Anatomy Team
MED 439

Revised & Approved

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MED439
KING SAUD UNIVERSITY

Cranial Nerves 2,3,4 & 6

CNS Block

Don't forget to check the Editing File

Color index:

Content
Male slides
Female slides
Important
Doctors notes
Extra information, explanation

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Objectives

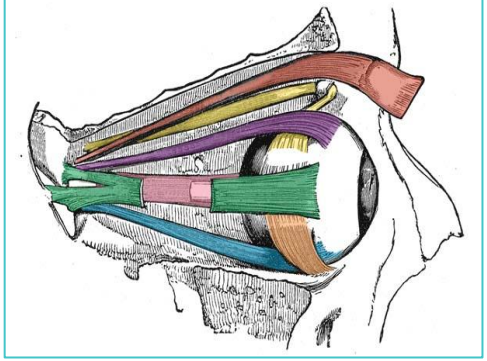
At the end of the lecture, students should be able to:

- 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.

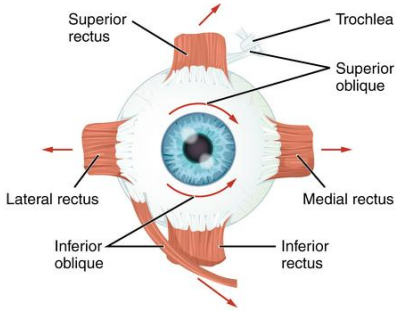
Extraocular Muscles (7 muscles)

- **1 Levator palpebrae superioris.**(Elevates the upper eyelid)
- 4 Recti muscles:
- **Medial rectus.**(medial)
- **Lateral rectus.**(lateral)
- **Superior rectus.**(upward and medially)
- **Inferior rectus.**.(downward and medially)
- 2 Oblique muscles:
- **Superior oblique.** (downward and laterally)
- **Inferior oblique.**(upward and laterally)

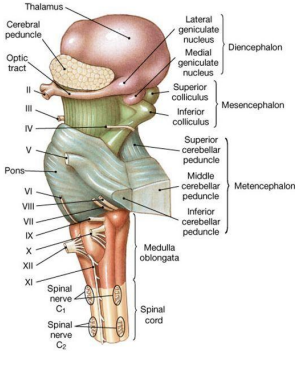
Eye (Lateral view)



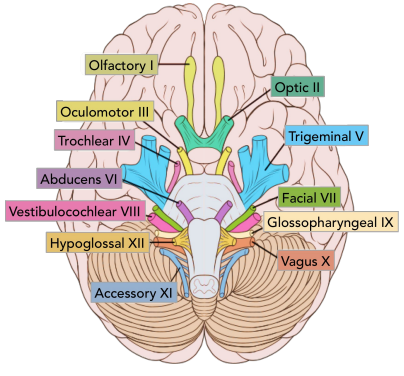
Eye (Anterior view)



Brainstem (lateral view)



Brainstem (ventral view)



❖ All muscles of the eye are supplied by the oculomotor nerve,
EXCEPT LR6 lateral rectus (by abducens) + SO4 superior oblique (by trochlear)

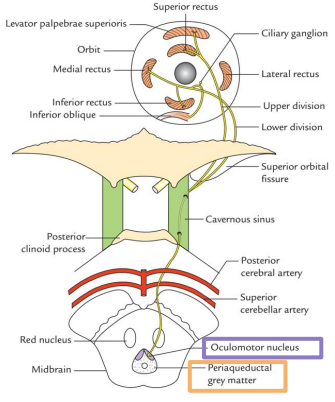
Oculomotor Nerve

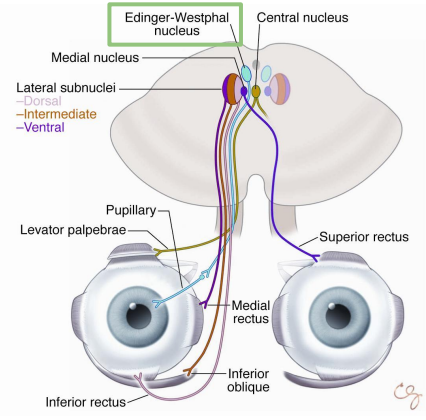
Oculomotor Nerve

Motor for most of extraocular muscles

Has 2 nuclei

Also carries preganglionic parasympathetic fibers to the pupillary constrictor (pupillary reflex) and ciliary muscles (accomodation).





