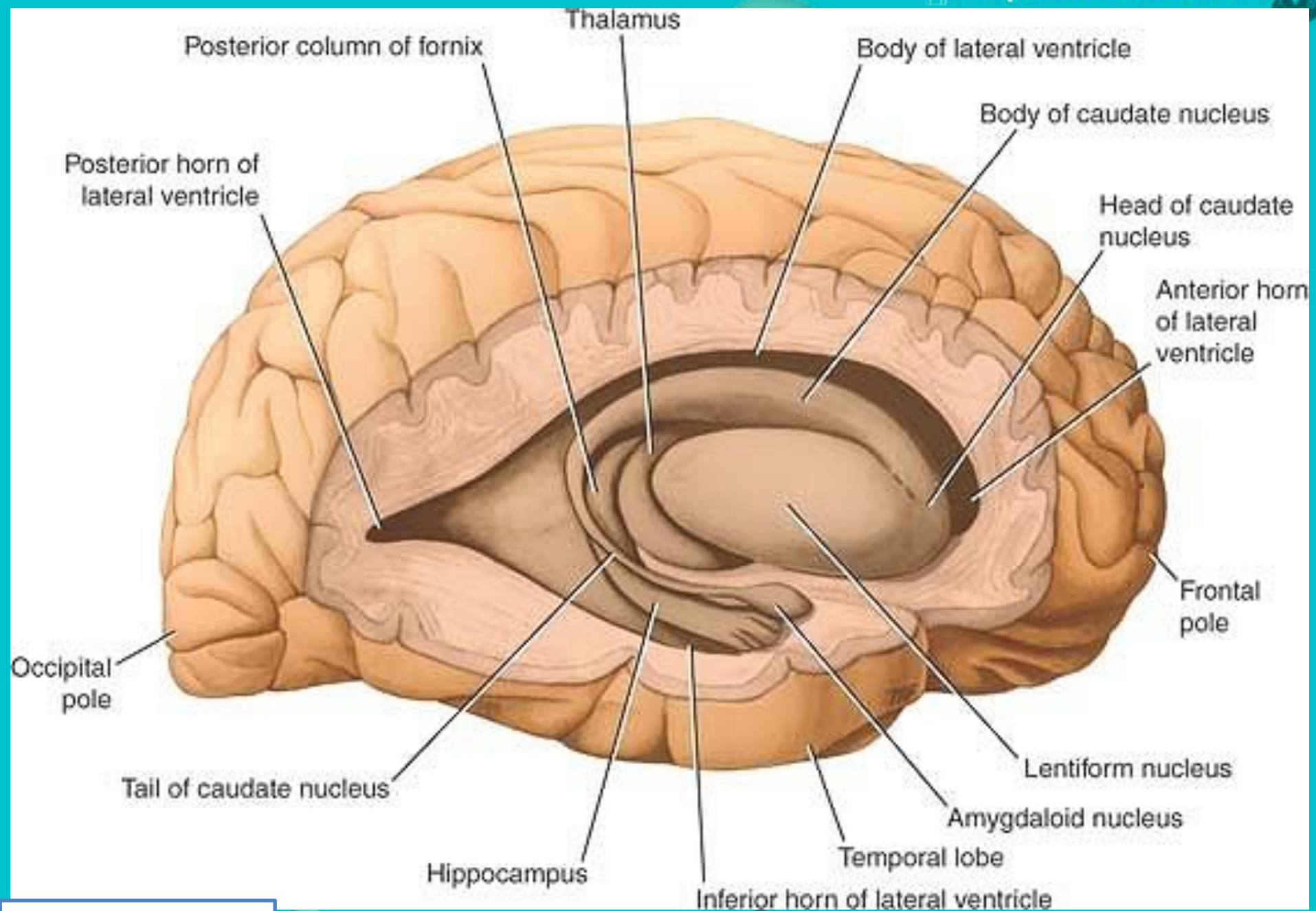


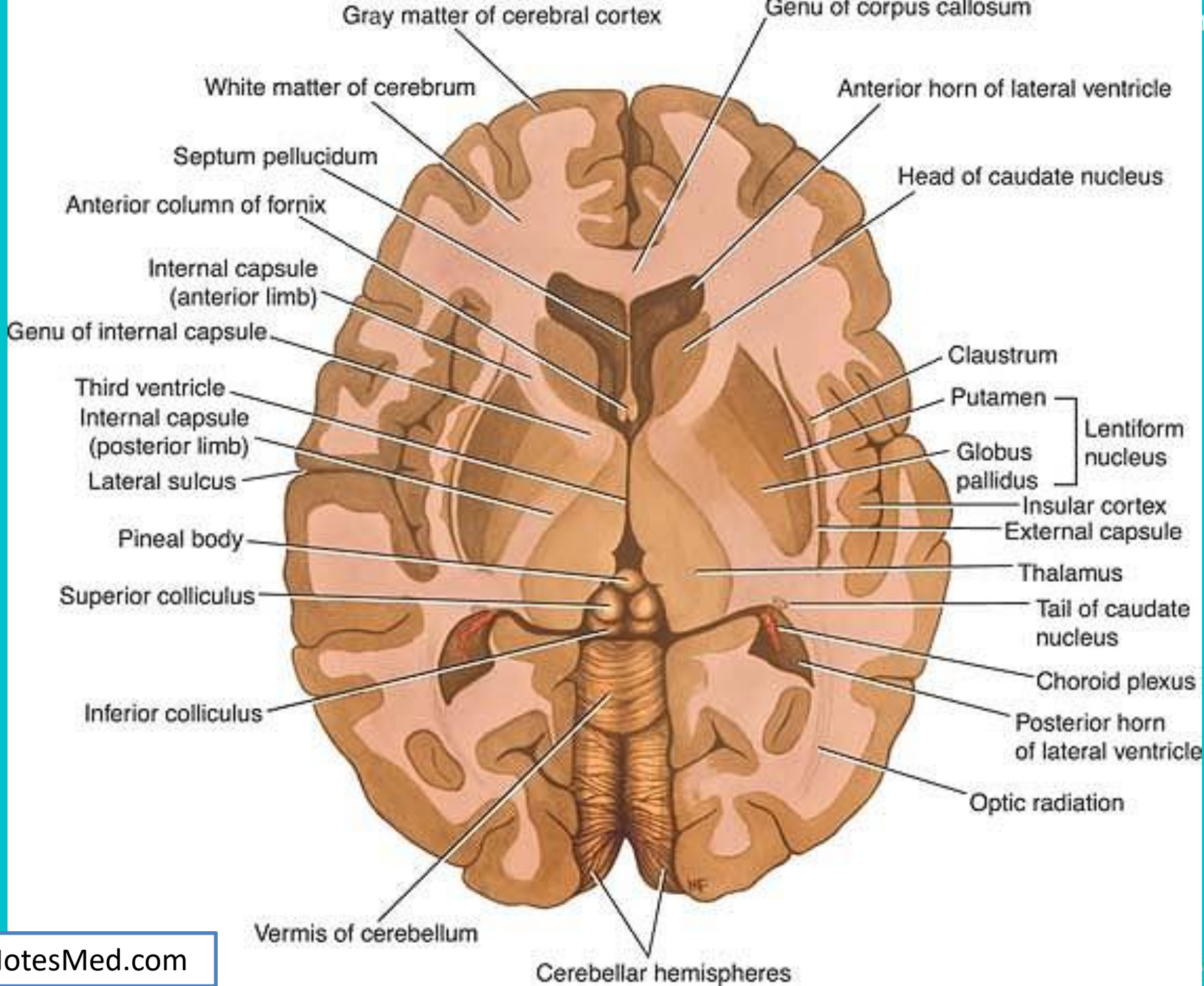


# BASAL GANGLIA

# BASAL GANGLIA

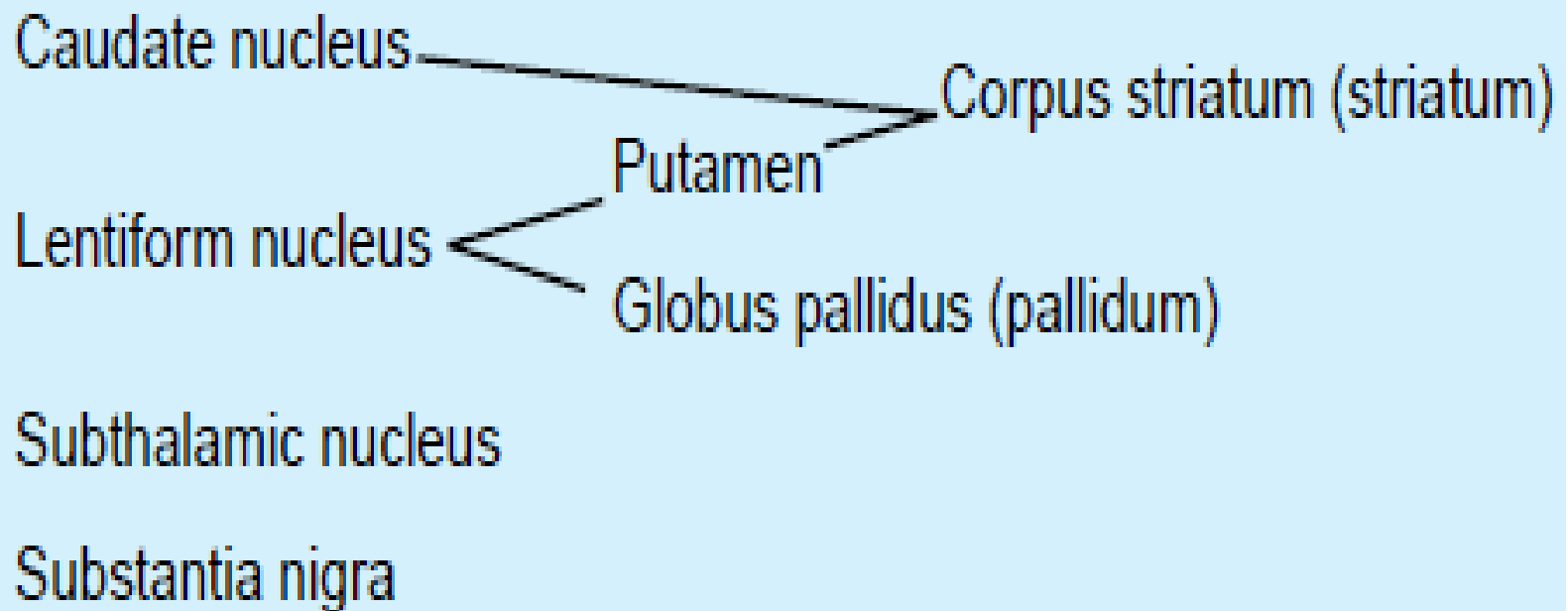
- A large subcortical mass of the grey matter in the cerebral hemisphere , derived from **telencephalon**.
- Includes:
  - a. Caudate nucleus
  - b. Lentiform nucleus:—putamen and globus pallidus
  - c. Amygdaloid nuclear complex
  - d. Claustrum







- **Functionally basal ganglia includes**



# Neuronal circuit

- Direct pathway: excitatory pathway
- Begins in the premotor & supplementary areas, primary motor cortex and somatosensory cortex- pass to the striatum- GPIS –thalamus- motor cortex
- Cortex to straitum-glutaminergic pathway
- Straitum to GPIS and GPIS to thalamus- GABAnergic pathway
- Thalamus to motor cortex-Glutaminergic pathway



# Indirect pathway: inhibitory

- motor cortex-striatum (Glutamatergic)
- striatum-GPe (GABAergic)
- GPe-subthalamus (GABAergic)
- subthalamus-GPi (Glutamatergic)
- GPi-Thalamus (GABAergic)
- Thalamus-cortex (Glutamatergic)

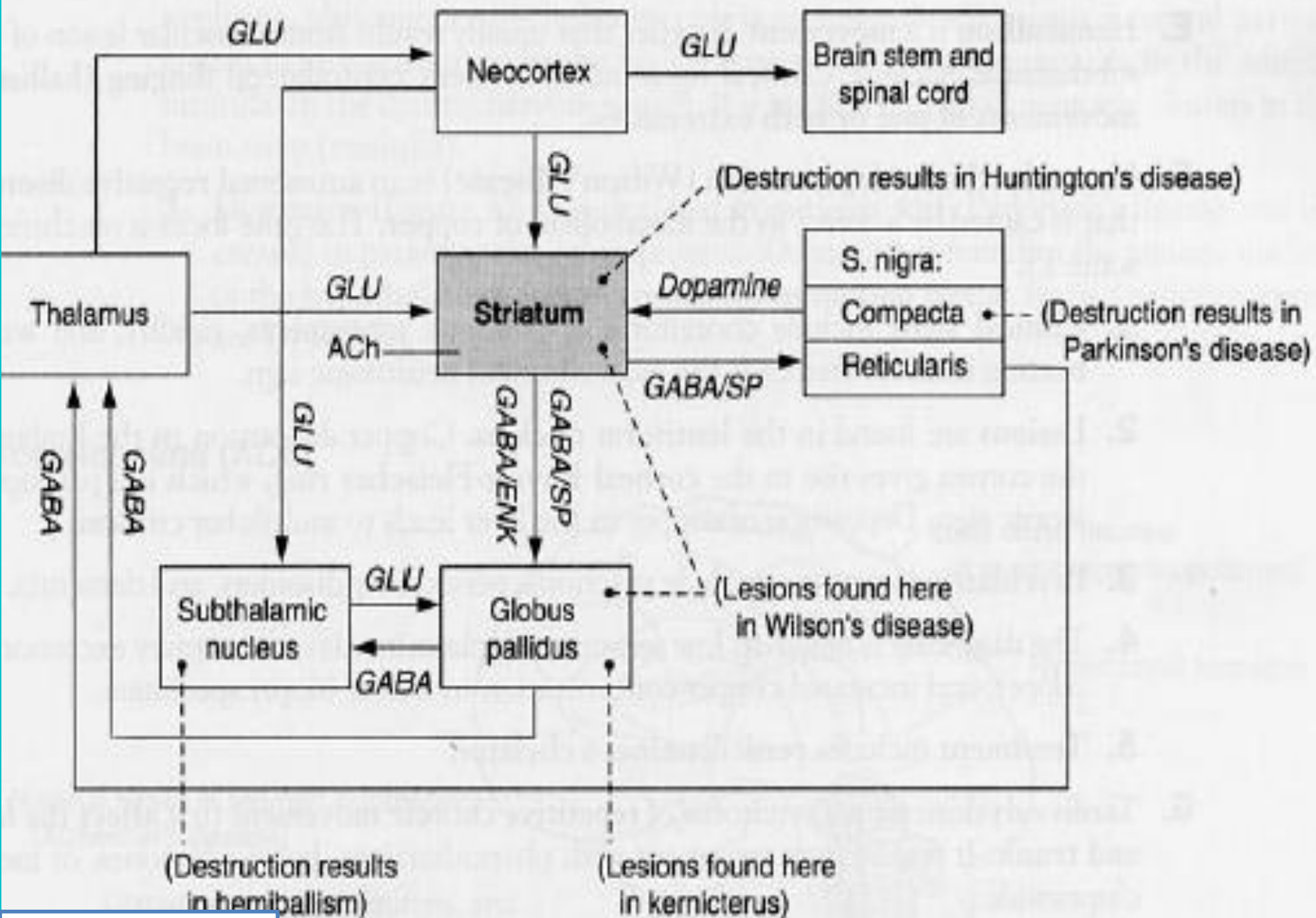


# Dopaminergic pathway

- Influence both direct and indirect pathway by nigrostriatal pathway
- Dopamine stimulate direct pathway by D1 receptor
- Dopamine inhibit indirect pathway by D2 receptor, this inhibition leads to excitation of the indirect pathway too



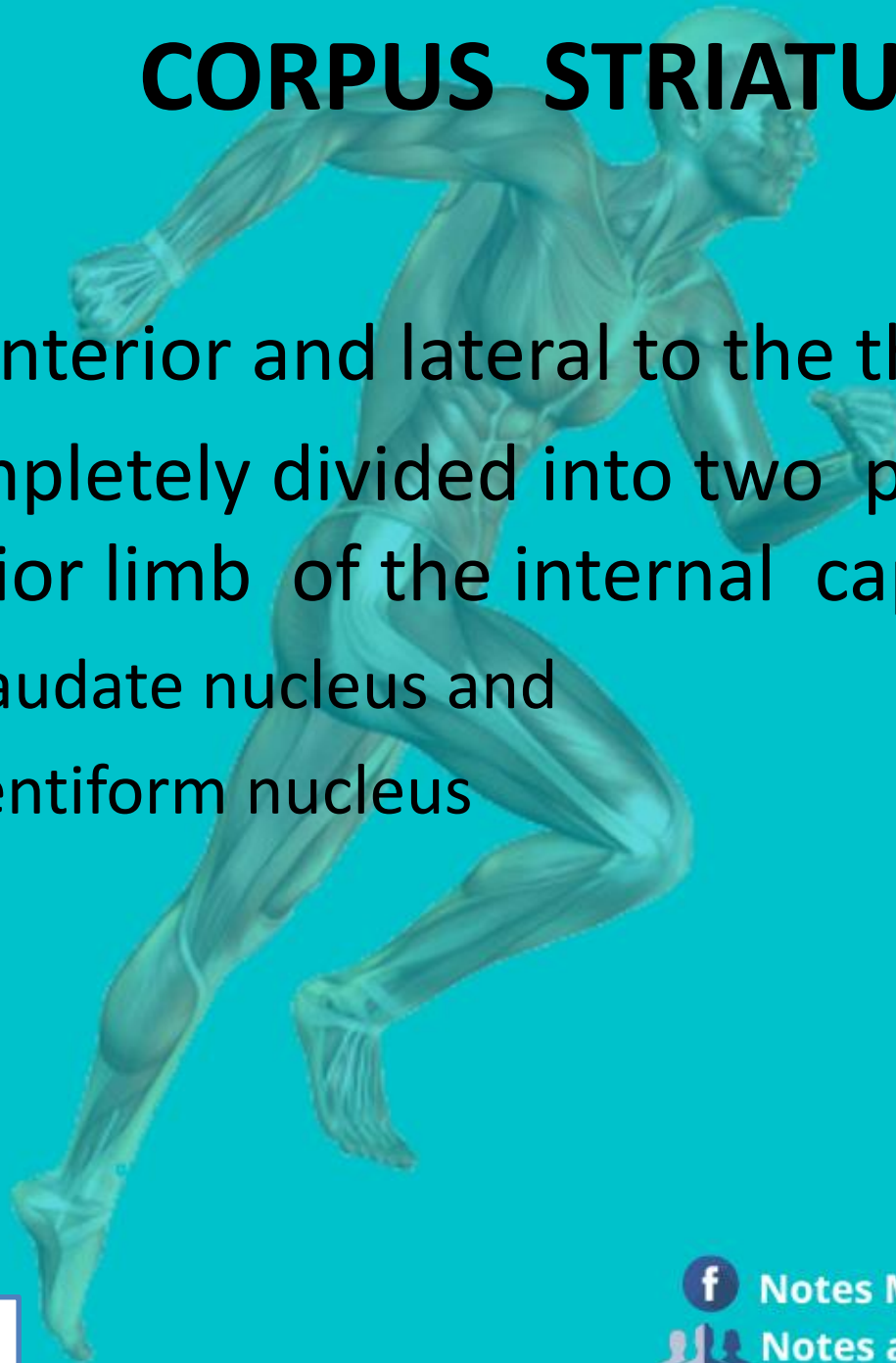






# CORPUS STRIATUM

- Lies anterior and lateral to the thalamus
- Incompletely divided into two parts by the anterior limb of the internal capsule.
  - a. Caudate nucleus and
  - b. Lentiform nucleus



