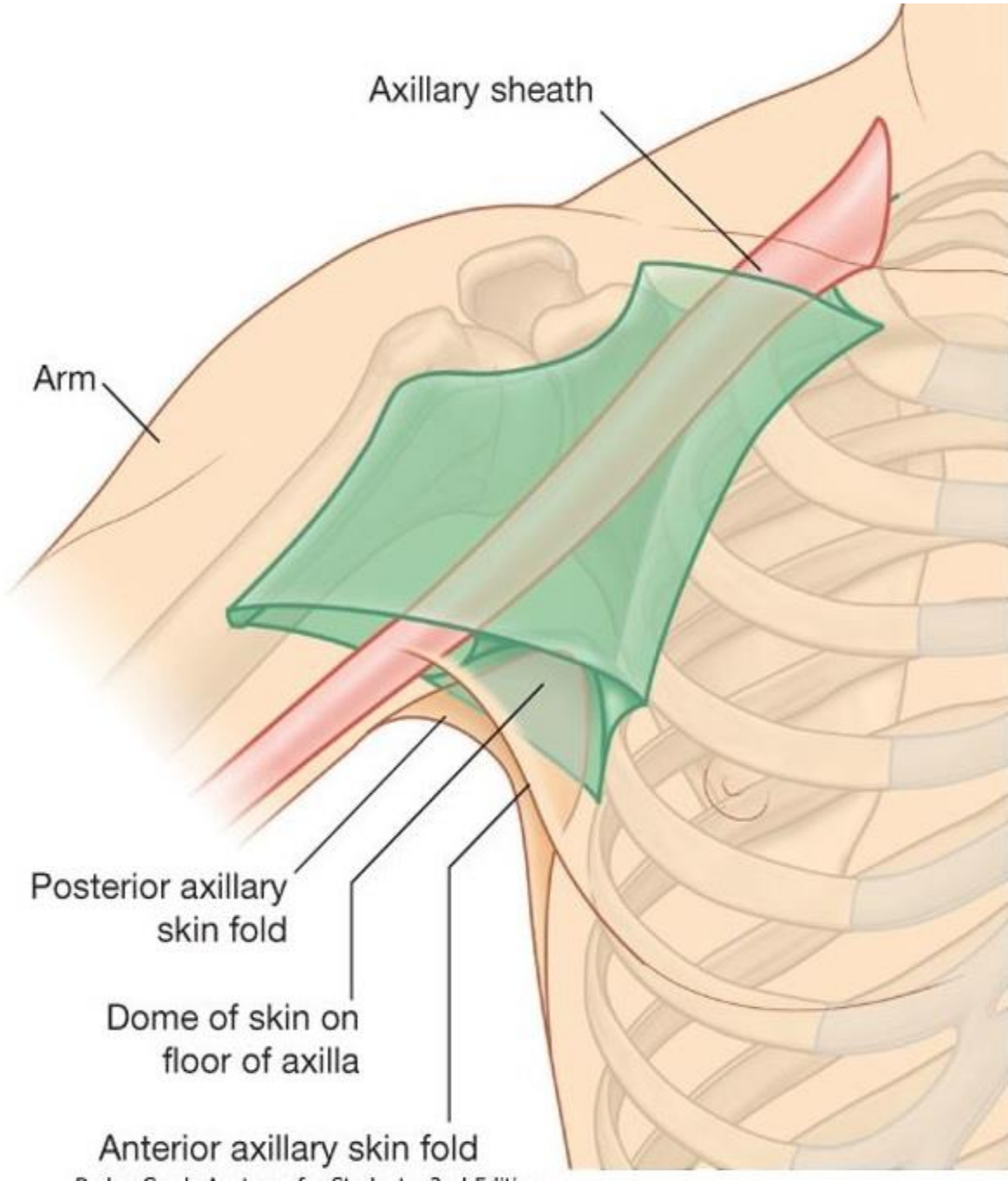
# Floor (Base)

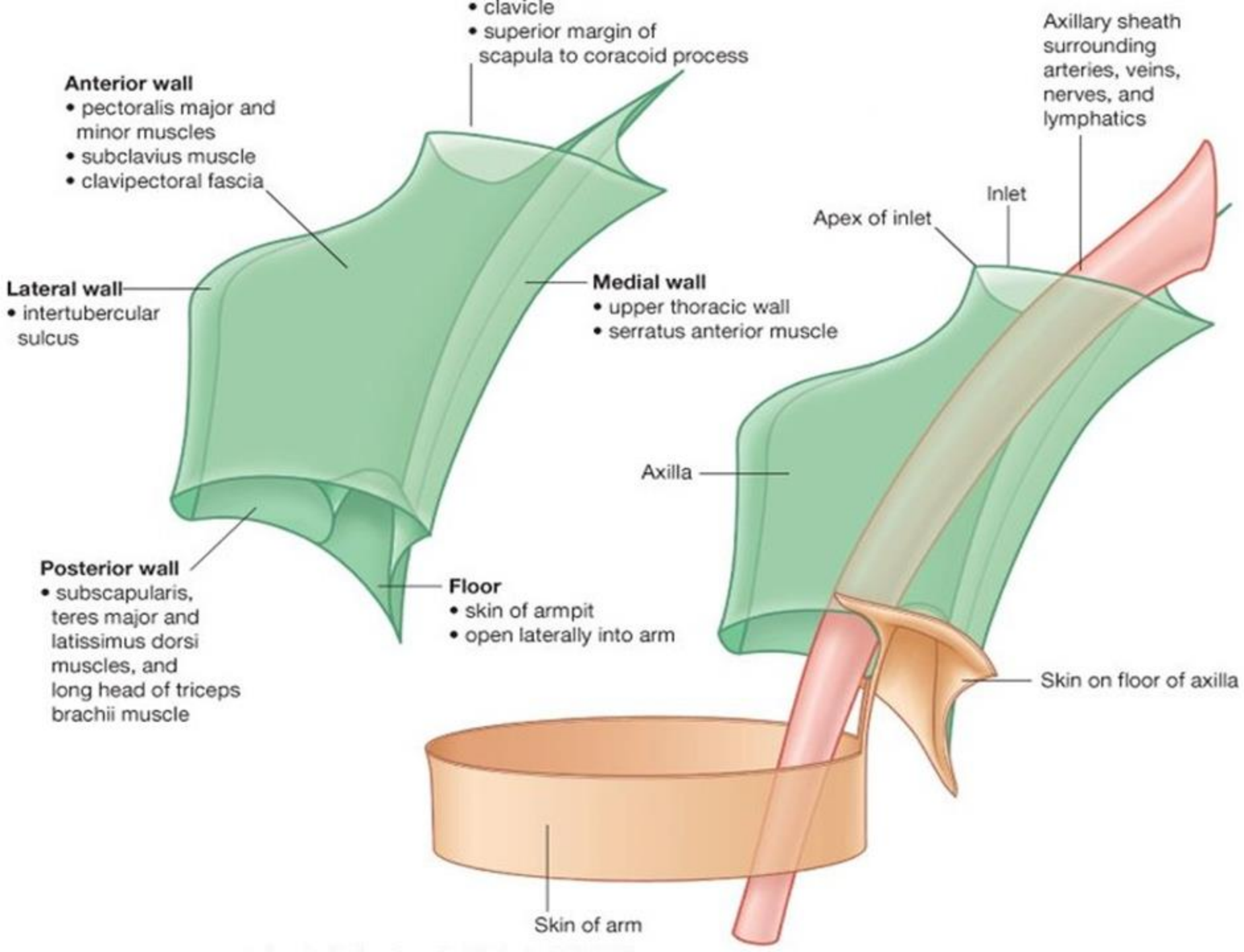
Formed by the

- Concave skin
- Subcutaneous tissue
- Axillary (deep) fascia

Bounded by the anterior and posterior axillary folds, the thoracic wall, and the medial aspect of the arm.

*The base is supported by the clavipectoral fascia.*

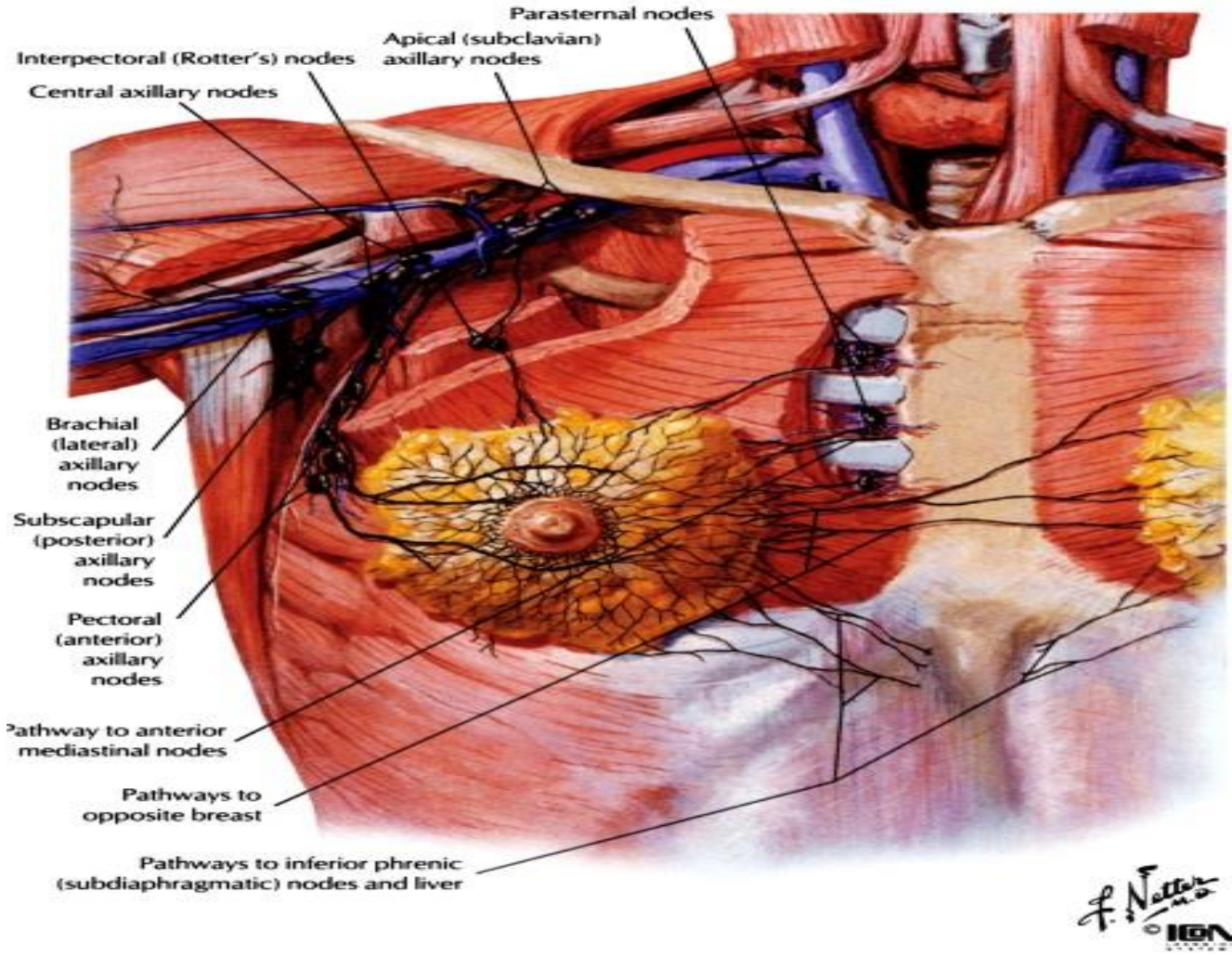


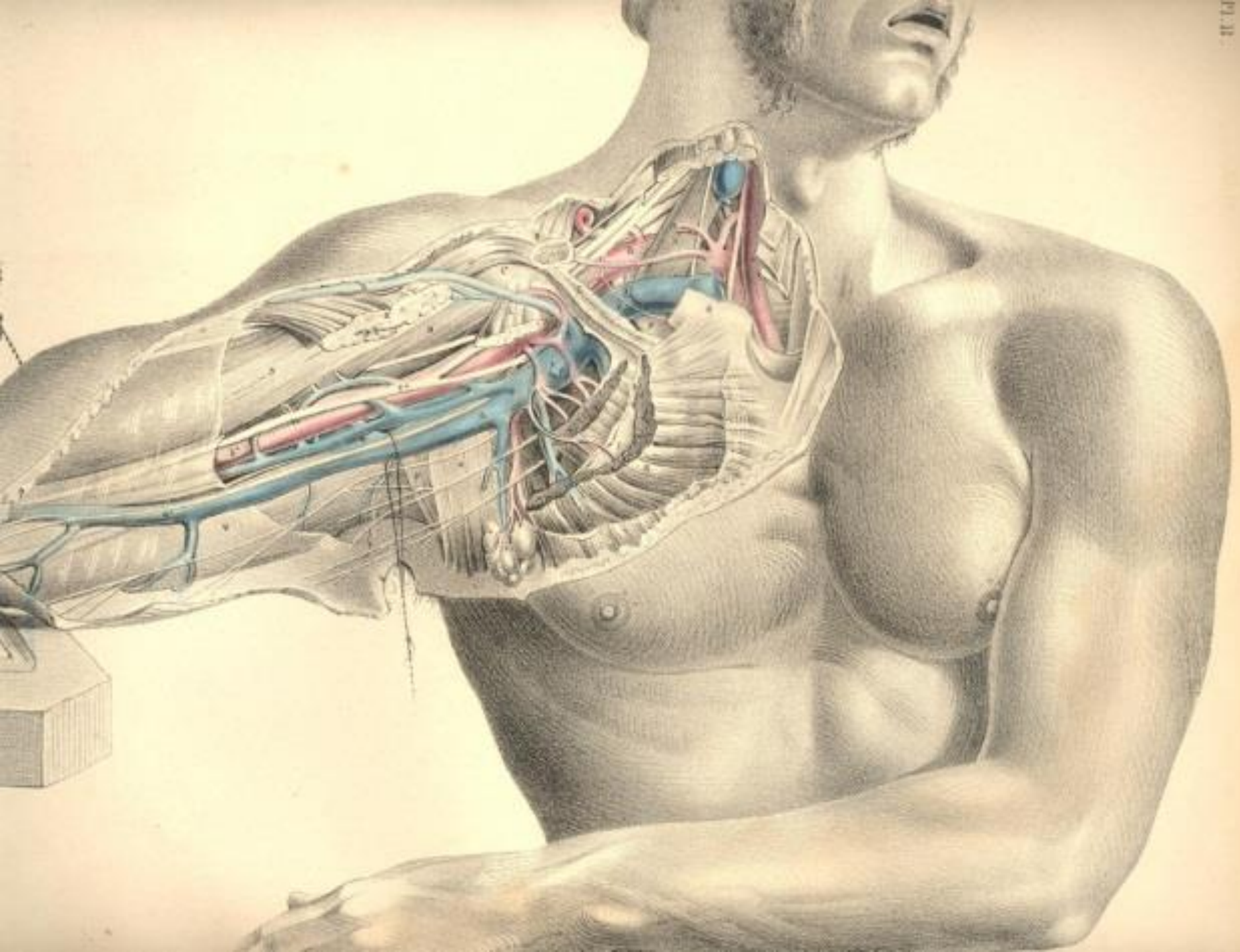

• clavicle
• superior margin of scapula to coracoid process
Anterior wall
• pectoralis major and minor muscles
• subclavius muscle
• clavipectoral fascia
Axillary sheath surrounding arteries, veins, nerves, and lymphatics
Inlet
Apex of inlet
Lateral wall
• intertubercular sulcus
Medial wall
• upper thoracic wall
• serratus anterior muscle
Axilla
Posterior wall
• subscapularis, teres major and latissimus dorsi muscles, and long head of triceps brachii muscle
Floor
• skin of armpit
• open laterally into arm
Skin on floor of axilla
Skin of arm

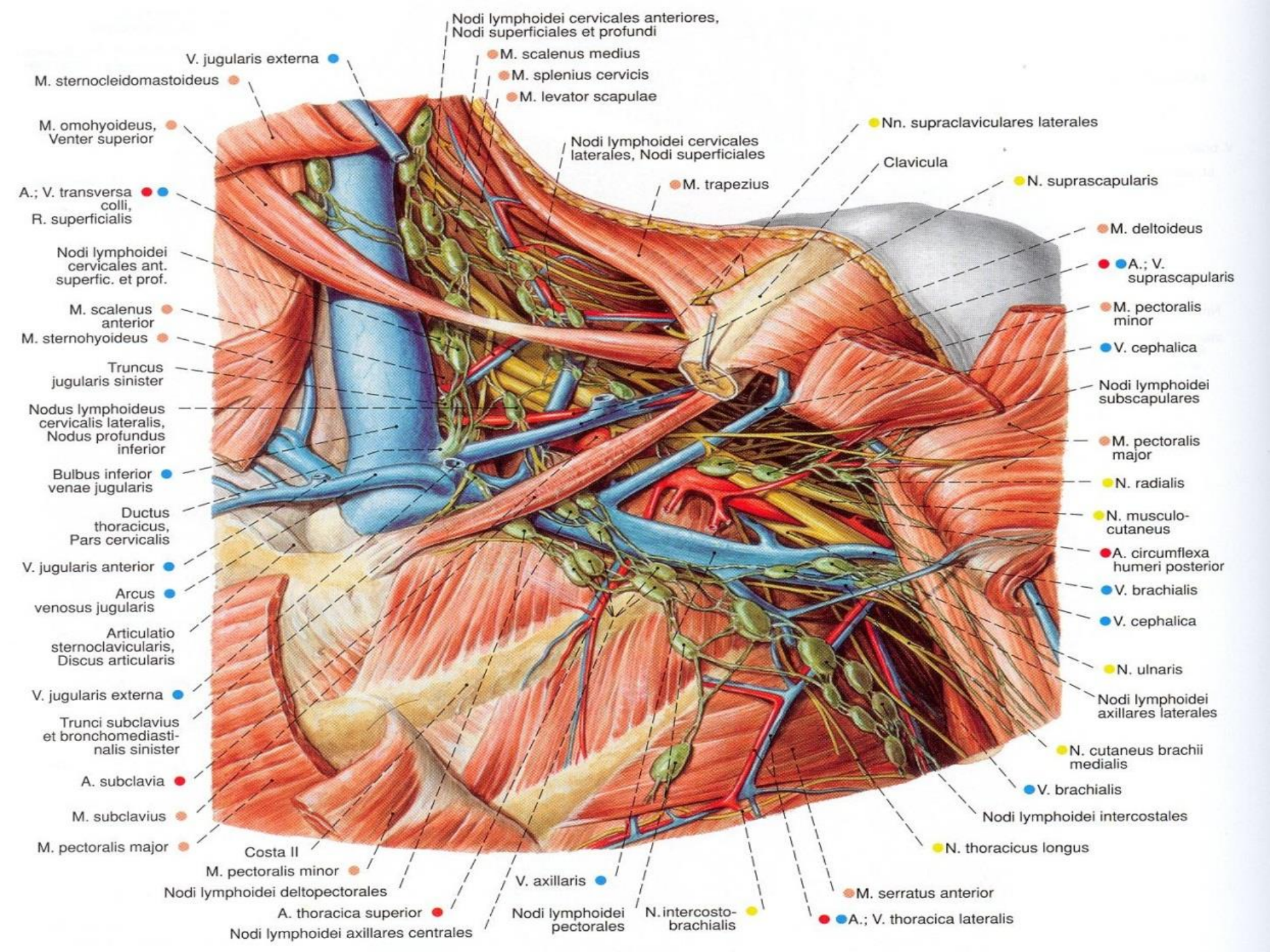
# Contents of the axilla

- Axillary artery and its branches
- Axillary vein and its tributaries
- Lymph vessels and lymph nodes
- Brachial plexus

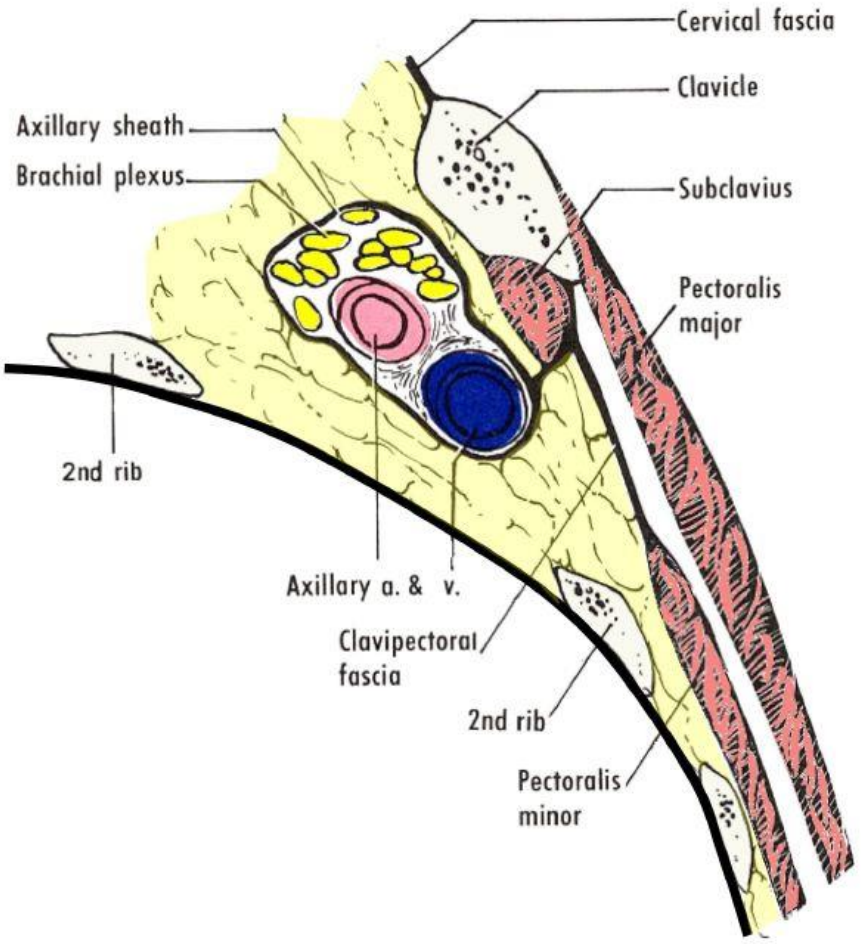
*These structures are embedded in fat.*






Nodi lymphoidei cervicales anteriores, Nodi superficiales et profundi
V. jugularis externa
M. scalenus medius
M. sternocleidomastoideus
M. splenius cervicis
M. levator scapulae
M. omohyoideus, Venter superior
Nn. supraclaviculares laterales
Nodi lymphoidei cervicales laterales, Nodi superficiales
Clavicula
A.; V. transversa colli, R. superficialis
M. trapezius
N. suprascapularis
M. deltoideus
Nodi lymphoidei cervicales ant. superfic. et prof.
A.; V. suprascapularis
M. scalenus anterior
M. pectoralis minor
M. sternohyoideus
V. cephalica
Truncus jugularis sinister
Nodi lymphoidei subscapulares
Nodus lymphoideus cervicalis lateralis, Nodus profundus inferior
M. pectoralis major
Bulbus inferior venae jugularis
N. radialis
Ductus thoracicus, Pars cervicalis
N. musculo-cutaneus
A. circumflexa humeri posterior
V. jugularis anterior
V. brachialis
Arcus venosus jugularis
V. cephalica
Articulatio sternoclavicularis, Discus articularis
N. ulnaris
V. jugularis externa
Nodi lymphoidei axillares laterales
Trunci subclavius et bronchomediastinalis sinister
N. cutaneus brachii medialis
A. subclavia
V. brachialis
M. subclavius
Nodi lymphoidei intercostales
M. pectoralis major
N. thoracicus longus
Costa II
M. pectoralis minor
V. axillaris
Nodi lymphoidei deltopectorales
M. serratus anterior
A. thoracica superior
Nodi lymphoidei pectorales
N. intercosto-brachialis
A.; V. thoracica lateralis
Nodi lymphoidei axillares centrales

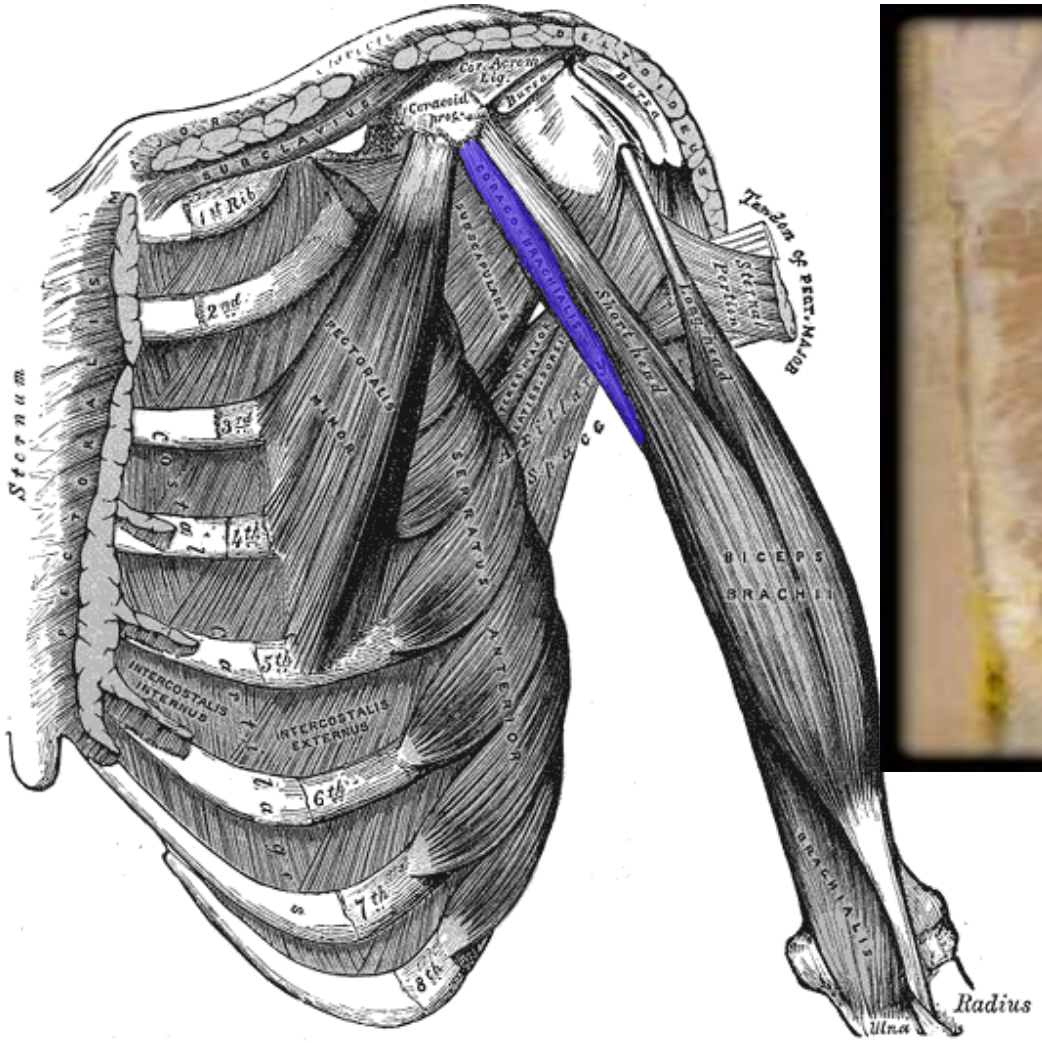
Proximally, the neurovascular structures are ensheathed in a sleeve-like extension of the cervical fascia, **axillary sheath**.

