

**CORTICAL MOTOR AREAS
&
DESCENDING MOTOR TRACTS
(PYRAMIDAL & EXTRA PYRAMIDAL SYSTEM)
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PART 2

EXTRA PYRAMIDAL SYSTEM

○ DEFINATION :

- Tracts other than corticospinal tracts are known as **EXTRA PYRAMIDAL TRACTS**.

○ COMPONENTS OF EXTRAPYRAMIDAL SYSTEM:

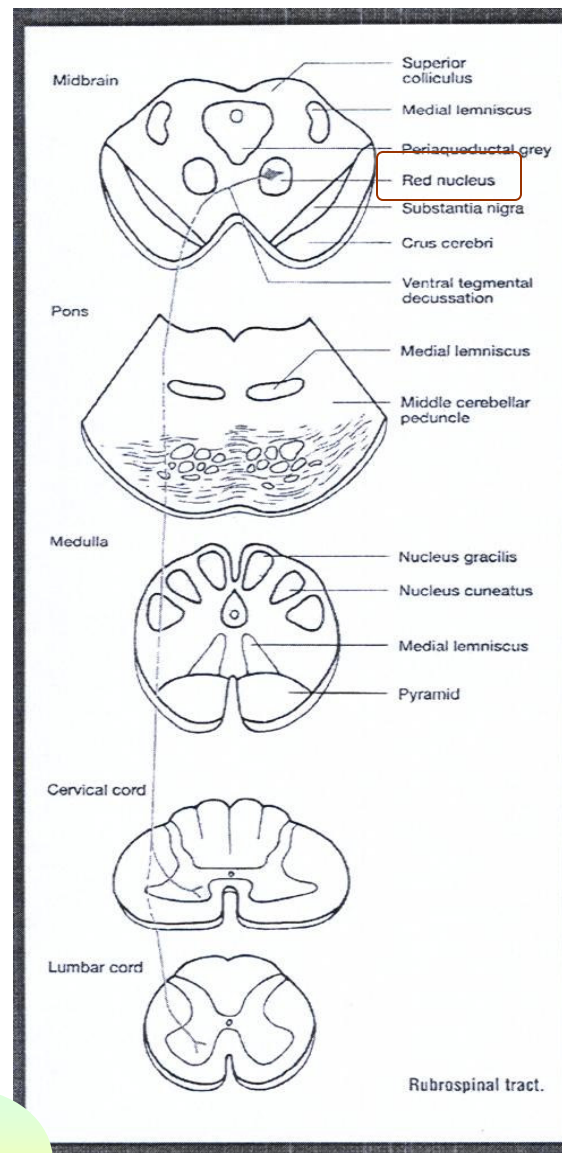
- **BASAL GANGLIA** (will be discussed later)
- **BRAINSTEM** Giving rise to following tracts:

- ✓ Rubrospinal tract
- ✓ Vestibulospinal tract
- ✓ Tectospinal tract
- ✓ Reticulospinal tract

VTR₂
never to be
used in
clinical
section

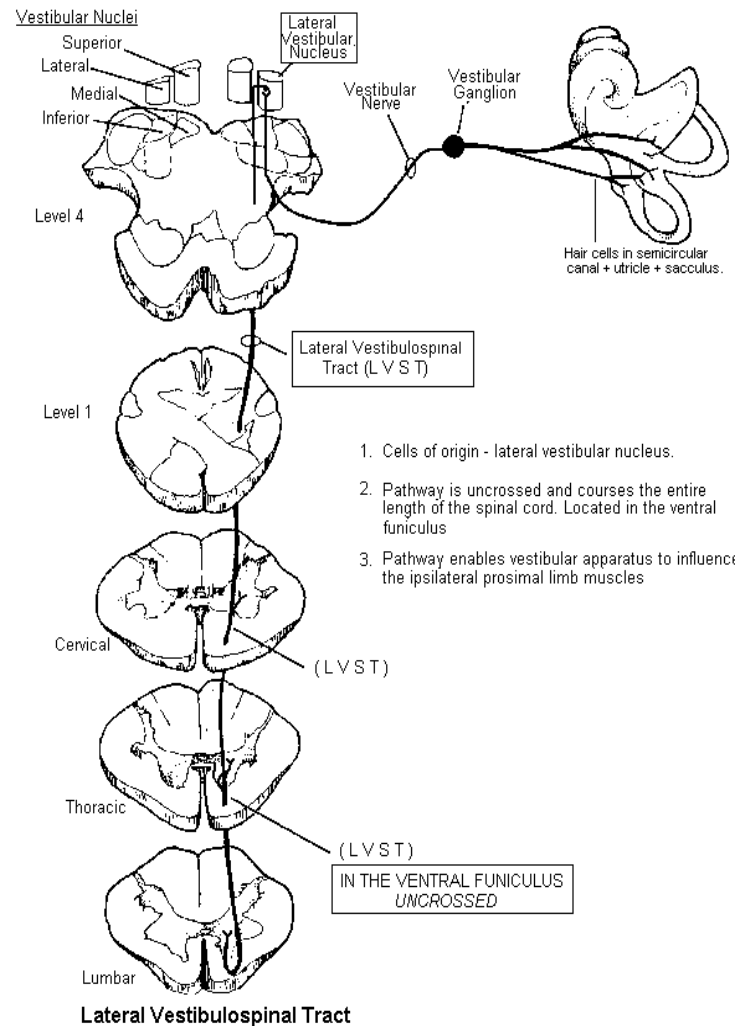
RUBROSPINAL TRACT:

