

# Introduction of Neuro anatomy

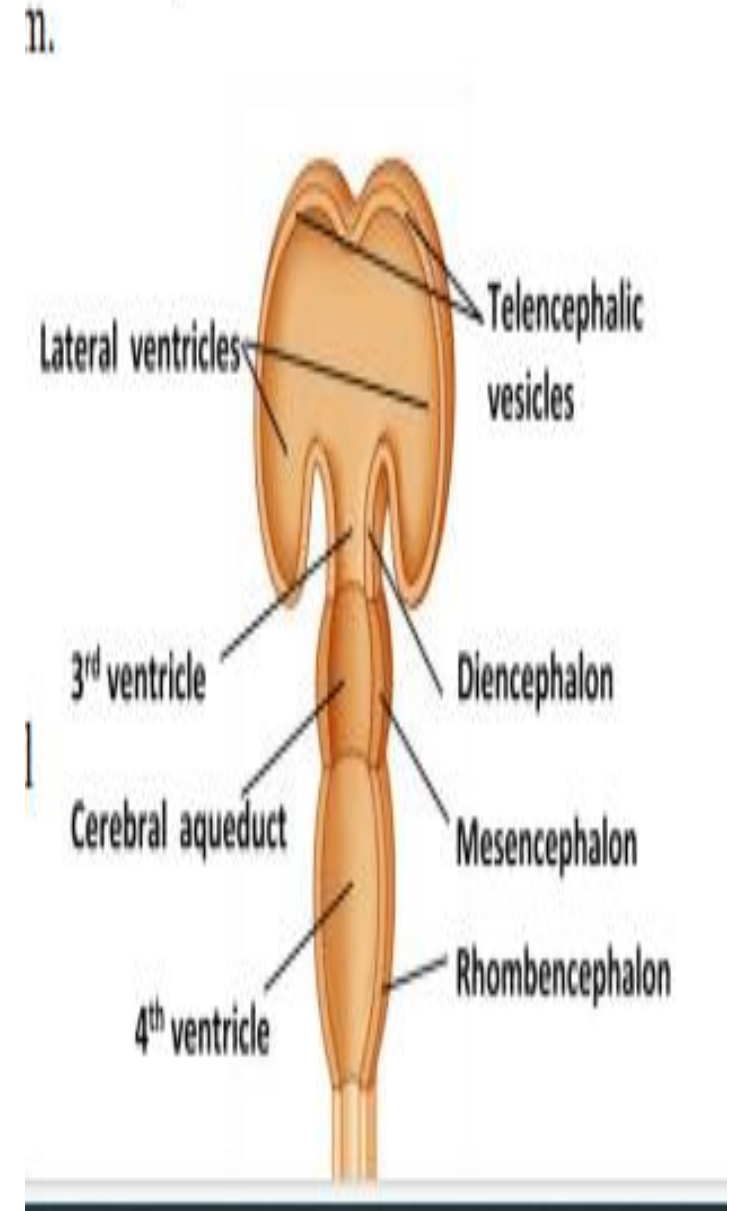
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Assistant Professor of anatomy and embryology

# 1- central nerves system

## Embryological,

- the neural tube gives the spinal cord and three brain vesicles
- **1. Forebrain (prosencephalon)** which gives a **median diencephalon** (its cavity is the 3<sup>rd</sup> ventricle) and
  - **2 Telencephalon “Cerebrum”**
- (each contains a cavity is the lateral ventricle)
- **2. Midbrain (mesencephalon)** whose cavity is the cerebral aqueduct of Sylvius
- **3. Hind brain (rhombencephalon)** which includes the pons, medulla oblongata and cerebellum (its cavity is the 4<sup>th</sup> ventricle)



**2. Peripheral nervous system (PNS)** which includes

12 pairs of cranial nerves,

31 pairs of spinal nerves

All ganglia.

# CELLS OF THE NERVOUS SYSTEM

**I. Neuron** = nerve cell It is the building unit of the nervous system; it consists of:

1. cell body (soma) containing the nucleus and cell organelles
2. processes: Many short dendrites (receiving inputs) One long axon (conducting outputs) that terminates by making synapses with dendrites of other neurons. The axons are generally called nerve fibers.

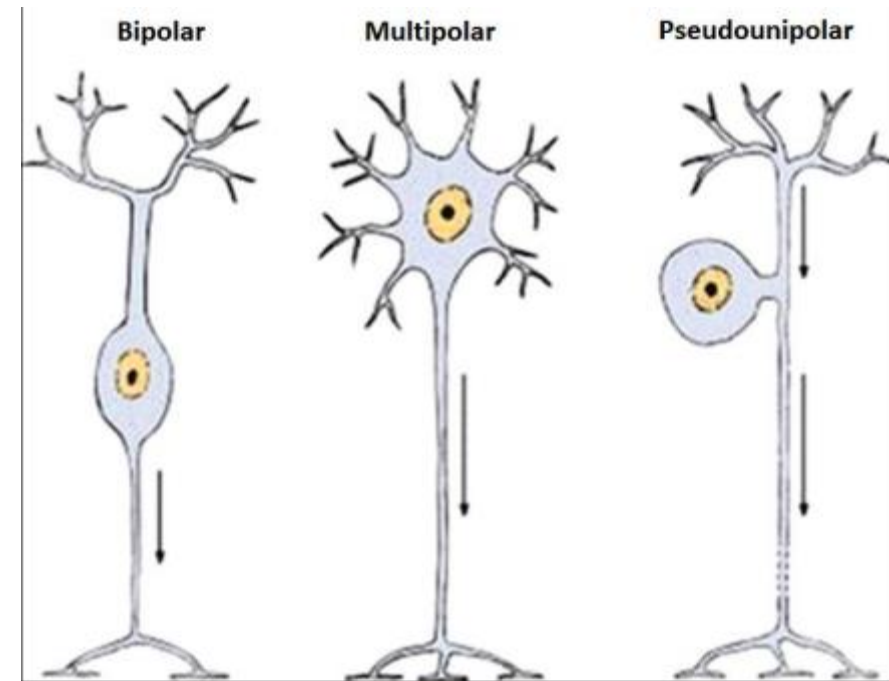
**Types of neurons:** According to the number of processes:

1. Unipolar (pseudounipolar): as in posterior root ganglion.
2. Bipolar: as in the retina, cochlear & vestibular ganglia
3. Multipolar: as in most parts of the brain & spinal cord.

According to the length of the axon:

**1. Golgi type I neuron:** of long axon as in long tracts of brain & spinal cord as in (pyramidal cells of cerebral cortex, Purkinje cells of cerebellar cortex & motor cells of spinal cord).

