ANATOMY

SHEET NO. 5

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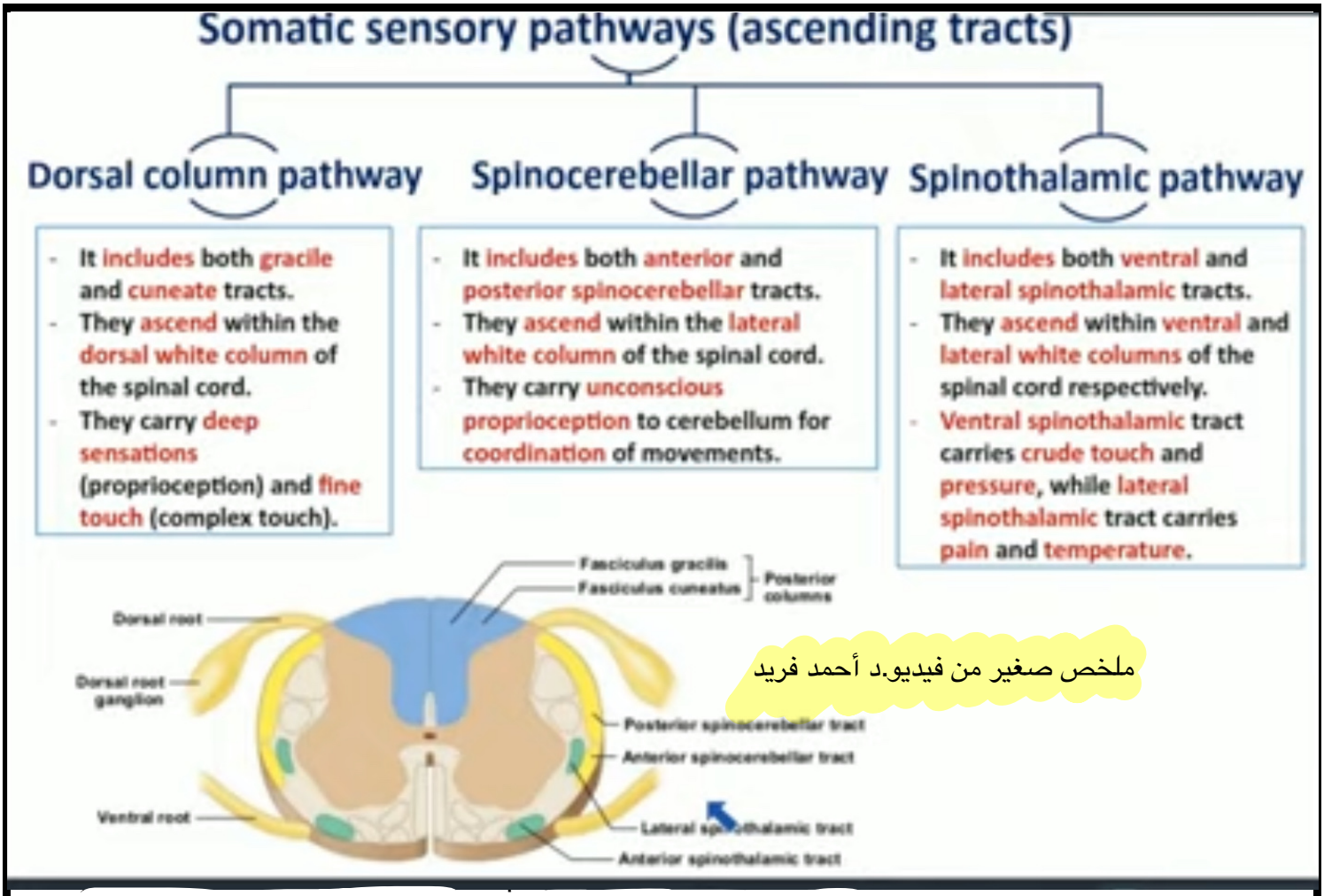


