

The orbit 2

The eye & optic nerve.



- 1-Describe the sensory, sympathetic and parasympathetic nerve supply.
- 2-Define the optic nerve.
- 3-Follow the optic nerve from the eyeball to its point of entry to the brain.
- 4-Review the list of structures making the eye and related structures.
- 5-Define the following: Optic groove, Optic vesicle. Lens placode Lens pit and vesicle. Optic cup.
- 6-Discuss briefly the changing processes that will take place to the above structures.



Nerves of the orbit

Sensory

Motor

Autonomic

Lacrimation

Ciliary ganglion

Sympathetic nerves

Optic
II

Trigeminal
V

Oculomotor
III

Trochlear
IV

Abducent
VI

Ophthalmic:

- 1) Lacrimal
- 2) Frontal
- 3) Nasociliary

Maxillary:

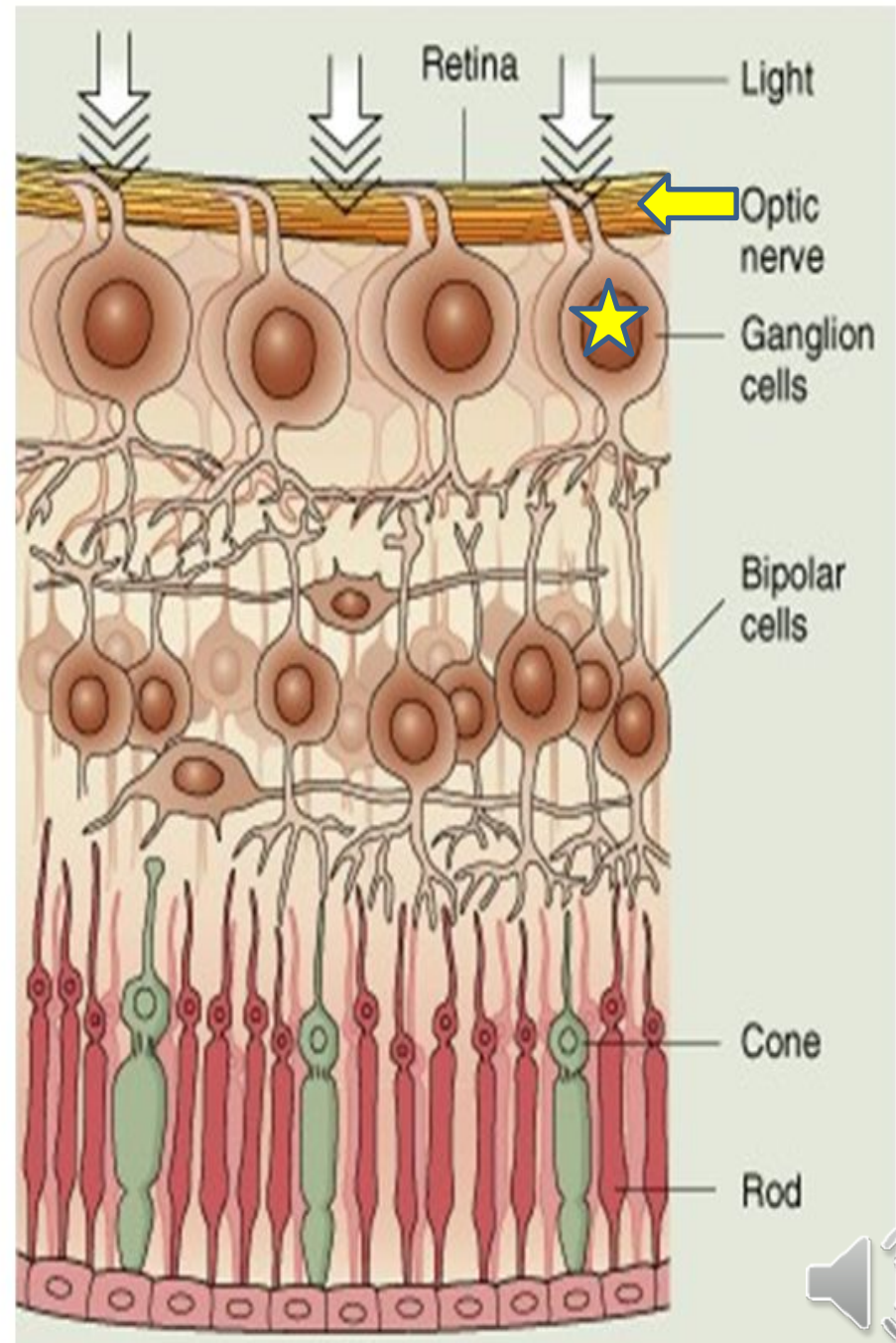
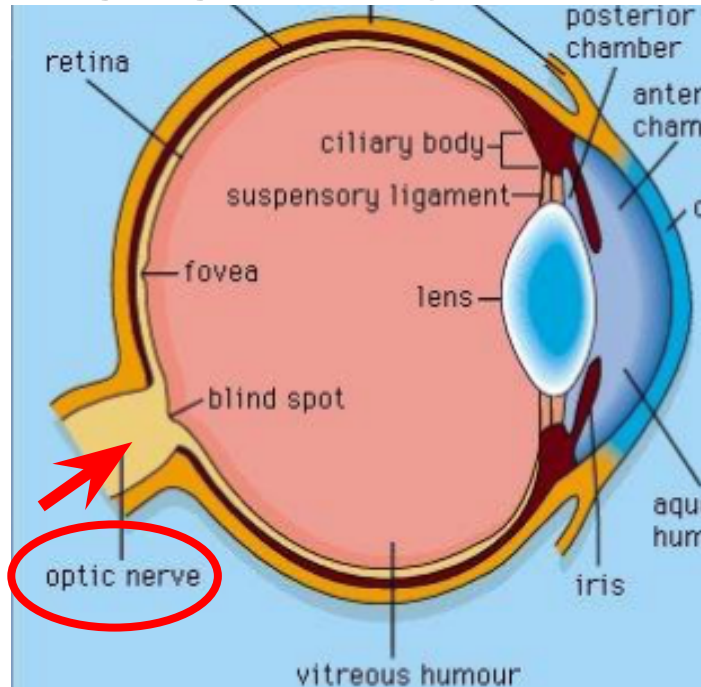
- 1) Infraorbital
 - 2) Zygomatic
- Pass from pterygopalatine fossa → IOF → floor of orbit.
These nerves use the orbit only as a means of exit



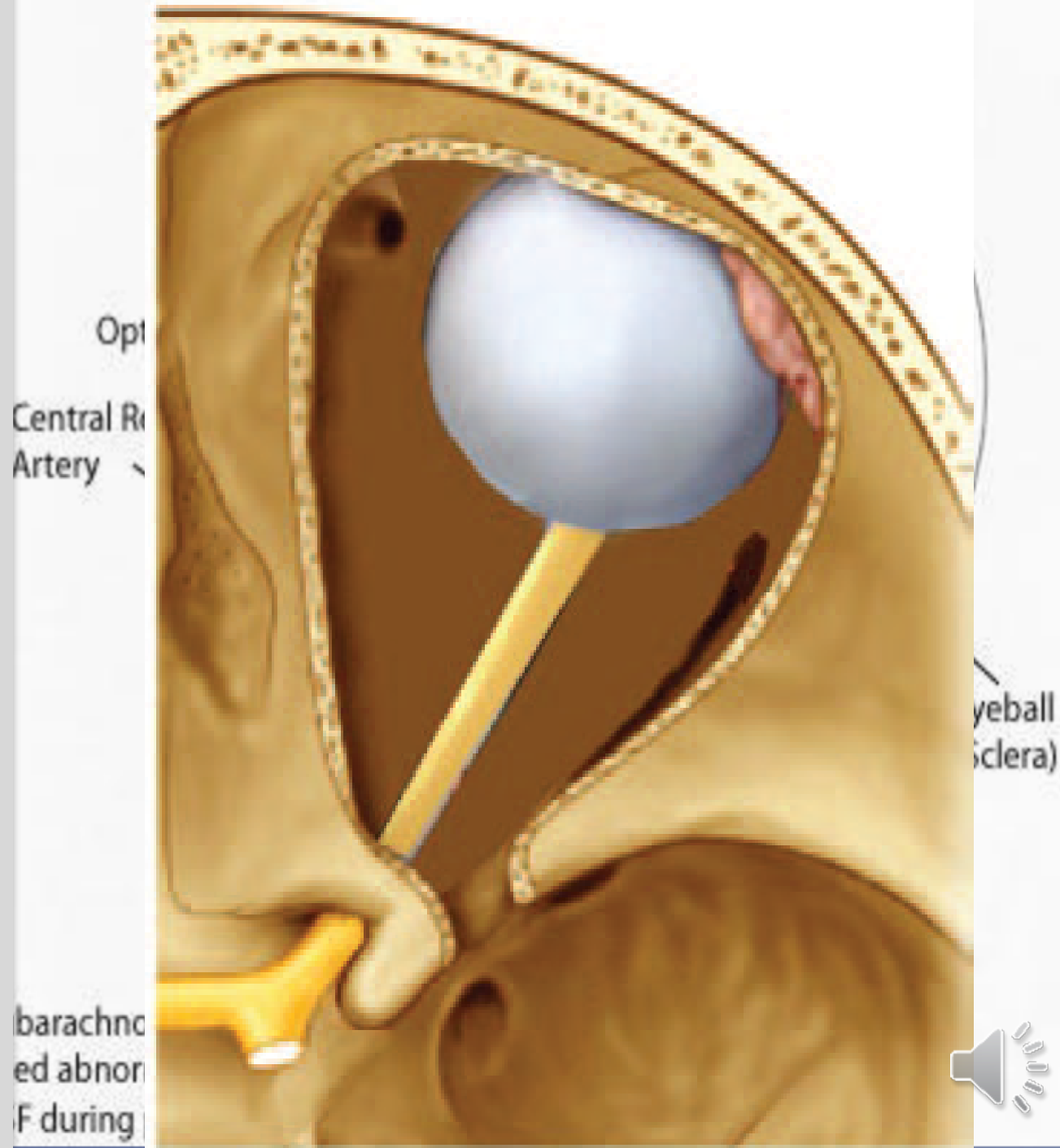
Sensory Nerves:

1) Optic nerve {II Cranial n} (40mm):

- Nerve of vision
- It passes through optic canal → middle cranial fossa → optic chiasma
- It is made up of axons of cells in ganglionic layer of retina.



- ❑ The entire optic nerve is **enclosed in the 3 meningeal sheaths** which are continuous with those of the brain.
- ❑ **Subdural & subarachnoid spaces extend around the nerve** as far as the eyeball.
- ❑ This accounts for **papilloedema** (oedema of optic disc) in case of increased intracranial pressure.
- ❑ Orbital part of optic nerve is longer than the distance between the eyeball & optic canal. This gives the nerve a **sinuous course** to allow free movements of eyeball without stretch on the nerve.



Relations of optic nerve:

In the orbit:

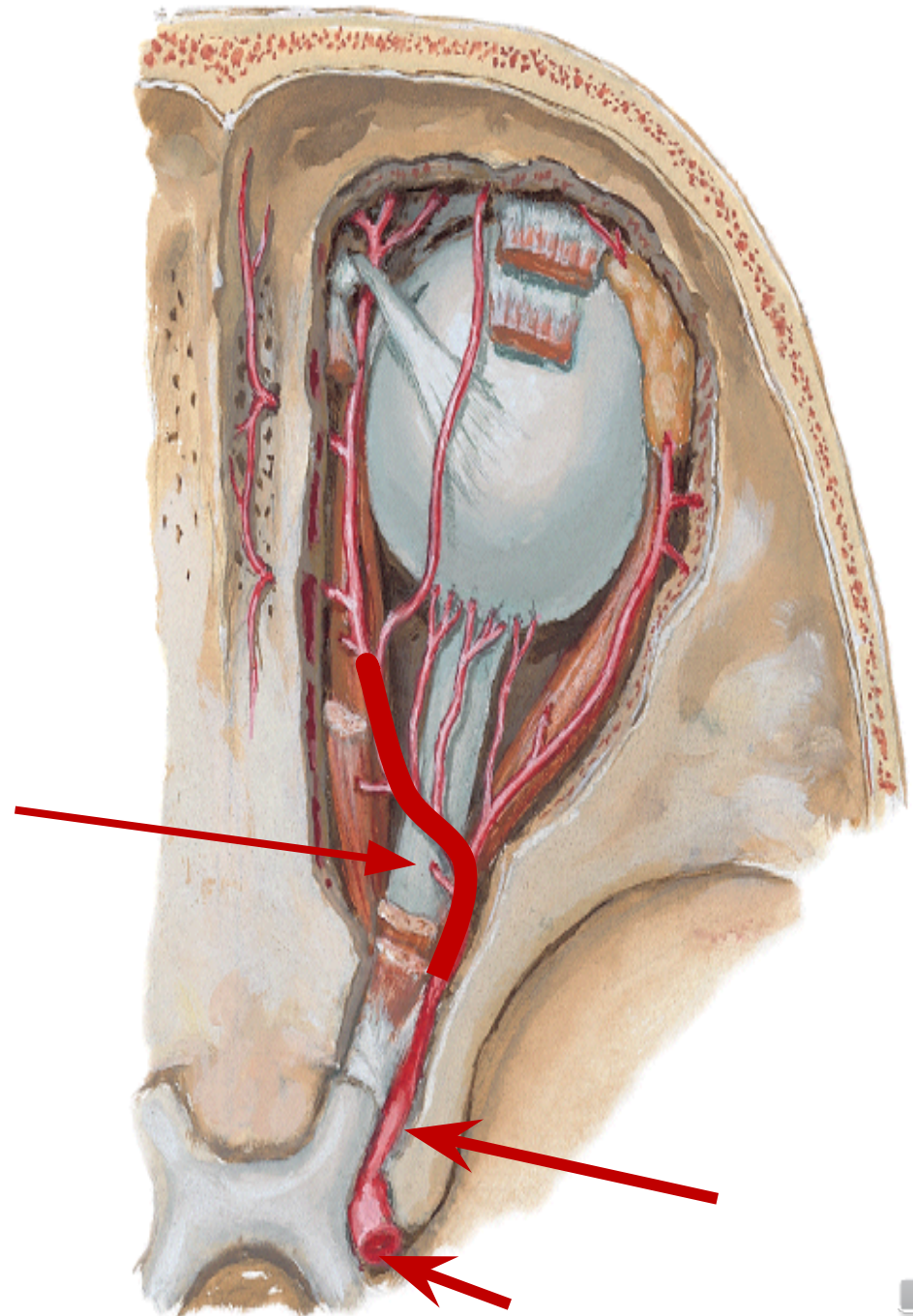
- Surrounded by recti muscles
- Ciliary ganglion is lateral to it
- Crossed by ophthalmic a. and nasociliary n.
- Pierced by central retinal vessels **1.25 cm behind eyeball**