**2. Golgi type II neuron:** of short axon (inhibitory in function), numerous in all parts of the CNS.



## II. Glial cells:

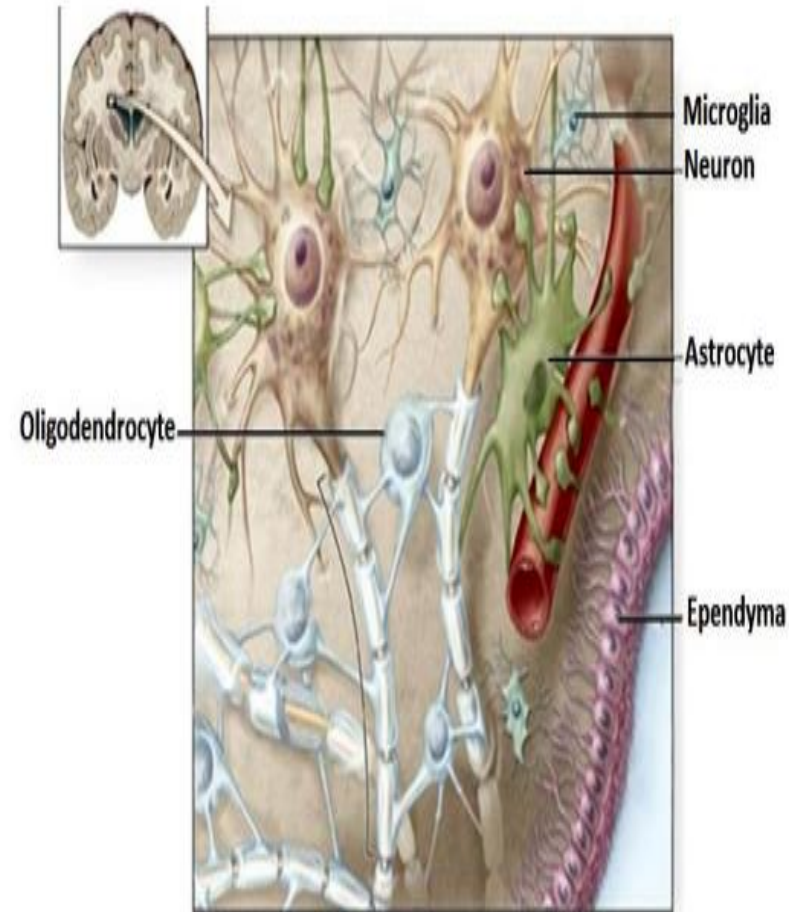
are non-excitabile, supporting, protecting and nourishing cells representing half the total volume of the CNS. There are 4 types of glia

**1. Astrocytes:** These are cells with many branches, forming the main support for the nerve cells & nerve fibers as well as electrical insulators.

**2. Oligodendrocytes:** These are small cells with few processes, responsible for the formation of the myelin sheath of the nerve fibers of the CNS.

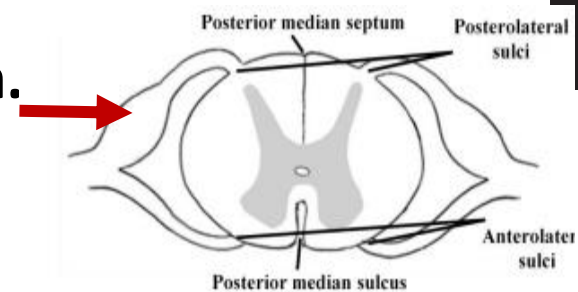
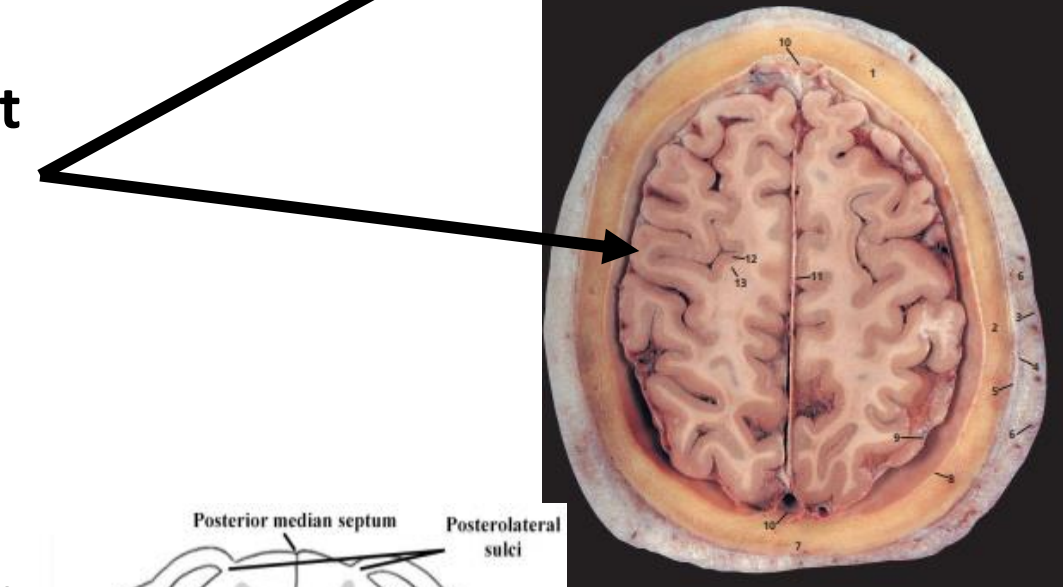
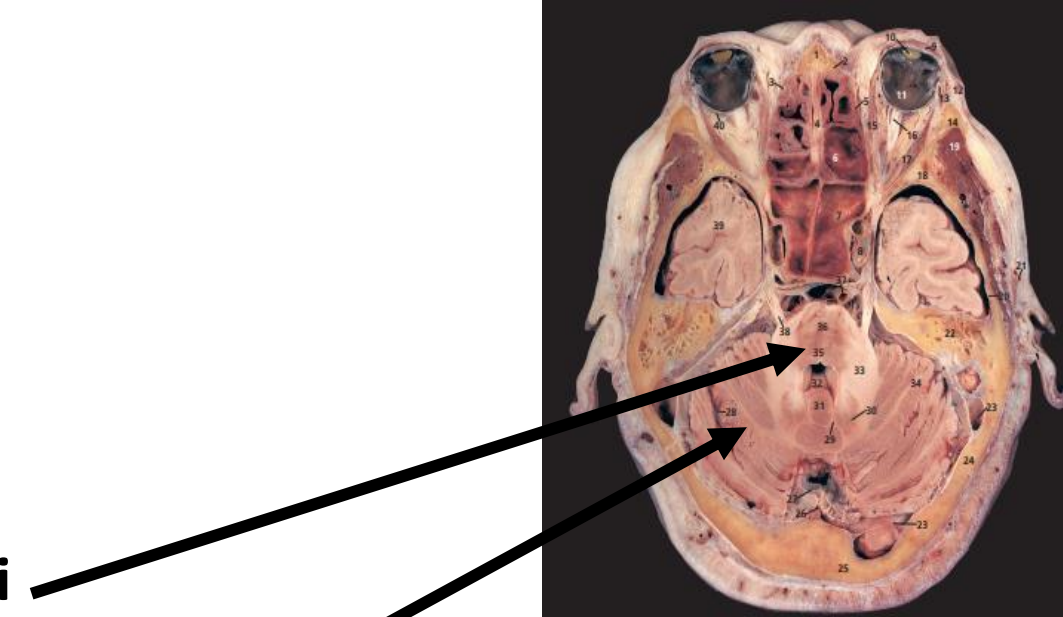
**3. Microglia:** The smallest glial cells (the only glial cells of mesodermal origin while other glial cells are of ectodermal origin.) They act as phagocytes in degenerative and inflammatory conditions.

**4. Ependyma:** These are cuboidal ciliated cells that line the cavities of the brain & spinal cord. They also form the cells of choroid plexus. They assist in the formation of CSF



# DEFINITIONS

- **Grey matter & white matter:** In the CNS, the cell bodies form the grey matter while the nerve fibers form the white matter.
- In the spinal cord, the white matter surrounds the grey matter which is H-shaped.
- In the brain stem, the grey matter collects into nuclei embedded in the white matter.
- In the cerebral hemispheres and the cerebellum, part of the grey matter collects into deep nuclei and another part spreads on the surface forming the cortex.
- Nucleus= a collection of cell bodies that have the same function within the CNS.
- the CNS, a collection of cell bodies is called ganglion.



