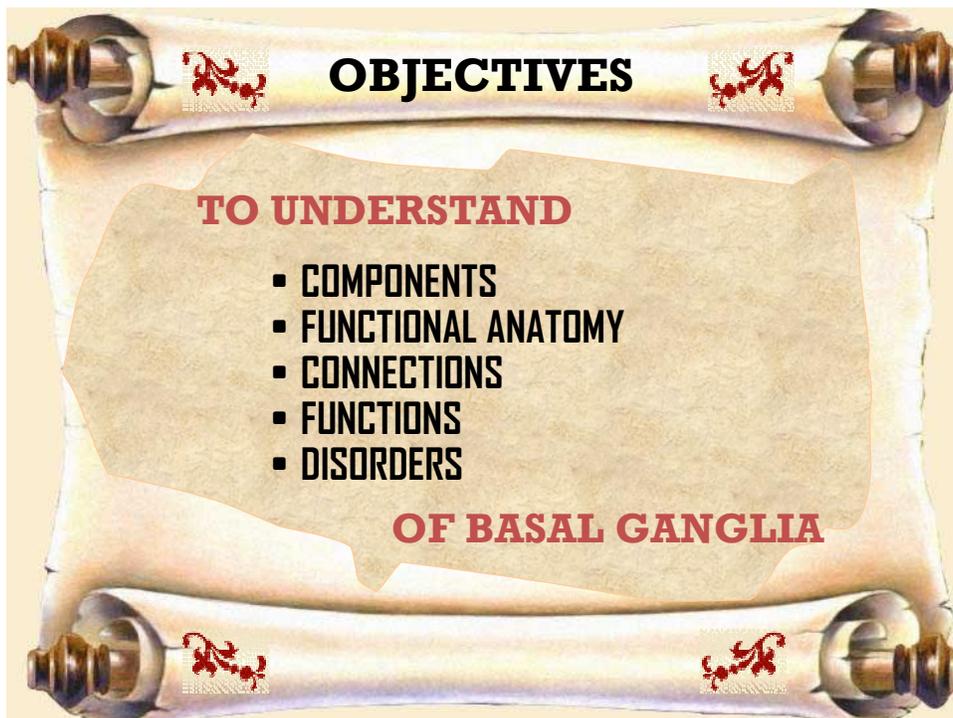


  
**BASAL GANGLIA AND CONTROL OF MOTOR  
FUNCTIONS**



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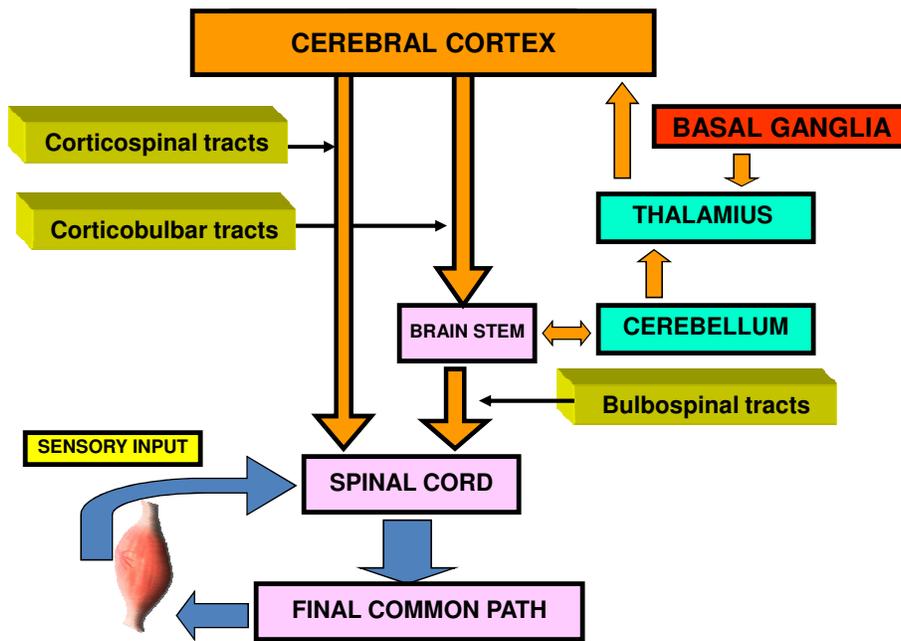


