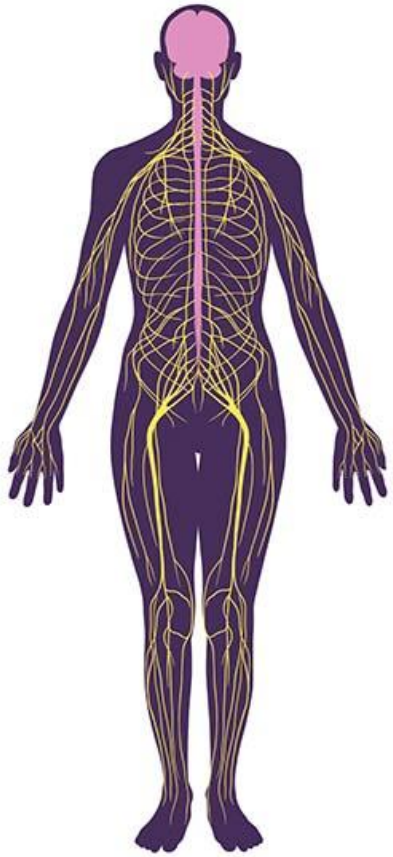
Introduction to the nervous system

Neurology Division
The University of Jordan

Central Nervous System (CNS)

- Brain and spinal cord
- Integration and processing center
- Protected by skull & vertebrae

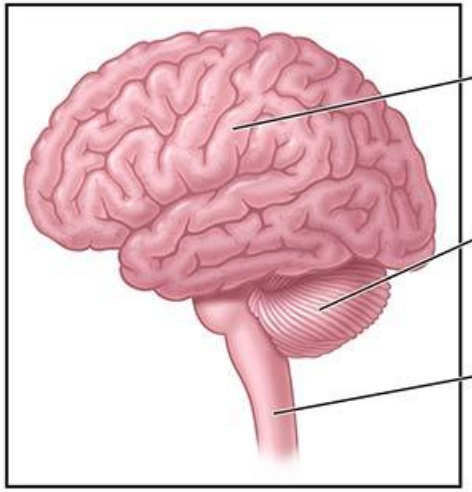
Central nervous system



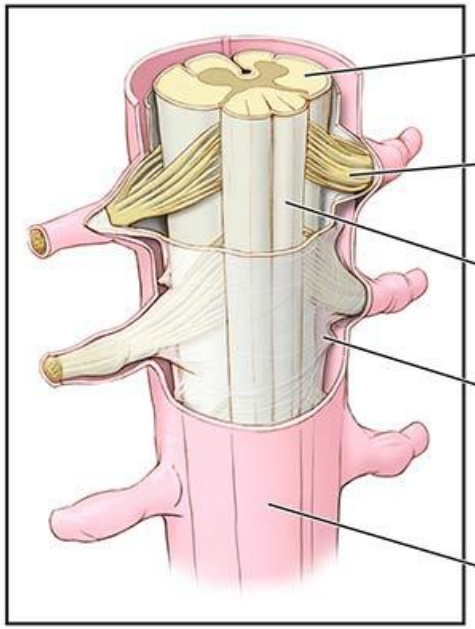
Central nervous system

Peripheral nervous system

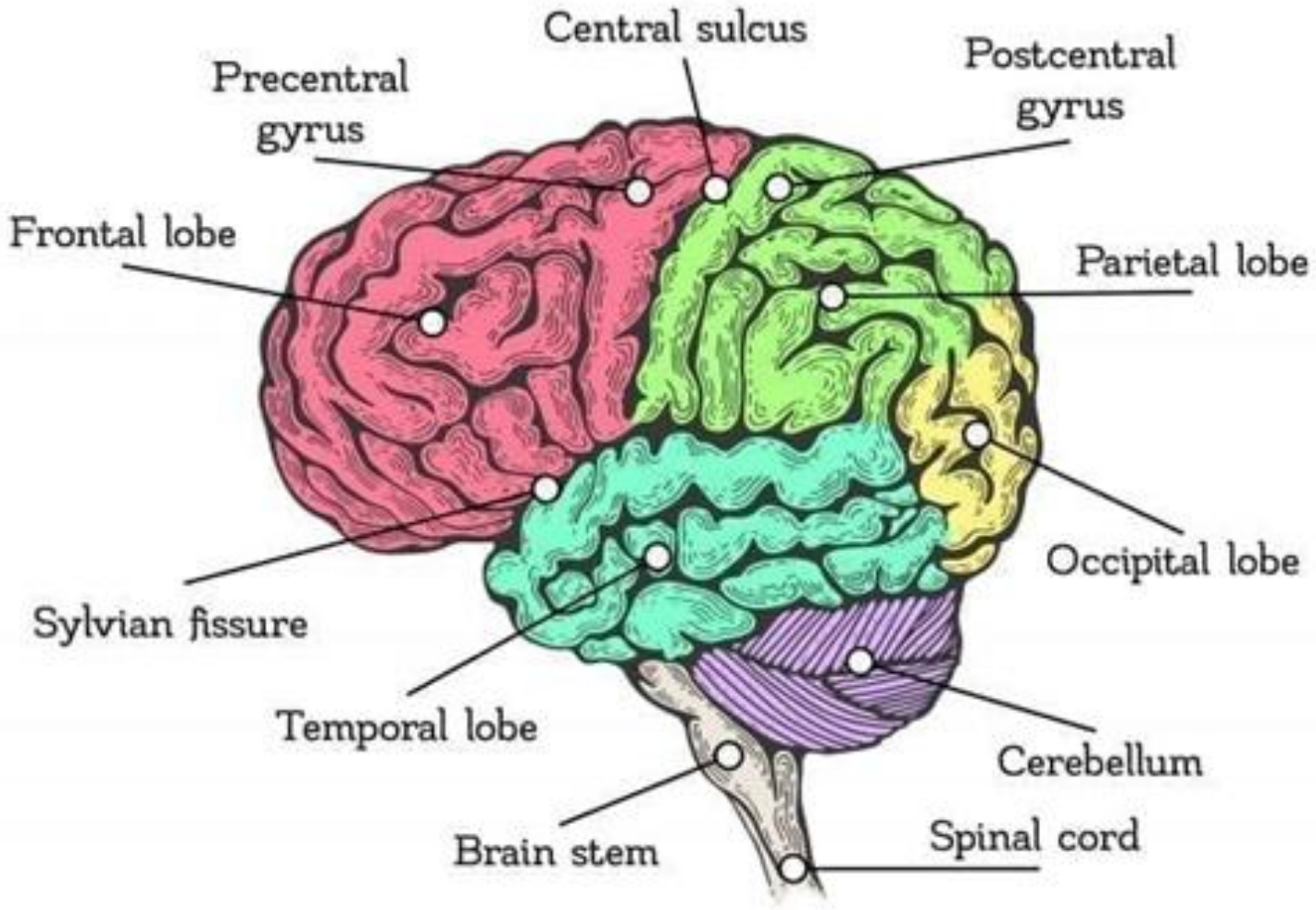
Brain (side view)