- **Phylogenetic grouping of corpus striatum**

- a) Neostriatum(striatum)

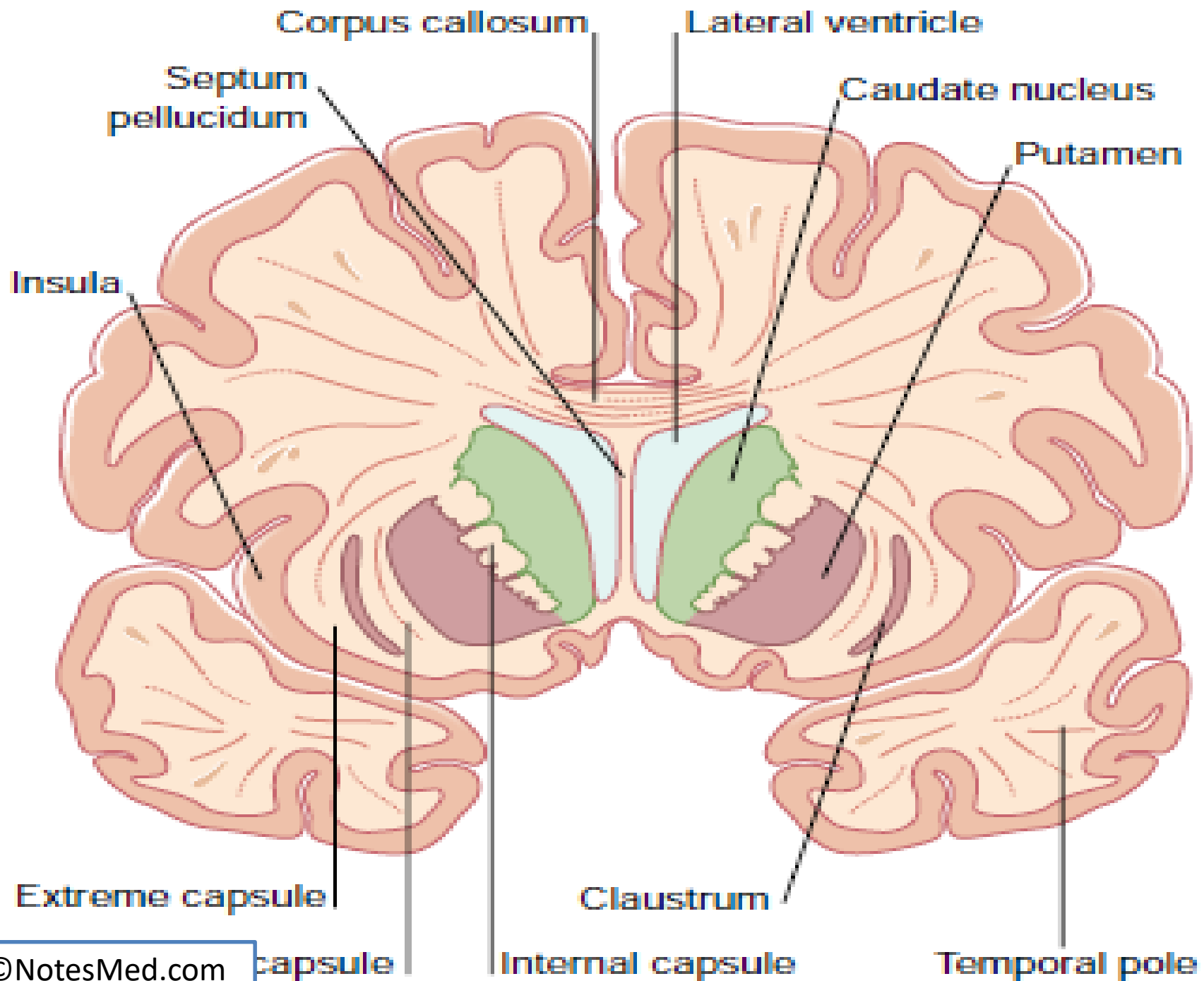
- Caudate nucleus and
    - Putamen

- both are identical in structure and is recent in phylogeny

- b) Paleostriatum

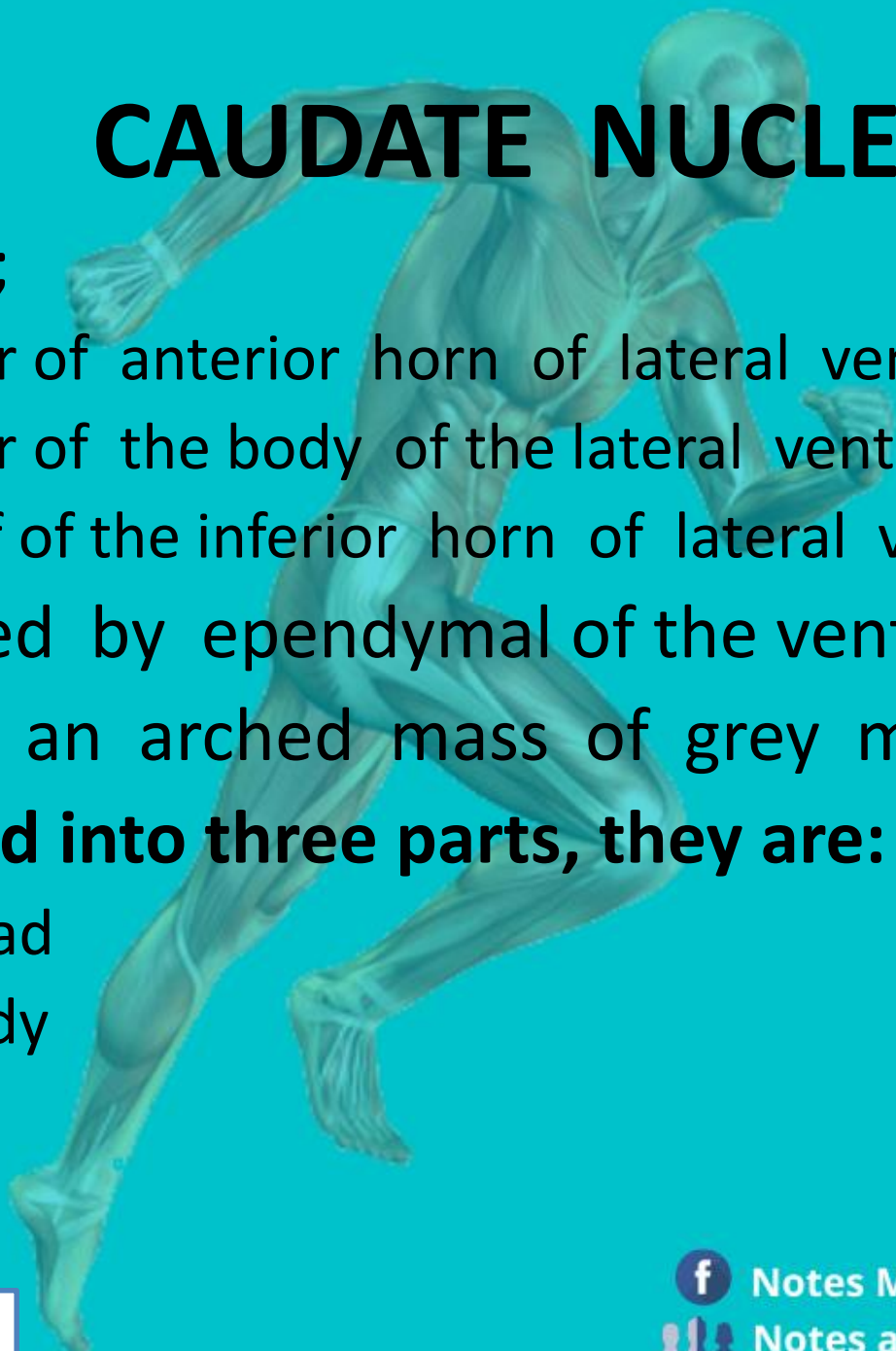
- Globus pallidum ( pallidum)

- old in phylogeny.



# CAUDATE NUCLEUS

- Forms;
  - Floor of anterior horn of lateral ventricle
  - Floor of the body of the lateral ventricle
  - Roof of the inferior horn of lateral ventricle.
- Covered by ependymal of the ventricle
- Forms an arched mass of grey mater.
- **Divided into three parts, they are:**
  - a. Head
  - b. Body
  - c. Tail





# CAUDATE NUCLEUS

## A. HEAD

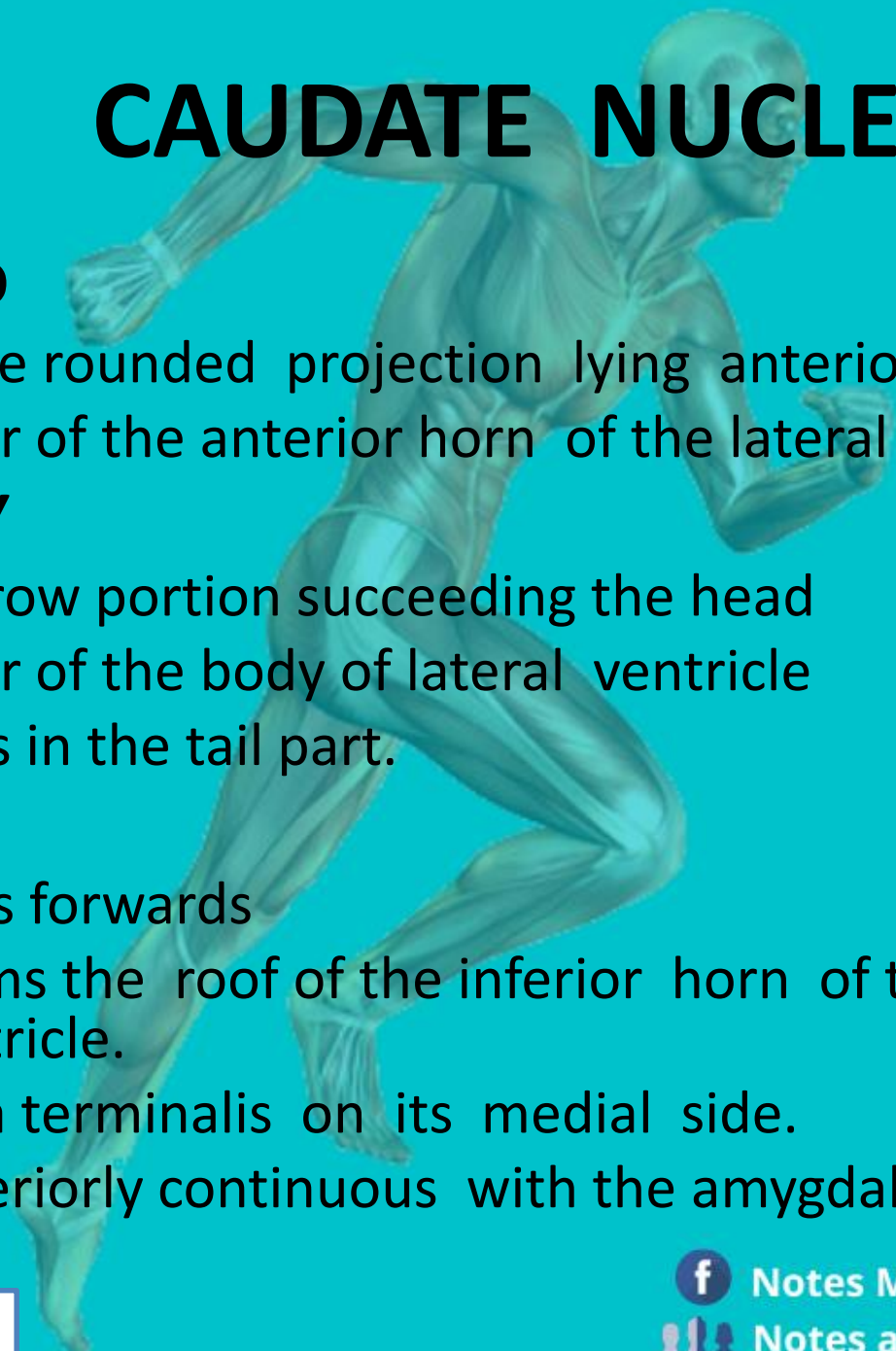
- Large rounded projection lying anteriorly
- Floor of the anterior horn of the lateral ventricle.

