

Sheet no. 17

Lecture title: The Orbit, Orbital Contents and Cranial Nerves III, IV & VI

Lecture date :24/2/2021

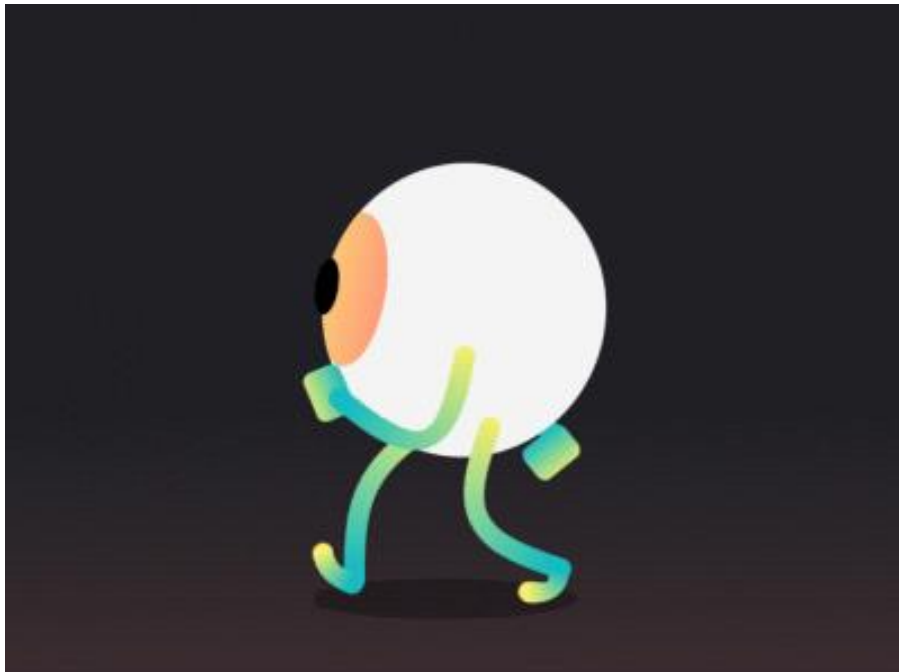
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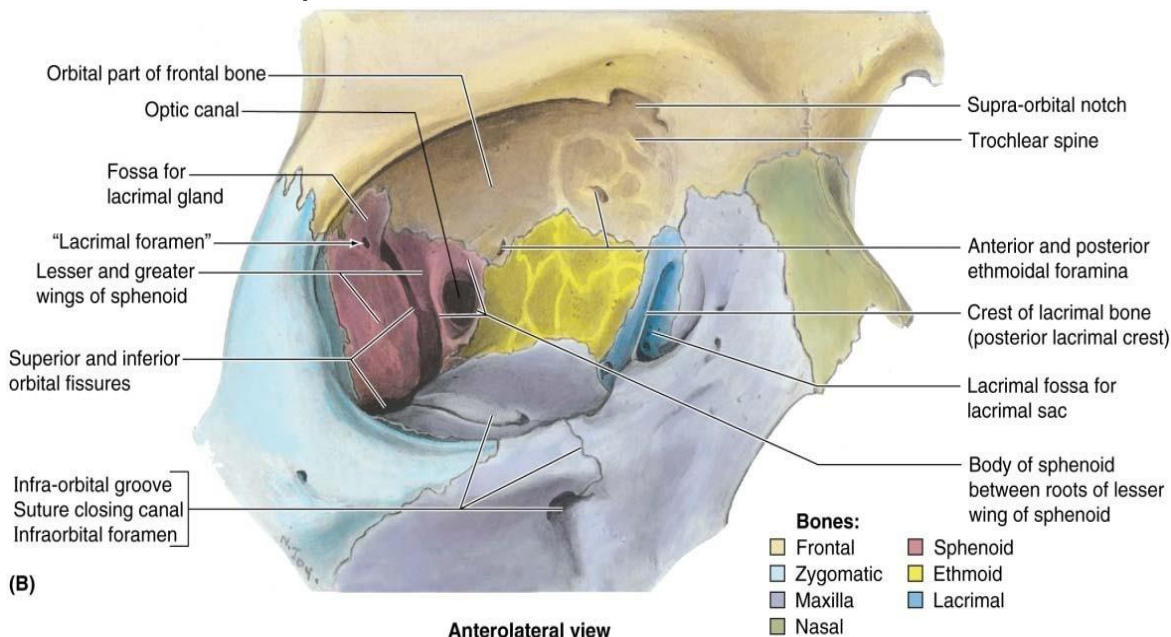
دعاء إلى فقيدنا وأخينا رشيد الهواملة :

اللهم اني اسالك له الدرجات العلى من الجنة، وادخله الجنة، وأسألك له خلاصاً من النار، ربنا لا تؤاخذنا إن نسينا أو أخطأنا، ربنا ولا تحمل علينا إصراً كما حملته على الذين من قبلنا، سبحانك ربّي واليك المصير



❖ Orbital Margins :

