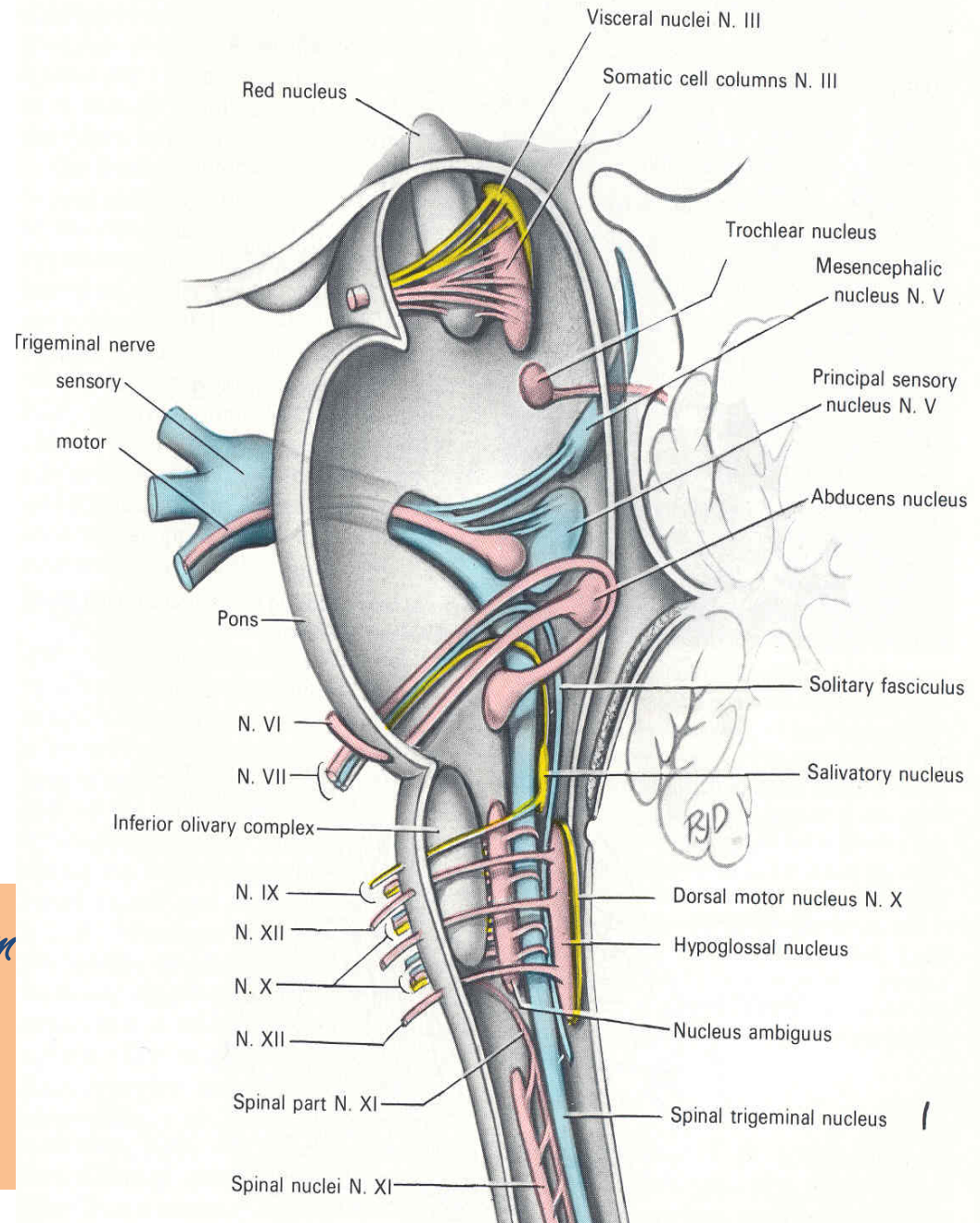


# THE CRANIAL NERVES

## 2, 3, 4, 6



*By Prof. Saeed Abuel Makarem*

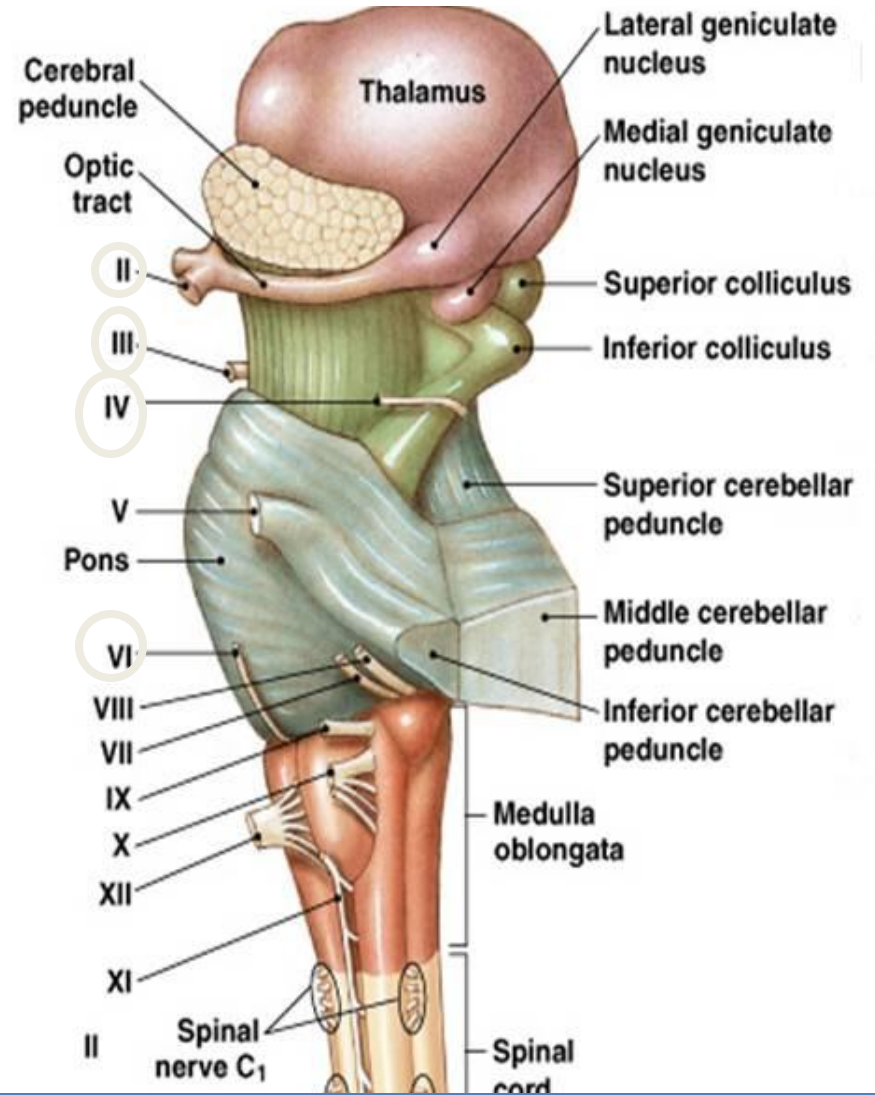
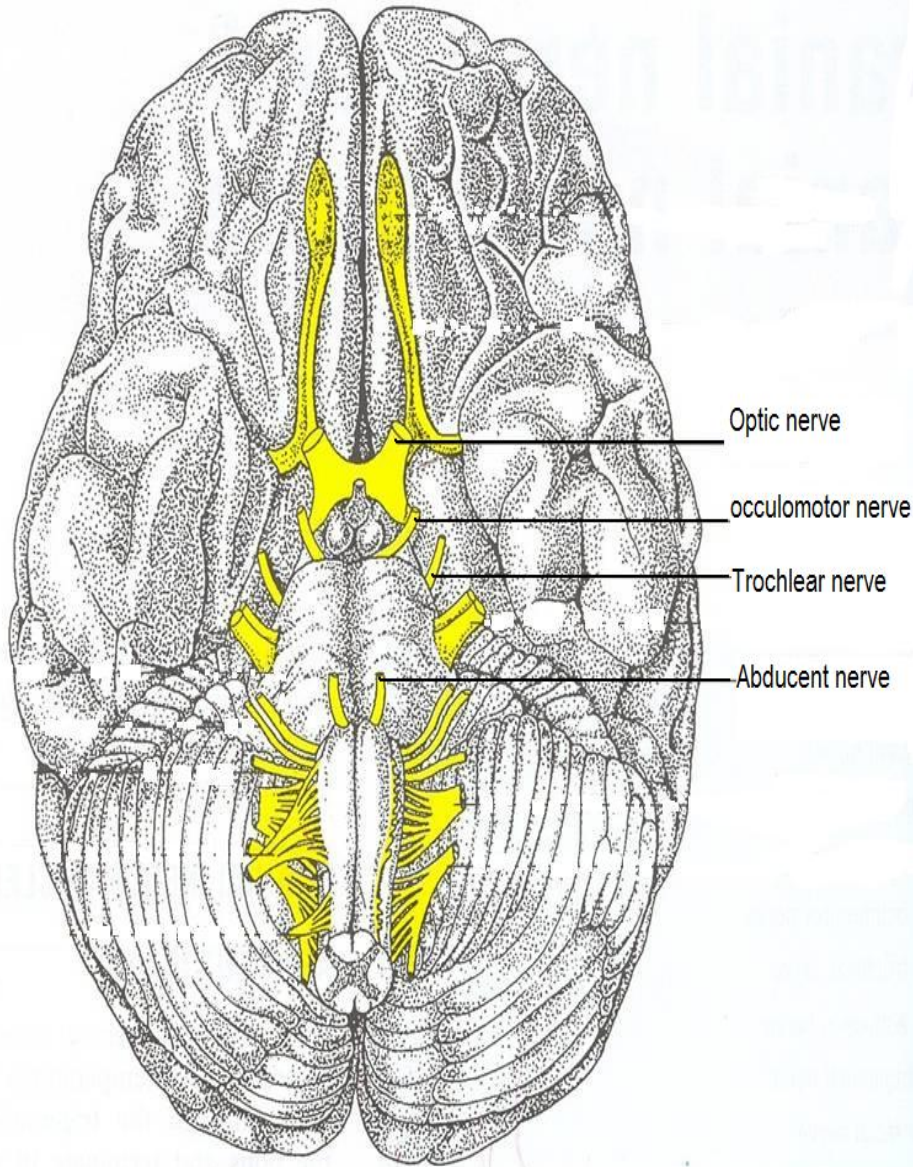
*&*

*Dr. Sanaa Alshaarawy*

# 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.
- Describe the **important relations** of oculomotor, trochlear, and abducent nerves **in the orbit**.
- List the **orbital muscles** supplied by each of these 3 nerves.
- Describe the **effect of lesion** of each of these 3 nerves.
- Describe the **optic nerve** and **visual pathway**.