# DEFINITIONS

- **Tract (fasciculus)= a bundle of nerve fibers within the CNS having the same origin, same termination and same function. Bundles outside the CNS constitute nerves.**
- **Pathway= a chain of successive tracts having the same function (e.g. carrying pain sensation).**
- **Lemniscus= collection of ascending fibers in the brainstem.**
- **Commissure= a band of white or grey matter connecting the right & left sides of the CNS across the midline.**
- **Decussation= a point at which an ascending or descending tract crosses the midline.**
- **Afferent= input i.e., going towards a certain structure. Efferent= output i.e., going away from a certain structure.**
- **Synapse= site of contact between two neurons; usually between the axon of one neuron and the dendrites of the other neuron**

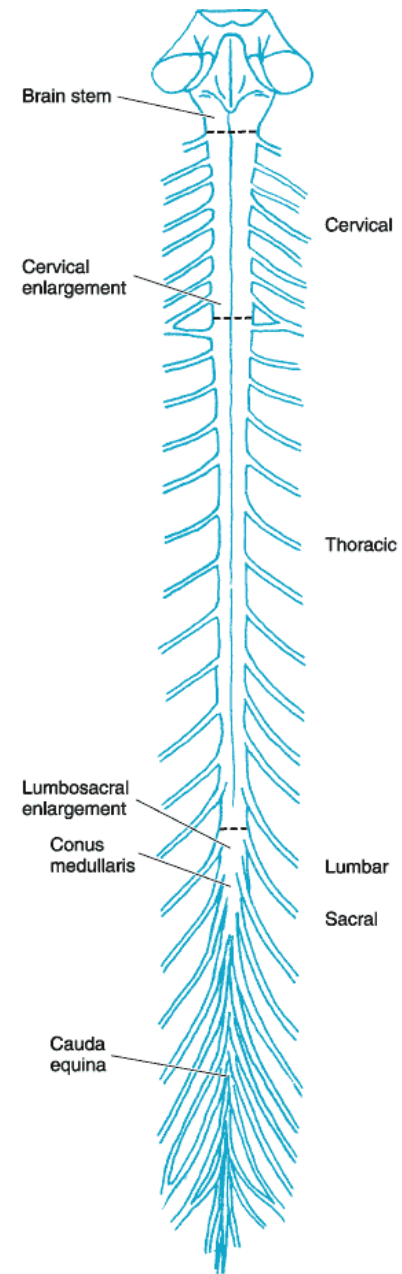
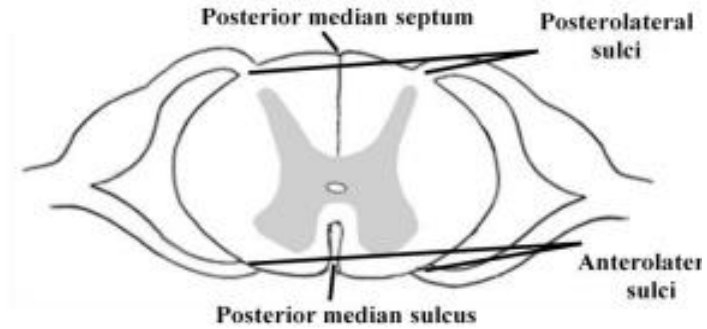
# Spinal Cord

## Gross morphology & internal structure



# External Features

- Part of central nervous system, it occupies upper two thirds of vertebral canal
- Cylindrical
- Length : 45 cm
- Begins at upper border of atlas as continuation of medulla
- Ends at lower border of first lumbar in adults & at birth it lies opposite L3
- 2 enlargements: cervical and lumbar
- Tapering lower end is called conus medullaris
- It has anterior median fissure and posterior median sulcus & 2 anterolateral & 2 posterolateral sulci



**Cervical enlargement:**

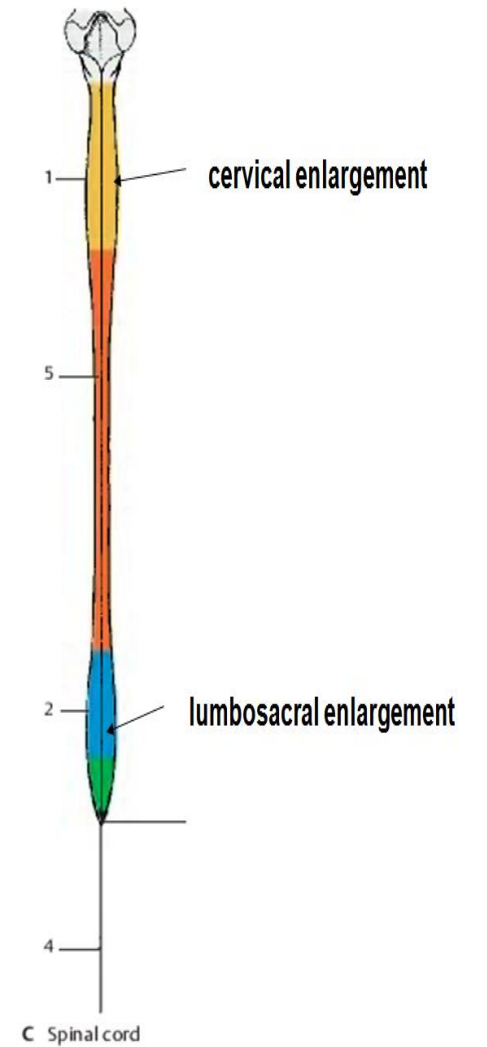
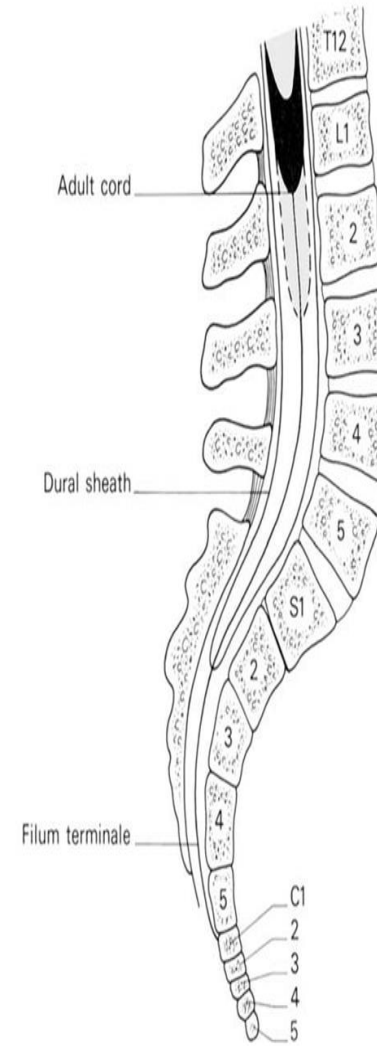
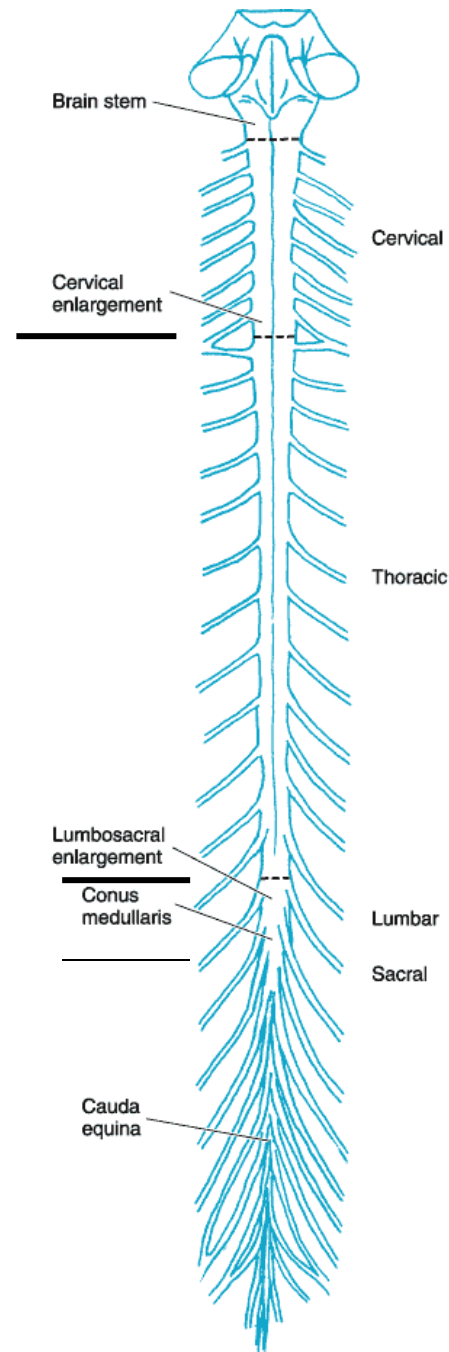
C4 to T 1

