CORTICAL MOTOR AREAS
&
DESCENDING MOTOR TRACTS
(PYRAMIDAL & EXTRA PYRAMIDAL SYSTEM)

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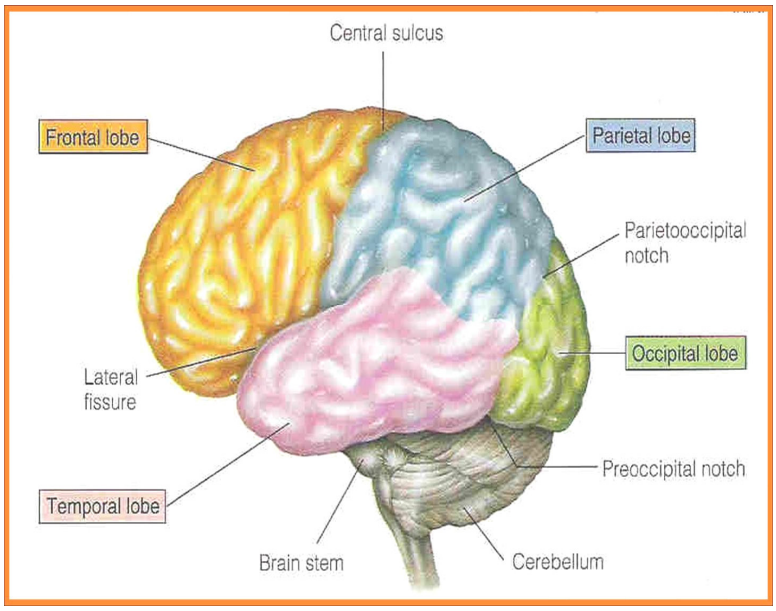
PART 1

- THE WORD MOTOR MEANS : M O V E M E N T
  N.B: From above (motor cortex) down to organs