**Brain (Ventral view)**

**Brain stem (Lateral view)**



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

- **1- Levator palpebrae superioris.** ★

- **4 Recti muscles:** ★

- **Superior rectus,**

- **Inferior rectus,**

- **Medial rectus,**

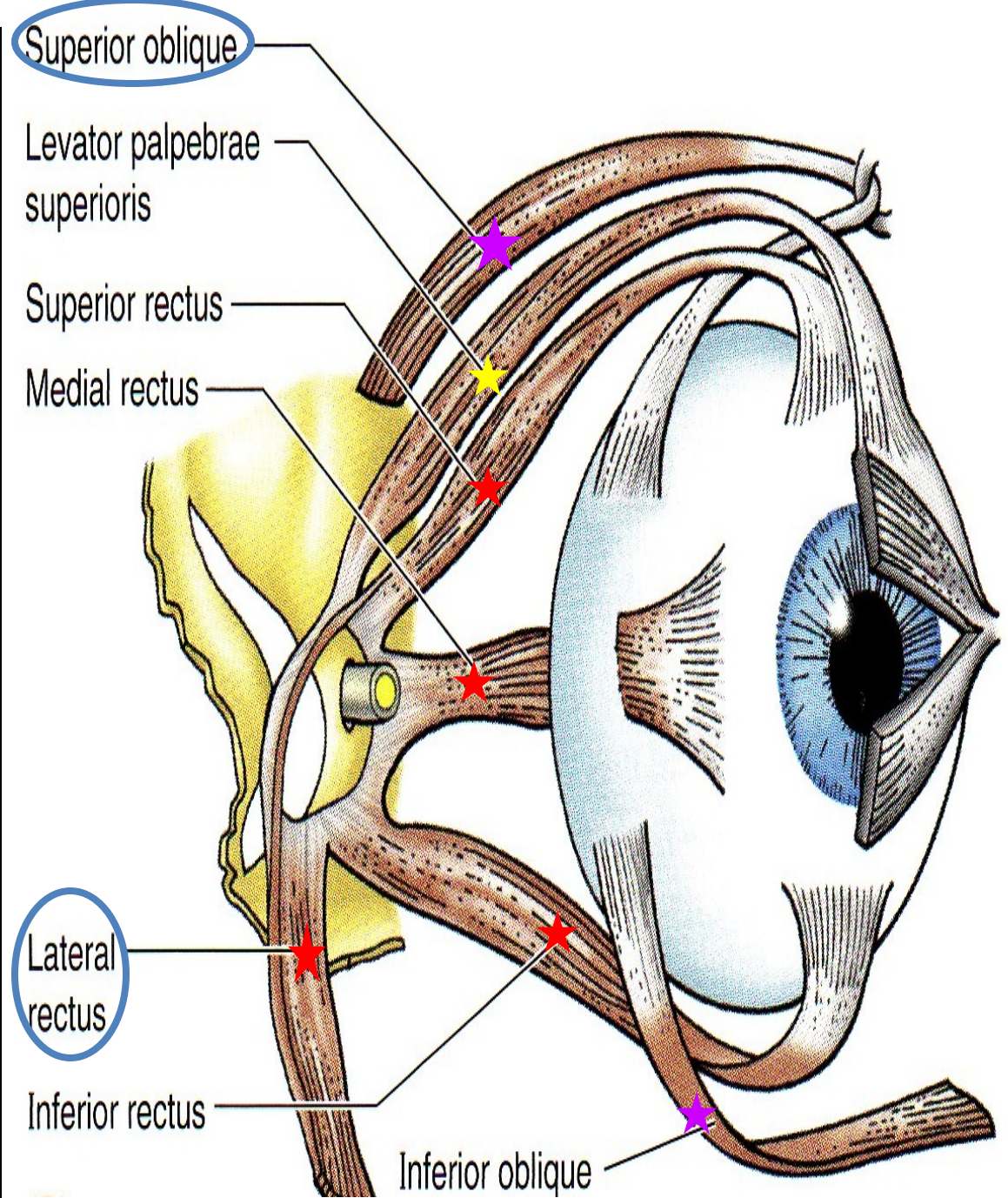
- **Lateral rectus,**

- **2 Oblique muscles:** ★

- **Superior oblique,**

- **Inferior oblique.**

- **NB. All muscles of the eye are supplied by the oculomotor nerve, EXCEPT LR6 + SO4**

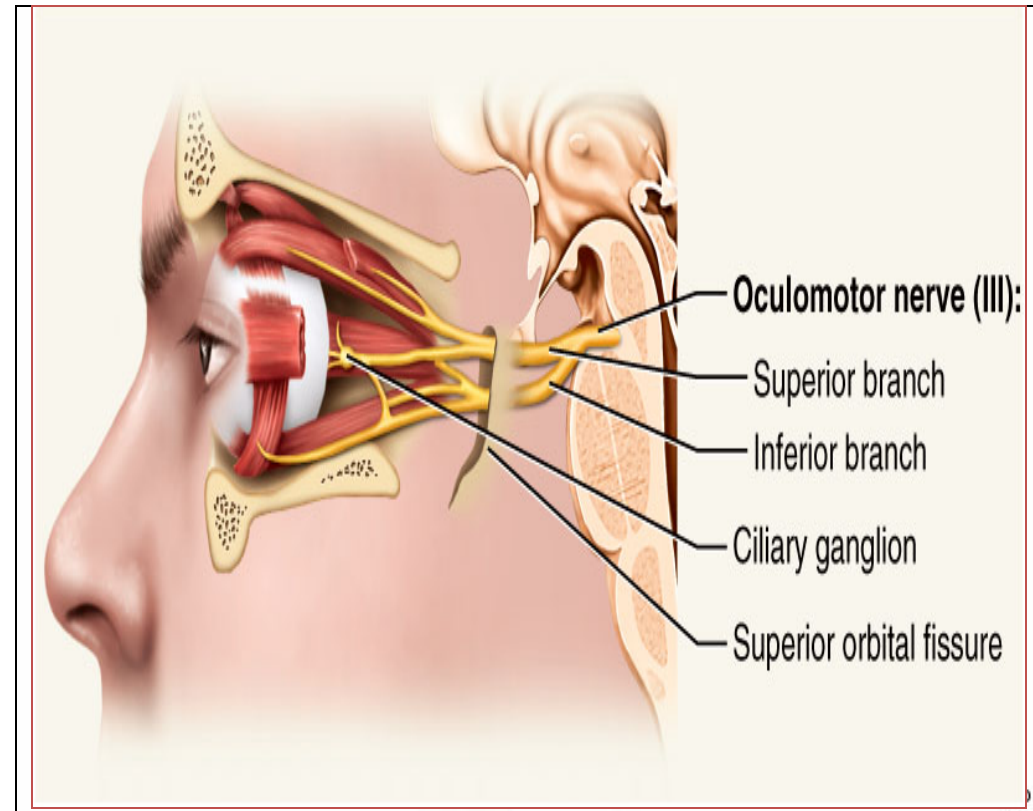
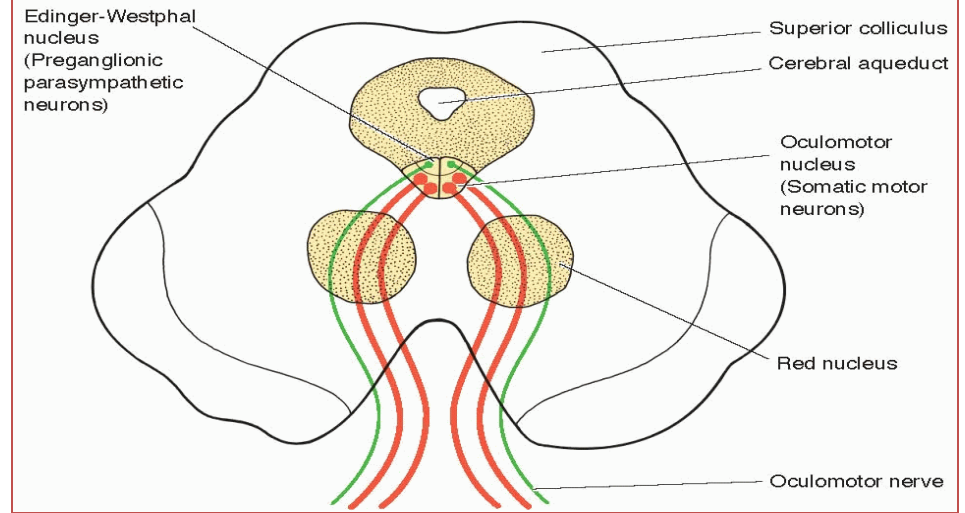






# Occulomotor Nerve

- **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 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** to the orbit **through the superior orbital fissure**.

