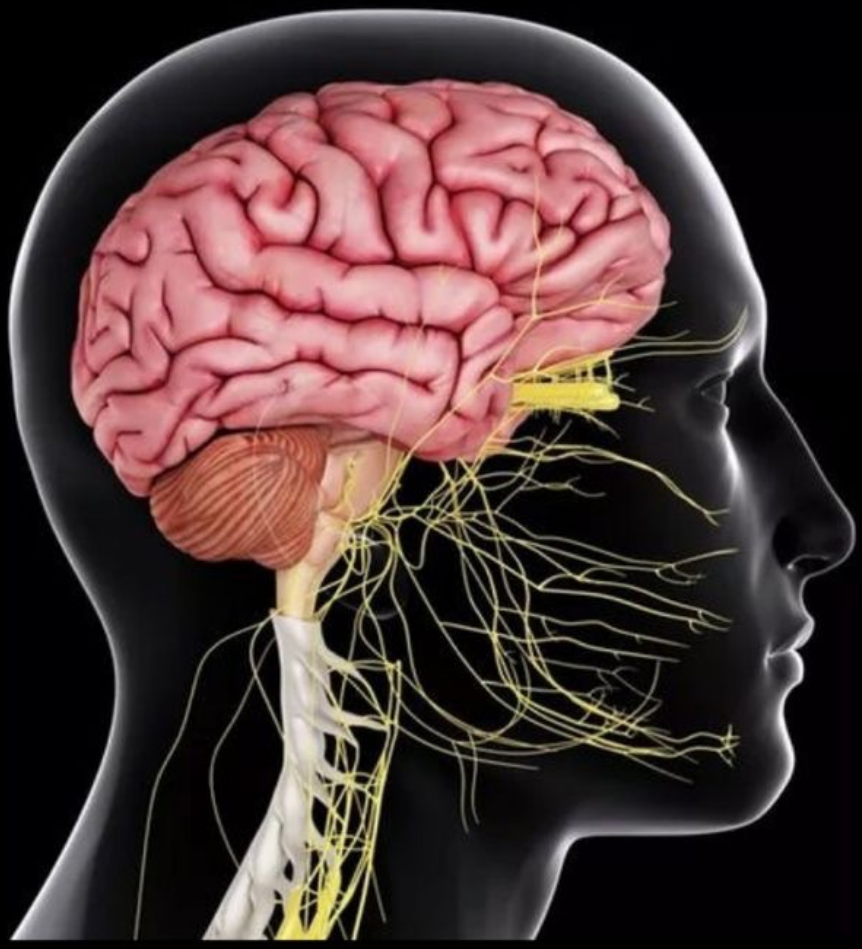
CENTRAL NERVOUS SYSTEM



SUBJECT : Anatomy

LEC NO. : 1

DONE BY : Batool ALzubaidi & Hashem Ata

وَقُل رَّبِّ زِدْنِي عِلْمًا

Introduction of Neuro anatomy

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اسئلة كل سيستم .. الهايلايت شو هو ؟ كل اشي حكاه او قراه الدكتور، التفريغ شامل ؟ اكيد طبعا كل حرف حيكون مكتوب و هاد الحكي لكل المحاضرات ان شاء الله ف اوثقوا فينا و ادعولنا

1- central nerves system

Brain and spinal cord (protected inside bone because they do not undergo regeneration)

Embryological,

Third week after fertilization (after a week of a missing period) , neural tube will arise from ectoderm

- the neural tube gives the spinal cord and three brain vesicles
  - **1. Forebrain (prosencephalon)** which gives a **median diencephalon** (its cavity is the 3 rd ventricle) and
    - **2 Telencephalon"Cerebrum"**

Will give the thalamus

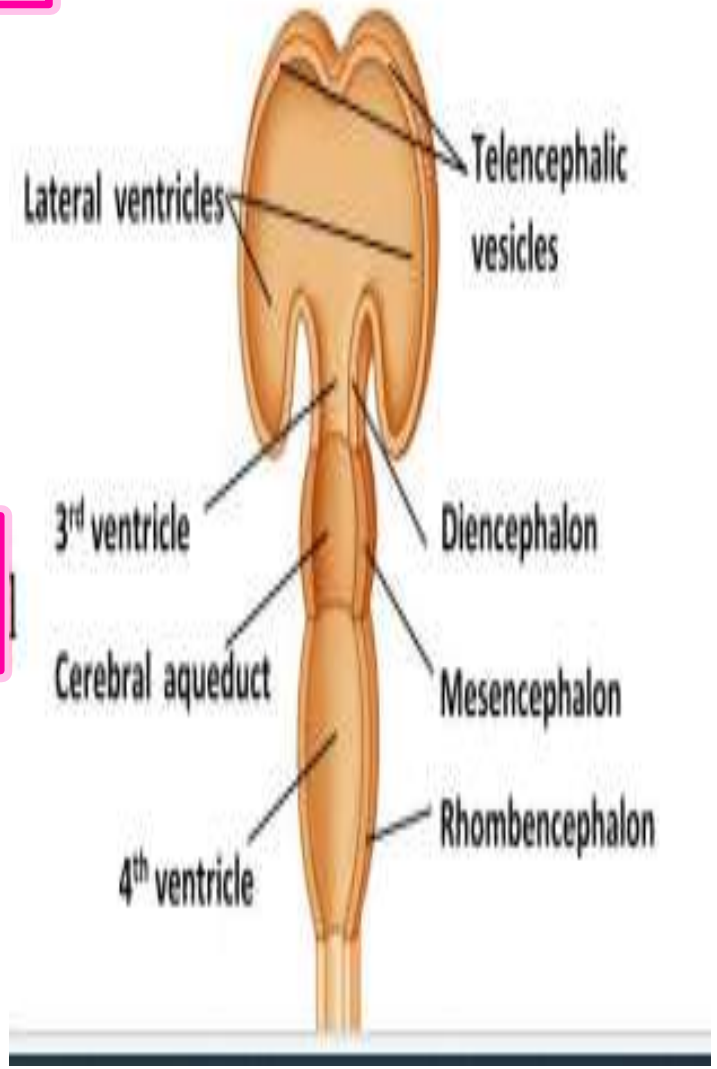
- (each contains a cavity is the lateral ventricle)

Upper part of brain stem

الي عليهم هايلايت غامق هم اسماء ال ventricles بكل جزء

- **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 th ventricle)

*Neural tube :—



skull and vertebrae ال يعني خارج bone ال تطلع برة nerves ال لـ ← Can be regenerated

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.

هاد الجزء بكون long axon

Types of neurons: According to the number of processes:

1. Unipolar (pseudounipolar): as in posterior root ganglion.

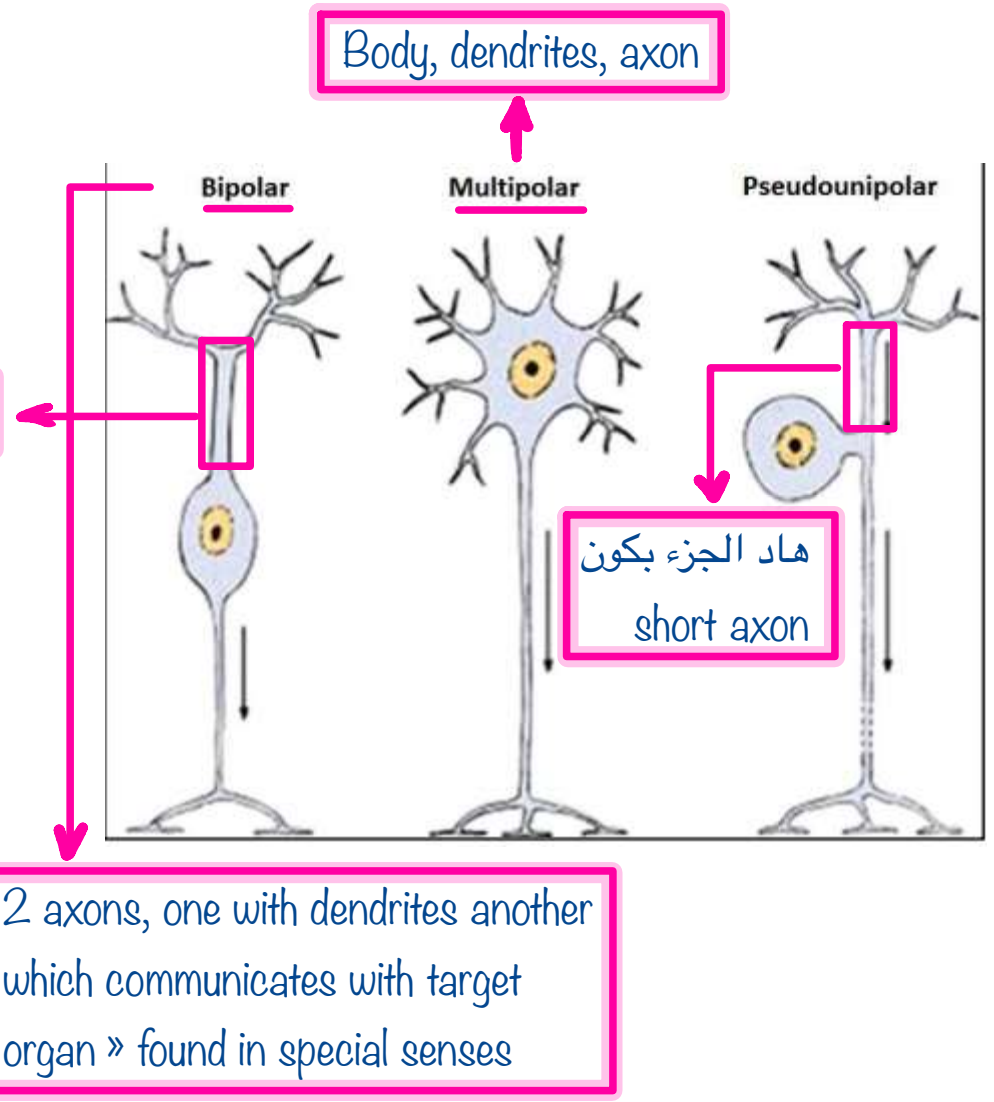
2. Bipolar: as in the retina, cochlear & vestibular ganglia + taste

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.



Servants cells for neurons

II. Glial cells:

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

Star shaped

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

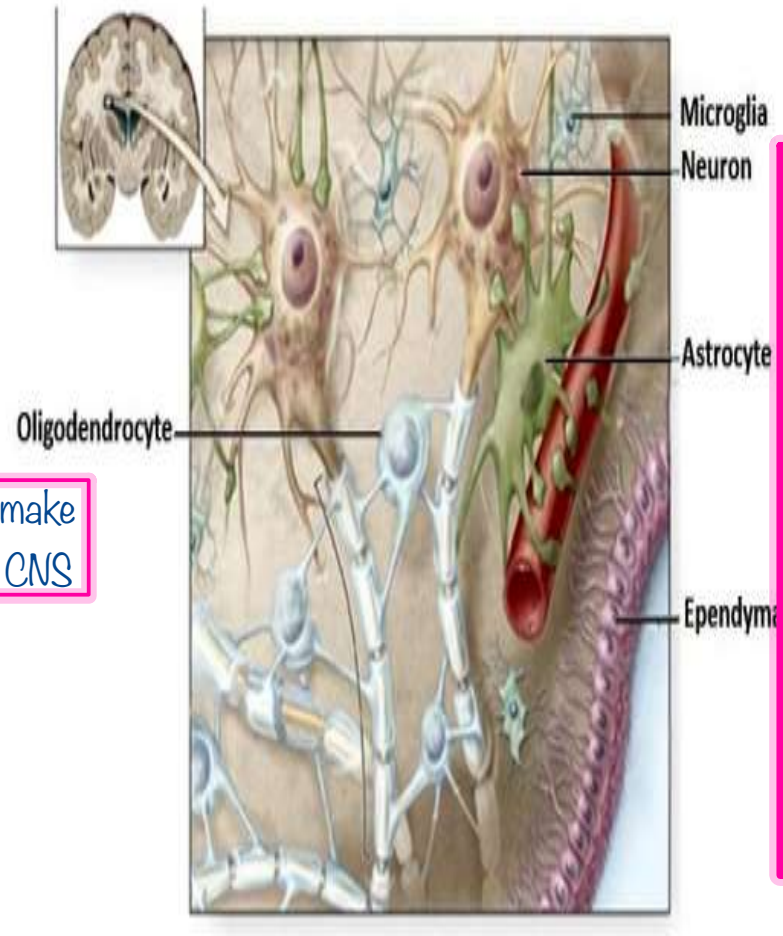
2. Oligodendrocytes: These are small cells with few processes, responsible for the formation of the myelin sheath of the nerve fibers of the CNS.

But they can't make regeneration in 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

The myelin sheath of peripheral nervous system formed by shwan cells » responsible for regeneration, that's why peripheral nervous system when injured can be regenerated



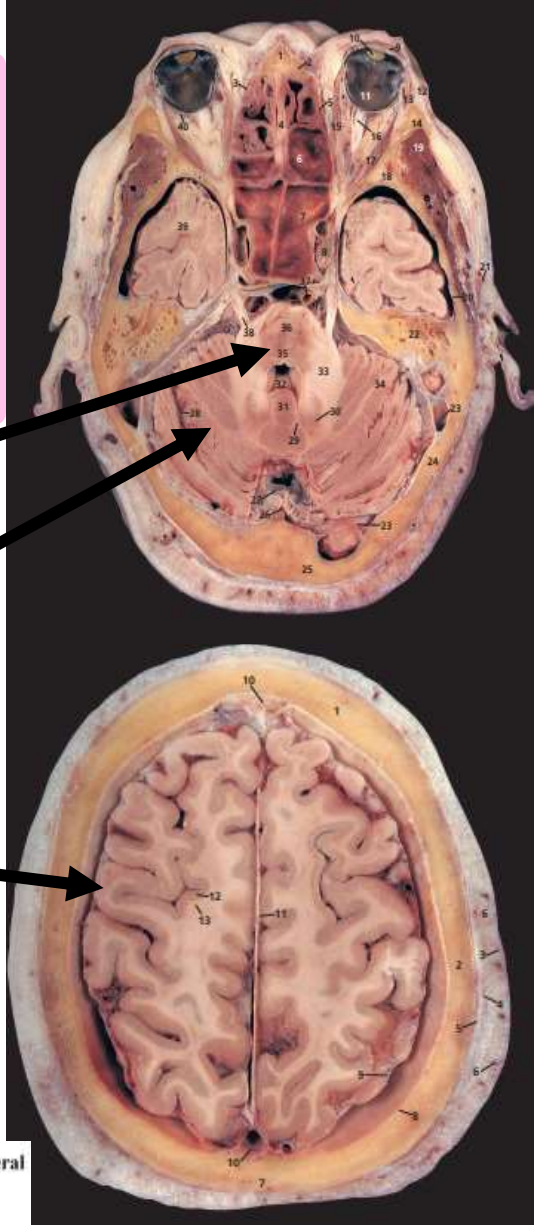
Generally speaking CNS is devoid from lymphatic tissue (no immune system), why it's isolated from lymphatic system?! To decrease the intense of autoimmune diseases to affect the cells in the central nervous system

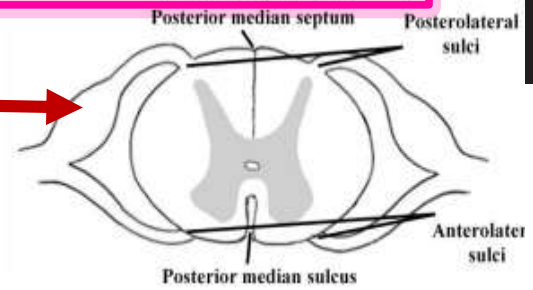
DEFINITIONS

- **Grey matter & white matter: In the CNS, the cell bodies form the grey matter while the nerve fibers form the white matter.**
  - Axons
- **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.**

لو افتح ال brain راح اشوف انه ال white matter جاي برة و ال gray matter لجوة و راح الاحظ islets of gray matter embedded inside white matter which are called nuclie

