Peripheral Nervous System Module

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The Orbit

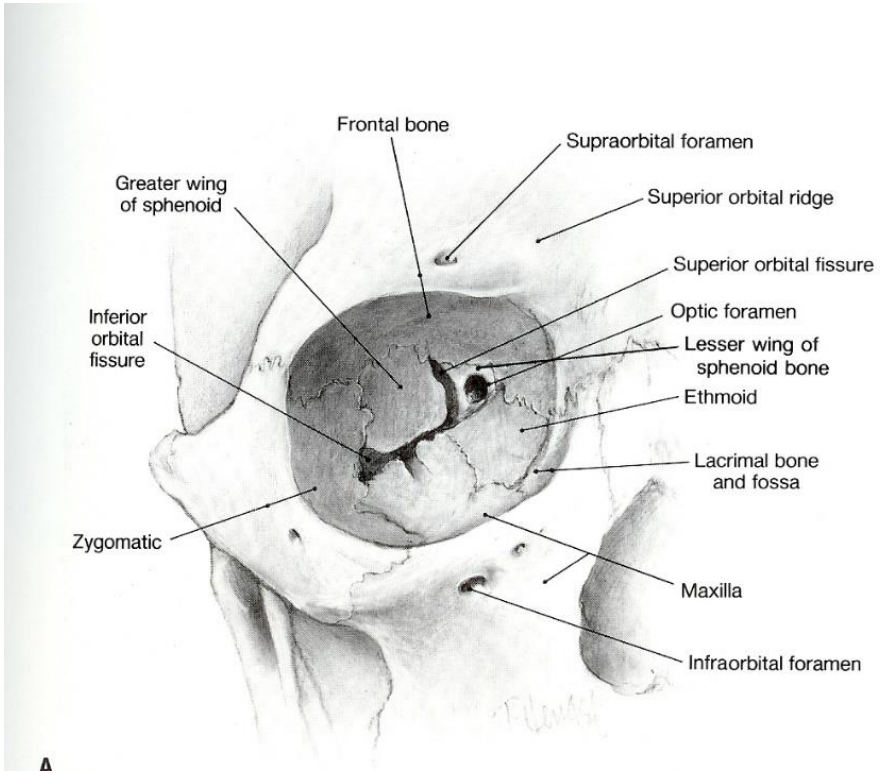
Orbit

- ***By the end of this session, you should be able to:***

1. Identify and recognize the different bones forming the orbit.
2. Recognize the different extraocular muscles, their action and control
3. Know the origin, course and distribution of the cranial nerves 3,4 and 6
4. Understand the main components and purpose of the light and accommodation reflexes

Orbital Volume

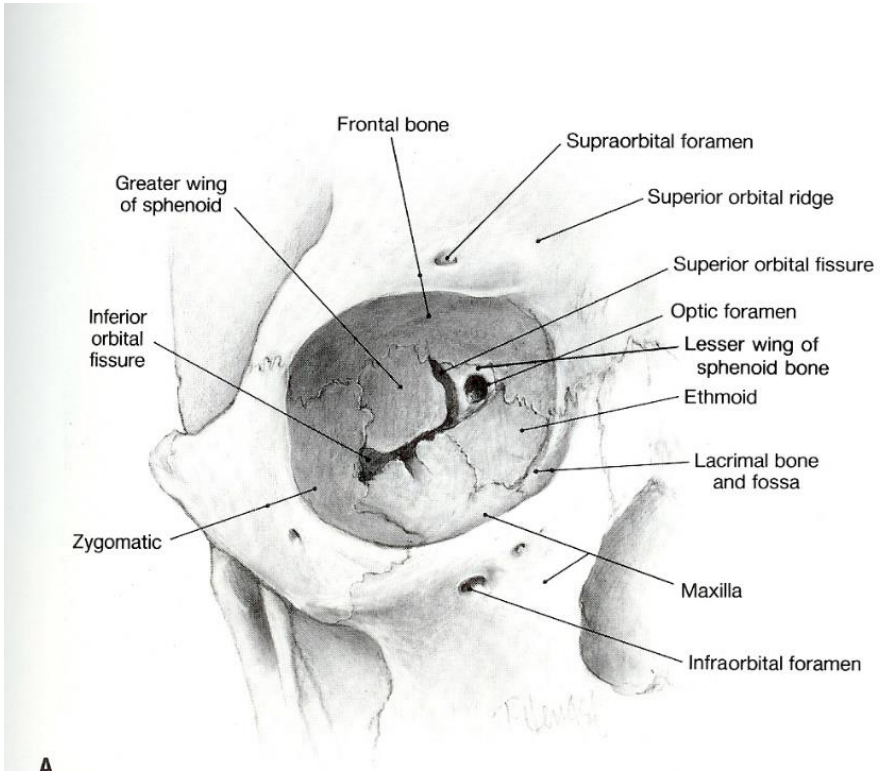
- The volume of each adult orbit is slightly less than ***30 cc***
- The orbital entrance averages about ***35 mm*** in ***height*** and ***45 mm*** in ***width***.
- The maximum width is about 1 cm (behind the anterior orbital margin)



Orbital Volume

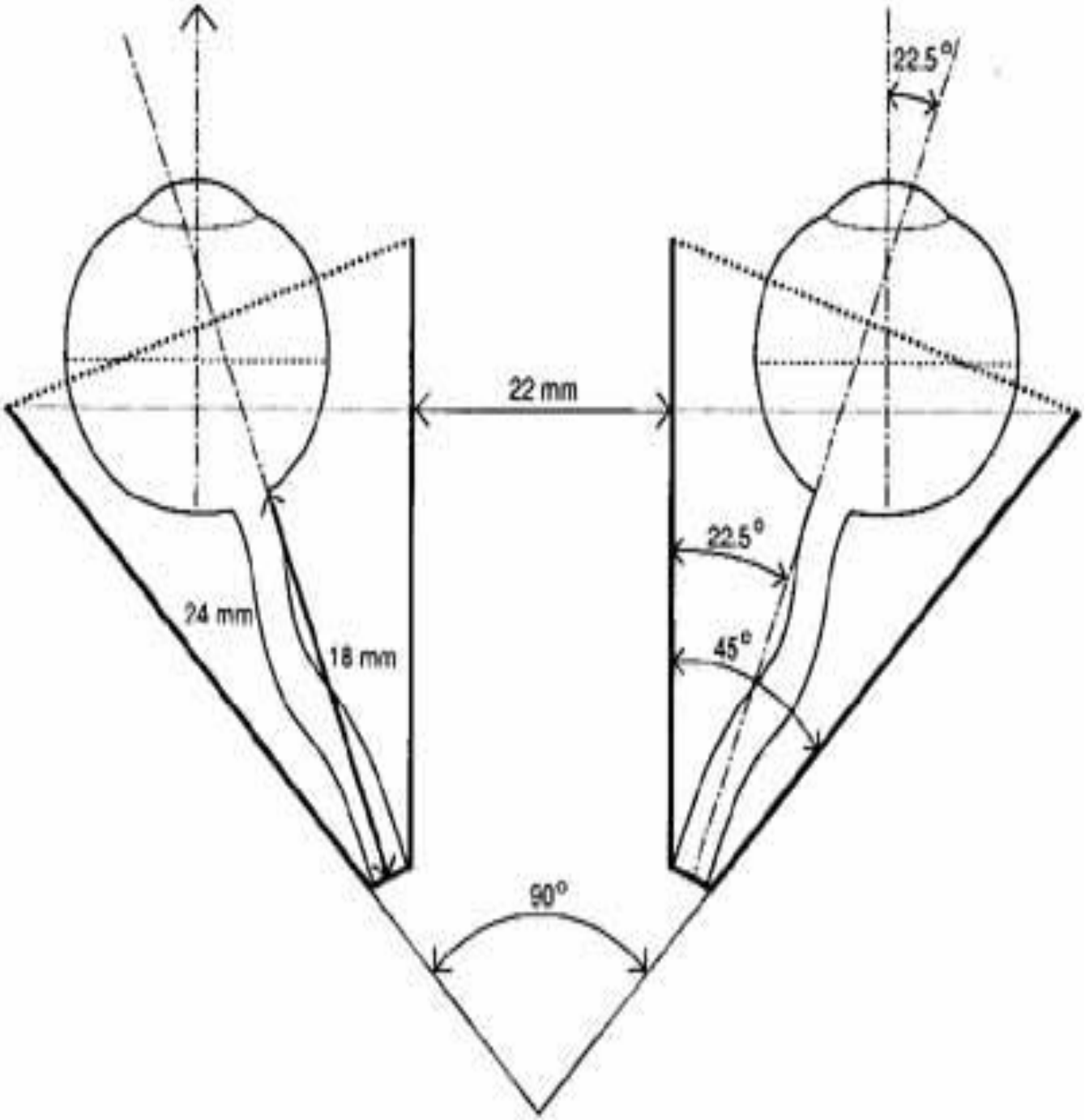
- In adults, the ***depth*** of the orbit varies from ***40 to 45 mm*** from the orbital entrance to the orbital apex

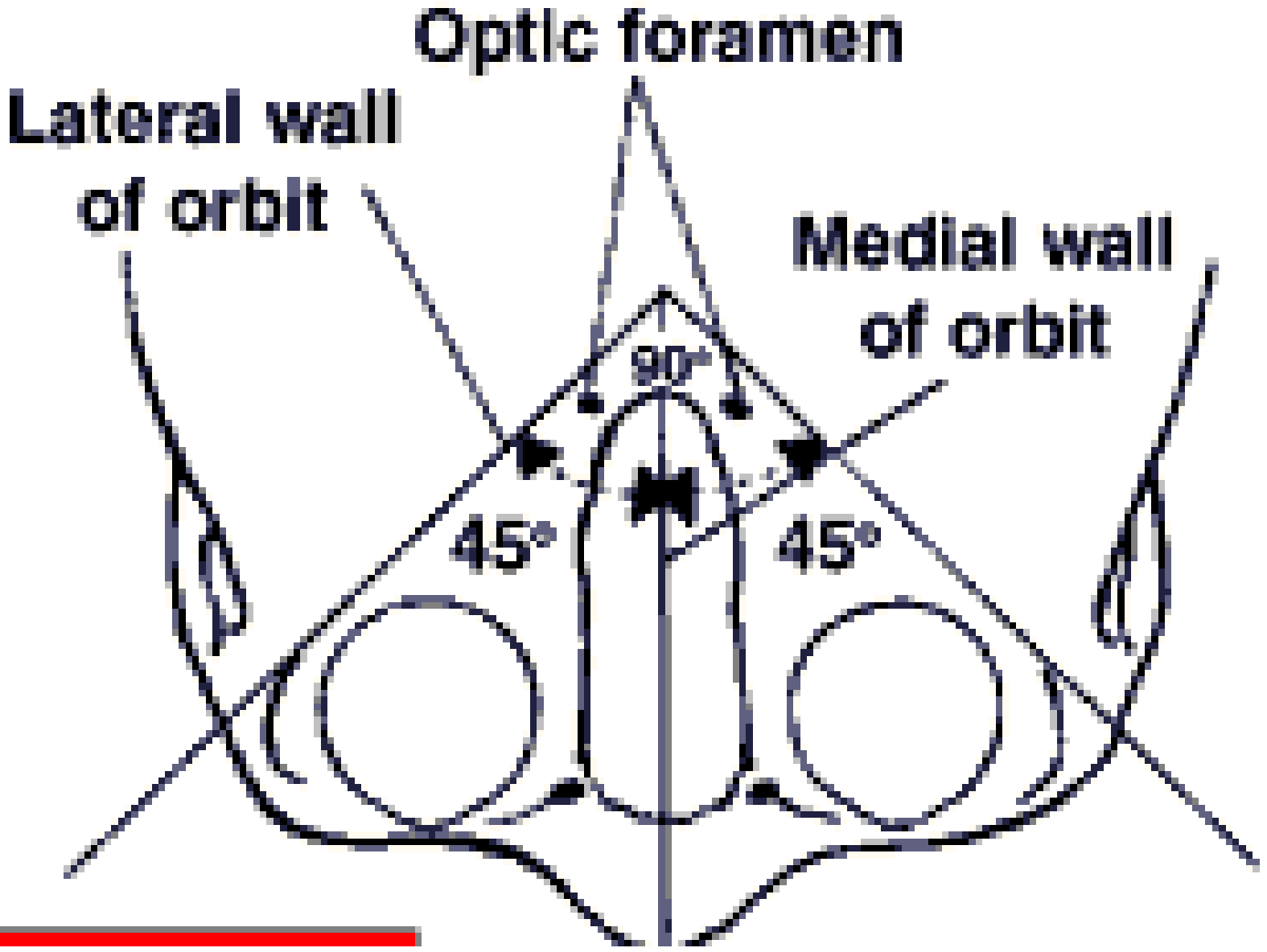
- Both race and sex affect each of these measurements.



Orbital Volume

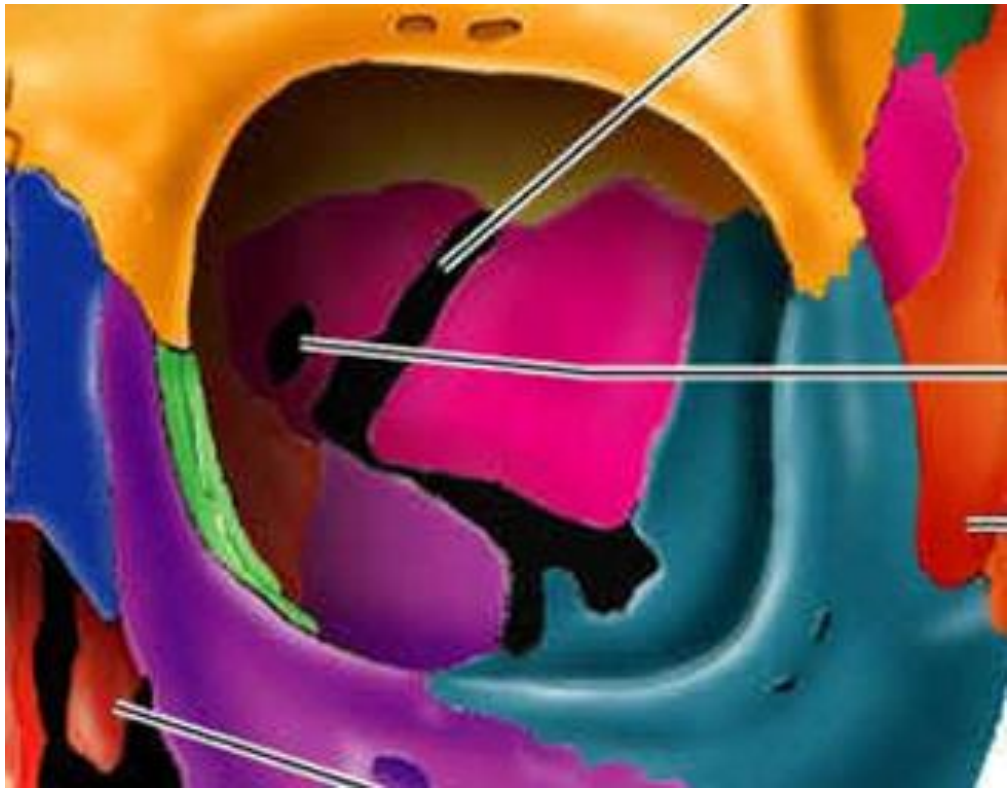
- ***Shape:*** The orbit resembles a four sided pyramid
- ***Axis:*** Long axis of each orbit passes backwards and medially
- ***Medial walls*** are parallel
- While the ***Lateral walls*** extension forms a right angle

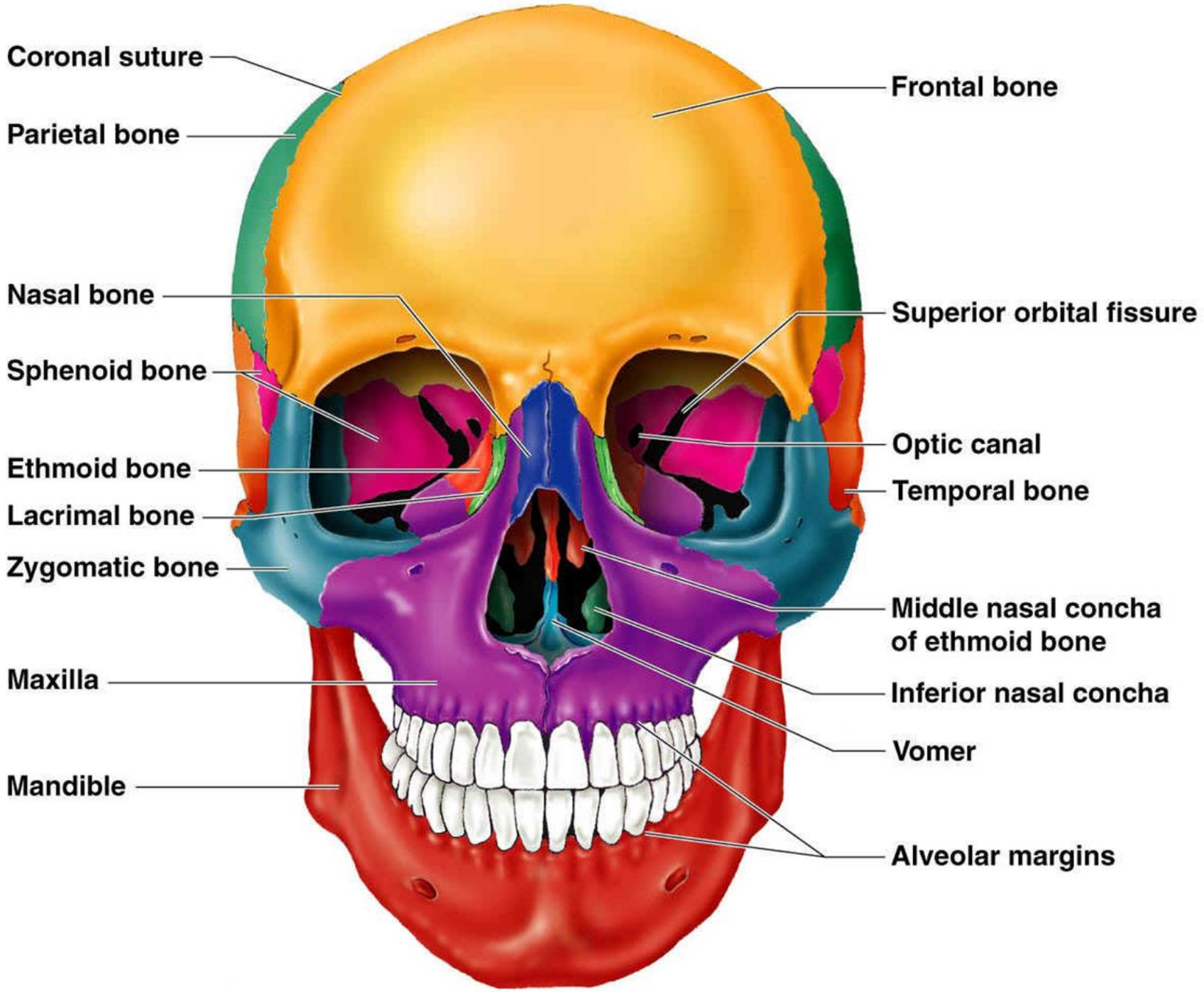

22.5°
22 mm
22.5°
24 mm
18 mm
45°
90°


Optic foramen
Lateral wall of orbit
Medial wall of orbit
90°
45°
45°

Bony Orbit

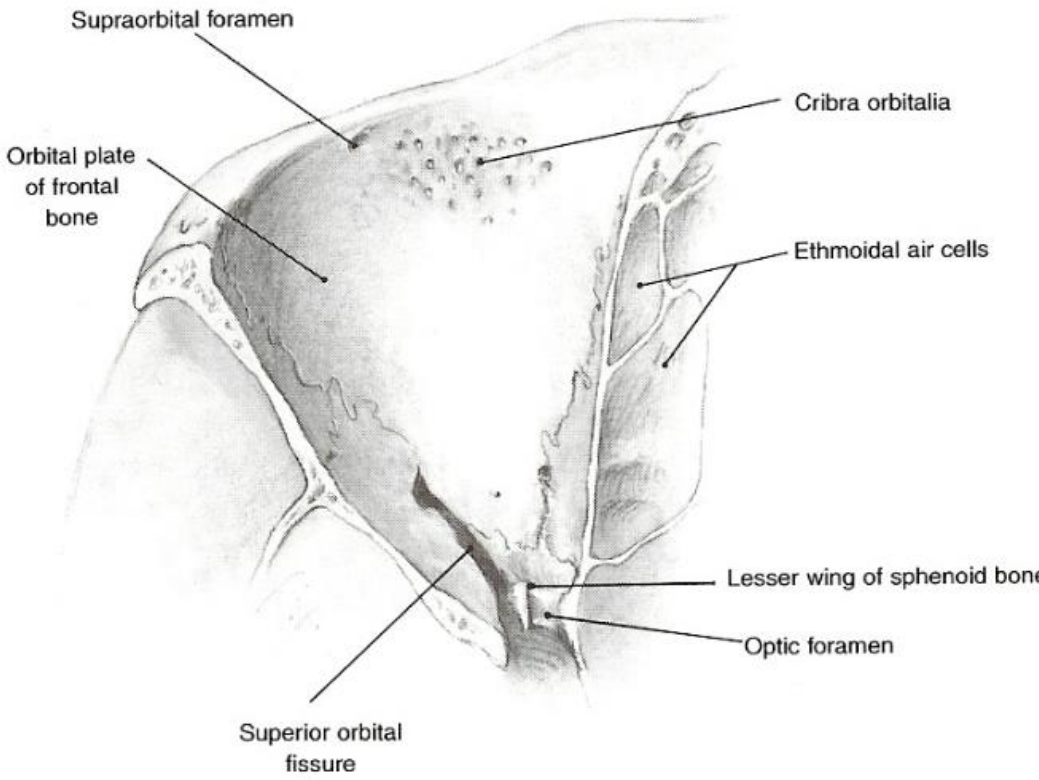
- **Seven bones make up the bony orbit:**
  - Frontal
  - Zygomatic
  - Maxillary
  - Ethmoidal
  - Sphenoid
  - Lacrimal
  - Palatine




Coronal suture
Parietal bone
Nasal bone
Sphenoid bone
Ethmoid bone
Lacrimal bone
Zygomatic bone
Maxilla
Mandible
Frontal bone
Superior orbital fissure
Optic canal
Temporal bone
Middle nasal concha of ethmoid bone
Inferior nasal concha
Vomer
Alveolar margins

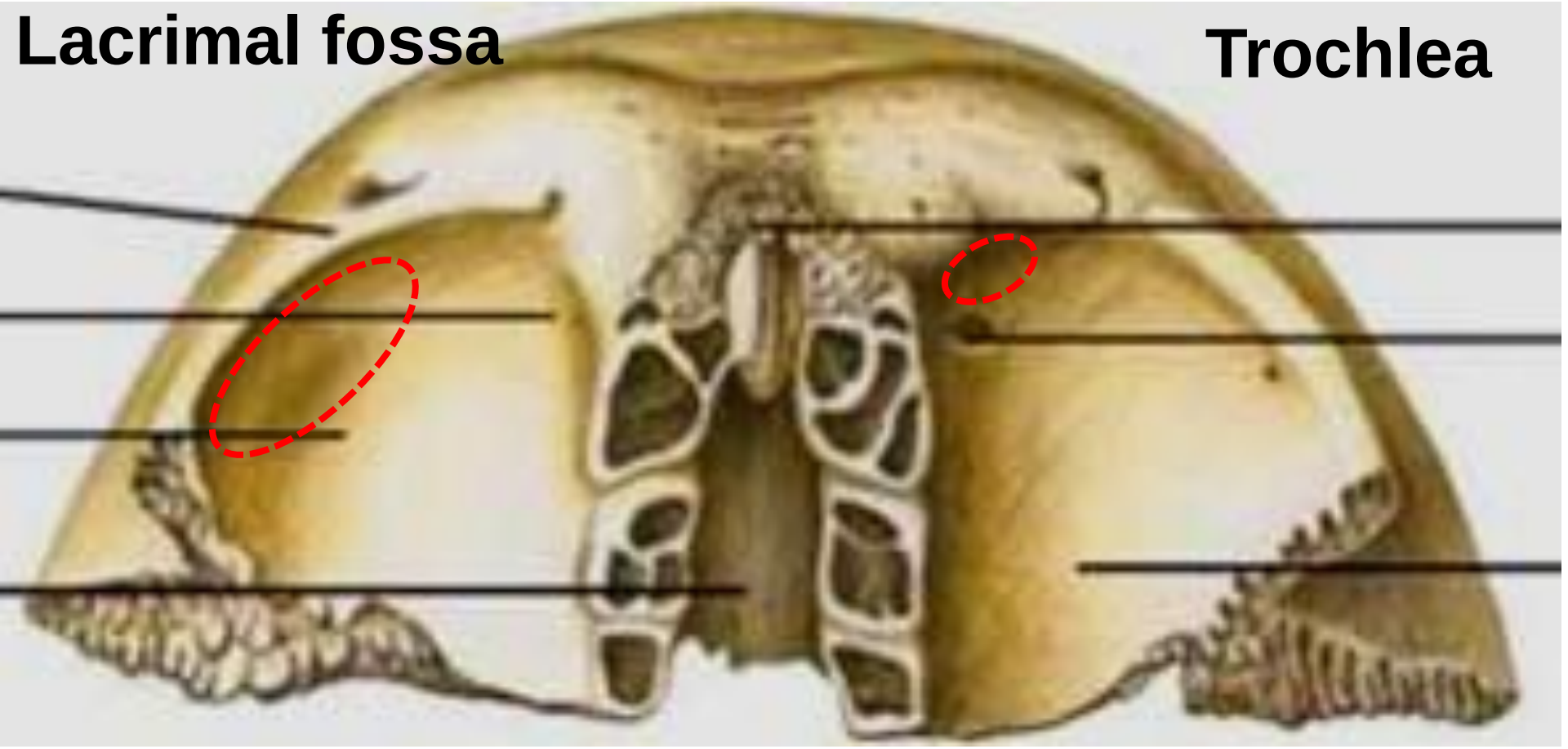
Orbital Roof

- The orbital roof formed from both the orbital plate of the frontal bone and the lesser wing of the sphenoid bone.



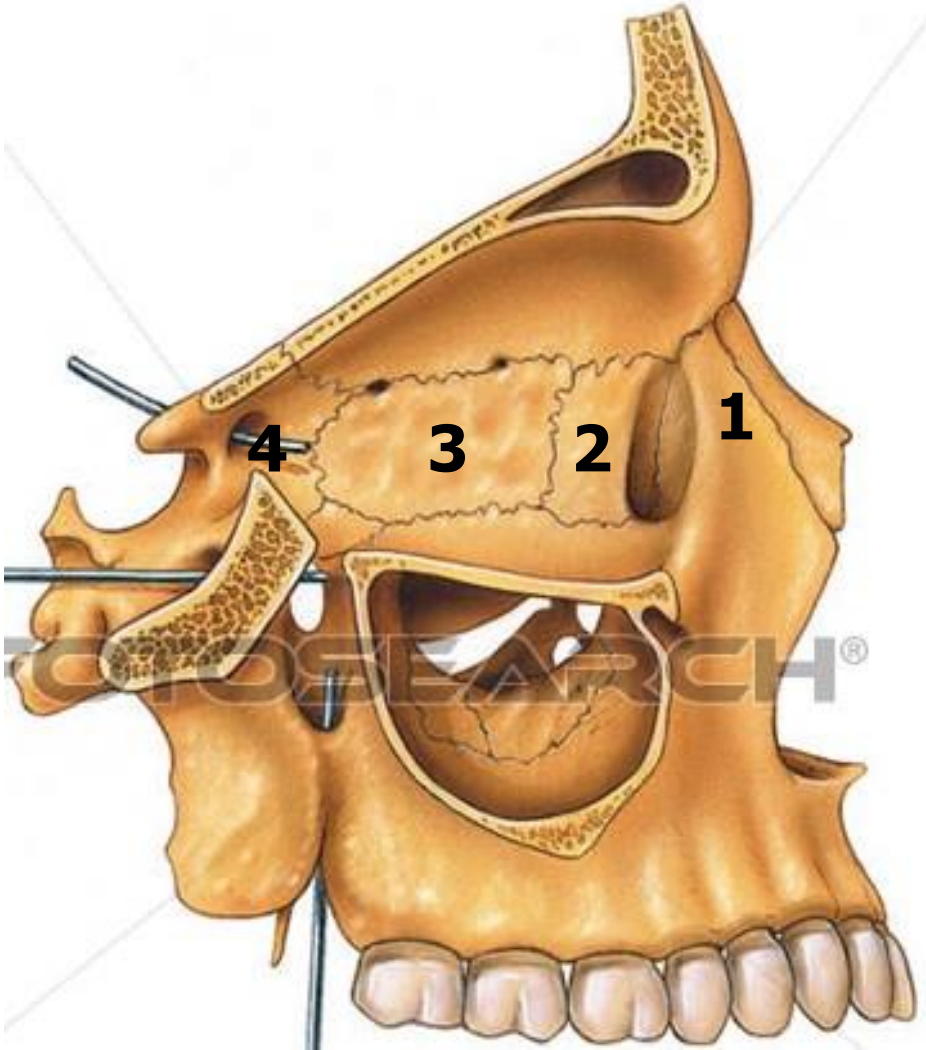
- Lacrimal fossa

- Fovea trochlearis


Lacrimal fossa
Trochlea

Medial Orbital Wall

- ***Then medial wall of the orbit is formed from four bones:***
  - Frontal process of the maxillary
  - Lacrimal bone and fossa
  - Orbital plate of the ethmoidal
  - Lesser wing of the sphenoid

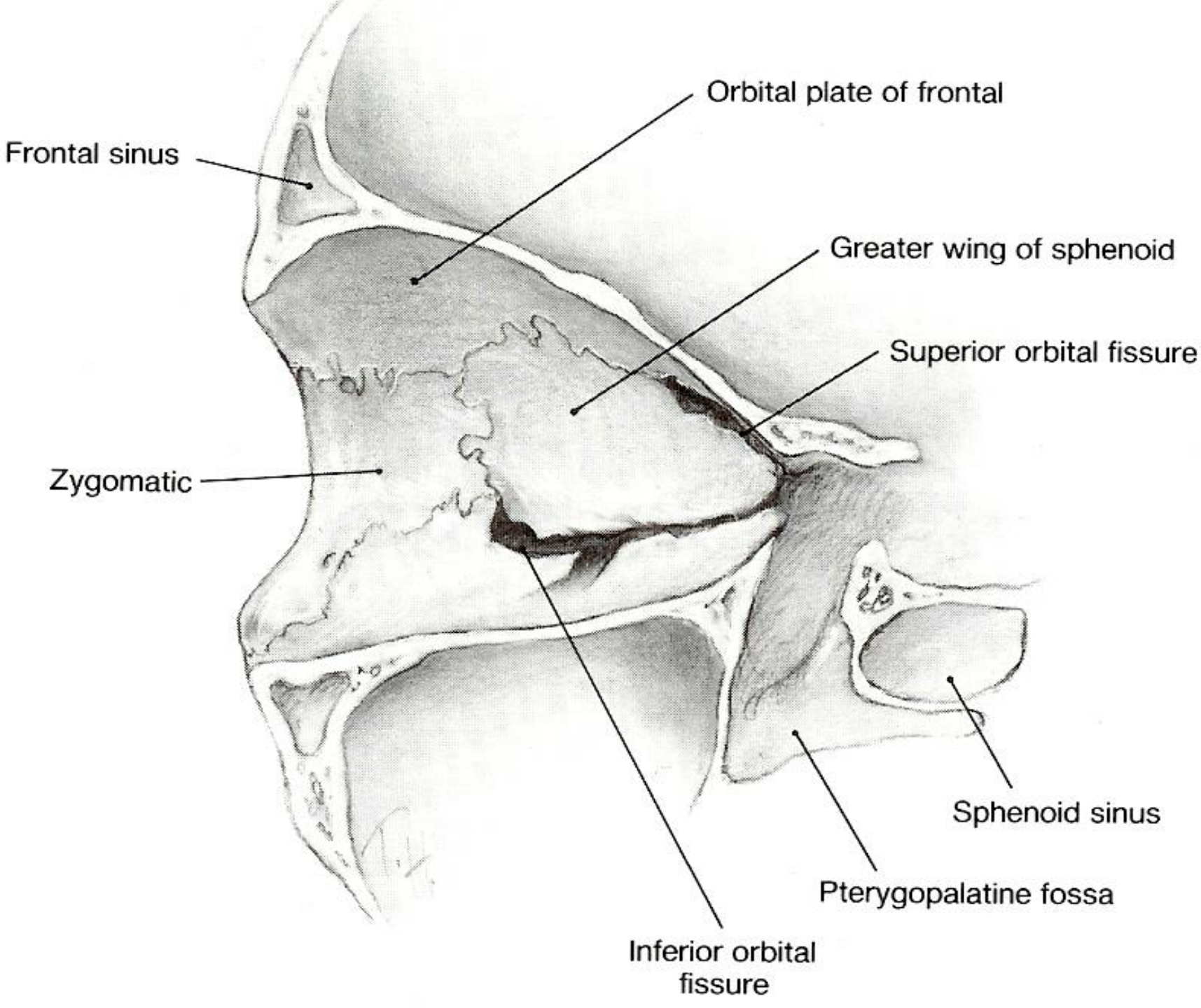


Orbital Floor

- ***The floor of the orbit is formed from three bones:***
  - Maxillary
  - Palatine
  - Orbital plate of the zygomatic
- Infraorbital groove

Lateral Orbital Wall

- ***Formed from two bones:***
  - Zygomatic
  - Greater wing of the sphenoid
- Thickest and strongest wall