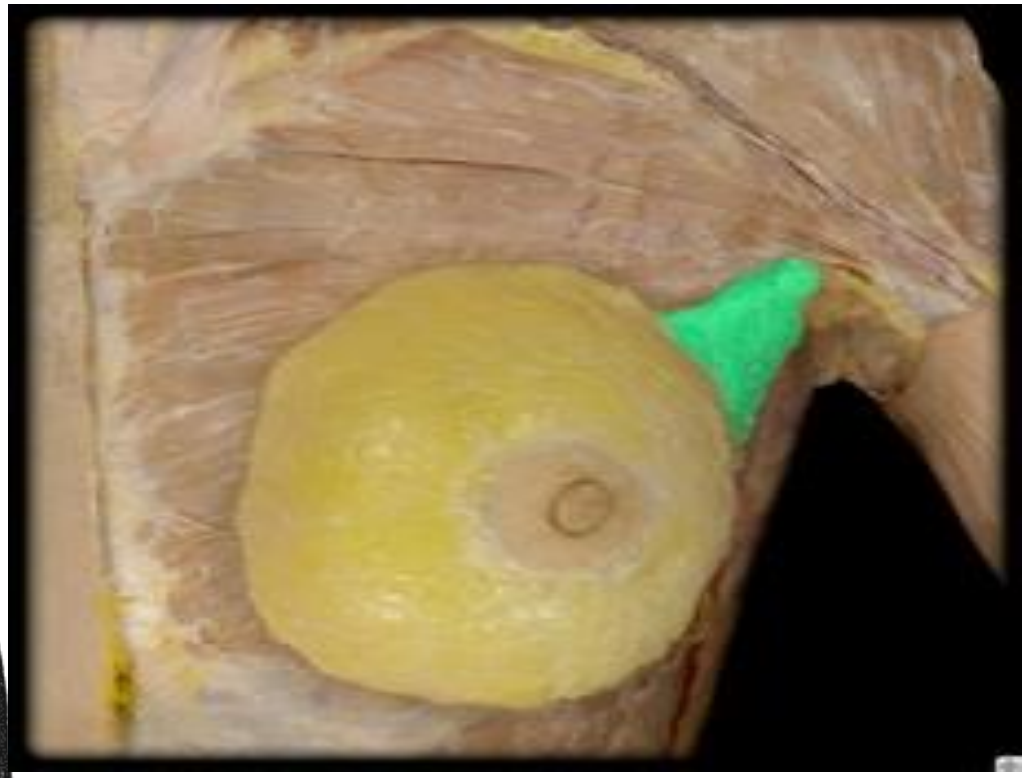


The space also contains the proximal parts of two muscles of the arm;

**biceps brachii** & **coracobrachialis muscles**

and axillary process of the breast.



# Axillary artery

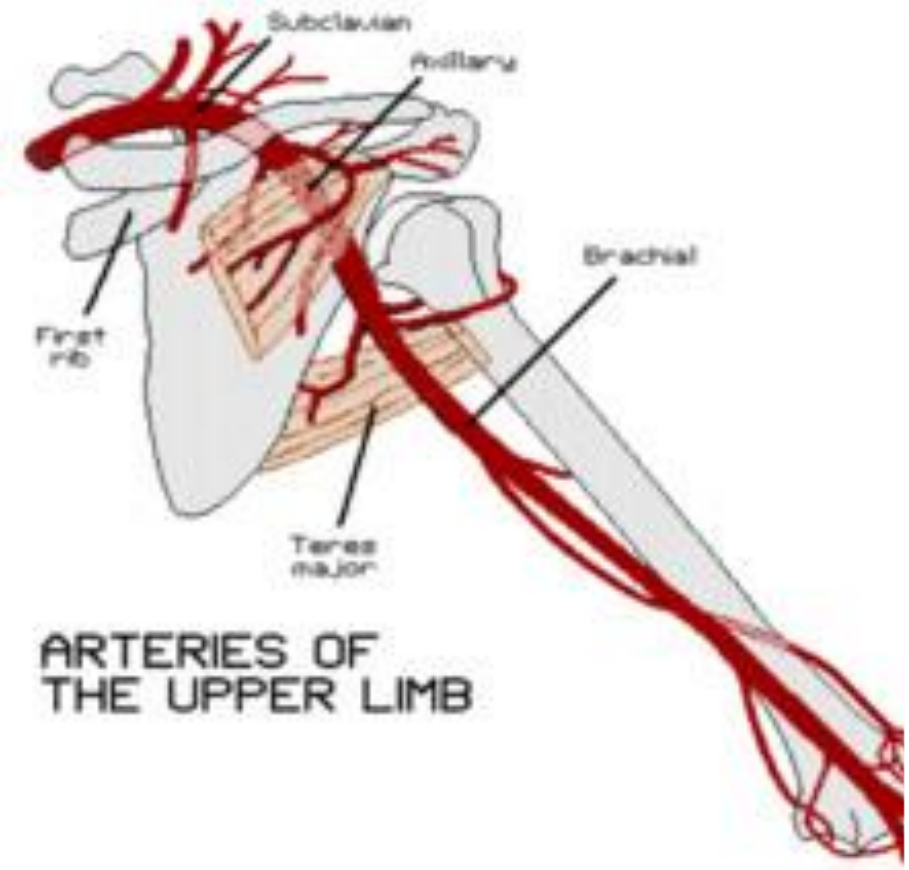
Supplies the walls of the axilla & related regions.

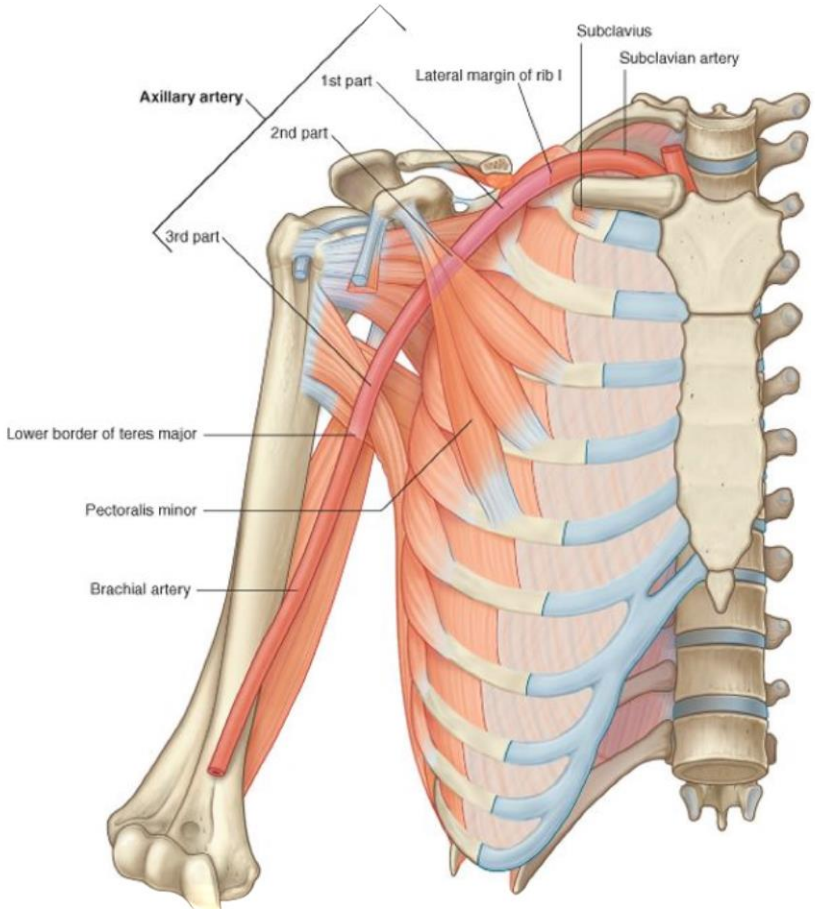
**Before:** Subclavian artery **After:** Brachial artery

From **lateral border of 1st rib**

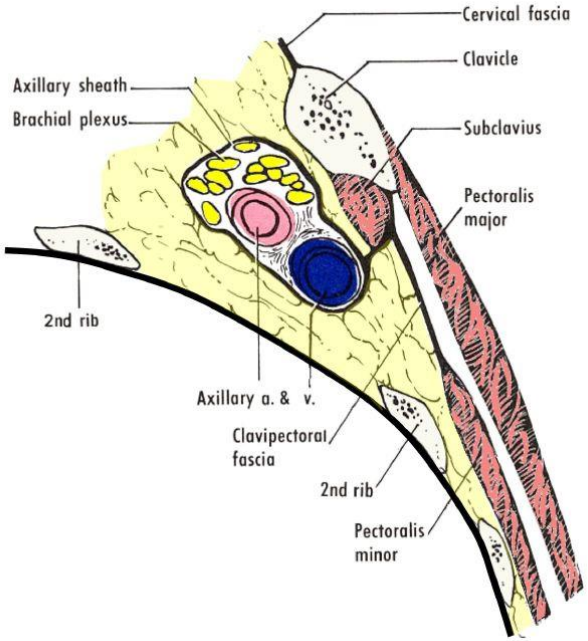
to

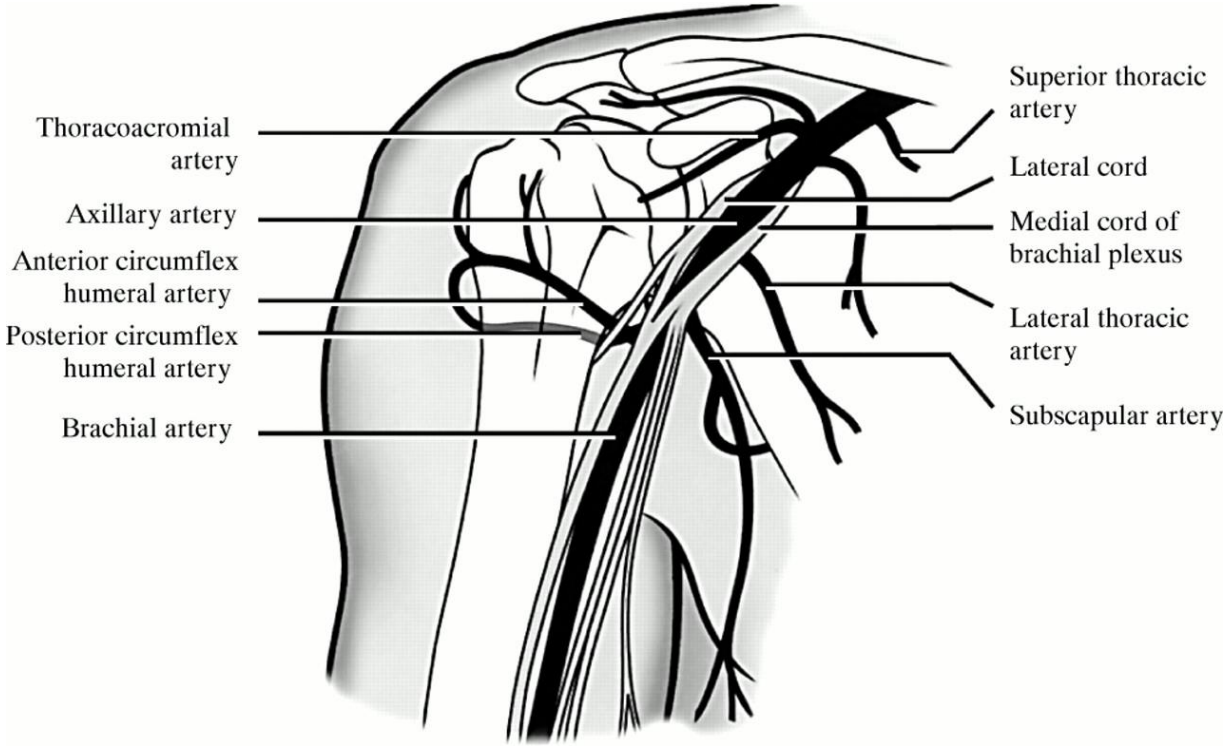
Inferior border of **teres major**



- Throughout its course, the artery is closely related to the cords of the brachial plexus and their branches and is enclosed with them in a connective tissue sheath called the axillary sheath.




- If this sheath is traced upward into the root of the neck, it is seen to be continuous with the prevertebral fascia.

Separated into 3 parts by the pectoralis minor muscle :

**1st part**

proximal to pectoralis minor

medial part of pectoralis minor & lateral part of first rib

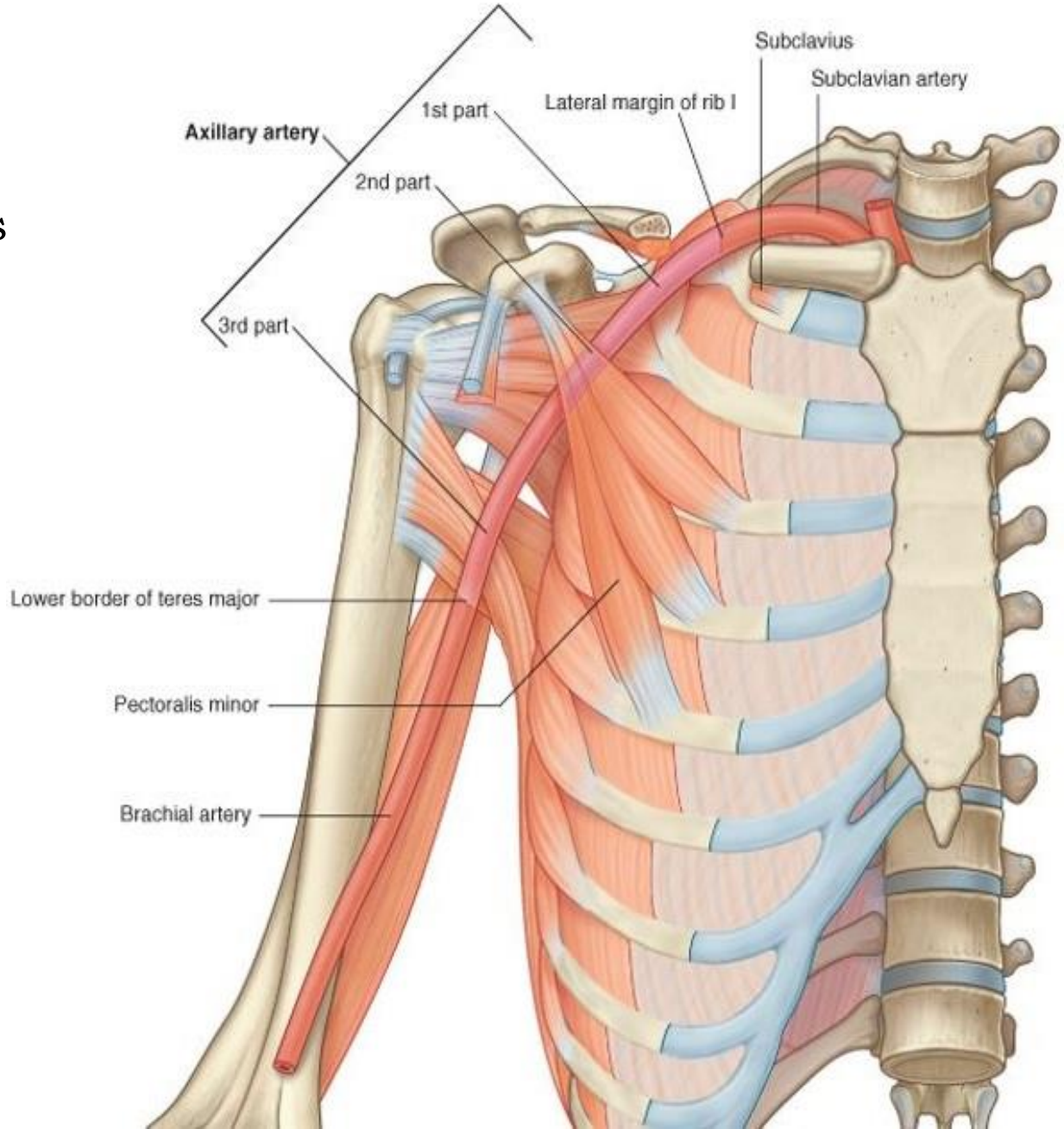
**2nd part**

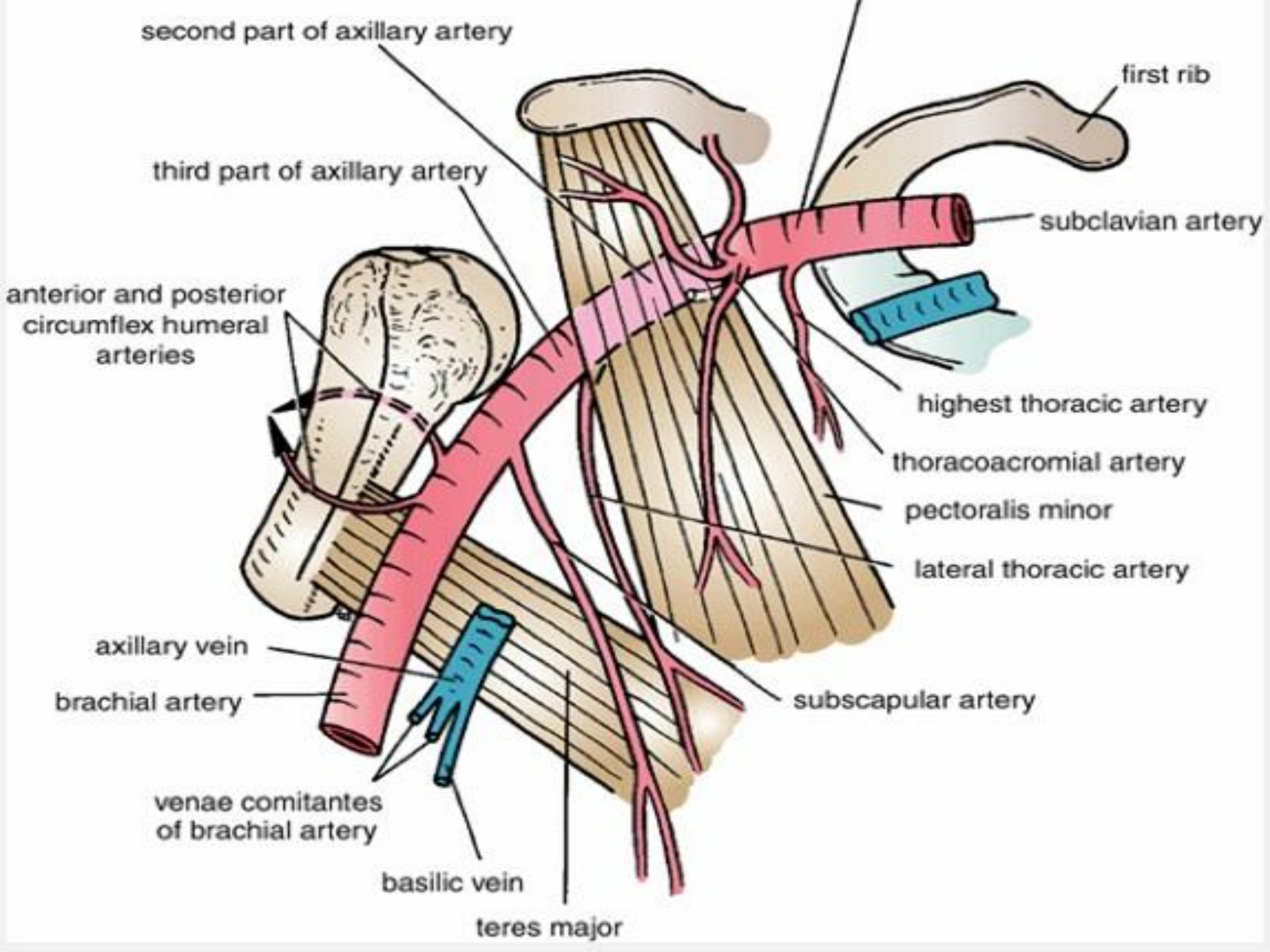
posterior to pectoralis minor

**3rd part**

distal to pectoralis minor

from lateral part of pectoralis minor to inferior border of teres **major**




second part of axillary artery
first rib
third part of axillary artery
subclavian artery
anterior and posterior circumflex humeral arteries
highest thoracic artery
thoracoacromial artery
pectoralis minor
lateral thoracic artery
axillary vein
brachial artery
subscapular artery
venae comitantes of brachial artery
basilic vein
teres major