**OBJECTIVES**

**TO UNDERSTAND**

- COMPONENTS
- FUNCTIONAL ANATOMY
- CONNECTIONS
- FUNCTIONS
- DISORDERS

**OF BASAL GANGLIA**

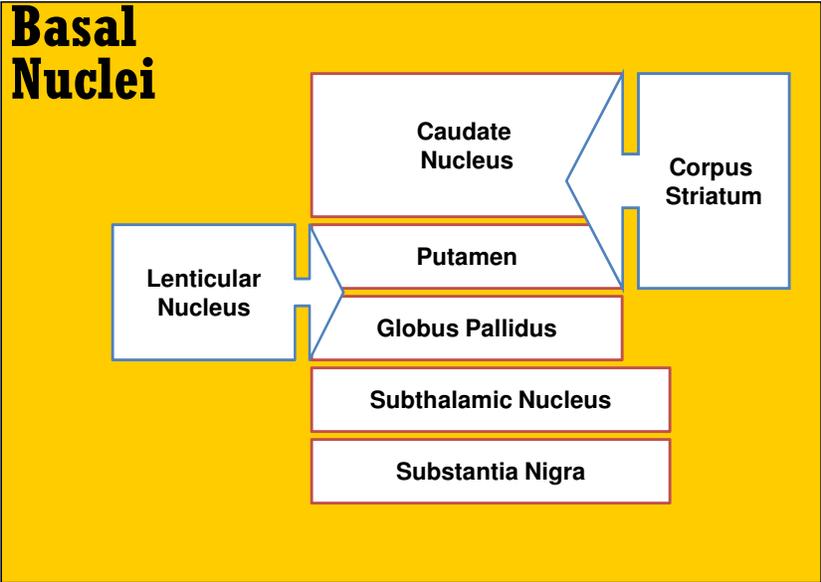


## BASAL GANGLIA

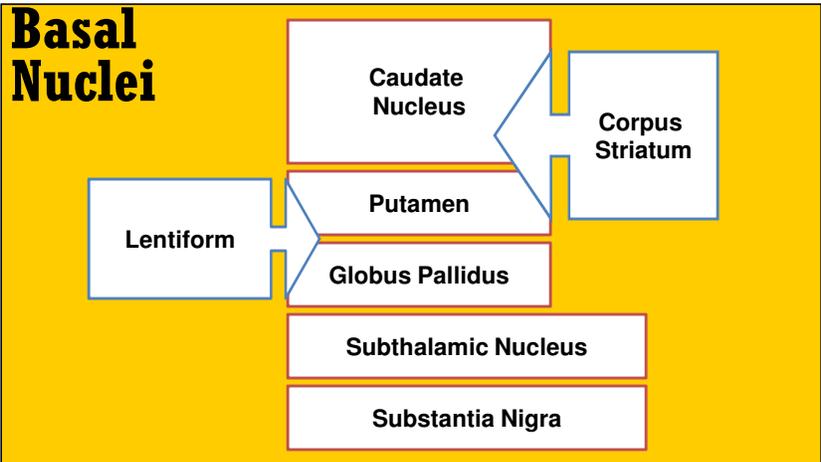
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THE BASAL GANGLIA ARE MASSES OF GREY MATTER MADE OF CELL BODIES LYING DEEP INSIDE THE WHITE MATTER OF THE CEREBRUM, AND MAKES UP PART OF THE MIDBRAIN.

An upper mass is called the caudate nucleus, is separated from a lower mass, the lentiform nucleus. The lentiform nucleus consists of the putamen and the globus pallidus. Other nuclei include the substantia nigra and subthalamic nucleus.



- ### 3 Connections to remember
- 1. Main input to the basal ganglia
  - 2. Main output from the basal ganglia
  - 3. Connections between parts of basal ganglia

