TRANSMISSION OF SIGNALS FROM THE MOTOR CORTEX TO THE MUSCLES

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Objectives

- Direct: Pyramidal pathway.
- Pyramidal pathway fibers.
- The pathway from motor cortex down to muscle.
- Indirect : extrapyramidal tract : Red nucleus

Motor signals are transmitted

- Directly from the cortex to the spinal cord through the corticospinal tract **(Pyramidal)**

- Indirectly through multiple accessory pathways that involve the basal ganglia, cerebellum, and various nuclei of the brain stem *(* **Extrapyramidal)**

Corticospinal (Pyramidal) Tract

- The most important output pathway from the motor cortex

- Its originates about:
- 30 percent from the primary motor cortex
- 30 percent from the premotor and supplementary motor areas
- and 40 percent from the somatosensory areas posterior to the central sulcus.

Pyramidal tract fibers

- Large fibers (3%)
- 16 μm in diameter
- originating from Betz cells

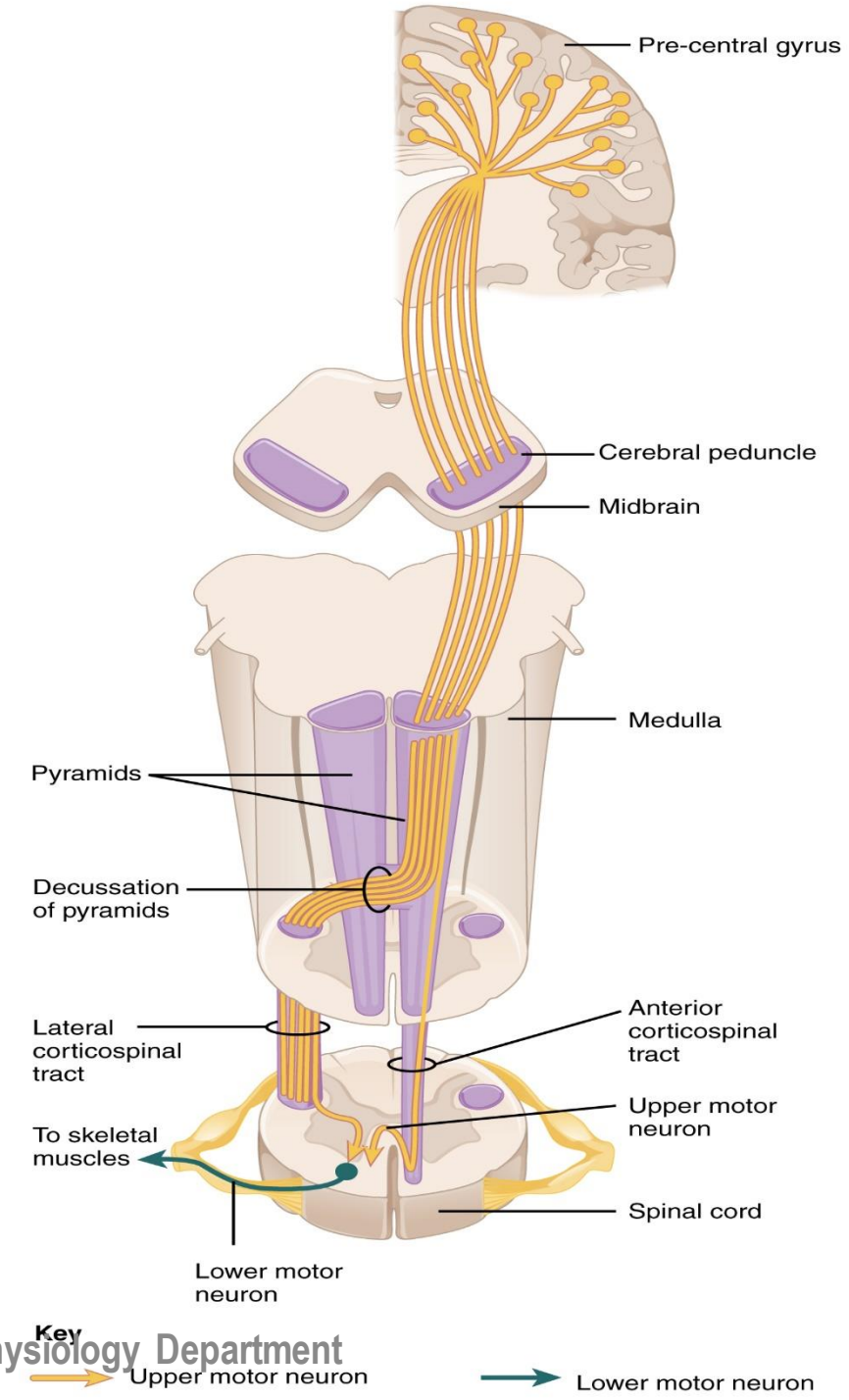
- Faster conduction (70m/sec)

