



**Anatomy Team**  
**MED 439**

Revised & Approved



**MED439**  
KING SAUD UNIVERSITY

# Anatomy of the Basal Ganglia

CNS Block

Don't forget to check the [Editing File](#)

Color index:

Content  
Male slides  
Female slides  
Important  
Doctors notes

Extra information, explanation

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# Objectives

At the end of the lecture, 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 term of connections.
- State briefly functions & dysfunctions of Corpus Striatum.

# BASAL GANGLIA (NUCLEI)

- Group of nerve cells deeply situated in cerebral hemispheres
- Deeply in the white matter of the Cerebral hemisphere

## Components:

**Caudate Nucleus**

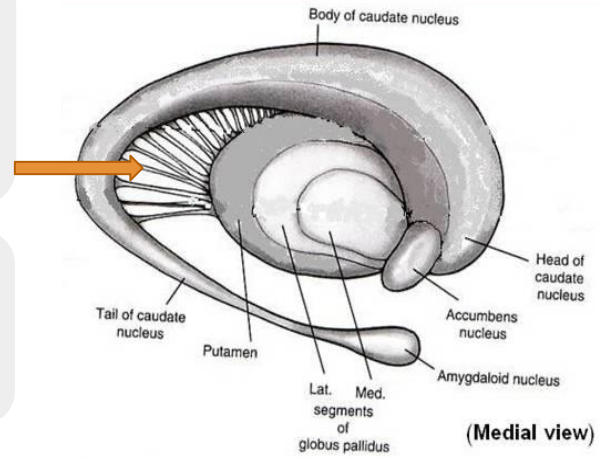
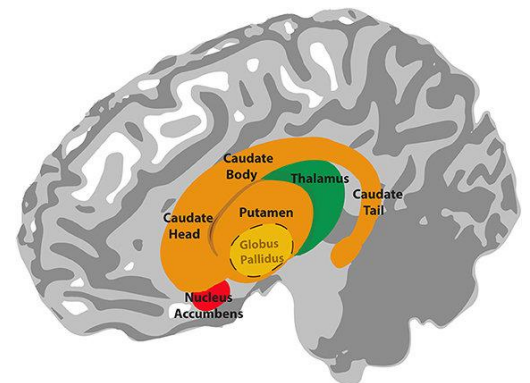
- Are functionally related to each other & called "**Corpus Striatum**"
- Part of extrapyramidal motor system, principally involved in the control of posture and movements (primarily by inhibiting motor functions)

**Lentiform Nucleus**  
(divided into Putamen & Globus Pallidus)

**Corpus Striatum:** 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**

**Amygdaloid Nucleus**  
(part of limbic system)

- is only embryologically related to Corpus Striatum
- Functionally related to the Limbic System



(Medial view)

# 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**.  
*Genu is the connection point of the anterior & posterior branches of the internal capsule*

## Putamen

- Larger darker lateral portion
- is more closely related to **Caudate nucleus** (regarding development, function & connections) and together constitute the **Neostriatum or Striatum**.

## Globus Pallidus

- Smaller, lighter medial portion
- the oldest part of corpus striatum and is called **Paleostriatum or Pallidum**