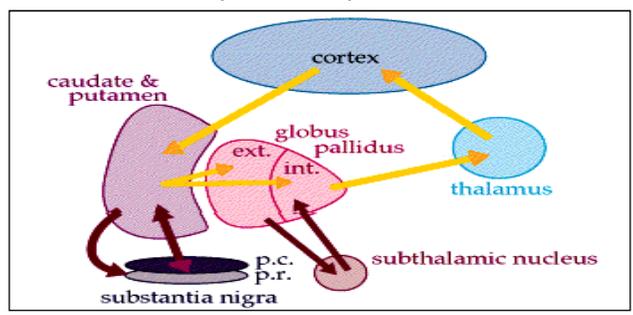


**MAIN INPUT TO THE BASAL GANGLIA**

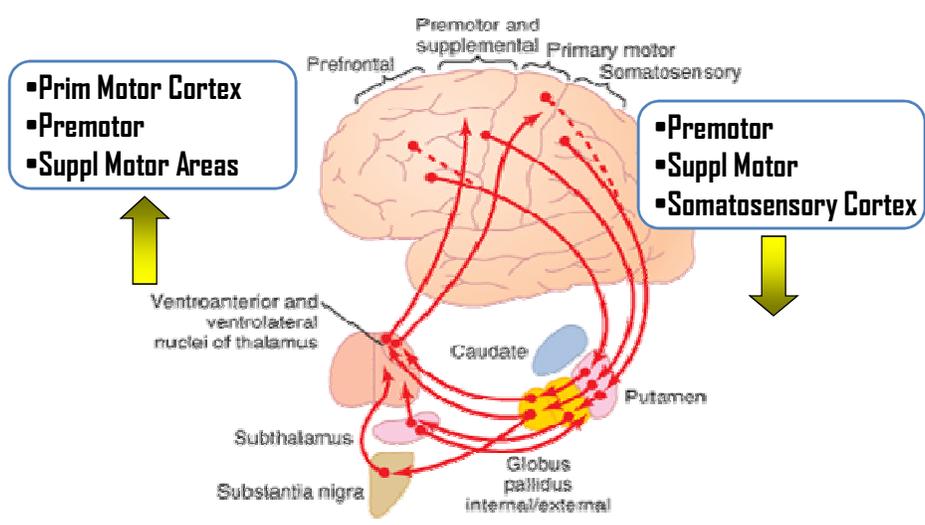
The comes from the cerebral cortex (motor area) and projects to the **NEOSTRIATUM** (a term for the caudate nucleus and putamen)

**THE MAIN OUTPUT**

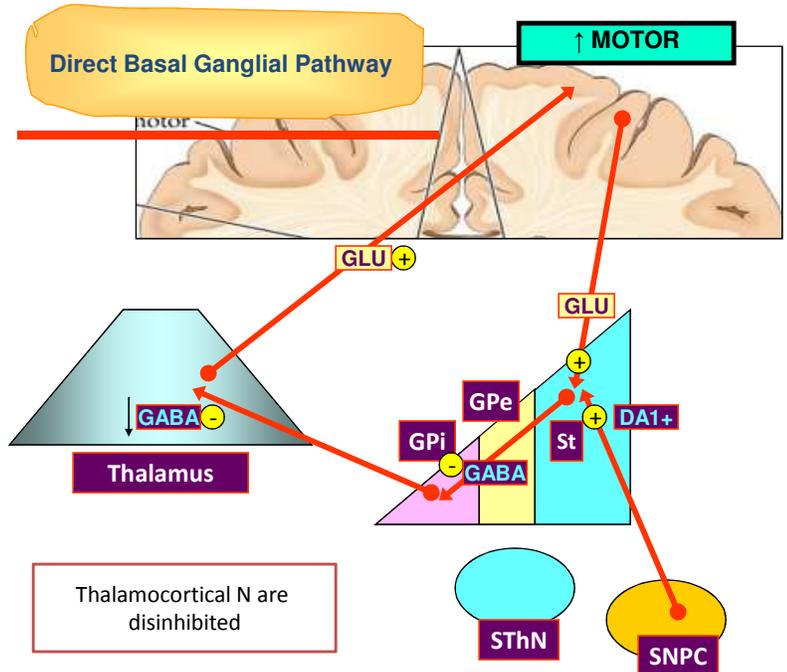
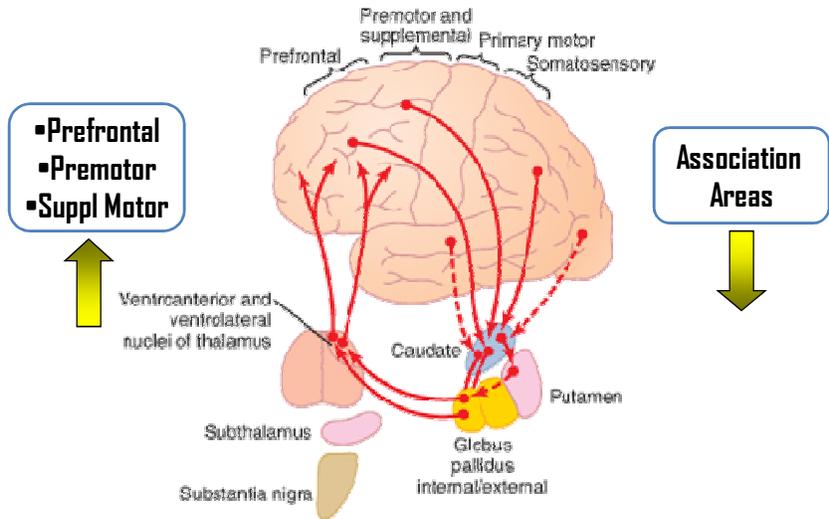
Is via the thalamus to the cerebral cortex (motor area)



