

# **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**

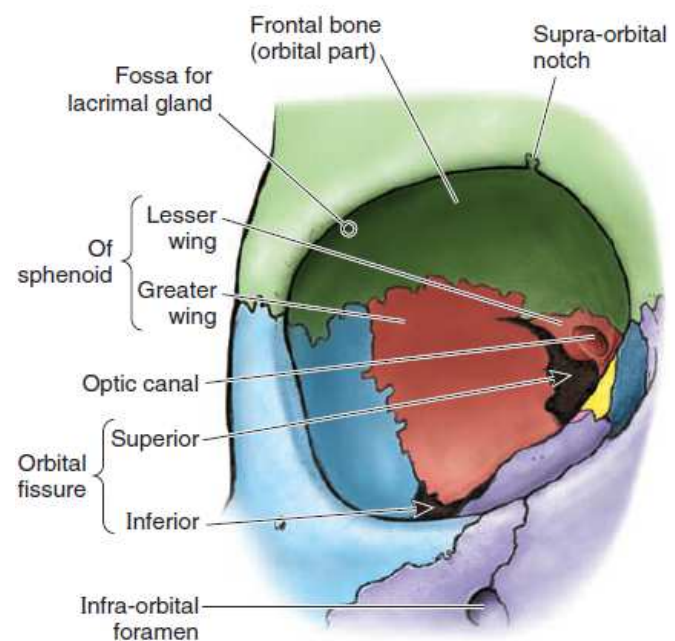
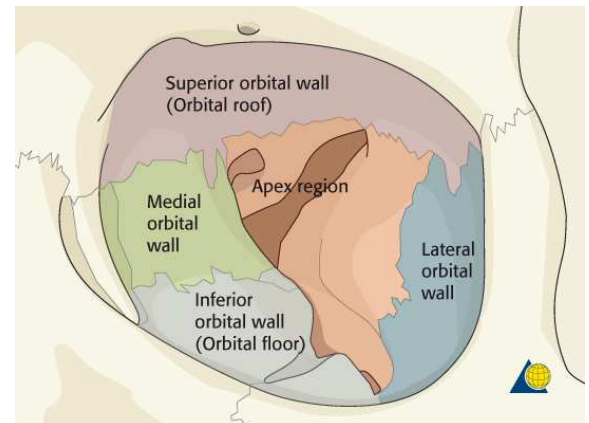
- Superior roof
- Inferior floor
- Medial wall
- Lateral wall

► Dimensions of orbit:

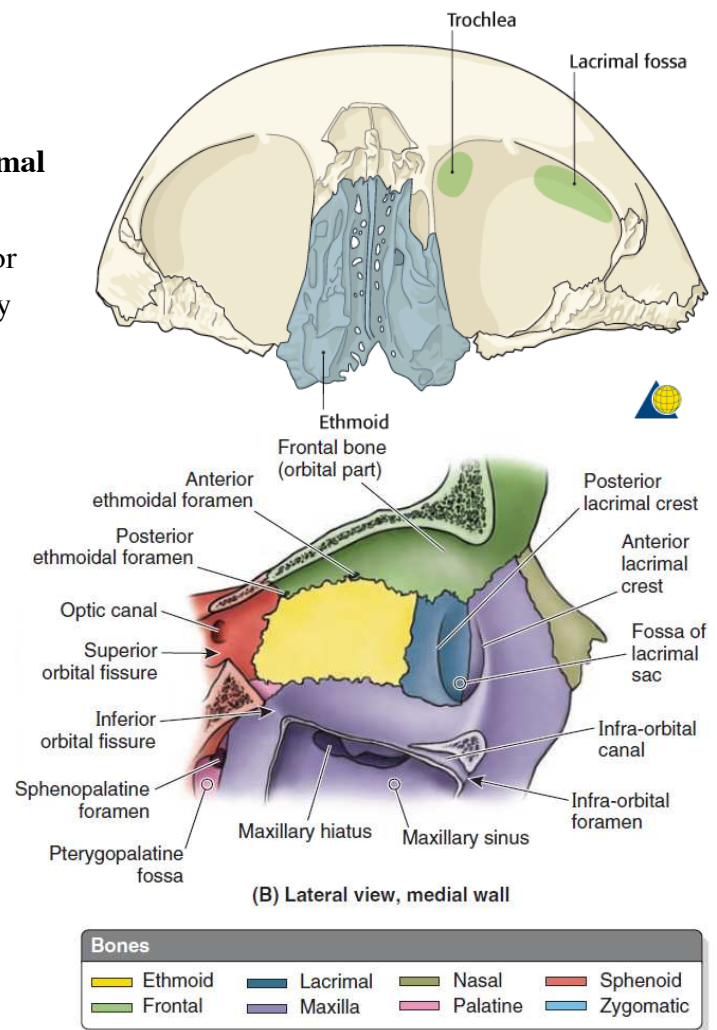
- Medial walls parallel and 25mm apart
- Widest dimension: 1cm (just behind anterior rim)
- Medial wall length = 45mm
- Two lateral walls form an angle of 90°

