



Dissection 7: Eye and Orbit

Objective 1)

Identify the elements of the bony orbit on a skull or x-ray.

- A). Frontal, Sphenoid, Ethmoid, Lacrimal, Zygomatic, Palatine, and Maxillary bones
- B). Superior wall (roof) of the orbit:
 - i. Frontal bone (orbital part) – separates the orbital cavity from the anterior cranial fossa and also has the fossa for lacrimal gland
 - ii. Also has sphenoid none (lesser wing)
- C). Medial wall of the orbit: paper thin
 - i. Ethmoid bone and contributions from frontal, lacrimal, and sphenoid bones
 - ii. Contains fossa for lacrimal sac
 - iii. Mnemonic: SELF (from posterior to anterior → sphenoid, ethmoid, lacrimal, frontal on top)
- D). Lateral wall of the orbit: thickest wall
 - i. Zygomatic bone (frontal process) and sphenoid (greater wing)
 - ii. Separates orbit from temporal and middle cranial fossae
- E). Inferior wall (floor) of the orbit:
 - i. Maxilla bone with contributions from zygomatic and palatine bones
 - ii. Separated from lateral wall by inferior orbital fissure
- F). Apex of orbit at optical canal just medial to the superior orbital fissure

Objective 2)

Indicate the structures lying superior, inferior, medial and lateral to the eyeball and the position of the eyeball relative to the bony orbit.

- G). Optic canal: located at the apex of the eyeball
- H). Superior and inferior orbital fissures: found inside the bony orbit.
 - i. Superior: oculomotor (CN III), trochlear (CN IV), abducens (CN VI), & ophthalmic div of trigeminal (CN V1) nerves travel to the orbit
 - ii. Inferior: through which a branch of the maxillary division of the trigeminal (CN V2).
- I). Frontal sinus: lies superior to the eyeball.
- J). Maxillary sinus: lies inferior to the eyeball.
- K). Ethmoid sinus: lies medial to eyeball

Objective 3)

Identify the extra-ocular muscles; indicate the nerve supply to each. Contrast the common clinical test for extra-ocular muscle function with the action of the individual muscles.

Levator palpebrae superioris:

- i. From lesser wing of sphenoid, superior and anterior optic canal to tarsal plate and skin of superior eyelid.
- ii. Innervated by oculomotor nerve (CN III)
- iii. Action: elevates superior eyelid
- iv. Contrast to test: eyelid droops

L). Superior rectus:

- i. From common tendinous ring to sclera just posterior to cornea
- ii. Innervated by oculomotor nerve (CN III)
- iii. Action: elevates, adducts, and rotates eyeball medially
- iv. Contrast to test: Eye will not go superiorly if turned laterally 35° because this isolates the muscle

M). Inferior rectus:

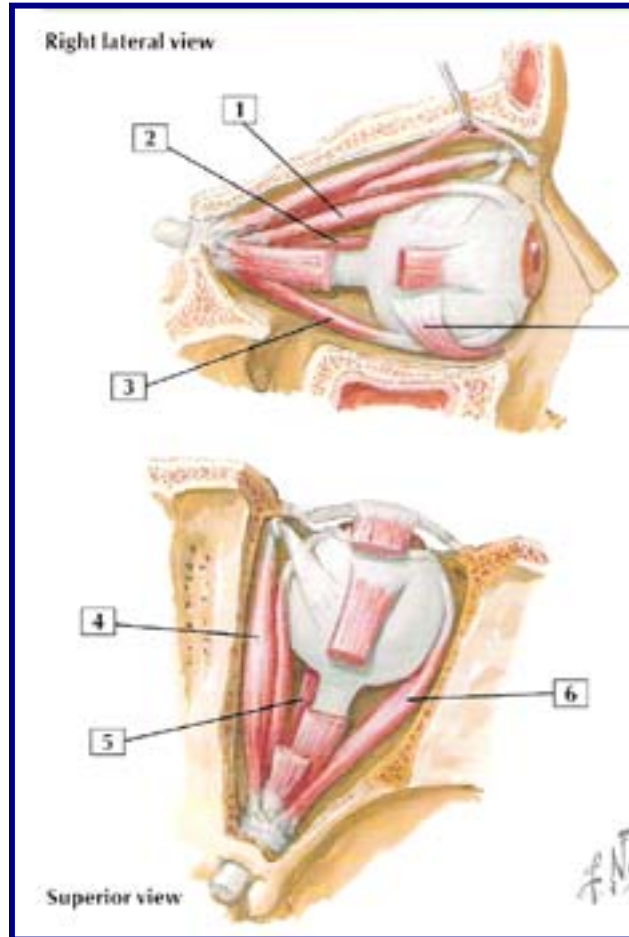
- i. From common tendinous ring to sclera just posterior to cornea
- ii. Innervated by oculomotor nerve (CN III)
- iii. Action: depresses, adducts, and rotates eyeball medially
- iv. Contrast to test: Eye will not go inferiorly if turned laterally 35° because this isolates the muscle

N). Lateral rectus:

- i. From common tendinous ring to sclera just posterior to cornea
- ii. Innervated by abducent nerve (CN VI)
- iii. Action: abducts eyeball
- iv. Contrast to test: Eye will not abduct properly to lateral side of orbit

O). Medial rectus:

- i. From common tendinous ring to sclera just posterior to cornea
- ii. Innervated by oculomotor nerve (CN III)
- iii. Action: adducts eyeball
- iv. Contrast to test: Eye will not adduct properly to medial side of orbit



- P). Superior oblique:
- i. From body the sphenoid through the trochlea and changes direction and inserts into sclera deep to superior rectus muscle
 - ii. Innervated by trochlear nerve (CN IV)
 - iii. Action: abducts, depresses, and rotates eyeball laterally
 - iv. Contrast to test: Eye will not go inferiorly if turned medially 35° because this isolates the muscle
- Q). Inferior oblique:
- i. From anterior part of floor of orbit to sclera deep to lateral rectus muscle
 - ii. Innervated by oculomotor nerve (CN III)
 - iii. Action: abducts, elevates, and rotates eyeball laterally
 - iv. Contrast to test: Eye will not go superiorly if turned medially 35° because this isolates the muscle
- R). Superior Tarsal Muscle (smooth muscle)
- a. Innervated by sympathetic nerve fiber
 - b. Helps levator palpebrae superioris in elevating superior eyelid and may cause the eye to be opened more widely during a sympathetic response, e.g. fright.

Objective 4)

Predict the functional deficit resulting from damage to the optic, oculomotor, trochlear, and/or abducens nerves.

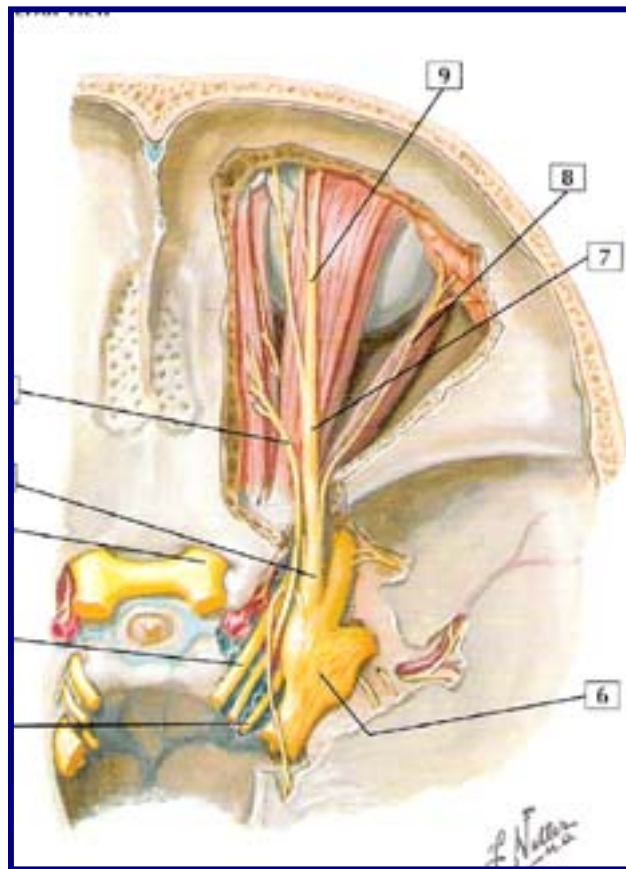
- S). Optic nerve (CN II) deficit: Loss of vision from retina
- T). Oculomotor nerve (CN III) deficit: Loss of innervation to superior rectus, inferior rectus, medial rectus, and inferior oblique muscles. This causes the loss of raising and adducting eyeball, dilated pupil, and eyelid droops (ptosis). Get down and out pointed eyeball because the lateral rectus and superior oblique muscles are unopposed.
- U). Trochlear nerve (CN IV) deficit: Loss of innervation to superior oblique muscle. Cannot lower eyeball when it is turned medially.
- V). Abducens nerve (CN VI) deficit: Loss of innervation to lateral rectus muscle. Cannot abduct eye past midpoint.
- W). Paralysis of more than 1 extra-ocular muscle, results in diplopia = double vision

Objective 5)

Follow the course of autonomic nervous supply to the orbital structures, indicating the pre- and post-ganglionic sources of innervation.

- X). Autonomic nervous control of the eye.
- i. Parasympathetic innervation
 1. Preganglionic cell bodies lie in brainstem near the oculomotor nucleus. These fibers “hitch” a ride with the oculomotor nerve (CN III) through the superior orbital fissure. They synapse in the ciliary ganglion with the cell bodies of postganglionic fibers, which travel through the short ciliary nerves to the sphincter pupillae of the pupil and the ciliary muscles of the lens. These control accommodation of the eyes when viewing objects a short distance away.
 2. Loss of parasympathetic NS causes an inability to constrict the pupil and an inability to accommodate lens. Also may signal damage to CN III because of “hitchhiking.”