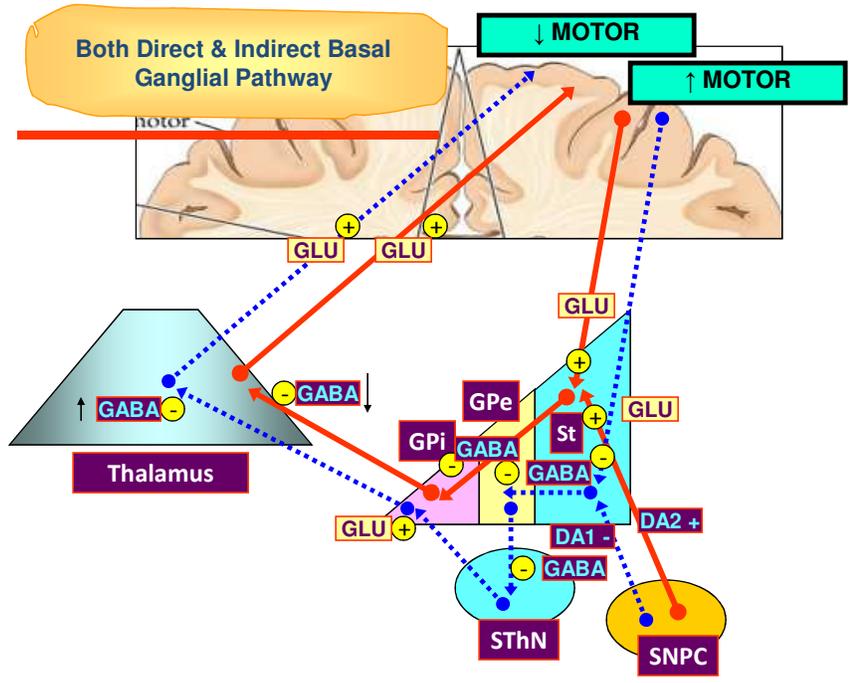
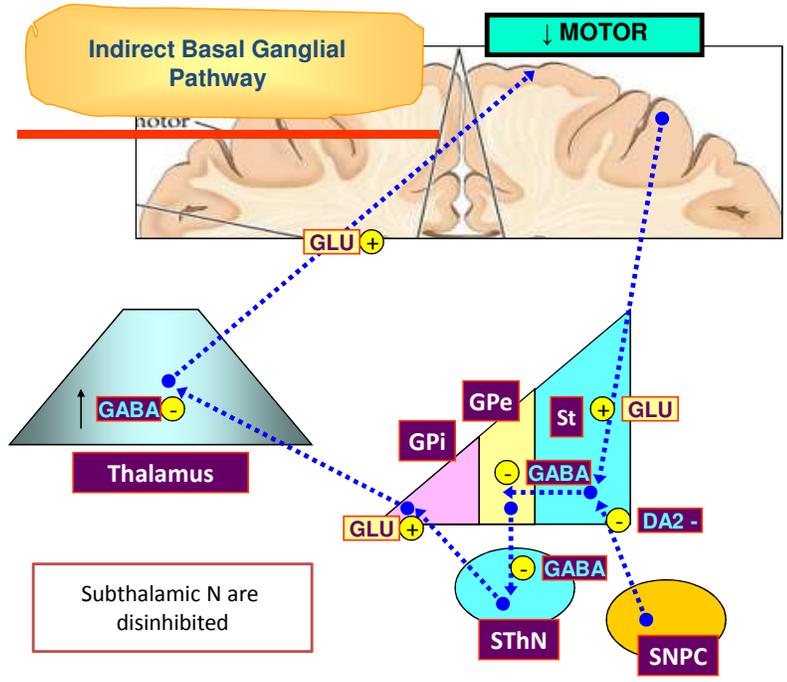
**The Putamen Circuit**