In the optic canal:

- Ophthalmic artery is inferolateral to optic n

In the cranial cavity:

- ICA is lateral to optic n



2) Ophthalmic nerve (purely sensory)



1) Lacrimal:

- Smallest branch of ophthalmic
- Enters orbit through SOF outside the tendinous ring
- Supplies lacrimal gland (sensory and secretomotor) &

lateral part of upper eyelid

2) Frontal:

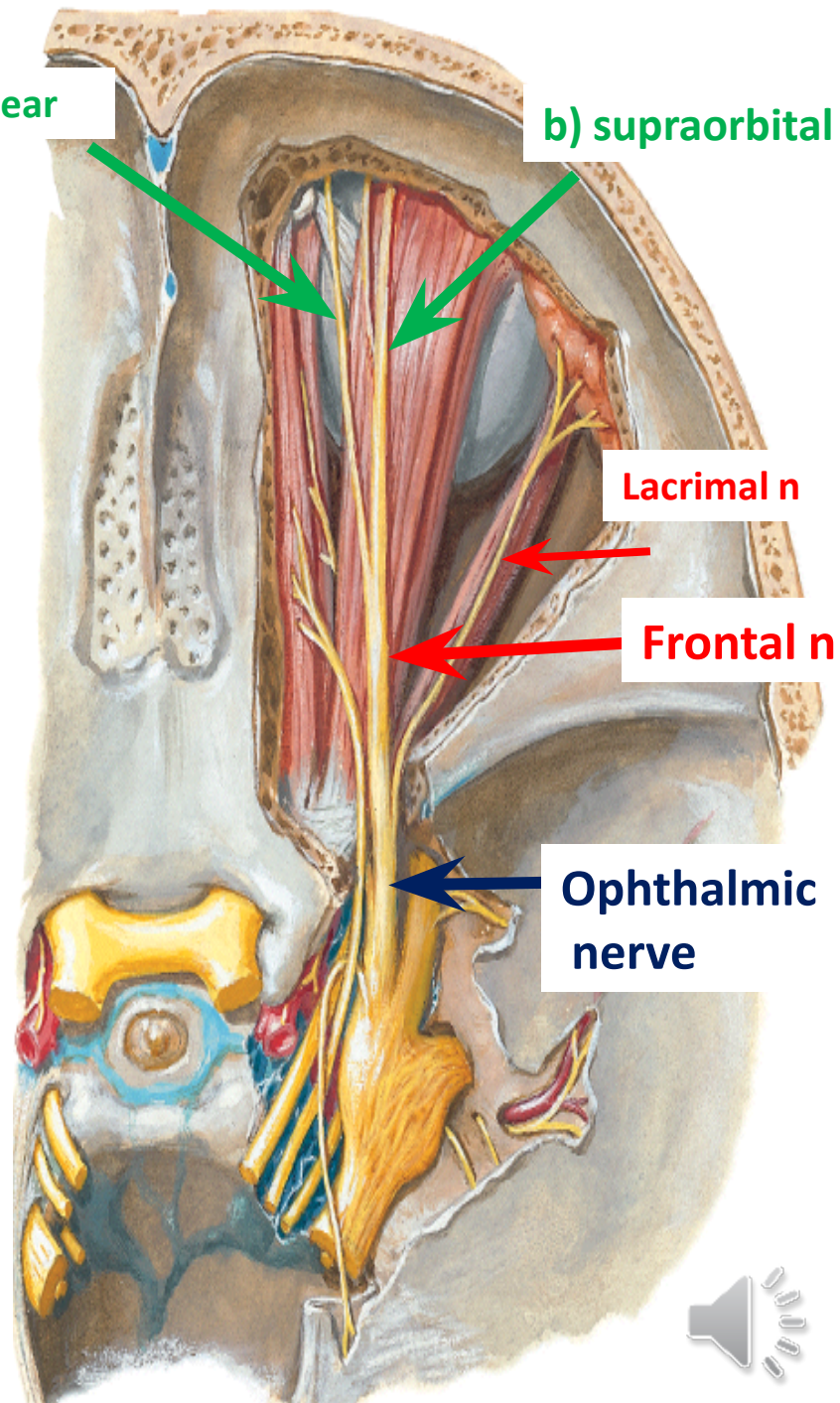
- Largest branch of ophthalmic
- Enters orbit through SOF outside the tendinous ring

(the most superior structure)

- At middle of orbit, it gives:
 - a) Supraorbital
 - b) Supratrochlear

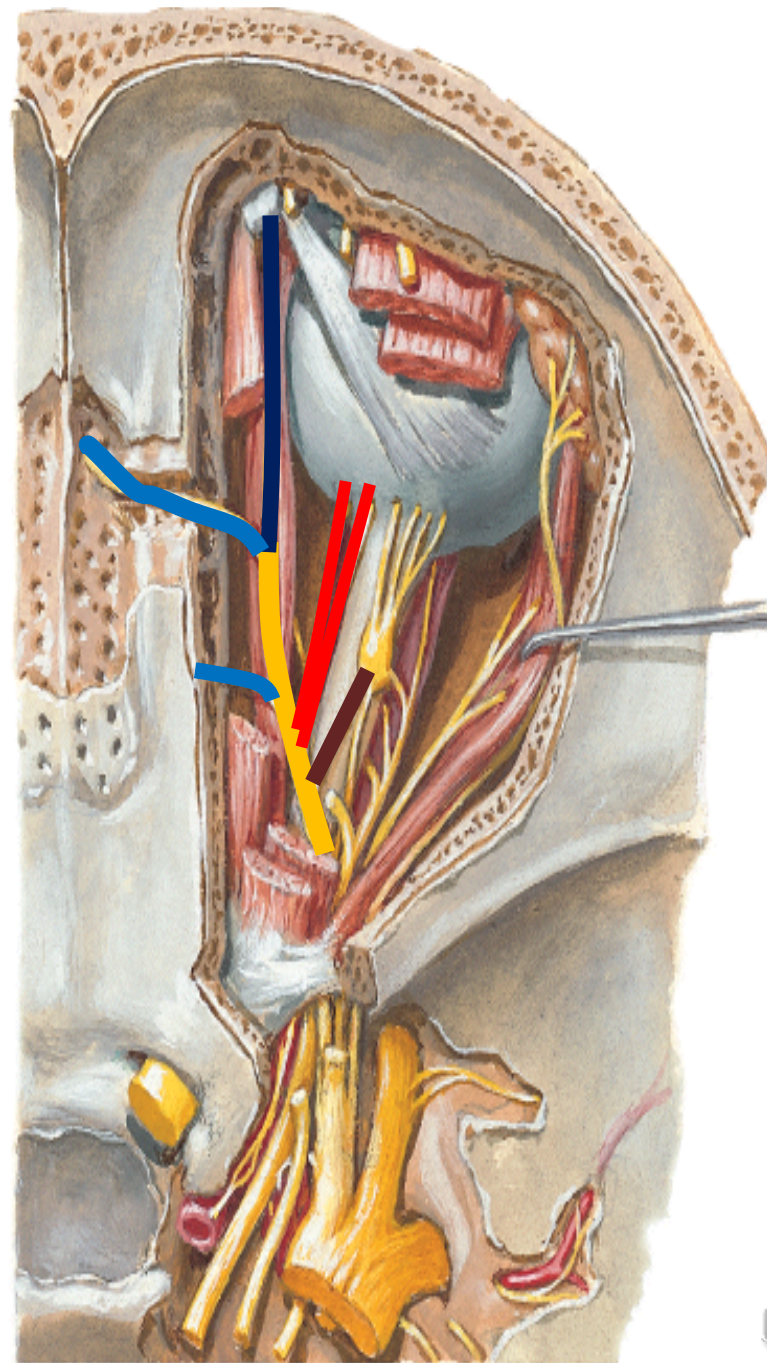
a) supratrochlear

b) supraorbital



3) **Nasociliary:**

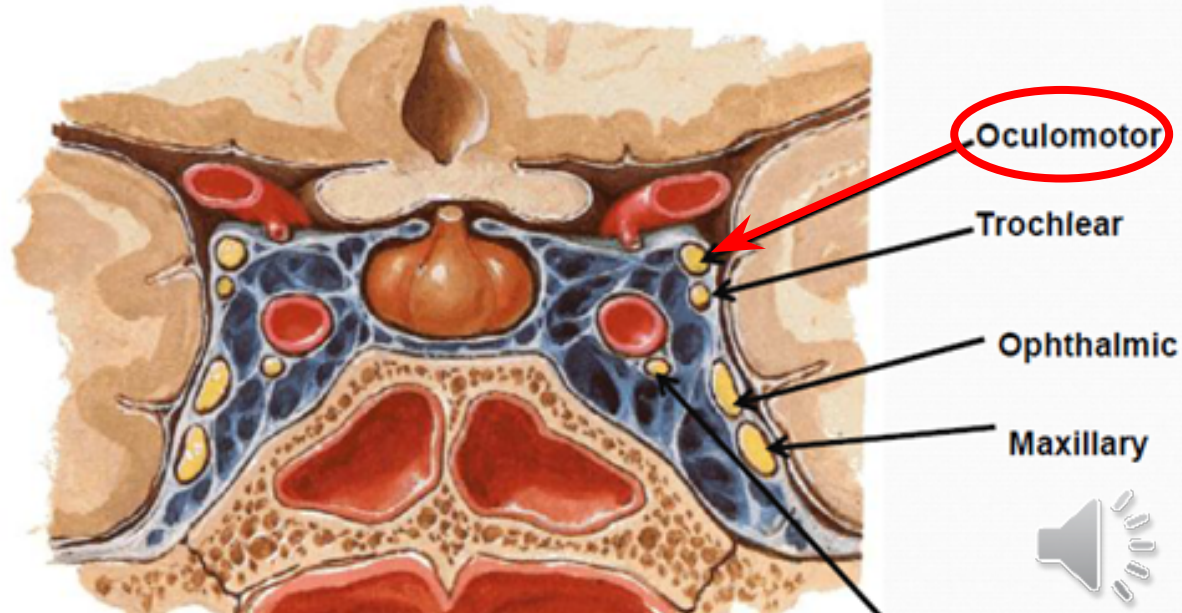
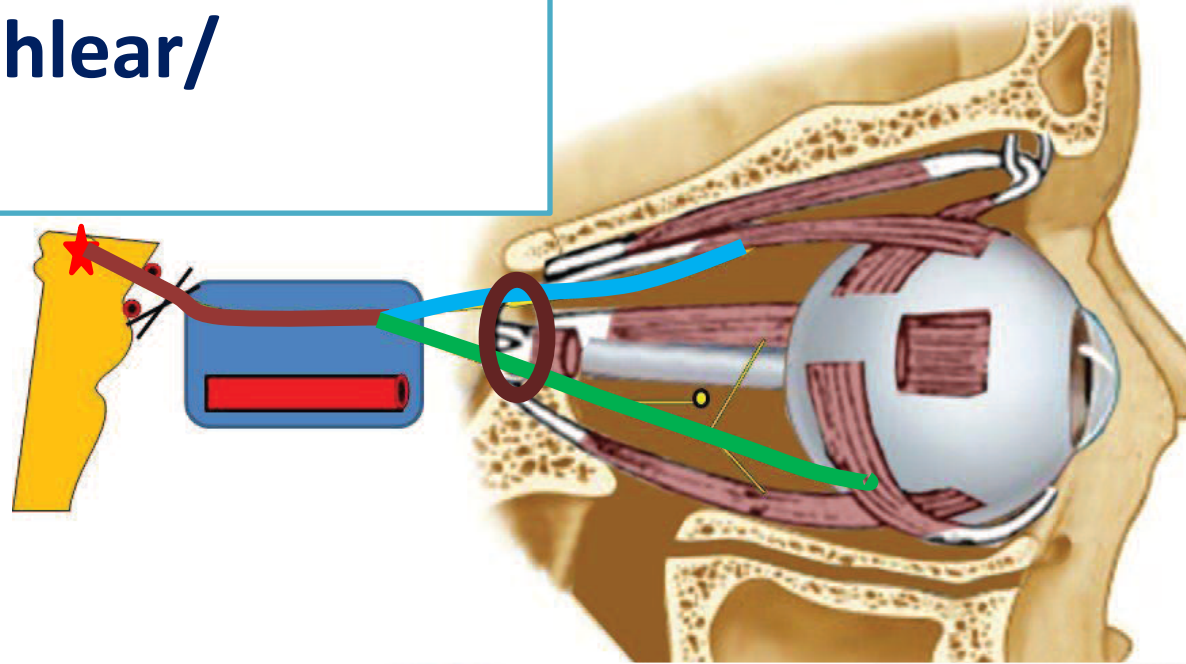
- **Crosses optic nerve from lateral to medial**
- **Runs along medial wall of orbit**
- **Branches:**
 1. **Communicating br to ciliary ganglion (sensory root)**
 2. **Long ciliary nerves** ☐ **motor sympathetic fibers to dilator pupillae**
 3. **Infratrochlear n** ☐ **skin of upper eyelid & side of nose**
 4. **Posterior ethmoidal n**
 5. **Anterior ethmoidal n**



