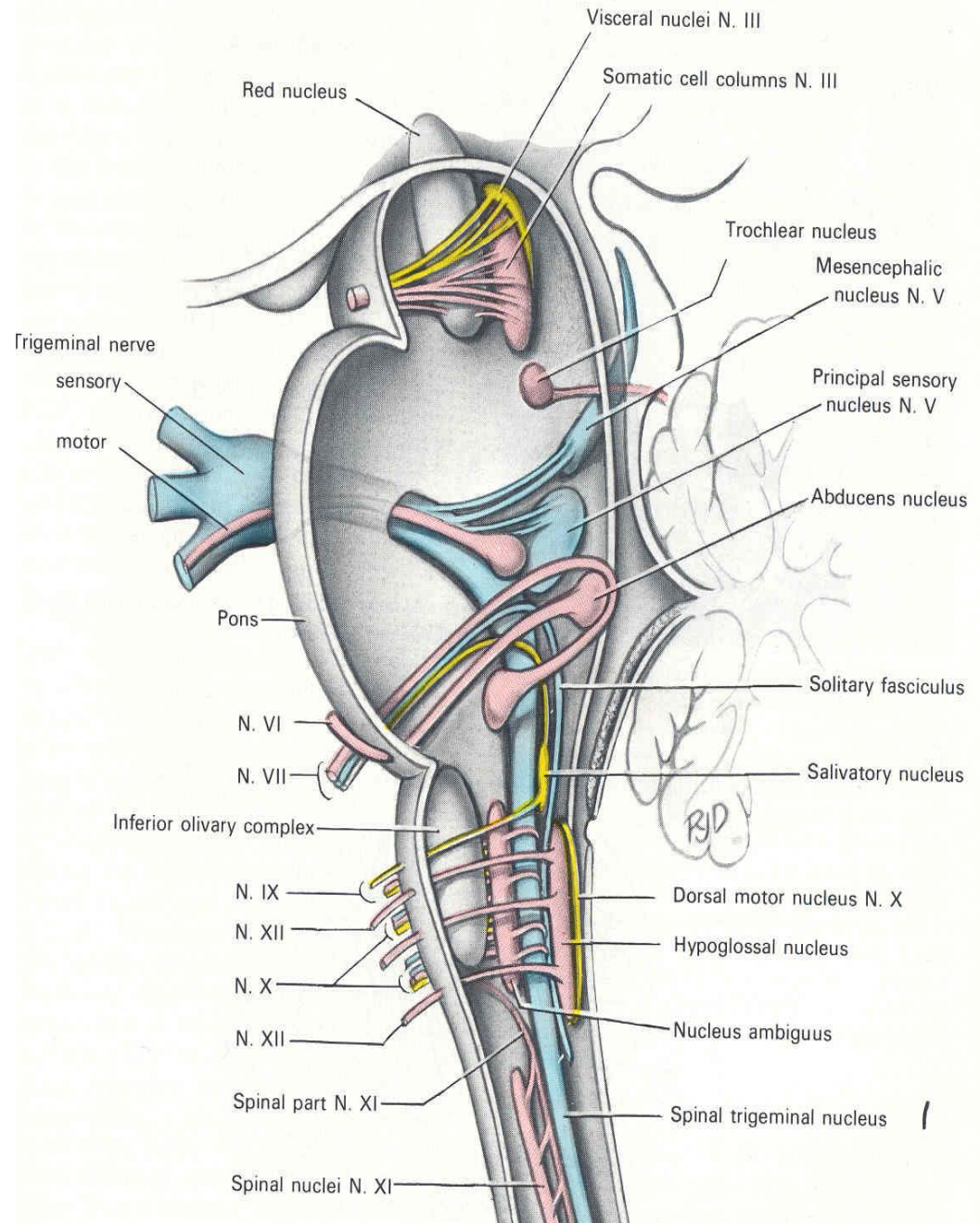


THE CRANIAL NERVES

2, 3, 4, 6

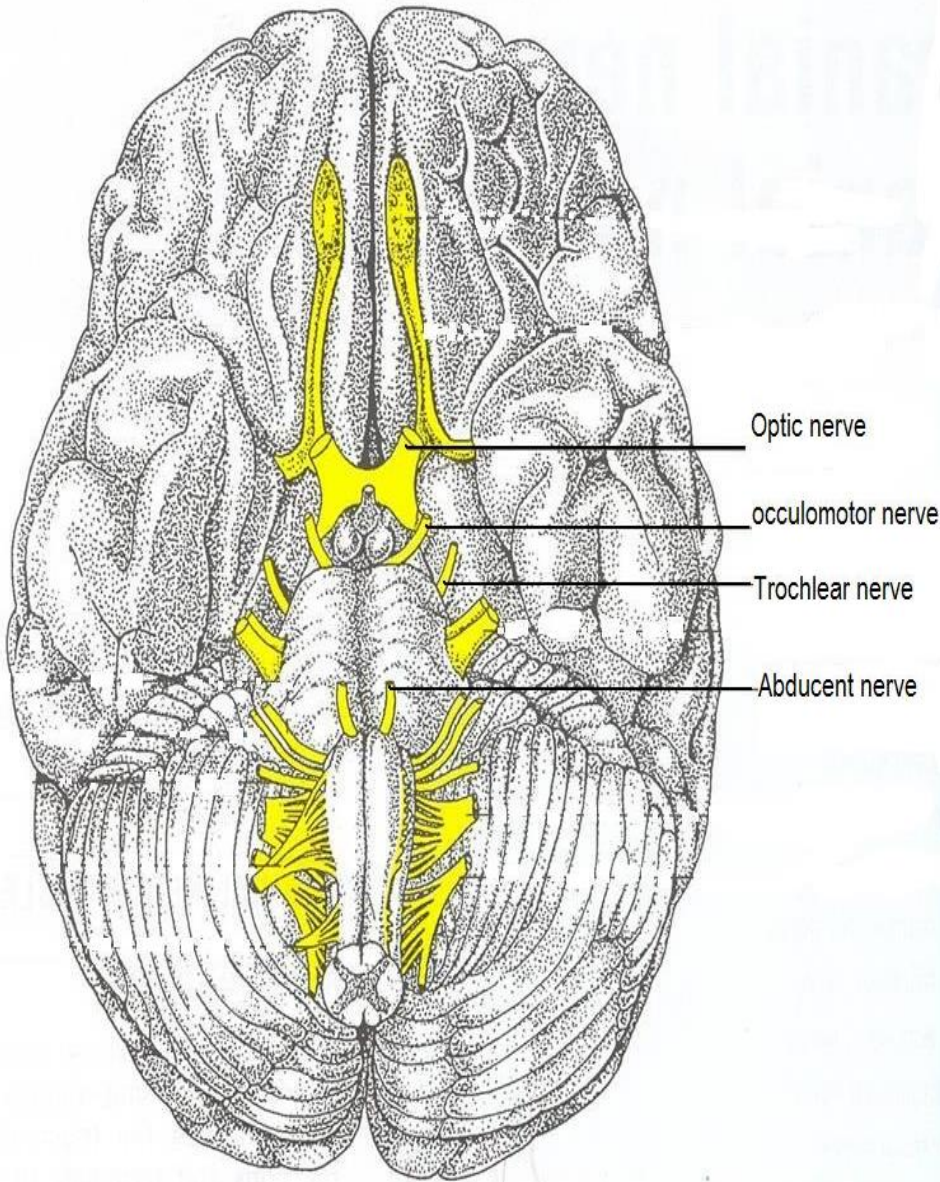


Prof. Saeed Abuel Makarem

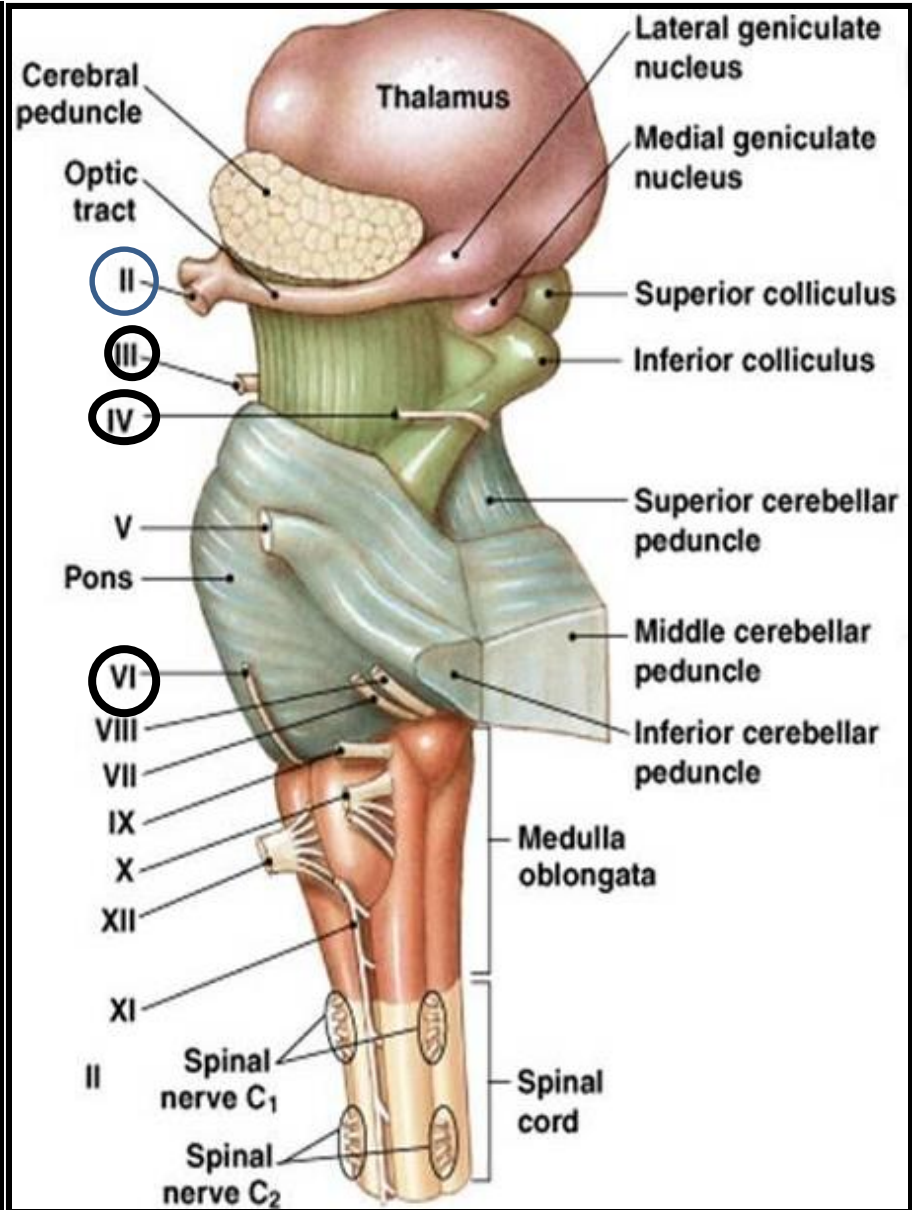
Objectives

By the end of the lecture, you should be able to:

- List the cranial nuclei related to oculomotor trochlear, and abducent nerves in the brain stem.
- Describe the type and site of each nucleus.
- Describe the site of emergence and course of these 3 nerves.
- List the orbital muscles supplied by each of these 3 nerves.
- Describe the effect of lesion of each of these 3 nerves.
- Describe briefly the optic nerve and visual pathway.