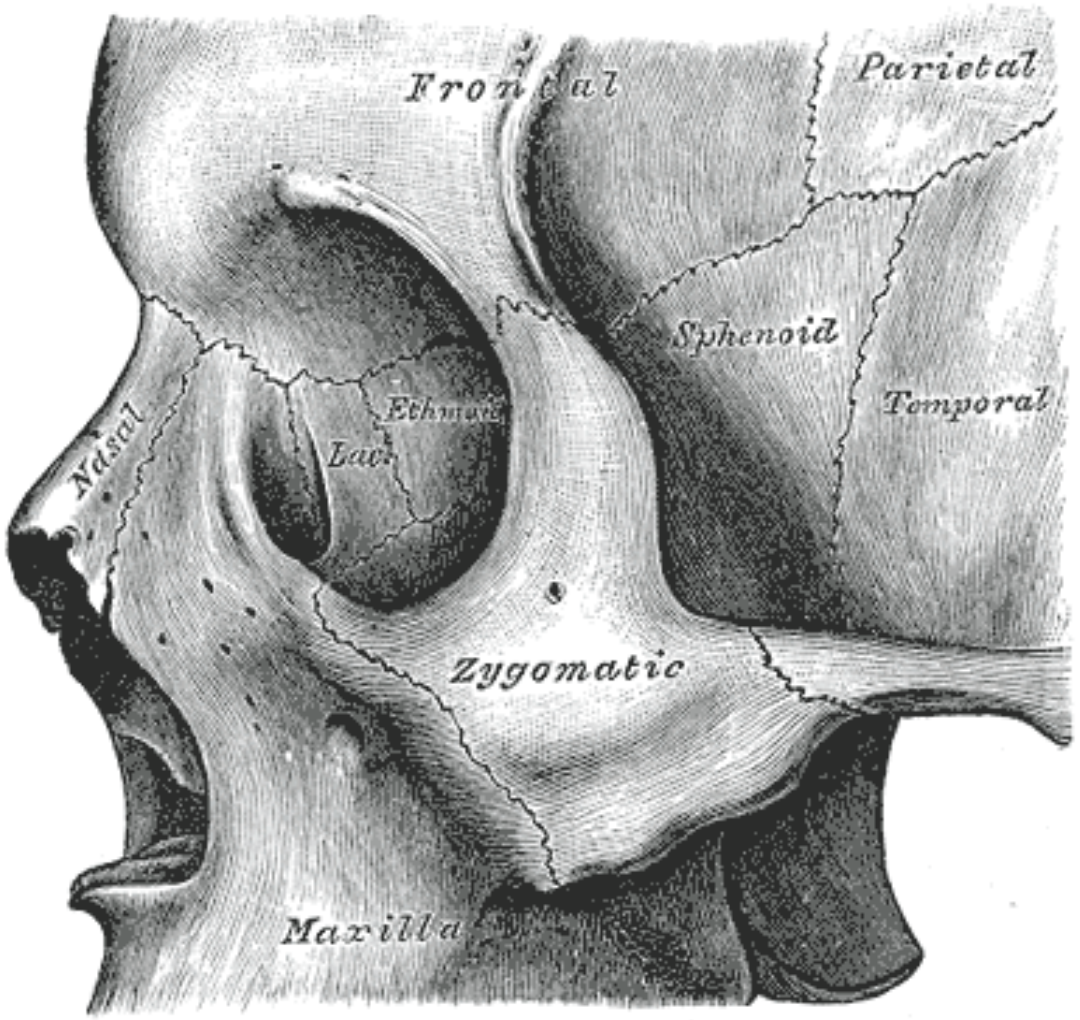

Orbital plate of frontal
Frontal sinus
Greater wing of sphenoid
Superior orbital fissure
Zygomatic
Sphenoid sinus
Pterygopalatine fossa
Inferior orbital fissure

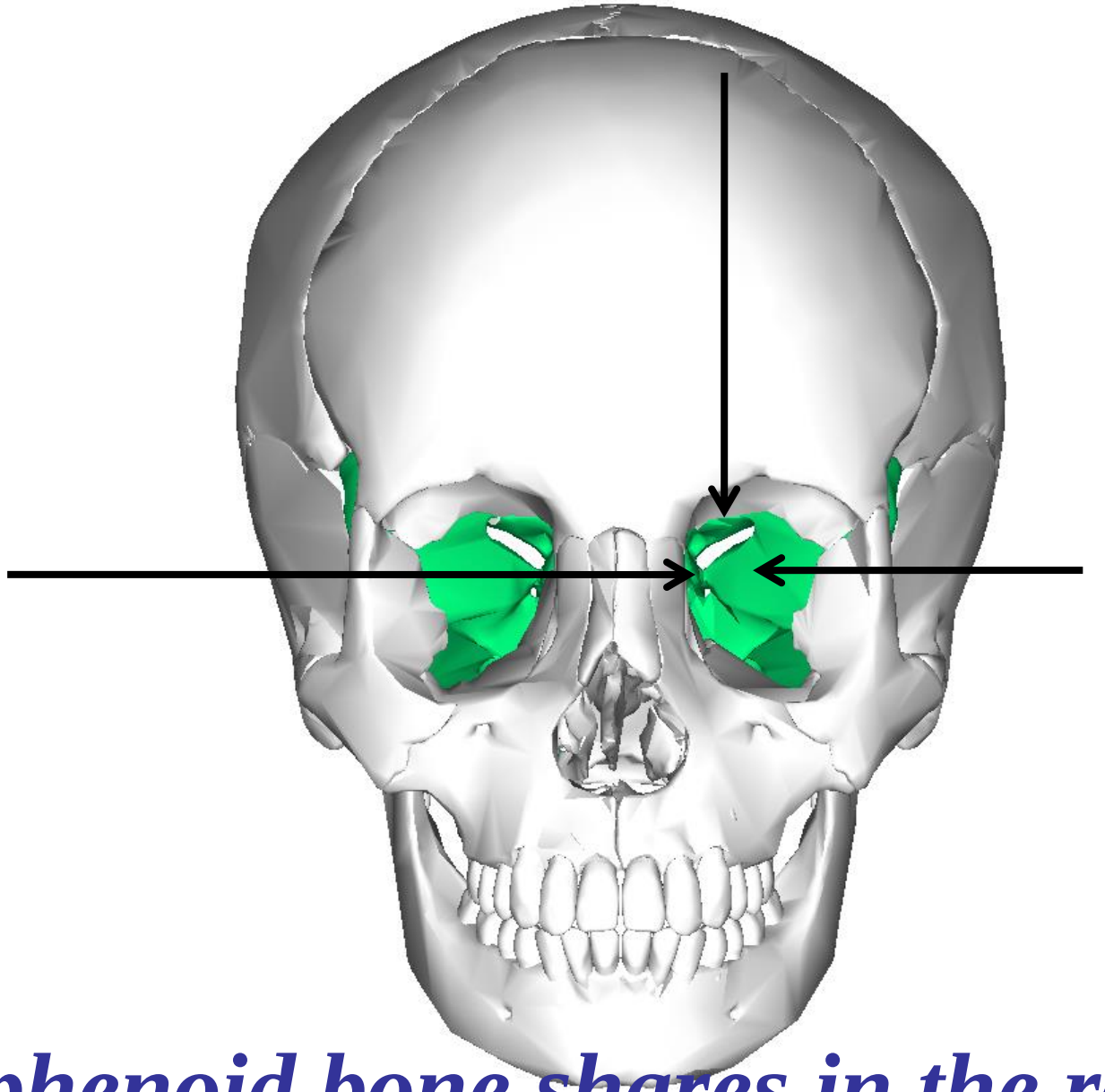
Lateral Wall

Greater wing – sphenoid

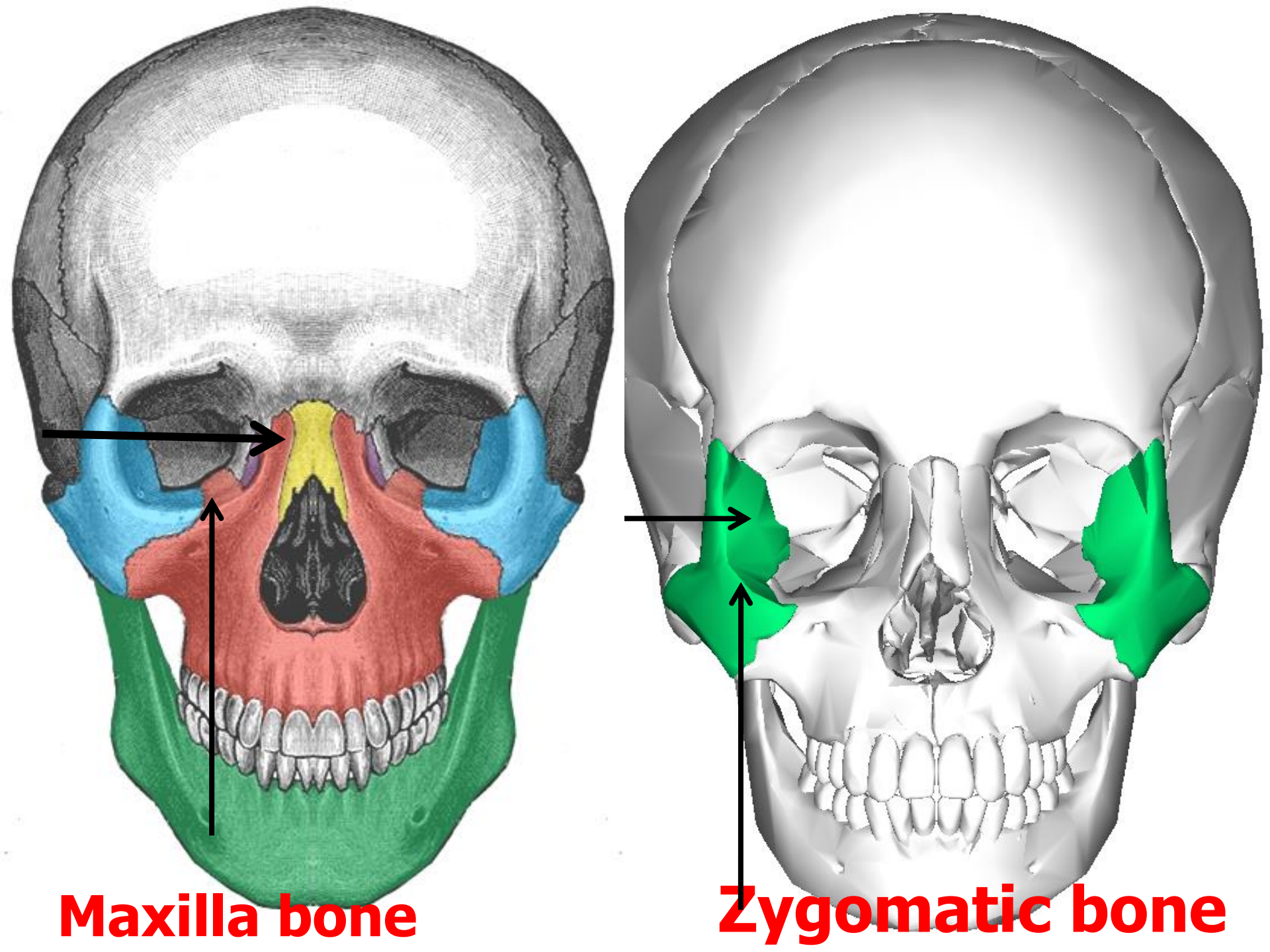
Orbital surface –

Frontal process of zygomatic





Sphenoid bone shares in the roof , medial, and lateral walls of the orbit


Maxilla bone
Zygomatic bone

Passages from Cranium to Orbit

1. Superior orbital fissure :

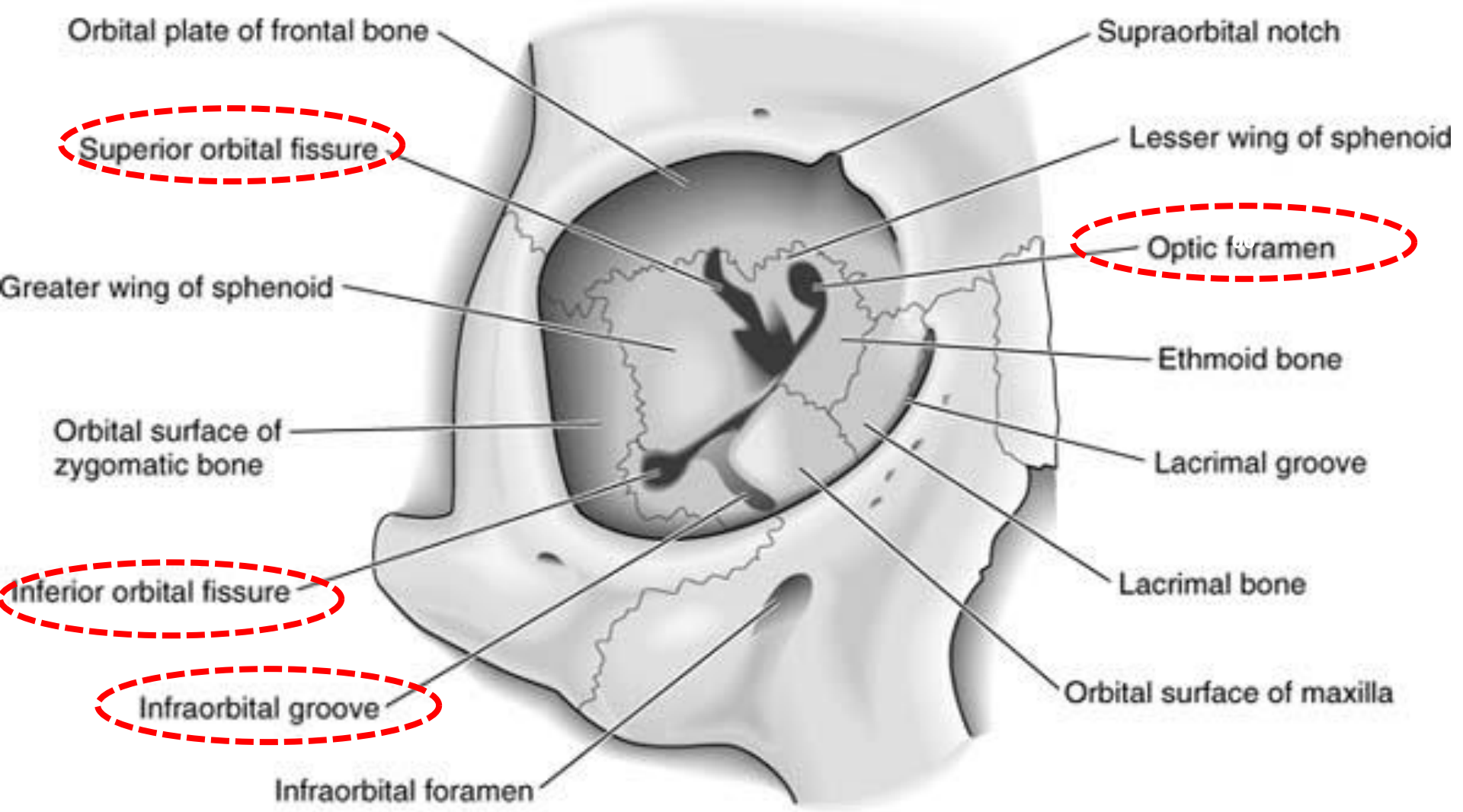
Between greater and lesser wings of sphenoid

2. Inferior orbital fissure :

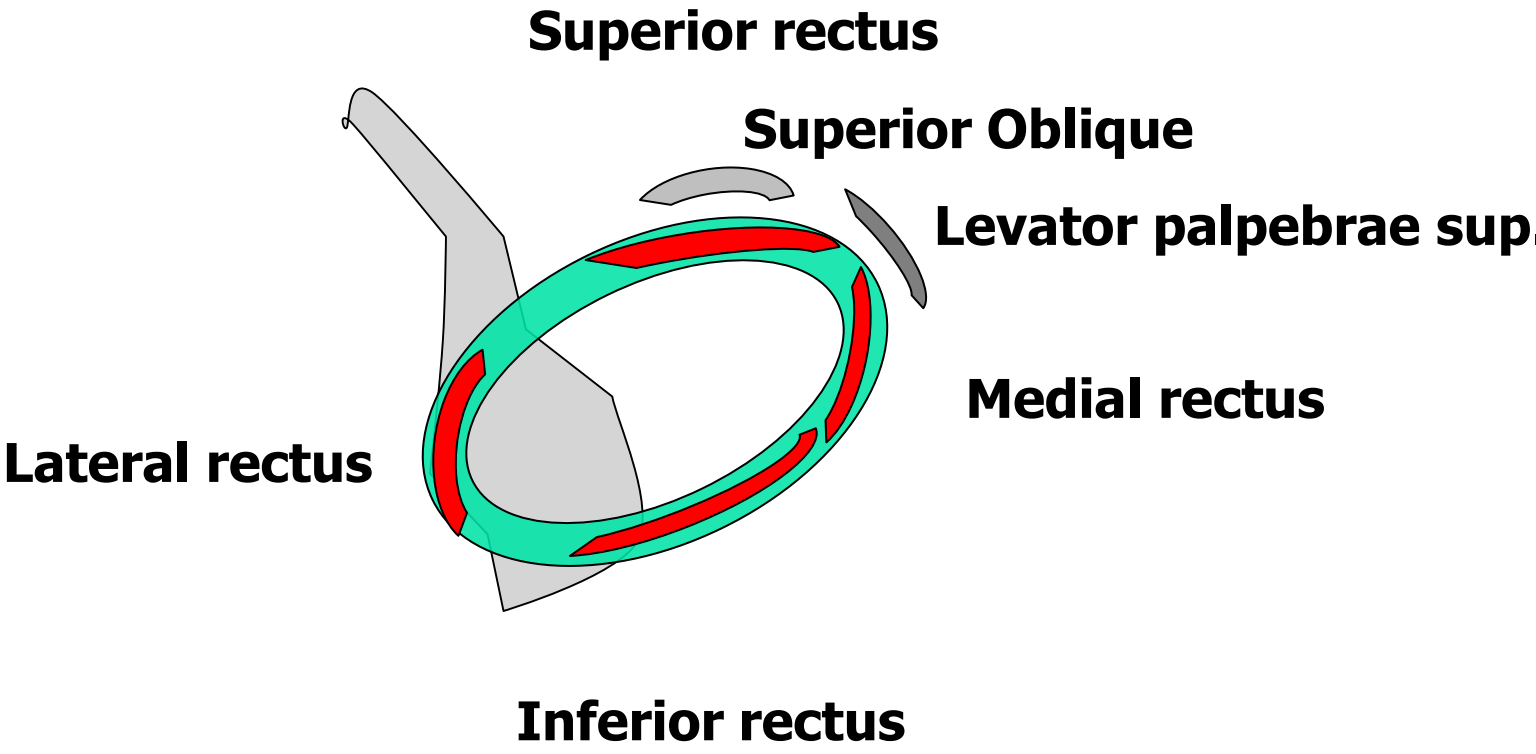
Lies between orbit floor and lateral wall of orbit, formed by sphenoid, maxillary & palatine

3. Optic foramen (optic canal)

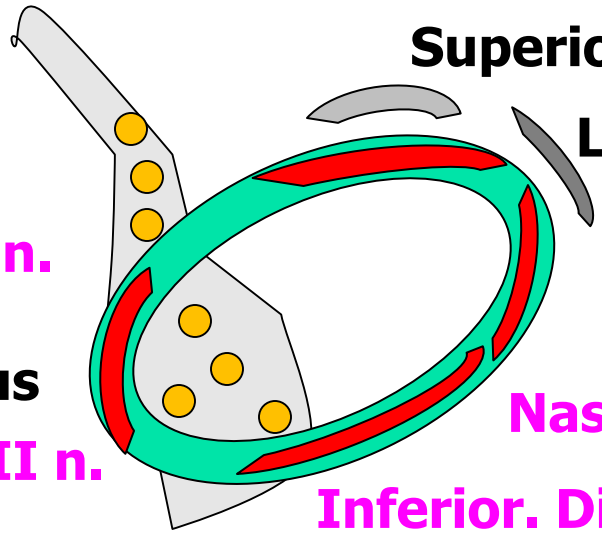
Bounded by two roots of lesser wing of sphenoid


Orbital plate of frontal bone
Supraorbital notch
Superior orbital fissure
Lesser wing of sphenoid
Optic foramen
Greater wing of sphenoid
Ethmoid bone
Orbital surface of zygomatic bone
Lacrimal groove
Lacrimal bone
Inferior orbital fissure
Infraorbital groove
Orbital surface of maxilla
Infraorbital foramen

Superior Orbital Fissure



Superior Orbital Fissure



Superior rectus

Superior Oblique

Levator palpebrae sup.

Lacrimal n.

Frontal n.

Trochlear n.

Medial rectus

Lateral rectus

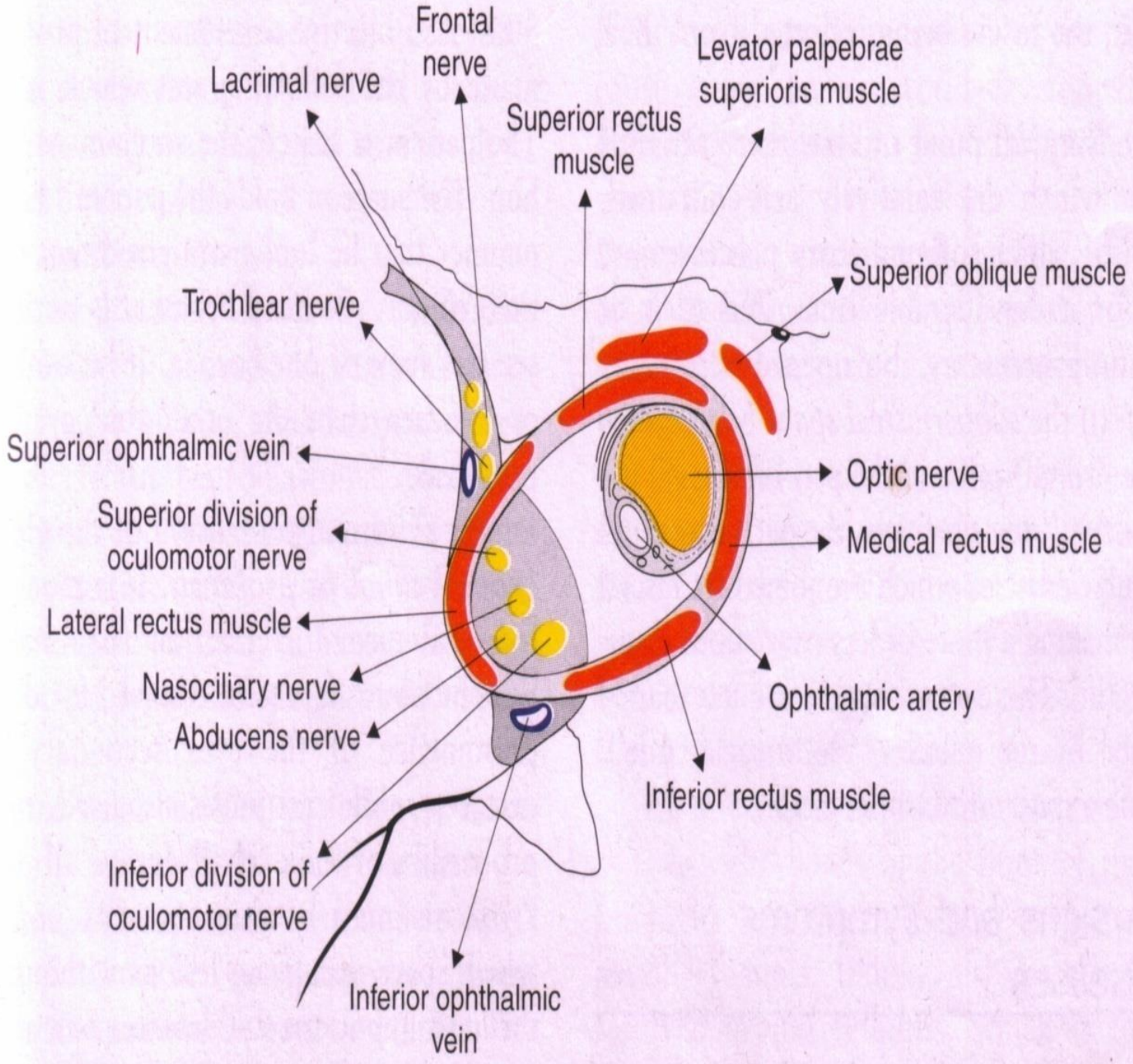
Nasociliary n.

Sup. Division of III n.

Inferior. Division of III n.

Abducent n.

Inferior rectus


Frontal nerve
Lacrimal nerve
Levator palpebrae superioris muscle
Superior rectus muscle
Superior oblique muscle
Trochlear nerve
Superior ophthalmic vein
Optic nerve
Superior division of oculomotor nerve
Medical rectus muscle
Lateral rectus muscle
Nasociliary nerve
Ophthalmic artery
Abducens nerve
Inferior rectus muscle
Inferior division of oculomotor nerve
Inferior ophthalmic vein

Structures passing from Superior Orbital Fissure

- A) Nerves arranged from lateral to medial:
- **Live----------lacrimal n.**
- **Free----------frontal n.**
- **To----------trochlear n.**

} Outside the ring

- **See----------superior division of oculomotor n.**
- **No----------nasociliary n.**
- **Insult-----inferior division of oculomotor n.**
- **At all-------abducent n.**

Contents of the Orbit

1- Eye ball
2- Fasciae and fat
3- Muscles of the eyeball

A- Intrinsic muscles:

1. Constrictor of the pupil (constrictor pupillae)
2. Dilator of the pupil (dilator pupillae)
3. Ciliary muscle

B- Extrinsic muscle:

1. Four recti muscles
2. Two oblique muscles
3. Levator palpebrae superiosis (the levator muscle of the eyelid)

Contents of the Orbit

4- Nerves:

A- Sensory:

1. Optic nerve
2. Branches of ophthalmic nerve; lacrimal, frontal and nasocilliary
3. Zygomatic nerve

B- Motor:

Oculomotor, Trochlear and Abducent nerves

C- Autonomic: sympathetic and parasympathetic

Contents of the Orbit

5-Vessels:

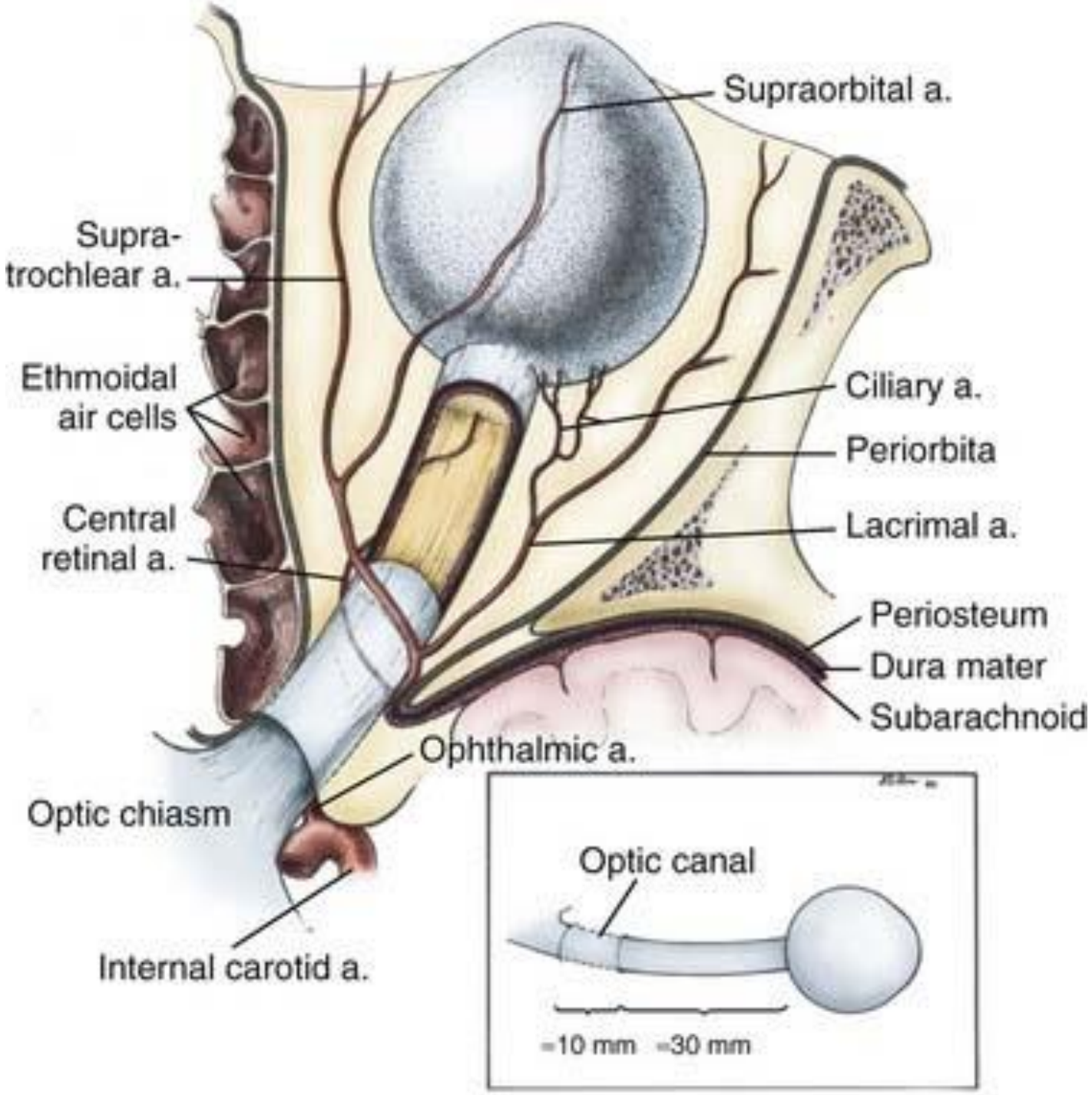
A- Ophthalmic artery

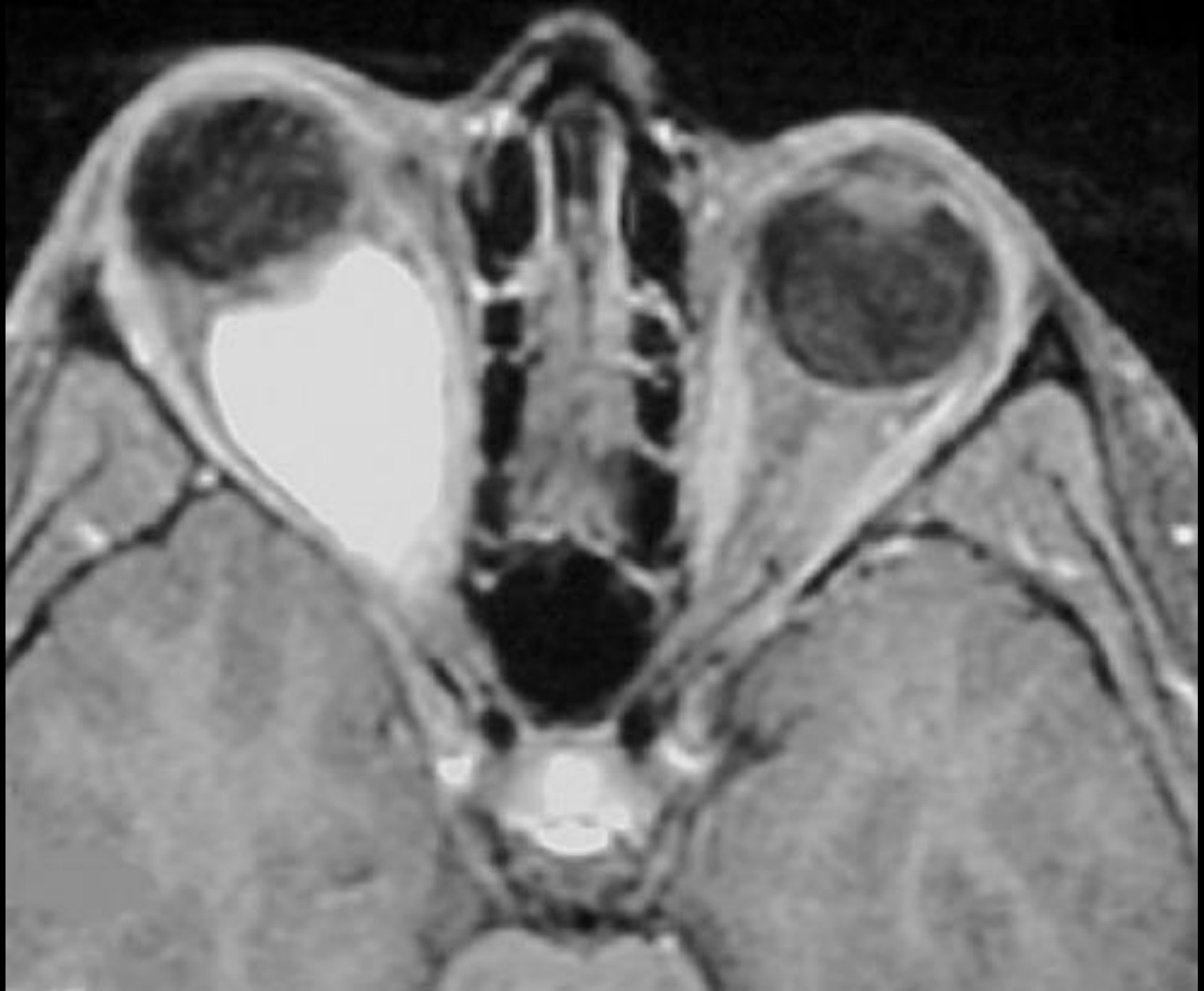
B- Superior and inferior ophthalmic veins

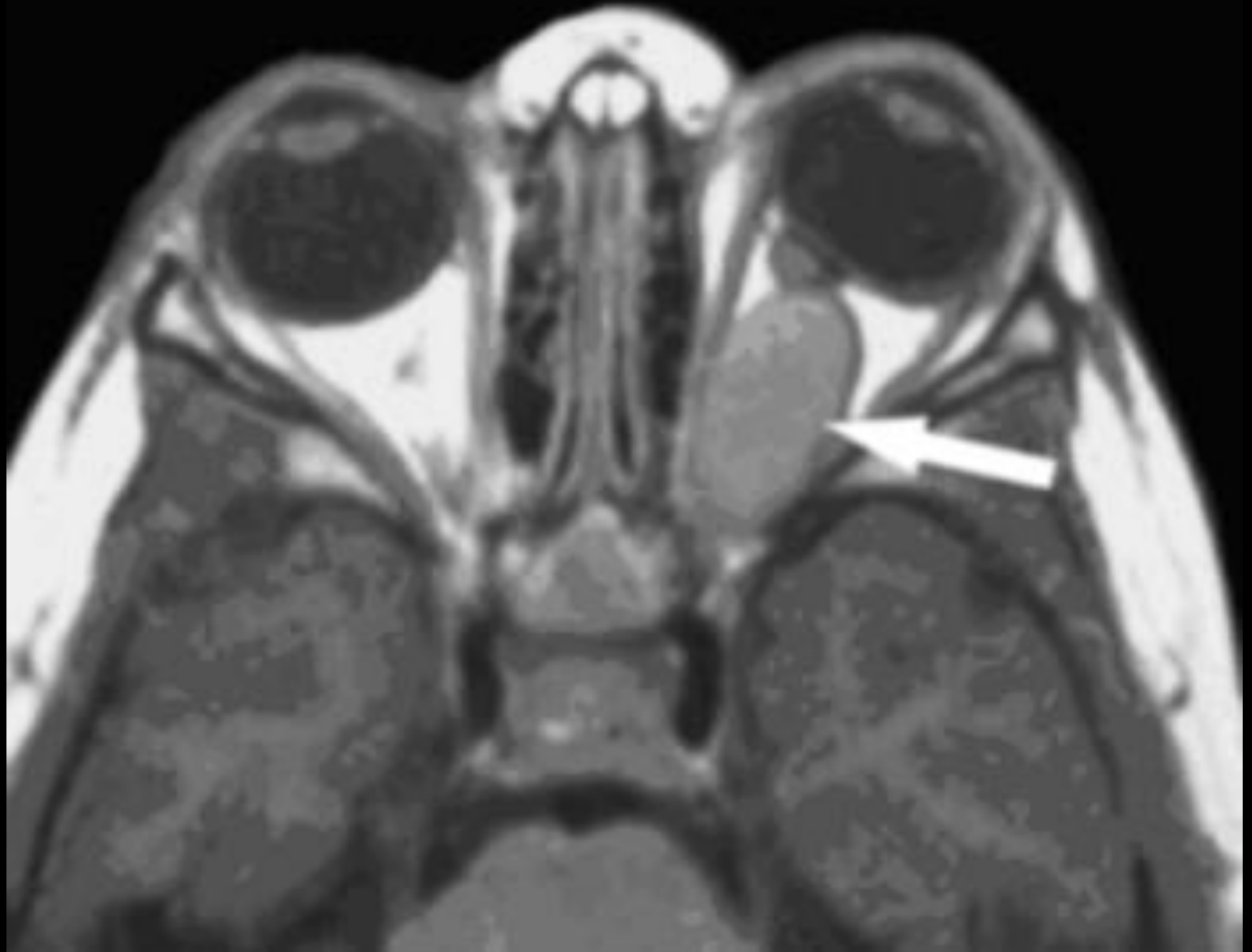
6- Lacrimal apparatus.

