

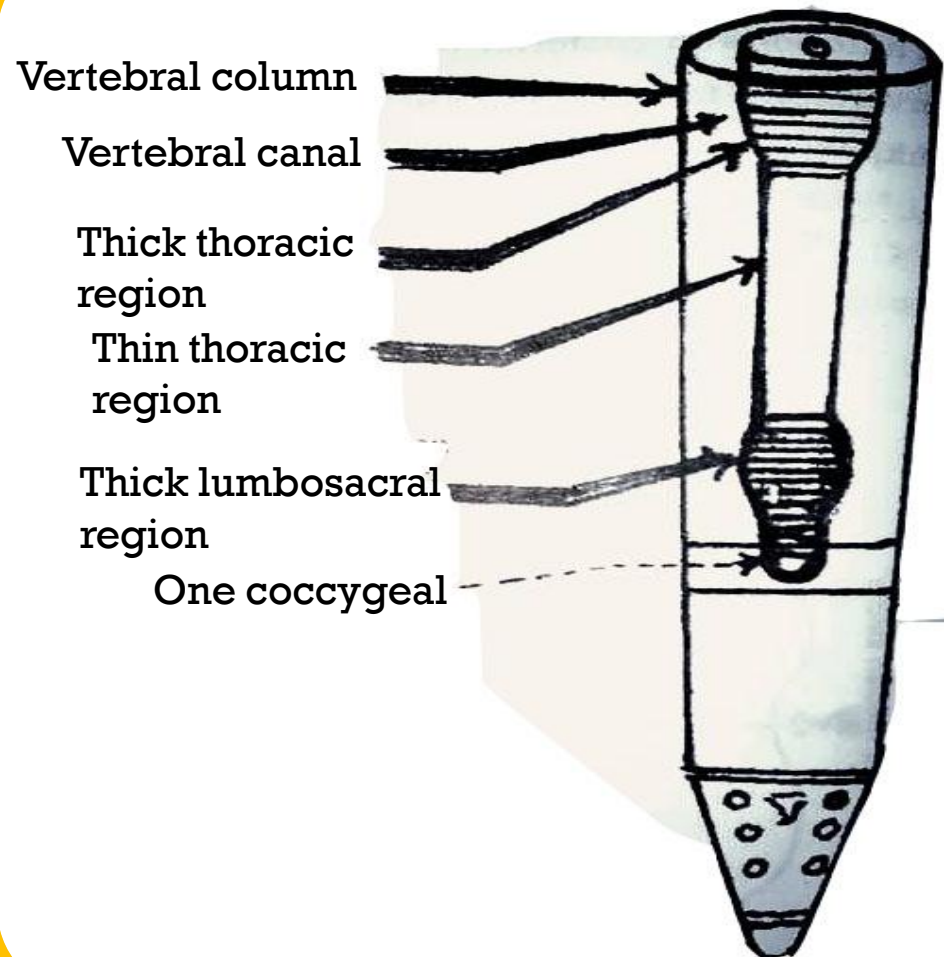
ANATOMY OF SPINAL CORD

Second year Tanta University, Egypt

The Spinal Cord

- ❑ It's the lower part of central nervous system.
- ❑ Its located in the vertebral column and extends from the level of foramen magnum to end (by conus medullaris) at the first lumbar.
- ❑ So, the rest of lumbar,sacral and coccygeal part of spinal cord are free from spinal cord i.e. the spinal cord is shorter than vertebral canal.
- ❑ The cord itself has thick cervical region (origin of brachial plexus) thin thoracic and thick lumbosacral (origin of lumbosacral plexus).

Spinal Cord Segments



Developmental age changes of the spinal cord

Intrauterine life

- The cord fills the whole length of the vertebral canal.

At birth

- Lower end of the cord is found at the level of third lumbar vertebrae (L3)

Adulthood

- The lower end of spinal cord recedes to the first lumbar vertebral (L1). It's adult length is about 45 cm.

External Features of Spinal Cord

- **Shape** : Cylindrical
- **Weight** : 30 grams
- **Diameter** : 1 cm
- **Length** : 45 cm (males)
42 cm (females)

Fixation

- Denticulate ligament
- Filum terminale
- Spinal nerve roots
- Fixation of its dura to foramen magnum
- Linea Pledius

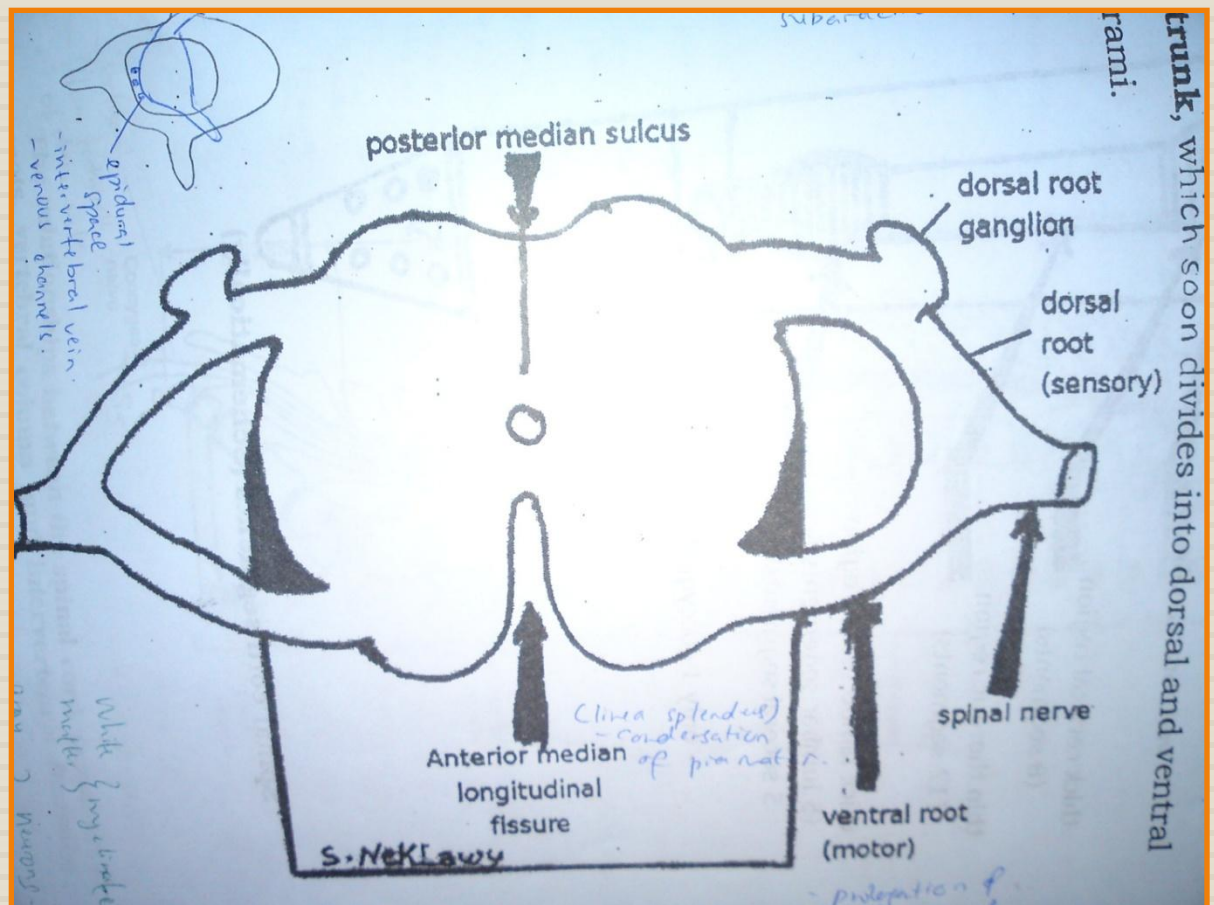
Sulci of Spinal Cord

- ❑ Anterior median fissure
- ❑ Posterior median sulcus
- ❑ Two anterolateral sulci
- ❑ Two posterolateral sulci