# The Caudate Circuit



BASAL GANGLIA



## Metabolic characteristics

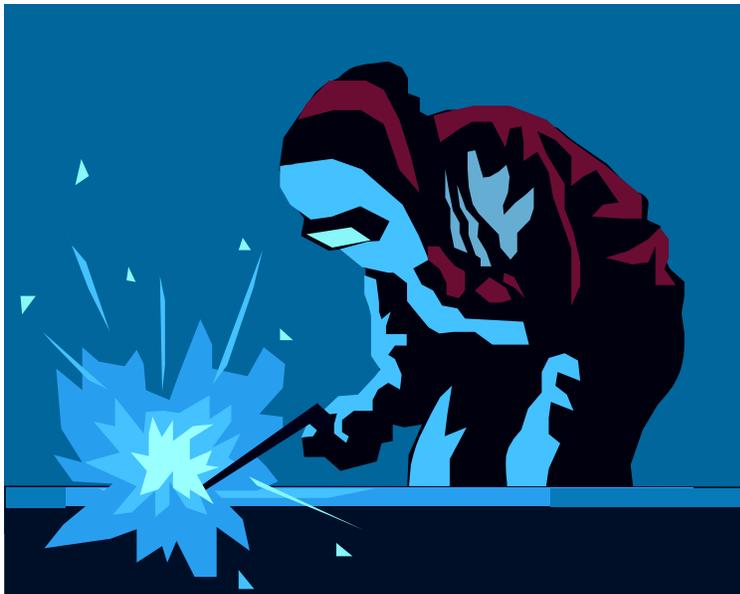
- High Oxygen consumption .
- High Copper content in **Wilson's disease** (Copper intoxication):
- Autosomal Recessive
- Copper binding protein **Ceruloplasmin** is low
- Lenticular degeneration occurs

## The Putamen Circuit

### Executes Patterns of Motor Activity

- Basal ganglia function in association with the corticospinal system to control *complex patterns of motor activity*.
- Examples are:
  - writing of letters of the alphabet.
  - cutting paper with scissors,
  - hammering nails,
  - shooting a basketball through a hoop,
  - passing a football,
  - throwing a baseball,
  - the movements of shoveling dirt,
  - most aspects of vocalization,
  - controlled movements of the eyes
  - virtually any other of our skilled movements, most of them performed subconsciously.







## The Caudate Circuit

### Cognitive Control of Sequences of Motor Patterns

- Cognition means the thinking processes of the brain, using both sensory input to the brain plus information already stored in memory. Thoughts are generated in the mind by a process called cognitive control of motor activity.
- Example: A person seeing a lion approach and then responding instantaneously and automatically by (1) turning away from the lion, (2) beginning to run, and (3) even attempting to climb a tree.
- Thus, cognitive control of motor activity determines subconsciously, and within seconds, which patterns of movement will be used together to achieve a complex goal



## The Caudate Circuit

### Change the Timing and to Scale the Intensity of Movements

- Two important capabilities of the brain in controlling movement are
  - (1) to determine how rapidly the movement is to be performed and
  - (2) to control how large the movement will be.
- For instance, a person may write the letter "a" slowly or rapidly. Also, he or she may write a small "a" on a piece of paper or a large "a" on a chalkboard. Regardless of the choice, the proportional characteristics of the letter remain nearly the same

## BASAL GANGLIA

### DISORDERS

MOVEMENTS (ATAXIA **Rate, Range, Force, Direction**)

