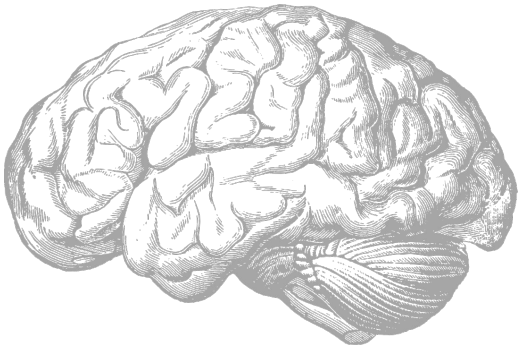
Cranial Nerves II, III, IV, VI

CNS Block



Color Index

- Main Text
- Female Slides
- Male Slides
- Drs' Notes
- Important
- Extra info

The Editing File

Objectives

- List the cranial nuclei related to **oculomotor**, **trochlear**, and **abducens** nerves in the brainstem.
- Describe the site and type of **each nucleus.**
- Describe the site of **emergence** and main points in the 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.**
- Mention the **clinical manifestations of visual** pathway lesion.

You can find Atlas by Clicking HERE!

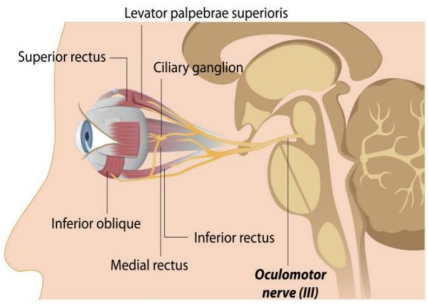
Oculomotor Nerve

Male Slides

Introduction:

The oculomotor nerve is the third nerve among the twelve pairs of cranial nerves.

1

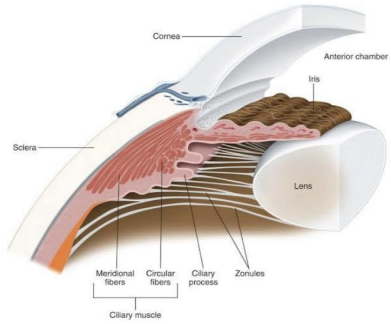


It provides motor for most of extraocular muscles.

2

Also, it carries preganglionic parasympathetic fibers to the pupillary constrictor (pupillary reflex) and ciliary muscle (accommodation).

3



4

The name reflecting the function of the nerve where the word “oculo” pertaining to the eye, while “motor” means producing movement.

Importance:

The oculomotor nerve has two main functions:

1- **Transmitting signals** to allow the eyes to move in all direction that are not controlled by other cranial nerves

2- Carrying **parasympathetic fibers** to the iris to be constricted during strong light.

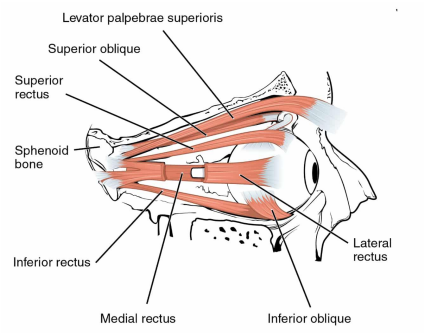
Any **damage** to the nerve can cause double vision **(diplopia)** and blown pupil that cannot be constricted.

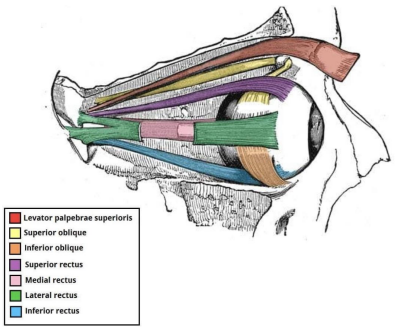
Extraocular Muscles

MCQ

Extraocular Muscles (7 muscles)

Levator palpebrae superioris





4 Recti muscles:

- Medial rectus.
- Lateral rectus.
- Superior rectus
- Inferior rectus

2 oblique muscles:

- Superior oblique.
- Inferior oblique

N.B

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

Oculomotor Nerve

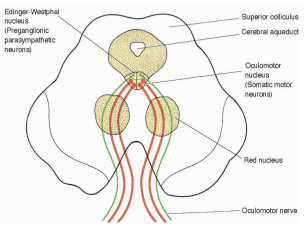
Type

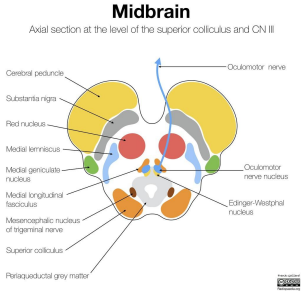
Motor for most of extraocular muscles.

It has two nuclei:

Main oculomotor nucleus:	▸ Lies in the midbrain at the level of **Superior colliculus.** ▸ Location in the periaqueductal gray matter.
Accessory nucleus (Edinger-Westphal nucleus):	Lies dorsal to the main (oculomotor) motor nucleus. Its cells are preganglionic parasympathetic neurons. It receives; 1- Corticonuclear fibers for **accommodation reflex.** 2- fibers from pretectal nucleus for the direct and consensual **pupillary reflexes.**

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





Oculomotor Nerve

Oculomotor nerve:

Axons from oculomotor nucleus:

It **curves ventrally** through the tegmentum and red nucleus in the midbrain.

The nerve emerges on the anterior surface of the midbrain in **interpeduncular fossa.**

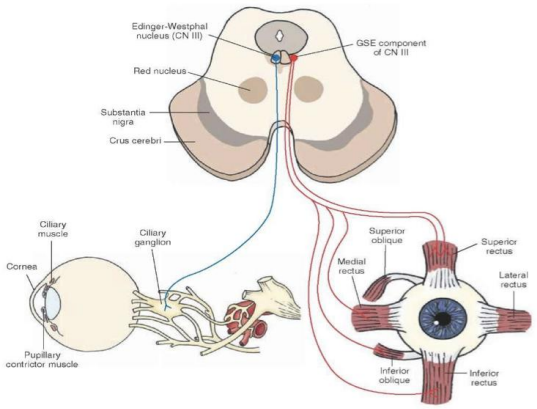
Then it passes forward between **posterior cerebral and superior cerebellar arteries.**

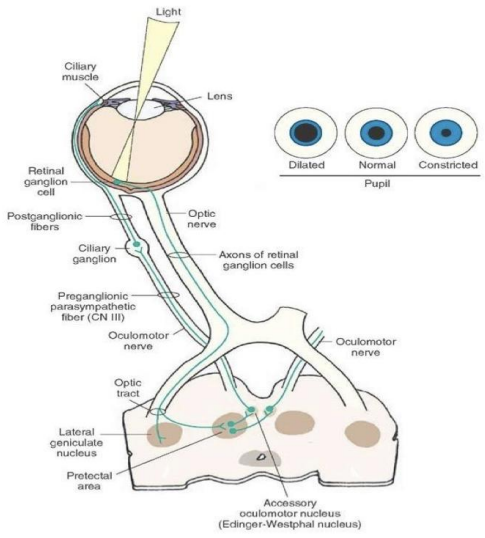
In the middle cranial fossa, it runs in the lateral wall of the cavernous sinus, and then it divides into superior and inferior divisions, which pass through the **superior orbital fissure** to the orbit.

Axons from Edinger-westphal nucleus:

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

2. Postganglionic fibers pass through the short ciliary nerves to the eyeball, **where they supply:**
   1- Constrictor Pupillae Muscle of the iris.
   2- Ciliary Muscle.





Oculomotor Nerve

MCQ

Oculomotor nerve:

Supply:	Responsible for/Nerve function:
Motor to: 1. Levator palpebrae superioris muscle. 2. Superior rectus muscle. 3. Medial rectus muscle. 4. Inferior rectus muscle. 5. Inferior oblique muscle. **Parasympathetic** to: 1. Constrictor pupillae Muscle. 2. Ciliary muscles.	▸ 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 (Constriction of ciliary muscle).

Oculomotor nerve lesion:

- **Lateral squint** (eye turns outward).