OPTIC CANAL

- It connects ***orbit to middle cranial fossa***.
- Transmits **optic nerve** and **ophthalmic artery**.
- ***Normal adult dimensions are attained by the age of 4-5 years.***
- Average length is 6-11mm.
- Tumors like optic nerve glioma and meningiomas may lead to enlargement of optic canal(detected on X-ray films.


Supraorbital a.
Supra-
trochlear a.
Ethmoidal
air cells
Central
retinal a.
Ciliary a.
Periorbita
Lacrimal a.
Periosteum
Dura mater
Subarachnoid
Ophthalmic a.
Optic chiasm
Internal carotid a.
Optic canal
10 mm
30 mm



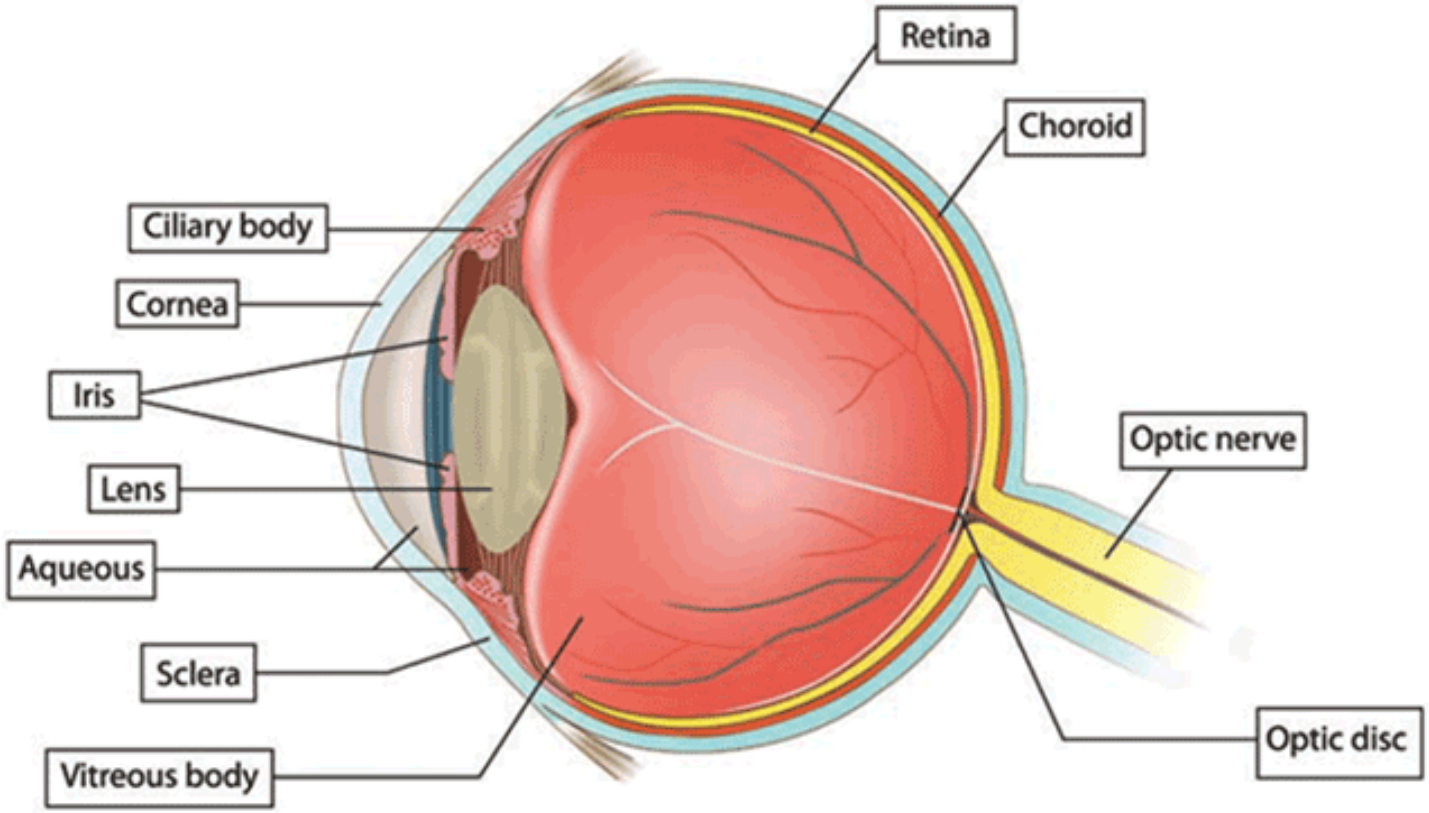


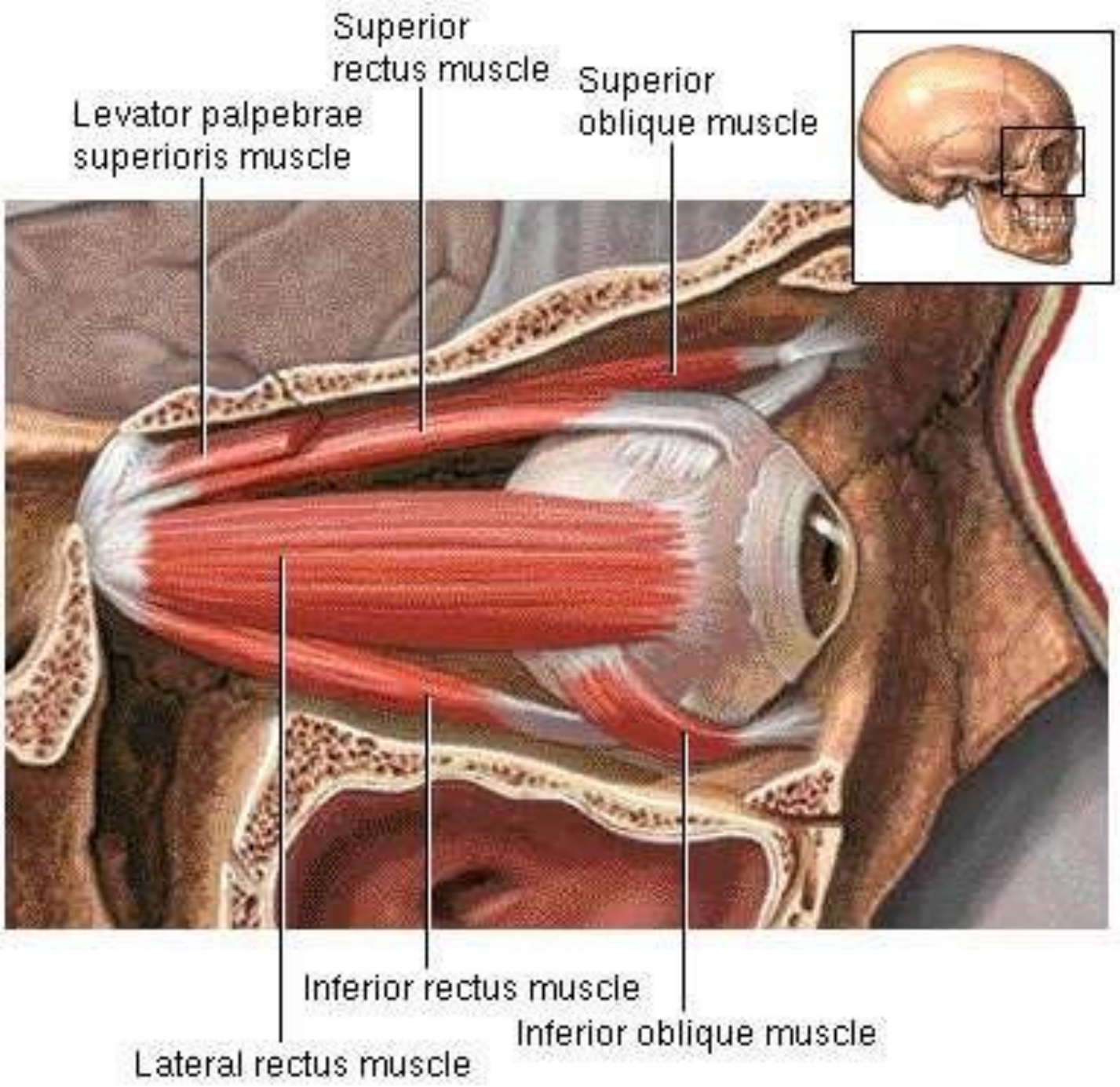
1- Eyeball consists of 3 layers:

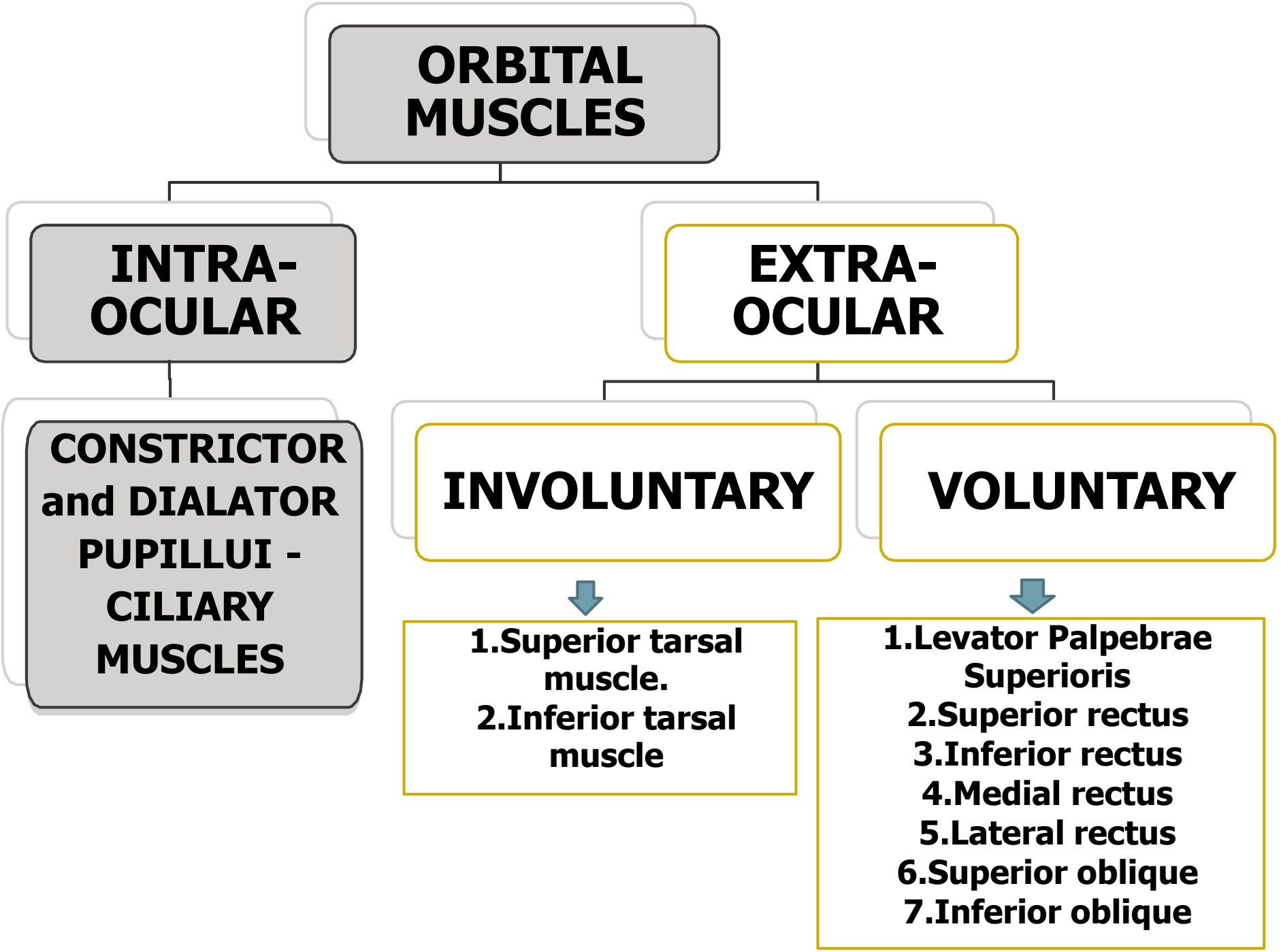
Fibrous layer: Cornea and sclera

Vascular layer: Choroid, ciliary body and iris

Nervous layer: Retina




Superior rectus muscle
Levator palpebrae superioris muscle
Superior oblique muscle
Inferior rectus muscle
Inferior oblique muscle
Lateral rectus muscle


ORBITAL MUSCLES
INTRA-OCULAR
EXTRA-OCULAR
CONSTRICTOR and DIALATOR PUPILLUI - CILIARY MUSCLES
INVOLUNTARY
VOLUNTARY
1.Superior tarsal muscle.
2.Inferior tarsal muscle
1.Levator Palpebrae Superioris
2.Superior rectus
3.Inferior rectus
4.Medial rectus
5.Lateral rectus
6.Superior oblique
7.Inferior oblique

Muscles of the orbit

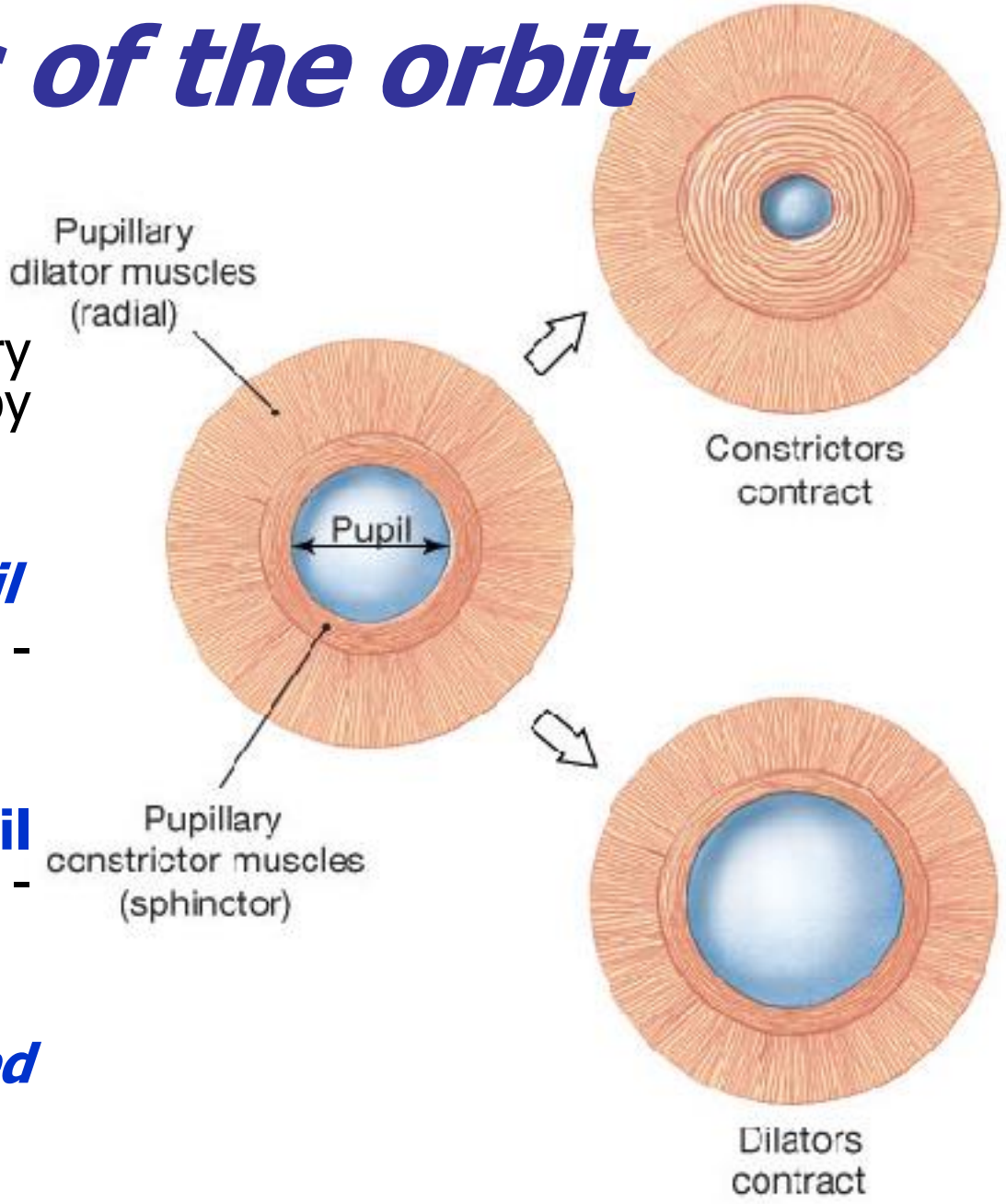
A- Intrinsic muscles:

They are smooth involuntary muscles supplied by autonomic nerves

1- Constrictor of the pupil (constrictor pupillae) - parasympathetic

2- Dilator of the pupil (dilator pupillae) - sympathetic

3-Ciliary muscle (attached to lens) parasympathetic



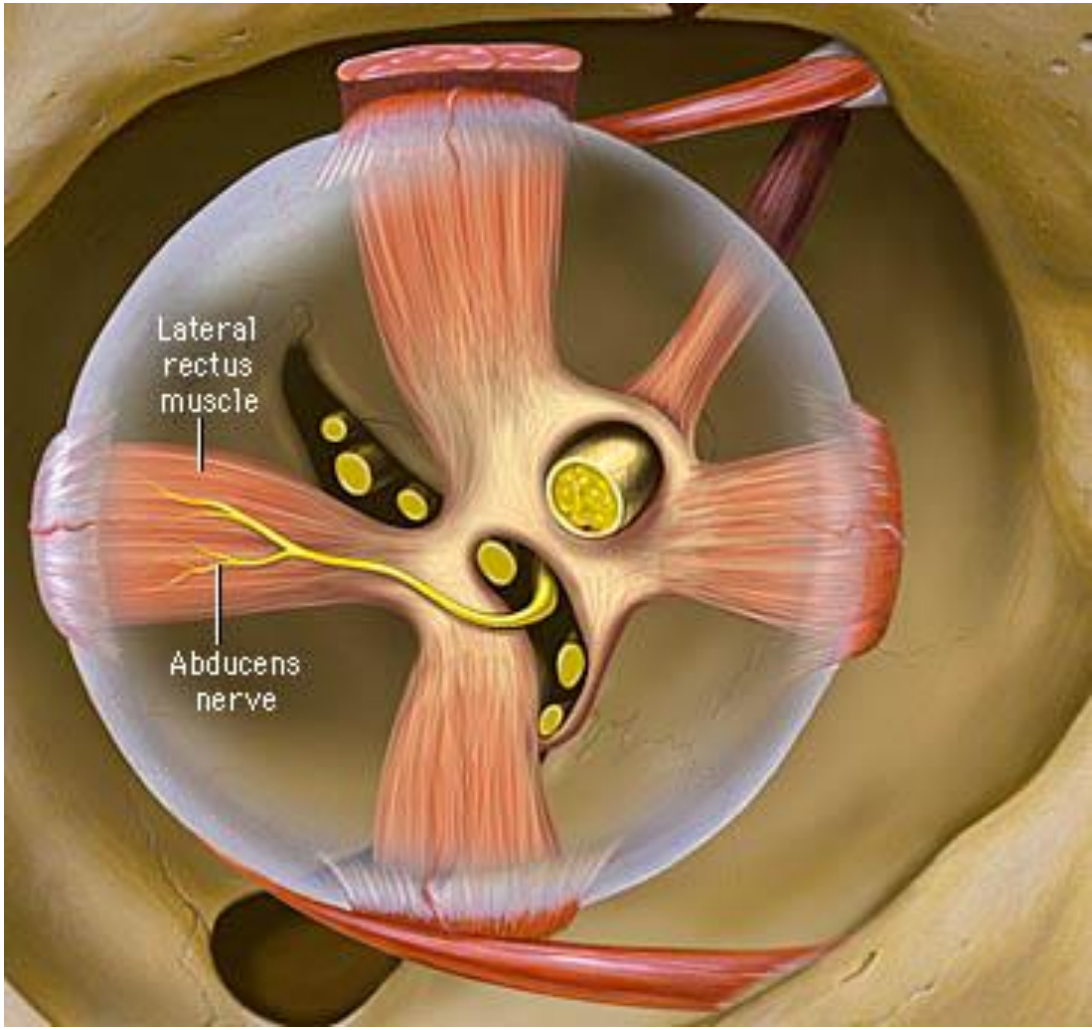
(c) Action of pupillary muscles

Extrinsic Muscles

- ***Superior palpebrae superiorios***

Four recti muscles displaying a muscular cone around the optic nerve

- Two ***oblique muscles***



LEVATOR PALPEBRAE SUPERIORIOS

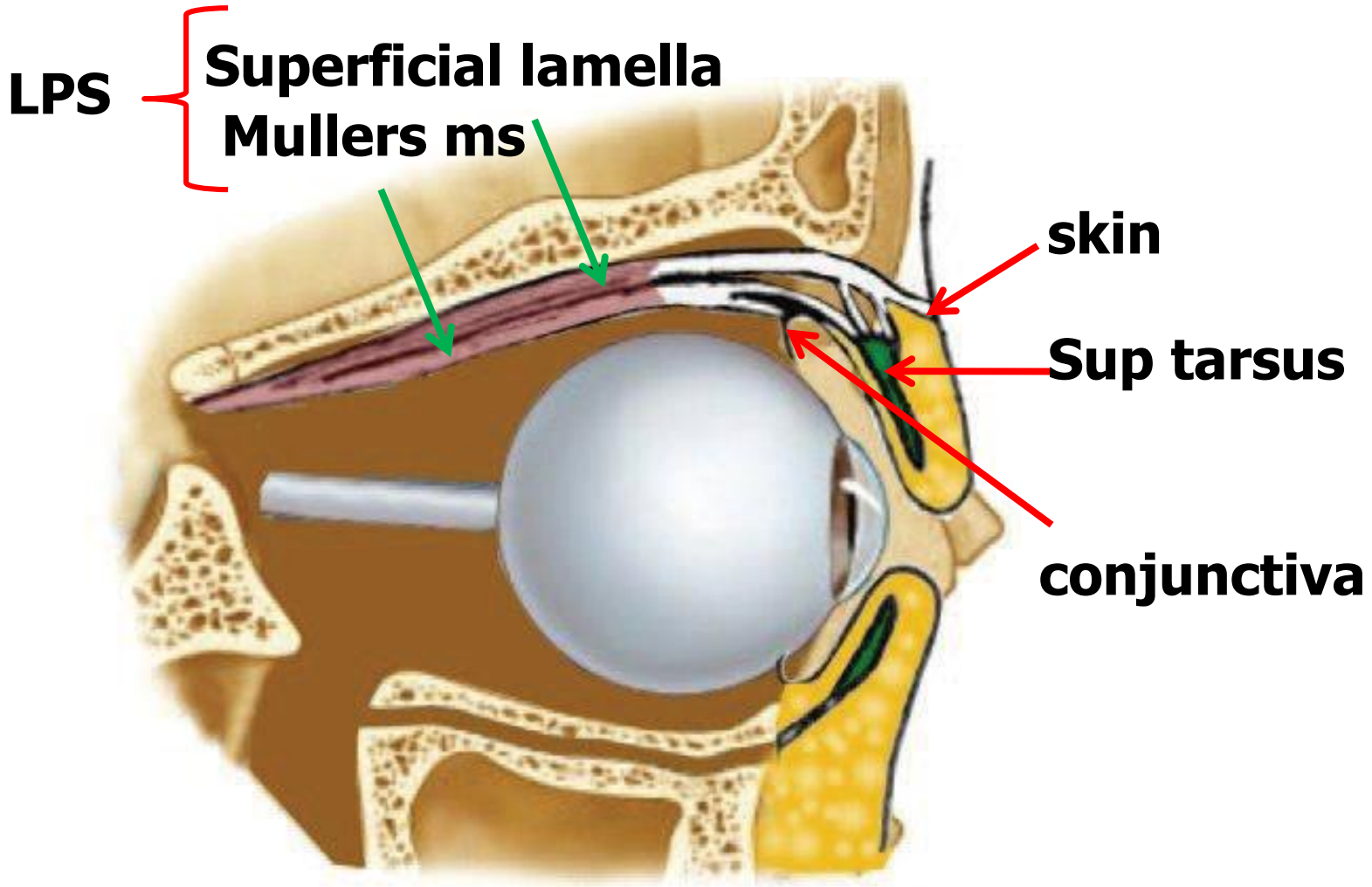
Origin:

- Roof of the orbit in front of the optic canal.

Insertion:

- ***Upper lamina (Voluntary)*** - skin of upper eyelid.
- ***Middle lamina (Involuntary)*** - Superior margin of upper tarsus.
- ***Lower lamina (Involuntary)*** – Superior conjunctival fornix

LEVATOR PALPEBRAE SUPERIORIOS



LEVATOR PALPEBRAE SUPERIORIOS

- ***Nerve Supply***

Voluntary part – Oculomotor Nerve

Involuntary part – Sympathetic enervation

- ***Action***

Elevation of upper eye lid

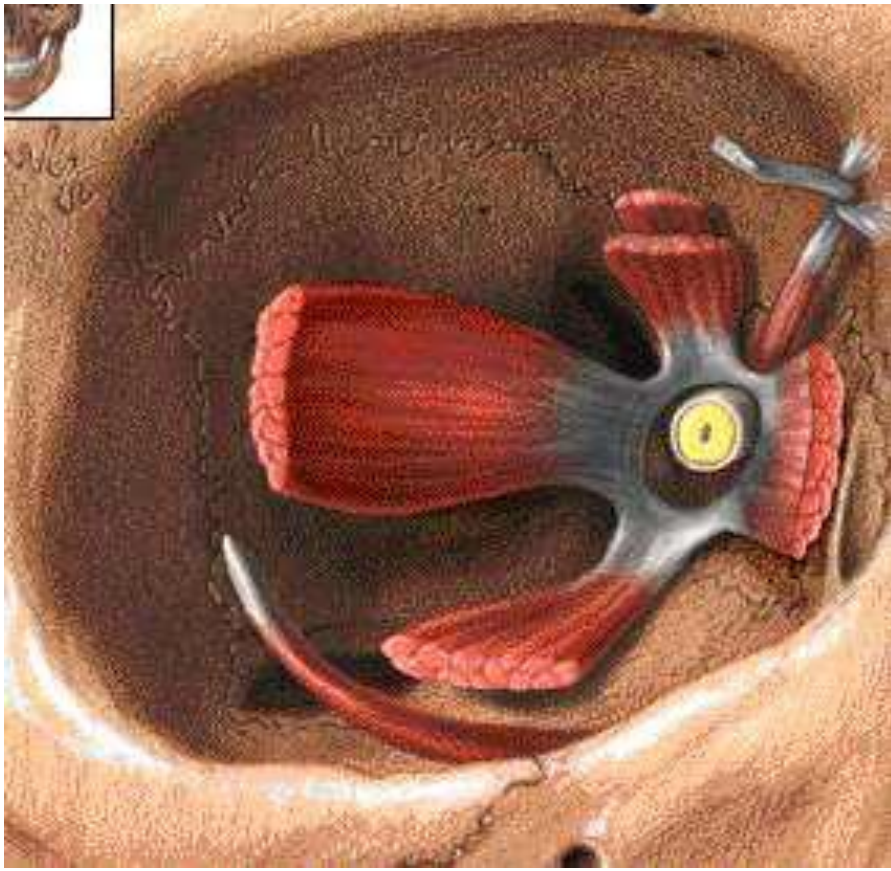
LEVATOR PALPEBRAE SUPERIORIOS

- **Complete ptosis** Injury to oculomotor nerve.

- **Partial ptosis** disruption of postganglionic sympathetic fibers from superior cervical sympathetic ganglion.

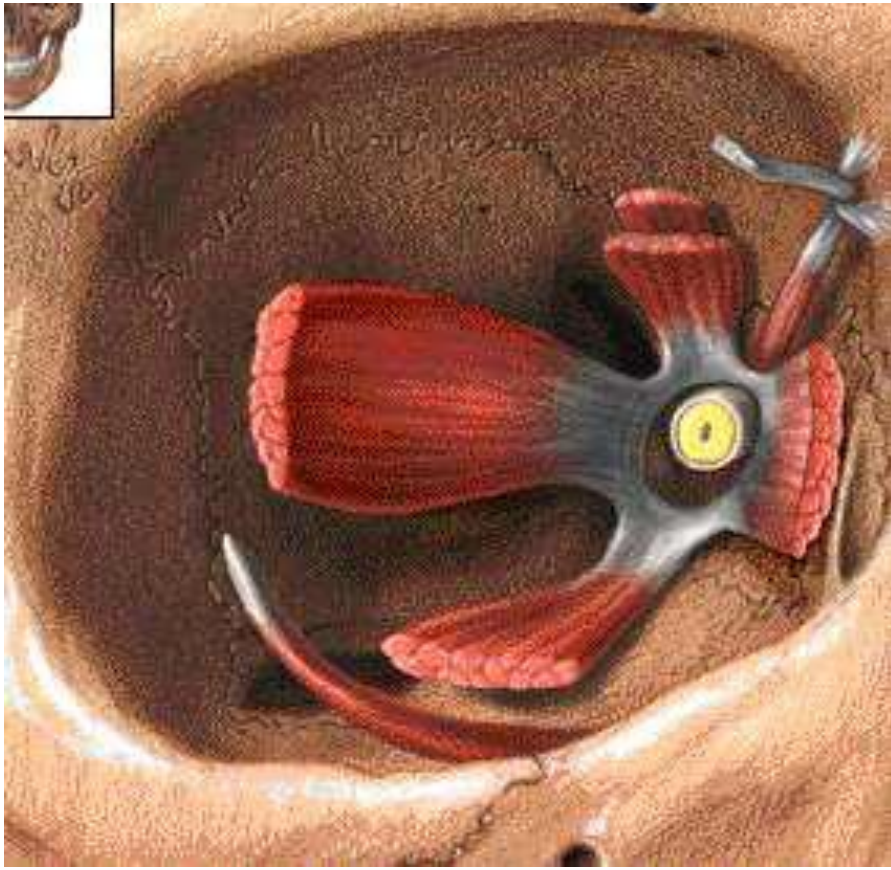
RECTI MUSCLES : ORIGIN

- Arises from a common tendinous ring knows as ***ANNULUS OF ZINN***
- Common ring of connective tissue
- Anterior to optic foramen enclosing the optic nerve
- Forms a muscle cone