SPEECH

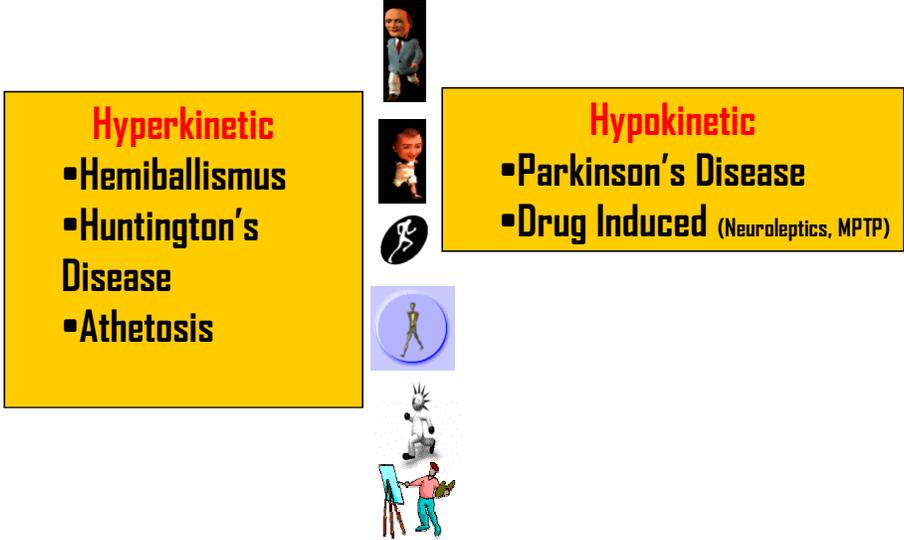
POSTURE

GAIT

MENTAL ACTIVITY

OTHERS

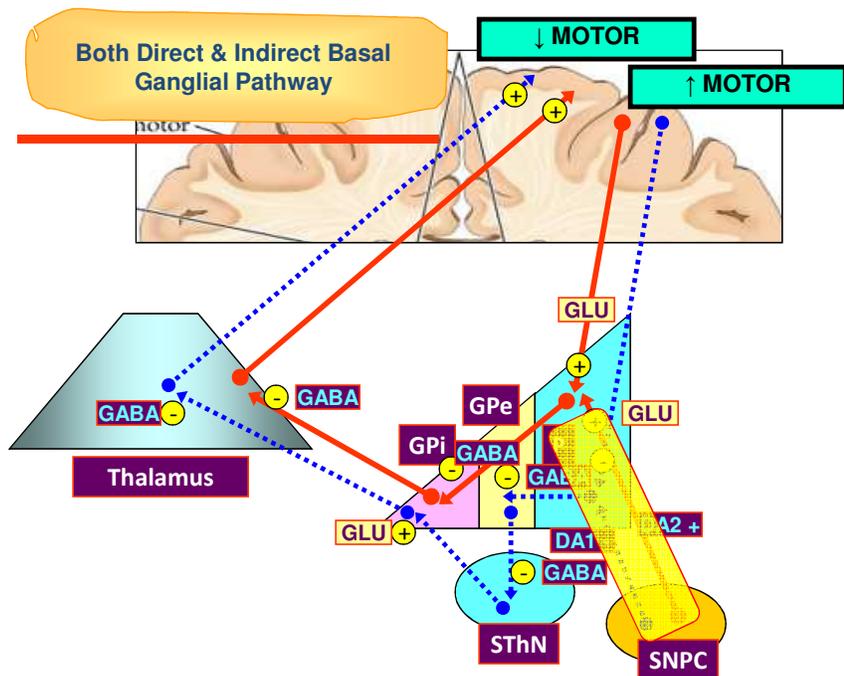
# Movement Disorders



Movement Disorder	Features	Lesion
Chorea	Multiole quick, random movements, usually most prominent in the appendicular muscles	Atrophy of the <b>striatum</b> . Huntington Chorea
Athetosis	Slow writhing movements, which are usually more severe in the appendicular muscles	Diffuse hypermyelination of <b>corpus striatum and thalamus</b>
Hemiballismus	Wild flinging movements of half of the body	Hemorrhagic destruction of contralateral <b>subthalamic n.</b> Hypertensive patients
Parkinsonism	Pill rolling tremor of the fingers at rest, lead pipe rigidity and akinesia	Degeneration of <b>Substantia Nigra</b>

# Parkinson's Disease

- Described by James Parkinson
- Degeneration of dopaminergic nigrostriatal neurons (60-80 %).
- Phentiazines(tranquilizers drugs) .
- Methyl-Phenyl-Tetrahydro-Pyridine (MPTP). The oxidant MPP+ is toxic to SN.
- Four cardinal symptoms
  - Tremor
  - Rigidity
  - Akinesia & Bradykinesia
  - Postural Changes
  - Speech Changes



## DYSARTHRIA

DISORDERED ARTICULATION

Slurred speech.