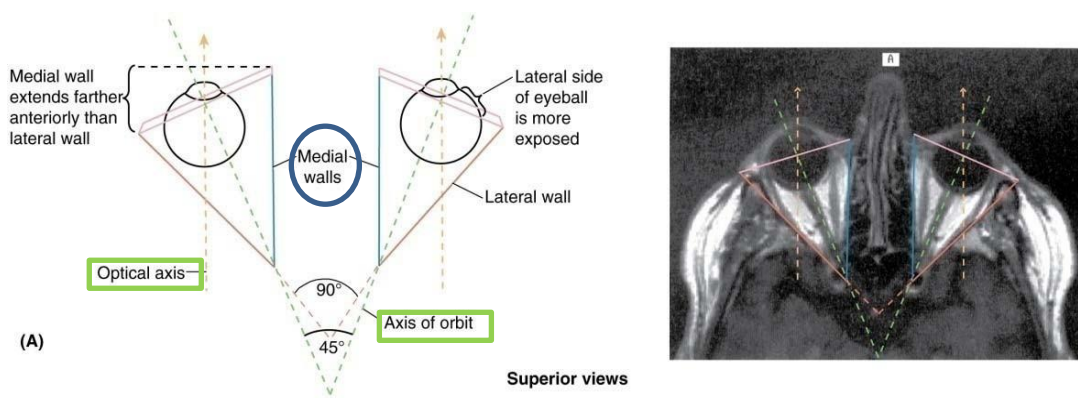
Almost oval in shape.



- **Superior margin:** Frontal bone.
 - Medially: Supra-orbital notch, sometimes it can be complete (foramen), it contains the supra- orbital nerve and vessels.
- **Lateral margin:** Zygomatic bone.
- **Inferior margin:** Zygomatic and Maxilla.
- **Medial margin:**
 - Upper part: Frontal bone.
 - Lower part: Frontal process of Maxilla.

❖ Orbital cavity:

- **Shape:** Conical in shape.
 - **Relations:**
 - **Inferior to:** the anterior cranial fossa (separated by the roof of orbital cavity)
 - **Anterior to:** middle cranial fossa (most openings in the cavity opens in the middle cranial fossa)
 - **Lateral to:** nasal cavity.
 - **Superior to:** Maxillary sinus.
 - **Orientation:**
 - **Anteriorly-Externally:** The base of the cones which is the marginal walls.
 - **Posteriorly-Internally:** The apex of cones which is the optic canal.
 - **Medially:** the two medial walls (of both cones) are parallel to each other, which means that the **axis of the cones** is diverged (making an angel with the midline) from inside to outside. (كلما اتجهوا للأمام يبعدوا عن بعض)
- BUT the **Anterior-posterior Axis of the Eyeball** is straight forward (unlike the axis of the cavities)



If the orientation of the Orbital AXIS is parallel, then we will need more space between the two orbital cavities and the lateral wall of the skull will move further away from each other and the head will be bigger.

But when the medial walls of the are parallel, then the space between orbital cavities in the skull is efficient.

• Walls of the cavity:

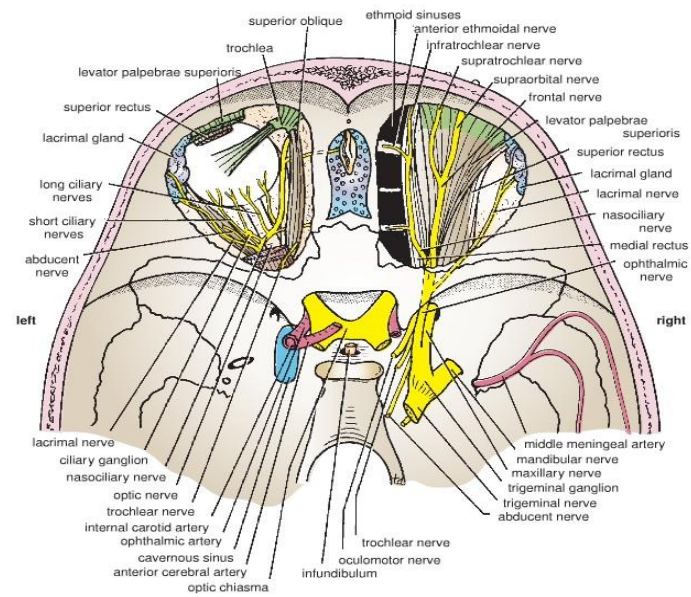
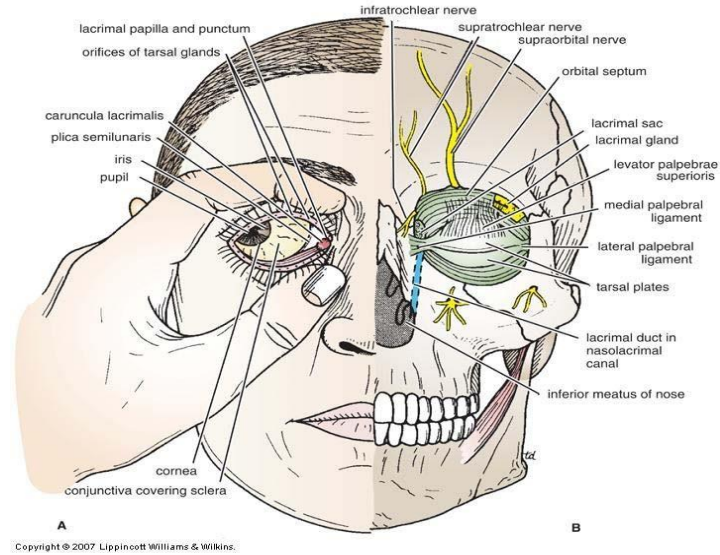
- **Roof:** Frontal bone (orbital process of frontal bone)
- **Floor:** Maxilla and most posteriorly is the tip of vertical plate.
- **Medial wall:** Ethmoid bone, Lacrimal bone and Maxilla.
- **Lateral wall:** Sphenoid bone (Lesser & Greater wings) & Zygomatic bone.

