

CNS

Spinal cord II

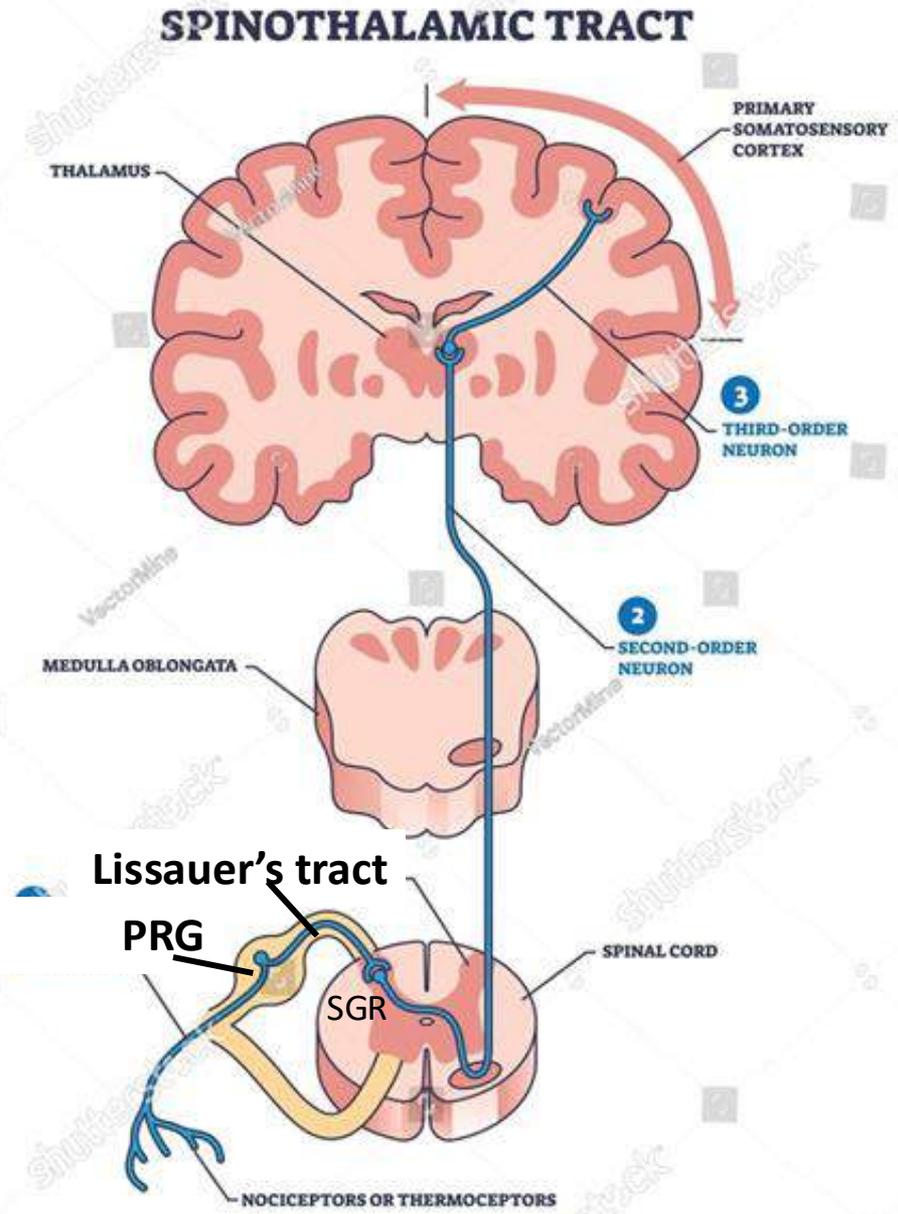
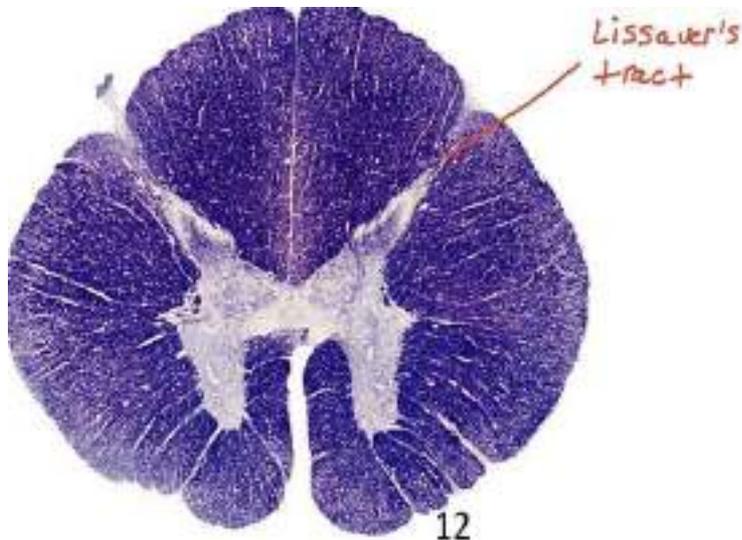
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The tracts in white matter of spinal cord

I-Short associative tracts:

- Lissauer's tract: Axons of posterior root ganglia enter spinal cord through lateral division of PRG then ascend or descend few segments then relay in SGR.



- II - Long tracts:** * Long ascending tracts (sensory)
- * Long descending tracts (motor)

A-The LONG ASCENDING (SENSORY) TRACTS: -

The sensory tracts are long ascending tracts carry sensation from all the body except the head. The sensations from the head are carried by **trigeminal nerve (cranial V)**.

- These sensory tracts are divided into three categories according to their termination:

I- Sensory tracts that reach cerebral cortex (C.C.):