- Ptosis (Drooping of the eyelid)

- Diplopia.
- Pupillary dilation
- Loss of accommodation (construction of pupillae & ciliary muscle).
- The eyeball is fully abducted and depressed (out and down) because of the unopposed activity of the lateral rectus (by CN-6) and superior oblique (by CN-4) muscles.

The preganglionic parasympathetic fibers run superficially in the nerve, so 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 (sluggish to fixed pupil).

Trochlear Nerve

Male Slides

Introduction

The trochlear nerve is the fourth nerve of the twelve pairs of cranial nerves.

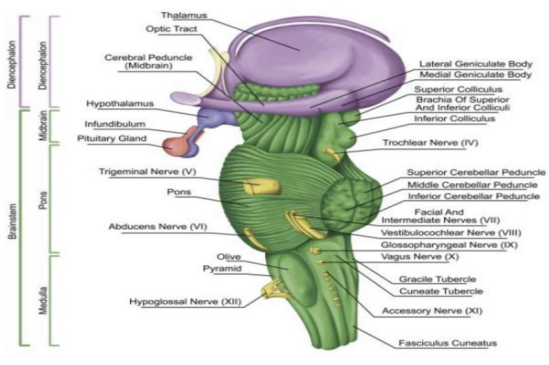
Based on number of axons, it is considered as the smallest cranial nerve with the longest intracranial course since it is the only cranial nerve originate from posterior aspect of midbrain.

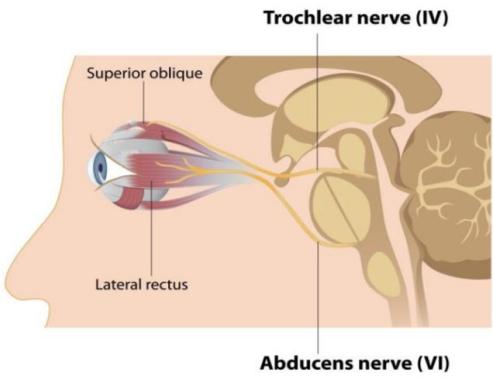
Trochlear nerve has a purely somatic motor function.

Importance

1 The trochlear nerve normal function is to control the muscle that move the eyeball down and out.

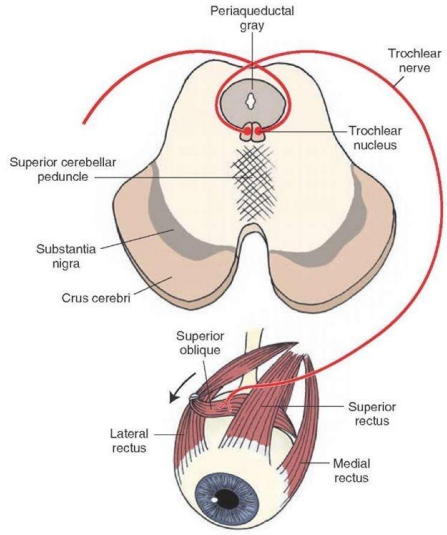
2 The damage of the nerve will cause diplopia (double vision) that will make us see objects doubled.





Trochlear Nerve

Introduction



Type

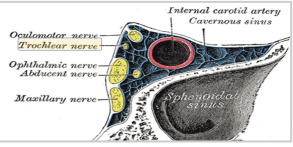
Motor

Location

Small motor nucleus located in the **periaqueductal gray matter** at the level of inferior colliculus. (Midbrain)

Course of the nerve:

Fibers curve backwards and decussate.



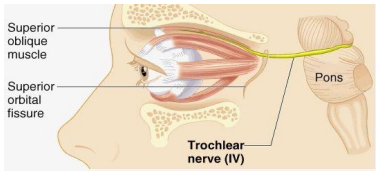
The nerve emerges immediately caudal to the inferior colliculus on the dorsal surface of brainstem (midbrain). N.B: it's the only cranial nerve emerges from the back of the brainstem.

It passes forward through middle cranial fossa in the lateral wall of the cavernous sinus below the oculomotor nerve.