Spinal Nerves

- ❖ 31 pairs
- ❖ 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, 1 coccygeal

Exterior surface of spinal cord



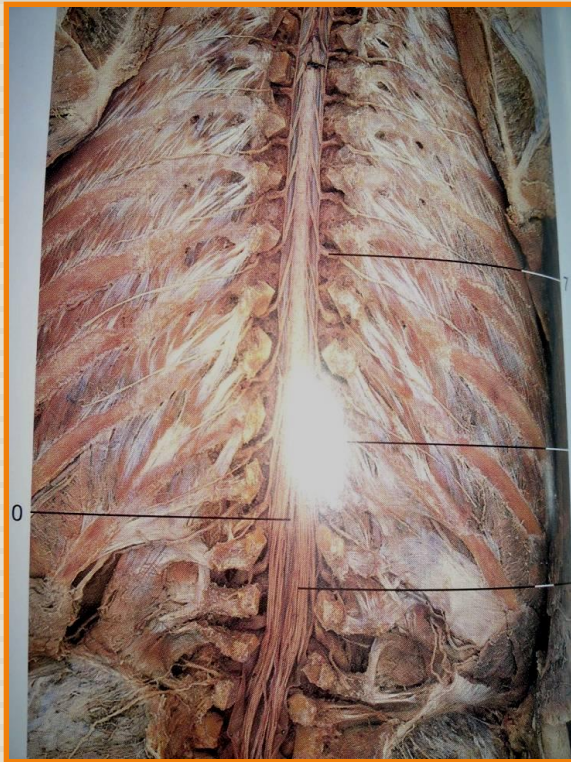
Terminal part of Spinal Cord



Thoracic Portion of Spinal Cord



Spinal Cord in Vertebral Canal



Spinal Cord and Medulla Oblongata



INTERNAL FEATURES OF SPINAL CORD

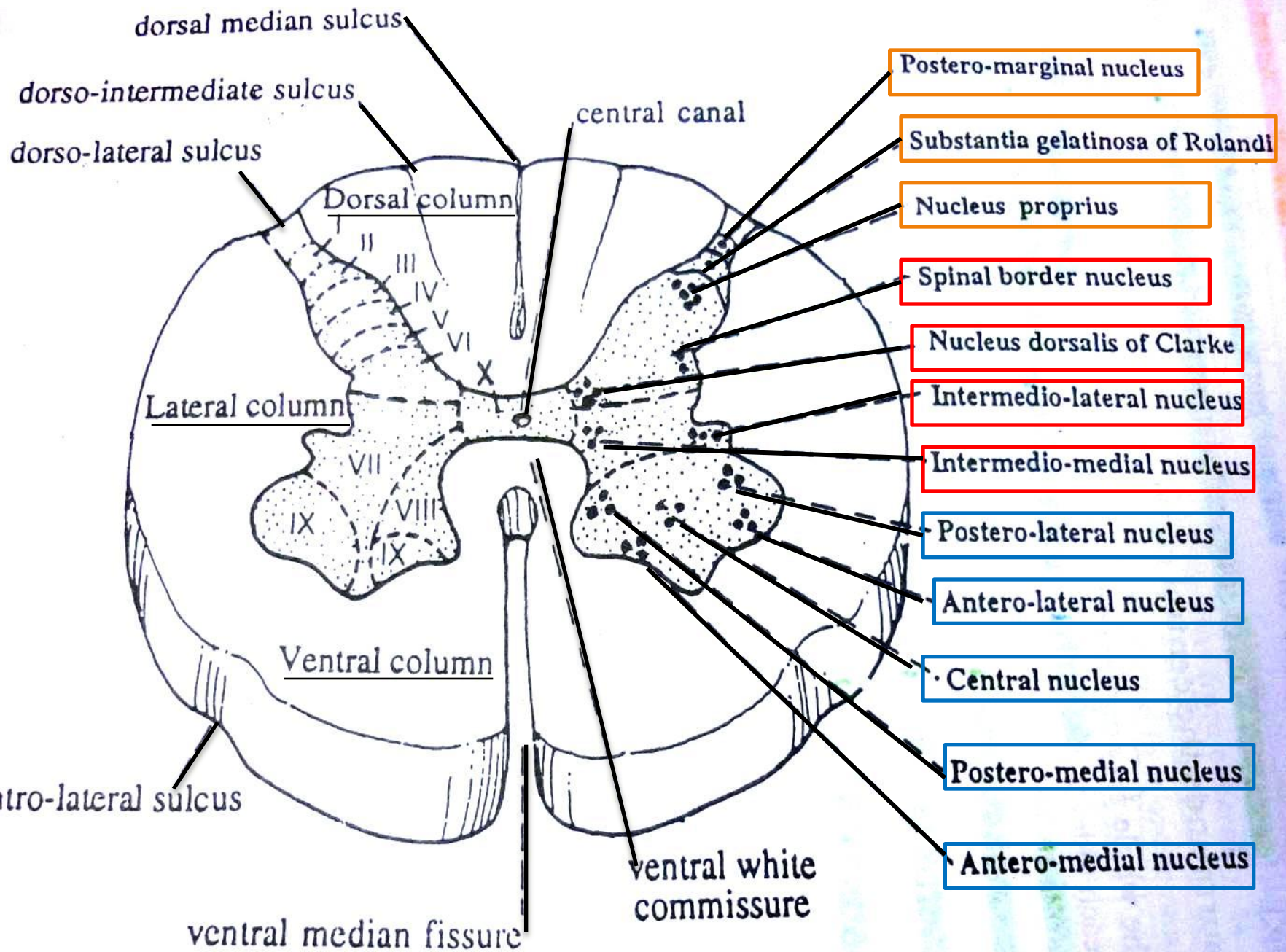
- Inside spinal cord, there is a central canal which contain fluid called **cerebrospinal fluid (CFS)**. The canal is surround by **grey matter** in form of **H-shaped horns**.
- There are 6 horns present in spinal cord :
 1. **2 dorsal horns**
 2. **2 lateral horns**
 3. **2 ventral horns**

□

	2 DORSAL HORNS (sensory horns)	2 VENTRAL HORNS (motor horns)	2 LATERAL HORNS (autonomic horns)
POSITION IN SPINAL CORD	Along the whole segment of spinal cord	Along the whole segment of spinal cord	Thoracic segment & lumbosacral segments
FUNCTIONS	Sensory functions	Motor functions	Autonomic functions
NUCLEI	<p>Receive exteroceptive and proprioceptive. The nuclei are :</p> <ol style="list-style-type: none"> I. Substantia gelatinosa of Rolandi II. Main sensory nucleus III. Nucleus dorsalis of Clarke 	<p>Supply skeletal muscle. The nuclei are :</p> <ol style="list-style-type: none"> I. Antero-medial nucleus II. Antero-lateral nucleus III. Postero-medial nucleus IV. Postero-lateral nucleus V. Central nucleus 	<p>Supply visceral structures. The nuclei are :</p> <ol style="list-style-type: none"> I. Intermedio-medial nucleus II. Intermedio-lateral nucleus

