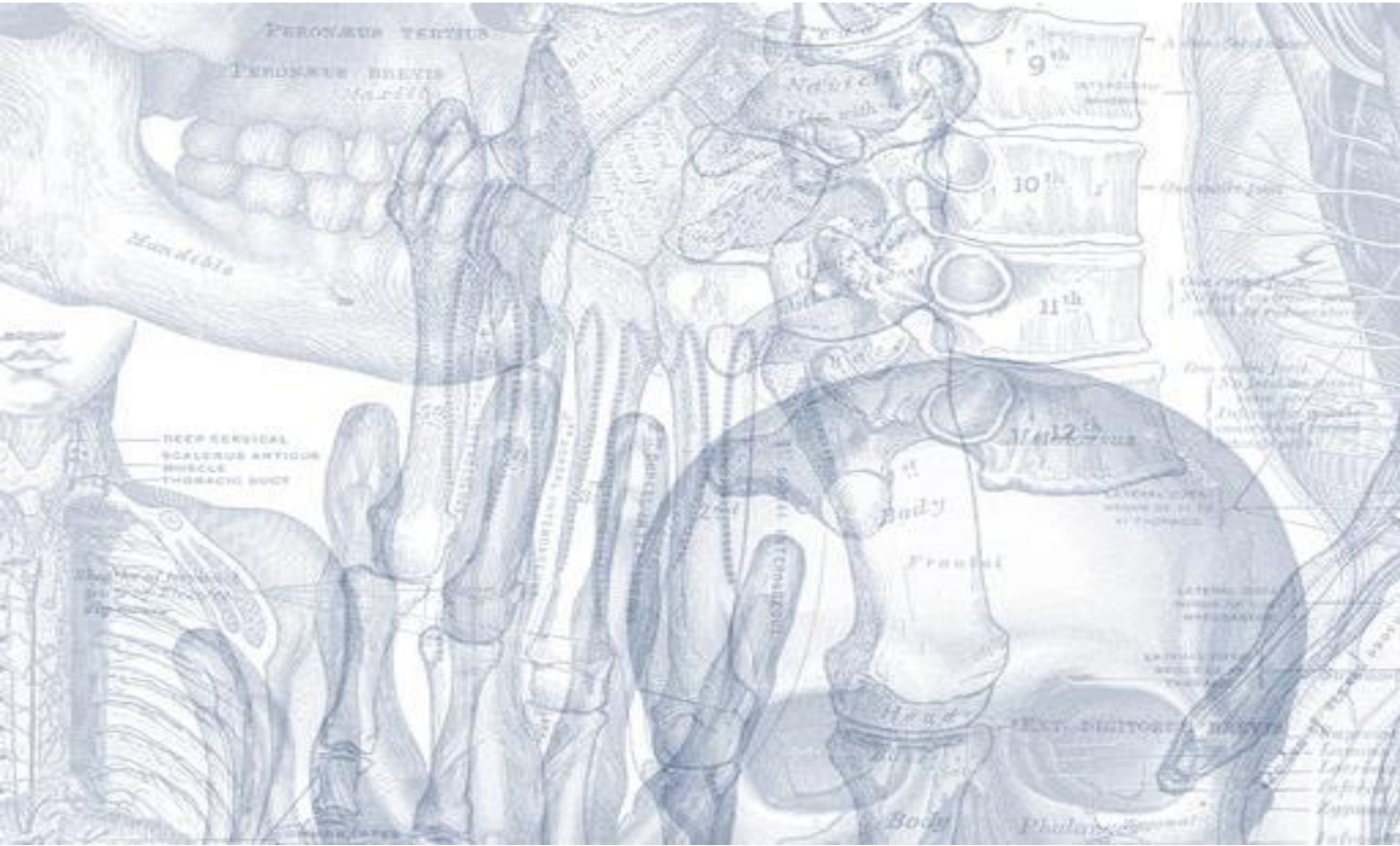


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Basal Ganglia

Please view our [Editing File](#) before studying this lecture to check for any changes.

Color Code

- Important
- Doctors Notes
- Notes/Extra explanation

Objectives

At the end of the lecture, the students should be able to:

- ✓ Define “basal ganglia” and enumerate its components.
- ✓ Enumerate parts of “Corpus Striatum” and their important relations.
- ✓ Describe the structure of Caudate and Lentiform (Putamen & Globus Pallidus) nuclei.
- ✓ Differentiate between striatum & paleostriatum in terms of connections.
- ✓ State briefly functions & dysfunctions of Corpus Striatum.

Basal Ganglia



02:00

- BASAL GANGLIA (NUCLEI) : group of nuclei deeply situated in cerebral hemispheres
- Components:

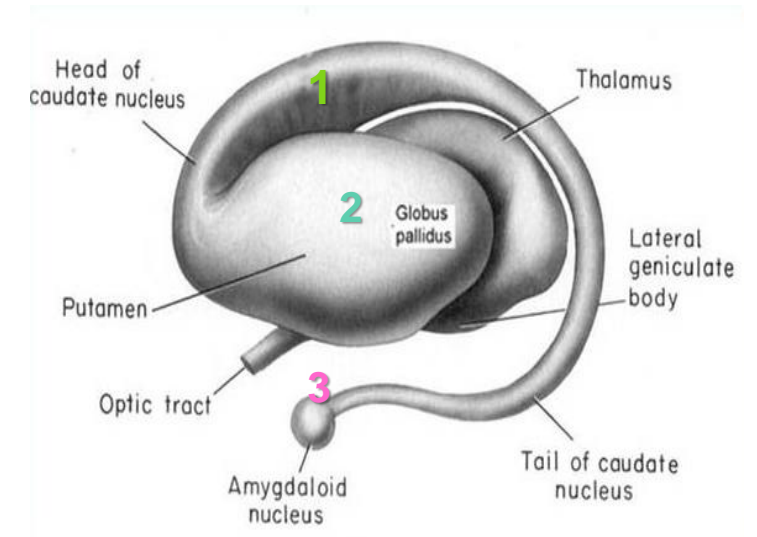
1. Caudate Nucleus

2. Lentiform Nucleus:
divided into **Putamen** & **Globus Pallidus**
lateral *medial*

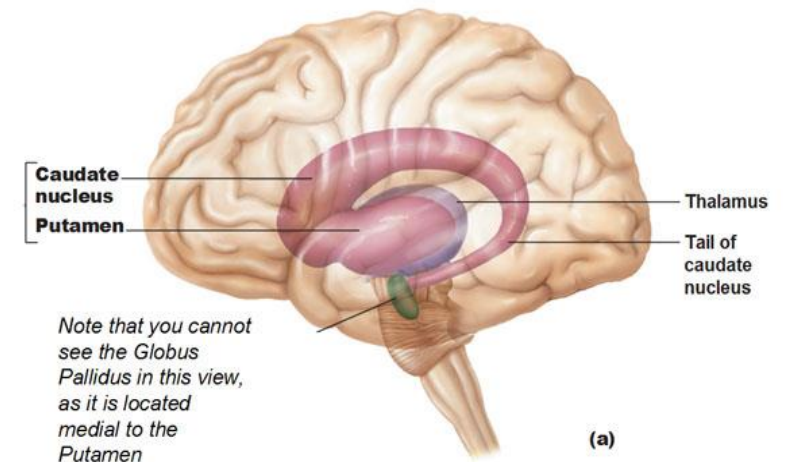
Caudate & Lentiform nuclei are functionally related to each other & called “**Corpus striatum**”: Part of *extrapyramidal motor system*, principally involved in the control of *posture and movements* (primarily by inhibiting **unwanted** motor functions)

3. Amygdaloid Nucleus

(**function is different**: part of limbic system) is only embryologically related to Corpus Striatum