Source of brachial plexus

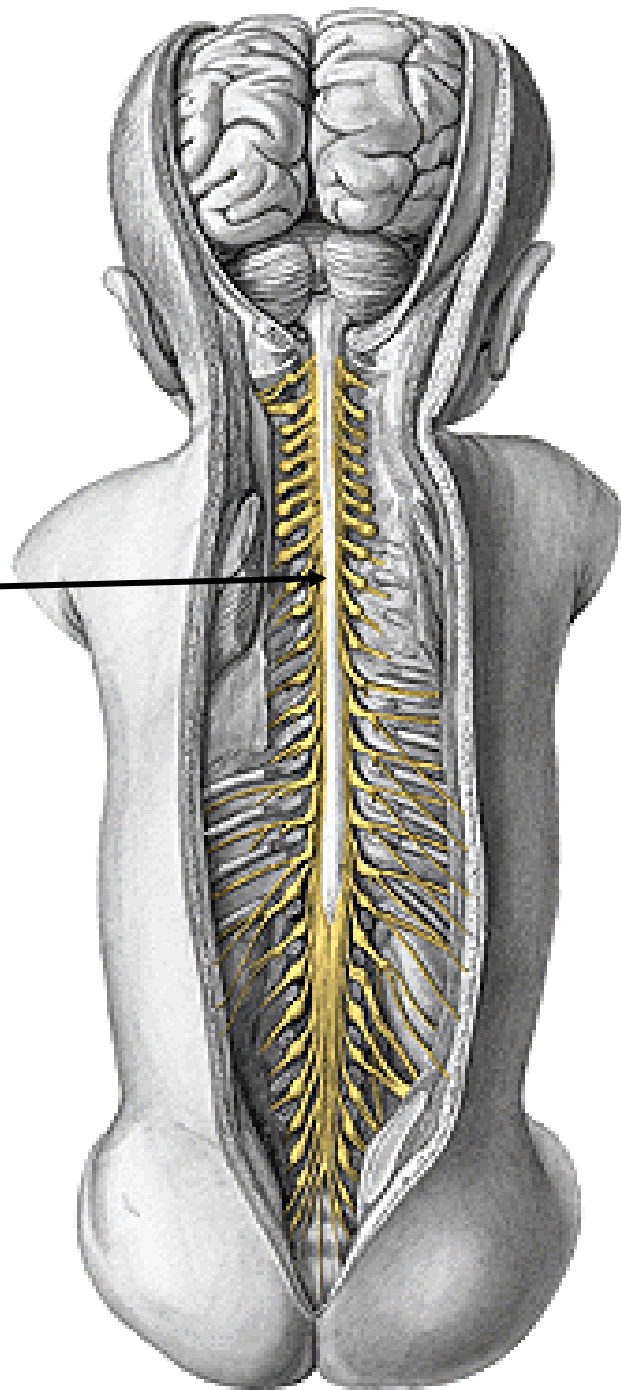
**Lumbar enlargement :**

L1 to S4

Source of nerves to lumbar & Sacral plexus



**Spinal cord**

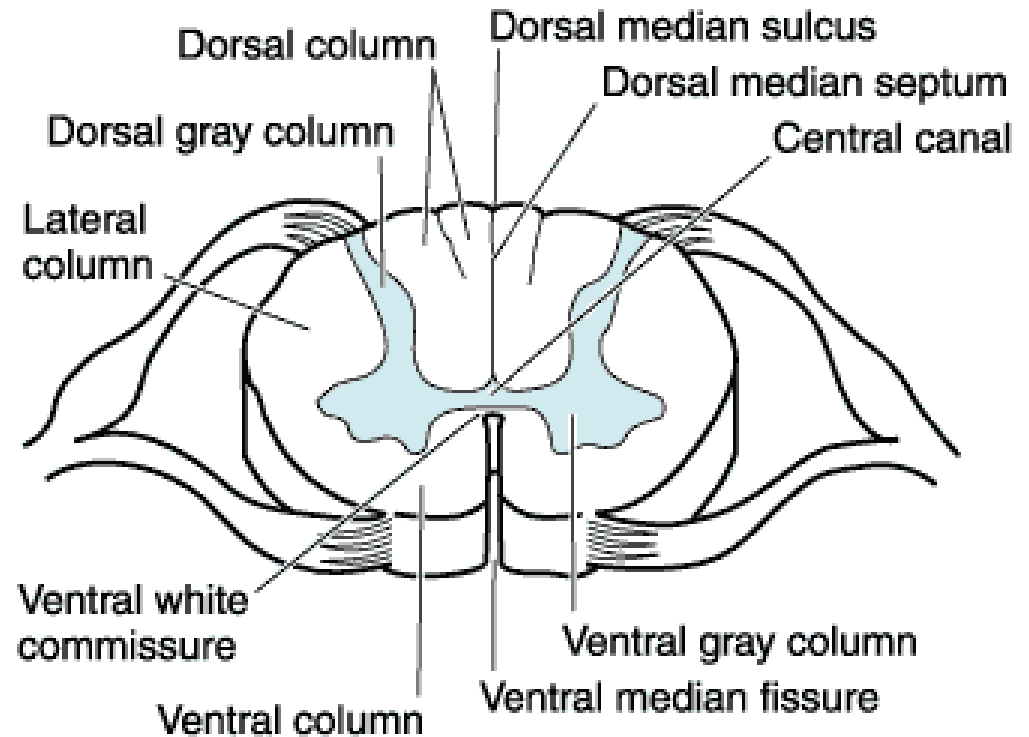


# Grooves and Segments

- 31 segments
- 8 cervical, 12 thoracic, 5 lumbar, 5 sacral & 1 coccygeal
- each segment gives origin to a pair of spinal nerve

## Grooves:

- Anterior median fissure
- Posterior median fissure
- 2 Posterolateral & 2 anterolateral sulcus



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# Coverings.

- Dura ( outer layer) ,arachnoid ( middle layer) and pia( inner layer)
- Dura and arachnoid ends at sacral 2
- Pia forms a prolongation called filum terminale, attach to back of coccyx

## Spaces

- **Subarachnoid space:** between arachnoid and pia contains

I- CSF&

II- 3 Ligaments supporting the spinal cord:

a. Filum terminale.