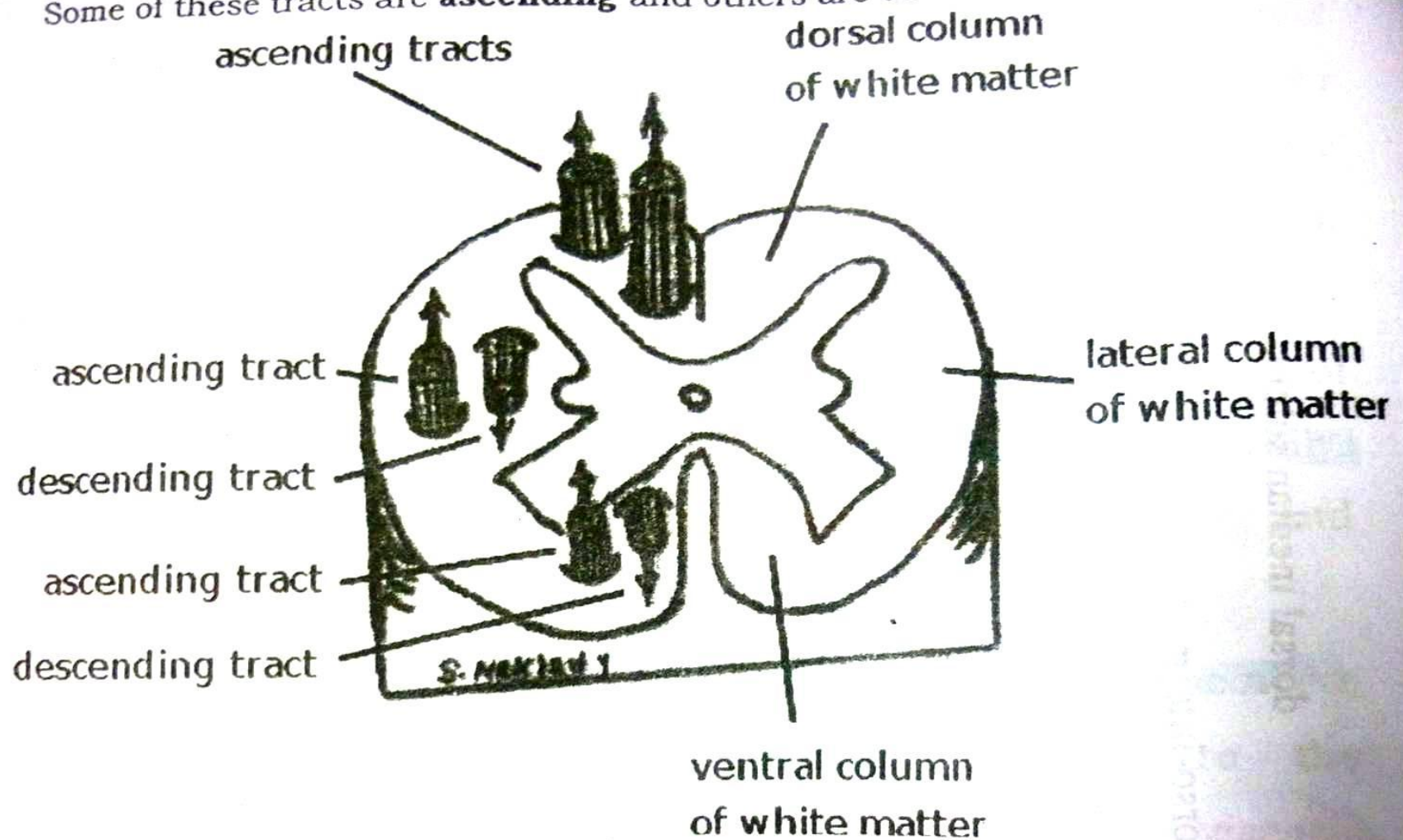
□ Nerve cells are arranged into 10 laminae; which have different properties :

1. **Lamina I**- at the tip of dorsal horns
2. **Lamina II until VI** - along dorsal horns
3. **Lamina VII and VIII** – at ventral horns
4. **Lamina IX** – at anterior part of ventral horns
5. **Lamina X** – around central canal



- Whole of the gray matter is surround by **white matter**.
On each side, there are **3 columns** saparated by sensory and motor horns.
 1. **Dorsal column**
 2. **Ventral column**
 3. **Lateral column**
- Through these column, there are nerves bundles called **tracts** running which classified into two groups; **ascending** and **desending tracts**.

Some of these tracts are ascending and others are descending



Some ascending and descending tracts in the columns of the spinal cord

Sensory and Motor Nuclei of Spinal Cord

NUCLEI	SITE	FUNCTIONS
1. Substantia gelatinoza of Rolandi	At tip of sensory horn of all segments	<ul style="list-style-type: none">• For pain and temperature sensation• Give 1st order neuron of lateral spinothalamic tract.
2. Main sensory nucleus (Nucleus propius)	At middle of sensory nucleus in all segments	<ul style="list-style-type: none">• Receive crude and presure sensation• Projects 1st order neuron of ventral spinothalamic tract

3. Nucleus Dorsalis (Clark's Coloumn)	At base of sensory horns of all thoracic segment and upper 3 lumbar	<ul style="list-style-type: none"> • Receive proprioceptive sensations from collateral branch of gracile tract. • Starts dorsal spinothalamic tract of same side • Starts ventral spinothalamic tract of same and opposite side
4. Lateral Nucleus (autonomic)	At lateral horn of all thoracic segment and upper 3 lumbar, and appear again at sacral 2,3,4.	<ul style="list-style-type: none"> • Autonomic (parasympathetic and sympathetic)
5. Ventro-medial motor nuclues	At middle part of motor horns in all segment.	<ul style="list-style-type: none"> • Effect axial musculature

6. Dorsal-medial motor nucleus	At thoracic and upper 3 lumbar	<ul style="list-style-type: none"> Supply axial muscle
7. ventro-lateral & dorso-lateral nuclei	Along lateral plane of motor horns in cervical and lumbosacral on.	Supply axial muscle
8. Central motor	In cervical and lumbosacral motor	<ul style="list-style-type: none"> Supply axial muscle

diagram

Functions of spinal cord

SENSORY

- Receives superficial general sensations from skin and mucous membrane from all of the body except face and other body organ
- Superficial external sensations is called Exteroceptive sensations
- Proprioceptive sensations receive deep types of sensation from tendons and muscles

MOTOR

- Motor nuclei convey efferent fibers which pass through spinal nerves to control all muscles of body except muscles of head and neck