Then enters the orbit through the **superior orbital fissure.**

Supply

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



Function

Rotates the eyeball **downwards** and **laterally.**

Lesion

Lesion of trochlear nerve results in **diplopia** (double vision) & inability to **rotate the eyeball inferolaterally.** Thus, the eye deviates; **upward** and slightly **inward** (**medially**). This person has difficulty in walking downstairs and reading.

Abducens Nerve (CN VI)

MCQ

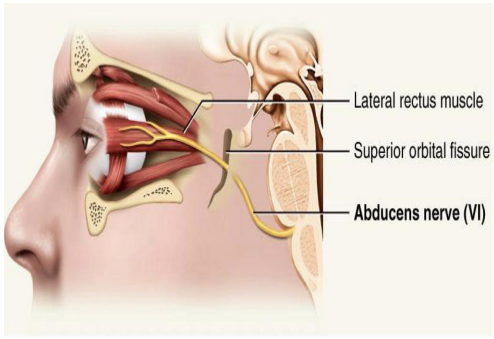
Introduction

Type

Only one (somatic) motor nucleus. (PURE motor nerve)

Location

Lies in caudal pons in the floor of the 4th ventricle.



Abducens nerve

- It forms the facial colliculus with the fibers of facial nerve looping around the nucleus.
- Lies close to the middle line, in a line with 3rd, 4th & 12th nerves.
- It emerges from the ventral aspect of brain , at the junction of the pons and the pyramid of the medulla oblongata.

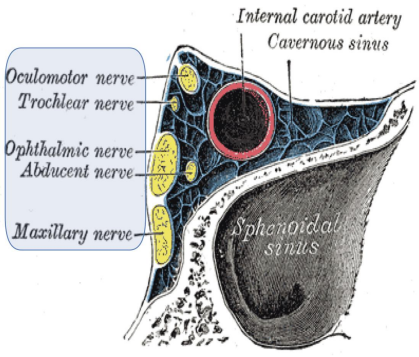
Course

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 eyeball laterally (abduction).

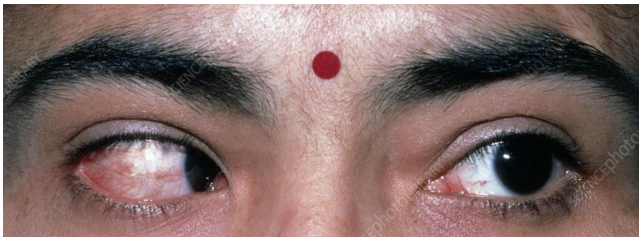


Lesion

Lesion results in:

1. Inability to direct the affected eye laterally, so it result in **(medial squint)**.

2. 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.



Medial Squint

Optic Nerve

Male Slides

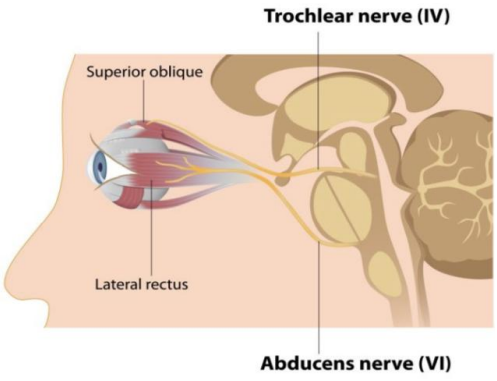
Introduction

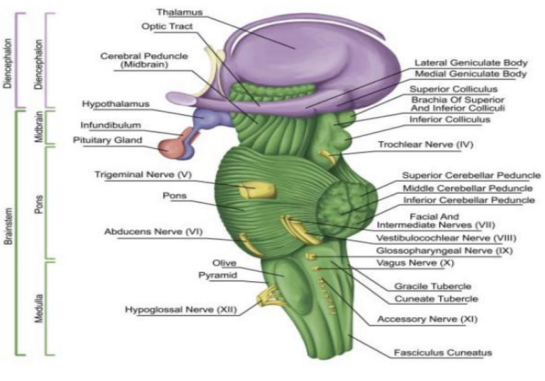
1	2	3	4
The optic nerve is the **second nerve** of twelve pairs of cranial nerves.	It is the only nerve - with olfactory nerve - that **doesn't emerge directly from the brainstem.**	The optic transmits **only sensory** information for vision.	**Photoreceptors** of the nerve is **Rods and Cones** of the retina.