• Openings in the orbital cavity:

1. **Supraorbital notch (foramen):** contains the supra-orbital nerve & vessels.
2. **Optic canal:** Contains the optic NERVE and ophthalmic ARTERY.
It opens superior lateral to the Sella turcica in the middle cranial fossa and ends within the lesser wing.
3. **Infra-orbital groove, canal, & foramen:** Infra-orbital nerves and blood vessels.
4. **Nasolacrimal canal:** Connects the orbit to the nasal cavity and contains the lacrimal apparatus to drain the excess of tears toward the nasal cavity (the physiological system containing the orbital structures for tear production and drainage
From google)
5. **Superior orbital fissure:** Contains the oculomotor nerve (III), Trochlear nerve (IV), Abducent nerve (VI), Ophthalmic branch of the trigeminal nerve (V) & Ophthalmic VEINS.
It opens between lesser and greater wings of sphenoid in the middle cranial fossa.
6. **Inferior orbital fissure:** Contains Branches of maxillary nerve and some blood vessels.
It Opens in pterygopalatine fossa (that contains the maxillary nerve)
7. **Anterior & posterior ethmoidal foramina:** Contain Anterior & posterior ethmoidal nerve (for ethmoidal cells) and vessels.
8. **Zygomatico-temporal opening:** Contain Zygomatico-temporal nerves and blood vessels.
9. **Zygomatico-facial openings:** Contain Zygomatico-facial nerves and blood vessel.

• Orbit Contents:

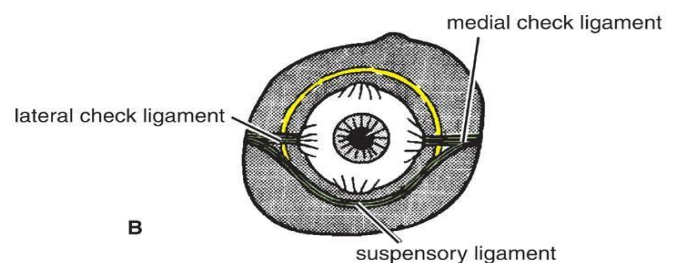
1. **Eyelid:** (Externally)
2. **Lacrimal apparatus:** Contains the lacrimal gland.
3. **Eyeball**
4. **Fascia:** Suspense the eyeball.
5. **Extra-ocular muscles:** control the eyeball movement.
6. **Nerves:** Sensory and motor (motor nerves are for extra and intra ocular muscles).
7. **Blood vessels**
8. **Fatty tissue:** In between all contents, for cushion and for trauma absorption.



❖ Fascia:

Functions of fascia:

- Covers the eyeball (sclera) -Dense irregular connective tissue similar to the deep fascia, important to fix the insertion of the extraocular muscles-
- Separate the eye from surrounding orbital fat.
- Protect the eye from infections in the surrounding structure.
- Facilitates movement of eye.
- Pierced by orbital (Extra-ocular) muscles and it is the insertion site for them.
 - Tubular sheath
- **Attaches to orbital walls by extension:**
 1. **Medial check ligaments**
 2. **Lateral check ligaments**
 - To fix the eye medially and laterally.
 3. **Suspensory ligament:** connect the medial ligament with the lateral ligament forming a basket under the eyeball to fix it in its place while the head movement.



❖ Extra-ocular Muscles:

- **Extrinsic muscles (have insertions in the eyeball):**

They are skeletal muscle, innervate by **GSE (General somatic efferent)**

1. **Superior rectus:** **Oculomotor nerve III**
2. **Inferior rectus:** **Oculomotor nerve III**
3. **Medial rectus:** **Oculomotor nerve III**
4. **Lateral rectus:** **Abducent nerve VI**

All these **Rectus** (And the **superior oblique**) originate from a ring surrounds the optic canal, (they originate from the apex of the conical shape) and insert anteriorly.

So, their orientation is along the axis of the orbit **not with axis of eyeball**.

5. **Superior oblique:** originate from the ring, passes forward & insert in trochlea in midline anteriorly then continue its way superior to eyeball and laterally to insert again posteriorly in the axis of eyeball. (its fiber orientation is from anterior to posterior)

Trochlear nerve VI.

6. **Inferior oblique:** Originate from medial wall anteriorly and insert posteriorly

Oculomotor nerve III.

7. **levator palpebrae superioris:** **Oculomotor nerve III**

The orientation of the fibres of **superior & inferior oblique** and **Superior & inferior rectus** differ from the axis of eyeball.

That helped them to form a complex movement (more than one movement).