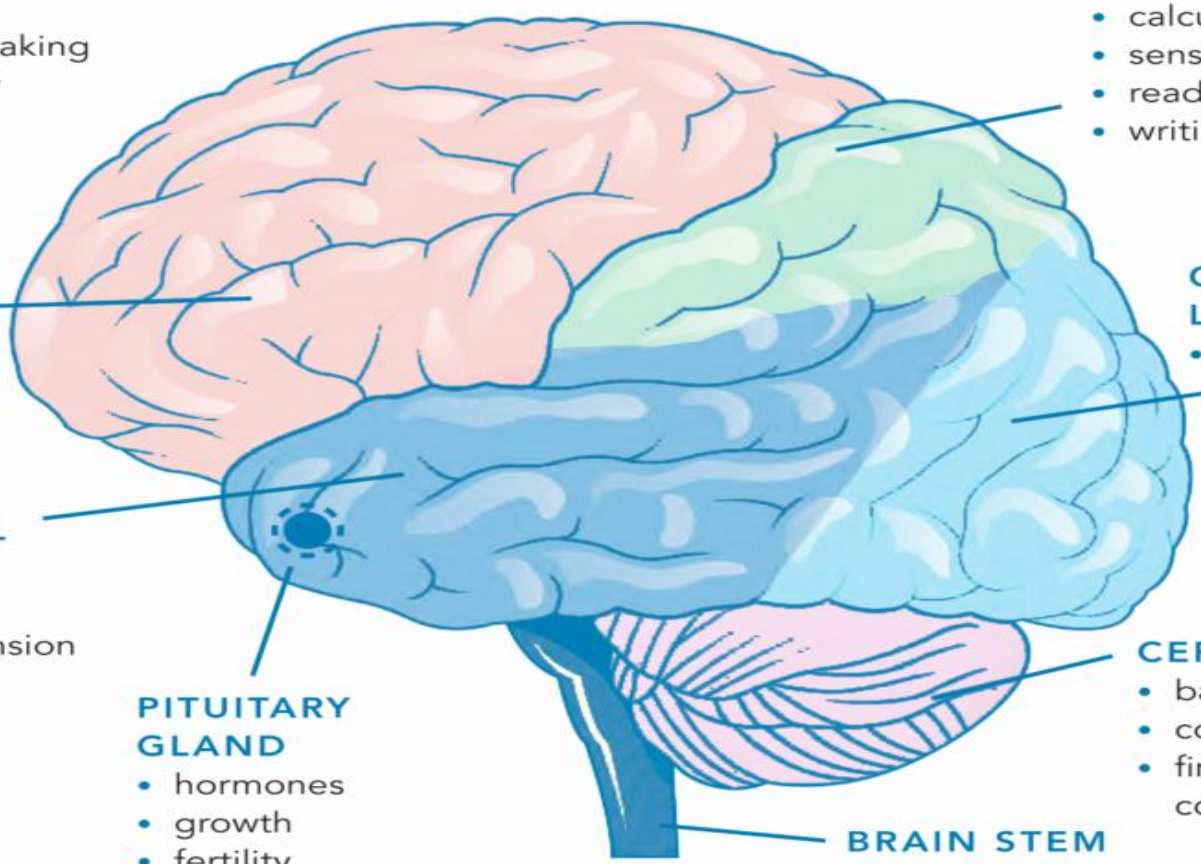
Spinal cord



Anatomy of the brain



BRAIN STRUCTURES AND THEIR FUNCTIONS



FRONTAL LOBE
- movement
- reasoning
- behavior
- memory
- decision making
- personality
- planning
- judgment
- initiative
- inhibition
- mood

PARIETAL LOBE
- telling right from left
- calculations
- sensations
- reading
- writing

OCCIPITAL LOBE
- vision

TEMPORAL LOBE
- language comprehension
- behavior
- memory
- hearing
- emotions

PITUITARY GLAND
- hormones
- growth
- fertility

CEREBELLUM
- balance
- coordination
- fine muscle control

BRAIN STEM
- breathing
- blood pressure
- heartbeat
- swallowing

Based on an illustration from National Brain Tumor Society's *The Essential Guide to Brain Tumors*

What are common conditions that affect the central nervous system?

- Alzheimer's disease.
- Multiple Sclerosis.
- Epilepsy.
- Stroke.
- Inflammation (transverse myelitis).
- Spinal cord trauma.
- Traumatic brain injury.

What are the signs or symptoms of central nervous system conditions?

- Loss of consciousness. (brainstem)
- Upper limb or lower limb weakness. (cerebral cortex)
- Dizziness/Imbalance. (Sensory or cerebellar)
- Confusion and/or memory loss.
- Involuntary movements. (Basal Ganglia)
- Headache.
- Pain, tingling or numbness in upper limbs or lower limbs.
- Seizures. (cortical neurons)

A 68-year-old male with a history of hypertension and diabetes presents to the ED with sudden onset **tongue heaviness** and **right-sided facial drooping, occurring 90 minutes ago.** He shows **right-sided weakness and a left gaze preference.**

TO SPOT THE SIGNS OF A STROKE,

B E F A S T

Balance: Loss of balance or coordination.

Eyes: Changes in vision.

Face: Drooping features on one side of the face.

Arms (and legs): Weakness in a limb.

Speech: Difficulty speaking or understanding others.

Time: Call 911 or emergency services right away.

Cleveland Clinic

Important Investigations

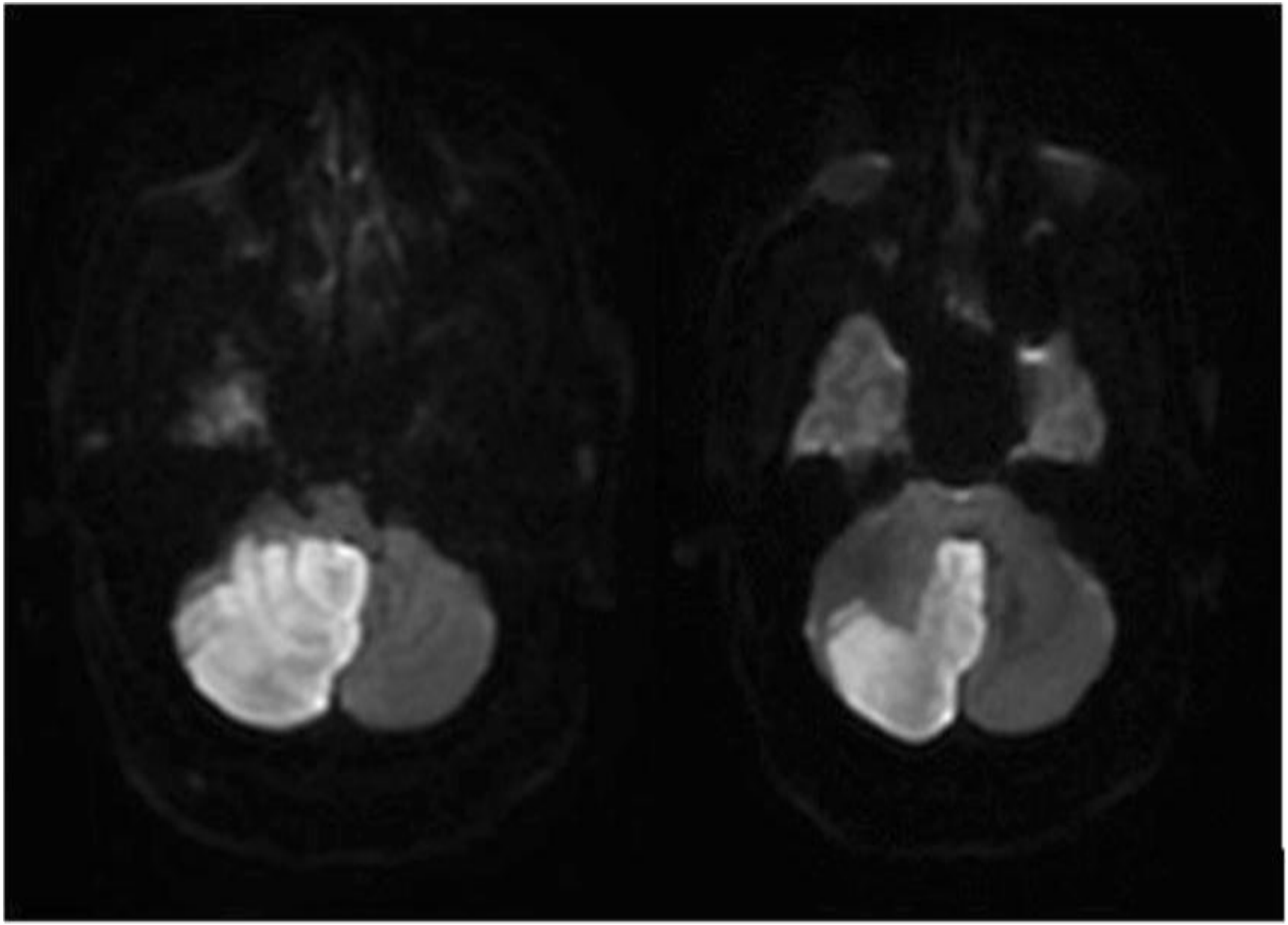
- Brain CT scan, Brain MRI, vessel MRA
- Blood work up: RBS, HBA1C, CBC, KFT, Lipid profile
- Echo, cardiac evaluation

