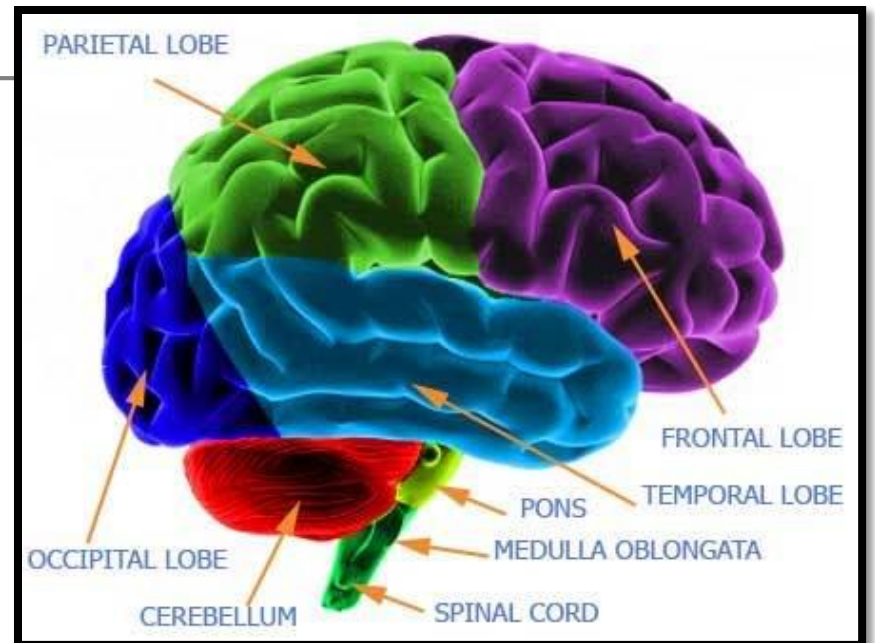


The Nervous System

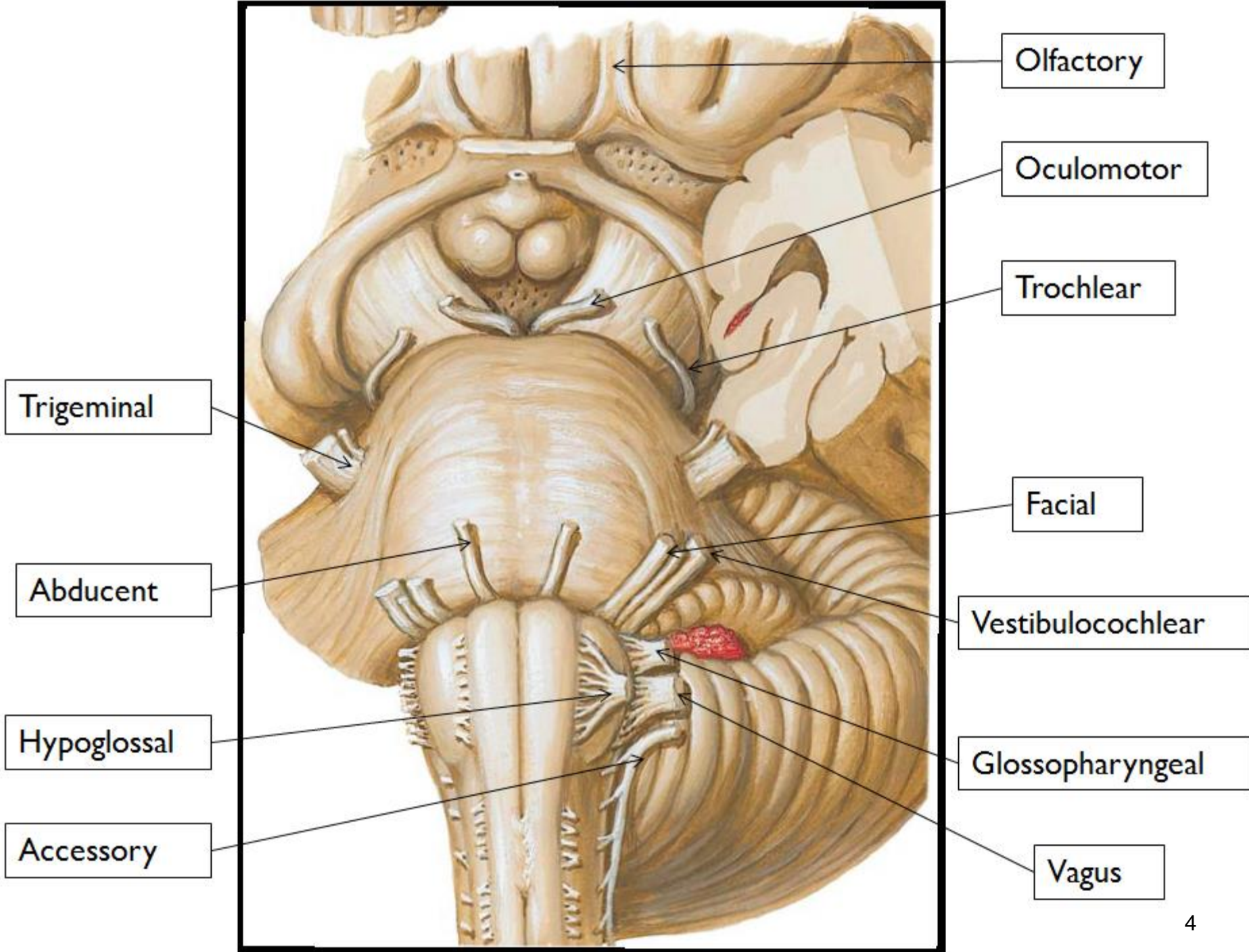


The Peripheral Nervous System

The Cranial Nerves

Cranial Nerve	Central Attachment	Main Functions
I – Olfactory	Cerebrum	Olfaction (Smelling)
II – Optic	Cerebrum	Vision (sight)
III – Oculomotor (autonomic)	Midbrain	Supply intrinsic and extrinsic muscles of eye.
IV – Trochlear SO4		
V – Trigeminal largest 3 Divisions	Pons	<ol style="list-style-type: none"> 1. Carry sensation from scalp and face (teeth) 2. Supply muscles of mastication
VI – Abducent LR6	Between Pons and Medulla	Supply extrinsic muscle of eye

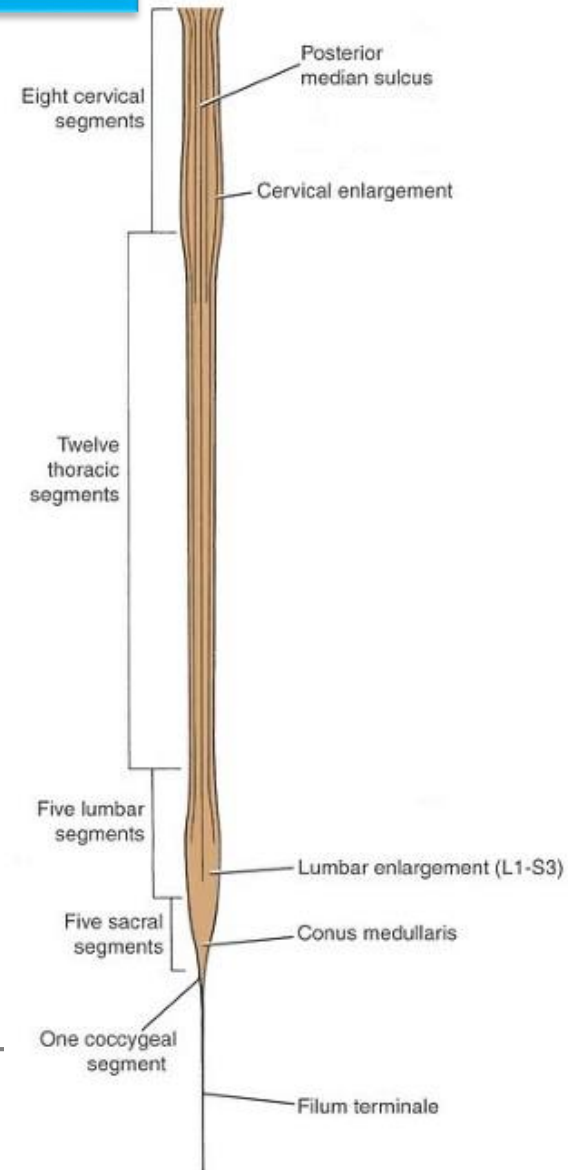
Cranial Nerve	Central Attachment	Main Functions
VII – Facial (autonomic)	Between Pons and medulla	<ol style="list-style-type: none"> 1. Supply muscles of facial expression 2. Carry taste sensations from anterior 2/3 of tongue 3. Secretions of tears and saliva
VIII - Vestibulocochlear	Between Pons and medulla	Hearing and equilibrium
IX – Glossopharyngeal (autonomic)	Medulla	<ol style="list-style-type: none"> 1. Supply some muscles 2. Carry taste sensation from posterior 1/3 of tongue 3. Secretions of parotid saliva
X – Vagus (autonomic)		<ol style="list-style-type: none"> 1. Supply various muscles 2. Carry various sensation
XI – Accessory	Medulla	Supply the sternocleidomastoid and trapezius muscles
XII – Hypoglossal		Supply all intrinsic muscles of the tongue (except palatoglossus)



The Central Nervous System

The Spinal Cord

- A grayish-white cylindrical structure
- Starts at the foramen magnum and ends at lower border of **L1** in adults. In children, it ends at **L3**
- Protected by the vertebral column and the three layers of meninges

