

L19 Orbit

A. Anatomy of Orbit

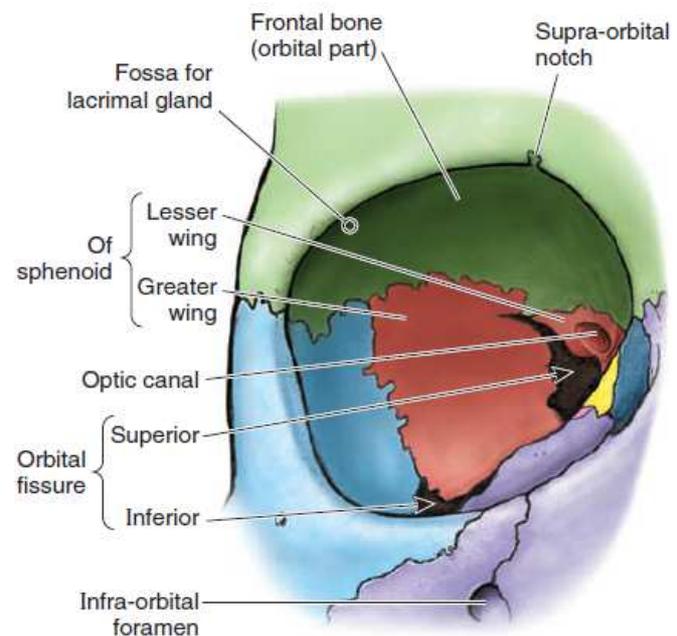
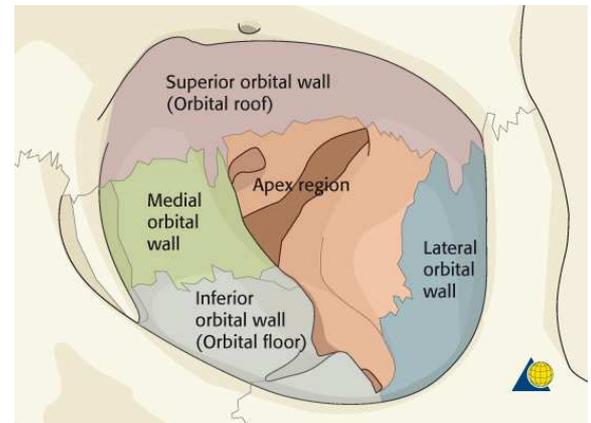
1. Bony Orbit

- ▶ **Orbit:** a pyramidal bony cavity that contains:
 - Ocular muscles
 - Fascia and fat
 - Nerves and vessels
 - Lacrimal gland
 - Eyeball

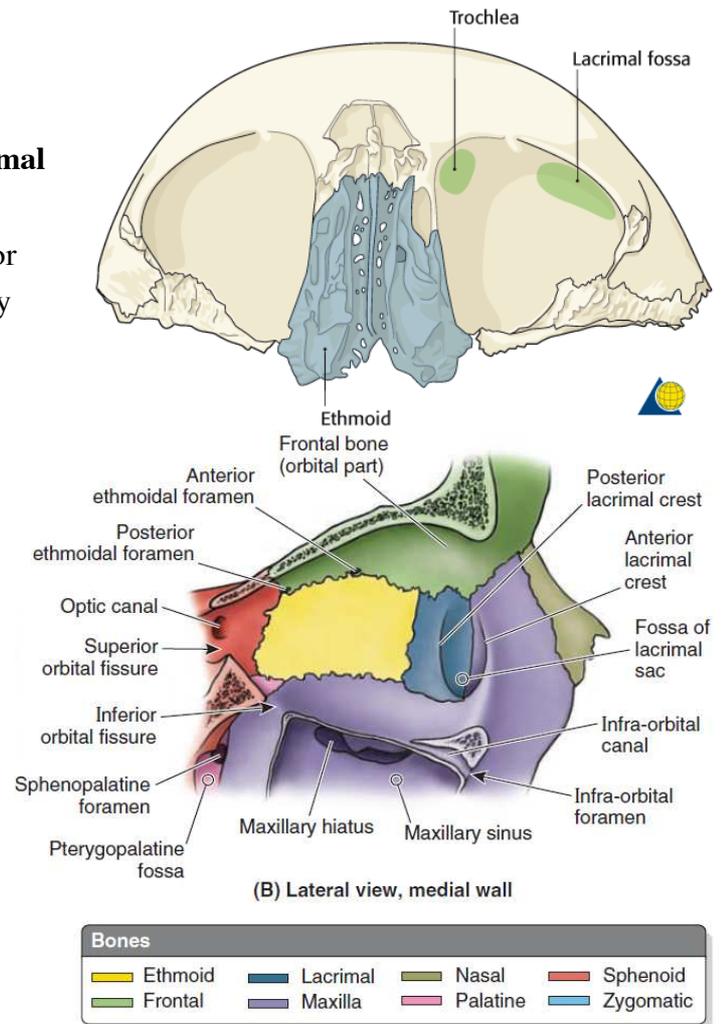
- ▶ Made up of four **walls** and one **apex**
 - Superior roof
 - Inferior floor
 - Medial wall
 - Lateral wall

- ▶ Dimensions of orbit:
 - Medial walls parallel and 25mm apart
 - Widest dimension: 1cm (just behind anterior rim)
 - Medial wall length = 45mm
 - Two lateral walls form an angle of 90°

- ▶ Composed of seven bones:
 - **Frontal bone**
 - **Zygomatic bone**
 - **Maxillary bone**
 - **Sphenoid bone:** greater and lesser wings
 - **Ethmoid bone**
 - **Palatine bone**
 - **Lacrimal bone**



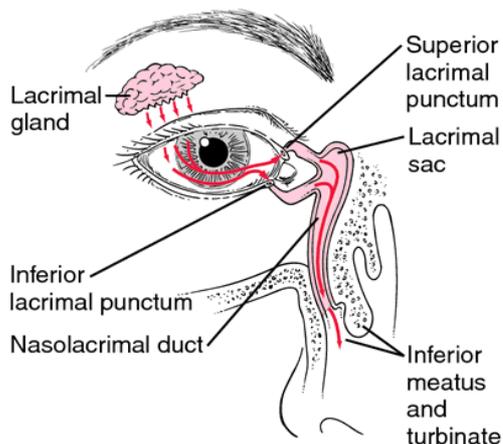
- ▶ Superior roof: thin
 - **Frontal bone**
 - **Fossa for lacrimal gland (lacrimal fossa)** located laterally
 - **Trochlea**: cartilaginous pulley for superior oblique located medially
 - **Lesser wing of sphenoid**
- ▶ Medial wall: thinnest
 - **Lamina papyracea of ethmoid bone**: extremely thin bony layer separating orbit from ethmoidal sinuses
 - **Frontal bone**
 - **Lacrimal bone**:
 - **Posterior lacrimal crest**
 - **Fossa for lacrimal sac**
 - **Sphenoid bone**
 - **Frontal process of maxilla**
 - **Anterior lacrimal crest**

