



Gaza Ophthalmic Centre

27.2.1 Basal Nuclei Part 2 Neurosciences I

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Motor Loops of the Basal Nuclei

- 3 functional motor loops:

1- Direct Motor Loop

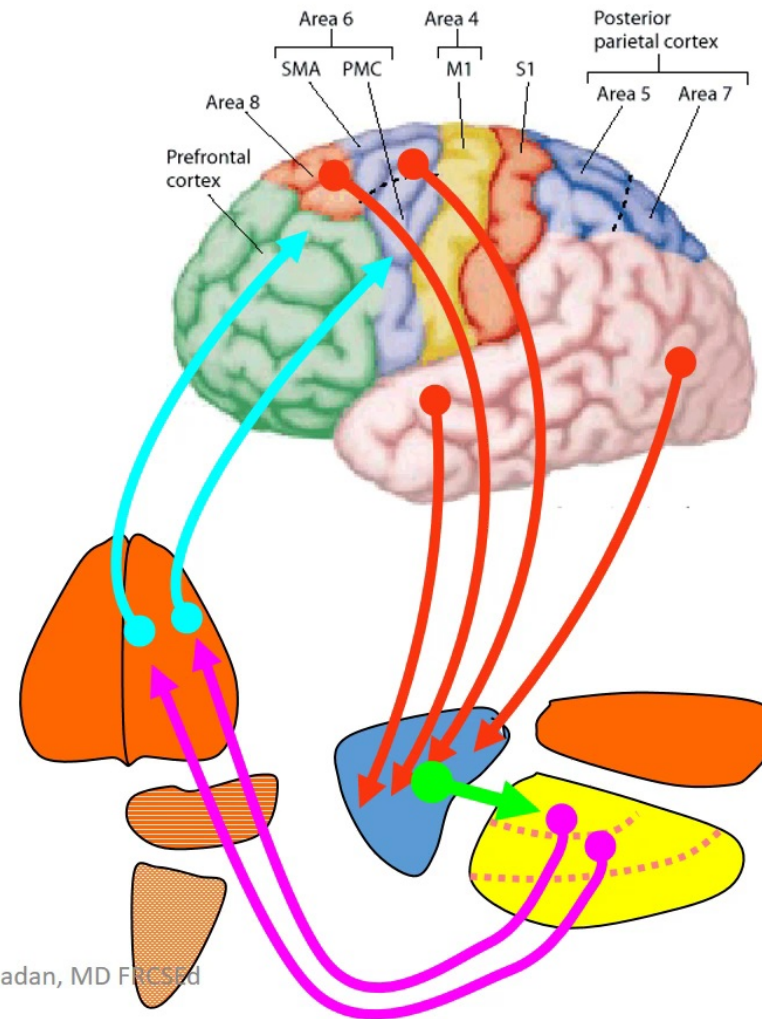
2- Indirect Motor Loop

3- Oculomotor Loop



The Caudate Circuit (Direct Loop)

- Association areas
 - → Caudate Nc
 - → Globus Pallidus
 - → VAN & VLN
- Thalamus
 - → Prefrontal
 - → Premotor
 - → Supplemental motor areas



I) Direct Motor Loop

- 5 neurons
- +
- Side Excitatory Projection
 - Dopaminergic
 - From Pars Compacta of Substantia Nigra
 - To D1 receptors in the Neostriatum



I) Direct Motor Loop

1- Cerebral Cortex →

- Cortico Striate
- (Excitatory)

2- Neostriatum →

- Striato Pallidal
- (inhibitory)

3- Globus Pallidus Interna

(spontaneous tonic inhibition of Thalamus)