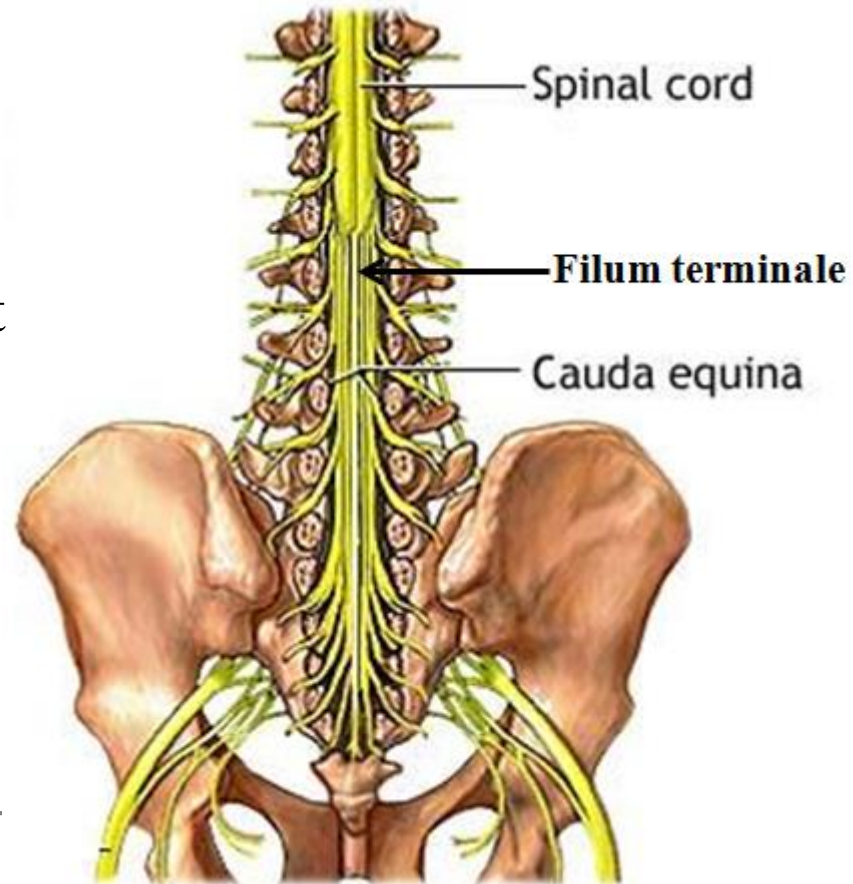


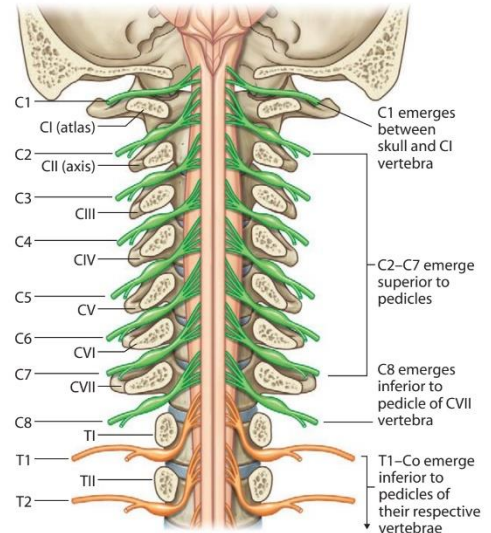
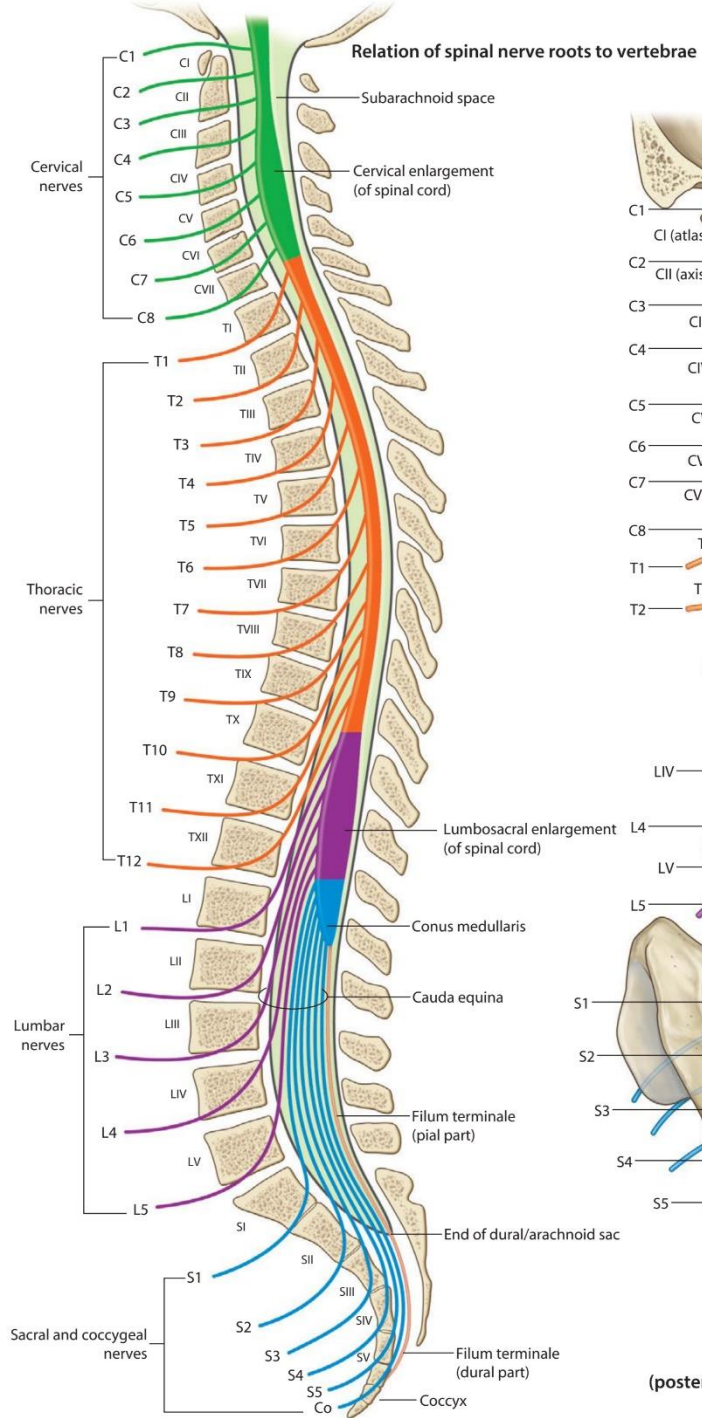
External features of the spinal cord

- It has two enlargements: cervical and lumbar. The **cervical enlargement** is the origin of the cervical and brachial plexuses. The **lumbar enlargement** is the origin of the lumbar and sacral plexuses
- The terminal part of the spinal cord is cone shaped and called the **Conus medullaris** →
- From the spinal cord arise the dorsal (posterior) and ventral (anterior) roots of the spinal nerves. The dorsal root possesses a swelling called the **Dorsal Root Ganglion** which contains bodies of neurons. The two roots unite to form the spinal nerves

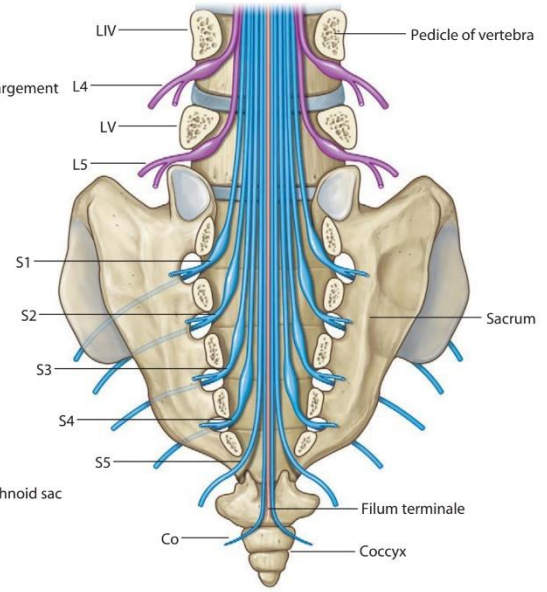


- The spinal cord is divided into segments: **8 Cervical, 12 Thoracic, 5 Lumbar, 5 Sacral and 1 Coccygeal**. From each segment arise a pair of spinal nerves. Thus, we have a total of 31 pairs of spinal nerves
- The nerves pass laterally to exit the vertebral column. The spinal cord is shorter than the spine. Therefore the lower nerves must pass down for a distance before exiting. These will form a structure like the wisp of hair around the filum terminale called the **Cauda Equina**



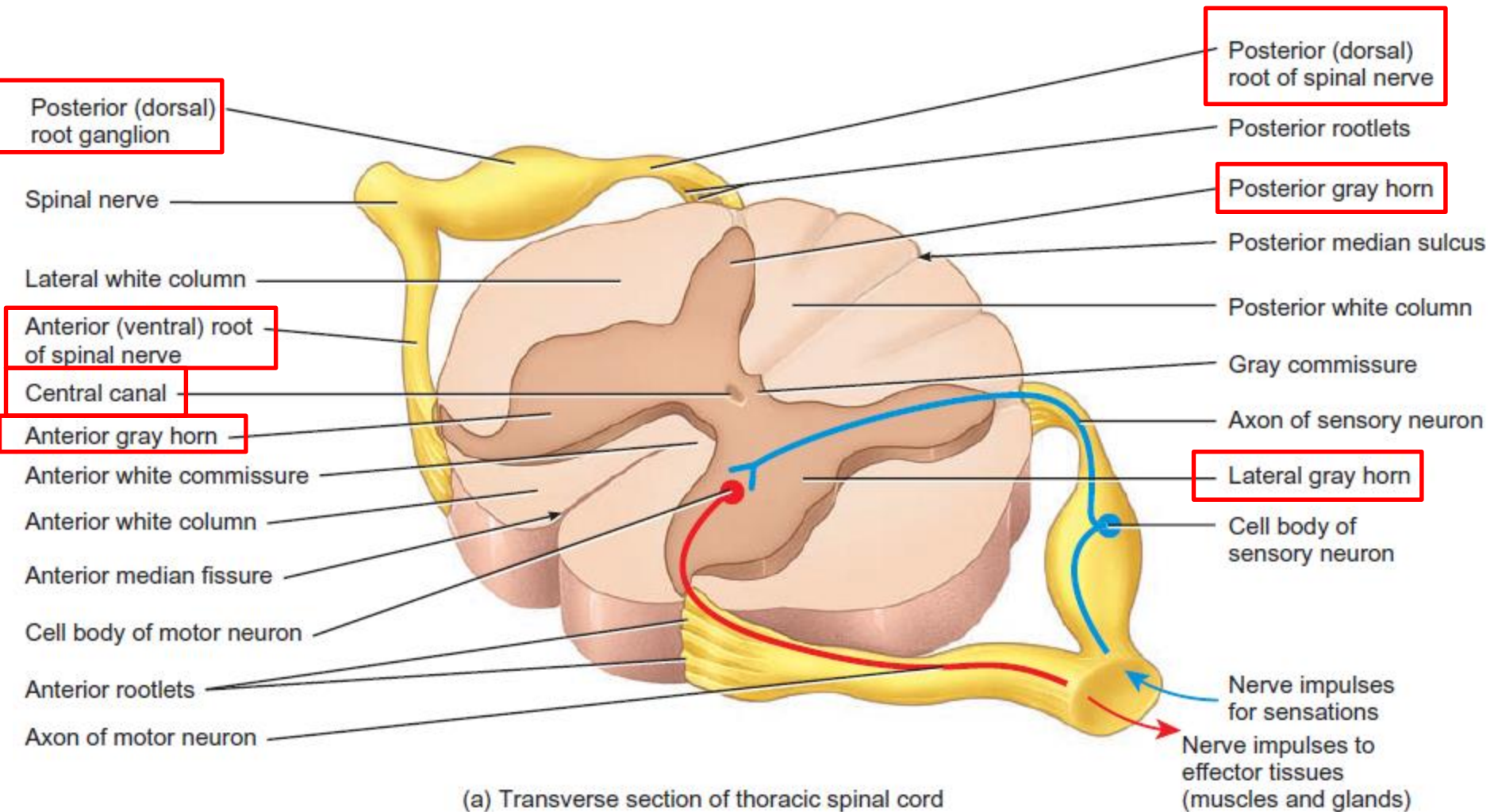


Nomenclature of spinal nerves (posterior view)