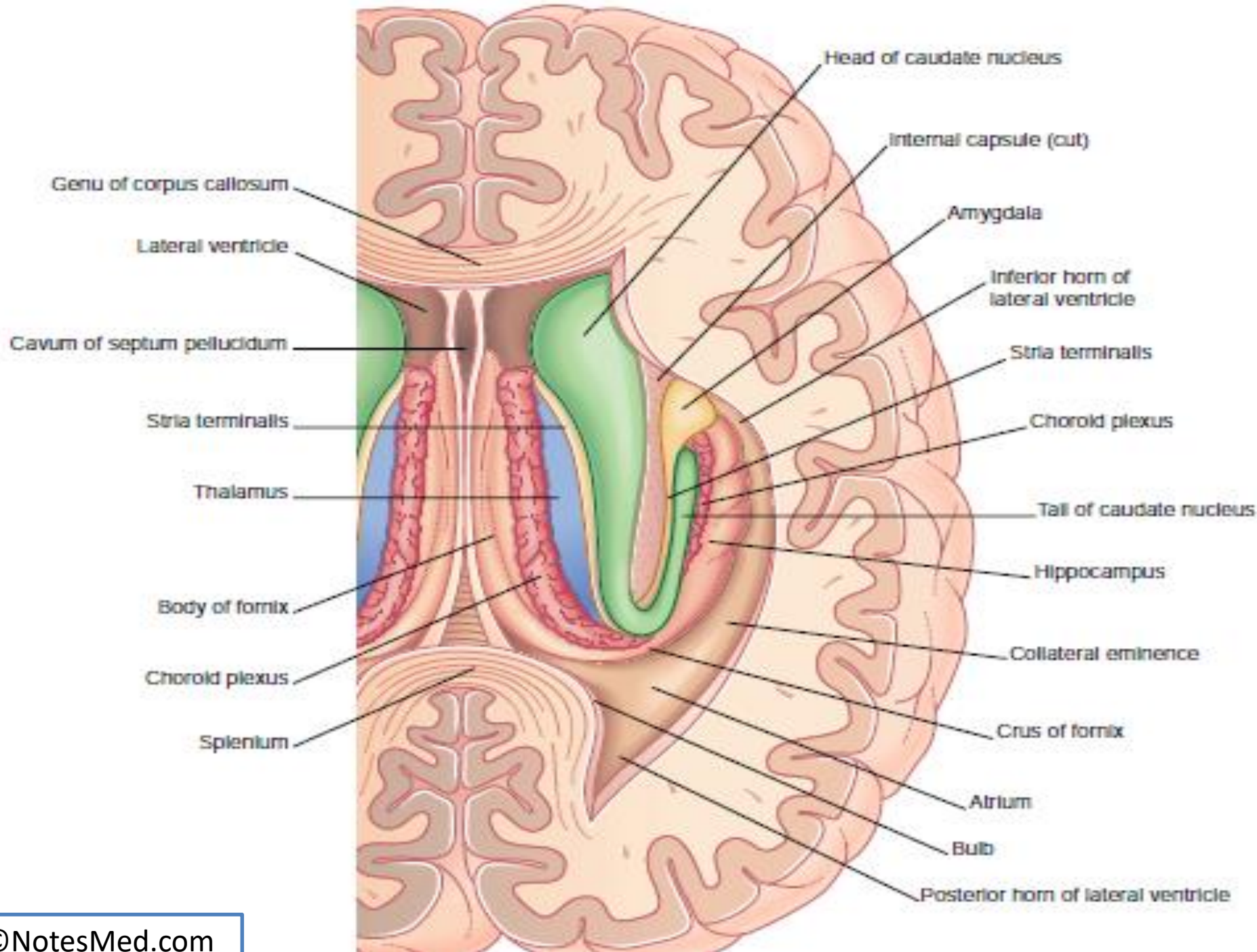
## B. BODY

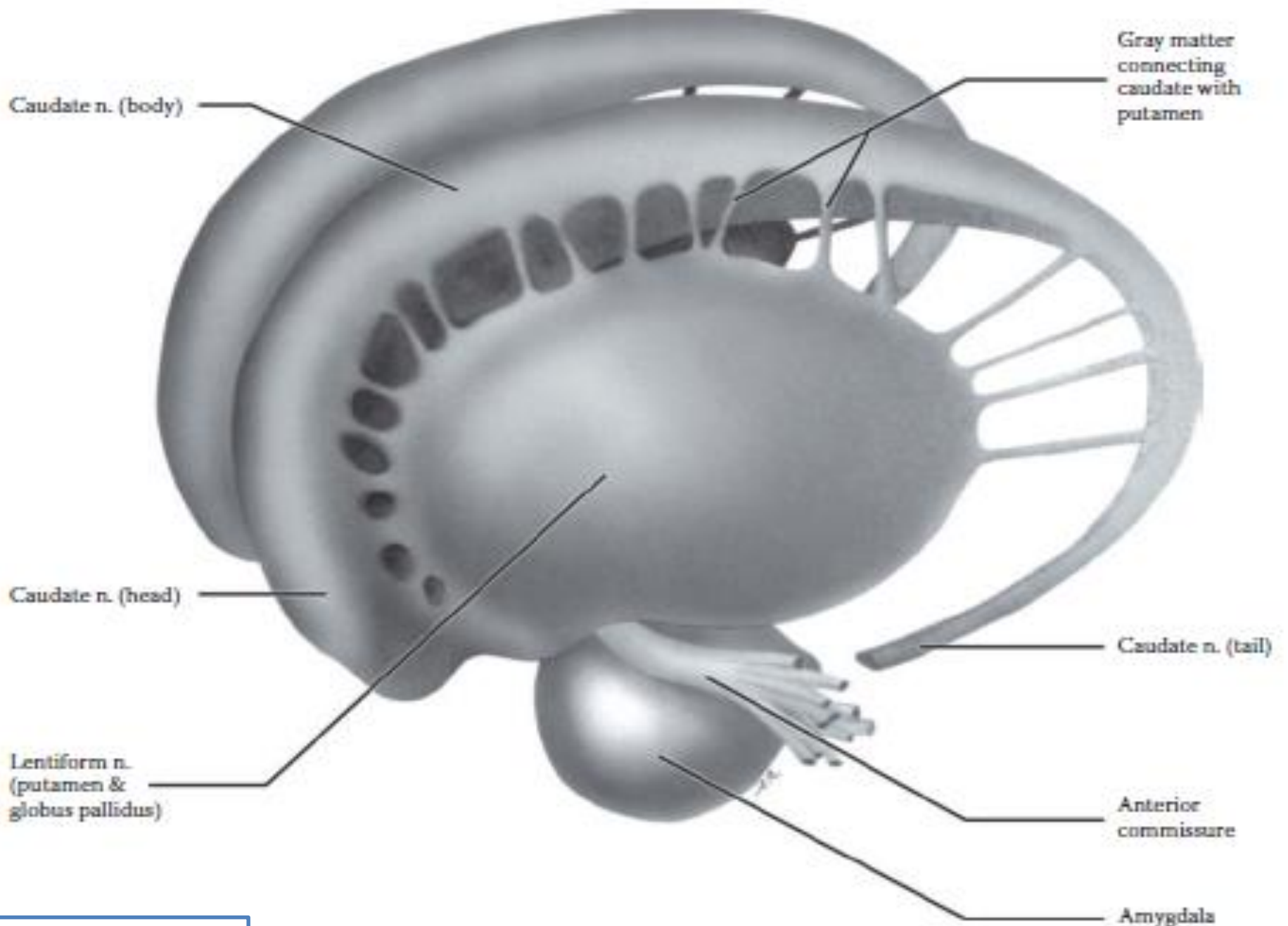
- Narrow portion succeeding the head
- Floor of the body of lateral ventricle
- Ends in the tail part.

## C. TAIL

- Runs forwards
- Forms the roof of the inferior horn of the lateral ventricle.
- Stria terminalis on its medial side.
- Anteriorly continuous with the amygdaloid nucleus.



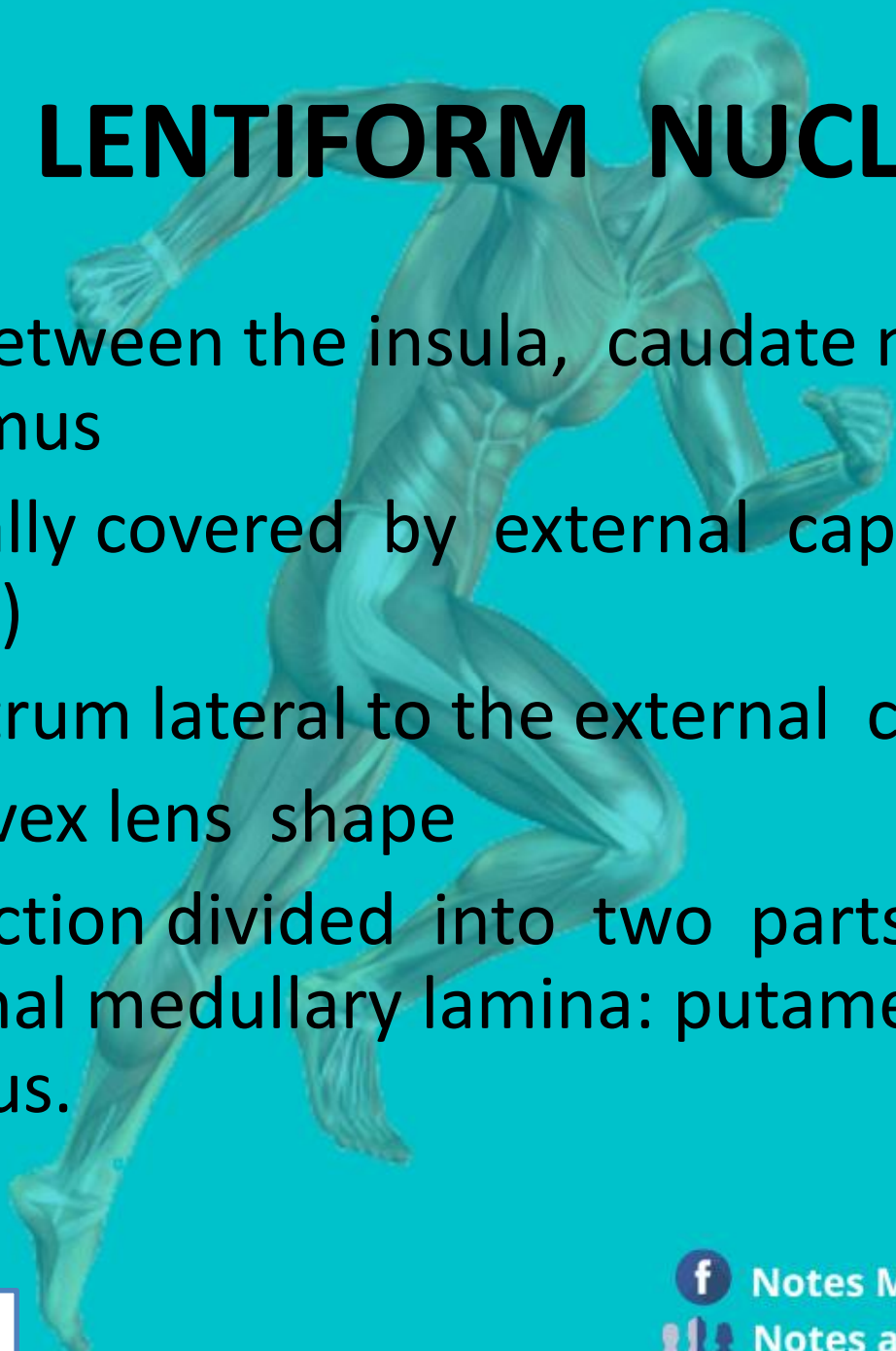


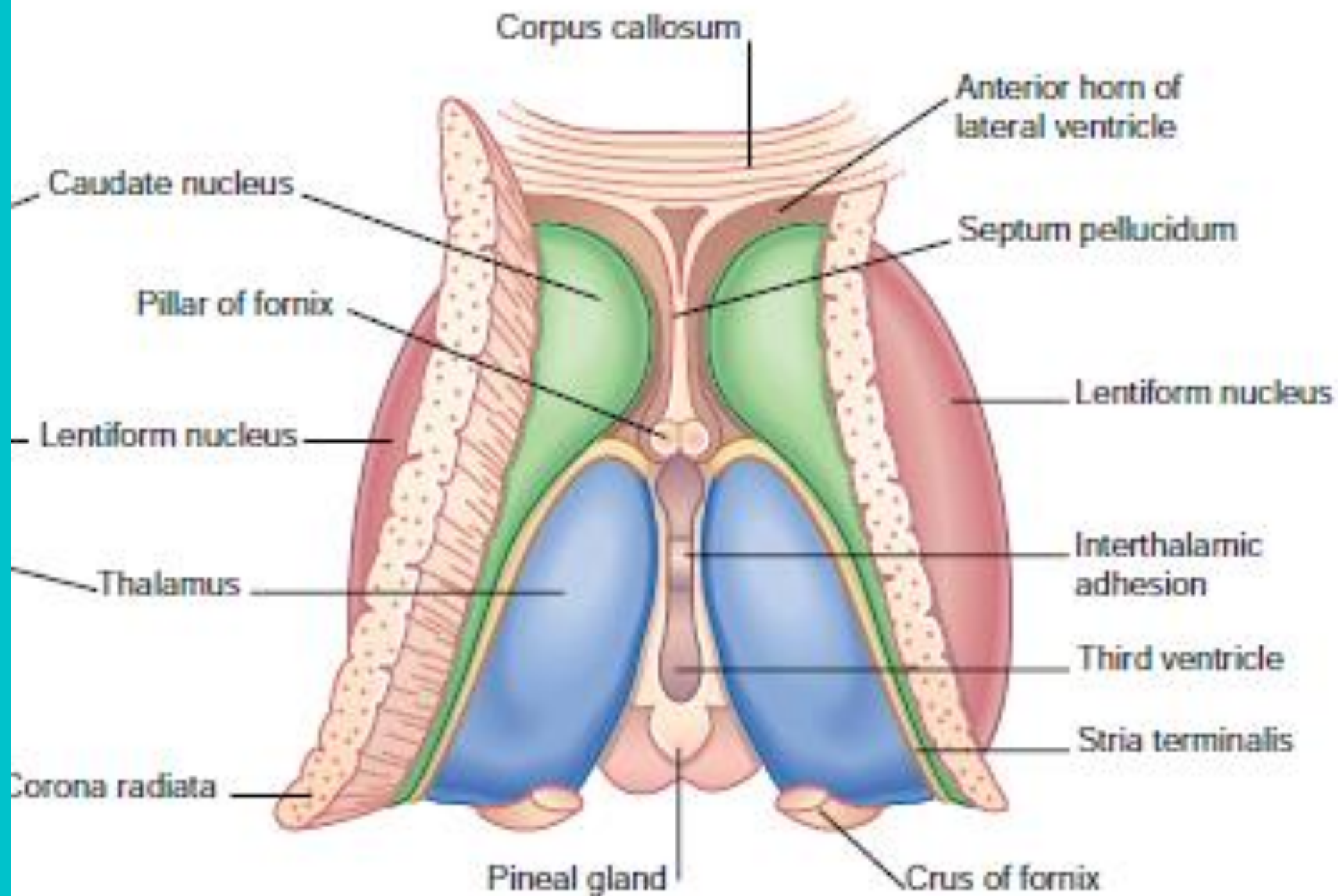




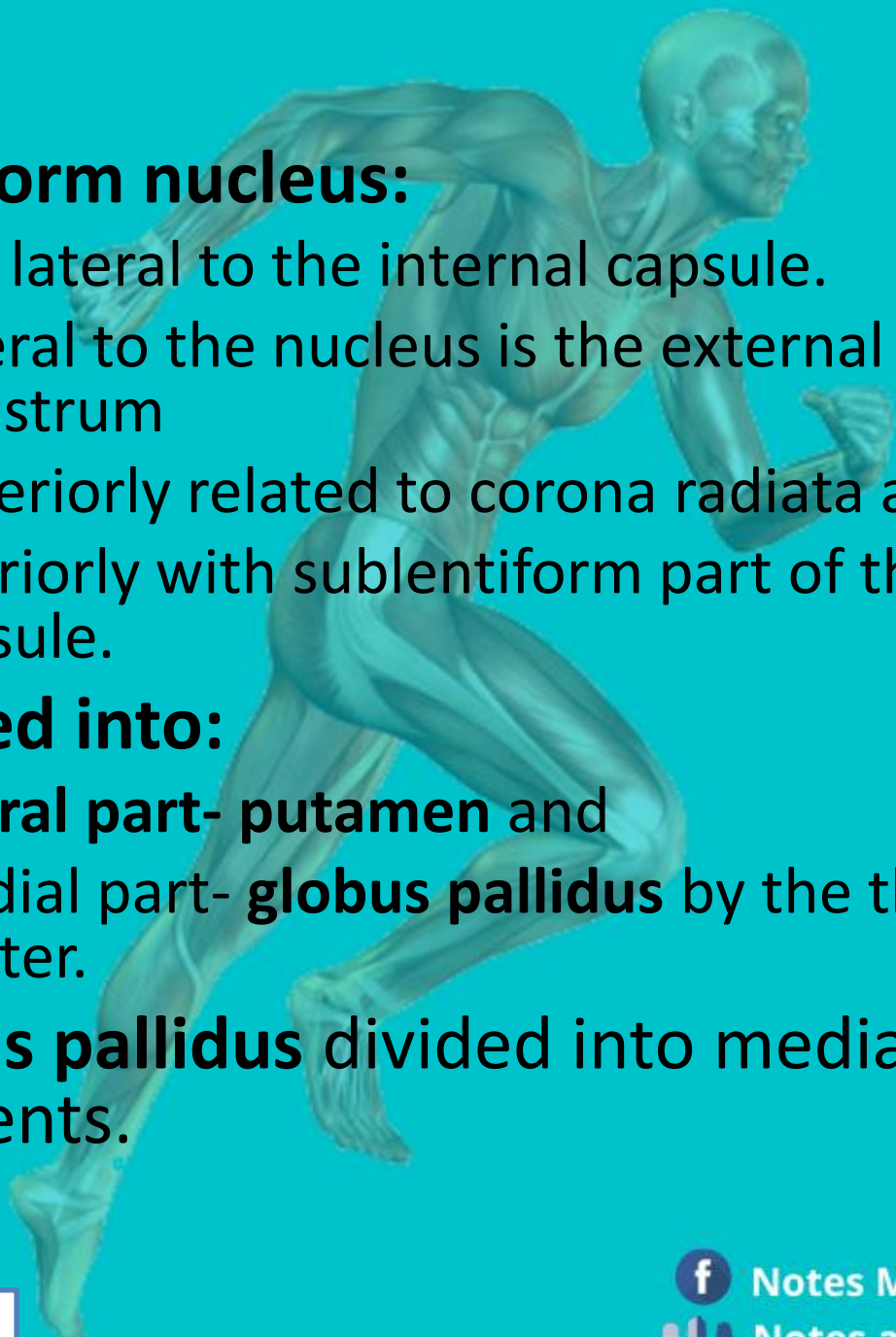
# LENTIFORM NUCLEUS

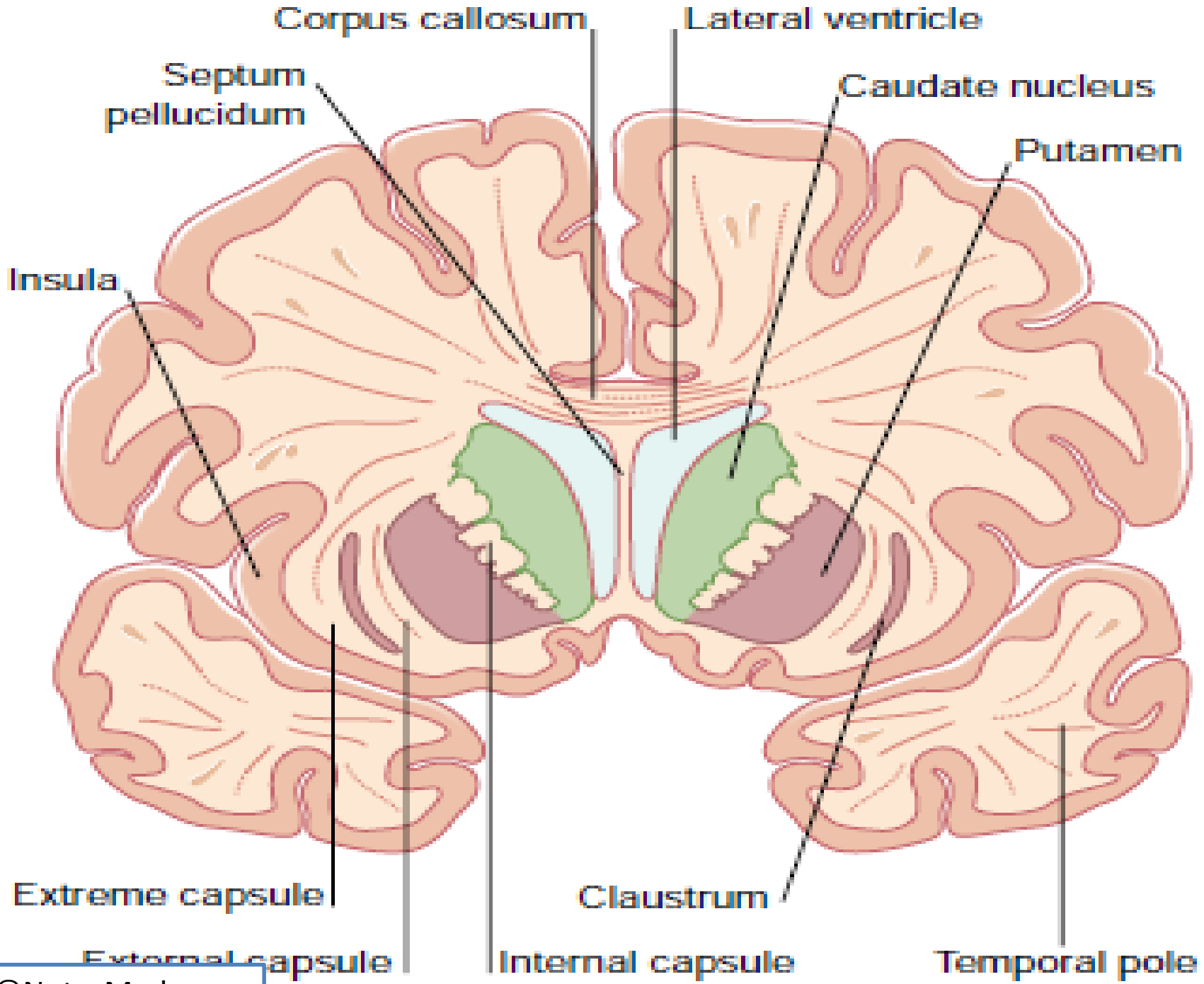
- Lies between the insula, caudate nucleus and thalamus
- Laterally covered by external capsule (white mater)
- Claustrum lateral to the external capsule.
- Biconvex lens shape
- On section divided into two parts by the external medullary lamina: putamen and globus pallidus.