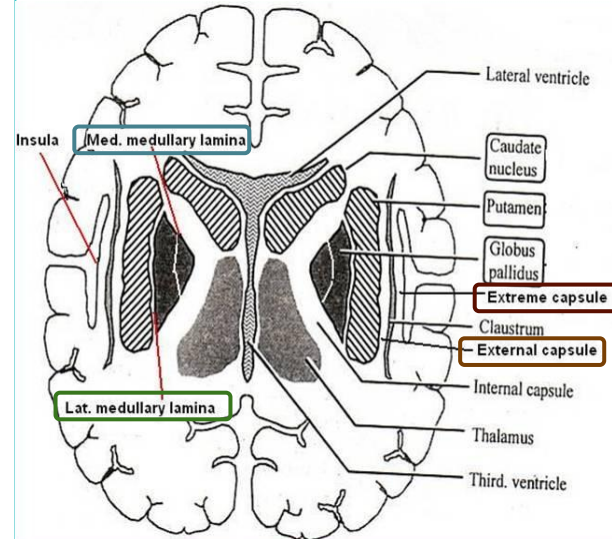
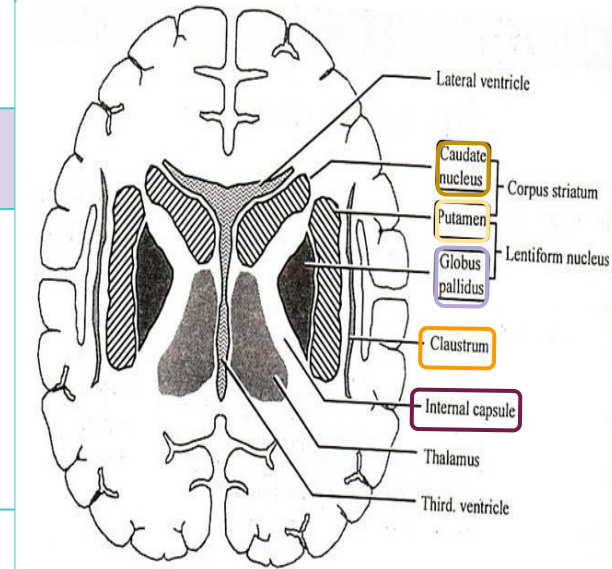
## Divisions

- Separated from globus pallidus 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 **Clastrum** into two layers:

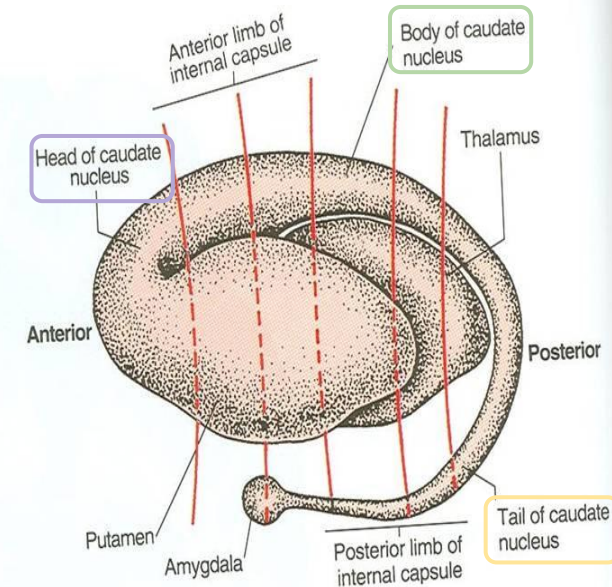
- **External capsule ( Medial )** between the putamen and claustrum.
- **Extreme capsule ( Lateral )** between the claustrum and the insula

- Consists of two divisions: the Lateral & the Medial 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**