Brain (Ventral view)



Brain stem (Lateral view)

- **EXTRA-OCULAR MUSCLES (7 muscles).**

- **Levator palpebrae superioris.**

- **4 Recti muscles:**

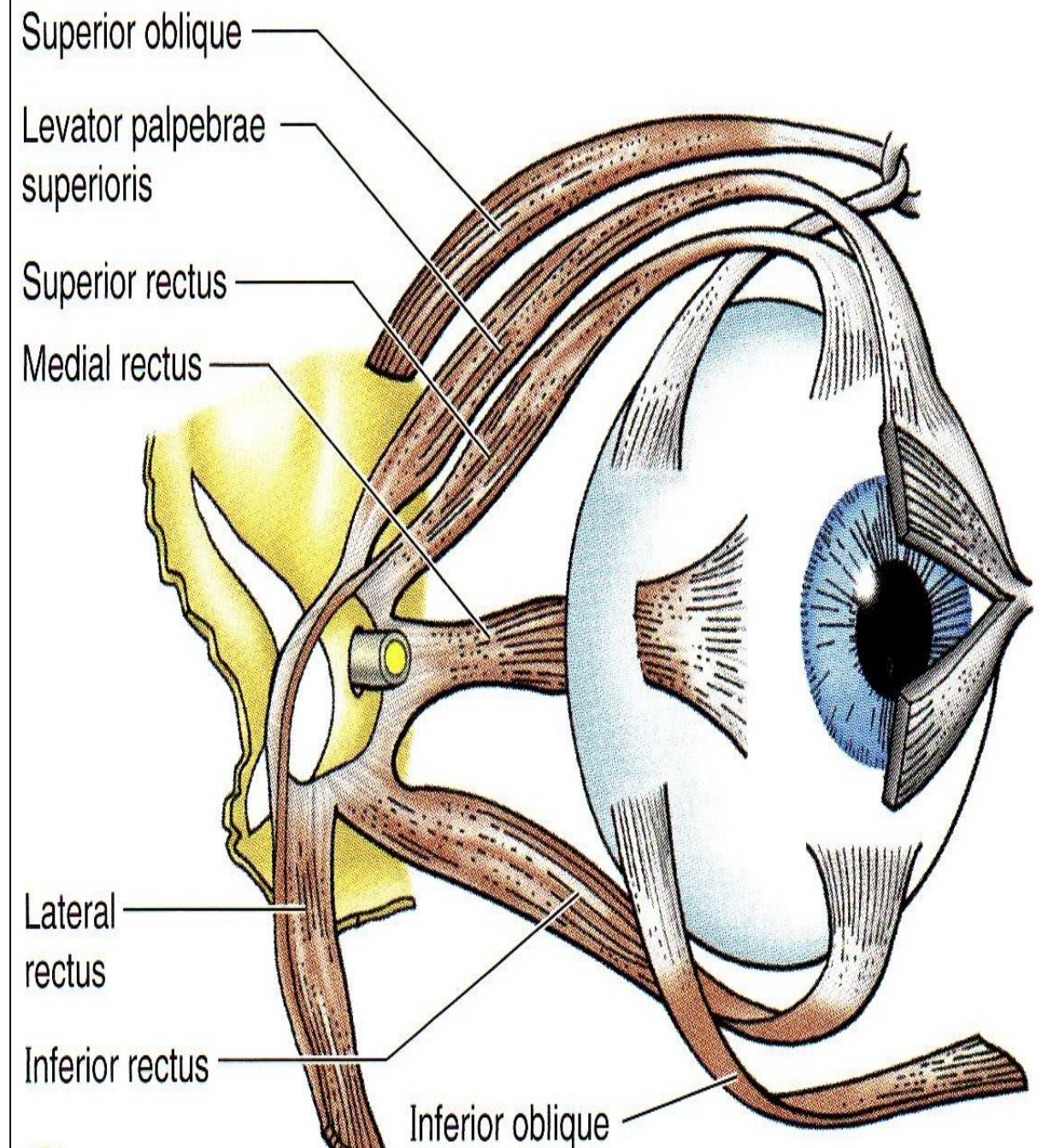
- **Medial rectus,**
- **Lateral rectus,**
- **Superior rectus,**
- **Inferior rectus.**

- **2 Oblique muscles:**

- **Superior oblique,**
- **Inferior oblique.**

- **NB. All muscles of the eye are supplied by the oculomotor nerve,**

- **EXCEPT LR6 + SO4**



Oculomotor Nerve

➤ **Motor** for most of **extraocular muscles**.

➤ Also carries preganglionic **parasympathetic** fibers to the pupillary constrictor and ciliary muscle.

➤ **Has two nuclei:**

1- Main oculomotor nucleus;

▪ Lies in the mid brain, at the level of **superior colliculus**.

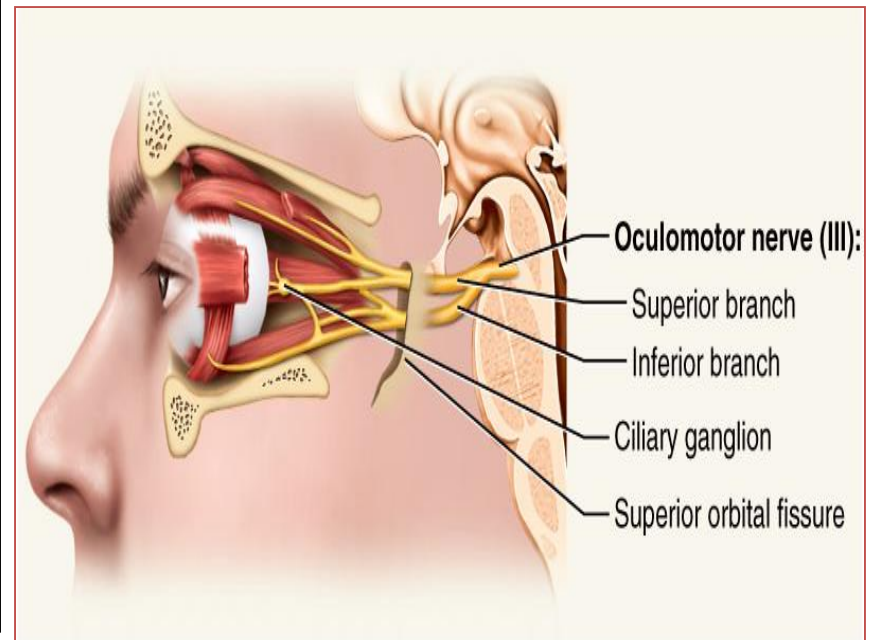
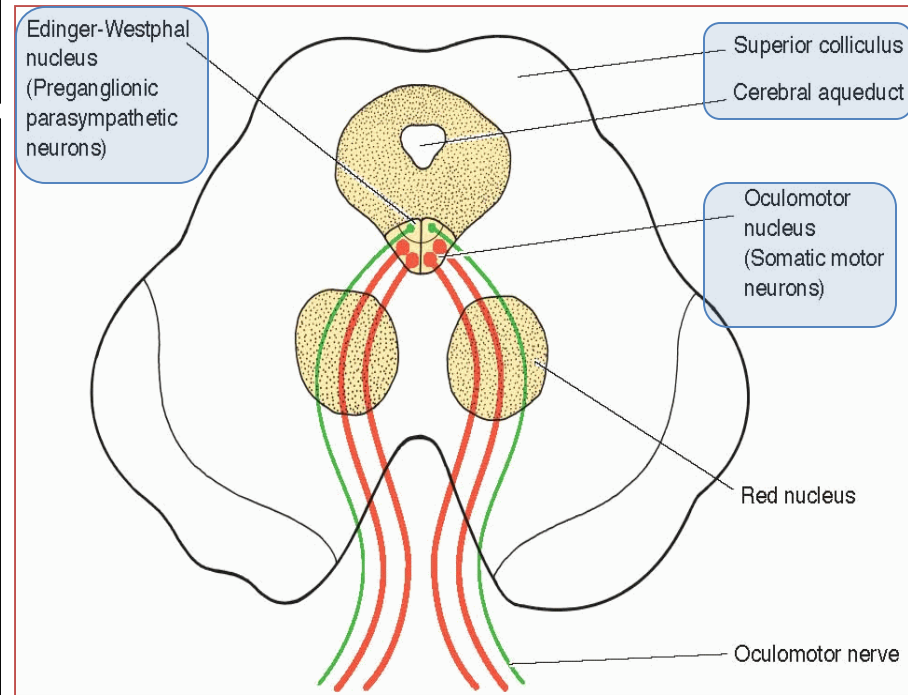
2- Accessory nucleus (Edinger-Westphal nucleus);

▪ Lies **dorsal to the main motor nucleus**,

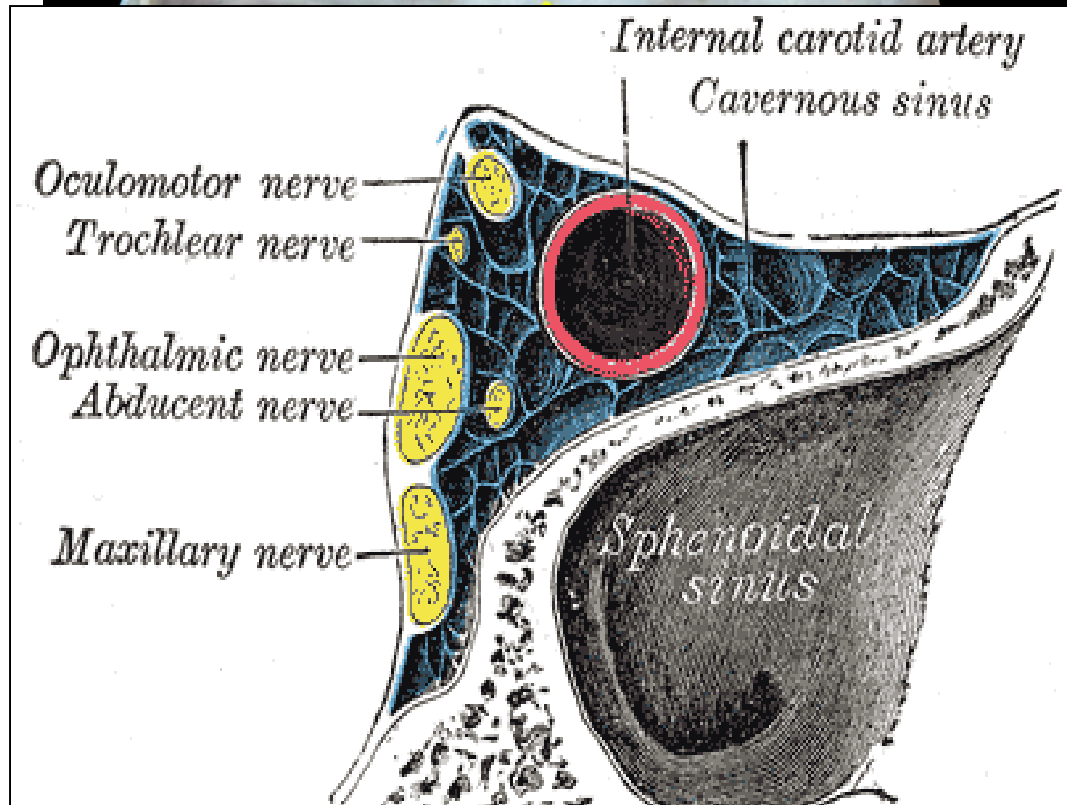
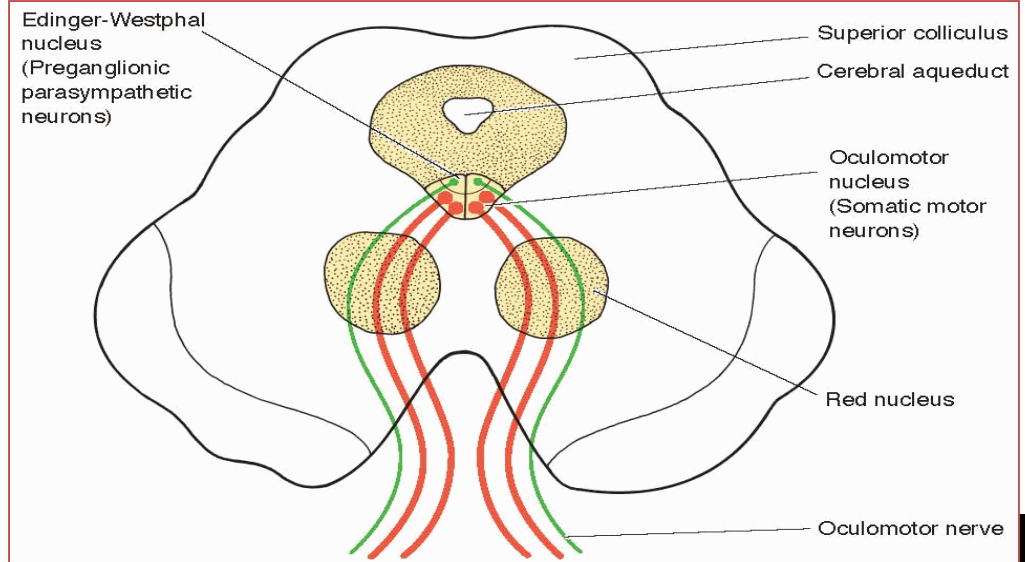
▪ Its cells are preganglionic parasympathetic neurons.