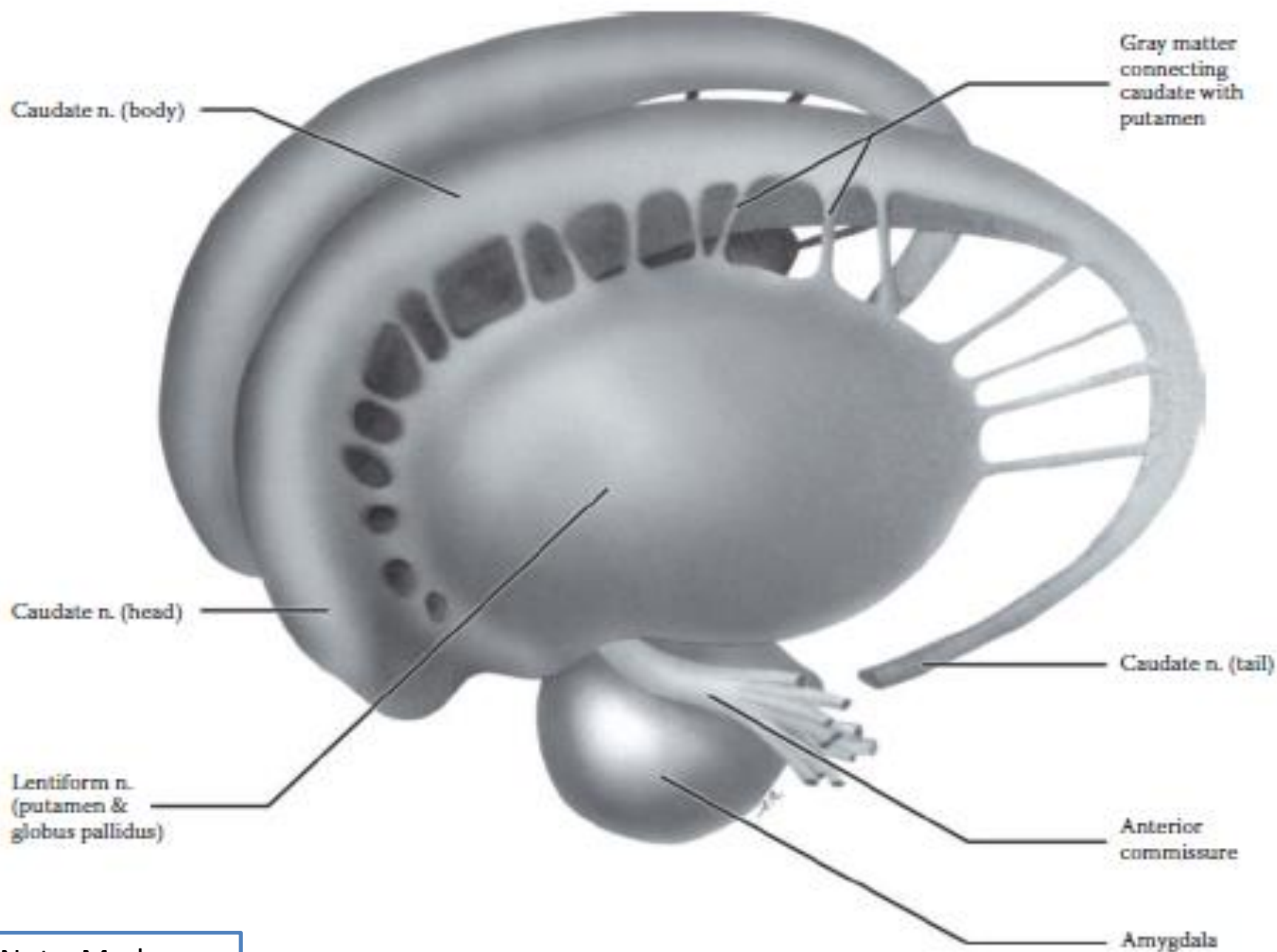


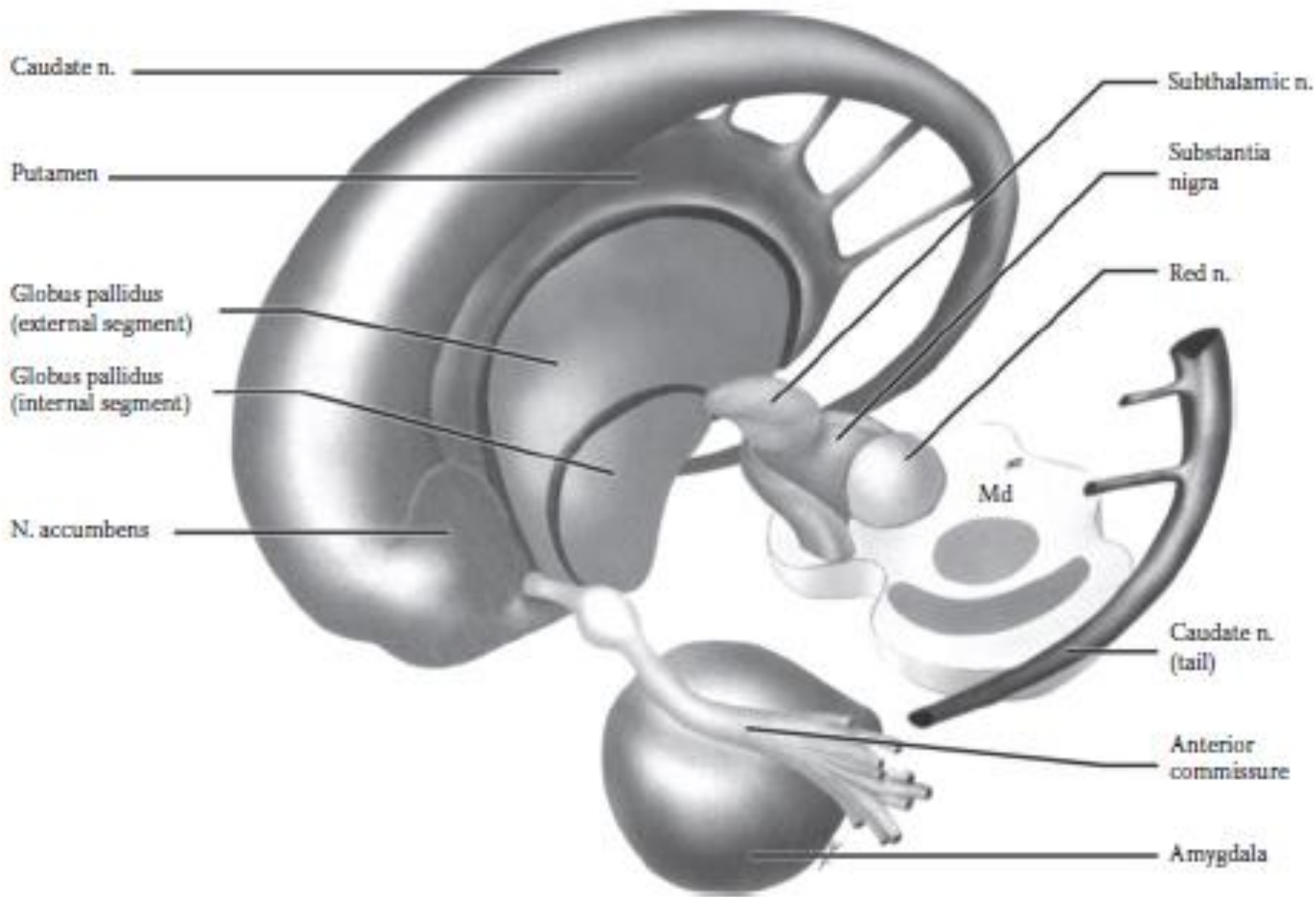


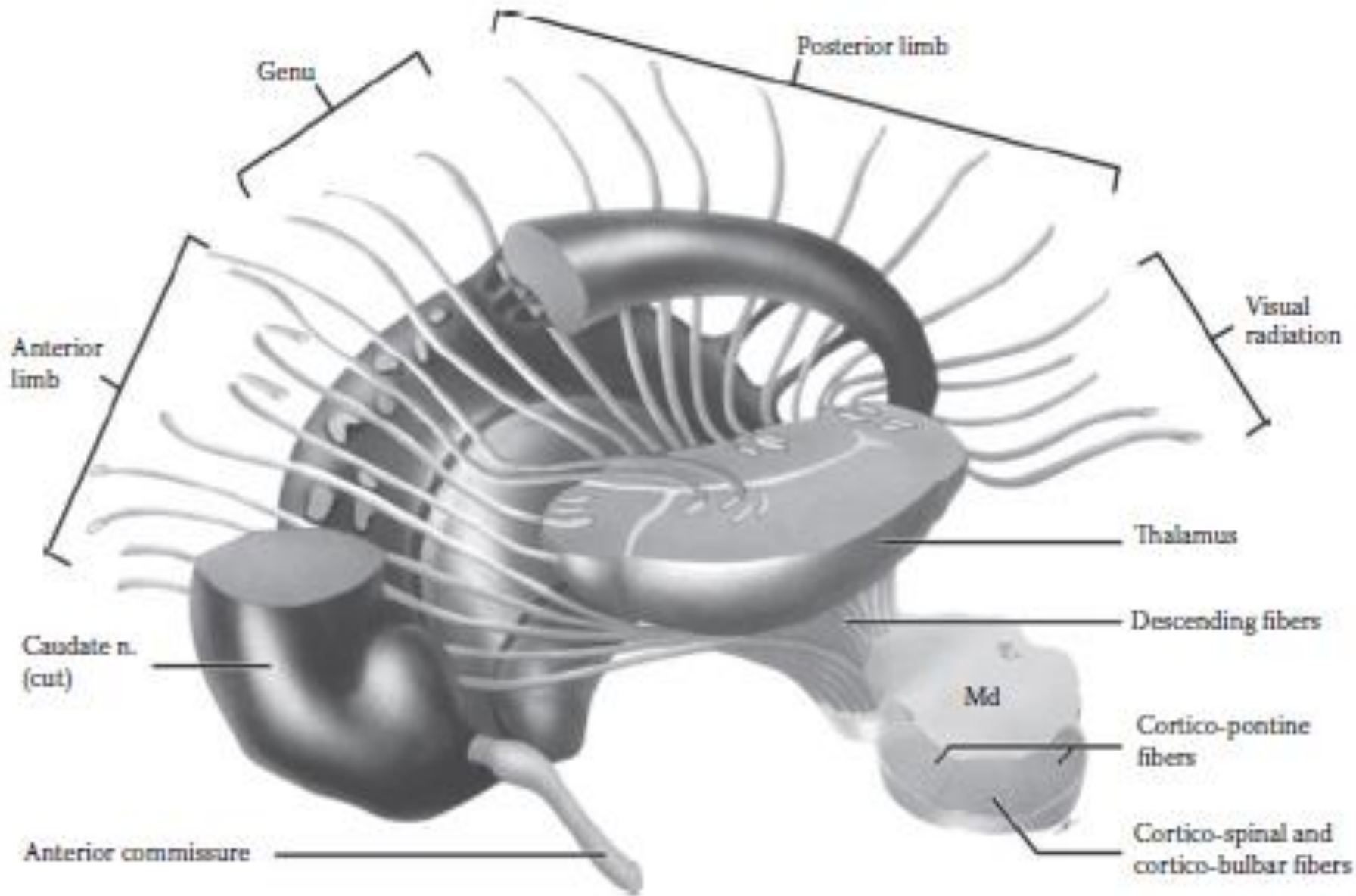
- **Lentiform nucleus:**
  - Lies lateral to the internal capsule.
  - Lateral to the nucleus is the external capsule and the claustrum
  - Superiorly related to corona radiata and
  - Inferiorly with sublentiform part of the internal capsule.
- **Divided into:**
  - **lateral part- putamen** and
  - Medial part- **globus pallidus** by the thin layer of white matter.
- **Globus pallidus** divided into medial and lateral segments.

