



431

CNS System
central Nervous

Block

Physiology Team

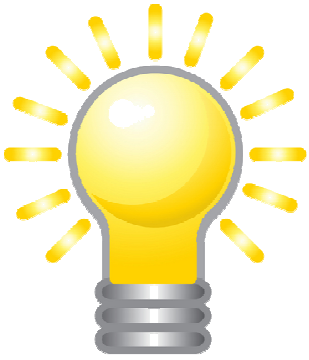
Explanation Of

Basal Ganglia Direct and Indirect Pathway

Helpful notes For Basal Ganglia Lecture

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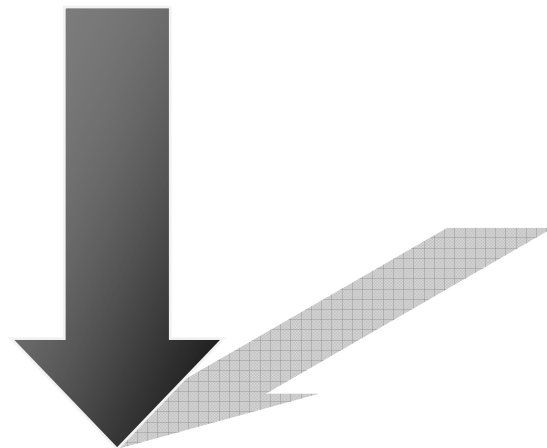
Before you begin studying the lecture,
here are some helpful notes:

1-Basal Ganglia are a group of nuclei (grey matter), located deep within cerebral hemispheres.

2- Anatomical Part of Basal Ganglia include: Caudate nucleus.
Putamen.
Globus pallidus.

3- Functional Part of Basal Ganglia include: Substantia nigra.
Subthalamic nuclei.

4- Basal Ganglia have 2 circuits: Direct and Indirect.
(what are they and why they called direct and indirect?
Why we need 2 circuits ?)



Direct Circuit :