▪ It **receives**; Corticonuclear fibers for the accommodation reflex,

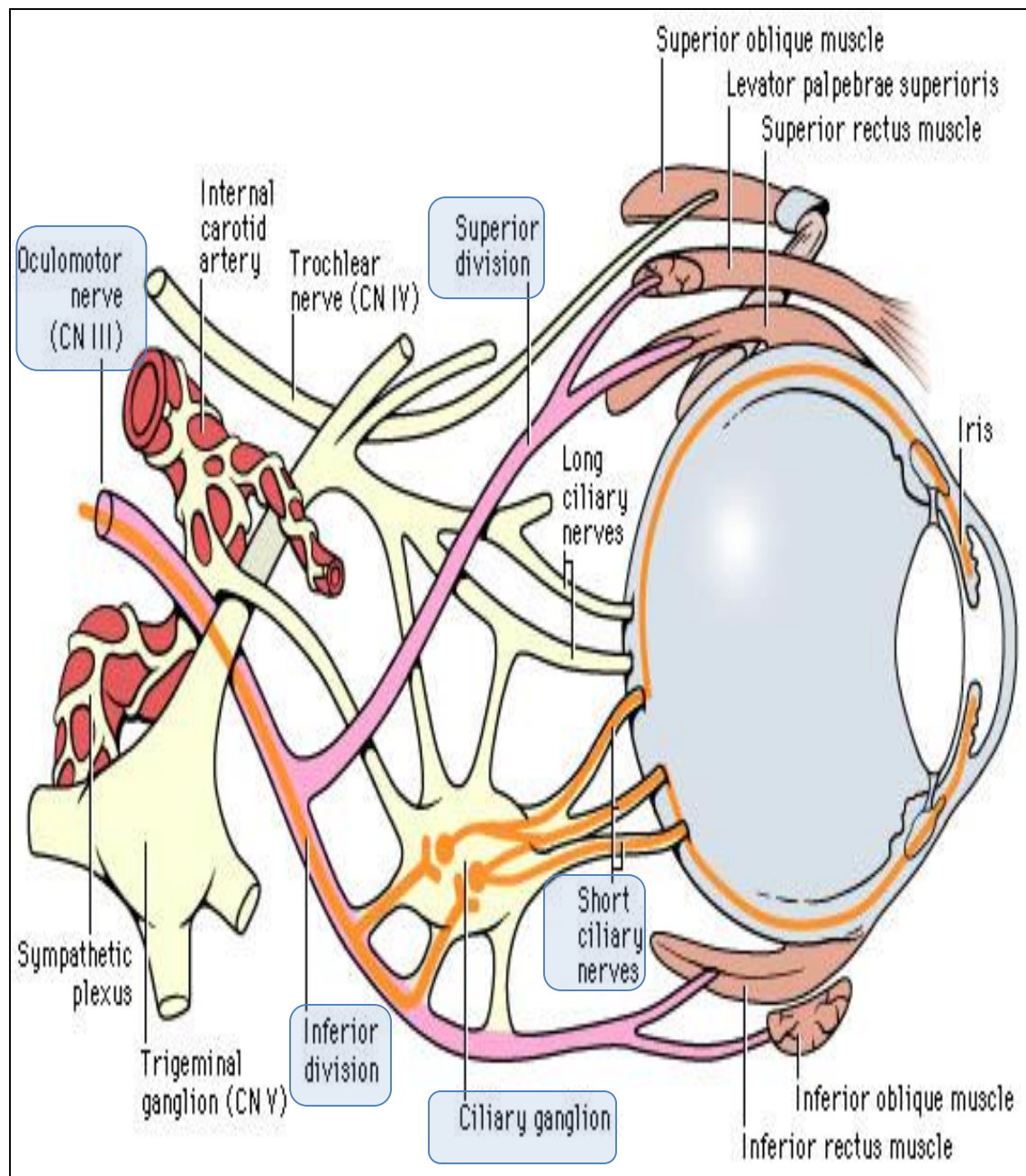
▪ Also from the **pretectal** nucleus for direct and consensual pupillary reflexes.



- Axons from the oculomotor nucleus **curve ventrally** through the tegmentum and the **red nucleus** in the midbrain.
- **The nerve emerges** on the anterior surface of the midbrain in the **interpeduncular fossa**.
- Then it passes forward between **2 arteries**, **posterior cerebral** and **superior cerebellar arteries**.
- In the middle cranial fossa it runs in the **lateral wall of the cavernous sinus**, then it divides into **superior and inferior divisions** which pass through the **superior orbital fissure** to the orbit .



- Axons from the **Edinger-Westphal nucleus** joins the oculomotor nerve fibers to the orbit, where they terminate in the **ciliary ganglion**, (one of the parasympathetic ganglia of the head and neck).
- Postganglionic fibers pass through the **short ciliary nerves** to the eyeball, where they supply:
- **Constrictor pupillae muscle** of the iris and
- **Ciliary muscle**.



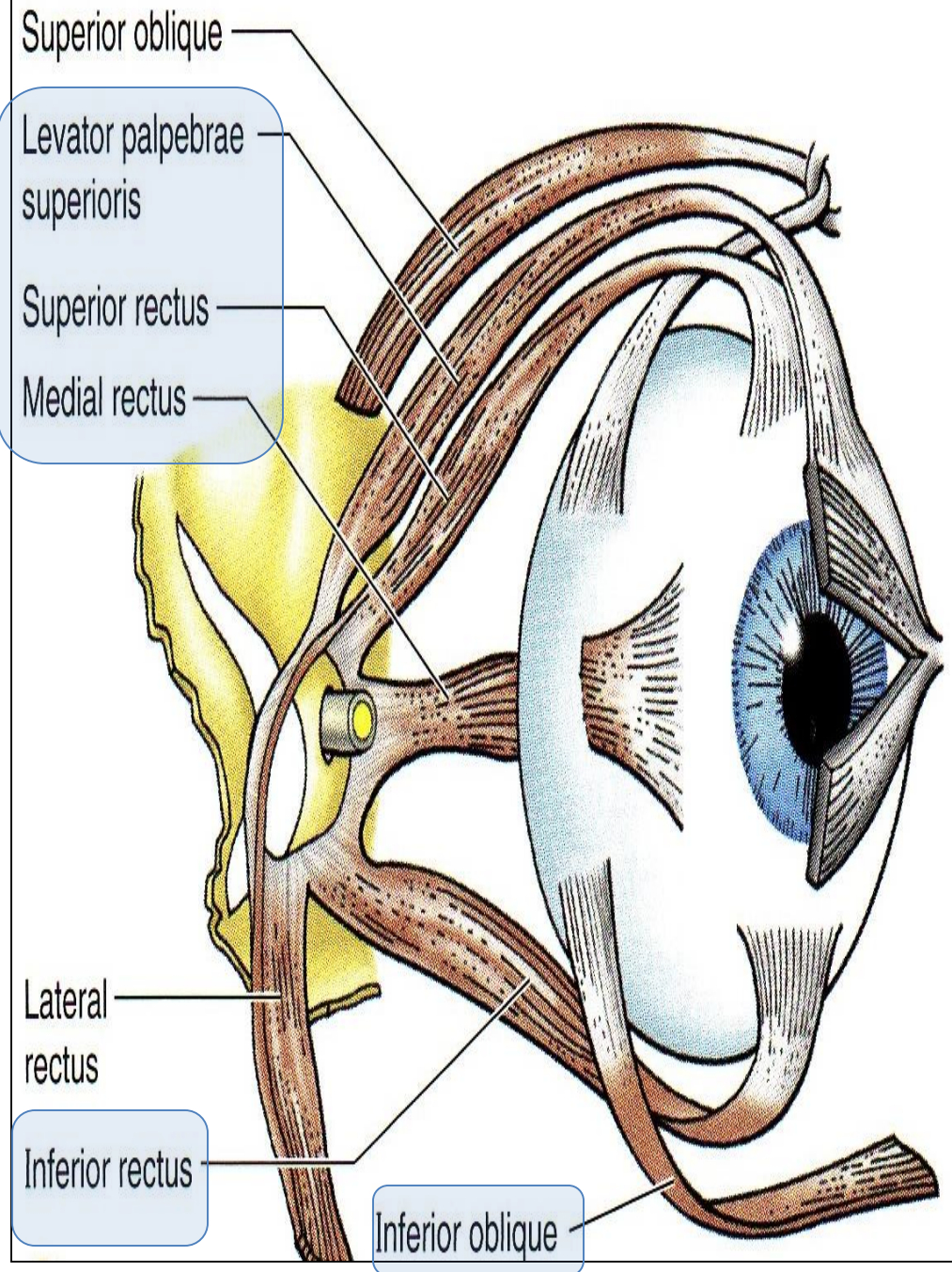
Oculomotor nerve supplies:

➤ Motor to:

1. **Levator palpebrae superioris**
 2. **Superior rectus** muscle
 3. **Medial rectus** muscle
 4. **Inferior rectus** muscle &
 5. **Inferior oblique** muscle.
- Parasympathetic fibers to
- 1- **Constrictor pupillae** and
 - 2- **Ciliary muscles**.

It is responsible for;

- Elevation of upper eyelid (open the eye).
- Turning the eye upward, downwards and medially,
- Constriction of the pupil.
- Accommodation reflex of the eye.



Occulomotor Nerve Lesion

- **Lesion** results in:
 - Lateral squint.
 - Ptosis.
 - Diplopia.
 - Pupillary dilatation.
 - Loss of accommodation.
 - The eye is fully abducted and depressed (down and out) because of the unopposed activity of the lateral rectus and superior oblique muscles.