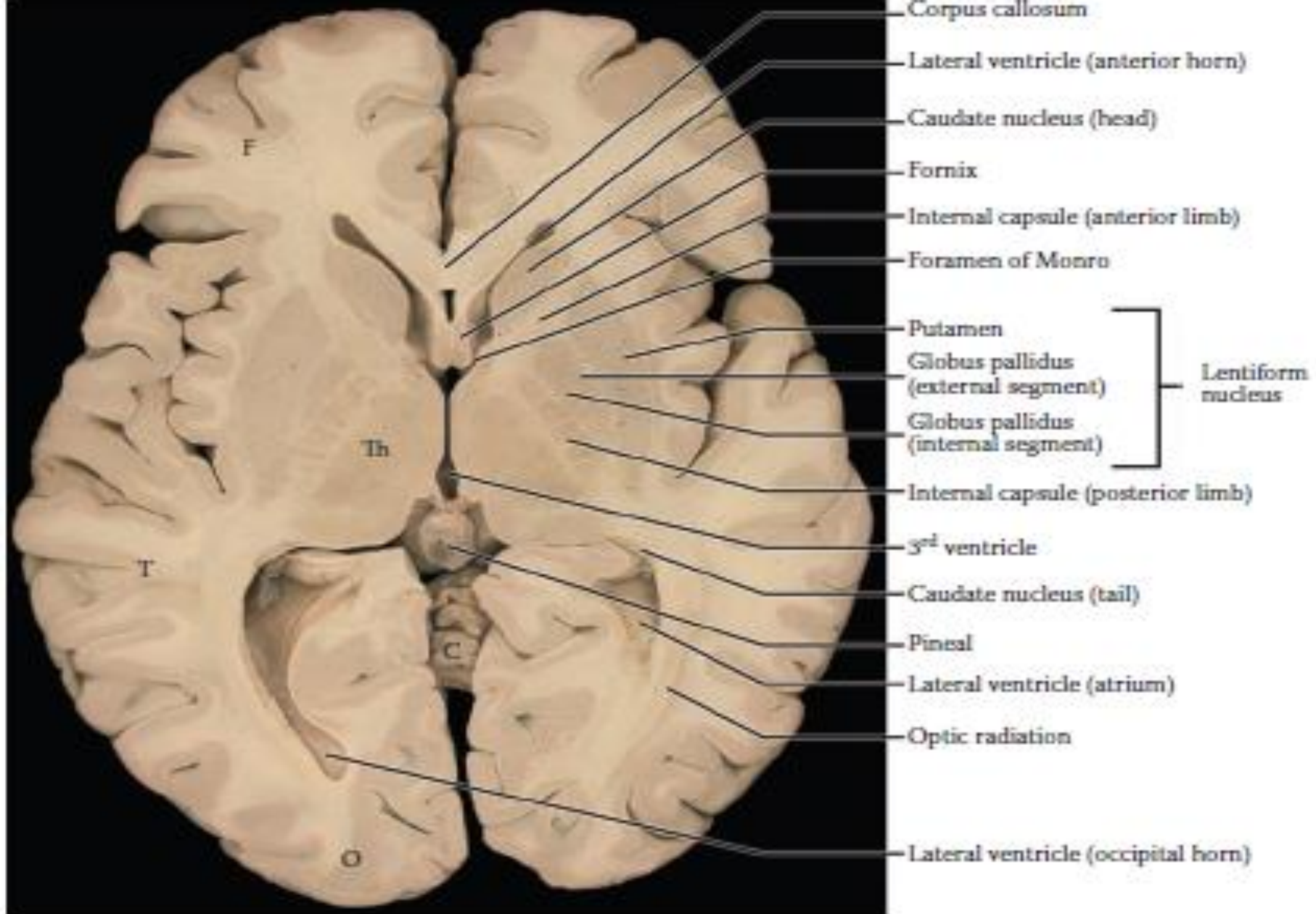


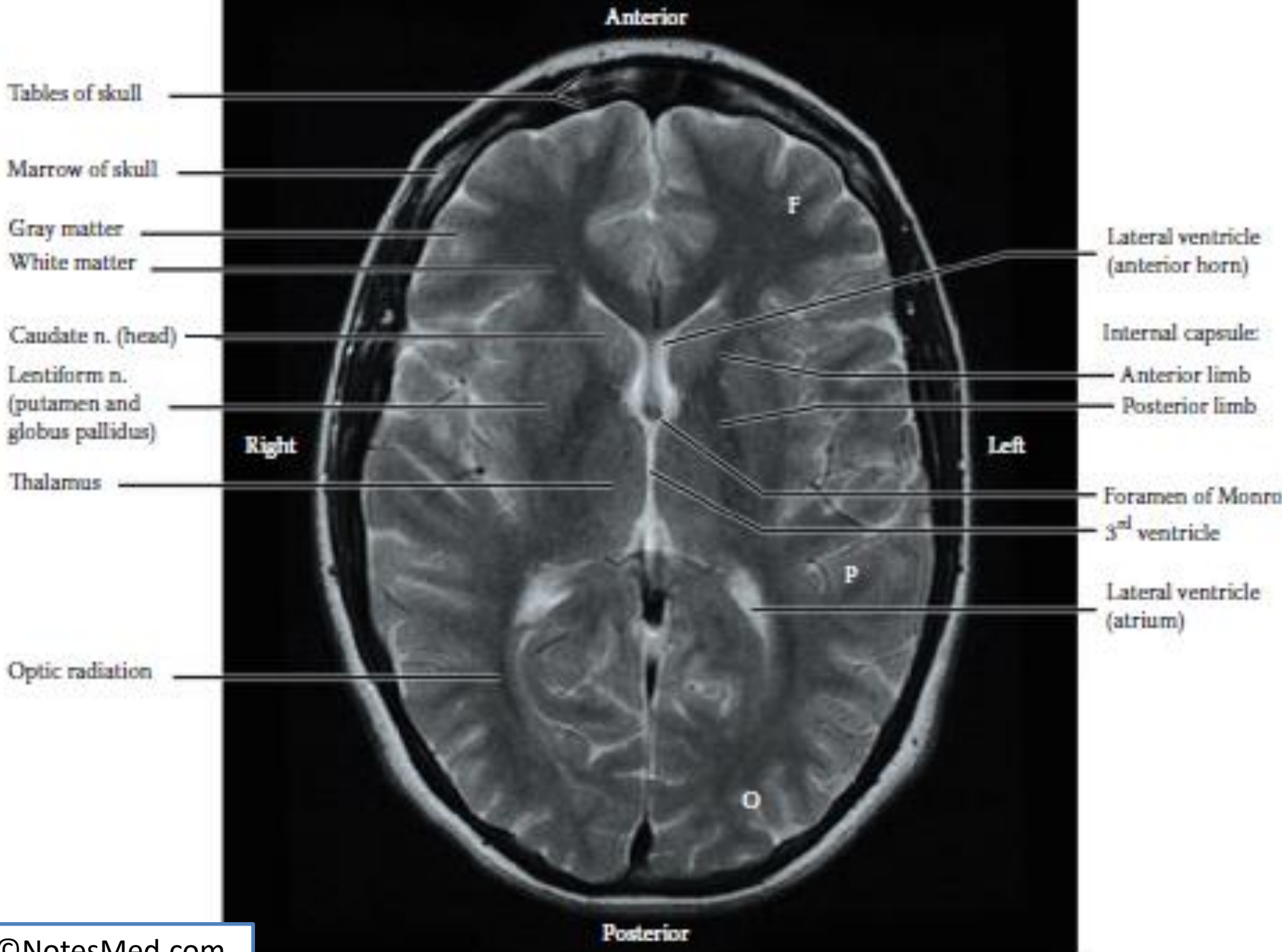














F = Frontal lobe

T = Temporal lobe

Lat = Lateral fissure

Ins = Insula

Th = Thalamus

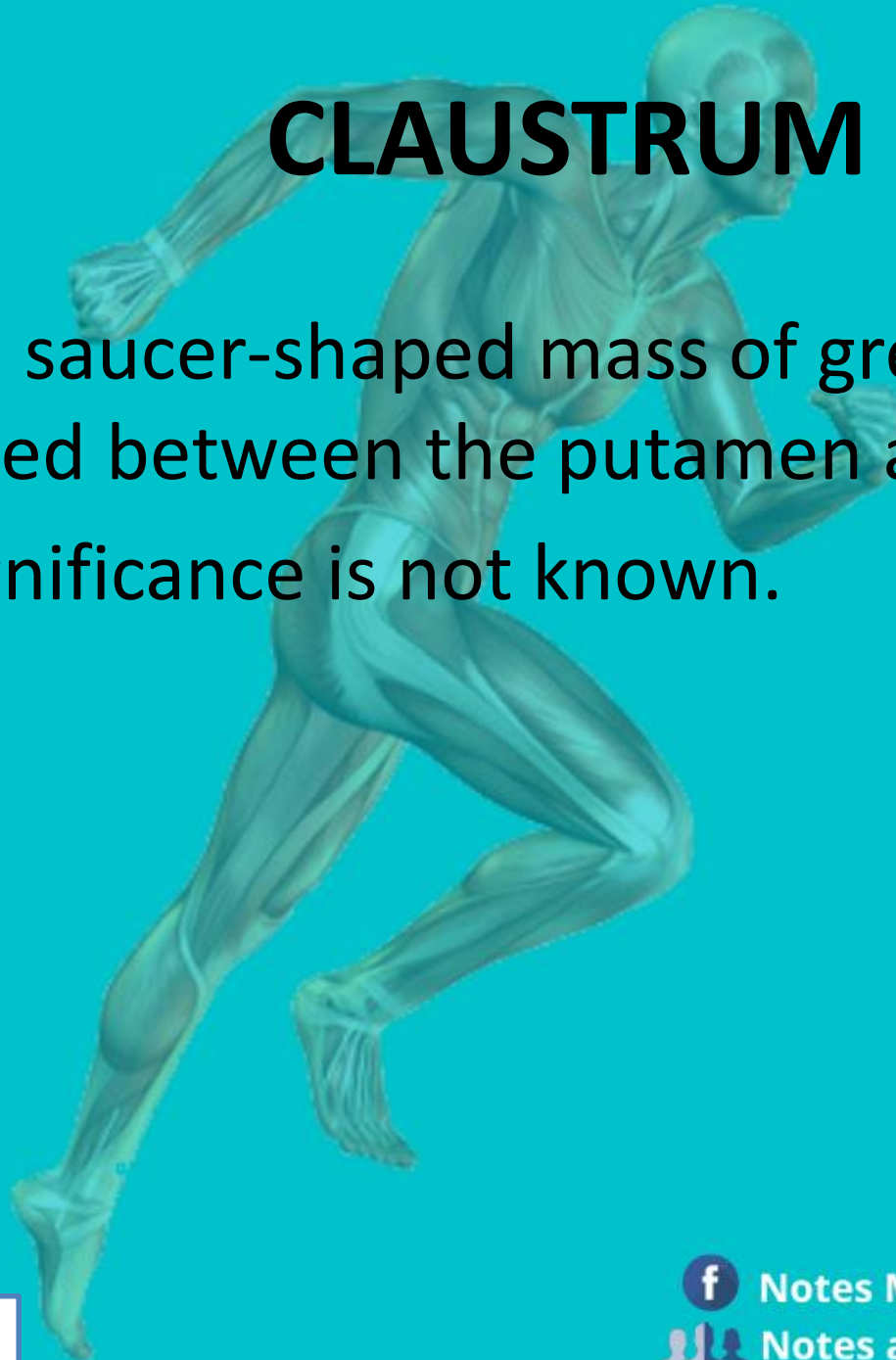
A = Amygdala

Po = Pons



# CLAUSTRUM

- a thin saucer-shaped mass of grey matter situated between the putamen and insula.
- Its significance is not known.



# Amygdaloid body (amygdala)

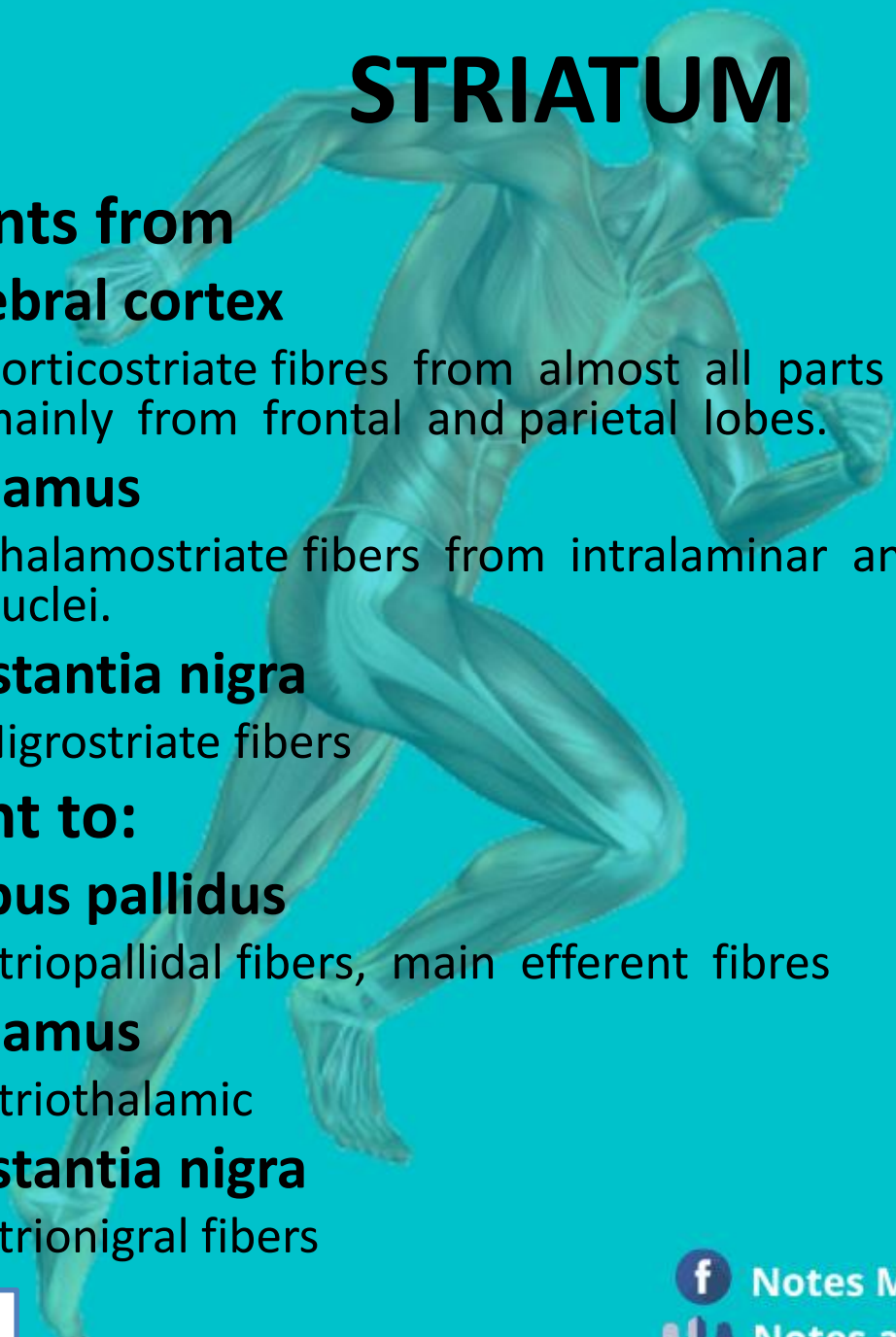
- An almond-shaped mass of grey matter in the temporal lobe,
- lying anterosuperior to the tip of inferior horn of lateral ventricle.
- Situated deep to uncus, which serves as a surface landmark for its location.
- The fibres arising from amygdaloid body form stria terminalis, which follow the inner curve of the caudate nucleus and terminate into septal area, anterior perforated substance, and anterior hypothalamic nuclei.
- The stria terminalis is the main efferent tract of the amygdaloid body.

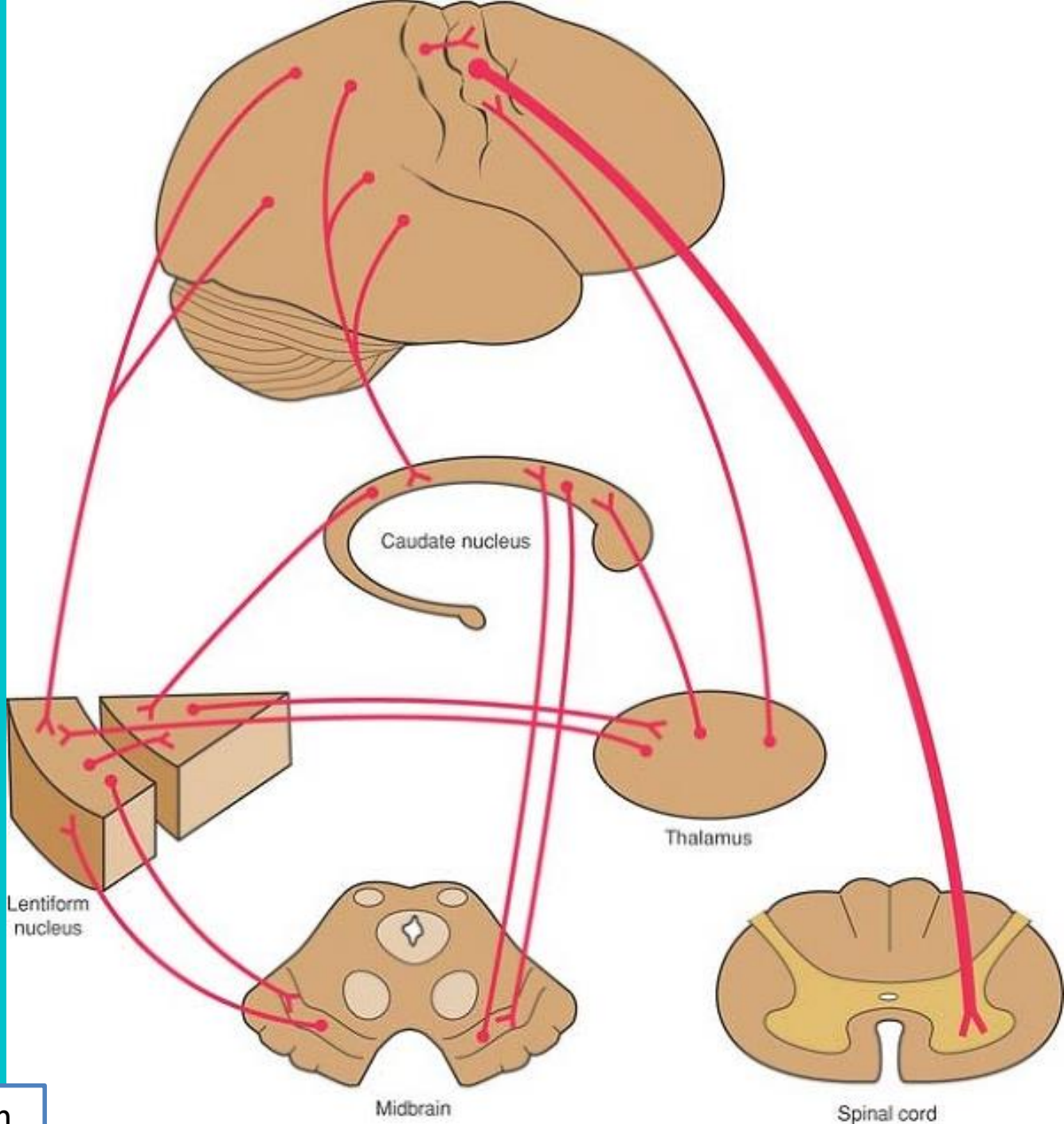
# CONNECTIONS OF CORPUS STRIATUM

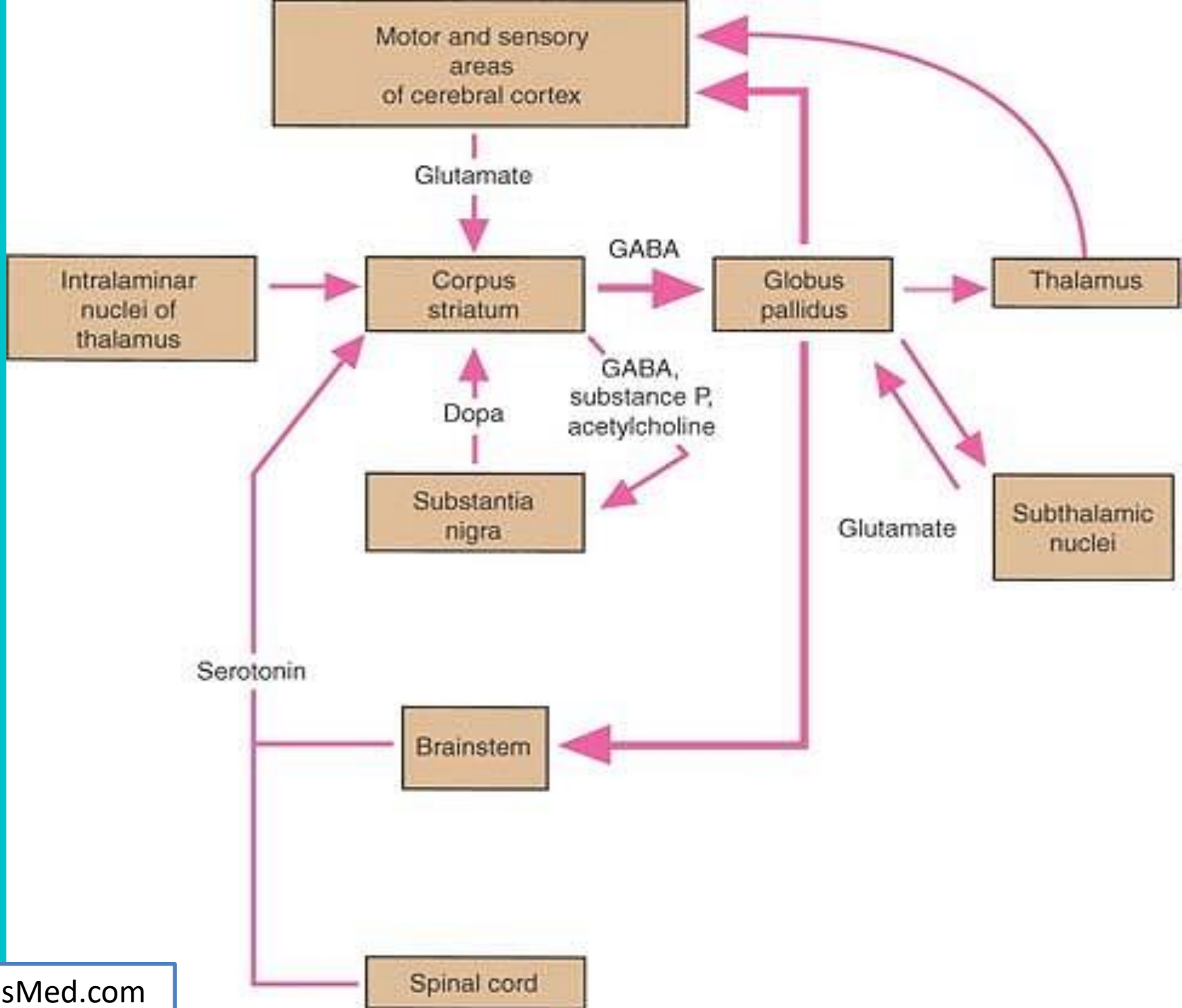
- Regarded as an important integrating centre playing an important role in the motor activities.
- **Striatum** (caudate nucleus and putamen)—mainly afferent fibers
- **Globus pallidus**-Efferent fibers.