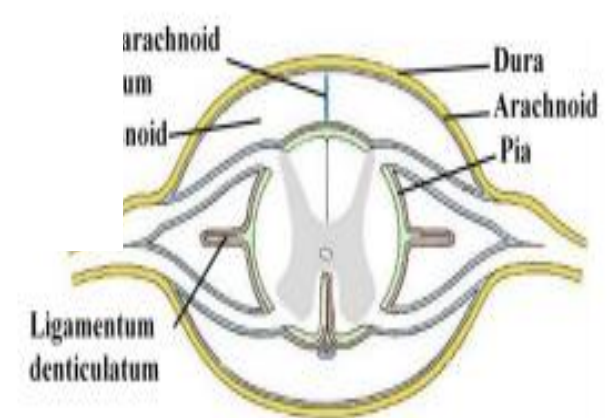
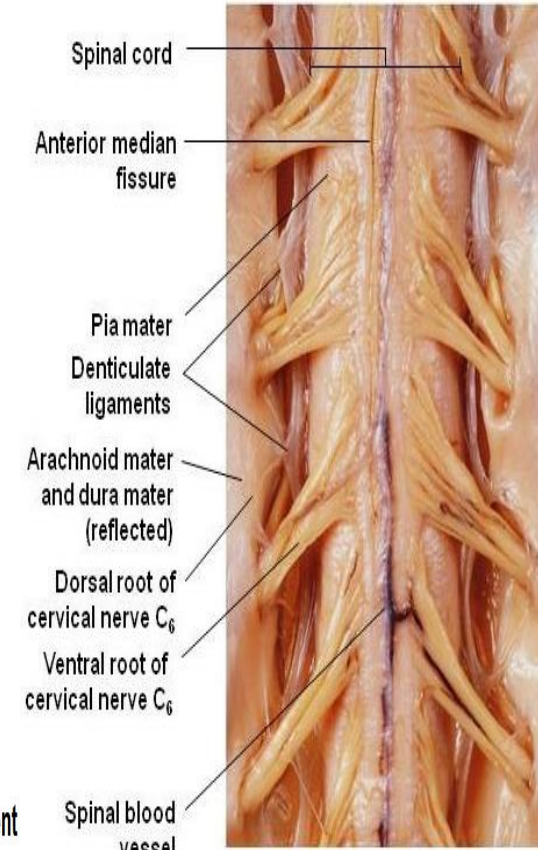
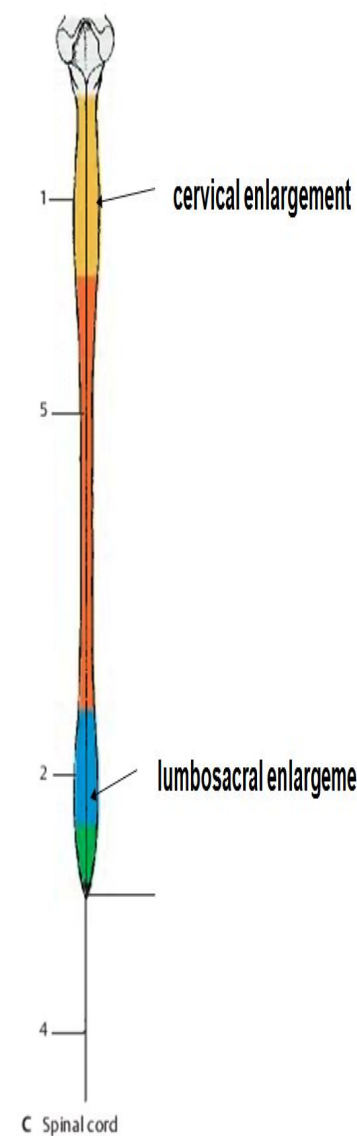
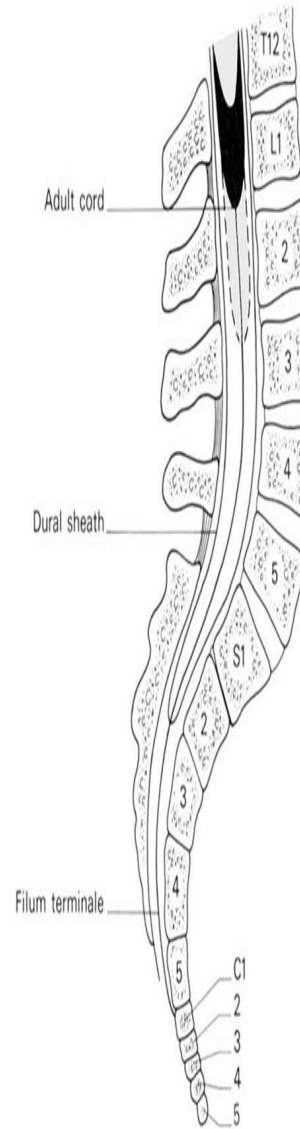
b. Ligamentum denticulatum: one on each side of the cord, extending laterally between the anterior and posterior roots of spinal nerves.

it has 21 teeth connecting the pia (on one side) to the arachnoid and dura (on the other side).

c. Subarachnoid septum: extends from the posterior median septum to the arachnoid mater

**Subdural space** ; between dura and arachnoid contains fluid

**Extra dural space:** between dura and walls of vertebrae it contains fat, small arteries ,venous plexus and lymphatics

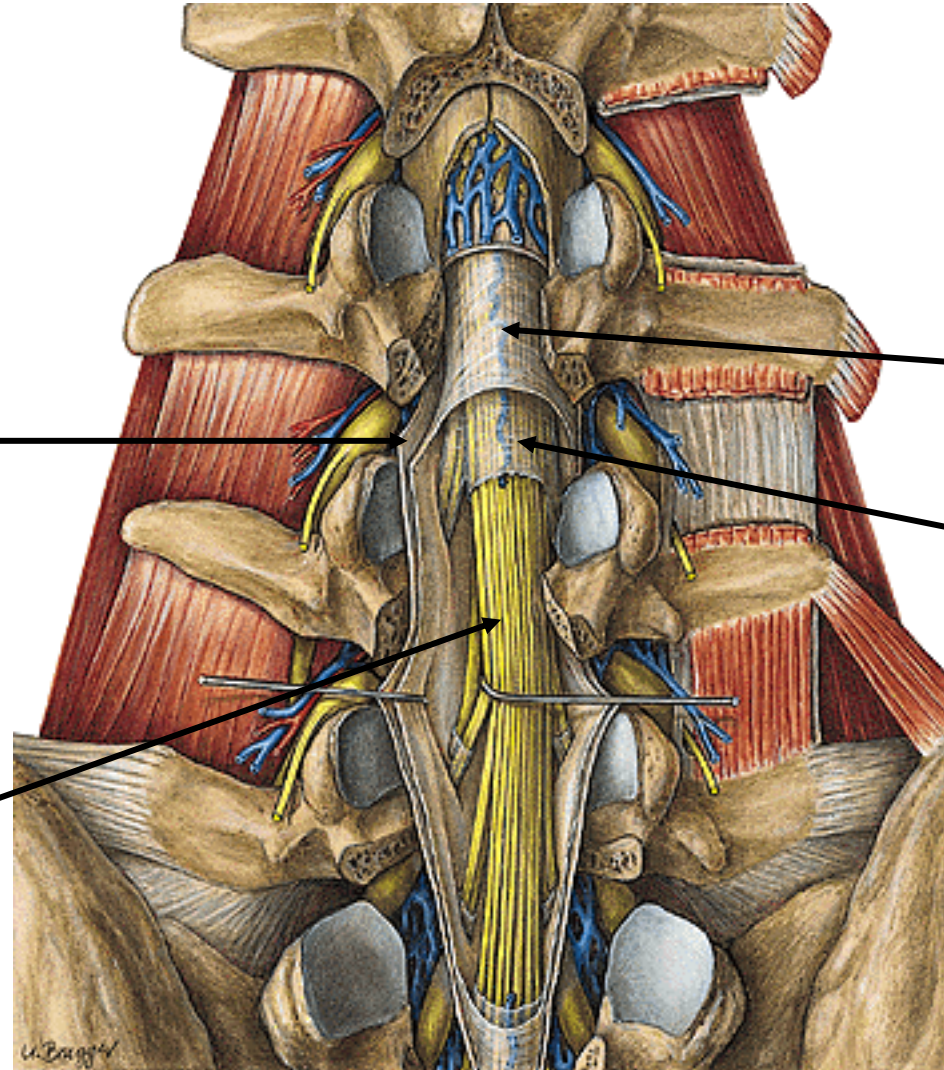


**Dura**

**Arachnoid**

**Pia**

The collection of the lumbar nerves, sacral and coccygeal spinal nerves below the spinal cord are called **Cauda equina**