- Ends directly in the α motor neuron

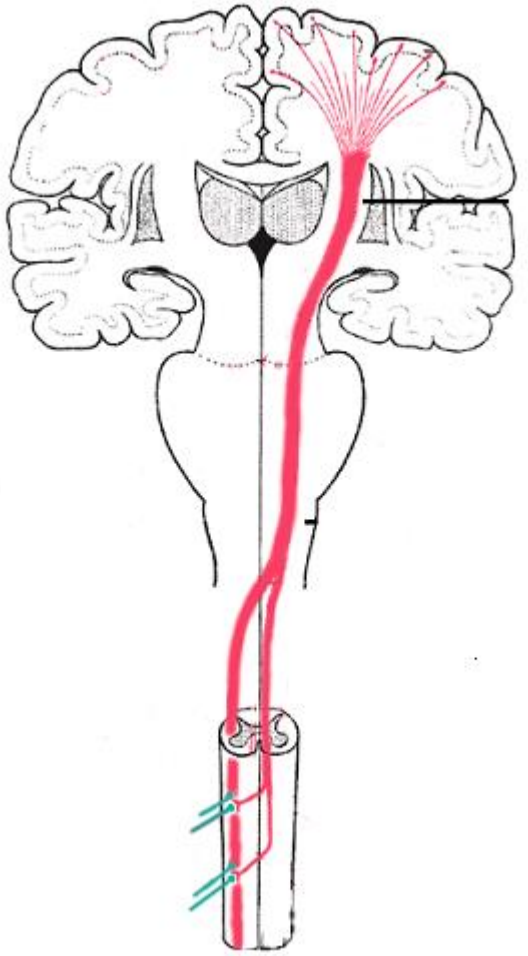
- Other fibers (97%)
- 4μm in diameter

- Slower conduction

- Synapse with interneurons which in turn synapse with α or γ motor neuron.

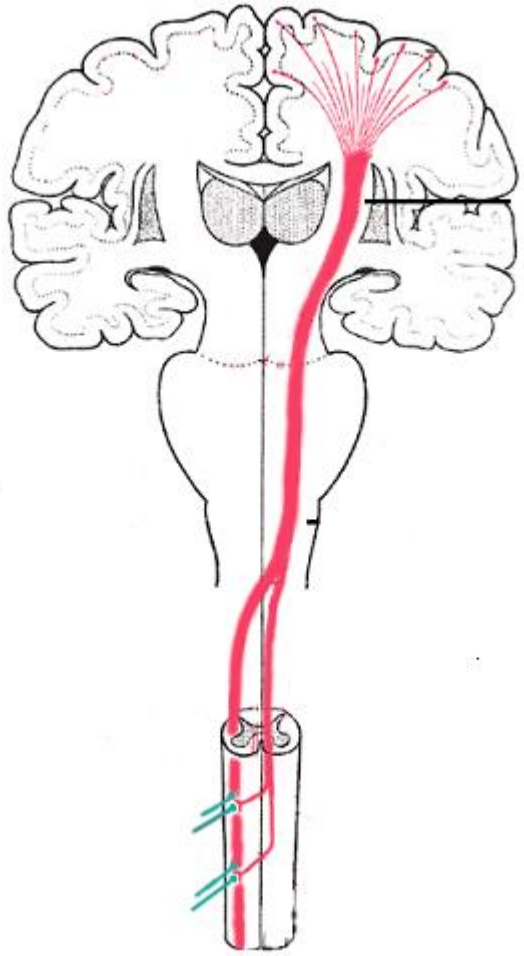

Pre-central gyrus
Cerebral peduncle
Midbrain
Medulla
Pyramids
Decussation of pyramids
Lateral corticospinal tract
Anterior corticospinal tract
Upper motor neuron
To skeletal muscles
Spinal cord
Lower motor neuron
Key
Upper motor neuron
Lower motor neuron

- The majority of the pyramidal fibers then cross in the lower medulla to the opposite side and descend into the lateral corticospinal tracts of the cord, finally terminating principally on the interneurons in the intermediate regions of the cord gray matter



- A few of the fibers do not cross to the opposite side in the medulla but pass ipsilaterally down the cord in the (ventral or anterior corticospinal tracts.)

- Many, if not most, of these fibers eventually cross to the opposite side of the cord either in the neck or in the upper thoracic region.