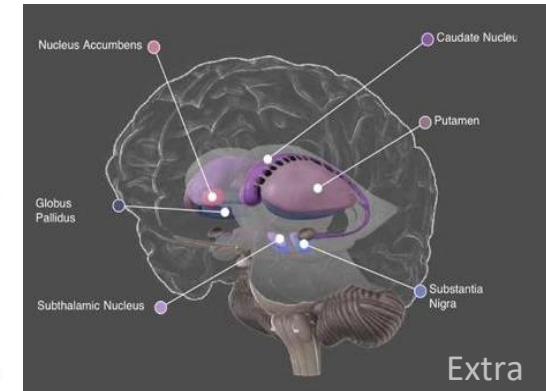
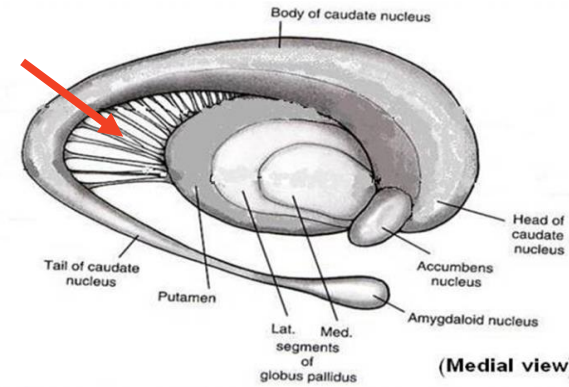
Basal Ganglia



Corpus Striatum

Nomenclature

Bands of grey matter pass from **lentiform** nucleus across the **internal capsule** to the **caudate** nucleus, giving the striated appearance hence, the name **corpus striatum**.



Lentiform Nucleus

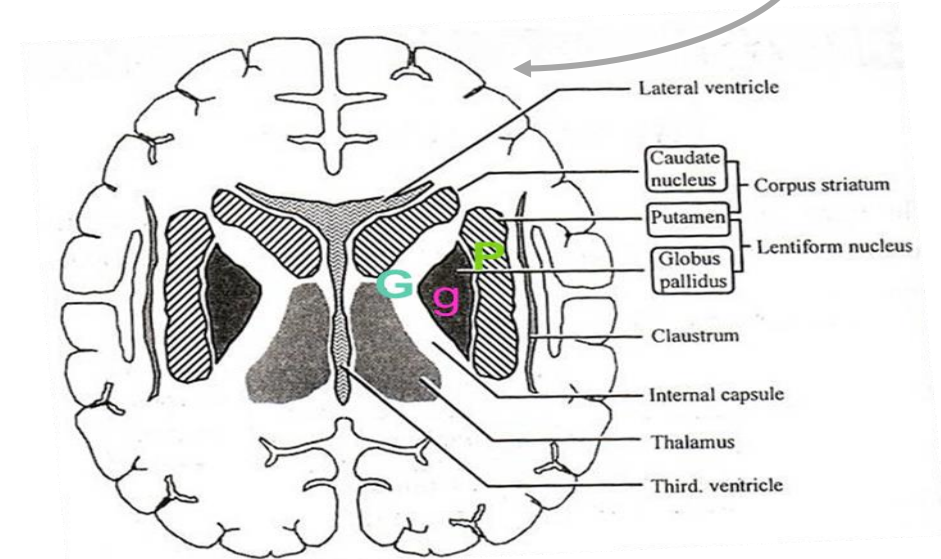
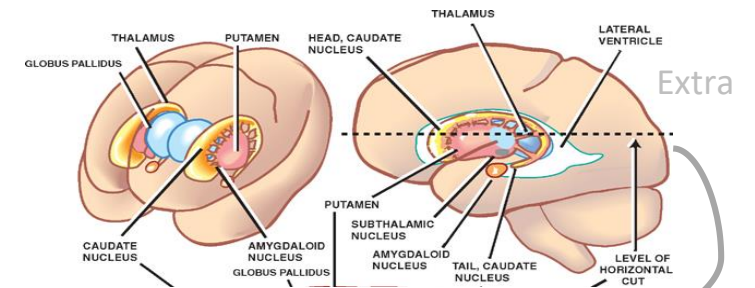
SHAPE:

three sided, wedge-shaped mass of grey matter, with a convex outer surface and an apex which lies against the *genu of the internal capsule* (**G**) Genu is a Latin word for "knee".

DIVISION:

 divided into

1. Larger darker lateral portion called **Putamen (P)**
2. Smaller, lighter medial portion called **Globus Pallidus (g)**



Corpus Striatum

Lentiform Nucleus

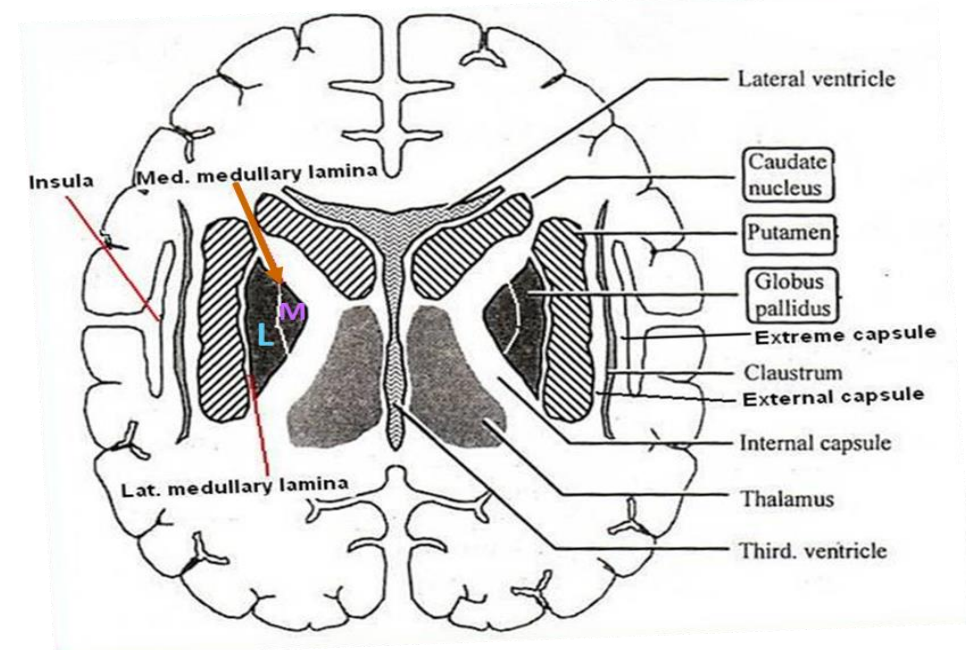
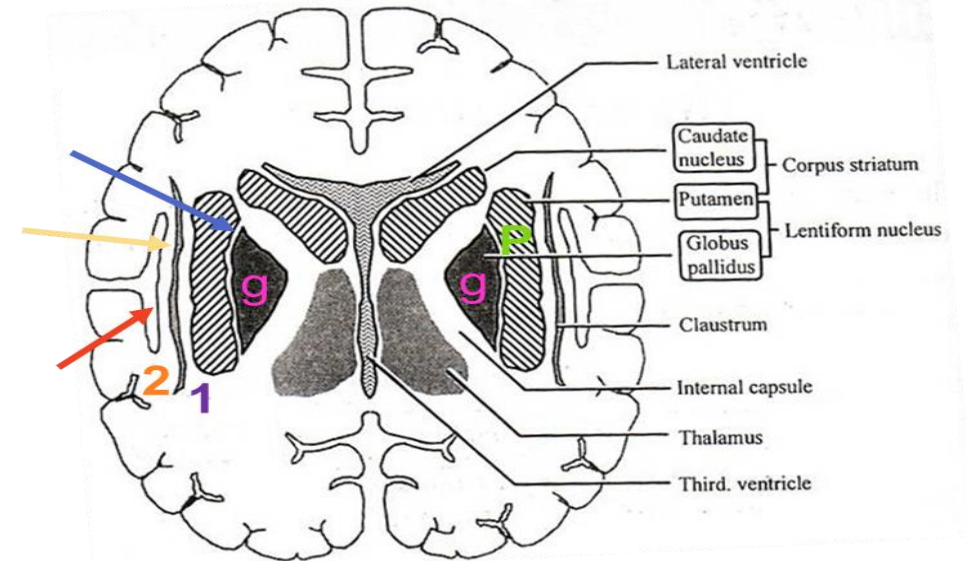
Putamen

- Separated from **globus pallidus (g)** by a thin sheath of nerve fibers, the **lateral medullary lamina**
- The white matter **lateral** to putamen is divided, by a sheath of grey matter, the **claustrum** into two layers:
 - external capsule **(1)** between the putamen and claustrum.
 - extreme capsule **(2)** between the claustrum and the **insula**

We saw 3 capsules: internal, external, and extreme. All are **white matter**.