They can overcome the differences between the axis of orbit and axis of eyeball

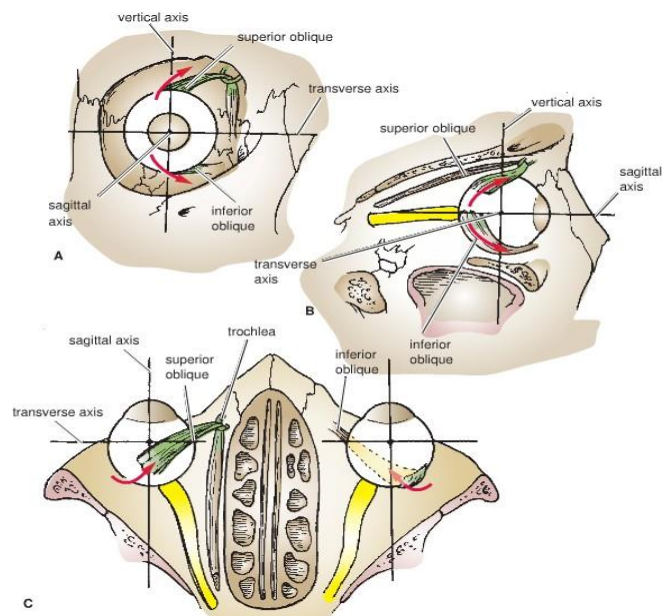
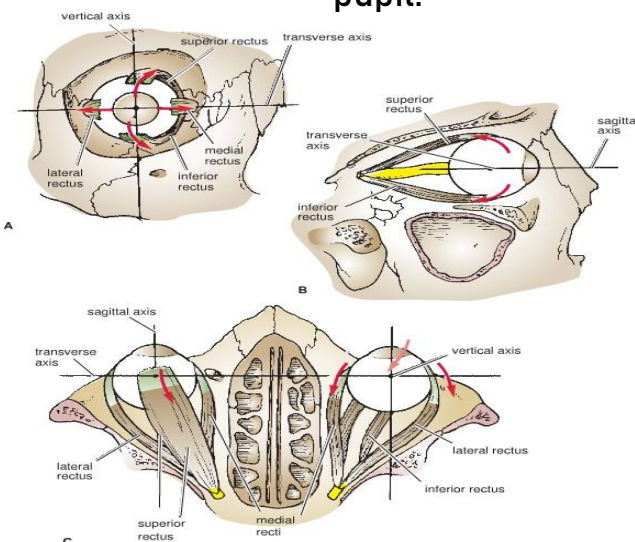
WHILE the orientation of **medial and lateral rectus** is with the axis of eyeball. (form a simple one movement)

- **Intrinsic muscles: Inside eyeball**

These are smooth muscles, innervate by **GVE (General visceral efferent)**.

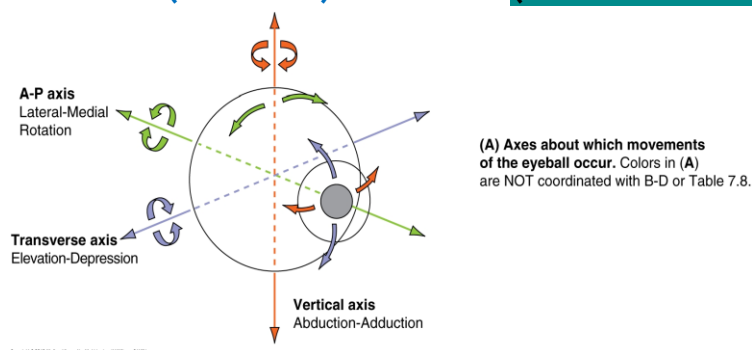
1. **Ciliary muscle:** **parasympathetic- oculomotor nerve III**
Control the lens.
2. **Constrictor pupillae of the iris:** **parasympathetic- oculomotor nerve III.**
3. **Dilator pupillae of the iris:** **sympathetic.**

Iris muscles Control the pupil.



❖ Axes of Eyeball movements:

1. **Vertical Axis:** Around this axis adduction & abduction occurs (medial and lateral movement).
2. **Transverse Axis:** Elevation & depression of eyeball.
3. **Anterior- posterior Axis (A-P axis):** Rotation. (we will not be asked about it)

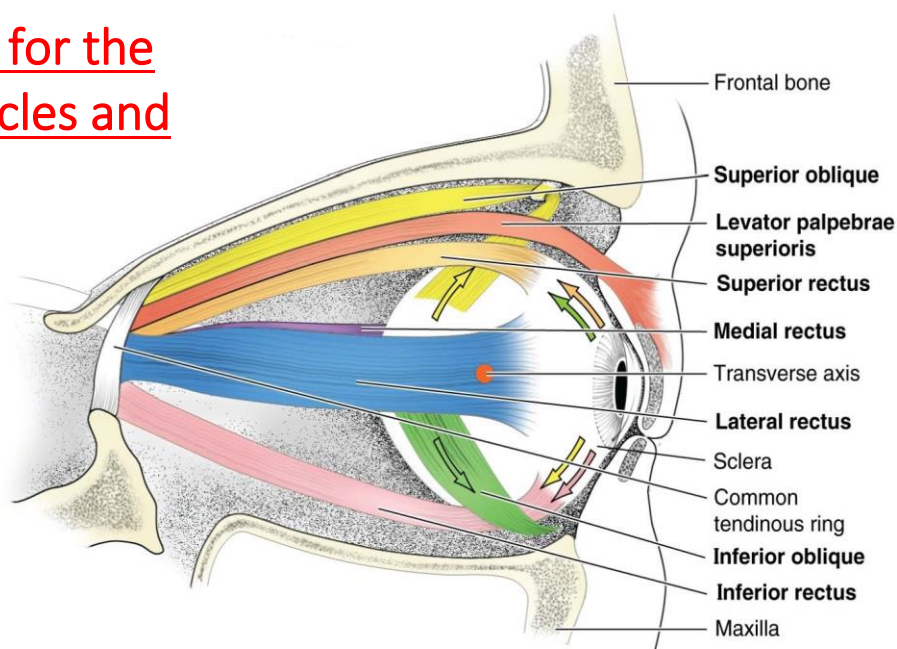


❖ Movement of the eye around Transverse Axis (medial-lateral axis):

Pay attention for the colors of muscles and arrows!