# Internal Structure

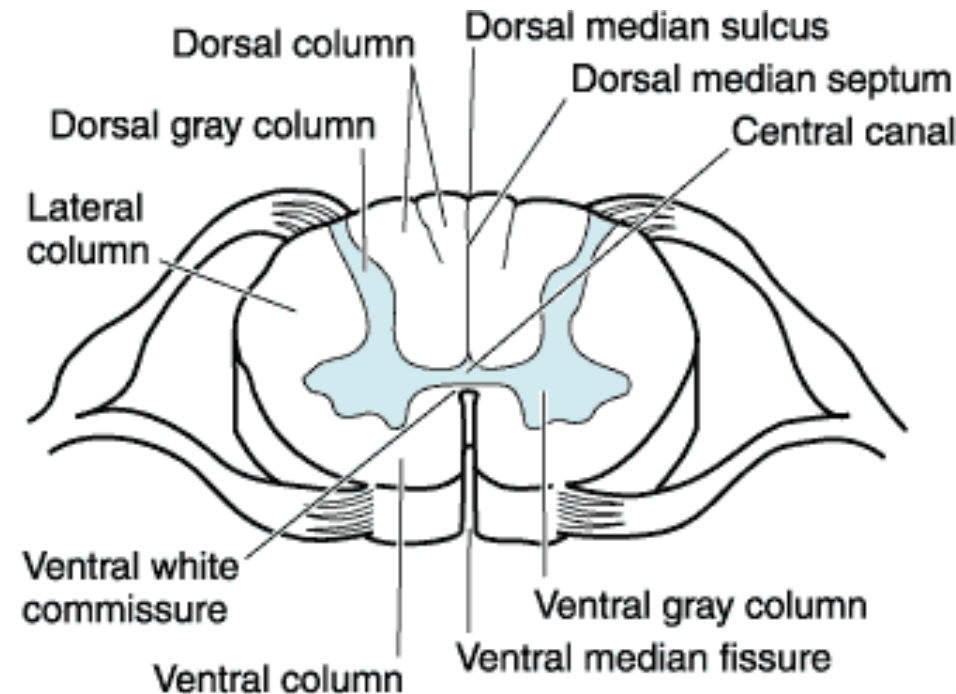
**Grey matter** : central H shaped with( nerve cells ,Unmyelinated nerve fibers.)

- dorsal horn: sensory
- ventral horn: motor
- Lateral horn: autonomic

**White matter**; 3 columns ( myelinated nerve fibers)

- Anterior
- Lateral
- posterior

**Central canal: narrow canal throughout the length**



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Its center contains a narrow central canal extending throughout the length of spinal cord.

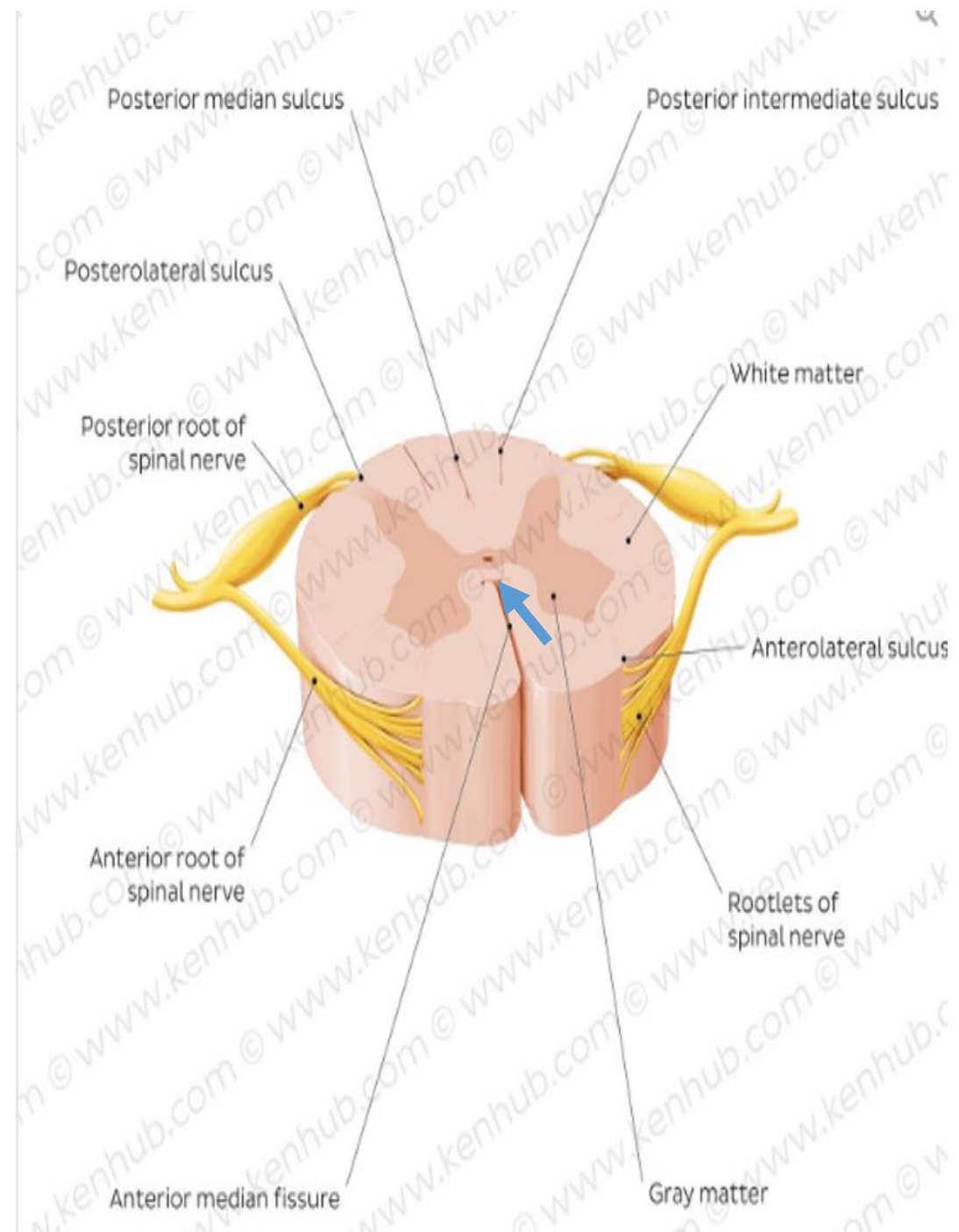
The cord is divided into right & left halves by an anterior median sulcus & a posterior median septum.

The two halves are connected by 3 commissures:

1- White commissure: behind the anterior median sulcus. →

2- Anterior grey commissure: in front of the central canal.

3-Posterior grey commissure: behind the central canal.





# Spinal Nerves

- 31 pairs
- Each is attached by 2 roots

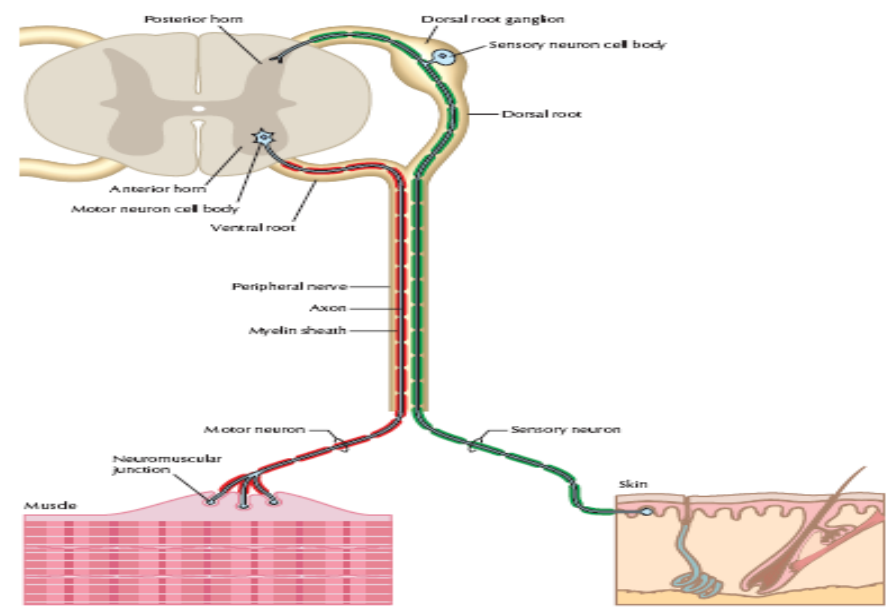
**Ventral root**: motor from anterior horn & sympathetic from lateral horn