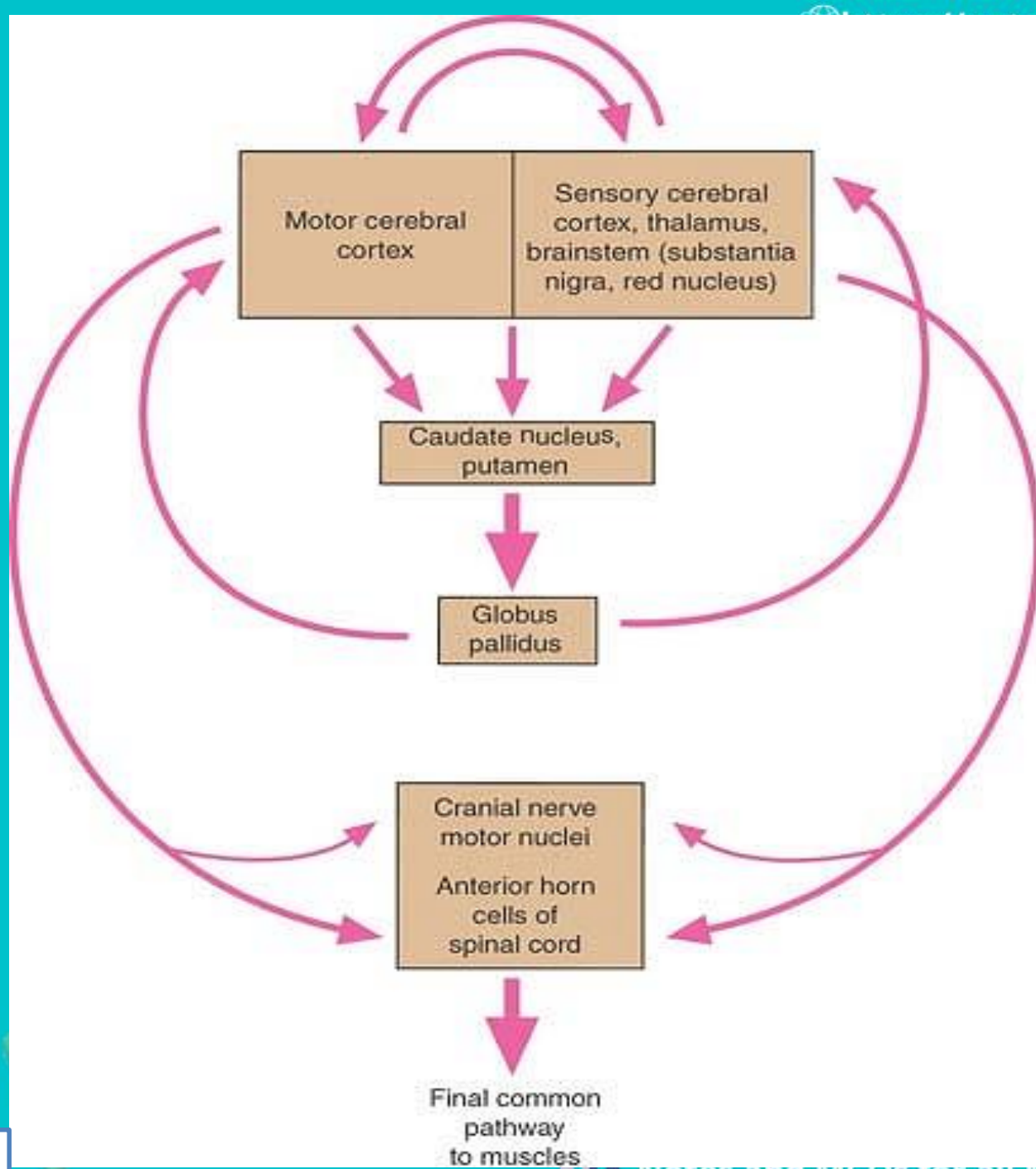
# STRIATUM

- **Afferents from**
  - **Cerebral cortex**
    - Corticostriate fibres from almost all parts of cerebral cortex; mainly from frontal and parietal lobes.
  - **Thalamus**
    - Thalamostriate fibers from intralaminar and medial thalamic nuclei.
  - **Substantia nigra**
    - Nigrostriate fibers
- **Efferent to:**
  - **Globus pallidus**
    - Striopallidal fibers, main efferent fibres
  - **Thalamus**
    - Striothalamic
  - **Substantia nigra**
    - Strionigral fibers