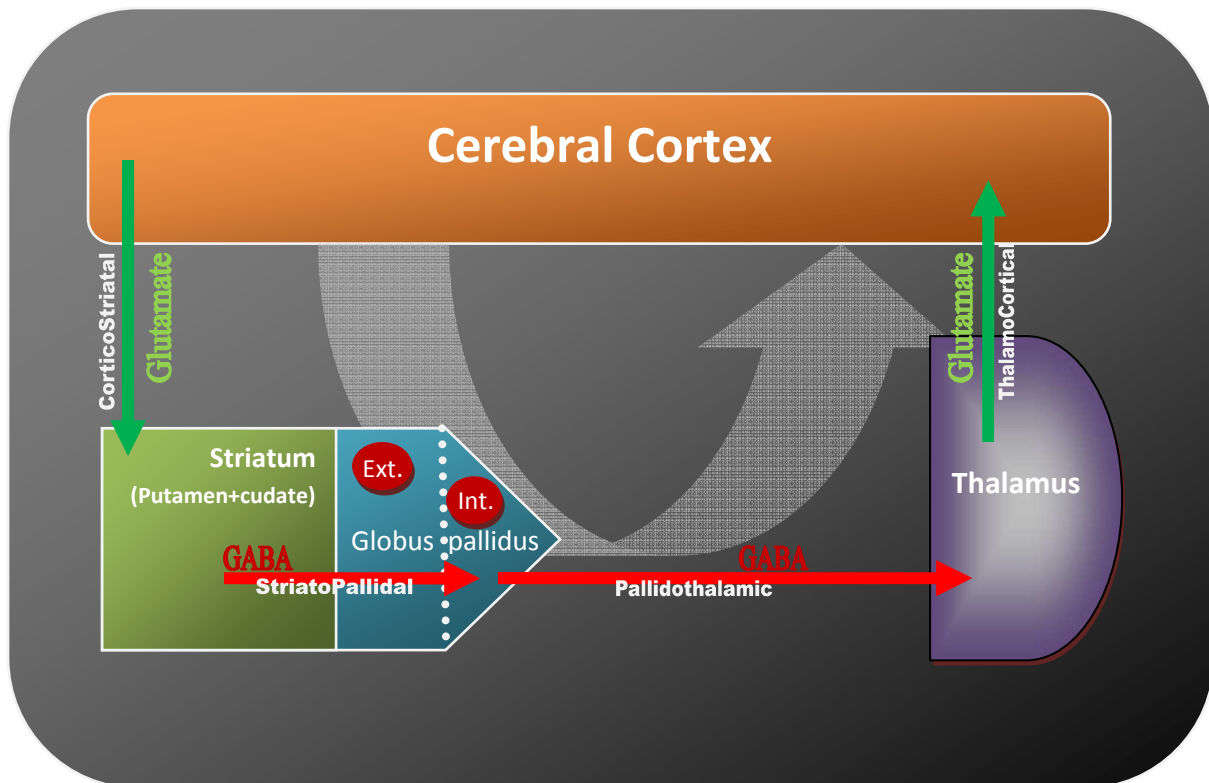
- It is a simple circuit that connects

1-Cerebral Cortex to Striatum

2- then to globus pallidus(internus)

3-then to thalamus

4-and finally to cerebral cortex Again.



Explanation:

1-Fibers From Cerebral Cortex to Striatum (**Corticostriatal**) are **Exitatory** Fibers releasing **GLUTAMATE** on the Next fibers to Excite them.

2- **Glutamate** will Exite the inhibitory(**StriatoPallidal**) Fibers making Them Produce **GABA** on the next Fibers.

3-**GABA** will inhibit the inhibitory Fibers (**Pallidothalamic**) preventing them from producing GABA on the next Fiber. (inhibiting the Inhibition)

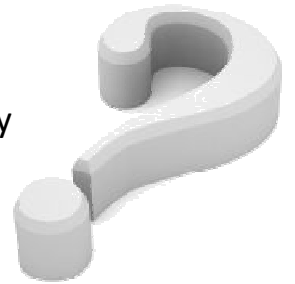
4- **GABA will not be Produced** .. So the excitatory Fibers (**Thalamocortical Fibers**) will be able to Produce **Glutamate** >> Excite The cerebral cortex and **Produce a Movement.**

What happens to the circuit when we are at Rest and there is No movement?

During rest:

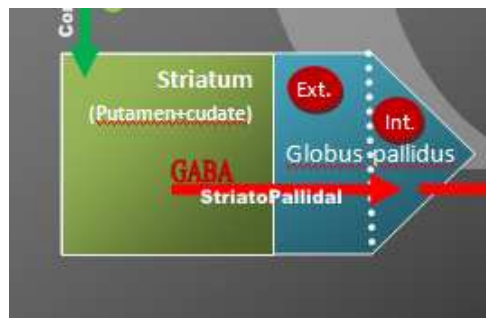
Globus Pallidus *internus* is very active producing so many GABA.

GABA will **inhibit** the next Fiber in the circuit which is the excitatory Thalamocortical Fibers >> No Glutamate >> **No movement.**



Why this Circuit is called Direct?

Because there is direct connection between the **Striatum** to the **Globus Pallidus *internus***. (by StriatoPallial Fibers)