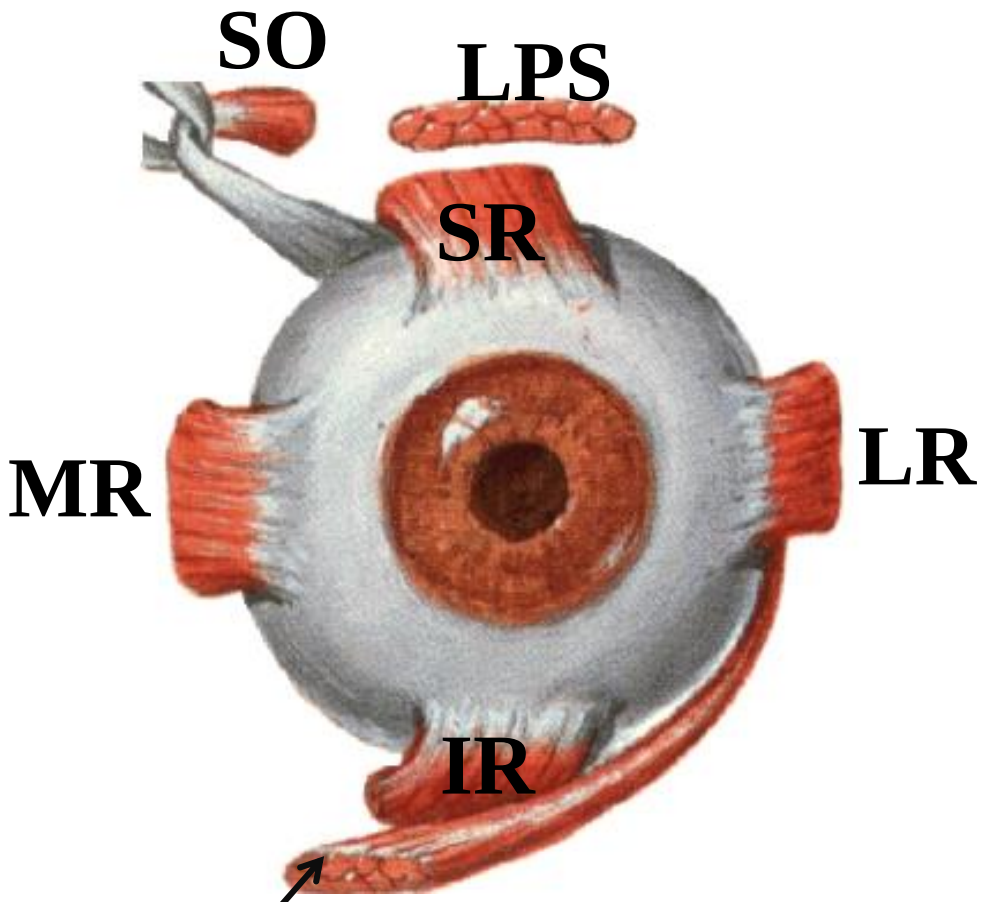
RECTI MUSCLES : INSERTION

- All at their principal directions anterior to the equator of the eye



Extrinsic Eye Muscles - Innervation and Action

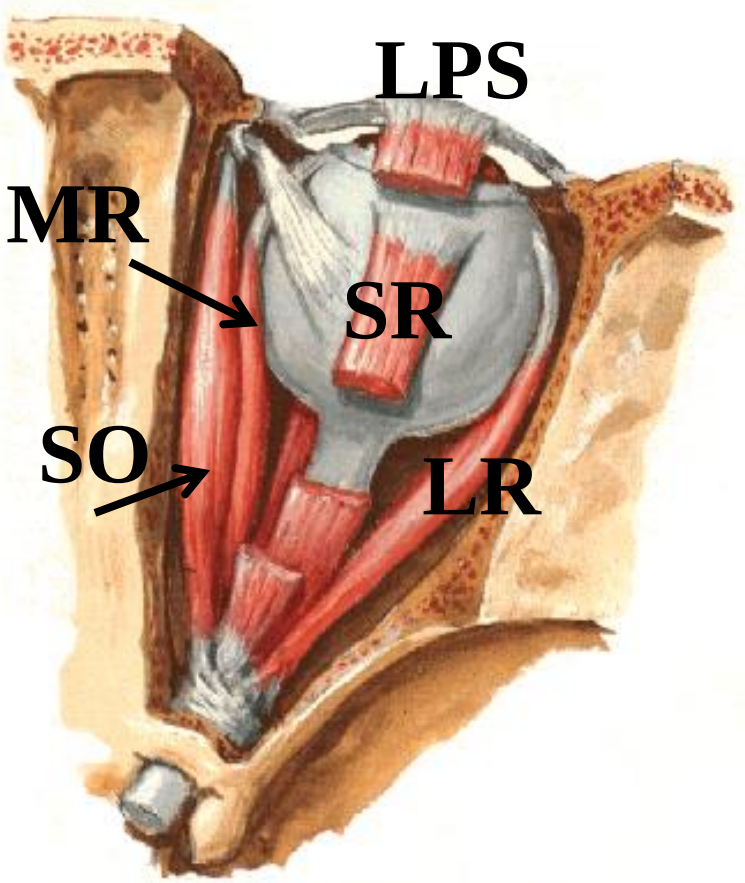
Anterior View of Left Eye

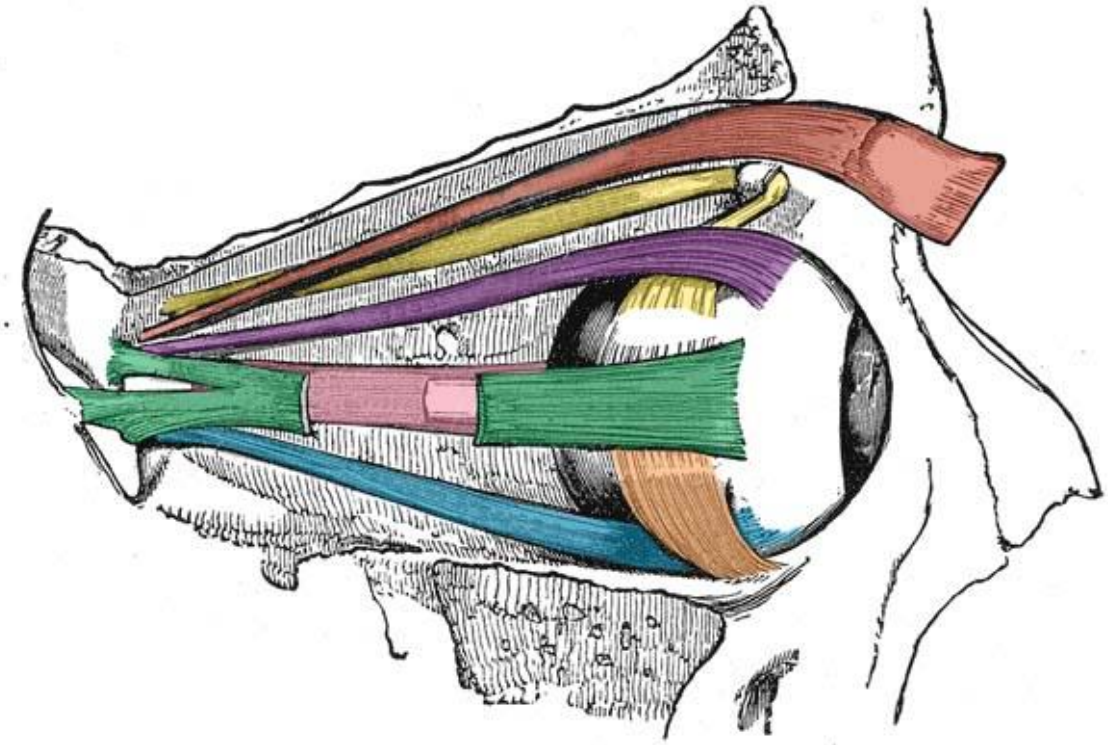


Inferior oblique

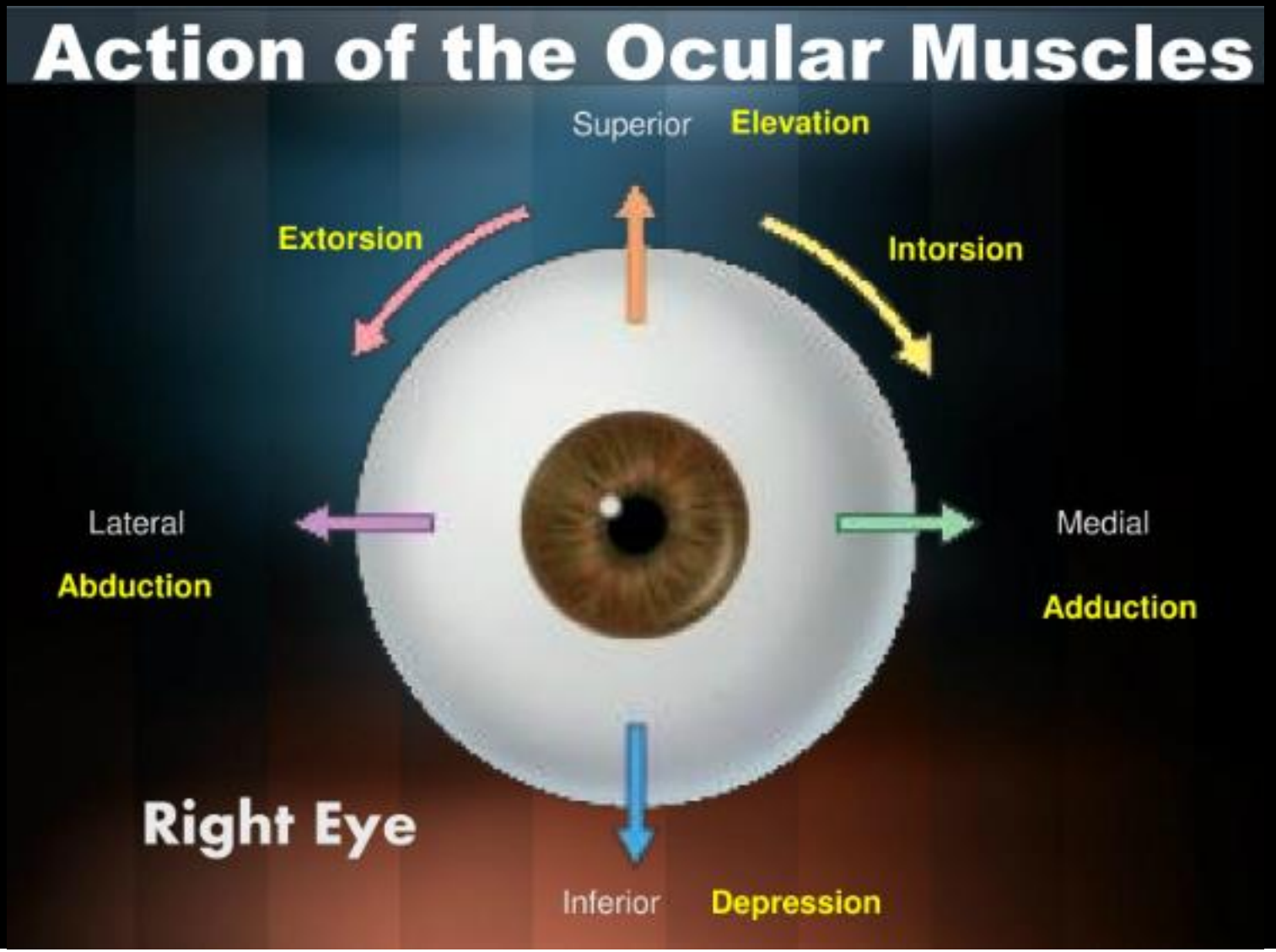
Extrinsic Eye Muscles

Superior View





- Levator palpebrae superioris
- Superior oblique
- Inferior oblique
- Superior rectus
- Medial rectus
- Lateral rectus
- Inferior rectus



Possible eye movements of the eyeball occurs around 3 axis:

1-Transverse----elevation and depression

2- Vertical----adduction and abduction

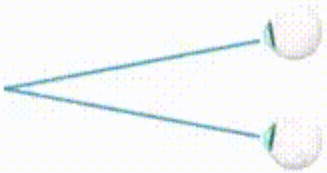
3- Anteroposterior----intorsion and extorsion

Six extraocular (outside the eye) muscles work in unison to control eye movement, and attach to the sclera.

Common tendinous ring
Four of the eye muscles (superior, inferior, medial, and lateral rectus) originate from the common tendinous ring and control most up-and-down and side-to-side movement.

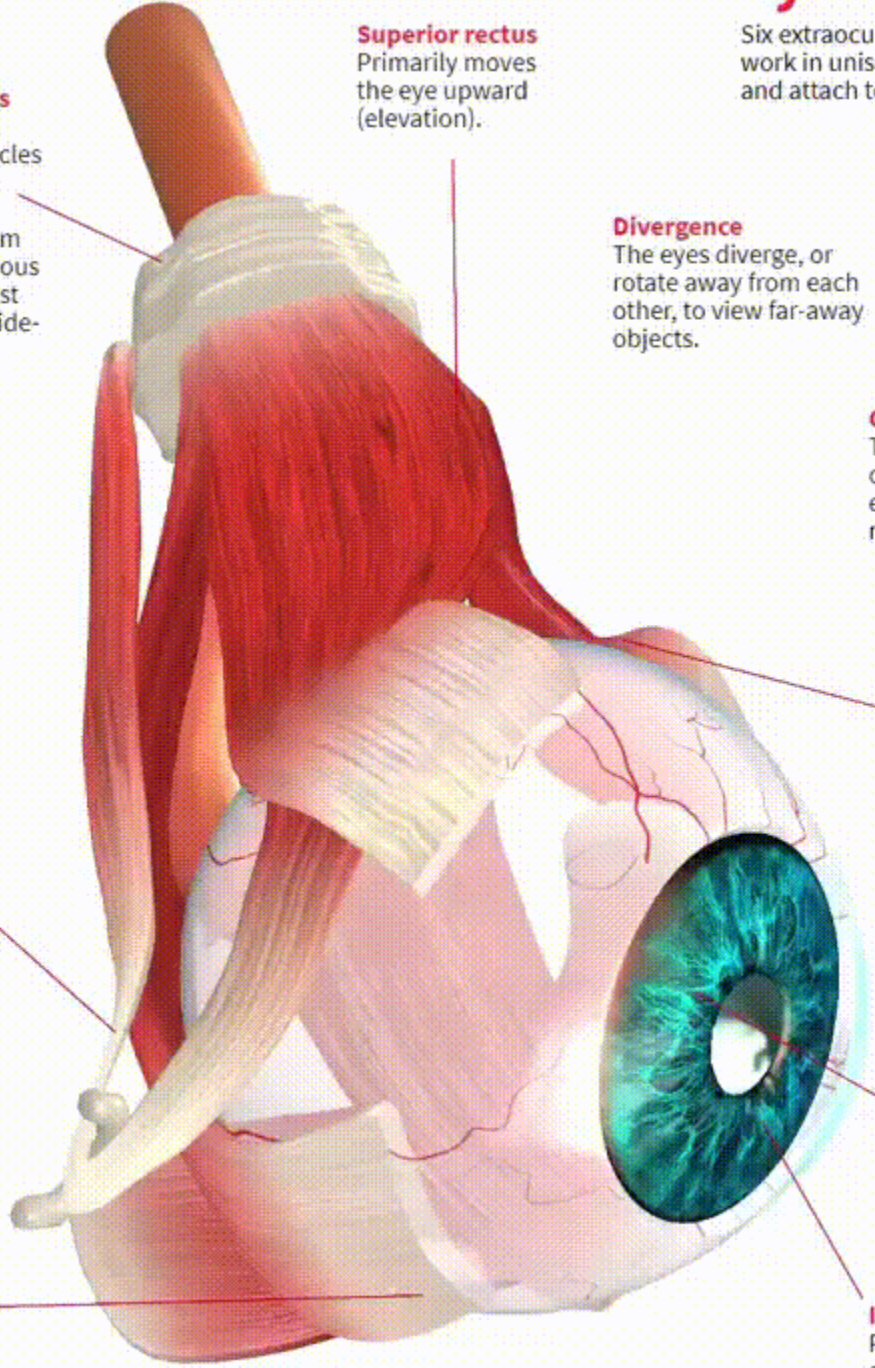
Superior rectus
Primarily moves the eye upward (elevation).

Divergence
The eyes diverge, or rotate away from each other, to view far-away objects.



Convergence
The eyes converge, or rotate towards each other, to view nearby objects.

Superior oblique
The superior oblique originates from the orbit (eye socket), near the nose, and loops through the **trochlea**, which acts as a pulley. It mainly rotates the eye toward the nose (intorsion), but also moves it downward (depression), and away from the nose (abduction).



Lateral rectus
Primarily moves the eye away from the nose (abduction).

Inferior oblique
The inferior oblique originates from the maxilla (upper jaw bone). It mainly rotates the eye away from the nose (extorsion), but also moves it upward (elevation), and away from the nose (abduction).

Medial rectus
Primarily moves the eye toward the nose (adduction).

Inferior rectus
Primarily moves the eye downward (depression).

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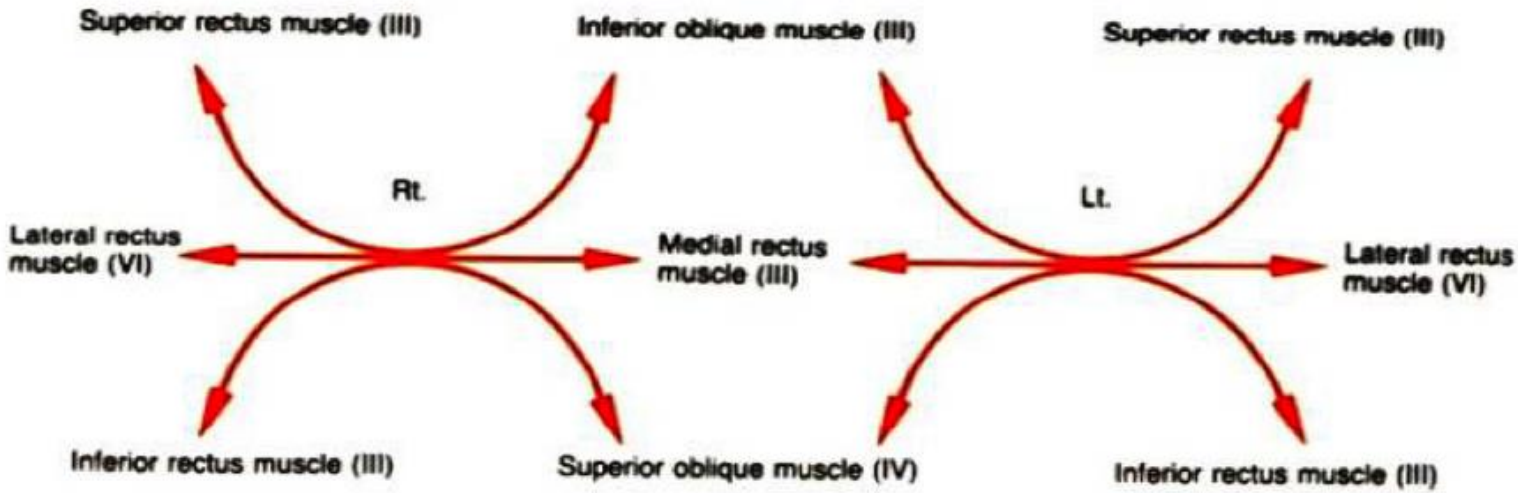
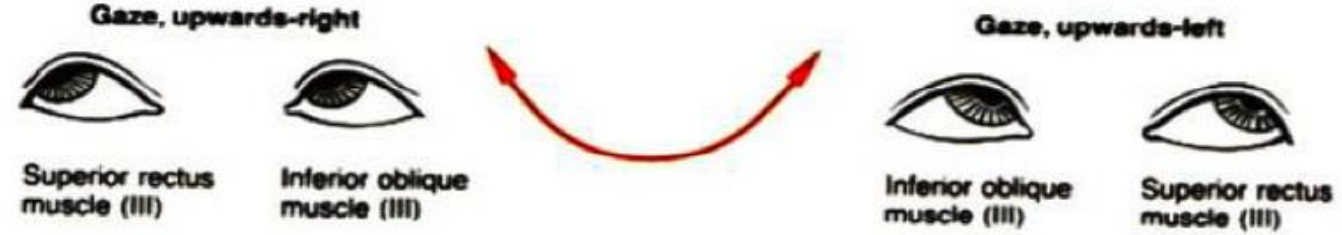

Superior rectus muscle (III)
Inferior oblique muscle (III)
Superior rectus muscle (III)
Rt.
Lt.
Lateral rectus muscle (VI)
Medial rectus muscle (III)
Lateral rectus muscle (VI)
Inferior rectus muscle (III)
Superior oblique muscle (IV)
Inferior rectus muscle (III)

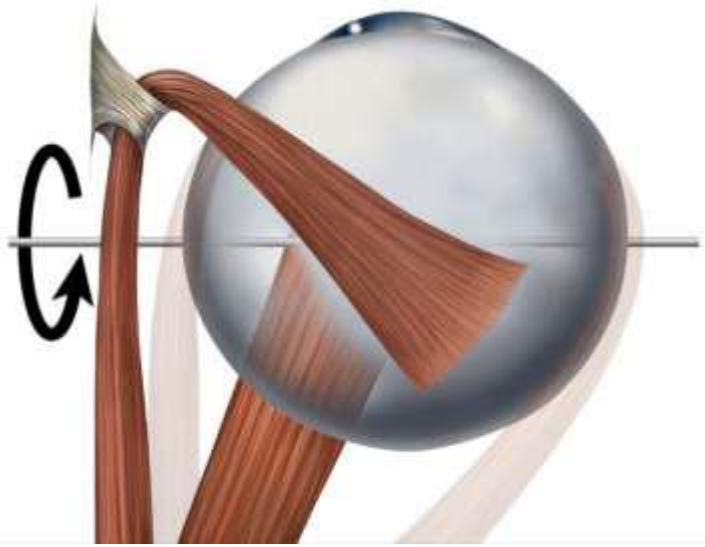

Gaze, upwards-right
Gaze, upwards-left
Superior rectus muscle (III)
Inferior oblique muscle (III)
Inferior oblique muscle (III)
Superior rectus muscle (III)

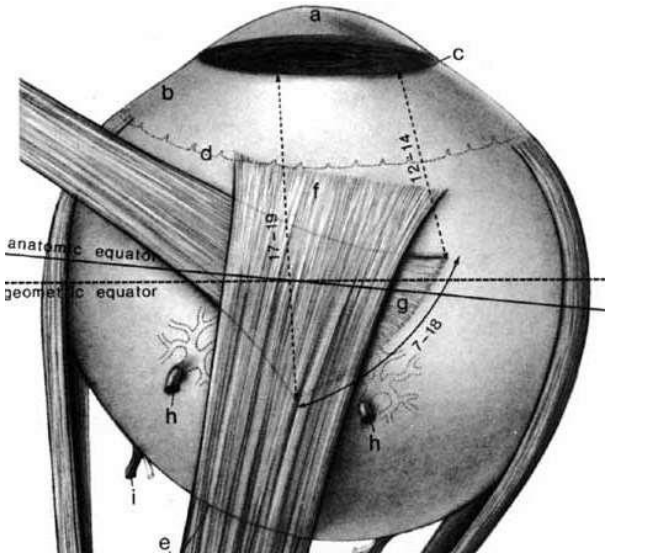

Gaze, right
Gaze, left
Lateral rectus muscle (VI)
Medial rectus muscle (III)
Medial rectus muscle (III)
Lateral rectus muscle (VI)


Gaze, downwards-right
Gaze, downwards-left
Inferior rectus muscle (III)
Superior oblique muscle (IV)
Superior oblique muscle (IV)
Inferior rectus muscle (III)

SUPERIOR OBLIQUE

- ***Anatomical origin :-*** Lesser wing of the sphenoid bone.
- ***Physiological origin*** is the trochlea, a cartilaginous "U" on the superior medial wall of the orbit
- ***Insertion:*** The insertion line is curved with its concavity facing the trochlea beyond the equator.
- **Longest and thinnest EOM**





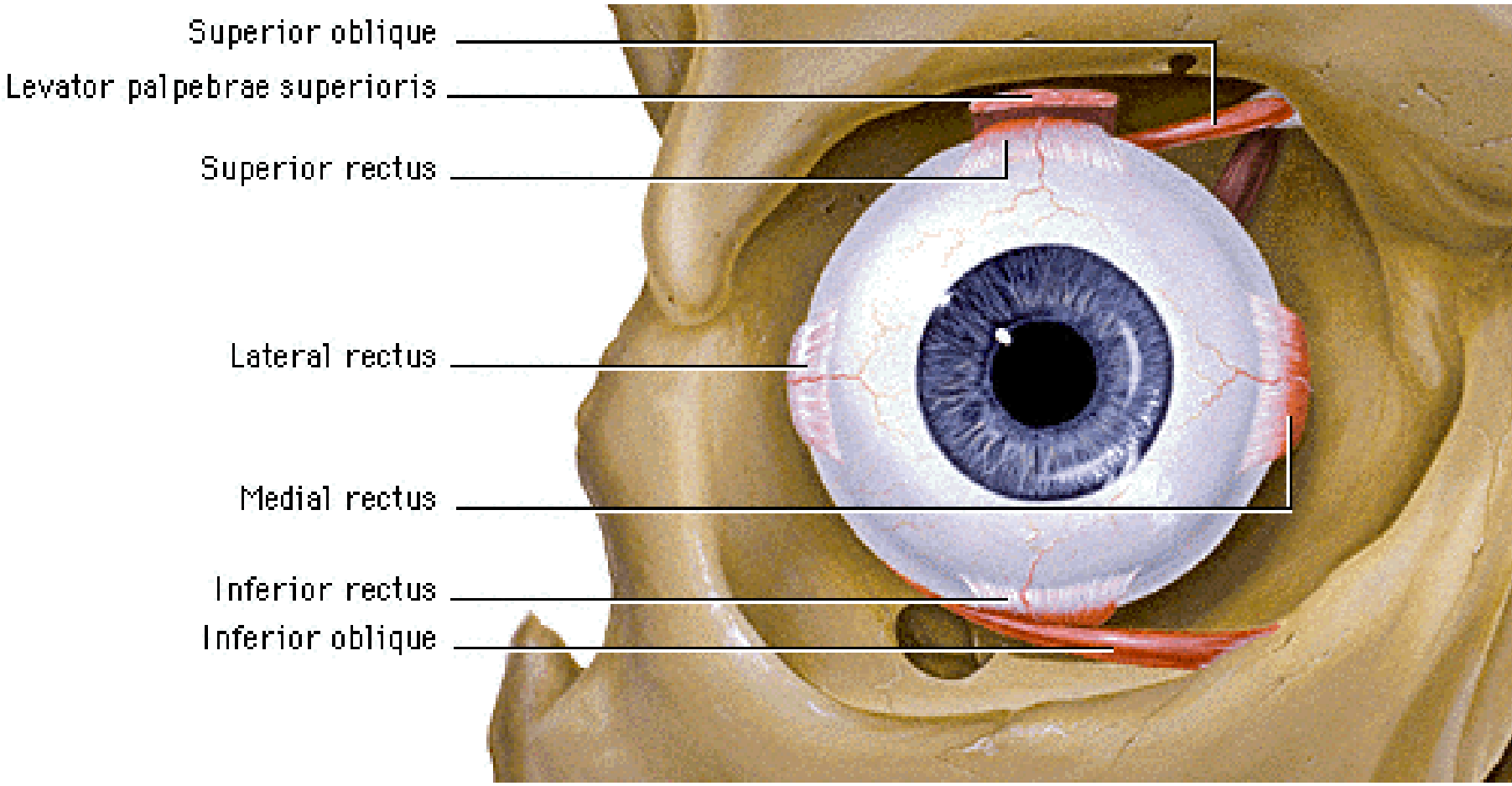
INFERIOR OBLIQUE

- ***Origin***

From a shallow depression on the orbital plate of maxilla

Just lateral to the lacrimal sac

The ONLY EOM originating in the anterior orbit.

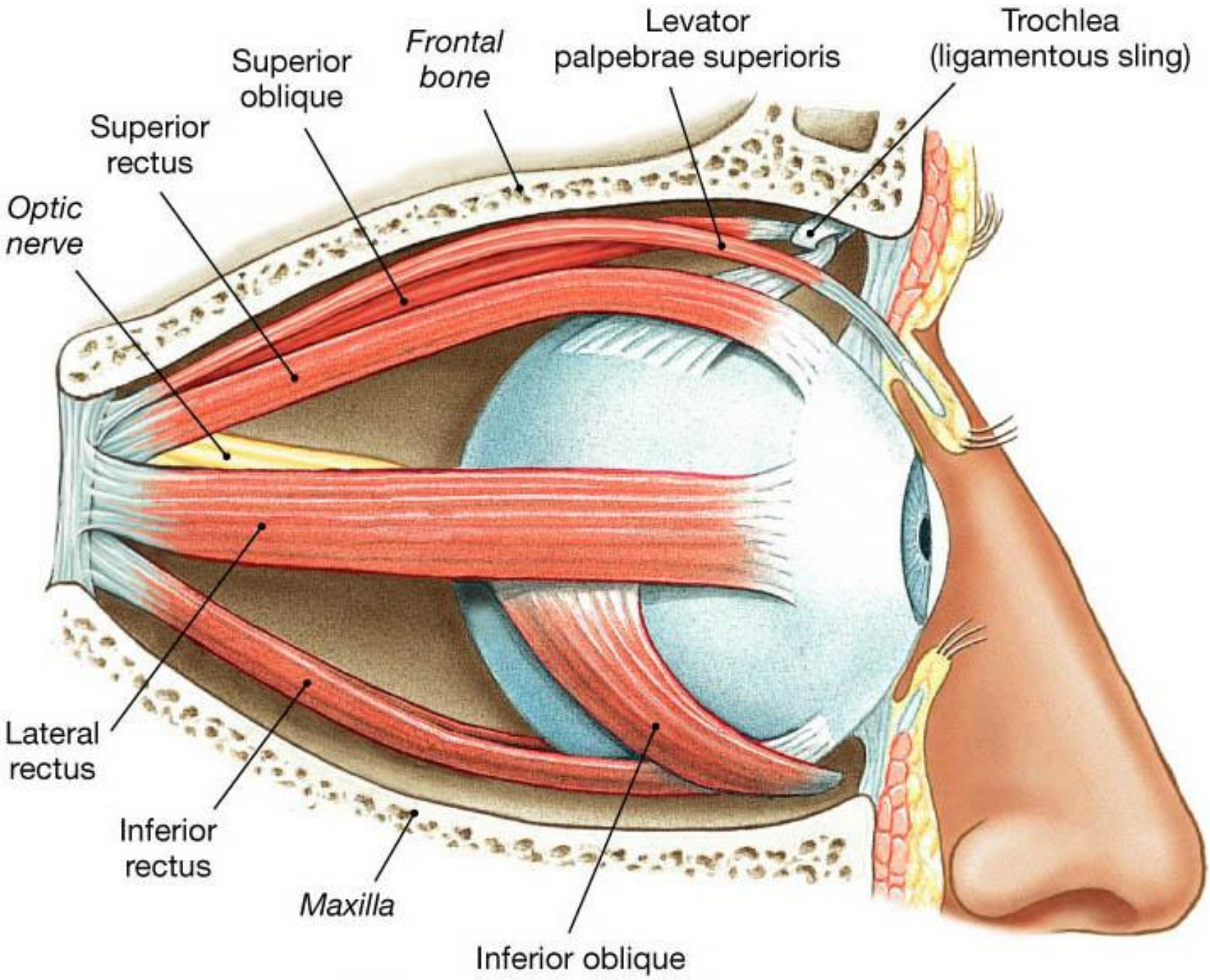

Superior oblique
Levator palpebrae superioris
Superior rectus
Lateral rectus
Medial rectus
Inferior rectus
Inferior oblique

INFERIOR OBLIQUE

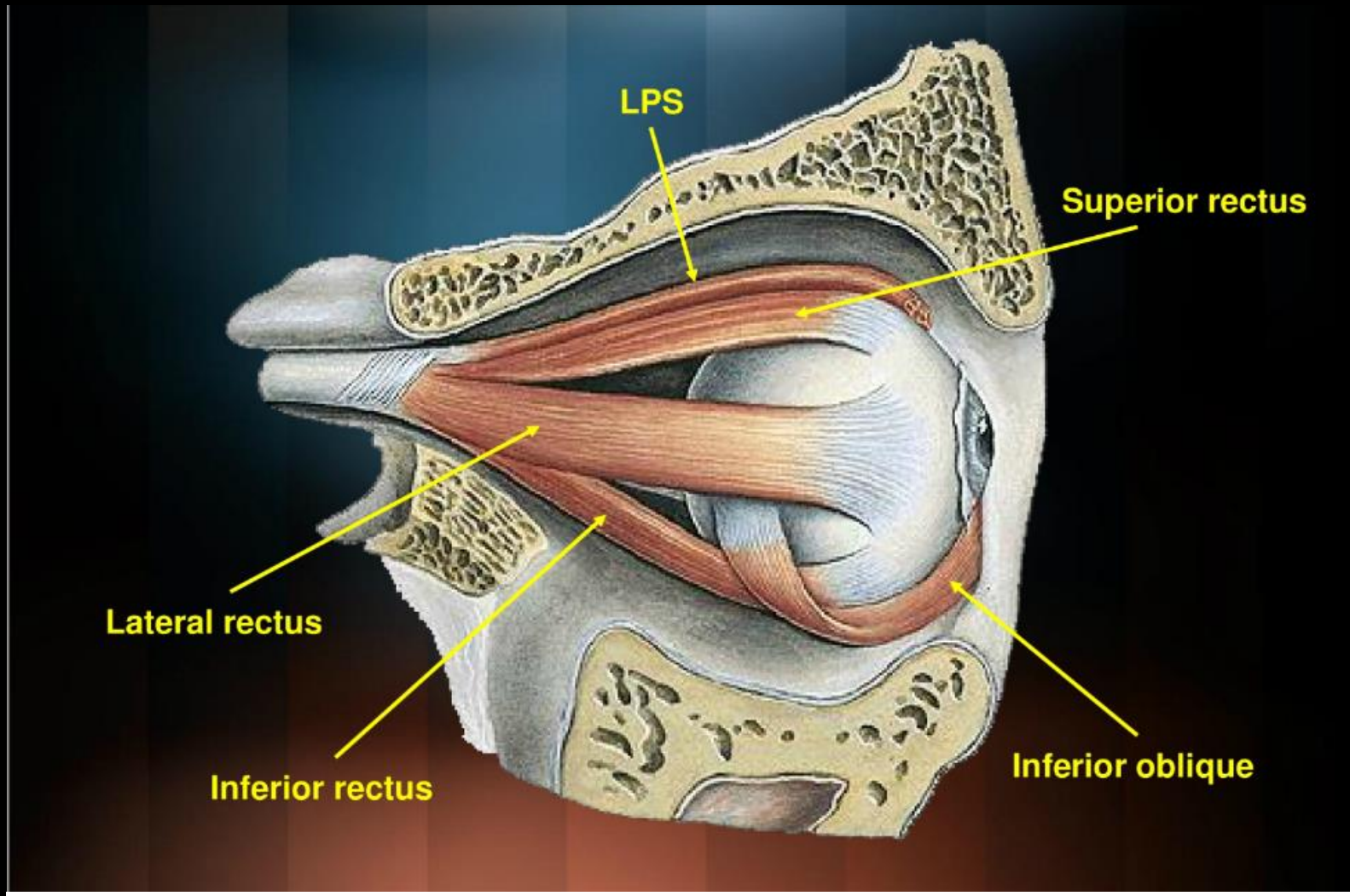
- ***Insertion***

Lower and outer part of sclera behind the equator

Nerve Supply: Oculomotor nerve – inferior division

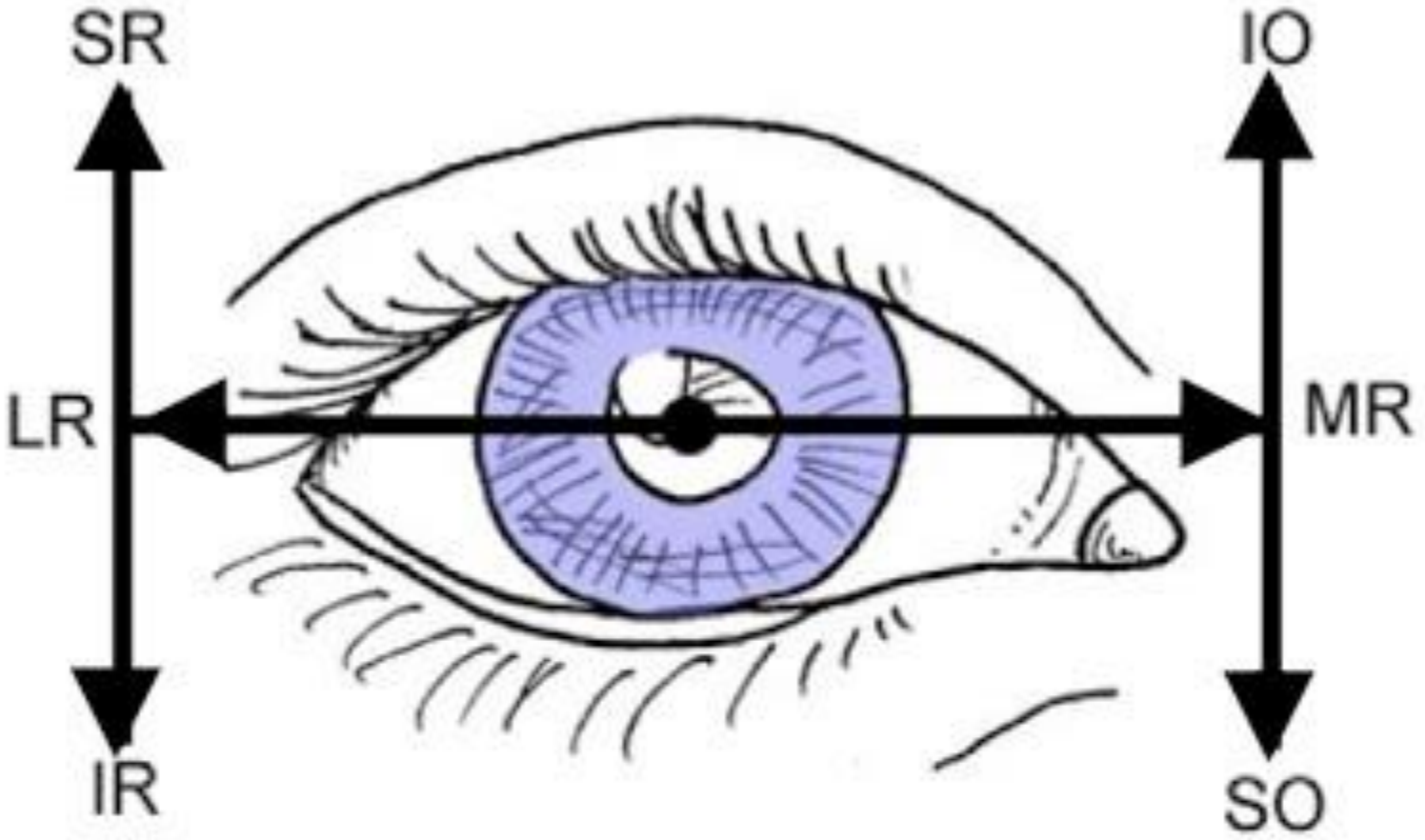


(a) Lateral surface, right eye



Nerve supply of the extrinsic muscles of the eye:

All are supplied by oculomotor (III) except SO4 (Trochlear) and LR6 (Abducent)



Anterior view of right eye - Clinical testing of eye muscles

Clinical Testing

Clinical Testing

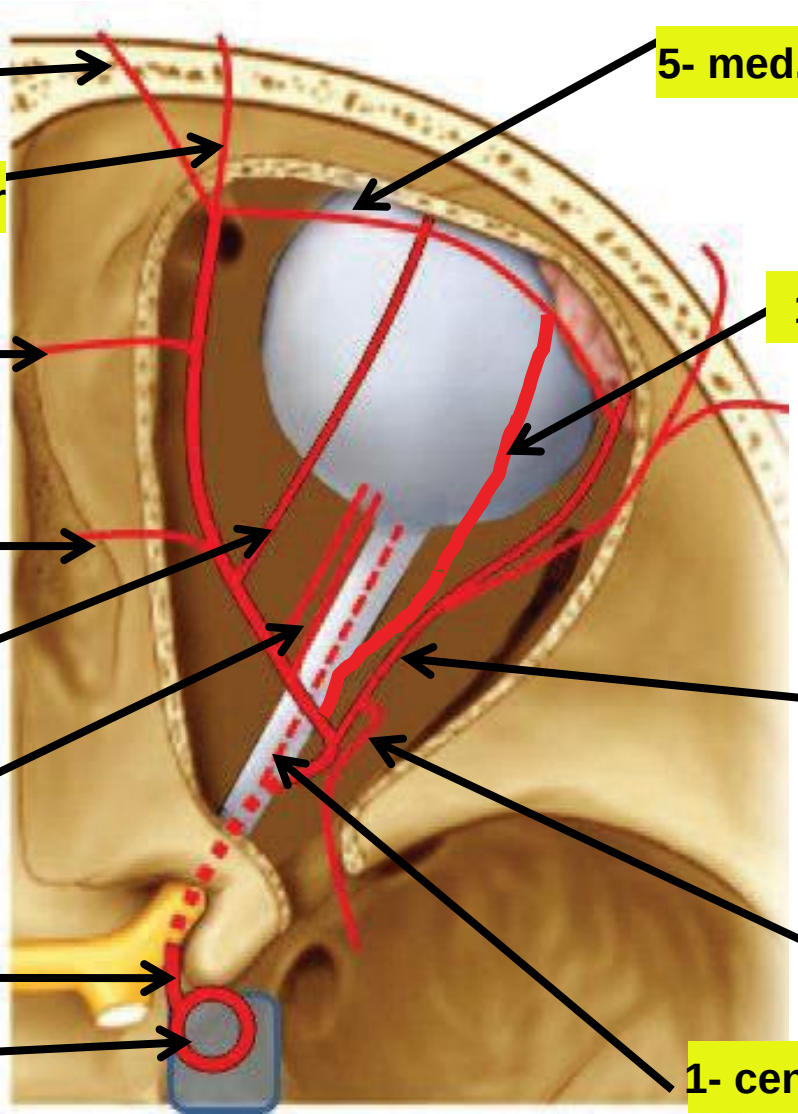
Muscle tested		Movement
SR		Looks laterally and upwards
IR		Looks laterally and downwards
LR		Looks laterally
MR		Looks medially
IO		Looks medially and upwards
SO		Looks medially and downwards

Ophthalmic artery

1- Origin: ICA

2- Course: In optic canal--- inferolateral to optic nerve
In the orbit----lat. , crossing then med to the optic nerve
Then it runs on the medial wall of the orbit between MR and SO muscles

3- Branches



11-dorsal nasal

10-supratrochlear

9- ant. ethmoidal

8- post. ethmoidal

7- supraorbital

6- post. ciliary

Ophthalmic a.