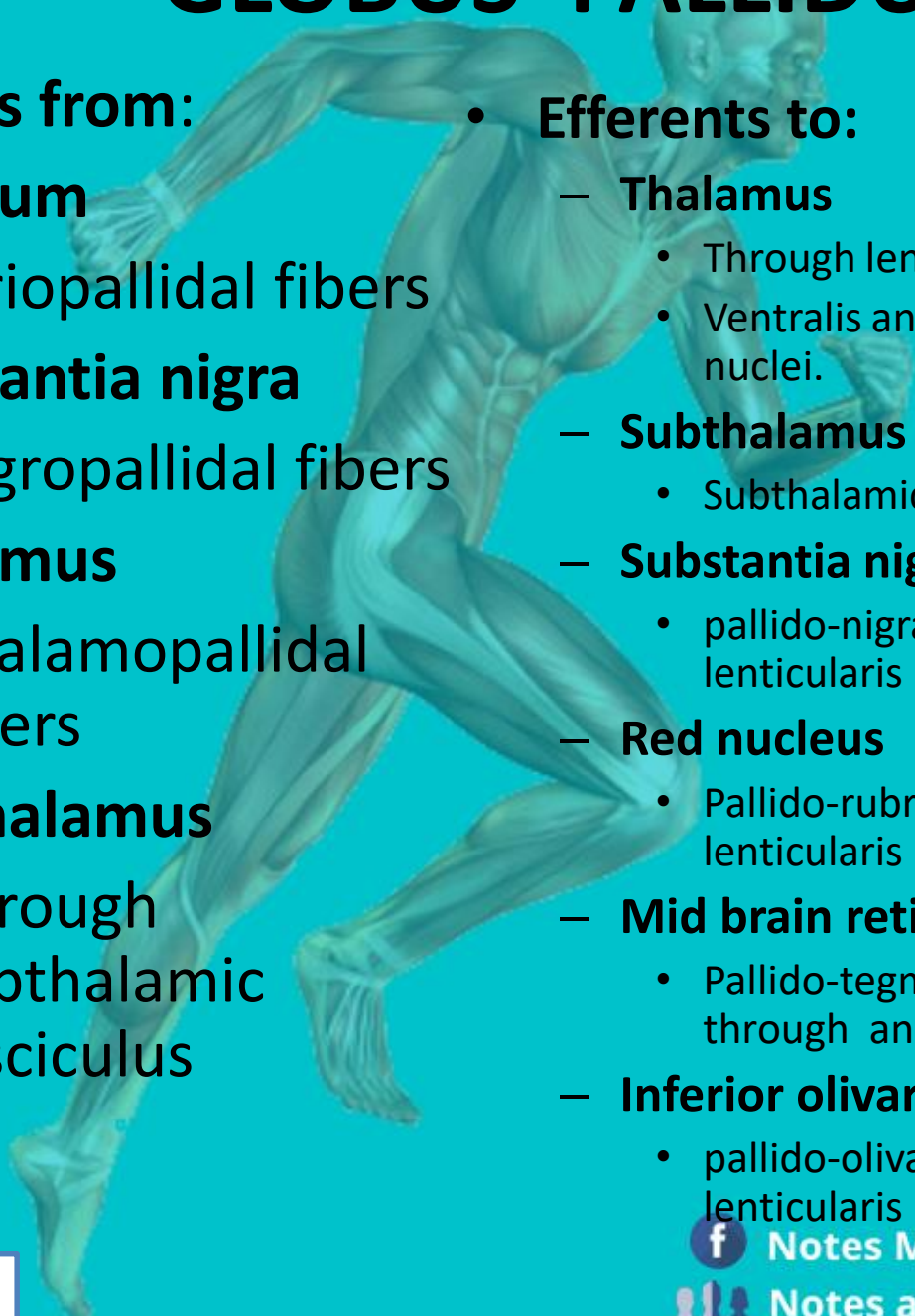


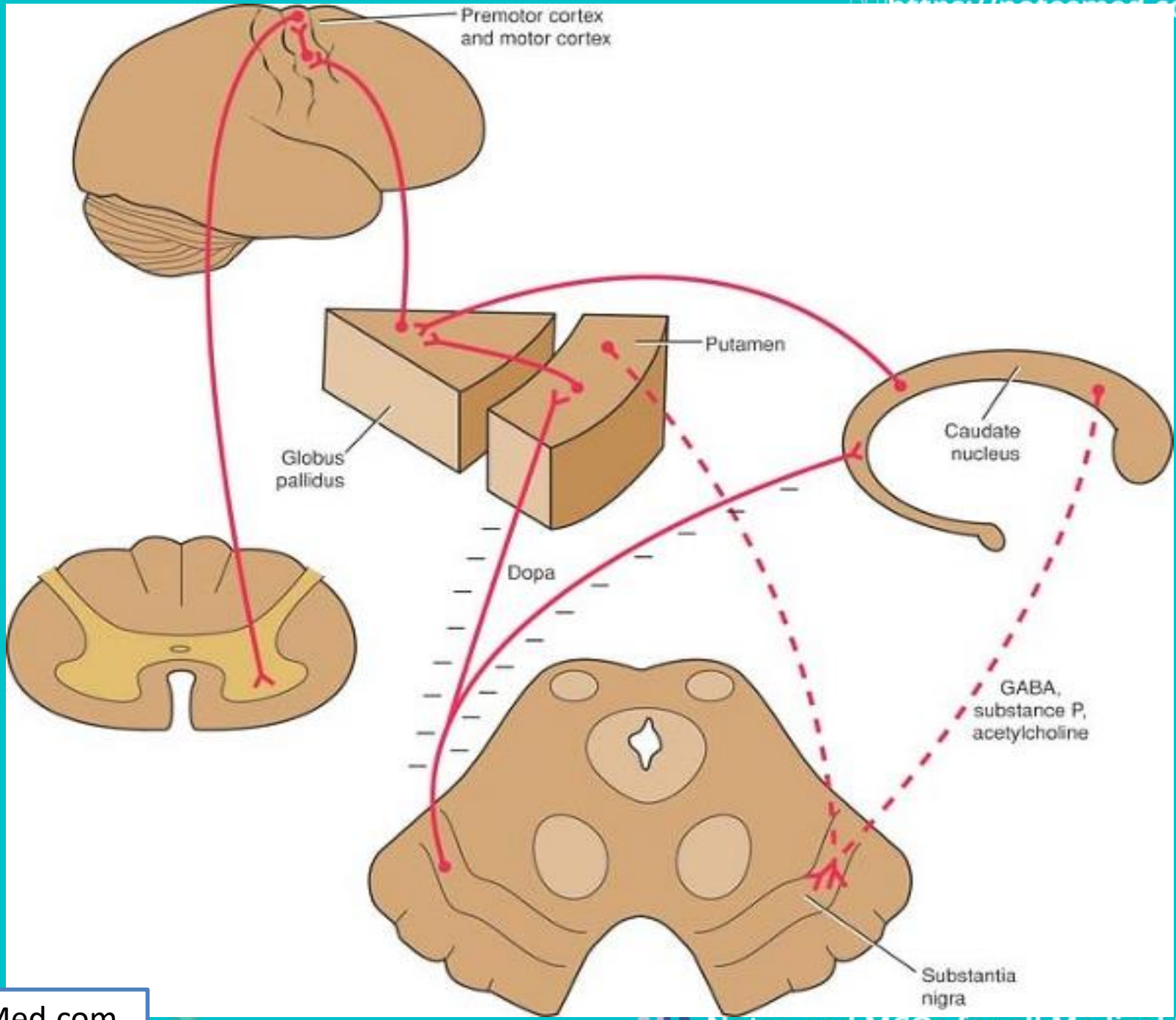


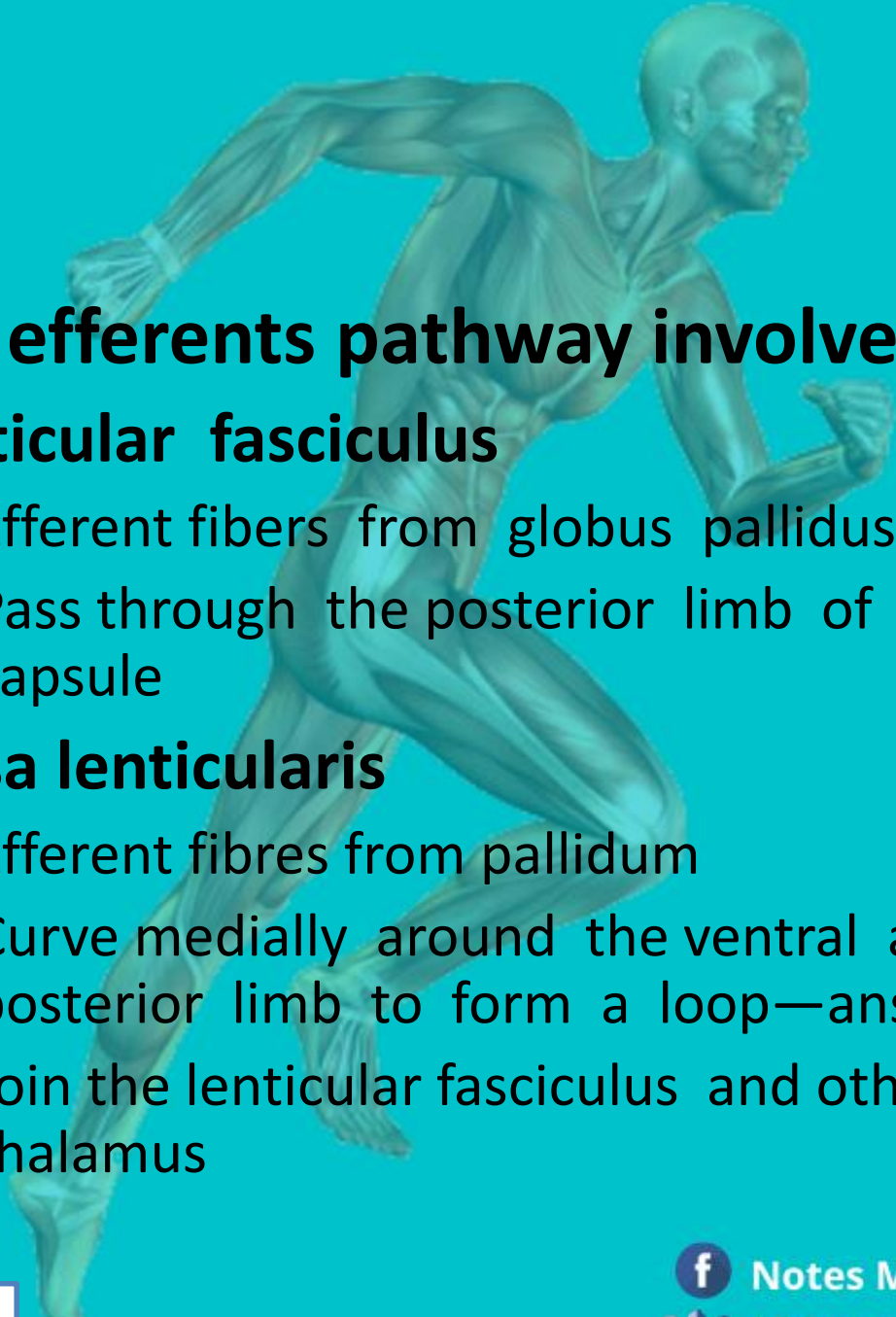
# GLOBUS PALLIDUS

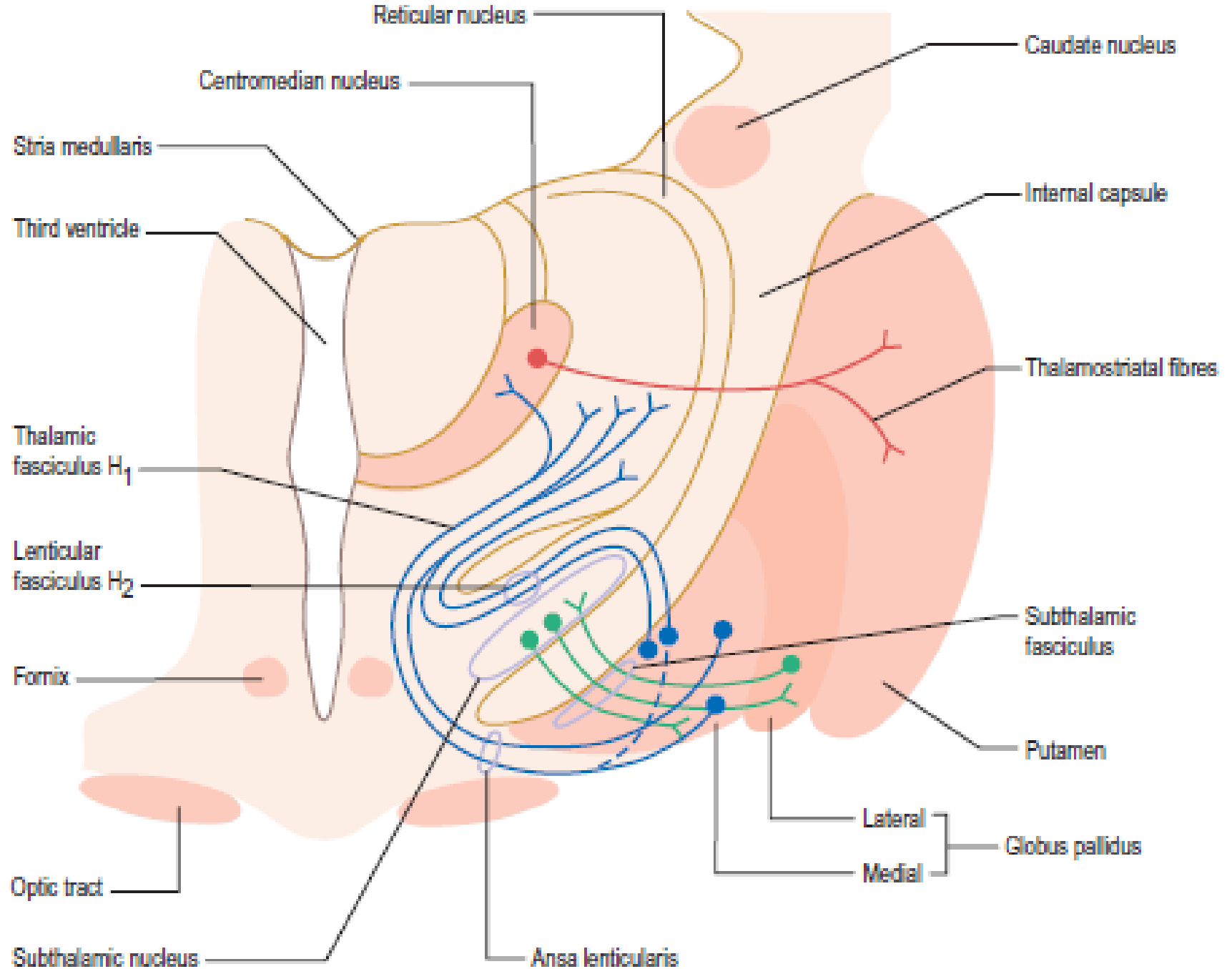


- **Afferents from:**
  - **Striatum**
    - Striopallidal fibers
  - **Substantia nigra**
    - Nigropallidal fibers
  - **Thalamus**
    - Thalamopallidal fibers
  - **Subthalamus**
    - Through subthalamic fasciculus
- **Efferents to:**
  - **Thalamus**
    - Through lenticular fasciculus
    - Ventralis anterior and ventralis lateral nuclei.
  - **Subthalamus**
    - Subthalamic fasciculus
  - **Substantia nigra**
    - pallido-nigral fibers through the ansa lenticularis
  - **Red nucleus**
    - Pallido-rubral fibers through the ansa lenticularis
  - **Mid brain reticular formation**
    - Pallido-tegmental (pallido-reticular) fibers through ansa lenticularis
  - **Inferior olivary nucleus**
    - pallido-olivary fibers through ansa lenticularis

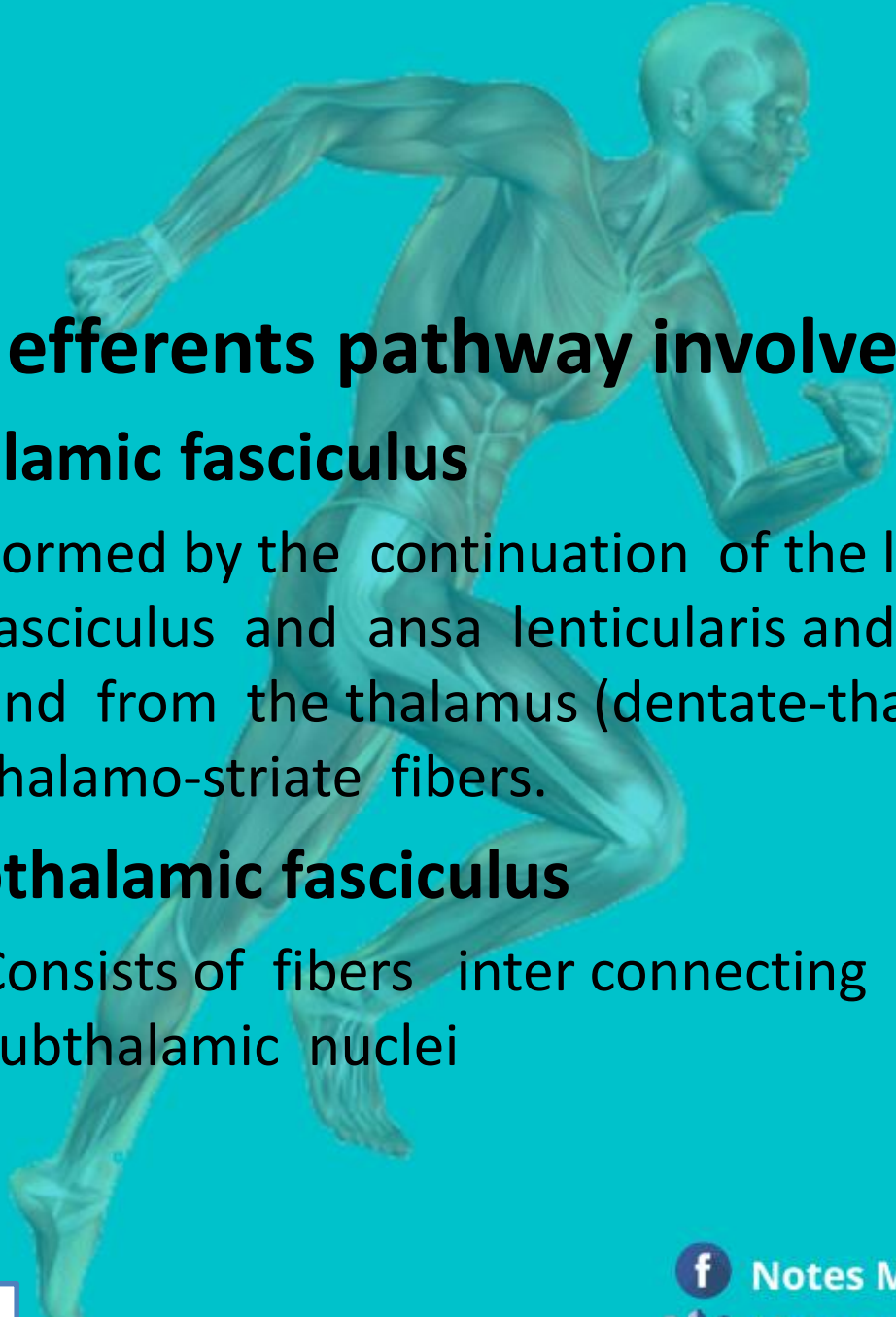




- 
- **Main efferents pathway involved are:**
    - **lenticular fasciculus**
      - Efferent fibers from globus pallidus
      - Pass through the posterior limb of the internal capsule
    - **Ansa lenticularis**
      - Efferent fibres from pallidum
      - Curve medially around the ventral aspect of the posterior limb to form a loop—ansa lenticularis
      - Join the lenticular fasciculus and other tracts of thalamus



**Fig. 14.12** Major interconnections of the basal ganglia.

- 
- **Main efferents pathway involved are:**
    - **Thalamic fasciculus**
      - Formed by the continuation of the lenticular fasciculus and ansa lenticularis and other tracts to and from the thalamus (dentate-thalamic and thalamo-striate fibers).
    - **Subthalamic fasciculus**
      - Consists of fibers inter connecting the pallidum and subthalamic nuclei

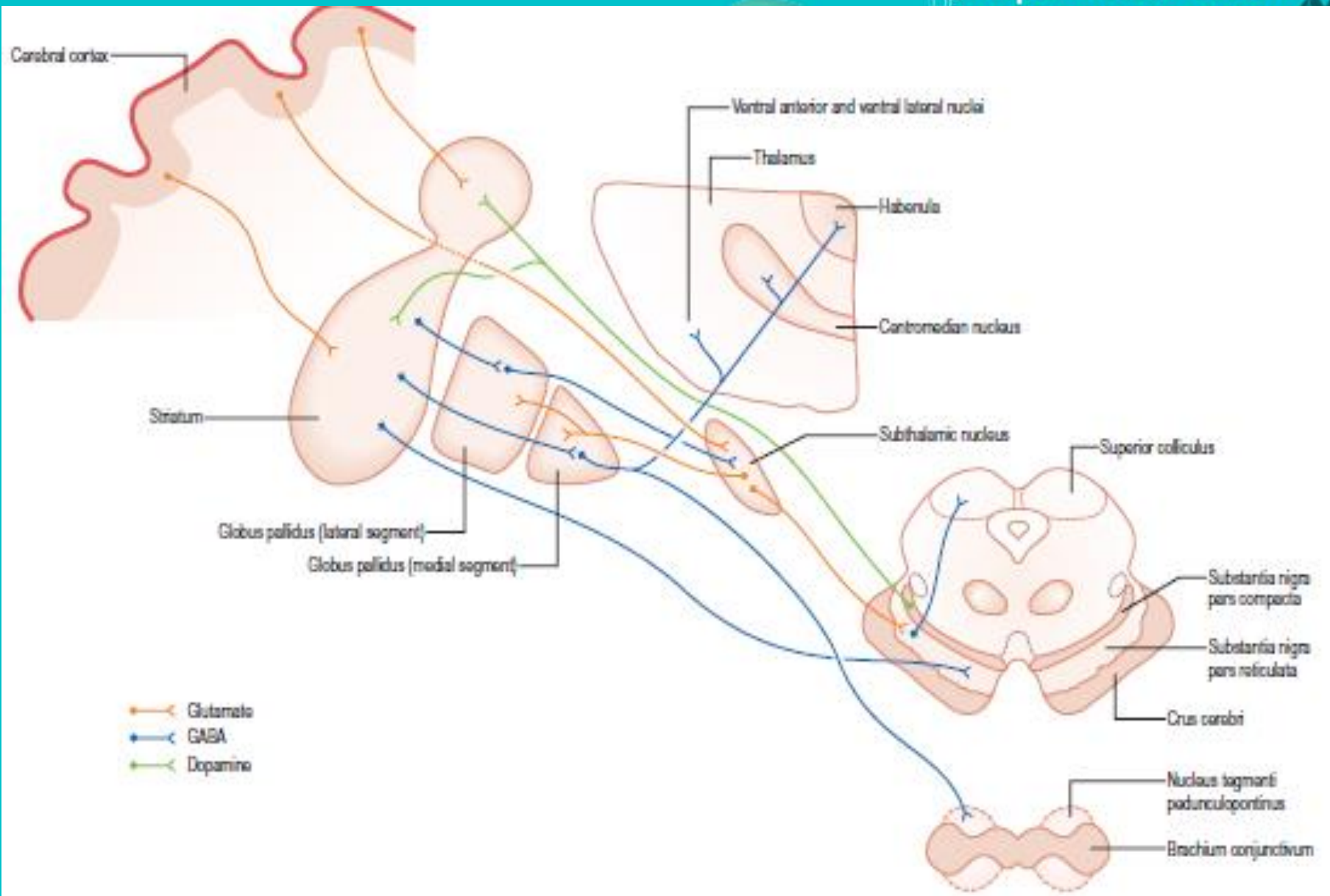
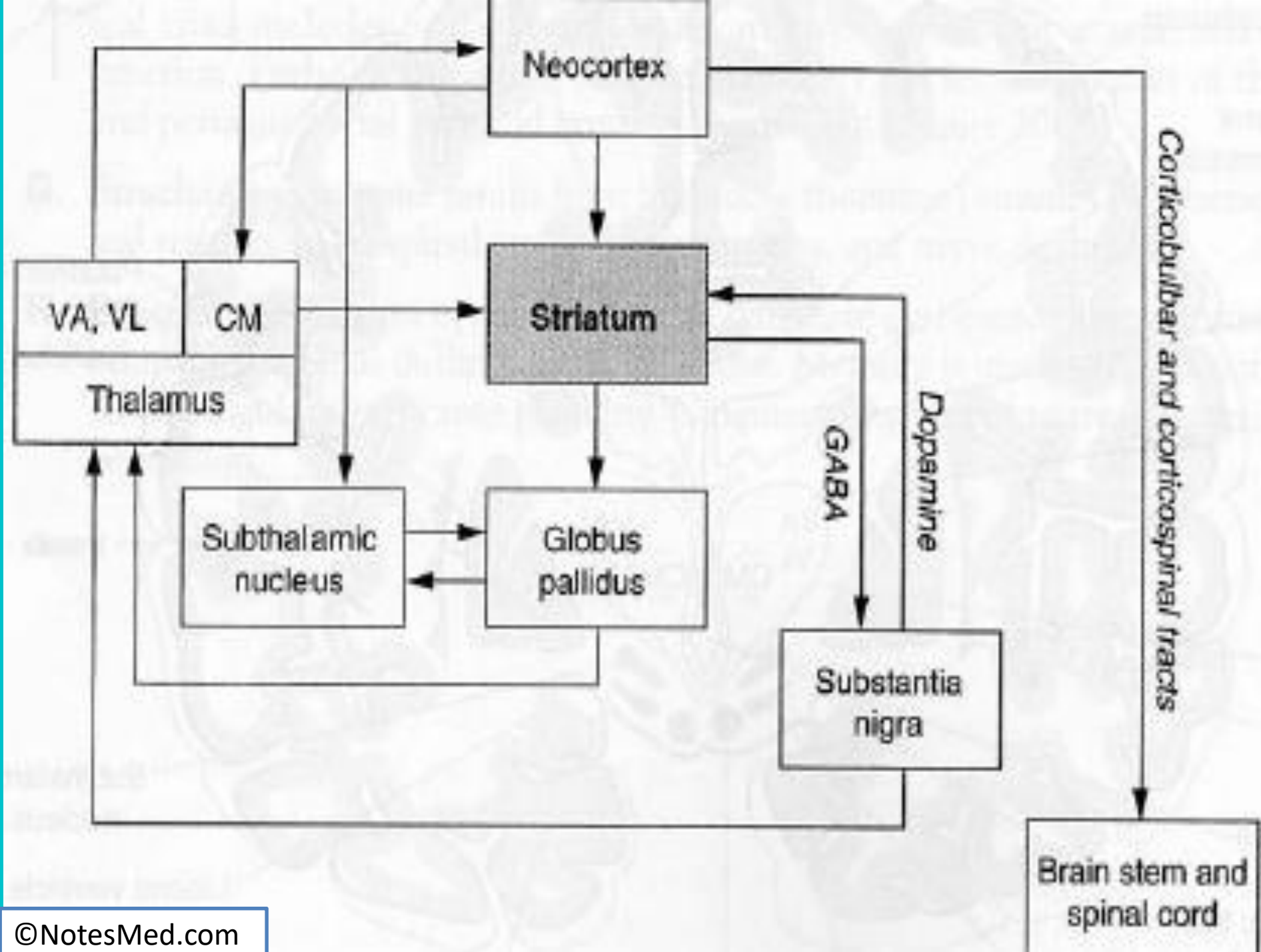
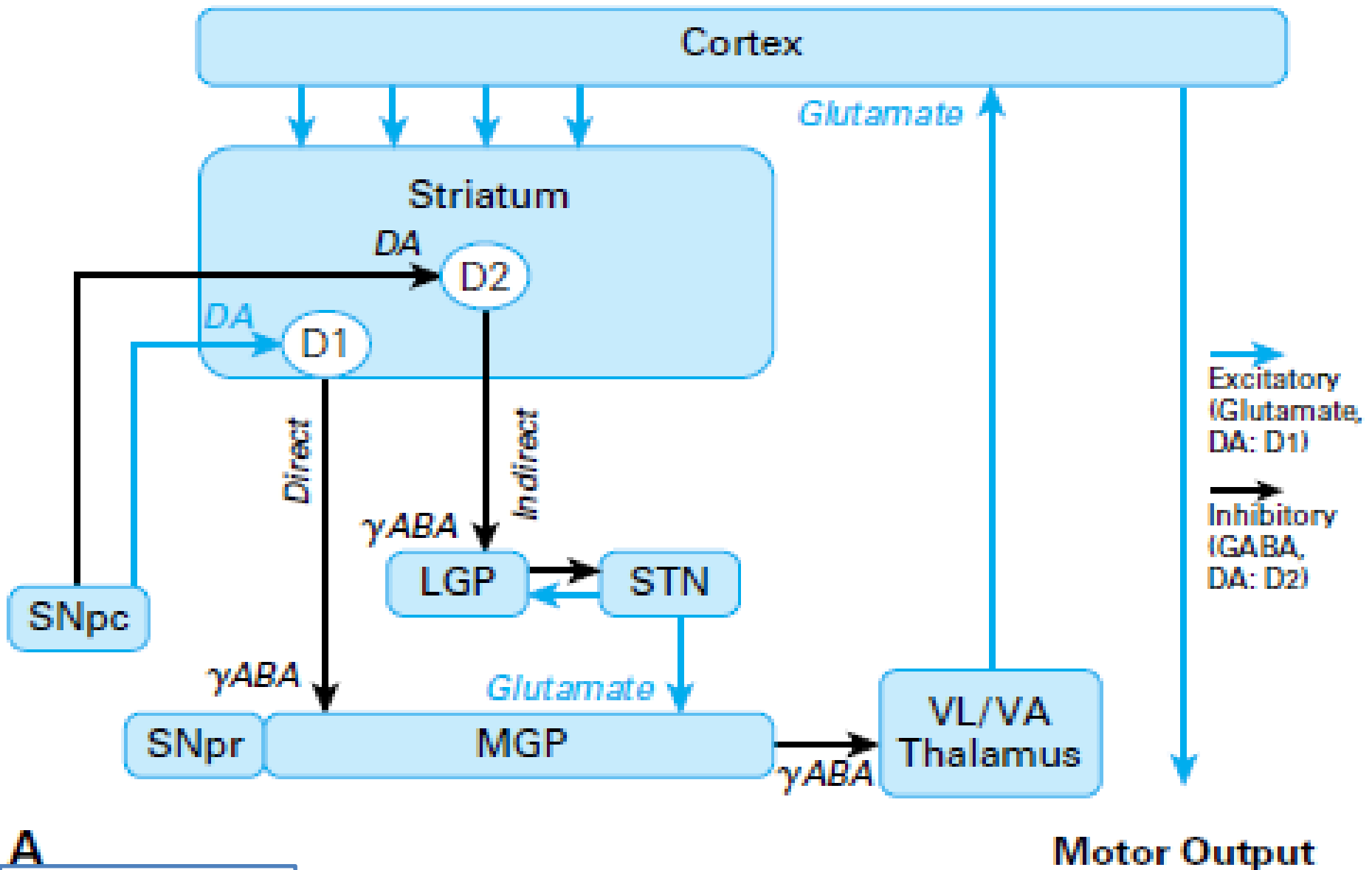


Fig. 14.14 Transverse section through the basal ganglia showing the principal connections of the globus pallidus with the thalamus and subthalamic nucleus.