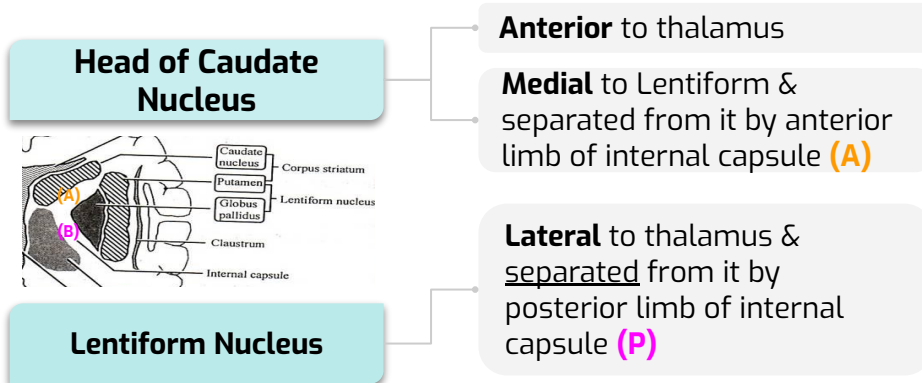


# CAUDATE NUCLEUS

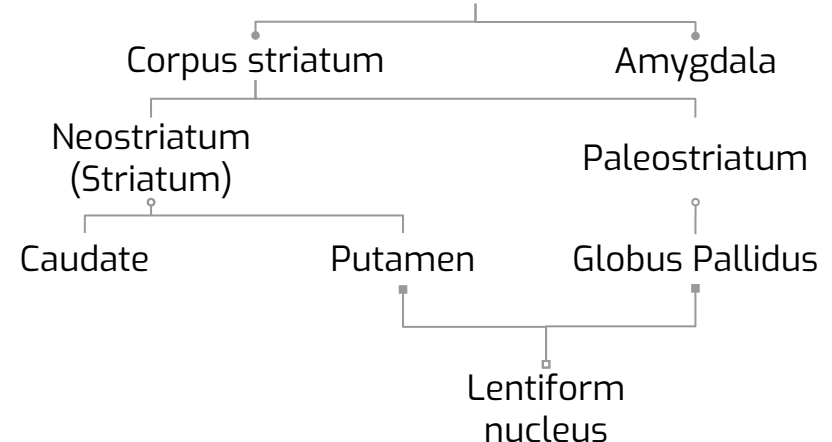
<b>Shape</b>	C-shaped mass of grey matter
<b>Components</b>	
<b>Head</b>	<ul style="list-style-type: none"> <li>• Rounded in shape</li> <li>• Lies anterior to thalamus (in frontal lobe)</li> <li>• Completely separated from the putamen by the internal capsule except rostrally where it is continuous with the putamen</li> </ul>
<b>Body</b>	<ul style="list-style-type: none"> <li>• Long &amp; narrow</li> <li>• Extends above thalamus (in parietal lobe)</li> </ul>
<b>Tail</b>	<ul style="list-style-type: none"> <li>• Long &amp; tapering</li> <li>• Descends into temporal lobe</li> <li>• Continuous with Amygdaloid Nucleus</li> <li>• <b>Inferior to the thalamus . Found in temporal lobe</b></li> </ul>