Motor Nerves of the Orbit (Oculomotor/ Trochlear/ Abducent)

1) Oculomotor (III Cranial N)

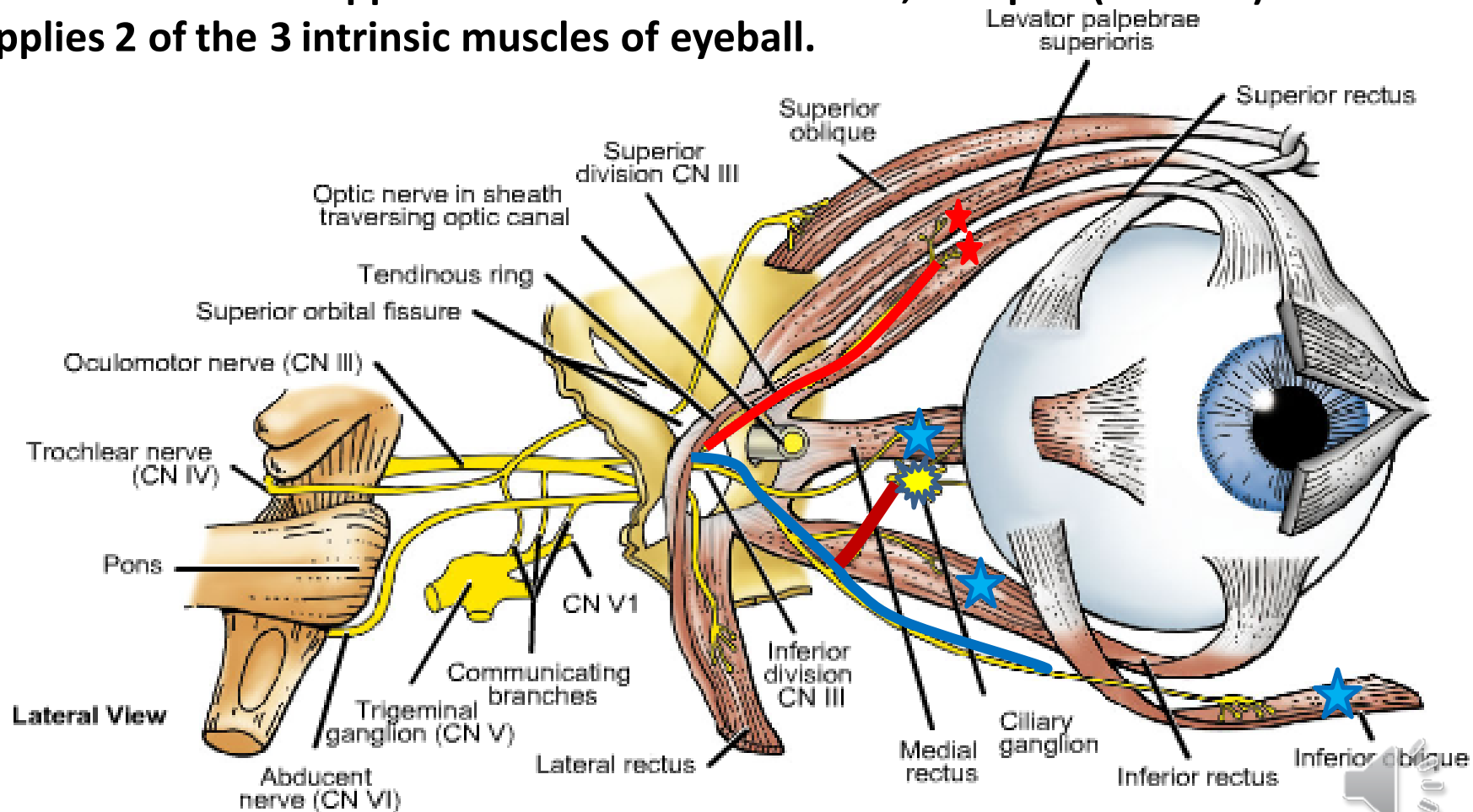
- ✓ Arises from the midbrain
- ✓ Pierces the dura **in front** of crossing of the free and attached margins of the tentorium cerebelli
- ✓ Runs in the lateral wall of cavernous sinus
- ✓ Divides into sup. and inf. divisions that enter the orbit through SOF inside the common tendinous ring

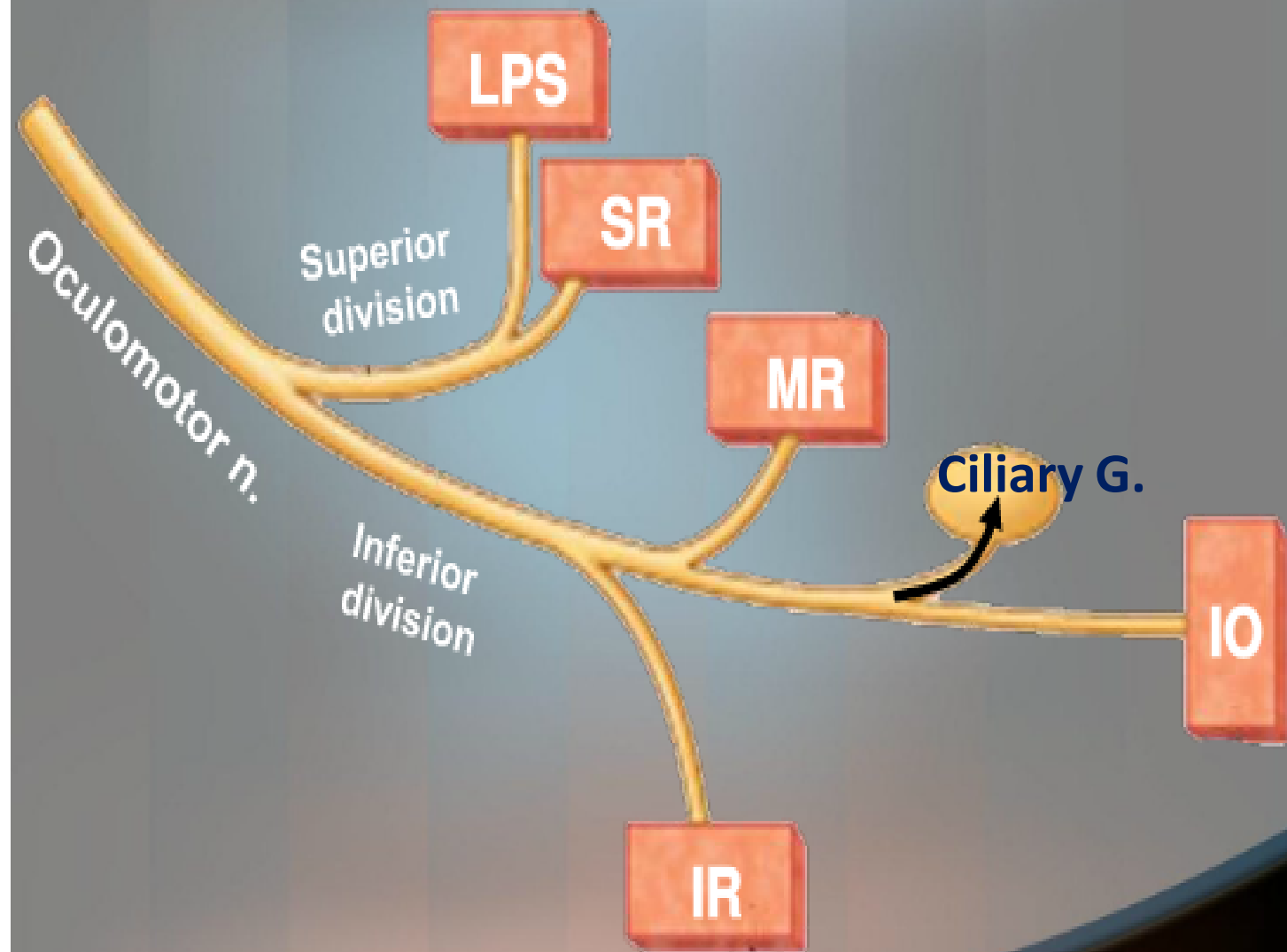


Oculomotor nerve supplies:

- 1) Superior division ? SR & LPS
- 2) Inferior division ? MR, IR & IO

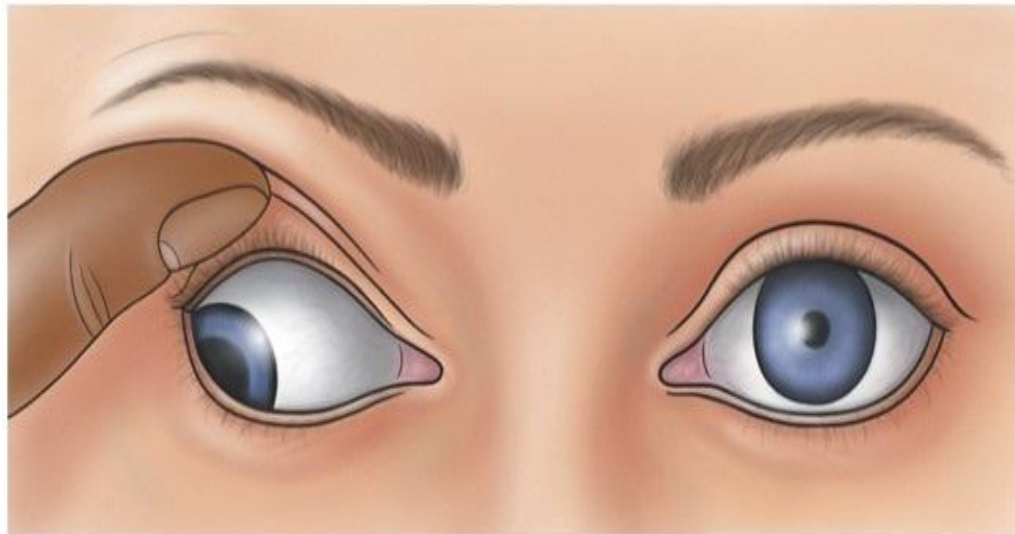
- ◆ Nerve to IO is the largest br. It gives a br to ciliary ganglion forming its motor (parasympathetic) root to sphincter pupillae & ciliary muscle
- ◆ Oculomotor nerve supplies all extraocular muscles , except 2 (SO & LR). It also supplies 2 of the 3 intrinsic muscles of eyeball.





Complete paralysis of the 3rd cranial nerve:

- 1- Lateral squint
- 2- Ptosis (drooping of the upper eye lid)
- 3- Dilatation of the pupil
- 4- Loss of accommodation



Right eye: Downward and outward gaze, dilated pupil, eyelid manually elevated due to ptosis

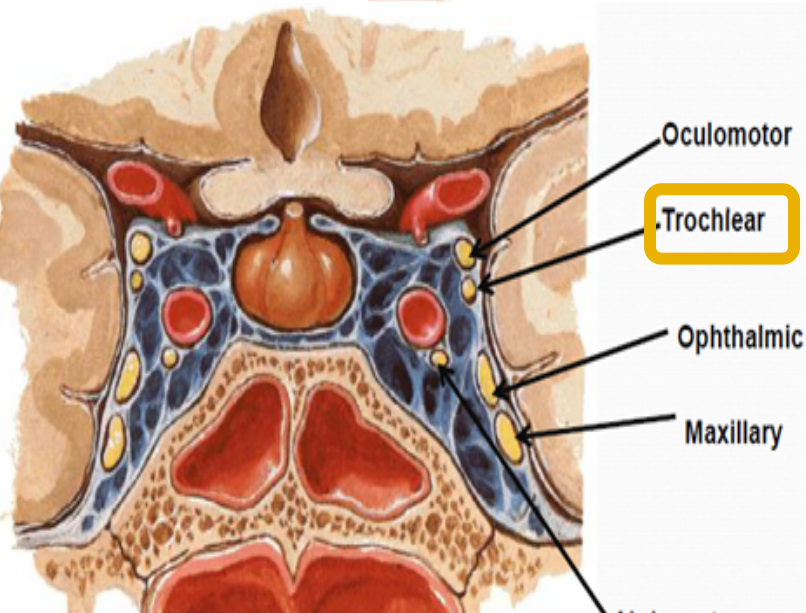
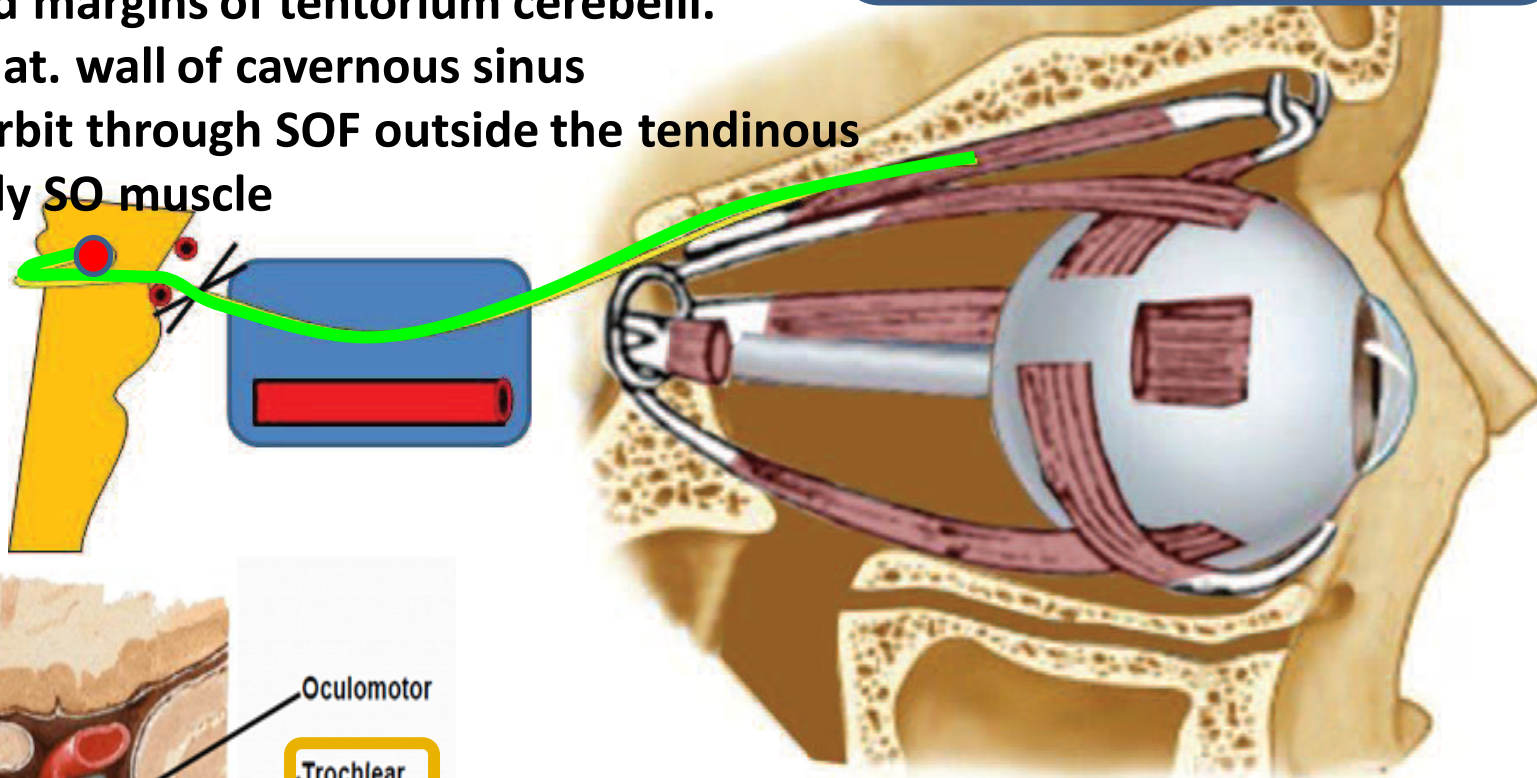
Left: Normal