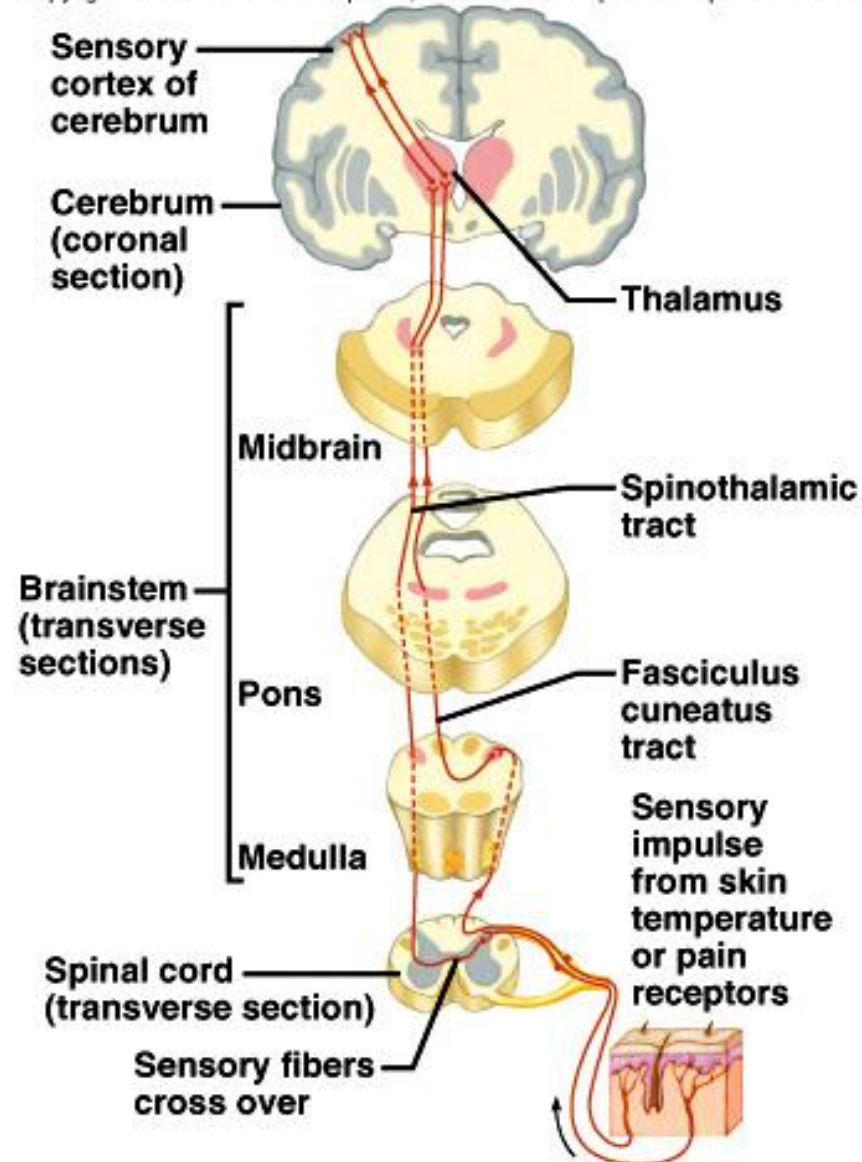
AUTONOMIC

- Sympathetic nuclei are found at thoraco-lumbar region of spinal cord which control erector pili muscle, vasomotor and dilates the pupil
- They may join spinal or cranial nerves or may pass directly
- Parasympathetic nuclei are located at sacral segments of spinal cords and control sphincters.
- They give pelvic splanchnic nerve which carries parasympathetic outflow to derivatives of the hind gut

Ascending tracts of spinal cord(sensory tracts)

Type of ascending tracts

- **Ascending spinal cord tracts**
 - gracile and cuneate (posterior white column)
 - spinothalamic
 - lateral and ventral
 - spinocerebellar
 - posterior and ventral



Spinothalamic tract

Pathway of the ascending tract

- **1st order Neuron:** Dorsal Root Ganglion (Spinal Ganglion)
- **2nd order Neuron:** Spinal Cord
- **3rd order Neuron:** Thalamus PLVNT
- **Termination:** Cerebral Cortex''postcentral gyrus''

Function of ascending tract

1- Gracile and Cuneate tracts :

- Discriminative touch
- Vibratory sense
- Conscious muscle joint sense (sense of position)

2- lateral spinothalamic tract :

- Pain
- Temperature

3- anterior spinothalamic tract :

- crude touch
- pressure

4- spinotectal tract :

Provide afferent information for spinovisual reflexes and brings movements of the eyes and head toward the source of the stimulation .

5- spino-olivary tract :

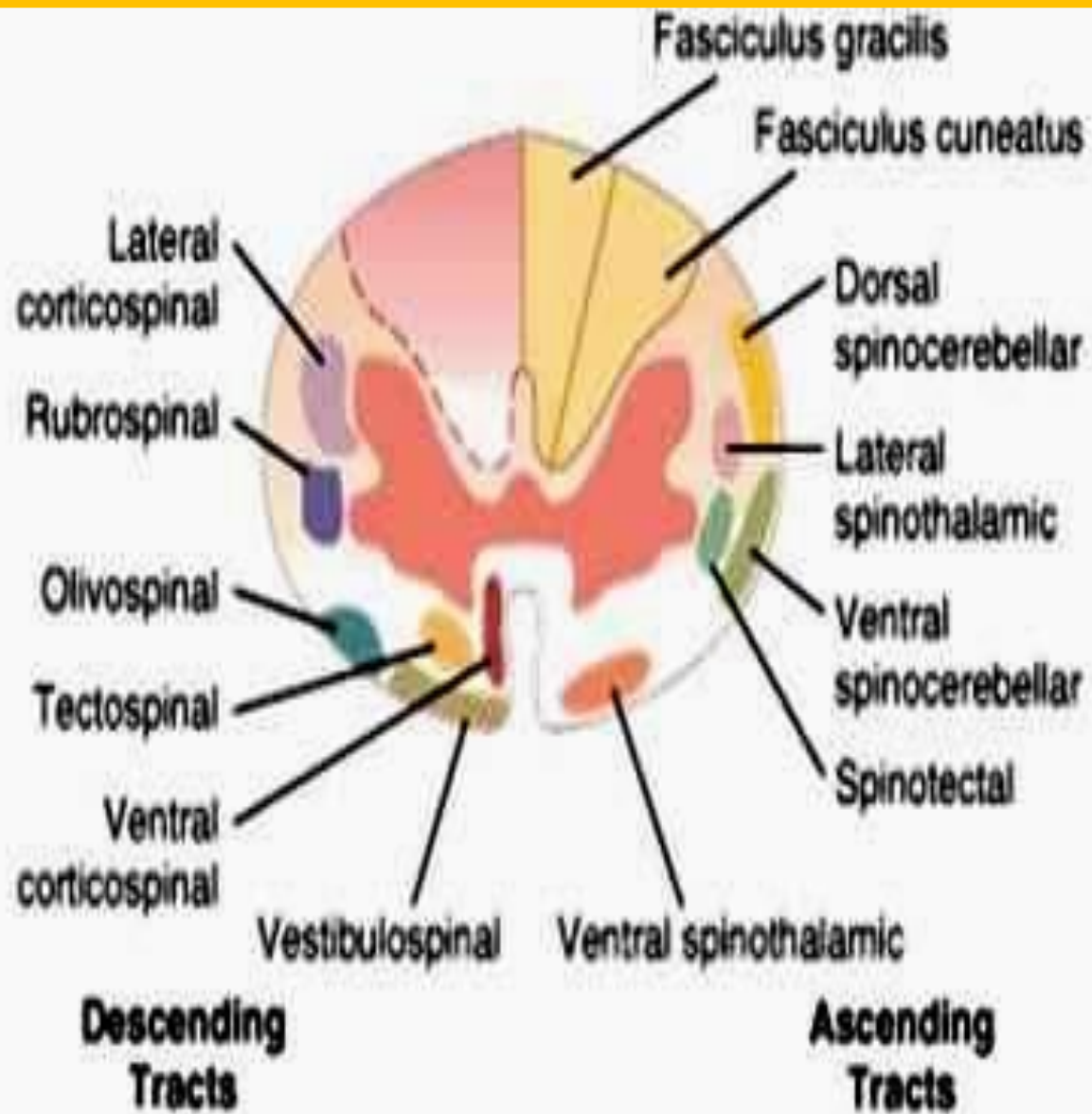
- ❑ Carries unconscious proprioceptive and exteroceptive sensation.

6- spinocerebellar tract (dorsal and ventral) :

- ❑ carry unconscious proprioceptive sensation

7- Lissauer's gelatinosa tract :

- ❑ Links the spinal segments.