Main oculomotor nucleus

- ❏ Lies in the midbrain at the level of superior colliculus
- ❏ Located in the periaqueductal grey matter

Accessory nucleus (Edinger-Westphal nucleus)

- ❏ Lies dorsal to the main motor nucleus
- ❏ Its cells are preganglionic parasympathetic neurons
- ❏ it receives; Fibres from the pretectal nucleus for the direct and consensual pupillary reflexes, and Corticonuclear fibers for accommodation reflex .

Oculomotor Nerve

Axons from the Oculomotor nucleus

➔ It curves 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.

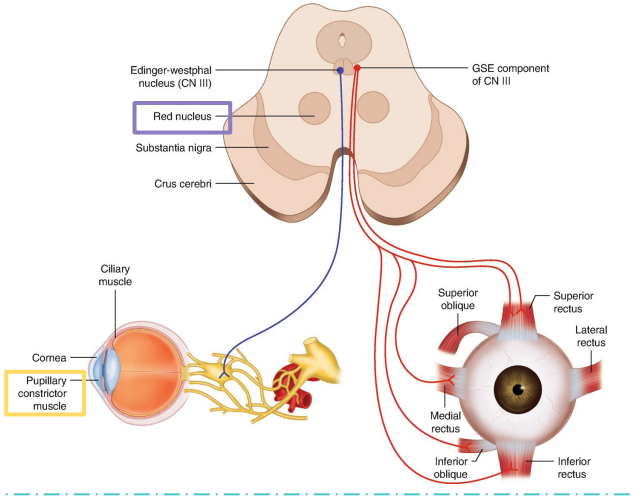
➔ In the middle cranial fossa it runs in the lateral wall of the cavernous sinus, then it divides into superior and inferior divisions which pass to the orbit through the superior orbital fissure.

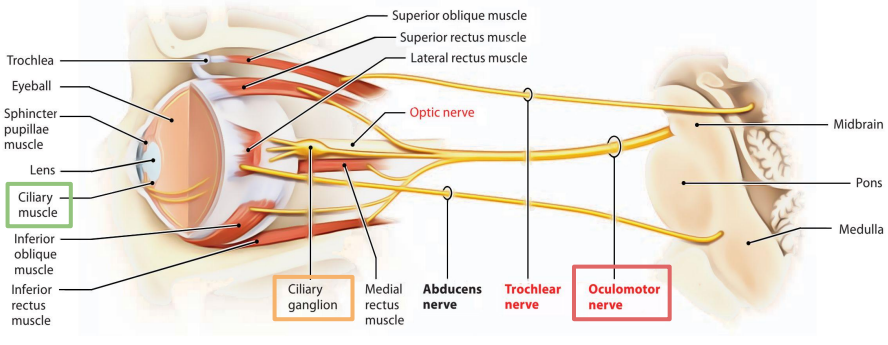
Axons from the Edinger-Westphal nucleus

➔ 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**
❑ **Ciliary muscle**.





Oculomotor Nerve

Oculomotor Nerve

Supplies

Motor to:

-Levator palpebrae superioris -Superior rectus muscle
-Medial rectus muscle
-Inferior rectus muscle
-Inferior oblique muscle.

Parasympathetic fibers to:

1- Constrictor pupillae and
2- Ciliary muscles.

Responsible for:

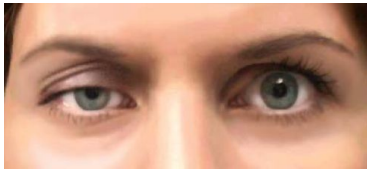
-Elevation of upper eyelid (open the eye)
-Turning the eyeball upward, downwards and medially
-Constriction of the pupil (Pupillary reflex).
-Accommodating reflex of the eyes.