→

- Ansa Lenticularis &
- Fasciculus Lenticularis



I) Direct Motor Loop

4- Thalamus VAN →

- Thalamo Cortical

5- Supplementary Motor Cortex →

- Cerebral Cortex
- 4&6

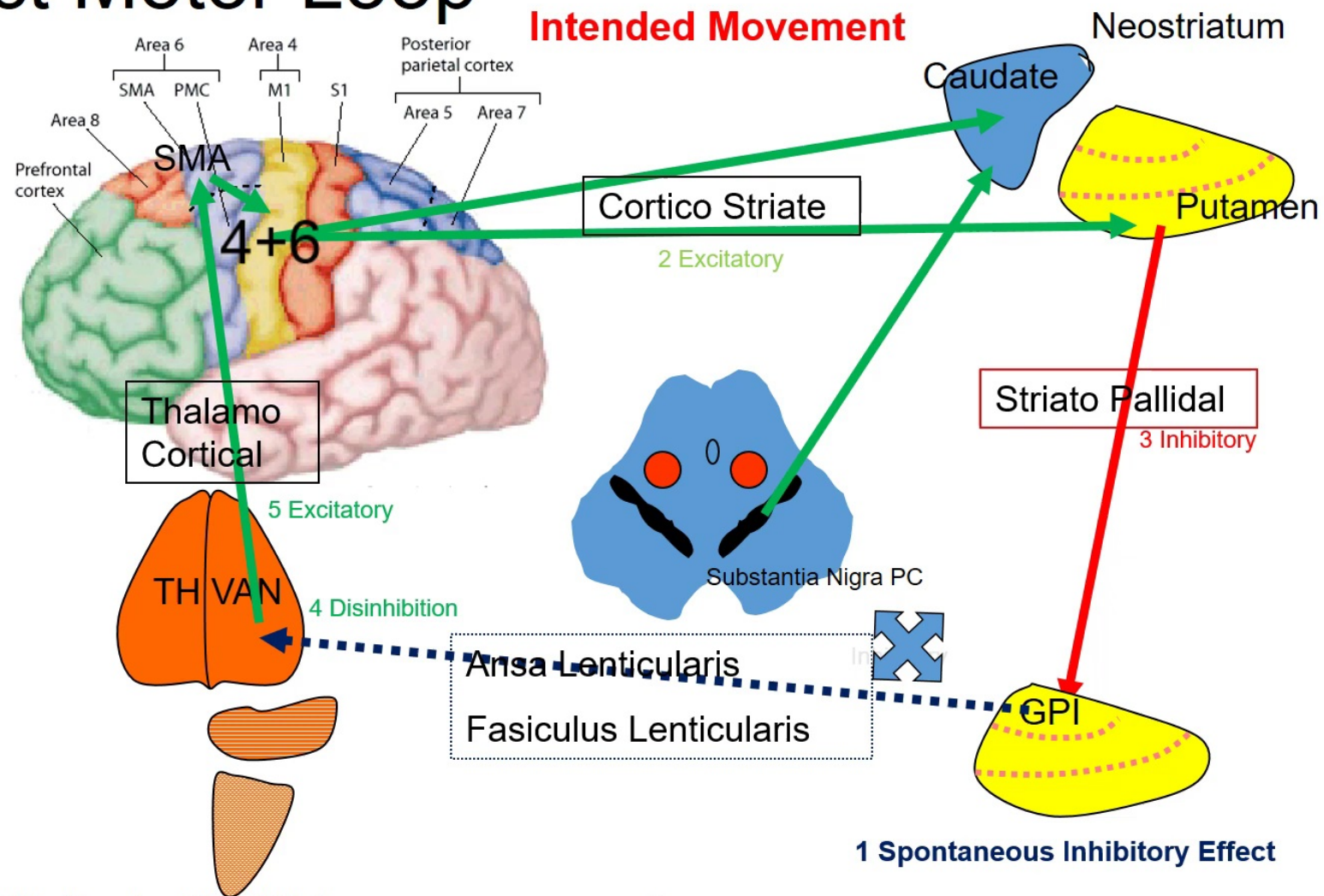


I) Direct Motor Loop

- Loop →
 - 1) Disinhibition of thalamus
 - (Activation)
 - 2) → Activation of
 - Motor Cortical areas
 - 3) → Intended Movement



Direct Motor Loop



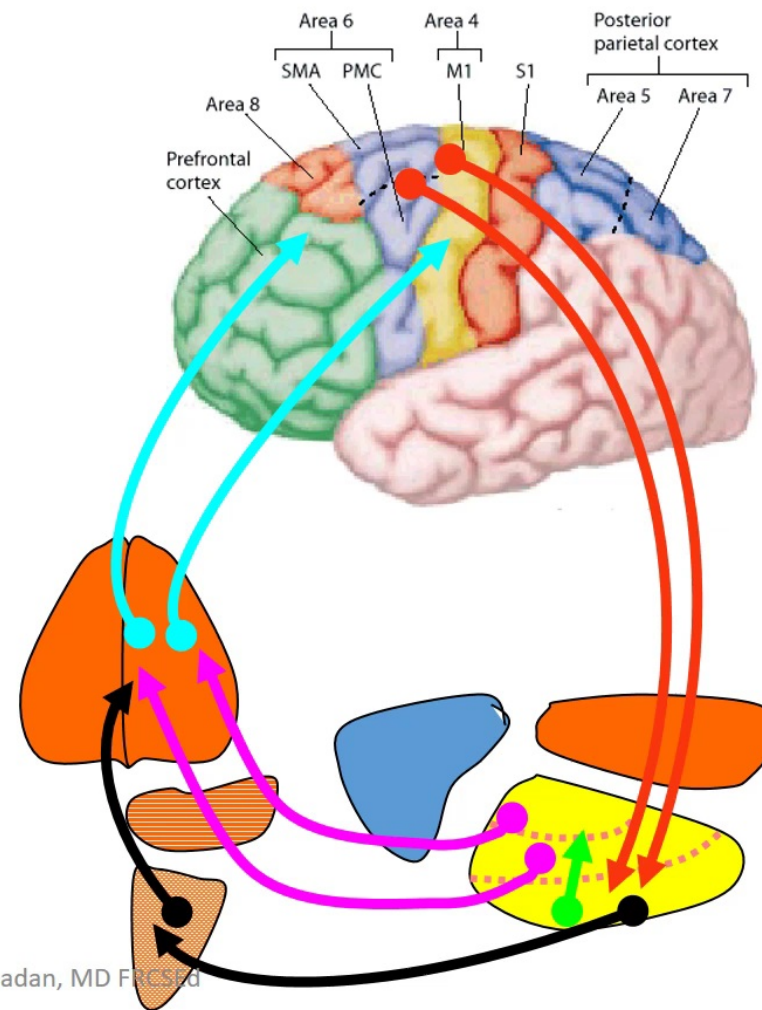
The Putamen Circuit (Indirect Loop)