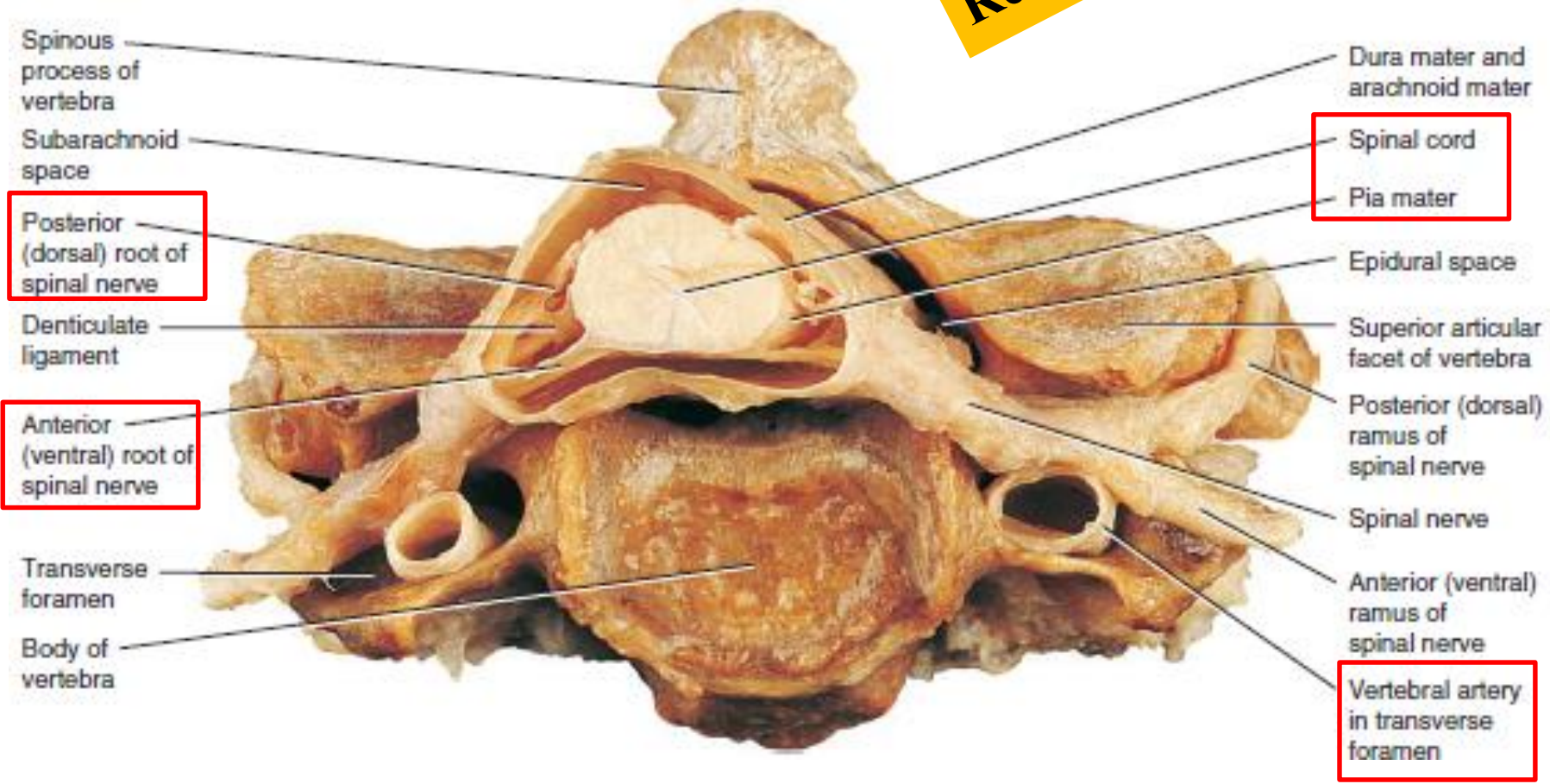


Sacral and coccygeal nerves (posterior view - vertebral arches removed)

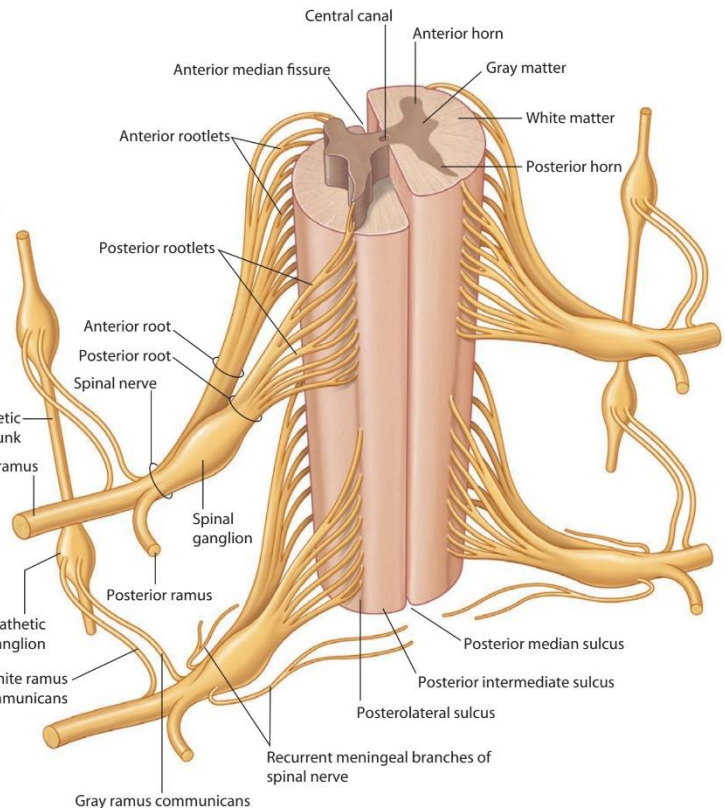
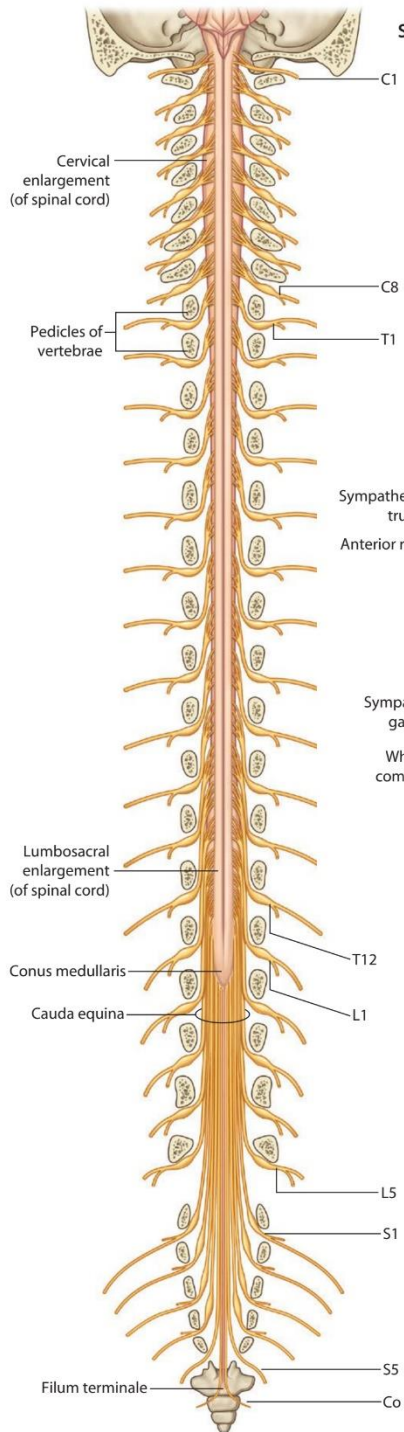
Internal features of the spinal cord