Collection of neurons outside central nervous system is called ganglia if inside central nervous system is called nuclie





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**

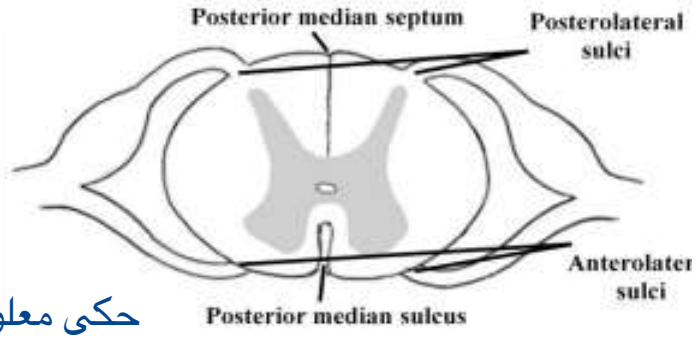
ال neuron لما يستقبل ال input راح يعمل synapse مع neuron اخر و ينقله المعلومة و هيك بكون عمل tract تاني

Special nerve fibers

يعني ال tract كان على اليمين و مرة وحدة عمل cross و صار على الشمال و طلع على جهة الشمال او العكس

Spinal Cord
Gross morphology & internal structure

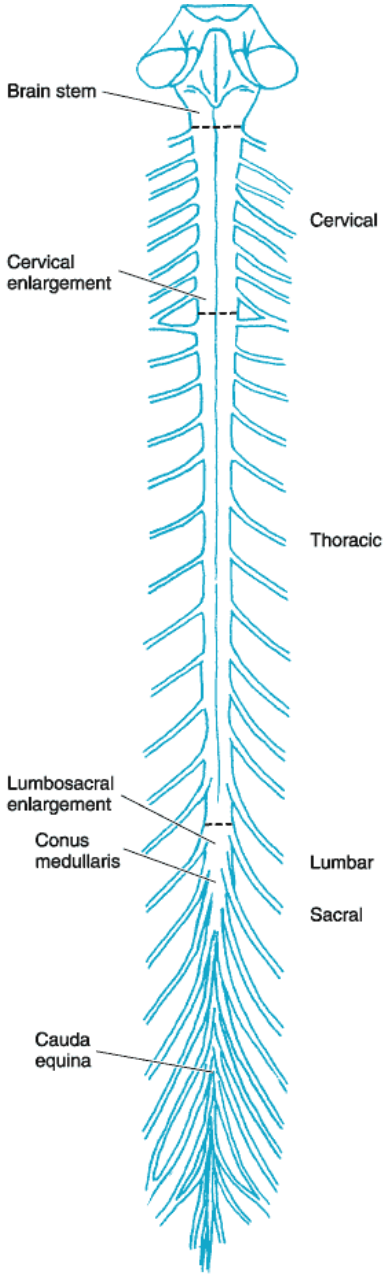
External Features



حكى معلومة مهمة

- 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 lumber 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 anteorlateral & 2 posterolateral sulci

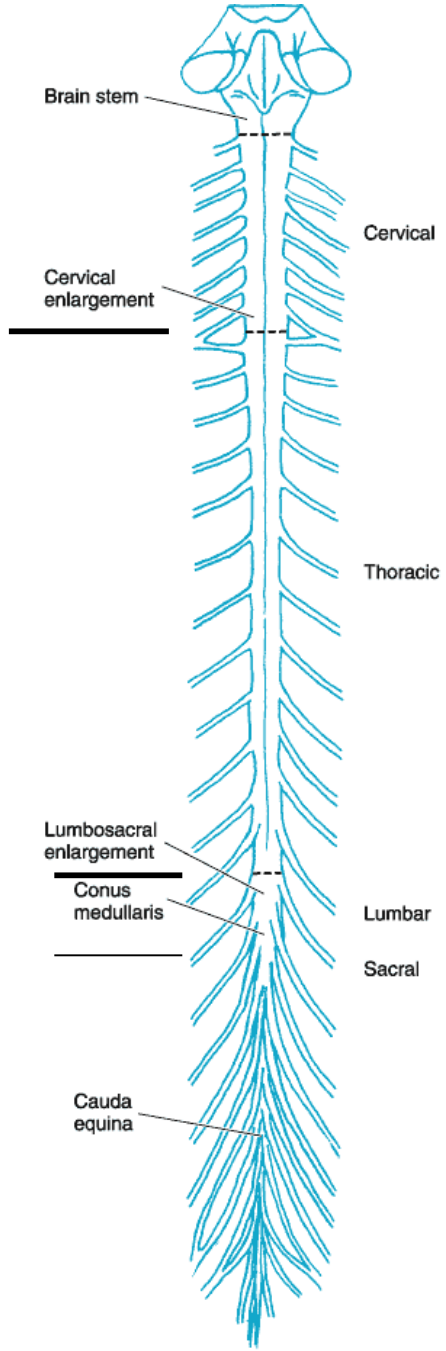
لما الجنين يكون ببطن امه بكون ماخد طول ال vertebral column كامل، و لكن ال growth of بصيرله بس بكون limited و لما ينولد بكون عند L3 و بس يكبر بوصل لل level of
اسرع من ال bone growth of central nervous system بالتالي ال canal بتكبر و هو