6 branches of axillary artery

1 branch **(1st part)**

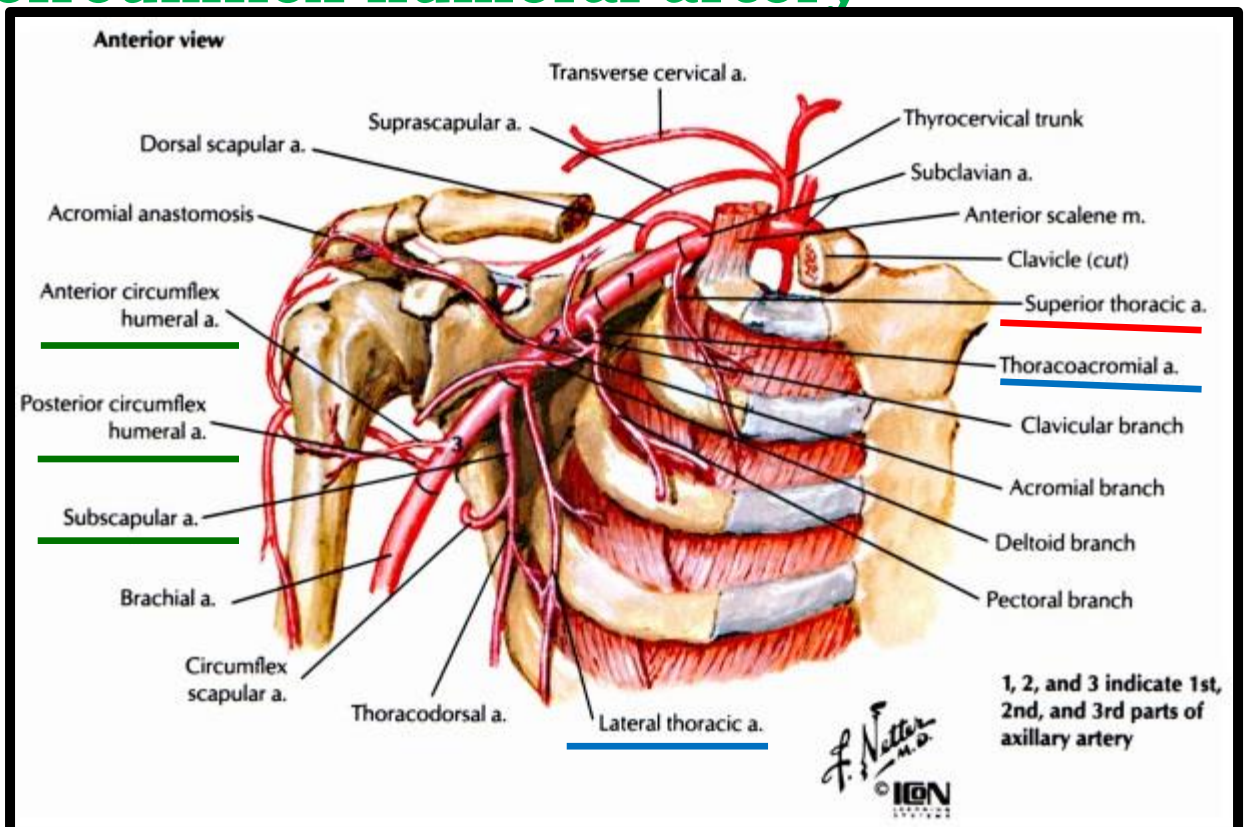
**superior thoracic artery**

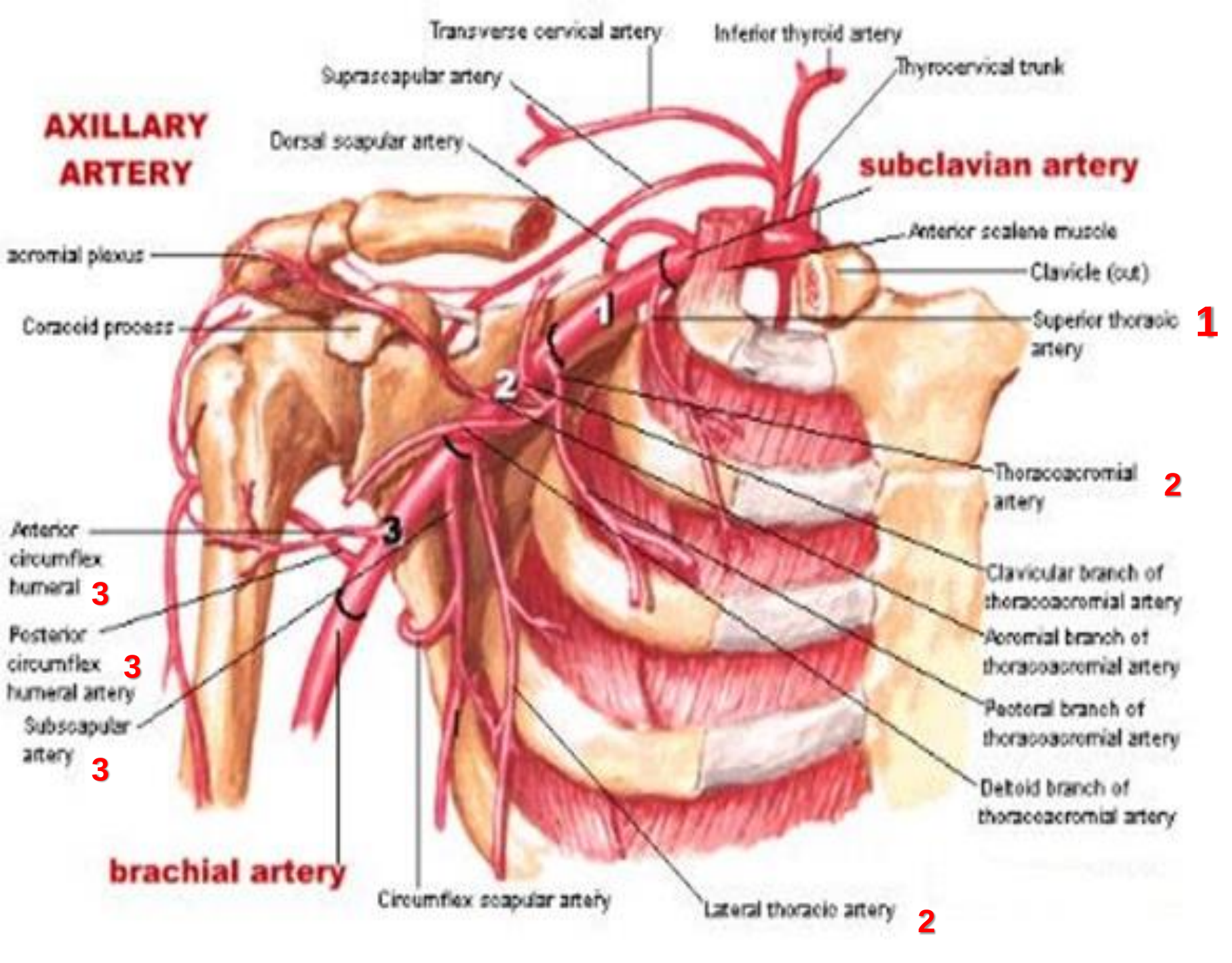
2 branches **(2nd part)**

**thoraco-acromial artery** & **lateral thoracic artery**

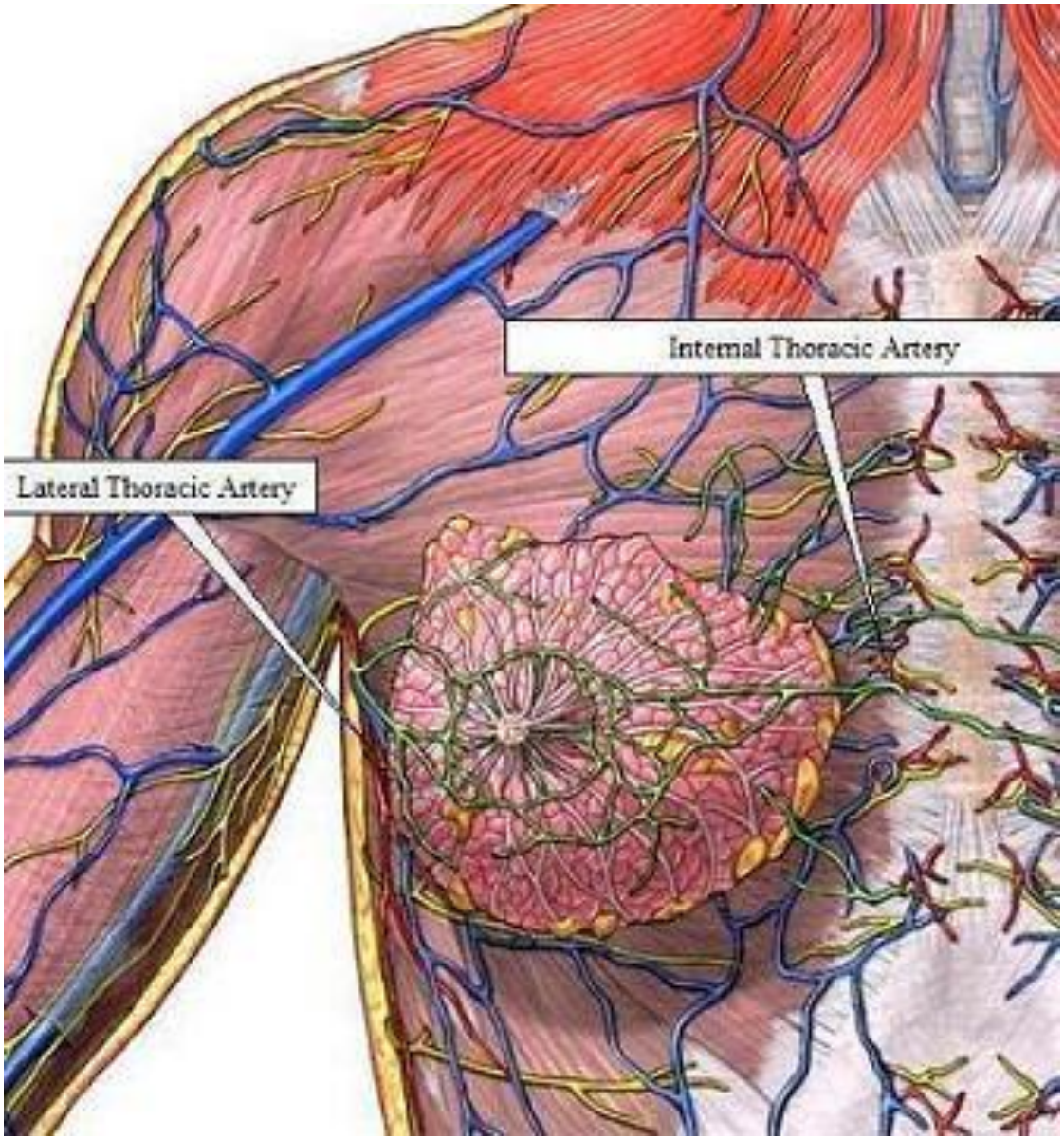
3 branches **(3nd part)**

**subscapular artery**, **anterior circumflex humeral artery**, **posterior circumflex humeral artery**

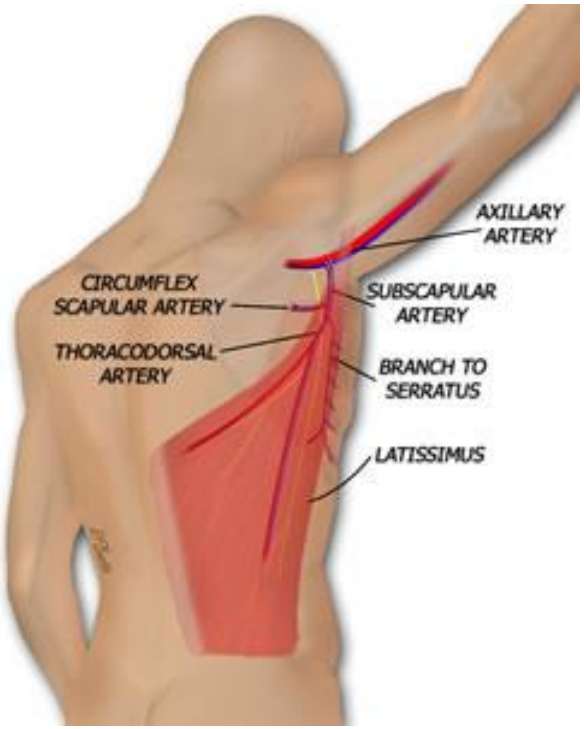


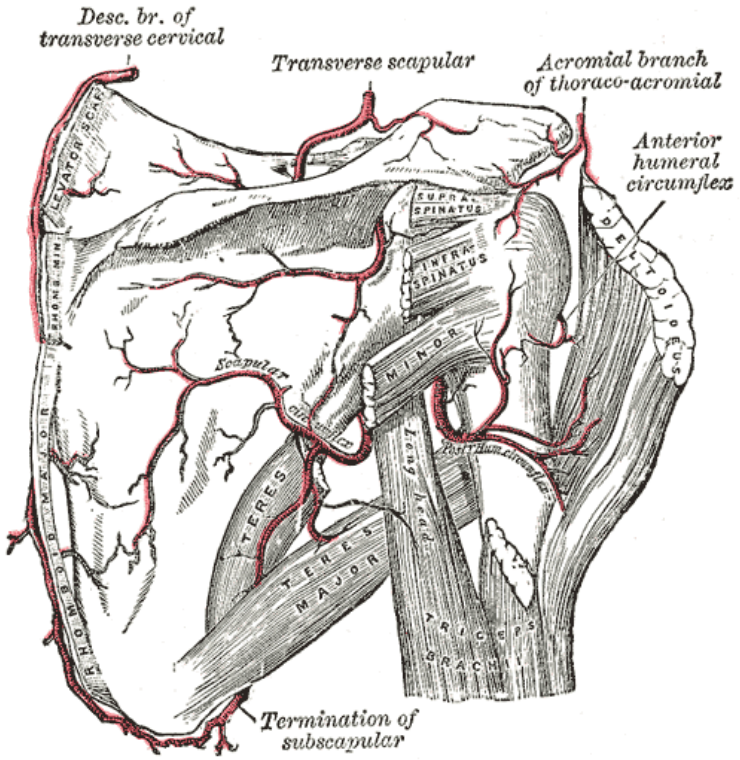

AXILLARY ARTERY
Transverse cervical artery
Inferior thyroid artery
Thyrocervical trunk
Suprascapular artery
Dorsal scapular artery
subclavian artery
Anterior scalene muscle
acromial plexus
Clavicle (cut)
Coracoid process
1
Superior thoracic artery
1
2
Thoracoacromial artery
2
Anterior circumflex humeral
3
Clavicular branch of thoracoacromial artery
Posterior circumflex humeral artery
3
Acromial branch of thoracoacromial artery
Pectoral branch of thoracoacromial artery
Subscapular artery
3
Deltoid branch of thoracoacromial artery
brachial artery
Circumflex scapular artery
Lateral thoracic artery
2

Branches of **lateral thoracic artery** contribute to the vascular supply of the breast.



Subscapular artery, largest branch of the axillary artery, terminates by dividing into:
**circumflex scapular** & **thoracodorsal arteries**.




The anterior circumflex humeral artery anastomoses with the posterior circumflex humeral artery. Along with these two arteries, the circumflex scapular artery and throcadorsal artery participate in the anastomoses around the scapula.

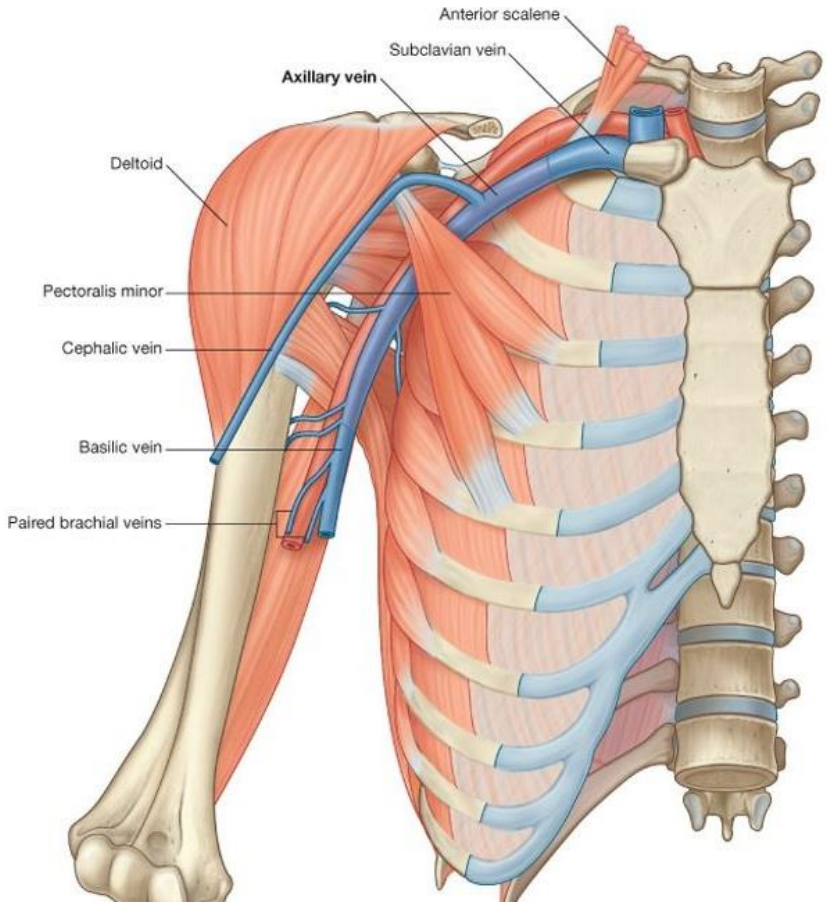
# Axillary vein

**Before:** Basilic vein **After:** Subclavian vein

From inferior border of **teres major**

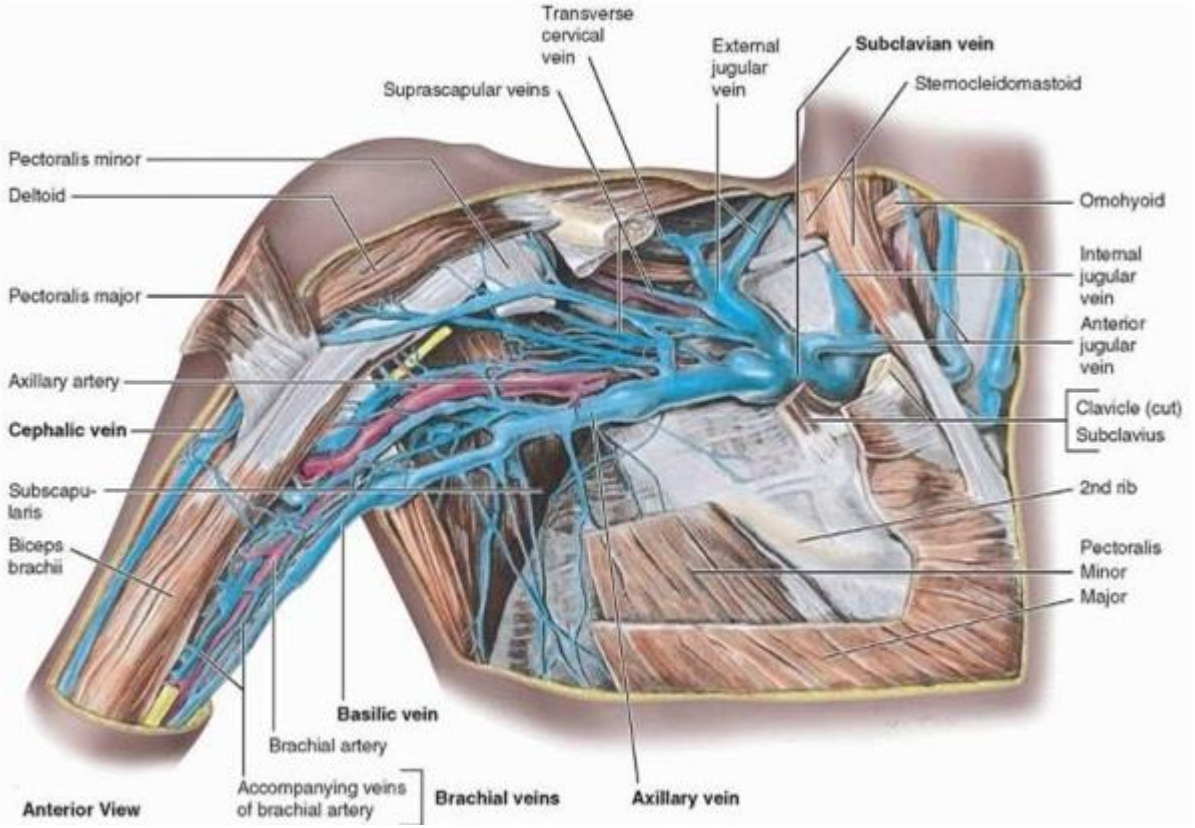
to

**lateral border of 1st rib**



Tributaries of the axillary vein generally follow the branches of the axillary artery.

Other tributaries include brachial veins & cephalic vein.

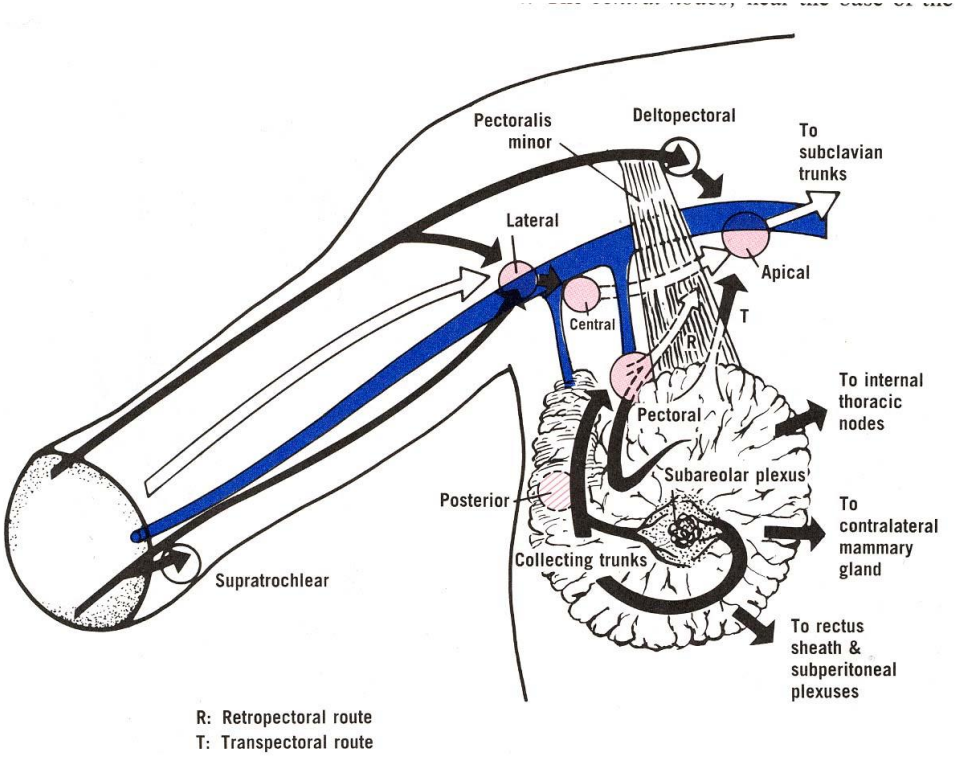


# Lymphatics in the axilla

Drainage from

- Upper limb
- An extensive area on the adjacent trunk

  Regions of the upper back & shoulder, lower neck, chest, upper anterolateral abdominal wall
- Drainage from ~ 75% of the mammary gland.