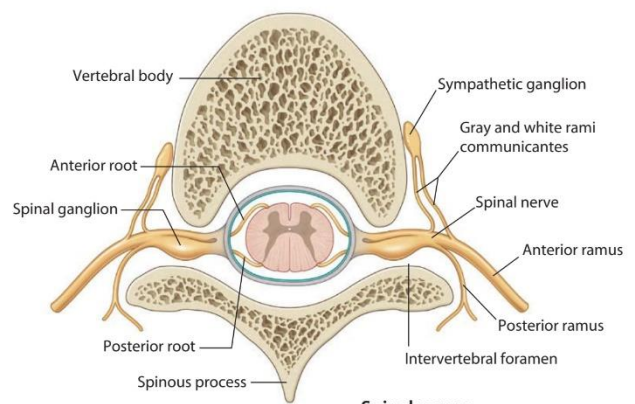
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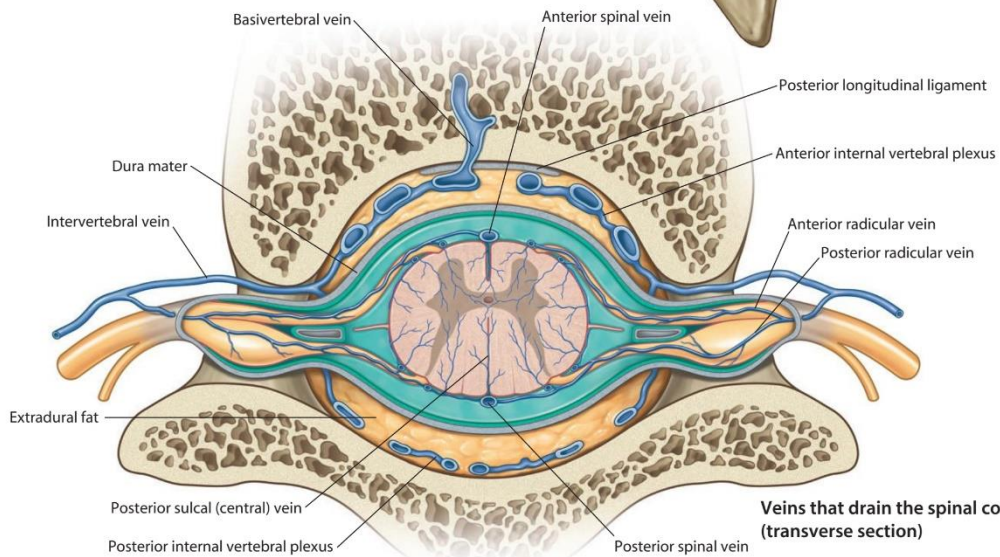
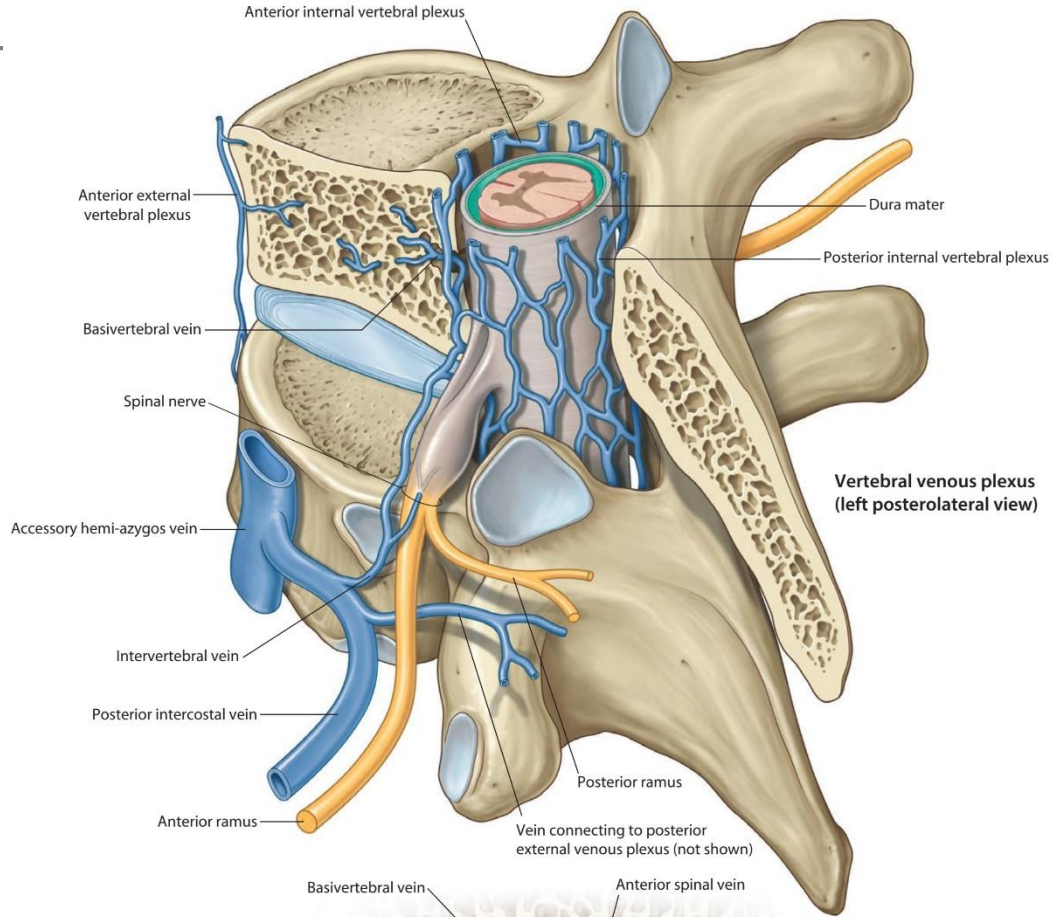
Spinal cord and spinal nerves in vertebral canal

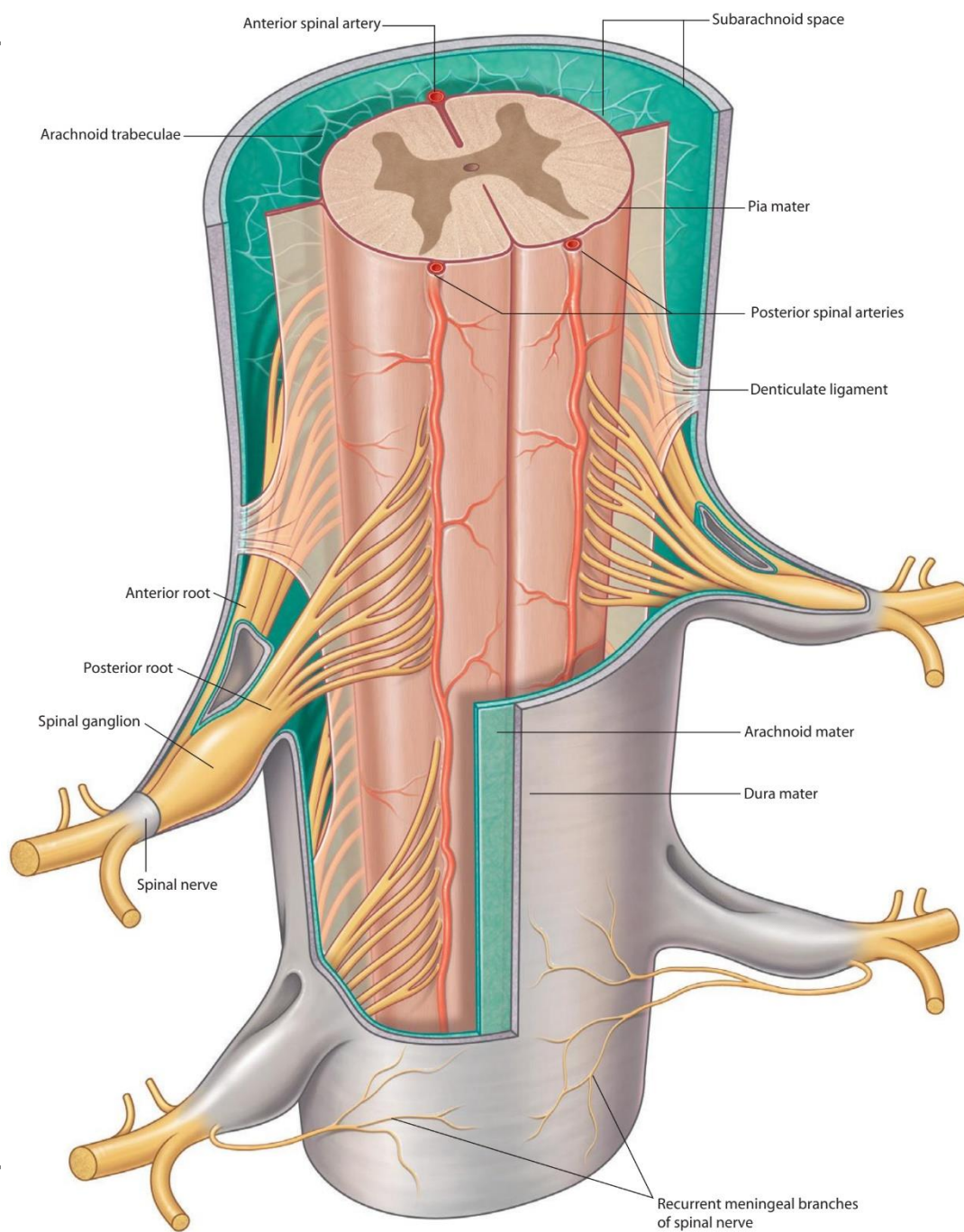


Features of the spinal cord (thoracic region) and basic organization of a spinal nerve (posterior view)



Spinal nerves (transverse section)





Meninges covering parts of the thoracic region of the spinal cord (posterior view)

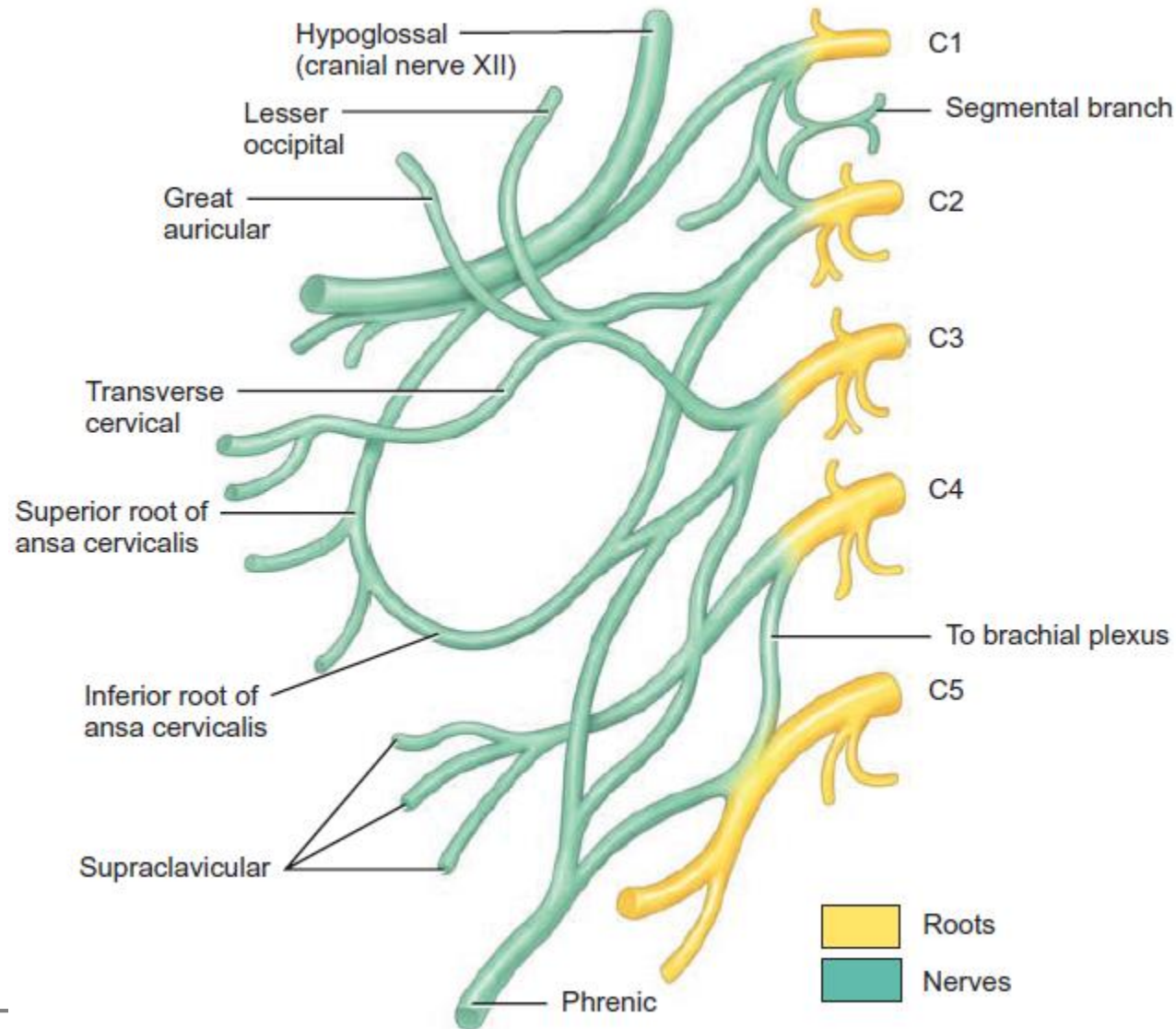
The Peripheral Nervous System

The Spinal Nerves

- 31 pairs; mixed nerves (**sensory and motor**)
- **Cervical (C1-C8), thoracic (T1-T12), lumbar (L1-L5), sacral (S1-S5) and coccygeal (C0).**
- A spinal nerve gives off two main branches: **anterior ramus and posterior ramus**
- Anterior rami of spinal nerves usually arranged in groups called plexuses. These include:
- **Cervical, Brachial, Lumbar and Sacral plexuses**