2) Trochlear Nerve:

- It arises from midbrain
- Pierces the dura **at** the point of crossing of the free and attached margins of tentorium cerebelli.
- Runs in the lat. wall of cavernous sinus
- Enters the orbit through SOF outside the tendinous ring to supply SO muscle

If trochlear nerve is damaged → double vision (diplopia) on looking down

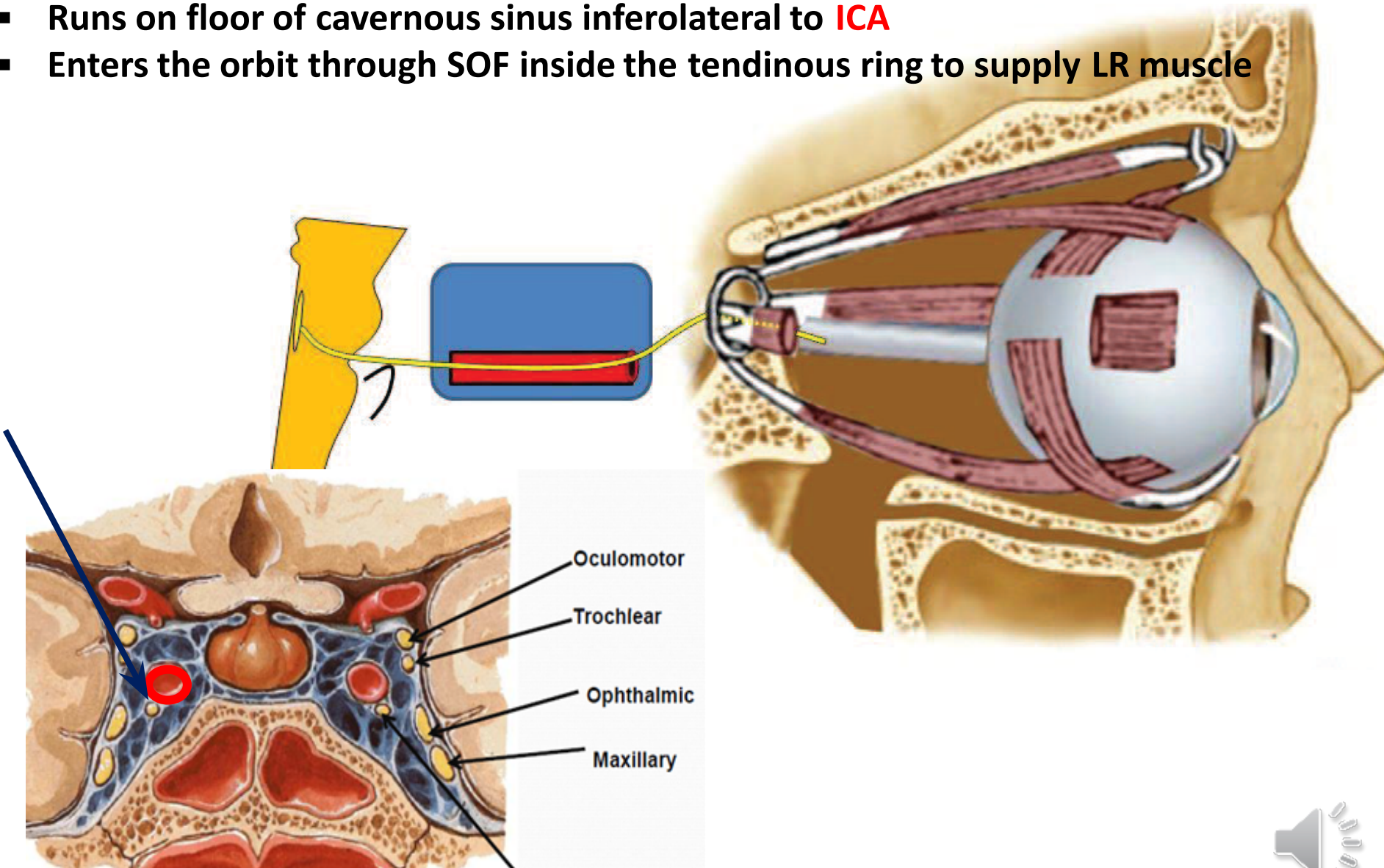


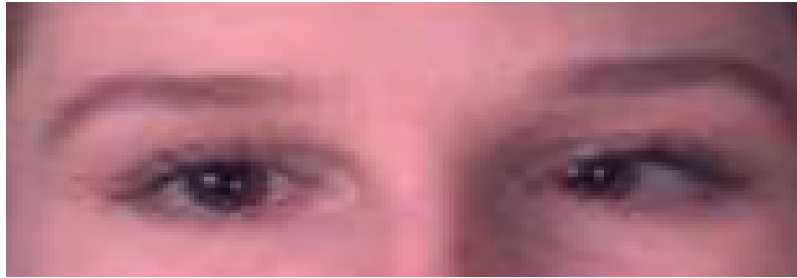
- ❑ It is the only cranial nerve that arises from dorsal aspect of brain stem.
- ❑ Trochlear nerve runs dorsally inside midbrain to decussate with opposite one so that trochlear nucleus supplies contralateral SO.



3) Abducent Nerve:

- It arises from lower border of pons.
- Runs on floor of cavernous sinus inferolateral to **ICA**
- Enters the orbit through SOF inside the tendinous ring to supply LR muscle





Paralysis of the abducent nerve results in \square medial squint & diplopia

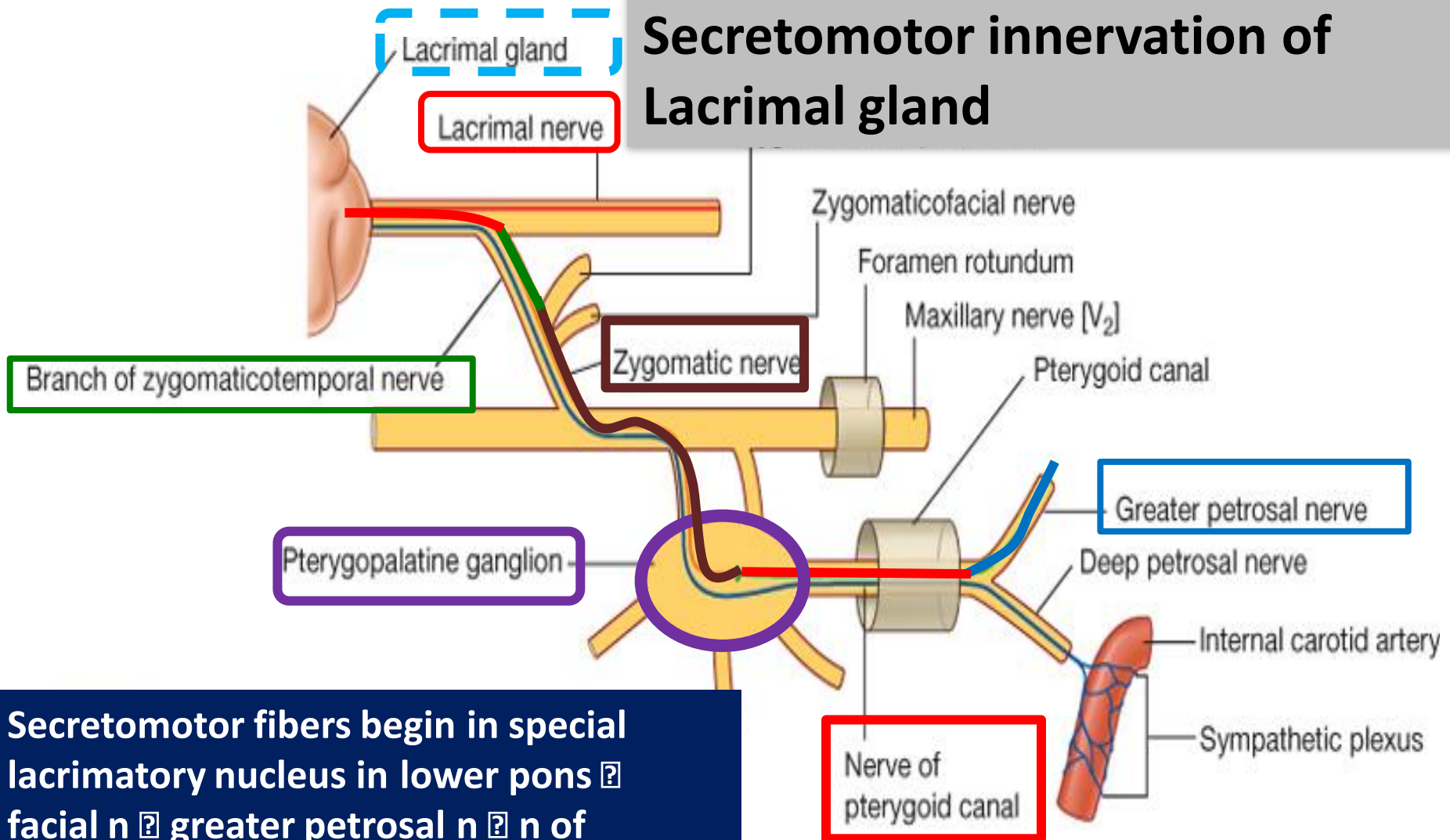


Autonomic nerves in the orbit:

- 1- Parasympathetic to sphincter pupillae & ciliary muscle
- 2- Sympathetic fibers to dilator pupillae muscle
- 3- Secretomotor fibers to lacrimal gland