II - Sensory tracts that reach cerebellum

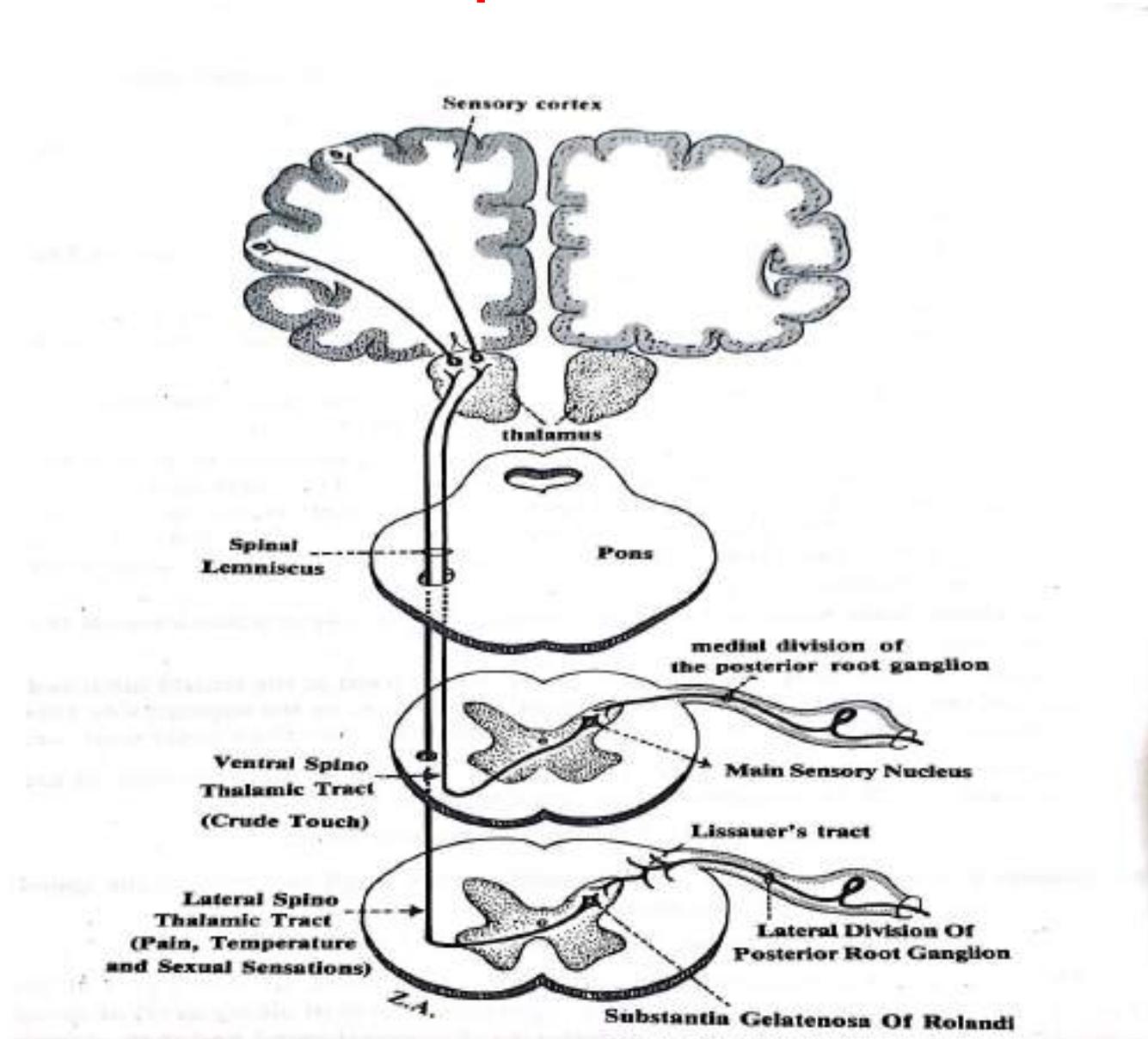
III-Sensory tracts that reach brain stem:

A-The LONG ASCENDING (SENSORY) TRACTS: -

I- Sensory tracts that reach cerebral cortex (C.C.): - All these tracts are known to carry conscious sensations which reach the cerebral cortex of opposite side (crossed) and any lesion in one of them leads to loss of sensation on the opposite side. They are four tracts:

- 1- Lateral spinothalamic tract
- 2- Ventral (anterior) spinothalamic tract
- 3- Gracil tract
- 4- Cuneate tract

Lateral & Ventral spinothalamic tracts



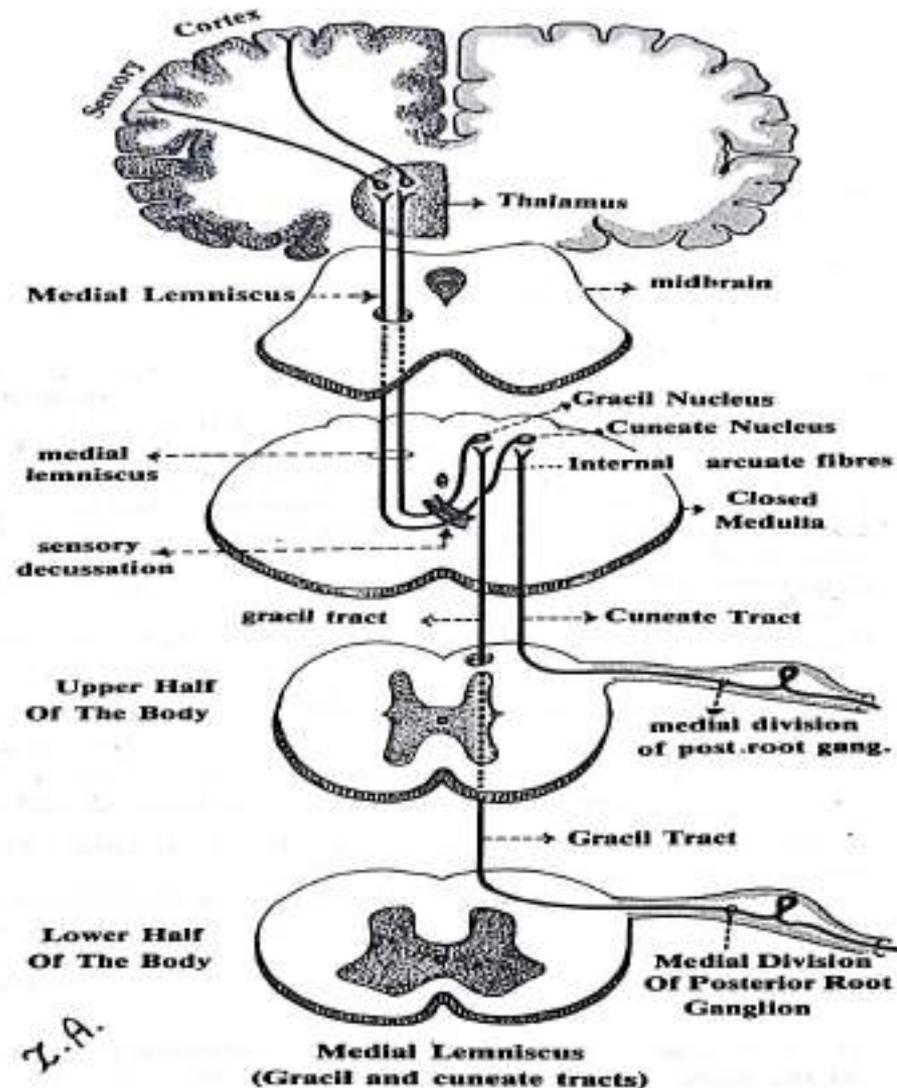
1. Lateral spinothalamic tract

- Long ascending tract present in all segments of spinal cord. It carries pain, temperature and sexual sensation.
- It arises as axons of the cells of **substantia gelatinosa of rolandi** of the opposite side. Its fibers cross in front of central canal and ascend separately in the opposite side of spinal cord and medulla. In the pons, it joins **ventral spinothalamic** to form **spinal lemniscus**. It ends in P.L.V.N. of thalamus then sensory cortex.

2. Ventral spinothalamic tract

- Long ascending tract present in all segments of spinal cord. It carries crude touch
- It arises as axons of the cells of **main sensory nucleus** of the opposite side. Its fibers cross in front of central canal and ascend separately in the opposite side of spinal cord and medulla. In the pons, it joins **lateral spinothalamic** to form **spinal leminiscus**. It ends in P.L.V.N. of thalamus then sensory cortex.

Gracil & Cuneate tracts



3. Gracil tract:

-long ascending tract present in all segments of spinal cord. It carries proprioceptive sensation and fine touch from lower half of body & lower limbs.