The preganglionic parasympathetic fibers run **superficially in the nerve** and are therefore the **first axons to suffer** when a nerve is affected by external pressure.

Consequently, the first sign of compression of the oculomotor nerve is **ipsilateral slowness of the pupillary response to light**.



Normal eye alignment



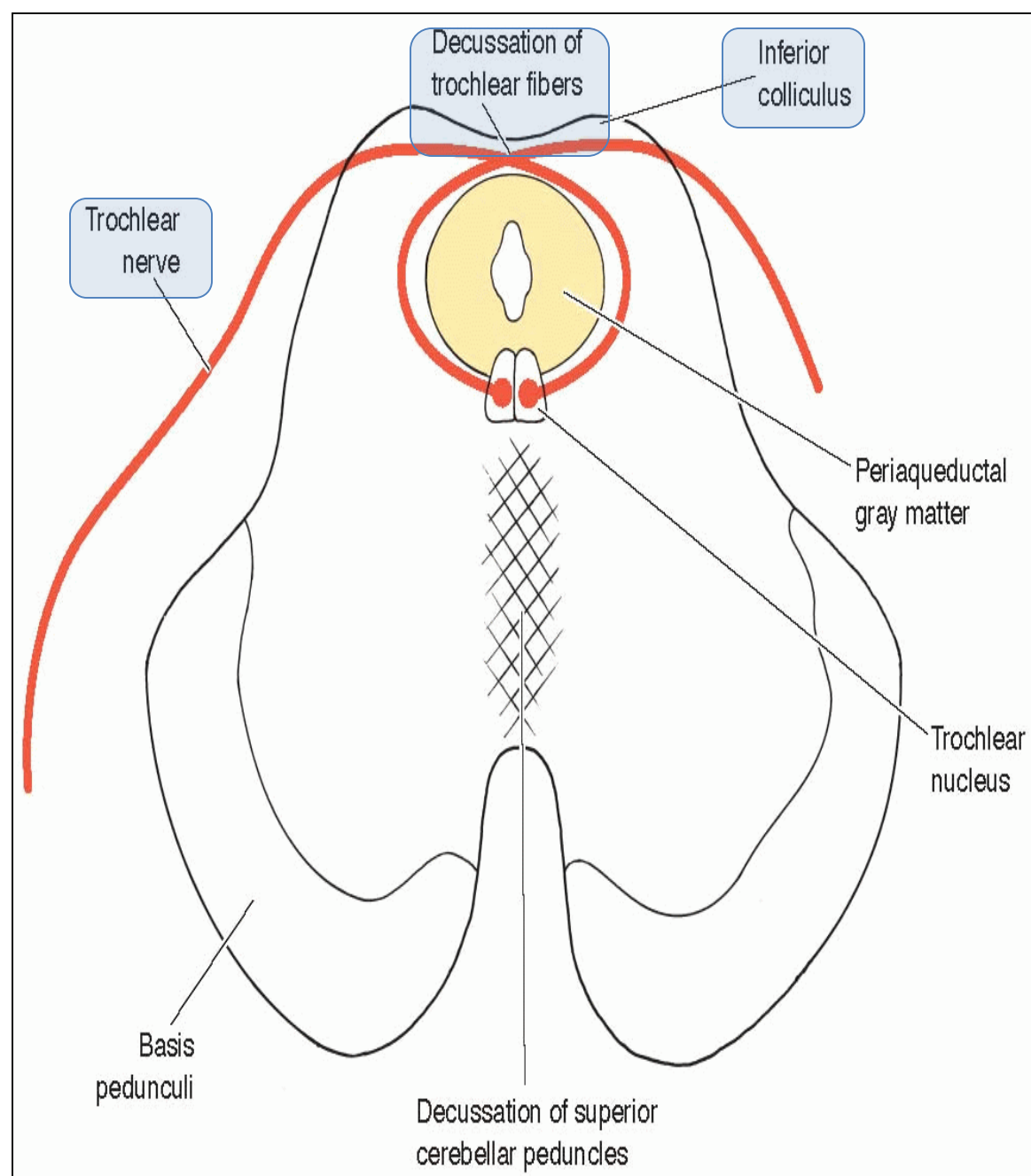
Lateral squint

Ptosis (drooping of the eyelid)



Trochlear Nerve

- ❑ Type: **motor**
- Small motor nucleus located in the **periaqueductal grey matter** at the level of **inferior colliculus**.
- Fibers curve backwards and decussate.
- The nerve **emerges immediately caudal to the inferior colliculus**, on the **dorsal surface of brain stem**.



➤ Then it passes forward through middle cranial fossa in the **lateral wall of the cavernous sinus, below the 3rd cranial nerve.**

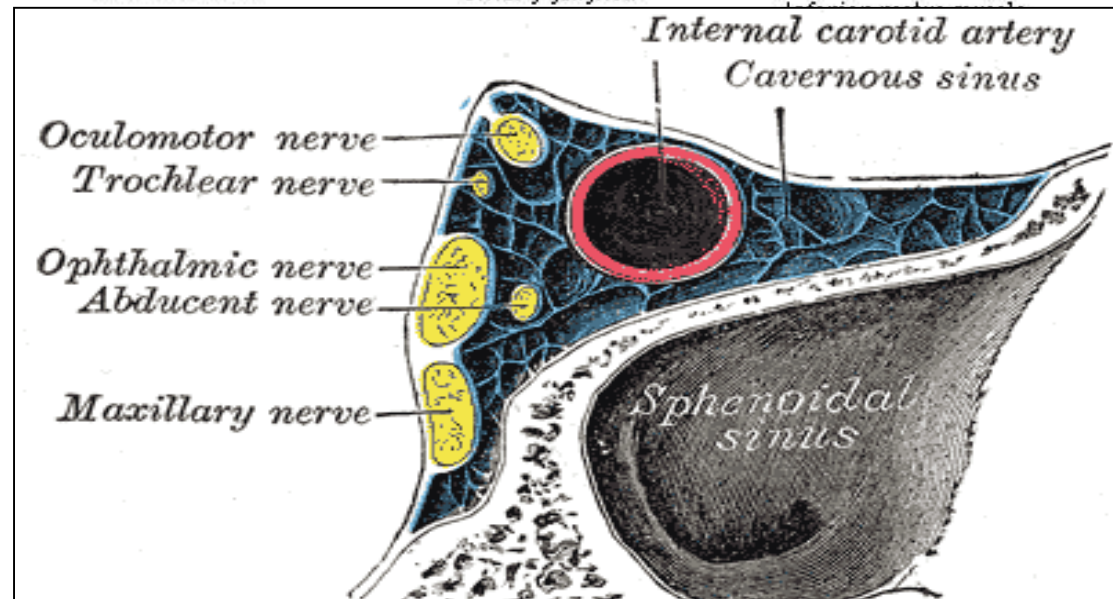
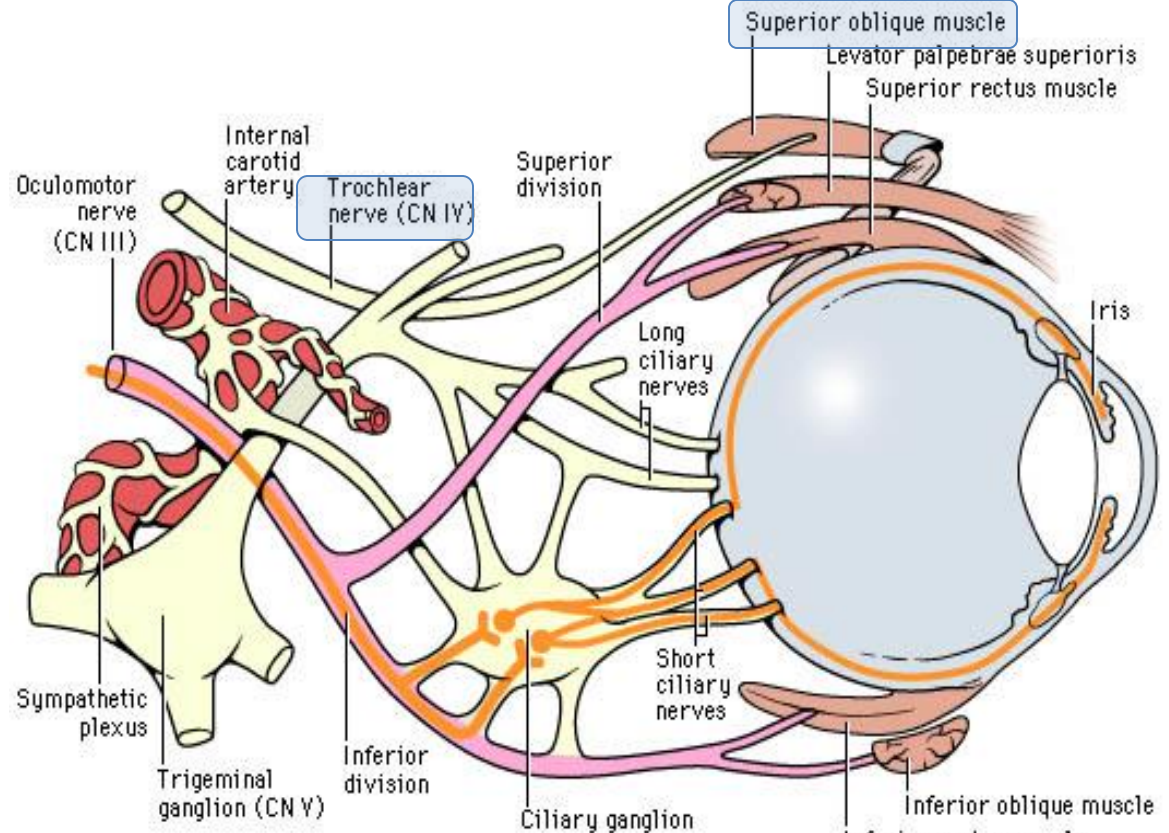
➤ Then it enters the orbit through the superior orbital fissure.

It supplies;

- Superior oblique muscle, (only one muscle).

Its function;

- Rotates the eye ball downwards and laterally.