<u>We are done with the lateral spinothalamic tract.</u>

<u>Anterior spinothalamic tract</u>: (ALS: Anteriolateral system)

- Modality: crude touch and pressure.
  The most important difference between the anterior and lateral components of ALS is the modality, modality of the lateral part is "pain and temperature" whereas the anterior part's modality is "crude touch and pressure".
  When we say ALS, the modality will be "crude touch, pressure, pain and temperature".
- Receptors: free nerve endings
- 1st Neuron: **Dorsal root ganglia** → Cell body
- 2nd Neuron: the **posterior horn of gray column** specifically in **nucleus proprius** which represents **laminae 3 and 4** of the gray matter and is associated with touch sensation. The axons of 2nd order neurons cross obliquely to the opposite side in the anterior gray and **white commissures**, ascending in the contralateral white column as the Anterior spinothalamic tract.
- 3rd Neuron: **Thalamus (VPL) Internal Capsule** ----- **Corona Radiata**.
- Termination: **Primary Somesthetic Area (SI)**

Spinotectal Tract:

Specifically → superior colliculi

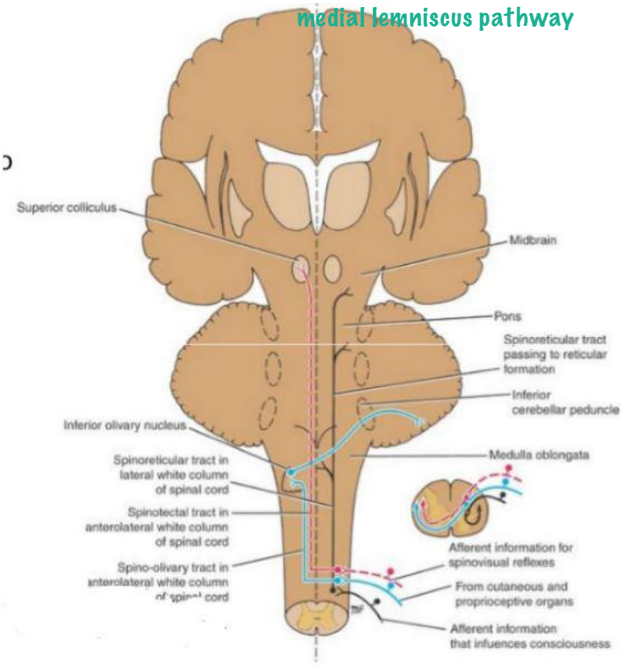
- This is a sensory tract that relays information from the spinal cord (spino) to the tectum (tectal). Hence the name Spinotectal
- The *tectum* (Latin for roof) is the dorsal side of the midbrain and is composed of four colliculi (2 superior and 2 inferior).
- The 4 colliculi collectively form a structure known as corpora quadrigemina
- The 2 superior colliculi have visual functions and are involved in visual reflexes, whereas the 2 inferior colliculi have auditory functions and are involved in auditory reflexes.

posterior aspect

❖ Organization of Spinotectal tract

- Ascend in the anterolateral white column lying close to the lateral spinothalamic tract
- Terminate: **superior colliculus**
- Provides afferent information for **spinovisual reflexes**.
- Explanation: the 1st order neurons start at the organs involved in the collection of information for the spinovisual reflexes, the cell bodies for them is, again, in the dorsal root ganglia. The 2nd order neurons synapses with the 1st order neurons early in the spinal cord, and then the axons of the 2nd order neurons cross the midline and ascend contra-laterally in the anterolateral white column of the spinal cord, lying close to the lateral spinothalamic tract. This tract terminates in the superior colliculus.
- **Note: In Medulla**: anterior spinothalamic tract + spinotectal + lateral spinothalamic = spinal leminiscus which ends in VPL

Remember that → when you hear this word "lemniscus" that's mean you are in medial lemniscus which is related to posterior column - medial lemniscus pathway