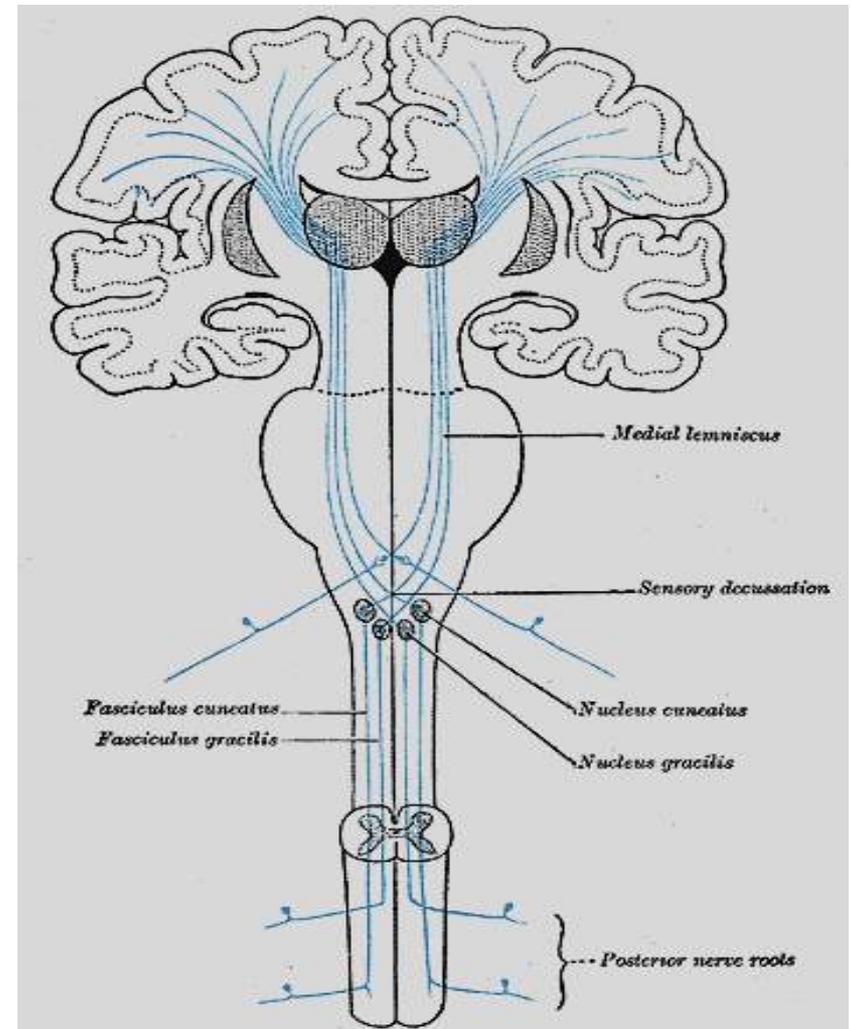
-The axons of large nerve cells of spinal ganglia (PRG) of lower 6 thoracic, lumbar and sacral ascend in spinal cord and then medulla to relay in gracil nucleus in medulla.

4. Cuneate tract:

-long ascending tract present in all cervical and upper thoracic of spinal cord. It carries proprioceptive sensation and fine touch from upper half of body & upper limbs.

-The axons of large nerve cells of spinal ganglia (PRG) of cervical and upper 6 thoracic ascend in spinal cord and then medulla to relay in cuneate nucleus in medulla.

- Axons from gracile and cuneate nuclei form the internal arcuate fibers which cross to opposite side forming sensory decussation. The crossed sensory fibers ascend in the opposite side as medial lemniscus. Then end in P.L.V.N. of thalamus then sensory cortex.



II - Sensory tracts that reach cerebellum (spinocerebellar pathway): - These tracts do not reach C.C. but carry sensation to cerebellar cortex of the same side for coordination (uncrossed) except anterior spinocerebellar. - Lesion in one of them dose not lead to loss of sensation but leads to loss of coordination.

They are four tracts:

1- Dorsal (posterior) spinocerebellar: arises as axons of clark nucleus of same side to cerebellum. It carries proprioceptive sensation from lower part of body

2- Ventral (anterior) spinocerebellar: arises as axons of clark nucleus of other side to cerebellum. It carries proprioceptive sensation from lower part of body

3- Cuneocerebellar.

4- Rostral spinocerebellar.

- The cuneocerebellar and rostral spinocerebellar tracts are the upper extremity homologs (arms, neck, upper trunk) of the dorsal and ventral spinocerebellar tracts, respectively.