Normal eye alignment

Oculomotor Nerve Lesion

1. Lateral squint
2. Ptosis
3. Diplopia
4. Pupillary dilatation (Sphincter muscle)
5. Loss of accommodation
   Ciliary muscle
6. The eyeball is fully abducted and depressed (down and out) because of the unopposed activity of lateral rectus and superior oblique.

Lateral squint



Ptosis

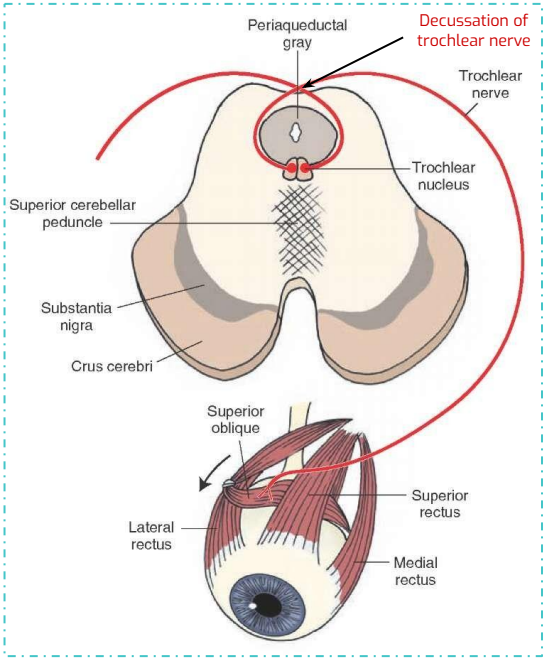
❖The preganglionic parasympathetic fibers run superficially in the nerve and are therefore the first axons to suffer when a nerve is affected by external pressure. Consequently, the first sign of compression of the oculomotor nerve is ipsilateral defect of the pupillary response to light.

Trochlear Nerve: 4th (IV) Cranial Nerve

❑ **Type** : Motor
❑ **location**: Small motor nucleus located in the periaqueductal grey matter at the level of inferior colliculus.

❑ **Course of the nerve :**

➔Fibers curve backwards and decussate.
➔The nerve emerges immediately caudal to the inferior colliculus, on the dorsal surface of brainstem.
➔It passes forward through middle cranial fossa in the lateral wall of the cavernous sinus.
➔ then enters the orbit through the superior orbital fissure.



Nerve Lesion

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

Supply

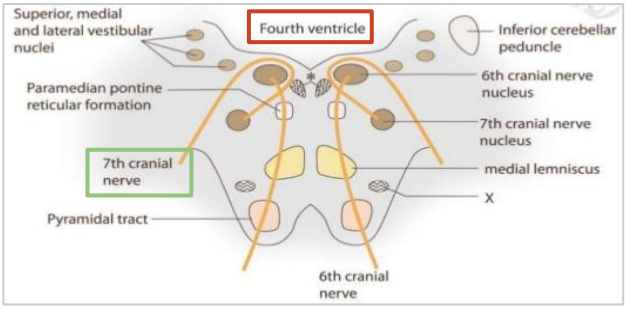
Superior oblique (SO4) muscle (only one muscle)

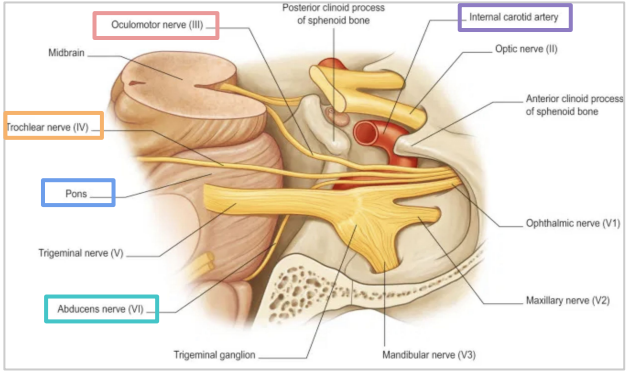
Function

Rotates the eyeball downwards and laterally.