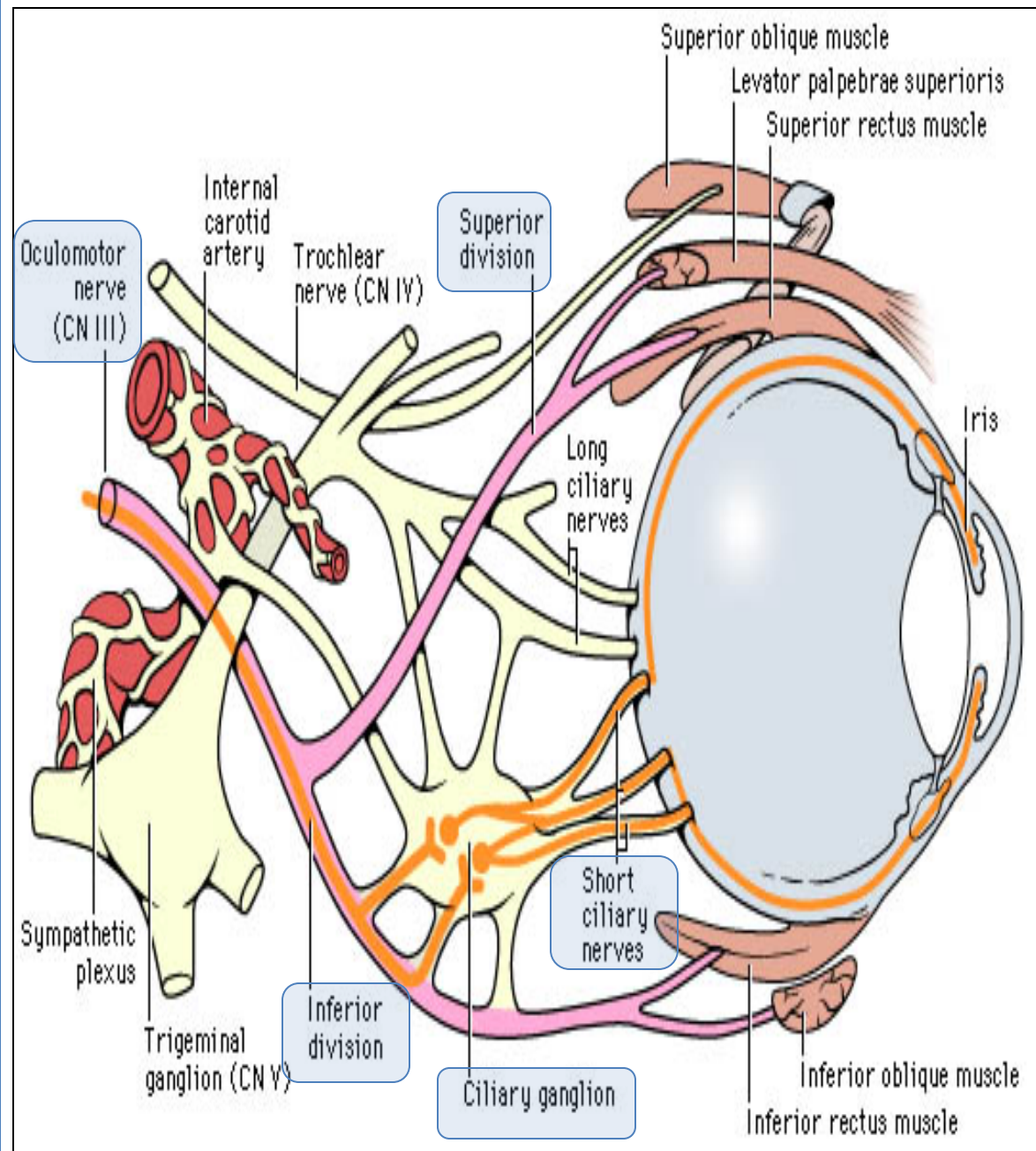


➤ **Axons from the Edinger-Westphal nucleus** accompany the oculomotor nerve fibers to the orbit, where they **terminate in the ciliary ganglion.**

➤ Postganglionic fibers pass through the **short ciliary nerves** to the eyeball, where they supply:

➤ **Constrictor pupillae muscle** of the iris and

➤ **Ciliary muscle.**



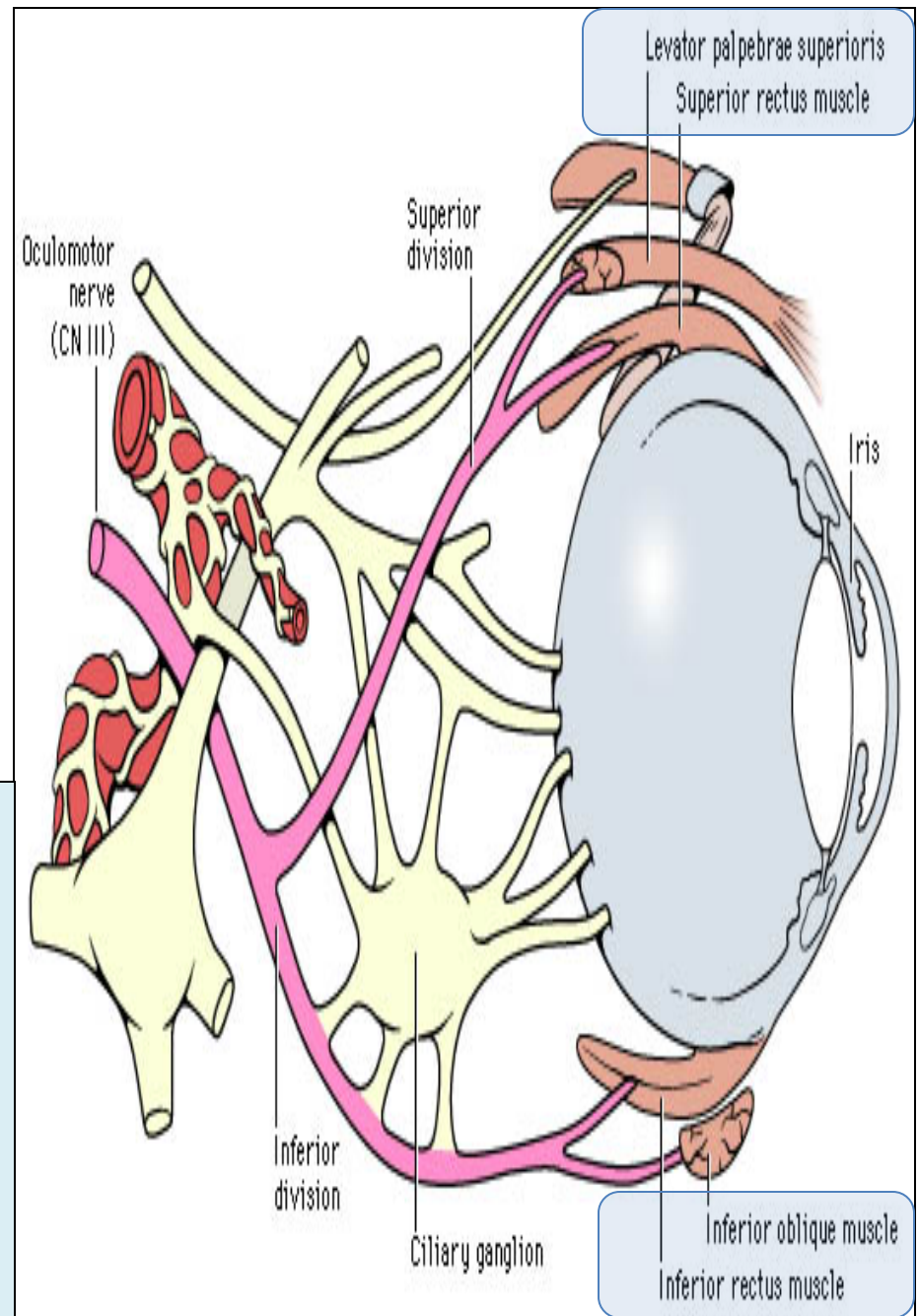
**So, Oculomotor nerve** supplies:

➤ **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.**



**So; It is responsible for;**

- Elevation of upper eyelid (open the eye).
- Turning the eyeball **upward, downwards and medially,**
- **Constriction of the pupil (Pupillary reflex).**
- **Accommodating reflex** of the eyes.



# Occulomotor Nerve Lesion

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

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 defect of the pupillary response to light.