Management

- Acute management: Aspirin 300 mg PO after excluding hemorrhage, thrombolytics and thrombectomy
- Secondary prevention: Dual APT vs Single APT, Statins, carotid endarterectomy

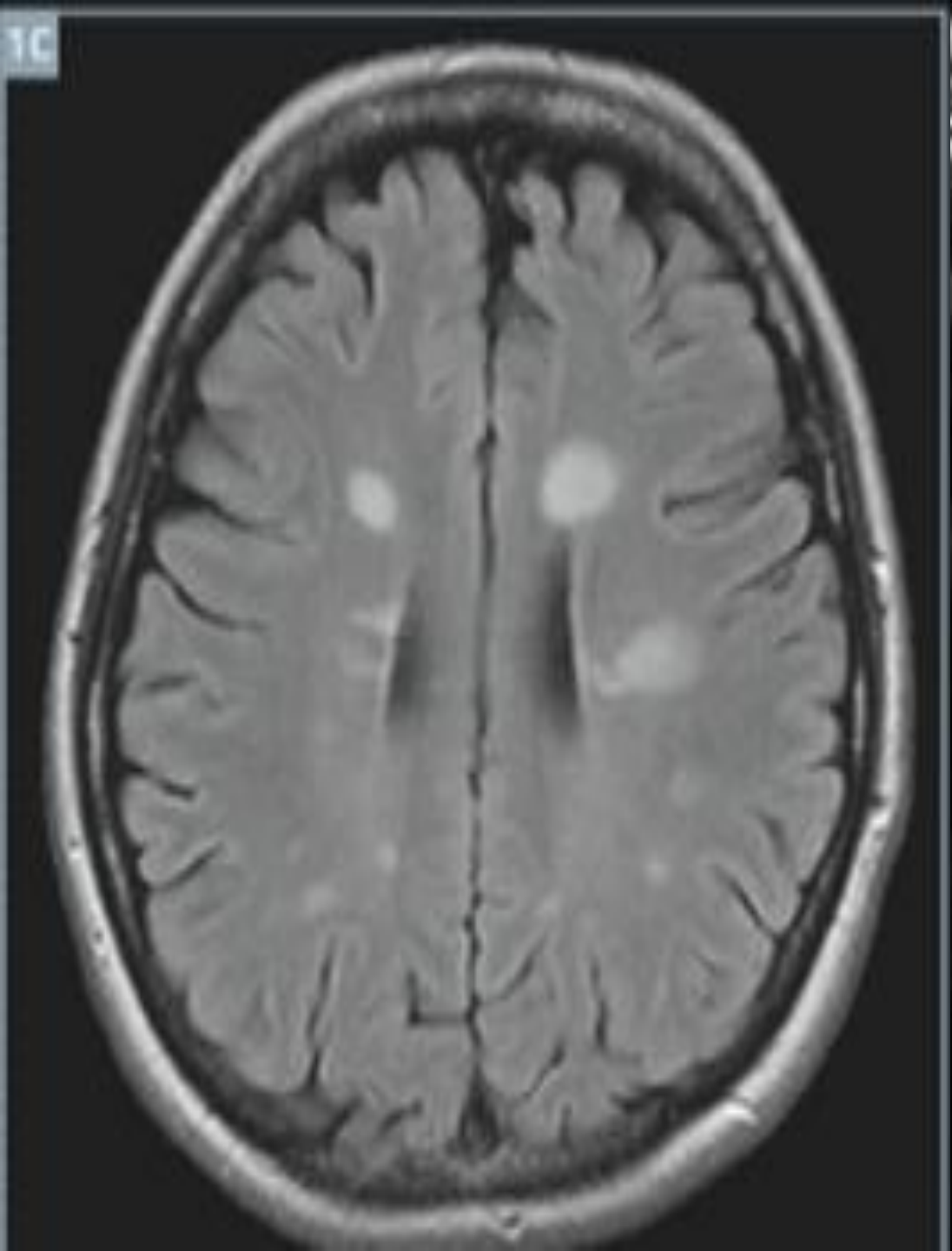
55-year-old male patient presented to emergency room with **imbalance of 2 days** duration. Upon examination, he has **dysarthria, nystagmus, right sided weakness, intentional tremor and past pointing when finger-nose and heel to shin are tested.**

- Question: Which structure is affected?
- Hint: Think **right side of cerebellum**



A 32-year-old woman presents to the emergency room with a **4 weeks history of right eye pain** and **blurring of vision**. She states that **three episodes** have occurred during the past 6 months. She reported an attack of **numbness in the left side of her body 1 year ago**. She states she has not observed any **gait disturbance**, fever, or **urinary incontinence**.

Upon evaluation, she has mild spasticity, generalized hyperreflexia, upgoing plantar response and clonus.



Important Investigations

- Brain MRI, Spinal MRI with contrast
- Visual studies (optic nerve)
- Lumbar puncture

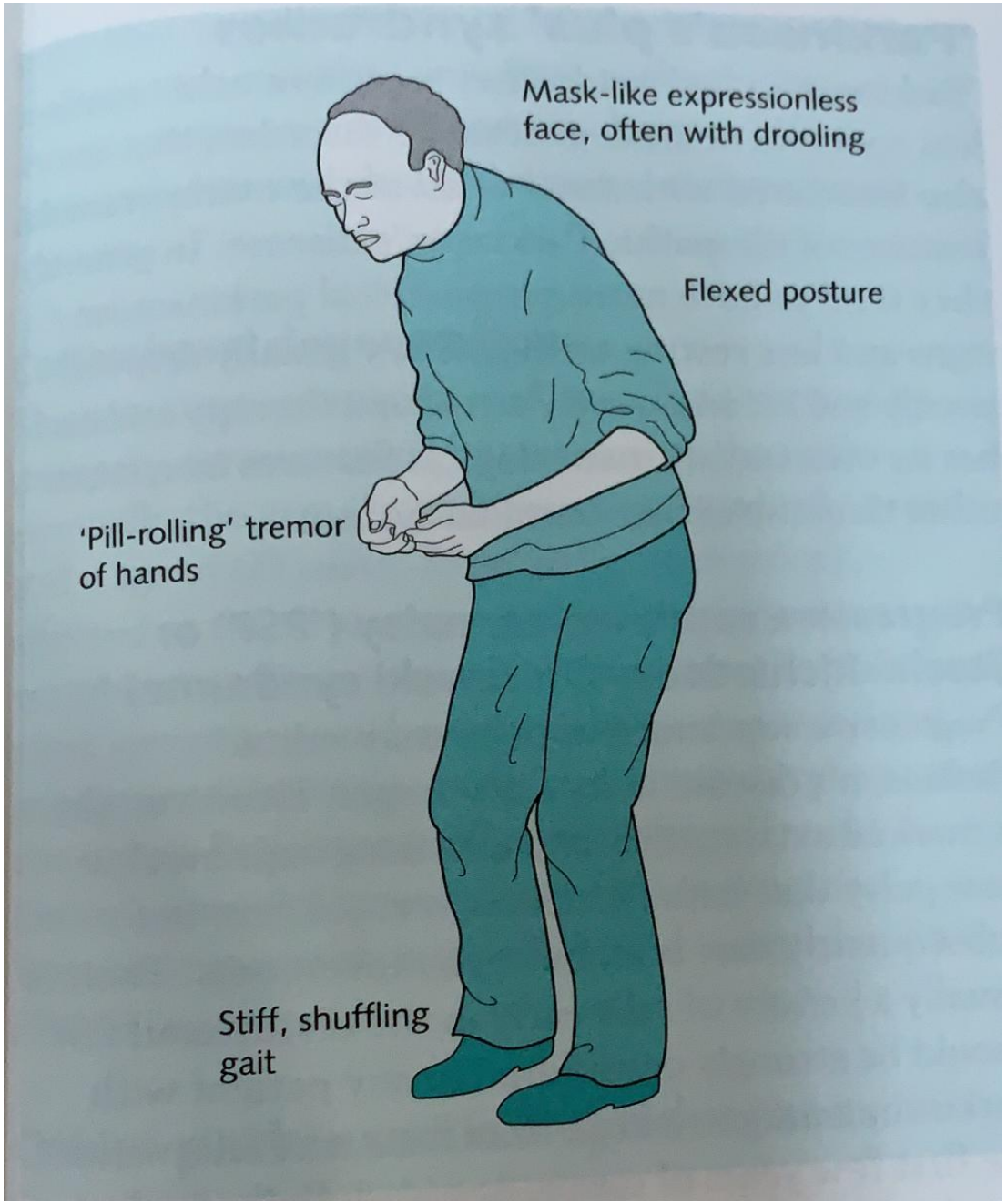
Management

- Acute management: IV methylprednisolone
- Long term therapy: disease modifying agents