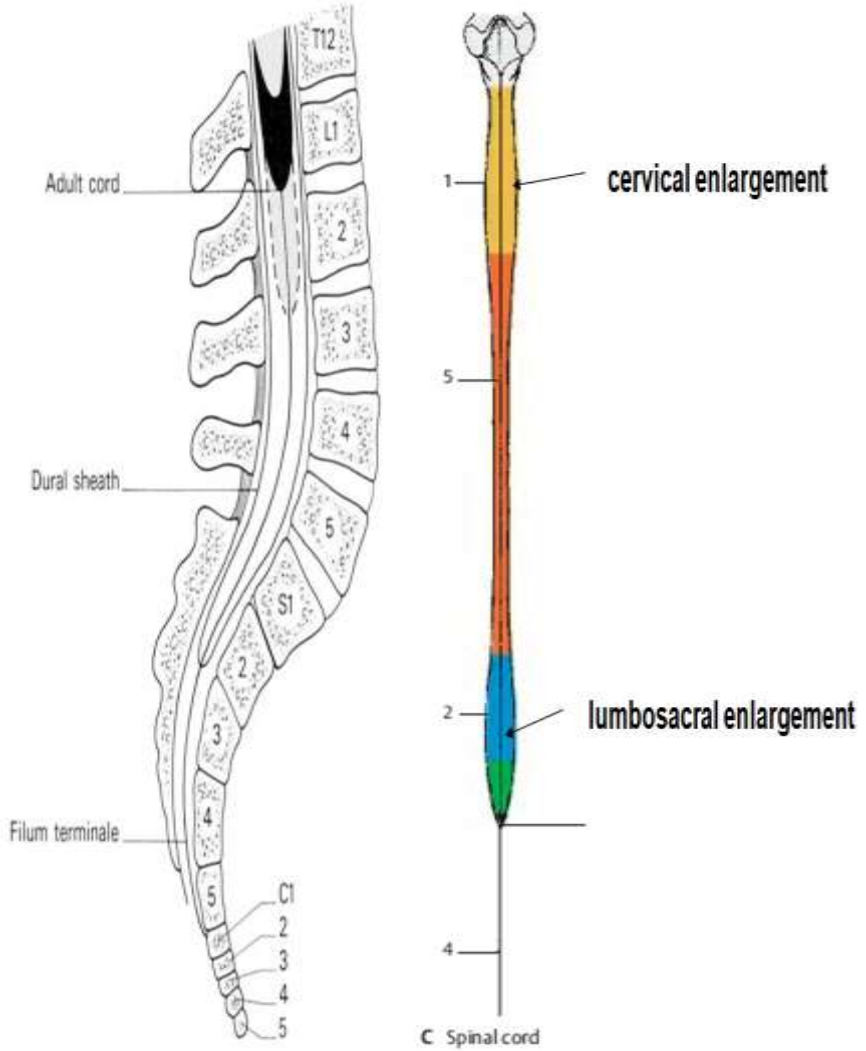


Cervical enlargement:
C4 toT 1
Source of brachial plexus

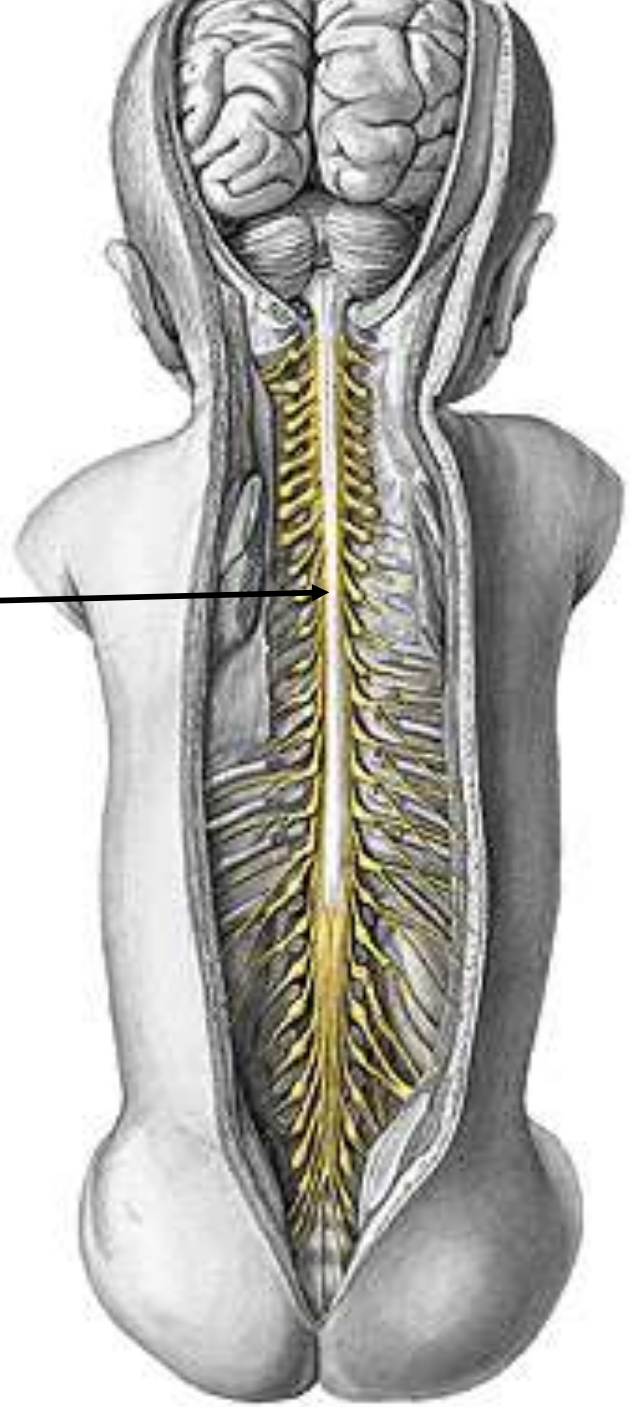
Lumbar enlargement :
L1 to S4
Source of nerves to lumbar & Sacral plexus

Cervical » gives brachial plexus which supplies muscles and sensations of upper limbs, lumbar » supplies muscles and sensations of lower limbs





Spinal cord



تذكروا ال dorsal rami طالع من ال dorsal horn و بكون pure sensory و ال ventral rami بطلع من ال ventral horn و بكون pure motor و بتجمعوا مع بعض بعملوا one spinal nerve بكون mixed بطلع من intervertebral foramen في ال vertebral canal و هيك بطلع من ال bone و بعمل ال nerve

Grooves and Segments

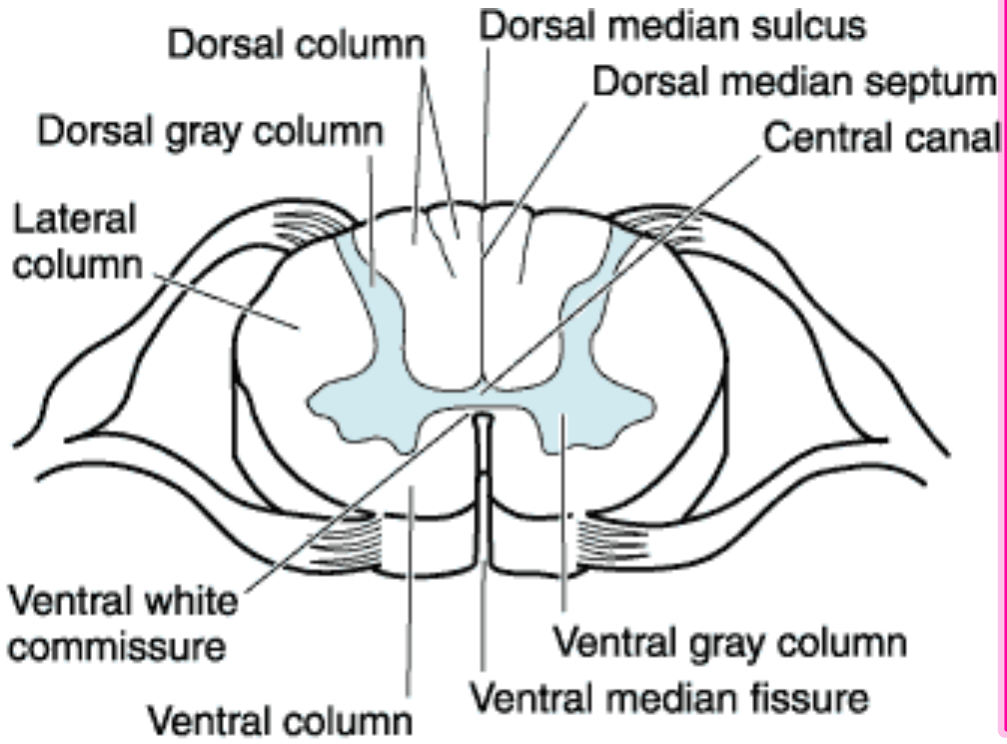
- 31 segments
- 8 cervical, 12 thoracic, 5 lumbar, 5 sacral& 1 coccygeal
- each segment gives origin to a pair of spinal nerve

مع انه عدد ال cervical vertebrae سبعة

Grooves:

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

Corresponding to the nerves



كل segment بكون مقابل ال vertebrae تاعته في الجنين اما لما يكبر بنشد لفوقو راح ناخد الاشي هاد بالتفصيل المحاضرة الجاي

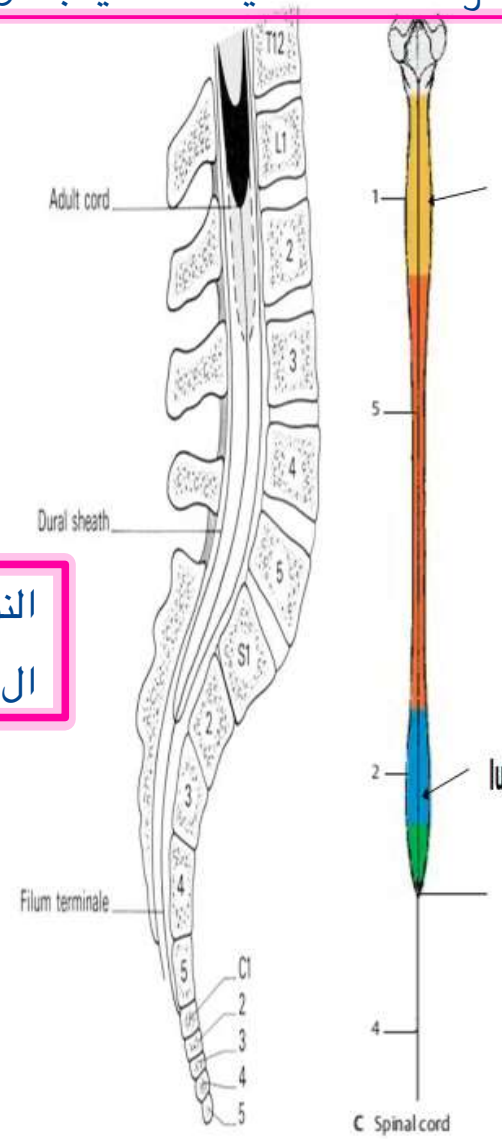
حكينا انه ال spinal cord قصير و نهايته عند اا هاد يعني انه مش كل ال segments بتكون corresponding لل vertebrae تاعته يعني مش شرط ال cervical يكون عند ال cervical vertebrae و انه ال thoracic segment تكون قبال ال thoracic vertebrae و هكذا