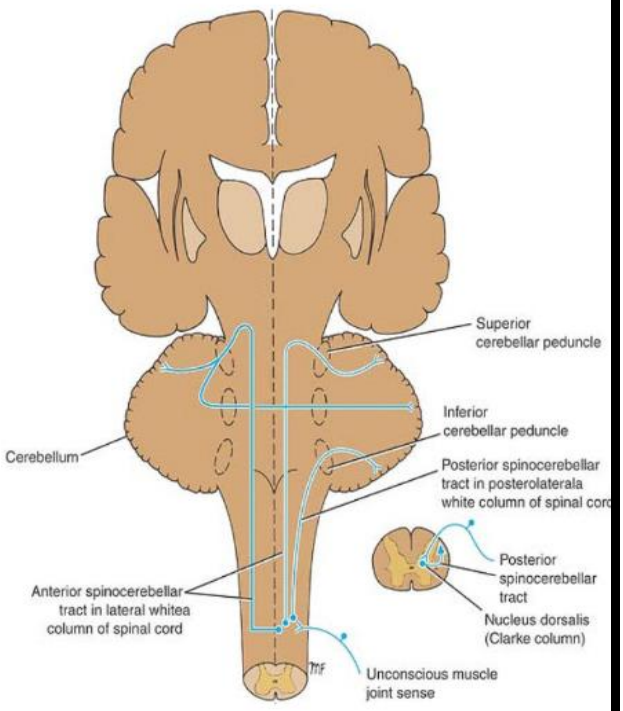
- **What are spinovisual reflexes?** The act of movement of the eyes, head and neck spontaneously towards the source of the stimulation. Happens at the level of spinal cord (no need for higher centers).
  Example: if you are walking and you step on a piece of glass, you unconsciously raise your leg away from the glass (withdrawal reflex) and then you immediately look toward the injury site (spinovisual reflex).
  Note: Remember that medial leminiscus was related to the dorsal column system.

ذكره الدكتور بس جبته من النت عشان تكون صيغة الكلام اوضح

The withdrawal reflex is a spinal reflex intended to protect the body from damaging stimuli. The reflex rapidly coordinates the contractions of all the flexor muscles and the relaxations of the extensors in that limb causing sudden withdrawal from the potentially damaging stimulus

Posterior and Anterior spinocerebellar: (from the spinal cord to the cerebellum)

- These two tracts are located in the anterolateral columns of the white matter. They don't reach the cortex, instead, they terminate at the cerebellum



Posterior spinocerebellar

- **Modality**: muscle and joint sensation (unconscious proprioception)
- **Receptors**: same as dorsal column system (Most receptors except free nerve endings)
- 1st order neuron axons terminate at the base of post gray column (**nucleus dorsalis or Clarks nucleus** in lamina 7) Synapse → in dorsal horn
- the axons of 2nd order neurons enter posterolateral part of the **lateral white matter column** on **the same side**.
- **ascend ipsilaterally** as the posterior spinocerebellar tract to medulla oblongata.
- Terminates in **cerebellar cortex** (through **inferior cerebellar peduncle**).

➢ *note: axons of lower lumbar and sacral spinal nerves ascend in the posterior white column until they reach L3 or L4 segments where they synapse with nucleus dorsalis*

Extra info:

- **Peduncle**= bundle of white matter.
- **superior cerebellar peduncle**: connect midbrain to cerebellum.
- **middle cerebellar peduncle**: connect pons to cerebellum.
- **inferior cerebellar peduncle**: connect medulla to cerebellum.

Note 1: in **dorsal column system and anterolateral system** eventually sensation from right side of the body will reach to the left cortex (no matter of the decussation site) and vice versa.

Note 2: in **spinocerebellar tracts** whether anterior or posterior, sensation from right side of the body will reach the right cerebellar cortex and vice versa.