- **Origin** : Red nucleus (mid brain).
- **Input** : Red nucleus gets input from both cerebellum and cerebral cortical motor areas.
- **Output** : Via Rubrospinal tract is directed to contralateral spinal motor neurons (crosses to opposite side at the level of nucleus and axons are located in lateral spinal white matter anterior to corticospinal tract.
- **Functions** : Involved in movements of distal limbs (hand & feet) also regulates tone and posture.
- It is excitatory to flexors and inhibitory to extensor muscles.



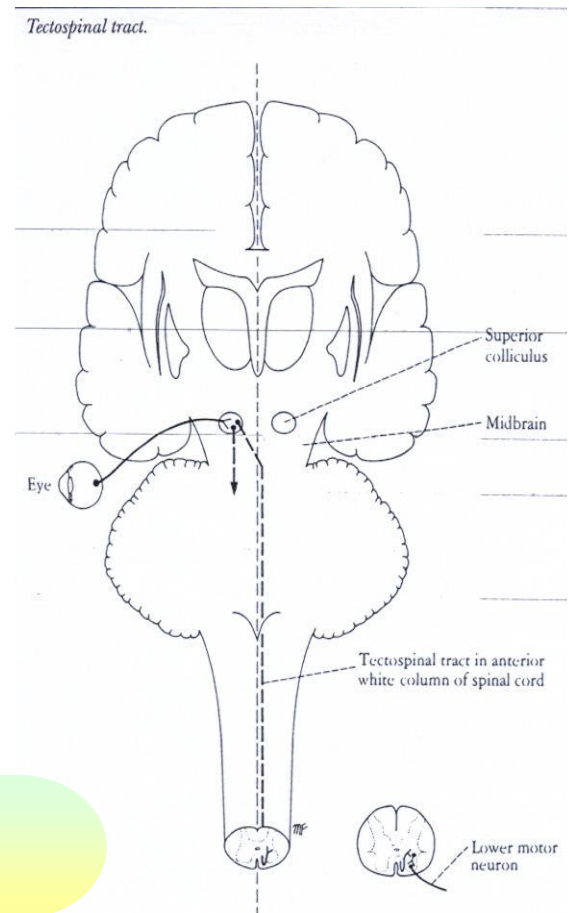
VESTIBULOSPINAL TRACT

- **Location** : Vestibular nuclei are located in Pons and Medulla
- **Input** : They receive input from Vestibular apparatus in the inner ear and Cerebellum
- **Output** : Mainly From Lateral vestibular nuclei to spinal cord in Vestibulospinal tract. It remains ipsilateral
- **Function** : Excitatory to ipsilateral extensor , Inhibitory to flexors muscles
- Regulates muscle tone for maintaining balance in response to head movement



TECTOSPINAL TRACT

- **Location** : originates in superior colliculus in midbrain.
- **Input** : from visual stimuli.
- **Output** : Conveys nerve impulses from superior colliculus (midbrain) to contralateral skeletal muscles that move the head and eyes in response to visual stimuli.
- **Function** : Involved in control of neck muscle in response to visual stimuli.