In this figure our consideration is the precentral gyrus which is the motor area

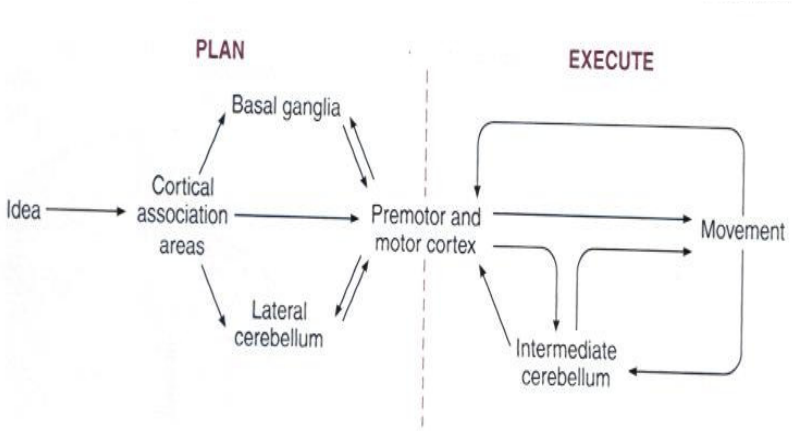


- **MOTOR SYSTEM INCLUDES:**

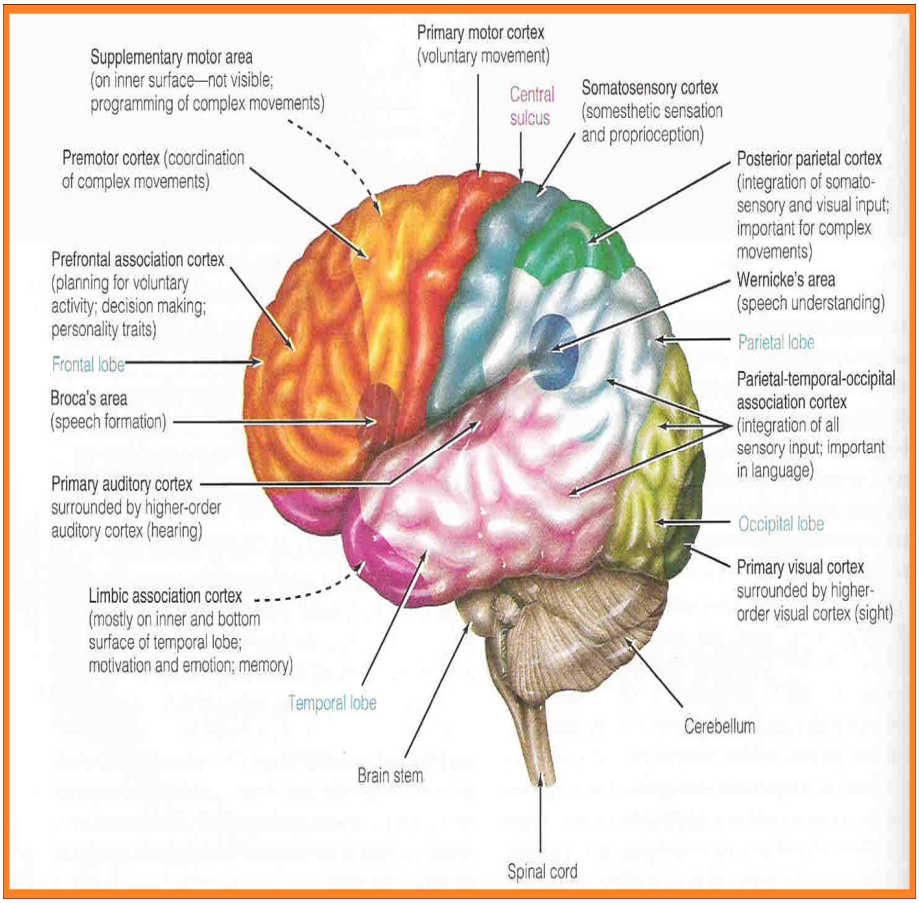
  - MOTOR CORTEX.
  - PYRAMIDAL TRACTS:
    - ✓ CORTICO SPINAL.
    - ✓ CORTICO BULBAR.
  - EXTRA PYRAMIDAL TRACTS.
  - BASAL GANGLIA.
  - CEREBELLUM.

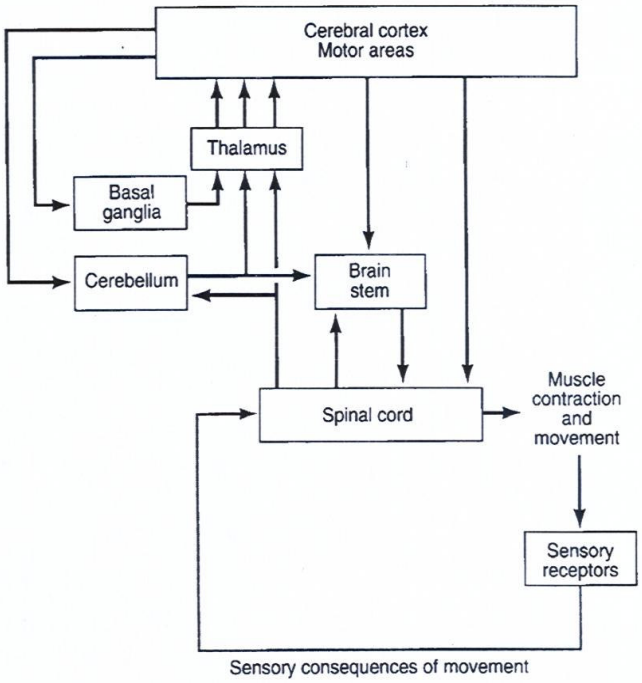
OVERVIEW OF MOTOR SYSTEM

- **Planning** for movement is the function of the following:
  - ✓ premotor area
  - ✓ supplementry motor area
  - ✓ cortical association area
  - ✓ basal ganglia
  - ✓ cerebellum.



- **Execution** of movement is the function of:
  - ✓ Primary motor area 4





MOTOR NEURON SUBSERVE 3 FUNCTIONS:

- **VOLUNTARY MOVEMENTS:**
  - Planned in brain supplementary motor area, basal ganglion, cerebellum (neo cerebellum)(lateral part), then commands are sent by primary motor area via corticospinal and Corticobulbar system (pyramidal system)

- **ADJUST BODY POSTURE:**
  - Posture is continually adjusted before and during movement by Posture regulating system.(Extapyramidal & motor area esp. the premotor area)

- **COORDINATE THE ACTIONS OF DIFFERENT MUSCLES TO MAKE MOVEMENT SMOOTH AND PRECISE:**
  - Movement is smooth and coordinated by medial and intermediate portion of cerebellum (spinocerebellum) & its connections