A 72-year-old gentleman presents to the neurology clinic with his family because they noticed he has **difficulty in initiating movements, abnormal posture with short steps while walking and abnormal shaking of his right-hand during rest.**

- Tremor
- Rigidity
- Akinesia
- Postural Instability

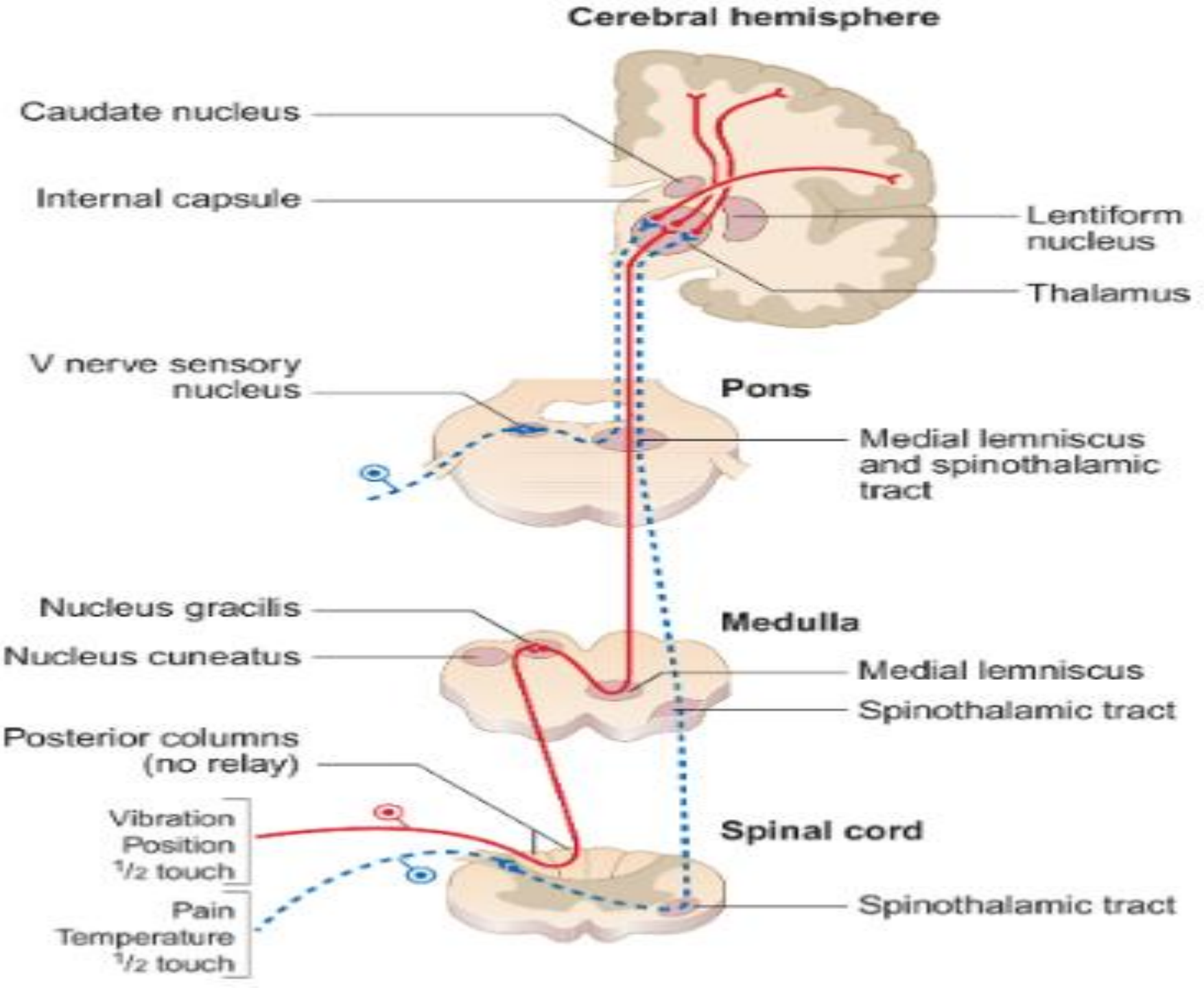
Treatment is Levodopa-Carbidopa



Spinal Cord

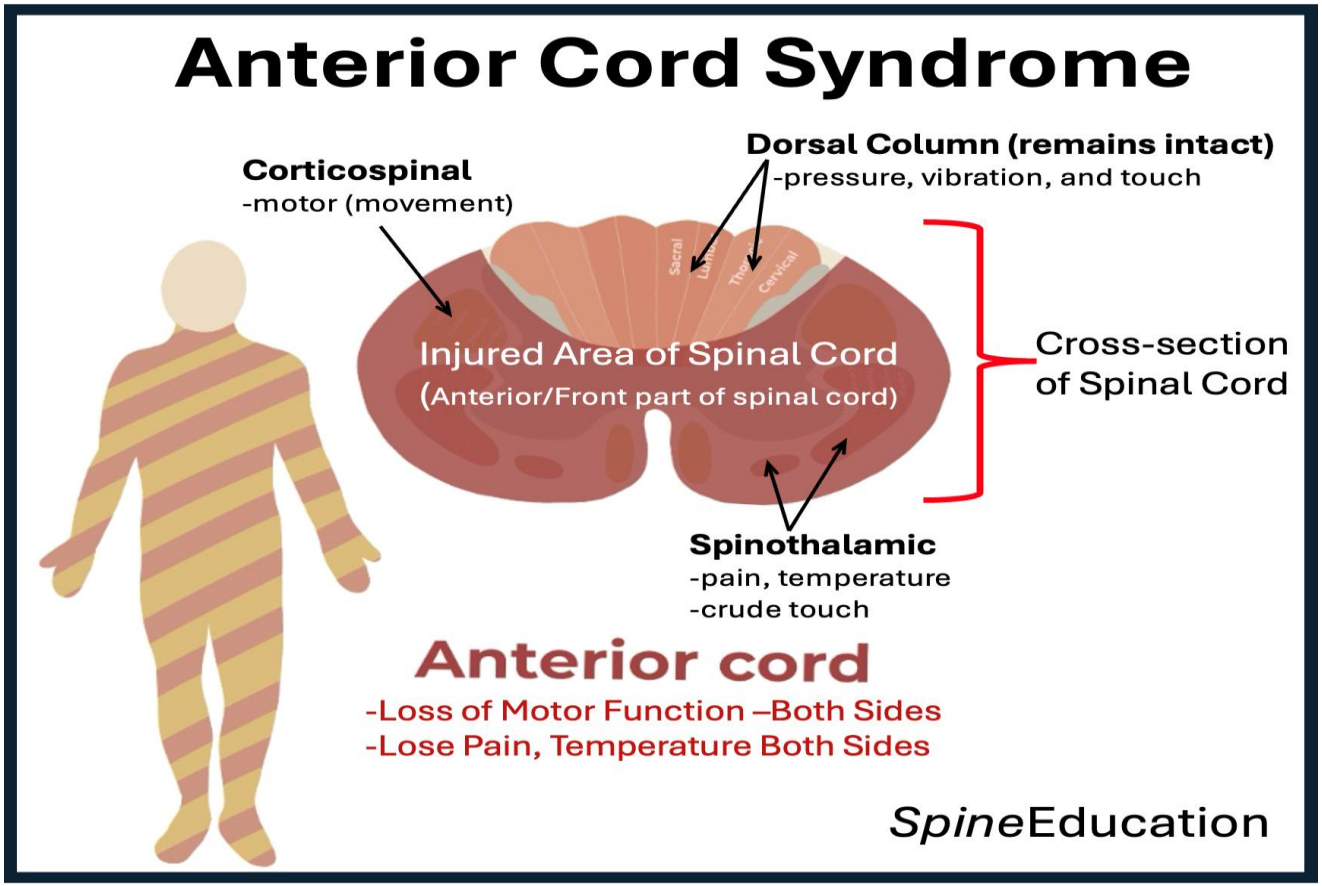
Traumatic and compressive spinal cord lesions cause loss or impairment of sensation in a dermatomal distribution below the level of the lesion.