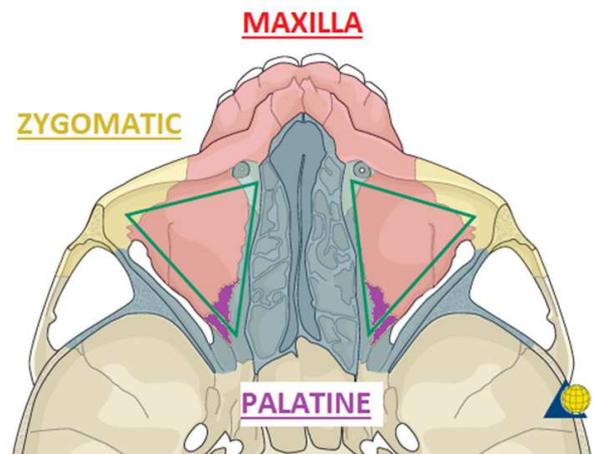
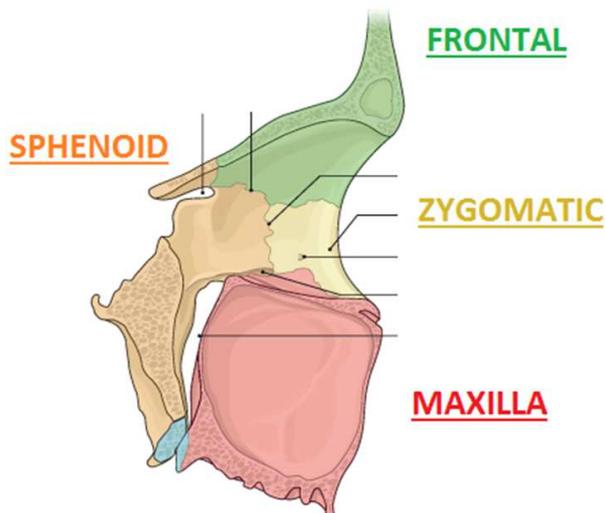


***Lacrimal sac** = dilated opening of nasolacrimal duct which eventually drains between maxilla and lacrimal bones into inferior meatus

Fossa for lacrimal sac is bound by **anterior and posterior lacrimal crests** on maxilla and lacrimal bones

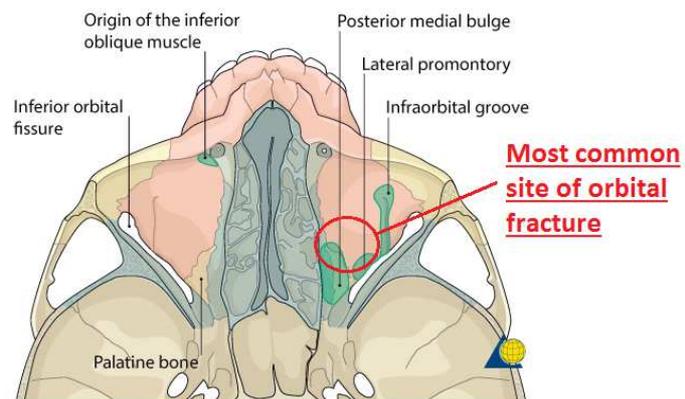
Lacrimal bone is sometimes removed in surgeries to correct nasolacrimal duct blockage.



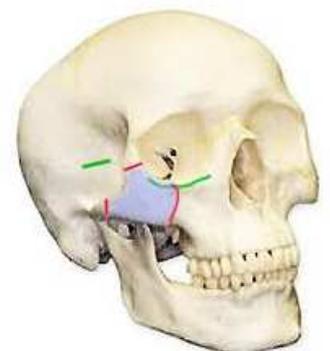


- ▶ Lateral wall: thickest
 - **Frontal process of zygomatic bone**
 - **Greater wing of sphenoid bone**
- ▶ Inferior floor: thin
 - **Maxilla bone**
 - **Zygomatic bone**
 - **Palatine bone**

- ▶ Orbital fractures:
 - Most common: posteromedial aspect of **orbital floor**
 - Usually medial to course of infraorbital n. and lateral to lacrimal sac
 - **Infraorbital n.** can be damaged or traumatized during injury and/or repair
 - Concomitant eyeball displacement (∵ floor provides support to the eyeball)

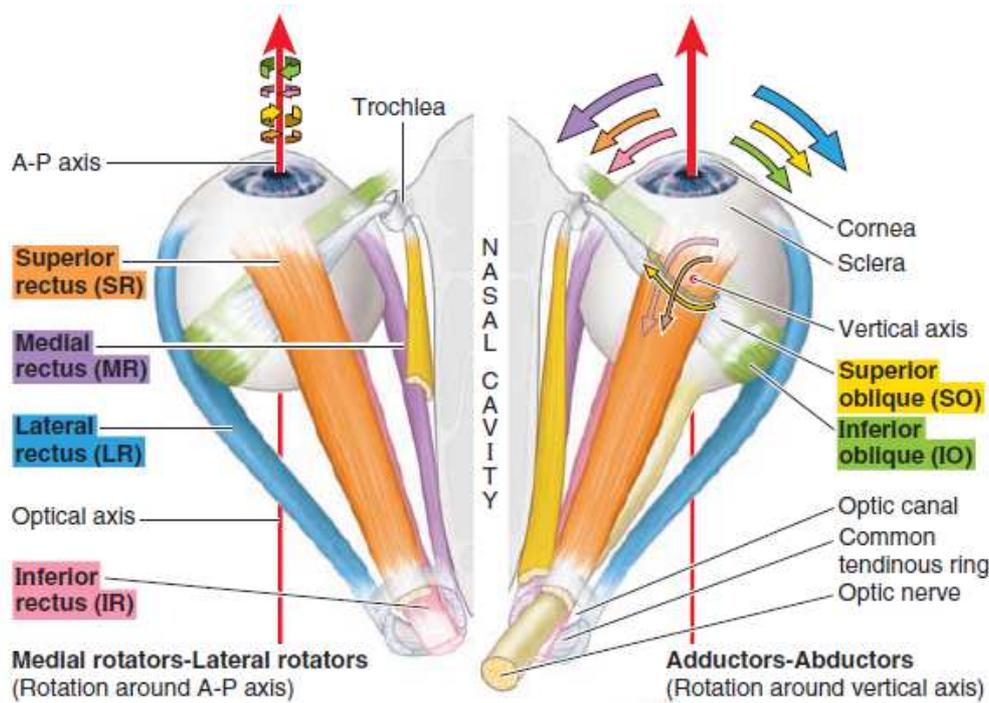


- Medial wall:
 - 'Cushion effect' of ethmoidal sinus
 - NOT commonest site of fracture despite being thinnest
 - No displacement of eyeball → less S/S
- Lateral wall:
 - Thickest → fracture rare
 - Usually complicated fractures, eg. **tripod fracture**



Tripod fracture

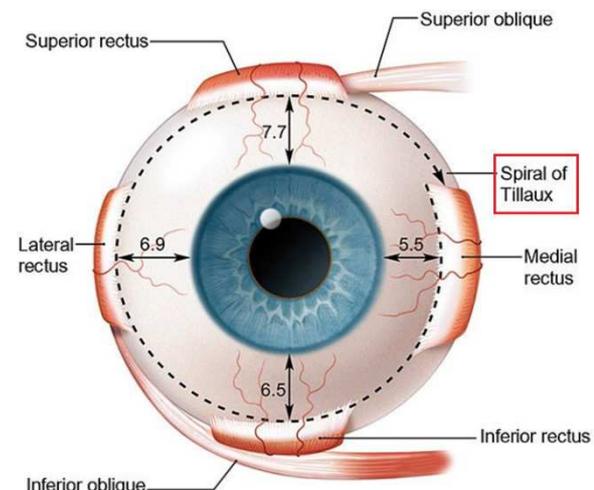
2. Muscles of Orbit



- ▶ **Extraocular muscles** include four **recti** and two **oblique muscles**
 - **Recti** (**superior, lateral, medial** and **lateral**) originates from the **annulus of Zinn** at medial apex of orbit to attach at sclera
 - **Superior oblique** originates from body of sphenoid bone with tendon passing through **trochlea** (anteromedial orbit) to insert into sclera deep to superior rectus
 - **Inferior oblique** originates from anterior floor of orbit and inserts at sclera deep to lateral rectus