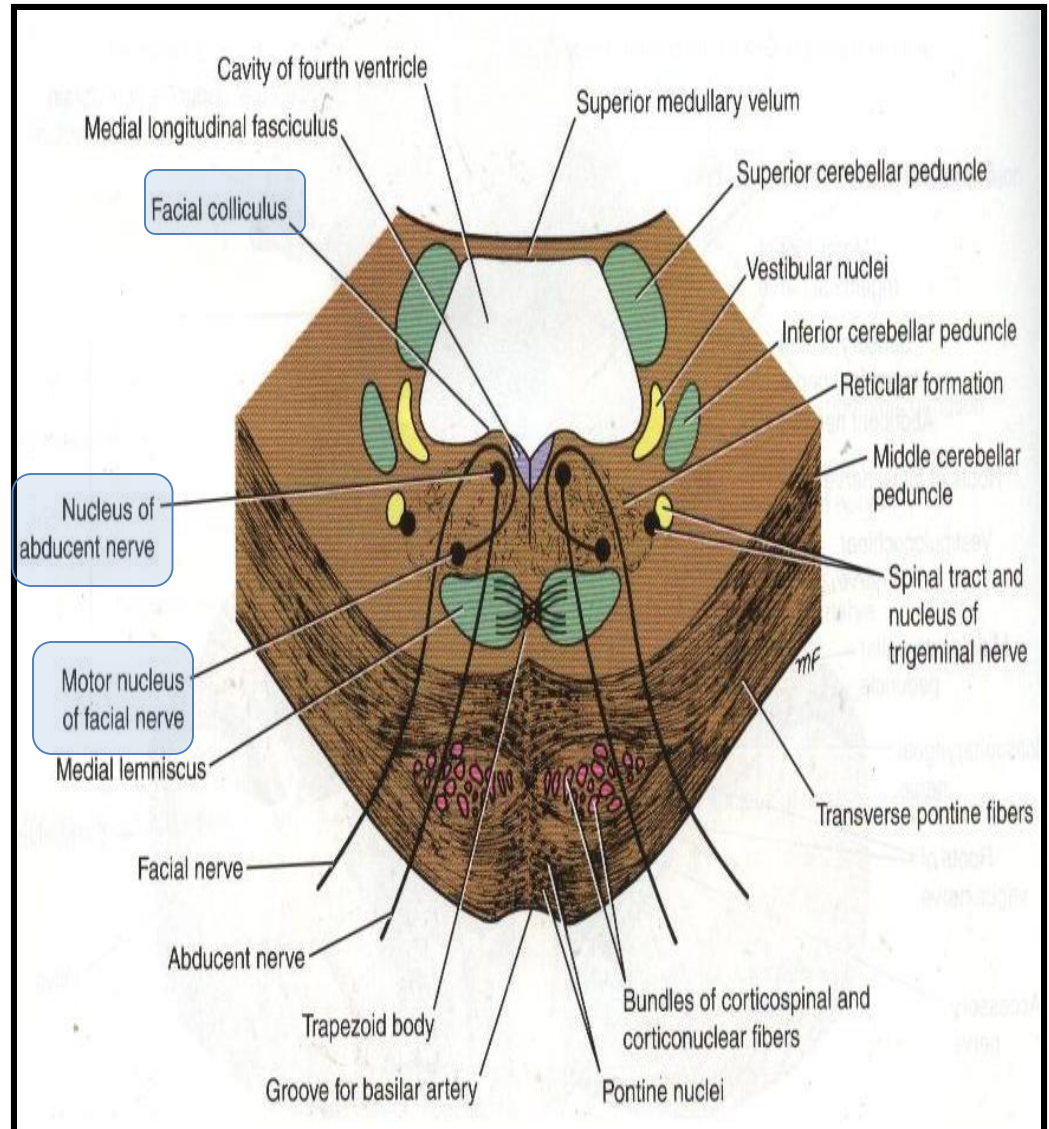
Trochlear Nerve Lesion

- Lesion results in **diplopia &**
- Inability to rotate the eye **infero-laterally**.
- So, the **eye deviates; upward and inward.**
- This person has difficulty in walking downstairs.



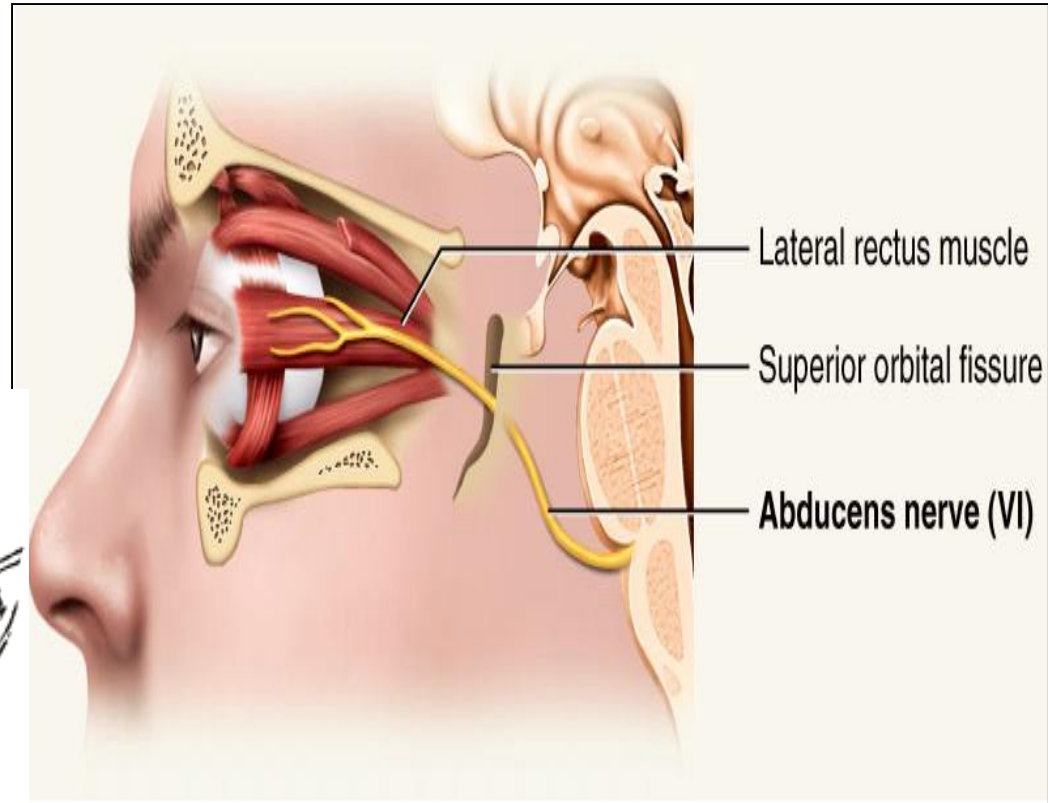
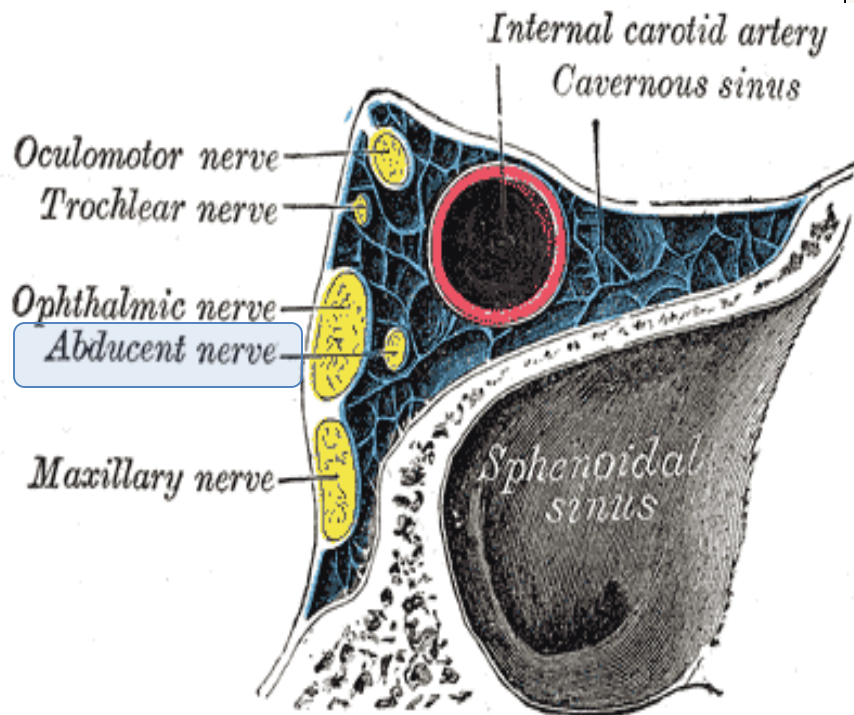
Abducent Nerve

- Only one **motor** nucleus.
- Lies in **caudal** pons in the floor of the **4th ventricle**.
- Lies close to the middle line, in a line with **3rd, 4th & 12th** nerves.
- Fibers of the facial nerve looping around the **Abducent nucleus**, forms the facial colliculus.
- It emerges from the ventral aspect of the brain stem at the junction of the **pons** and **pyramid** of the medulla oblongata.



Abducent Nerve

- It passes through cavernous sinus, lying below and lateral to the **internal carotid artery**.
- Then it enters the orbit through the **superior orbital fissure**.
- **It supplies**; the **lateral rectus** muscle which rotates the eye ball laterally; (abduction).



Abducent Nerve Lesion

Lesion results in:

- Inability to direct the affected eye laterally, so it result in **(medial squint)**.
- A nuclear lesion may also involve the nearby nucleus or axons of the **facial nerve**, causing paralysis of all facial muscles in the ipsilateral side.