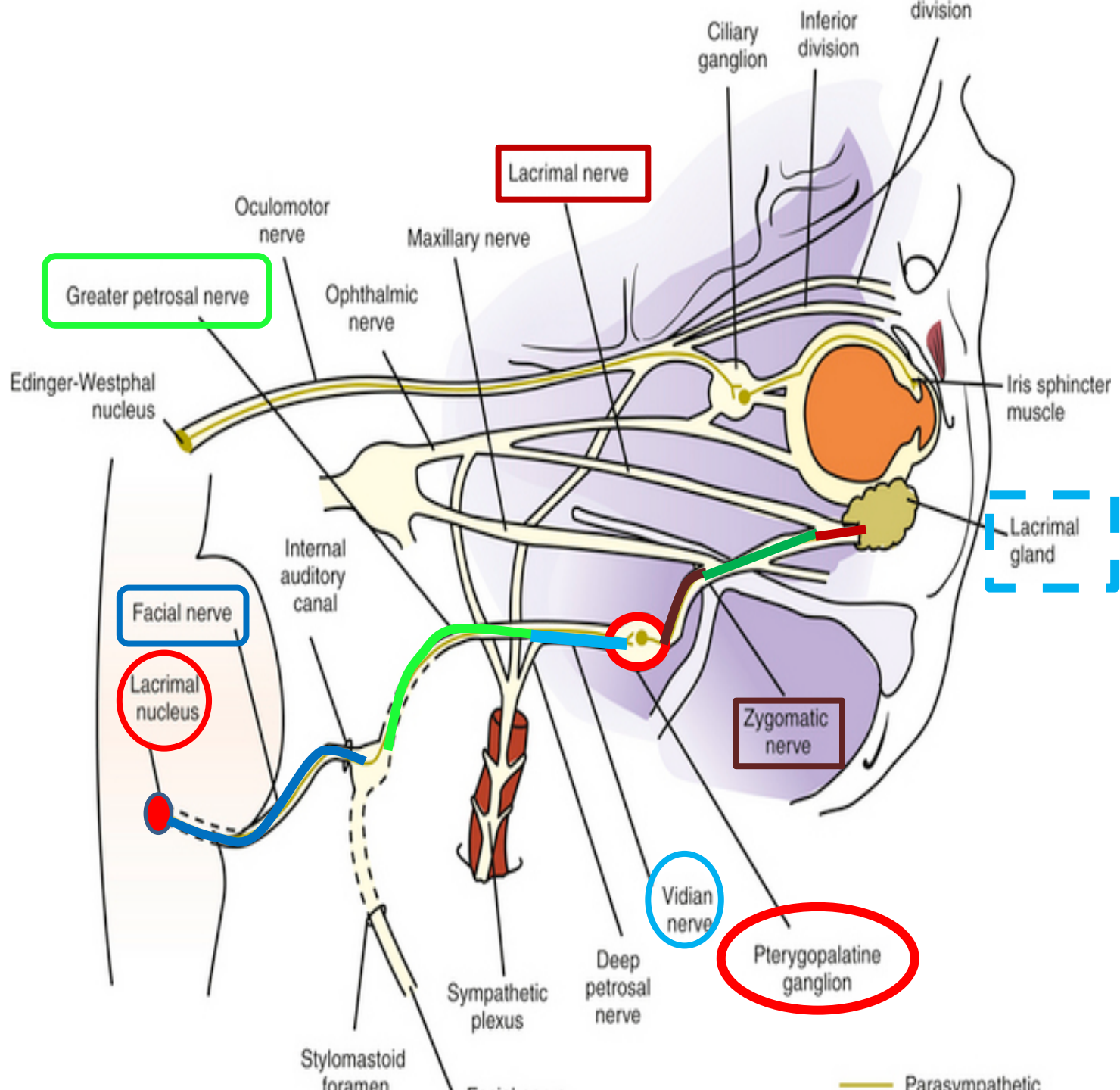


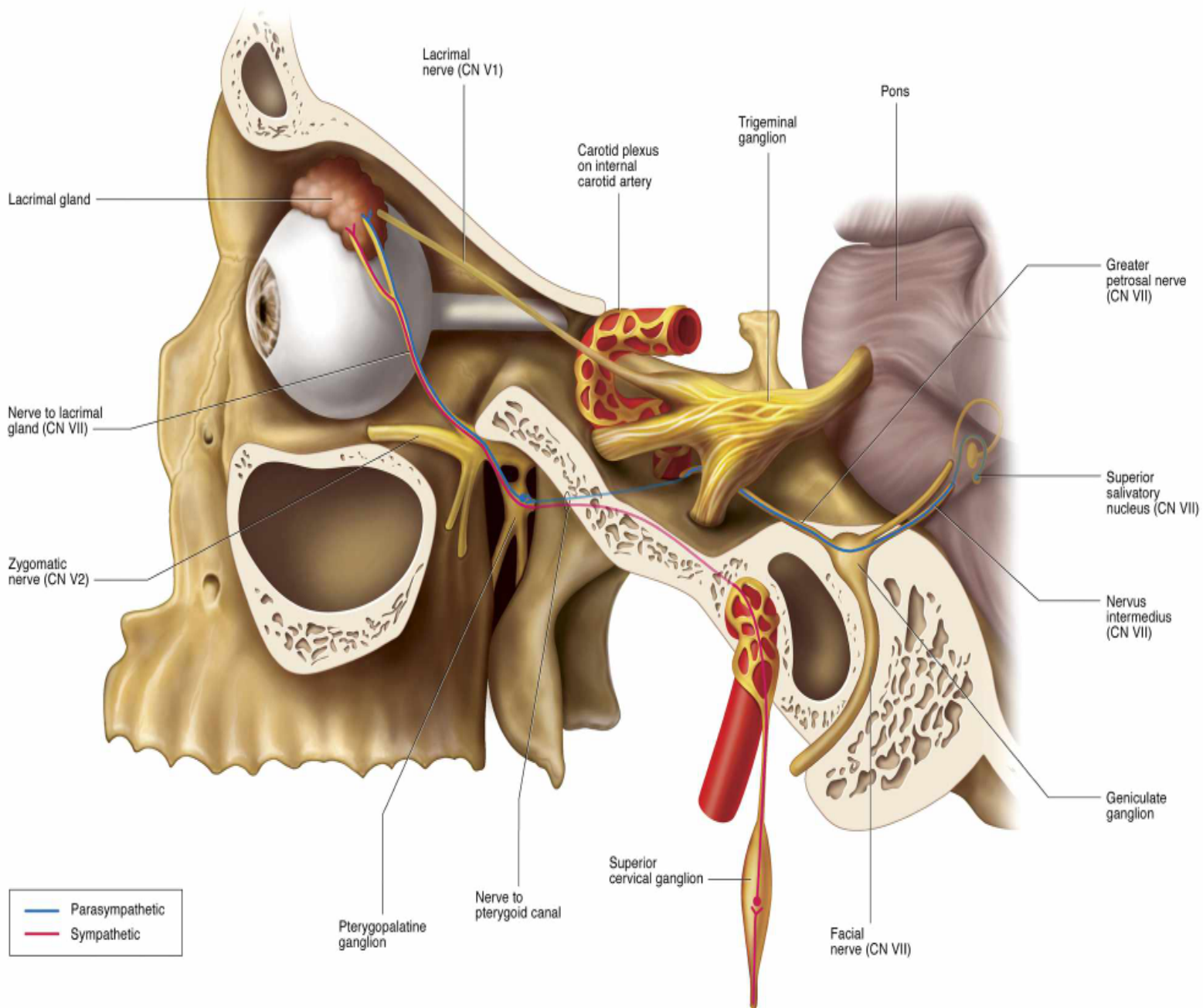
Secretomotor innervation of Lacrimal gland



Secretomotor fibers begin in special lacrimatory nucleus in lower pons
facial n
greater petrosal n
n of pterygoid canal
relay in pterygopalatine ganglion
zygomatic n
zygomaticotemporal n
lacrimal n
lacrimal gland

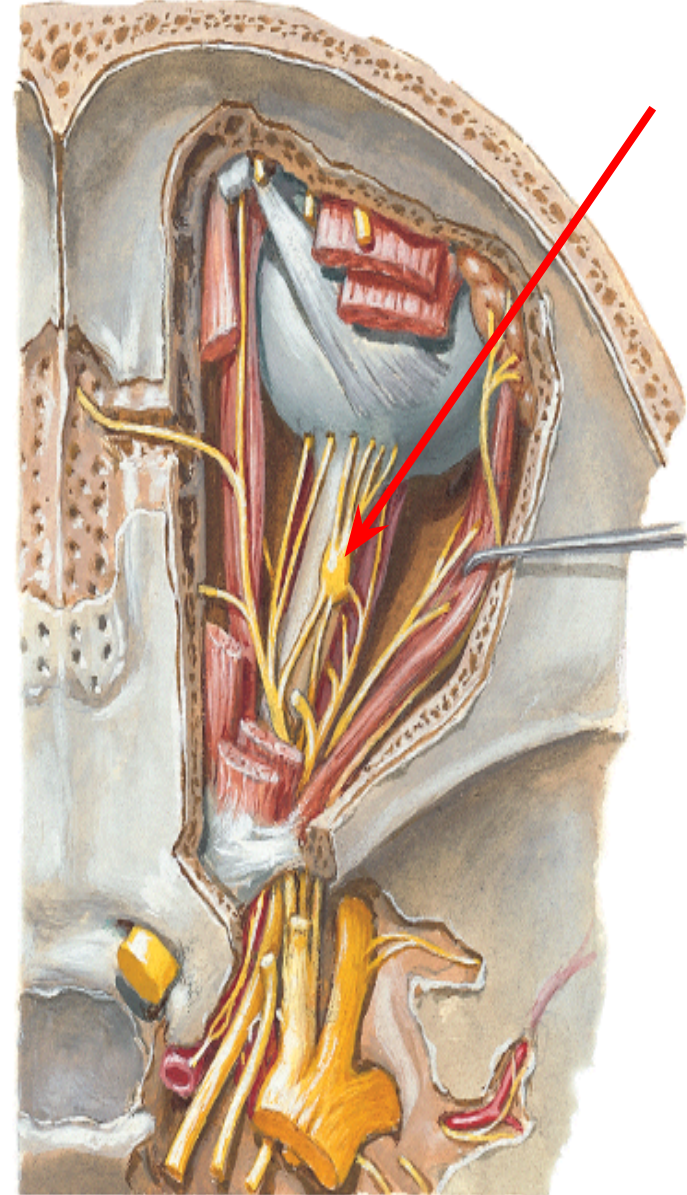
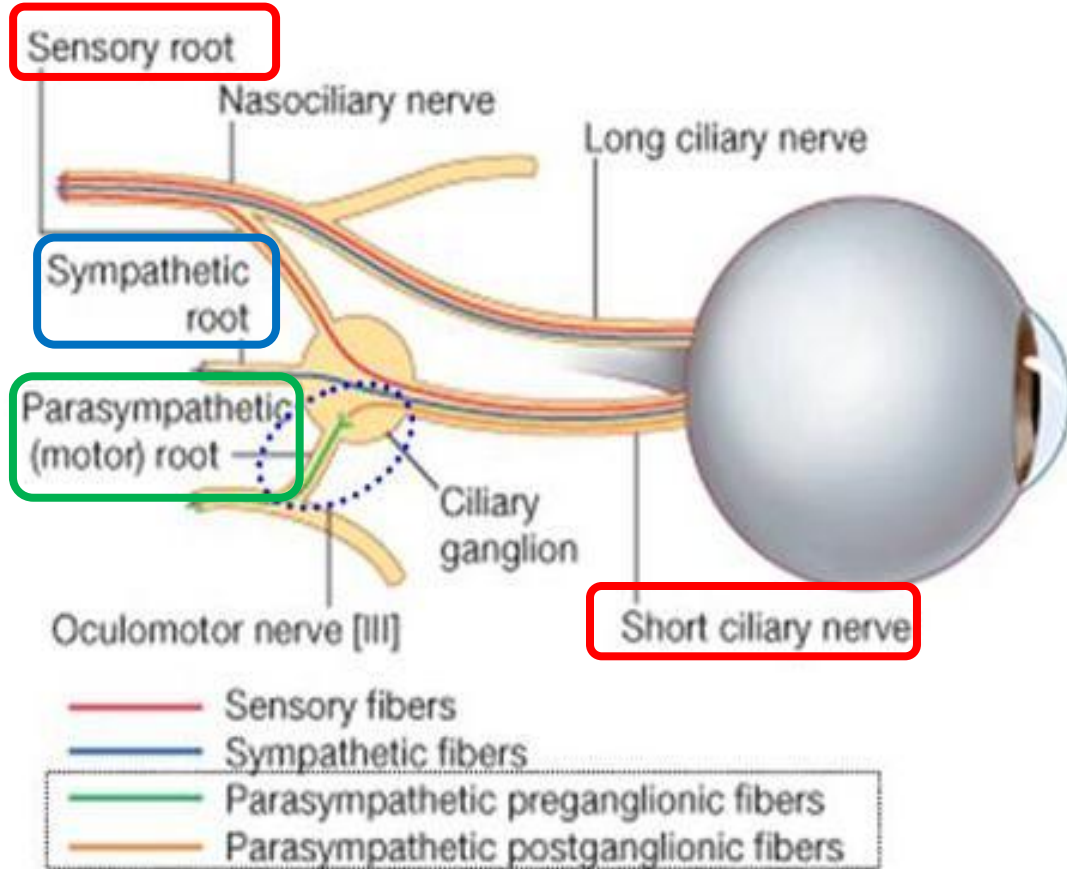


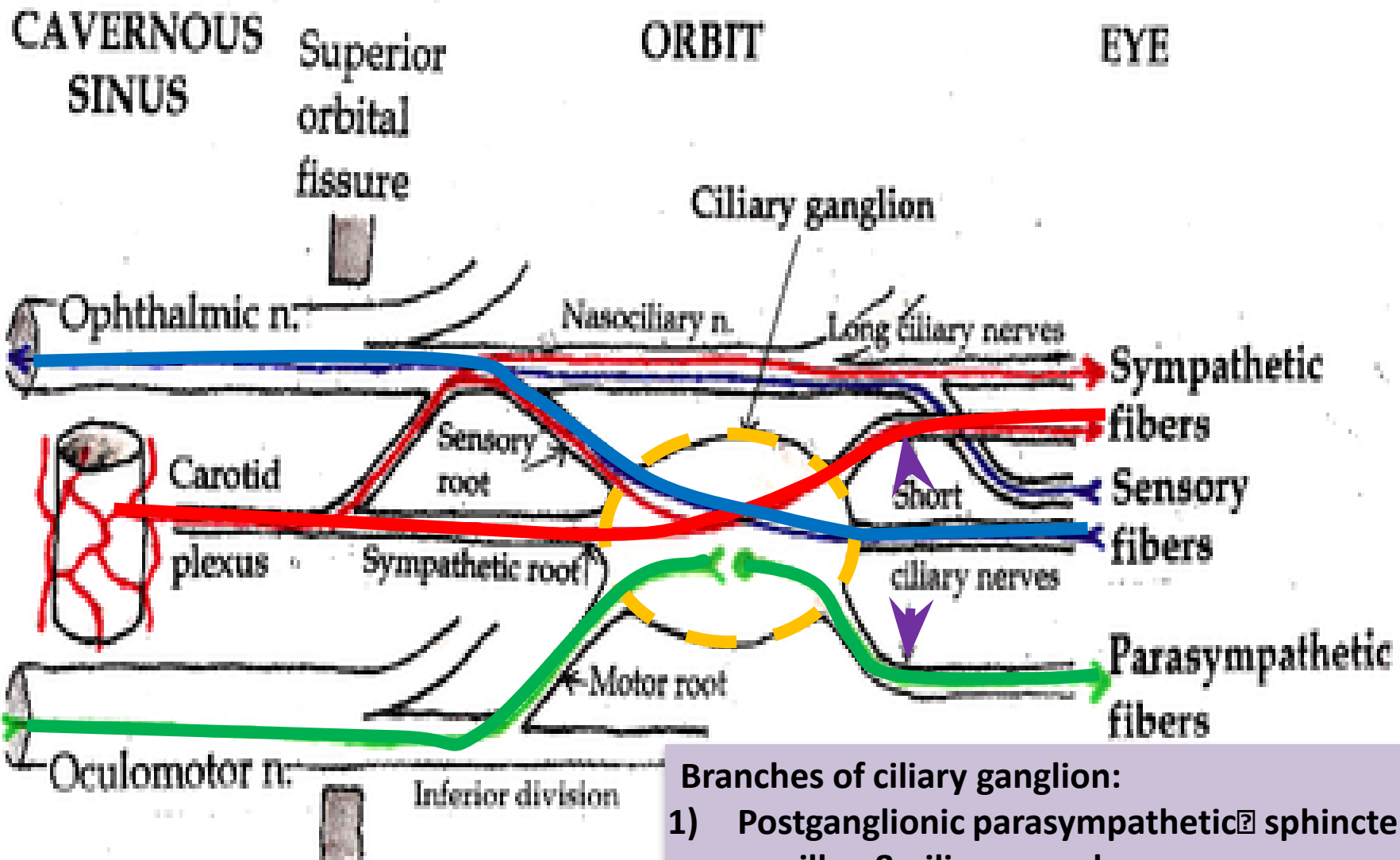




Ciliary Ganglion:

- ❑ **Site:** lateral to the optic nerve inside the orbit
- ❑ **Roots:**
 - a) Parasympathetic root: arises from the nerve to inferior oblique
 - b) Sympathetic root: branch from the plexus around ICA
 - c) Sensory root: branch from nasociliary
- ❑ **Branches:** short ciliary nerves





- Branches of ciliary ganglion:**
- 1) Postganglionic parasympathetic → sphincter pupillae & ciliary muscle
 - 2) Postganglionic sympathetic → blood vessels of eyeball
 - 3) Sensory from eyeball



Face Development

Under the inductive effect of 2 **mesodermal** organizing centers; (located ventral to the forebrain & hindbrain), **5 facial prominences (primordia)** appear around the stomodeum (primitive mouth) during the **4th** week.

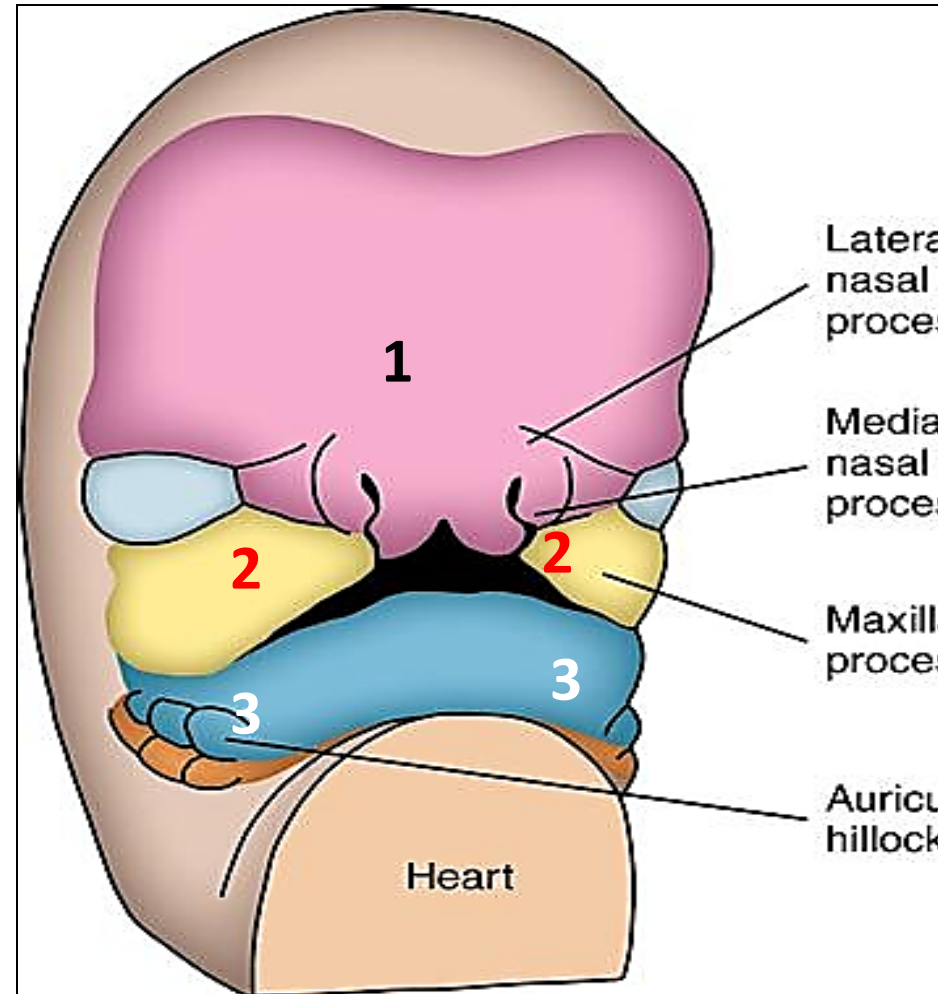
•These **5 facial prominences or primordia** include:

1.A single frontonasal prominence (**FNP**). *Ventral to forebrain*

2.Paired maxillary prominences.

3.Paired mandibular prominences.

-Both maxillary & mandibular prominences are derived from the **1st pharyngeal arches**.



All the 5 prominences are produced by neural crest cells that migrate into the pharyngeal arches during 4th week of development.



Note that:

•The 5 facial prominences surround the stomodeum as follows:

1)Frontonasal prominence:

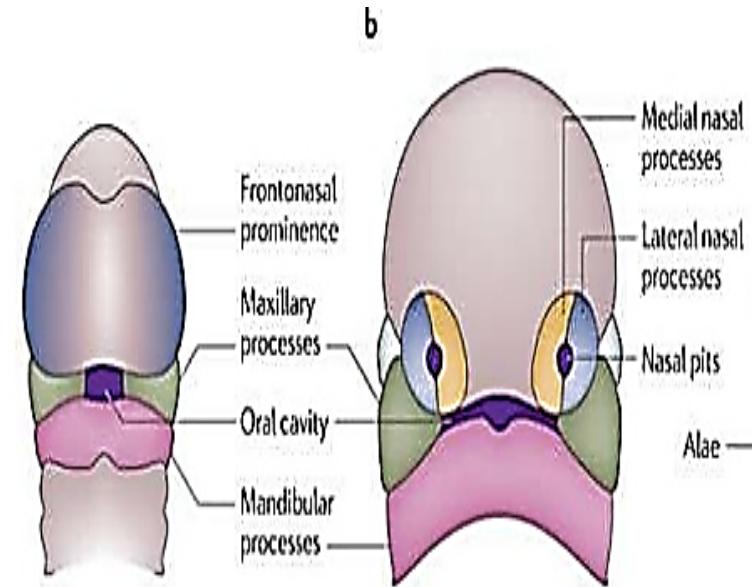
-Its **frontal** part forms the forehead.

-Its **nasal** part forms the rostral (cranial boundary of the stomodeum & the nose.

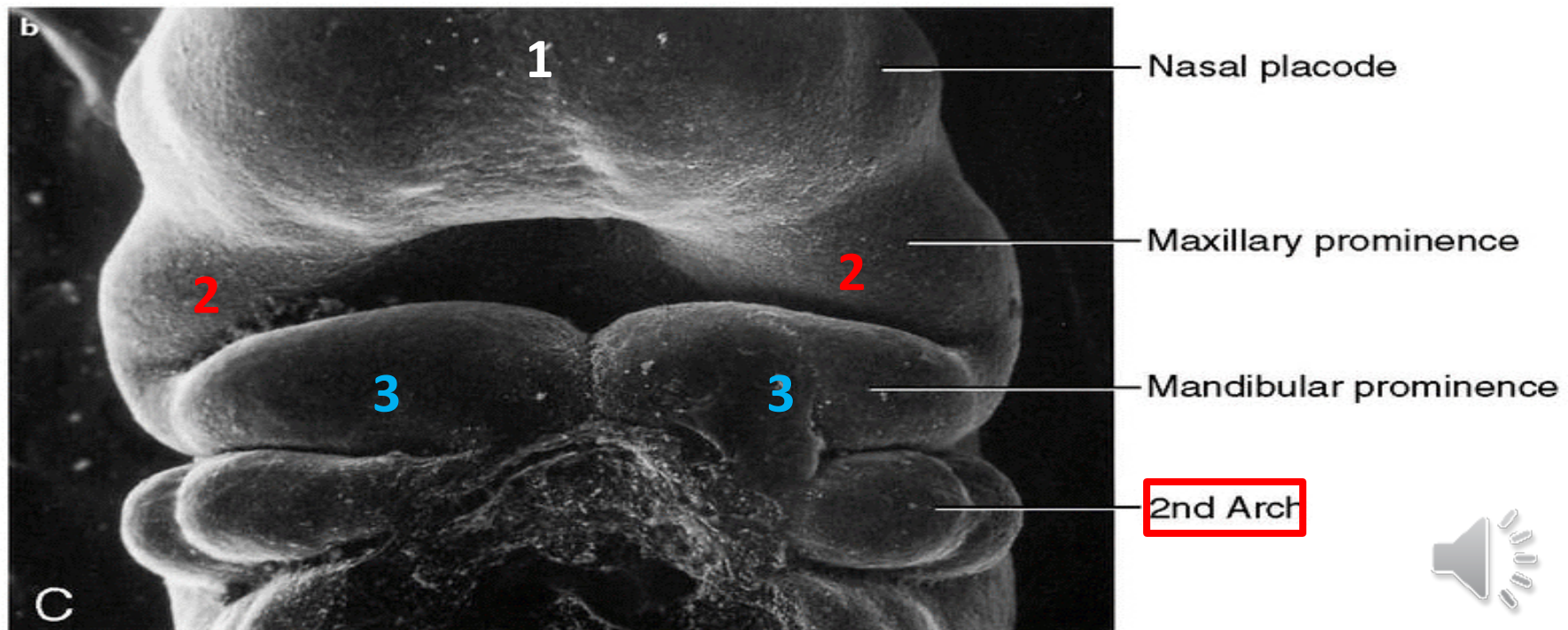
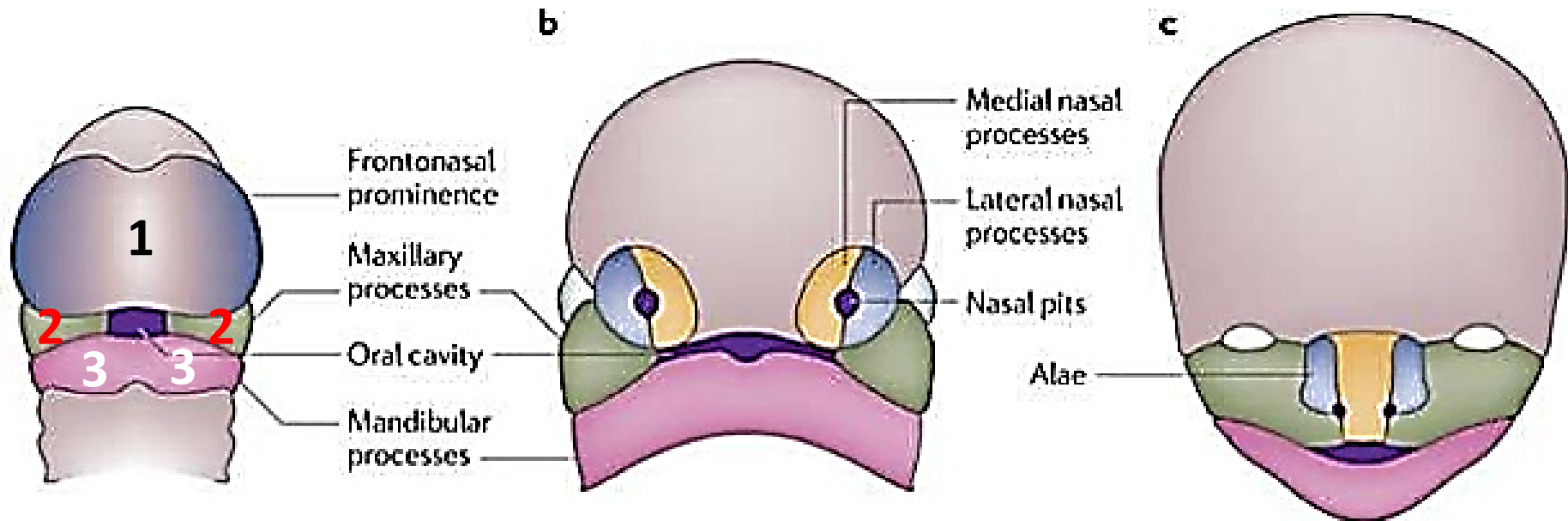
2)Maxillary prominences form the latera boundaries of the stomodeum.

3)Mandibular prominences constitute the caudal boundary of the stomodeum.

•The lower jaw & lower lip are the first parts of the face to form by fusion of the medial ends of the 2 mandibular prominences.