▶ **Spiral of Tillaux:**

- Distances between different recti insertion into sclera and **corneal limbus** varies
- ↑distance going from medial rectus clockwise
- Clinically important as an indication of original orientation of eyeball when it is displaced
→ Identification of recti muscles by measurement of the distance with a caliper



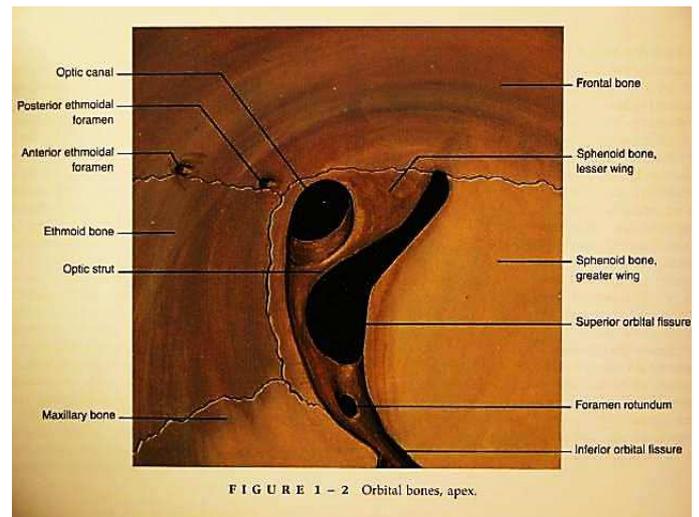
▶ **Actions of extraocular muscles:**

- **Obliques abduct** vs **recti adduct** (except LR)
- **Superiors intort** vs **inferiors extort**
- **Recti** act according to their names vs **obliques** act opposite to their names

▶ **Levator palpebrae superioris:** elevates eyelid

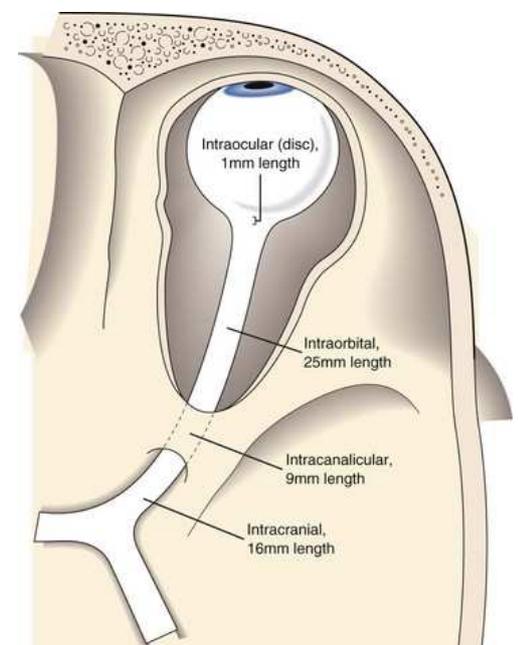
3. Apex of Orbit

- ▶ **Annulus of Zinn (annular tendon, oculomotor foramen):** common tendinous origin of all four recti muscles
 - Levator palpebrae superioris and oblique muscles originate outside annulus of Zinn from the bony orbit
- ▶ Foramina and fissures of apex:
 - **Optic canal**
 - **Superior orbital fissure** separating roof and lateral wall
 - **Inferior orbital fissure** separating lateral wall and floor



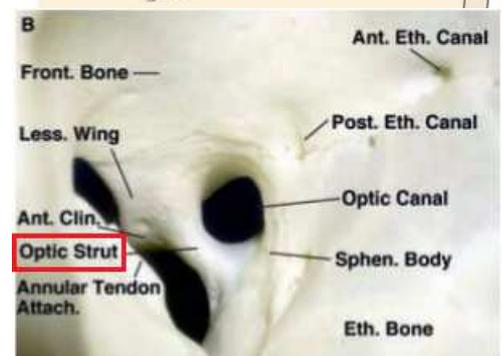
a. Optic Canal

- ▶ **Optic canal:**
 - Located between **lesser wing** (lateral) and **body of sphenoid** (medial)
 - Transmits **optic nerve** and **ophthalmic artery**
- ▶ **Optic nerve:**
 - Length = ~47-50mm
 - **Intraocular portion** = ~1mm
 - **Intraorbital portion** = ~25-30mm
 - S-shaped and mobile
 - allow eyeball movement
 - **Intracanalicular portion** = ~6-9mm
 - **Intracranial portion** = ~10mm



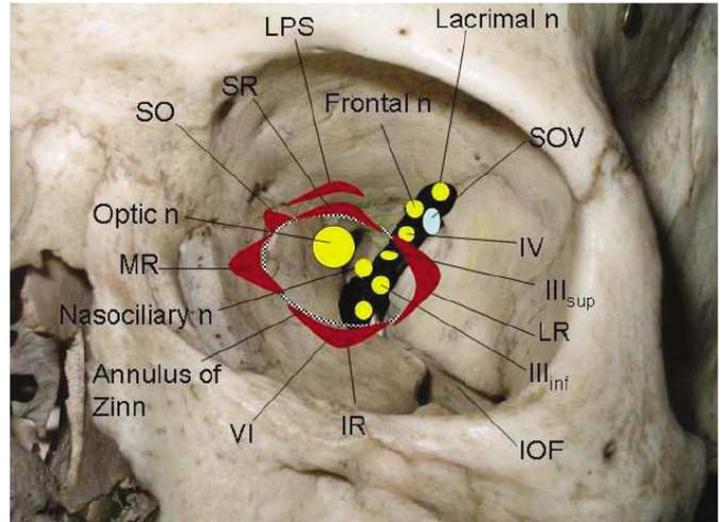
***Optic strut** = a small pillar of bone between optic canal and superior orbital fissure

Relevance: preserved in orbital decompression surgeries as it keeps the eyeball at the right position by supporting the **optic nerve**.



b. Superior Orbital Fissure

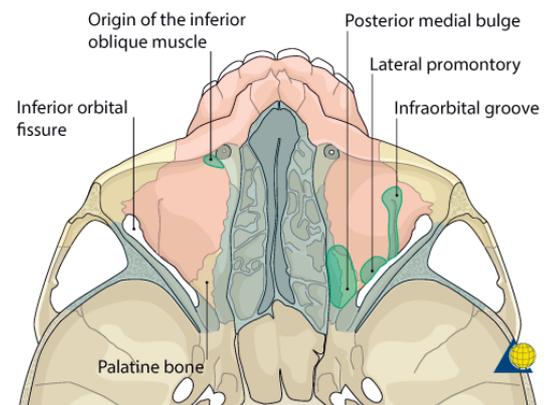
- ▶ **Superior orbital (oblique) fissure:**
 - Located between **greater** and **lesser wings of sphenoid**
 - Divided by **annulus of Zinn** into **extraconal** and **intraconal compartments**
- ▶ **Extraconal compartment** transmits: *LFT SOV*
 - **Lacrimal n. (III)**
 - **Frontal n. (III)**
 - **Trochlear n. (CN IV)**
 - **Superior ophthalmic v.**
- ▶ **Intraconal compartment** transmits: *NASO₂*
 - **Nasociliary n. (III)**
 - **Abducens n. (CN VI)**
 - **Sympathetic nerve plexus** from ICA at cavernous sinus
 - **Oculomotor n. (CN III):**
superior and inferior divisions