Cervical Plexus

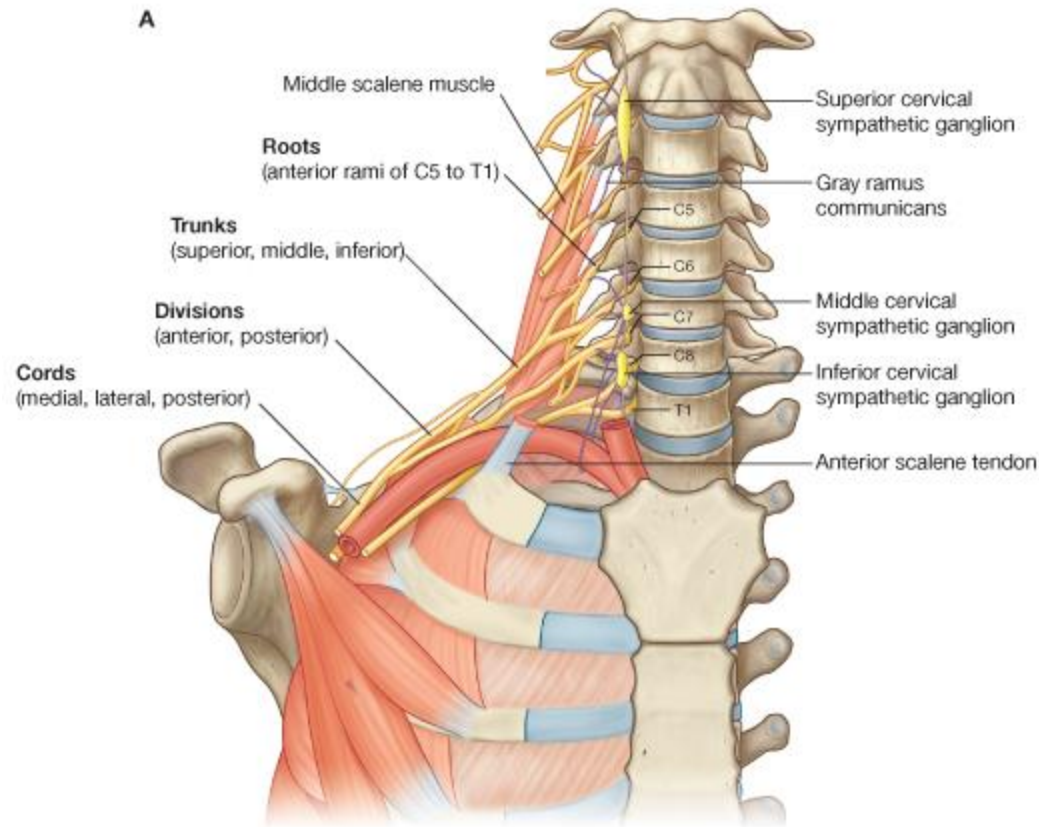
- Present in the neck
- Formed of anterior rami of C1-C4
- The **Phrenic** nerve **C-3,4,5** is an important nerve arising from this plexus. It supplies the **diaphragm**



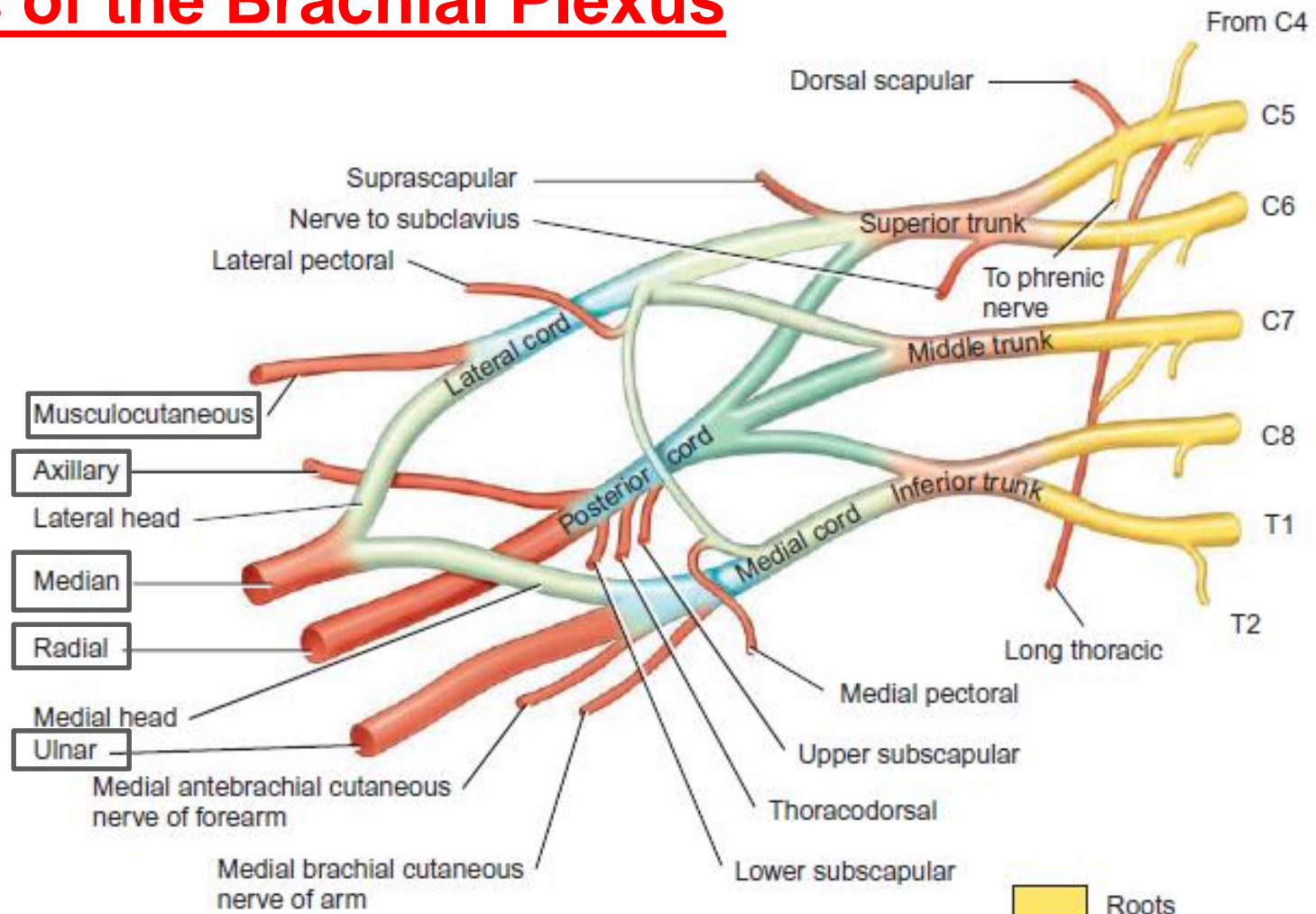
Brachial Plexus

- Formed by the anterior rami of C5,6,7,8 & T1.
- Supplies the shoulders and upper limbs.
- Important nerves arising from the brachial plexus are:

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

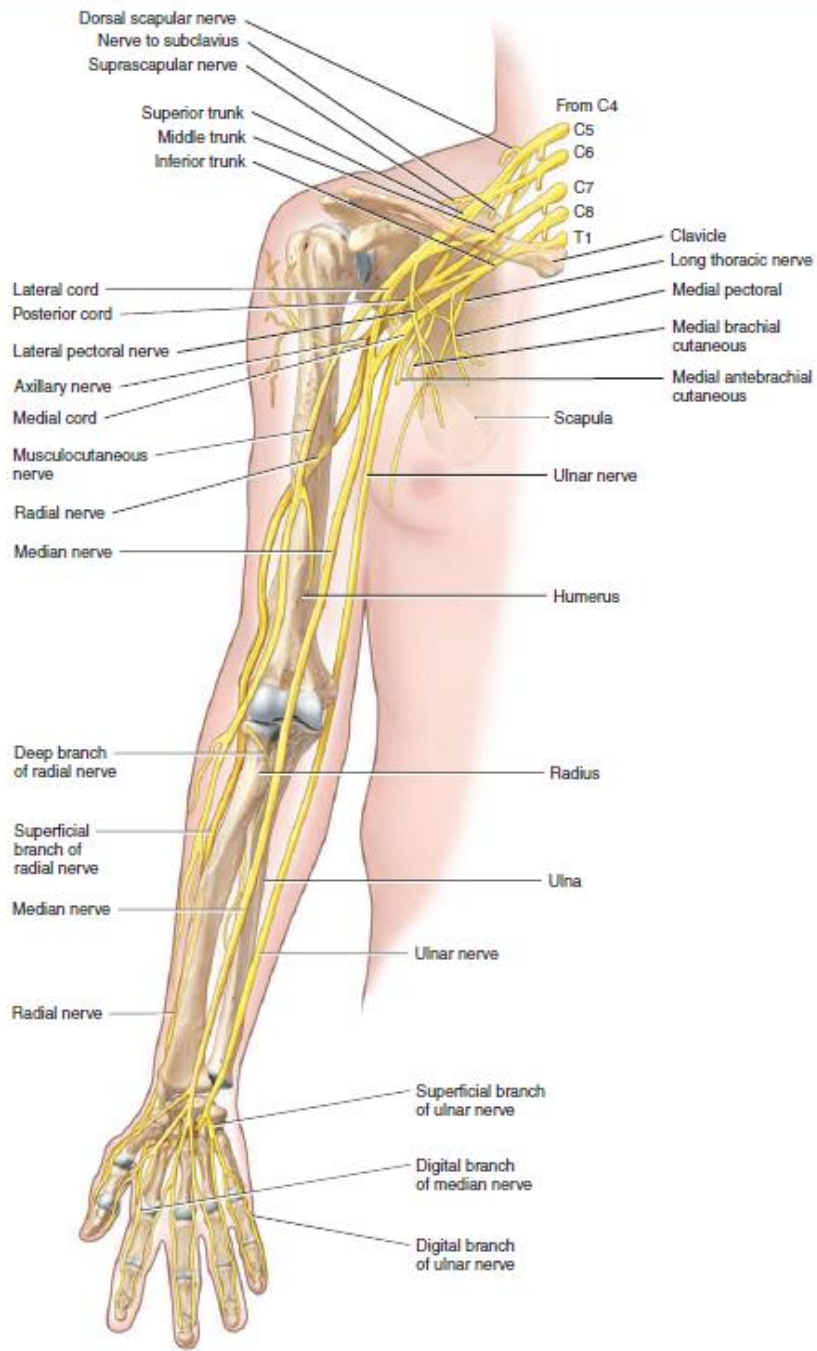


Parts of the Brachial Plexus



(a) Origin of brachial plexus

- Roots
- Trunks
- Anterior division
- Posterior division
- Cords
- Branches



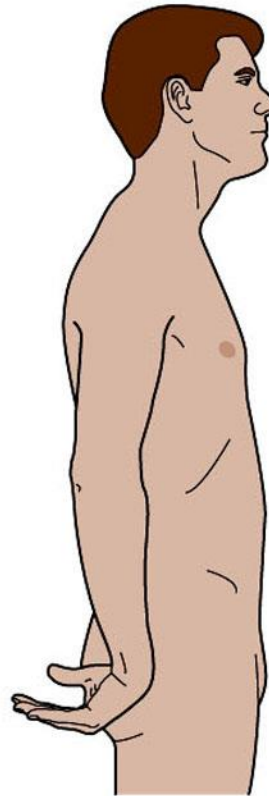
(b) Distribution of nerves from the brachial plexus