Normal eye alignment



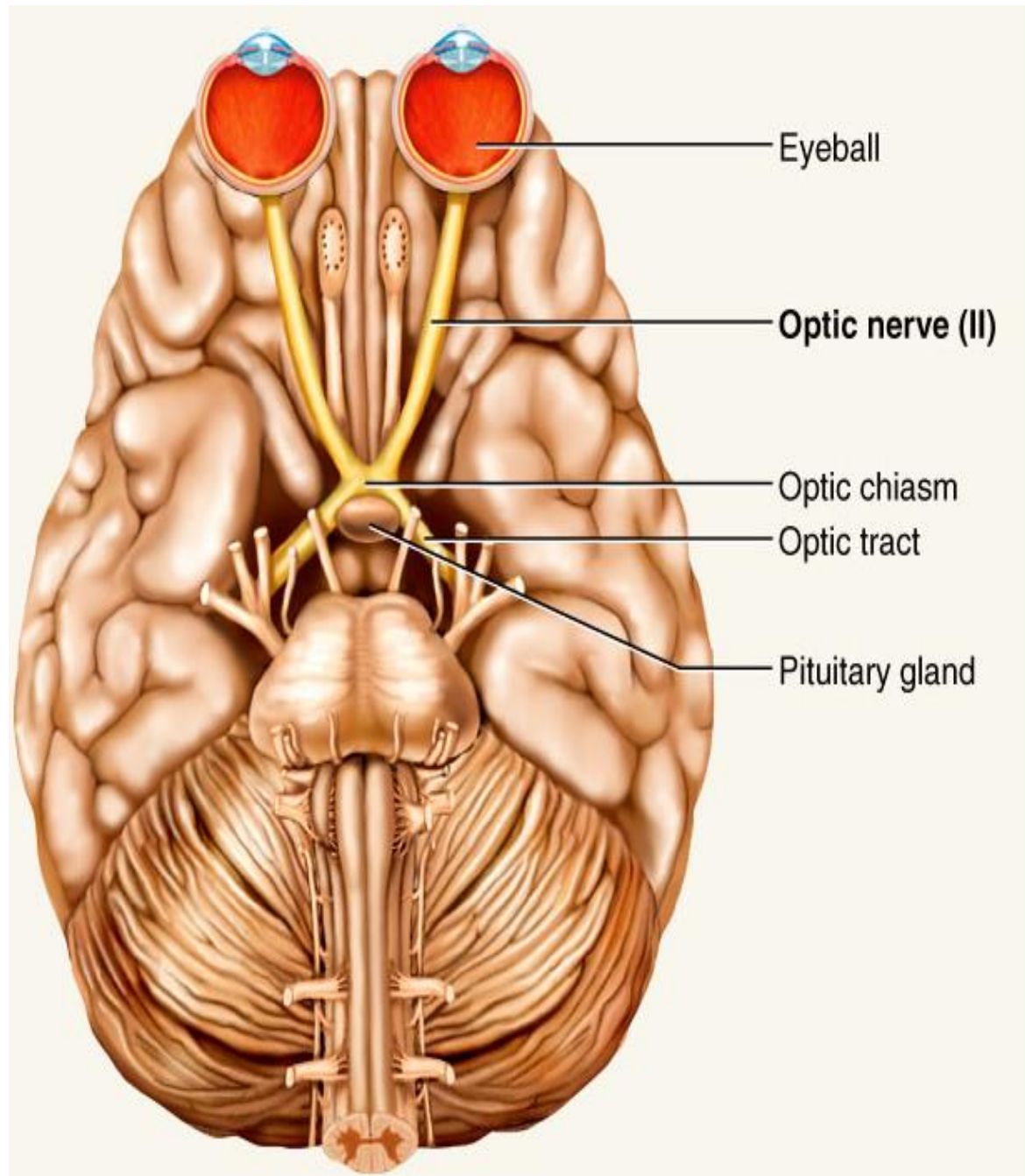
Medial squint

Optic Nerve

Type: **Special sensory**

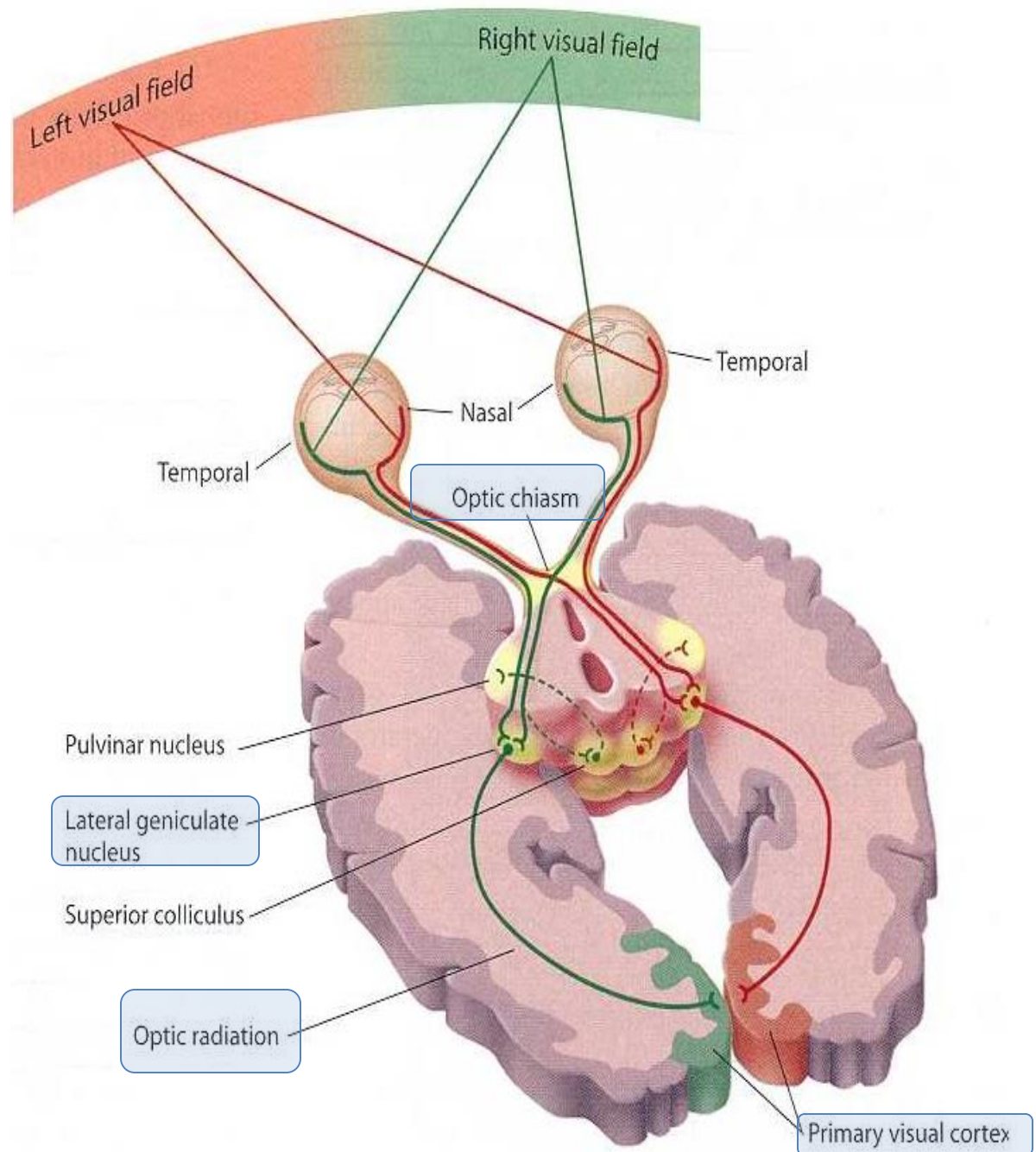
Function: **Vision**

Lesion results in:
visual field defects
and loss of visual
acuity, a defect of
vision is called
anopsia.



Visual Pathway

1. **O**ptic nerve.
2. **O**ptic chiasm.
3. **O**ptic tract.
4. **L**ateral geniculate body (nucleus).
5. **O**ptic radiation.
6. **V**isual cortex.



Visual Pathway

➤ Photoreceptors:

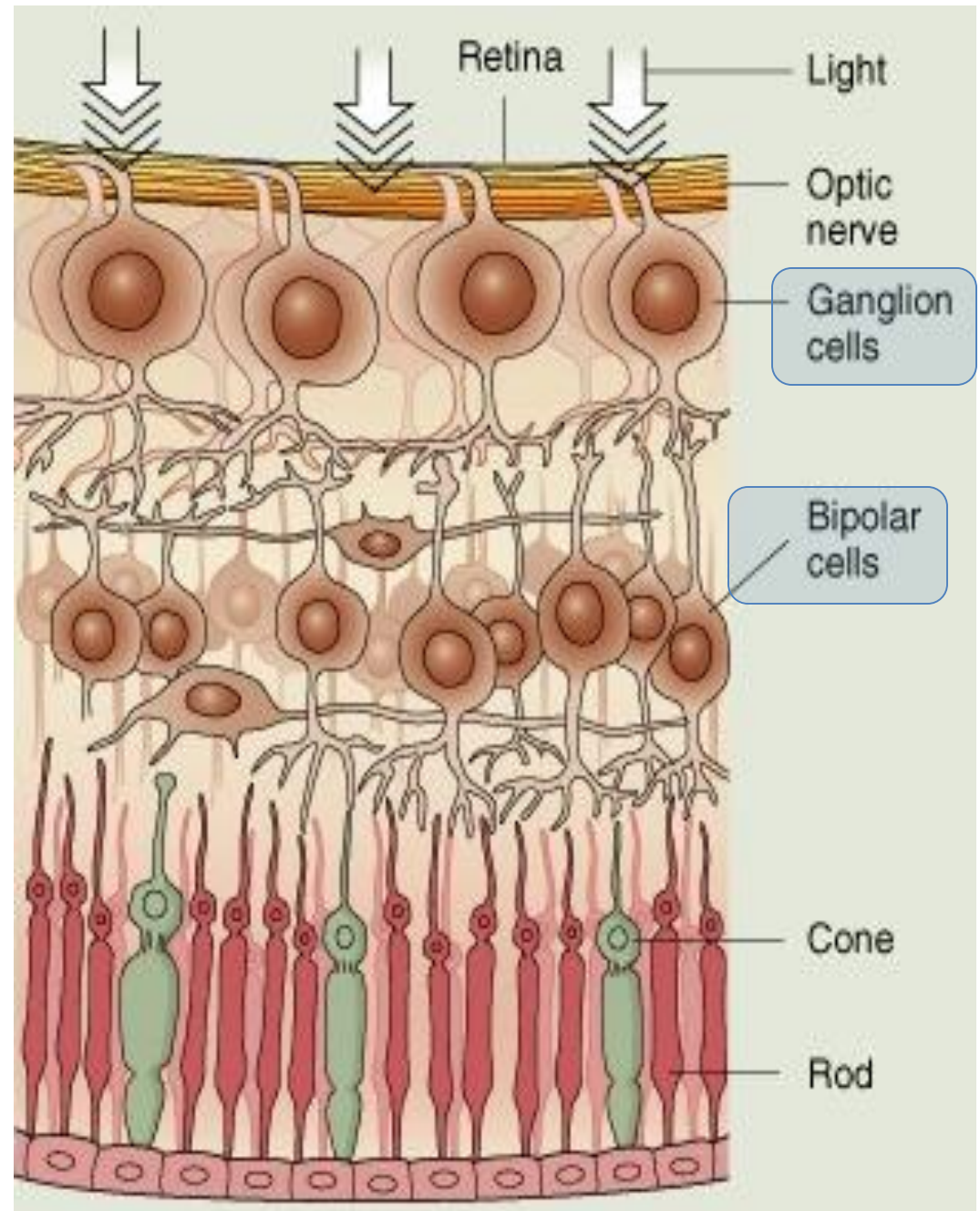
Rods & Cones of the retina.

➤ **Three** neurons pathway:

- **1st order neurons:**
Bipolar cells of retina
- **2nd order neurons:**
Ganglion cells of retina.

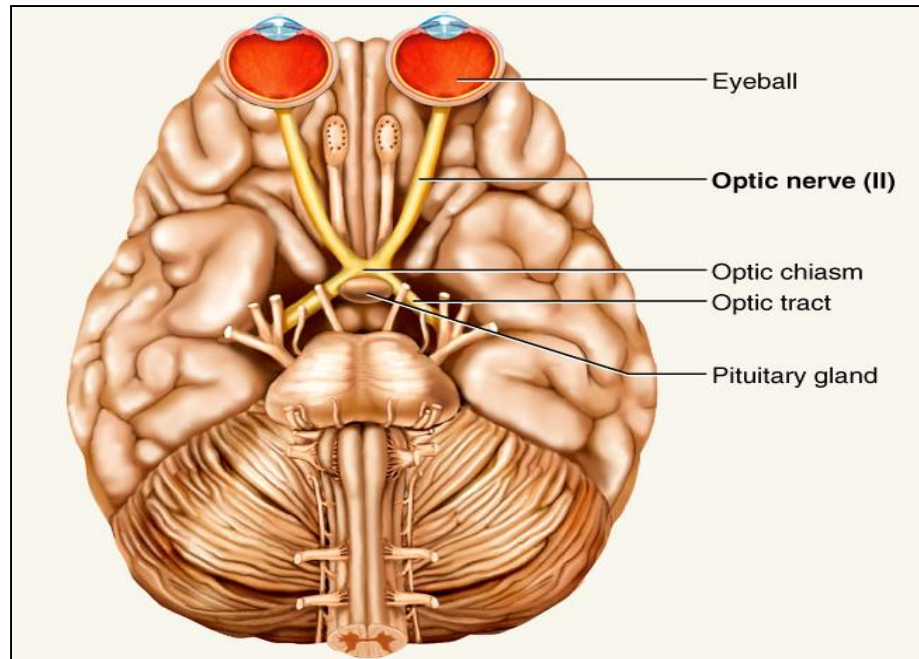
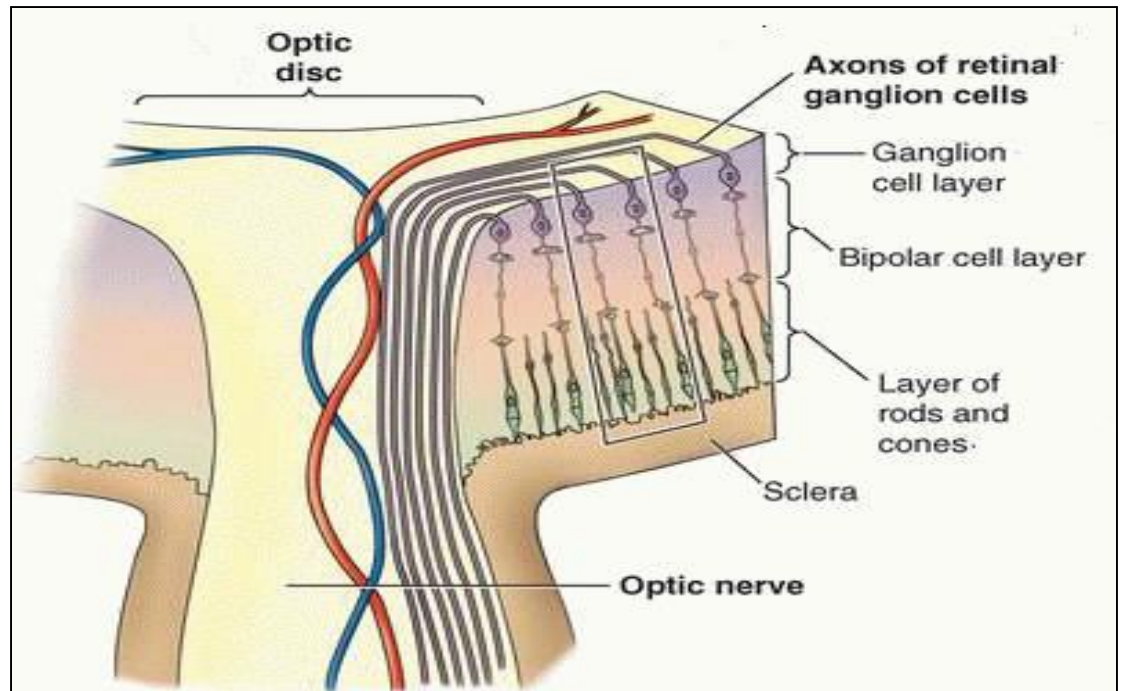
Their axons form the optic nerve