Facial prominences



Facial prominences

The 5 facial prominences

1 FNP

NP →

2

2 MXP

3

3

MDP

BA2

2nd arch

BA3

3rd arch



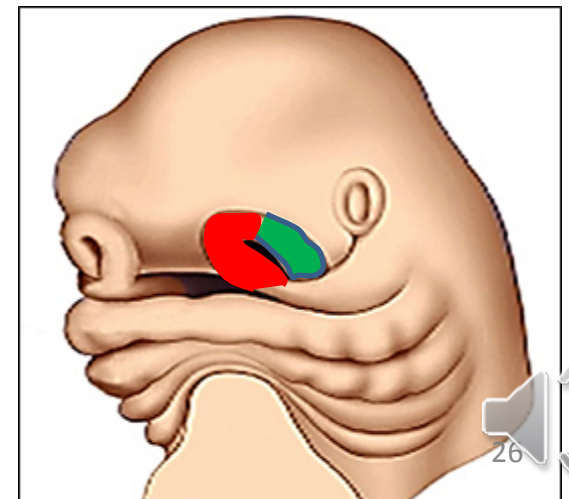
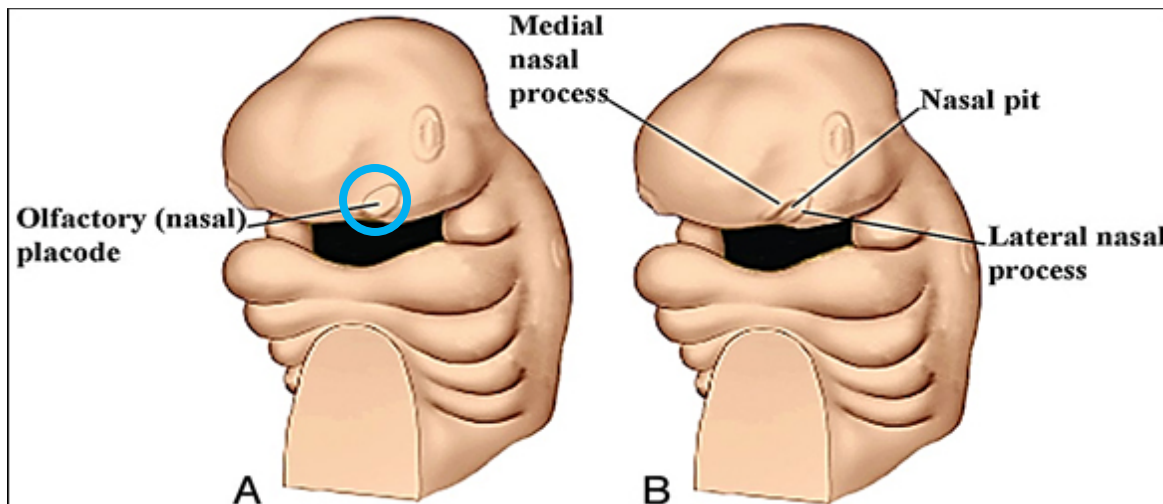
A] Changes in the frontonasal prominence (FNP):

.By the end of 4th week, bilateral oval thickenings of the surface ectoderm (**nasal placodes**) appear on inferolateral parts of FNP.

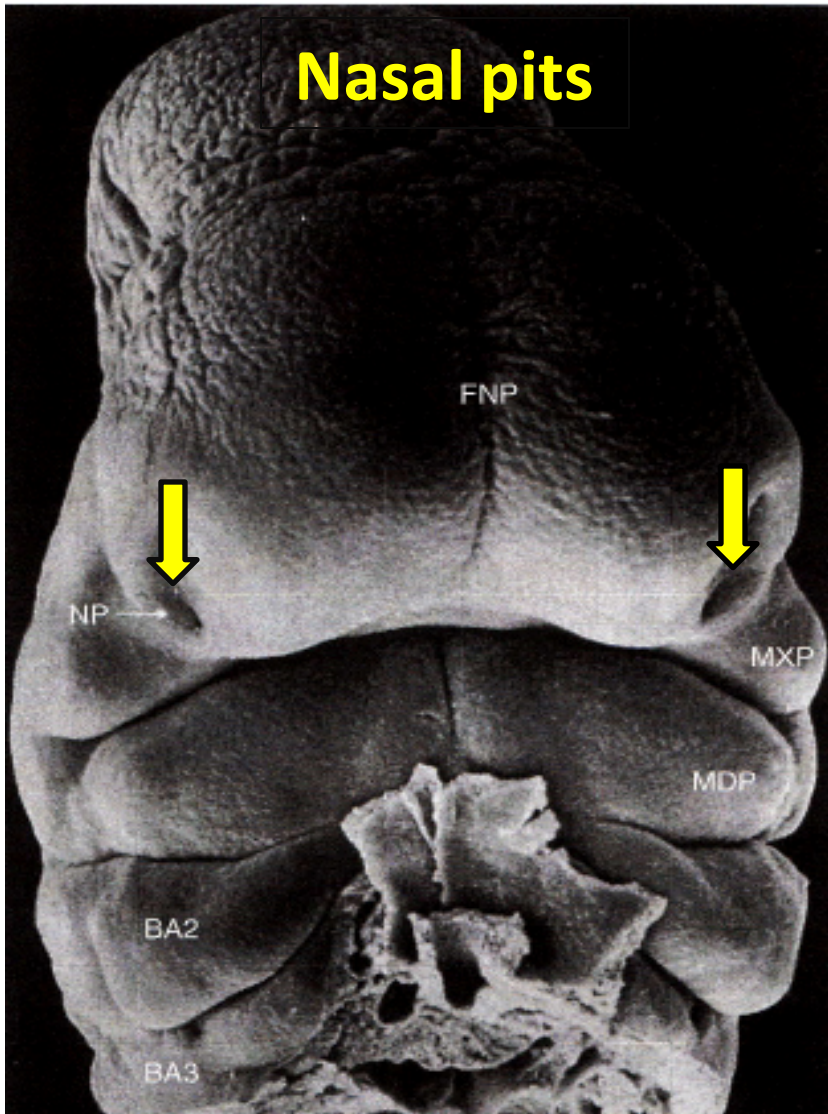
.Nasal placodes are depressed to form **nasal pits** ⇒ **Nasal sacs**.

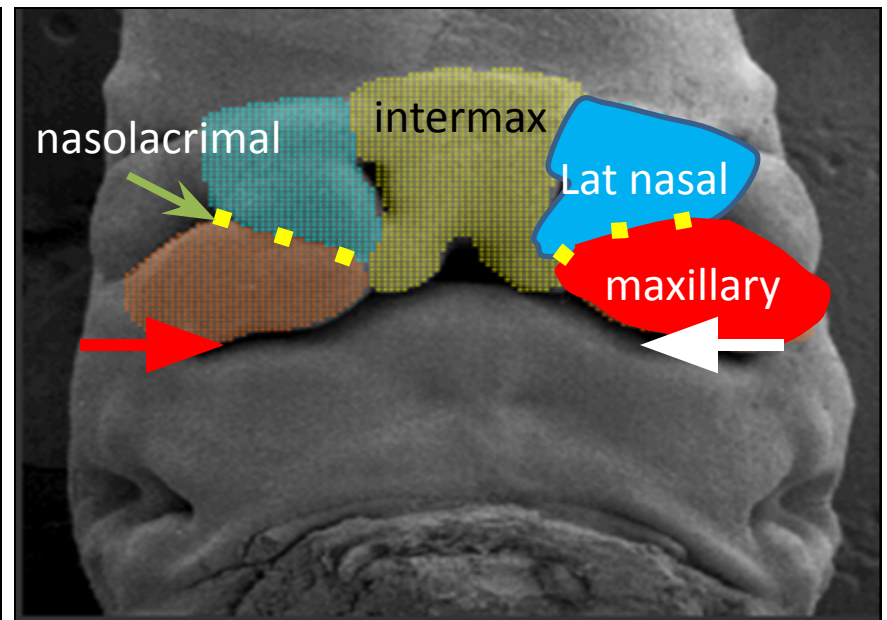
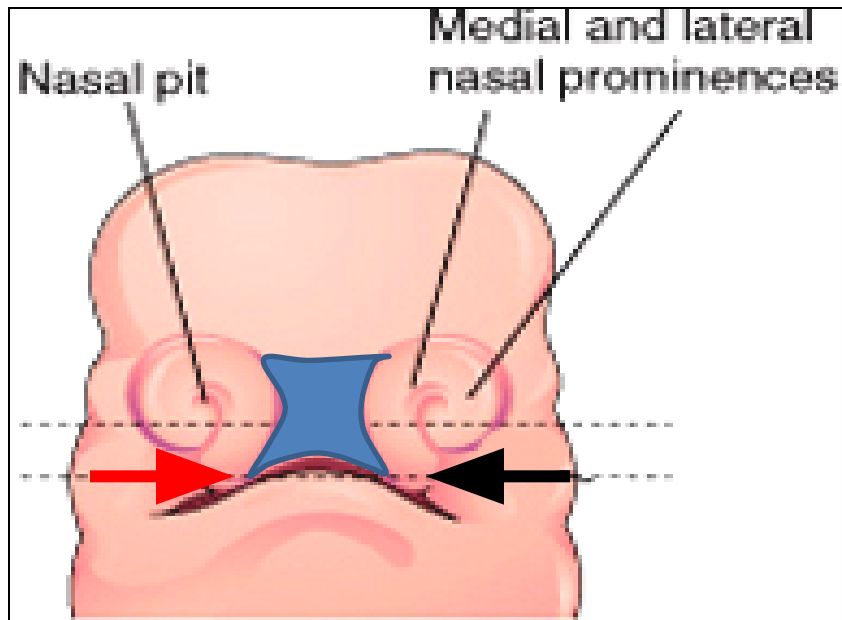
.The mesenchyme in the margins of nasal placodes proliferates, producing horseshoe-shaped elevations (**medial** & **lateral nasal prominences**) which surround the nasal pits.

.**Nasal pits** are the primordia of the anterior nares (**nostrils**) & nasal cavities.



Nasal pits





Maxillary prominences enlarge & grow **medially** toward each other ⇒ Push medial nasal prominences toward the median plane & each other.

The 2 medial nasal prominences fuse together in median plane to form a **median nasal prominence (intermaxillary segment)**.

.Each **lateral nasal prominence** fuse with the ipsilateral side of median nasal prominence ⇒ Formation of **anterior nares**.

-Laterally, each lateral nasal prominence is separated from the maxillary prominence by the nasolacrimal groove.

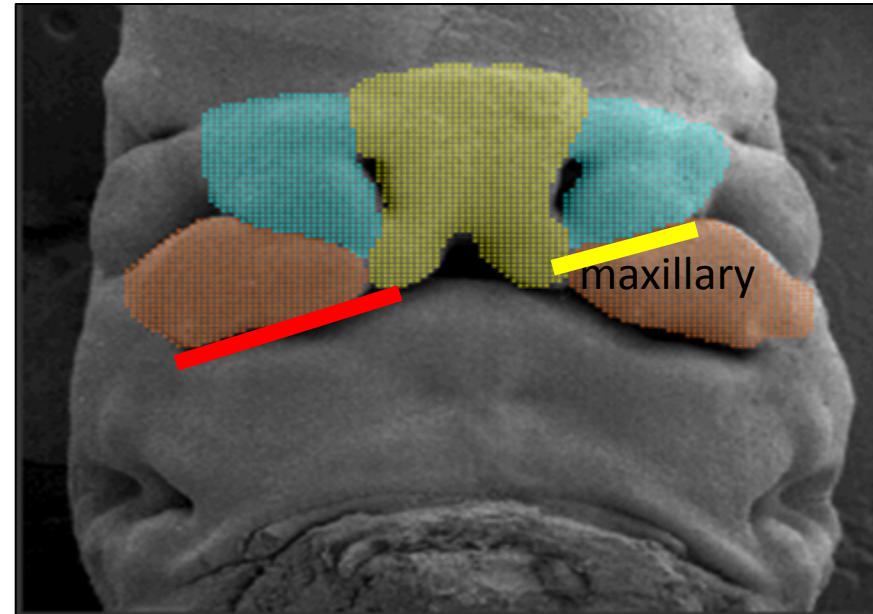


By the end of 6th week, each **maxillary** prominence fuses (merges) with **3** adjacent prominences:

Merging with medial nasal prominence ⇒ Continuity of the upper jaw & lip and separation of the nasal pits from the stomodeum.

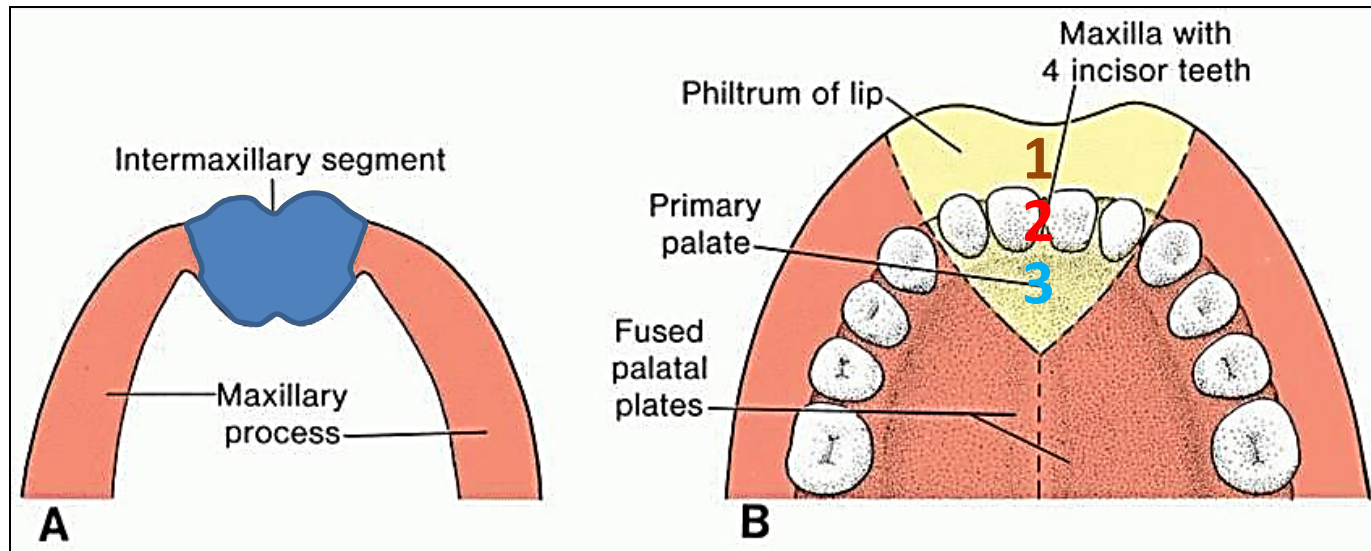
Merging with lateral nasal prominence along the nasolacrimal groove.