**Superior branch of inferior ophthalmic vein also drain via superior orbital fissure, either by joining SOV or separately to cavernous sinus.*

c. Inferior Orbital Fissure

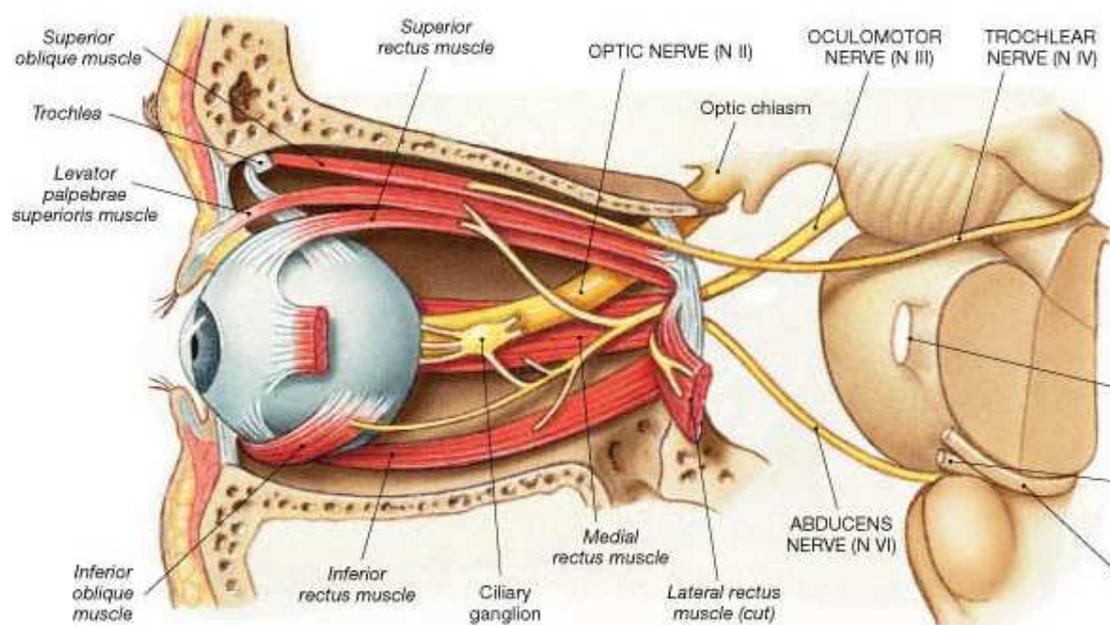
- ▶ **Inferior orbital fissure:**
 - Located between **greater wing** and **maxilla**
 - Connects with **infratemporal** and **pterygopalatine fossae**
- ▶ **Contents:**
 - **Inferior ophthalmic vein** (inferior branch)
 - **Maxillary n. (CN V₂)** and its branches
 - **Branches of pterygopalatine ganglion** (parasympathetic)



**Note that the infraorbital groove runs anteriorly from the fissure on maxilla and is eventually covered by a bony lamina, forming infraorbital canal for infraorbital A/V/N to pass from pterygopalatine fossa through orbital floor to the face.*

4. Innervation of Orbit

a. Motor Nerves



► Oculomotor n. (CN III):

- Divides into **superior** and **inferior divisions** before entering orbit
- Enters orbit through **intraconal superior orbital fissure**
- **Superior division** supplies:
 - **Levator palpebrae superioris (LPS)**
 - **Superior rectus**
- **Inferior division** supplies:
 - **Medial rectus**
 - **Inferior rectus**
 - **Inferior oblique**

► Trochlear n. (CN IV):

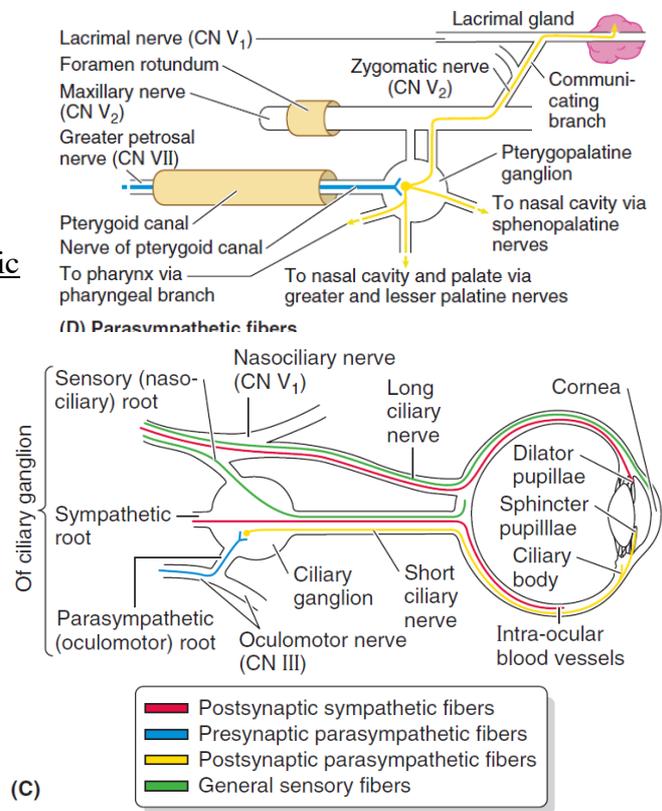
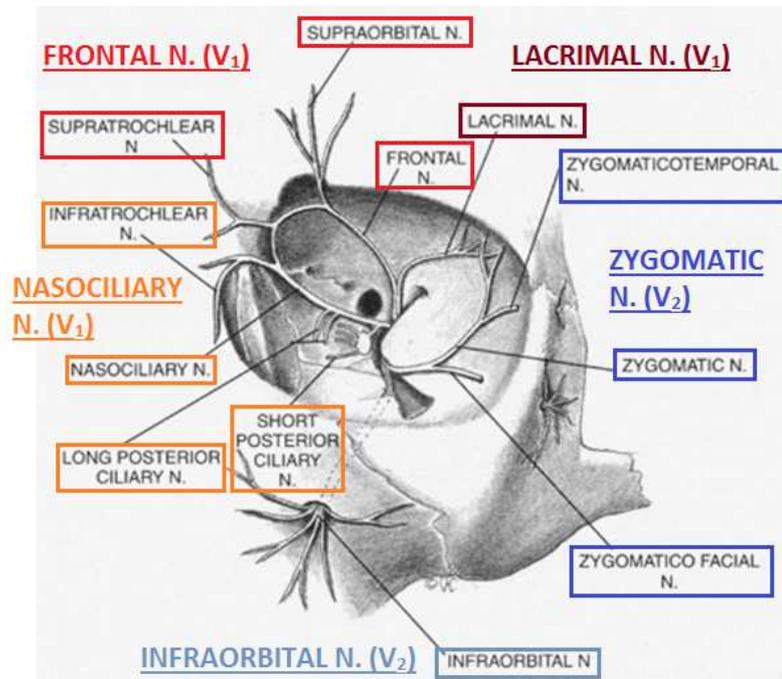
- Enters orbit through **extraconal superior orbital fissure**
- Supplies **superior oblique** only

► Abducens n. (CN VI):

- Enters orbit through **intraconal superior orbital fissure**
- Supplies **lateral rectus** only

