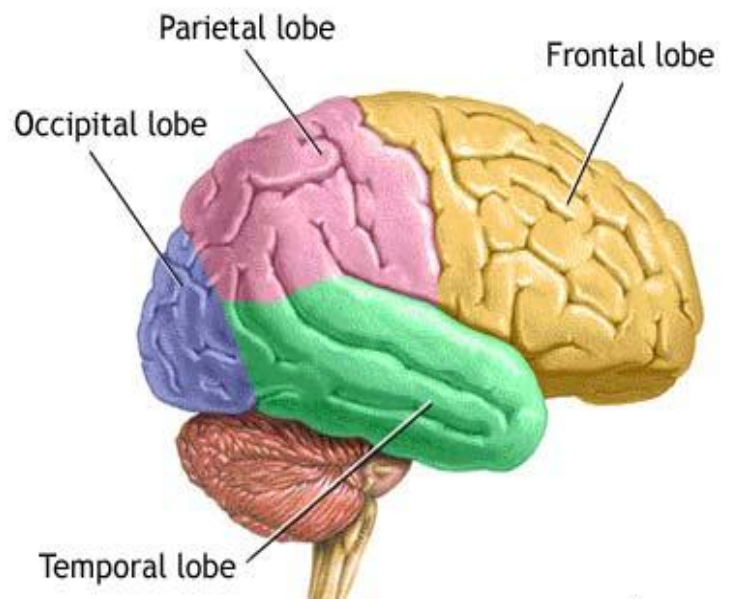


Cortical Motor Areas & Pyramidal System

- The word motor means :: M O V E M E N T .

- **MOTOR SYSTEM INCLUDES:**

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

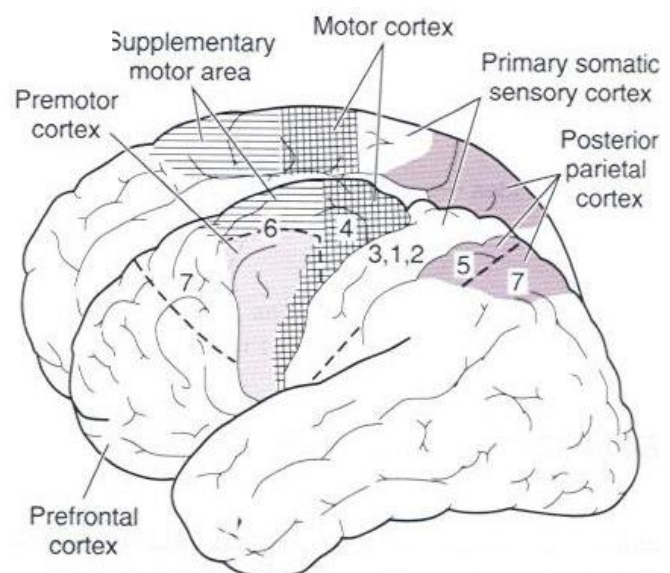


- **LEVELS OF MOTOR CONTROL :**

- Cerebral cortex.
- Brain stem.
- Spinal cord.

- **MOTOR AREAS OF CEREBRAL CORTEX :**

- Primary Motor Cortex (M-I) .
- Supplementary Motor Area (M-II) .
- Premotor Cortex (M-III) .
- Frontal Eye Field Area.
- Broca's Area for speech.

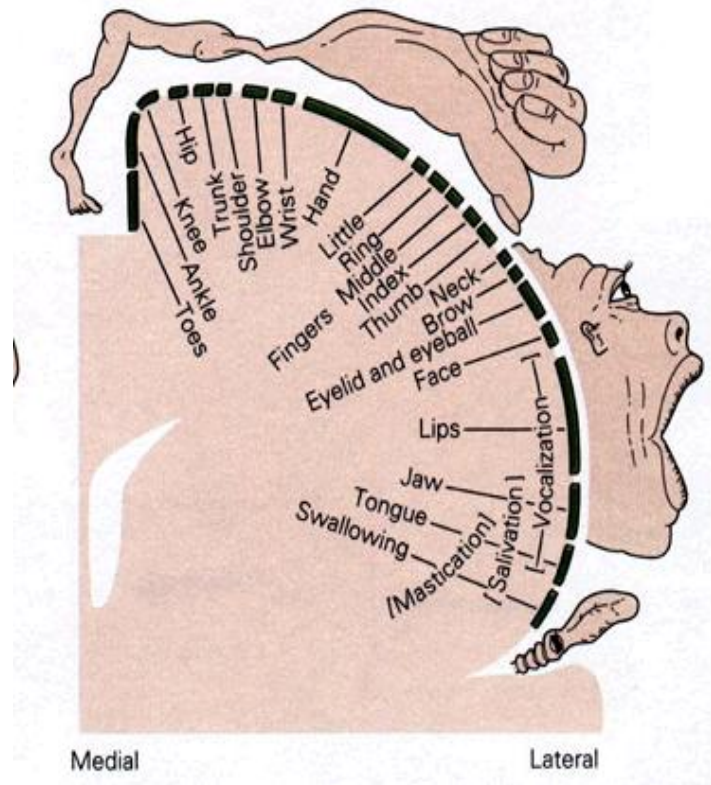


N.B.