Globus Pallidus

- Consists of two divisions, the **lateral (L)** & the **medial (M)** segments, separated by a thin sheath of nerve fibers, the **medial medullary lamina**.
- The medial segment is similar, in terms of cytology and connections with the **pars reticulata** of *substantia nigra*



Corpus Striatum

Caudate Nucleus

- *Shape*: C-shaped mass of grey matter Looks like comma: ;
- *Components*: head, body & tail

1. Head:

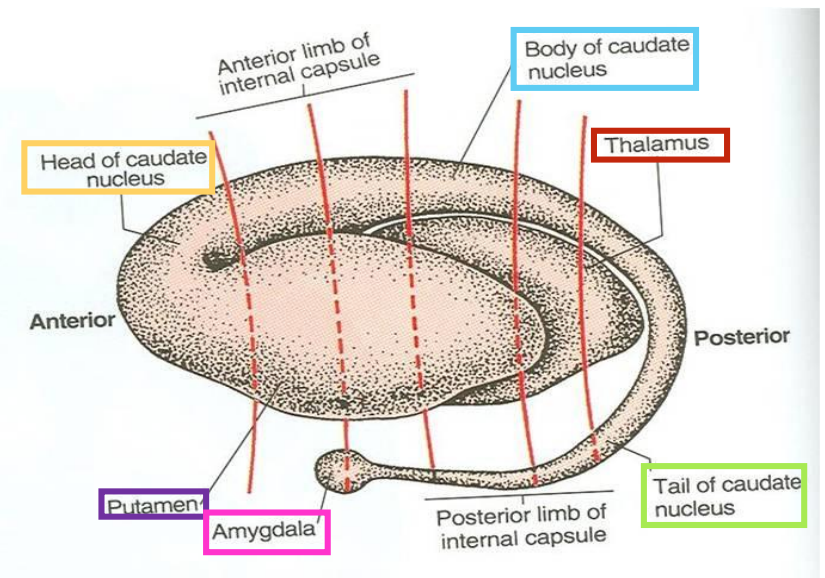
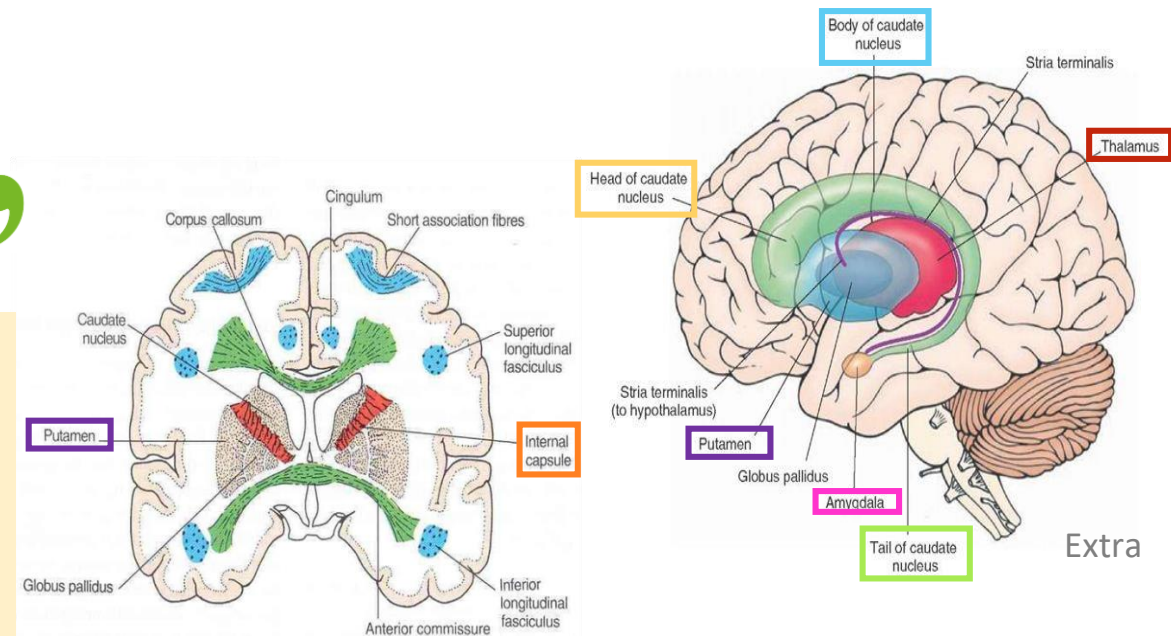
- Rounded in shape
- Lies **anterior** to thalamus (in frontal lobe)
- Completely separated from the putamen by the internal capsule except **rostrally** where it is continuous with the putamen

2. Body:

- Long & narrow
- Extends above thalamus (in parietal lobe)

3. Tail:

- Long & tapering
- Descends, below thalamus, into temporal lobe
- Continuous with Amygdaloid Nucleus



Corpus Striatum

Important relations

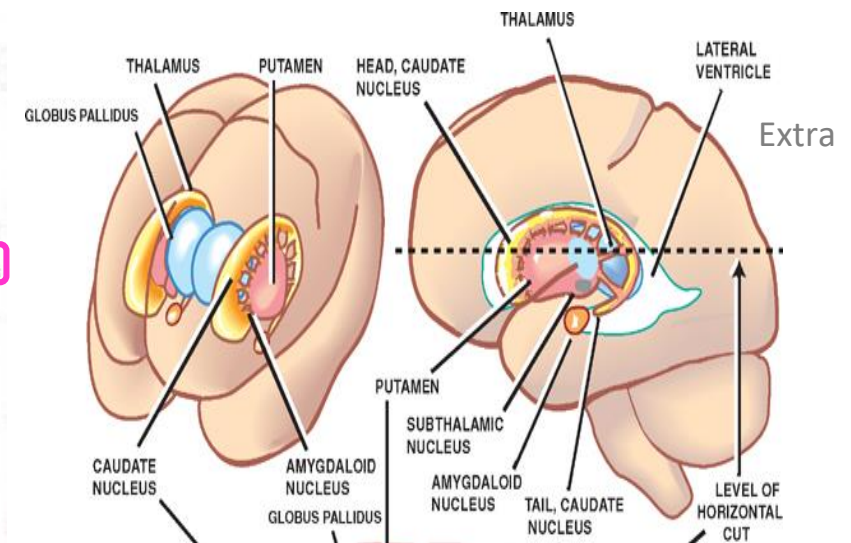
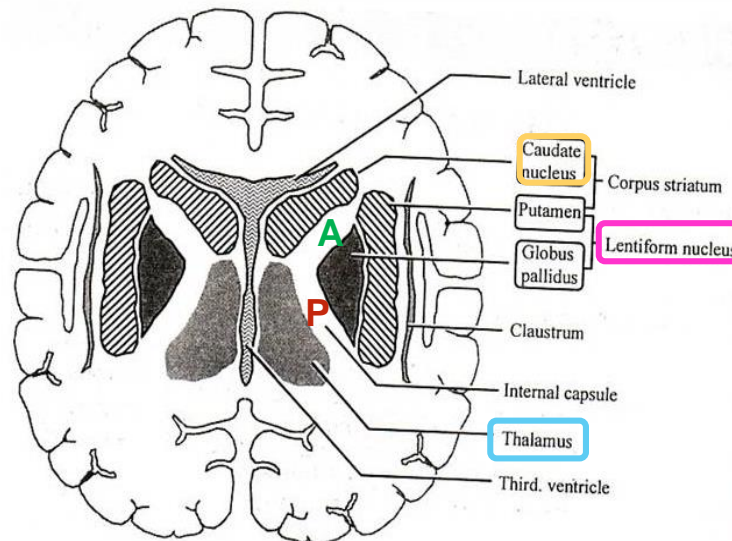
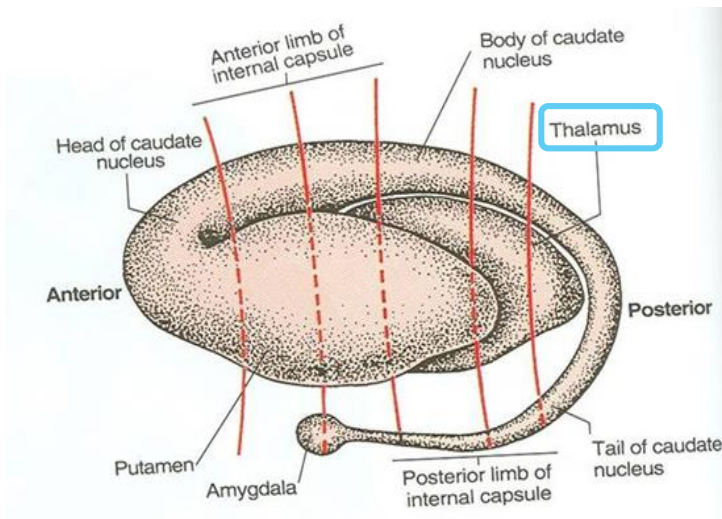