## Important Relations of corpus striatum:



## Basal ganglia 📺



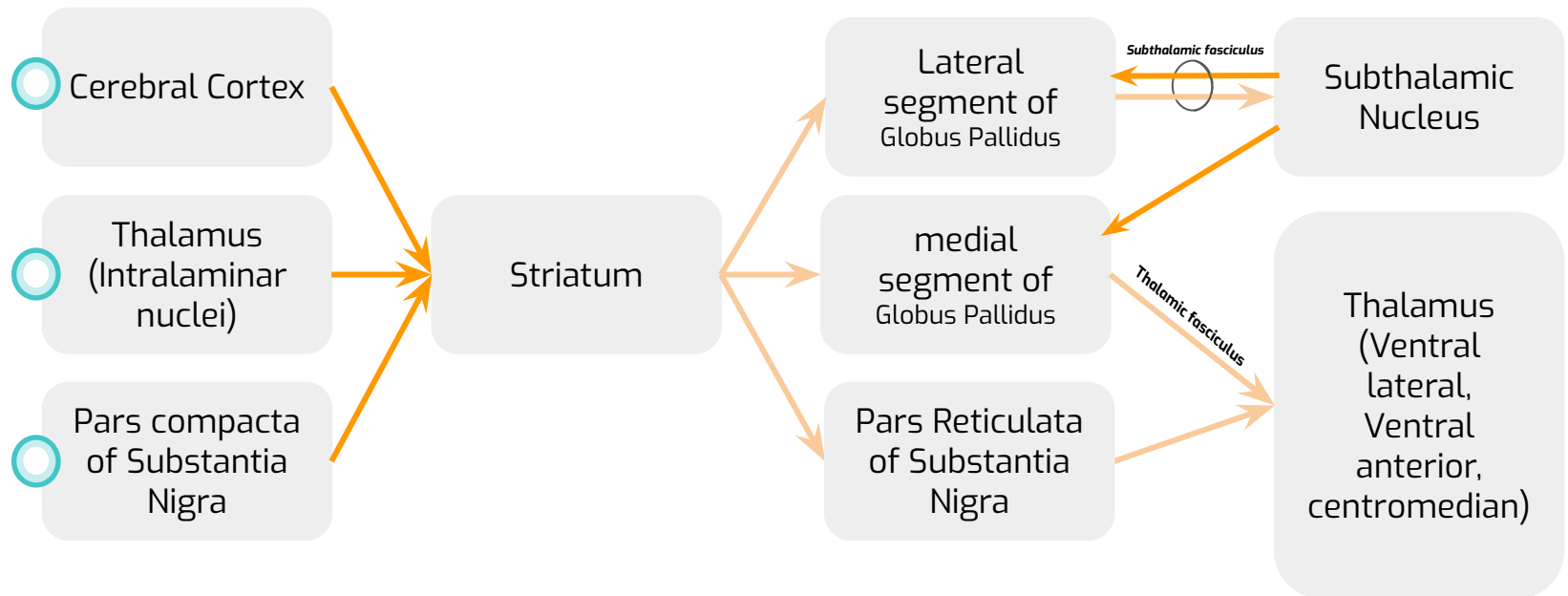


## The input portion:

- **Striatum (Caudate and Putamen)**

## The output portion

- **Paleostriatum (Globus Pallidus)**
- **medial segment of Globus Pallidus + Pars Reticulata of Substantia Nigra**



Affrents



Efferents



# CORPUS STRIATUM

## Function

The corpus striatum assists in regulation of voluntary movement and learning of motor skills as they:

- Facilitate behavior and movement that are required and appropriate.
- Inhibit unwanted or inappropriate movement.

## Dysfunction

Its dysfunction does NOT cause: paralysis, sensory loss or ataxia It leads to:

- Abnormal motor control: emergence of abnormal, involuntary movements (dyskinesias)
- Alteration in muscle tone: hypertonia/hypotonia
- Dr's note :note that the sensory sensation is normal and that's important thing to differentiate PD



**T** Tremor: shaking, usually starting on one side

**R** Rigidity: stiffness of the limbs, neck, or trunk

**A** Akinesia: loss or impairment in power of voluntary movement

**P** Posture and balance

## Females dr note:

:there's extra information on boys slides don't worry about it main contents are in females slides

## Afferent Fibers ( Input):

Corticostriate Fibers:	Thalamostriate Fibers:	Nigrostriate Fibers:	Brain stem Strial Fibers:
<p>From all parts of <b>cerebral cortex</b> (mostly from sensory-motor cortex) axons pass to caudate nucleus and putamen  <b>Glutamate</b> is the neurotransmitter of this fibers.</p>	<p>From intralaminar nuclei of <b>thalamus</b> axons pass to caudate nucleus and putamen</p>	<p>Axons from <b>Substantia nigra</b> of midbrain pass to caudate nucleus and putamen. Neurotransmitter is <b>Dopamine</b>.</p>	<p>Ascending fibers from <b>brain stem</b> end in caudate nucleus &amp; putamen. <b>Serotonin</b> is the neurotransmitter</p>
<p>It is believed that the last 2 groups are inhibitory in function</p>			