- ii. Sympathetic innervation
 - 1. Preganglionic fibers arise in the thoracic spinal cord region and join the sympathetic chain. They travel to the superior cervical ganglion where they synapse. The postganglionic fibers then travel up and follow the blood vessels (internal carotid, ophthalmic) into the head and jump on the nasociliary nerve. From there, the postganglionic sympathetic fibers will either from the long ciliary nerves and go to the eye or pass through the ciliary ganglion without synapsing and leave it as short ciliary nerves. They innervate the vessels of the orbit and the dilator pupillae.
 - 2. Loss of sympathetic causes an inability to dilate the pupil so it stays constricted
- iii. Ciliary ganglion: very small group of nerve cell bodies lying b/ optic nerve (CN II) and the lateral rectus muscles towards posterior limit of orbit
- iv. Short Ciliary nerves:
Consist of postganglionic parasympathetic fibers originating in ciliary ganglion that synapse with preganglionic parasympathetic axons from the oculomotor nerve (CN III) and postganglionic sympathetic fibers that also pass through it.
- v. Long ciliary nerves:
Transmit postganglionic sympathetic fibers to the dilator pupillae and afferent fibers from iris and cornea.
- vi. Nasociliary nerve:
Comes off the ophthalmic nerve (CN V₁) and carries postganglionic sympathetic axons, but it also splits off the anterior and posterior ethmoidal nerves to the ethmoidal sinuses and the infratrochlear nerve.



Y). Autonomic nervous supply to the lacrimal gland:

- i. Parasympathetic innervation:
 - 1. The preganglionic parasympathetic secretomotor fibers begin at nuclei near the origin of the facial nerve (CN VII) are conveyed by it through the temporal bone. The preganglionic parasympathetic axons then form the great petrosal nerve and course along the middle

cranial fossa where they combine with the deep petrosal nerve (postganglionic sympathetic axons) and form the nerve to the petrosal canal that brings them to the pterygopalatine ganglion to synapse with a postganglionic fiber. Postganglionic parasympathetic fibers from the pterygopalatine ganglion jump onto the maxillary nerve (CN V₂) to the lacrimal gland, mucosa of the nasal cavity and mucosa of the oral cavity.

ii. Sympathetic innervation:

1. Vasoconstrictive postganglionic sympathetic fibers brought from superior cervical ganglion by the internal carotid plexus and form the deep petrosal nerve to join with the parasympathetic fibers forming the nerve to the pterygoid canal. They then transverse to the pterygopalatine ganglion, pass through it, and pass with the postganglionic parasympathetic axons to the lacrimal gland, mucosa of the nasal cavity and mucosa of the oral cavity.

Objective 6)

Trace the flow of blood into and out of the orbit and orbital structures.

Z). Blood in:

- i. Ophthalmic artery: Branches off of the internal carotid artery to transverse the optic foramen to reach optic cavity.
 1. Central retinal artery: From ophthalmic artery and runs in dural sheath of optic nerve and pierces nerve near eyeball. Appears at center of optic disc to supply neural retina (except rods and cones).
 2. Supraorbital artery: From ophthalmic artery and passes superiorly and posteriorly from supraorbital foramen to supply forehead and scalp.
 3. Supratrochlear artery: From ophthalmic artery to pass from supraorbital margin to forehead and scalp.
 4. Lacrimal artery: From ophthalmic artery and passes along superior border of lateral rectus muscle to supply lacrimal gland, conjunctiva, and eyelids.
 5. Dorsal nasal artery: From ophthalmic artery and courses along dorsal aspect of nose to supply its surface.
 6. Short posterior ciliary arteries: From ophthalmic artery and pierce sclera at periphery of optic nerve to supply choroids, which in turn supplies the cones and rods of neural retina.
 7. Long posterior ciliary arteries: From ophthalmic artery and pierce sclera to supply ciliary body and iris.
 8. Anterior ciliary artery: From ophthalmic artery and pierce sclera at the periphery of iris and forms network in iris and ciliary body.
 9. Posterior ethmoidal artery: From ophthalmic artery and passes through posterior ethmoidal foramen to posterior ethmoidal cells.
 10. Anterior ethmoidal artery: From ophthalmic artery and passes through anterior ethmoidal foramen to anterior cranial fossa to supply anterior and middle ethmoidal cells, frontal sinus, nasal cavity, and skin on dorsum of nose.
- ii. Infraorbital artery: From 3rd part of maxillary artery and passes along infraorbital groove and foramen to face.

- AA). Blood out:
- i. Veins of the orbit are tributaries of the superior and inferior ophthalmic veins that pass through the superior orbital fissure and enter the cavernous sinus. The inferior ophthalmic vein also drains to the pterygoid venous plexus, especially when the head is erect.
 - ii. The central retinal vein usually enters cavernous sinus directly, but it may drain into ophthalmic veins and drains retina.
 - iii. The vorticosse veins from the middle vascular layer of the eyeball drain into the ophthalmic veins.
 - iv. The scleral venous sinus is a vascular structure encircling the anterior chamber of the eye through which the aqueous humor is returned to the blood circulation.