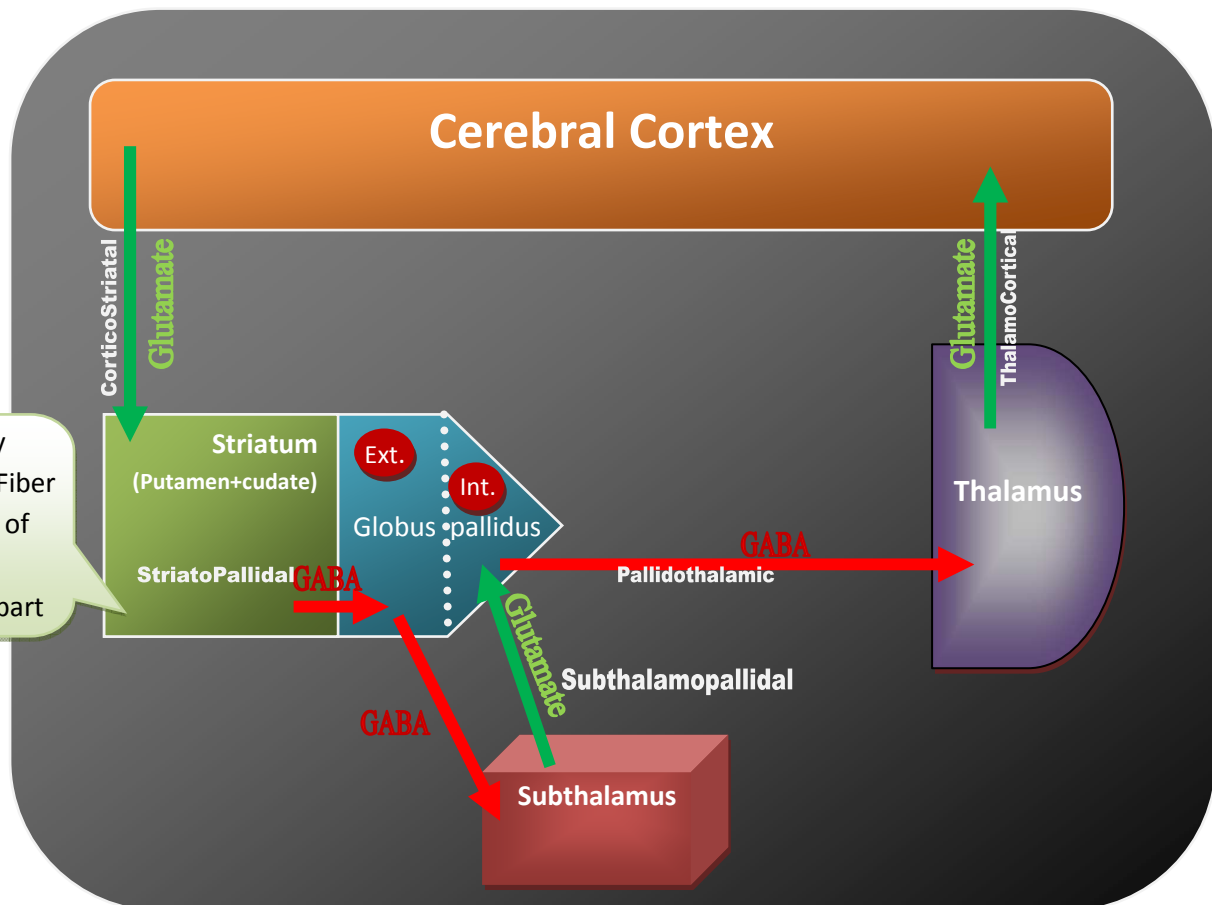


Indirect Circuit

The same as direct circuit.

Except that there is additional fibers and structures.

It is called **indirect** Because there is **NO** direct connection between the Striatum to the **Globus Pallidus internus**. Instead of StriatoPallial Fibers there is 2 fibers (**to and from subthalamic nuclei**):



Explanation:

- 1- Fibers From Cerebral Cortex to Striatum (**Corticostriatal**) are **Excitatory** Fibers releasing **GLUTAMATE** on the Next fibers to Excite them.
- 2- **Glutamate** will Excite the inhibitory (**StriatoPallidal**) Fibers making Them Produce **GABA** on the next Fibers.
- 3- **GABA** will inhibit the inhibitory fiber from GB Ext to Subthalamus, releasing the excitatory Fiber (**SubthalamoPallidal**) from inhibition. (**inhibit inhibition**)
- 4- **SubthalamoPallidal** release **Glutamate** to Excite the next inhibitory fiber **Pallidothalamic** to Produce **GABA**.
- 5- Excitatory **Thalamocortical** Fibers are inhibited > **No Glutamate** > **No movement**.

Direct	indirect
Striatum influencing the Globus pallidus directly	Striatum influencing the Globus pallidus indirectly via the subthalamus
For exciting the Flexor Group of muscle	For inhibiting the Extensor Group (the 2 pathways antagonist each other)
Produce Movement	Inhibit Movement