## Efferent fibers (Output):

Striatopallidal fibers:	Striatonigral fibers:
<ul style="list-style-type: none"> <li>• These fibers pass from striatum (caudate nucleus &amp; putamen) to globus pallidus.</li> <li>• Gamma-aminobutyric acid (<b>GABA</b>) is the neurotransmitter.</li> </ul>	<ul style="list-style-type: none"> <li>• These fibers pass from caudate nucleus &amp; putamen to Substantia nigra.</li> <li>• Some fibers use GABA as a neurotransmitter, and others use substance p (a neuropeptide works as a neurotransmitter to excite most cellular processes).</li> </ul>



## Function:

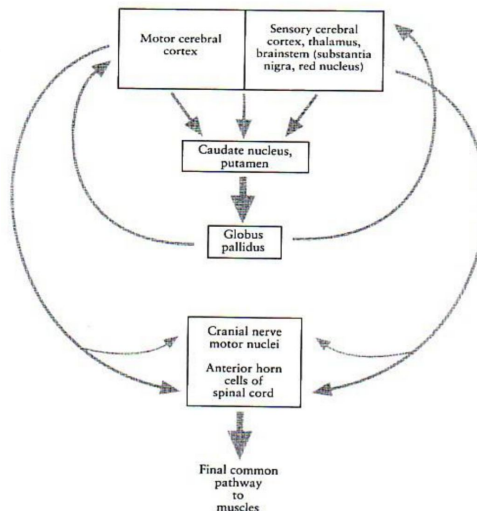
-Control of movements

-Planning and programming of movements

-Cognition

## Introduction to function of basal Nuclei

Basically the activity of basal nuclei begins by information received from sensory cortex, thalamus, substantia nigra, and red nucleus, according to thoughts of mind. This information is integrated within striatum and channeled within globus pallidus and outflow back to motor areas of cerebral cortex, and other motor area in brain stem. Thus the basal nuclei can control muscular movement through its effect on cerebral cortex. So basal nuclei assist in regulation of voluntary movement and learning of motor skills.



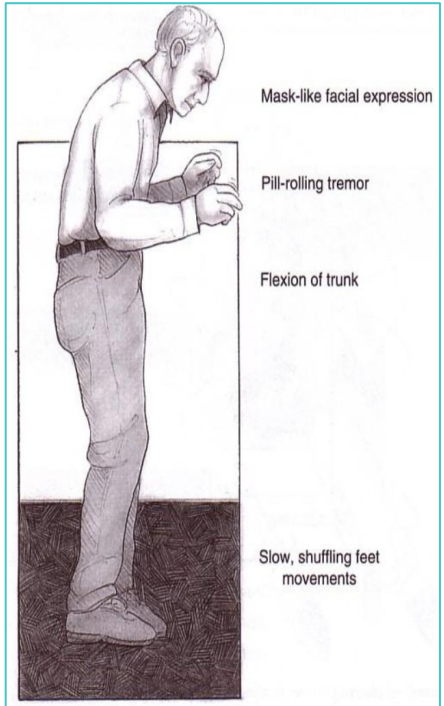
## Functions of basal ganglia

- 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.



## Parkinson's disease, paralysis Agitans

Lesion	Features		
Neuronal degeneration in substantia nigra leading to reduction of dopamine within corpus striatum.	Tremors	Rigidity	Akinesia
	Pill-rolling, involuntary, rhythmic, oscillating movements. It occurs during rest, it is called static tremors.	It occurs in both flexors and extensors, but more in flexors giving flexion attitude. It is called <b>pipe rigidity</b> .	it means lack of movement; Absence of swinging arm during walking, mask face, low-volume slow monotonous speech, and shuffling gait.