# Normal Functional Anatomy of Motor Cortex Basal Ganglia and Thalamus



A

# Functions of the basal ganglia

- Planning and Initiation of movements.
- Controlling complex patterns of motor activities- **function of putamen circuit.**  
Executes skilled motor activities like cutting paper with a scissor, hammering on nail, shooting a basket ball.
- Cognitive control of sequence of motor patterns **function of caudate circuit.**
- Timing and scaling of the movement.

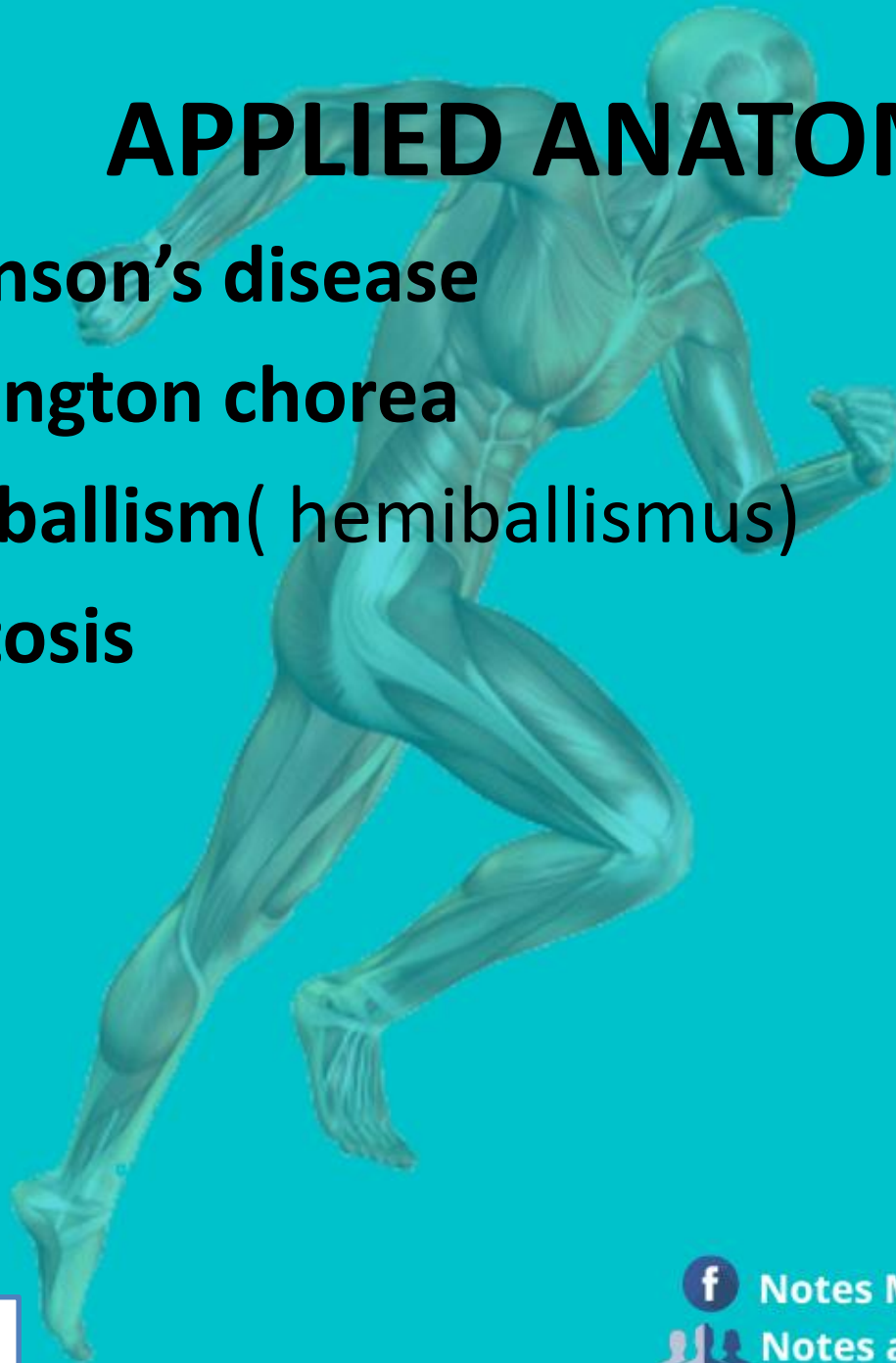
# Functions of the basal ganglia

- Regulation of muscle tone
- Initiation of movements generated by internal cues such as scratching, moving the hands over the face, facial expression etc.
- It suppresses unwanted actions which might interfere with a desired movement whilst amplifying and facilitating those processes which contribute towards desired movement



# APPLIED ANATOMY

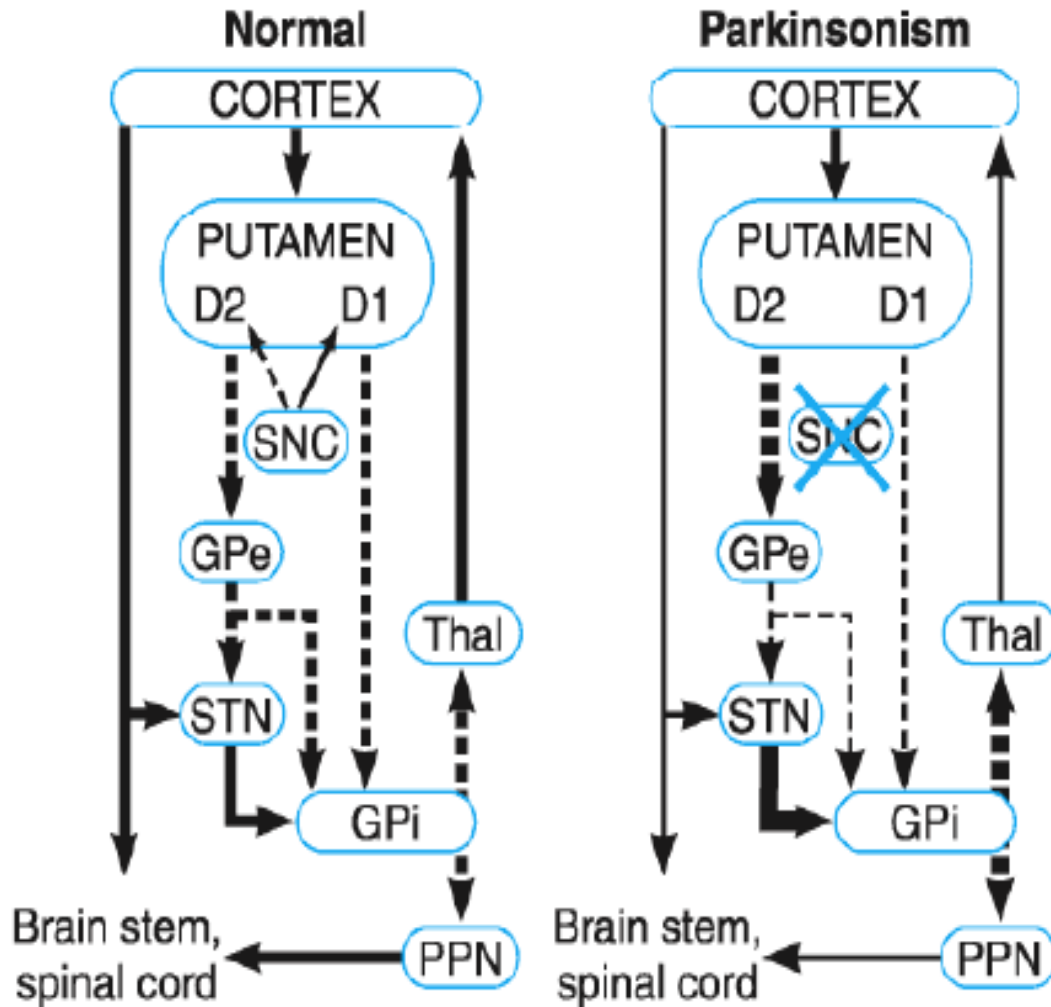
- **Parkinson's disease**
- **Huntington chorea**
- **Hemiballism( hemiballismus)**
- **Athetosis**



# Parkinson's disease

- Resting tremor-
  - Rigidity affects all somatic musculature
  - predilection to the flexure-stooped posture
  - Lead pipe rigidity or cogwheel type of muscular rigidity
  - Bradykinesia
  - Pin rolling movements of fingers.
  - Mask-like face or loss of facial expression

# Pathogenesis of Parkinsonism



Solid lines- excitatory  
Dashed lines-inhibitory

# Disorders of Basal Ganglia

## Parkinson's Disease

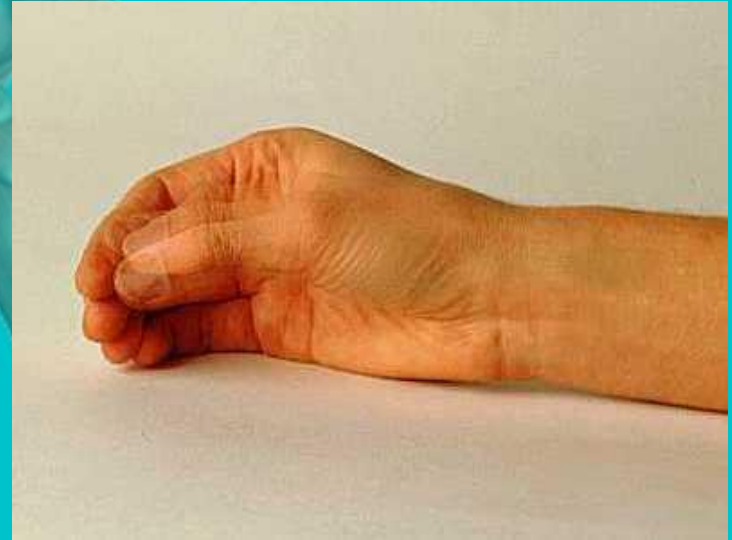
- Onset > 60 years
- Causes due to degeneration of substantia nigra
- Concentration of dopamine in nigrostriatal system is reduced.
- Drugs that blocks D2 dopamine receptors
- MPTP (methyl-phenyl-tetrahydropyridine) induced Parkinsonism.



# Parkinsonism

## Clinical Features:

1. Rigidity
2. Resting tremors
3. Akinesia or hypokinesia
4. Slow, monotonous speech
5. Mask-like face

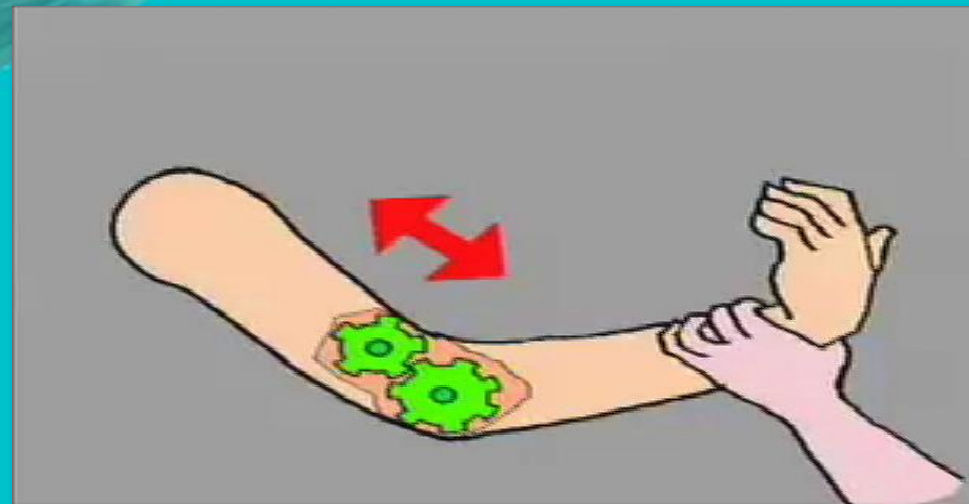
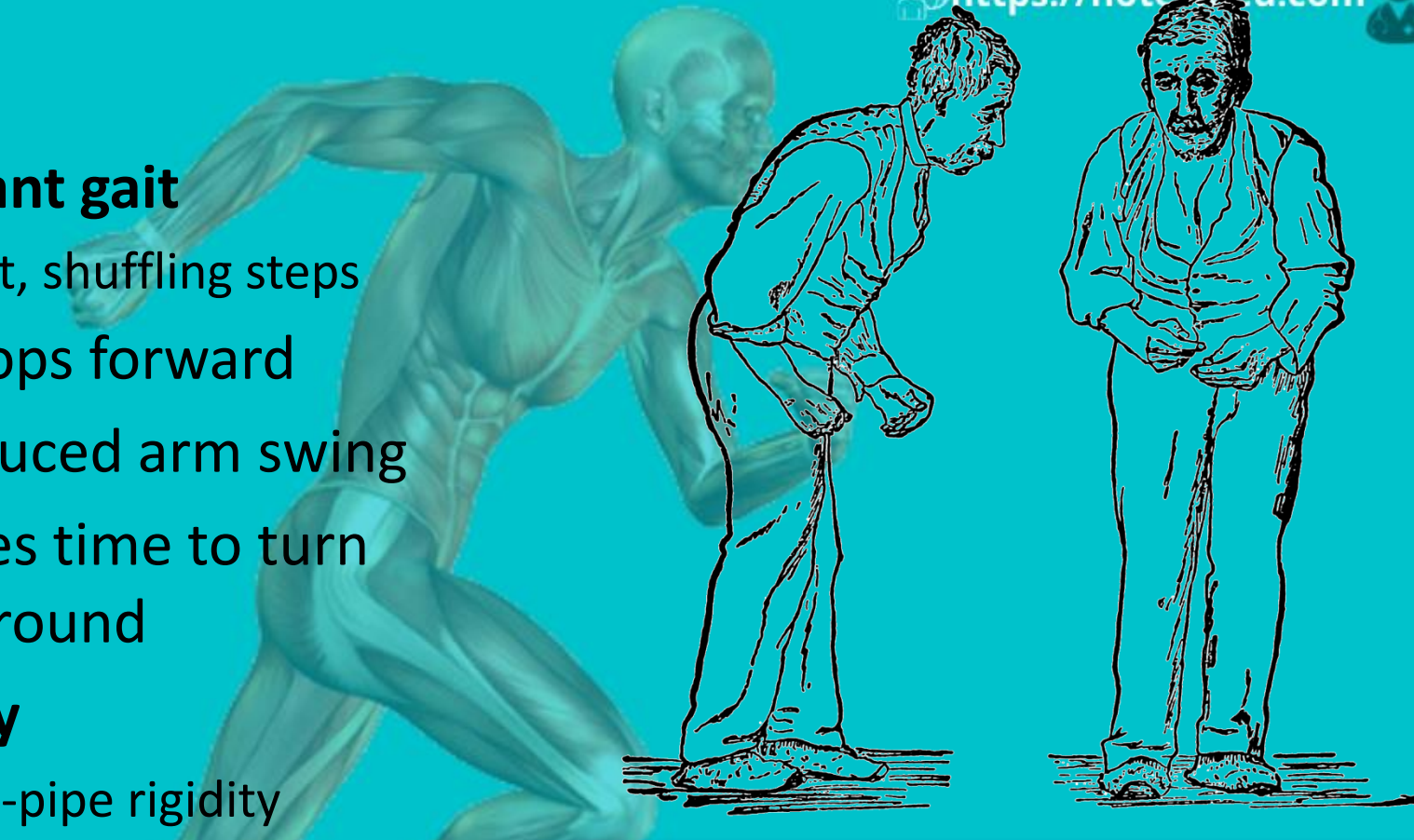


- **Festinant gait**

- Short, shuffling steps
- Stoops forward
- Reduced arm swing
- Takes time to turn around

- **Rigidity**

- Lead-pipe rigidity
- Cog-wheel rigidity



# Parkinson's disease: Treatment

1. Drug Therapy
  - L-DOPA
2. Surgical: Pallidotomy, thalamotomy.
3. Tissue transplants : adrenal medulla, carotid body, fetal striatal tissues



# Disorders of Basal Ganglia

## Huntington's Disease

- Hereditary disorder (Onset- 30-40s)
- Due to damage to GABAergic neurons in the caudate nucleus and putamen. Damage to this inhibitory pathway results in hyperkinetic features which include:
  - i) Hyperkinetic choreiform movements
  - ii) Slurred speech
  - iii) Progressive loss of memory



# Disorders of Basal Ganglia

## Athetosis and Hemiballism

- **Athetosis-**
  - Primarily due to lesion of globus pallidus.
  - Spontaneous and continuous writhing movements of a hand, arm, the neck or face.
- **Hemiballism:**
  - Due to damage of the subthalamic nucleus. Characterized by sudden flailing movements affecting whole of the opposite side of body