- Fibers from Cerebral Cortex

- Premotor
- Supplemental motor
- → Putamen
- → Globus Pallidus
- → VLN & VAN

- Thalamus

- → Primary Motor Cortex



2) Indirect Motor Loop

- 7 Neurons

+

- Side inhibitory projection
 - Dopaminergic
 - From Pars Compacta
 - To D2 receptors in the Neostriatum



2) Indirect Motor Loop

1- Cerebral Cortex



- Cortico Striate

2- Neostriatum



- Striato Pallidal



3- Globus Pallidus Externa



2) Indirect Motor Loop

3- Globus Pallidus Externa



- Fasciculus Subthalamicus

4- Subthalamic Nc



- Subthalamo Pallidal
- (Excitatory)

5- Globus Pallidus Interna



- Ansa Lenticularis &
- Fasciculus Lenticularis



2) Indirect Motor Loop

6- Thalamus

→ II

- Thalamo Cortical vvv

7- Supplementary Cortex

→

- Motor Cortex vvv
- 4 & 6

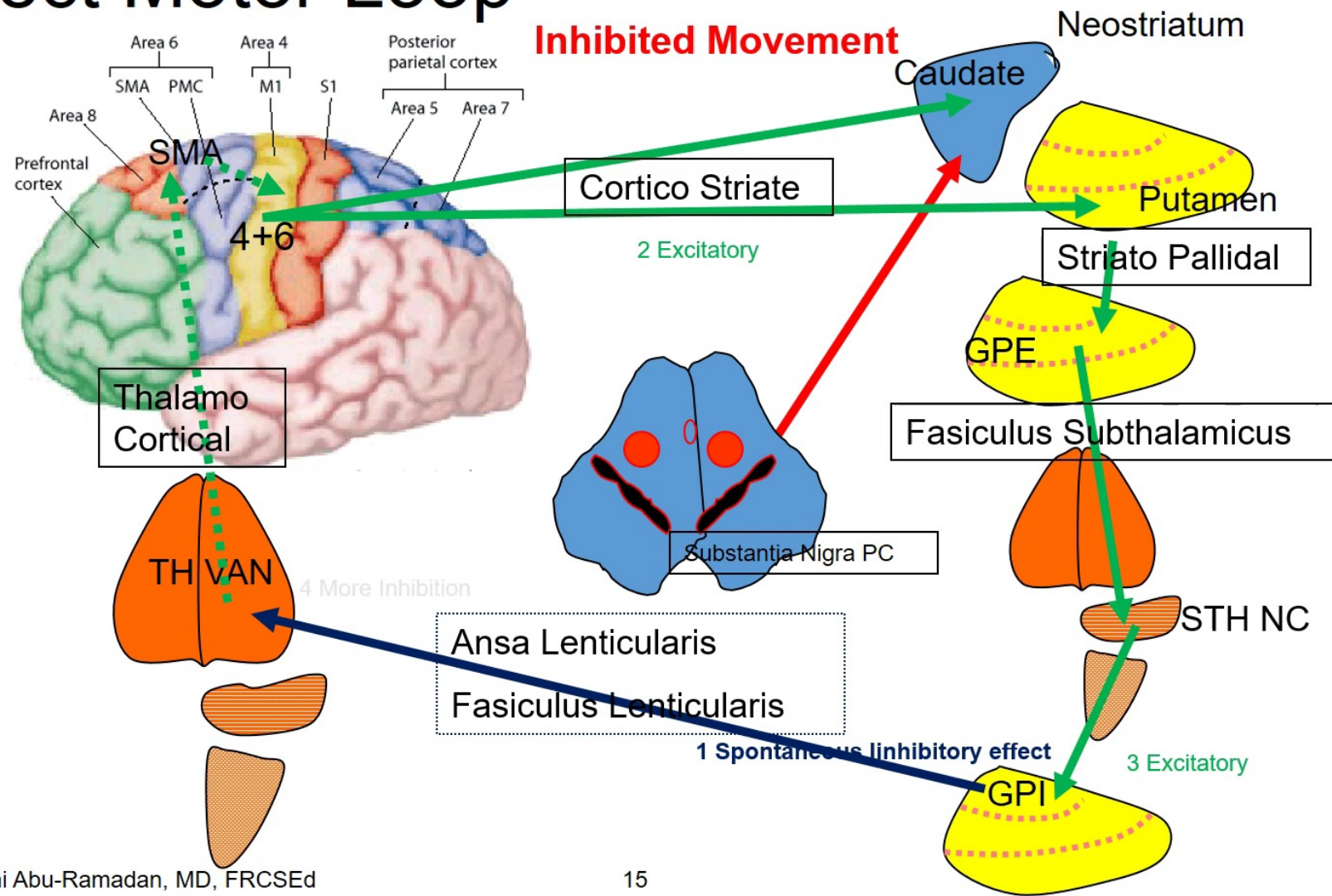


2) Indirect Motor Loop

- Loop
 1. Further inhibition of Thalamus
 2. Inhibition of cortical areas
 - (responsible for **Unwanted** movements)
- NB
 - Nigro striate f inhibits
 - D2 receptors in
 - Neostriatum
 - Striato Pallidal →
 - GP externa →
 - Subthalamic Nc →
 - GP Interna



Indirect Motor Loop

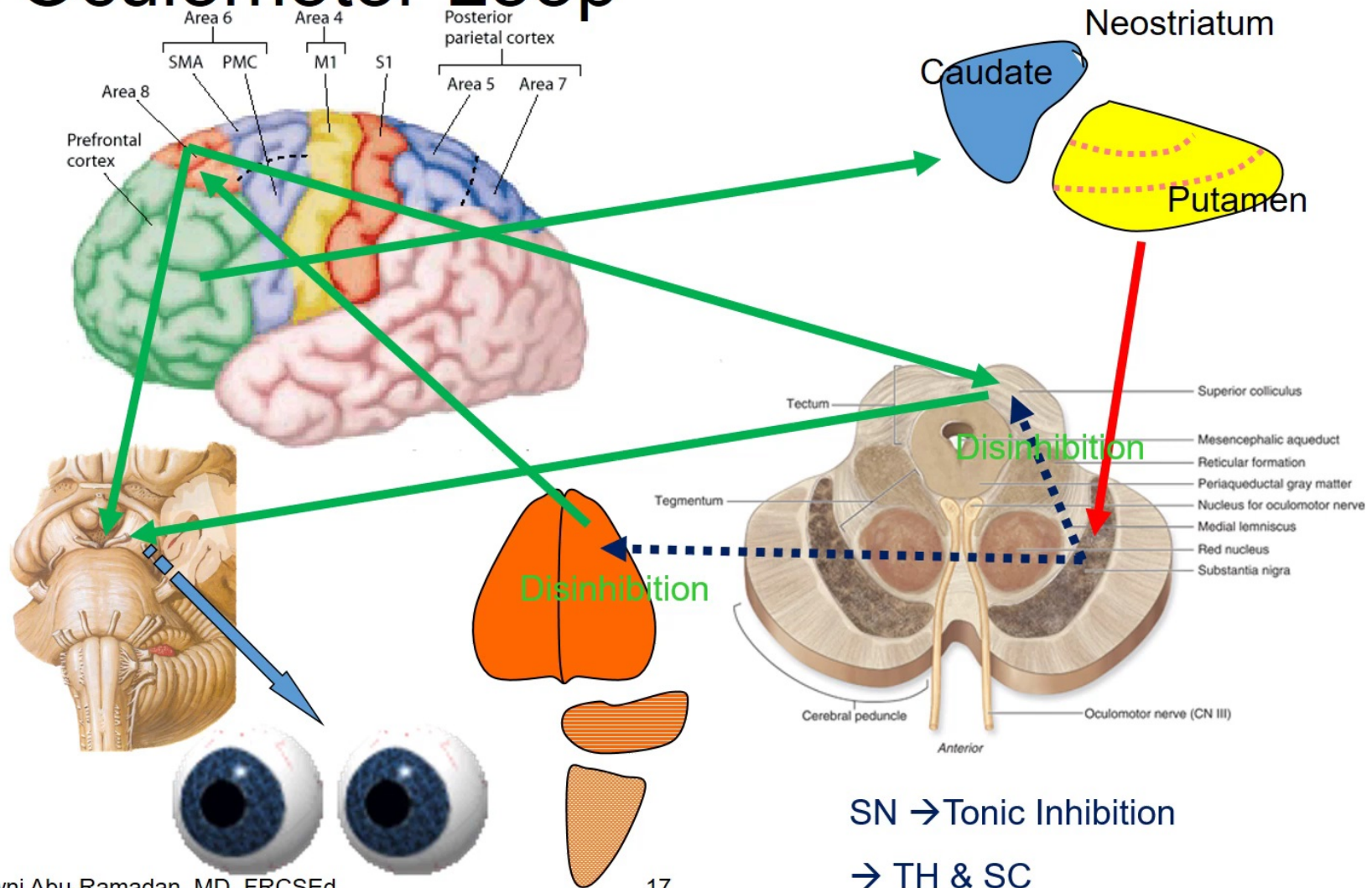


3) Oculomotor Loop

- 5 neurons
- Side projection to the
 - Superior Colliculus
 - → Disinhibited
- → Gaze Centres →
 - Inhibition of “Pause” neurons
 - Activation of excitatory “Burst” neurons
- → Control of Eye Movement