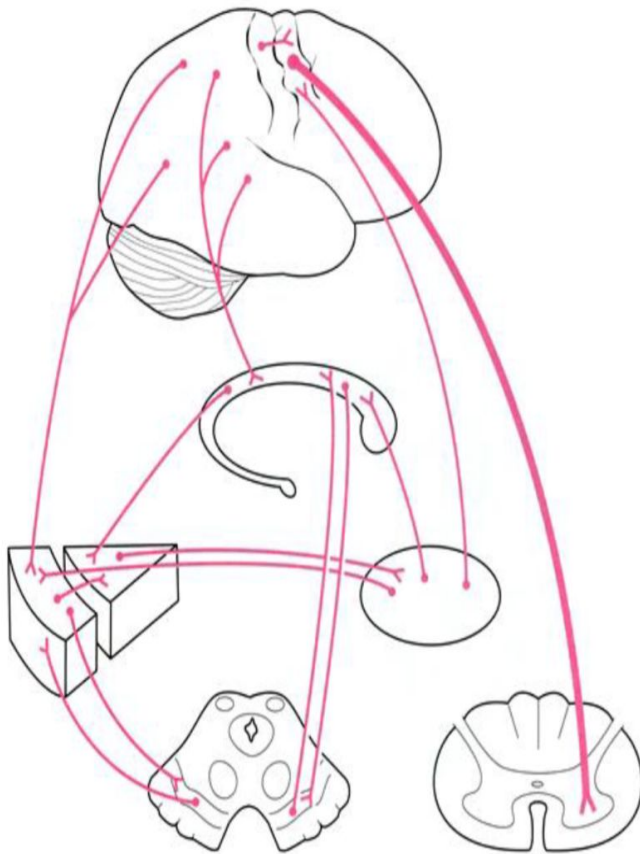
## Parkinson's Disease

- Described by James Parkinson
- Degeneration of dopaminergic nigrostriatal neurons (60-80 %).
- Methyl-Phenyl-Tetrahydro-Pyridine (MPTP). The oxidant MPP+ is toxic to substantia nigra (particularly pars compacta)
- Four cardinal symptoms: **Tremor- Rigidity-Akinesia & Bradykinesia -Postural Changes - Speech Changes.**

# Parkinson's disease VS Huntington's disease

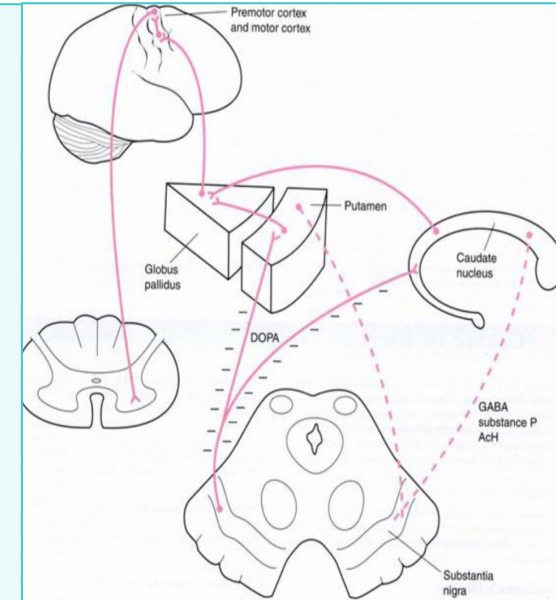
In male slides

Main Connections between Cortex,  
basal Nuclei, Thalamic Nuclei  
Brainstem & Spinal Cord



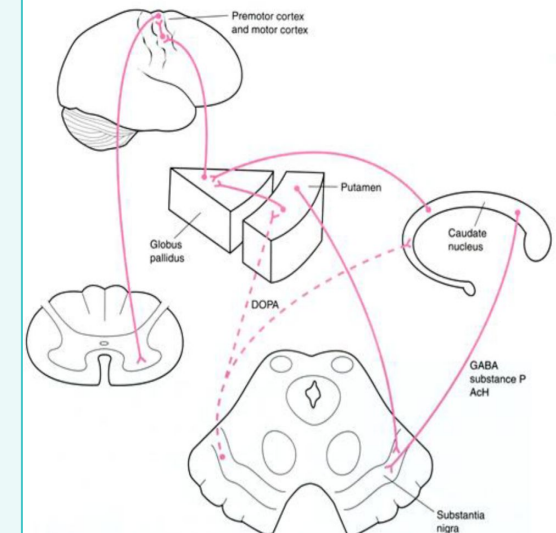
## Huntington's Disease:

degeneration of  
inhibitory pathway  
between corpus striatum  
& Substantia nigra.