Language is intact, cf. aphasia.

Paralysis, slowing or incoordination of muscles of articulation or local discomfort causes various different patterns of dysarthria.

### Examples

- 'gravelly' speech of upper motor neurone lesions of lower cranial nerves,
  - jerky, ataxic speech of cerebellar lesions (Scanning Speech),
  - **the monotone of Parkinson's disease (Slurred)**
  - speech in myasthenia that fatigues and dies away
- Many aphasic patients are also somewhat dysarthric.

## PARKINSON'S DISEASE

RESTING TREMORS

RIGIDITY LEAD PIPE & COG WHEEL

MONOTONOUS SLURRED ANARTHRIA

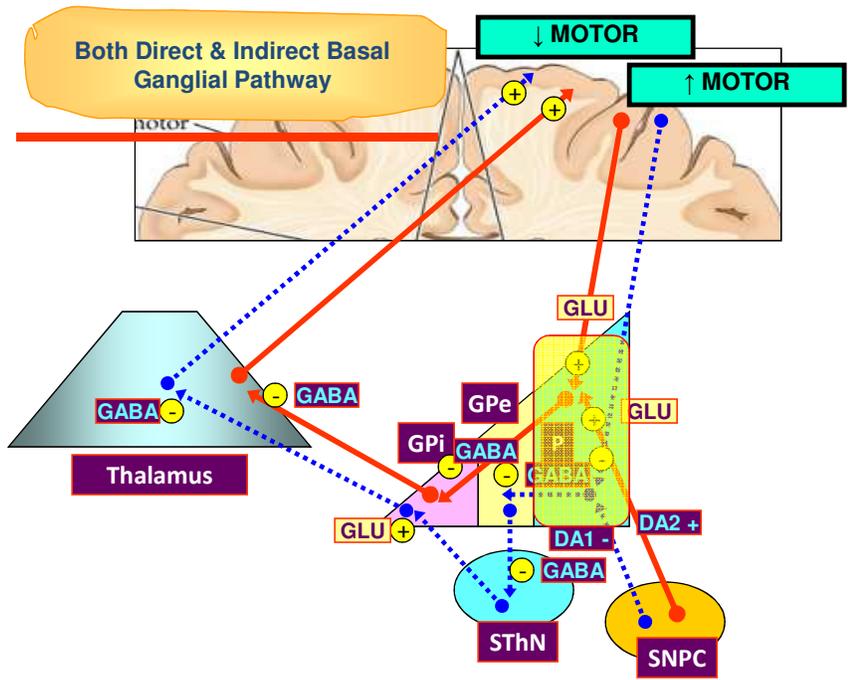
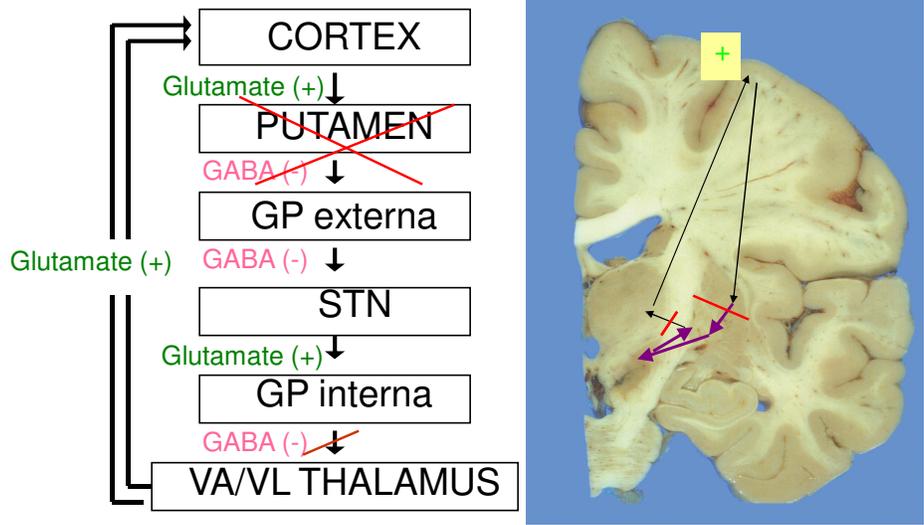
ABSENCE OF ASSOCIATED UNCONCIOUS MOVEMENTS (SWINGING OF ARMS DURING WALKING .