Lesions of the brachial plexus

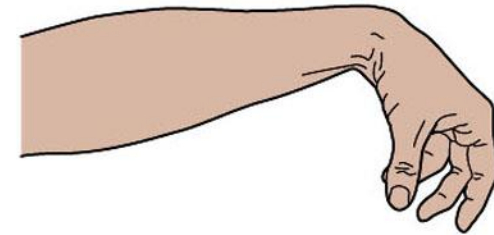
1. Complete lesions, gunshots (very rare). All muscles are affected except trapezius.
2. Upper trunk lesions (Erb-Duchenne Palsy)
3. Lower trunk lesions (Klumpke's Palsy)

Injuries to the Brachial Plexus

- **Injury to the superior roots of the brachial plexus (C5–C6):** Erb-Duchenne palsy (waiter's tip position)



(a) Erb-Duchenne palsy
(waiter's tip)

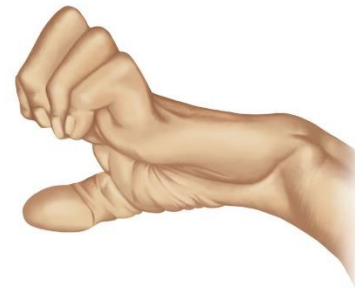


(b) Wrist drop

Figure 13.09 Tortora - PAP 12/e
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Lesions of lower trunk of brachial plexus

- Are usually traction injuries, caused by excessive abduction of the arm (falling from height).
- **T1 and C8 are usually torn**, nerve fibers from these segments run in the **ulnar** and **median**.
- The hand has claw appearance caused by:
 - Hyperextension of metacarpophalangeal joints (by the unopposed extensor digitorum)
 - Flexion of interphalangeal joints (lumbrical muscles are non functioning)
- Loss of sensation along the medial aspect of the arm and forearm.



Total claw hand

Long thoracic nerve injury

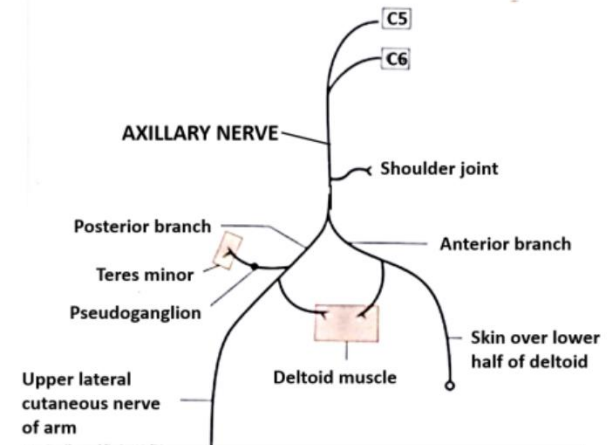
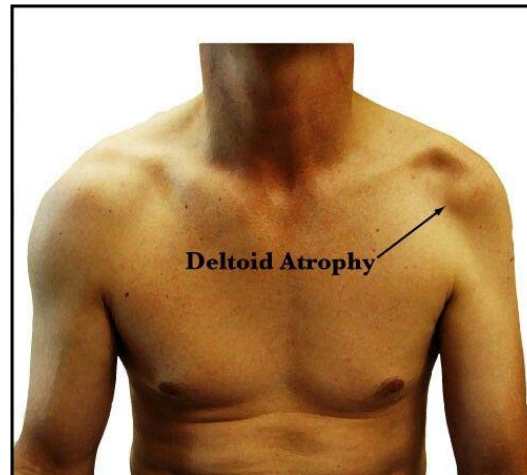
Surgical procedures, mastectomy may injure long thoracic nerve.

Paralysis of **the serratus anterior** results in posterior protrusion of the scapula in a condition known as "**winged scapula**".



Axillary nerve injury

- Dislocations of glenohumeral joint and fractures of the surgical neck of the humerus.
- Paralysis of **deltoid** and **teres minor**
- Deltoid becomes rapidly wasted and greater tubercle of the humerus becomes palpable
- Loss of sensation over lower 1/2 of deltoid
- Sensation over upper 1/2 of deltoid is normal as it is supplied by supraclavicular nerves C 3,4

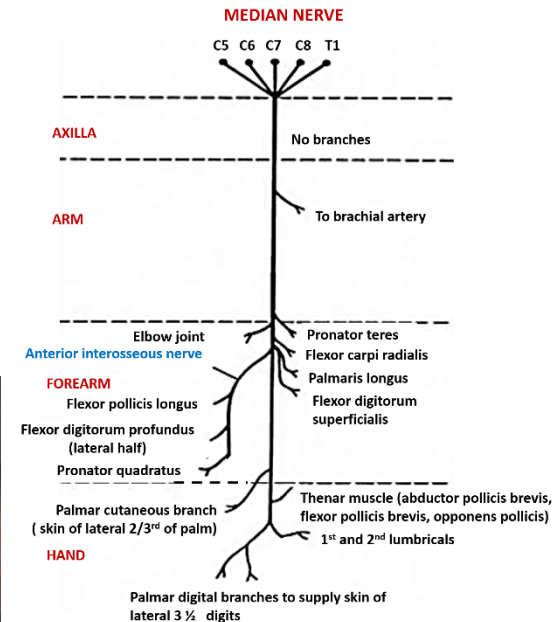


Median nerve injury

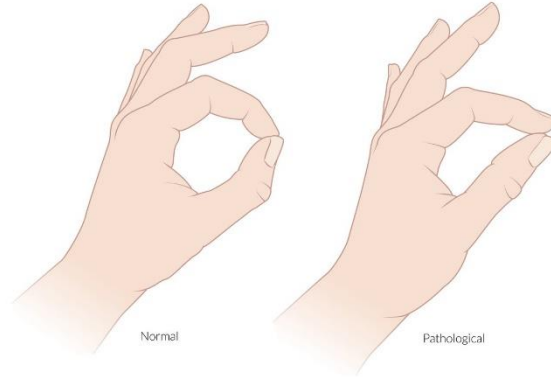
Supracondylar fractures of the humerus and penetrating wounds at the proximal part of the flexor retinaculum are the most common causes of injury.

“Ape hand”.

Flexors of forearm are paralysed (EXCEPT two muscles!!)

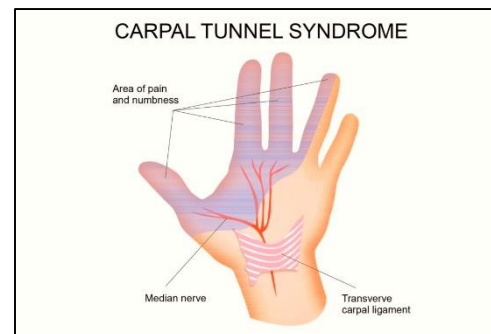
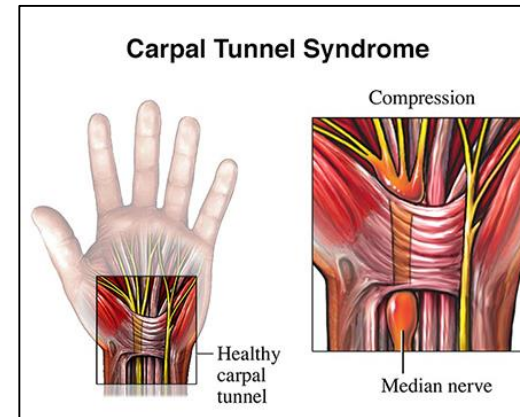


- **OK sign to test median nerve**



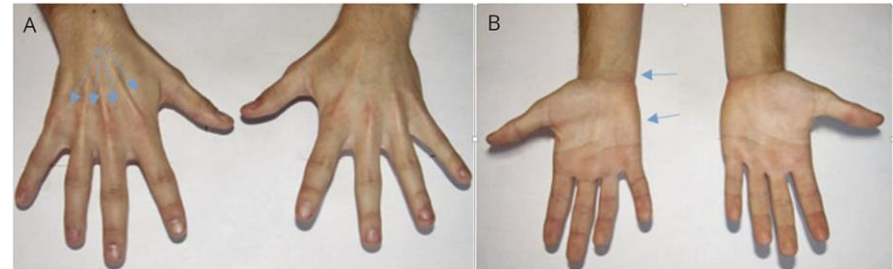
Carpal tunnel syndrome

- Carpal tunnel syndrome (CTS) is an entrapment neuropathy caused by compression of the **median nerve** as it travels through the wrist's carpal tunnel.
- Symptoms of carpal tunnel syndrome include pain, numbness, and paraesthesia
- Symptoms are limited to skin areas supplied by median nerve
- **Thenar muscles atrophy** and impaired sensibility in the distribution of the median nerve are signs of severe and



Ulnar nerve injury

- Most commonly injured at **the elbow**, where it lies behind the **medial epicondyle** and at **the wrist** where it lies superficial to flexor retinaculum with the ulnar artery.
- Claw hand (clawing prominent at medial aspect).
- **Extensor digitorum muscle** is unopposed due to the paralysis of the FDP (medial side)
- 3rd and 4th lumbricals are non-functional



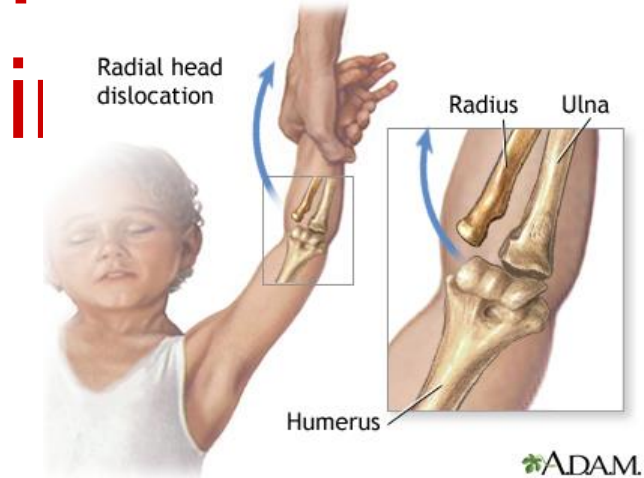
Hollowing between the metacarpal

Flattening of the hypothenar eminence and loss of the convex surface at medial aspect of the hand (blue arrows)



“Claw hand”

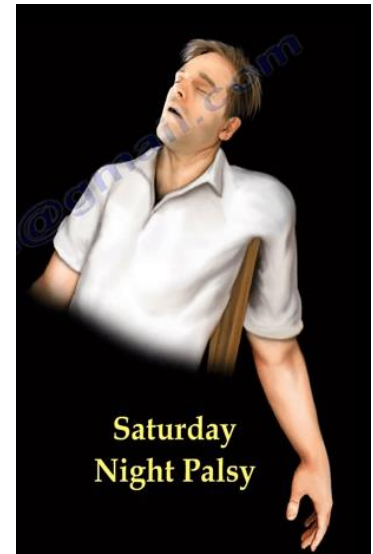
Radial nerve



swinging a child by their hands or arms or lifting up a child by one arm.