ICA

5- med. palpebral

12- long ant. ciliary

4- lacrimal

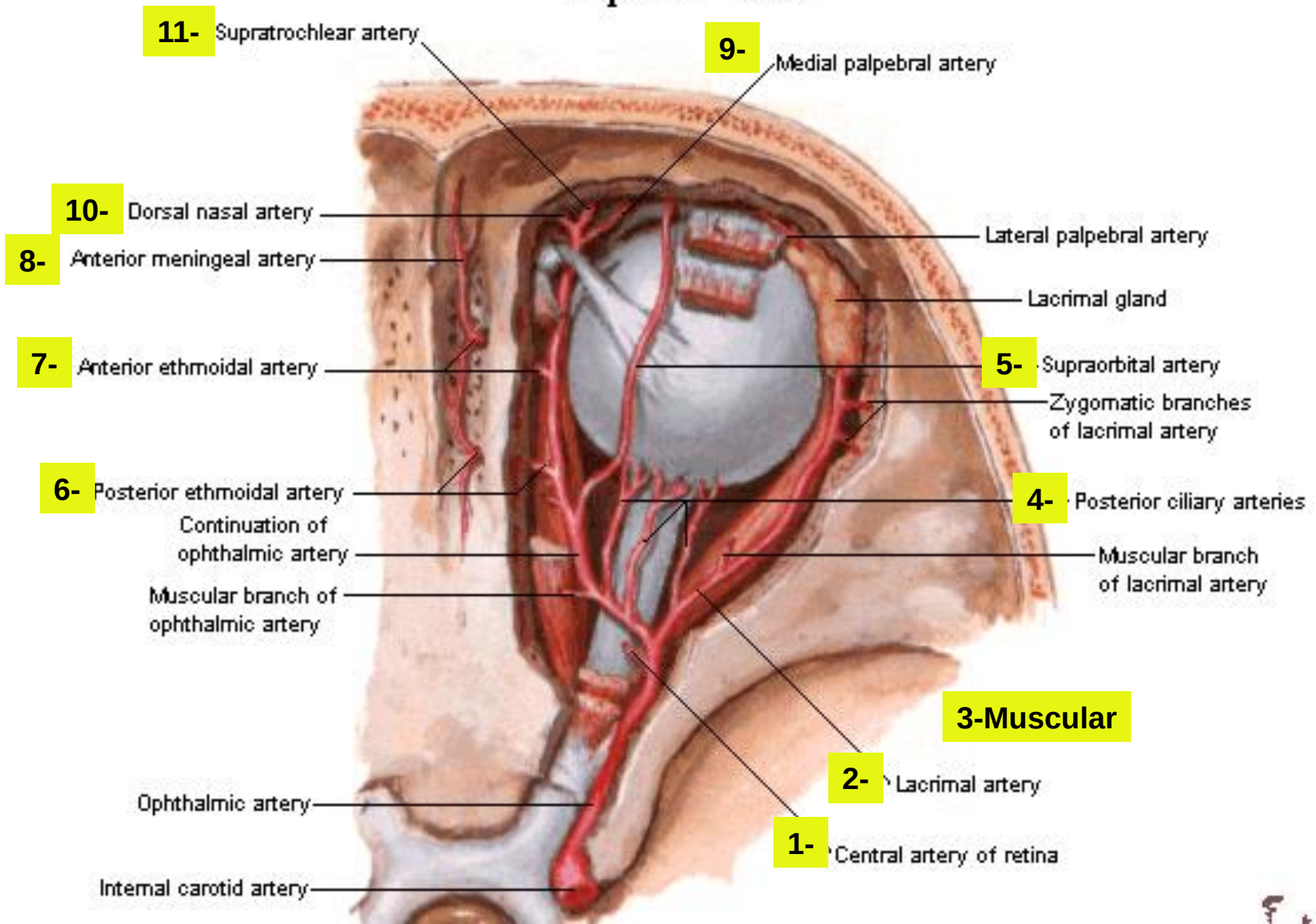
3-Muscular

2- meningeal

1- central retinal artery

Arteries and Veins of Orbit and Eyelids

Superior View



Venous Drainage

- The orbit is drained by superior and inferior ophthalmic veins.
- Both veins pass backwards through superior orbital fissure and drain into ***cavernous sinus***.

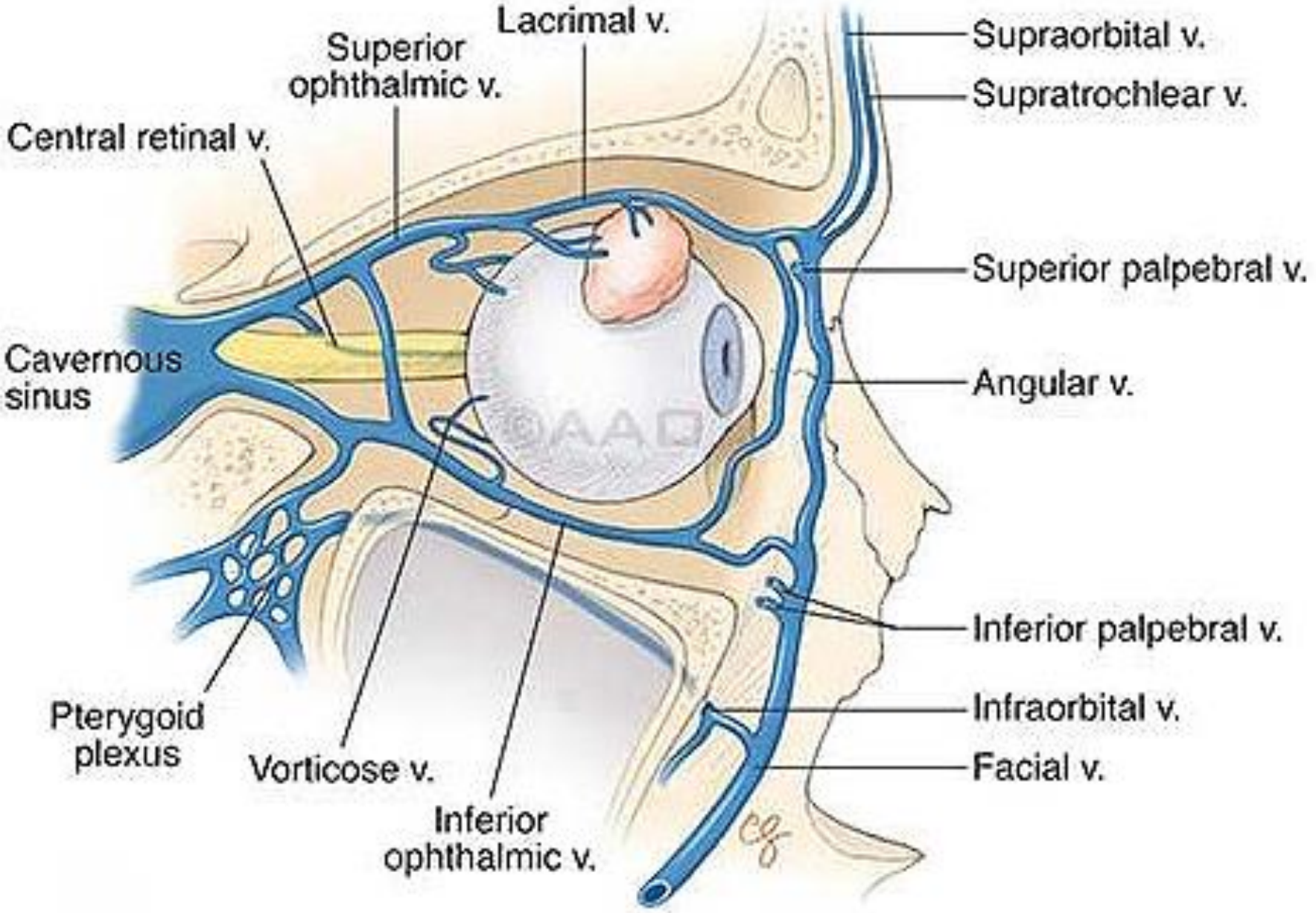
- ***The superior ophthalmic vein*** communicates anteriorly with facial vein.

- The ***inferior ophthalmic vein*** communicates through the inferior orbital fissure with the pterygoid venous plexus (***dangerous area***)

Lymph vessels:

No lymph vessels or nodes are present in the orbit.

The cornea has no blood supply , nourished by acquis humour

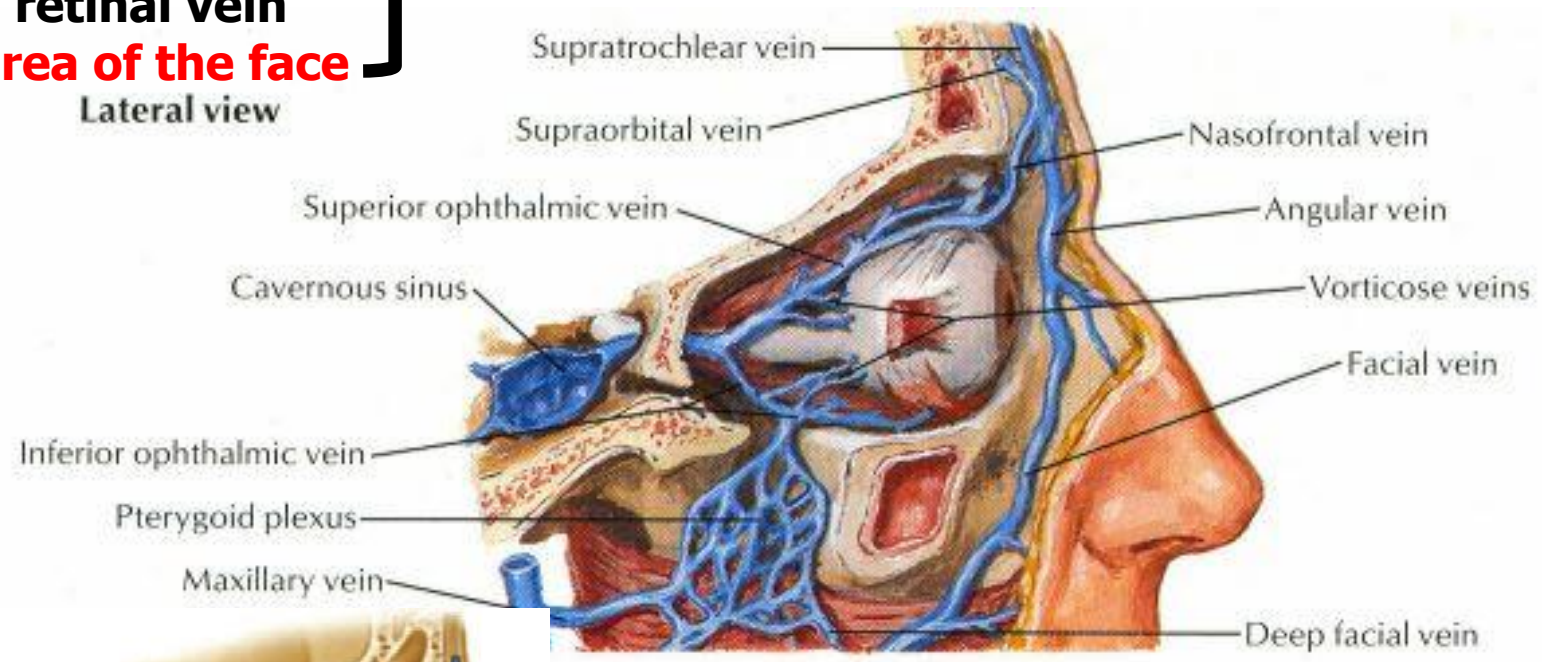

Lacrimal v.
Superior ophthalmic v.
Central retinal v.
Supraorbital v.
Supratrochlear v.
Superior palpebral v.
Cavernous sinus
Angular v.
Inferior palpebral v.
Infraorbital v.
Facial v.
Pterygoid plexus
Vorticose v.
Inferior ophthalmic v.

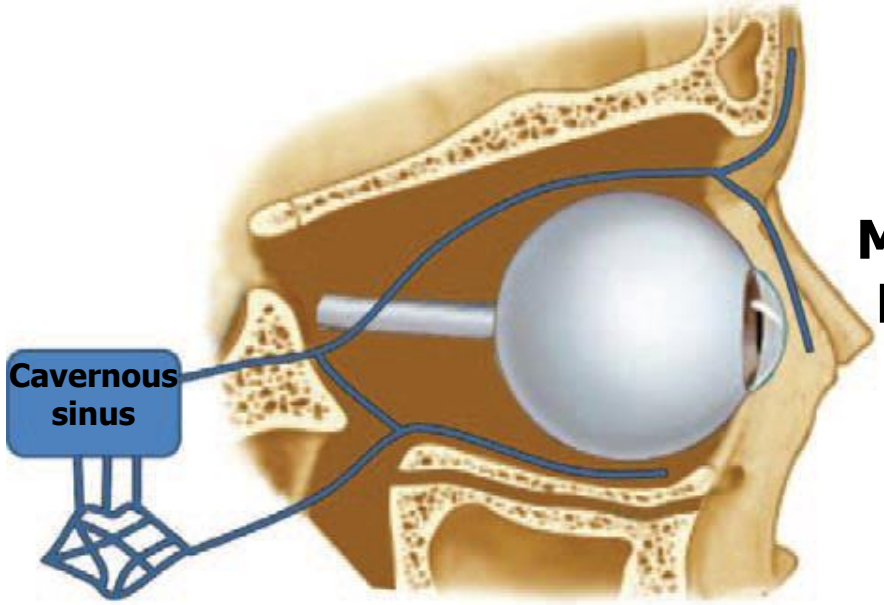
Venous drainage:

1- Superior ophthalmic vein
2- Inferior ophthalmic vein
3- Central retinal vein

Drain in the cavernous sinus

Dangerous area of the face

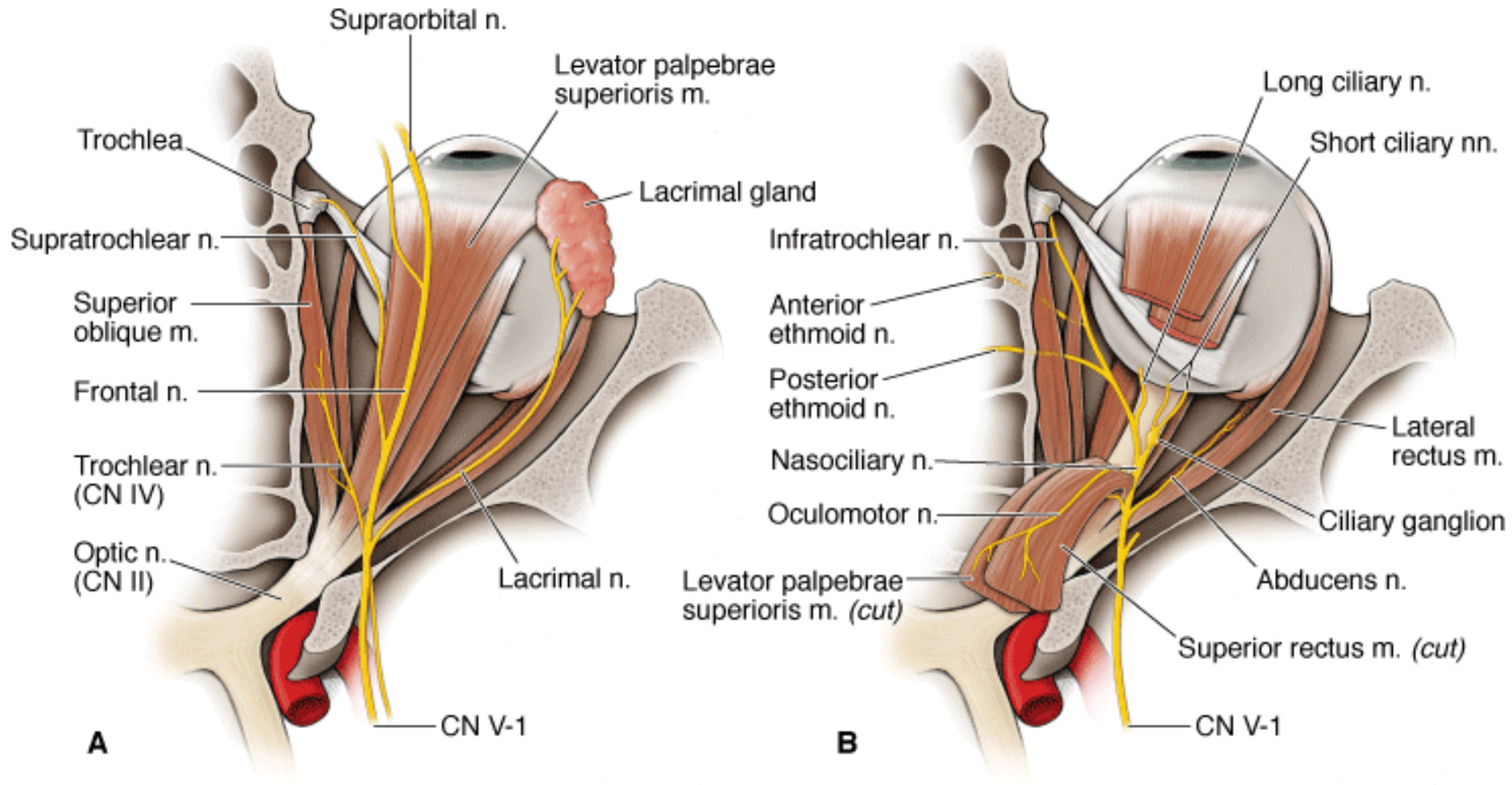




Lymphatic drainage:

Medial part----submandibular LN
Lateral part----Pre-auricular LN

Nerves of the Orbit



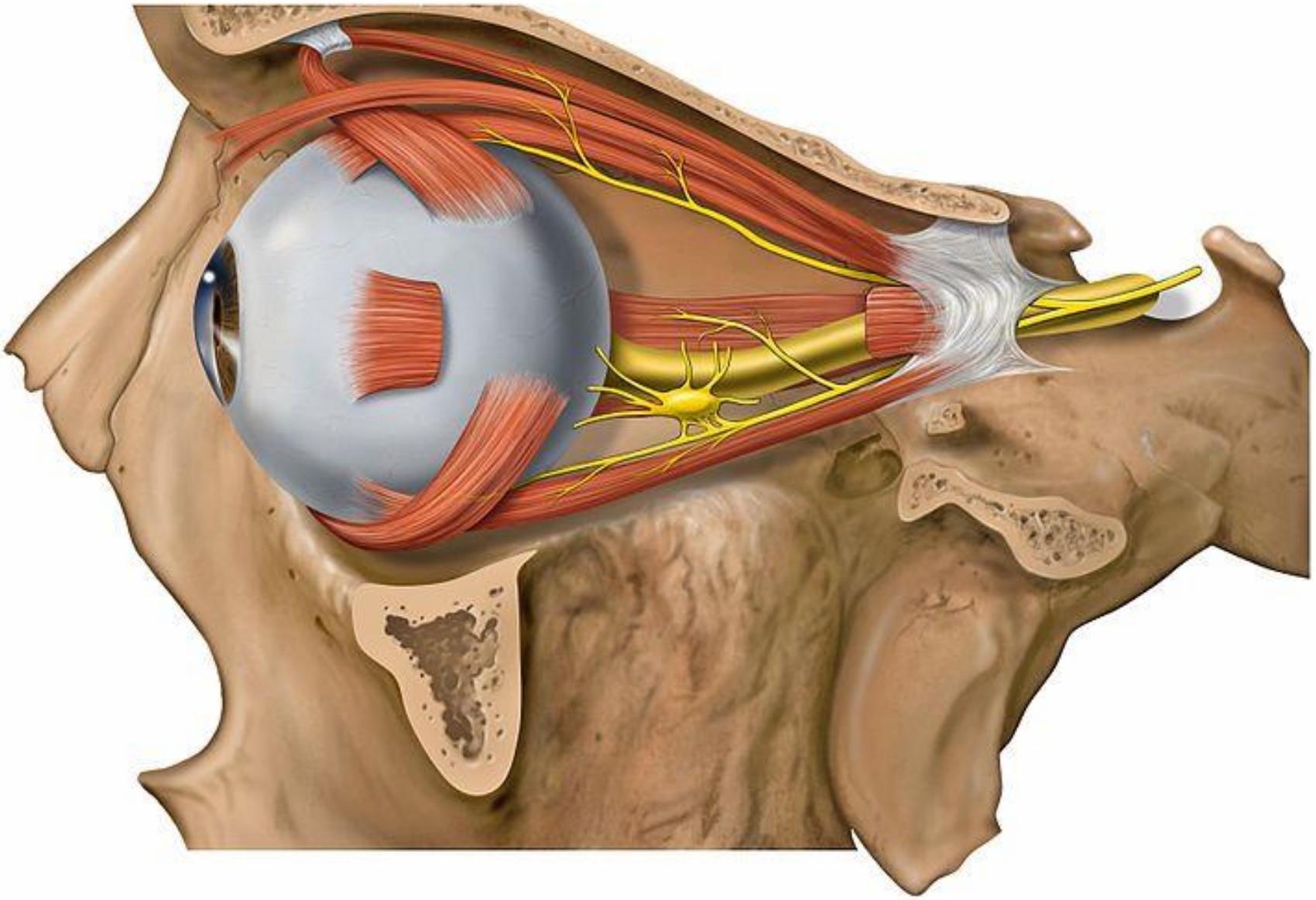
Ciliary Ganglion

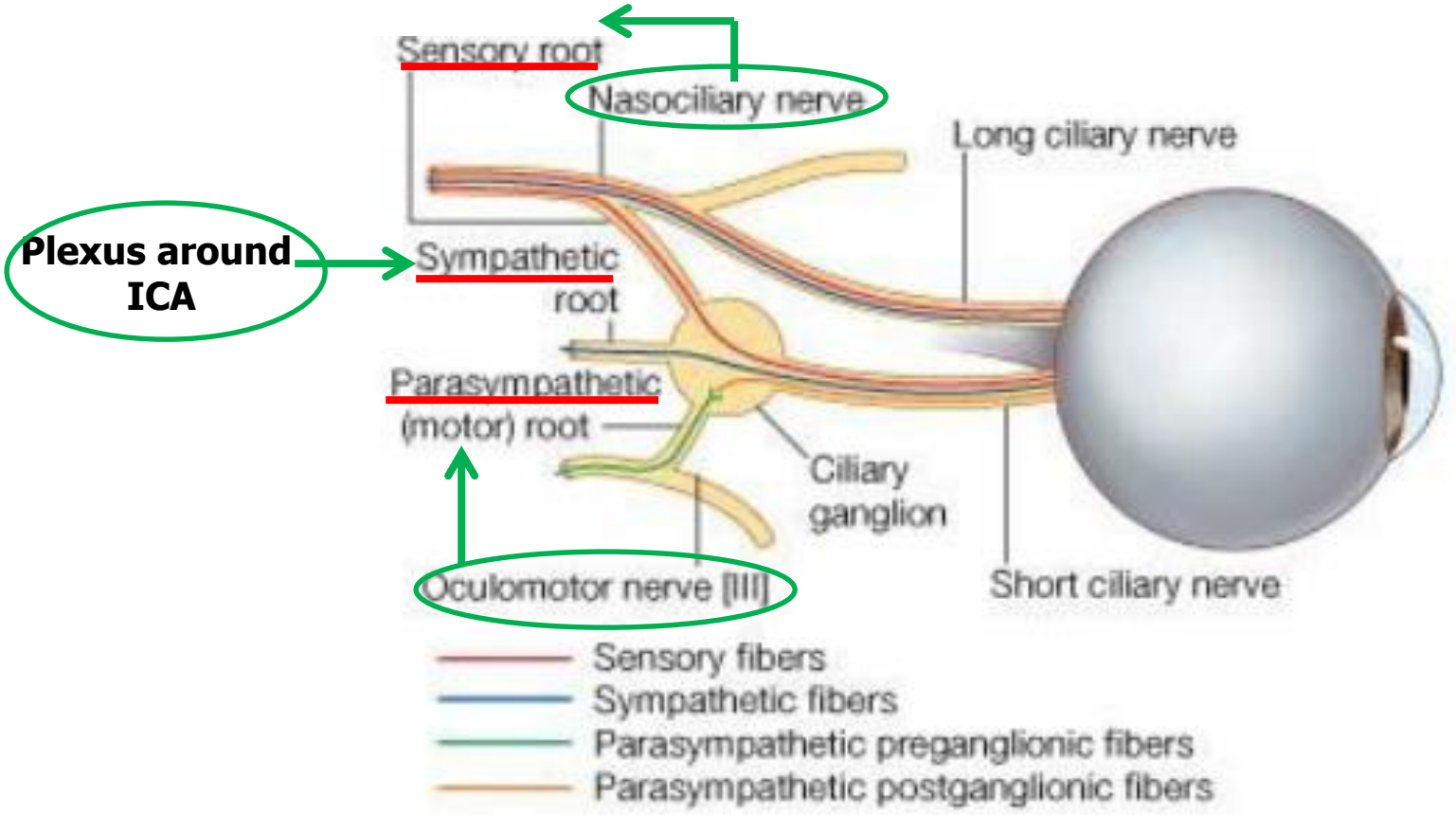
- ***Lateral to the optic nerve inside the orbit***

- ***Roots:***

1. ***Parasympathetic root***: arises from the nerve to inferior oblique of the oculomotor
2. ***Sympathetic root***: branch from the plexus around ICA
3. ***Sensory root***: branch from nasociliary

- ***Branches:*** short ciliary nerves




Sensory root
Nasociliary nerve
Long ciliary nerve
Plexus around ICA
Sympathetic root
Parasympathetic (motor) root
Ciliary ganglion
Oculomotor nerve [III]
Short ciliary nerve
Sensory fibers
Sympathetic fibers
Parasympathetic preganglionic fibers
Parasympathetic postganglionic fibers

Ciliary Ganglion

- ***Parasympathetic root:***

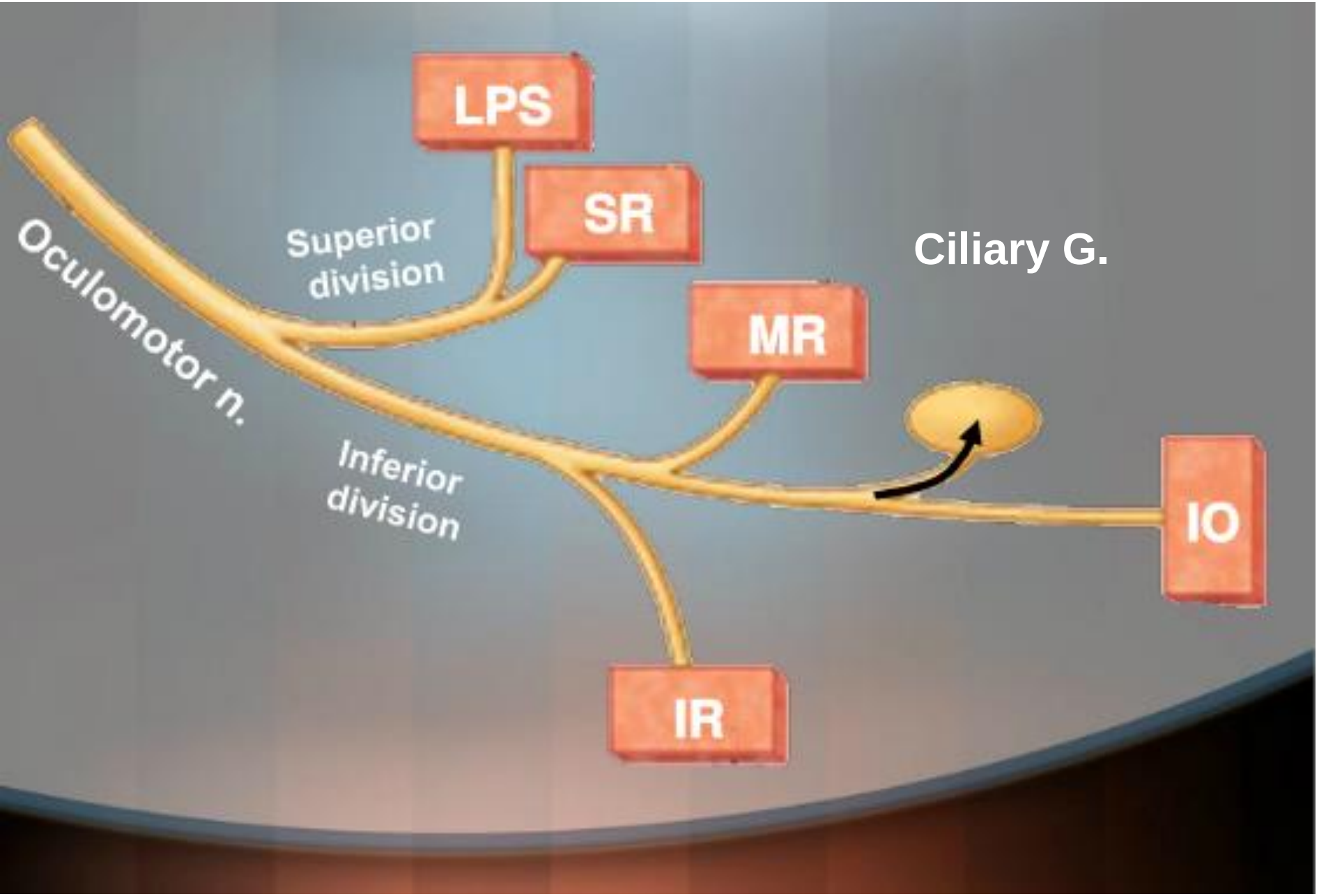
- Edinger-Westphal nucleus (a part of the brainstem) which form synapses with the ciliary neurons. The *postganglionic* axons run in the short ciliary nerves and innervate eye muscles:

- The **sphincter pupillae** constricts the pupil, a movement known as Miosis and contractions to ciliary muscles

Ciliary Ganglion

- ***Sympathetic root:***

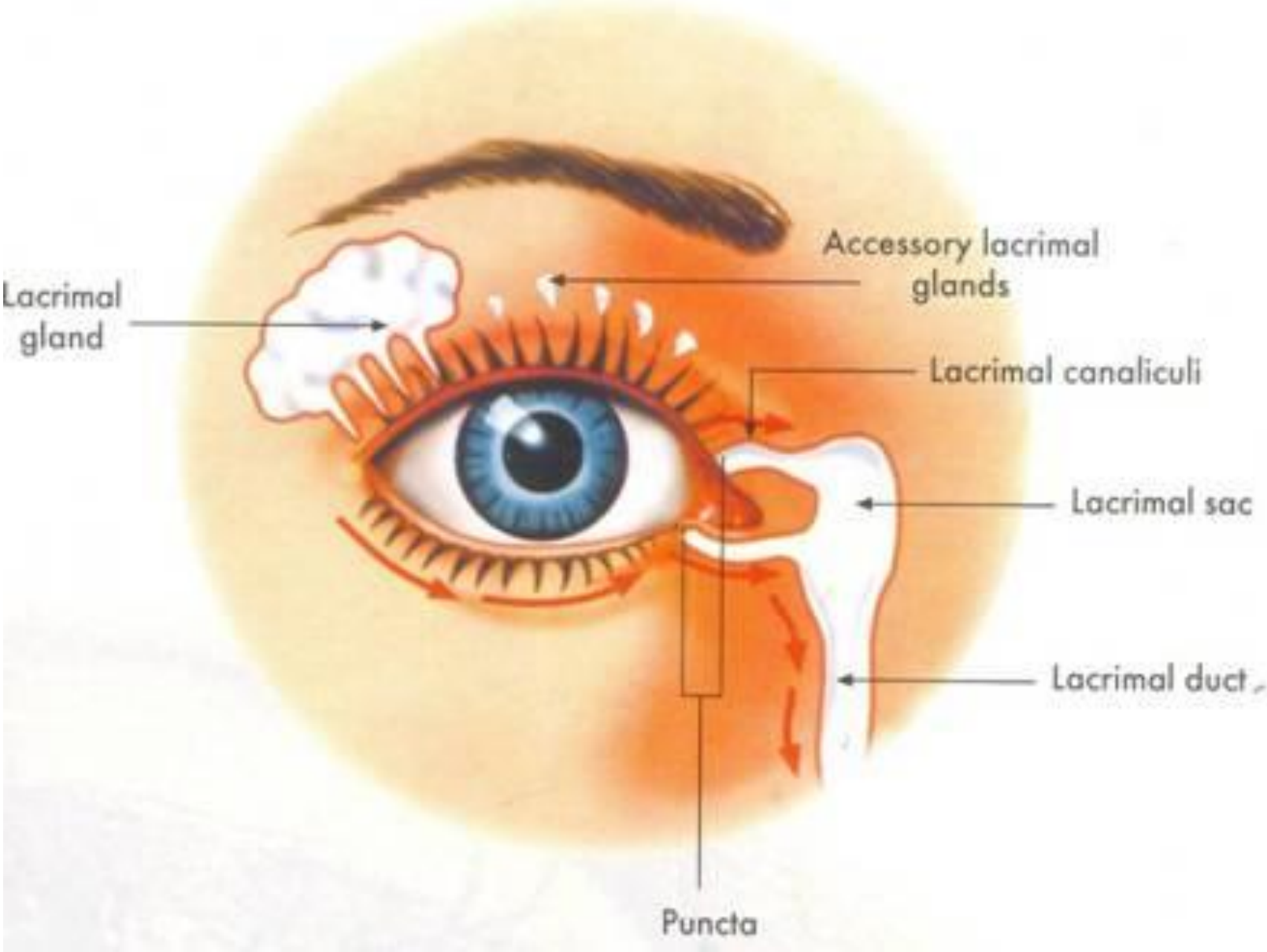
- Branches from plexus around ICA passing without relay in the inferior division of the oculomotor nerve to the ***dilator pupillae*** through short ciliary nerves and relaxation of ciliary muscles


LPS
SR
MR
IO
IR
Superior division
Inferior division
Oculomotor n.
Ciliary G.