- 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 anterior horn cells) .

PRIMARY MOTOR CORTEX

- Primary motor cortex (M1) lies in the frontal lobe in precentral gyrus (**Broadmanns area 4**).
- The body is represented up-side down: (legs medially - hands , face , lips & tongue laterally) .
- Hand and mouth has a greater area of representation (more than half) .
- Representation of each body part proportionate in size to the skill of that part being used (fine movement => bigger representation) .
- Facial area is represented **bilaterally**, but rest of the representation is generally unilateral.
- It controls the musculature of the opposite side of the body.
- Pure **Lesions** in M-I are rare :
 - ✓ Patients may have contra lateral weakness in distal muscles (e.g. fingers) .
 - ✓ Ability to control fine movements is gone.
 - ✓ Ablation of M-I alone cause hypotonia (not Spasticity) .



SUPPLEMENTARY MOTOR AREA

- It is located in both lateral and medial aspect of the frontal lobe .
- Projects to primary motor cortex .
- Involved in planning and programming of motor sequences .
- **Lesions** in M-II produces awkwardness in performing complex activity like bimanual coordinated activity .

PREMOTOR AREA

- Pre motor area lies 1 to 3 cm anterior to primary motor cortex in frontal lobes (**Broadmann's** area 6) .
- Organization of premotor 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 .
- Its lesions do not cause paralysis but only slowing of the complex limb movement .
- Lesion may result in loss of short-term or working memory .
- When damaged with supplementary cortex it may result in APRAXIA .

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 is involved in motor activity .

CORTICOSPINAL & CORTICOBULBAR SYSTEM (PYRAMIDAL TRACTS)

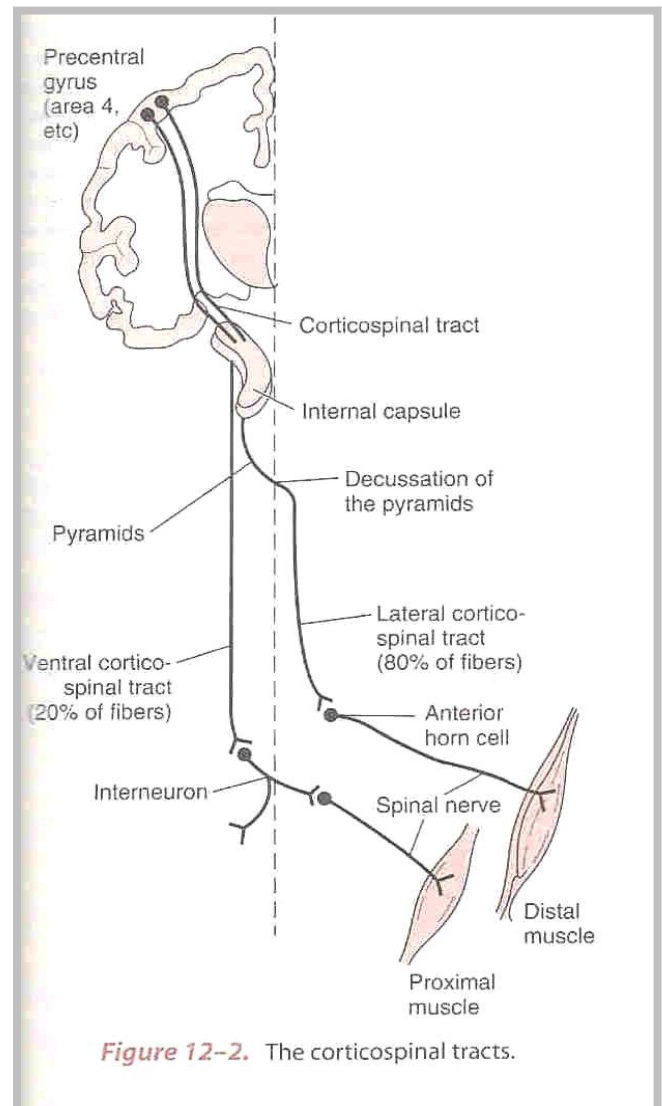
- Motor signals are transmitted directly from the motor cortex to the spinal cord through corticospinal tracts (Direct tracts both of them).
- Corticobulbar tracts means motor neurons from motor cortex to cranial nerve nuclei in brain stem .
- **N.B.** to all cranial nerves except those for the (1 , 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 .