- **3rd order neurons:**
Neurons in the lateral geniculate body.
Their axons terminate in primary visual cortex.



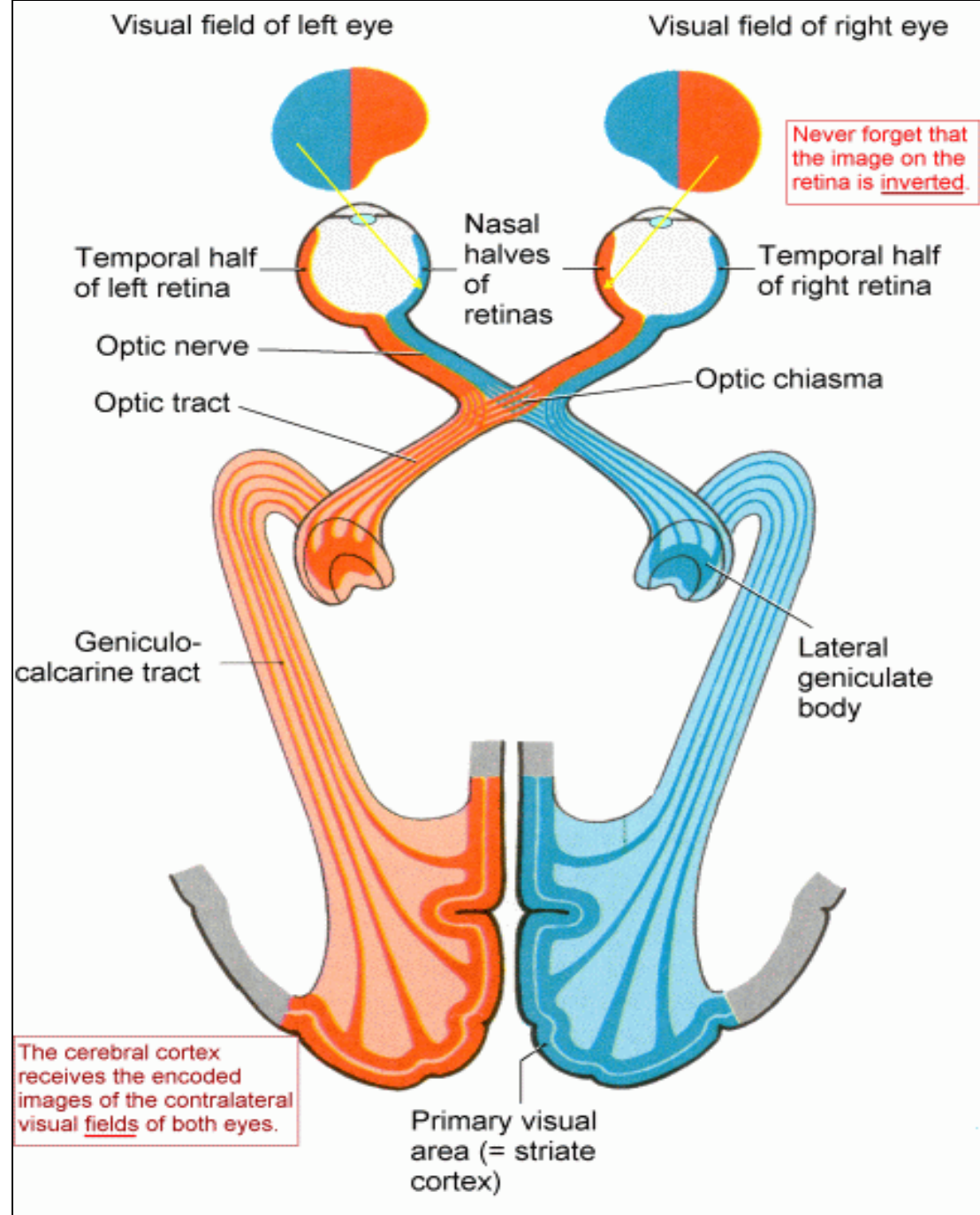
Optic Nerve

- Axons of ganglion cells converge at the **optic disc** and pass as the **optic nerve**.
- Then the nerve passes posteromedially in the orbit.
- Then exits through the **optic canal** to enter the middle cranial fossa to join the **optic chiasma**.



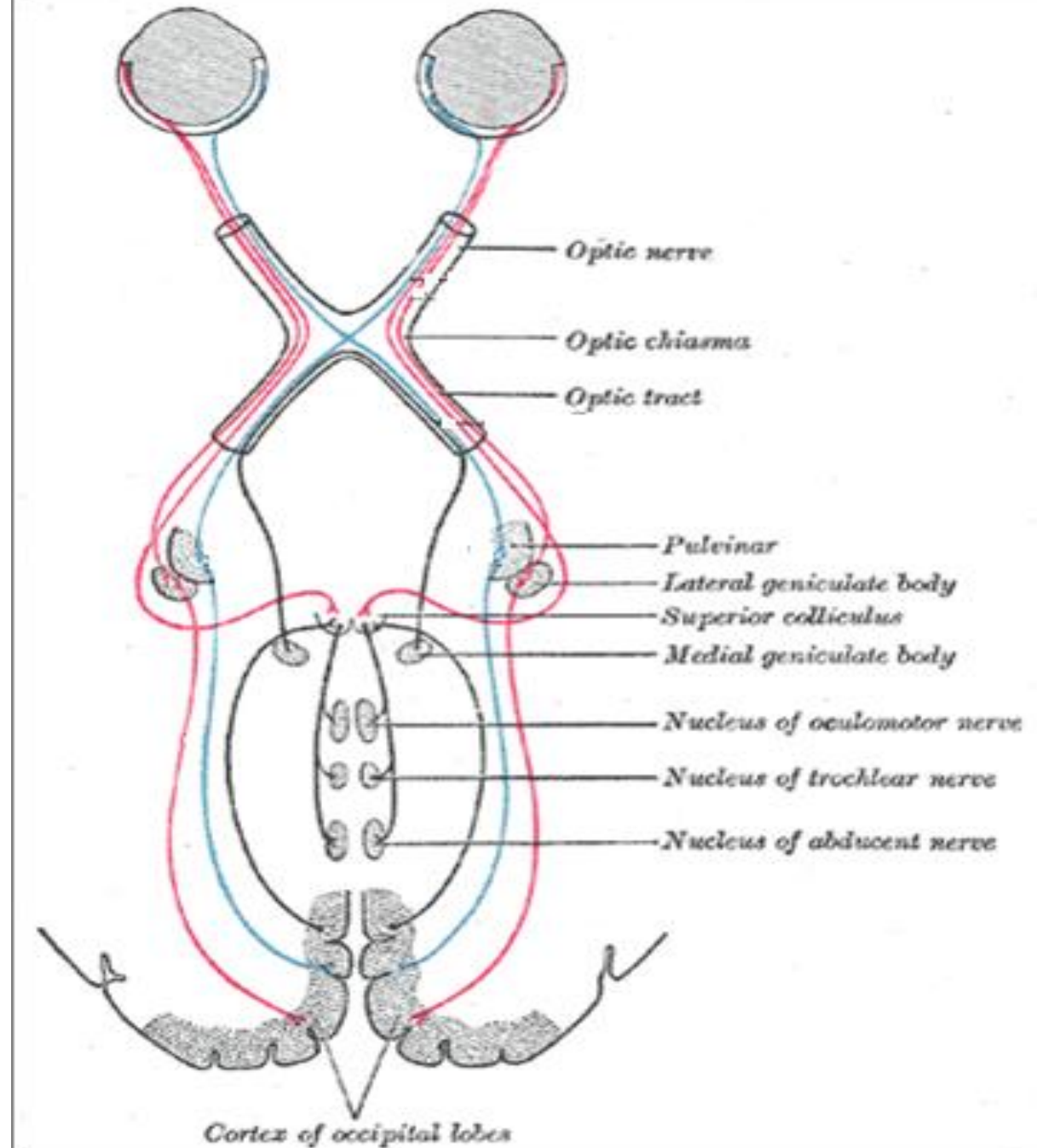
Optic Chiasma

- Fibers from the **nasal (medial) half of retina decussate** in the chiasm and **join uncrossed fibers of the other temporal (lateral) half of the retina** to form the **optic tract**.
- The **decussation** of nerve fibers in the chiasm results in the right optic tract conveying impulses from the left **visual eye field** and vice versa.
- The partial crossing of optic nerve fibers in the optic chiasma is a requirement for **binocular vision**.