Normal eye alignment



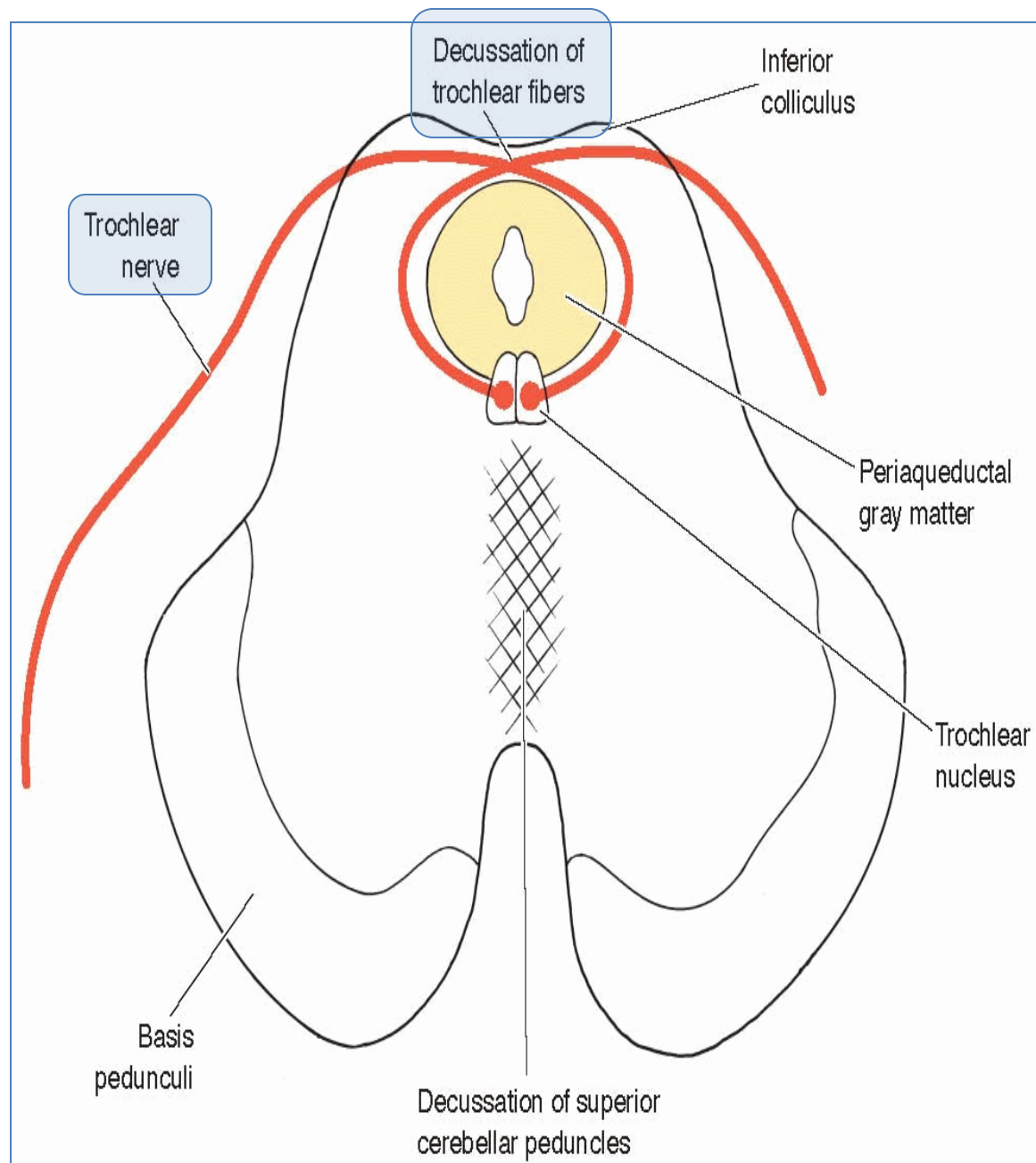
Lateral squint

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.**



# Trochlear Nerve

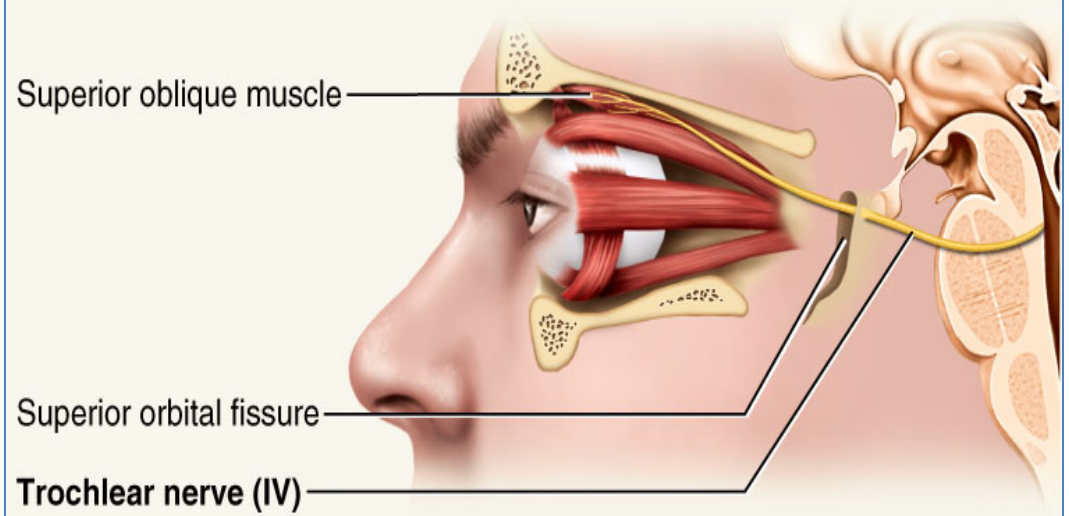
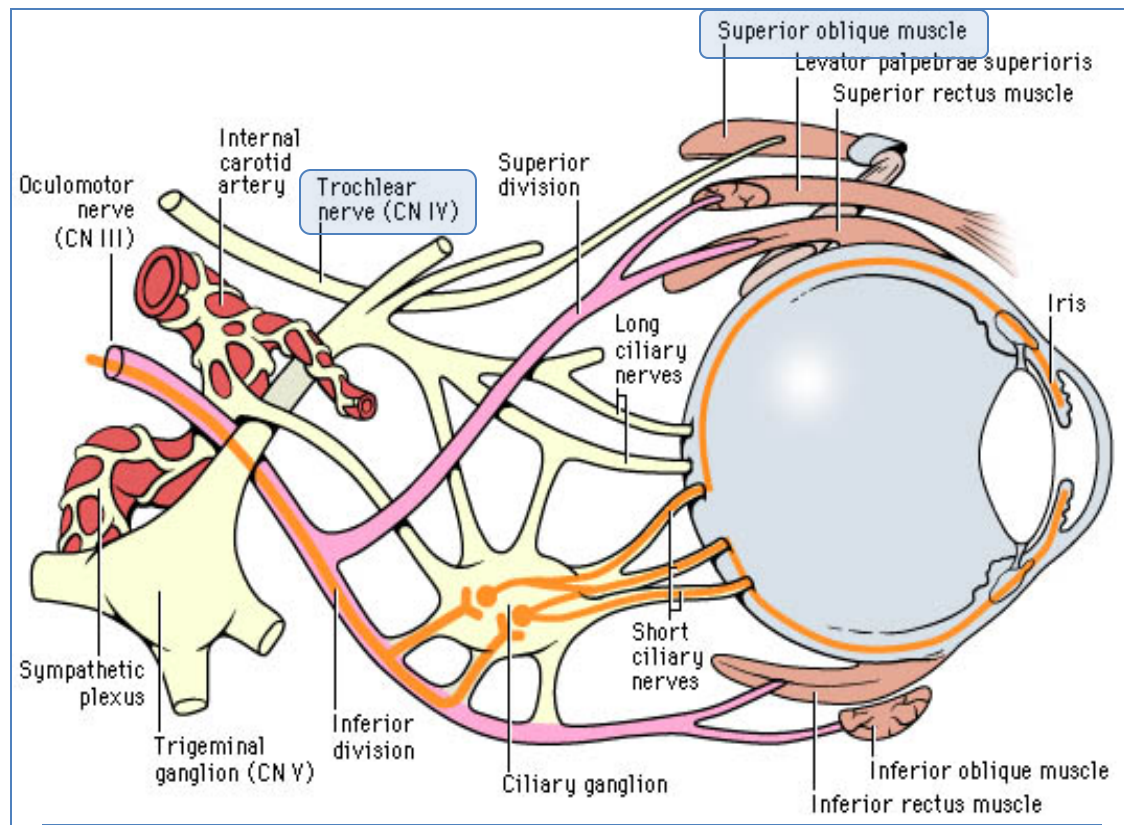
- It passes forward through **middle cranial fossa** in the **lateral wall of the cavernous sinus**.
- The nerve then enters the orbit through the **superior orbital fissure**.

## It supplies;

- **Superior oblique (SO4) muscle**, (only one muscle).

## Its function;

- Rotates the eye ball **downwards and laterally**.