Importance

It provide us the visual capacity for gratitude as we understand the way we see.

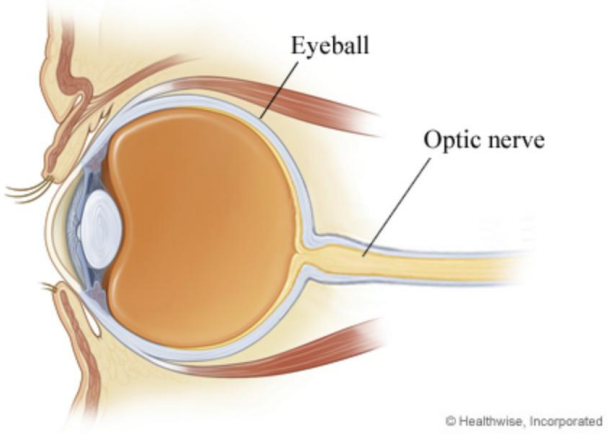
Any damage to the optic nerve can cause loss of our vision, and therefore, we lose our privileges to see, and to enjoy movies and outdoor atmospheres.





Optic Nerve (CN II)

Introduction



Type

Special Sensory Nerve

Function

Vision

Photoreceptors

Rods and **Cons** of the retina.

Lesion

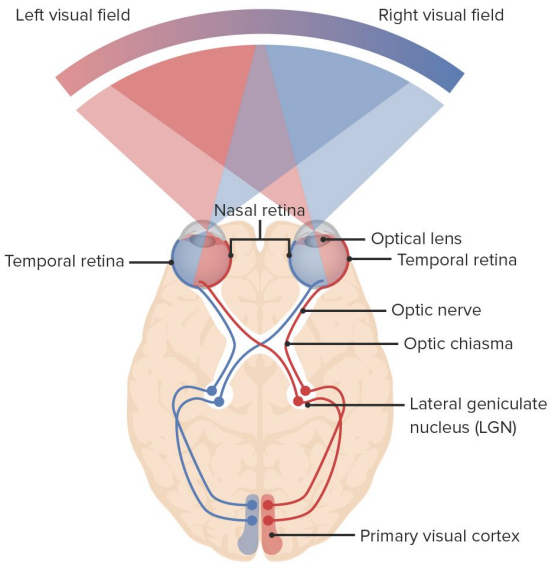
Visual field defects and **loss of visual acuity.**
A defect of vision is called **anopsia.**

3 Neurons Pathway

1st Order Neurons:
Bipolar cells of retina

2nd Order Neurons:
1- Ganglion cells of **retina.** 2- Their axons form the **optic nerve.**

3rd Order Neurons:
1- Neurons in the **lateral geniculate** body. 2- Their axons terminate in **primary visual cortex.**



Visual pathway/
Nerve course

Optic Nerve

Optic Chiasma

Optic Tract

Lateral geniculate body (Nucleus)

Optic Radiation

Visual Cortex

Details in the next slide

Visual Pathway

MCQ

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** forming the **optic chiasma.**

Optic disc is optic nerve head; it is the point of the 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 forming 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.**

Optic Tract:

- **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.**

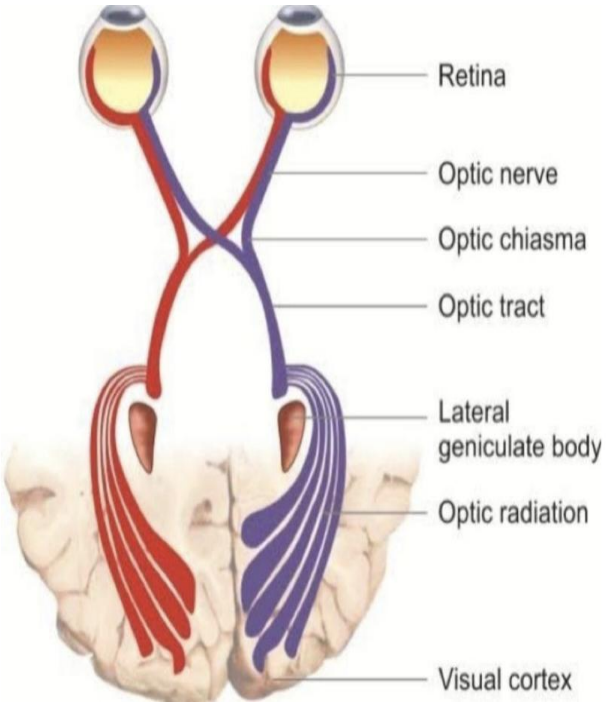
Visual cortex:

- 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.