**Dorsal root**: purely sensory, carries dorsal root ganglion with pseudounipolar neurons

A- peripheral processes pass peripheral

B- central processes enters cord

- Both roots unite forming a mixed nerve (**the spinal nerve**), which exits the vertebral canal through the intervertebral foramen (IVF) and soon divides into 2 rami (both are mixed):



# Spinal nerves

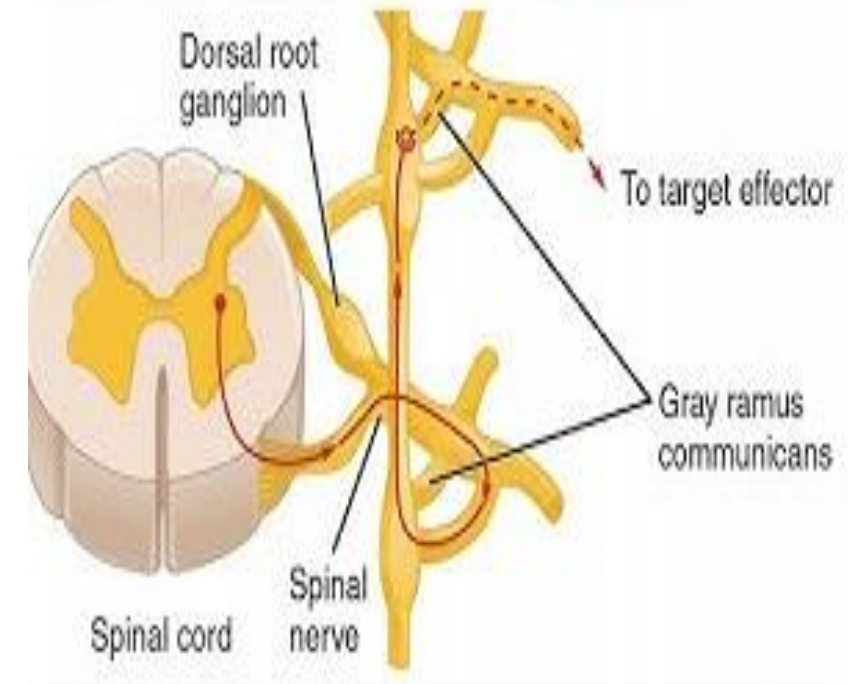
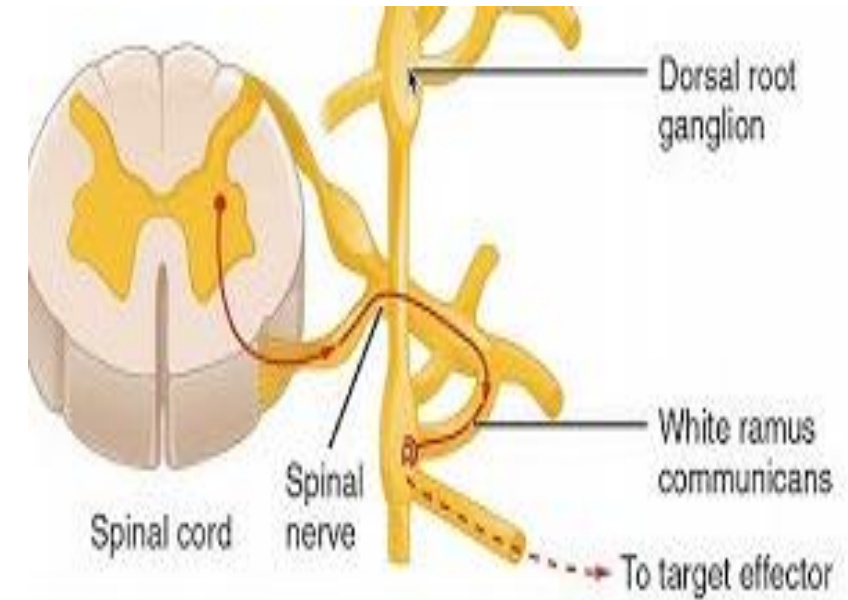
## Anterior rami:

- Form plexus except 12 thoracic
- Only 14 anterior rami (12 thoracic + upper 2 lumbar) send **white rami communicants** [preganglionic] to sympathetic ganglia.

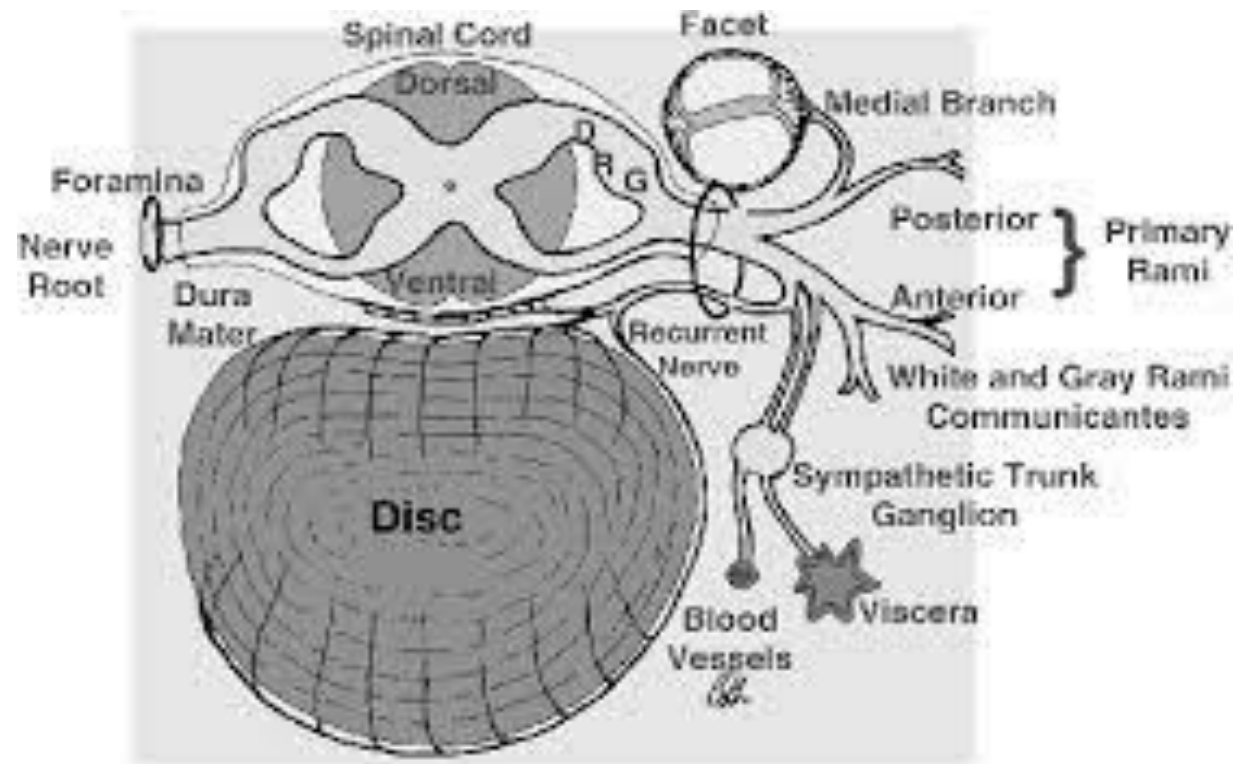
Distributing to the 23 pairs of sympathetic ganglion, then the ganglion send back the **postganglionic grey rami communicants** To all the 31 anterior rami to reach the target effectors.