The Oculomotor Loop



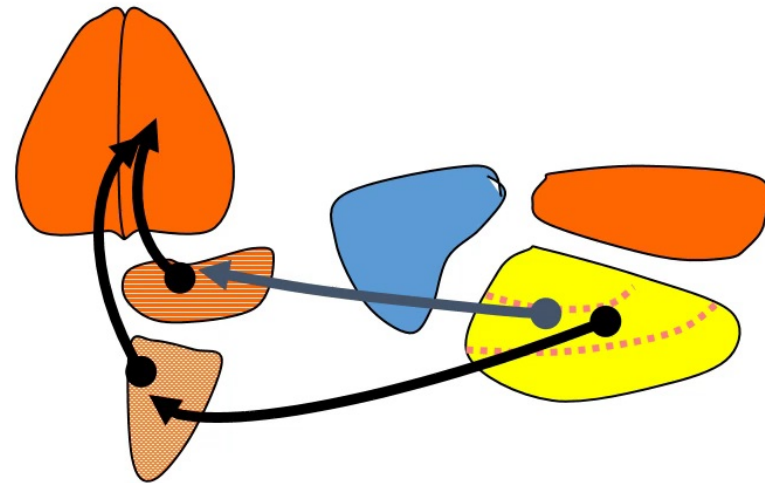
BN Outflow Tracts to BS

- Fibers from Globus Pallidus

1. → Subthalamus
2. → Substantia Nigra

- →

1. RF → Reticulospinal T
2. Red Nc → Rubrospinal T
3. VNc → Vestibulospinal T
4. Inf Olive → Olivospinal T



Basal Nuclei Lesion

1. Caudate

1. Inability to organize movement to complex goal
2. Inability to write or draw to a fixed scale
3. Loss of timing & scaling of movement

2. Putamen

1. Motor apraxia



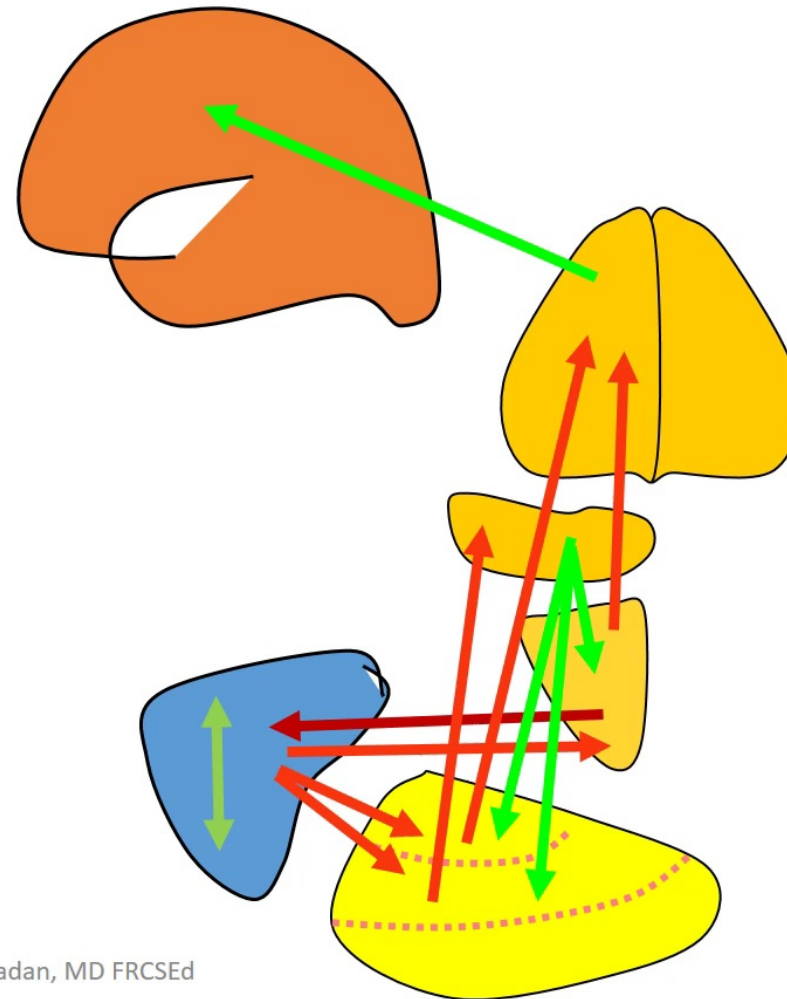
Basal Nuclei Lesion

- Wilson's disease
 1. Low Ceruloplasmin
 2. Hepatolenticular degeneration
- Parkinsonism
 - SN –X
→
 - Loss of dopaminergic neurons