RETICULOSPINAL TRACT

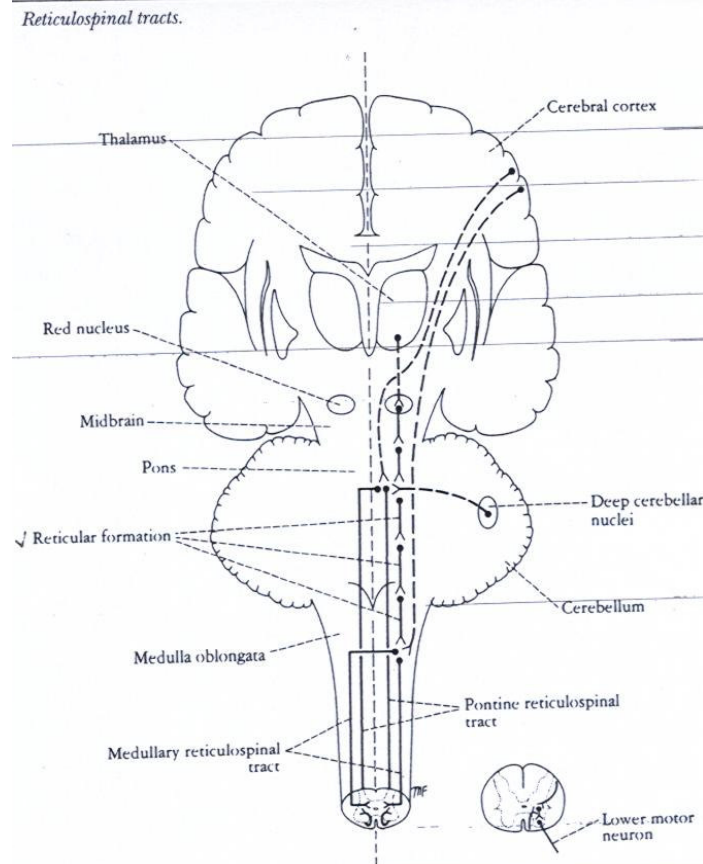
- **Location** : Reticular formation in the central grey matter of brain stem.
- **Input** : Afferent input to reticular formation comes from spinal cord, vestibular nuclei, cerebellum, Sensory motor cortex, globus pallidus & Lat. Hypothalamus.
- **Output** : Descending tract arise from nuclei in pons and medulla.

1] *Pons* - Pontine Reticulospinal tract runs ipsilaterally;

- ✓ **Function** : Excitatory to Axial extensor muscles.

2] *Medulla* - Medullary reticulospinal tract runs ipsilaterally (some cross also).

- ✓ **Function** : Inhibitory to axial extensor Muscle.



DESCENDING EXTRA PYRAMIDAL MOTOR TRACT TO SPINAL INTERNEURON AND MOTOR NEURON

Rubrospinal	Extrapyramidal	Red nucleus (midbrain)	Crossed
Tectospinal	Extrapyramidal	Superior colliculus (midbrain)	Crossed
Vestibulospinal	Extrapyramidal	Vestibular nuclei (medulla oblongata)	Uncrossed
Reticulospinal	Extrapyramidal	Reticular formation (medulla and pons)	Crossed

- ✓ These tracts **terminate** on anterior horn interneurons. Occasionally they terminate directly on anterior horn motor neurons.

FUNCTIONS OF EXTRA PYRAMIDAL SYSTEM OR MULTINEURONAL SYSTEM

- REGULATION OF BODY POSTURE, INVOLVING INVOLUNTARY MOVEMENTS OF LARGE MUSCLE GROUPS OF TRUNK AND LIMBS.

APPLIED

- **Extra pyramidal tracts** : some are excitatory and other are inhibitory to muscle tone .
 - ✓ overall effect – strong inhibitory effect over Gamma Motor Neuron in anterior horn cell.

What will be the effect of extra pyramidal lesions ?

- Hypertonia

Why ?