Lacrimal Gland

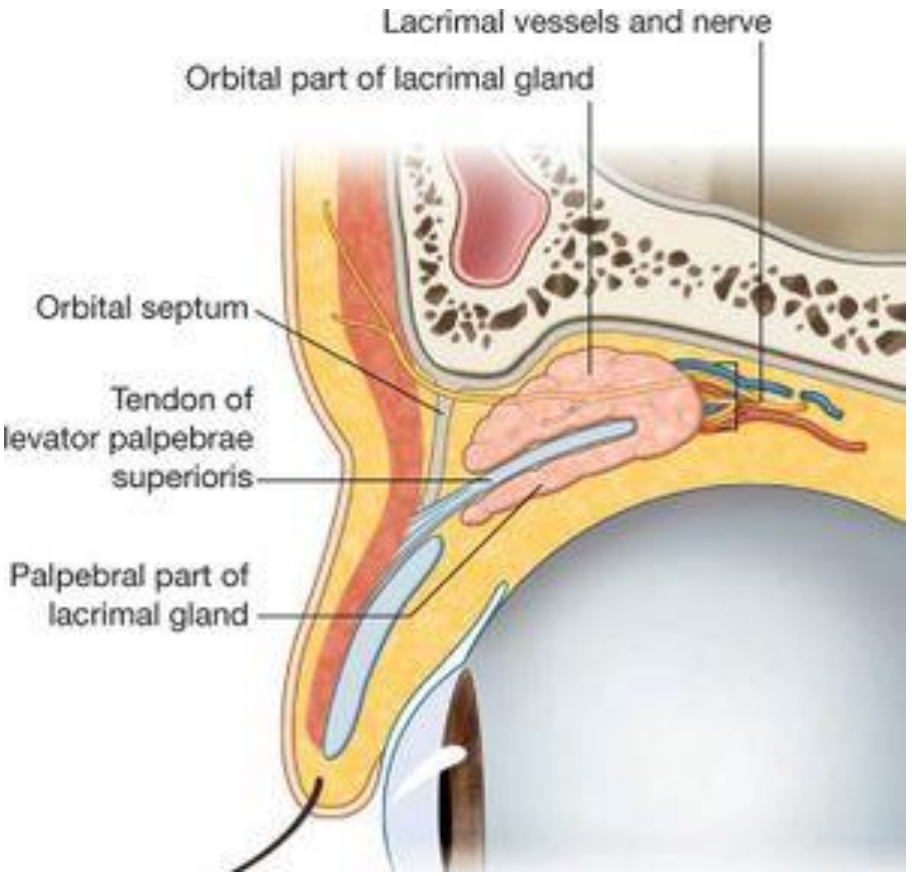
- ***Lacrimal gland is located in the supero-temporal portion of orbit***
- It lies in the ***shallow lacrimal fossa*** of frontal bone
- It is composed of numerous secretary units called acini
- It measures 20mm / 12mm

LACRIMAL SYSTEM



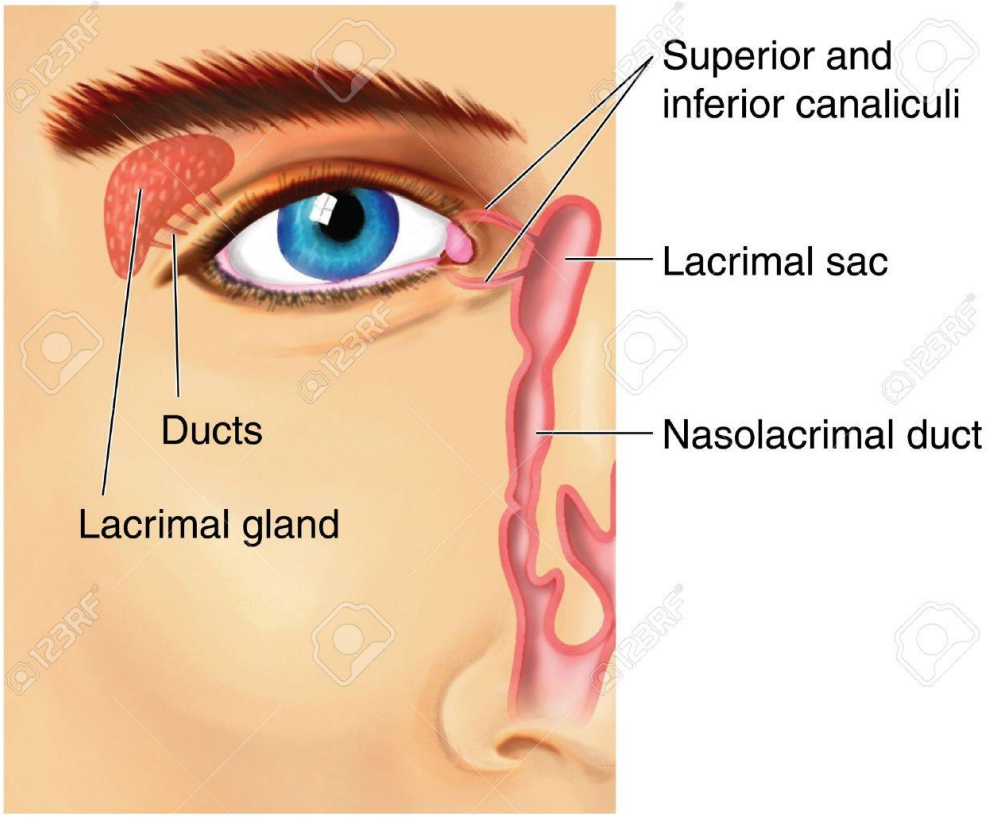
Lacrimal Gland

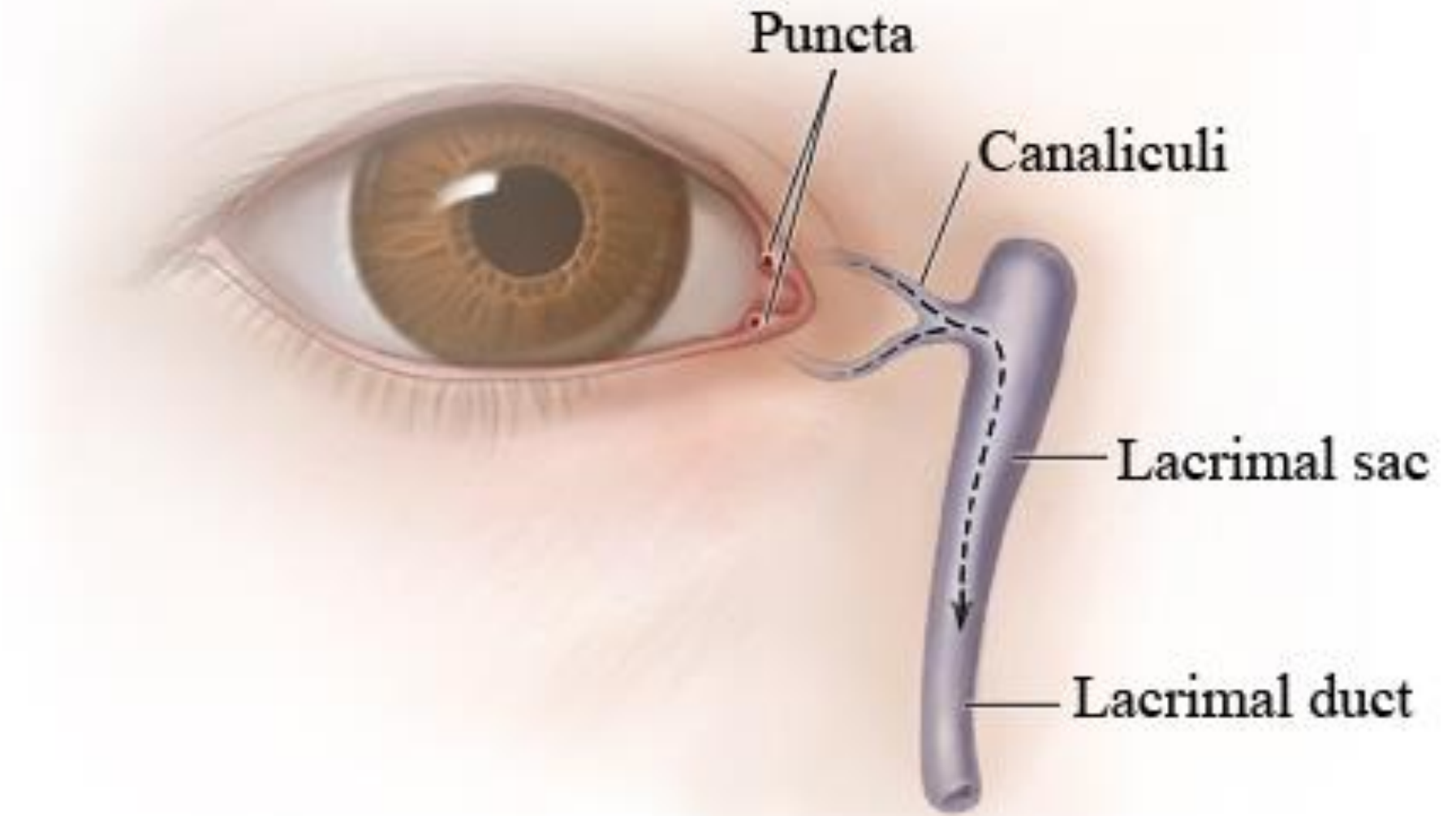
- A fibrous band incompletely divides the gland into two lobes, the posterior larger orbital lobe and the anterior smaller palpebral lobe
- Ducts from the orbital lobe will have to pass through the palpebral lobe to drain
- Damage to the palpebral lobe blocks drainage to the entire gland



Lacrimal Gland

- Superior canaliculus is 8 mm long
- Inferior canaliculus is 10 mm long
- These two canaliculi joint to form a common canaliculi before joining the sac
- Opening of common canaliculi into nasolacrimal sac is known as **internal punctum**





Lacrimal sac leads to nasolacrimal duct, opening at the nasal cavity in the inferior meatus

At birth, the **nasolacrimal duct** may not be fully developed, causing a watery eye.

Oculomotor Nerve

- ***Consists of two components with distinct functions***

- The ***somatic motor component*** of CN III plays a major role in ***controlling*** the ***muscles*** responsible for the precise ***movement*** of the ***eyes*** for visual tracking or fixation on an object.

- The ***visceral motor component*** is involved in the ***pupillary light and accommodation reflexes***.

Oculomotor Nerve

1. ***Somatic motor***

(General somatic efferent), Supplies four of the six extraocular muscles of the eye and the levator palpebrae superioris muscle of the upper eyelid.

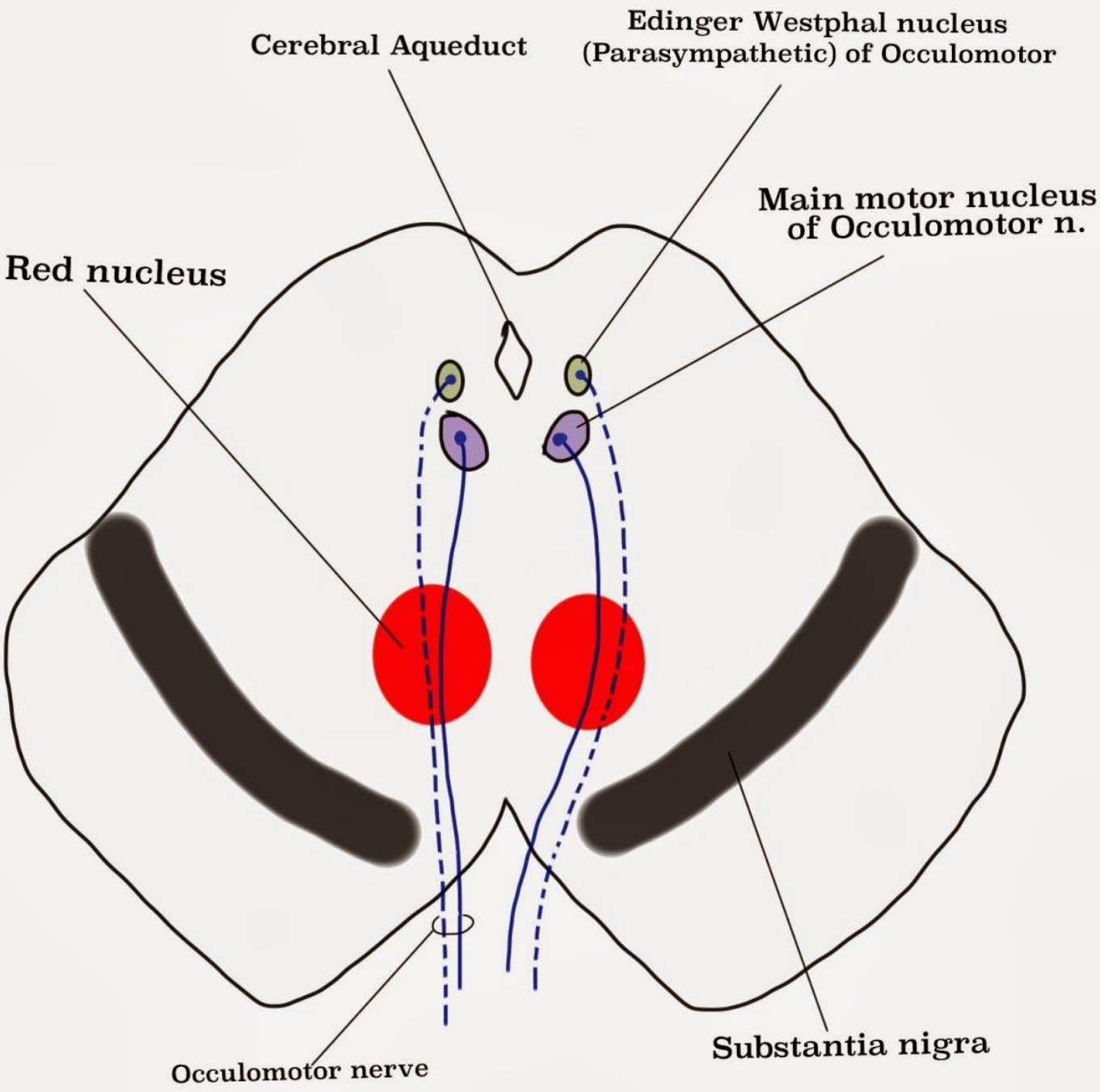
2. ***Visceral motor***

- (General visceral efferent)
- Parasympathetic innervation of the constrictor pupillae and ciliary muscles.

Oculomotor Nerve

- The somatic motor component of CN III originates from the oculomotor nucleus located in the rostral midbrain at the level of the **superior colliculus**.

- Like other somatic motor nuclei, the oculomotor nucleus is located near the midline just ventral to the cerebral aqueduct.


Cerebral Aqueduct
Edinger Westphal nucleus
(Parasympathetic) of Occulomotor
Main motor nucleus
of Occulomotor n.
Red nucleus
Occulomotor nerve
Substantia nigra

Oculomotor Nerve

Origin:

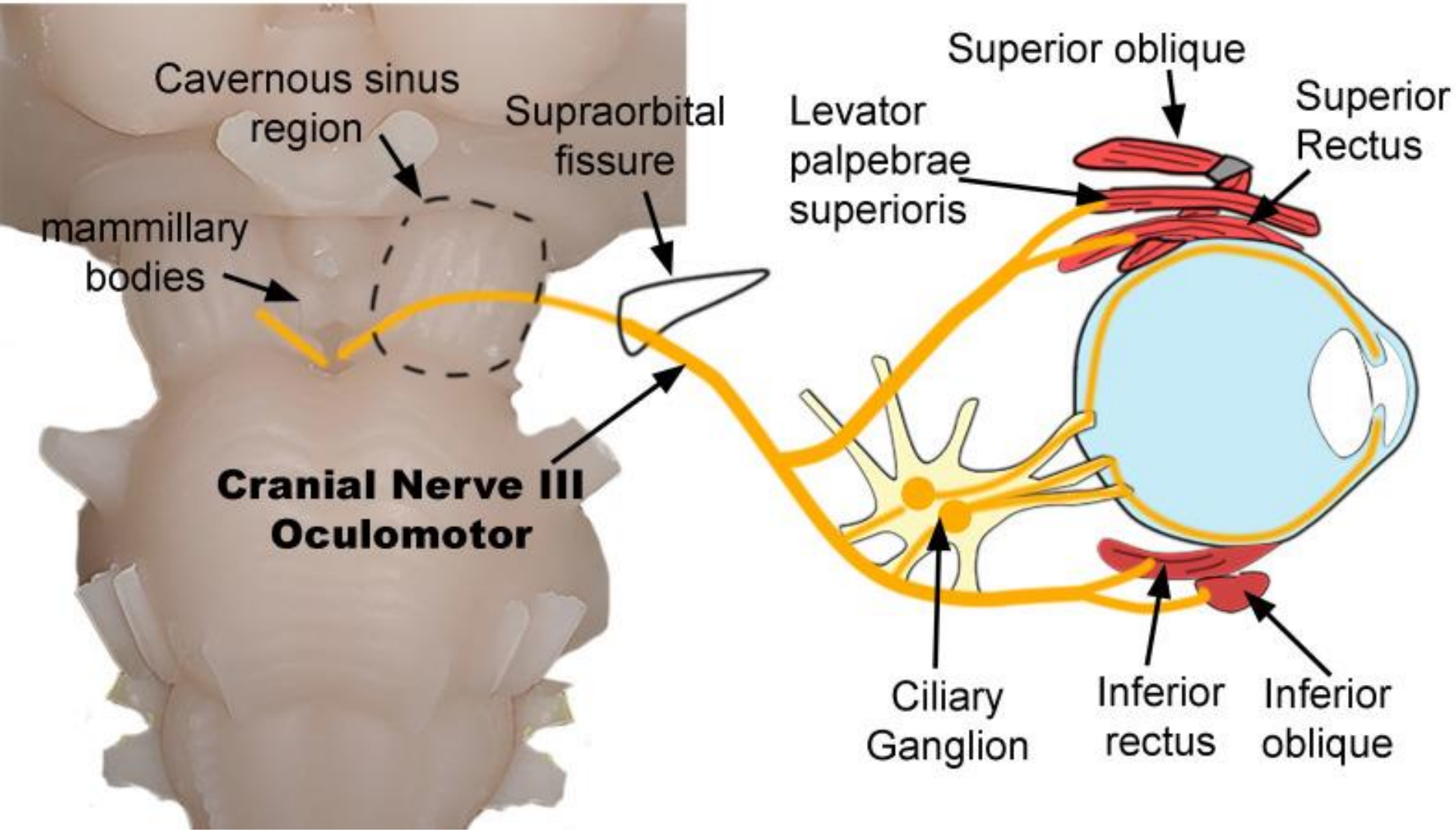
- In a coronal cross-section of the brainstem the oculomotor nucleus is "V-shaped" and is **bordered medially by the Edinger-Westphal nucleus** and **laterally and inferiorly by the medial longitudinal fasciculus** which allows communication between various brainstem nuclei.

Oculomotor Nerve

Origin:

- Fibers leaving the oculomotor nucleus travel ventrally in the tegmentum of the midbrain passing through the red nucleus and medial portion of the cerebral peduncle to emerge in the interpeduncular fossa at the junction of the midbrain and pons.

Oculomotor Nerve (III) Pathway

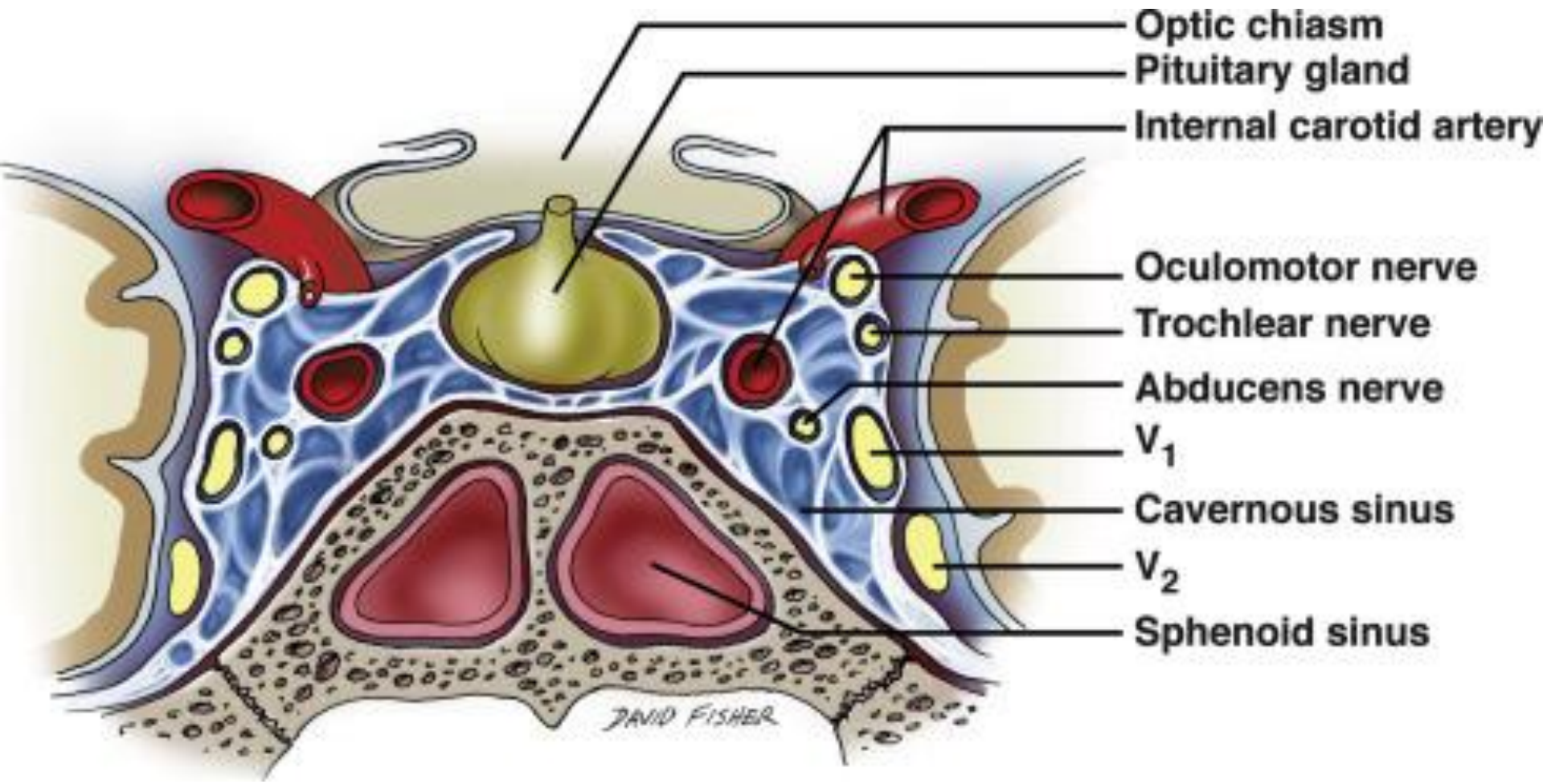


Oculomotor Nerve

Intracranial Course:

- Upon emerging from the brainstem, the oculomotor nerve passes between the posterior cerebral and superior cerebellar arteries and pierces the dura mater to enter the cavernous sinus.

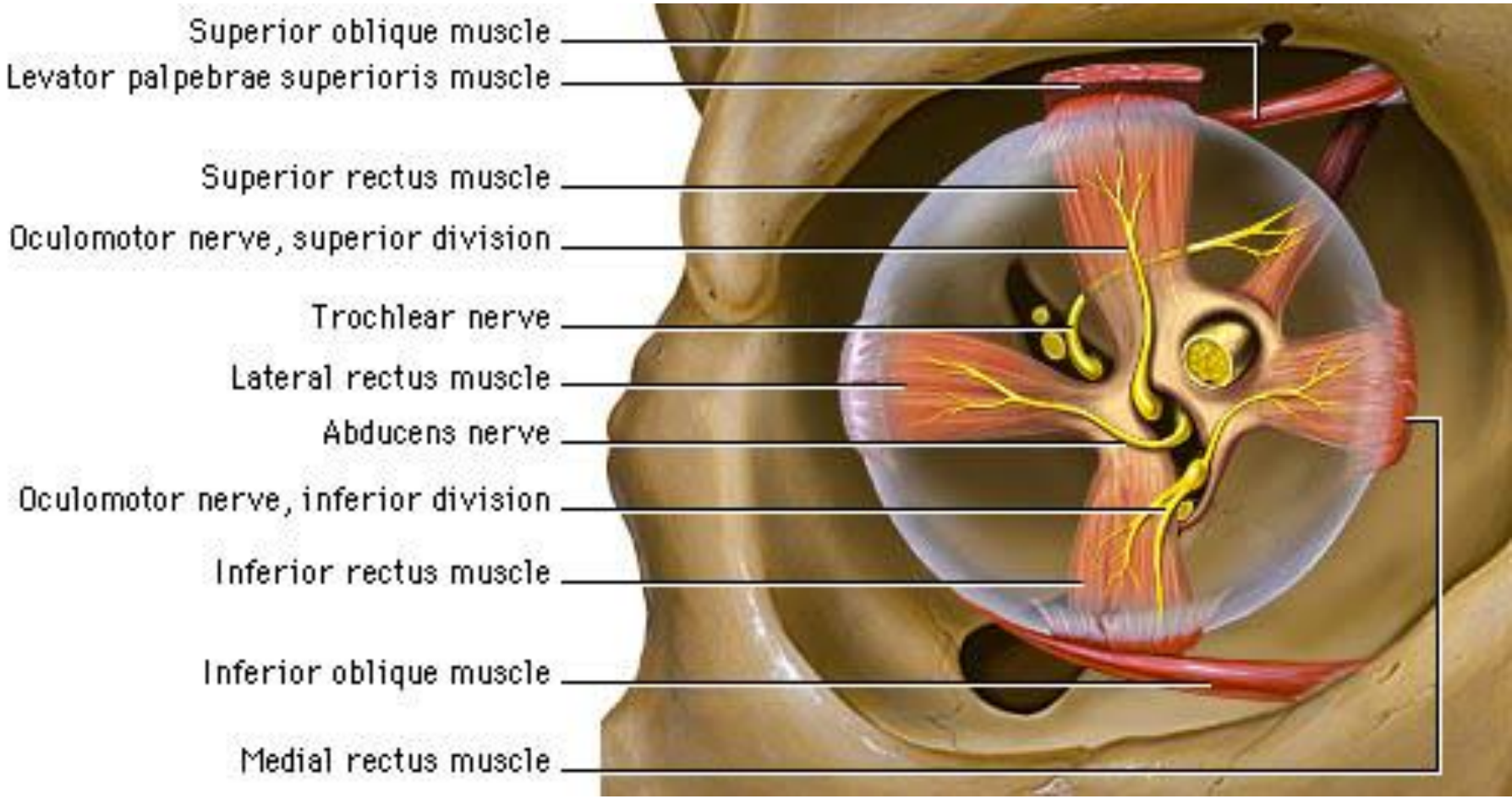
- The nerve runs along the lateral wall of the cavernous sinus just superior to the trochlear nerve and enters the orbit via the superior orbital fissure

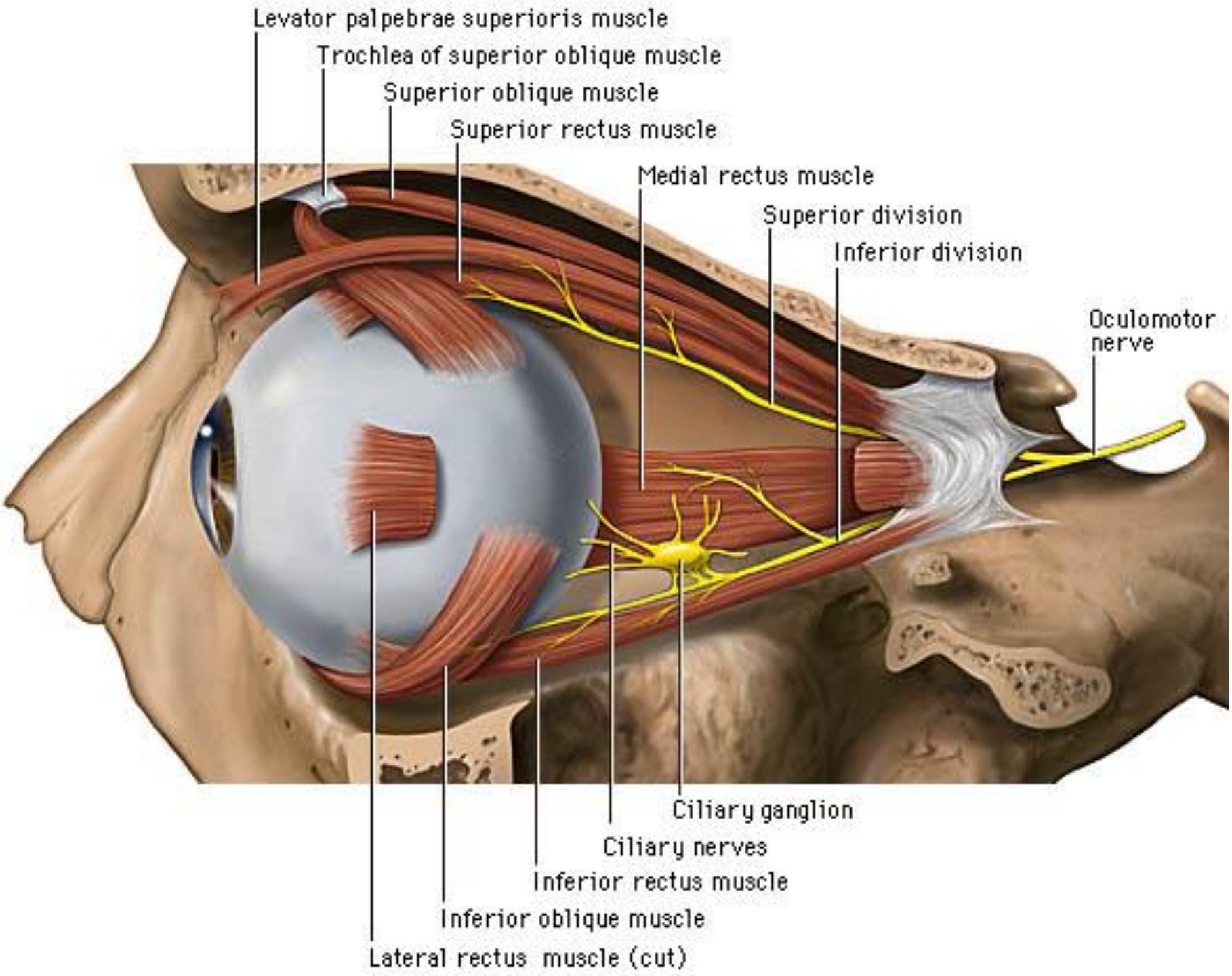

Optic chiasm
Pituitary gland
Internal carotid artery
Oculomotor nerve
Trochlear nerve
Abducens nerve
V1
Cavernous sinus
V2
Sphenoid sinus
DAVID FISHER

Oculomotor Nerve

- Within the orbit CN III fibers **pass through the tendinous ring** of the extraocular muscles and divide into superior and inferior divisions.

- The superior division ascends lateral to the optic nerve to innervate the superior rectus and levator palpebrae superioris muscles on their deep surfaces.


Superior oblique muscle
Levator palpebrae superioris muscle
Superior rectus muscle
Oculomotor nerve, superior division
Trochlear nerve
Lateral rectus muscle
Abducens nerve
Oculomotor nerve, inferior division
Inferior rectus muscle
Inferior oblique muscle
Medial rectus muscle


Levator palpebrae superioris muscle
Trochlea of superior oblique muscle
Superior oblique muscle
Superior rectus muscle
Medial rectus muscle
Superior division
Inferior division
Oculomotor nerve
Ciliary ganglion
Ciliary nerves
Inferior rectus muscle
Inferior oblique muscle
Lateral rectus muscle (cut)

Oculomotor Nerve

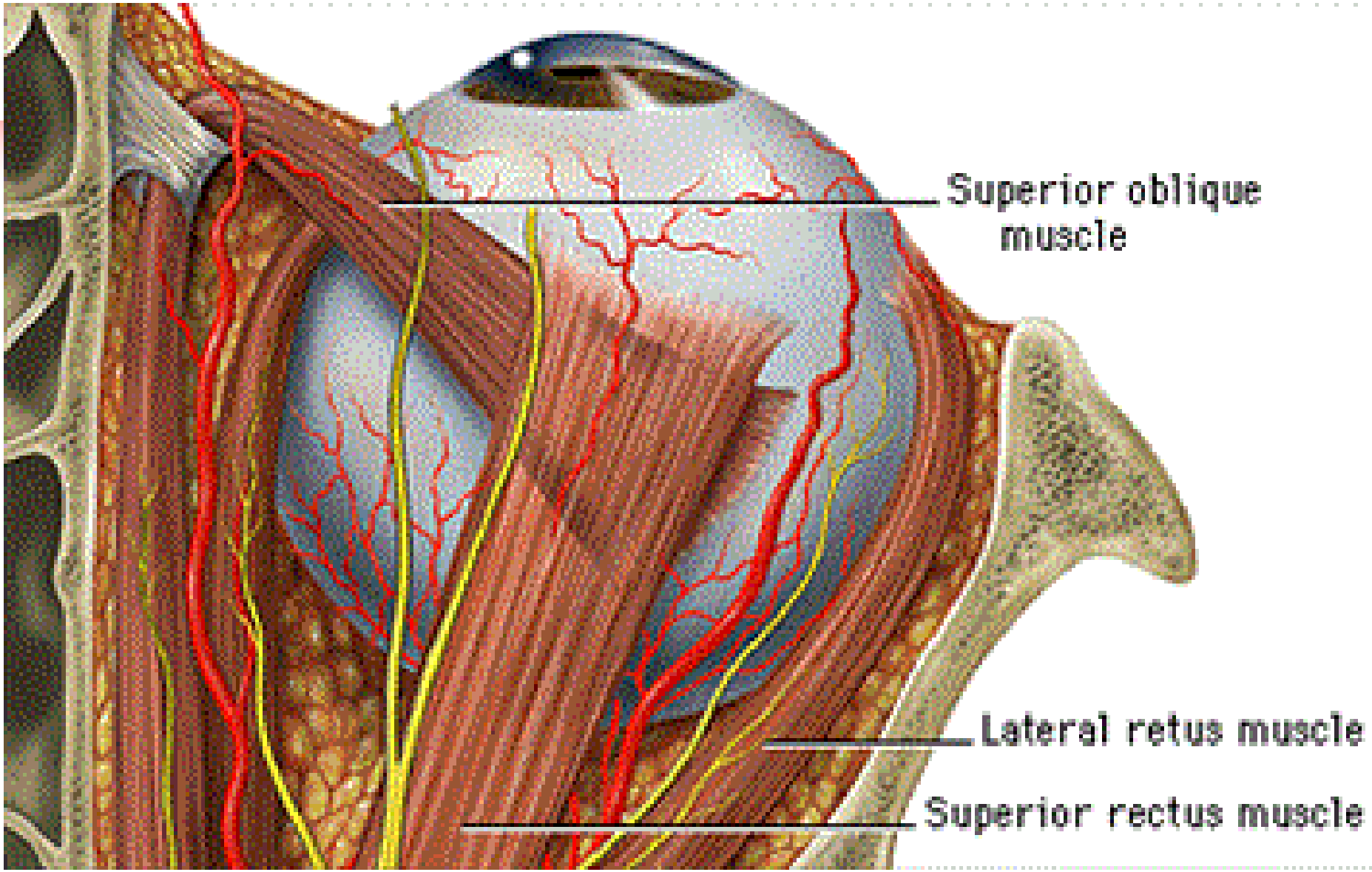
- The inferior division of CN III splits into three branches to innervate the medial rectus and inferior rectus muscles on their ocular surfaces and the inferior oblique muscle on its posterior surface

Trochlear Nerve

- The trochlear nerve has ***only*** **a somatic motor component**

Somatic motor

- (General somatic efferent) innervates the superior oblique muscle of the ***contralateral*** orbit.