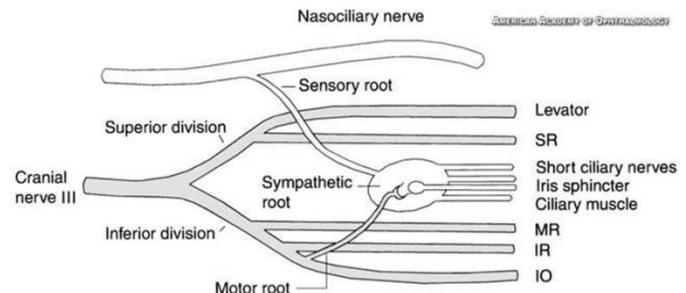
b. Sensory Nerves

- ▶ **Ophthalmic n. (CN V₁)** divides into three divisions before entering orbit
- ▶ **Frontal n. (V₁):**
 - Enters orbit via **extraconal superior orbital fissure**
 - Runs superomedially
 - **Supraorbital n.** exits through supraorbital notch → face
 - **Supratrochlear n.** → face
- ▶ **Lacrimal n. (V₁):**
 - Enters orbit via **extraconal superior orbital fissure**
 - Runs superolaterally
 - Joined by communicating branch from **zygomatic n. (V₂)** to carry parasympathetic fibres from pterygopalatine ganglion
 - Provides general sensory innervation to lacrimal gland
- ▶ **Nasociliary n. (V₁):**
 - Enter orbit via **intraconal superior orbital fissure**
 - Runs medially
 - **Infratrochlear n.** → face
 - **Long ciliary n.** → GSA + SN (from sup. cervical ganglion) to eyeball
 - **Ciliary ganglion** → **short ciliary n.** → GSA to eyeball

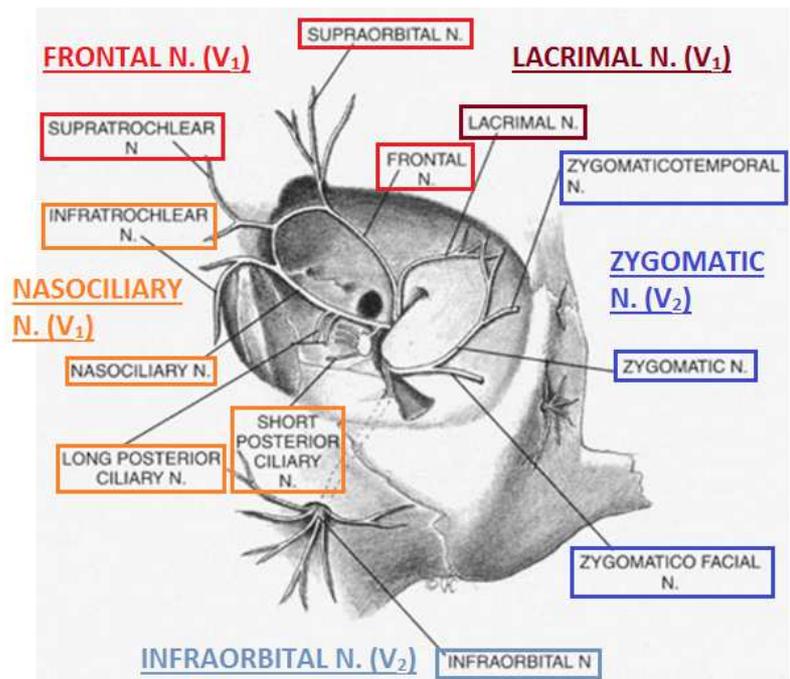


Note that the sympathetic and parasympathetic fibres in ciliary ganglion and short ciliary n. are contributed by a **separate sympathetic root from the carotid plexus and **n. to inferior oblique (III)** respectively.*

***Note that **infratrochlear n.** from nasociliary n. supplies skin of tip of nose. Therefore herpes zoster at nose tip would indicate a high chance of eye involvement (due to CN V₁) involvement.*



- ▶ **Zygomatic n. (V₂):**
 - Enters orbit via **inferior orbital fissure**
 - Runs laterally
 - **Zygomatofacial n.** → face
 - **Zygomatocotemporal n.** → face
- ▶ **Infraorbital n. (V₂):**
 - Enters orbit via **inferior orbital fissure**
 - Runs along **infraorbital groove** and eventually exits onto the face via **infraorbital canal**

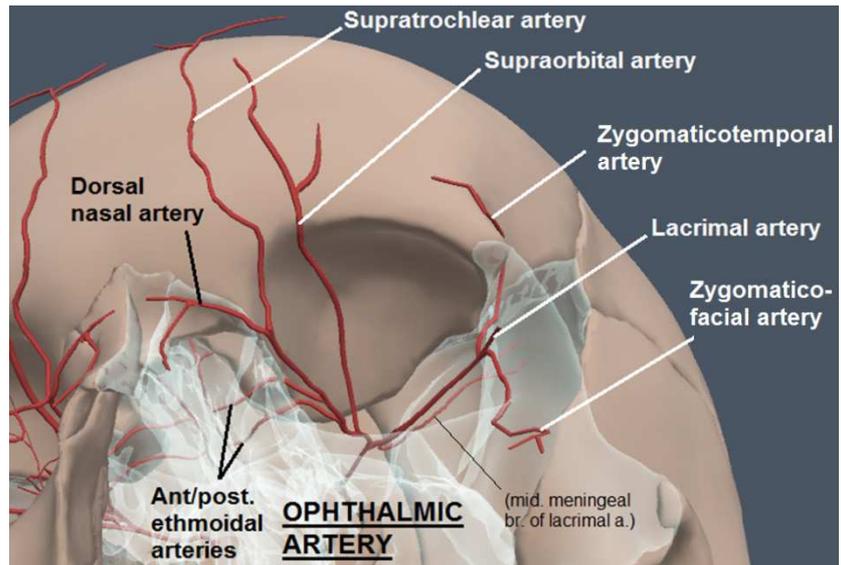


5. Vasculature of Orbit

- ▶ Chief supply by **ophthalmic artery**:
 - Enters orbit through **optic canal** together with optic nerve
- ▶ **Ocular branches** supplying the eye:
 - **Central artery of retina**
 - Pierces optic n. and runs within it
 - Emerges at the optic disc to supply **retina**
 - An end artery: only blood supply to retina
 - blindness if blocked
 - **Anterior ciliary artery** (from **muscular branches**) → choroid
 - **Posterior ciliary artery** → choroid + parts of CN II

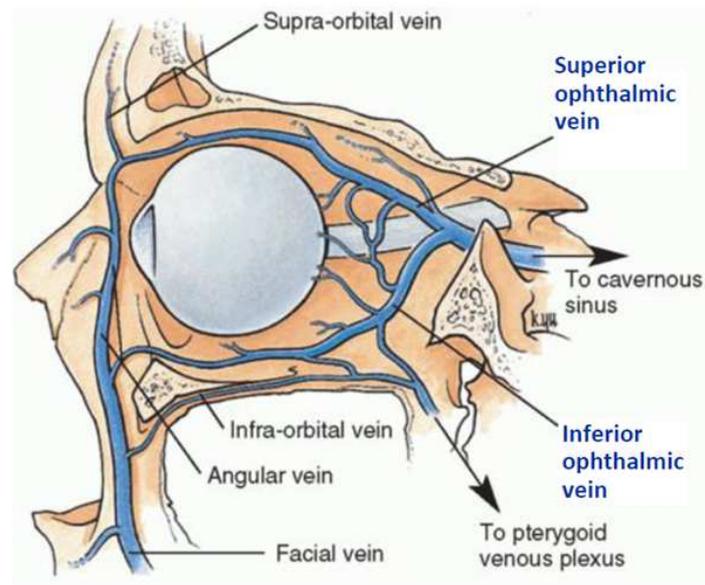
► **Orbital branches** supplying the orbit and surrounding structures:

- Superiorly:
 - **supratrochlear** and **supraorbital aa.** to forehead
- Laterally: **lacrimal a.** then giving off **zygomaticofacial** and **zygomaticotemporal aa.** after passing through zygomatic bone
- Medially:
 - **A/P ethmoidal aa.** into the ethmoidal sinus and nasal cavities
 - **Dorsal nasal a.** to dorsal surface of the nose



► **Superior ophthalmic vein:**

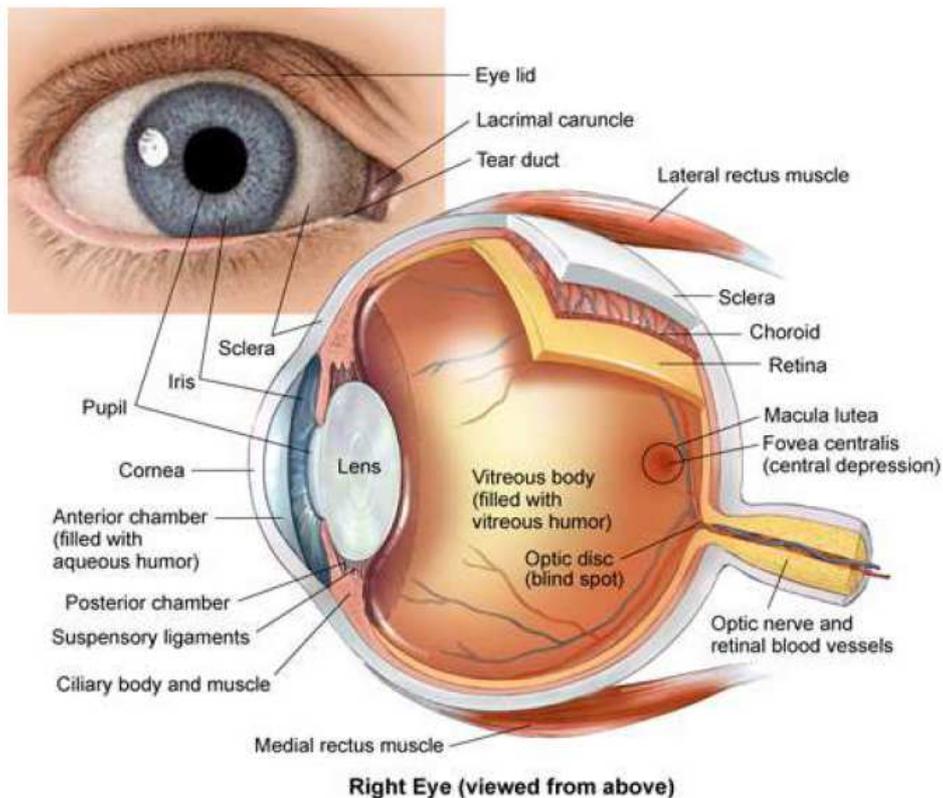
- Connects with supraorbital and angular veins
- Passes across superior part of orbit
- Leaves orbit through **superior orbital fissure** between greater and lesser wings of sphenoid to drain into **cavernous sinus** in the cranial cavity



► **Inferior ophthalmic vein:**

- Smaller and passes inferiorly in the orbit
- Receives blood from muscles and posterior part of eye
- Leaves orbit posteriorly by:
 - Joining with **superior orbital vein** and leaves via sup. orbital fissure
 - Passes through **inferior orbital fissure** to join **pterygoid venous plexus** via **pterygopalatine fossa**

B. Anatomy of Eyeball

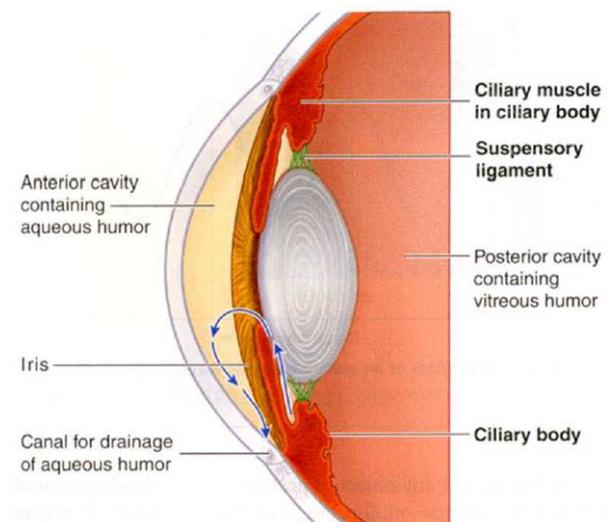


- ▶ **Eyeball** lining divided into three layers:
 - Outer layer: **sclera + cornea**
 - Fibrous in nature
 - **Sclera** opaque due to irregular arrangement of collagen
 - **Cornea** transparent due to regular collagen arrangement
 - Middle layer: **choroid + iris + ciliary body**
 - Vascular, pigmented layer
 - Inner layer: **retina**
 - Consists of photoreceptors and nerve fibres
- ▶ Effect of parasympathetic stimulus:
 - Contraction of **ciliary body**
 - ↓tension on lens via **suspensory ligaments**
 - near vision
 - Contraction of **sphincter pupillae**
 - constriction of pupils

- ▶ **Fundus:** internal surface of eye
 - Can be visualized by **fundoscopy**
 - **Optic disc:** site of attachment of optic n. (CN II)
 - **Optic cup:** white, cup-like bulging area at the centre of optic disc
 - Veins appear darker than arteries
 - Clinical relevance:
 - **Glaucoma:** ↑IOP results in enlargement of optic cup
 - **Papilloedema:** blurring of disc margin and swollen disc indicating ↑ICP

1. Support of Eyeball

- ▶ **Lens** divide interior of eyeball into:
 - **Posterior cavity** filled with **vitreal humour**
 - **Anterior cavity** filled with **aqueous humour**
 - **Anterior chamber** anterior to pupil
 - **Posterior chamber** posterior to pupil
 - Function of eyeball humour: provides mechanical support to eyeball



- ▶ **Vitreous humour:**
 - Contains 1% hyaluronic acid (and other proteins) → gel-like
 - Stagnant (no circulation) → no effect on intra-ocular pressure
- ▶ **Aqueous humour:**
 - Watery
 - Formed at **posterior chamber** by a capillary network in **ciliary body**
 - Travels through pupil into **anterior chamber**
 - Drains via **Schlemm's canal** from anterior chamber to blood
 - Clinical relevance: **glaucoma**
 - Caused by excess buildup of intraocular pressure
 - Can result from Schlemm's canal blockage
 - Relieved by **parasympathomimetics** (eg. pilocarpine)
 - ∴ contraction of ciliary body pulls open trabeculae draining into Schlemm's canal

► **Tenon's capsule:**

- Forms a fascial sheath surrounding the eyeball
- Envelopes the eyeball from optic nerve to corneoscleral junction
- Pierced by tendons of extraocular muscles and continuous with its muscular sheath