A zone of hyperesthesia may be found immediately above the level of sensory loss.


Cerebral hemisphere
Caudate nucleus
Internal capsule
Lentiform nucleus
Thalamus
V nerve sensory nucleus
Pons
Medial lemniscus and spinothalamic tract
Nucleus gracilis
Nucleus cuneatus
Medulla
Medial lemniscus
Spinothalamic tract
Posterior columns (no relay)
Vibration
Position
1/2 touch
Spinal cord
Pain
Temperature
1/2 touch
Spinothalamic tract

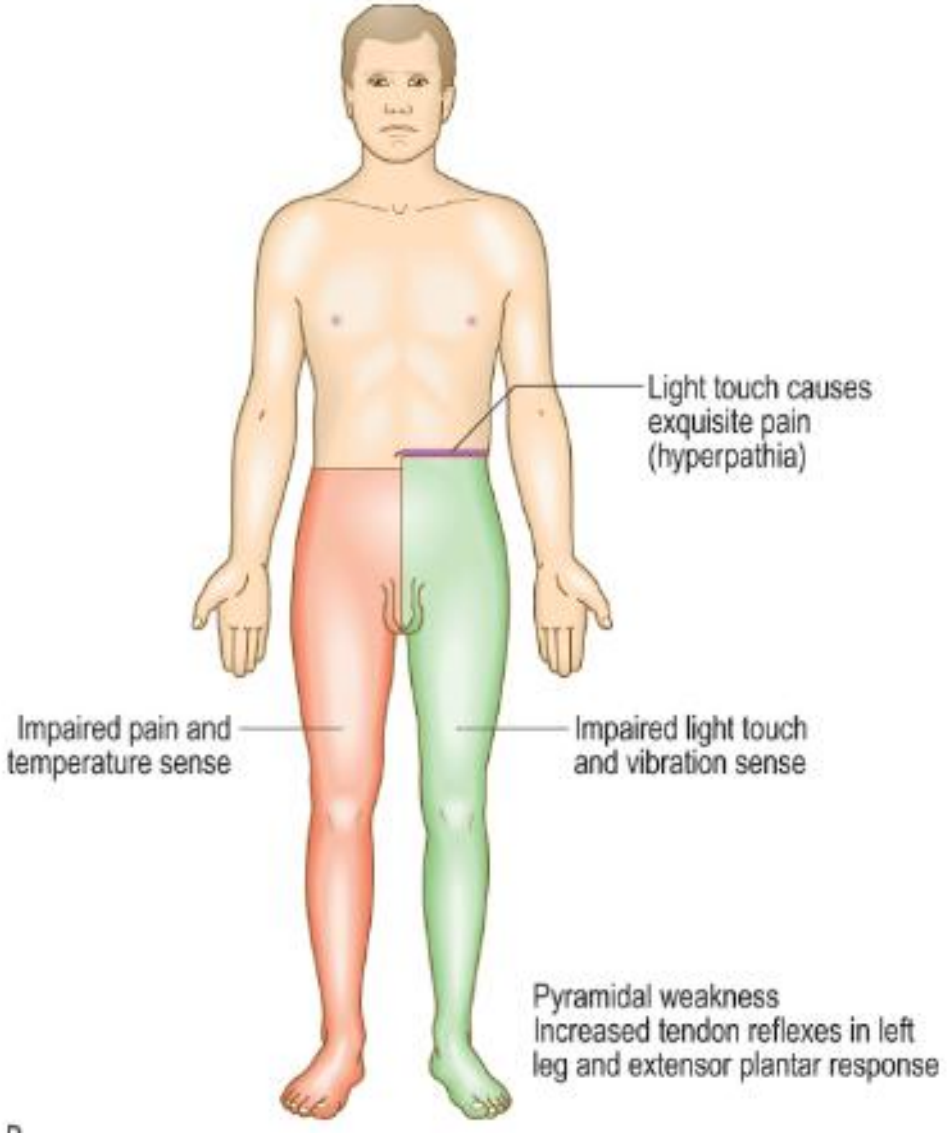
- **<u>Anterior spinal artery syndrome:</u>**

Results in loss of spinothalamic sensation and motor function, with sparing of dorsal column sensation.



- **Brown-Séquard syndrome:**

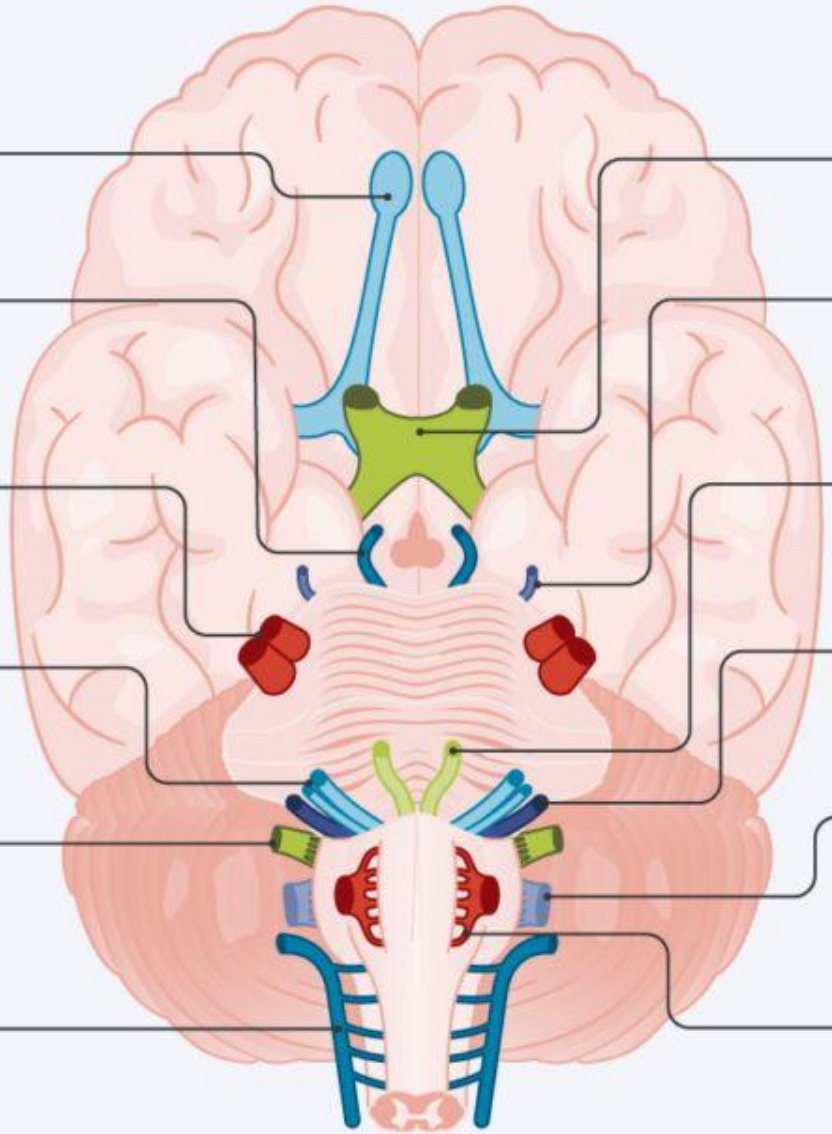
  When one-half of the spinal cord is damaged.
  This is characterized by ipsilateral motor weakness and loss of vibration and joint position sense, with contralateral loss of pain and temperature.