(B) Lateral view

Elevators-Depressors
(Rotation around transverse axis)



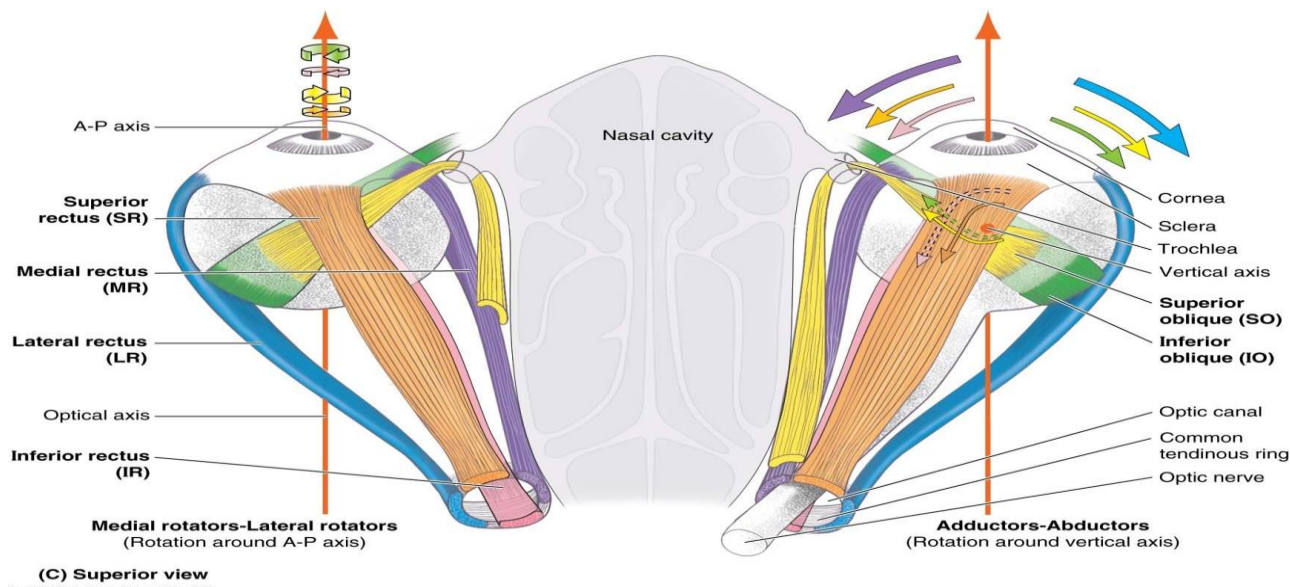
1. Elevation by Superior rectus and inferior oblique.

(*Inferior oblique originates anteriorly and insert behind the axis, -contraction result in pulling the eyeball from the insertion site to the origin site which means pulling the eyeball from behind and to inferior anterior resulting in elevation- its elevation is in this way ↻ Notice the green arrows in the picture)

2. Depression by Inferior rectus and superior oblique.

(*superior oblique originates posteriorly and insert twice firstly in the trochlea -in the midline anteriorly- and then behind the axis, -the opposite of the inferior oblique- its depression is in this way ↻ Notice the Yellow arrows in the picture)

❖ Movement of the eye around Vertical Axis:



1. **Adduction** (medially) by **medial rectus** mainly, **superior and inferior rectus**.
(*superior & inferior rectus fibers are oblique and medial to the axis of eye (they will form action on it as we said they form a complex movement {one on transverse axis- elevation and depression & one on vertical axis-adduction} here they can exert a medial movement)).
2. **Abduction** (laterally) by **lateral rectus** mainly, **superior and inferior oblique**.
(*Superior & inferior oblique fibers originates medial to the axis and they insert posterior lateral to it {so here, contraction of the muscle will cause pulling of the eyeball from posterior lateral to anterior medial resulting in abduction})

❖ Summary:

Memorize each movement resulted from which muscles or which complex muscle, such as the circled one resulted from inferior oblique moving lateral and superior (elevation and abduction).