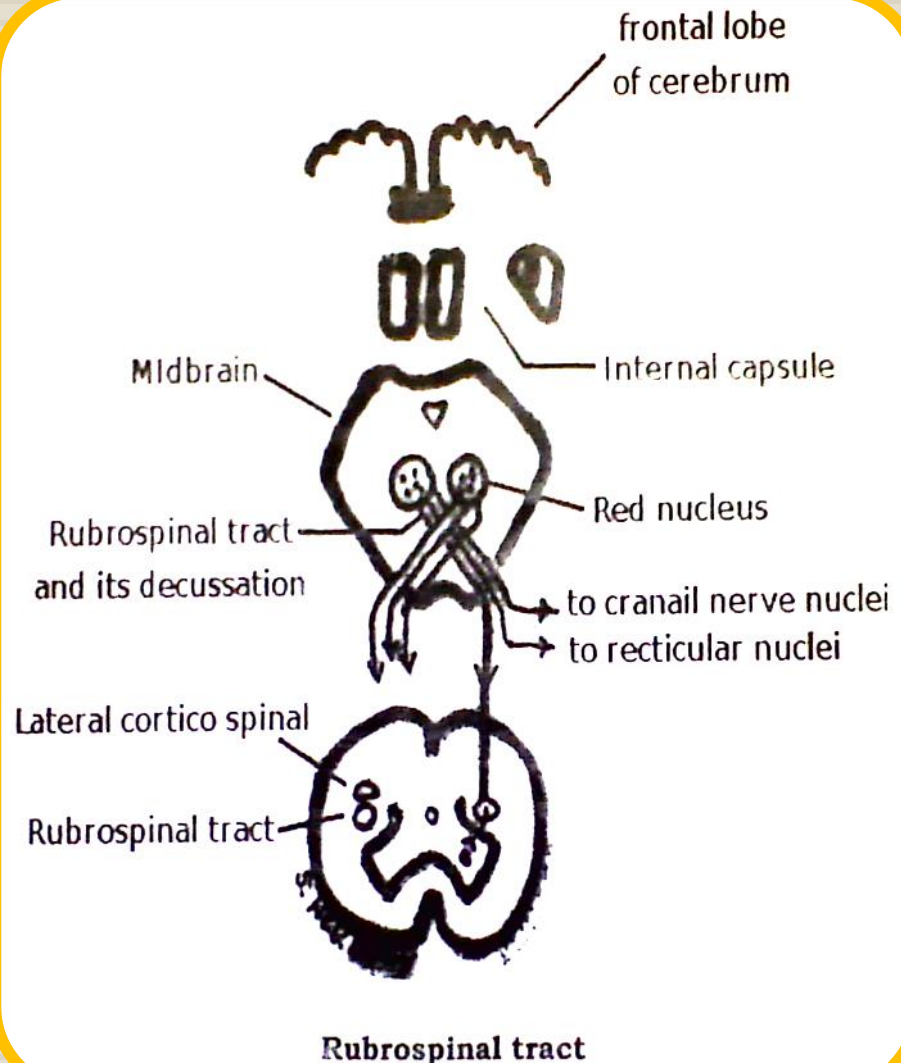


Descending tracts

Extrapyramidal tracts to spinal cord nuclei

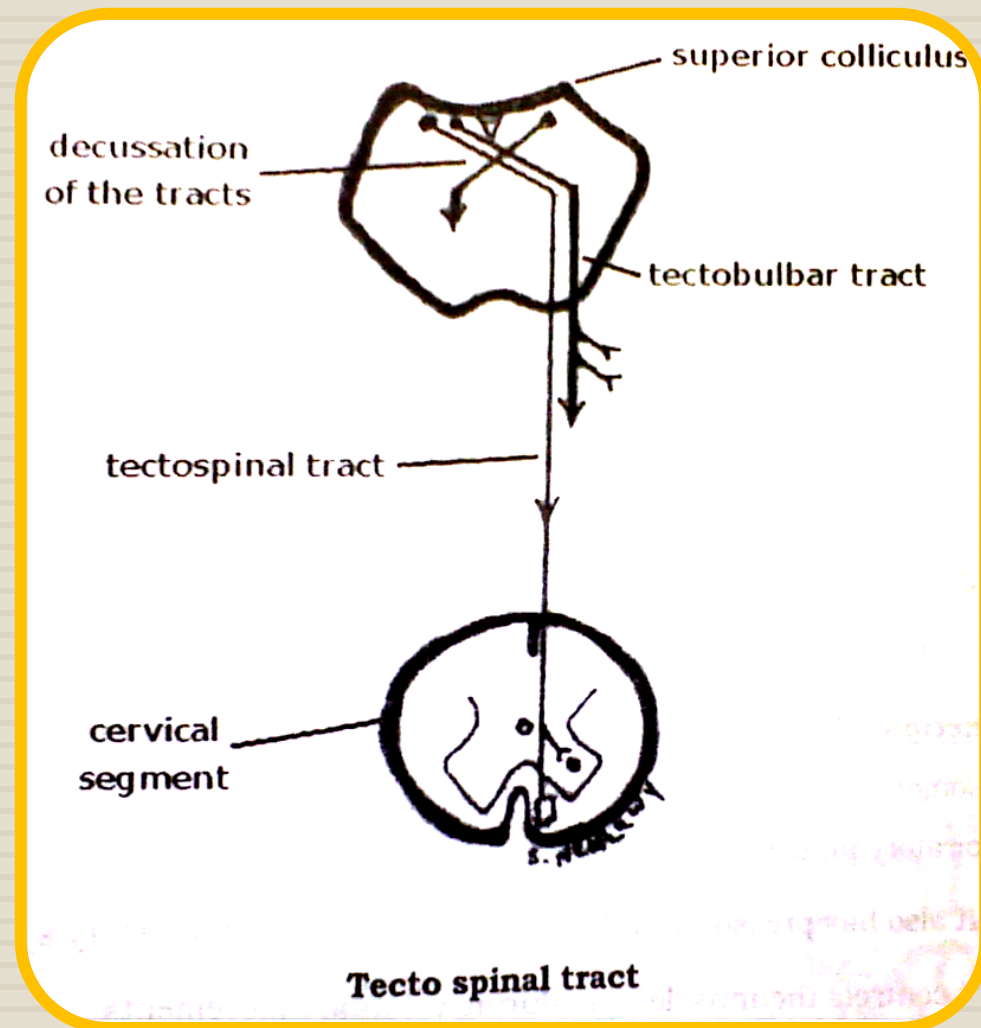
Rubrospinal tract

- ❑ Origin : Red nucleus in midbrain
- ❑ Site & Course : descends into lateral column of spinal cord just ventral corticospinal tract
- ❑ End : anterior horn motor nuclei of opposite side
- ❑ Function : facilitator to flexors of opposite limbs



Tectospinal tract

- Origin : superior colliculus nuclei
- Site & Course : descends and crosses to locate on surface of ventral column. It relays on anterior horn nuclei
- End : cervical anterior horn cells of opposite side
- Function : visuospatial reflex to move eyes and neck toward stimulus reflexly

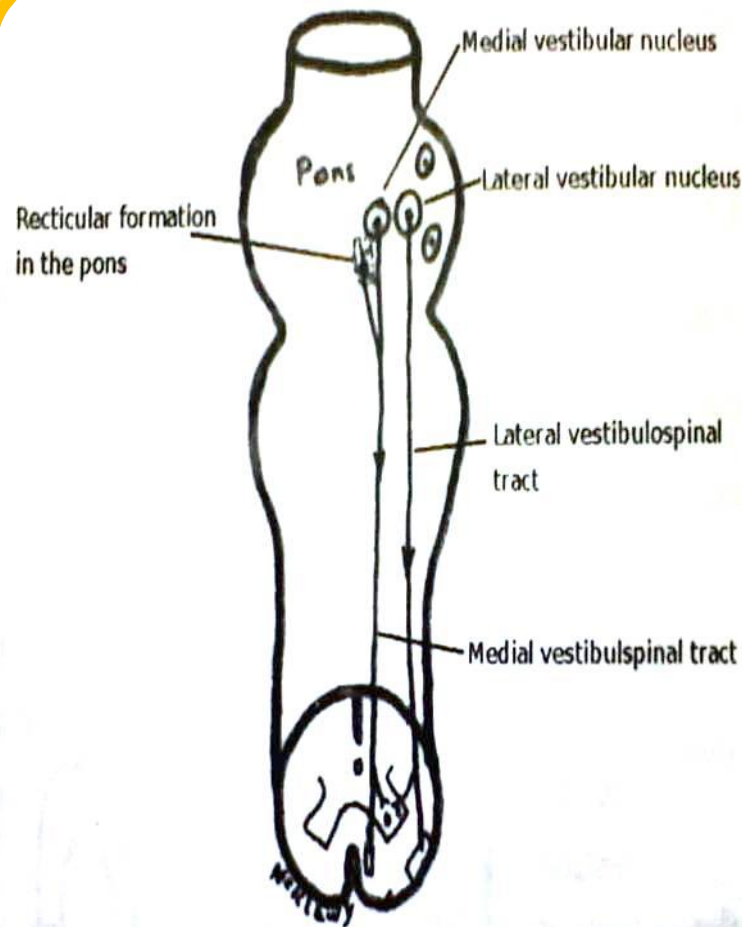


Olivospinal tract

- Origin : inferior olivary nucleus in medulla
- Site & Course : descends without crossing
- End : cervical anterior horn cells of same side
- Function : equilibrium and proprioceptives