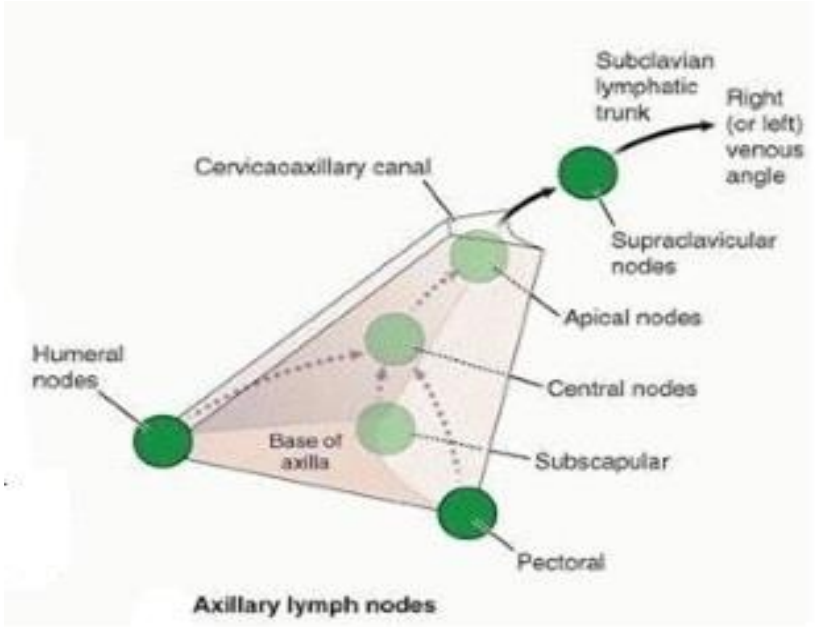
The 20-30 axillary nodes are divided into
5 groups - on the basis of location-

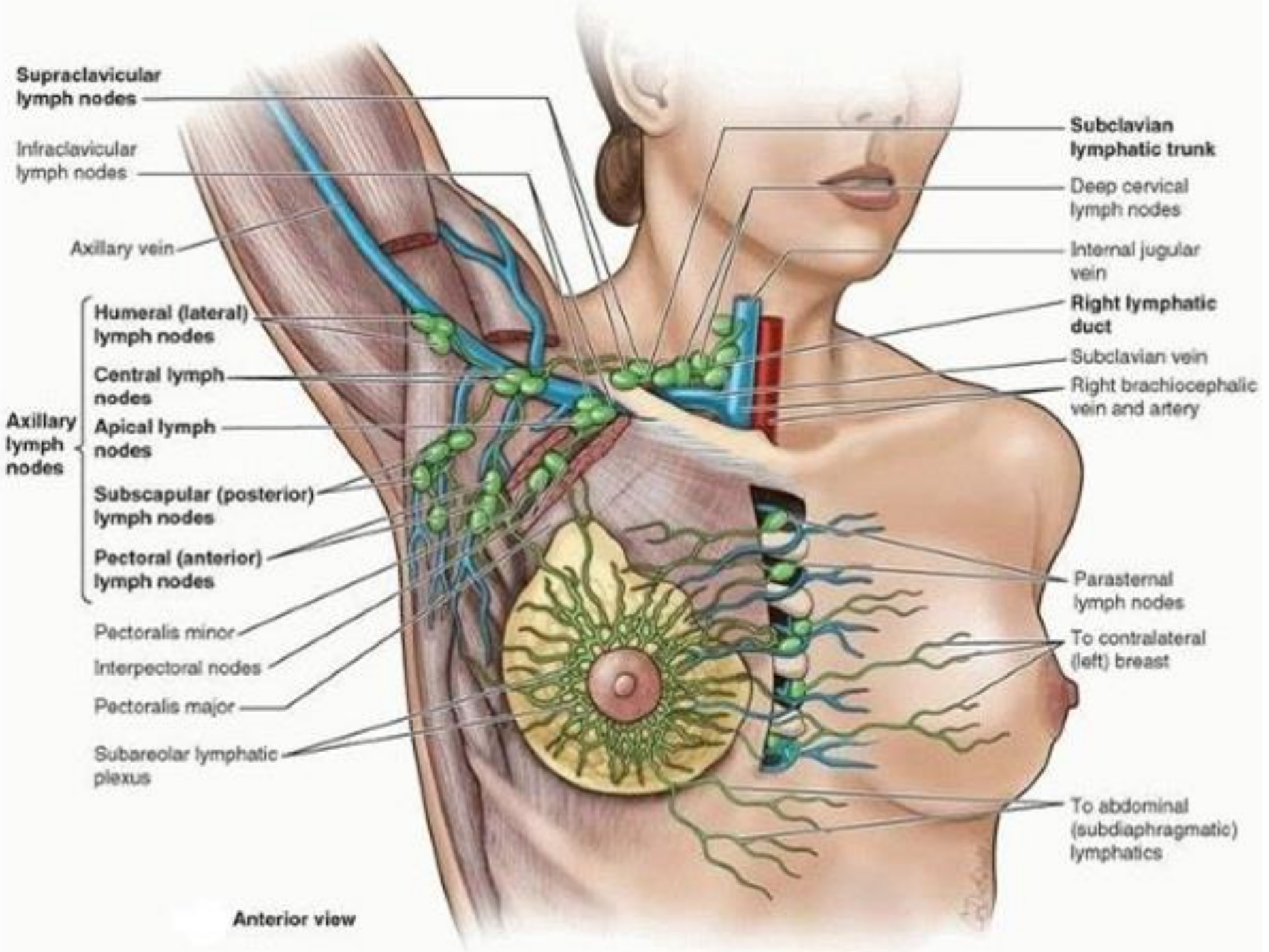
*The groups are arranged in a manner that reflects the pyramidal shape of the axilla.*

**Humeral (lateral) nodes**
**Pectoral (anterior) nodes**
**Subscapular (posterior) nodes**

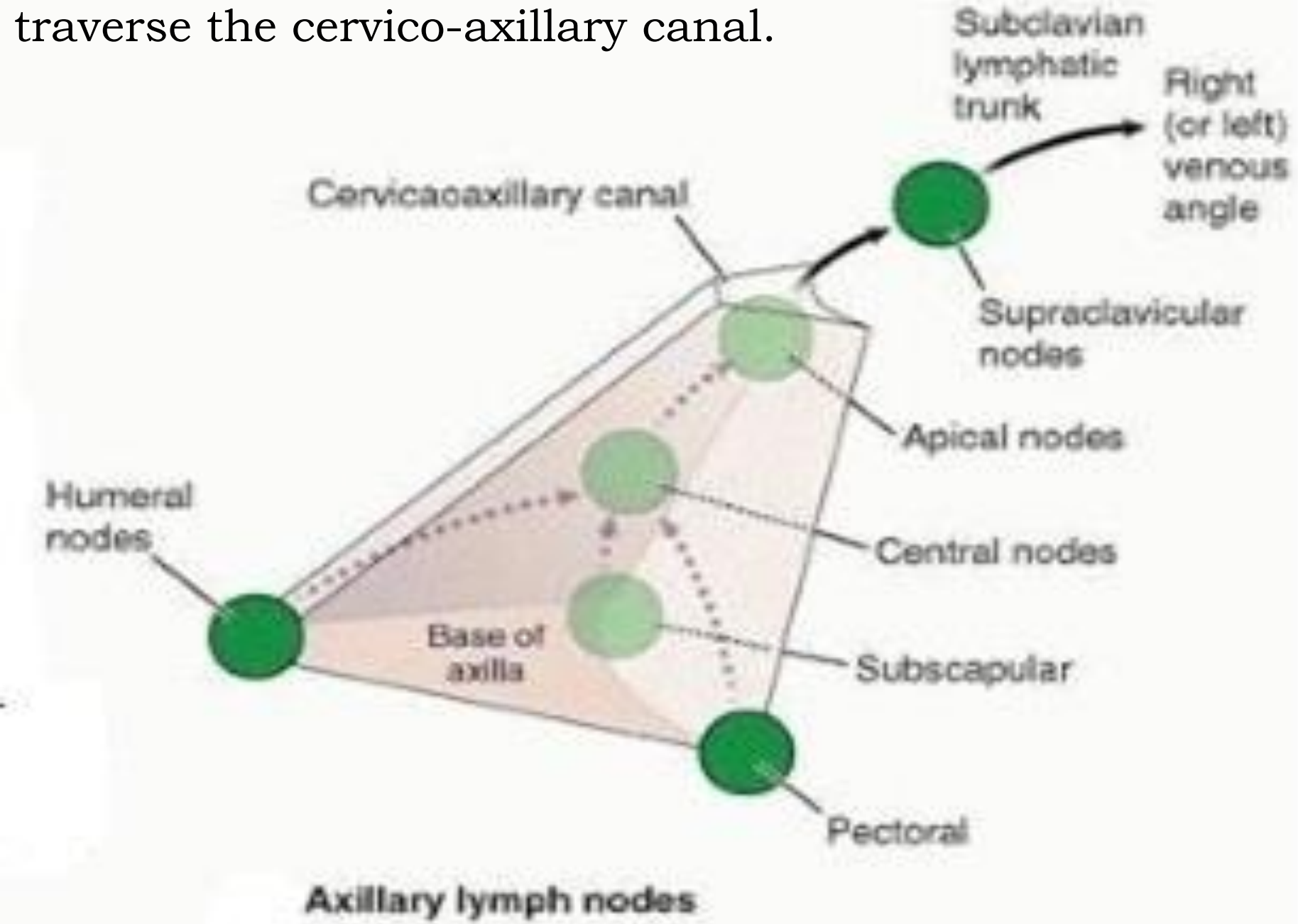
**Central nodes**

**Apical nodes**

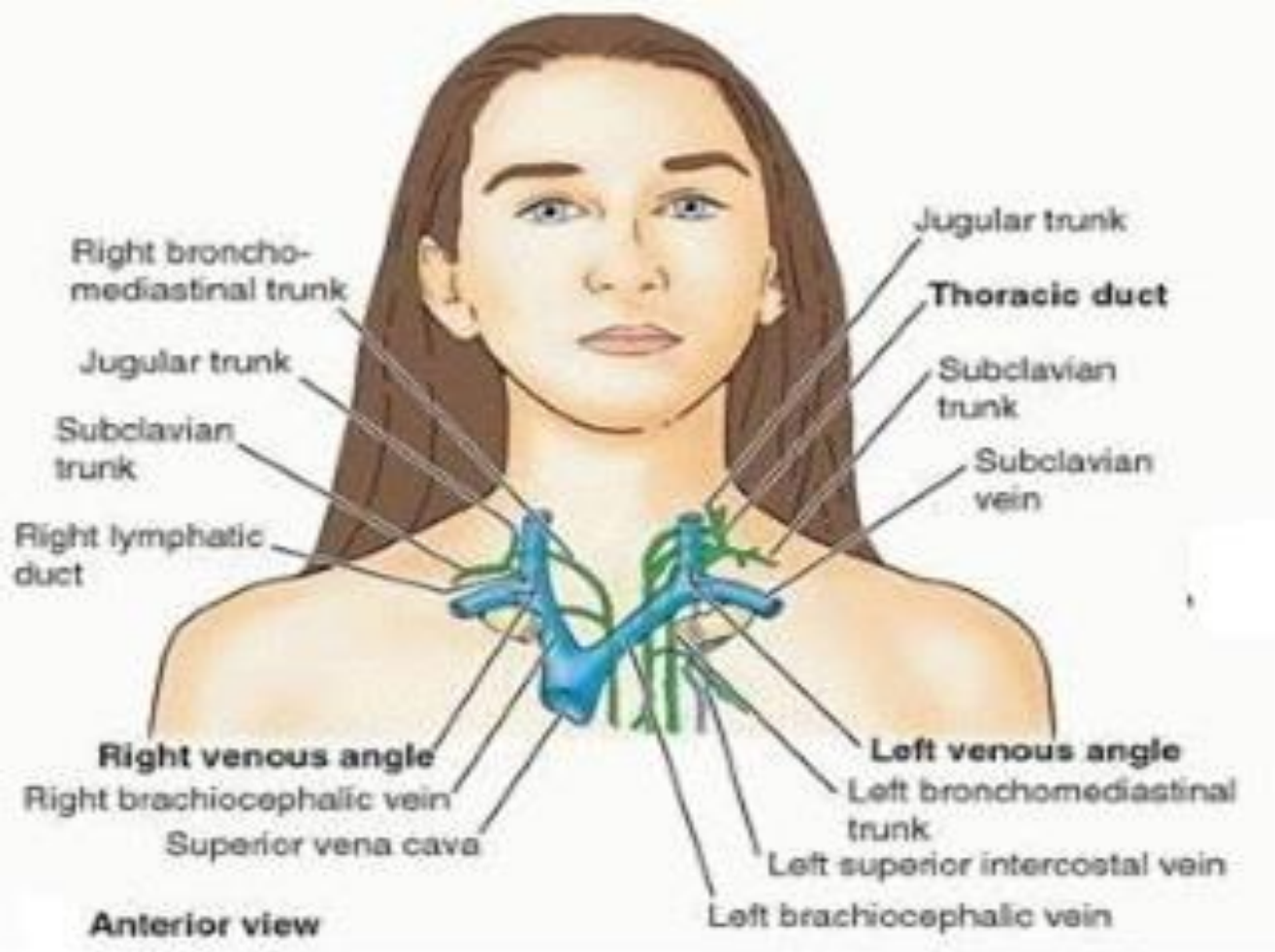



Supraclavicular lymph nodes
Infraclavicular lymph nodes
Axillary vein
Axillary lymph nodes
Humeral (lateral) lymph nodes
Central lymph nodes
Apical lymph nodes
Subscapular (posterior) lymph nodes
Pectoral (anterior) lymph nodes
Pectoralis minor
Interpectoral nodes
Pectoralis major
Subareolar lymphatic plexus
Subclavian lymphatic trunk
Deep cervical lymph nodes
Internal jugular vein
Right lymphatic duct
Subclavian vein
Right brachiocephalic vein and artery
Parasternal lymph nodes
To contralateral (left) breast
To abdominal (subdiaphragmatic) lymphatics
Anterior view

Efferent vessels from the apical group traverse the cervico-axillary canal.



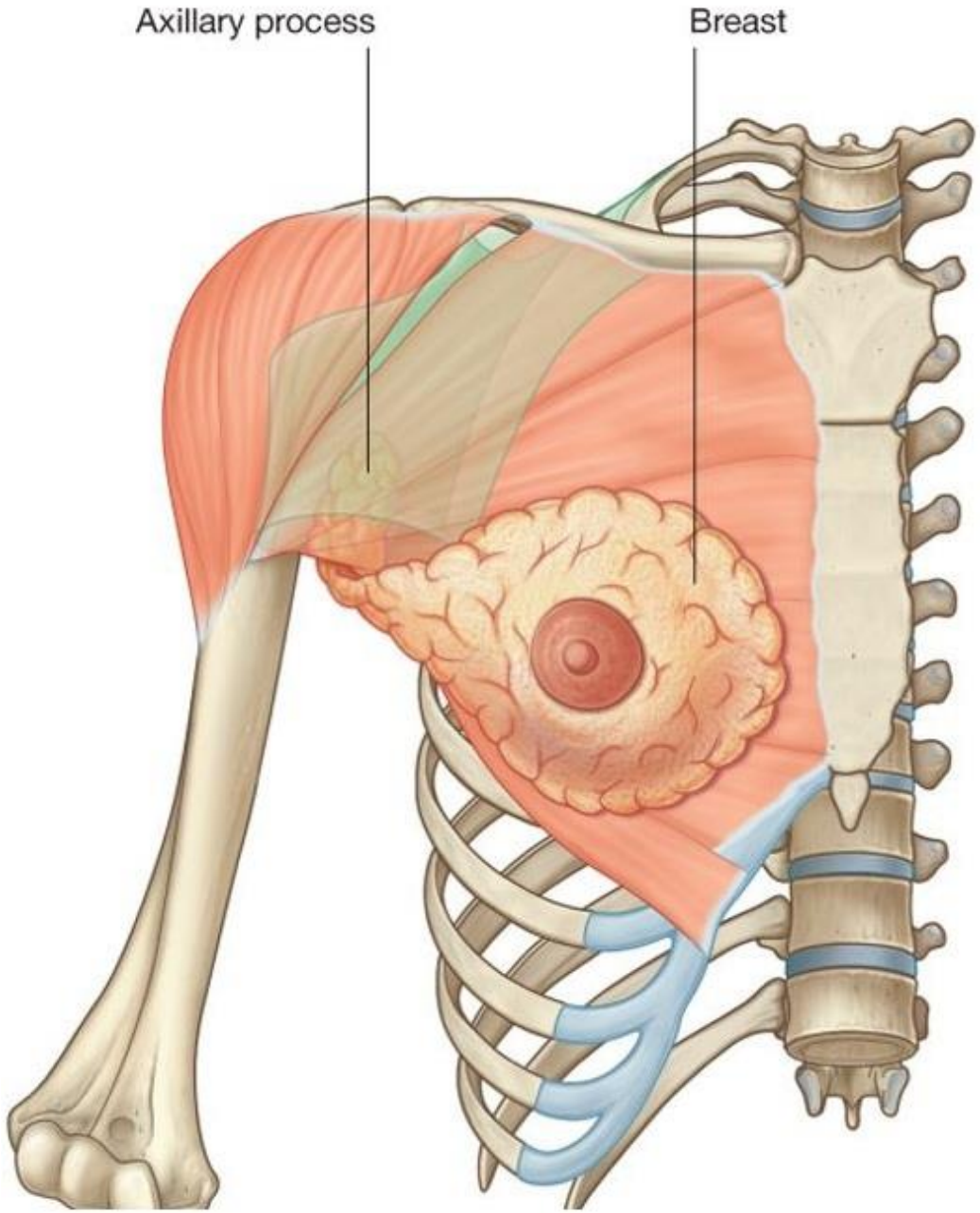
Efferent vessels from the apical group converge to form the **subclavian lymphatic trunk**, which usually joins the venous system at the junction between **right subclavian vein** & **right internal jugular vein** in the neck.



# Axillary process of the mammary gland

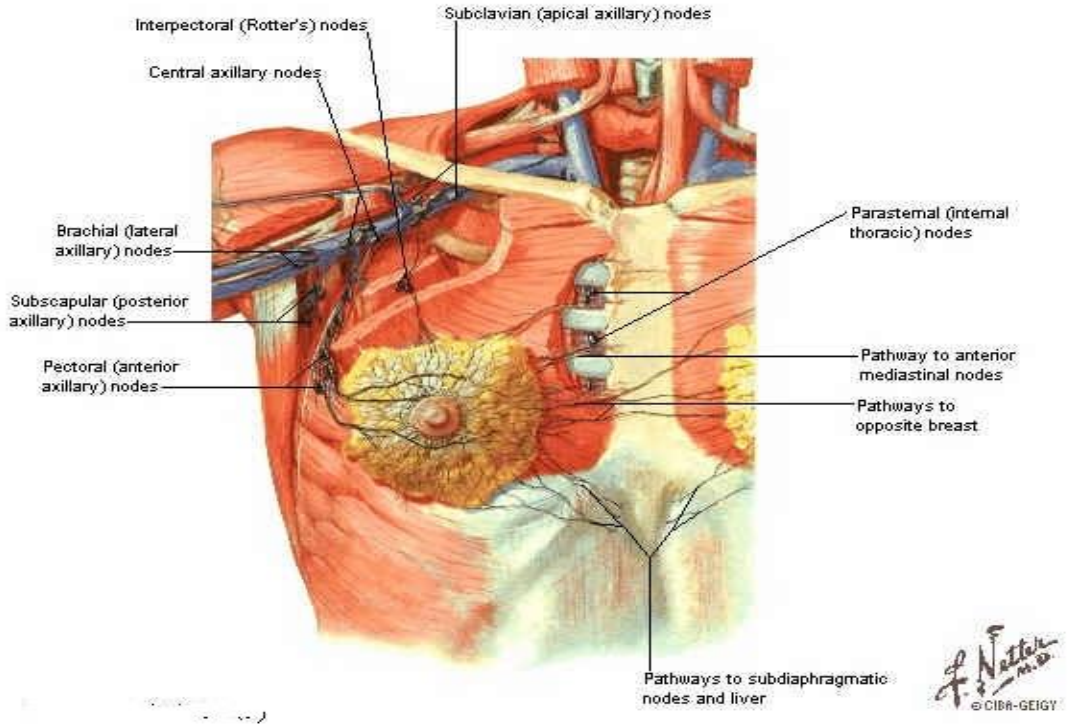
- In some cases, the superolateral region of breast may pass around the margin of pectoral muscle and enters the axilla.

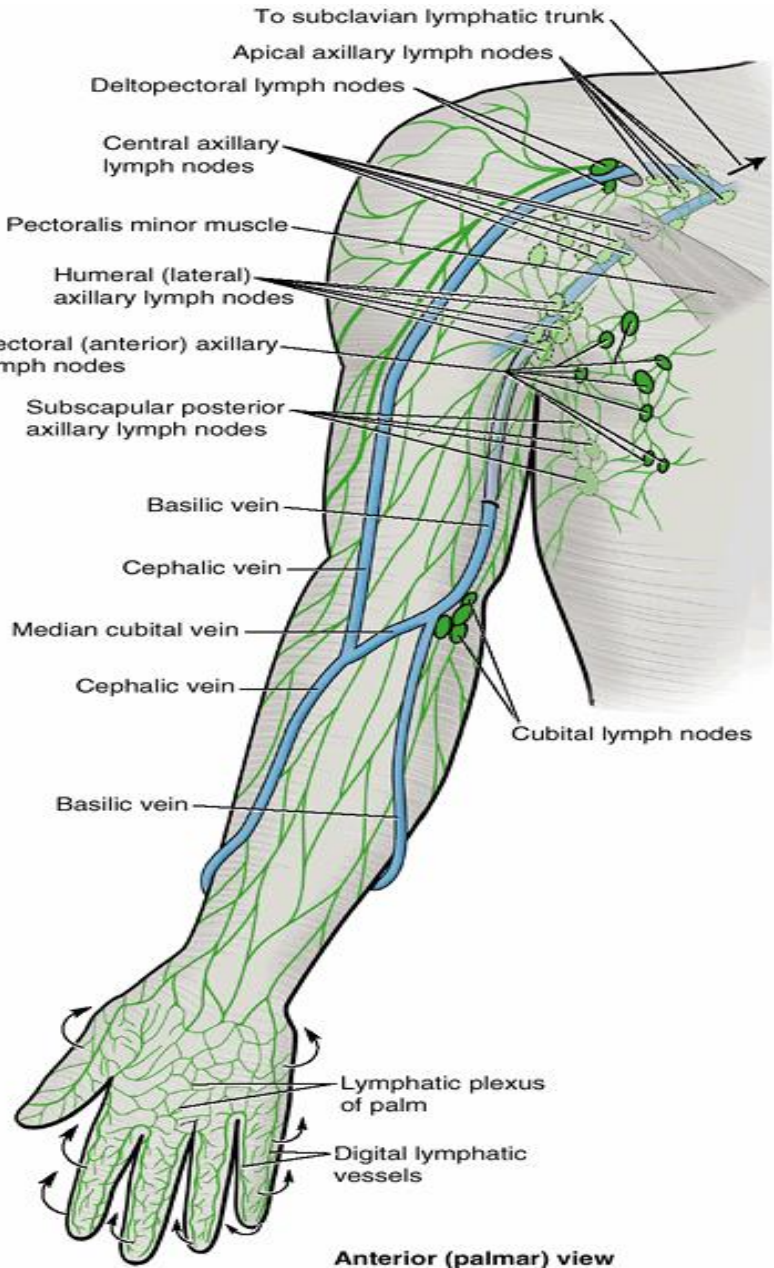
- This axillary process rarely reaches as high as the apex of the axilla.



In metastatic cancer of the apical group, the nodes often adhere to the **axillary vein**, which may necessitate excision of part of this vessel.

Enlargement of the apical nodes may obstruct the cephalic vein superior to the pectoralis minor.



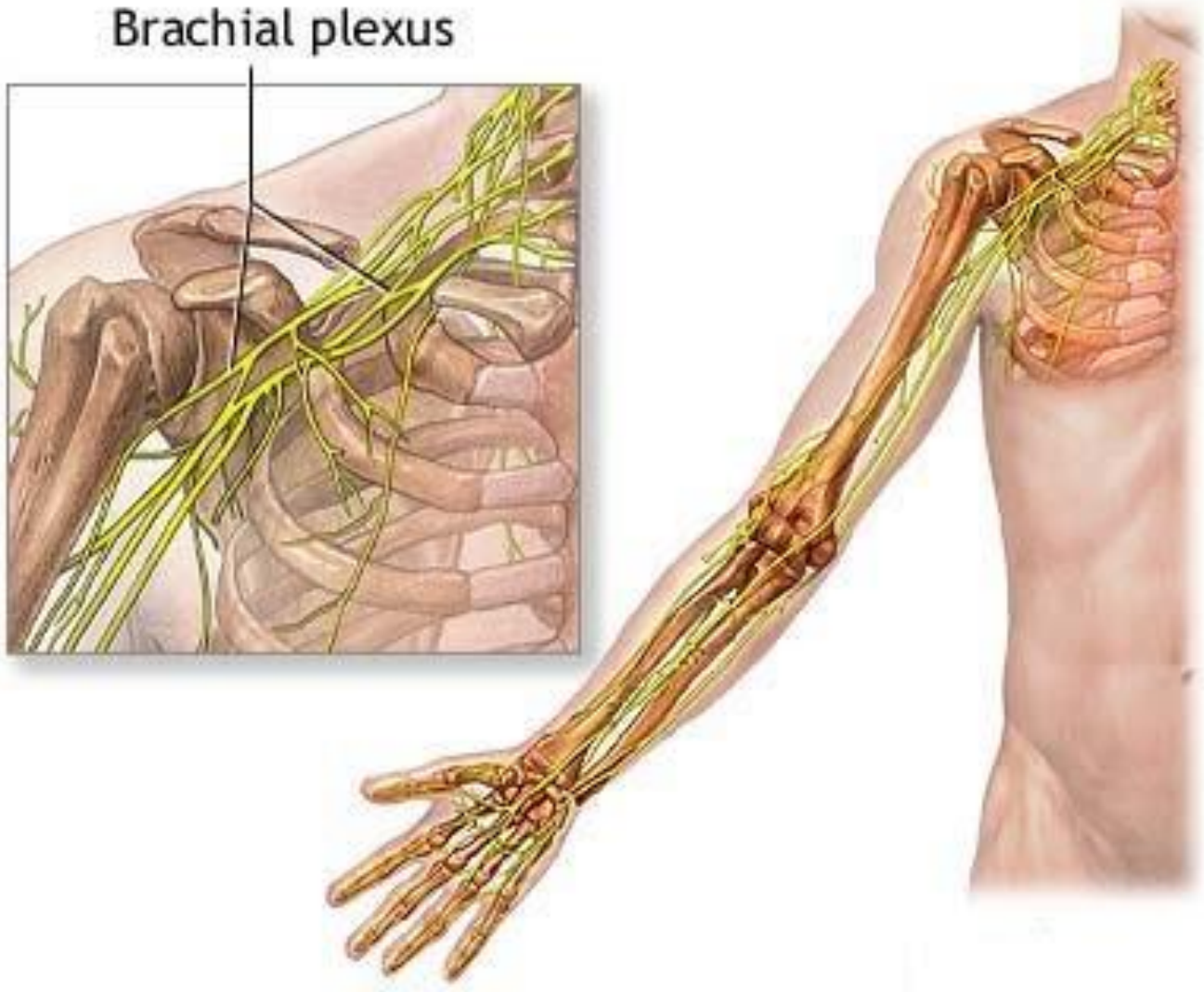



The examination of the axillary lymph nodes always forms part of the clinical examination of the breast.