► Superiorly,

- Fusion with muscle sheaths of superior rectus and LPS

► Inferiorly,

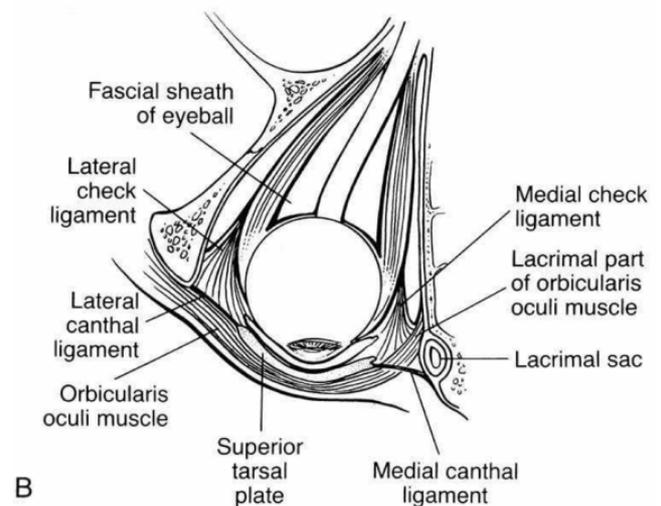
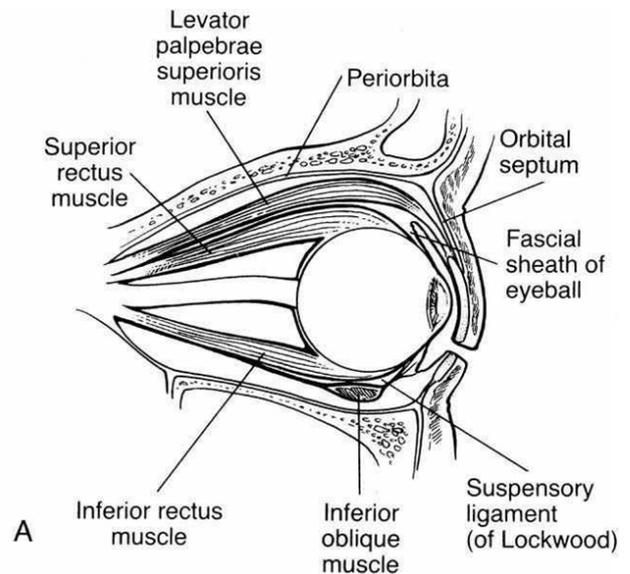
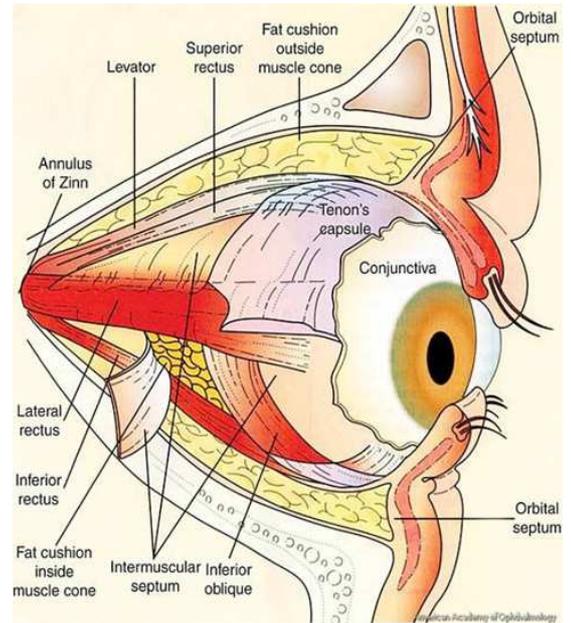
- Fusion with muscle sheaths of inferior rectus and inferior oblique
- Sheath of inferior rectus expanded to attach to

inferior tarsus

- Forms a hammock-like sling (**suspensory ligament**) to suspend the eyeball in orbit

► Laterally/medially,

- **Lateral check ligament:** strong expansion of lateral rectus sheath to zygomatic bone
- **Medial check ligament:** strong expansion of medial rectus sheath to lacrimal bone
- Function: restrains ('checks') movements of lateral and medial recti



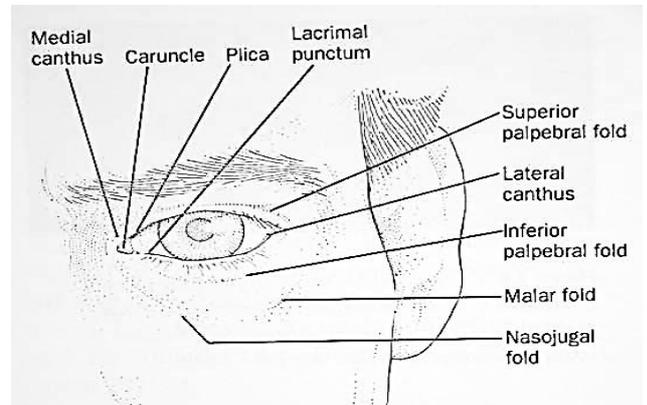
C. Anatomy of Eyelids

► Functions:

- Protects cornea and eyeball from foreign body, dust, injury and light
- Enables spreading of tears to keep cornea moist during blinking
- Contributes to facial features

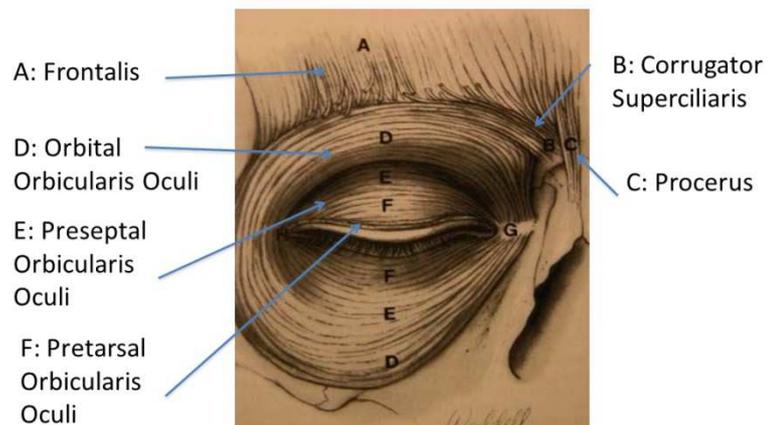
► Surface anatomy:

- **Superior and inferior palpebral folds** divides each eyelid into **orbital** and **tarsal parts**
- **Palpebral fissure:** elliptical space enclosed by the eyelids
- **Medial and lateral canthi:** boundaries of palpebral fissure
- **Caruncle:** small pink nodule at medial canthus of eye
 - Made of skin with sebaceous and sweat glands
- **Plica semilunaris:** small fold of bulbar conjunctiva on medial canthus of eye
- **Lacrimal punctum:** opening near medial canthus that drains tears into nasolacrimal duct



► Periocular muscles:

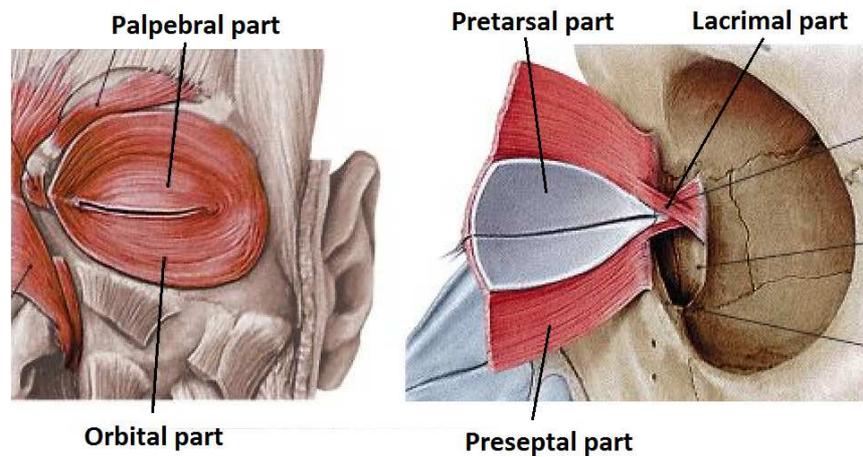
- **Frontalis** draws skin on forehead and upper eyelid upwards
- **Corrugator supercillii** draws skin above eye inferomedially
- **Procerus** draws skin on forehead inferiorly
- **Orbicularis oculi** form concentric rings around the eye



- ▶ Layers of eyelid:
 - Skin
 - Subcutaneous areolar tissue
 - Striated muscles
 - Submuscular areolar tissues
 - Fibrous layer (skeleton of eyelids)
 - Conjunctiva

1. Muscles of Eyelid

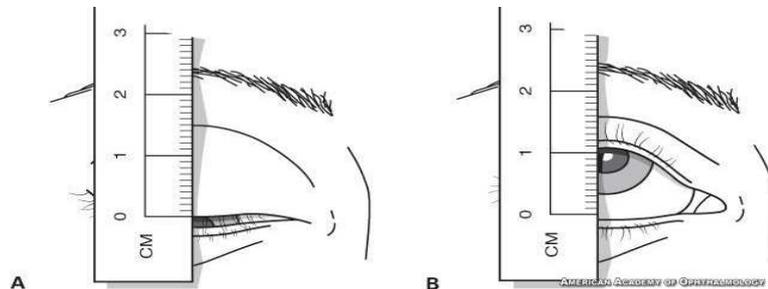
- ▶ **Orbicularis oculi:**
 - Three layers:
 - **Orbital part**
 - **Palpebral part =**
preseptal + pretarsal parts
 - **Lacrimal part**
 - Function: closes the eyelids
 - Innervation: **zygomatic branch of facial n.**



- ▶ **Levator palpebrae superioris (LPS):**
 - Only present in upper eyelid
 - Origin: lesser wing of sphenoid (superior to optic canal)
 - Insertion:
 - **Tarsal plate** via wide aponeurosis
 - **Müller's (superior tarsal) muscle** (smooth muscle) extends from levator aponeurosis to tarsal plate
 - Skin of eyelid
 - Function: raises upper eyelid
 - Innervation: **superior division of CN III**

▶ **Test for LPS function:**

- Patient asked to look down then look up
- Difference in eyelid position measured
- Must press on **frontalis** to negate its effect (inserts into orbicularis oculi fibres)



**Eyelid crease marks the attachment of levator palpebrae superioris onto upper eyelid. This attachment is located more inferiorly in Asians and therefore giving the 'single eyelid' appearance to Asians.*

2. Fibrous Layer of Eyelids

- ▶ Divides eyelid into anterior and posterior parts
- ▶ **Tarsal plates:** dense bands of connective tissue near the edge of eyelid
 - Attached to bony orbit via **medial** and **lateral palpebral ligaments**
 - Join at **medial** and **lateral canthi**
 - **Tarsal (Meibomian) glands** secrete lipids to lubricate edges of eyelid
 - **Eyelashes** anchor at tarsal plates
- ▶ **Septum orbitale:** weak c.t. membrane spanning between tarsus and bony orbit
 - Continuous with periosteum of orbital margin
 - Clinical relevance: **postseptal cellulitis** much more dangerous than **preseptal cellulitis** due to venous connection with cavernous sinus

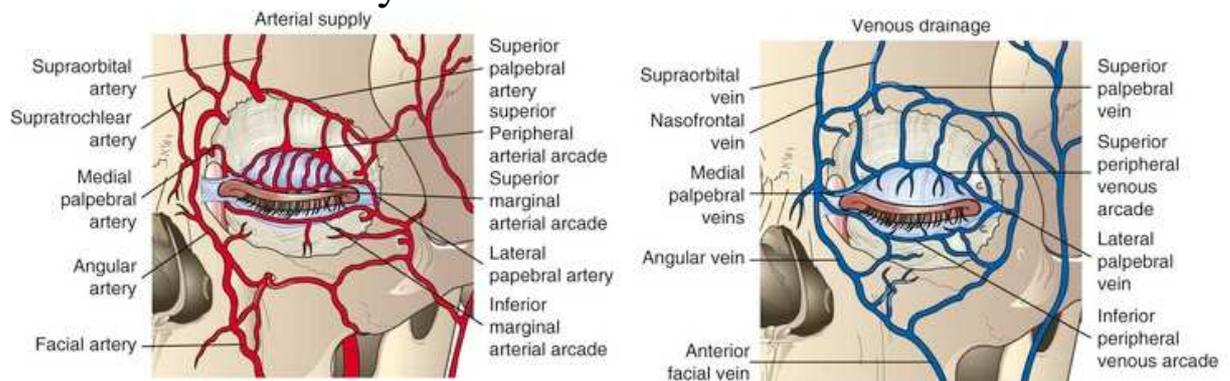
3. Conjunctiva

- ▶ **Palpebral conjunctiva:** posterior lining of eyelids
- ▶ **Bulbar conjunctiva:** lining on anterior surface of eyeball
- ▶ **Fornix:** where bulbar conjunctiva becomes palpebral
- ▶ Joins to form **conjunctival sac**

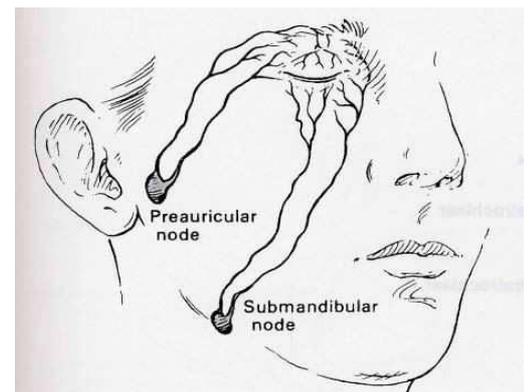
4. Innervation

- ▶ Superior eyelid:
 - **Supraorbital n.**
 - **Lacrimal n.**
 - **Supratrochlear n.**
 - **Infratrochlear n.**
- ▶ Inferior eyelid:
 - **Infraorbital n.**

5. Vasculature of Eyelids



- ▶ Extensive anastomoses
- ▶ Arterial supply: **medial and lateral palpebral arteries**
- ▶ Venous supply: **medial and lateral palpebral veins**
- ▶ Lymphatic drainage:
 - Upper eyelid → **preauricular node**
 - Lower eyelid → **submandibular node**



D. Anatomy of Lacrimal System

- ▶ **Lacrimal gland:** a pair of almond-shaped glands
 - Function: secretion of tears
 - Lies in **fossa for lacrimal gland** in superolateral part of orbit
 - Innervation:
 - Secretomotor: greater petrosal n. (VII) synapsing at pterygopalatine ganglion
 - General sensory: lacrimal br. of ophthalmic n. (V₁)
- ▶ Drainage of tears from surface of eye:
 - Two **lacrimal puncta** near medial canthus
 - **Lacrimal canaliculus**
 - **Common canaliculus (Sinus of Maier)**
 - **Lacrimal sac**
 - **Nasolacrimal duct**
 - **Inferior meatus** of nasal cavity