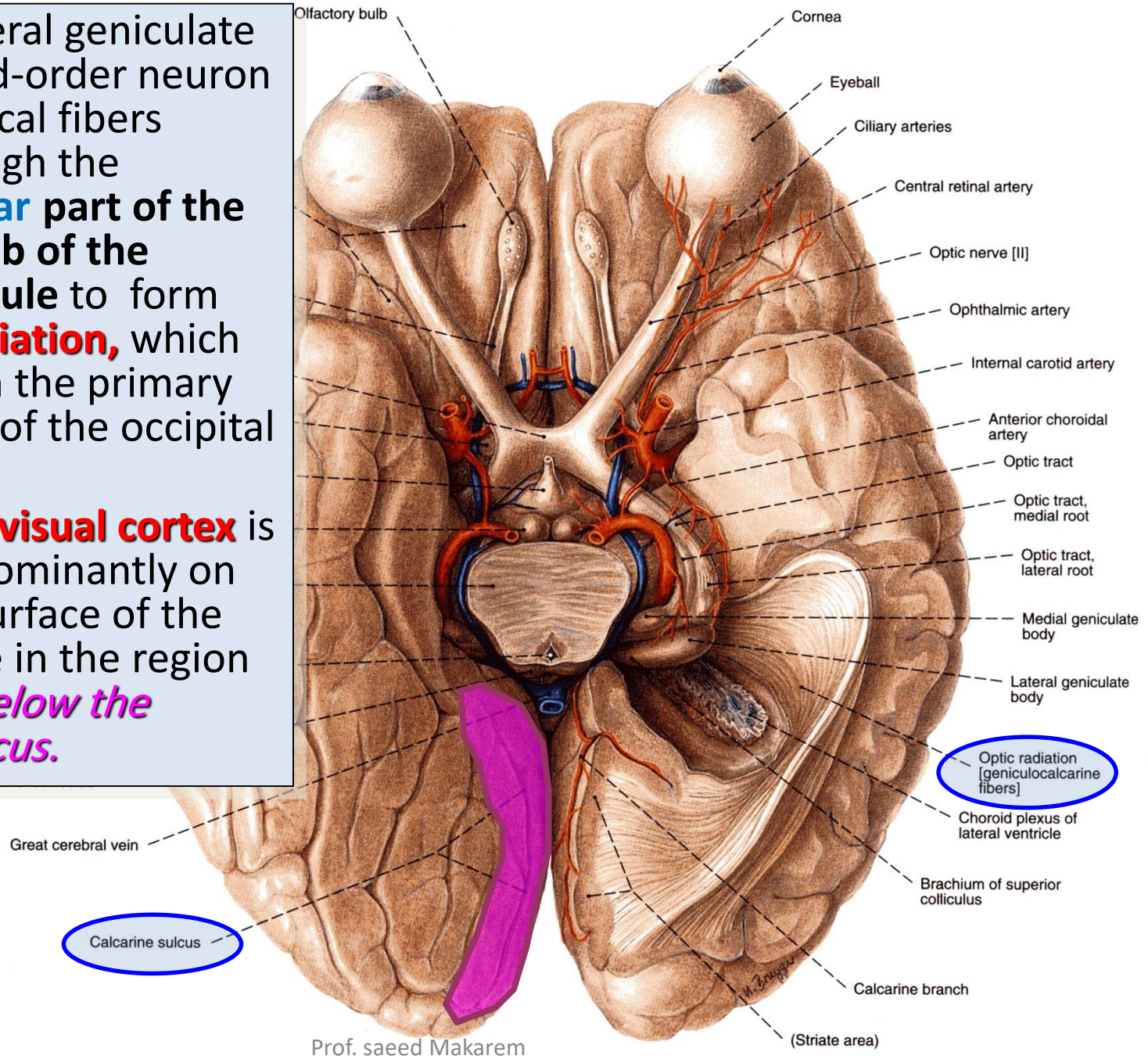


Optic Tracts

- Fibers in the optic tracts:
 - Mainly terminate in the (LGB), lateral geniculate body of the thalamus (**3rd order neuron**).
 - A few fibers terminate in pretectal area and superior colliculus.
 - These fibers are related to light reflexes.



- From the lateral geniculate nucleus, third-order neuron thalamocortical fibers project through the **retrolenticular part of the posterior limb of the internal capsule** to form the **optic radiation**, which terminates in the primary visual cortex of the occipital lobe.
- The **primary visual cortex** is located predominantly on the medial surface of the occipital lobe in the region *above and below the calcarine sulcus*.

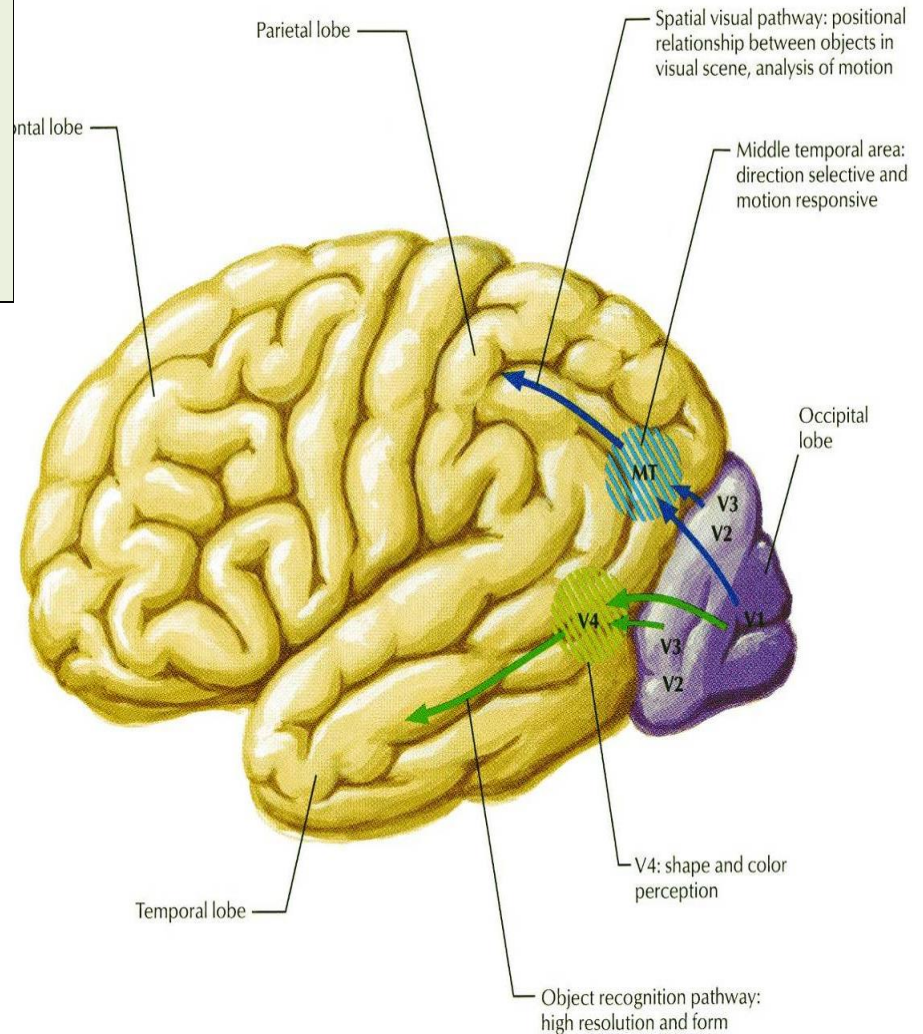


Visual Cortex

- The **primary visual cortex** (area 17 according to **Brodmann's classification**) that occupies the upper and lower lips of the calcarine sulcus on the medial surface of the cerebral hemisphere.

The **visual association cortex is extensive**, including the whole of the **occipital lobe**, the adjacent **posterior part of the parietal lobe**.

This cortex is involved in **interpretation** and recognition of objects and perception of **color, depth, motion**, and other aspects of vision.



1. Monocular blindness:

loss of vision in the affected eye by:

Cataract,

Intraocular hemorrhage,

Retinal detachment, or

Disease of the optic nerve like: Multiple sclerosis and

Optic nerve tumors,

2. Bitemporal hemianopia.

Compression of the central part of the optic chiasm by an adjacent pituitary tumour.

3. Contralateral Homonymous hemianopia:

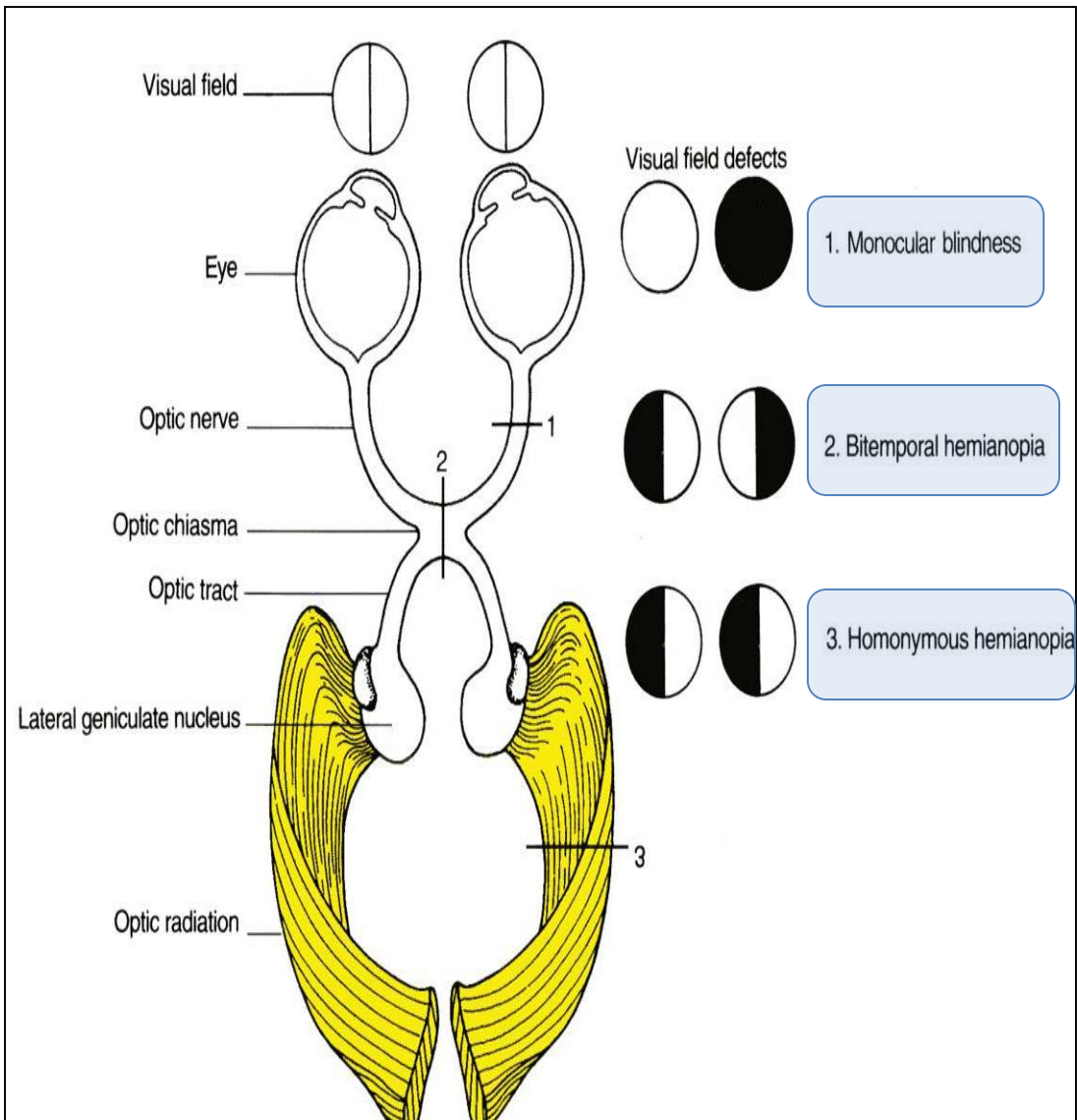
Vascular and neoplastic lesions of:

Optic tract,

Lateral geniculate body and

Optic radiation produce a.

Visual field deficits



THANK YOU

WHICH DISEASE IS THIS?

Retinitis Pigmentosa

- **Retinitis pigmentosa** is an *inherited* metabolic disorder of the photoreceptor and retinal pigment epithelial cells.
- *It is due to mutation of a key protein in the retinal photoreceptors.*
- *Which protein?*
- **Rhodopsin.**
- There is:
 - **Progressive night blindness**
 - **Peripheral visual field constriction.**
 - **Pigmentation of the retina visible on ophthalmoscopy.**
- *Which type of photoreceptor is affected?*
- **Rods.**