With the patient standing or sitting, he or she is asked to place the hand of the side to be examined on the hip and push hard medially. This action of adduction of the shoulder joint causes the pectoralis major muscle to contract maximally so that it becomes hard like a board. The examiner then palpates the axillary nodes.

**EXAMINATION OF THE LYMPH NODES**

# BRACHIAL PLEXUS



# BRACHIAL PLEXUS

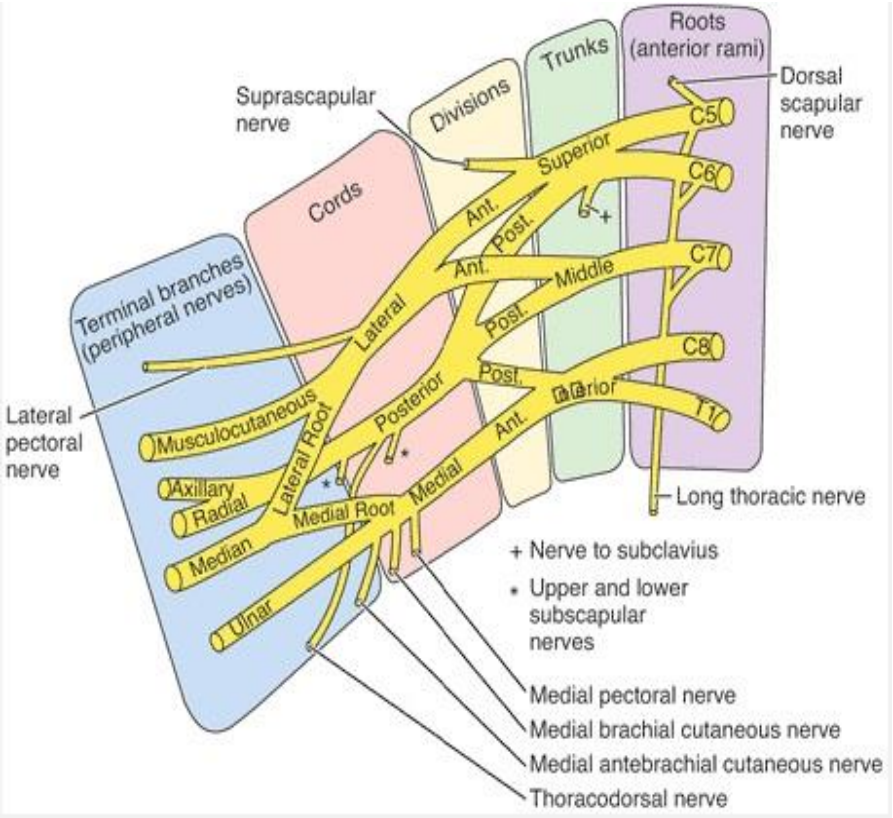
**a somatic nerve plexus - upper limb**

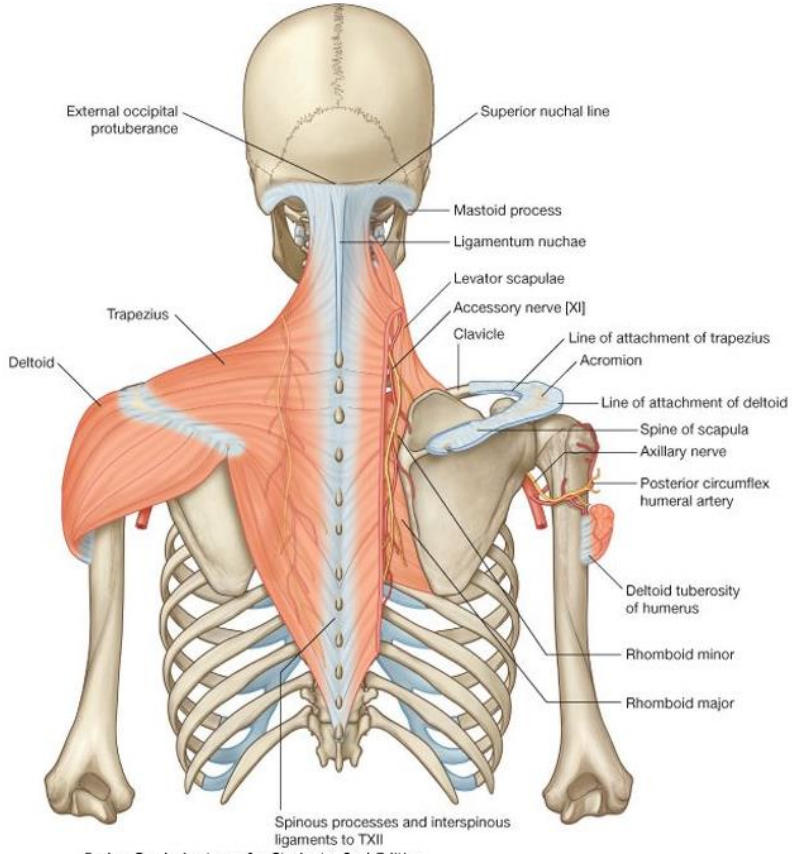
formed by intercommunications among **ventral rami of**

lower 4 cervical nerves ( C 5 - C 8) & T 1

responsible for motor innervation to all of **muscles of upper limb**

exception **trapezius.**



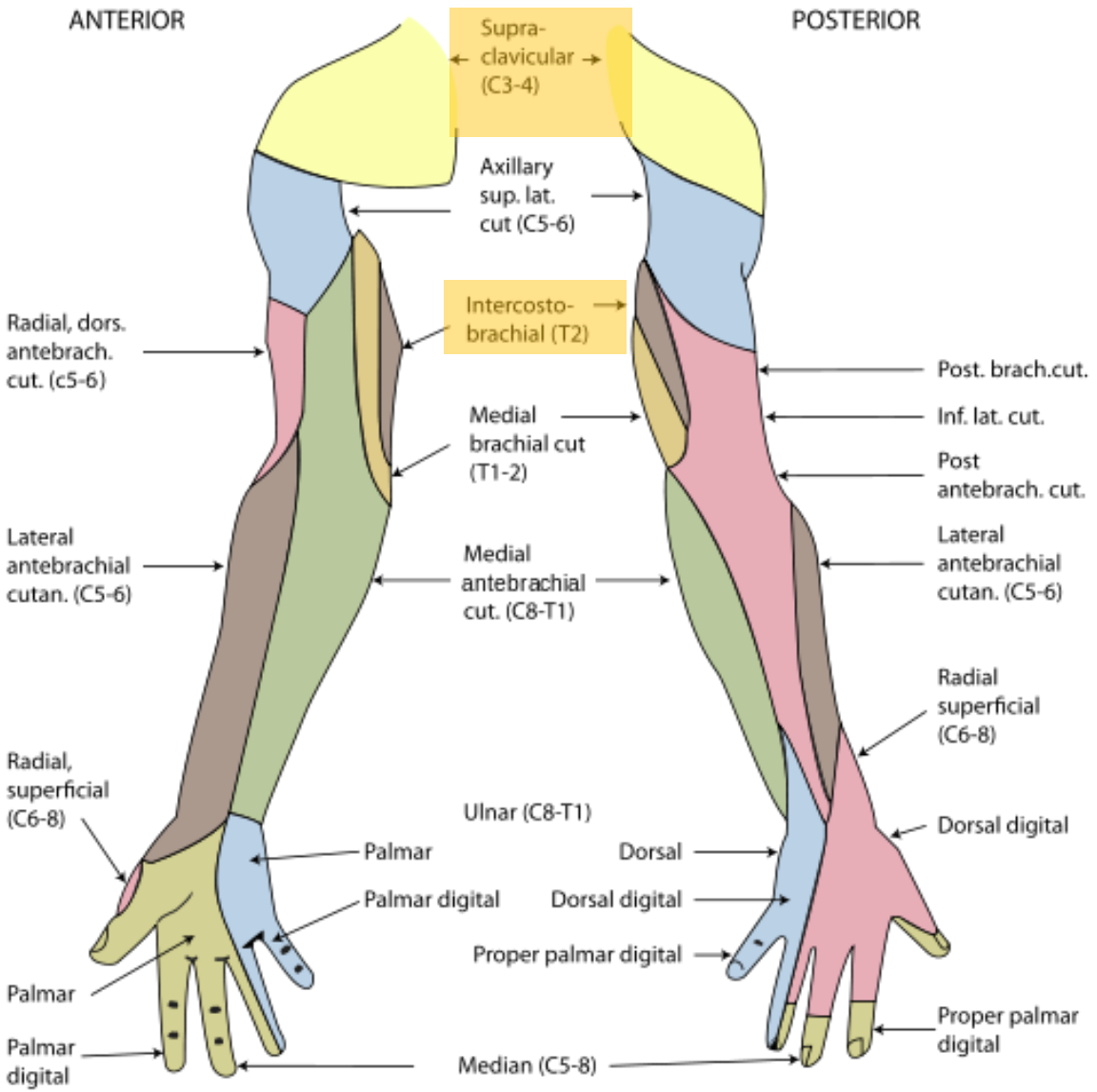



# BRACHIAL PLEXUS

**supplies all of the cutaneous innervation of the upper limb**

exception

- ❑ area of the axilla (armpit) (intercostobrachial nerve)
- ❑ an area just above the point of shoulder (supraclavicular nerves)
- ❑ dorsal scapular area (cutaneous branches of dorsal rami)




communicates with the sympathetic nervous system..

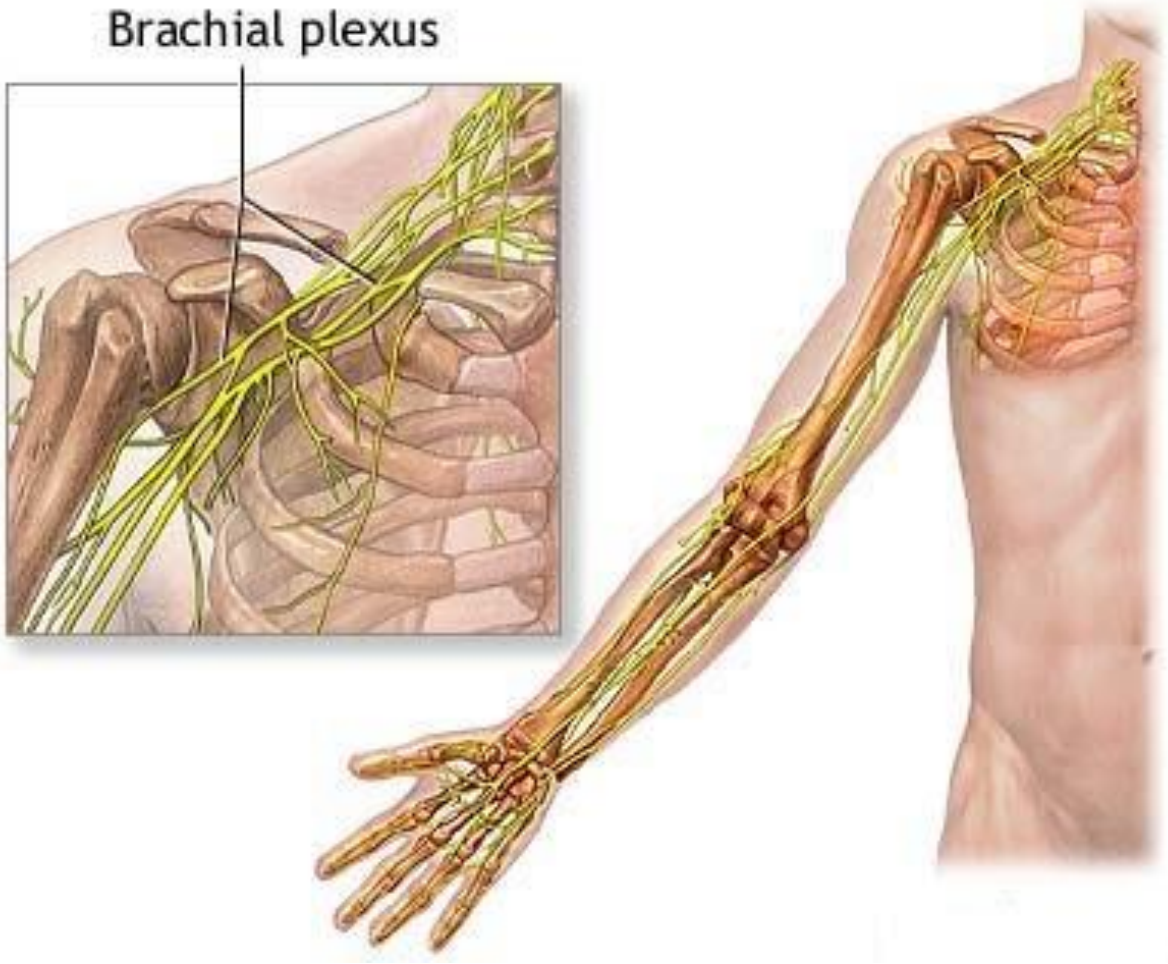
The nerves entering the upper limb provide the following important functions:

- Sensory innervation to skin & deep structures (e.g. joints)
- Motor innervation to the muscles
- Influence over the diameters of the blood vessels by the sympathetic vasomotor nerves
- Sympathetic secretomotor supply to the sweat glands.

At the root of the neck, the nerves form

**Brachial plexus**

Nerve fibers derived from different segments of the spinal cord arranged and distributed efficiently in various parts of the upper limb.

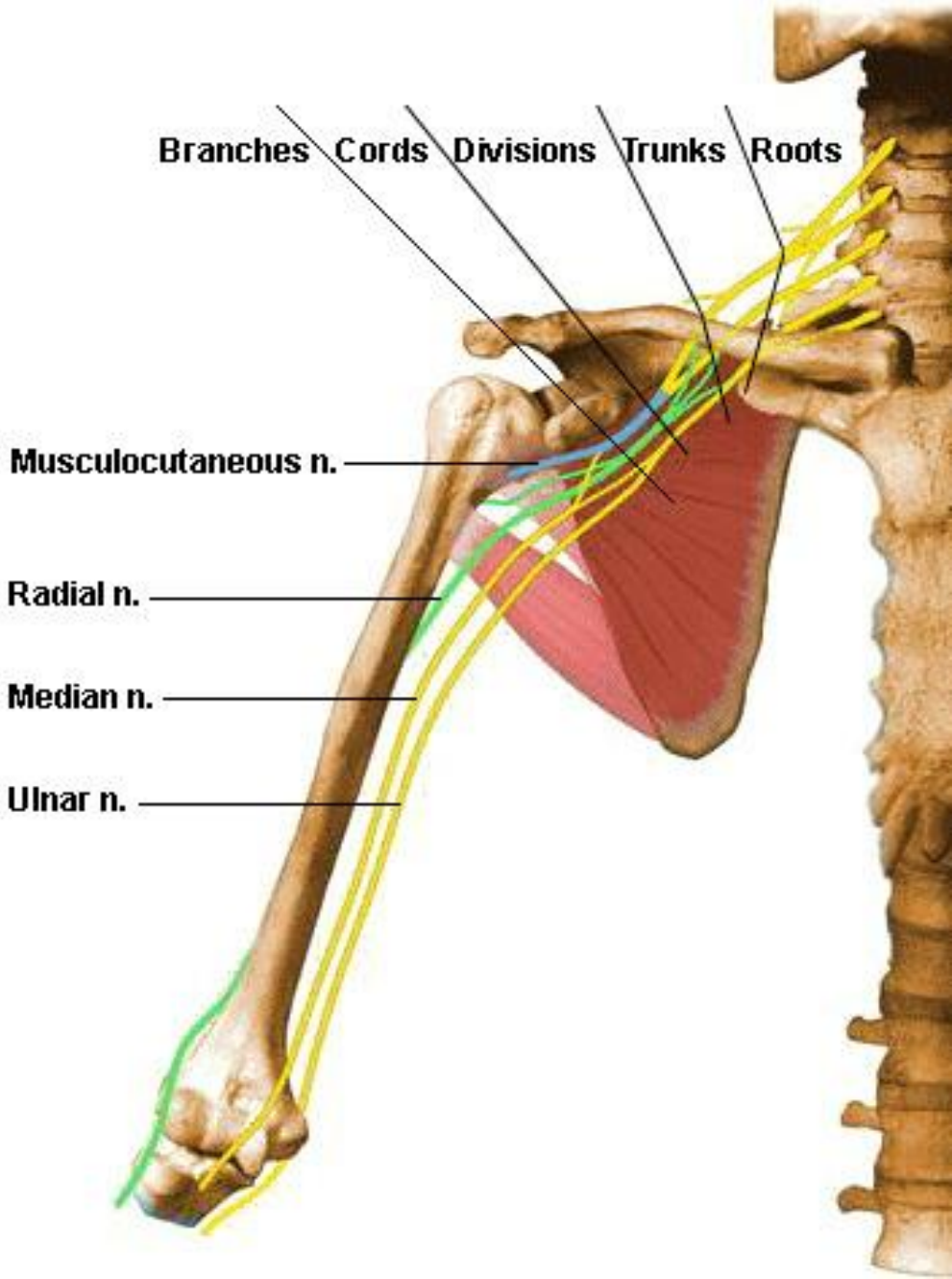


begins in the neck and extends into the axilla.

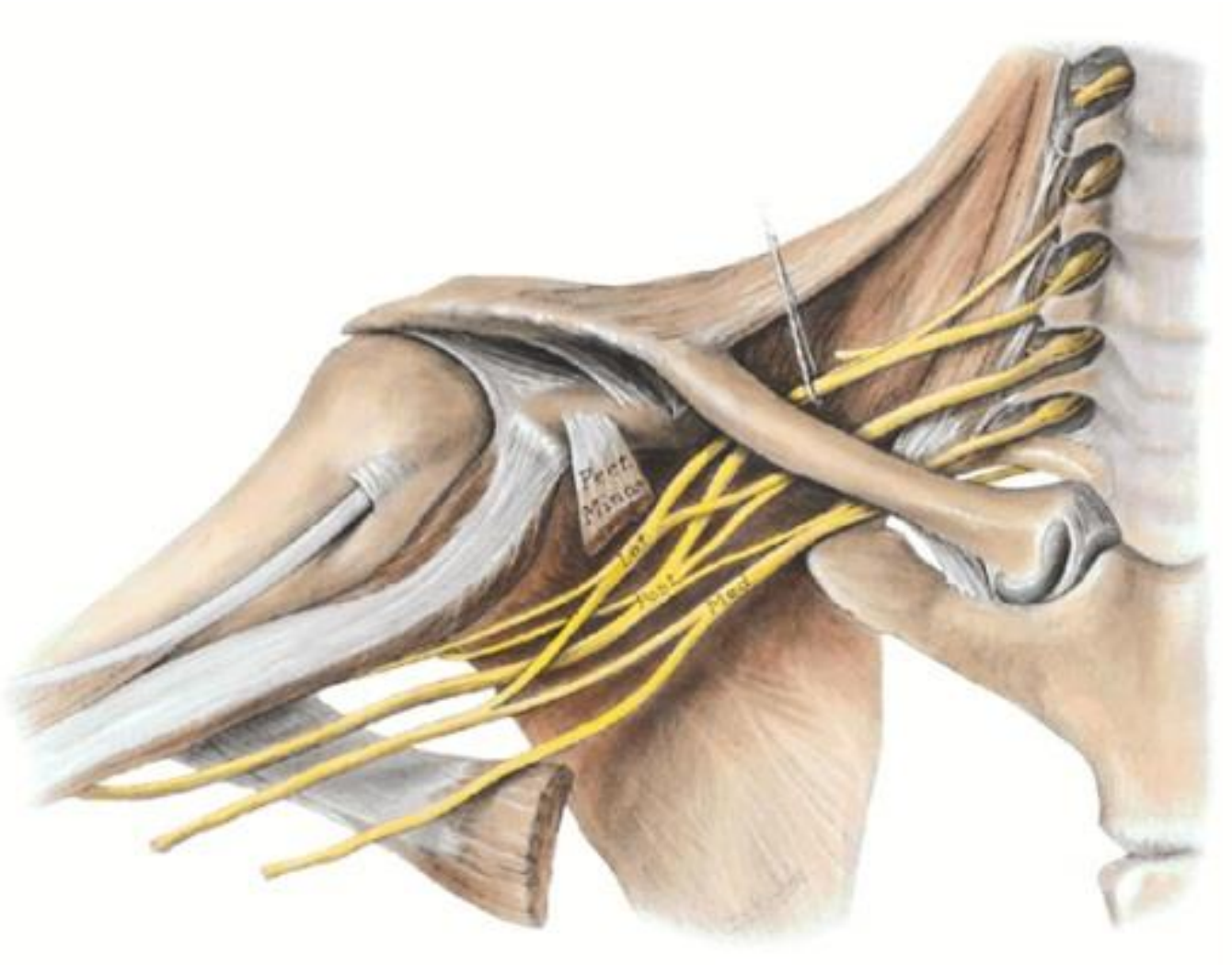
Almost
**all branches**
of the brachial plexus
arise in the axilla
(after the plexus
has crossed the 1st rib).

**"Randy Travis Drinks Cold Beer"**
**R**oots
**T**runks
**D**ivisions
**C**ords

**B**ranches
· Alternatively:
"**R**ead **T**he **D**amn **C**adaver **B**ook!"
· Alternatively:
"**R**eal **T**exans **D**rink **C**oors **B**eer".