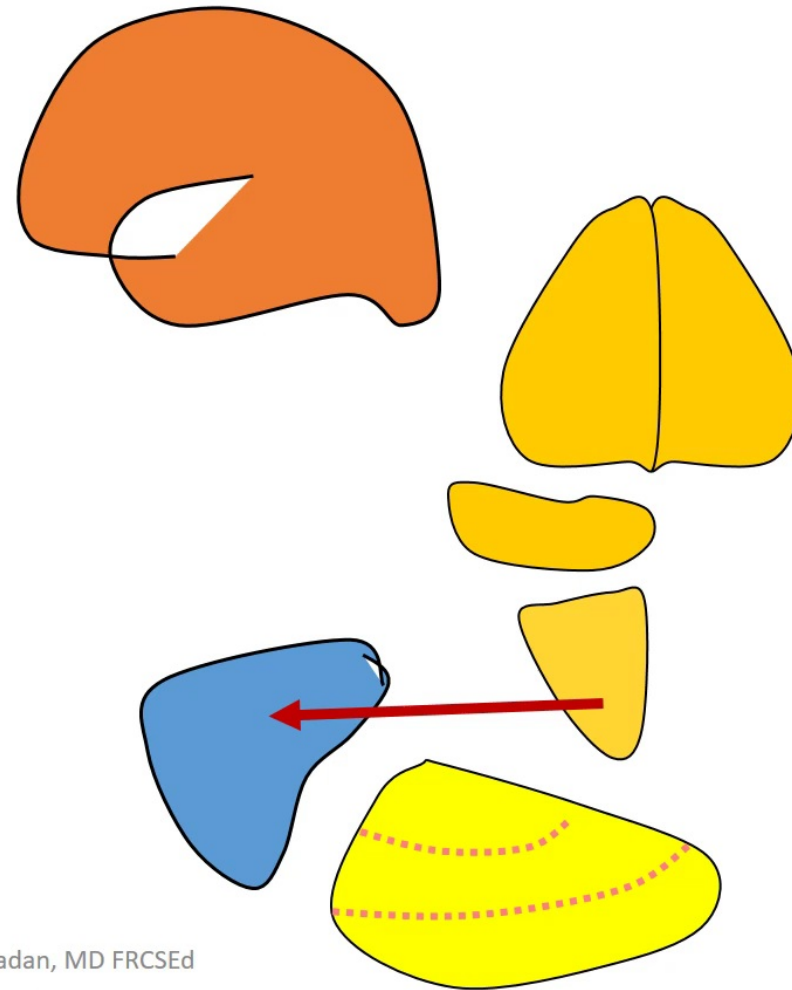
Basal Nuclei Neurotransmitter

1. Dopamine (-)
2. GABA (-)
3. Glutamate (+)
4. Acetylcholine (+)



Basal Ganglia Neurotransmitter

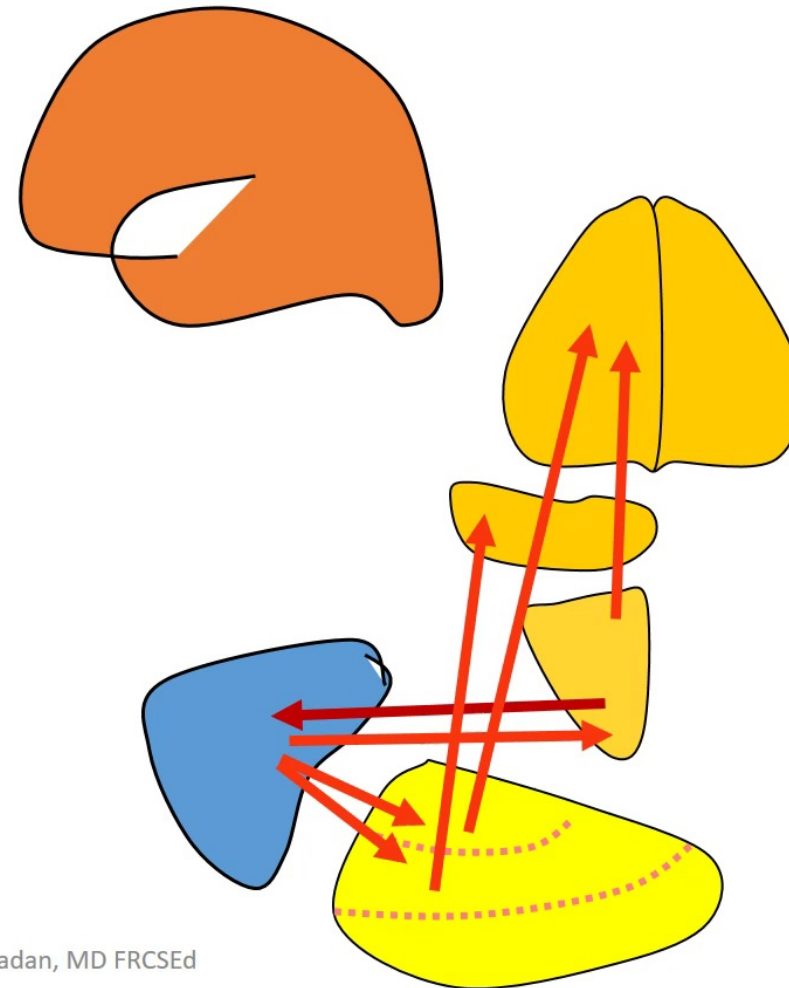
- Dopamine (-)
 - Pars Compacta (SN)
-
- Corpus Striatum