“Extrapyramidal” System

_All descending tracts other than the pyramidal tract called extrapyramidal tracts

_Pyramidal and extrapyramidal tracts should function together for smooth activity

_Background tone, posture, equilibrium etc., are maintained by extrapyramidal system

_Voluntary activity is controlled by pyramidal system

Extrapyramidal fibers arise from

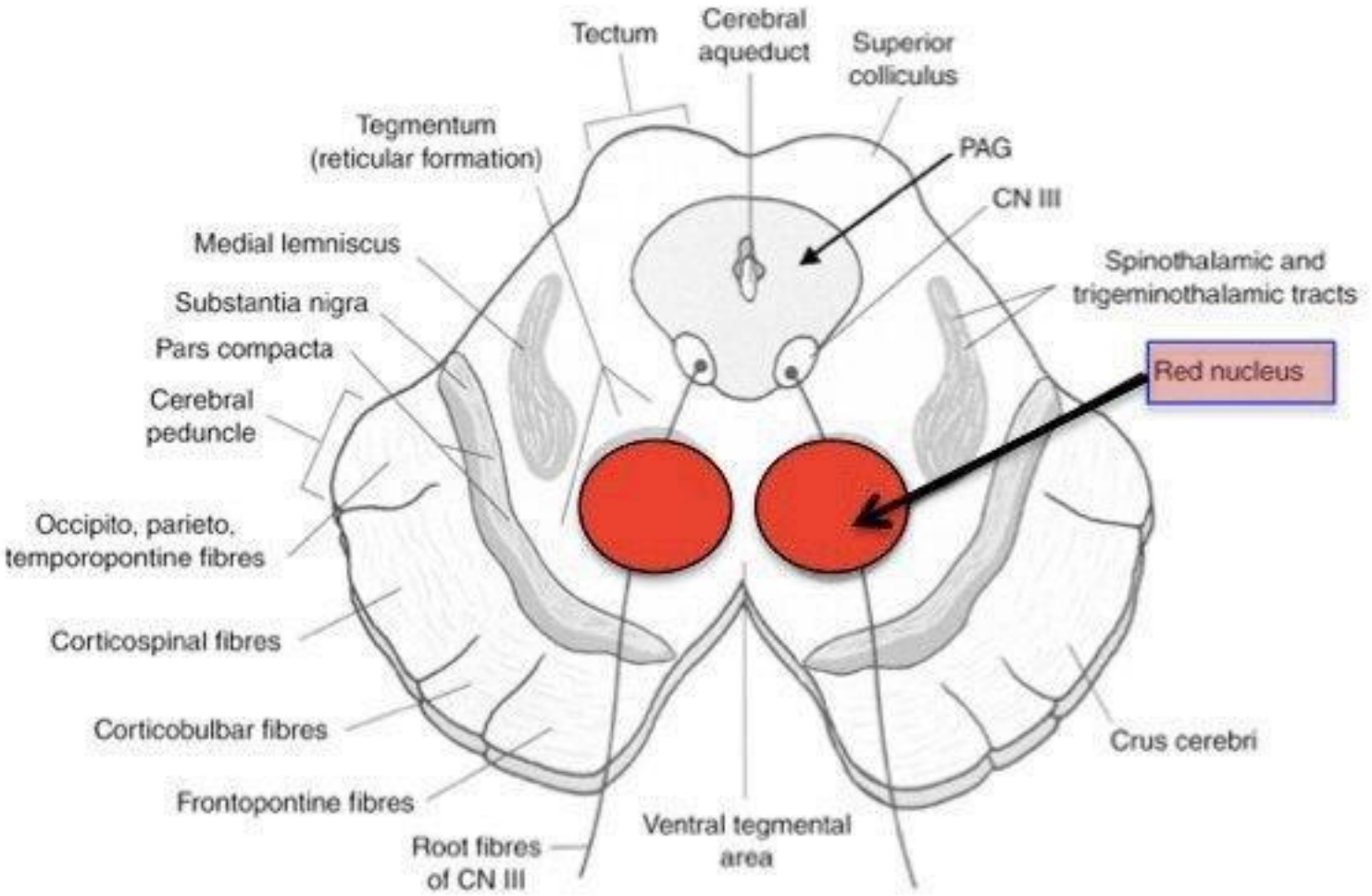
1. Cerebral cortex

2. Subcortical structures

- **Basal Ganglia**
- **Reticular formation of brain stem**
- **vestibular nuclei**
- **Red Nucleus**

And others like tectal nucleus and olivary nucleus

Red Nucleus


Tectum
Cerebral aqueduct
Superior colliculus
Tegmentum (reticular formation)
PAG
CN III
Medial lemniscus
Spinothalamic and trigeminothalamic tracts
Substantia nigra
Pars compacta
Red nucleus
Cerebral peduncle
Occipito, parieto, temporopontine fibres
Corticospinal fibres
Corticobulbar fibres
Crus cerebri
Frontopontine fibres
Ventral tegmental area
Root fibres of CN III