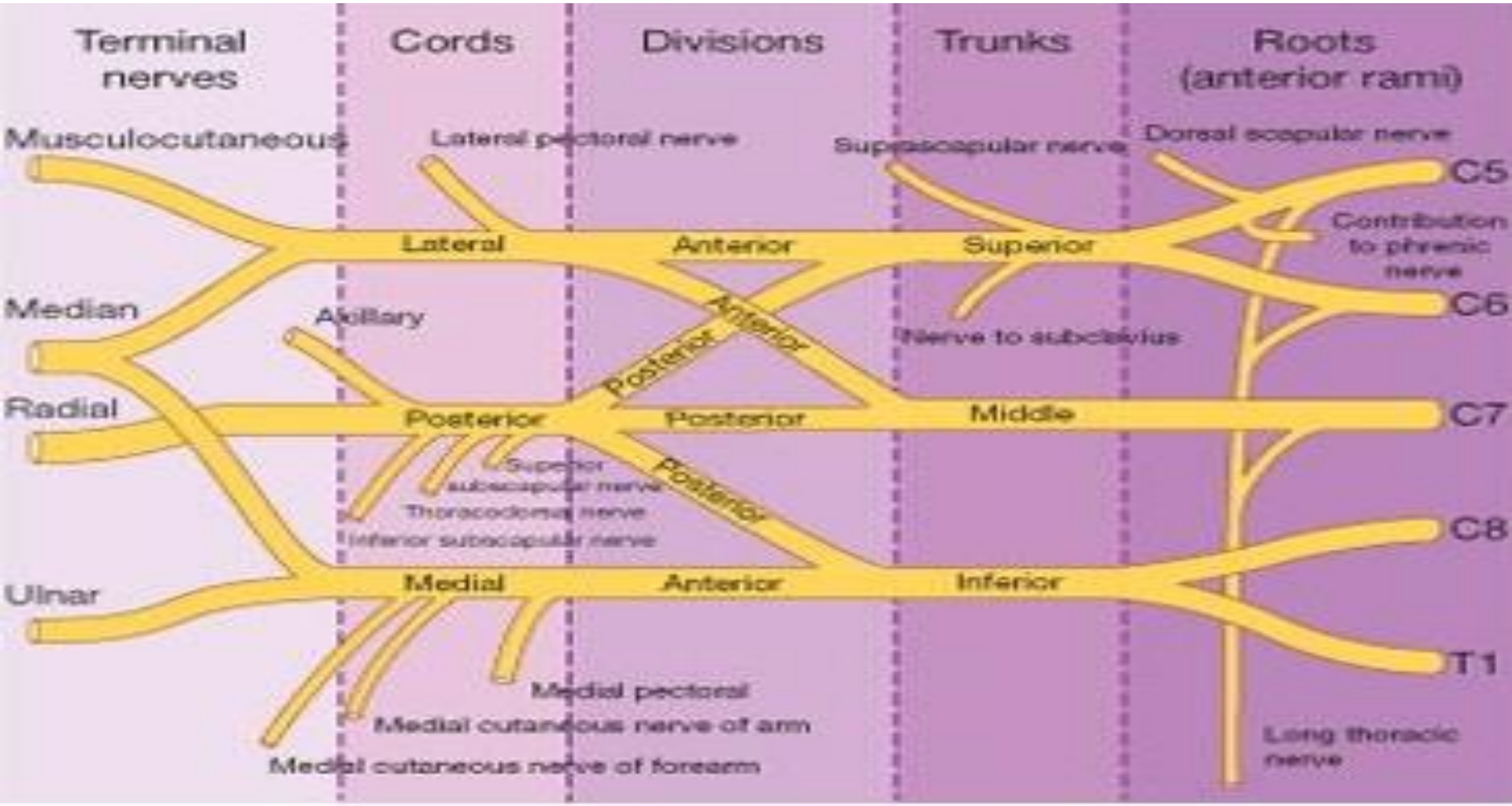


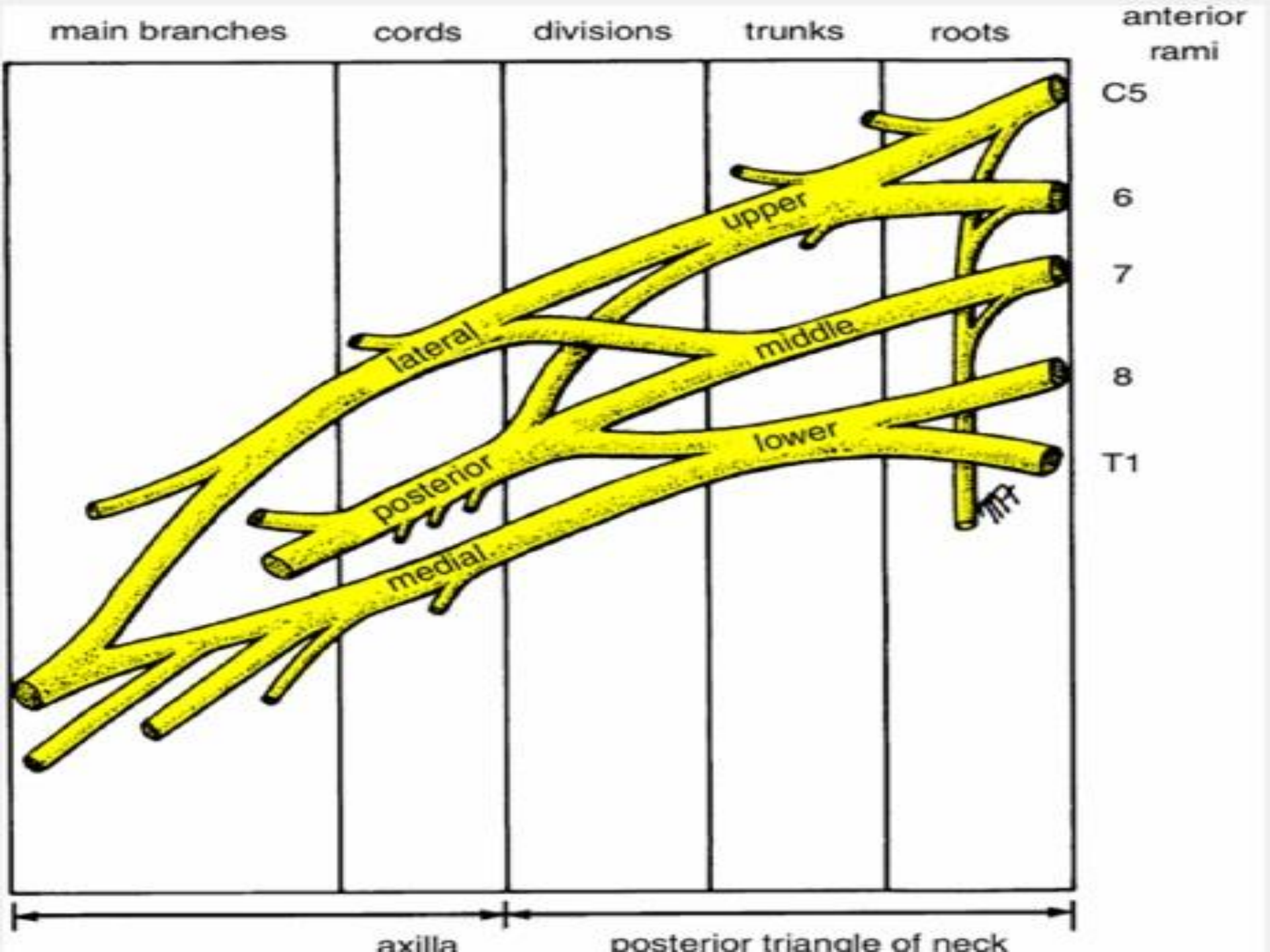
Originates in the neck, passes laterally and inferiorly over rib I, and enters the axilla.

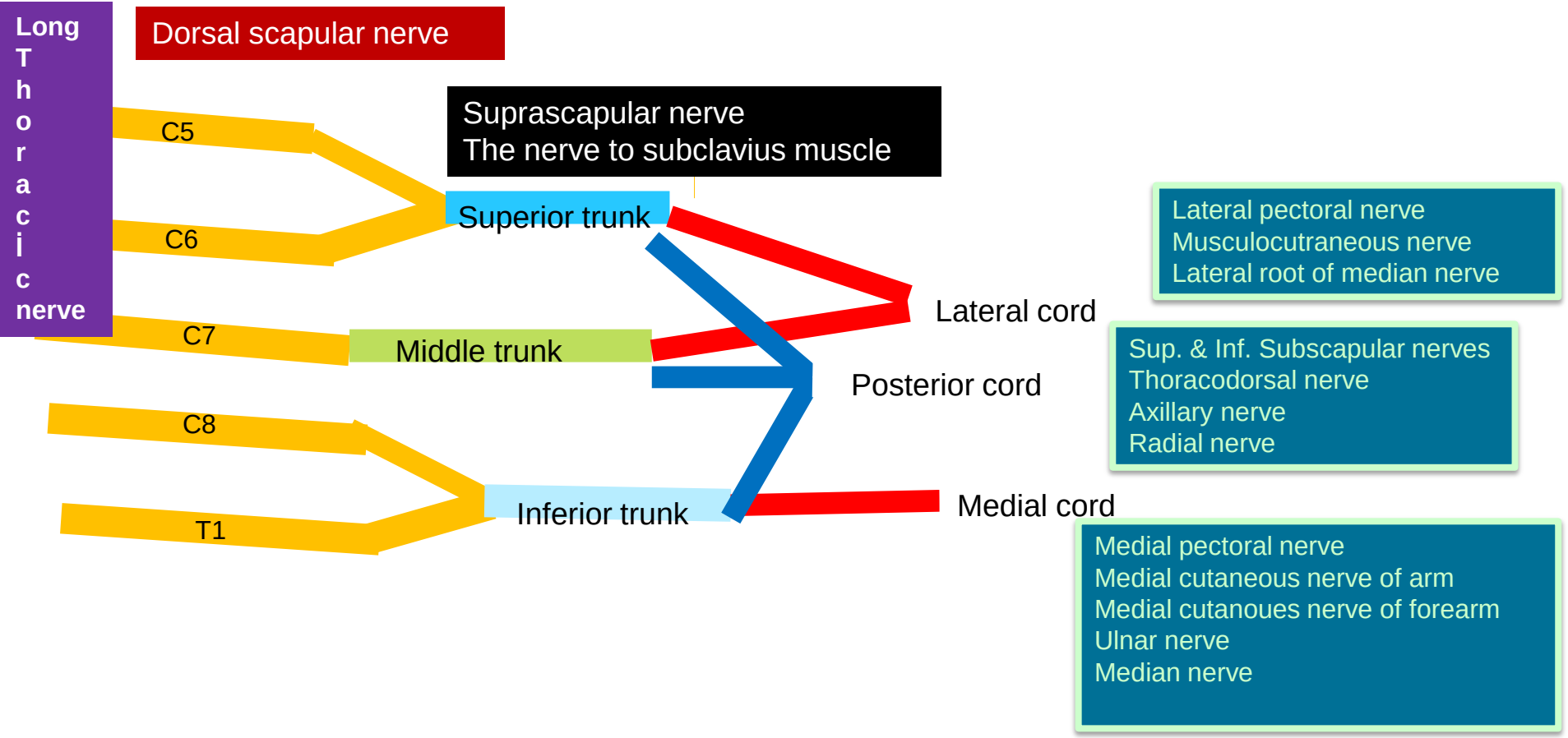


The parts of the brachial plexus, from medial to lateral, are **roots**, **trunks**, **divisions**, and **cords**.

All major nerves that innervate the upper limb originate from the brachial plexus, mostly from the cords.




main branches
cords
divisions
trunks
roots
anterior rami
C5
6
7
8
T1
upper
lateral
middle
lower
posterior
medial
axilla
posterior triangle of neck




**Red: Anterior division**
**Blue: Posterior division**

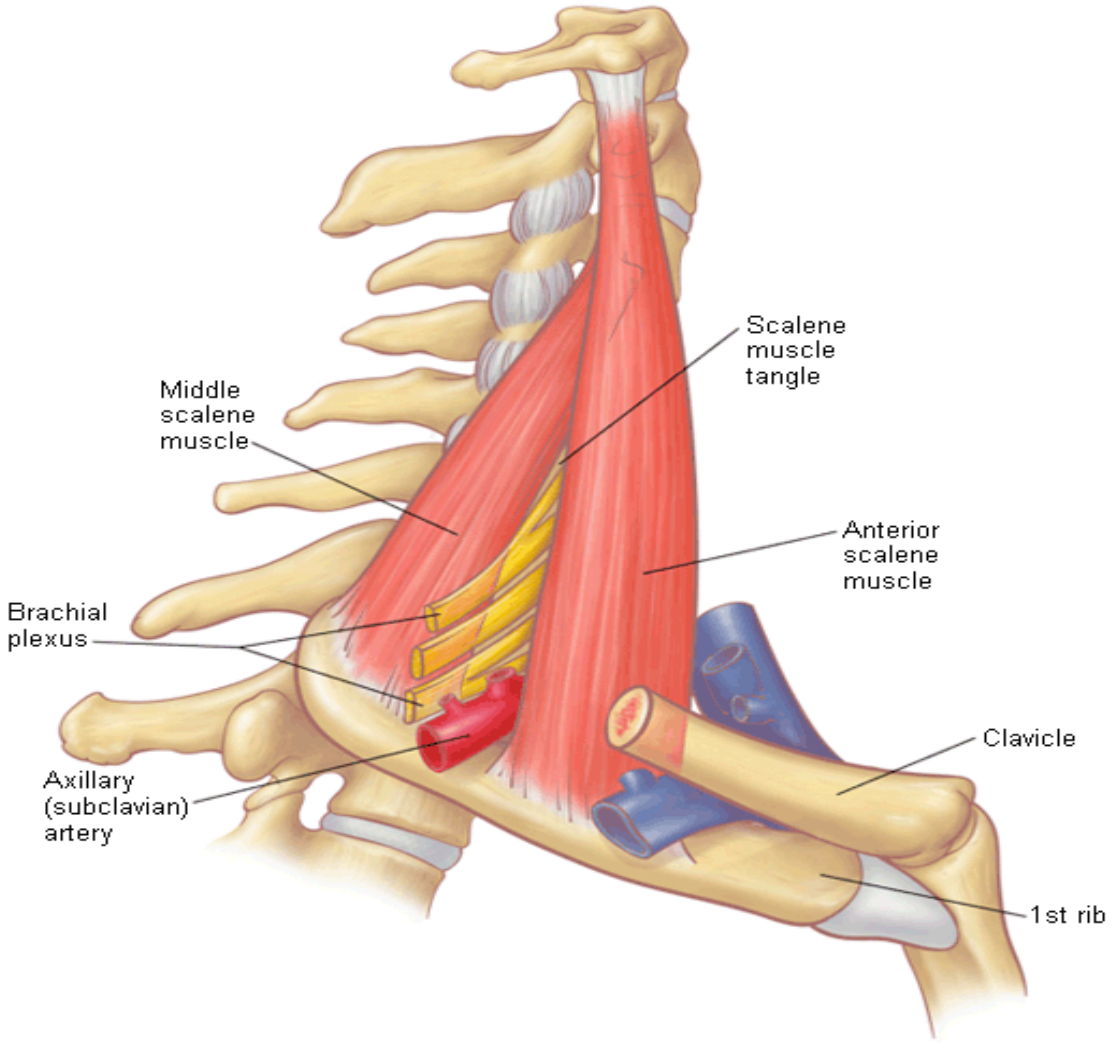
**"Randy Travis Drinks Cold Beer"**
**R**oots
**T**runks
**D**ivisions
**C**ords

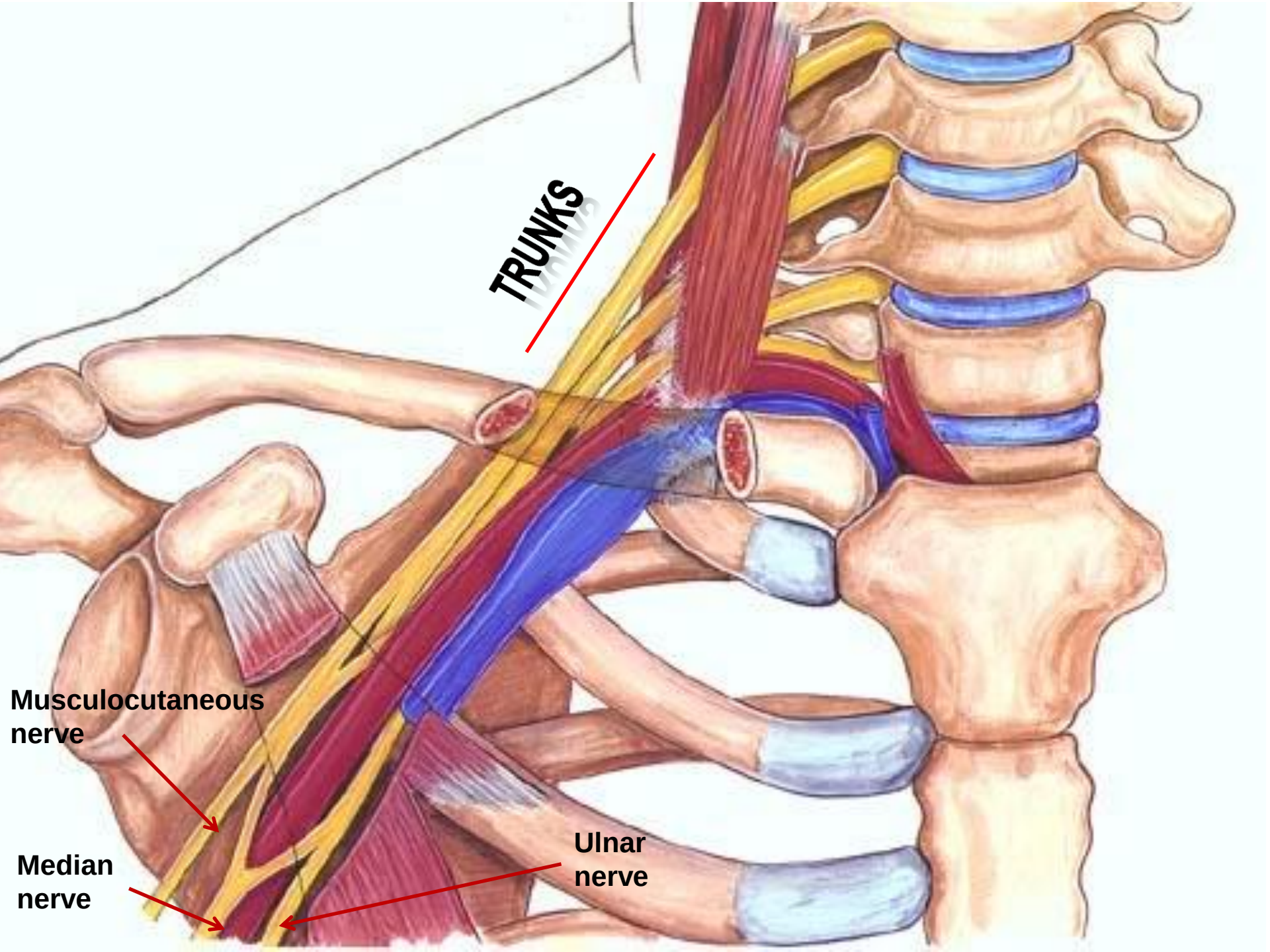
**B**ranches
· Alternatively: "**R**ead **T**he **D**amn **C**adaver **B**ook!"
· Alternatively: "**R**eal **T**exans **D**rink **C**oors **B**eer".

- Proximal posterior to the subclavian artery in the neck

- More distal regions surround the axillary artery

The roots of the plexus usually pass through the gap between **anterior & middle scalene muscles.**




TRUNKS
Musculocutaneous nerve
Median nerve
Ulnar nerve

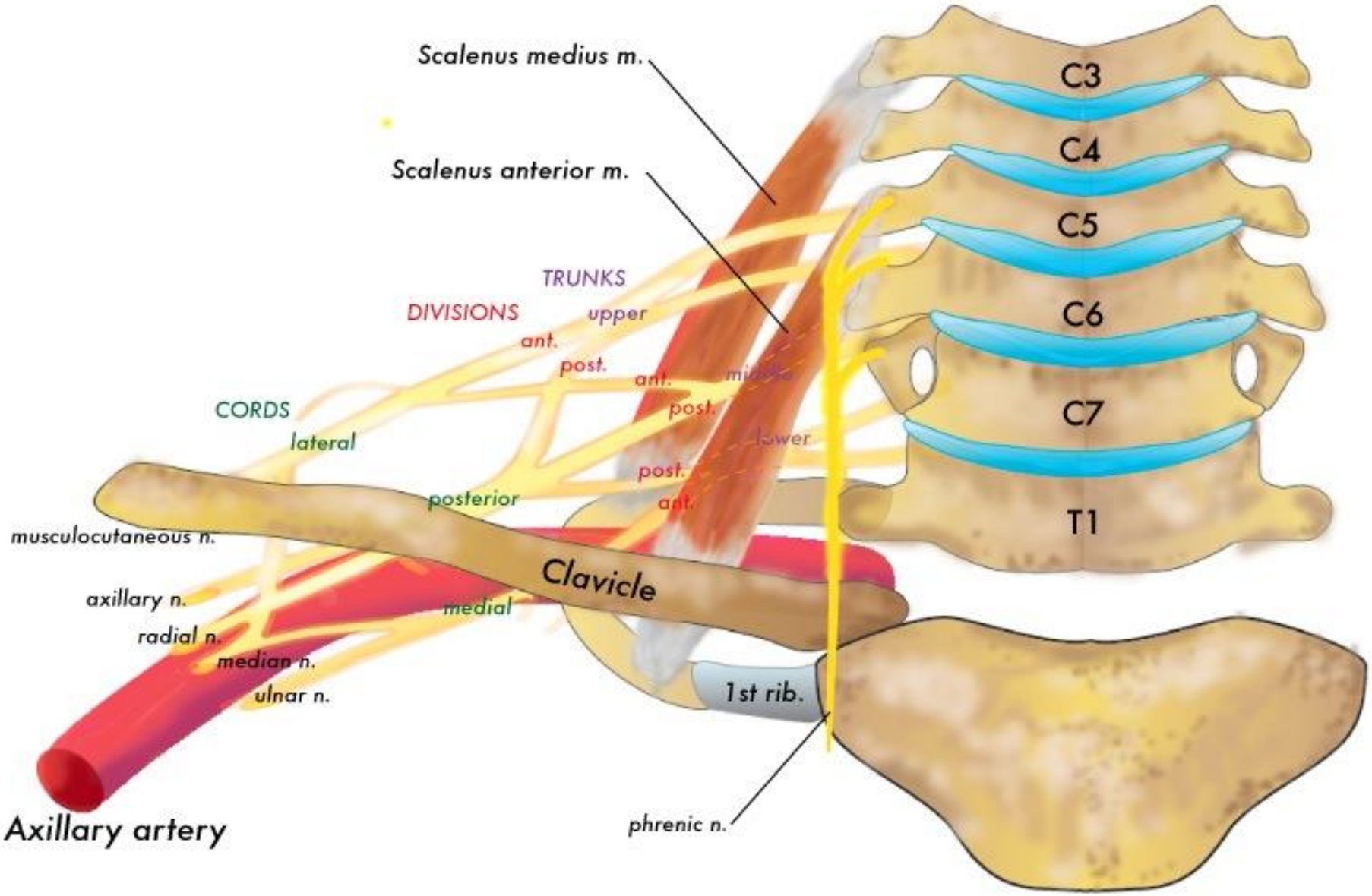
# ROOTS

## Anterior rami of C5 to C8, and most of T1.

The roots & trunks enter the the neck by passing between the anterior scalene and middle scalene muscles.

Close to their origin, the roots receive gray rami communicantes from the sympathetic trunk.

These carry postganglionic sympathetic fibers onto the roots for distribution to the periphery.

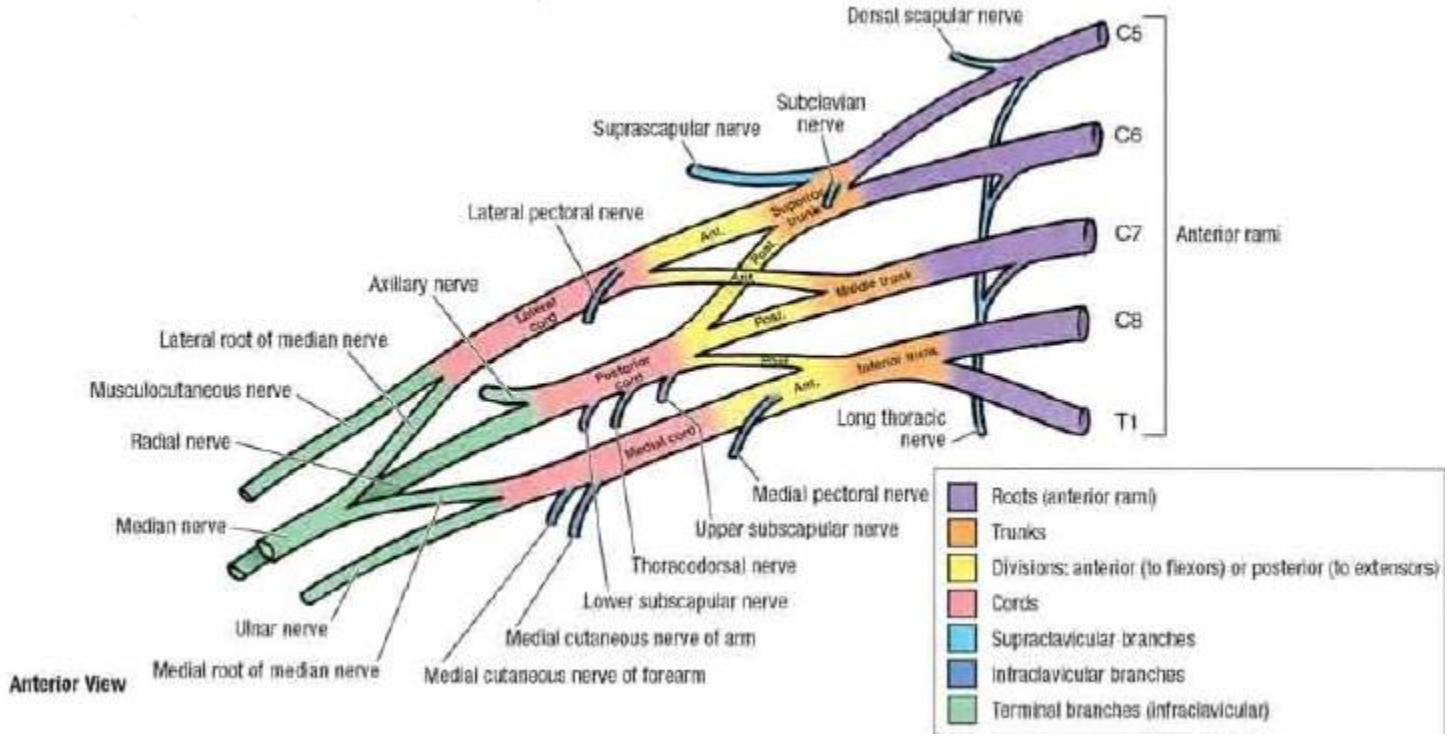

Scalenus medius m.
Scalenus anterior m.
C3
C4
C5
C6
C7
T1
TRUNKS
DIVISIONS
upper
ant.
post.
ant.
post.
CORDS
lateral
posterior
musculocutaneous n.
Clavicle
axillary n.
radial n.
median n.
ulnar n.
medial
1st rib.
Axillary artery
phrenic n.