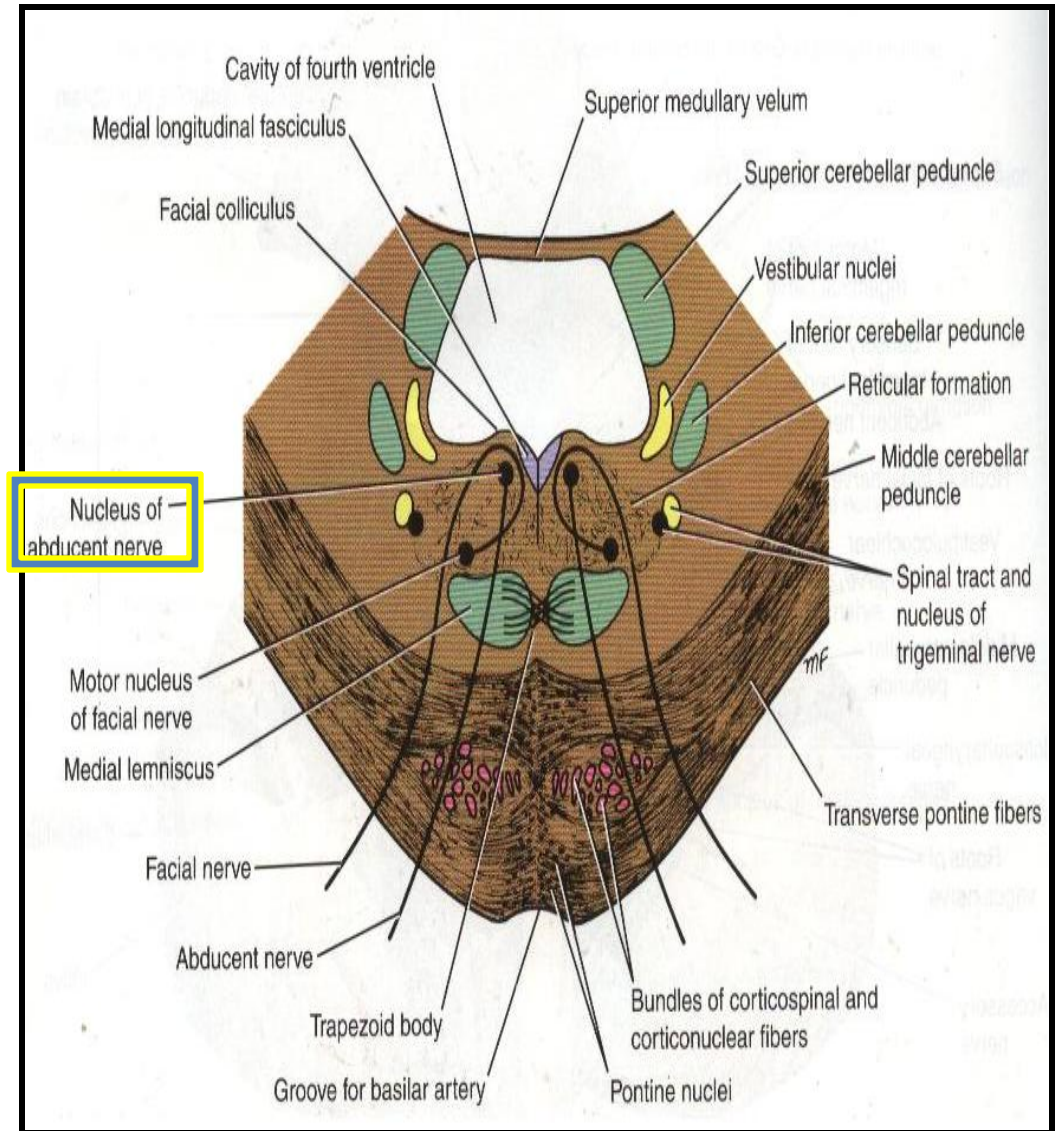
## Trochlear Nerve Lesion

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



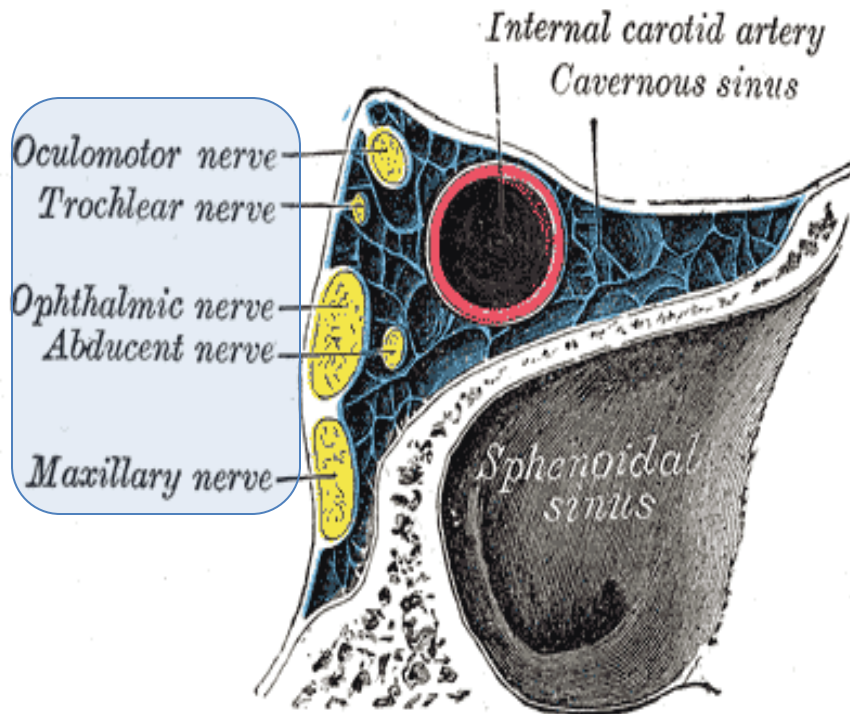
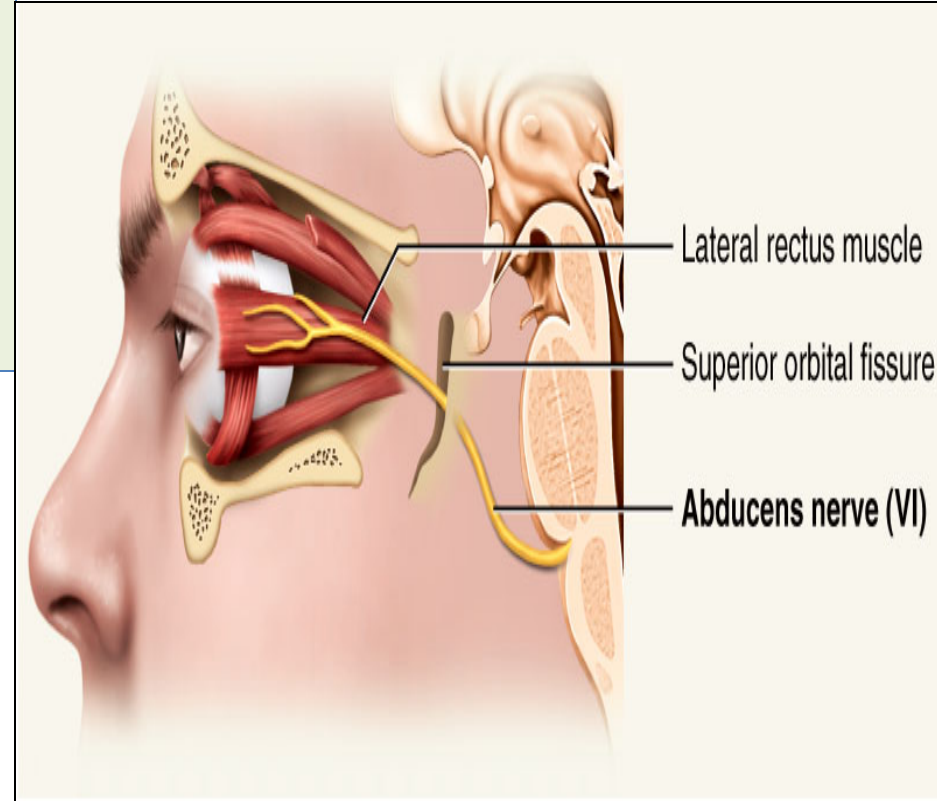
# Abducent Nerve

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



- 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 (LR6)** muscle which **rotates the eye ball laterally** ; (abduction).