* Brainstem located anterior to the cerebellum , and the area btw these structure called fourth ventricle

- fourth ventricle aka cavity of the hindbrain

Rexed laminae

- **Lamina 1** relay information related to pain and temperature
- **Lamina 2:** relay information related to pain and temperature **(pain modulation)**
- **Lamina 3 and 4:** nucleus proprius; these laminae have many interneurons

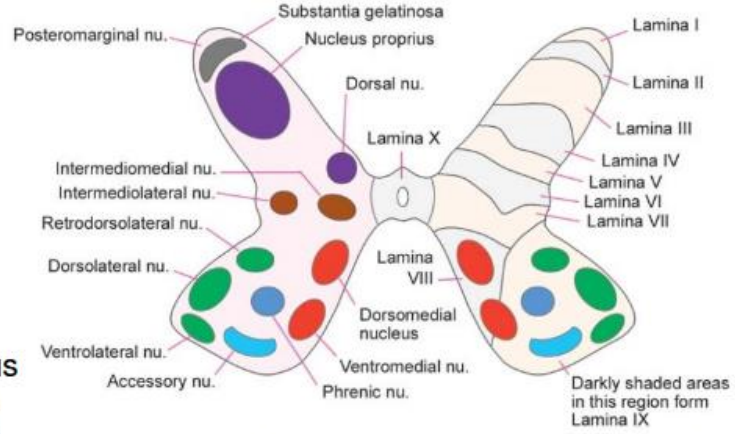


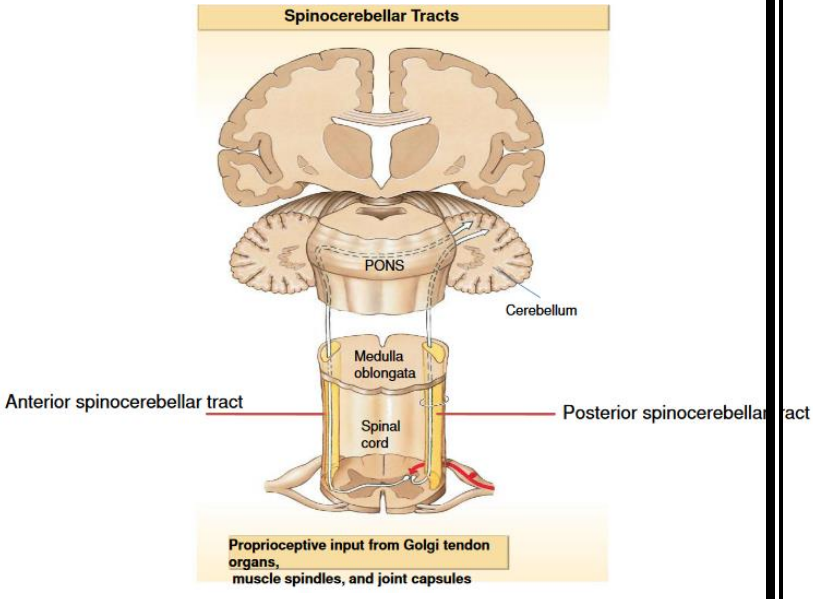
Fig. 5.2. Subdivisions of the grey matter of the spinal cord. The left half of the figure shows the cell groups usually described. The right half shows the newer concept of laminae.

- **Lamina 5:** relay information related to pain and temperature
- **Lamina 6:** presents only at the cervical and lumbar enlargements and receives proprioception
- **Lamina 7: Intermedio-lateral** nucleus, contains preganglionic fibers of sympathetic (T1 -L2). **Intermedio-medial nucleus** ,all over the spinal cord, receive visceral pain. **Dorsal nucleus of Clark's** presents at (C8 – L2 or T1-L4) , relay center for **unconscious proprioception**