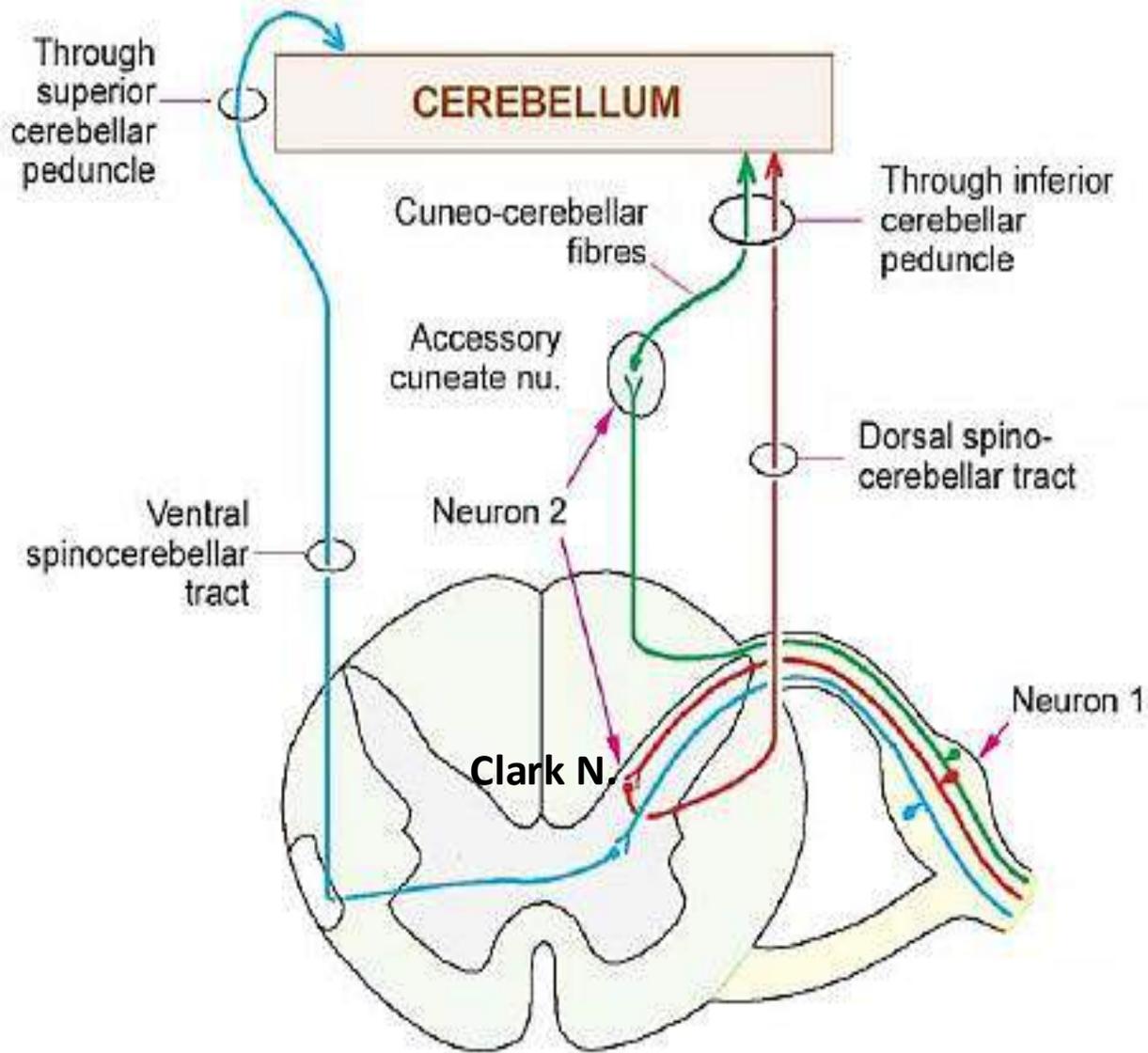
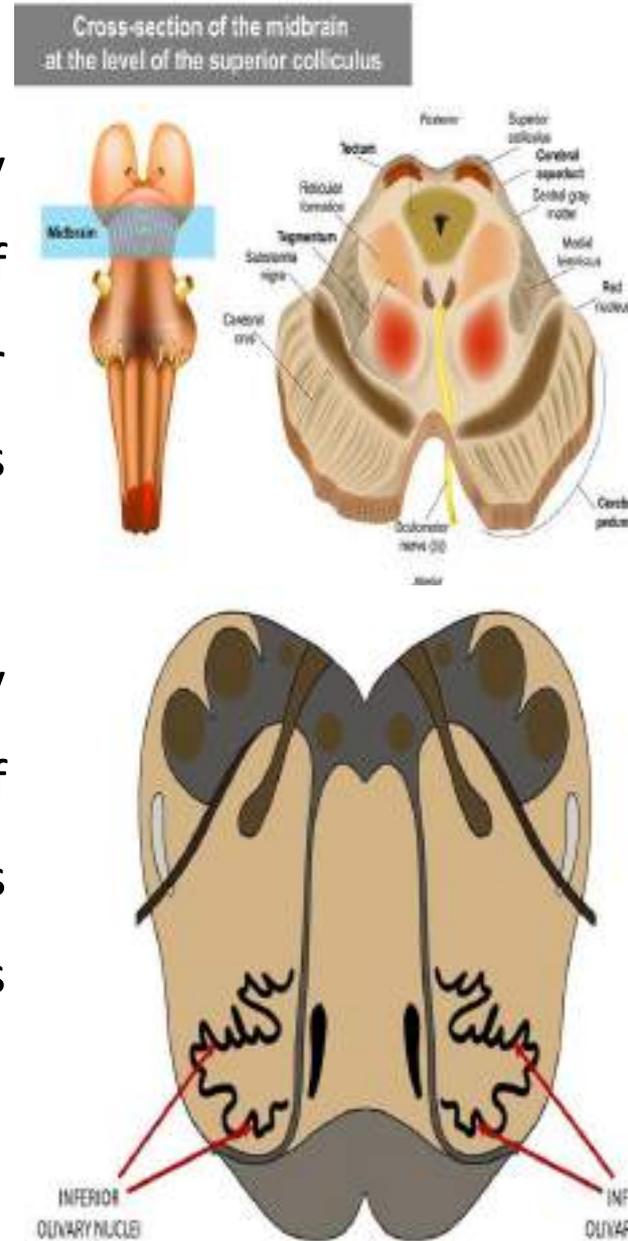


Fig. 9.8.
Scheme to show
the main features
of the
spinocerebellar
pathways.

III-Sensory tracts that reach brain stem:

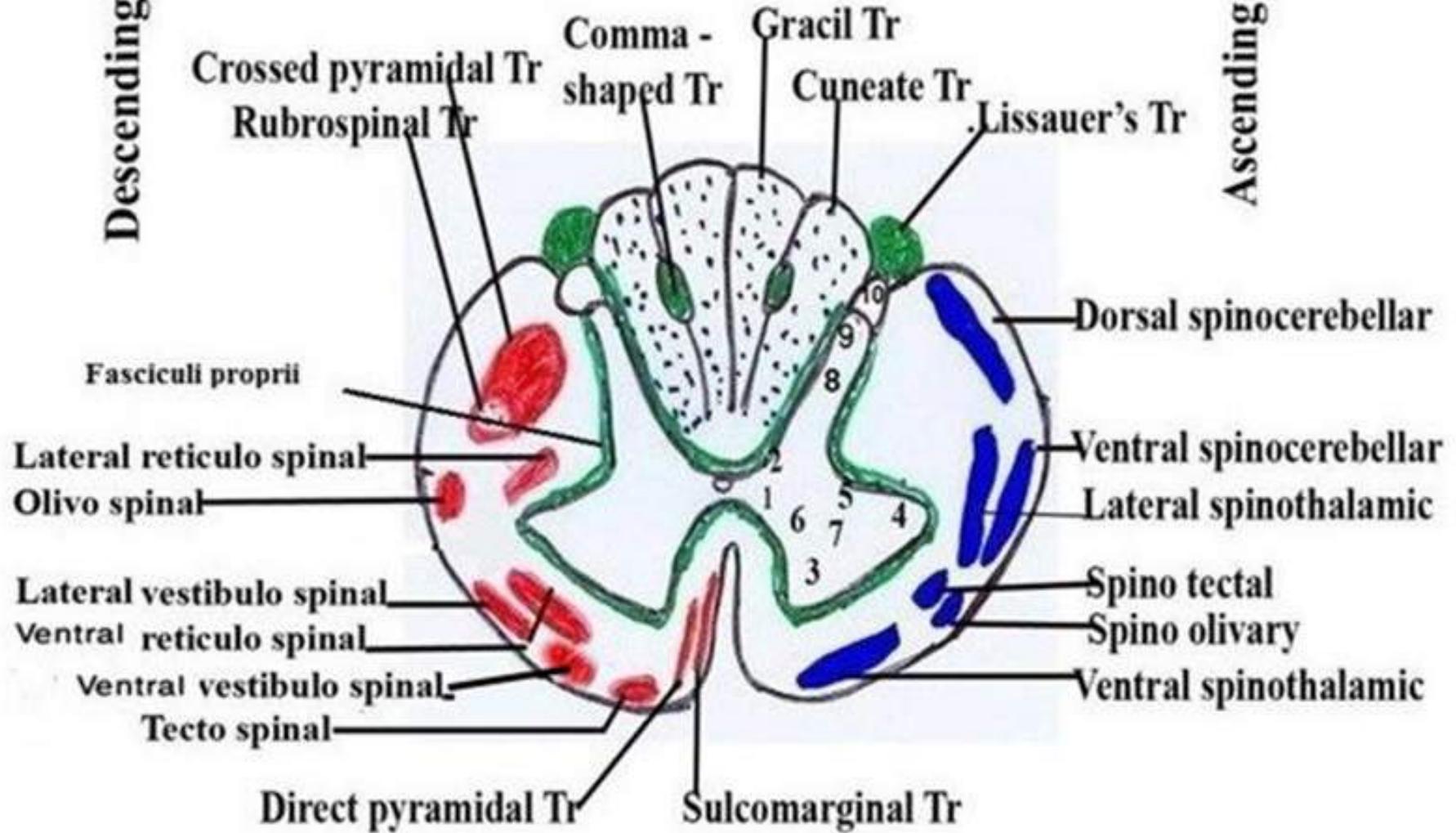
1- Spino-tectal: arises as axons of main sensory nucleus of opposite side. Its fibers cross in front of central canal and ascend to end in superior colliculus of midbrain (tectum). It carries spinovisual reflexes.