# TRUNKS

In the inferior part of the neck, the roots of the brachial plexus unite to form three trunks:

- **Superior trunk** formed by union of C5 & C6 roots
- **Middle trunk** a continuation of C7 root
- **Inferior trunk** formed by the union of C8 & T1 roots

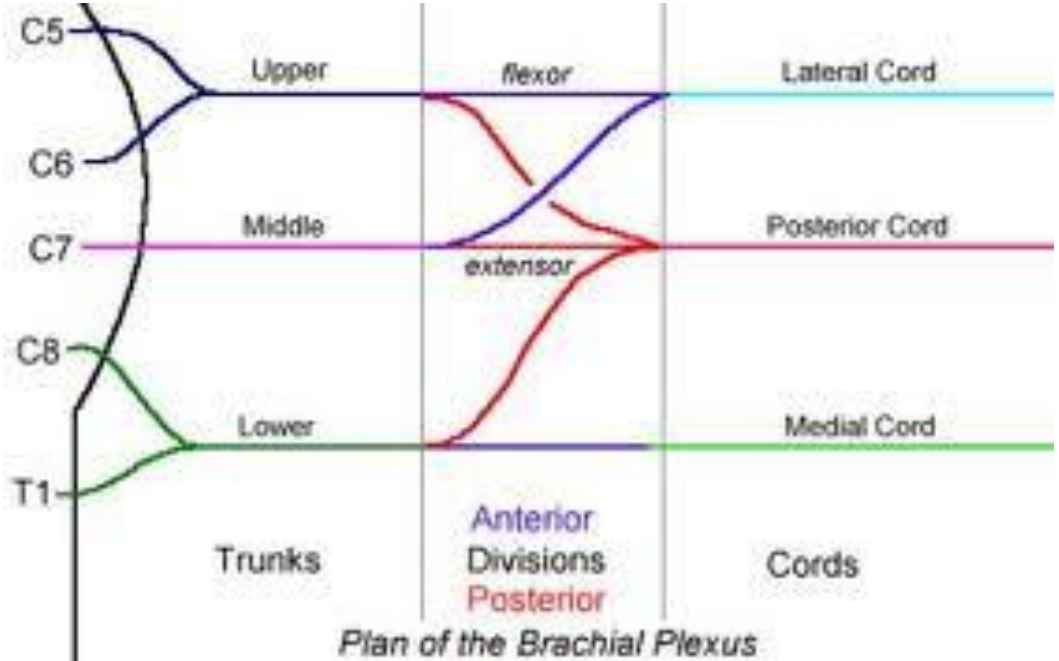
*The inferior trunk lies on rib I posterior to the subclavian artery; the middle and superior trunks are more superior in position.*



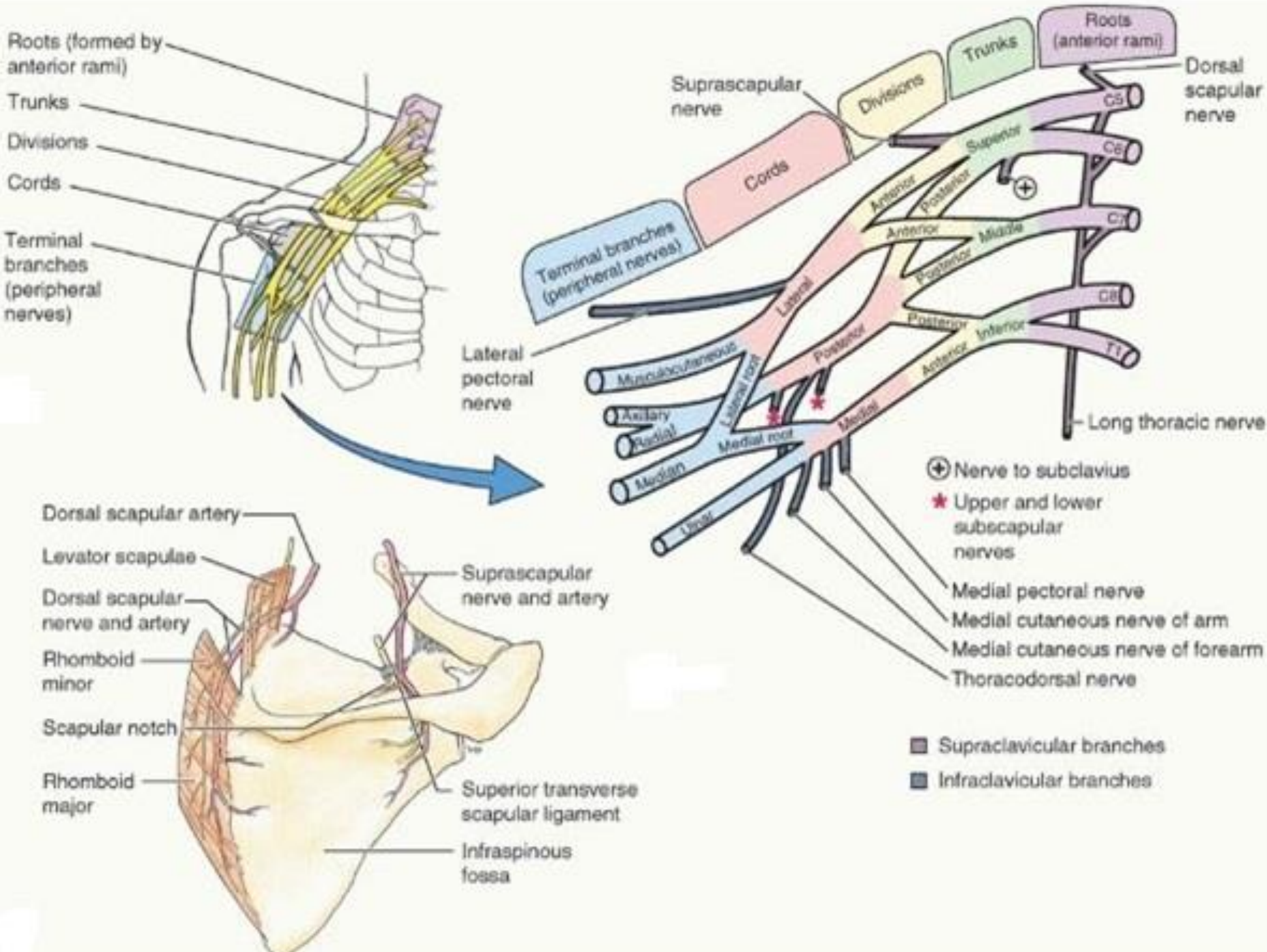
# DIVISIONS

Each trunk divides into:
**anterior** & **posterior divisions** as the plexus passes through the cervicoaxillary canal posterior to the clavicle.

**Anterior divisions of the trunks**
supply **anterior (flexor) compartments** of the upper limb
**Posterior divisions of the trunks**
supply **posterior (extensor) compartments**.
*No peripheral nerves originate directly from the divisions of the brachial plexus.*

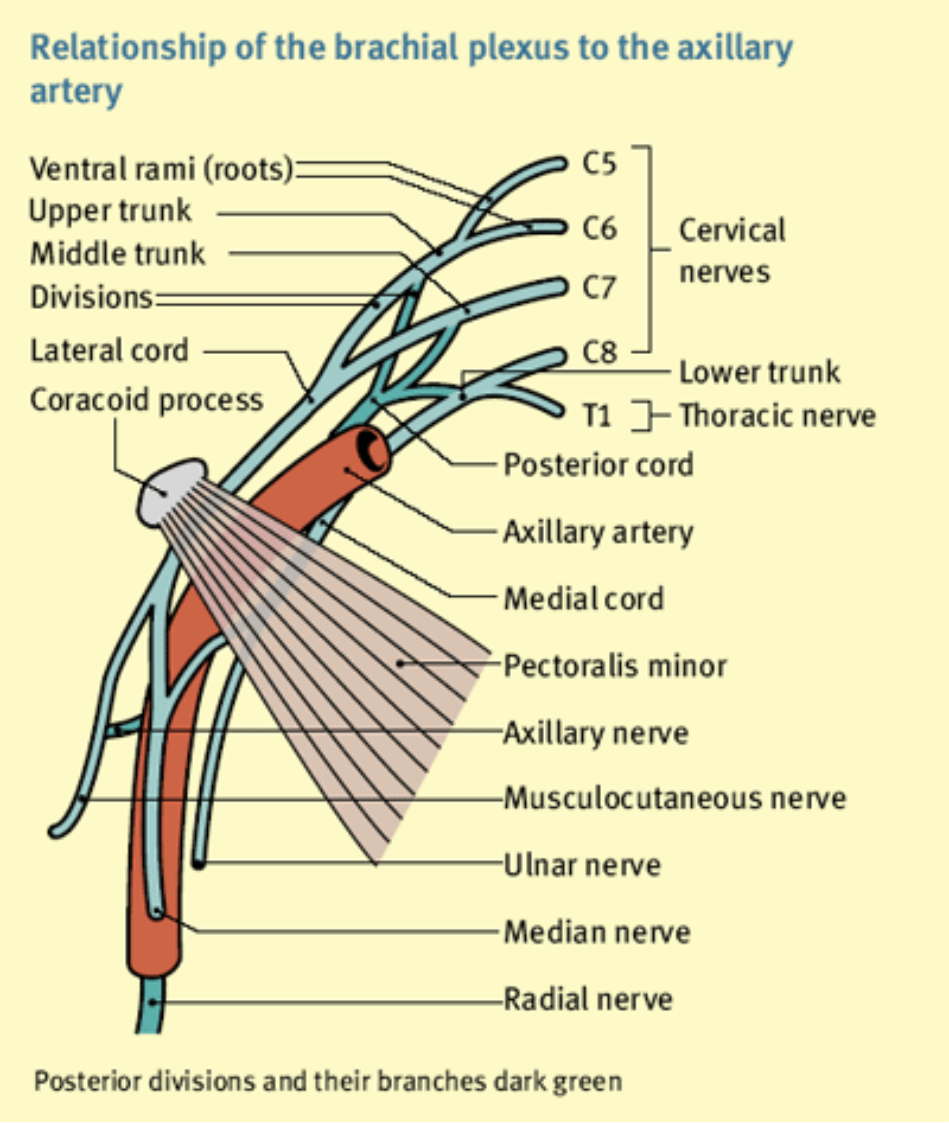


Plan of the Brachial Plexus


Roots (formed by anterior rami)
Trunks
Divisions
Cords
Terminal branches (peripheral nerves)
Roots (anterior rami)
Trunks
Divisions
Cords
Terminal branches (peripheral nerves)
Suprascapular nerve
Dorsal scapular nerve
C5
C6
C7
C8
T1
Superior
Anterior
Posterior
Anterior
Middle
Posterior
Lateral
Posterior
Anterior
Inferior
Musculocutaneous
Axillary
Radial
Median
Ulnar
Lateral root
Medial root
Posterior
Lateral
Medial
Lateral pectoral nerve
Long thoracic nerve
Nerve to subclavius
Upper and lower subscapular nerves
Medial pectoral nerve
Medial cutaneous nerve of arm
Medial cutaneous nerve of forearm
Thoracodorsal nerve
Supraclavicular branches
Infraclavicular branches
Dorsal scapular artery
Levator scapulae
Dorsal scapular nerve and artery
Rhomboid minor
Scapular notch
Rhomboid major
Suprascapular nerve and artery
Superior transverse scapular ligament
Infraspinous fossa

# CORDS

The three cords of the brachial plexus originate from the divisions and are related to the second part of the axillary artery.



**Lateral cord**

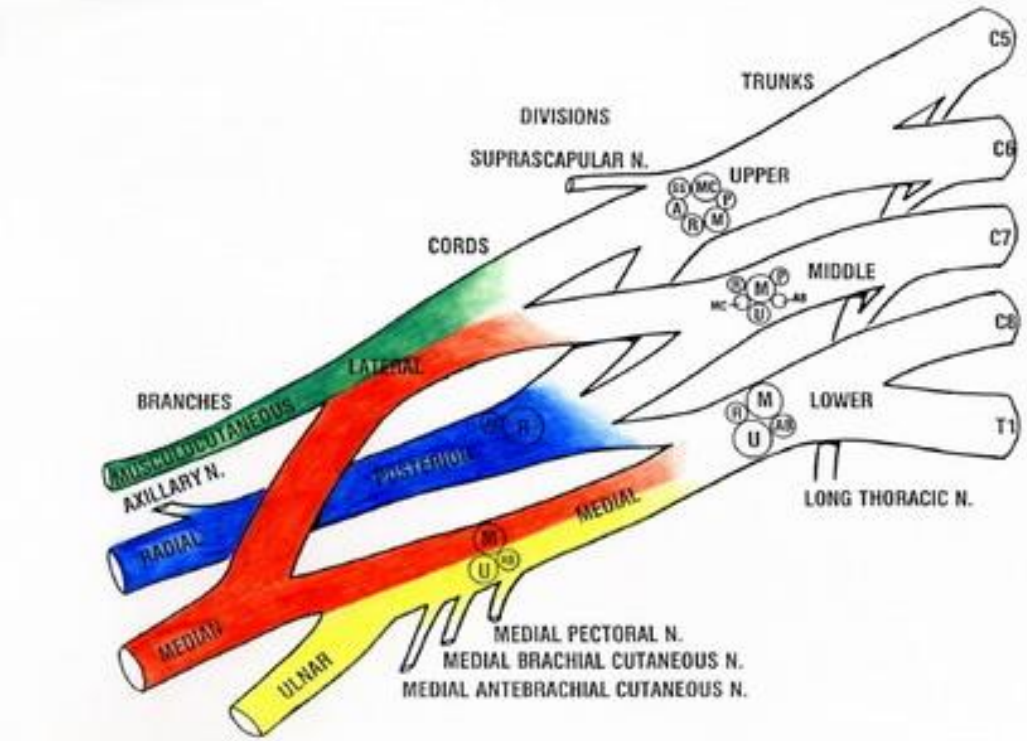
Union of **anterior divisions of upper & middle trunks** (C5-C7)

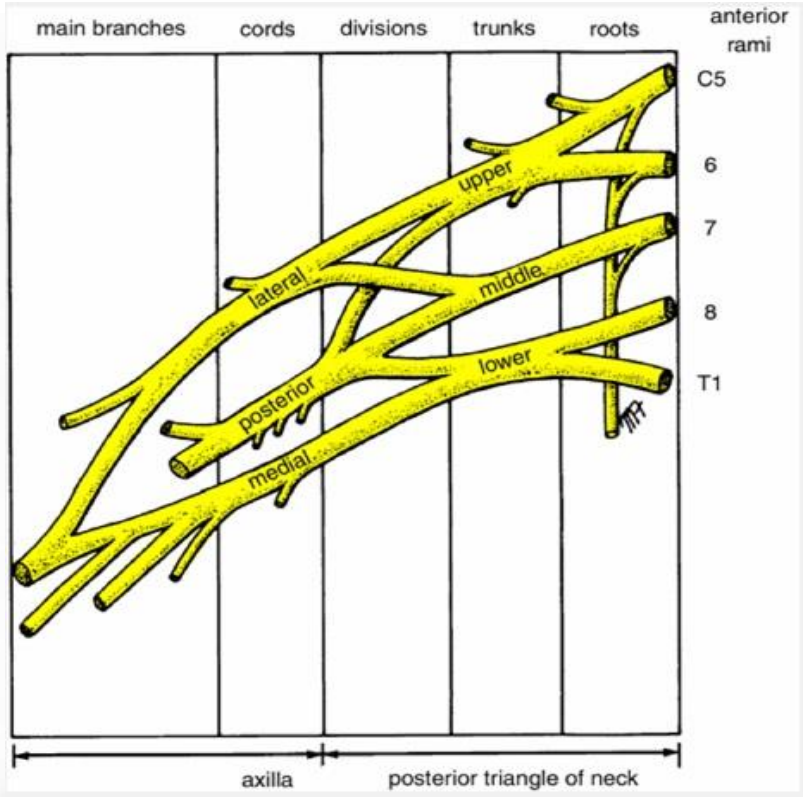
**Medial cord**

Continuation of **anterior division of inferior trunk** (C8-T1)

**Posterior cord**

**Union of all three posterior divisions** (C5 to T1)



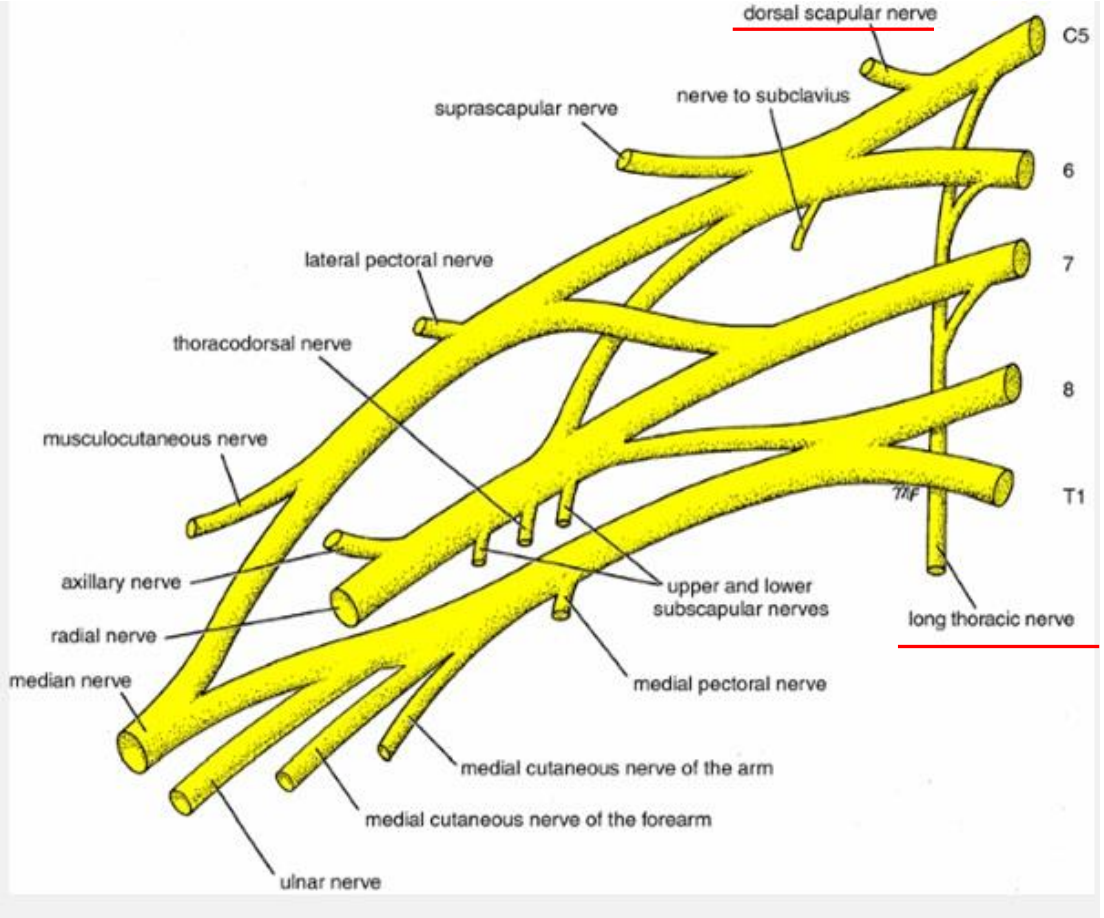



# Branches

## Branches of the roots

**Dorsal scapular nerve** (C5 root of the brachial plexus) innervates **rhomboid major and minor muscles**

**Long thoracic nerve** (anterior rami of C5 to C7) innervates **serratus anterior muscle**



# Branches of the trunks

The only branches from the trunks of the brachial plexus are 2 nerves ;originate from the superior trunk.

**Suprascapular nerve** (C5 & C6) innervates **supraspinatus** & **infraspinatus muscles**

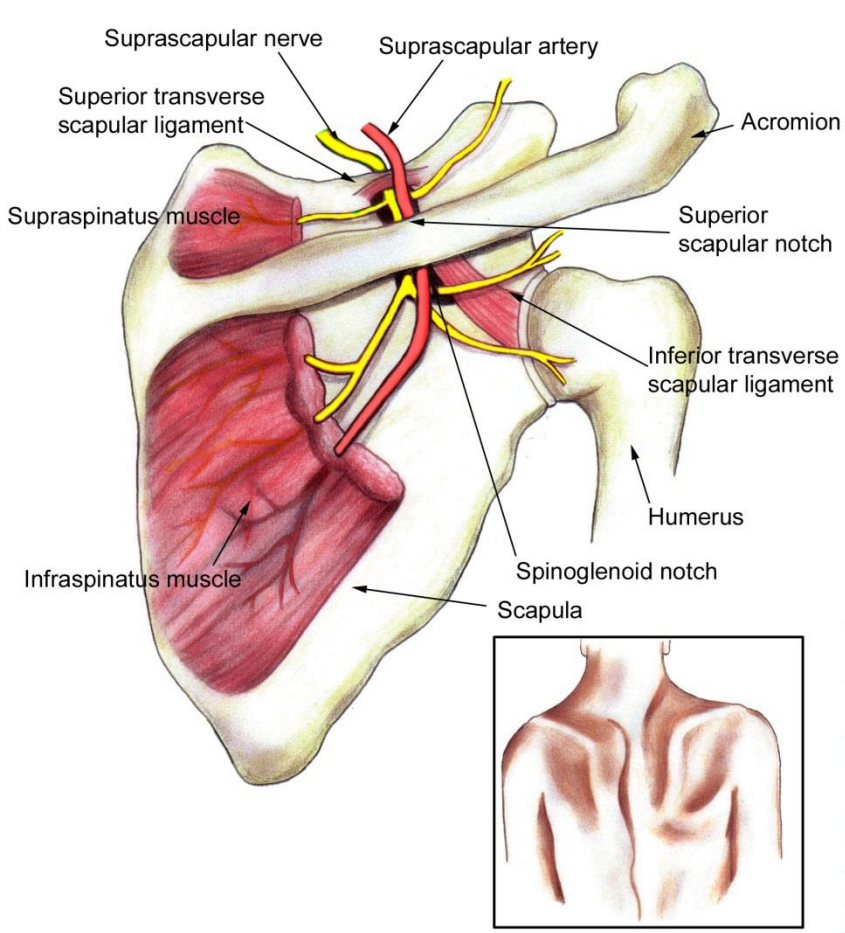
Suprascapular
Origin: Superior trunk
Spinal segments: C5, C6

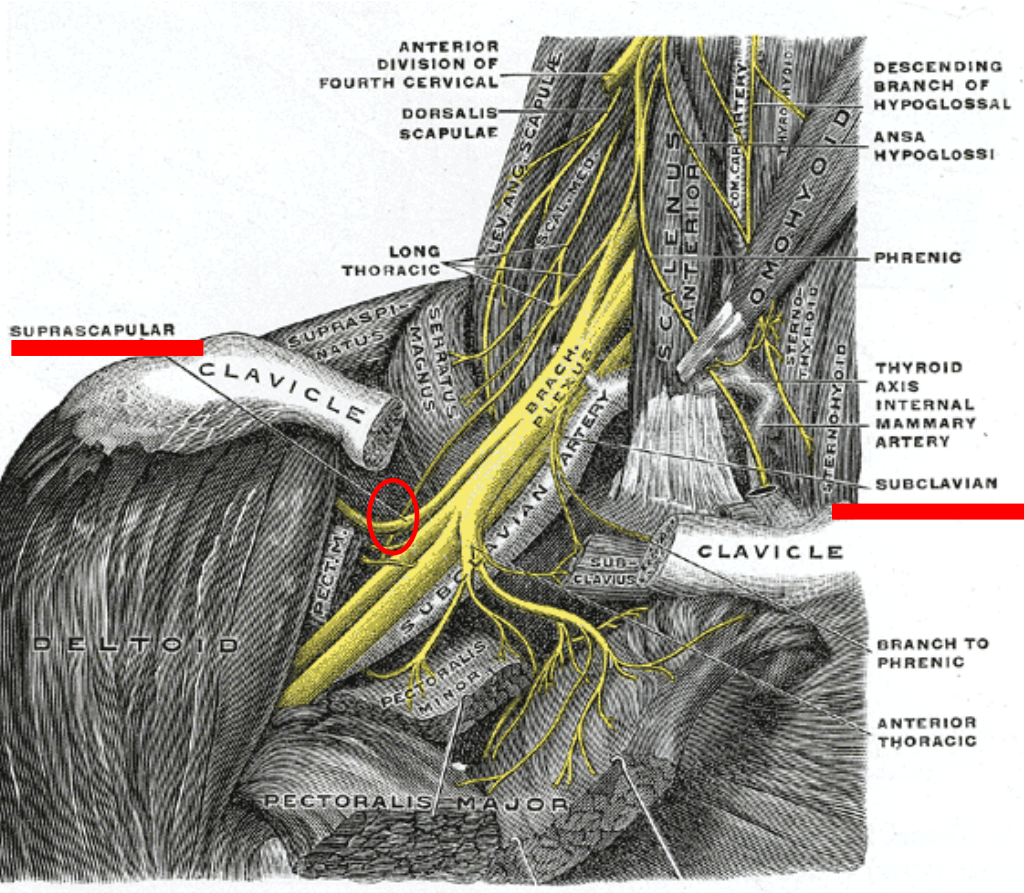
Function: motor
Supraspinatus, infraspinatus