THE RED NUCLEUS

- Structure in the rostral midbrain involved in motor coordination

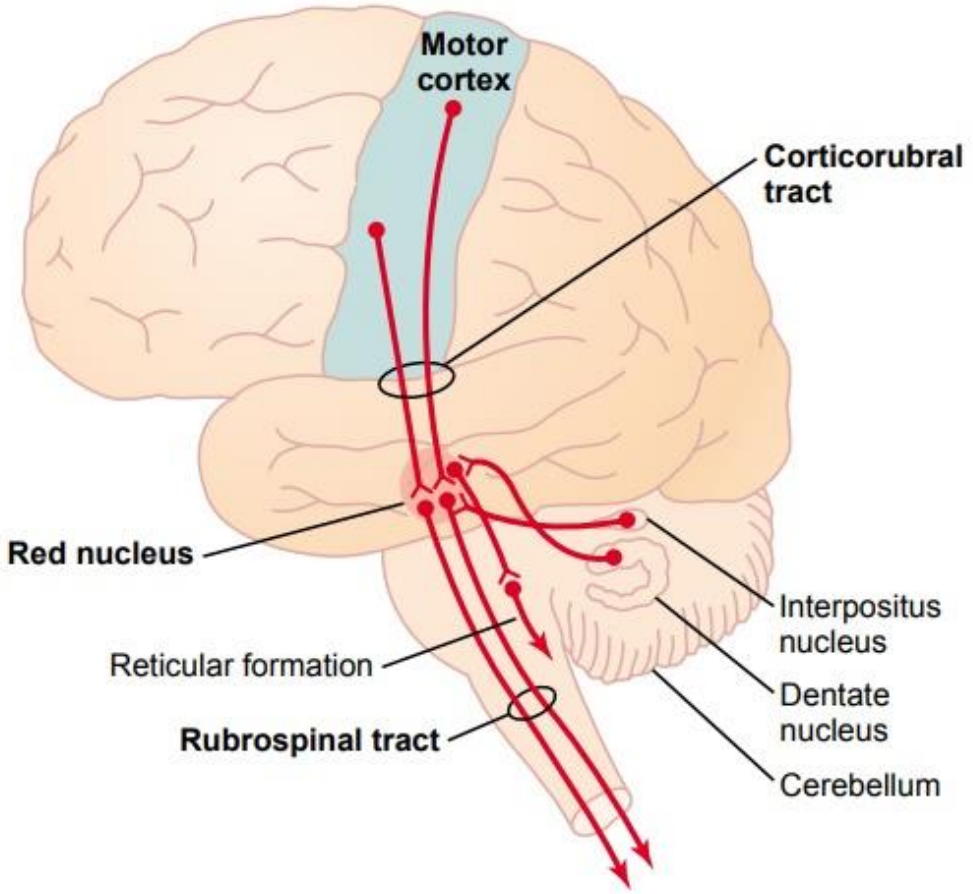
SERVES AS AN
ALTERNATIVE PATHWAY FOR
TRANSMITTING CORTICAL SIGNALS
TO THE SPINAL CORD

Corticorubrospinal

Fibers from primary motor cortex synapse with large neurons in magnocellular portion of red nuceus → **corticorubral tract**

Fibers from red nucleus to spinal cord → **rubrospinal tract**

Which crosses to the opposite side in the lower brain stem and follows a course immediately adjacent and anterior to the corticospinal tract .


Motor cortex
Corticorubral tract
Red nucleus
Reticular formation
Rubrospinal tract
Interpositus nucleus
Dentate nucleus
Cerebellum

Functions of Corticorubrospinal tract

- It has a representation of all the muscles of the body, as is true of the motor cortex.

  The representation of the different muscles is far less developed than in the motor cortex (it is relatively small in human beings)

- The corticorubrospinal pathway serves as an accessory route for transmission of signals from the motor cortex to the spinal cord.

- When the corticospinal fibers are destroyed but the corticorubrospinal pathway is intact,

  discrete movements can still occur, except that the movements for fine control of the fingers and hands are considerably impaired.

Recap

1. Pathways of motor transmission : direct Pyramidal and indirect Extrapyramidal .

2.corticospinal tract :The majority will cross in the lower medulla to the opposite side and descend into the lateral corticospinal tracts of the cord, terminating on the interneurons in the intermediate regions of the cord gray matter.

few of the fibers do not cross to the opposite side in the medulla but pass ipsilaterally down the cord in the (ventral or anterior corticospinal tracts.)

3. Red nucleus: Structure in the rostral midbrain involved in motor coordination, transmission of discrete signals from the motor cortex to the spinal cord.

Thank You