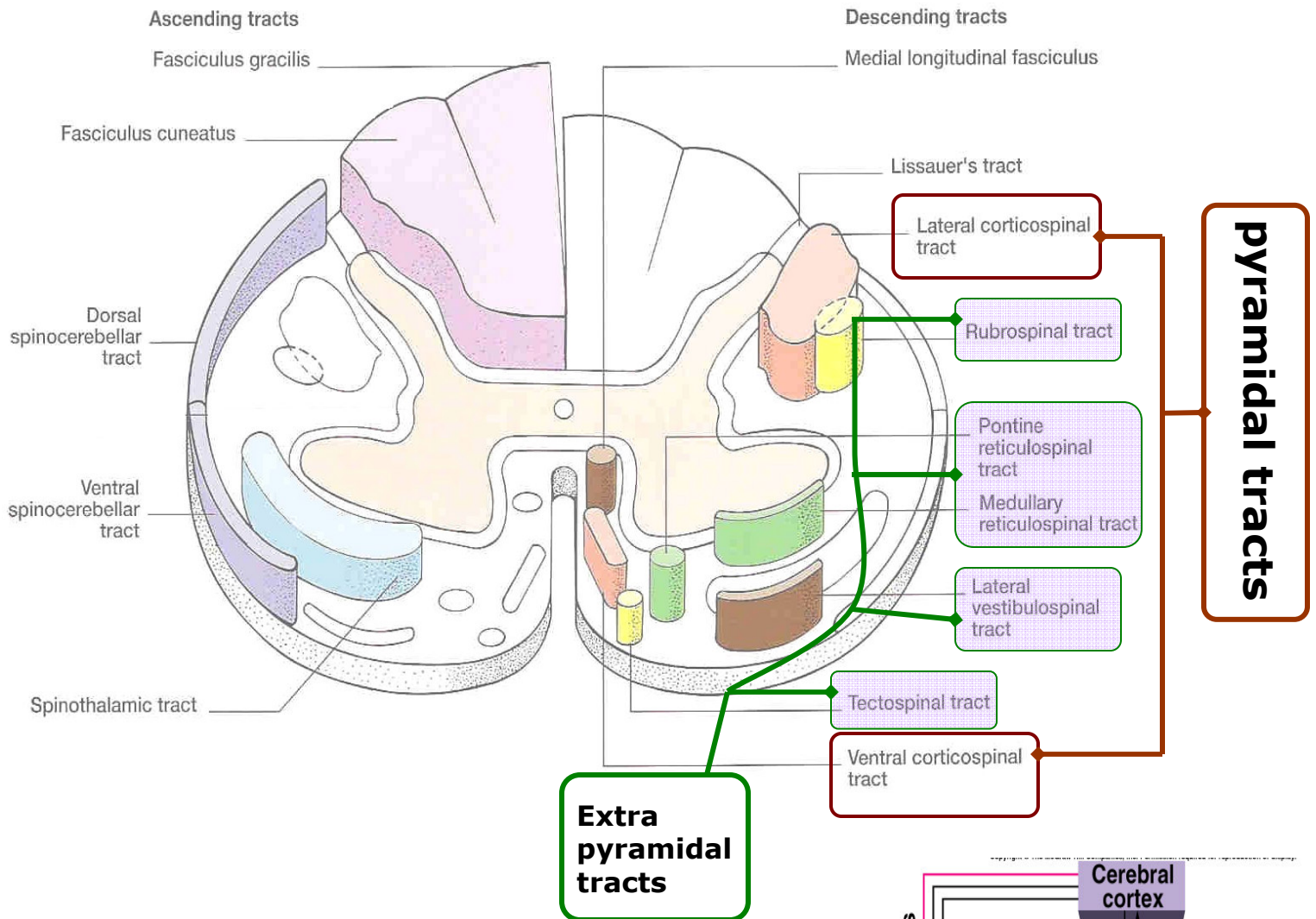
- Because strong inhibitory effect over Gamma motor neuron is lost.

IMPORTANT

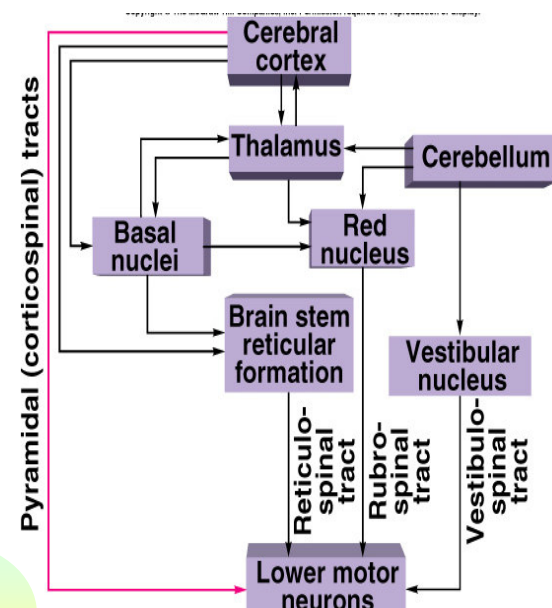
- Complex and overlapping function exist between Pyramidal and extra pyramidal systems for example while doing fine work like needle work (Pyramidal system) one has to subconsciously assume a particular posture of arms(extra pyramidal system) that enables to do your work.

SUMMARY OF PYRAMIDAL AND EXTRAPYRAMIDAL PATHWAYS

TRANSVERSE SECTION SPINAL CORD



- ✓ Pyramidal tract descend directly without synaptic interruption from cerebral motor cortex to spinal cord (on interneuron and ant. Horn cells).
- ✓ While , In extra Pyramidal tract No direct control of motor cortex or basal ganglia on spinal cord but via nuclei in midbrain and brainstem .