Note inability of patient to extend right wrist (Wristdrop).



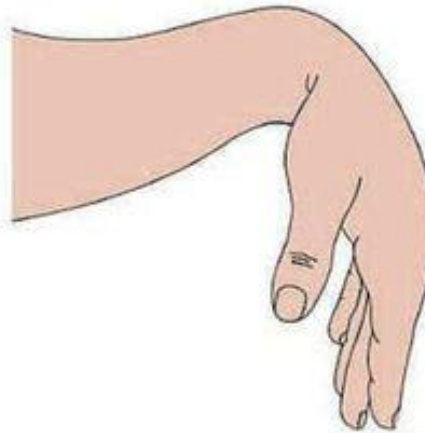
Nerve Injuries

**APE
HAND**



**Median Nerve
Injury**

**WRIST
DROP**



**Radial Nerve
Injury**

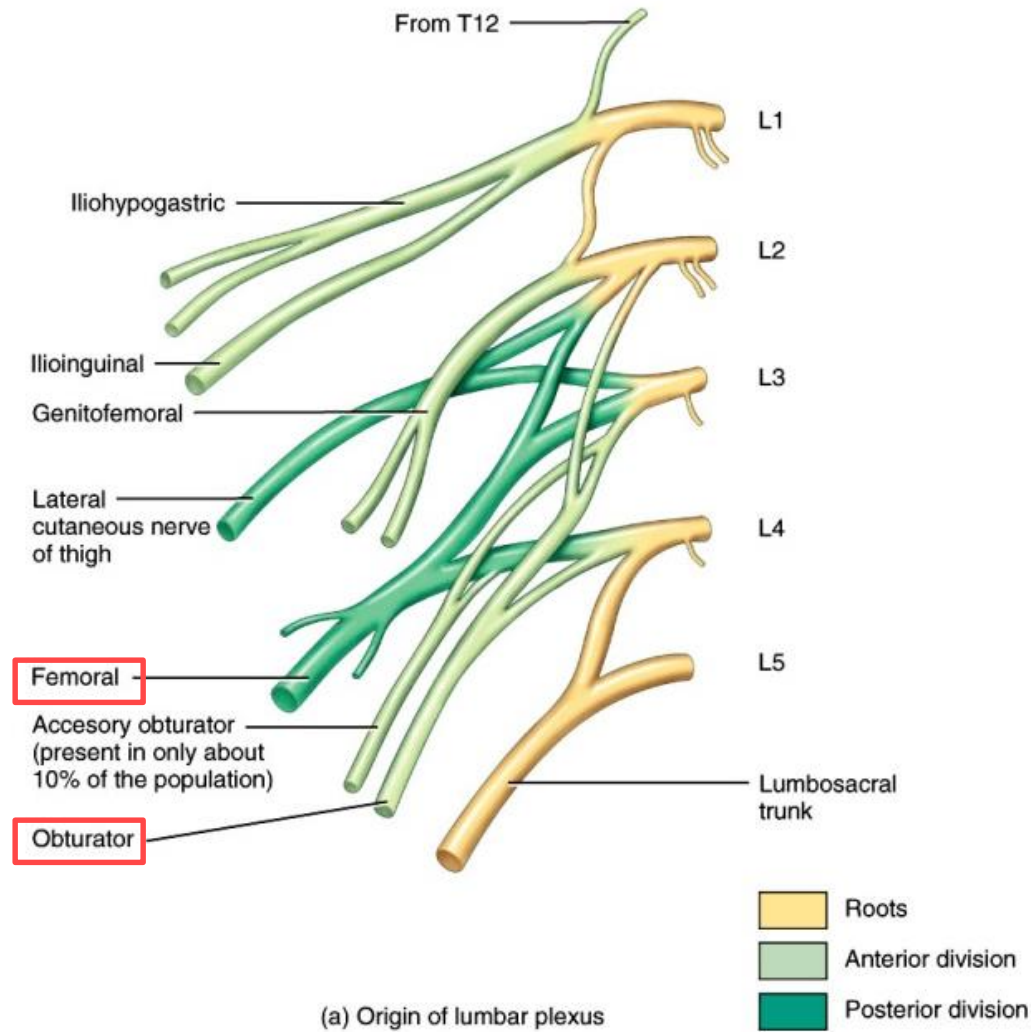
**CLAW
HAND**



**Ulnar Nerve
Injury**

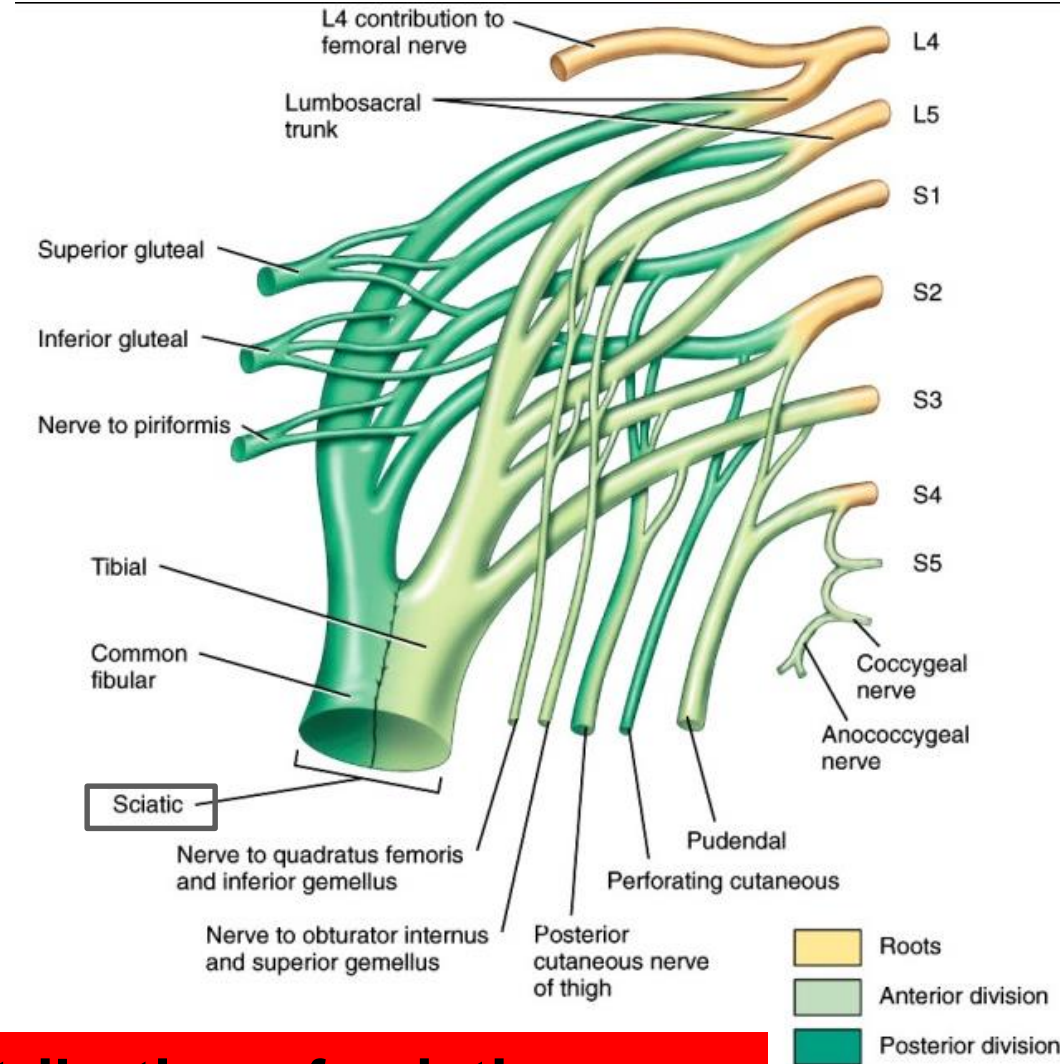
Lumbar Plexus

- Formed by the anterior rami of **L1-L4**.
- **Femoral** and **obturator** nerves arise from this plexus



Sacral Plexus

- Formed by the anterior rami of **L4-L5** and **S1-S4**.
- Supplies the buttocks, perineum, and lower limbs.
- Gives rise to the largest nerve in the body- the **sciatic nerve**.