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 TRACT** of the cord .
- 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 .

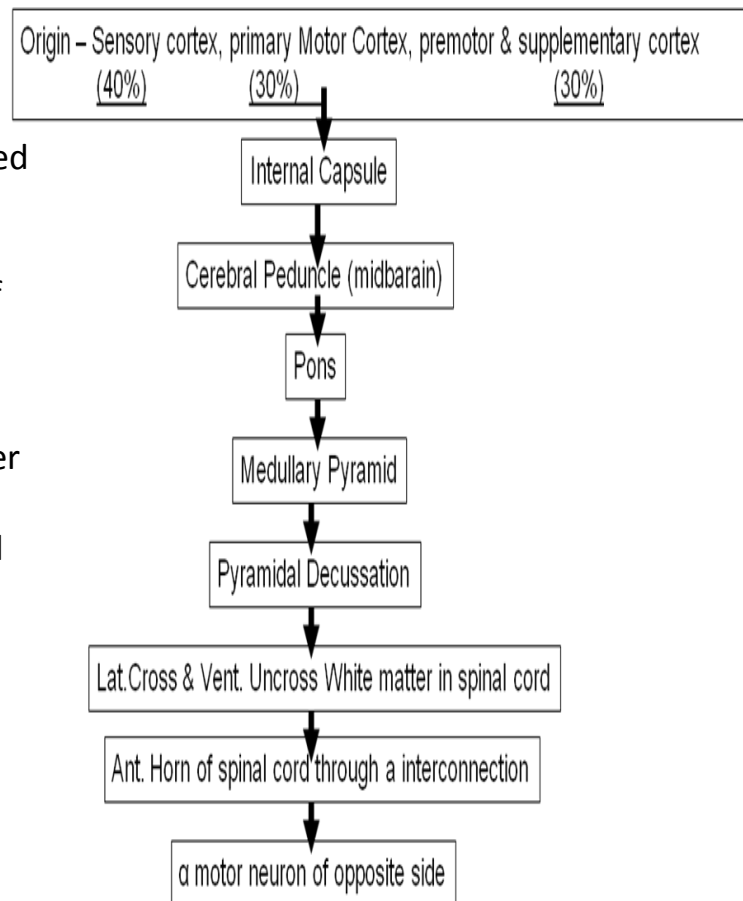


- **Note that:**

- 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.
- These large fibers represents only 3 % of total number of fibers in corticospinal tract .
- Other 97 % are small fibers with diameter less than (4 μm) from small pyramidal cells found in many areas of the cerebral cortex .

- **FUNCTIONS :**

- **LATERAL CORTICOSPINAL TRACT:**
Fine movements of fingers (skilled voluntary movement) .
- **VENTRAL CORTICOSPINAL TRACT:**
It may be concerned with control of bilateral postural movements by the supplementary motor cortex .



CORTICOBULBAR TRACTS (CORTICONUCLEAR TRACTS)

- Corticospinal tract descend through the brain stem, they give rise to fibers which synapse with **cranial motor nuclei** supplying the muscles of face. These fibers form **CORTICOBULBAR TRACTS** .
- **N.B.** to all cranial nerves except those for the (1 , 2 , 8) which are **sensory**.

SUMMARY

- **Planning** of movement is the function of all the following:

- premotor area .
- supplementary motor area .
- cortical association area .
- basal ganglia .
- cerebellum .

while **Execution** of the movement is the function of **PRIMARY MOTOR AREA** .

- **CORTICOSPINAL 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 TRACTS (or CORTICONUCLEAR TRACTS)** .

GENERAL NOTES

- **There are two types of motor neurons :**

1) Upper motor neuron (corticospinal & corticobulbar) :

Starts from motor cortex and ends in

- Cranial nerve nucleus (corticobulbar).
- Anterior horn of spinal cord in opposite side(corticospinal tracts).

2) Lower Motor Neuron :

Starts from anterior horn of spinal cord and ends in appropriate muscle of the same side.

e.g. All peripheral motor nerves.

- **REFERENCE :**

Review of Medical Physiology by Gannon (22nd edition) , pages (203-210) .