Head of Caudate Nucleus:

- Anterior to thalamus
- Medial to Lentiform & separated from it by *anterior limb of internal capsule (A)*

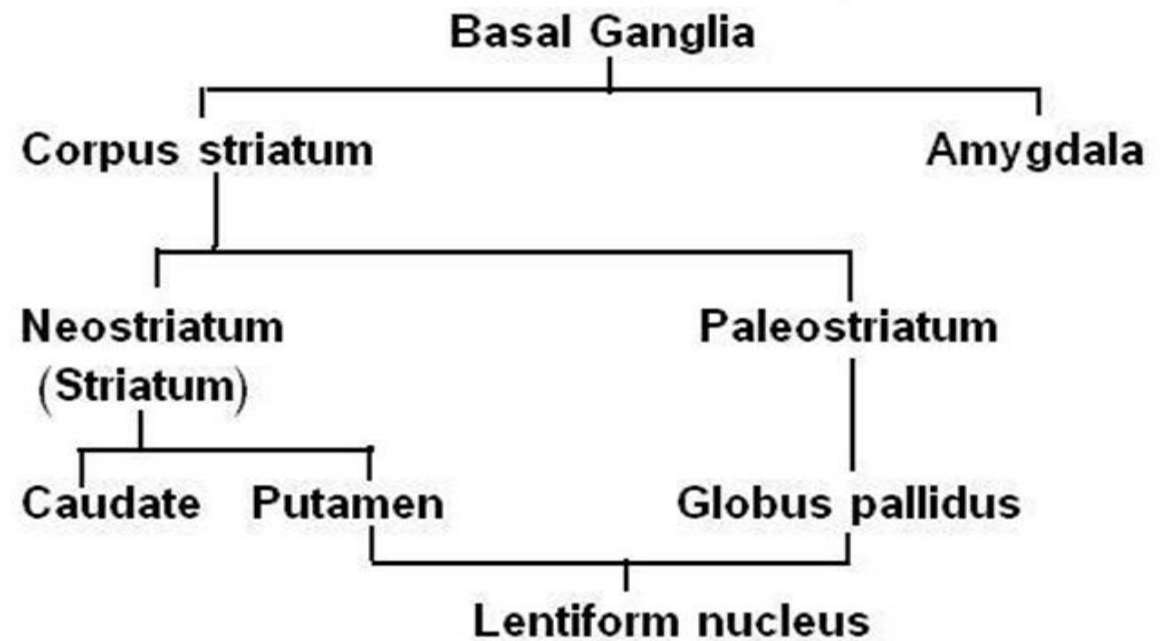
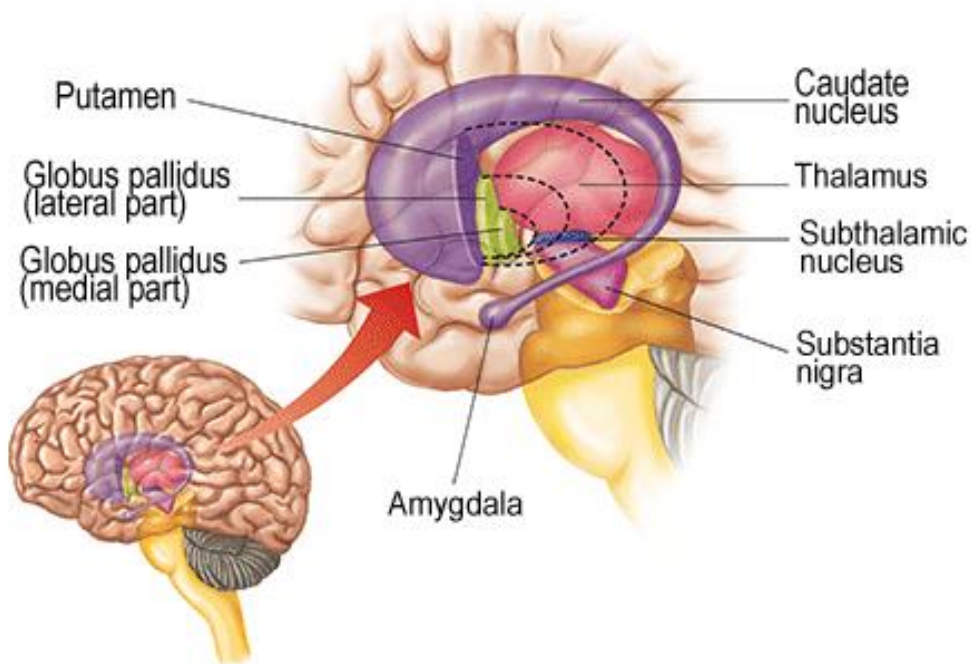
Lentiform Nucleus:

- Lateral to thalamus & separated from it by *posterior limb of internal capsule (P)*



Corpus Striatum Important

- **Putamen** is more closely related to **Caudate nucleus** (regarding development, function & connections) and together constitute the **neostriatum** or **striatum**.
- The **globus pallidus** is the *oldest* part of **corpus striatum** and is called **paleostriatum** or **pallidum**.