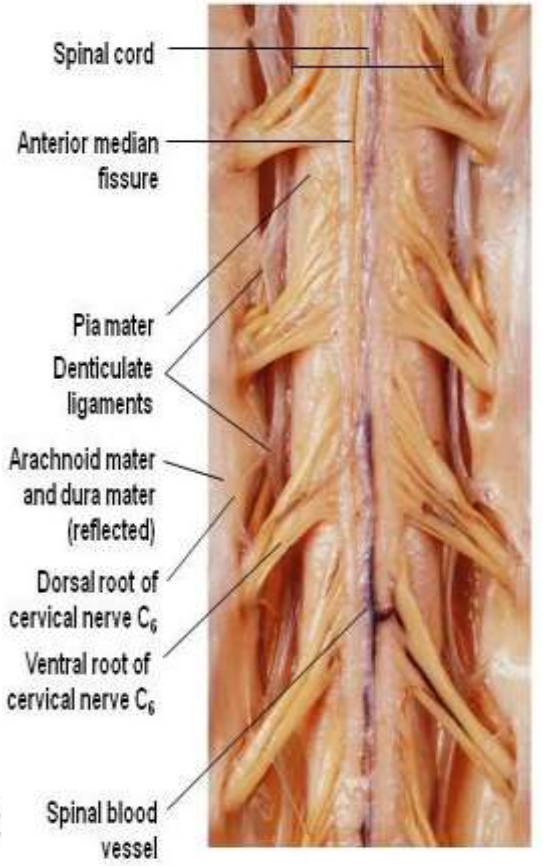
كيف اعرف امام من الخلف في ال spinal cord؟ في ال dorsal root ganglia بتكون موجودة بالخلف، و ال H shape تاع ال gray matter بكون سميك من ناحية ال anterior و رفيع او tapering ناحية ال posterior

Coverings:

ال meninges الأغشية السحائية بغطوا كل ال CNS

- 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& → It's like a cushion around brain

II- 3 Ligaments supporting the spinal cord:

النوتس الي حكاه عن coverings و ال filum ligament بالصورة تحت

a. Filum terminale.

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

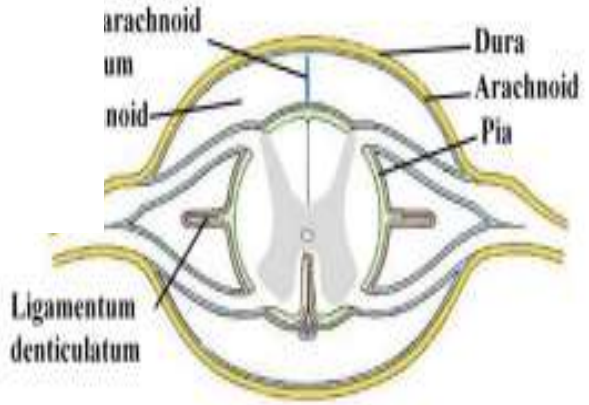
it has 21 teeth connecting the pia (on one side) to the arachnoid and dura (on the other side).

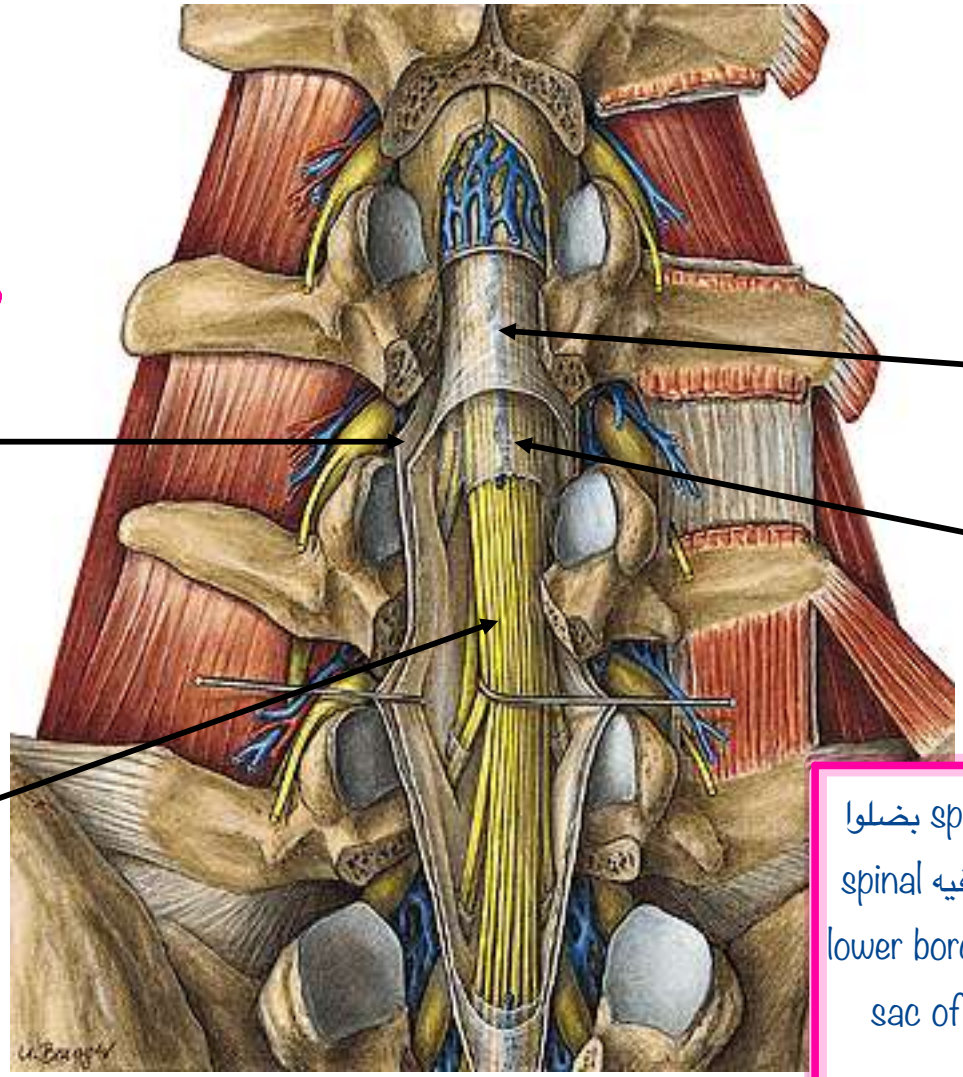
c. Subarachnoid septum: extends from the posterior median septum to the arachnoid mater

Subdural space ; between dura and arachnoid contains fluid

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

ركزوا انهم برة حكينا جوة ما في





Tough fibrous layer attached to bone

الام الجافية ← **Dura**

Vascular layer

Arachnoid → الام العنكبوتية

Pia → الام الحنون

Adherent to the brain, spinal cord and brain stem

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

النوتة تحت و حكى راح نرجعلها المحاضرة الجاي بالتفصيل

ال dura و ال arachnoid ما بنتهوا عند اا زي ال spinal cord بضلوا مكملين لعند level of S2 (الجزء منهم من عند اا ل S2 ما فيه spinal cord) .. اما ال pia بتنتهي عند ال lower border of the spinal cord بس بتكمل زي الخيط ماشي جوا ال sac of arachnoid and dura لحد level S2 بعدين بعمل penetratiion بثقبها و بكمل لاخر coccygeal piece و بسمي هاد الجزء filum terminal و الي بعمله انه بشد ال spinal cord لتحت عشان ما يتحرك يمين و شمال