Medial Vestibular spinal tract

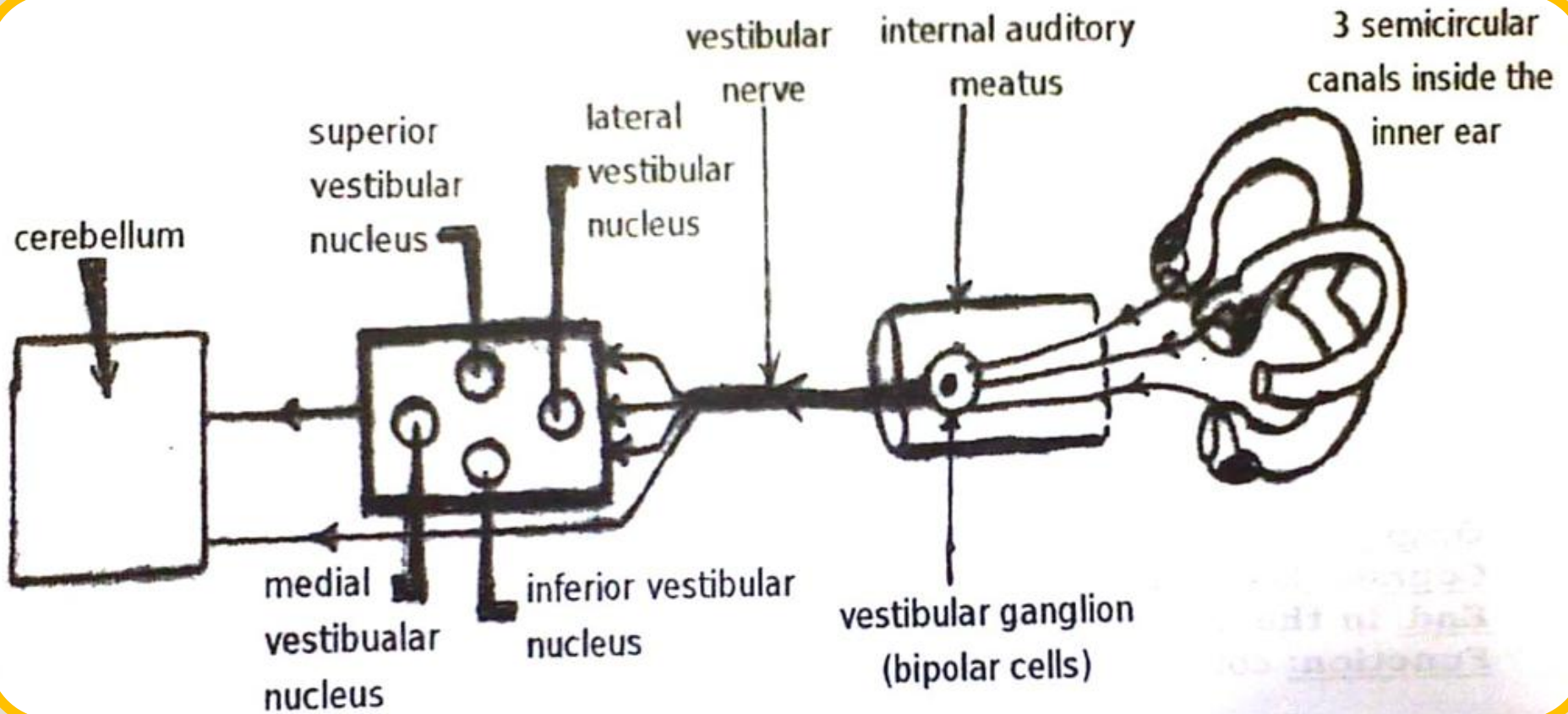
- Origin : medial, lateral and inferior vestibular nuclei
- Site & Course : Into medial column of same side along anterior median fissure (sulcomarginal)
- End : anterior horn cells of cervical and thoracic regions of same side
- Function : equilibrium