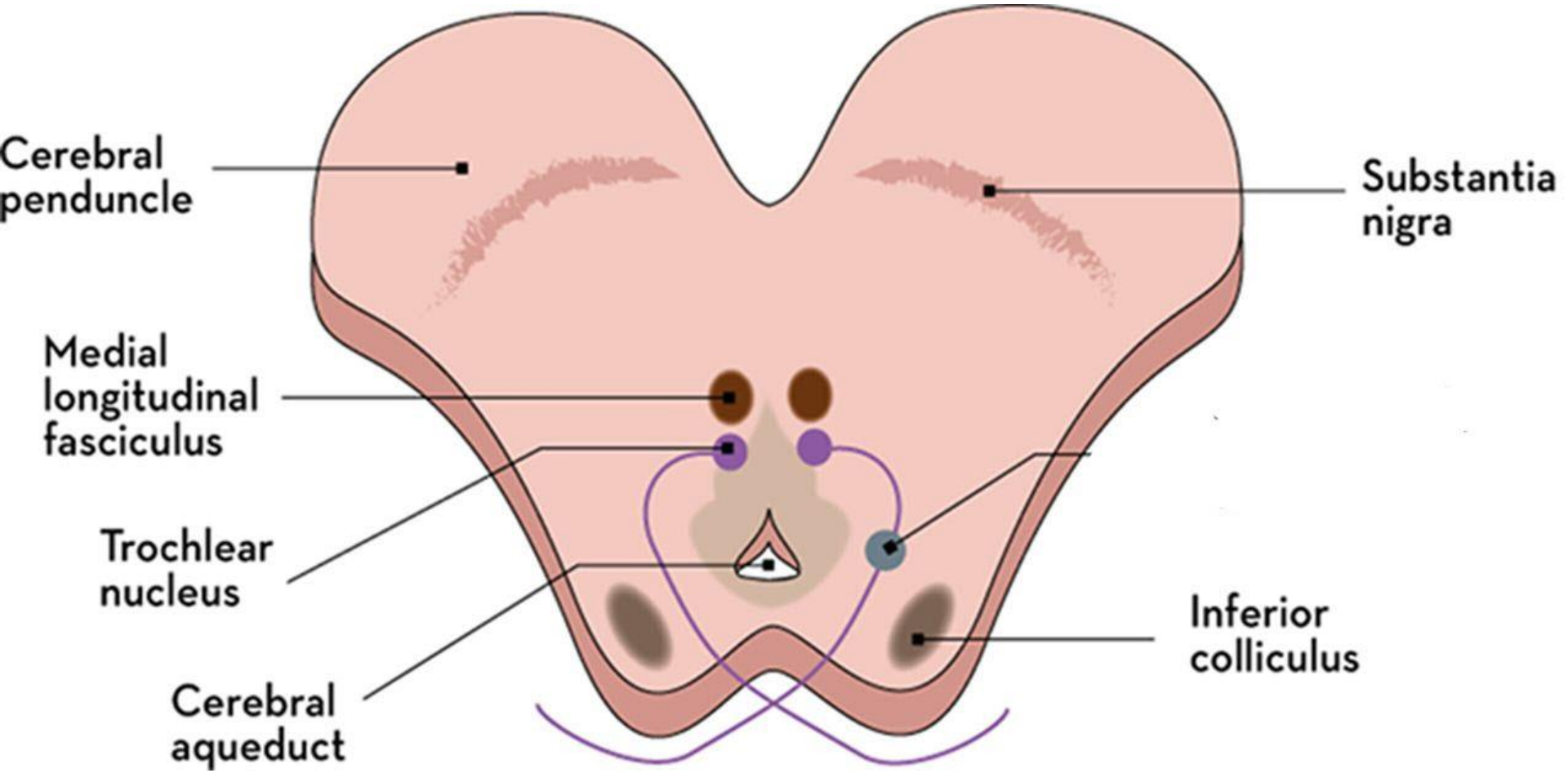

Superior oblique muscle
Lateral retus muscle
Superior rectus muscle

Trochlear Nerve

Origin:

- The fibers of the trochlear nerve originate from the trochlear nucleus located in the tegmentum of the midbrain at the level of the **inferior colliculus**.

- The nucleus is located just ventral to the cerebral aqueduct. It is readily identifiable by its **close association with the myelinated medial longitudinal** fasciculus that allows communication between various brainstem nuclei.

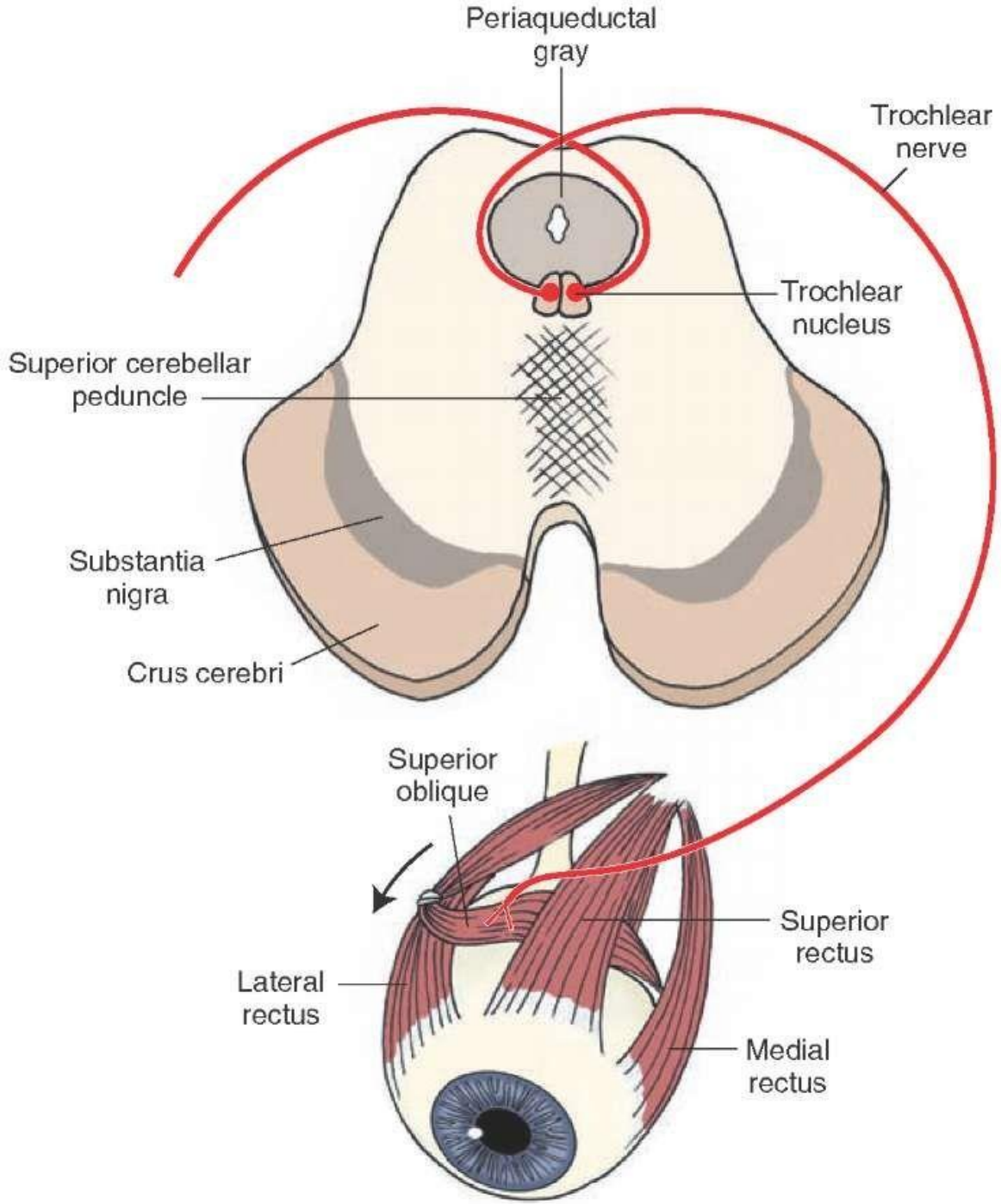

Cerebral penduncle
Substantia nigra
Medial longitudinal fasciculus
Trochlear nucleus
Inferior colliculus
Cerebral aqueduct

Trochlear Nerve

Origin:

- Fibers leaving the trochlear nucleus travel ***dorsally*** to wrap around the cerebral aqueduct.

- All fibers of the two trochlear nerves decussate and exit the dorsal surface of the brainstem just **below the contralateral inferior colliculus.**

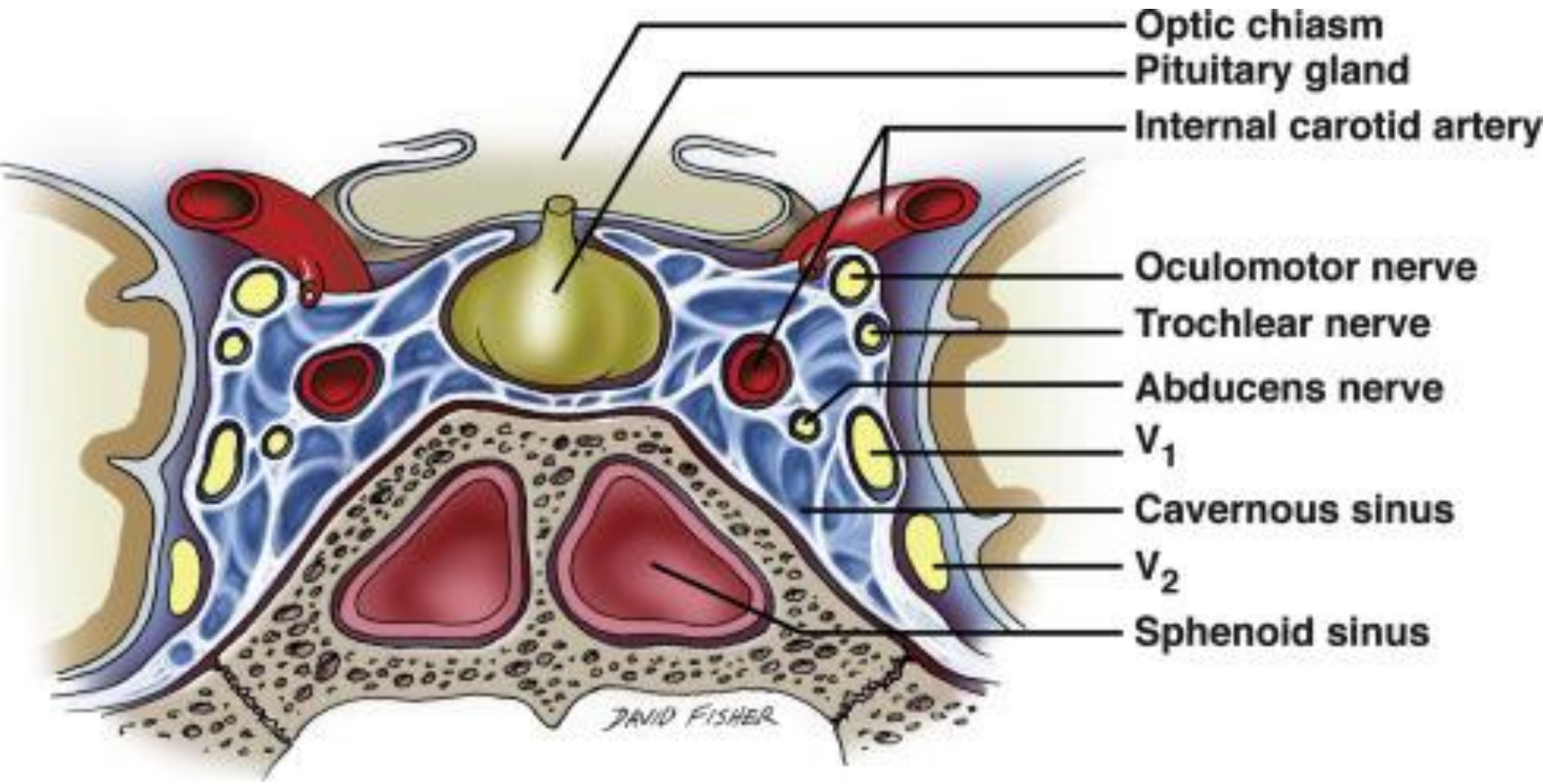

Periaqueductal gray
Trochlear nerve
Trochlear nucleus
Superior cerebellar peduncle
Substantia nigra
Crus cerebri
Superior oblique
Superior rectus
Lateral rectus
Medial rectus

Trochlear Nerve

Intracranial Course

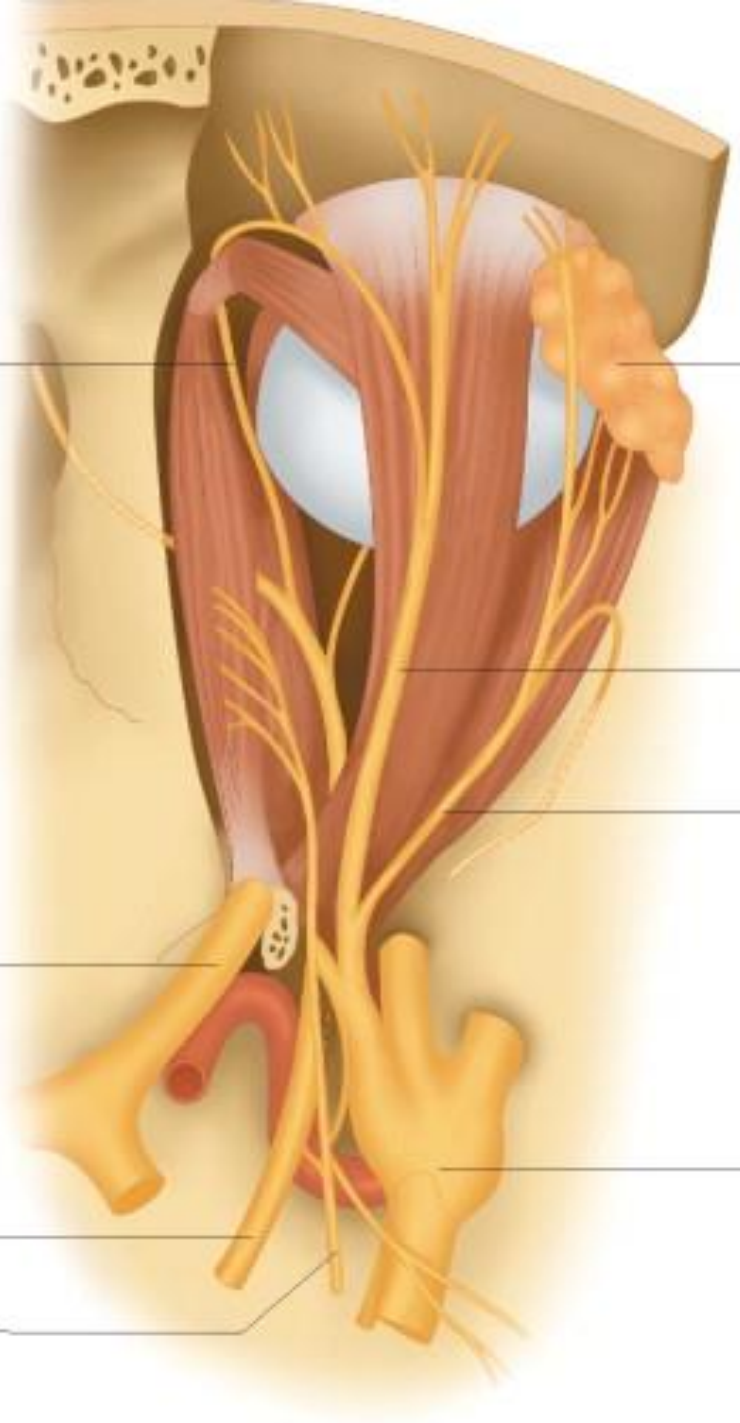
- Upon emerging from the dorsal surface of the brainstem the trochlear nerve curves around the brainstem in the subarachnoid space and emerges between the **posterior cerebral and superior cerebellar arteries** (**along with CN III fibers**).

- The trochlear nerve then enters and runs along the lateral wall of the cavernous sinus with CNS III, V, and VI.


Optic chiasm
Pituitary gland
Internal carotid artery
Oculomotor nerve
Trochlear nerve
Abducens nerve
V1
Cavernous sinus
V2
Sphenoid sinus
DAVID FISHER

Trochlear Nerve

- From the cavernous sinus the trochlear nerve enters the orbit through the superior orbital fissure.
- CN IV **does not pass through the tendinous ring** of the extraocular muscles, rather it passes above the ring.
- The trochlear nerve then crosses medially along the roof of the orbit above the levator palpebrae and superior rectus muscles to innervate the **superior oblique muscle**


Infratrochlear nerve
Lacrimal gland
Frontal nerve
Lacrimal nerve
Optic nerve
Trigeminal ganglion
Oculomotor nerve
Trochlear nerve

Trochlear Nerve

- ***Unique Features:***

1. **Is the only nerve to exit from the dorsal surface of the brain.**
2. **Is the only nerve in which all the lower motor neuron fibers decussate.**
3. **Has the longest intracranial course.**
4. **Has the smallest number of axons.**

More liable to nerve injury

Abducent Nerve

- Has **only** **a somatic motor component**.
- ***Somatic motor***: innervates the lateral rectus muscle of the ipsilateral orbit.
- The lateral rectus muscle is responsible for lateral gaze (its contraction causes the eye to be abducted)

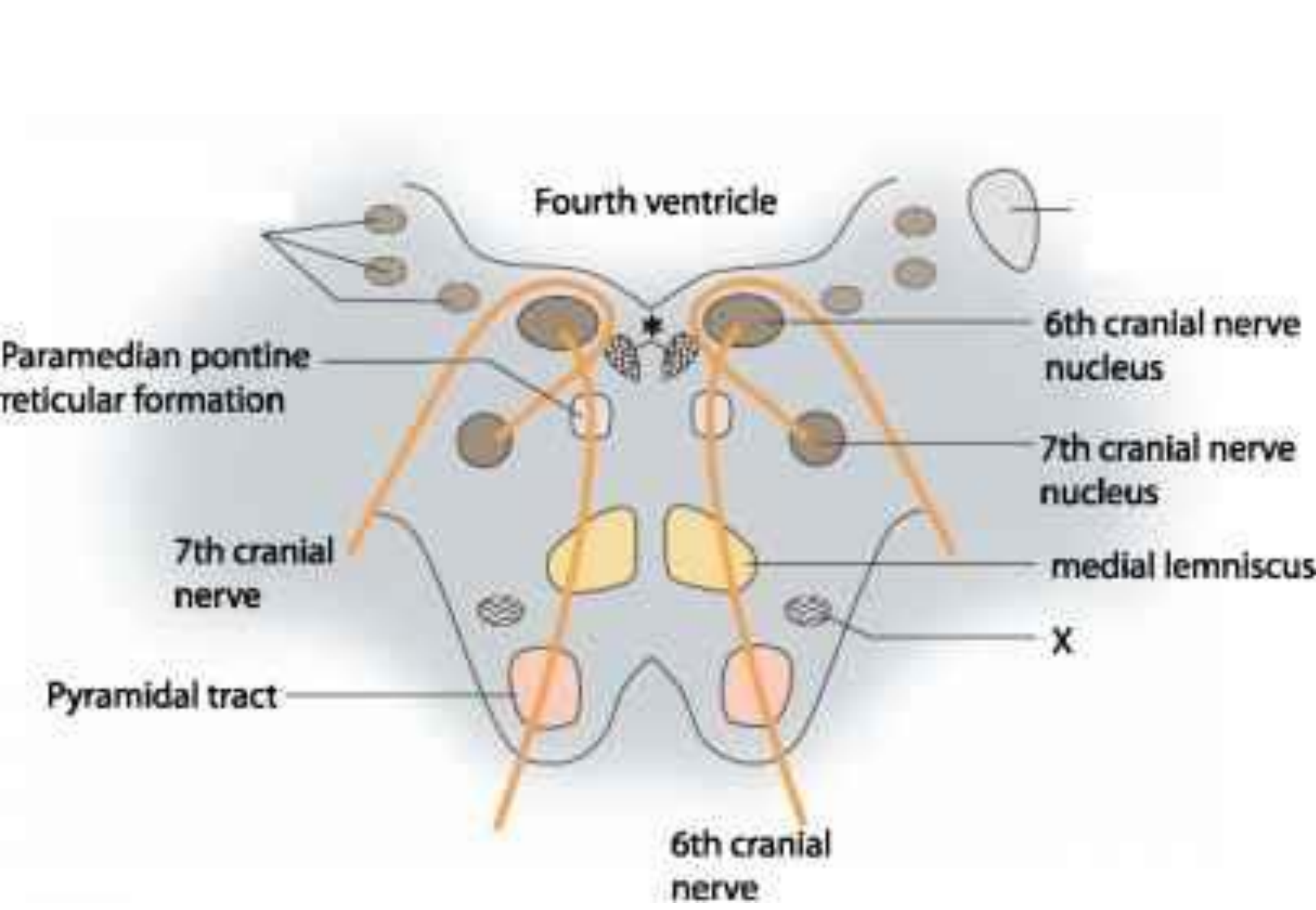
Abducent Nerve

Origin:

- The fibers of the abducens nerve originate from the abducens nucleus located in the **caudal pons** at the ***level*** of the ***facial colliculus***.

- The nucleus is located just ventral to the fourth ventricle near the midline. Axons of CN VII (facial nerve) loop around the abducens nucleus and give rise to a bulge in the floor of the fourth ventricle - ***the facial colliculus***.

- Fibers leaving the abducens nucleus travel ventrally to exit the brainstem at the **pontomedullary junction**.


Fourth ventricle
6th cranial nerve nucleus
Paramedian pontine reticular formation
7th cranial nerve nucleus
7th cranial nerve
medial lemniscus
X
Pyramidal tract
6th cranial nerve

Abducent Nerve

Intracranial course:

- Upon exiting the brainstem the abducens nerve climbs superiorly along the ventral surface of the pons and turn anteriorly to enter the cavernous sinus.

- The abducens nerve travels inside the cavernous sinus along with the intracavernous part of the internal carotid artery (ICA)

Abducent Nerve

- From the cavernous sinus the abducens nerve enters the orbit through the ***superior orbital fissure.***

- CN VI passes ***through the tendinous ring*** of the extraocular muscles and innervates the lateral rectus muscle on its deep surface

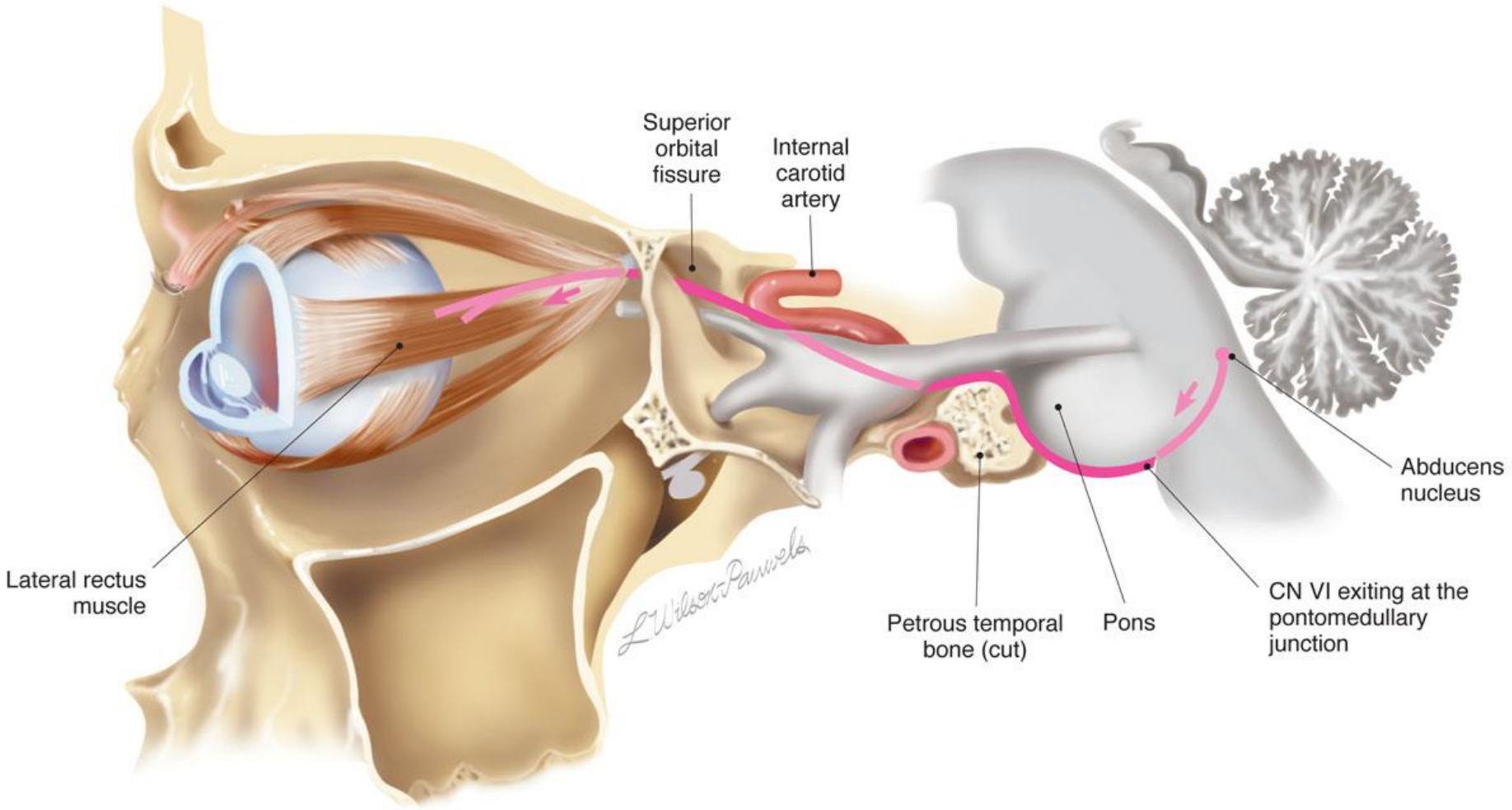
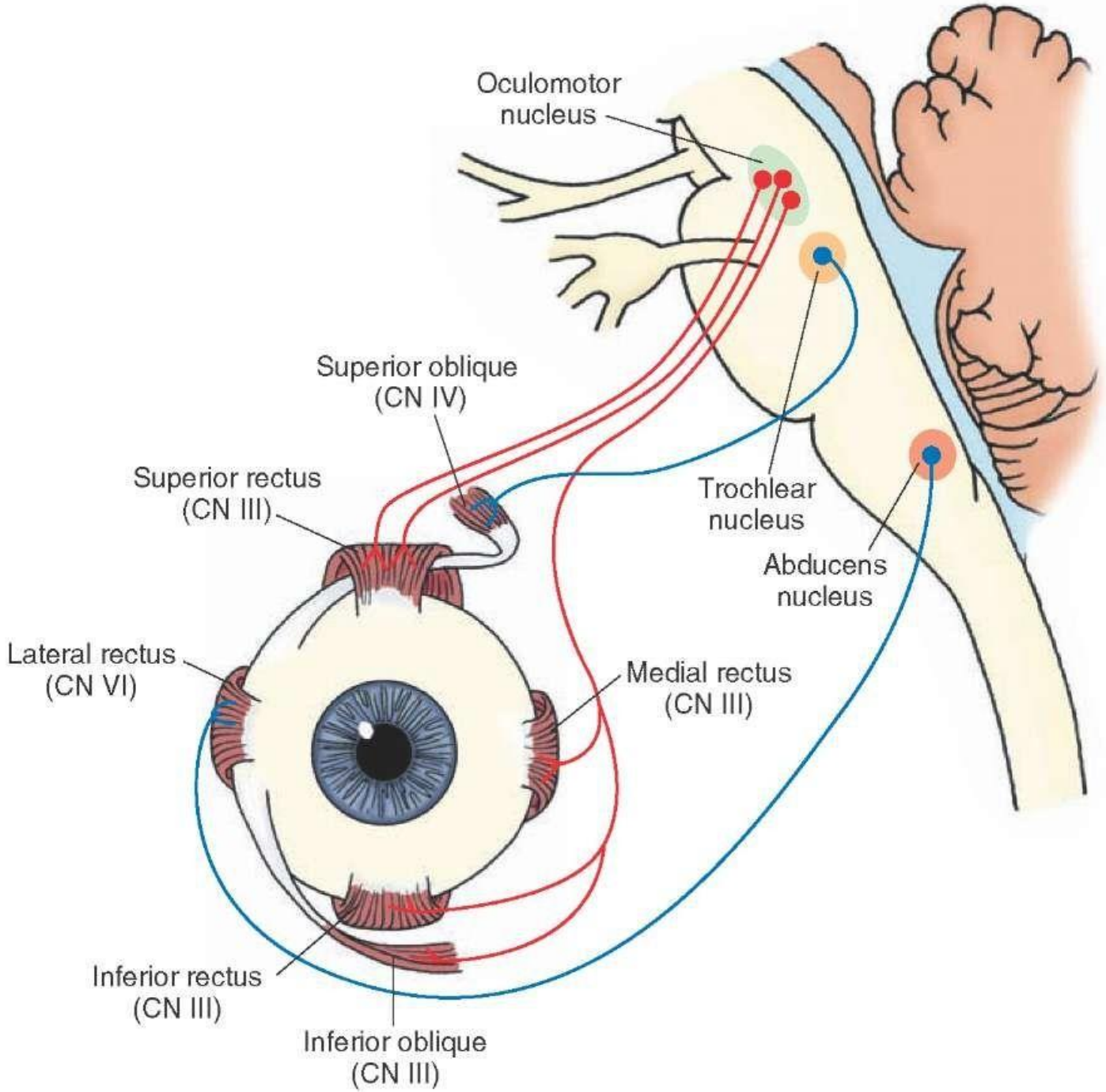
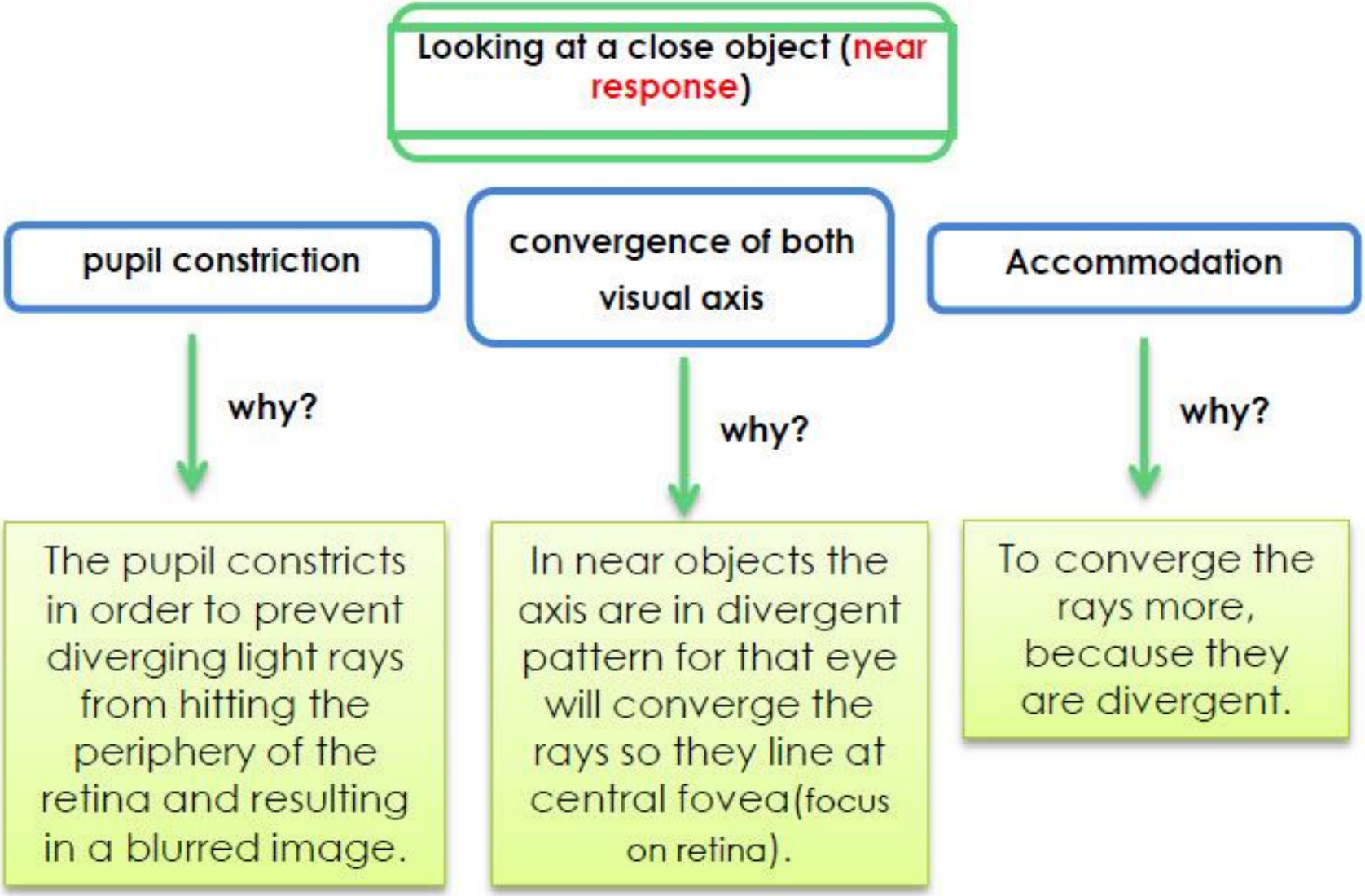
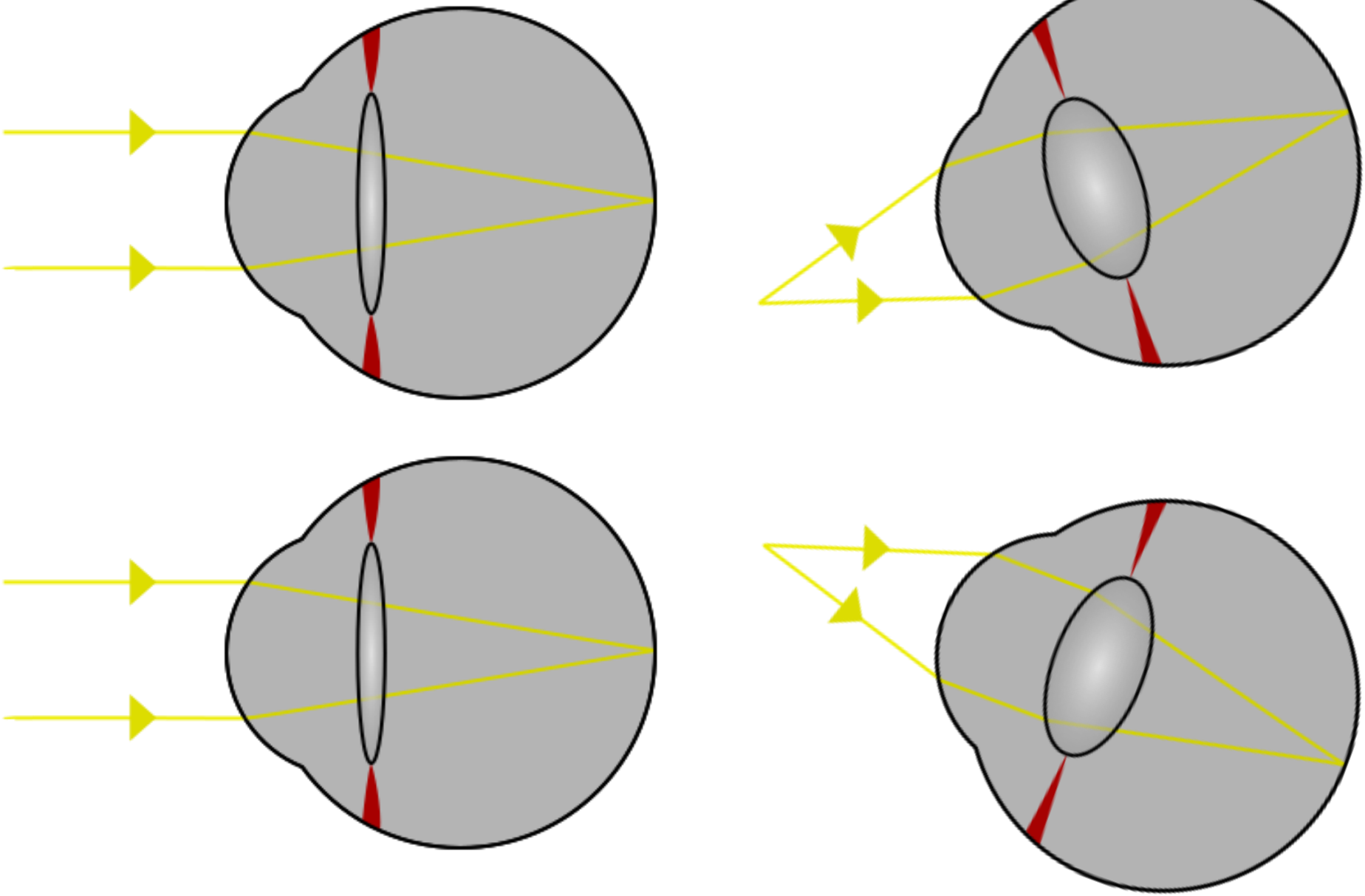


Figure VI–1 Overview of the abducens nerve.