Basal Ganglia Neurotransmitter

- GABA (-)

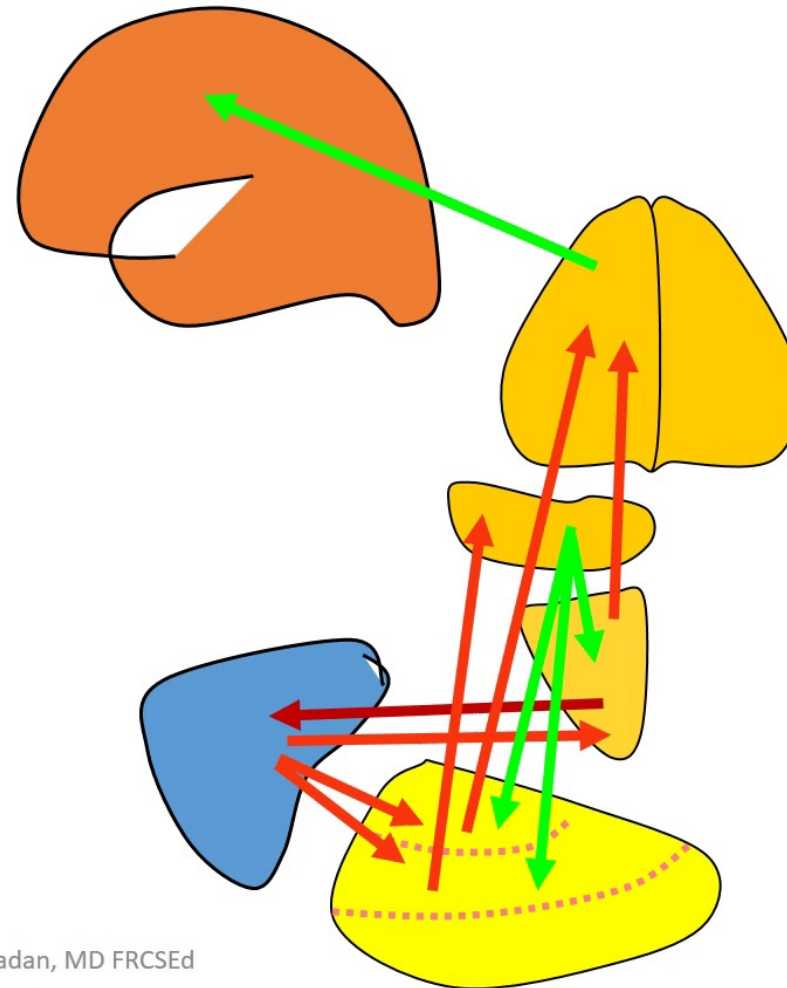
1. Corpus Striatum → Pars Reticulata (SN)
2. Corpus Striatum → Globus Pallidus (2)
3. Ext Globus Pallidus → Subthalamus
4. Int Globus Pallidus → Thalamic VANc & VLNc
5. Substantia Nigra → Thalamus