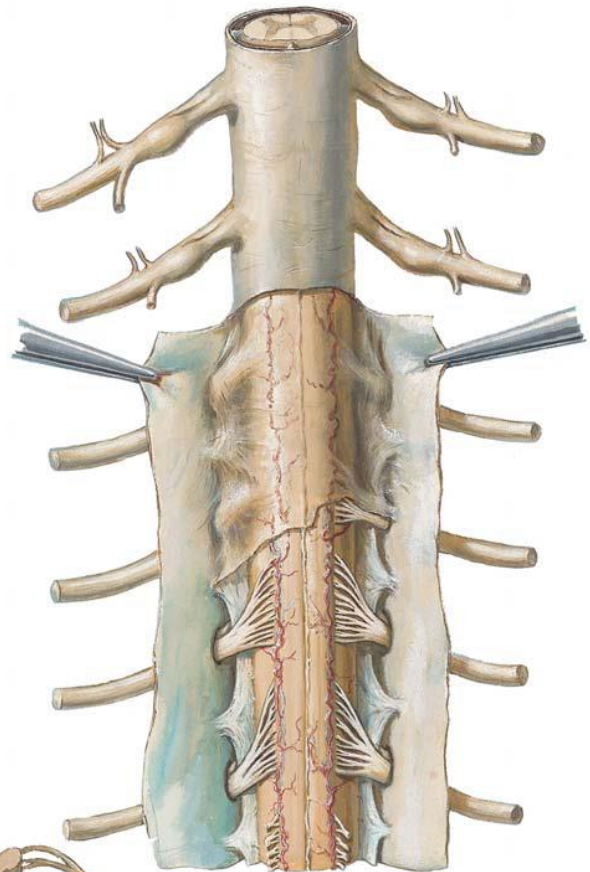
## Posterior rami:

- small
- supply skin and muscles of back
- Both rami of C1 spinal nerve are purely motor.



- Recurrent meningeal nerve: It is the first branch of the mixed spinal nerve, just outside IVF.
- it re-enters the spinal canal via IVF to supply the dura, periosteum, blood vessels & I.V. discs. It plays a role in referred pain or occipital headache



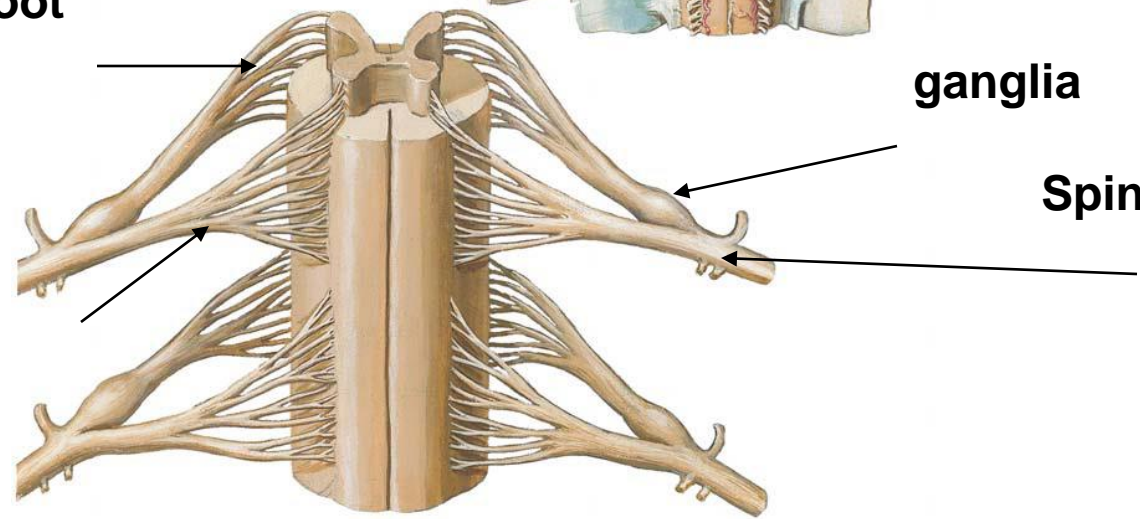


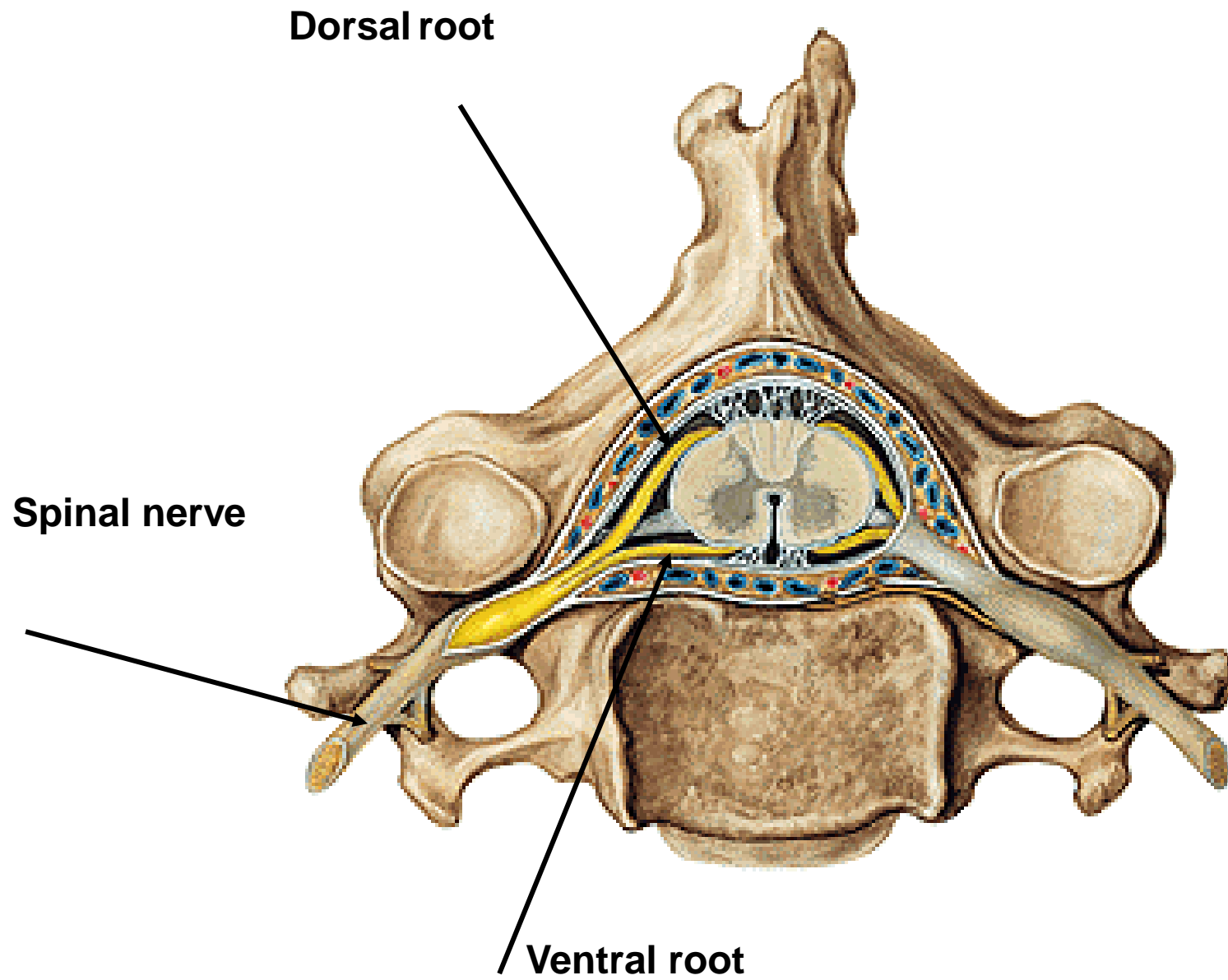
**Dorsal root**

**ganglia**

**Spinal nerve**

**Ventral root**





Thank you