Peripheral Nervous System (PNS)

- Cranial and spinal nerves
- Connects CNS to body

12 cranial nerves



olfactory
smell

oculomotor
eye movement and pupil reflex

trigeminal
face sensation and chewing

facial
face movement and taste

glossopharyngeal
throat sensation, taste, and swallowing

accessory
neck movement

optic
vision

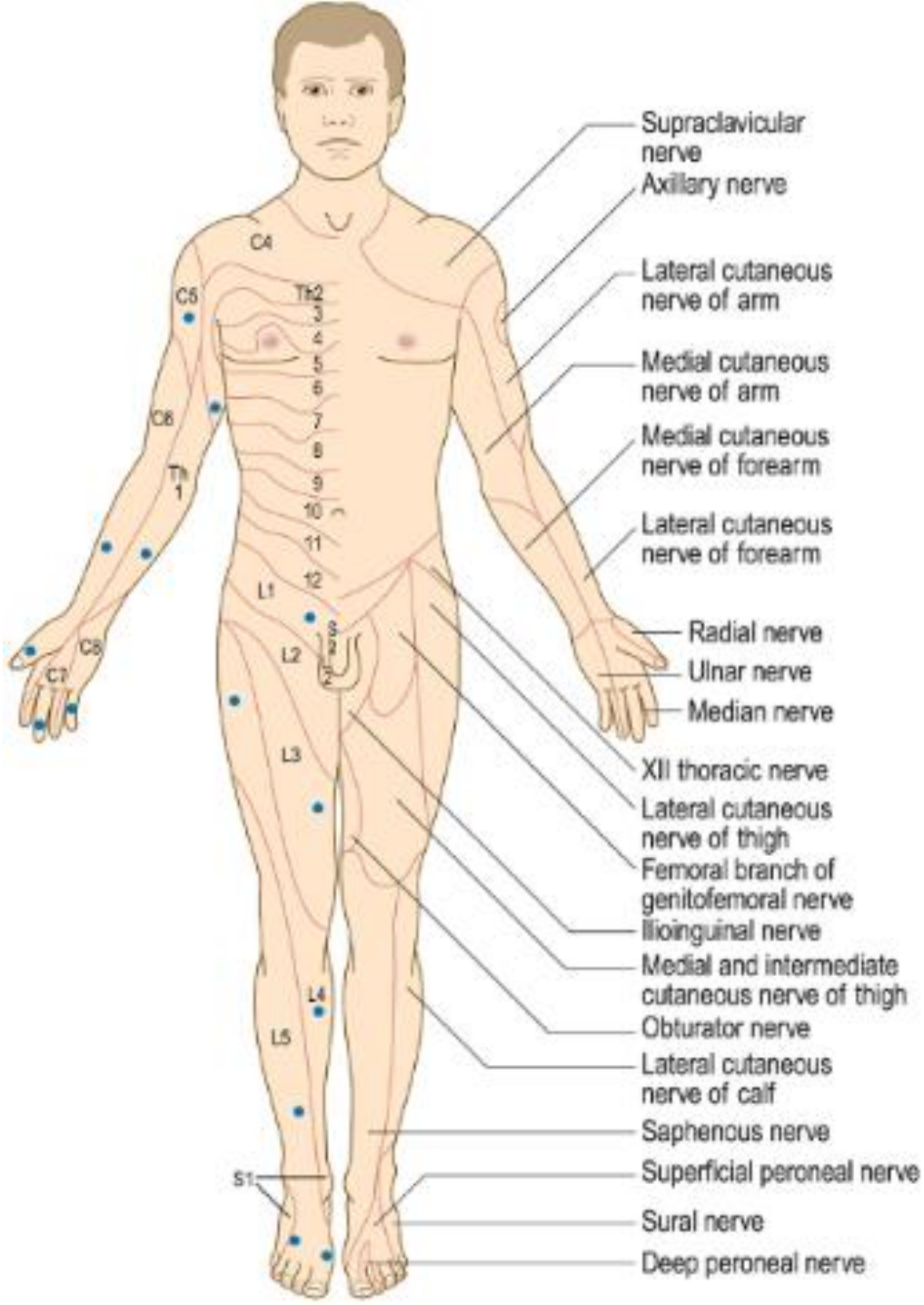
trochlear
eye movement

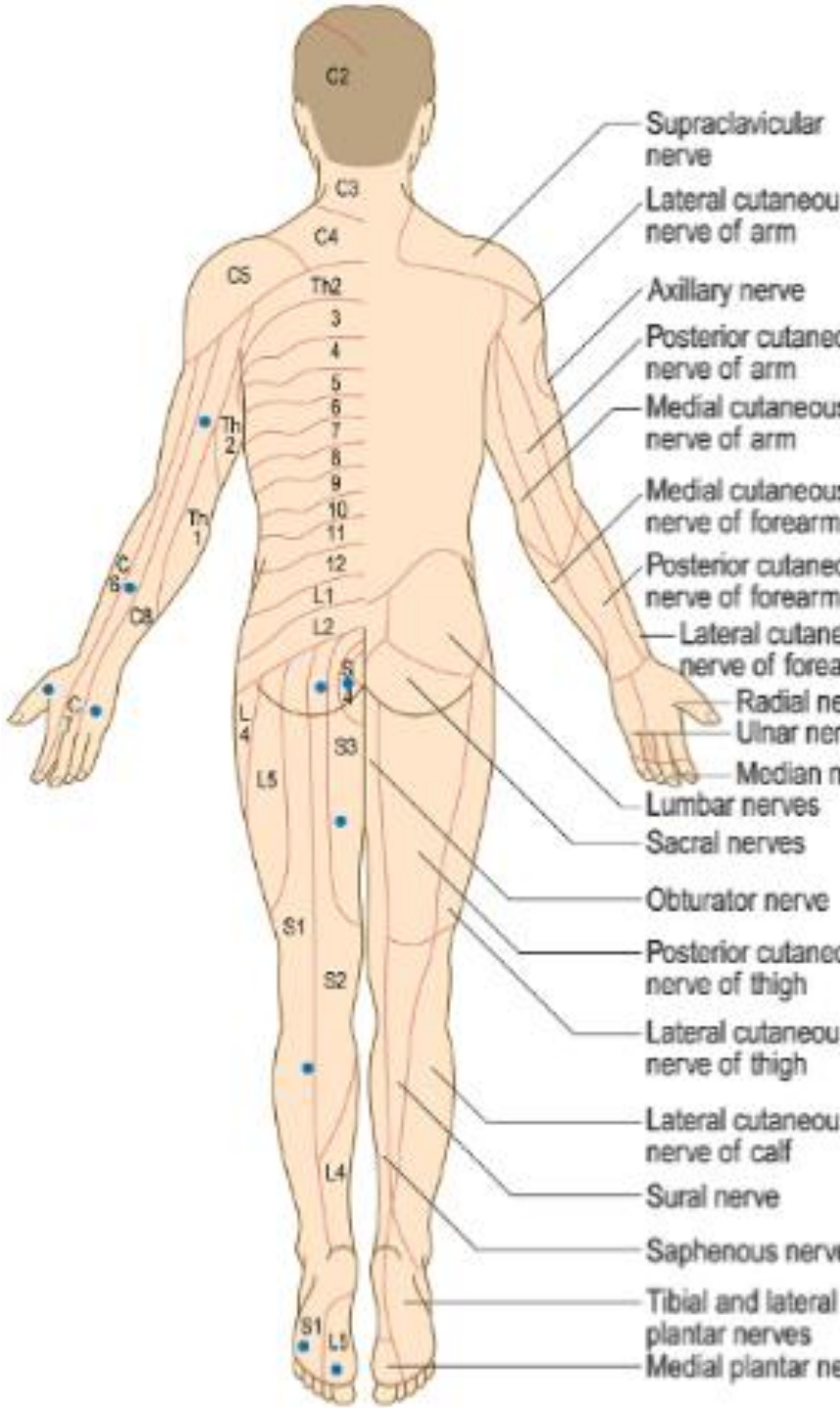
abducens
eye movement

vestibulocochlear
hearing and balance

vagus
movement, sensation, and abdominal organs

hypoglossal
movement, sensation, and abdominal organs


Supraclavicular nerve
Axillary nerve
Lateral cutaneous nerve of arm
Medial cutaneous nerve of arm
Medial cutaneous nerve of forearm
Lateral cutaneous nerve of forearm
Radial nerve
Ulnar nerve
Median nerve
XII thoracic nerve
Lateral cutaneous nerve of thigh
Femoral branch of genitofemoral nerve
Ilioinguinal nerve
Medial and intermediate cutaneous nerve of thigh
Obturator nerve
Lateral cutaneous nerve of calf
Saphenous nerve
Superficial peroneal nerve
Sural nerve
Deep peroneal nerve
C4
C5
C6
C7
C8
Th1
Th2
L1
L2
L3
L4
L5
S1