Basal Ganglia Neurotransmitter

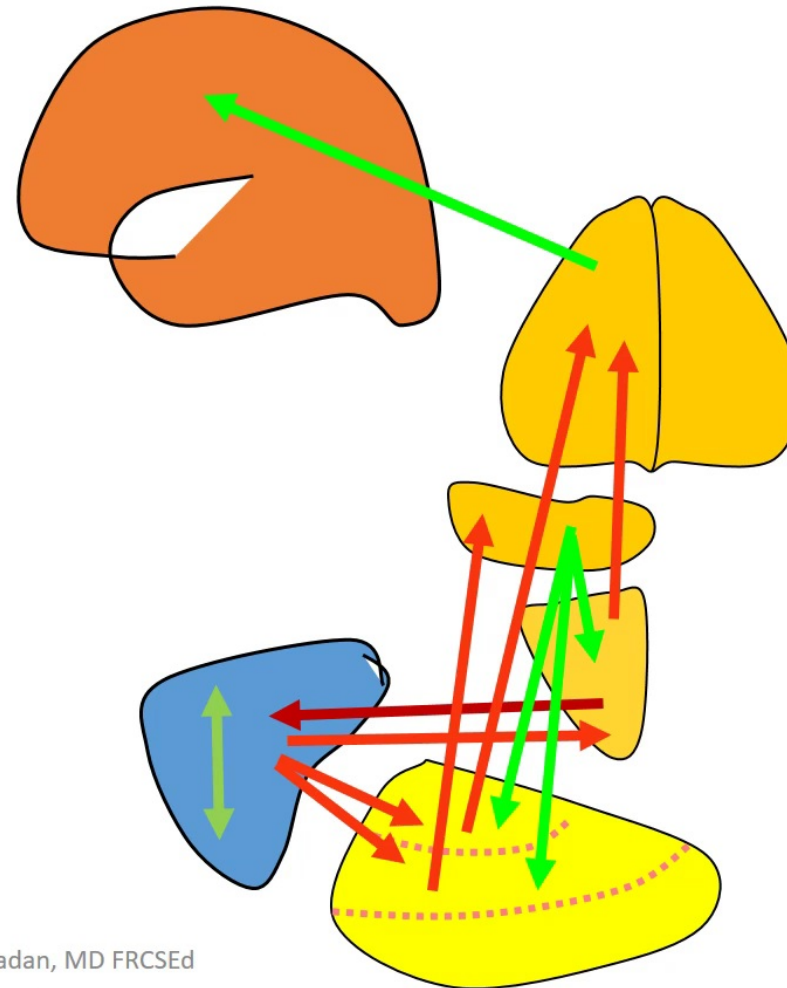
- Glutamate (+)

1. Subthalamus → Globus Pallidus (2)
2. Subthalamus → Substantia Nigra (2)
3. Thalamus → Cerebral Cortex



Basal Ganglia Neurotransmitter

- Acetylcholine (+)
- Intrastratial fibers



Parkinsonism

- Paralysis Agitans
 - Lesion in Substantia Nigra
 - Degeneration of
 - Dopaminergic neurons
 - Projecting into striatum
1. Idiopathic
 - Elderly
 - Atherosclerosis →
 - Loss of dopamine & dopamine receptors
 2. Iatrogenic
 - Phenothiazine tranquillizers
 - --x D2 dopamine receptors



Parkinsonism Pathogenesis

- Imbalance <>
 1. Excitation &
 2. inhibition at
- BN

Loss of

- Dopaminergic
- Inhibition of the
- Putamen



Normal Effect

Normal

1. Substantia Nigra → **Inhibits** Putamen
2. Putamen → **Inhibits** Globus Pallidus Externa
3. GPE → **Inhibits** Sub Thalamic Nucleus
4. STN → **Stimulates** Globus Pallidus Interna
5. GPI → **Inhibits** Thalamus
6. TH → **Stimulates** Cortex



SN Dopaminergic Effect

- Normal

1. SN **Inhibits** PT
2. PT **Loss of Inhibition** on GPE
3. GPE **Inhibits** STN
4. STN **Loss of Stimulation** to GPI
5. GPI **Loss of Inhibition** on TH
6. TH **Stimulates** CC

- Parkinsonism

1. **No Inhibition** of PT
2. PT **Inhibits** GPE
3. GPE **Loss of Inhibition** on STN
4. STN **Stimulates** GPI
5. GPI **Inhibits** TH
6. TH **Loss of Stimulation** to CC



C/P of Parkinsonism

1. Rigidity
2. Static tremors
3. Akinesia
4. CCC



C/P of Parkinsonism

- Rigidity
 1. Lead pipe rigidity
 2. Cog wheel rigidity
 3. Flexors > extensors
- Corticospinal tract
 - → Continuous excitatory signals
 - → @MN of Flexors & Extensors



C/P of Parkinsonism

- Static tremors
 1. Present at rest
 2. Disappear during movement or sleep
 3. Rhythmic
 4. Involuntary
 5. Alternating contraction of antagonistic muscles
 6. Distal joints



C/P of Parkinsonism

- Akinesia
 - Difficulty in initiating voluntary movements
 - Absence of motor activity
 - Decrease in associated movement



C/P of Parkinsonism

- CCC
 - Mask face
 - Slow monotonous speech
 - Shuffling short step gait
 - Bent forward



Treatment of Parkinsonism

- Anticholinergic drugs
- L- Dopa
 - Crosses BBB
- Surgical
 - Electrocoagulation of thalamic nuclei
VLN & VAN



Chorea

- Lesion in the Caudate & Putamen
- During rest
 - Rapid
 - Involuntary
 - Dancing jerky movements
- Extremities
- Facial muscles



Huntington's Chorea

Inherited AD

- Chromosome 4
- 3-4 Decade
- Degeneration of GABA & Ach neurons
- Hyperkinetic choreoform movement
- Hypotonia
- Progressive dementia



Athetosis

- Globus Pallidus lesion
- Worm like movements
 - Slow
- Hypertonia
- Hands
- Arms
- Neck
- Face



Hemiballismus

- Subthalamic nucleus damage (CL)
- Involuntary
 - Violent
- One side of body
- Whole limb



Thank You