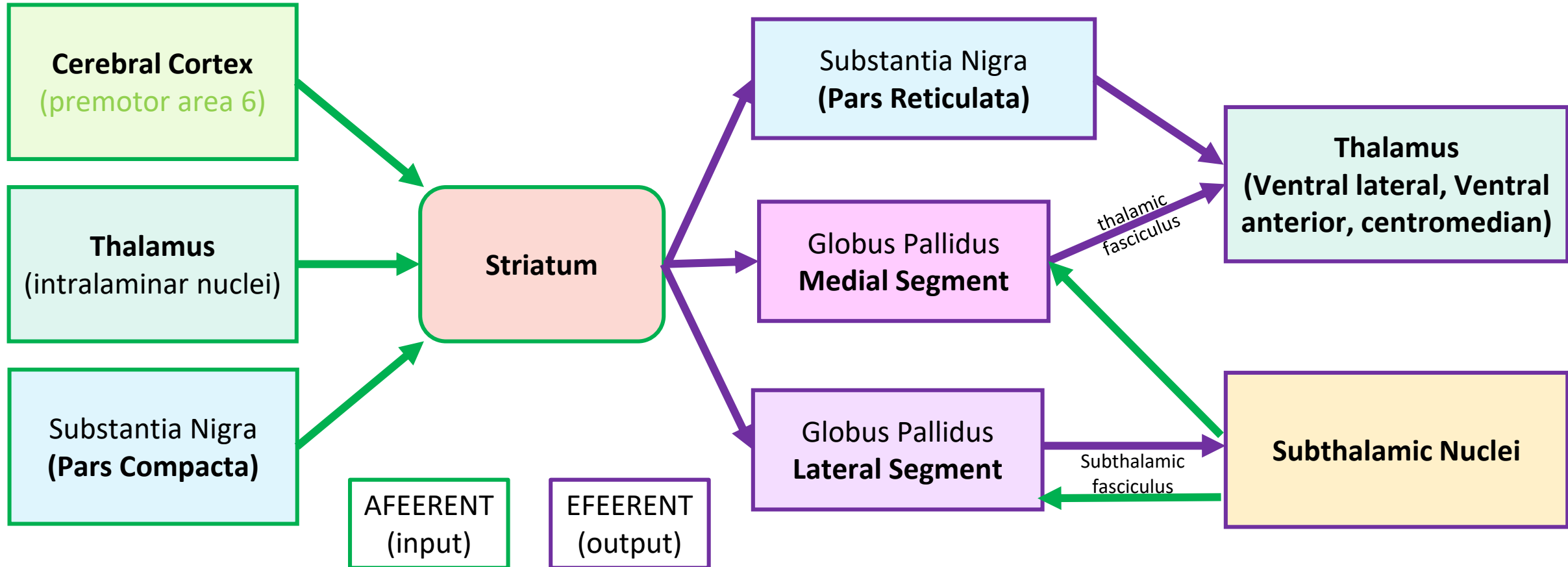


Corpus Striatum **Very important!**

Striatum (Caudate & Putamen)
“The input portion of Corpus striatum”

Paleostriatum (Globus Pallidus)
“The output portion of corpus striatum:
medial segment of G.P. + Pars Reticulata of S.N.*”

*Substantia Nigra is divided into Pars Compacta and Pars Reticulata
(which is structurally similar to the medial segment of globus pallidus)



Corpus Striatum

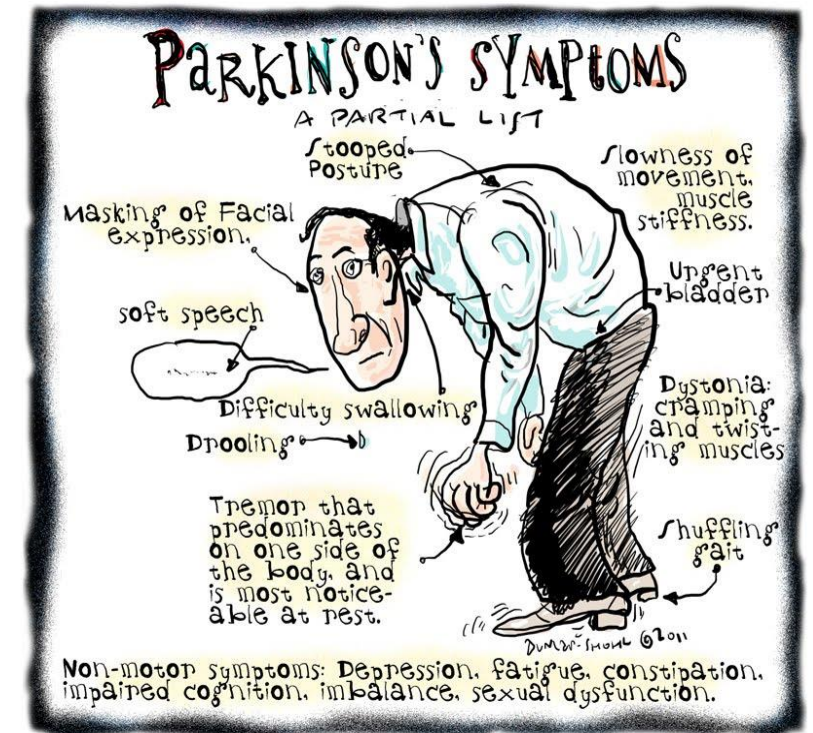
Function

- The corpus striatum assists in regulation of voluntary movement and learning of motor skills.
- Their function is to facilitate behavior and movement that are required and appropriate, and **inhibit** unwanted or inappropriate movement.

Dysfunction = Parkinsonism

- Its dysfunction **does NOT** cause paralysis, sensory loss or ataxia
- Its dysfunction **leads to:**
 - Abnormal motor control: emergence of abnormal, involuntary movements (**dyskinesias**)
 - Alteration in muscle tone: **hypertonia/hypotonia**
 - **Soft speech**
 - **Stooped posture**
 - **Nonmotor symptoms: depression, constipation, fatigue.**

Extra: Mohammed Ali, the famous boxer, had parkinsonism.



Connection Of Corpus Striatum

Afferent Fibers (input)

1- Corticostriate Fibers:

- **From** all parts of cerebral cortex (mostly from sensory- motor cortex) axons pass
- **to** caudate nucleus and putamen.
- *Glutamate* is the neurotransmitter of this fibers.

2-Thalamostriate Fibers :

- **From** intralaminar nuclei of thalamus axons pass
- **to** caudate nucleus and putamen.

3- Nigrostriate Fibers :

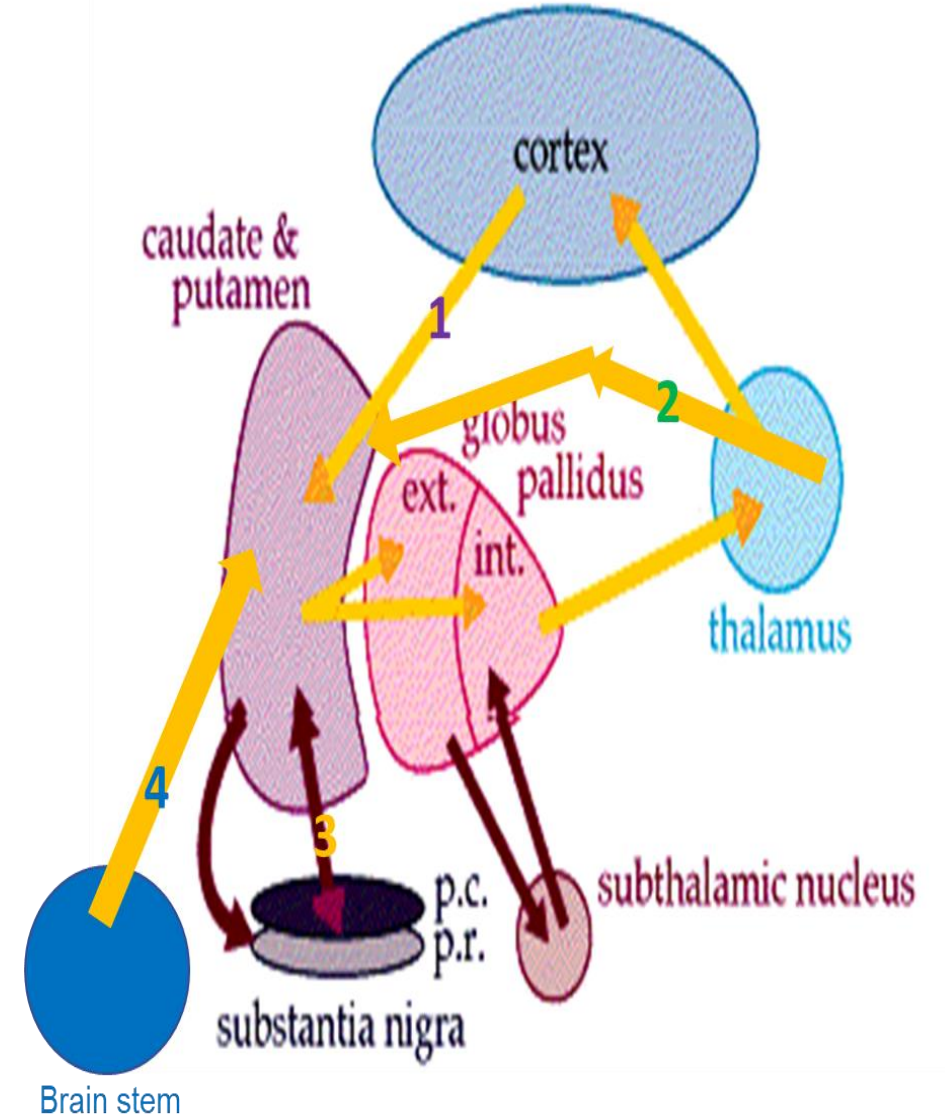
- Axons **from** Substantia nigra of midbrain pass
- **to** caudate nucleus and putamen.
- Neurotransmitter is *Dopamine*.