Pictures are in the next slide

Pics of the Visual Pathway

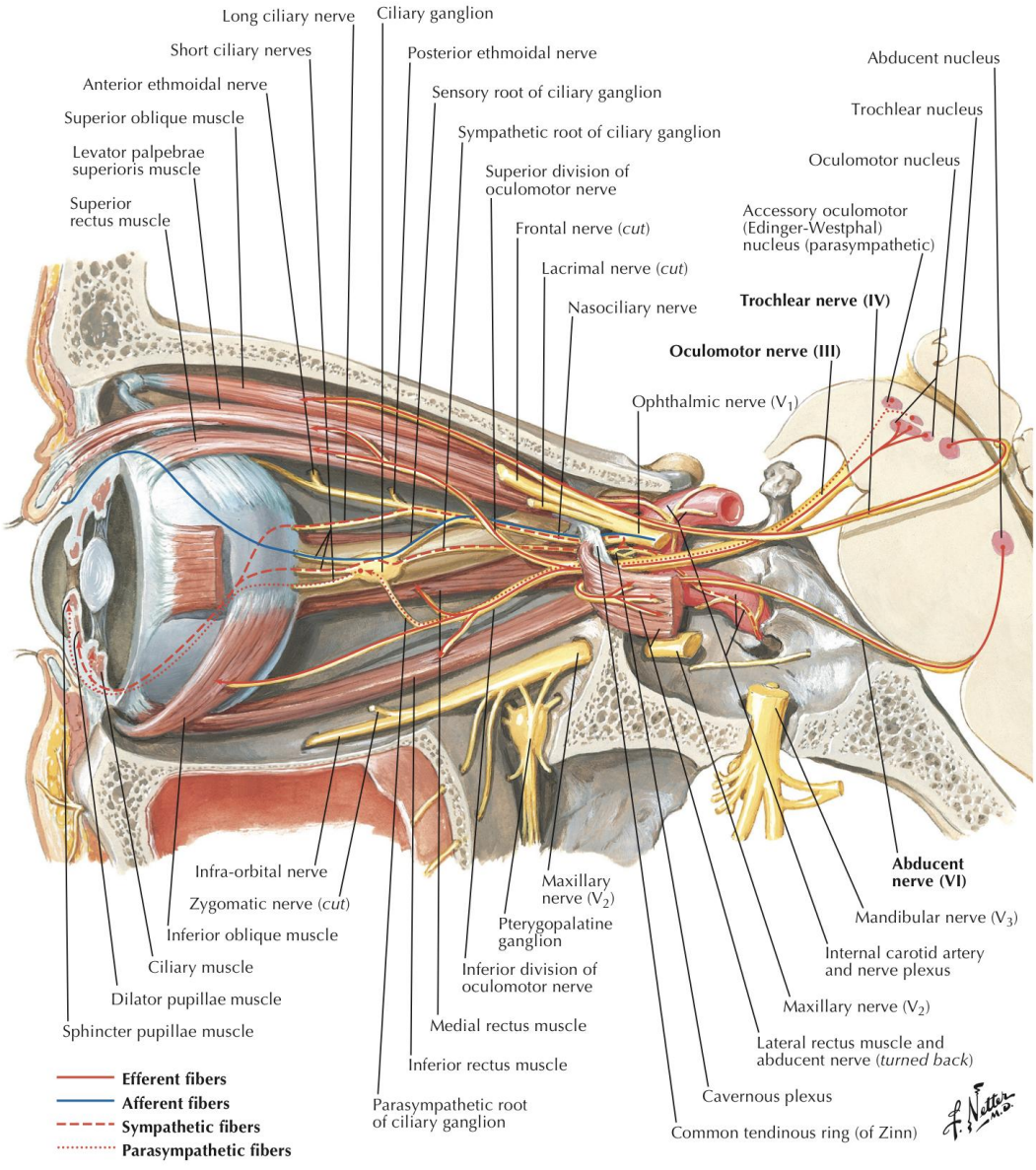


Female Slides

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

A: Temporal retinal fibers from the left eye and nasal retinal fibers from the right eye form the left optic tract.

EXTRA PICTURE FOR SUMMARY



Visual Field Deficits

MCQ

Visual Field Deficits

Monocular Blindness:

- disease of the optic nerve (multiple sclerosis and optic nerve tumors)
- leads to: loss of vision in the affected eye.

Bitemporal Hemianopia:

- Compression of the optic chiasm bv an adjacent pituitary tumour
- Have difficulty seeing objects on their outer visual fields

Contralateral Homonymous Hemianopia:

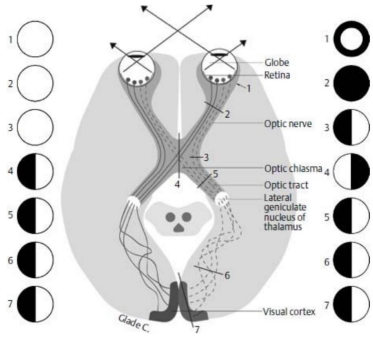
- Vascular and neoplastic lesions of the optic tract. optic radiation or occipital / visual cortex
- Patient can not see objects on their left or right sides of visual fields

Disease of the Eyeball:

- Cataract - Intraocular haemorrhage - Retinal detachment

Normal vision

Blindness

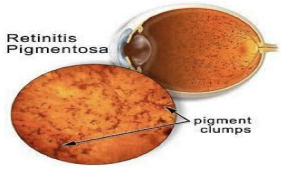


Retinitis Pigmentosa

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.



Which type of photoreceptors is affected?

Rods.

Symptoms:
Triple P

1- **P**rogressive night blindness
2- **P**eripheral visual field constriction.
3- **P**igmentation of the retina visible by ophthalmoscope

MCQs

Q1.If a patient is recently diagnosed with Bitemporal hemianopia. Where is the most likely site of lesion? Female Slides

A. Right optic tract.	**B.** Left eye.	**C.** Left optic radiation.	**D.** Optic chiasma.

Q2. If a patient is recently diagnosed as left homonymous hemianopia. Where is the most likely site of lesion? Female Slides

A. Right optic tract.	**B.** Optic chiasma.	**C.** Left optic nerve.	**D.** Left occipital cortex.

Q3. Medial squint is caused by injury to:

A. Abducent	**B.**Oculomotor	**C.** Trochlear	**D.** Optic

Q4. Which one of the following nerves supplies the superior rectus muscle?

A. Optic	**B.** Abducent	**C.** Oculomotor	**D.** Trochlear

Q5. Which of the following nerves emerges between pons and pyramid?

A.Trigeminal	**B.**Trochlear	**C.** Abducent	**D.** Vestibulocochlear

Q6. Which of the following has parasympathetic supply to the pupil of the eye

A. Optic nerve	**B.** Oculomotor nerve	**C.** Trochlear nerve	**D.** Facial nerve

A1. D A2. A A3. A A4. C A5. C A6.B

FOR ANKI FLASHCARDS

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Lama Alsuliman

Aljoharah Alkhalifah

Aishah Boureggah

Maryam Alghannam

Lama Alotaibi

Wafa Alakeel

Ghaida Aldossary

Retal Alshohail

Norah Almania

Deena Almahawas

Omar Almogren

Nazmi M Alqutub

Abdulaziz Alqarni

Mansour Alotaibi

Khalid Alsobei

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