LEVELS OF MOTOR CONTROL

- CEREBRAL CORTEX
- BRAIN STEM
- SPINAL CORD

Exta. Info: Brain death is the death of brain stem

MOTOR AREAS OF CEREBRAL CORTEX

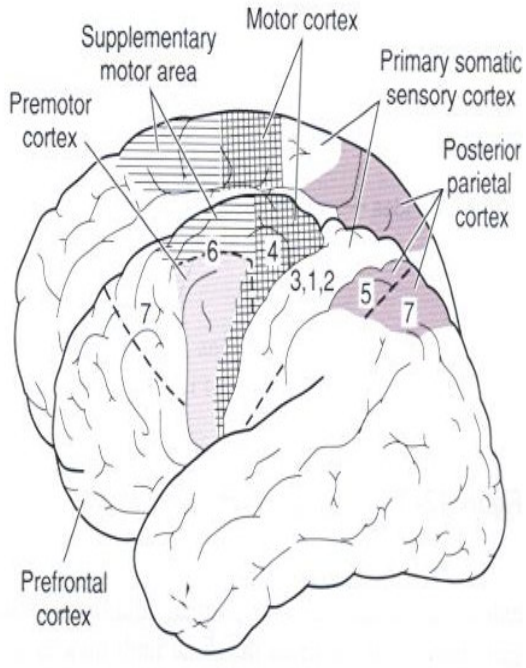
THREE MAJOR AREAS:

I. **PRIMARY MOTOR CORTEX** (M1)
   - Executes commands to motor neuron (Broad man's area 4) in frontal lobe.

II. **PREMOTOR CORTEX** (M3) (Broad man's area 6)

III. **SUPPLEMENTARY MOTOR CORTEX** (M2)

- ✓ Both Premotor and supplementary motor cortex project to primary motor cortex and are involved in coordinating & planning movement
- ✓ All three regions project to spinal cord via corticospinal tract. (Then to ant. horn)

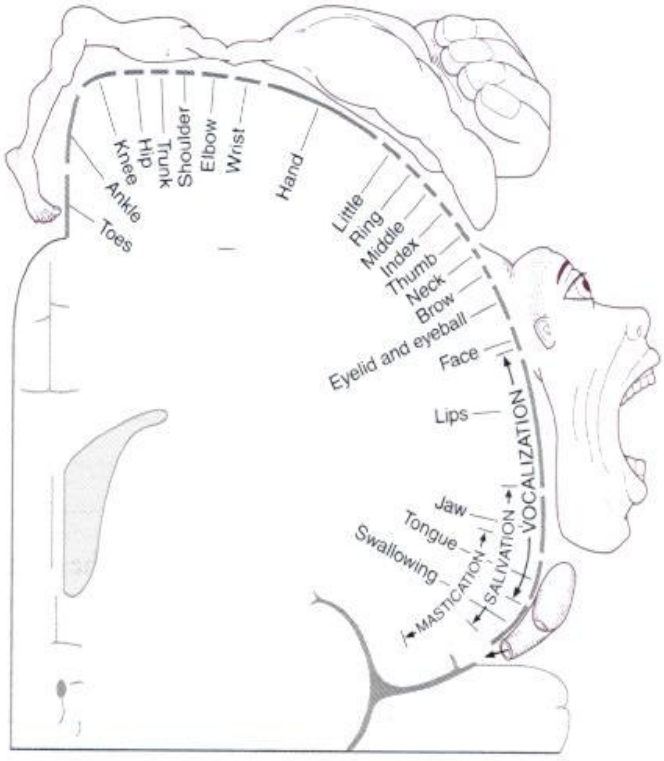


PRIMARY MOTOR CORTEX

- Primary motor cortex (M1) lies in the frontal lobe in precentral gyrus, also called Broadmanns area 4

- The body Is represented up-side down:

  - ✓ leg's medially => hands => face => lips & tongue laterally.
  - ✓ the hands are represented bigger than those of the legs.
  - ✓ Face is represented more than other areas.



- the representation is according to the type of movement to be done (fine movement => bigger representation)

- Left area control the right part of the body.