**The nerve to subclavius muscle** (C5 & C6) innervates **subclavius muscle**

Nerve to subclavius
Origin: Superior trunk
Spinal segments: C5, C6

Function: motor
Subclavius


Suprascapular nerve
Suprascapular artery
Superior transverse scapular ligament
Acromion
Supraspinatus muscle
Superior scapular notch
Inferior transverse scapular ligament
Humerus
Spinoglenoid notch
Infraspinatus muscle
Scapula


ANTERIOR DIVISION OF FOURTH CERVICAL
DORSALIS SCAPULAE
LONG THORACIC
SUPRASCAPULAR
CLAVICLE
DELTOID
PECTORALIS MINOR
PECTORALIS MAJOR
SUBCLAVIAN ARTERY
BRACH. PLEXUS
SUPRASPINATUS
SERRATUS MAGNUS
SCALENUS ANTERIOR
OMOHYOID
STERNOHYOID
DESCENDING BRANCH OF HYPOGLOSSAL
ANSA HYPOGLOSSI
PHRENIC
THYROID AXIS
INTERNAL MAMMARY ARTERY
SUBCLAVIAN
BRANCH TO PHRENIC
ANTERIOR THORACIC

# Branches of the lateral cord

## Lateral pectoral nerve pectoralis major muscle

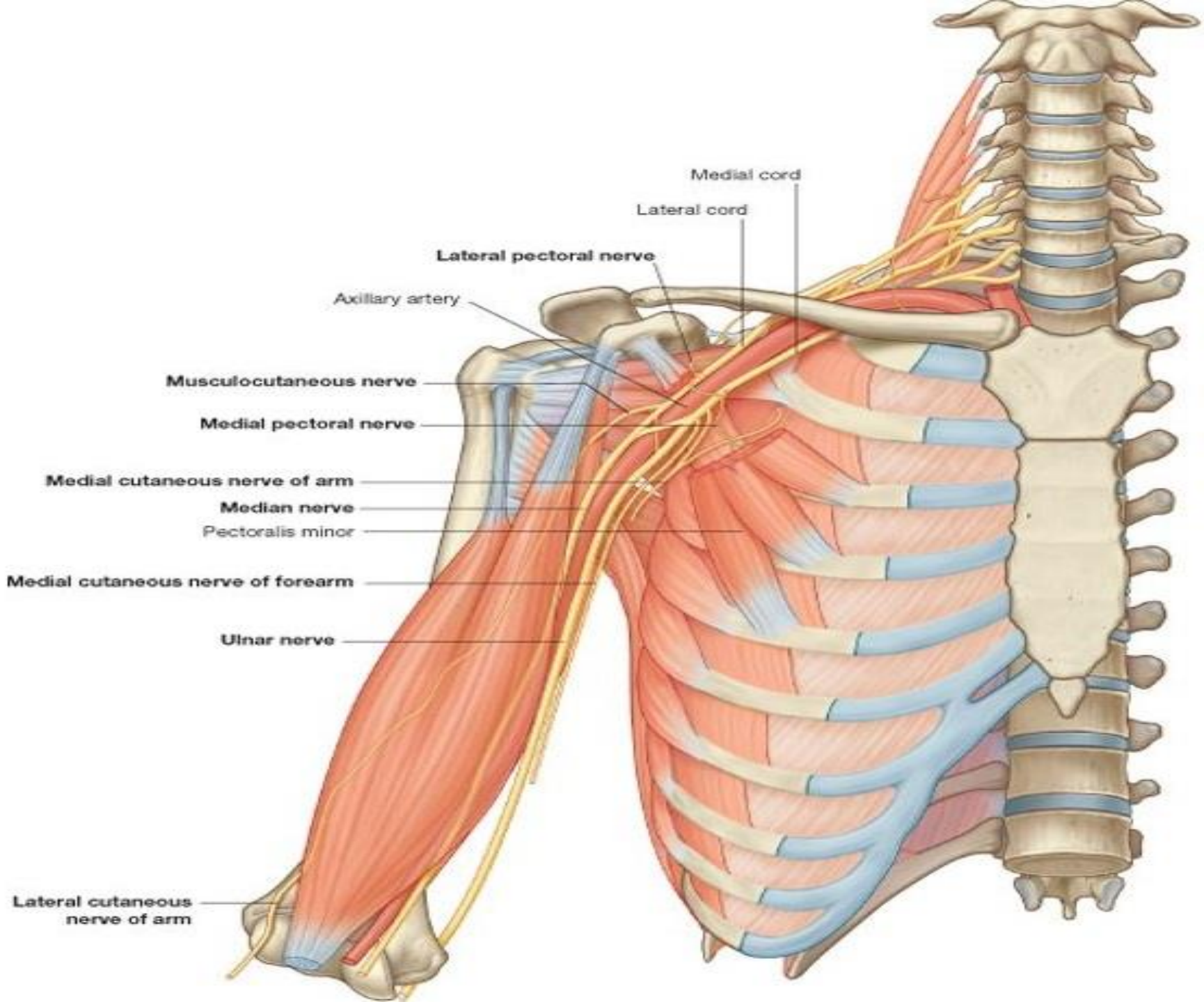
Lateral pectoral

Origin: Lateral cord

Spinal segments: C5 to C7

Function: motor

Pectoralis major

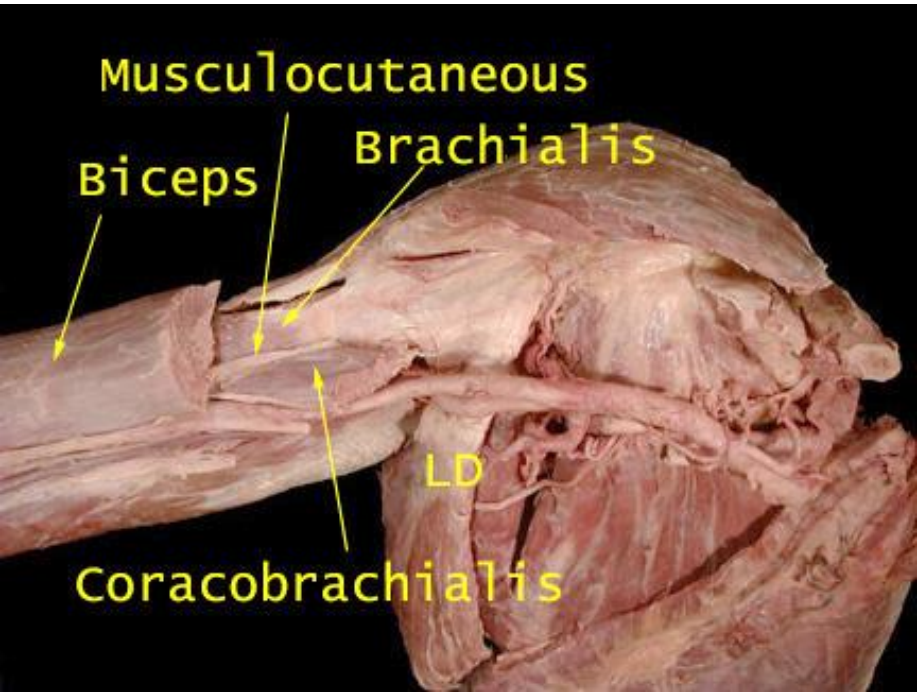

Medial cord
Lateral cord
Lateral pectoral nerve
Axillary artery
Musculocutaneous nerve
Medial pectoral nerve
Medial cutaneous nerve of arm
Median nerve
Pectoralis minor
Medial cutaneous nerve of forearm
Ulnar nerve
Lateral cutaneous nerve of arm

# Branches of the lateral cord

## Musculocutaneous nerve

| | | |
|---|---|---|
| Musculocutaneous<br>Origin: Lateral cord<br>Spinal segments: C5 to C7 |  | Function: motor<br>All muscles in the anterior compartment of the arm<br>Function: sensory<br>Skin on lateral side of forearm |

**Coracobrachialis**
**Biceps brachii**
**Brachialis**
**All 3 flexor muscles @ anterior compartment of the arm**
Terminates as **lateral cutaneous nerve of forearm**.

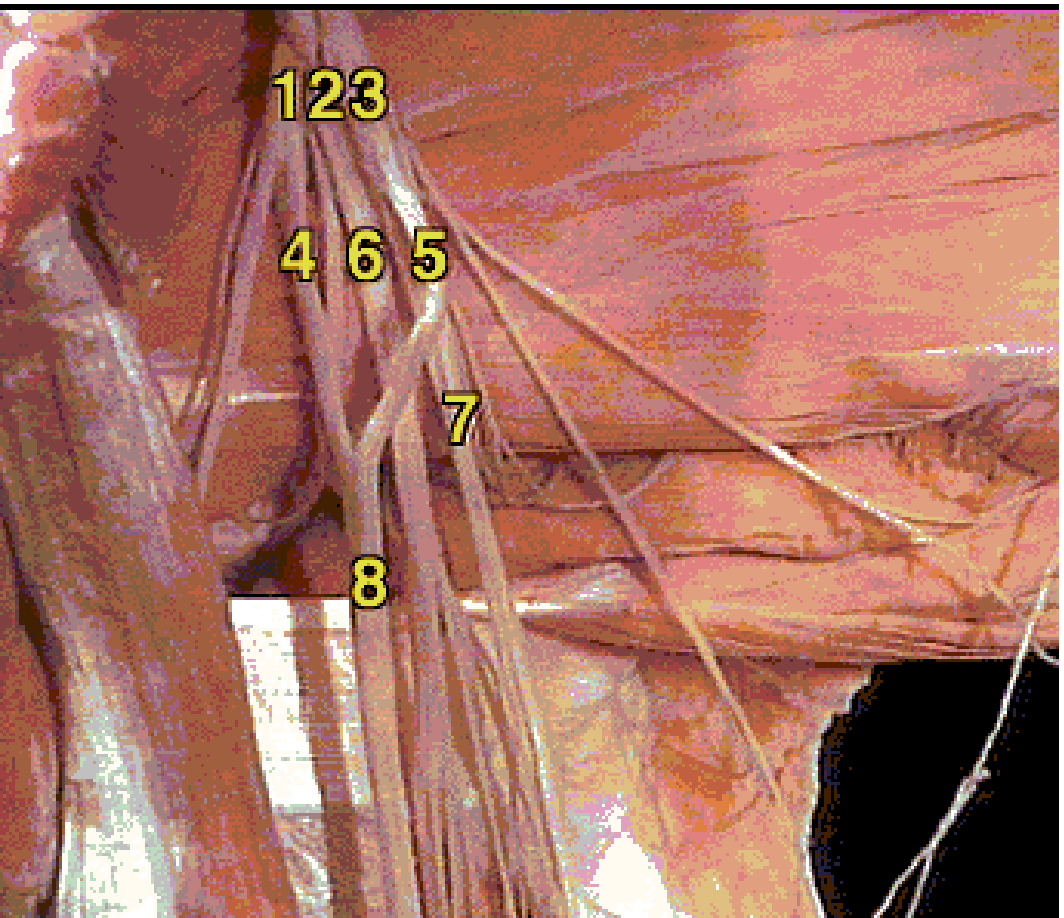


# Branches of the lateral cord

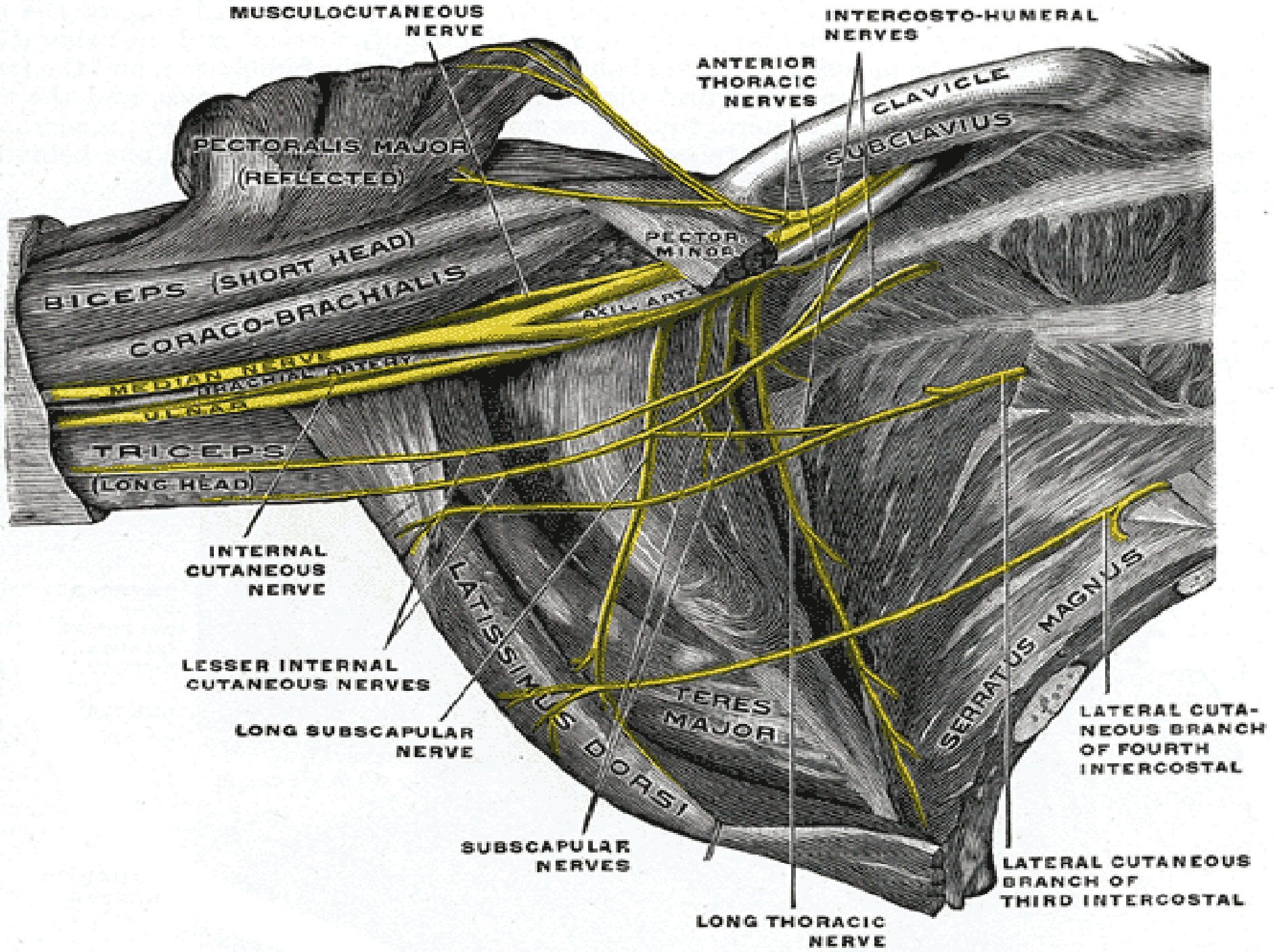
## Lateral root of median nerve

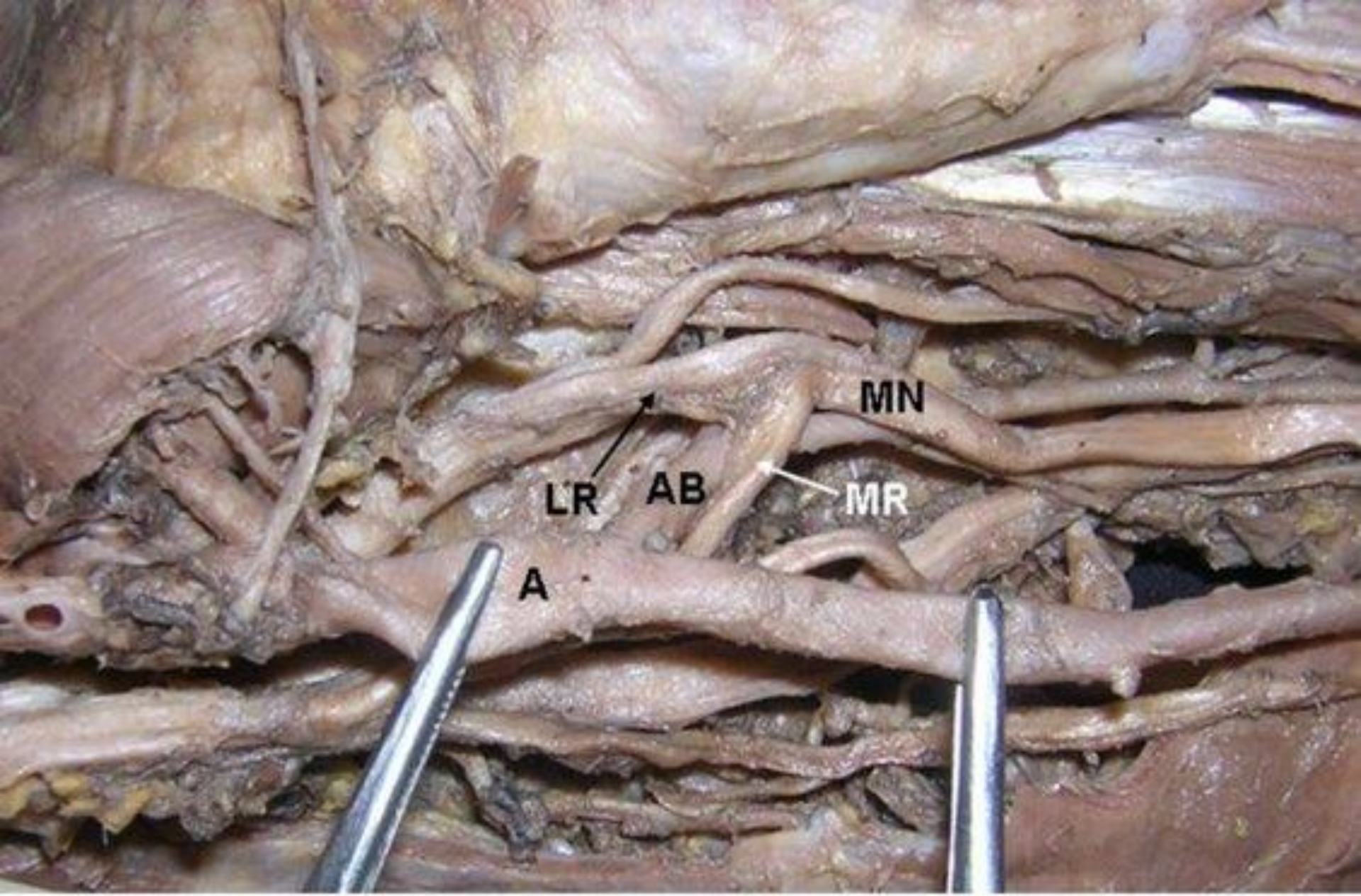
- ✓ Largest terminal branch of the lateral cord

- ✓ Passes medially to join a similar branch from the medial cord to form the **median nerve**.




1. Lateral cord
2. Posterior cord
3. Medial cord
4. Lateral root of median nerve
5. Medial root of median nerve
6. Radial nerve
7. Ulnar nerve
8. Median nerve


MUSCULOCUTANEOUS NERVE
INTERCOSTO-HUMERAL NERVES
ANTERIOR THORACIC NERVES
CLAVICLE
SUBCLAVIUS
PECTORALIS MAJOR (REFLECTED)
PECTOR. MINOR
BICEPS (SHORT HEAD)
CORACO-BRACHIALIS
AXIL. ART.
MEDIAN NERVE
BRACHIAL ARTERY
ULNAR
TRICEPS (LONG HEAD)
INTERNAL CUTANEOUS NERVE
LESSER INTERNAL CUTANEOUS NERVES
LONG SUBSCAPULAR NERVE
LATISSIMUS DORSI
TERES MAJOR
SERRATUS MAGNUS
LATERAL CUTANEOUS BRANCH OF FOURTH INTERCOSTAL
SUBSCAPULAR NERVES
LONG THORACIC NERVE
LATERAL CUTANEOUS BRANCH OF THIRD INTERCOSTAL




A – third part of axillary artery, AB – anomalous branch, MR – medial root of median nerve, LR – lateral root of median nerve, MN – median nerve.

# Branches of the medial cord

1) **Medial pectoral nerve**

**pectoralis major & minor**

2) **Medial cutaneous nerve of arm**

*(medial brachial cutaneous nerve)*

**medial 1/3 of distal arm**

3) **Medial cutaneous nerve of forearm**

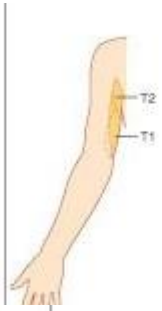
*(medial antebrachial cutaneous nerve)*

**medial surface of the forearm down to the wrist**

4) **Ulnar nerve**

5) **Median nerve**

Medial cutaneous of arm
Origin: Medial cord
Spinal segments: C8, T1



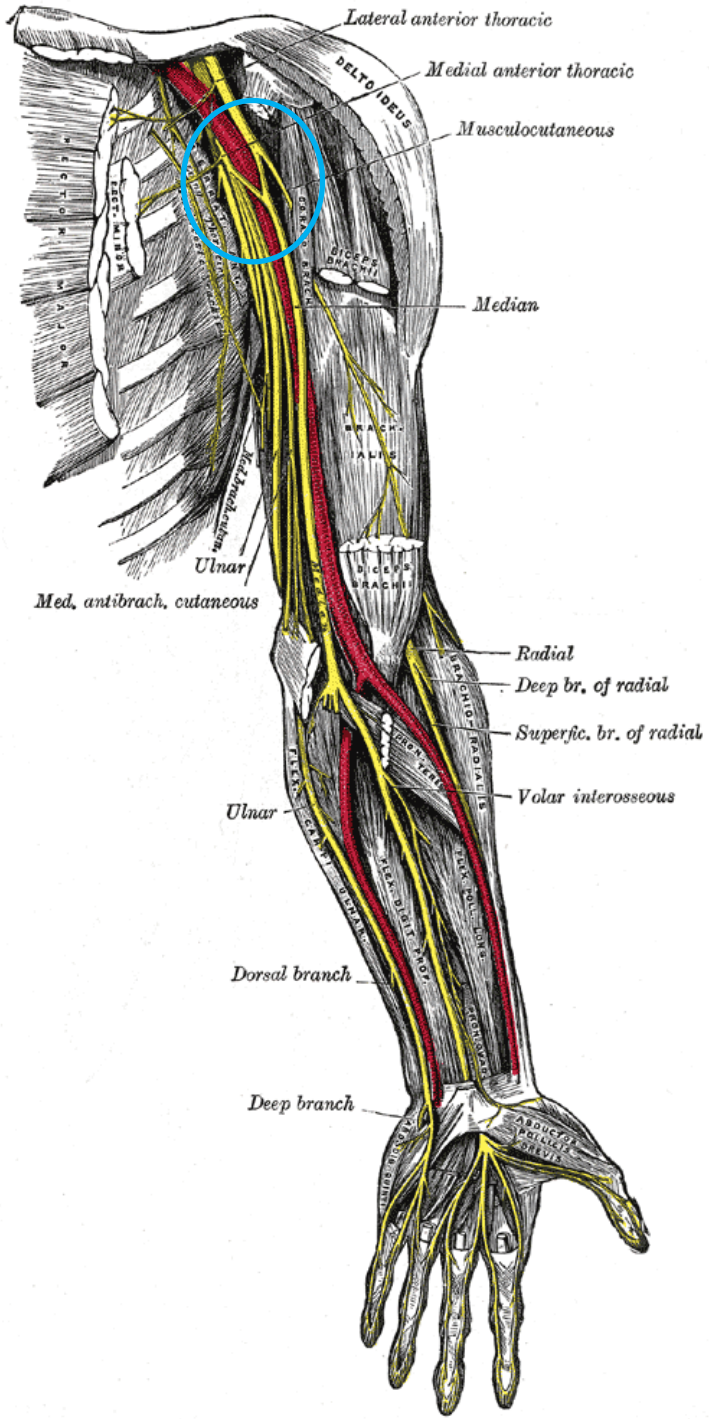

Function: sensory
Skin on medial side of distal one-third of arm

Medial pectoral
Origin: Medial cord
Spinal segments: C8, T1

Function: motor
Pectoralis major, pectoralis minor

Medial cutaneous of forearm
Origin: Medial cord
Spinal segments: C8, T1

Function: sensory
Skin on medial side of forearm




**Musculocutaneous nerve**, **lateral root of the median nerve**, **median nerve**, **medial root of the median nerve**, **ulnar nerve** form an **M** over the **third part of the axillary artery**.

This feature, together with penetration of the coracobrachialis muscle by the musculocutaneous nerve, can be used to identify components of the brachial plexus in the axilla

# Branches of the posterior cord

1) **Superior subscapular nerve** **subscapularis muscle**

2) **Thoracodorsal nerve** **latissimus dorsi**

3) **Inferior subscapular nerve** **subscapularis & teres major**

4) **Axillary nerve** **deltoid and teres minor**

5) **Radial nerve**

All these nerves except the radial nerve innervate muscles associated with the posterior wall of the axilla; the radial nerve passes into the arm and forearm.