FACIAL EXPRESSION IS MASKED

SIMIAN POSTURE

SWEATING

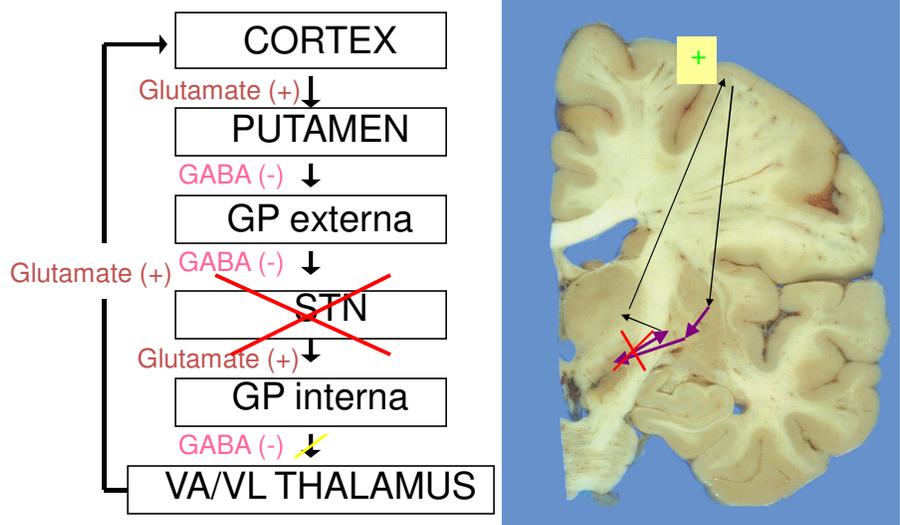
# Huntington's Disease

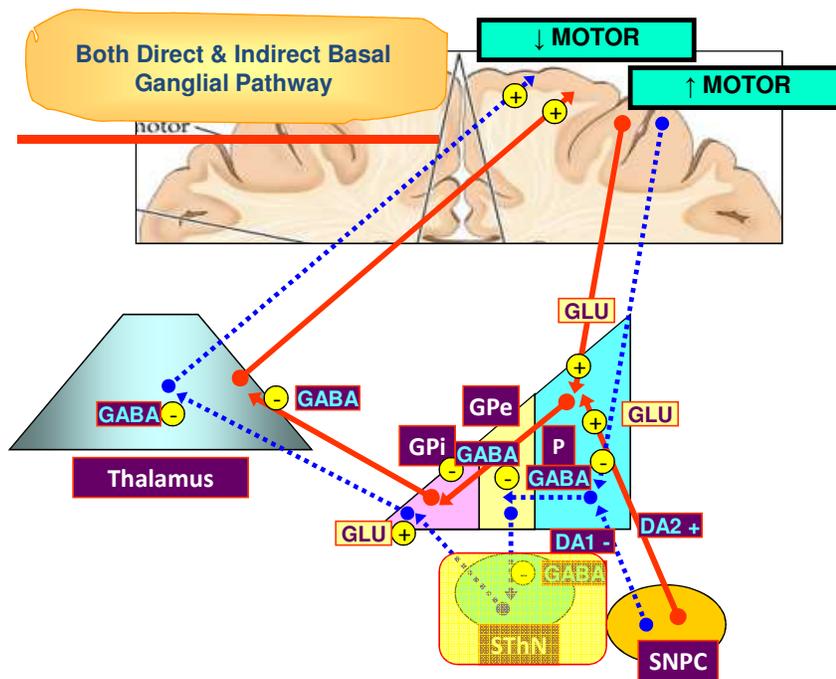


# Huntington's Disease

- Hereditary , autosomal dominant
- Rare onset at 30-40s as early as 20s
- Disease of caudate & putamen.
- Early, Jerky movement of hands toward end of reaching an object
- Later, hyperkinetic choreiform movements appear and gradually increase until they incapacitate the patient
- Slurred speech and incomprensive
- Progressive Dementia
- Loss of GABA nergic neurons

# Hemiballismus





## Hemiballismus

- Injury usually to STN
- Decreased inhibition (Indirect Pathway)
- Characterized by uncontrolled flinging
- TX: Dopamine Antagonist