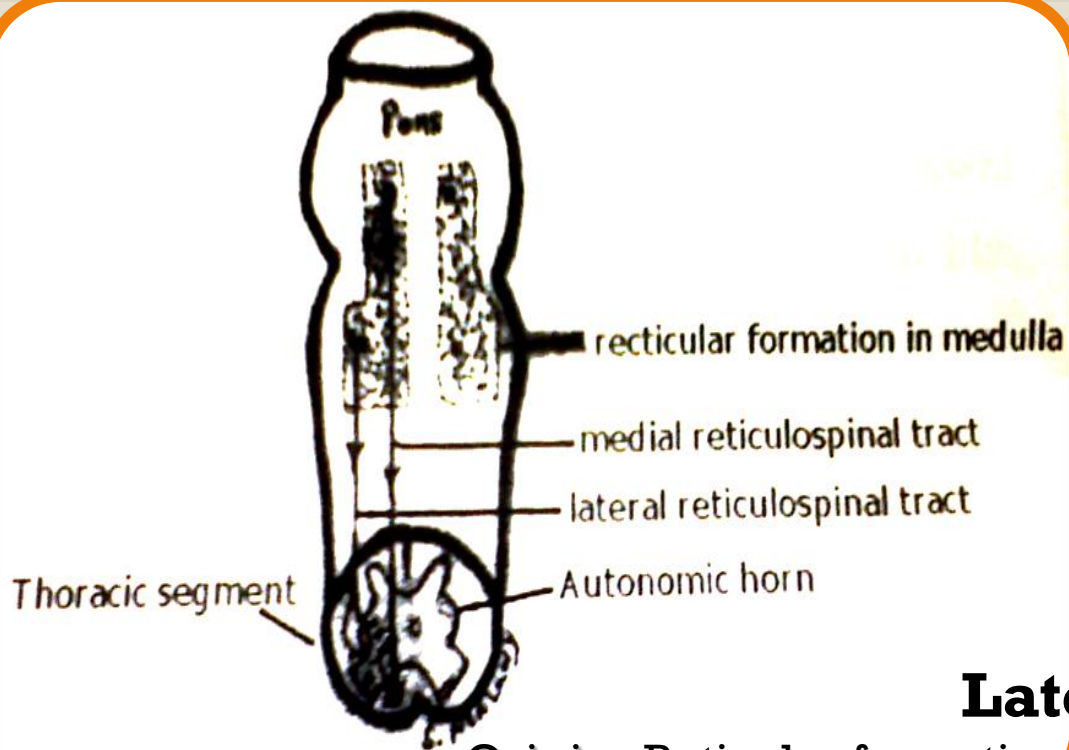


Lateral and medial vestibulo spinal tract

Lateral Vestibular spinal tract

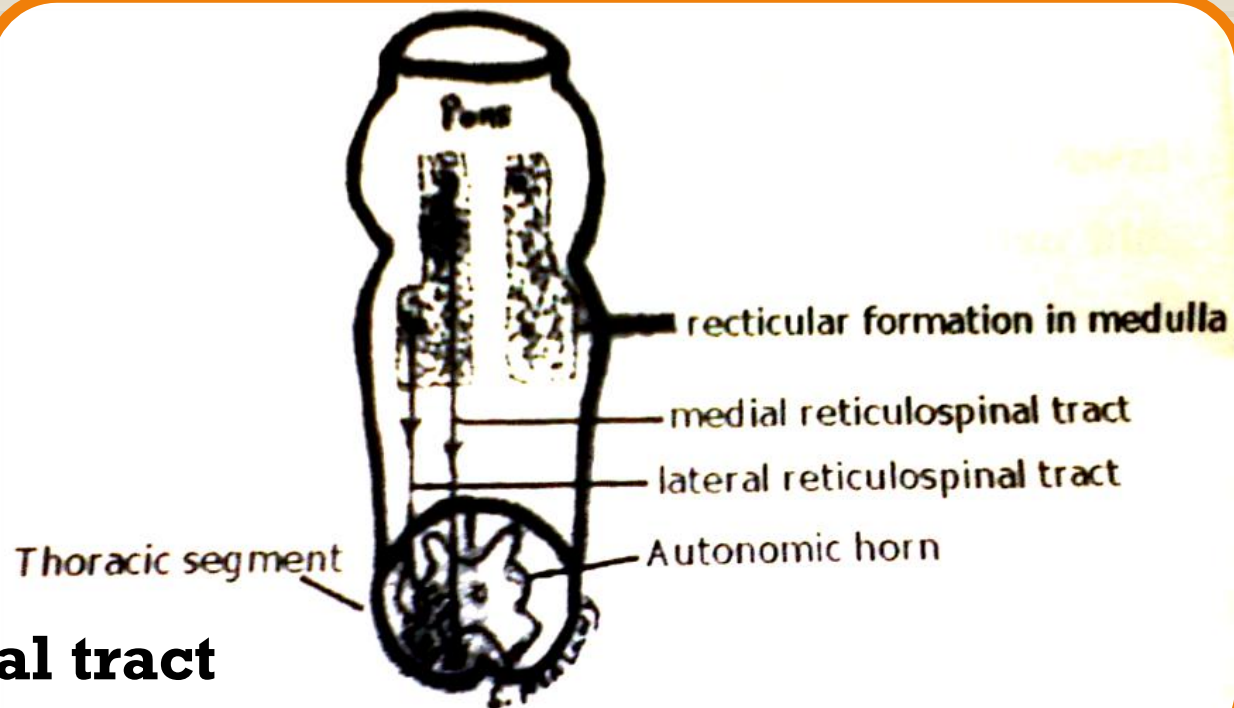
- Origin : lateral vestibular nucleus in pons
- Site & Course : descending on same side on surface of ventral column of all spinal segments
- End : anterior horn cells of all segments of spinal cord of same side
- Function : equilibrium





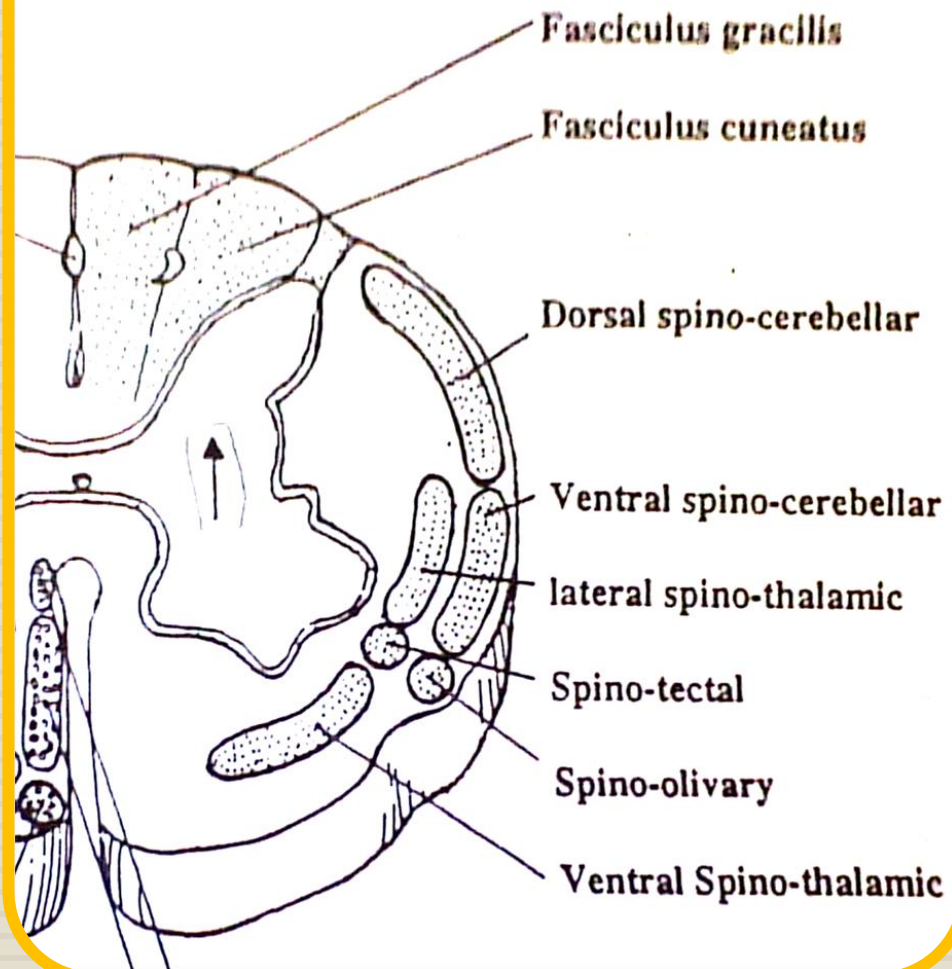
Lateral Reticulospinal tract

- Origin : Reticular formation nuclei in medulla of opposite side
- Site & Course : lateral column just medial to lateral corticospinal tract and in all segments of spinal cord
- End : anterior horn cells of opposite side and lateral horn cells (autonomic)
 - Function : facilitatory to extensor muscles through its connection with extrapyramidal centre (corpus striatum) and also has pressor & depressor effects on respiration and circulation through its connection with hypothalamus



Medial Reticulospinal tract

- Origin : Reticular formation nuclei of pons of same side
- Site & Course : Descends on same side along ventral white column
- End : anterior horn cells all over the cord of same side and also lateral horn of same side
- Function : facilitatory to extensor muscles through its connection with extrapyramidal centre (corpus striatum) and also has pressor & depressor effects on respiration and circulation through its connection with hypothalamus (same side like lateral reticulospinal tract)