Internal Structure

شو هي ال cuada equina؟ مش حكينا الجنين ببطن امه ال spinal cord بكون على طول ال vertebrae كلهم و بكون كل nerve طالع من ال corresponding vertebrae و بعدها بقصر ال spinal cord بس ال nerves لسا بتطلع من ال vertebral foramens تاعتها يعني nerve S2 راح يطلع من vertebrae S2 و لكن ال origin راح يكون من ال segment الي عند ال lumbar region .. ف ال collection تاعت نهاية ال lumbar,sacral,coccygeal nerves راح يتجمعوا ك nerves منفصلة بالكيس تاع ال dura and arachnoid و اسميهم cauda equina زي ذيل الحصان

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

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

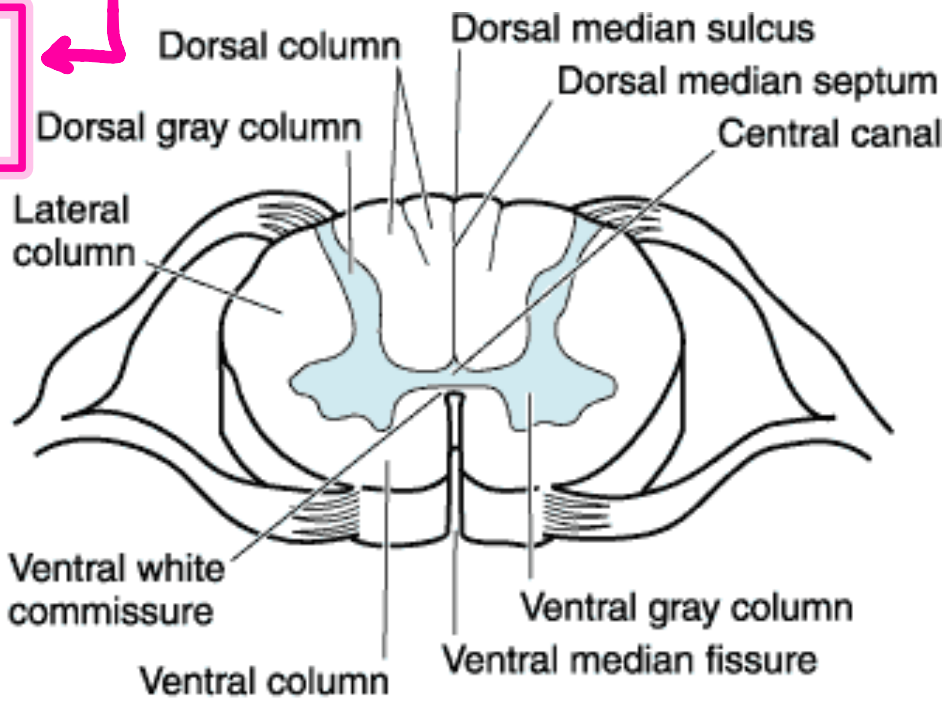
Sympathetic fibers

ممكن الاقي axons مع ال cell بس بتكون unmyelinated bodies

White matter; 3 columns (myelinated nerve fibers)

- Anterior
- Lateral
- posterior

Central canal: narrow canal throughout the length



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:

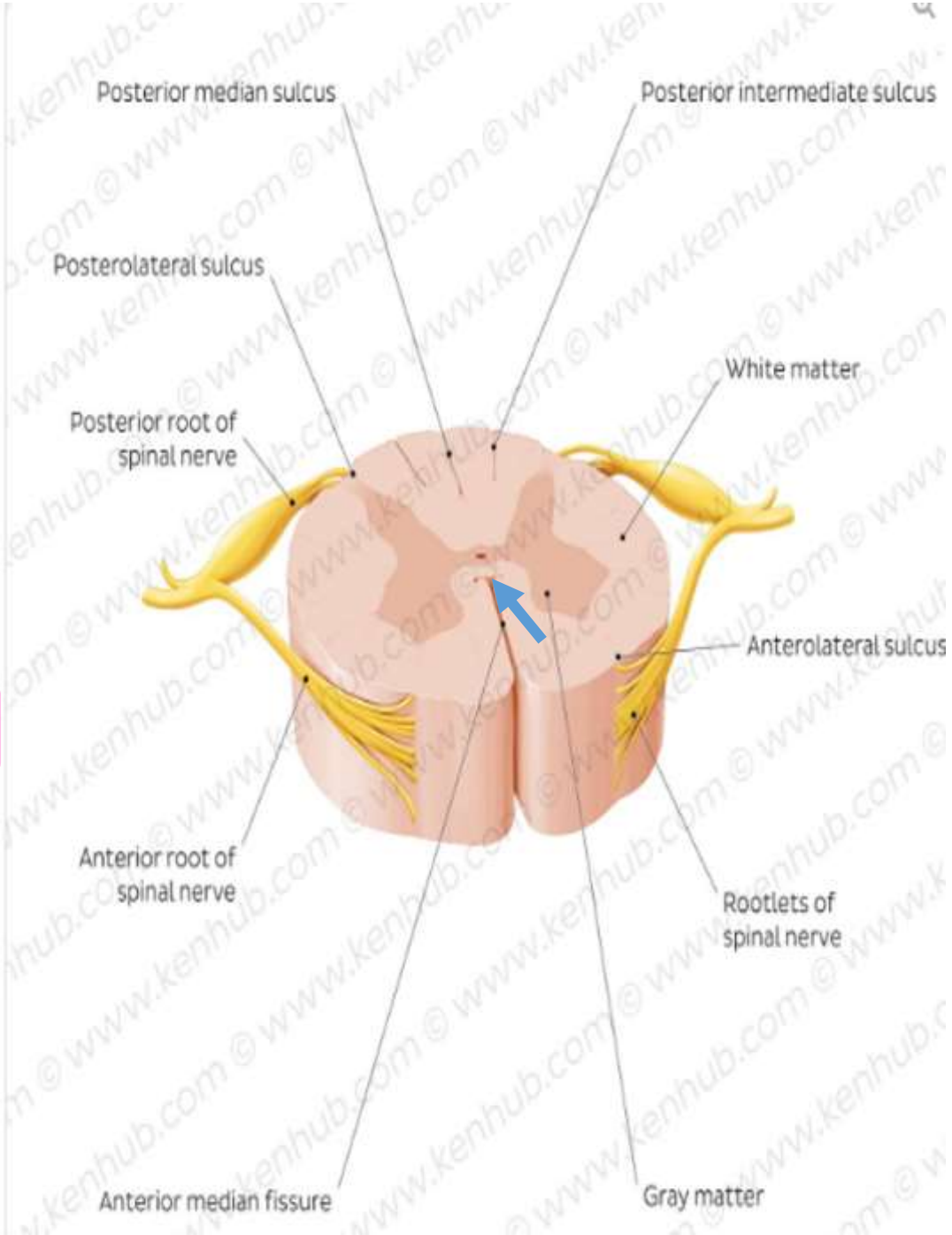
White = myelinated axons

1- White commissure: behind the anterior median sulcus.

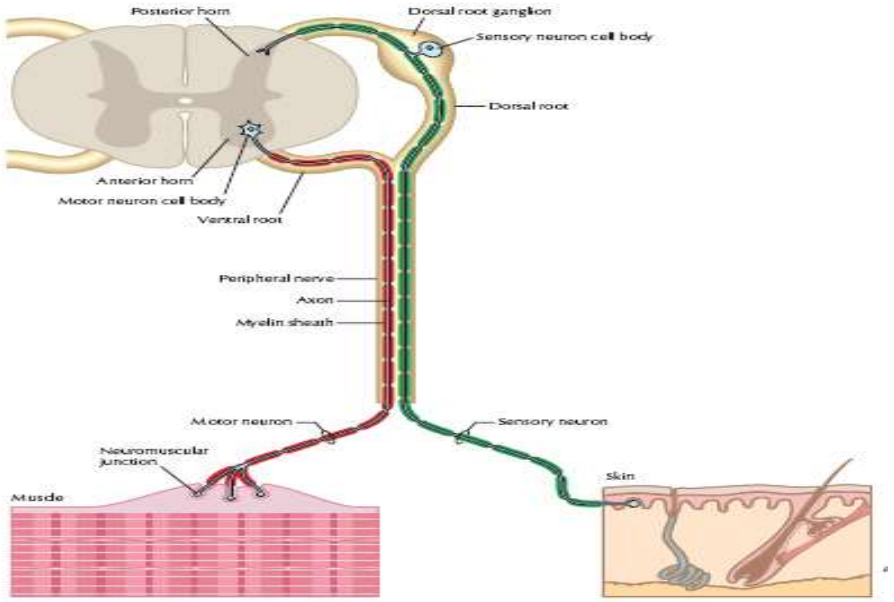
2- Anterior grey commissure: infront of the central canal.