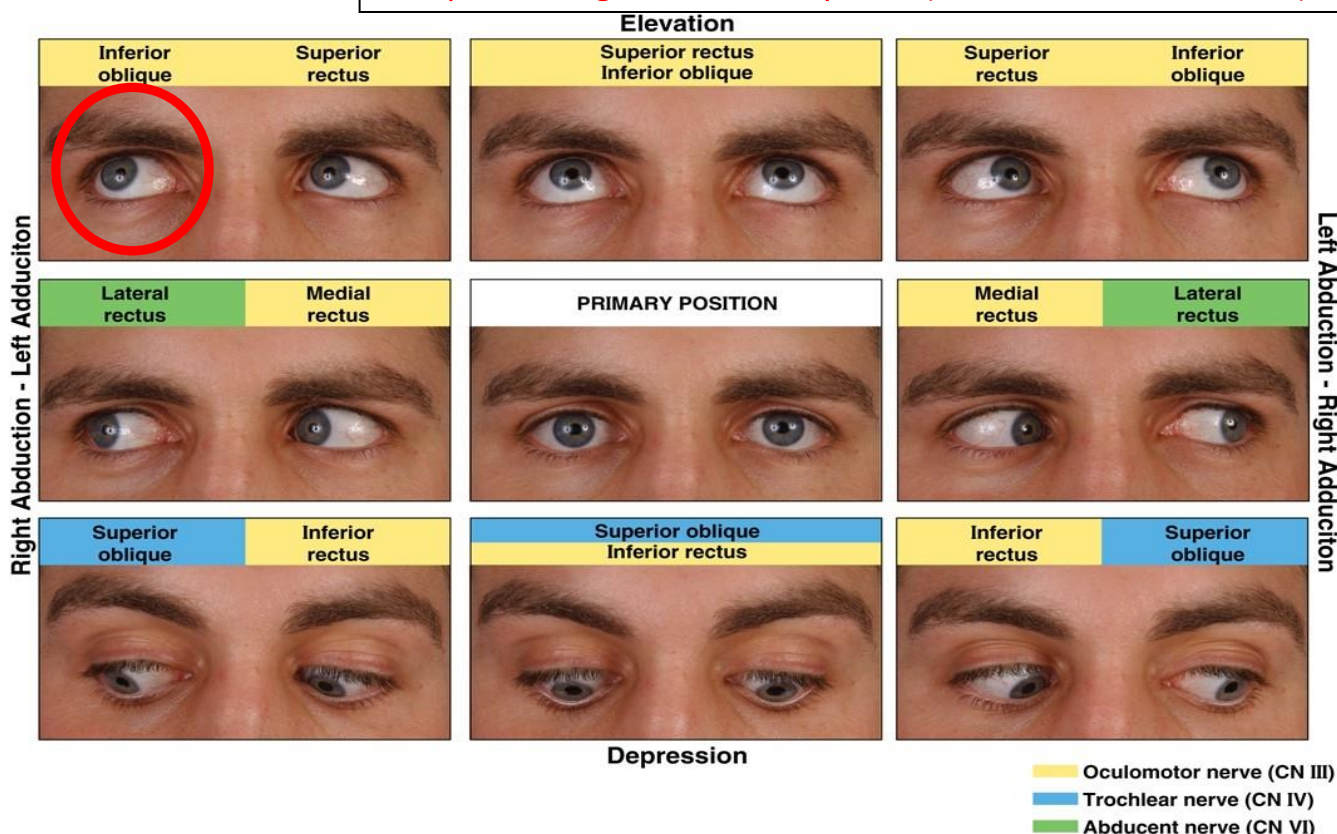
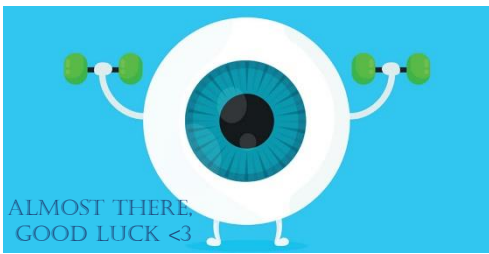


Table 18-1 Muscles of the Eyeball and Eyelids

Muscle	Origin	Insertion	Nerve Supply	Action
Extrinsic Muscles of Eyeball (Striated Skeletal Muscle)				
Superior rectus	Tendinous ring on posterior wall of orbital cavity	Superior surface of eyeball just posterior to corneoscleral junction	Oculomotor nerve (third cranial nerve)	Raises cornea upward and medially
Inferior rectus	Tendinous ring on posterior wall of orbital cavity	Inferior surface of eyeball just posterior to corneoscleral junction	Oculomotor nerve (third cranial nerve)	Depresses cornea downward and medially
Medial rectus	Tendinous ring on posterior wall of orbital cavity	Medial surface of eyeball just posterior to corneoscleral junction	Oculomotor nerve (third cranial nerve)	Rotates eyeball so that cornea looks medially
Lateral rectus	Tendinous ring on posterior wall of orbital cavity	Lateral surface of eyeball just posterior to corneoscleral junction	Abducent nerve (sixth cranial nerve)	Rotates eyeball so that cornea looks laterally
Superior oblique	Posterior wall of orbital cavity	Passes through pulley and is attached to superior surface of eyeball beneath superior rectus	Trochlear nerve (fourth cranial nerve)	Rotates eyeball so that cornea looks downward and laterally
Inferior oblique	Floor of orbital cavity	Lateral surface of eyeball deep to lateral rectus	Oculomotor nerve (third cranial nerve)	Rotates eyeball so that cornea looks upward and laterally
Intrinsic Muscles of Eyeball (Smooth Muscle)				
Sphincter pupillae of iris			Parasympathetic via oculomotor nerve	Constricts pupil
Dilator pupillae of iris			Sympathetic	Dilates pupil
Ciliary muscle			Parasympathetic via oculomotor nerve	Controls shape of lens; in accommodation, makes lens more globular
Muscles of Eyelids				
Orbicularis oculi (Table 13-2)				
Levator palpebrae superioris	Back of orbital cavity	Anterior surface and upper margin of superior tarsal plate	Striated muscle oculomotor nerve, smooth muscle sympathetic	Raises upper lid

From Snell RS: Clinical Anatomy. 7th Ed. Philadelphia: Lippincott Williams & Wilkins, 2004, p. 828.



Nerves of the Orbit:

Nerves that move the eyeball:

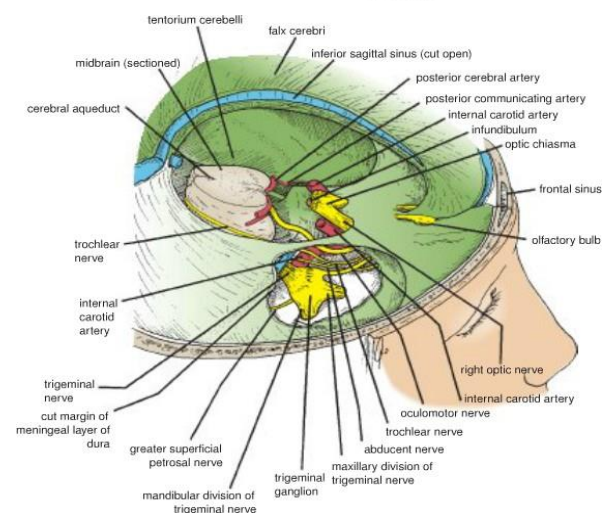
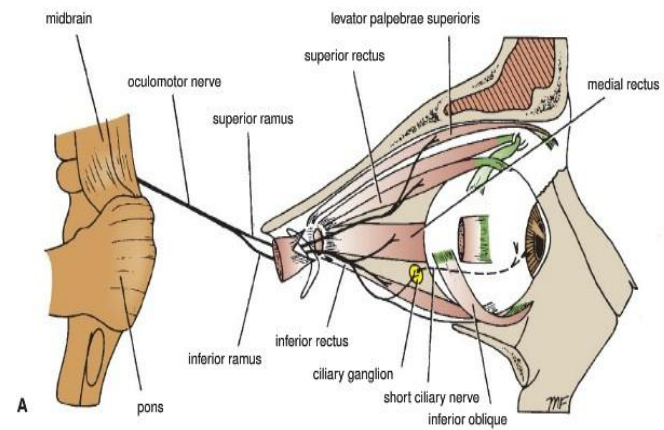
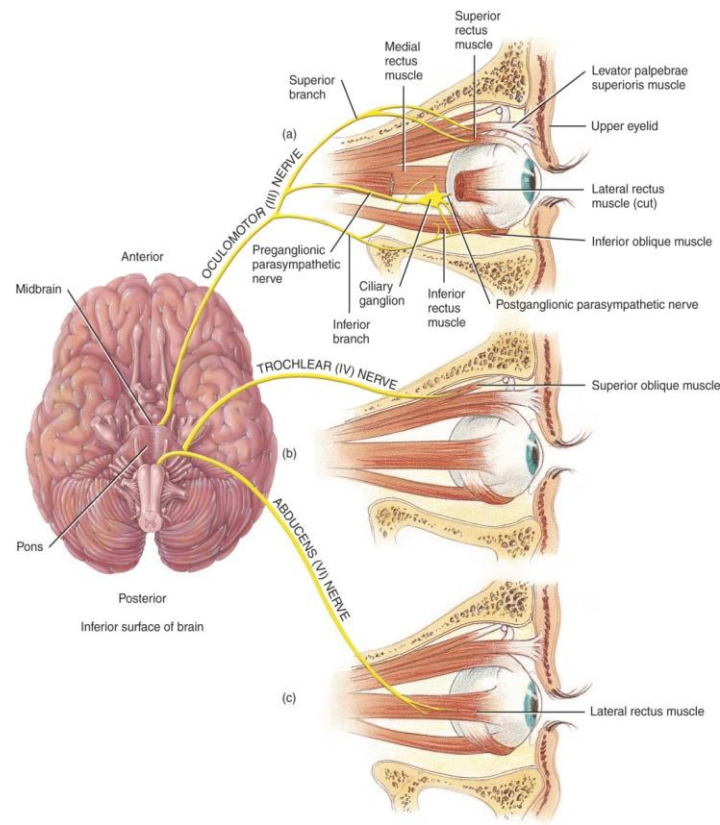
1. Oculomotor III
2. Trochlear IV
3. Abducens VI

1. Oculomotor (III):

Mixed nerve; principally motor (mainly GSE for extrinsic muscles and part GVE –parasympathetic for intrinsic muscles) And sensory (afferent) for proprioceptive.

Pathway:

Nuclei is in upper part of Midbrain then the axons leave the midbrain anteriorly from the inter-peduncular fossa, in the cranial cavity it walks along with the lateral wall of Cavernous sinus lateral to sella turcica then before entering orbital cavity it gives **superior and inferior branches** then both enter the orbital cavity through Superior orbital fissure.



- The superior branch innervates:
 - Superior rectus and levator palpebrae superioris mm.
- The inferior branch innervates:
 - Medial rectus, inferior rectus, and inferior oblique mm.
 - Parasympathetic innervation via the ciliary ganglion-Short ciliary nerves to the intrinsic eye muscles

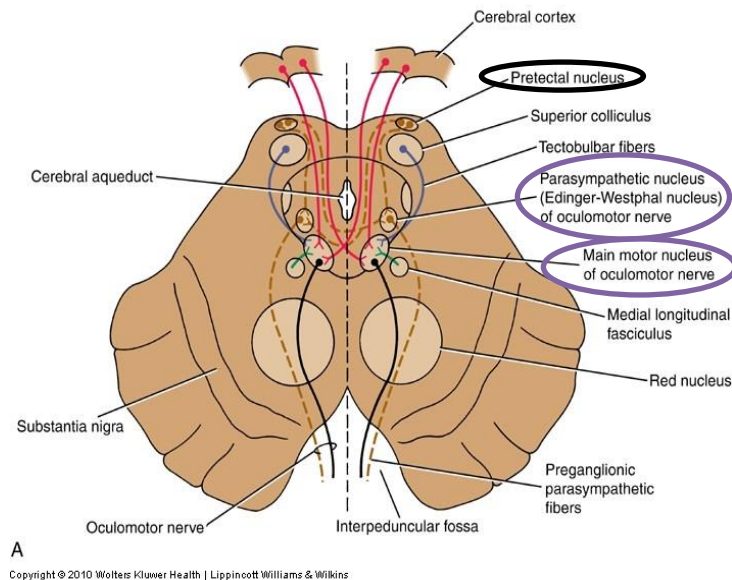
Nuclei of oculomotor nerve:

Has 2 nuclei.

1. Main motor nucleus (GSE)

For extrinsic muscles.