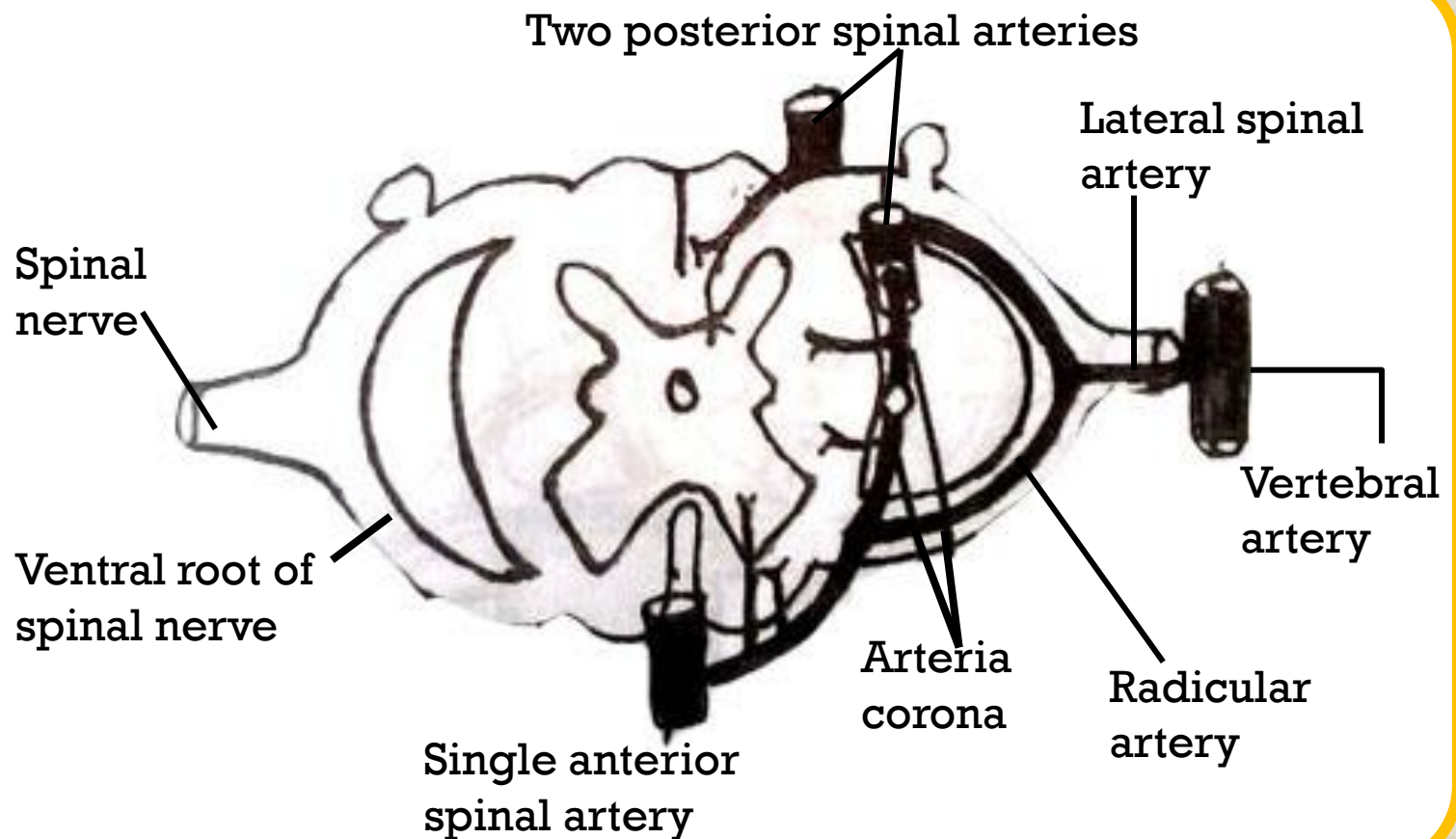


DESCENDING tract of Spinal Cord

Arteries Around The Surface Of Spinal Cord

Arteries	Origin & Site	Course & Supply
1- Single Anterior Spinal Artery	From each vertebral artery inside the skull i.e. we have 2 ant. Spinal arteries on both sides	-they unite forming single ant. Spinal artery -supply ant. column and ant. horn.
2- Two Posterior Spinal Arteries	From each vertebral artery inside skull i.e. we have 2 posterior spinal arteries on each side	-they didn't unite. -posterior arteries supplies post. column and post. horn -the ant artery shares in formation of arteria corona(supply lat. column)
3- Lateral Spinal Arteries	From vertebral artery, ascending&deep cervical, and descending aorta at intervertebral foramina	-each run along the spinal nerve trunk to divide into ant and post radicular arteries. -these arteries anastomose with arteria corona to supply lat column.

Arterial Supply

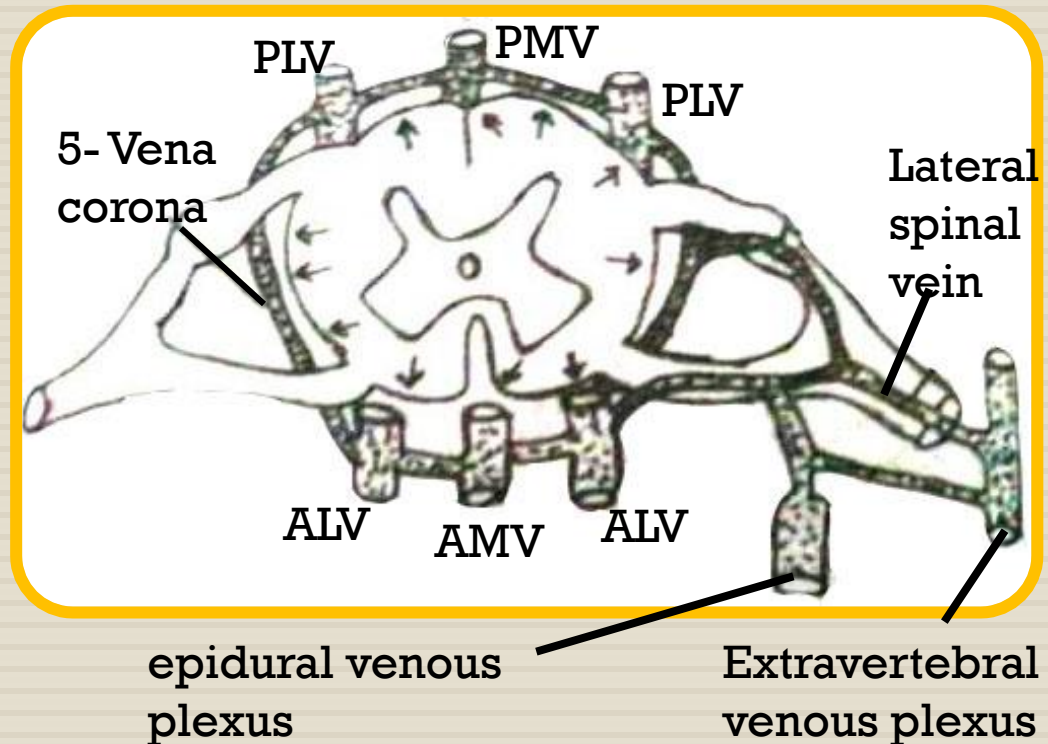


Veins Around The Surface Of Spinal Cord

Venous return

- 1- one anterior median vein(AMV)
- 2- one posterior median vein(PMV)
- 3- Two anterior lateral veins(ALV)
- 4- Two posterior lateral veins(PLV)
- 5- Vena corona

- These are six channels are freely connected with each other to encircle the spinal cord by what called “**Vena Corona**”.
- It drains interior of the cord.
- Then venous blood goes to epidural venous plexus.
- Obstruction of venous return causes edema of spinal cord with subsequent paralysis.



Meninges

Pia mater (inward)	<ul style="list-style-type: none">-support spinal cord by 42 ligaments, project from side of pia mater and dented, called ligamentum denticulate-each ligamentum denticulate passes laterally, piercing arachnoid mater and dura mater to attach the inner surface of vertebra-1st denticulum inside cranial cavity just above foramen magnum
Arachnoid mater (middle)	<ul style="list-style-type: none">-covers by pia mater but leaving space called subarachnoid space that filled with cerebrospinal fluid & extend to level 2nd sacral segment(S2)
Dura mater (outward)	<ul style="list-style-type: none">-thickest & lines the body canal of vertebral column.-extend down to S2, same with arachnoid mater & pierced by filum terminal for reaching coccyx-surrounded by 2 spaces, inner called subdural space and outer called epidural space.-both contain spinal blood vessels

The End

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