2- Spino-olivary: arises as axons of main sensory nucleus of opposite side. Its fibers cross in front of central canal and ascend to end in olivary nucleus in medulla then enter the cerebellum. It carries proprioceptive sensation



Descending tracts

Ascending tracts



• **B- LONG DESCENDING (MOTOR) TRACTS:**

- All voluntary movements are done by nerve impulse starting from cerebral cortex, to Anterior Horn nuclei of spinal cord or motor nuclei of cranial nerves then go to skeletal muscle.
- This pathway is divided into upper and lower motor neuron.
- The axons of upper motor neuron reach lower motor neuron through long descending tracts.
- The lower motor neuron includes anterior horn nuclei of the spinal cord and motor cranial nuclei of the brain stem.

- The long descending tracts are classified into:

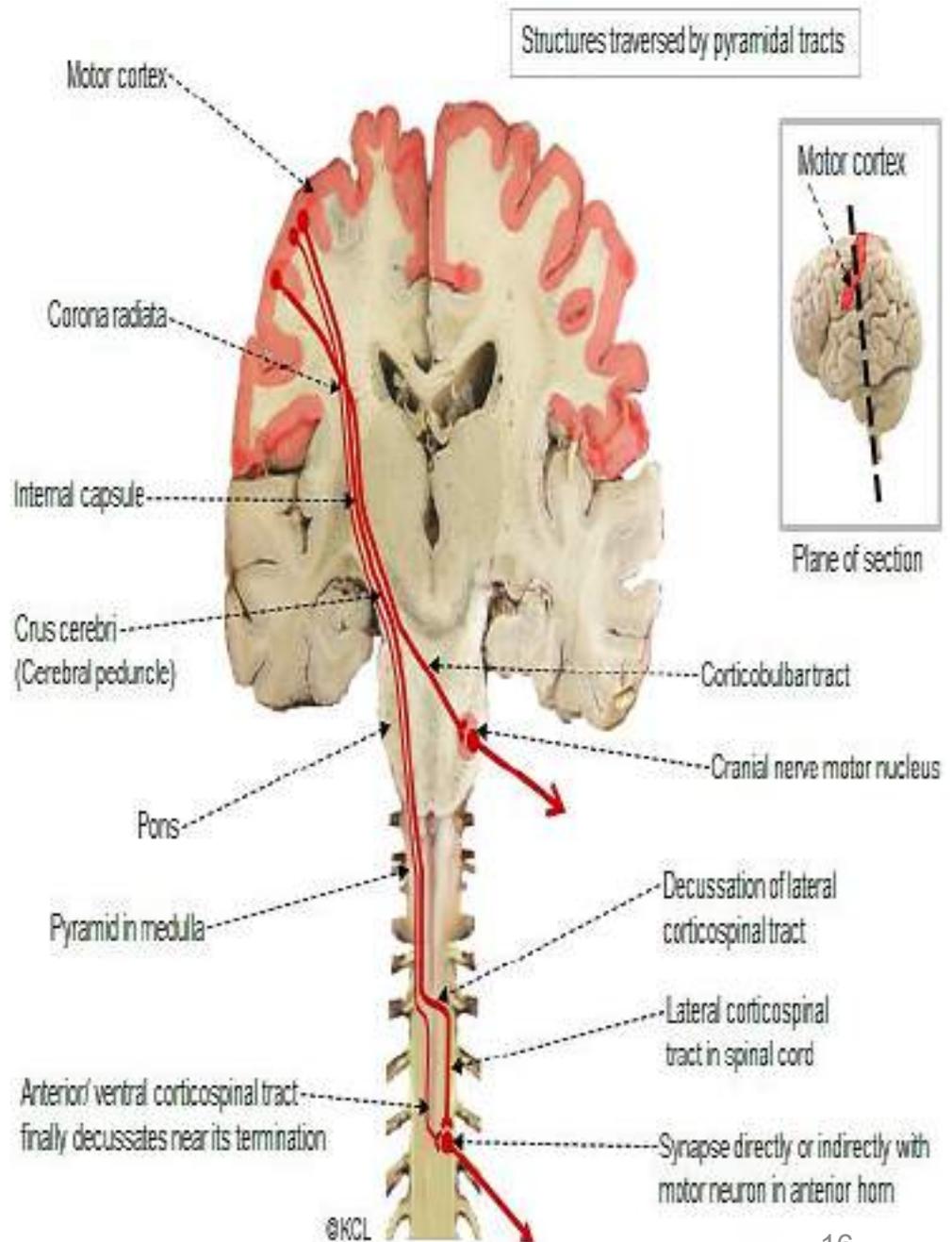
I- Pyramidal tracts: that include:

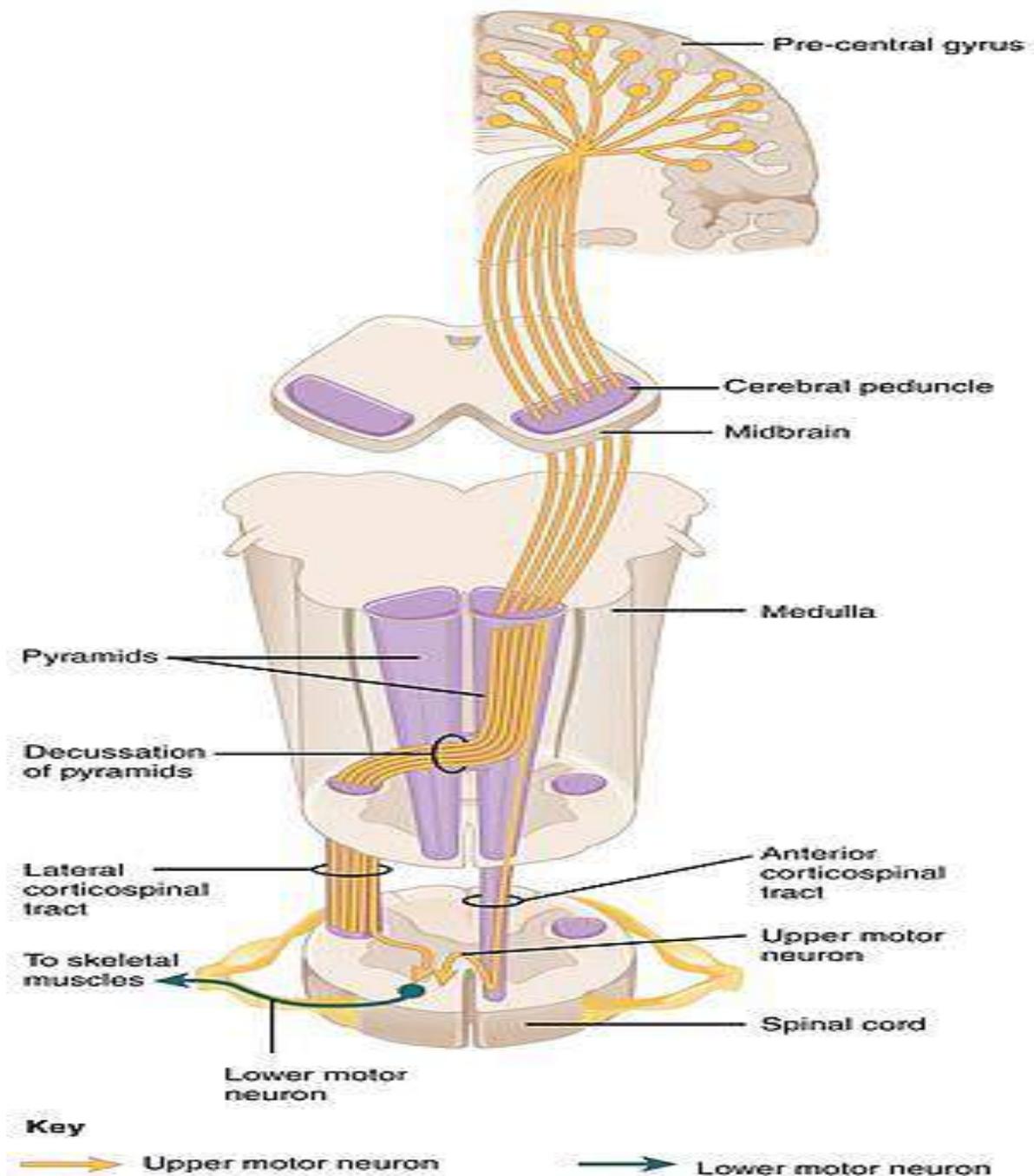
1) **Cortico-spinal tract** → to spinal cord

2) **Cortico-bulbar** (cortico nuclear) → to cranial nerve nuclei of opposite side

- Medial corticobulbar tract end in motor nuclei of 3,4,6 cranial nerves

- Lateral corticobulbar tract end in motor nuclei of 5,7,9,10,11,12 cranial nerves





Cortico-spinal tracts

Origin: Betz cells and pyramidal nerve cells from motor cerebral cortex

Pathway (Course):

- 1- In the cerebral hemisphere;** The fibers descend into the corona radiata.
- 2- In the internal capsule;** They descend in the posterior limb.
- 3- In the midbrain;** they descend in the **middle** part of the cerebral peduncle.
- 4- In the pons;** the fibers form separate bundles descending in the ventral part of the pons (basis pontis) separated by the transverse pontine fibers.
- 5- In the upper part of the medulla oblongata;** the fibers collect again forming the pyramid.
- 6- In the lower part of the medulla;**
 - a- 80%- 85%** of the fibers of the pyramid cross to the opposite side in the motor decussation and forming Lateral cortico-spinal tract in the spinal cord.
 - b- 15- 20%** of the fibers of the pyramid descend on the same side forming the anterior cortico-spinal tract in the spinal cord.

7- In the spinal cord; the fibers gradually diminish in size as it descends.

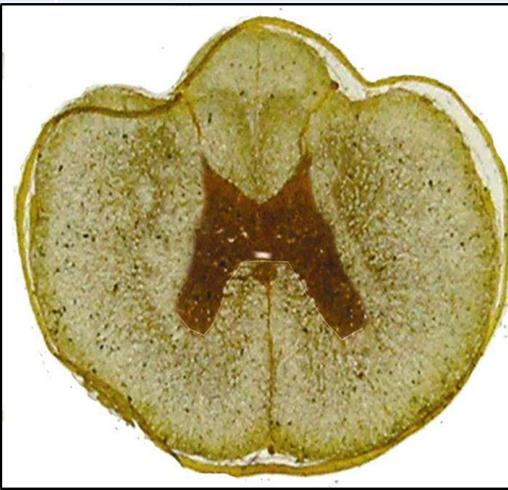
a- Lateral cortico-spinal tract (crossed pyramidal tract) descends in the lateral column of the white matter to relay in the anterior horn cells (AHC) of the same side.

b- Anterior cortico-spinal tract (direct pyramidal tract) descends in the anterior column of the white matter of cervical and upper thoracic. Its fibers cross the middle line to relay in the anterior horn cells of the opposite side before its termination.

II- Extra-pyramidal tracts: that includes 4 single tracts and 2 paired tracts:

- 1) Rubrospinal tract. (red nucleus of midbrain)
- 2) Olivospinal tract. (olivary nucleus of medulla)
- 3) Sulco-marginal tract (join ventral vestibulo spinal tract medial longitudinal bundle or fasciculus in brain stem)
- 4) Tecto-spinal tract. (tectum of midbrain)
- 5) Lateral & ventral (anterior) reticulo-spinal tracts reticular formation in brain stem)
- 6) Lateral & ventral (medial) vestibulo-spinal tracts (vestibular nuclei in pons)

	Cervical	Lower Thoracic	Lumbar
Shape	Oval	Round	Oval
Central canal	More anterior	Slight anterior	Central
Posterior horns	Thin & diverging	Thin & parallel	Thick & parallel
Anterior horns	Thick	Thin & parallel	Thick & parallel
Lateral horns	-----	present	Present (L1-L3) only
White matter		Large compared to grey matter	Very little compared to grey matter