Abducent Nerve: 6th (VI) Cranial Nerve

Feature	Only one motor nucleus.
Feature	Lies in caudal pons in the floor of the **4th ventricle**.
Feature	Lies close to the middle line, in a line with **3rd**, **4th** & 12th nerves.
Feature	It forms the facial colliculus with the fibers of **facial nerve** looping around the nucleus.
Feature	It emerges from the ventral aspect of brain , at the junction of the **pons** and the pyramid of the medulla oblongata.
Feature	It passes through cavernous sinus, lying below and lateral to the **internal carotid artery**, Then it enters the orbit through the superior orbital fissure.
Supply	The lateral rectus (LR6) muscle which rotates the eyeball laterally (abduction).
Lesions	- 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



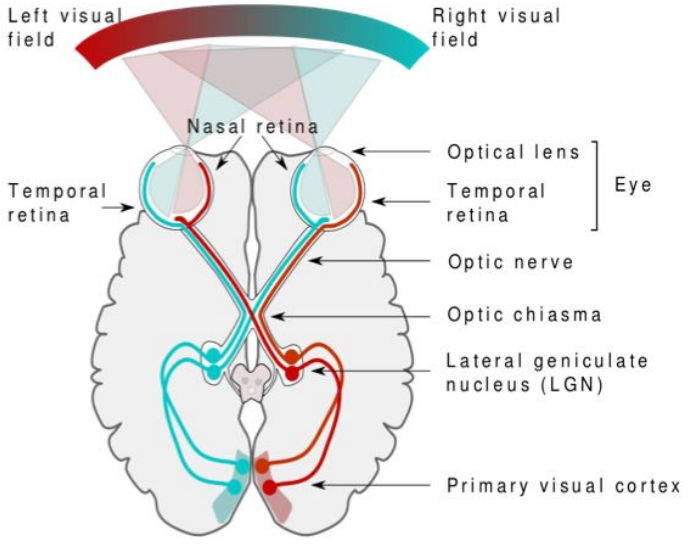



Normal eye alignment


Medial squint

Optic Nerve: 2nd (II) Cranial Nerve

- **Type**: Special sensory nerve.
- **Function**: Vision.
- **Lesion**: visual field defects and loss of visual acuity, a defect of vision is called anopsia.



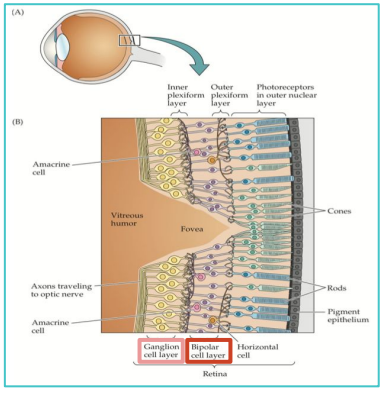
Visual Pathway:

Optic nerve → Optic chiasm → Optic tract → Lateral geniculate body "nucleus" → Optic radiation → Visual cortex

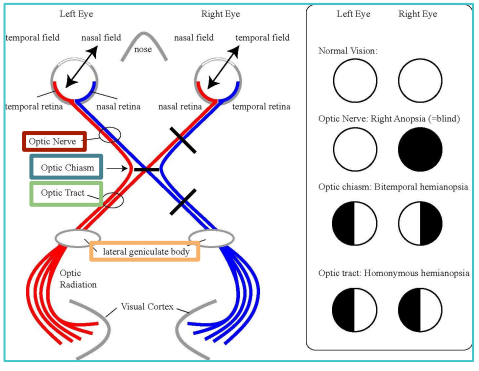
Visual Pathway

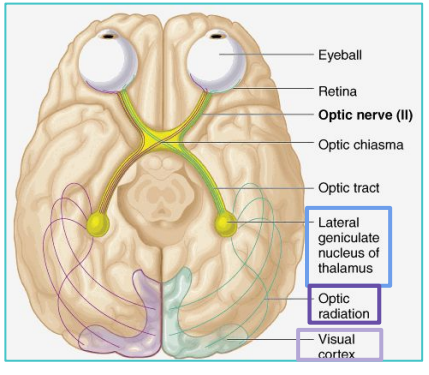
Photoreceptors:

Rods & Cones of the retina



3 Order Neurons Pathway	**1rst 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 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 Disc:** it is optic nerve head; it is point of exit for ganglion cell axons leaving the eye.
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 results in the right optic tract conveying 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?** temporal retinal fibers from the left eye and nasal retinal fibers from the right eye form the left optic tract,
Optic Tract	❑ 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.
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 & Visual Field deficits

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 primary cortex: I saw something, while Association cortex: what did I see (recognition & interpretation)
Each primary cortex has an association cortex.
(MED438)

Disease of the eyeball:
(cataract, intraocular haemorrhage, retinal detachment)

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 Defects

Monocular Blindness	Bitemporal hemianopia	Contralateral homonymous hemianopia
Disease of the optic nerve (multiple sclerosis and optic nerve tumors) Lead to: loss of vision in the affected eye	By an adjacent pituitary tumour, compression of optic chiasm occurs.	Vascular and neoplastic lesions of the optic tract, optic radiation or occipital cortex

MCQ

Q1: The oculomotor nerve has?			
A: Motor fibers	B : Sensory fibers	C: Sympathetic fibers	D: Parasympathetic fibers

Q2: Nerve that responsible for Accommodating reflex of the eyes and Elevation of upper eyelid ?			
A: Optic Nerve	B: Oculomotor Nerve	C: Trochlear Nerve	D: Abducent Nerve

Q3: lesion of Oculomotor Nerve results in ?			
A: Medial squint	B: Lateral squint	C: Diplopia	D: B & C

Q4: Trochlear Nerve supply which muscle ?			
A: Medial rectus	B: Lateral rectus	C: Superior oblique	D: Inferior oblique

Q5: Abducent Nerve supply which muscle ?			
A: Medial rectus	B: Lateral rectus	C: Superior oblique	D: Inferior oblique

Q6: Lesion of Abducent Nerve results in ?			
A: Medial squint	B: Lateral squint	C: Loss of accommodation	D: Ptosis

Answer key:
1 (A & D) , 2 (B) , 3 (D) , 4 (C) , 5 (B) , 6 (A)

MCQ

Q7: 2nd order neuron in the visual pathway is?			
A: Bipolar cells of retina	B: Ganglion cells of retina	C: Neurons in the lateral geniculate body	D: none of the above

Q8: Axons of retinal ganglion cells converge at?			
A: Optic disc	B: Optic tract	C: Optic chiasma	D: lateral geniculate nucleus

Q9: The disease that lead to bitemporal hemianopia is?			
A: Monocular Blindness	B: Compression of the optic chiasm	C: Contralateral homonymous hemianopia	D: None of the above

Q10: Which of the following is NOT part of the visual pathway			
A: Visual Defects	B: Optic radiation	C: Visual cortex	D: Optic chiasm

Q11: Disease of the optic nerve (multiple sclerosis and optic nerve tumors) will lead to?			
A: Bitemporal hemianopia	B: Loss of vision in the affected eye	C: Intraocular haemorrhage	D: A&C

Q12: Which of the following is (area 17 of Brodmann's)			
A: The primary visual cortex	B: Optic nerve	C: Optic canal	D: The visual association cortex

Answer keys:
7(B) , 8(A) , 9(B) , 10(A) , 11(B) , 12(A)

SAQ

Q1: list the muscles supplied by Oculomotor Nerve.

Q2: The edinger-westphal nucleus receives fibers from corticonuclear fibers for?

Q3: Enumerate the visual pathway?

Q4: Define Photoreceptors.

Answers

1 :
It's motor to : Levator palpebrae superioris , Superior rectus muscle , Medial rectus muscle , Inferior rectus muscle , Inferior oblique muscle
Parasympathetic fiber to : .
Constrictor pupillae , Ciliary muscle

2 : Accommodation reflex

3 : Optic nerve, Optic chiasm, Optic tract, Lateral geniculate body, Optic radiation, Visual cortex.

4: Rods and Cones of the retina

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