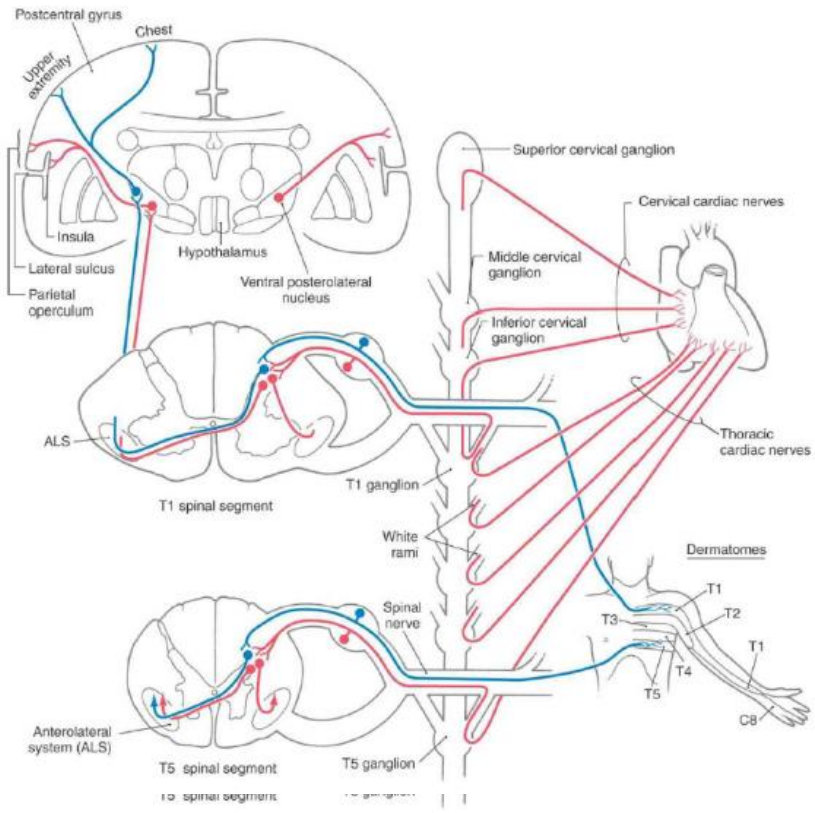
Note : the type of sensation that reaches cerebellum (unconscious level) is proprioception.

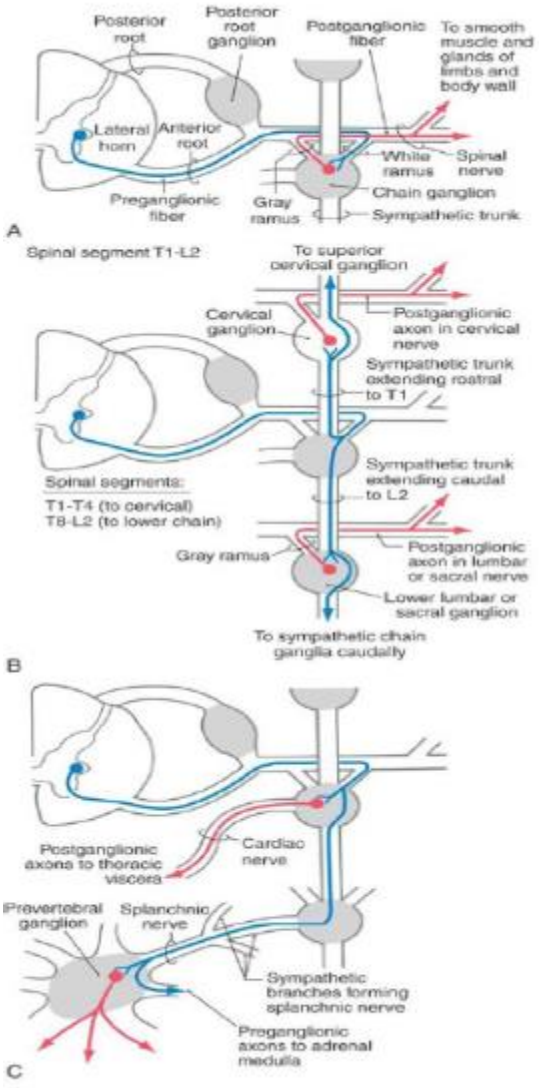
Anterior spinocerebellar tract:

- **Muscle and joint sensation (unconscious proprioception).**
- 1st order neuron axons terminate at the base of post gray column **(nucleus dorsalis)**
- **Two pathways for the axons:**
  1- **the majority** of axons of 2nd order neurons cross to opposite side and ascend as anterior spinocerebellar tract in the contralateral white column.
  2- **the minority** of axons ascend as anterior spinocerebellar tract in the lateral white column of the same side.
- Ascend as anterior spinocerebellar tract to medulla oblongata and pons.
- Terminates in cerebellar cortex, (through superior cerebellar peduncle).
  the fibers that crossed over in spinal cord **cross back** within cerebellum.



don't panic, these two figures are explained in the video (15:00 – 19:00) for more explanation about referred pain. Please refer to the video.





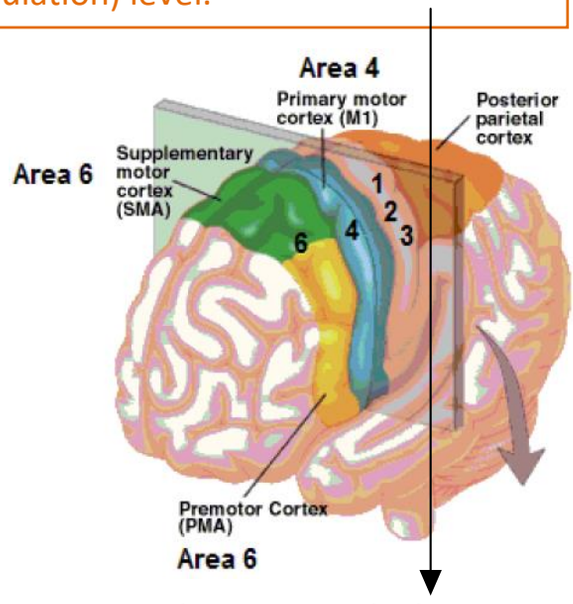
Hello everyone, 😊 in this sheet we'll start with **Motor tracts** (descending tracts)

The descending tract is divided into 2 parts: Pyramidal and Extrapyramidal tracts:

1. **Pyramidal tracts** (mainly corticospinal tracts) are responsible for: **Conscious** control of skeletal muscles movement.
2. **Extrapyramidal tracts** are responsible for: **Subconscious** control of skeletal muscles movement, like regulation of balance, muscle tone, eye, hand, and upper limb position.

When you hear the word "**subconscious**", you may think of smooth muscles! However, don't be confused; the **smooth muscles** are totally supplied by **autonomic** NS. On the other hand, the **skeletal muscles** are supplied by **somatic** NS (voluntary movements), but the **control of the skeletal muscle movement** can be on either the conscious level (you are aware of) or the subconscious (coordination / modulation) level.

The **motor system** starts from the cortex and descends downwards (opposite to sensory system).
In this picture, we have the **motor cortex** which is in the frontal lobe (anterior to the central sulcus).
It is **divided into areas:** (according to Brodmann)



- **Area 4** is named pre-central gyrus (primary motor cortex). The **pyramidal** tracts descend from it mainly.
- **Area 6** which is responsible for the coordination of skeletal muscle movement. The **extrapyramidal** tracts descend from it mainly.
- Believe it or not, some motor neurons start from **Area 312** on the cortex, which is a sensory area.

To test neurological disease
مش بمعنى انه هاد هو الفحص
لو طلبت من الشخص على سبيل
المثال يرفع ايده رح يرفعها بس ما
بقدر يتحكم بحركتها هاي الفكرة من
ال **subcoscious level**

Area 6 is divided into 2 parts with a huge overlap between them:

1. **The premotor area** (often most lateral): uses **external cues,** such as vision & hearing.
2. **The supplementary motor area** (most medial): uses **internal cues**, related to memory.