# Abducent Nerve





## 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



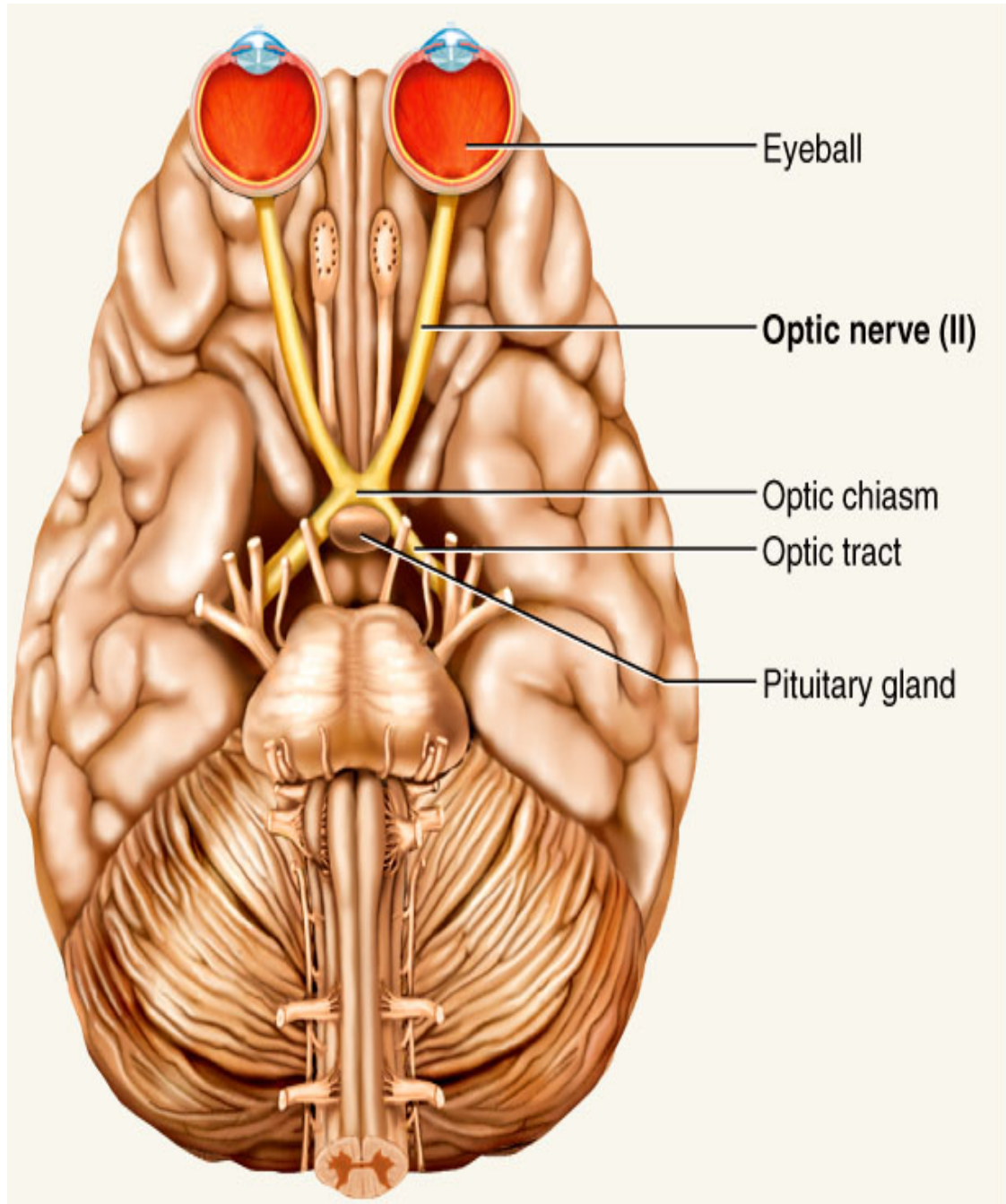
Medial squint

# Optic Nerve

**Type:** Special sensory  
N.

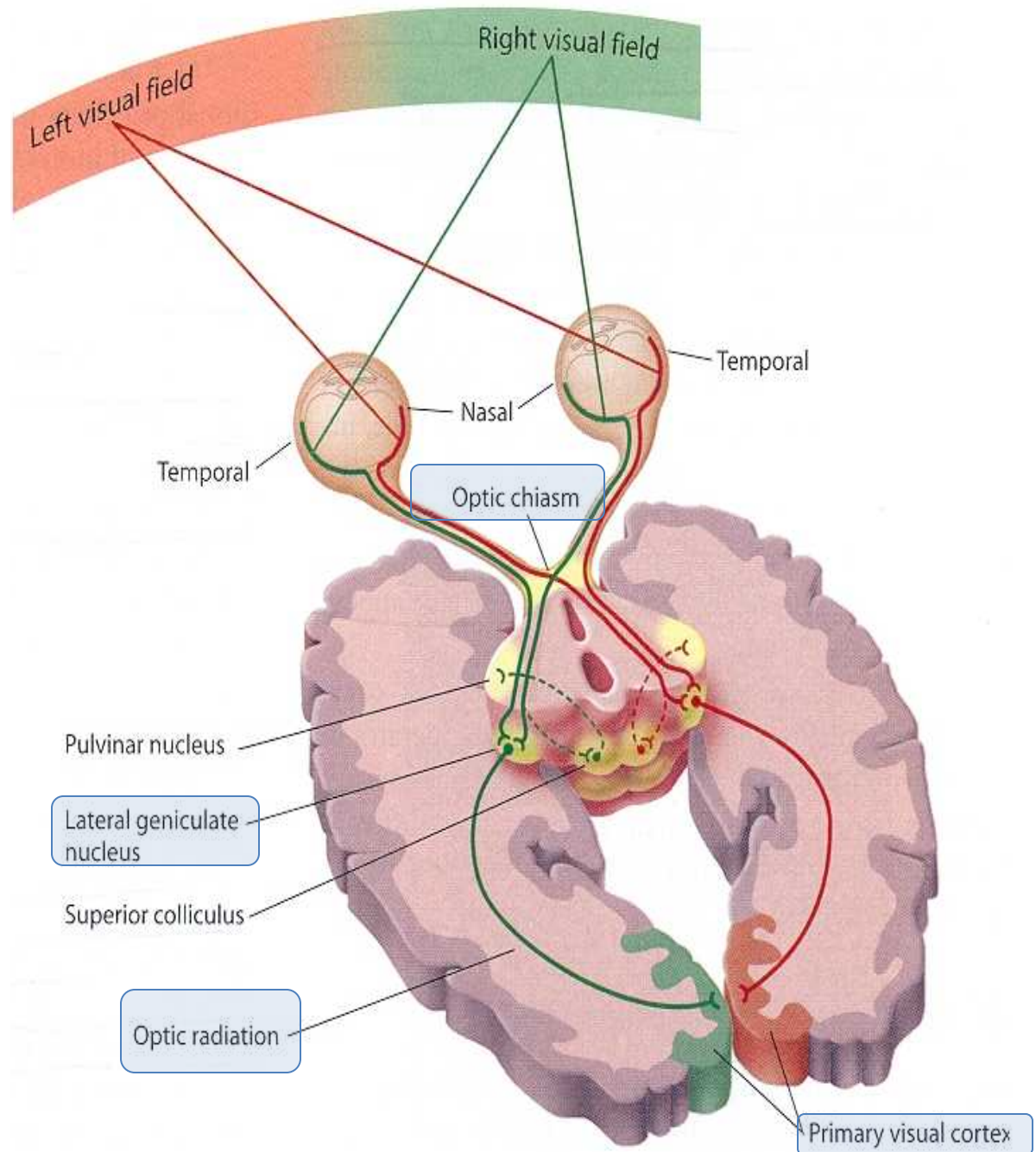
**Function:** Vision

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



# Visual Pathway

1. **Optic nerve.**
2. **Optic chiasm.**
3. **Optic tract.**
4. **Lateral geniculate body (nucleus).**
5. **Optic radiation.**
6. **Visual cortex.**





# Visual Pathway

## ➤ Photoreceptors:

**Rods & Cones** of the retina

## ➤ Three neurons pathway

### ▪ 1<sup>st</sup> order neurons:

**Bipolar cells** of retina

### ▪ 2<sup>nd</sup> order neurons:

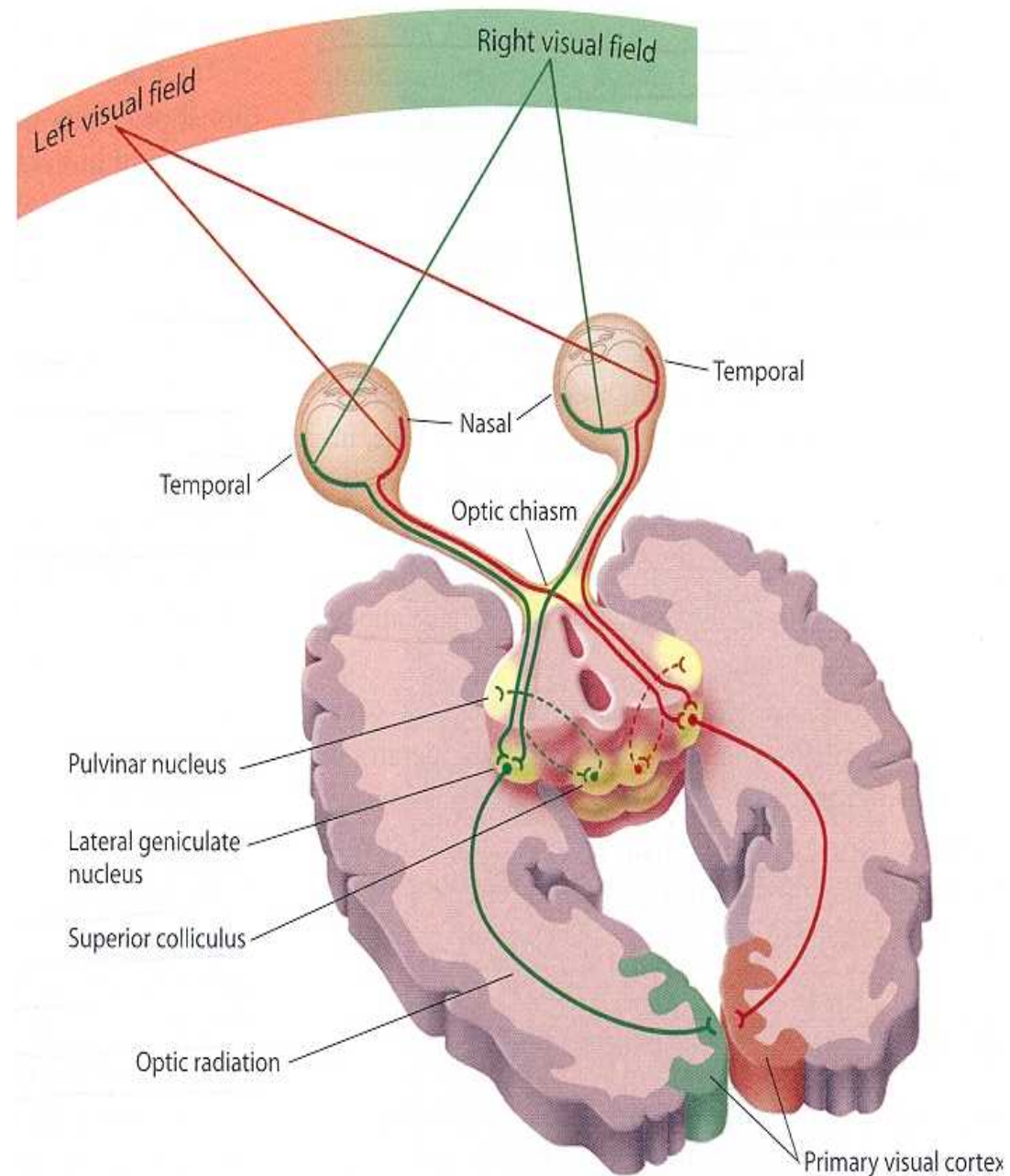
**Ganglion cells** of retina.

Their axons form the **optic nerve**

### ▪ 3<sup>rd</sup> order neurons:

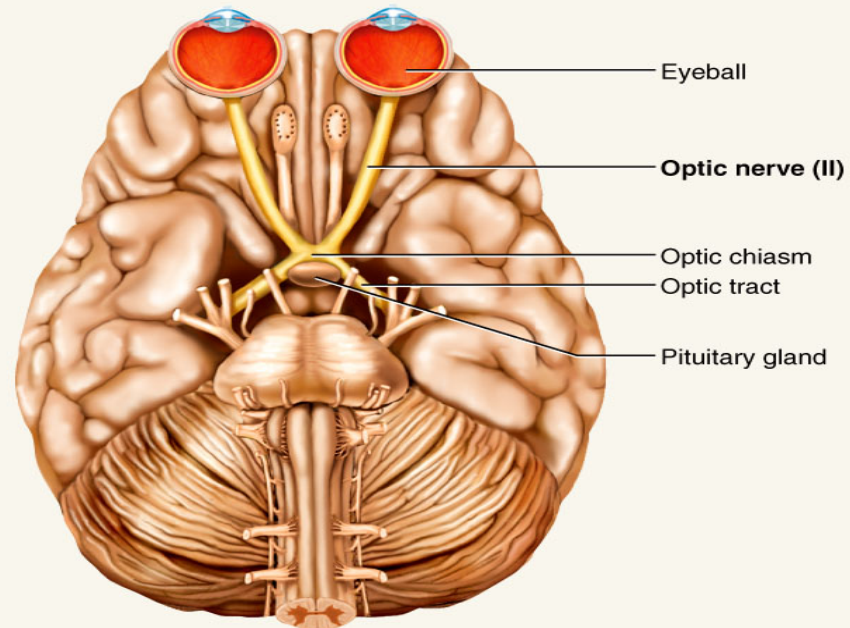
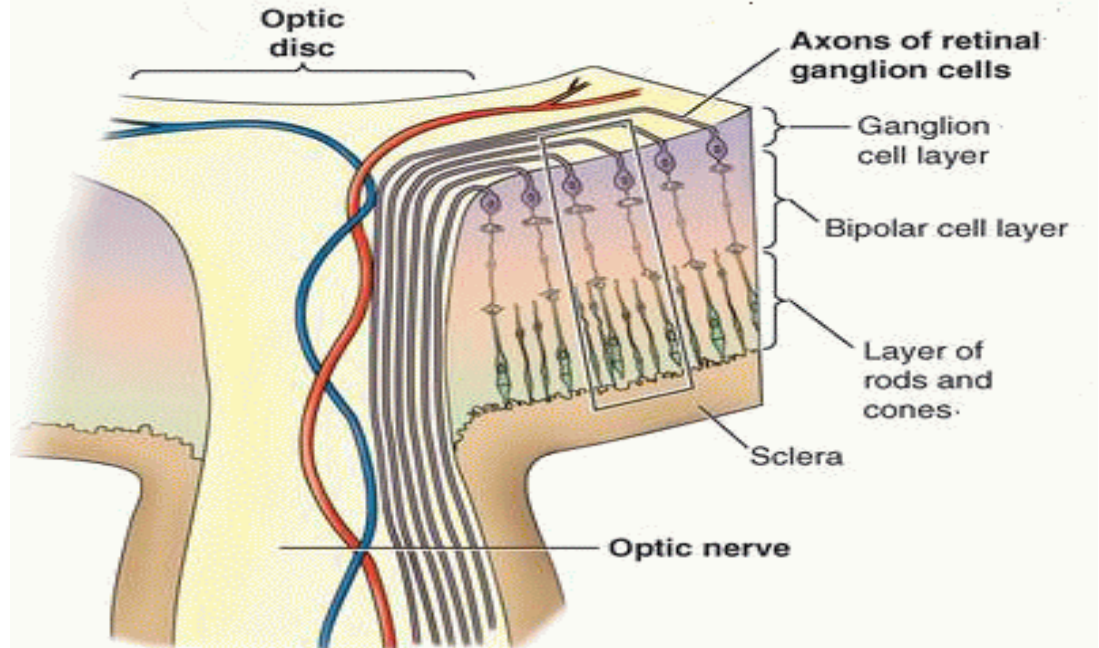
**Neurons in the lateral geniculate body.**