4- Brain stem Strial Fibers :

- Ascending fibers **from** brain stem
- **end in** caudate nucleus & putamen.
- *Serotonin* is the neurotransmitter.

It is believed that the last 2 groups are inhibitory in function

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و السلايدات المتوافقة مع البنات هي المعتمدة



Connection Of Corpus Striatum

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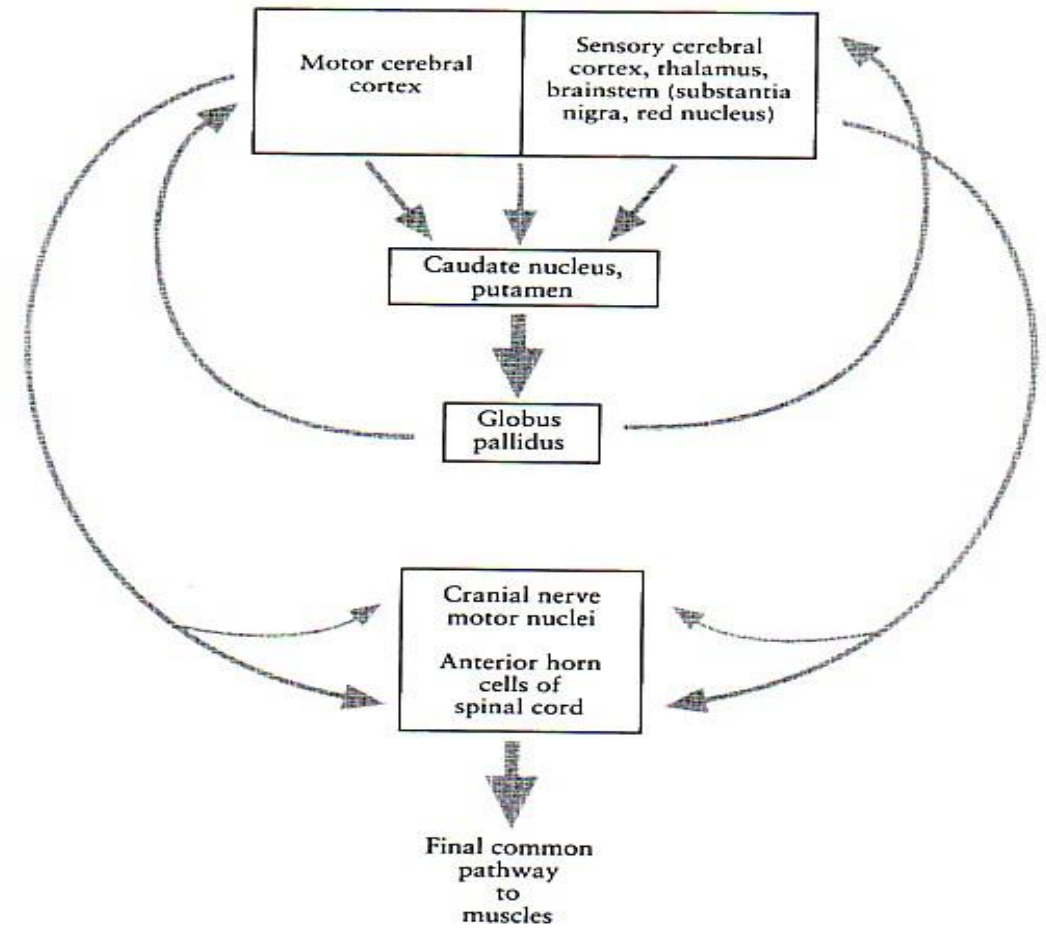
Efferent Fibers (Output)

1-Striatopallidal fibers:

- These fibers pass **from** corpus striatum (caudate nucleus & putamen)
- **to** globus pallidus.
- *Gamma-aminobutyric acid (GABA)* is the neurotransmitter.

2-Striatonigral fibers:

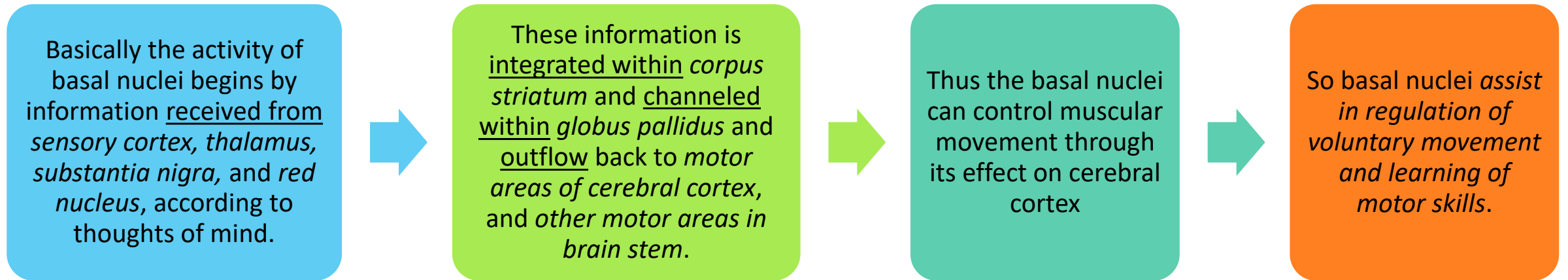
- These fibers pass **from** caudate nucleus & putamen
- **to** Substantia nigra.
- Some fibers use *GABA* as a neurotransmitter, and others use *substance p*.



Functions of Basal Ganglia

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1. Control of movements
2. Planning and programming of movements
3. Cognition



Functions of basal ganglia:

- **Design of plans**, which convert thoughts and ideas into motor actions: to produce a coordinated organized purposeful movement. e.g. dressing.
- Determining the **timing and scale of movement**: to what extent the movement will be fast, and how long it will last.
- **Storage** of motor programs of familiar motor actions: e.g. signature.

Parkinsonism (Parkinson's disease, paralysis Agitans)

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○ Described by James Parkinson

○ *Lesion:*

Neuronal degeneration* in **substantia nigra** leading to **reduction of dopamine** within corpus striatum.

○ *Features:*

1- Tremors:

Pill-rolling, involuntary, rhythmic, oscillating movements. It occurs during waking time during rest, it is called static tremors.

2- Rigidity:

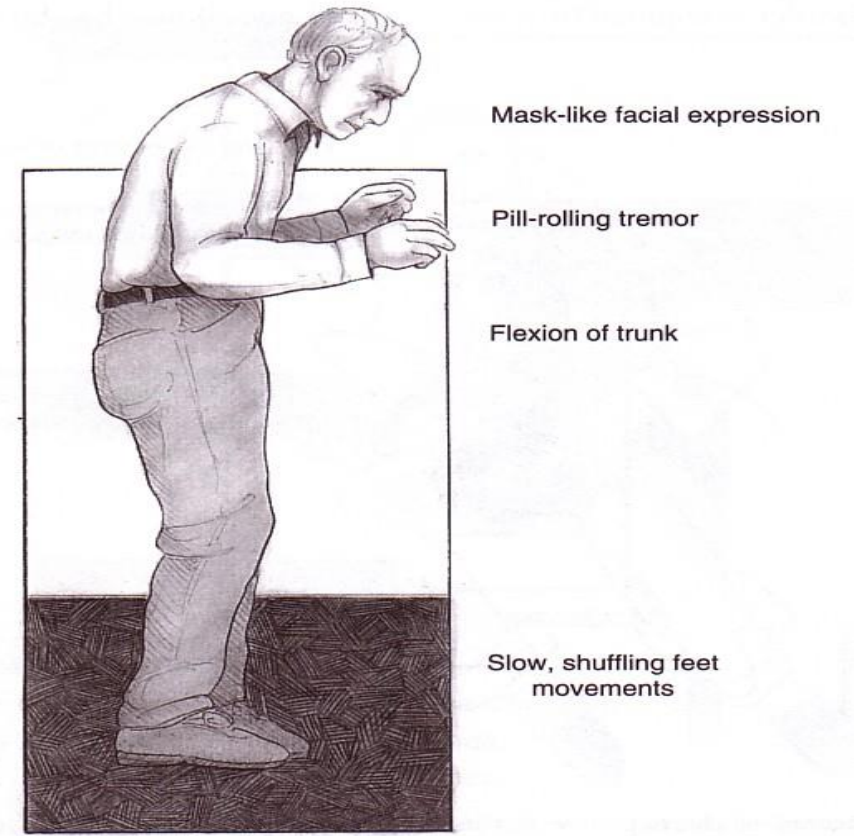
It occurs in both flexors, and extensors, but more in flexors giving flexion attitude. It is called lead pipe rigidity.

3- Akinesia:

it means lack of movement; Absence of swinging arm during walking, mask face, low- volume slow monotonous speech, and shuffling gait.

○ Four cardinal symptoms:

- 1. Tremor & Rigidity,
- 2. Akinesia & Bradykinesia,
- 3. Postural Changes,
- 4. Speech Changes

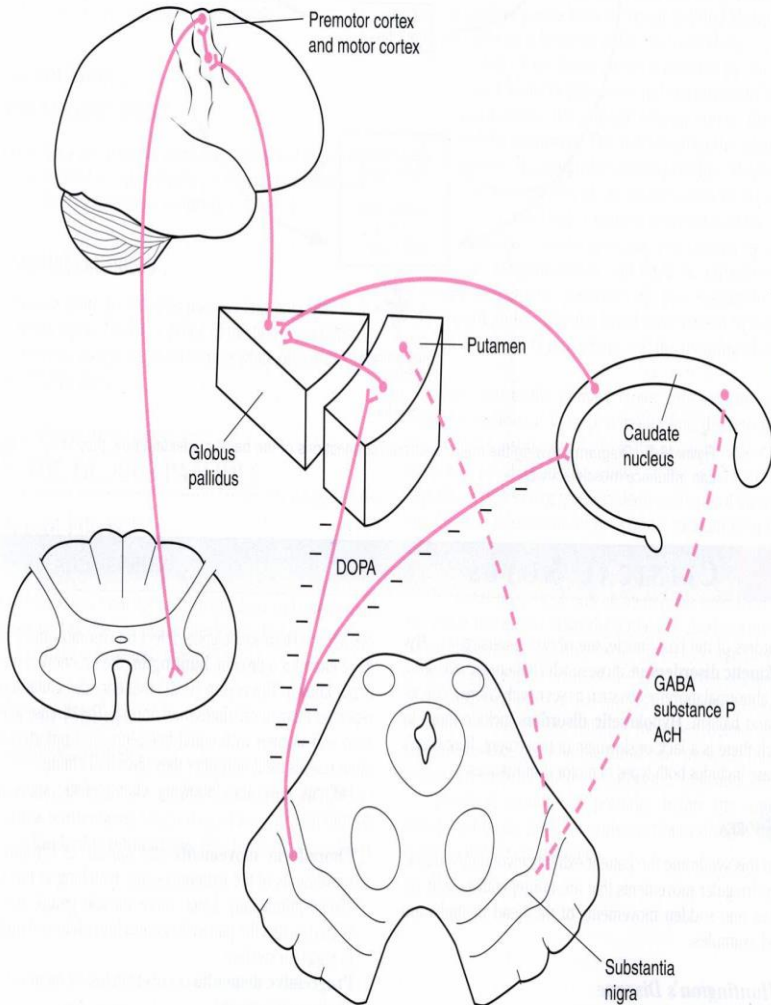


أعراض المرض لا تظهر إلا بعد ما يحصل:

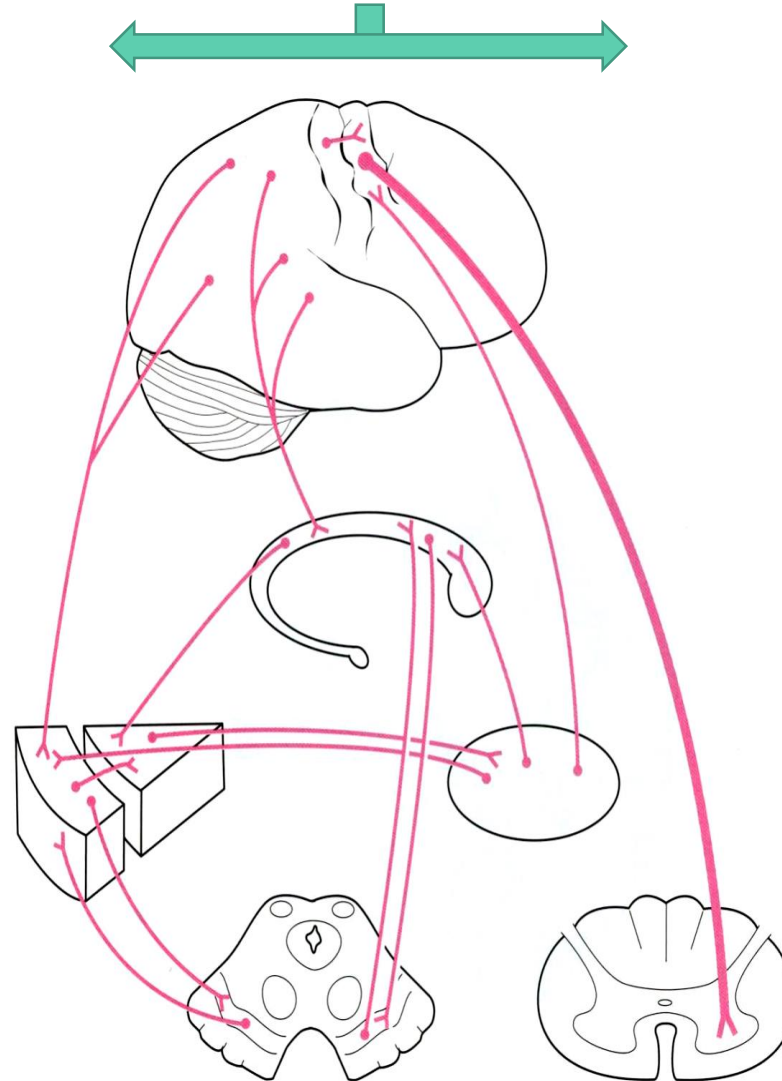
*Degeneration of dopaminergic nigrostriatal neurons (60-80 %).

Methyl-Phenyl-Tetrahydro-Pyridine (MPTP).
The oxidant MPP+ is toxic to SN.