- MORE THAN HALF OF PRIMARY CORTEX IS **FOR HANDS& SPEECH (IMP)**

- **Important points regarding primary motor area:**

  - ✓ Feet are at the top of the gyrus and face at the bottom.
  - ✓ Arms and the hand area in the mid portion.
  - ✓ Remember feet medially and face laterally.
  - ✓ Facial area is represented bilaterally, but rest of the representation is generally unilateral.

Remember:

- Cortical motor area controls the musculature on the opposite side of the body
- Cortical representation of each body part is proportionate in size to the skill of that part being used for fine voluntary movement .
- Therefore the area involved in hand movement and in speech have large representation in the cortex (more than half of primary motor cortex).
- Both individual muscles and movements are represented in M1 area.
- Cells in cortical motor area are arranged in columns .

PRE MOTOR AREA

- Pre motor area lies 1 to 3 cm anterior to primary motor cortex in frontal lobes.
- Topographical organization of pre motor cortex is roughly the same as that of primary motor cortex.
- Projects to brainstem area for postural control and to motor cortex also.
- Its function is still incompletely understood but maybe concerned with posture and planning of movement.

✓ Topographical organization = body representation.

SUPPLEMENTARY MOTOR AREA

- It is located in the frontal lobe.
- Projects to primary motor cortex.
- Involved in planning and programming of motor sequences.

POSTERIOR PARIETAL CORTEX (SOMATOSENSORY AREA)

- Corticospinal and Corticobulbar tracts get fibers from somatosensory area.
- Somatosensory area projects to premotor area also.
- Lesions of somatosensory area causes defects in motor performance like inability to execute learned sequence of movement eg. Eating with knife and fork.

✓ SO, it has some motor activity (imp)

CORTICOSPINAL & CORTICOBULBAR SYSTEM
(PYRAMIDAL TRACTS)

- Motor signals are transmitted directly from the motor cortex to the spinal cord through corticospinal tracts (Direct tracts both of them).

- Corticobulbar tracts means motor neurons from motor cortex to cranial nerve nuclei in brain stem.

  ✓ N.B: to all cranial nerve nuclei except those for the (1,2&8) which are sensory.

CORTICOSPINAL TRACTS:

- It is the most important motor pathway from motor cortex

- Corticospinal tracts (Pyramidal tracts) originates :
  - 30 % from Primary Motor Cortex
  - 30 % from Premotor and Supplementary Motor Area
  - **40 % from Somatosensory Area**

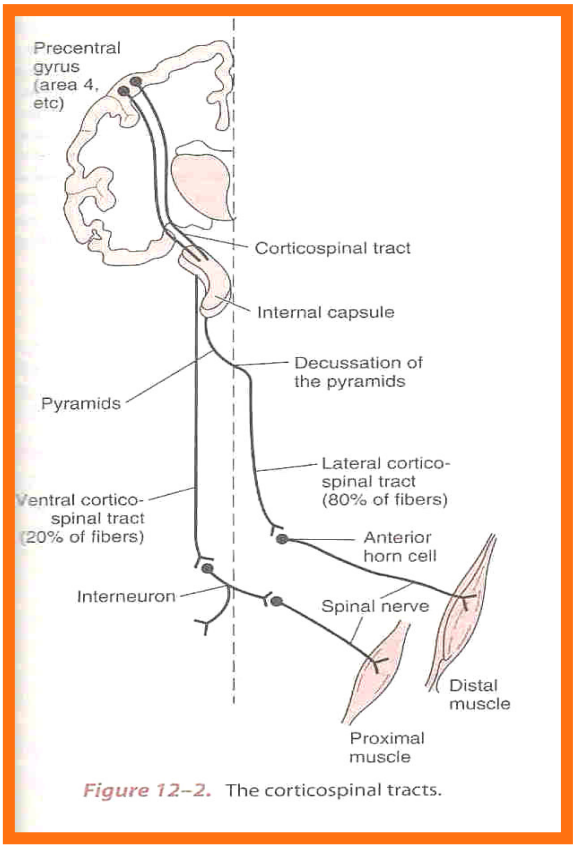


Figure 12–2. The corticospinal tracts.