Their axons **terminate** in **primary visual cortex.**



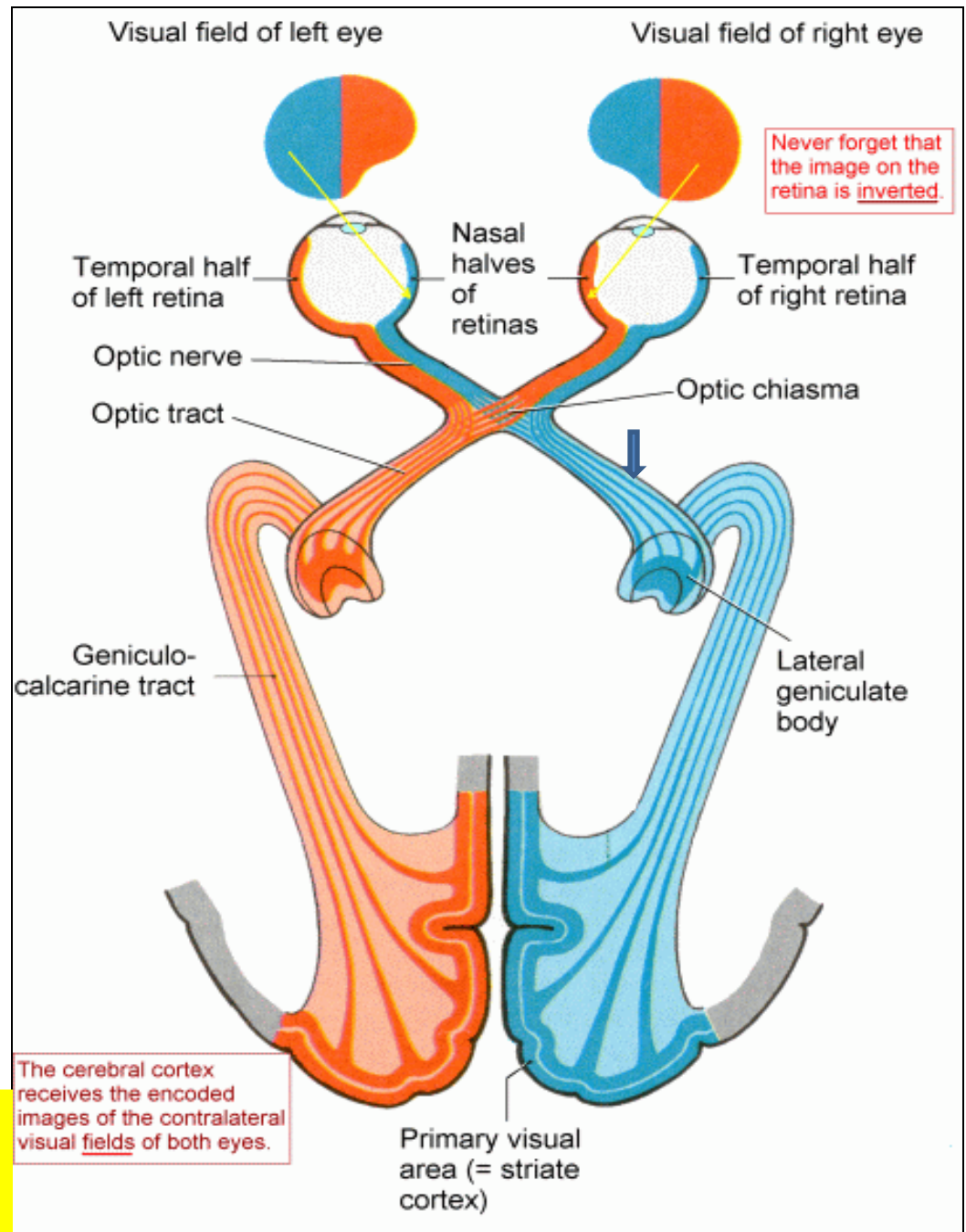
# Optic Nerve

- **Axons** of retinal **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 form the **optic chiasma**.



# Optic Chiasma

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

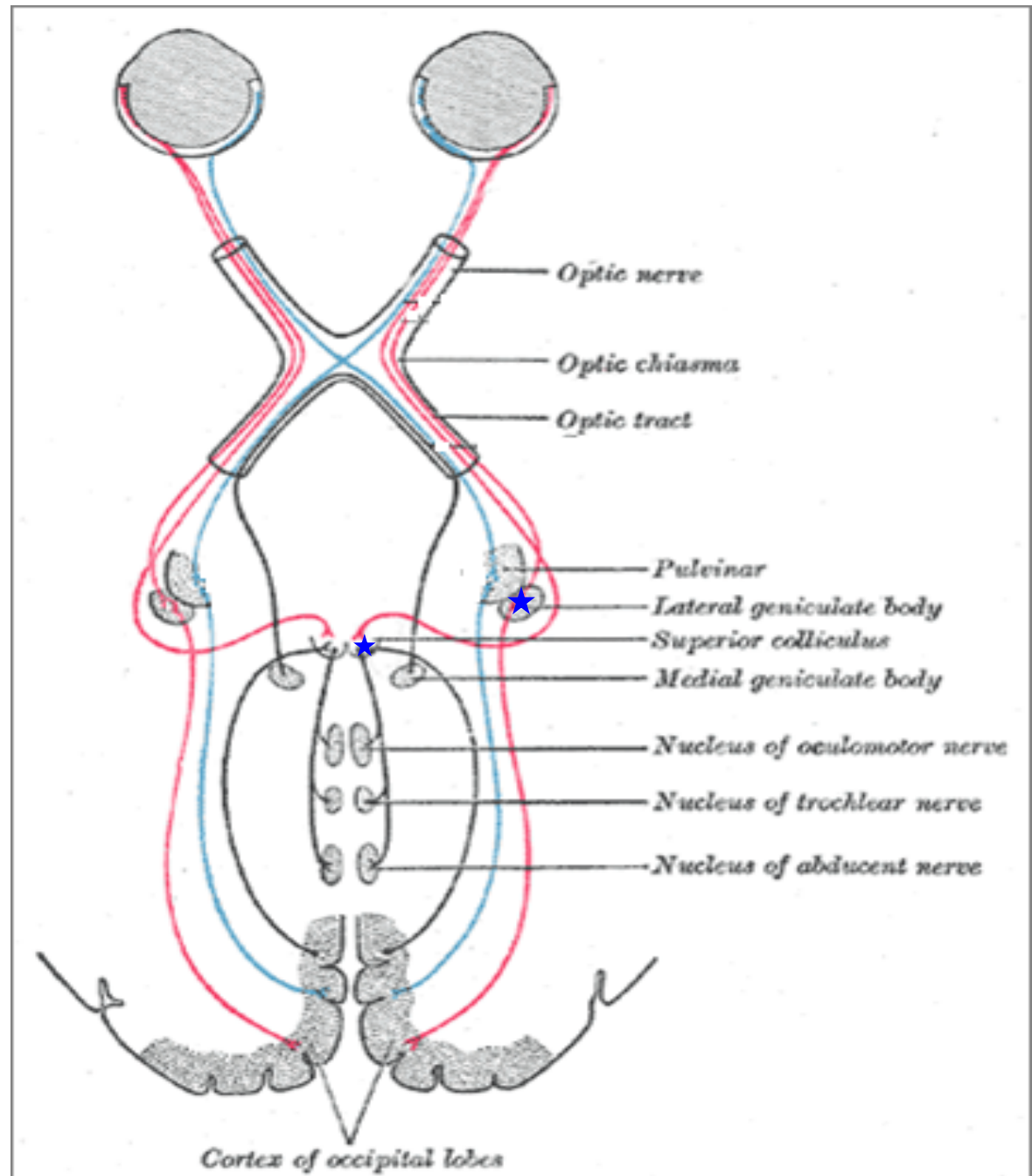


Which retinal fibres are present in the left optic tract??????????

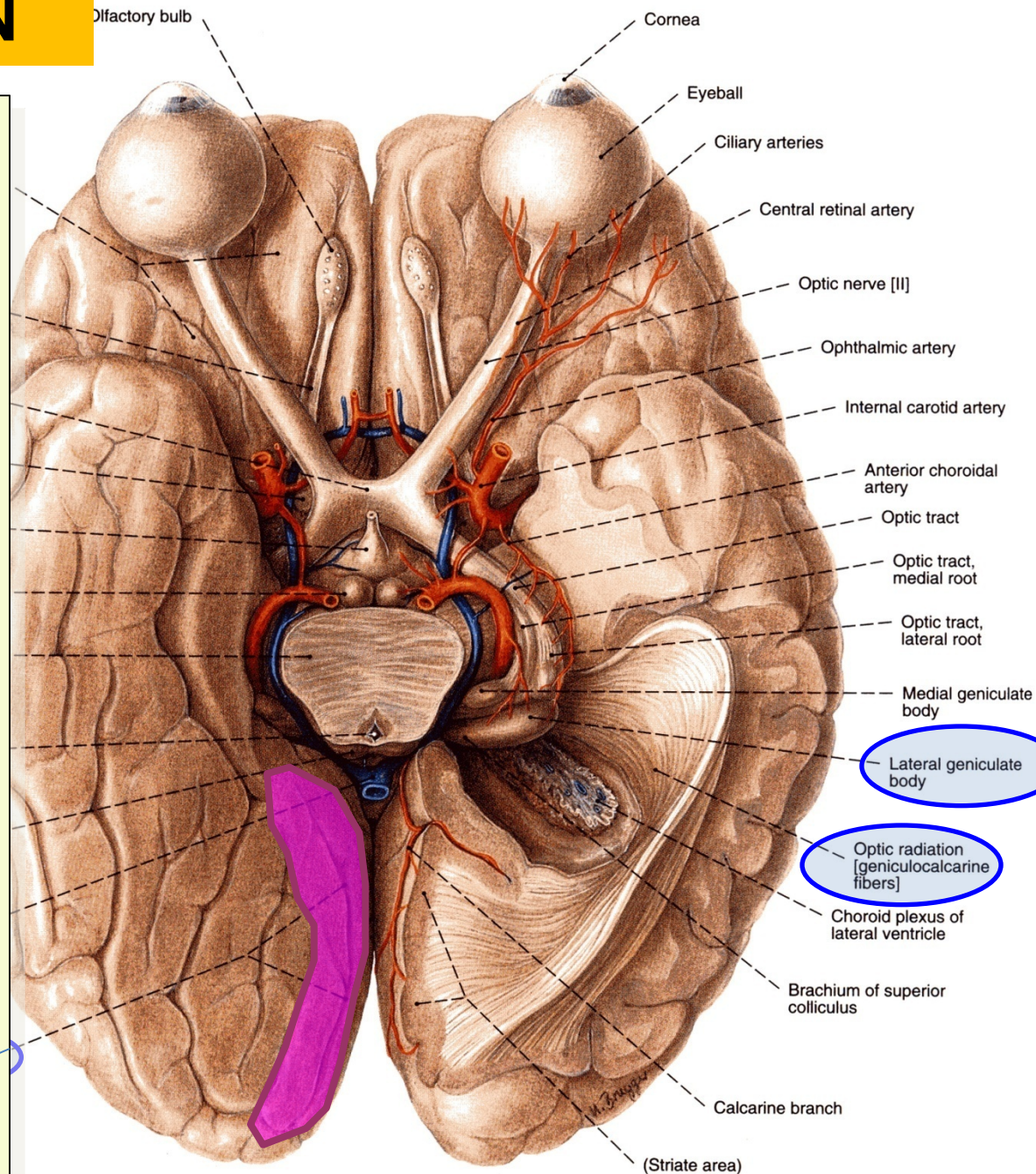


# Optic Tracts

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



# OPTIC RADIATION



- From the **lateral geniculate nucleus** (third-order neuron), **thalamocortical fibres** project through the **retrolenticular part of the posterior limb of the internal capsule** as the **optic radiation**, which terminates in the **primary visual cortex** of the **occipital lobe**.