- **Location:** in the midbrain, at the level of superior colliculi in tegmentum, close to midline
- **Relations:**
Anterior to: cerebral aqueducts and PAG
PAG: Peri-Aqueductal Grey, Grey matter surround the cerebral aqueduct. and anterior to Superior colliculi
- **Connections**
 - 1) With Cerebral Cortex (corticobulbar tract- crossed and uncrossed- bilateral)
 - 2) With superior colliculus
- **Fibers course**



Any nerve controls eyeball must have connection with sup. Colliculi. Because sup. colliculi contain the visual pathway – movement of head in response to visual stimuli–.

2. Accessory parasympathetic nucleus (Edinger-Westphal nucleus) (GVE)

For intrinsic muscles.

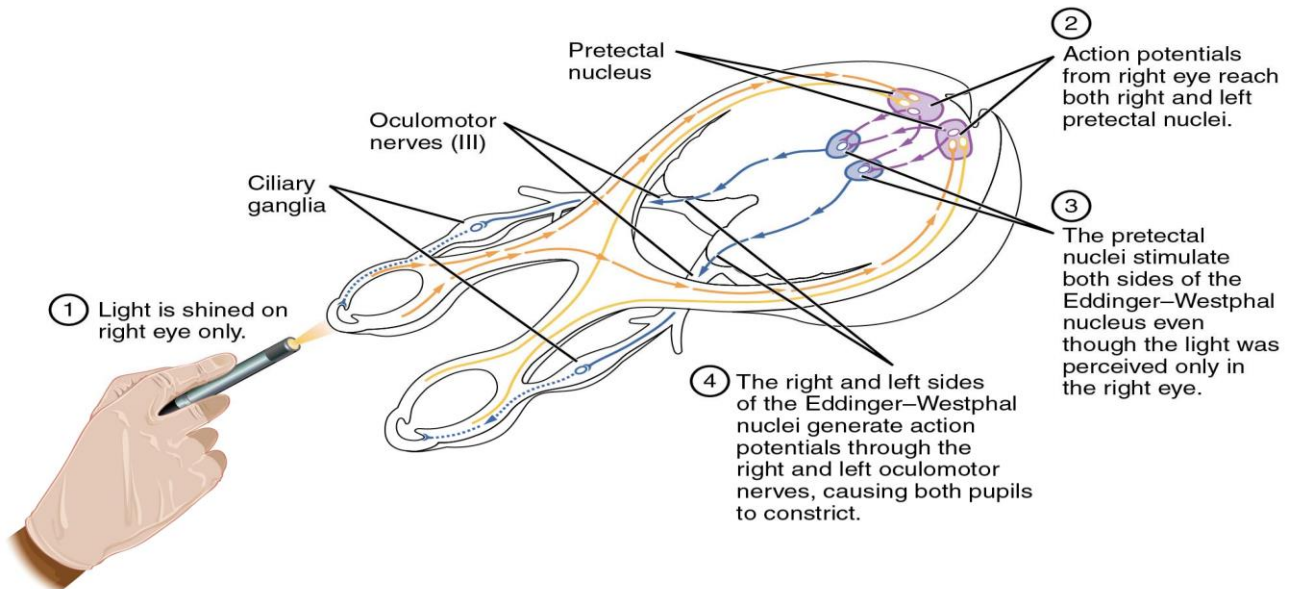
Fibers of these nuclei are unilateral and uncrossed, the Rt. Nucleus control the Rt. Eye and the Lt nuclei for the Lt eye.

- **Location:** In midbrain, in tegmentum, at superior colliculi level
- **Relations:**
Posterior lateral to motor nucleus of oculomotor nerve (Main motor nucleus)
- **Connections**
With Pretectal nucleus –bilateral for pupil reflexes (constriction of the pupil in response to light)
- **Fibers course**

• Major functions of oculomotor nerve:

- Regulating movements of upper eyelid and eyeball
- Adjustment of lens for near vision, and constriction of pupil

○ Pupillary Light Reflex: (notice everything in the picture)



When light is shined in the right eye, signals are translocated by optic nerves that is connected bilaterally with pretectal nuclei which means that stimuli in the Rt eye will affect both nuclei, pretectal nucleus are connected bilaterally to Edinger-Westphal nuclei (but fibers of these nuclei are connected unilaterally to the eyes which means each side controls its own side eye only) so the result will be constriction of both eyes.

If the stimuli are to the Rt eye AND:

- **Cut the Rt optic nerve:**
Both eyes lose reflexes because stimuli will not reach the pretectal nuclei.
- **Cut in the Rt optic tract near the pretectal nucleus:**
Both eyes will have reflexes since the Lt pretectal nucleus will compensate because it is connected bilaterally with the oculomotor nerve.
- **One pretectal nucleus is damaged:**
The other one compensates and reflexes for both eyes are not lost.
- **Cut in Rt oculomotor nerve:**
The reflex will take place in the Lt eye only.

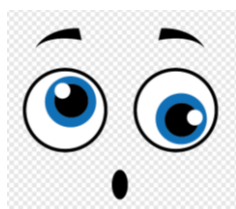
LESION IN OCULOMOTOR NERVE:

- Drooping of the superior eyelid.
- Ptosis (denervation of levator palpebrae)
- External ophthalmoplegia: Eye look down & out (denervation of extraocular muscles) which is the function of superior oblique.
 - Diplopia
- Internal ophthalmoplegia: Dilated, fixed pupil & Paralysis of accommodation (no parasympathetic)

Test:

- Asked to move the eye: Unable to move up, down, or medial.
- At rest looks down & lateral.

Test of cranial nerves actions and reflexes is representative of integrity of their nuclei in the brainstem (which is very vital structure).



Thank you <3 😊