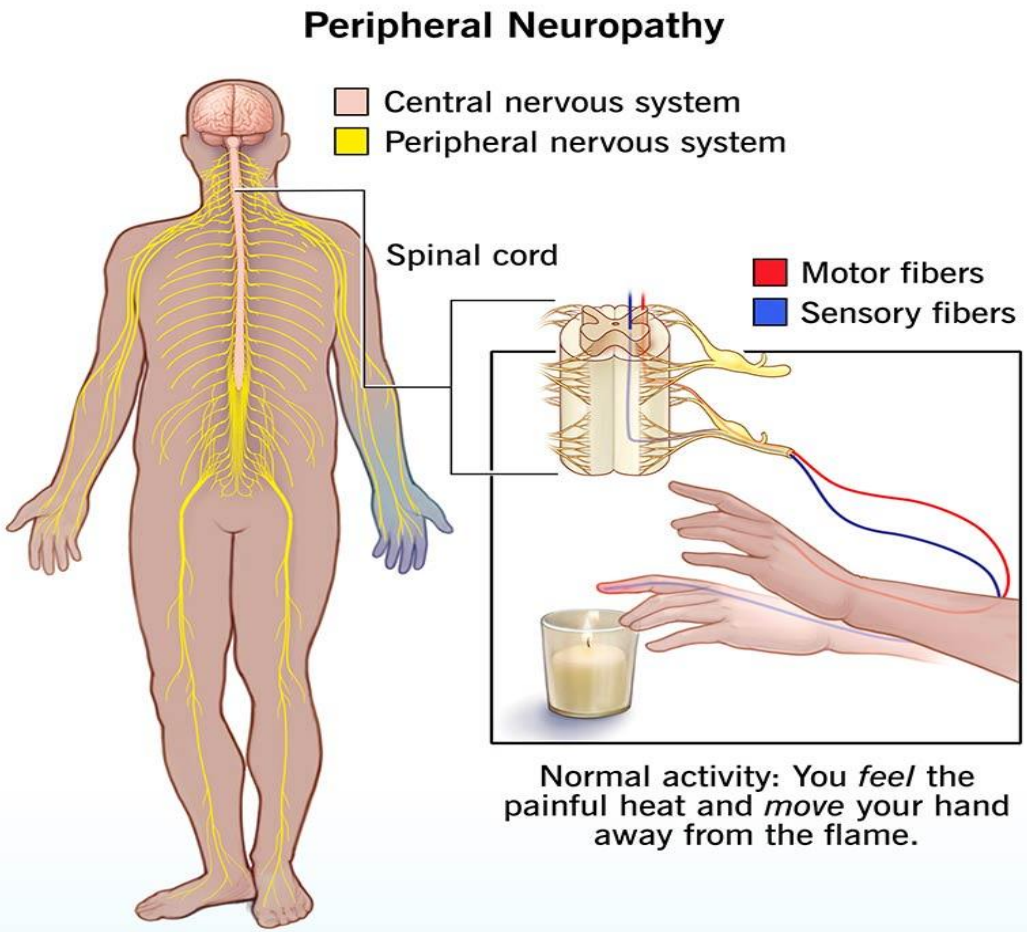

C2
C3
C4
C5
Th2
Th1
C6
C8
L1
L2
L4
L5
S1
S2
S3
Supraclavicular nerve
Lateral cutaneou nerve of arm
Axillary nerve
Posterior cutane nerve of arm
Medial cutaneou nerve of arm
Medial cutaneou nerve of forearm
Posterior cutane nerve of forearm
Lateral cutane nerve of forea
Radial ne
Ulnar ner
Median n
Lumbar nerves
Sacral nerves
Obturator nerve
Posterior cutane nerve of thigh
Lateral cutaneou nerve of thigh
Lateral cutaneou nerve of calf
Sural nerve
Saphenous nerv
Tibial and lateral plantar nerves
Medial plantar ne

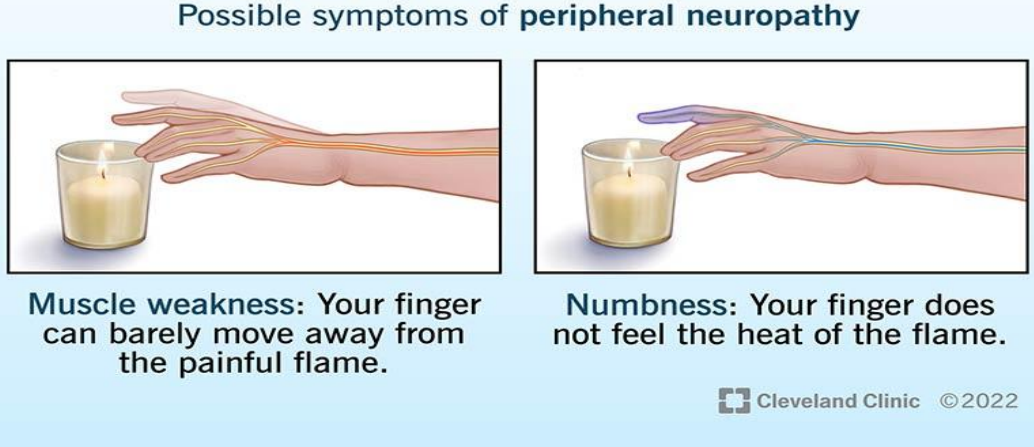
The symptoms are:

- Motor.
- Sensory and pain.
- Autonomic.