## Parkinson's Disease:

degeneration of  
inhibitory pathways  
between Substantia  
Nigra & corpus striatum.



# MCQ

**Q1: Lentiform Nucleus is divided to?**

**A: Putamen & Corpus Striatum**

**B: Putamen & Globus Pallidus**

**C: Caudate & Lentiform nuclei**

**D: Globus Pallidus and Amygdaloid Nucleus**

**Q2: Bands of grey matter pass from lentiform nucleus across the internal capsule to the caudate nucleus, is?**

**A: Putamen**

**B: Globus Pallidus**

**C: Corpus Striatum**

**D: Thalamic fasciculus**

**Q3: Putman is part of?**

**A: Neostriatum**

**B: Paleostriatum**

**C: Pallidum**

**D: Claustrum**

**Q4: Globus Pallidus is divided to Lateral & the Medial segments separated by ?**

**A: pars reticulata of substantia nigra**

**B: Medial Medullary lamina.**

**C: Claustrum**

**D: Lateral Medullary Lamina**

**Q5: Caudate Nucleus body is found in which cerebral lobe?**

**A: Frontal**

**B: Occipital**

**C: Temporal**

**D: Parietal**

**Q6: The input (Afferent) Portion of corpus striatum is part of?**

**A: Striatum**

**B: Pallidum**

**C: medial segment of G.P.**

**D: Pars Reticulata of S.N.**

Answer key:

1(B) . 2 (C) . 3 (A) . 4 (B) . 5 (D) . 6 (A)

# MCQ

**Q7: Corticostriate Fibers produce which of the following neurotransmitters?**

**A: Serotonin**

**B: Dopamine**

**C: Glutamate**

**D: acetylcholine**

**Q8: which of the following fibers is inhibitory in function?**

**A: Corticostriate Fibers**

**B: Thalamostriate Fibers**

**C:Striatonigral fibers**

**D: Nigrostriate Fibers**

**Q9: Parkinson's disease is Neuronal degeneration in which of the following?**

**A: substantia nigra**

**B: thalamus**

**C: red nucleus**

**D: globus pallidus**

**Q10:Which of these is NOT a symptom of Parkinson's Disease?**

**A: Tremors**

**B: Rigidity**

**C: Akinesia**

**D: Chorea**

**Q11:degeneration of inhibitory pathway between corpus striatum & Substantia nigra causing which disease?**

**A: Parkinson's disease**

**B: Huntington's Disease:**

**C: alzheimer disease**

**D: none of them**

**Q12:which of the following fibers is releasing (GABA)?**

**A:Thalamostriate Fibers**

**B: Brain stem Strial Fibers**

**C: Nigrostriate Fibers**

**D: Striatopallidal fibers**

Answer key:  
7(C) , 8(D) , 9(A) , 10(D) , 11(B) , 12(D)

# SAQ

Q1: Describe lentiform nucleus and caudate nucleus shapes

Q2: What are the important relations of the Lentiform Nucleus?

Q3: enumerate the Afferent Fibers of the Corpus Striatum.

Q4: how can basal ganglia regulate the voluntary movement?

## Answers

1 : lentiform nucleus is a 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.

Caudate nucleus is a C-shaped mass of grey matter.

2 : It's lateral to thalamus & separated from it by posterior limb of internal capsule.

3 : Corticostriate Fibers-Thalamostriate Fibers-Nigrostriate Fibers-Brain stem Strial Fibers

4: by its effect on cerebral cortex (primarily by inhibiting motor functions)

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## A special thanks to Mohamed Alquhidan

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