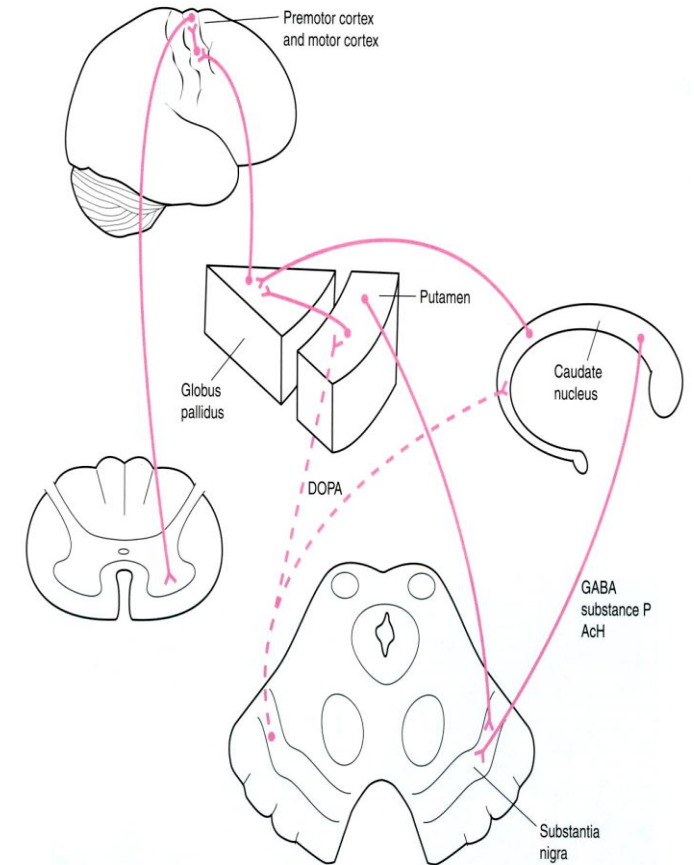
Huntington's Disease:
degeneration of inhibitory pathway
between corpus striatum &
Substantia nigra



**Main Connections between Cortex,
basal Nuclei, Thalamic Nuclei
Brainstem & Spinal Cord**
These are the normal connections.
Any degeneration will lead to



Parkinson's Disease:
degeneration of inhibitory
pathways between Substantia
Nigra & corpus striatum

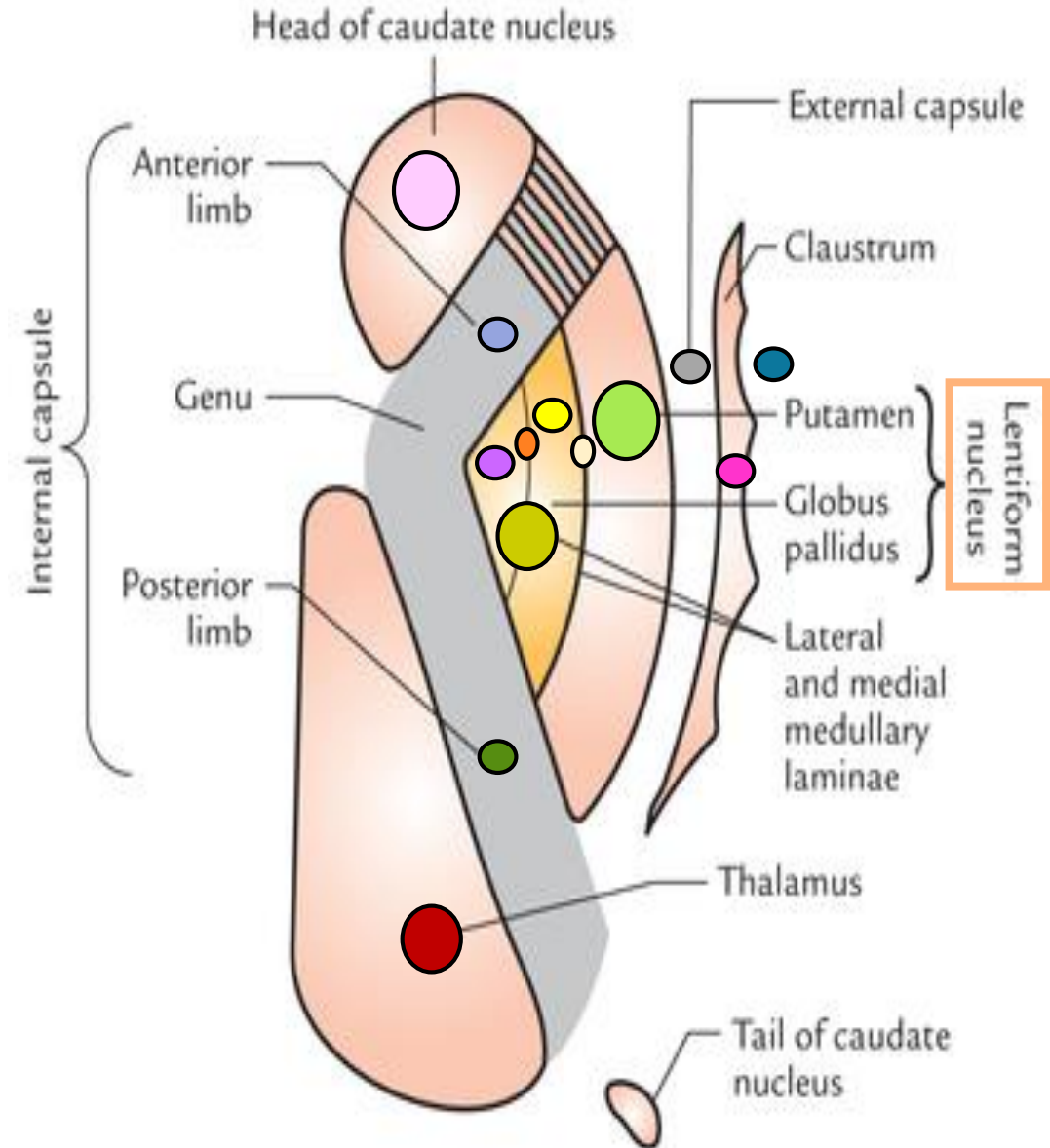


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Summary

Basal Ganglia			
Corpus Striatum			Amygdaloid
Caudate	Lentiform		
	Putamen	Globus Pallidus	
Neostriatum		Paleostriatum	

Structure	Separates	
Clastrum	Extreme capsule	External capsule
Lateral medullary lamina	Putamen	Globus pallidus
Medial medullary lamina	Lateral segment of globus pallidus	Medial segment of globus pallidus
Anterior limb of internal capsule	Lentiform	Caudate (head)
Posterior limb of internal capsule	Lentiform	Thalamus



Corpus striatum are primarily concerned with control of posture & movement.

The **striatum** is the **input** region of corpus striatum,

while the medial segment of **globus pallidus** & pars reticulata of **substantia nigra** are the **output** portion.

Afferent fibers of striatum come from:

1. cerebral cortex,
2. intralaminar nucleus of thalamus &
3. pars compacta of substantia nigra.

Afferent fibers of both lateral & medial segments of globus pallidus come from:

1. striatum and
2. subthalamic nucleus.

Efferent fibers of striatum is directed to

1. globus pallidus &
2. pars reticulata of substantia nigra.

Efferent fibers of **lateral** segment is directed to subthalamic nucleus.

Efferent fibers of **medial** segment is directed to

1. ventral lateral,
2. ventral anterior &
3. centromedian nucleus of thalamus.

Questions

1. What is the caudate nucleus shaped like?

- a) C-shaped mass of white matter
- b) C-shaped mass of grey matter
- c) G-shaped mass of grey matter
- d) None are correct

2. The Lentiform Nucleus is related to the thalamus ____?

- a) Medially
- b) Superior to the thalamus
- c) laterally
- d) Inferior to

3. The two division of the globus pallidus are seperated by ____?

- a) The medial medullary lamina
- b) The lateral medullary lamina
- c) Insula
- d) Lateral ventricle

4. What part of the caudate nucleus is continues with the amygdaloid nucleus?

- a) Body
- b) Head
- c) A and b
- d) Tail

5. What does the dysfunction of the corpus straitum lead to?

- a) Paralysis
- b) Hypertonia
- c) Ataxia
- d) Sensory loss

6. What are the components of the basal ganglia?

- 1. Caudate Nucleus
- 2. Lentiform Nucleus
- 3. Amygdaloid Nucleus

7. What is the oldest part of corpus striatum?

The globus pallidus

1.B

2.C

3.A

4.D

5.B



Leaders:

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Jawaher Abanumy

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Abdulmalek alhadlaq
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Abdulrahman almalki
Abdulmohsen alkhalaf
Talal alhuqayl



Feedback



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[Anatomy Team](https://www.youtube.com/AnatomyTeam)

References:

- 1- Girls' & Boys' Slides
- 2- Greys Anatomy for Students
- 3- TeachMeAnatomy.com