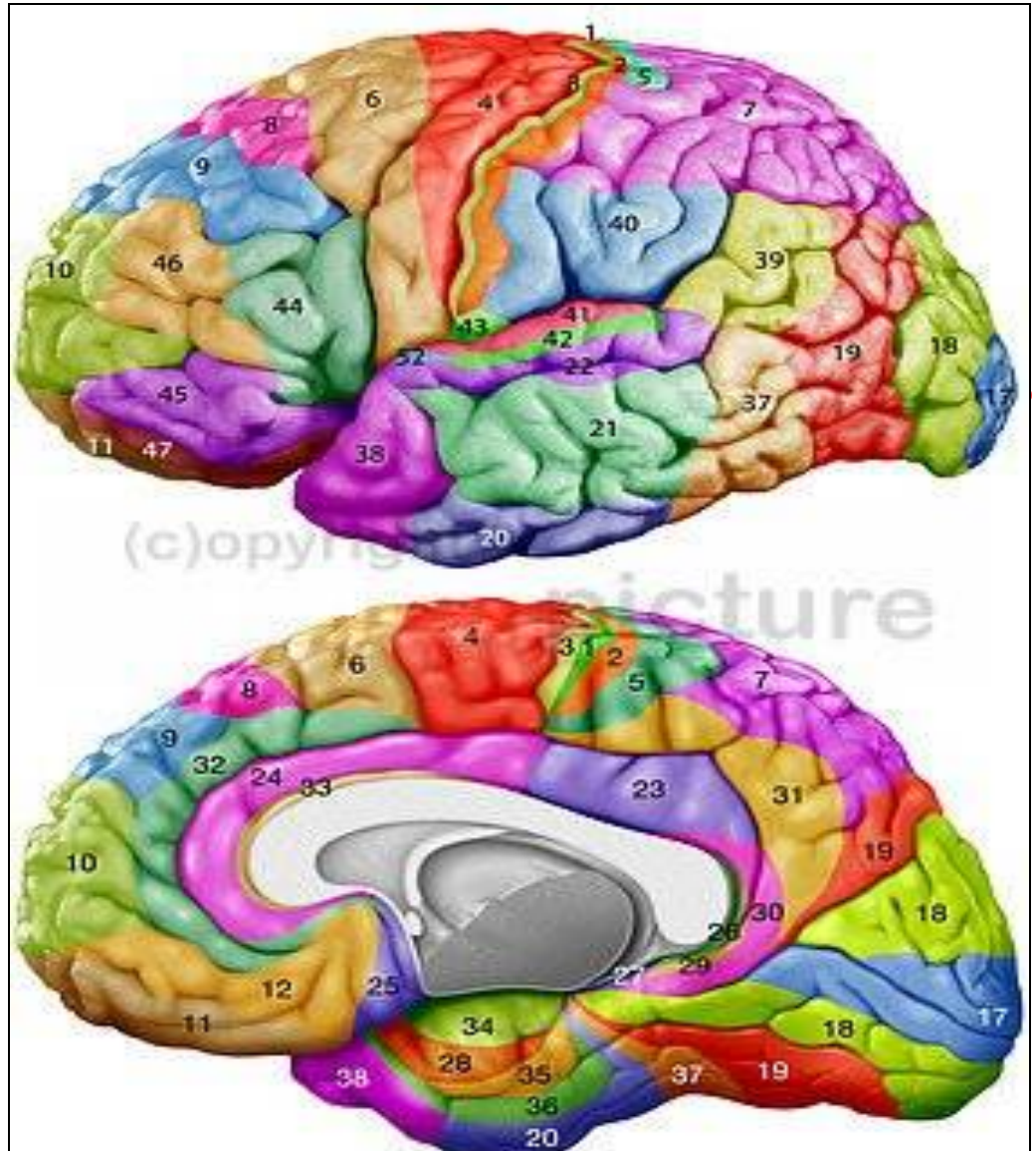
- The **primary visual cortex** is **located predominantly** on the medial surface of the hemisphere in the region **above and below the calcarine sulcus**.



# Visual Cortex

- The primary visual cortex (**area 17 of Brodmann's**) 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 **most of occipital lobe**, & 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.





# Visual field deficits

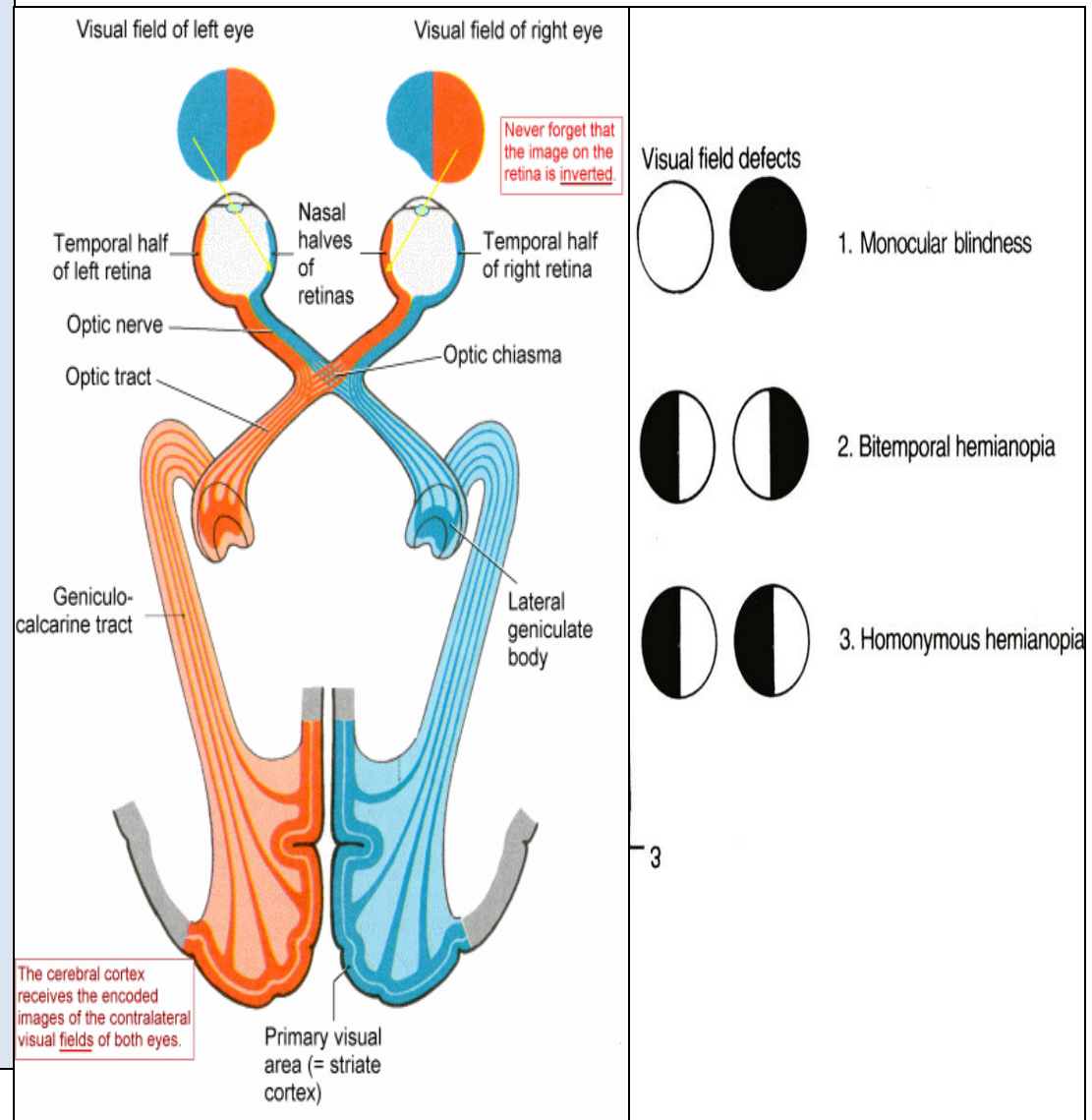
## Disease of the eyeball

(cataract, intraocular haemorrhage, retinal detachment) and

**1. disease of the optic nerve** (multiple sclerosis and optic nerve tumors) **lead to : loss of vision in the affected eye (monocular blindness).**

**2. Compression of the optic chiasm** by an adjacent pituitary tumour **leads to : bitemporal hemianopia.**

**3. Vascular and neoplastic lesions of the optic tract, optic radiation or occipital cortex** **produce : contralateral homonymous hemianopia.**





THANK YOU



# FOR YOU

## Visual field deficits

- A person may not be able to see objects on their left or right sides of visual fields (homonymous hemianopsia) if the optic tract or radiation or visual cortex affected.
- or may have difficulty seeing objects on their outer visual fields (bitemporal hemianopsia) if the optic chiasm is involved.

• The **pretectal area**, or **pretectum**, is a midbrain structure composed of seven nuclei and comprises part of the subcortical visual system. **Pretectal nuclei are** bilateral group of highly interconnected nuclei located near the junction of the midbrain and forebrain.