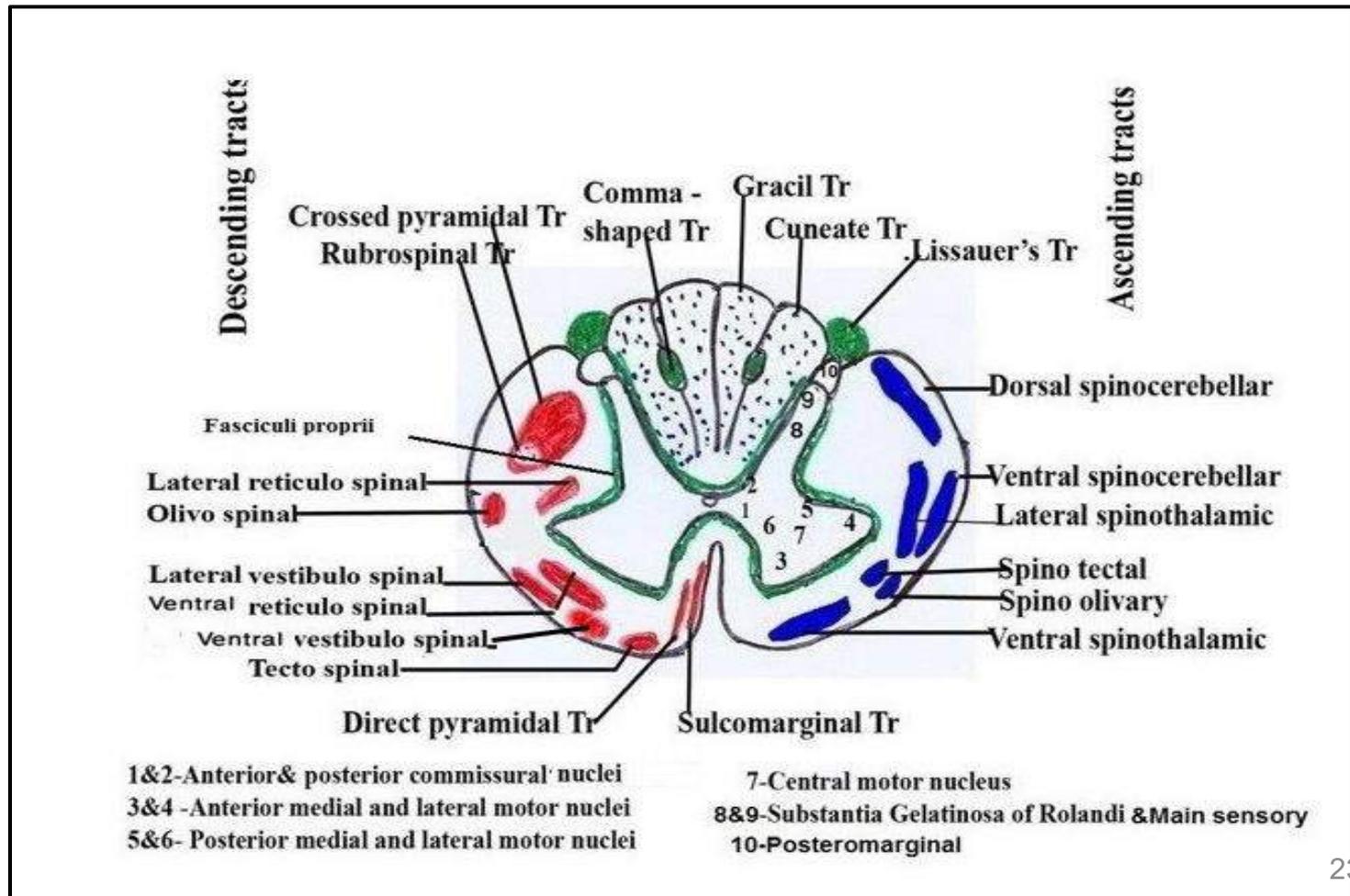


Levels of the spinal cord:

- Spinal cord at the cervical region.
- Spinal cord at the upper thoracic region.
- Spinal cord at the lower thoracic region.
- Spinal cord at the lumbar region.

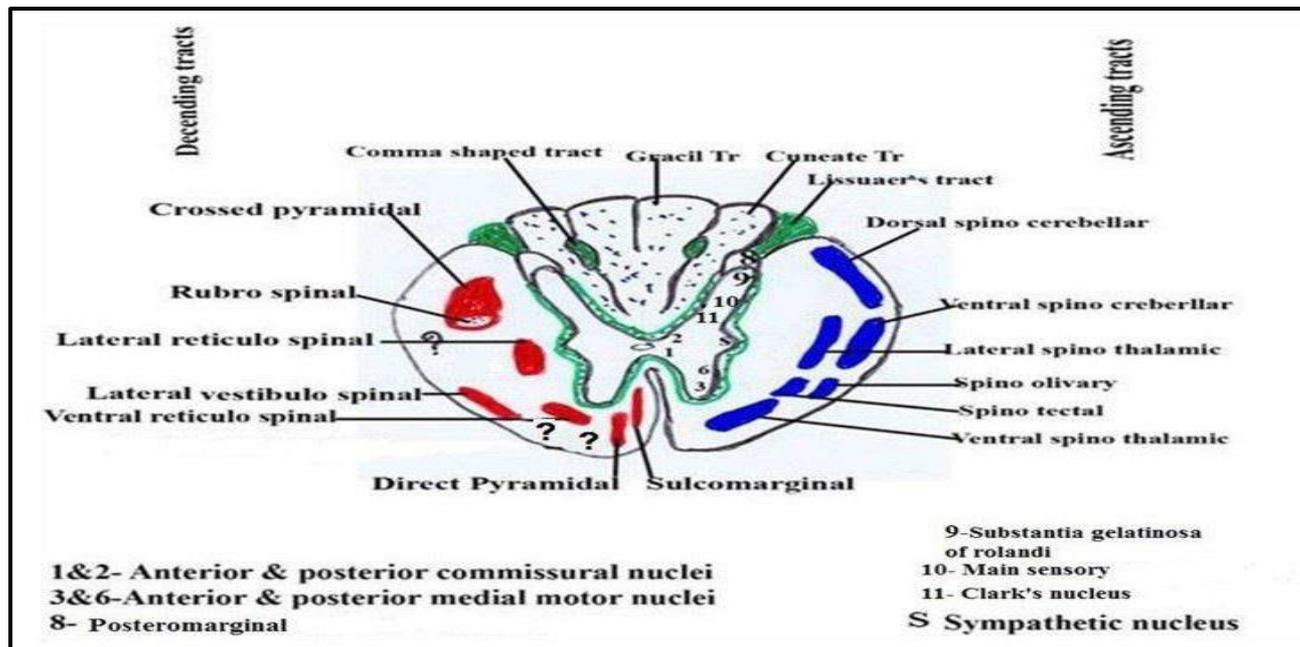
Spinal cord at the cervical region:

- The grey matter contains all motor, sensory and commissural nuclei except Clark's nucleus (only present in C8).
- The white matter is abundant and full of almost all short and long tracts.