Oculomotor nucleus
Superior oblique (CN IV)
Superior rectus (CN III)
Trochlear nucleus
Abducens nucleus
Lateral rectus (CN VI)
Medial rectus (CN III)
Inferior rectus (CN III)
Inferior oblique (CN III)

Accommodation Reflex





Accommodation Reflex

Pathway:

- Optic nerve ⇒ Optic tract ⇒ Lateral Geniculate body ⇒ Optic Radiation ⇒ ***Primary Visual Cortex*** ⇒ ***Association Visual Cortex*** ⇒ Optic Radiation ⇒ Brachium of Superior Colliculus ⇒ Superior Colliculus ⇒ Edinger Westphal Nucleus ⇒ Oculomotor Nerve

Accommodation Reflex

Cones & rods

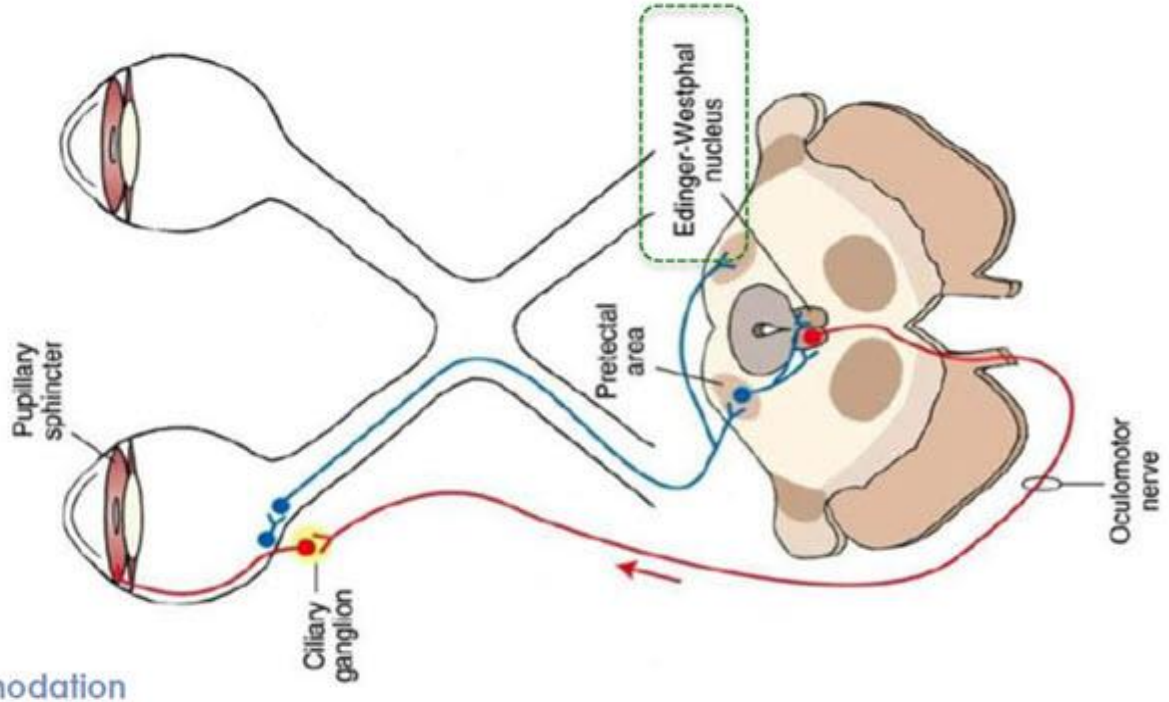
bipolar cells

ganglion cells

optic nerve

optic chiasma

optic tract



accommodation pathway

LGB in thalamus

optic radiation (from LGB axons)

visual cortex occipital cortex (Broadmann area 17)

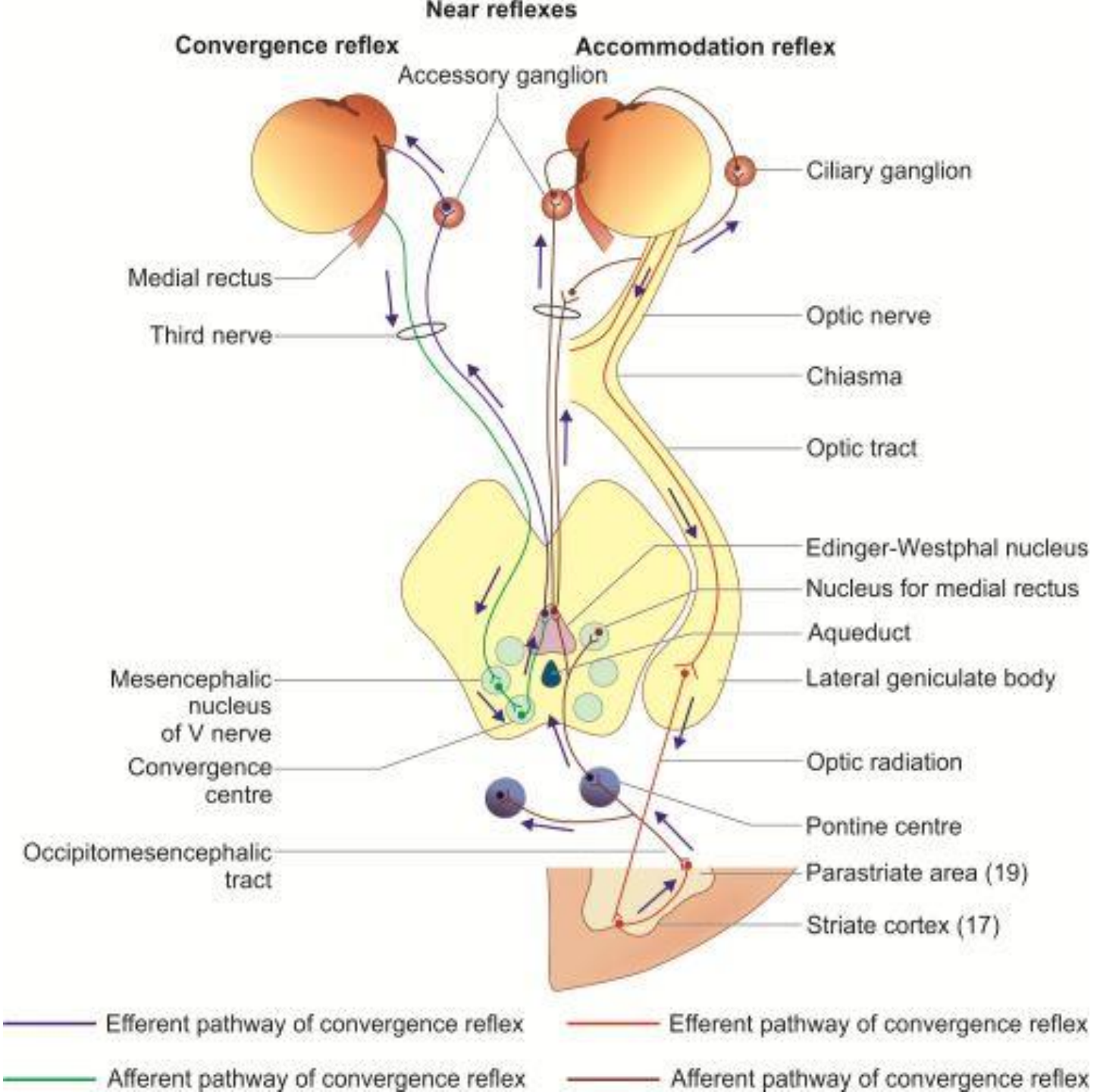
superior colliculus in midbrain

*EWN (mid brain)

oculomotor nerve to cilliary ganglion

short ciliary nerve

cilliary body contraction (accommodation. Reflex) & contraction of iris muscles for miosis of **near response**


Near reflexes
Convergence reflex
Accommodation reflex
Accessory ganglion
Ciliary ganglion
Medial rectus
Third nerve
Optic nerve
Chiasma
Optic tract
Edinger-Westphal nucleus
Nucleus for medial rectus
Aqueduct
Lateral geniculate body
Mesencephalic nucleus of V nerve
Convergence centre
Optic radiation
Pontine centre
Occipitomesencephalic tract
Parastriate area (19)
Striate cortex (17)
Efferent pathway of convergence reflex
Efferent pathway of convergence reflex
Afferent pathway of convergence reflex
Afferent pathway of convergence reflex

Pupillary Light Reflex

- Anatomically, the afferent limb consists of the retina, the optic nerve, and the ***pretectal nucleus*** in the midbrain, at level of superior colliculus.

- Ganglion cells of the retina project fibers through the optic nerve to the ipsilateral pretectal nucleus.

- The efferent limb is the pupillary motor output from the pretectal nucleus to the ciliary sphincter muscle of the iris. The pretectal nucleus projects crossed and uncrossed fibers to the ***Edinger-Westphal nuclei both sides***, which are also located in the midbrain.

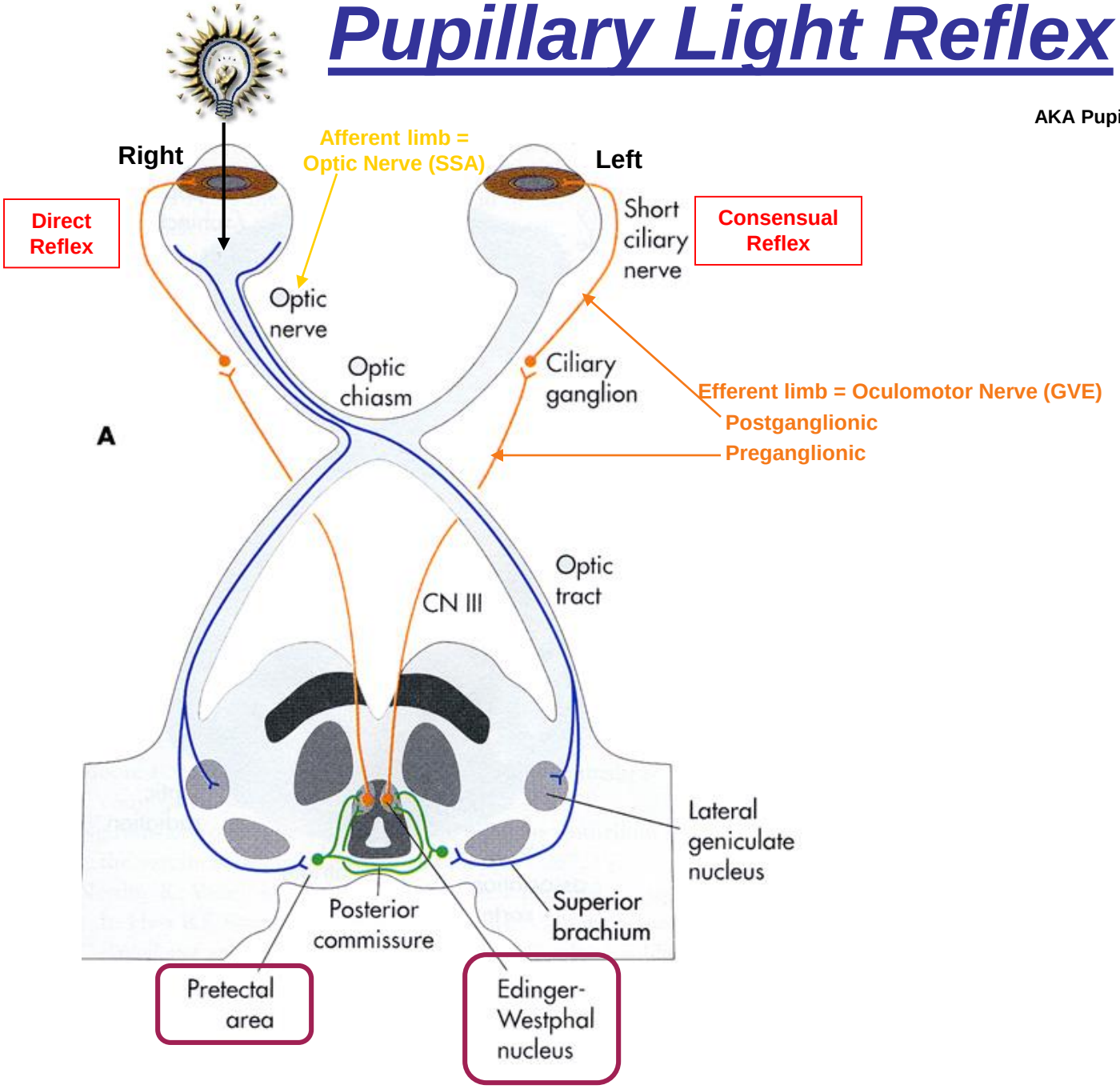
Pupillary Light Reflex

- Each ***Edinger-Westphal nucleus*** gives rise to preganglionic parasympathetic fibers which ***exit with CN III*** and synapse with postganglionic parasympathetic neurons in the ***ciliary ganglion***. Postganglionic nerve fibers leave the ciliary ganglion ***to innervate the ciliary sphincter***.

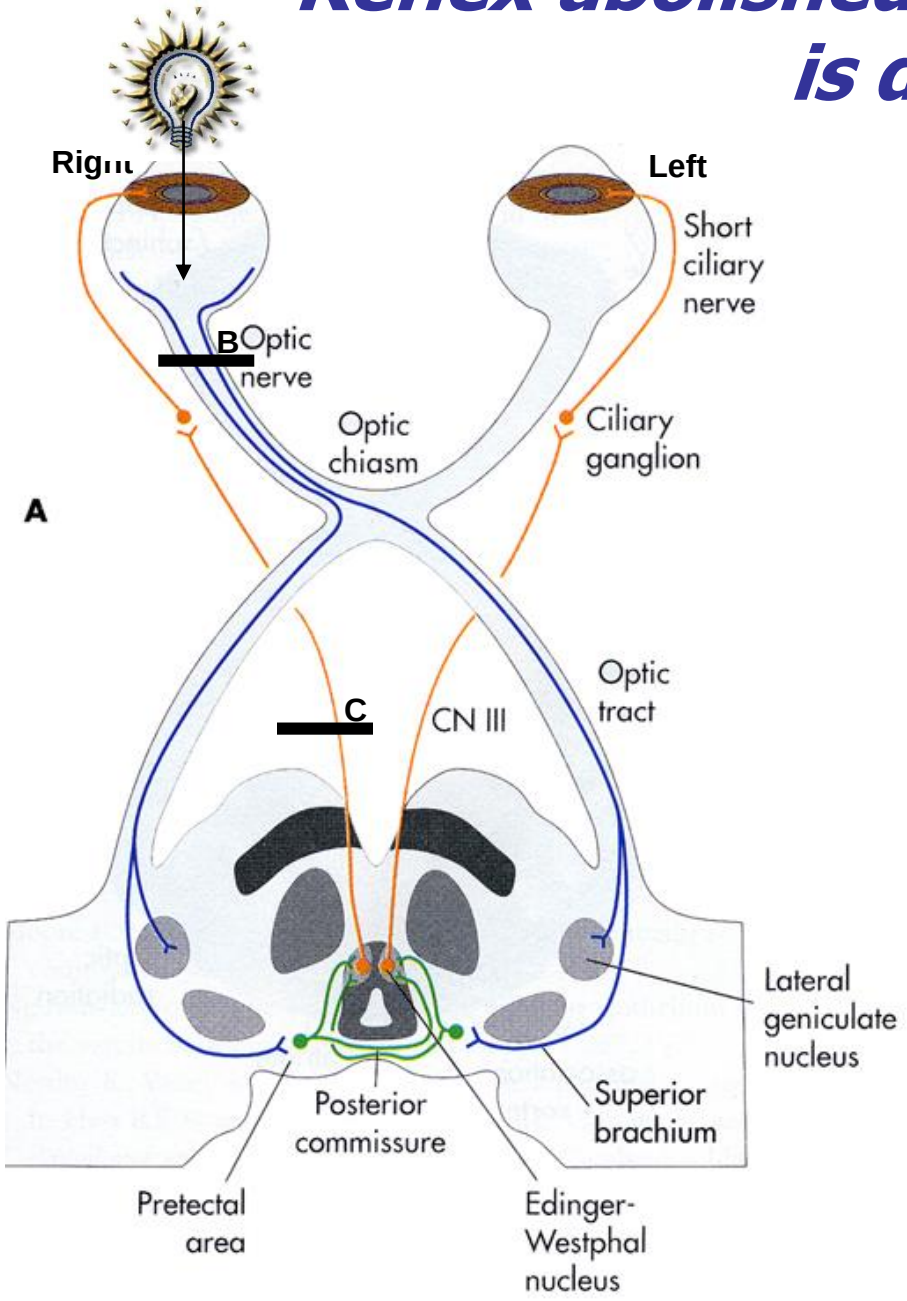
- Each afferent limb has two efferent limbs, one ipsilateral and one contralateral. The ***ipsilateral efferent limb*** transmits nerve signals for ***direct light reflex of the ipsilateral pupil***. The ***contralateral efferent limb*** causes ***consensual*** light reflex of the ***contralateral pupil.***

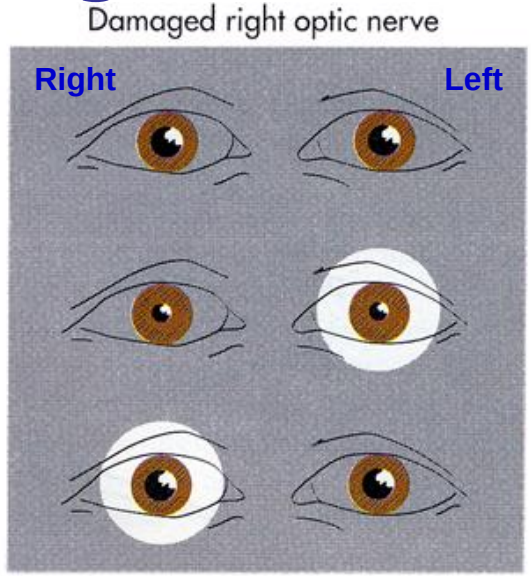
Pupillary Light Reflex

AKA Pupillary Light Reflex

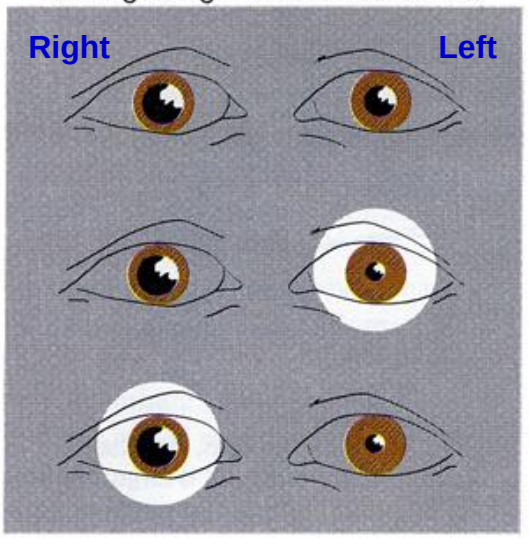


Reflex abolished if afferent or efferent is damaged.





Afferent defect



Efferent defect

Light Reflex

- In a patient with total blindness in one eye due to an afferent defect, a consensual light reflex can be elicited in the "blind" eye upon stimulation of the "good" eye. (illustrated in the previous slide)

- Blindness due to a lesion in the optic radiation or visual cortex would ***NOT*** result in ***loss of the pupillary light reflex since this is a SUBCORTICAL pathway.***

Pathway of consensual Pupillary light reflex (indirect):

Cones & rods

bipolar cells

ganglion cells

optic nerve

optic chiasma

optic tract

Visual pathway

LGB in thalamus

optic radiation (from LGB axons)

visual cortex (occipital cortex (Broadmann area 17))

X

X

Pupillary light reflex

*pretectal nucleus

superior colliculus in midbrain

EWN (mid brain)

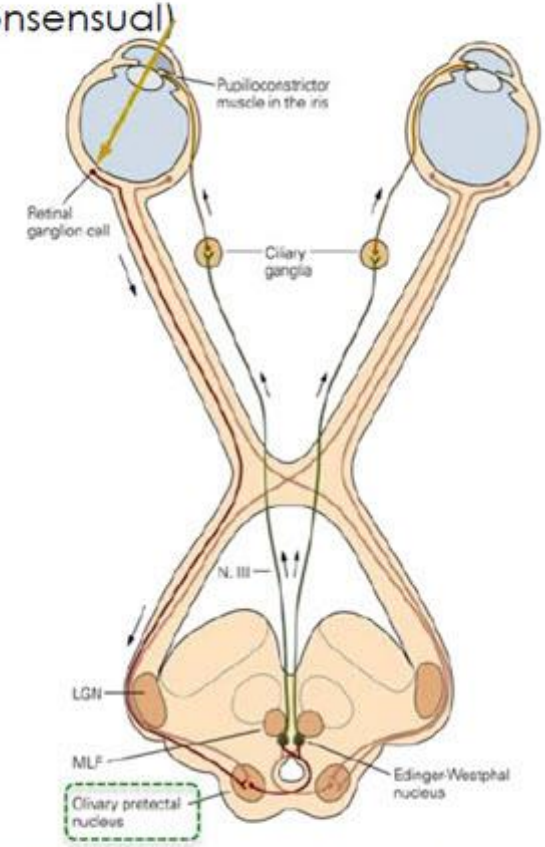
oculomotor nerve to cilliary ganglion

accommodation pathway

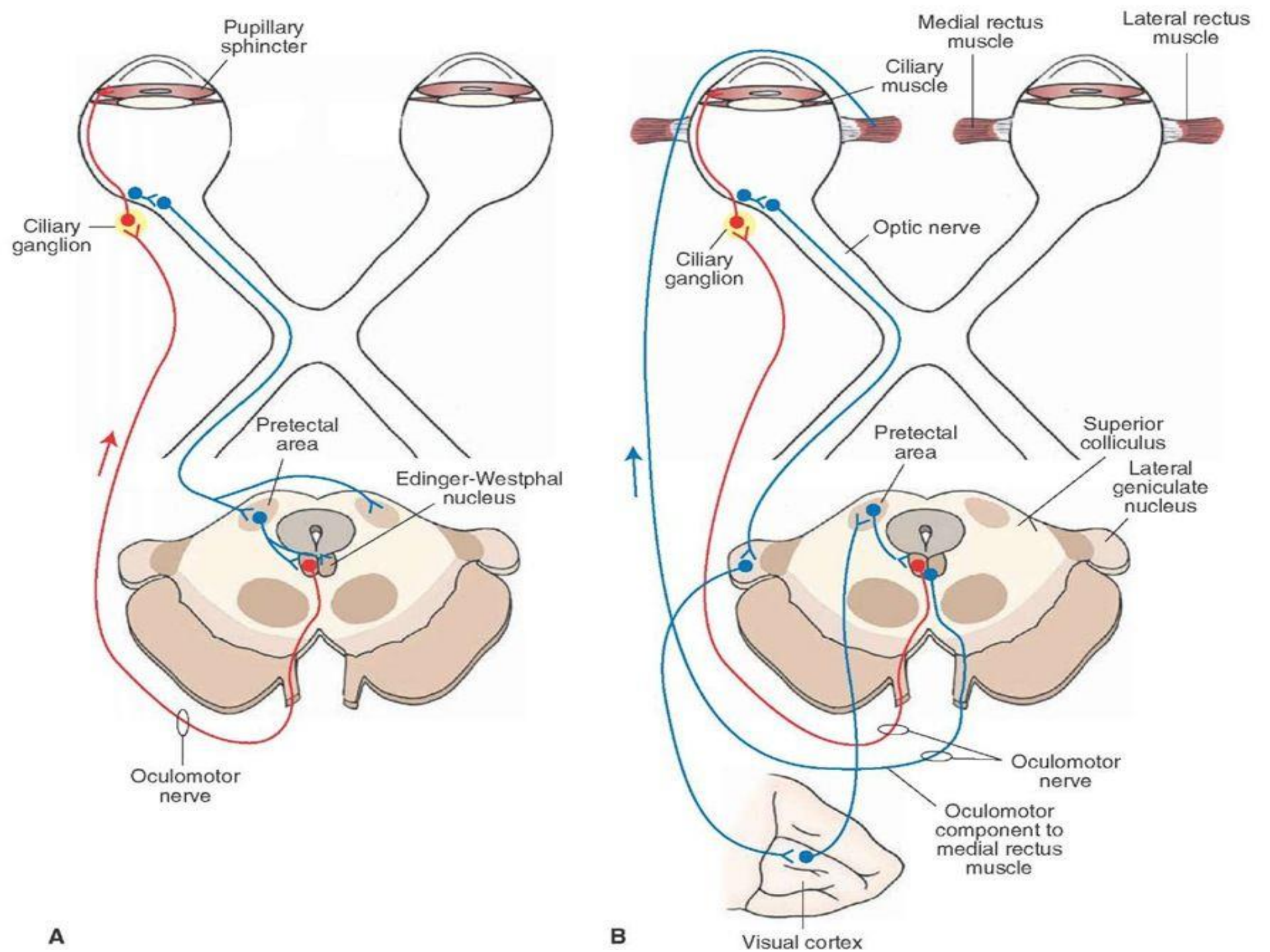
short ciliary nerve

constrictor pupillae → miosis in both eyes.

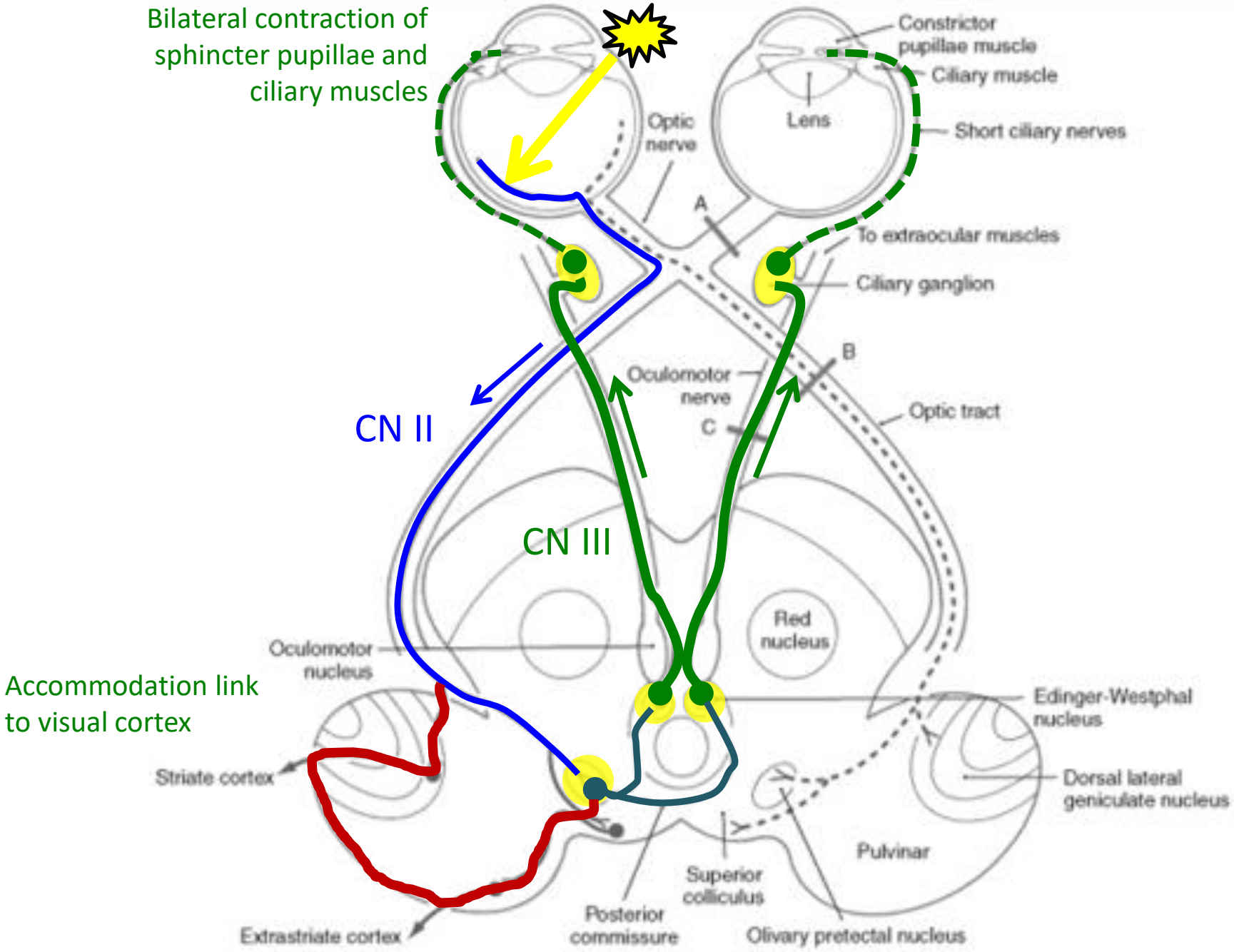
- Light on one eye pupil will constrict of **this pupil** (directly) & the **other pupil** (indirectly or consensual)



Conversely, in darkness, **the reflex becomes inhibited**, which results in dilation of the pupil.


Pupillary sphincter
Ciliary ganglion
Pretectal area
Edinger-Westphal nucleus
Oculomotor nerve
A
Medial rectus muscle
Lateral rectus muscle
Ciliary muscle
Optic nerve
Ciliary ganglion
Pretectal area
Superior colliculus
Lateral geniculate nucleus
Oculomotor nerve
Oculomotor component to medial rectus muscle
Visual cortex
B

Pupillary and Accommodation Reflexes



Autonomic Control **of Accommodation and Pupillary Aperture**

PARAsympathetic

1. parasympathetic preganglionic fibers in the *Edinger- Westphal nucleus* to ***third nerve*** to **the *ciliary ganglion***.

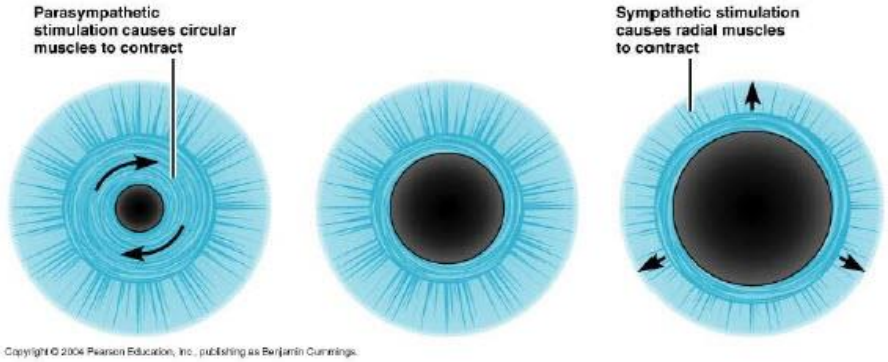
1. Then preganglionic fibers synapse with postganglionic parasympathetic neurons, which send in short *ciliary nerves* into the eyeball to:

- **The ciliary muscle** that controls focusing of the eye lens
- **The sphincter of the iris** that constricts the pupil.

Sympathetic

1. The sympathetic innervation of the eye originates in lateral horn cells of the first thoracic segment of the spinal cord.
2. to sympathetic chain to the superior cervical ganglion.
3. synapse with postganglionic neurons. sympathetic fibers spread along the surfaces of the carotid artery ,to:

- Innervate the radial fibers of the iris (which open the pupil)



- For further inquiries ***PLZ*** feel free to contact at any time through email

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