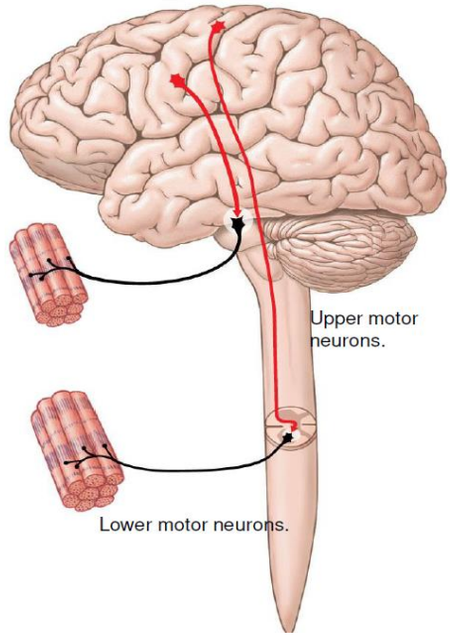
To perform a motor activity**,** we need **cues**. To understand it read the following:

An experiment was done on monkeys: they put in front of a monkey 3 electric bulbs with their switches, and they trained the monkey to click on the switch belonging to the bulb switched ON. **Now the monkey can transfer sensory data to motor activity.** Then, if the **premotor area** of the monkey was damaged but without any physical change (paralysis or blindness), the monkey **will lose the coordination** or the ability to convert his sensory data (visual input) to a motor activity.

What is the difference between area 4 and area 6?

- Imagine we have a lesion in **area 4** (mainly pyramidal tracts) → **paralysis** will happen → can't move the muscles at all.
- If the lesion was in **area 6** (extrapyramidal) → **no paralysis**, the person still can contract his muscles and do certain movements. For example, he can simply raise his hand, but he can't do fine or coordinated movements (like inserting a thread into the hole of a needle).

A quick introduction to the pyramidal tracts (conscious movement):



Starting with the **Upper motor neuron** from the **cortex** (more than one origin but mainly from area 4) → to the level of **spinal cord** → synapse with **interneuron** (lamina 8) → activation of **lower motor neuron** (its cell body in the anterior horn / lamina 9) → to **skeletal muscle**.

*Cranial nerves don't have anterior horn cells, instead they have motor nuclei. We'll talk about them later. *

- Types: **Corticospinal tracts: Anterior & lateral**.

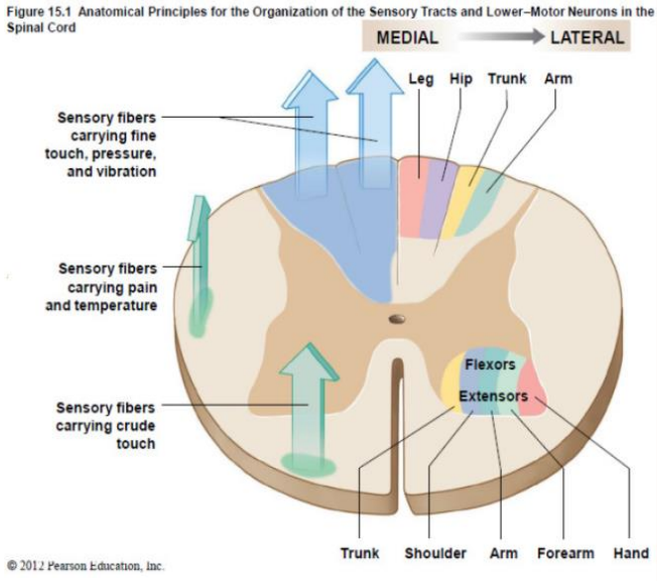
The extra-pyramidal tracts (subconscious control):
Here's some notes about them. It will be explained in details later in the sheet.