Grey = umyelinated axons

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:

Supplies most of body muscles

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

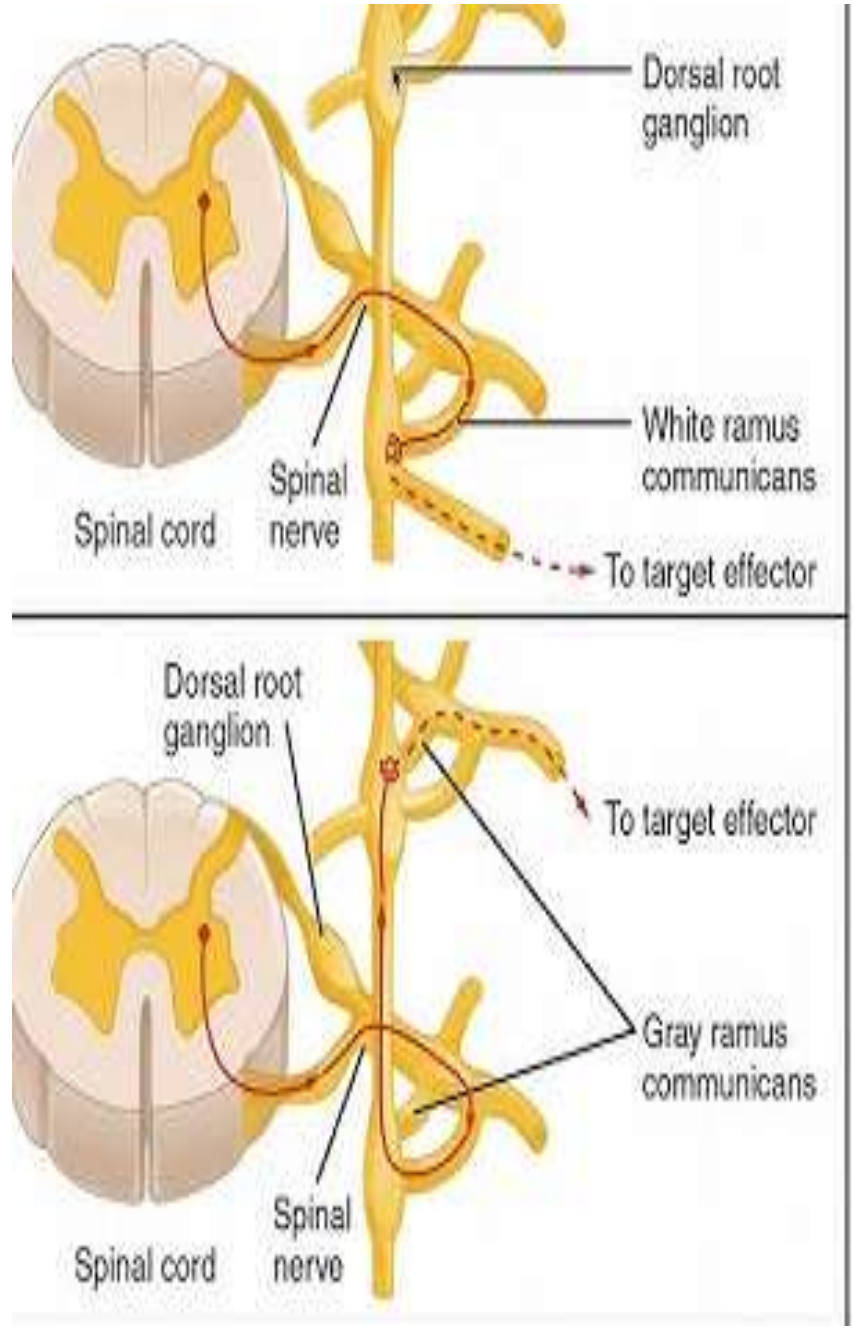
Distributing to the 23 pairs of sympathetic ganglion, then the ganglion send back the **postganglionic grey rami communicants** To all the 31 anterior rami to reach the target effectors.

حكى هاي المعلومة ما راح ننسال فيها لانها PNS و راح تنعاد

Posterior rami:

- small
- supply skin and muscles of back

- Both rami of C1 spinal nerve are purely motor.