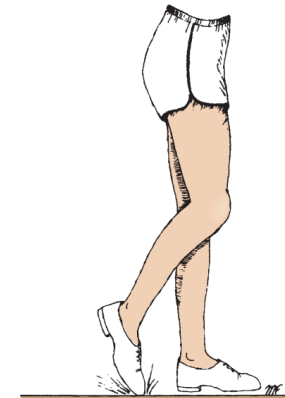
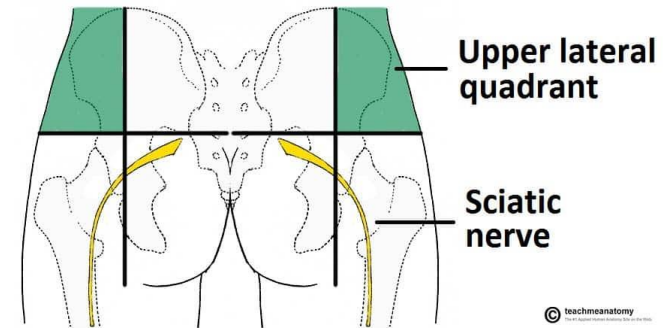


Sciatica: Pain along the distribution of sciatic nerve

Lesions associated with the nerves of lower limb

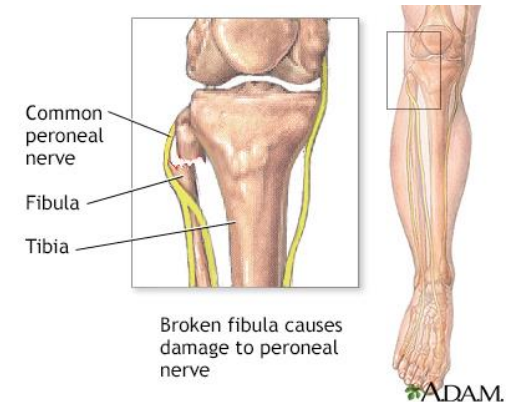
Sciatic Nerve Injury:

- Penetrating wounds, fractures of the pelvis, or dislocations of the hip joint. It is most frequently injured by **badly placed intramuscular injections in the gluteal region (IM inj. Should be at the upper outer quadrant of the buttock)**.
- in 90% of injuries, **the common peroneal** part of the nerve is the most affected. This can probably be explained by the fact that the common peroneal nerve fibers lie most superficial in the sciatic nerve.
- **Motor consequences:** The hamstring muscles are paralyzed, but weak flexion of the knee is possible because of the action of the Sartorius (femoral nerve) and gracilis (obturator nerve). All the muscles below the knee are paralyzed, and the weight of the foot causes it to assume the plantar-flexed position, or **foot drop**.
- **Foot drop is inability to lift the frontal part of foot up due to the weakness of dorsiflexors of the foot (tibialis anterior).**



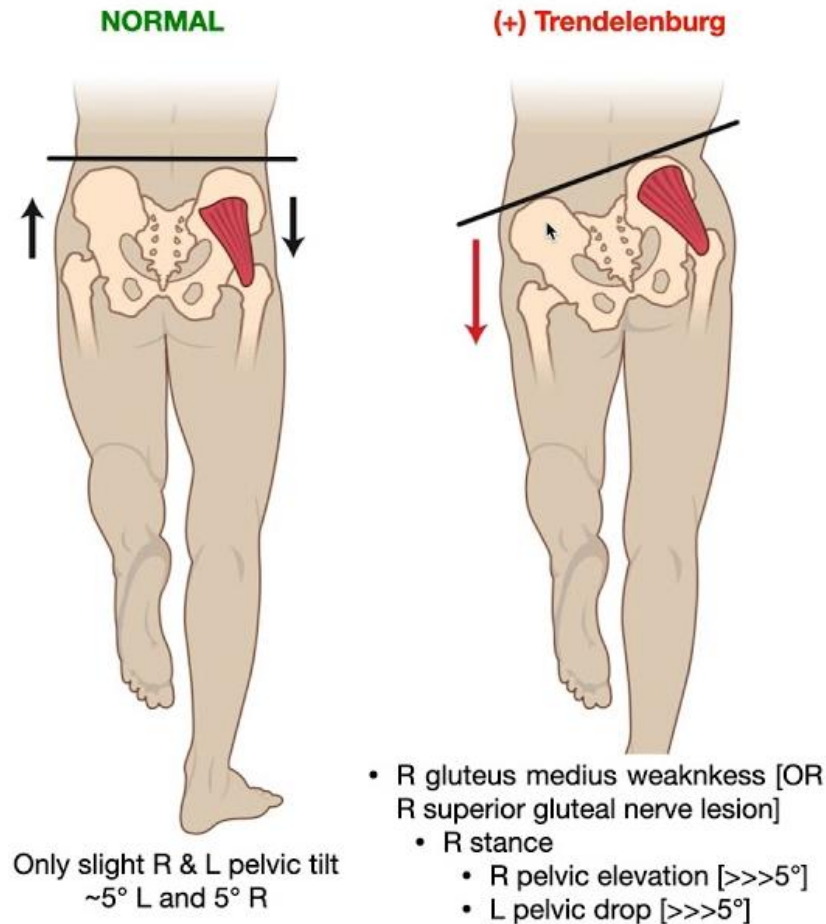
Dorsiflexors are paralysed >>> plantar flexors will be unopposed

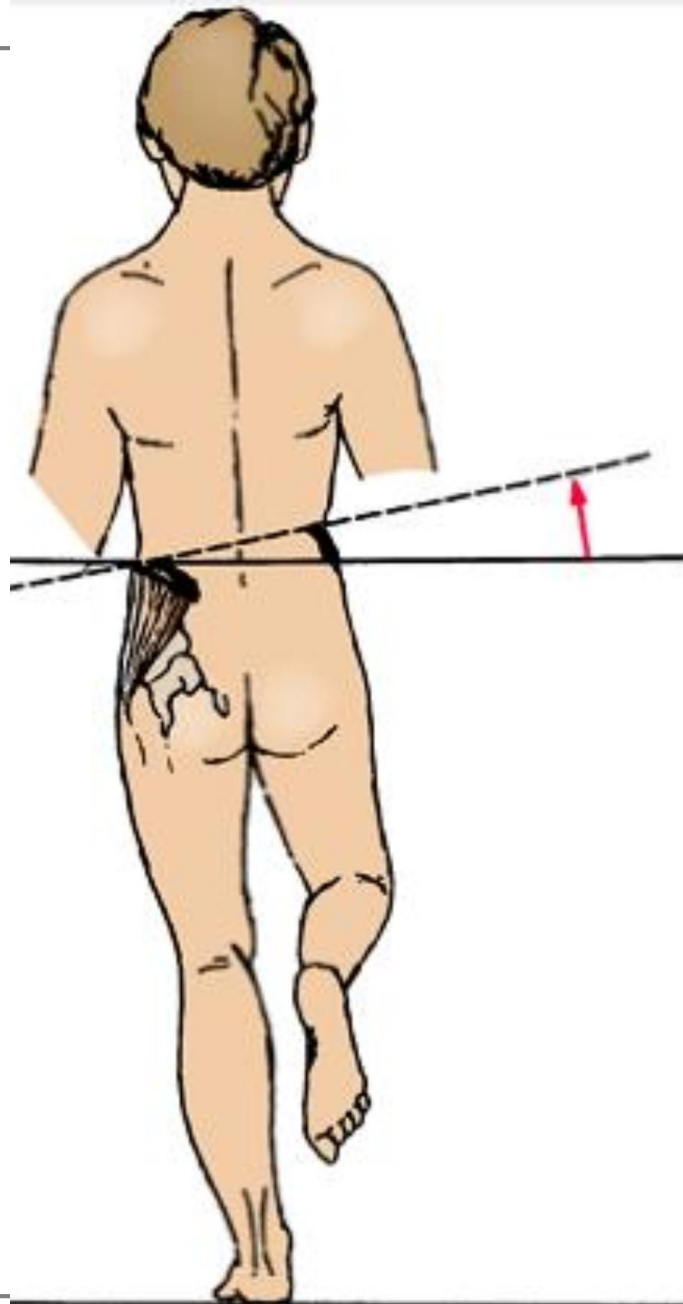
1. **Femoral Nerve Injury:** can be injured in stab or gunshot wounds but a complete division of the nerve is rare.
 - Motor consequences: **The quadriceps femoris** muscle is paralyzed, and the knee cannot be extended.
 - Sensory consequences: Skin sensation is lost over the anterior and medial sides of the thigh, over the medial side of the lower part of the leg, medial side of the foot (saphenous nerve)



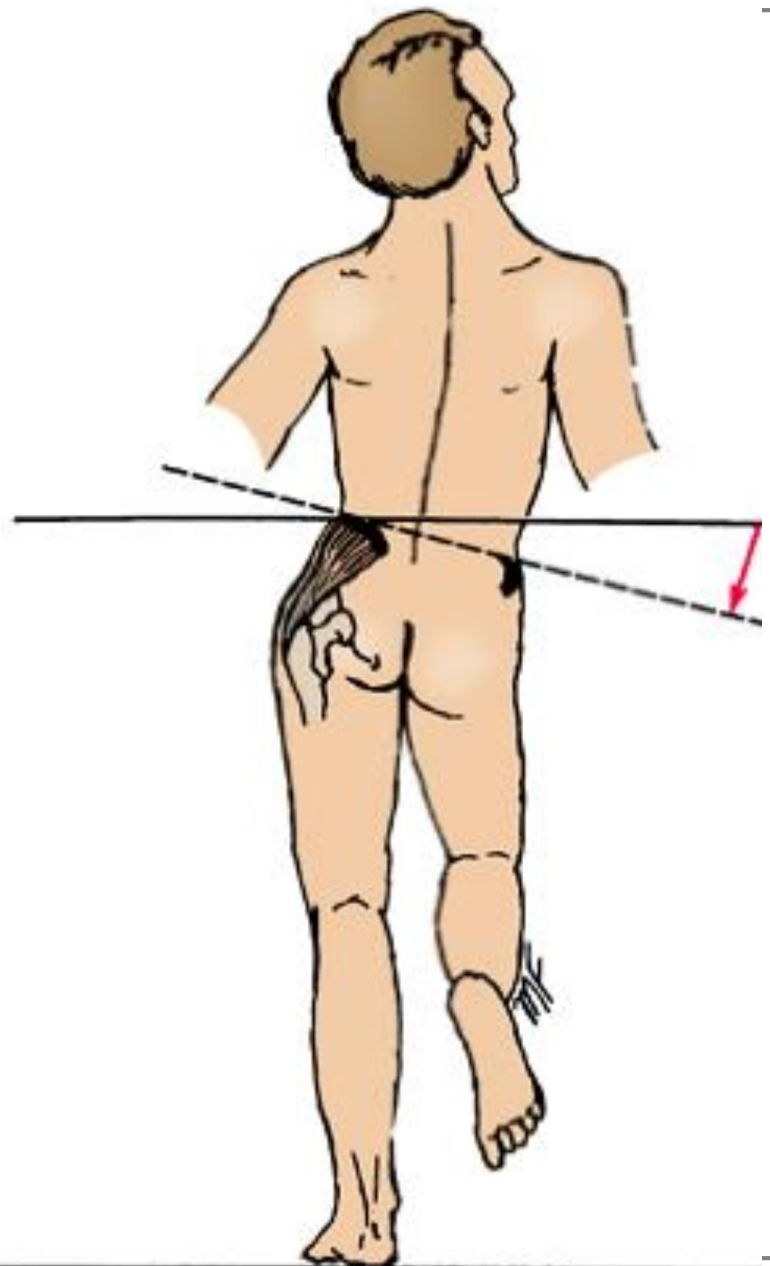
Injury to superior gluteal nerve

- Supplies **gluteus Medius** and **Minimus** muscles.
- They prevent **tilting of the pelvis to the unsupported raised limb** by contraction of muscles of supported side, so they are important during walking and running (**Main abductors of the thigh**)
- If glutei medius & minimis are paralysed, patient can not walk normally.
- When the foot of the normal side is raised, the pelvis tilts to that side.
- If paralysis is on one side → **lurching gait**.
- If on both sides → **waddling gait**.
- If superior gluteal nerve is injured on one side, ask patient to stand on affected side, the pelvis tilts to the normal side denoting a **positive Trendelenburg's sign**.





normal



positive Trendelenburg's sign

شكرًا