- **Vestibulospinal tracts:** Start in the vestibular nuclei in the brainstem (between lower part of the pons & upper part of medulla oblongata). The vestibular nuclei are sensory nuclei of the vestibular nerve part of the vestibulocochlear (8th cranial) nerve, which is responsible of sense of balance.
- **Reticulospinal tracts:** Start in reticular formation, which is a network of neurons in the core of the brainstem.
- **Rubrospinal tracts:** (rubro=red): Start in the red nucleus (piece of gray matter that is highly vascular and located in the midbrain) and it has an important role in the control of motor system.
- **Tectospinal tracts:** (tecto=posterior aspect of midbrain). 10:00

The tracts are named because of their dimension. **Extrapyramidal** tracts arise in the brainstem and descend to the spinal cord but are **under the influence of the cerebral cortex** (area 6). So, to be more precise, they should be named cortico-Vestibulospinal, cortico-Reticulospinal, etc… (just for abbreviation we don't start with cortico-).

Anatomically, why are they named pyramidal tracts?
Pyramidal tracts pass from a part of the medulla oblongata on its anterior aspect called **pyramid** (due to its shape), and we have 2 pyramids one on the right & one on the left. (check the picture in page 4 to see the pyramid).
Extrapyramidal tracts are named so because they don't pass through these pyramids.

Motor horns:



We'll start talking generally about the **anterior horn:** The somato-tropic principle:

- The **medial** part of the anterior horn supplies the trunk & shoulder which are **medial/axial muscles** near the trunk (related to vertebral column / girdles). **(All segments).**
  Movement: mainly **upright posture and balance.**
- **Lateral** aspect supplies hand, forearm, or generally the **distal muscles. (Only enlargements).**
  Movement: **skilled movement** (writing, playing, drawing, etc.).
- Also, the anterior horn can be divided anteriorly and posteriorly:
  Extensors muscles anteriorly & **Flexors posteriorly**.

Lamina of motor system:

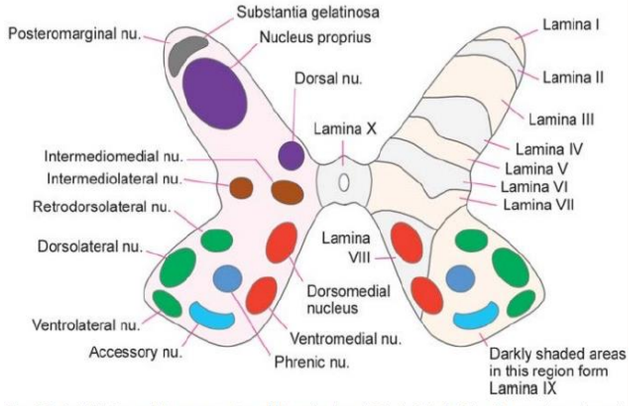


Fig. 5.2. Subdivisions of the grey matter of the spinal cord. The left half of the figure shows the cell groups usually described. The right half shows the newer concept of laminae.

- **Lamina 8:** motor **interneurons**, Commissural nucleus.
- **Lamina 9:** ventral horn, cell body of **lower motor neuron (LMN)**, divided into nuclei:
  - **Ventromedial**: all segments (extensors of vertebral column).
  - **Dorsomedial**: T1-L2 (intercostals and abdominal muscles).
  - **Ventrolateral**: C5-C8 (arm), L2-S2 (thigh).
  - **Dorsolateral**: C5-C8 (Forearm), L3-S3 (Leg).
  - **Reterodorsolateral**: (In the enlargements) C8-T1 (Hand), S1-S2 (foot) → these are responsible for skilled movement. Notice that these muscles are mainly flexors, so they're retrodorsal.
  - **Central**: Phrenic nerve (C3-C5) → activates lower motor neuron that supplies the diaphragm.

  (Only ventromedial nuclei are shown in all segments, the rest are shown only in specific segments).
- **Lamina X or 10:** Surrounds the central canal – the grey commissure. Its function is still not clear and controversial (more references in lab 1).

20:00