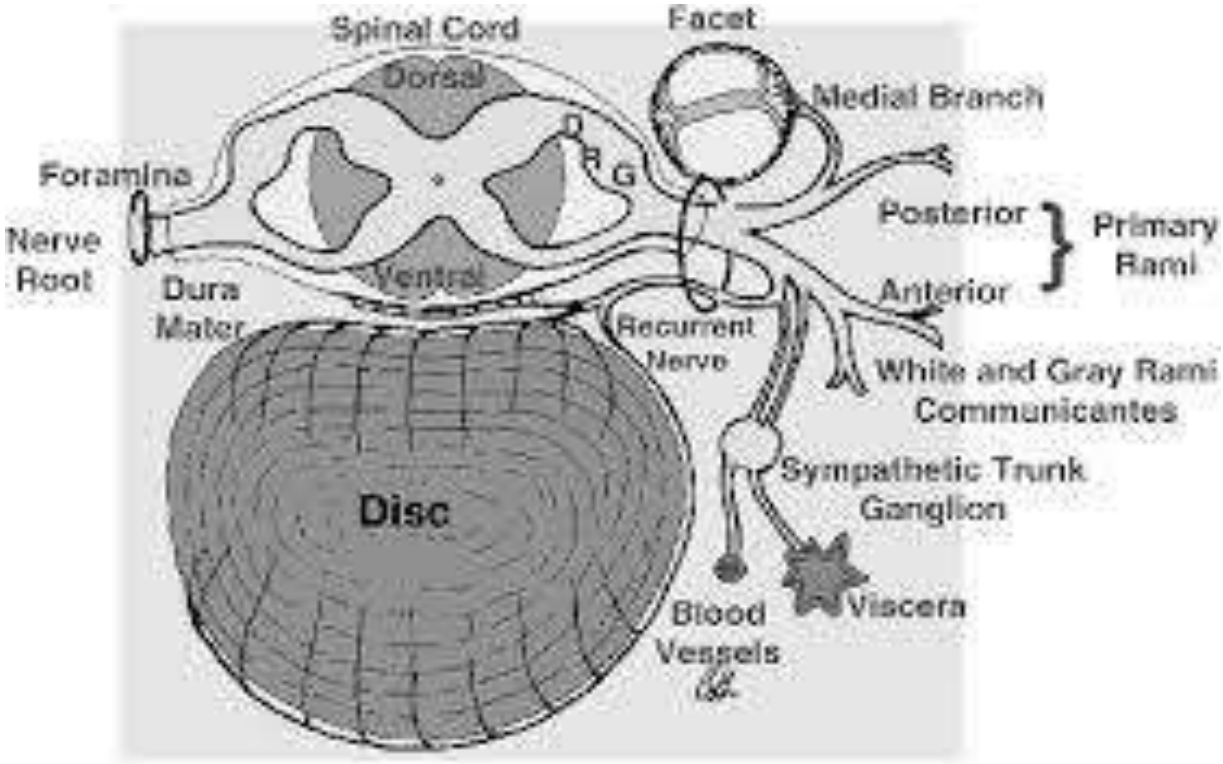


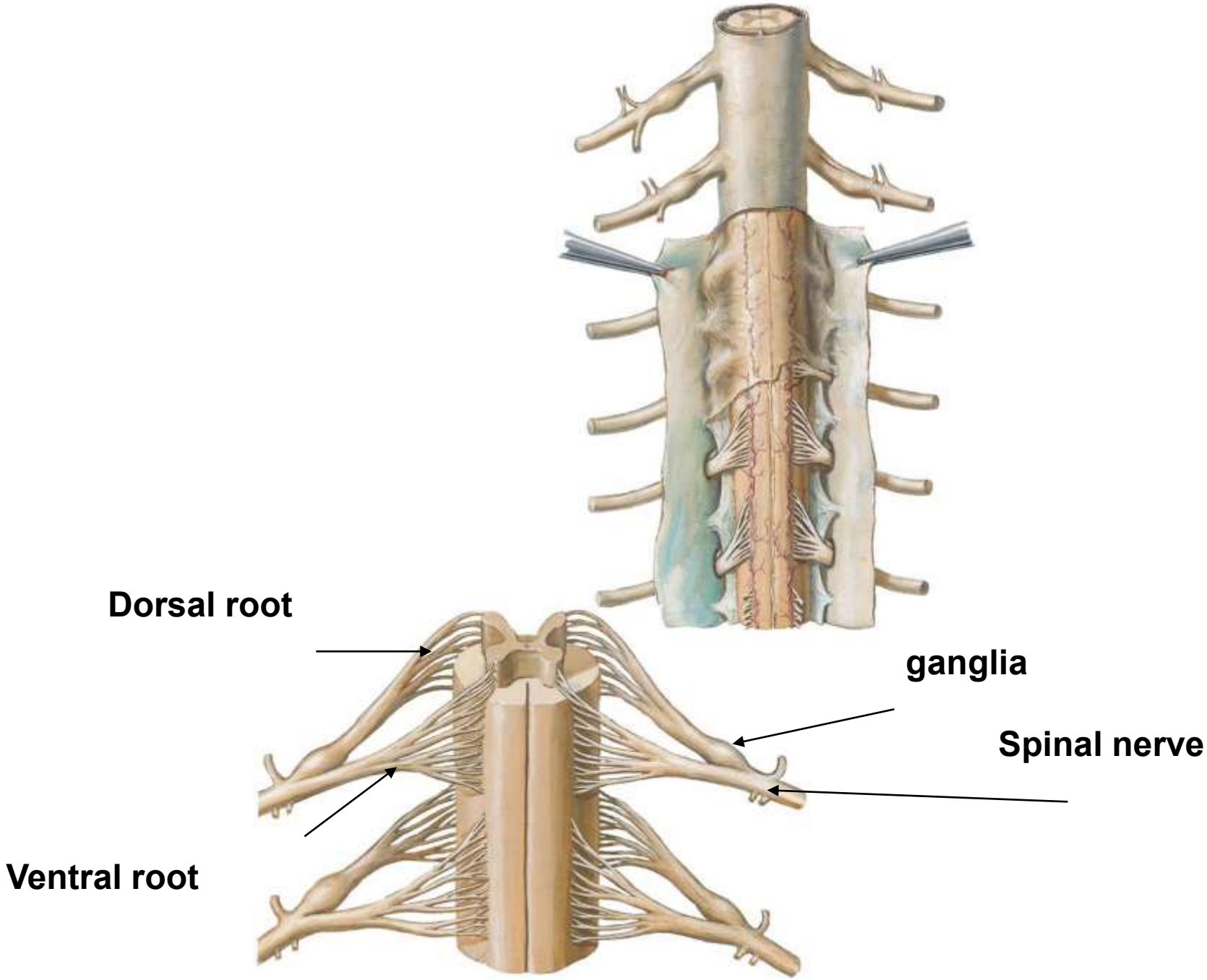
sensation فقط

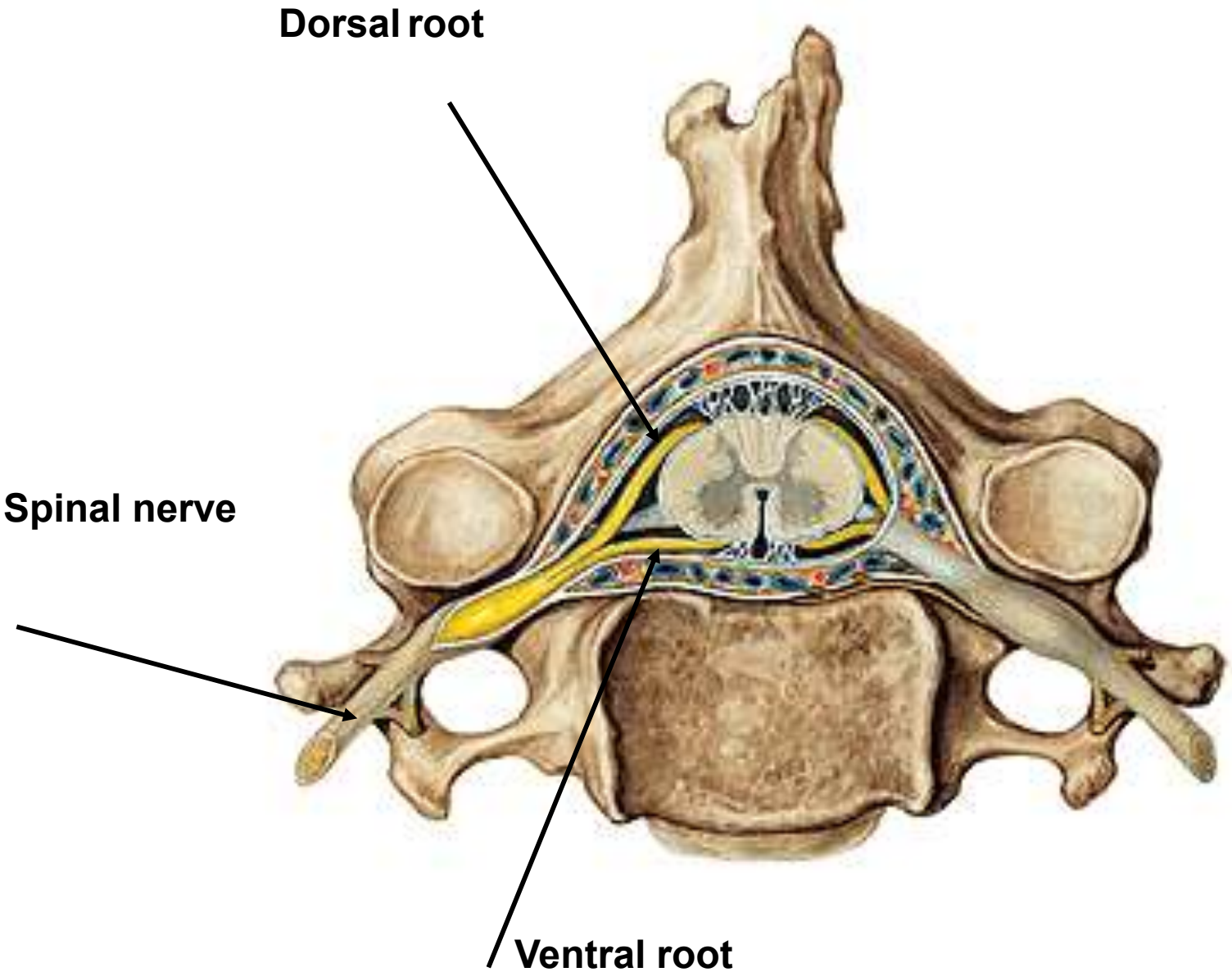
➢ Recurrent meningeal nerve: It is the first branch of the mixed spinal nerve, just outside IVF.

➢ 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

يعني لما حدا يجي عنده مشكلة بضهره او اشي راح يكون عنده صداع بالراس من فوق عند occipital ليش؟ بسبب هاد ال recurrent nerve الي بطلع من ال ventral rami




Dorsal root
ganglia
Spinal nerve
Ventral root


Dorsal root
Spinal nerve
Ventral root

خلوا ال feelings على جنب و ركزوا على ال goals مو ضايللناغير سيستمين كل ما حسيتوا انكم تعبتوا تذكروا قربنا نخلص basic

Thank you