-This establishes continuity between the side of the nose (formed by the lateral nasal prominence) & the cheek (formed by the maxillary prominence).



Intermaxillary segment (Median nasal prominence) gives:

1. Deep middle part of the upper lip.
2. Premaxillary part of the upper jaw (carries upper 4 incisors) & its associated gum.
3. Δ primary palate.



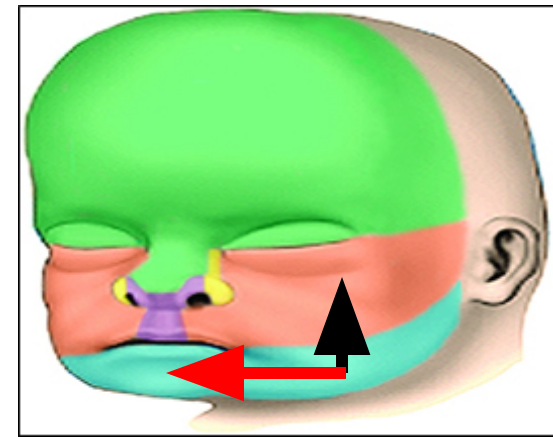
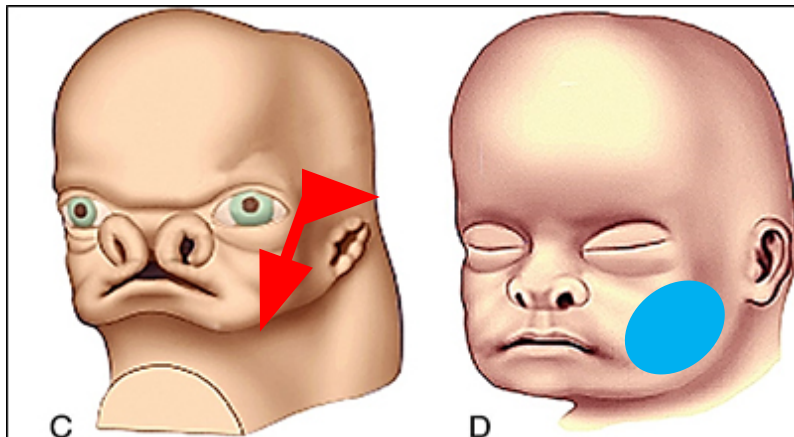
Merging with mandibular prominence to form the cheek & thus ↓ the width of the stomodeum.

Changes in the mandibular prominence:

.Each mandibular prominence merges with 2 adjacent prominences:

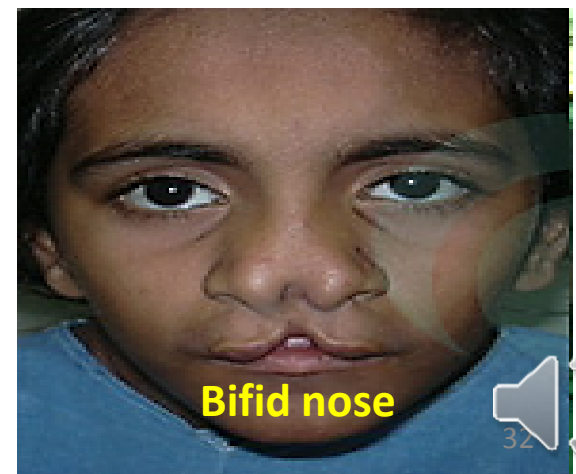
1. Ipsilateral maxillary prominence → Cheek.

2. Contralateral mandibular prominence, caudal to stomodeum → Lower lip & jaw.



facial anomalies:

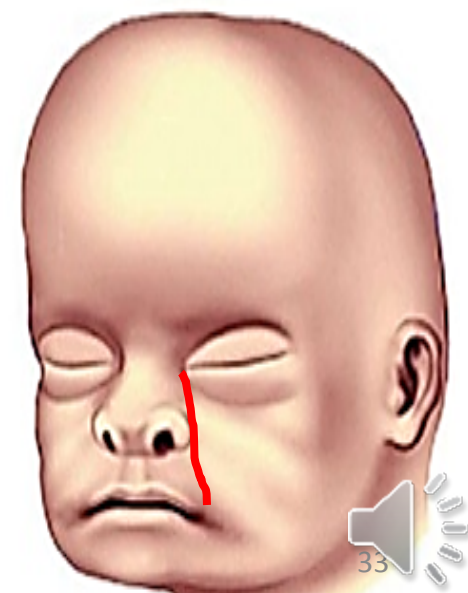
1. **Macrostomia:** Wide mouth opening due to underfusion of the maxillary & mandibular prominences of 1st arch.
2. **Microstomia:** An abnormally small mouth opening due to excessive merging of the maxillary & mandibular prominences.
3. **Absence of the nose:** A very rare condition which occurs when no nasal placodes form.
4. **Bifid nose:** This results when the medial nasal prominences do not merge completely. D



5-Oblique facial cleft (orbito-facial fissure): Rare condition which may be unilateral or bilateral. *Along nasolacrimal groove*

- The cleft extends from upper lip to medial margin of the orbit.
- It results from failure of fusion of maxillary prominence with lateral nasal prominence on one or both sides.

.The nasolacrimal duct fails to develop on the affected side (**persistent nasolacrimal groove**).



DEVELOPMENT OF THE EYE

- **Sources:**

Neuroectoderm (forebrain) optic vesicle optic nerve, retina, ciliary body & iris

Surface ectoderm lens vesicle + corneal epithelium

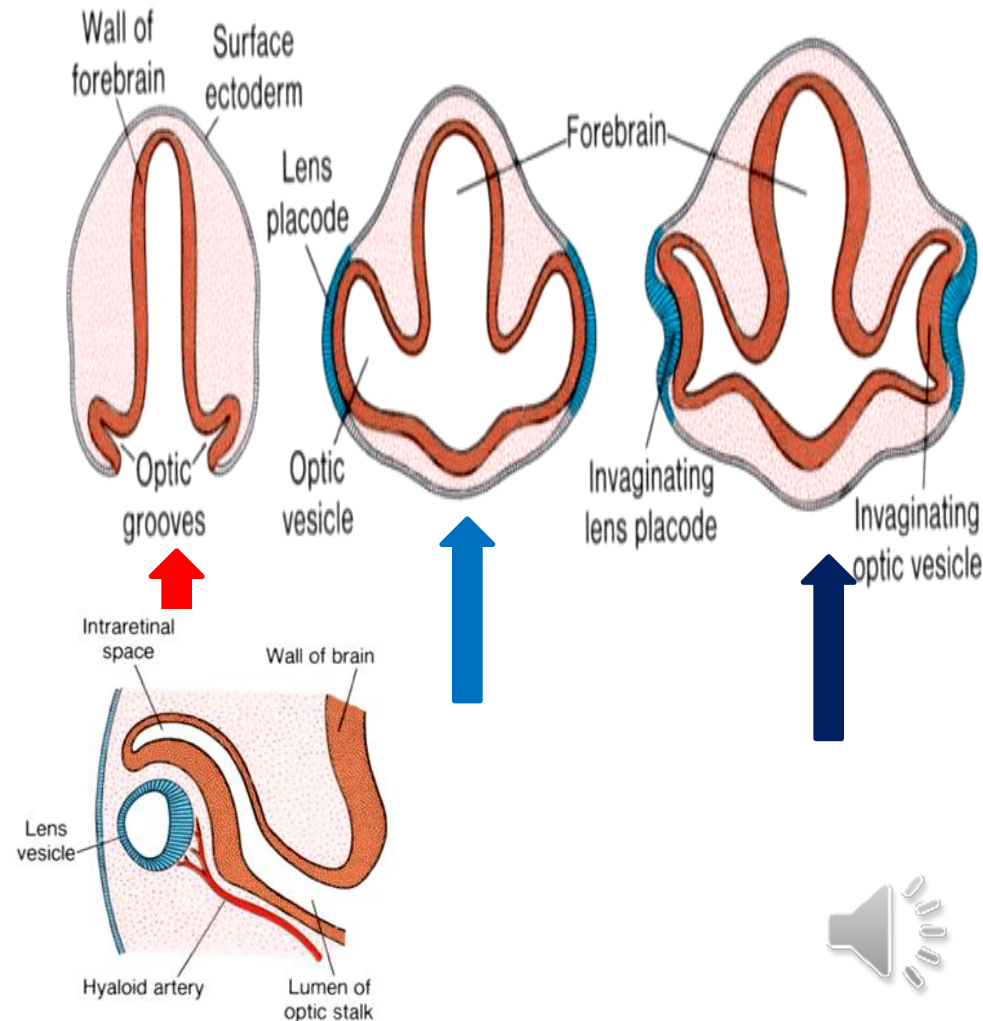
Mesoderm choroid, sclera, cornea except epithelium, anterior chamber, vitreous body



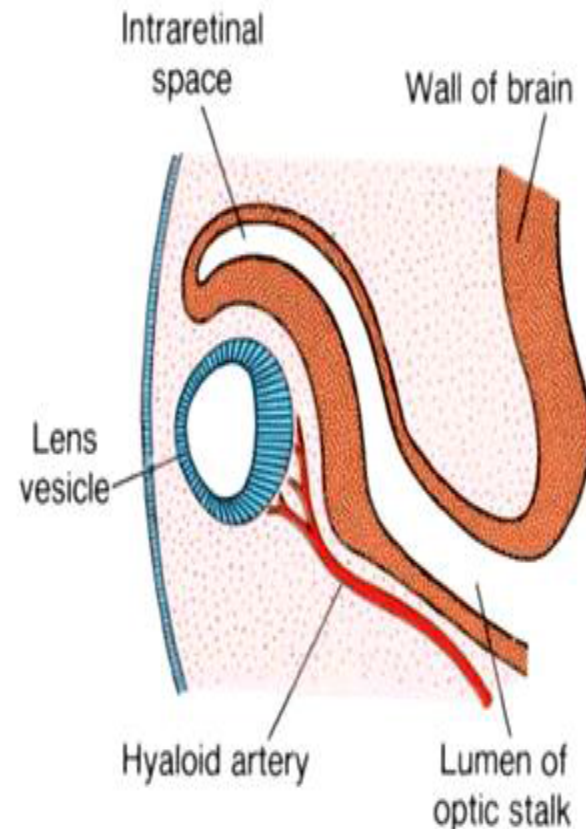
ECTODERMAL DERIVATIVES

(optic vesicle & lens vesicle)

- **At the end of the 4th wk, a pair of “optic vesicles” appears as outpockets from the sides of the forebrain.**
- **The optic vesicles contact the surface ectoderm and induce changes necessary for lens formation.**
- **At first a thickening “lens placodes” which invaginates “lens pit” until separating from the surface “lens vesicle”.**



- **At the same time, the optic vesicle begins to invaginate to form a double-layered optic cup.**
- Its outer layer the pigment layer of the retina.
- The posterior 4/5 of the inner layer the remaining layers of the retina whereas its anterior 1/5 the ciliary body & the iris.
- The space between the 2 layers of the cup “the intraretinal space” soon disappears and the fused layers form the pigment and neural layer of the retina.



- A 9-year-old boy is brought to the emergency department by his mother. He tripped on the carpet while playing tag with his sister in the living room and fell
- face-first onto the corner of a wooden coffee table. Fortunately, his eye just missed the corner of the table, however, his left cheek hit the table just below his eye
- forcing the lower lateral margin of the eye away from the orbit. Gentle palpation indicates that both his zygomatic bone and a lateral portion of the maxilla are broken
- and dislocated from the rest of his face. The boy's nose, medial portion of the maxillary bone and maxillary teeth are all intact. When the "H" test is performed, the left
- eye has more limited movement than the right eye and cannot look above the horizon. Which extraocular muscle is likely trapped in which facial bone?
- a. Inferior rectus muscle in the ethmoid bone
- b. Inferior rectus muscle in the maxillary bone
- c. Medial rectus muscle in the frontal bone
- d. Medial rectus muscle in the maxillary bone
- e. Superior rectus muscle in the sphenoid bone



- A 53-year-old woman has paralysis of the right side of her face that produces an expressionless and drooping appearance. She is unable to close her right eye, has
- difficulty chewing and drinking, perceives sounds as annoyingly intense in her right ear, and experiences some pain in her right external auditory meatus. Physical
- examination reveals loss of the blink reflex in the right eye on stimulation of either cornea and loss of taste from the anterior two-thirds of the tongue on the right. The
- inability to close the right eye is the result of involvement of which one of the following?
- a. Zygomatic branch of the facial nerve
- b. Buccal branch of the trigeminal nerve
- c. Levator palpebrae superioris muscle
- d. Superior tarsal muscle (of Muller)
- e. Orbital portion of the orbicularis oculi muscle



- When a physician examines the "corneal reflex" in a patient, she/he touches the cornea with a wisp of cotton that causes the eyelid to rapidly shut. As with most
- reflexes, one is testing both the afferent information that is carried back to the central nervous system and the reflex motor response. What specific cranial nerve
- branches are responsible for both the afferent and efferent parts of the corneal reflex?
- a. Short ciliary nerve (CN III); zygomatic and temporal branches of the facial nerve (CN VII)
- b. Short ciliary nerve (CN III); oculomotor nerve (CN III)
- c. Long ciliary nerve (CN V'); zygomatic branches of the facial nerve (CN VII)
- d. Long ciliary nerve (CN V'); infraorbital branch of the trigeminal nerve (CN V2)
- e. Infraorbital nerve (CN V2); zygomatic branches of the facial nerve (CN VII)