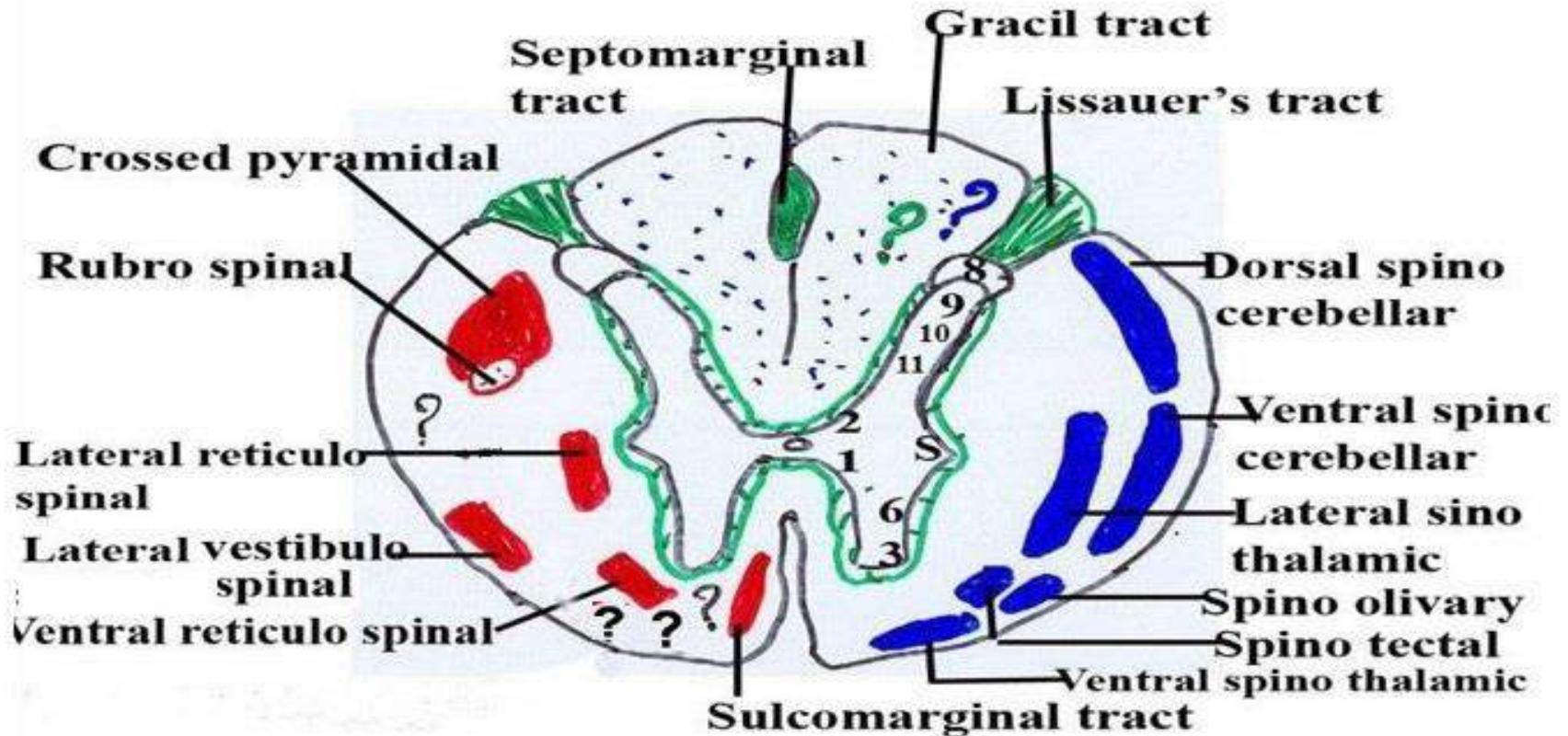


Spinal cord at the upper thoracic region

- The posterior horns contain **Clark`s nucleus** in addition to the same nuclei in the cervical region while the anterior horns contain **the medial nuclei only**. It has lateral horns which contain **sympathetic nuclei**.
- The white matter contains the same tracts as in cervical region except (three extrapyramidal tracts) **olivospinal, ventral vestibulospinal & tectospinal** tract that are absent.



Spinal cord at lower thoracic region



1&2 - Anterior & posterior commissural nuclei
 3&6 - Anterior & posterior medial motor nuclei
 8 - Posteromarginal
 9 - Substantia gelatinosa of rolandi

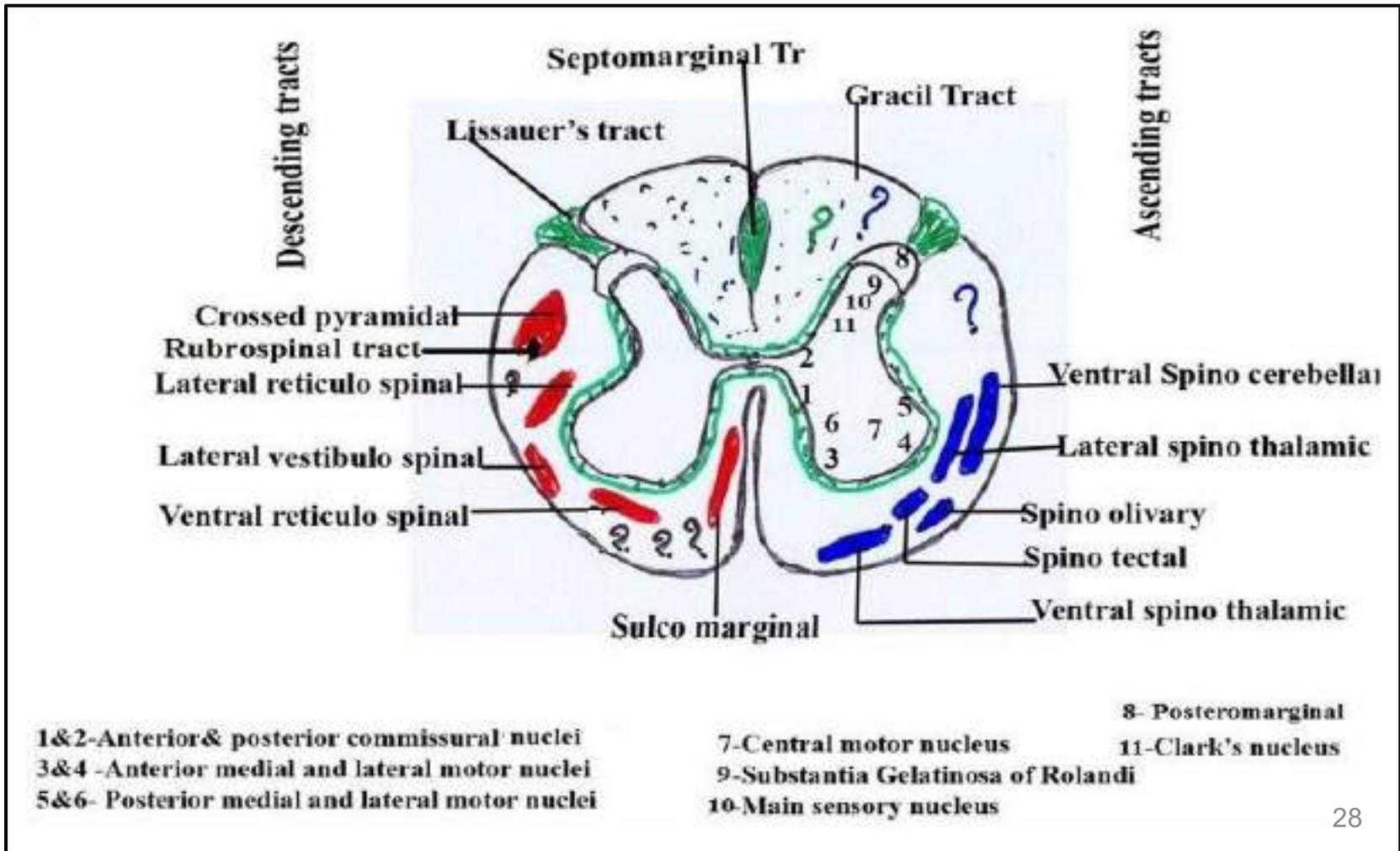
10 - Main sensory nucleus
 11 - Clark's nucleus
 5 - Sympathetic nucleus

Spinal cord at lower thoracic region:

- The posterior horns contain **Clark`s nucleus** in addition to the same nuclei in the cervical region while the anterior horns contain the **medial nuclei only**. It has lateral horns which contain **sympathetic nuclei**.
- The white matter contains the same tracts as in cervical region except **comma shaped tract, cuneate tract and direct pyramidal tract** in addition to the three previous absent tracts. The **septomarginal** short tract appears.

Spinal cord at the lumbar region:

- The grey matter contains all motor, sensory and commissural nuclei
- The white matter contains the same tracts as in lower thoracic but; **posterior spinocerebellar** tract is absent.



THANK YOU