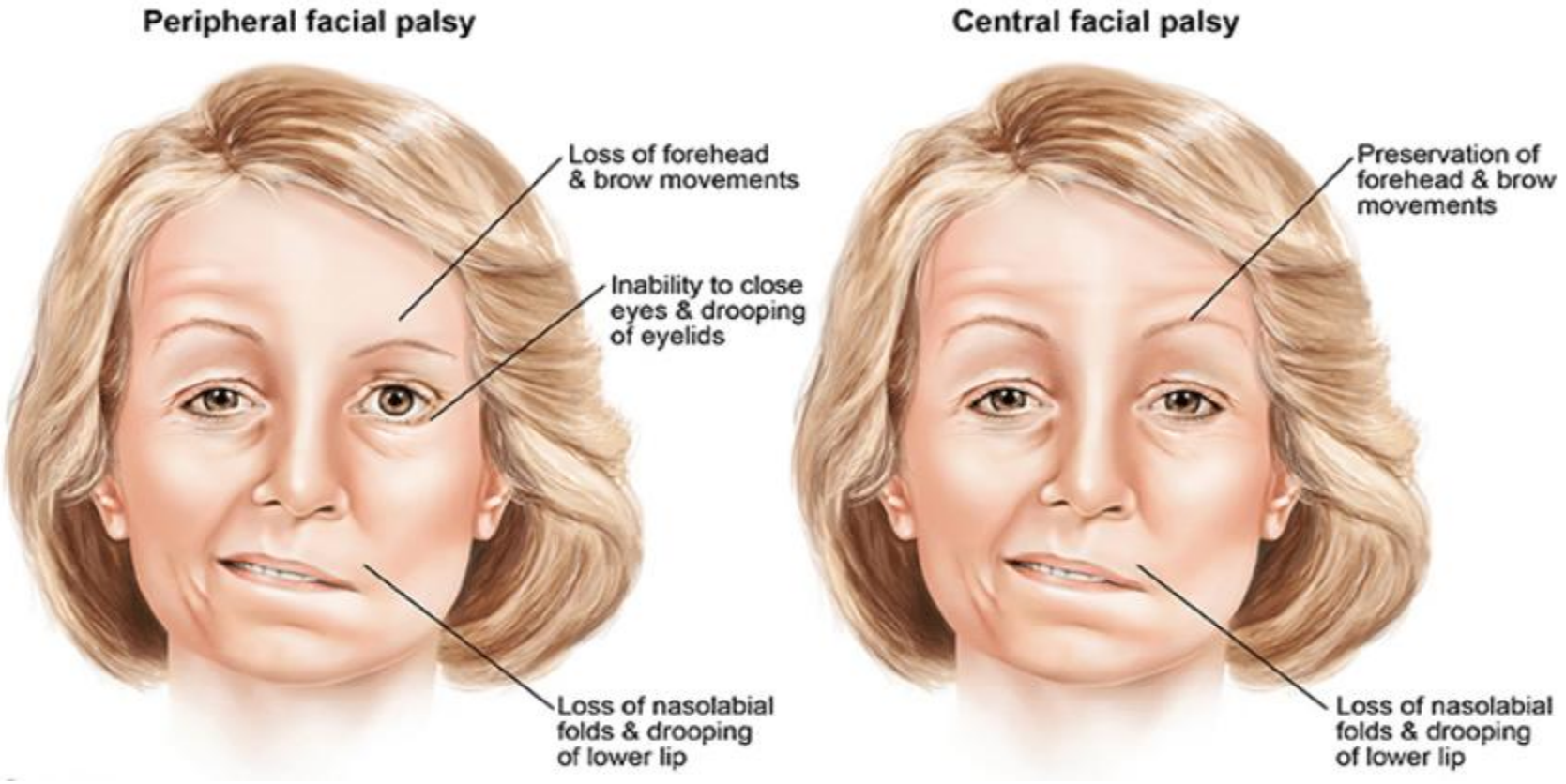
Peripheral neuropathy happens in two main ways:

- Demyelinating neuropathy
- Axonal degeneration





60-year-old female patient presented to neurology clinic with history of **left sided facial weakness, mouth deviation to the right, inability to close the left eye of 1 day duration.**



A 50-year-old female patient known to have **diabetes and hypothyroidism** presented to clinic with history of **unpleasant tingling sensation in both hands especially at night** of three months duration. Upon examination, you noticed **weak thumb abduction and no muscle weakness.**

Carpal tunnel syndrome

- is the most common entrapment neuropathy
- This may be compressed as it passes between the flexor retinaculum and the carpal bones at the wrist
- initially produces sensory symptoms

Common peroneal nerve

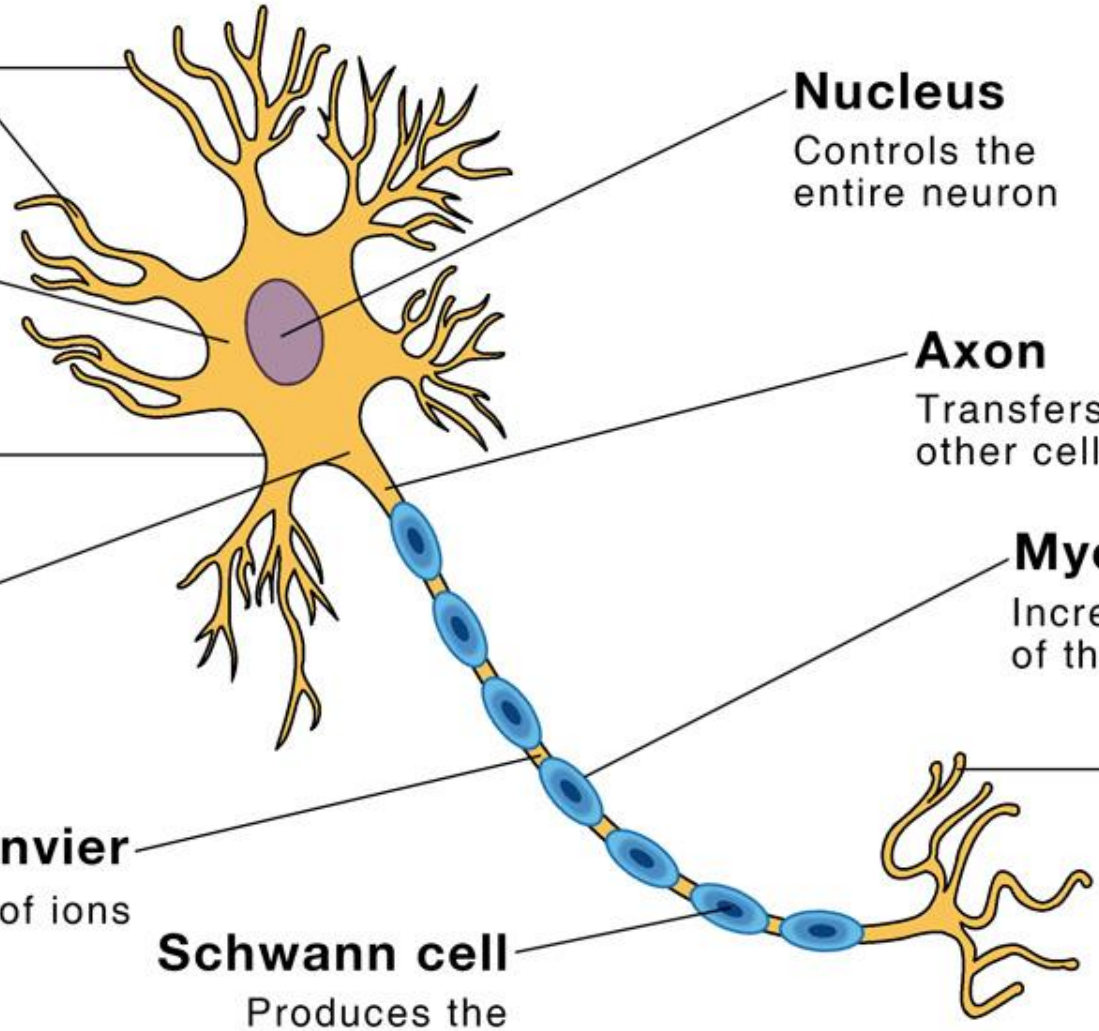
- This typically presents with foot drop.

- It may be damaged in fibular head fractures, or compressed particularly in immobile patients, or because of repetitive kneeling or squatting.

Neuron Structure

- Cell body
- Dendrites receive signals
- Axon transmits signals
- Synapse = communication

Parts of a Neuron with Functions



Dendrites
Receive signals from other cells

Cell body
Organizes and keeps the cell functional

Cell membrane
Protects the cell

Axon hillock
Generates impulse in the neuron

Nucleus
Controls the entire neuron

Axon
Transfers signals to other cells and organs

Myelin sheath
Increases the speed of the signal

Axon terminal
Forms junctions with other cells

Node of Ranvier
Allow diffusion of ions

Schwann cell
Produces the myelin sheath

Think-Pair-Share

- What happens if myelin is lost?

A. Faster conduction

B. Slower conduction

C. No change

Clinical Correlations

Multiple Sclerosis → demyelination

Parkinson's → basal ganglia

Stroke → blood supply interruption

Quick Quiz

- Which is part of PNS?

A. Brain

B. Spinal cord

C. Cranial nerves

Quick Quiz

- Which of the following is not considered as parietal lobe function?

A. Calculation

B. Vision

C. Sensation

Quick Quiz

- Which is of the following is a PNS disease?

A. Multiple Sclerosis

B. Dementia

C. Trigeminal Neuralgia