COURSE OF CORTICOSPINAL TRACT:

- After leaving the motor cortex it passes through **posterior limb** of internal capsule

- Then downwards through brainstem (Midbrain ,Pons and Medulla)

- It forms pyramids of medulla therefore Corticospinal pathway are referred as Pyramidal system

- Majority of Pyramidal fibers (80%) then cross in lower medulla to the opposite side and descend in **lateral Corticospinal tracts of the cord**

  ✓ Lateral corticospinal tracts terminate principally on the Interneuron(97%), in the intermediate region of cord grey matter & a few terminate on sensory relay neurons in dorsal horn and very few terminate directly on Anterior Motor Neuron.(3%)

- Few of the corticospinal fibers (20%) do not cross to the opposite side in medulla, but pass Ipsilaterally (same side) of the cord and are called VENTRAL CORTICOSPINAL TRACT

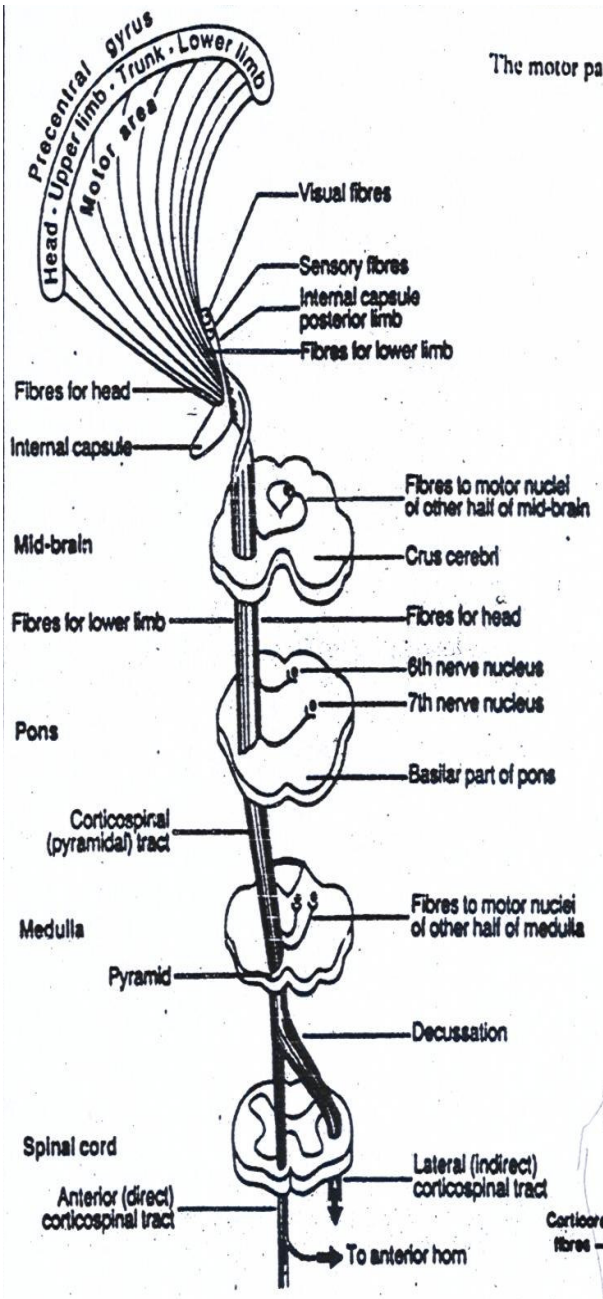
    - ✓ Many of these ventral corticospinal fibers eventually pass to the opposite side in the spinal cord

Note that:

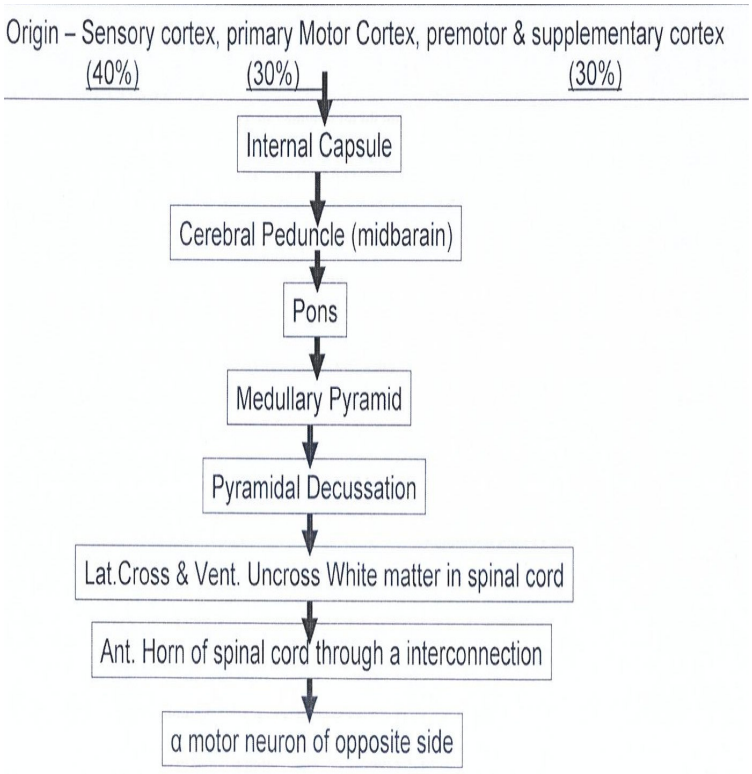
- Pyramidal tracts have large myelinated fibers 16 µm in diameter. These fibers originate from Giant Pyramidal cells called Betz cells found only in Primary motor cortex.

- Total number of fibers in each corticospinal tract is about 1 million but these large fibers represents only 3 % of total number(30,000)

- Other 97 % are small fibers with diameter less than 4 µm from small pyramidal cells found in many areas of the cerebral cortex.



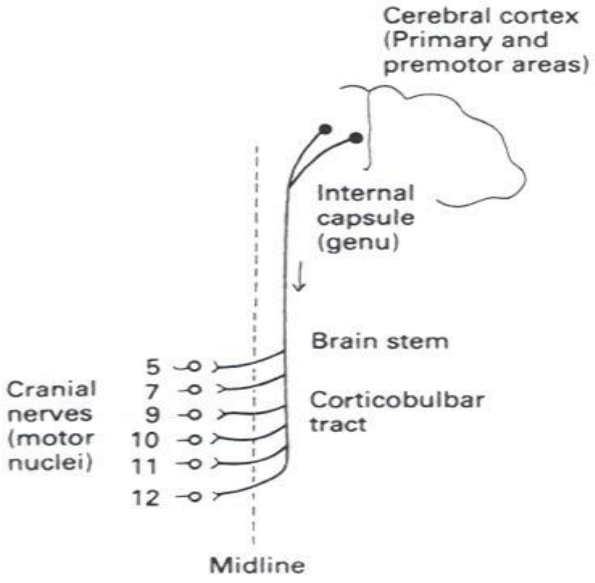
Conclusion:



CORTICOBULBAR TRACTS

- Corticospinal tract descend through the brain stem, they give rise to fibers which cross to opposite side and synapse with <u>cranial motor nuclei</u> supplying the muscles of face. These fibers form Corticobulbar tract.

- As we said before :
  - ✓ N.B: to all cranial nerve nuclei except those for the (1,2&8) which are sensory.



FUNCTIONS

- **LATERAL CORTICOSPINAL TRACT:**
  - ✓ <u>Fine movements of fingers that is **skilled** voluntary movement</u>

- **VENTRAL CORTICOSPINAL TRACT:**
  - ✓ <u>It may be concerned with control of **bilateral postural movements** by the *supplementary motor cortex*</u>

SUMMARY

CORTICOSPINAL TRACTS OR PYRAMIDAL TRACTS:

- 80 % cross in the medulla => Lateral corticospinal tract
- 20 % do not cross in medulla => Ventral or anterior Corticospinal tract (They cross in spinal cord)
- The nerve fibers that pass from the motor cortex to cranial nerve nuclei are called Corticobulbar tract

APPLIED ASPECTS

- Pure Pyramidal lesion causes hypotonia and flaccidity.
- Why ?
  - ✓ Because they are facilitatory to muscle tone and deep reflexes therefore when corticospinal tracts are damaged it causes hypotonia and flaccidity.
- BUT REMEMBER PURE PYRAMIDAL LESIONS DO NOT OCCUR USUALLY IN HUMANS.

General Notes

1- upper motor neuron:
- ✓ from cortex down to ant. Horn cells
- ✓ (ant. Horn cells are not included)
- ✓ it include pyramidal & extra pyramidal tracts.

2- lower motor neuron:
- ✓ from ant. Horn cells to muscles & organs