Differences between pyramidal and extra pyramidal tracts

PYRAMIDAL TRACTS

1. -Lateral corticospinal
-Ant. or ventral corticospinal
- Corticobulbar
2. Cell bodies that contribute to pyramidal tracts are located in precentral gyrus (Primary, Premotor and supplementary motor cortex) and somatosensory area.
3. Pyramidal tract descend directly without synaptic interruption from cerebral motor cortex to spinal cord (on interneuron and ant. Horn cells).
4. - 80 % of Corticospinal tracts (lateral) cross in medulla.

- 20 % of corticospinal tract (ventral) cross in spinal cord.

✓ Because of crossing cerebral cortex controls opposite side of the body.
5. **Function:**
 - Lat. Corticospinal tract : fine movement of fingers eg. Writing, needle work.
 - Ventral corticospinal tract : Axial or Postural Movement.

EXTRA PYRAMIDAL TRACTS

1. -Rubrospinal
-Vestibulospinal
-Reticulospinal
-Tectospinal
2. They originate in Midbrain and brainstem nuclei and have influence of cerebral cortex, basal ganglia and cerebellum which can stimulate or inhibit these nuclei.
3. No direct control of motor cortex or basal ganglia on spinal cord but via nuclei in midbrain and brainstem.
4. Major extra pyramidal tracts, some cross and others are uncrossed.
5. **Function:**
 - Control of body posture involving involuntary movements of axial and Proximal limb muscle.

COMMON WORDS USED IN NEUROPHYSIOLOGY AND CLINICAL NEUROLOGY

- **PYRAMIDAL TRACTS:**

- ✓ PYRAMIDAL LESION - HYPOTONIA.
- Pure pyramidal lesions usually don't occur in humans.

- **EXTRAPYRAMIDAL TRACTS:**

- ✓ EXTRAPYRAMIDAL LESIONS - HYPERTONIA (Rigidity).

UMN (Upper motor neuron):

UMN : Motor tracts coming from Brain to Ant. Horn cells.

- UMN lesion causes :

- ✓ Increased tone (Spasticity).
- ✓ Increased reflexes.
- ✓ Clonus: Repetitive contraction and relaxation of muscle on oscillating fashion every second or so.
- ✓ Babinski sign: stimulation of the sole of the foot along outer border causes extension of big toe upward and fanning of other toes.
 - ✓ Babinski's sign is hard sign for upper motor neuron lesion, signifies damage to lateral corticospinal tract.
 - ✓ (Normally in adults this stimulation causes plantar reflex that is downward flexion of big and small toes.)

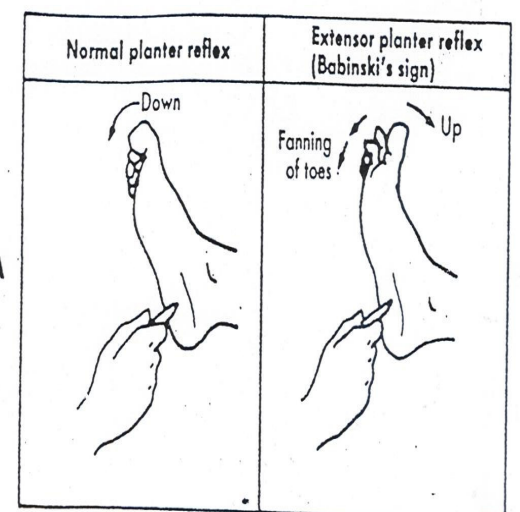


FIGURE 8-18 Babinski's sign. A, The normal response to stroking the plantar surface of the foot. B, Babinski's sign (extensor plantar reflex) in a person with an interruption of the corticospinal tract.

Note: below one year of age Babinski reflex is normally present. Why?

LMN (Lower motor neuron):

LMN : Motor tracts coming from Ant. Horn cells to periphery.

- LMN lesion (As final pathway to the muscle is damaged) causes :
 - ✓ Decreased tone (Hypotonia / Flaccidity).
 - ✓ Decreased power of the muscles.
 - ✓ Decreased reflexes.
 - ✓ Wasting of muscles.

Remember :

- ✓ HEMIPLEGIA : Paralysis (loss of power) of half side of the body.
- ✓ HEMIPARESIS : Partial loss of power of half side of the body.
- ✓ PARAPLEGIA : Paralysis in both legs.
- ✓ PARAPARESIS : Partial loss of power in both legs.
- ✓ QUADRIPEGIA : Paralysis in all four limbs.
- ✓ MONOPEGIA : Paralysis in one limb.