► Composed of seven bones:

- **Frontal bone**
- **Zygomatic bone**
- **Maxillary bone**
- **Sphenoid bone:** greater and lesser wings
- **Ethmoid bone**
- **Palatine bone**
- **Lacrimal bone**



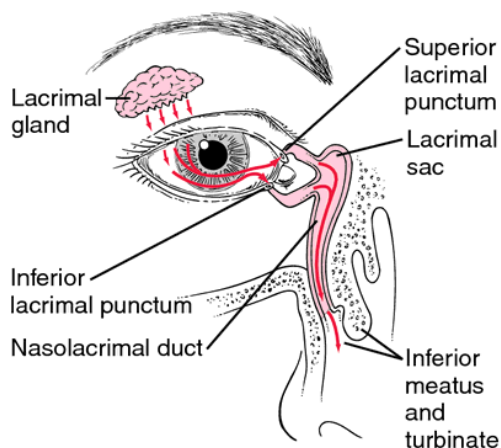
- ▶ Superior roof: thin
  - **Frontal bone**
    - **Fossa for lacrimal gland (lacrimal fossa)** located laterally
    - **Trochlea**: cartilaginous pulley for superior oblique located medially
  - **Lesser wing of sphenoid**
- ▶ Medial wall: thinnest
  - **Lamina papyracea of ethmoid bone**: extremely 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**

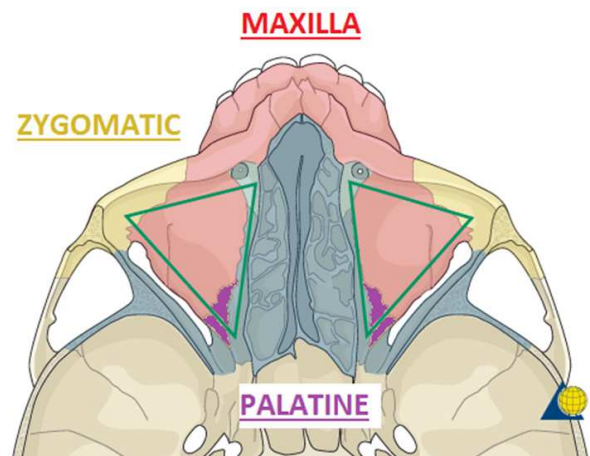
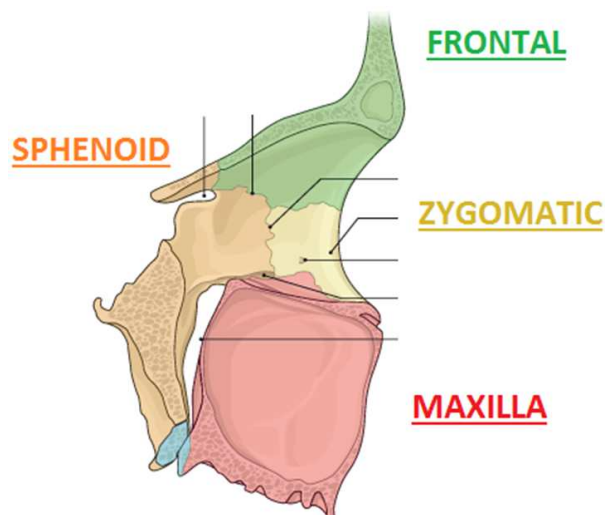


*\***Lacrimal sac** = dilated opening of nasolacrimal duct which eventually drains between maxilla and lacrimal bones into inferior meatus*

***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.*

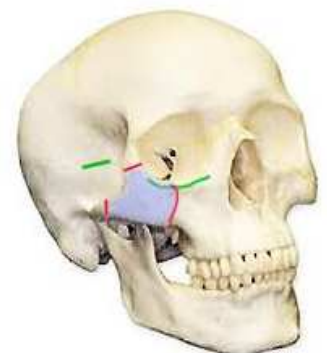
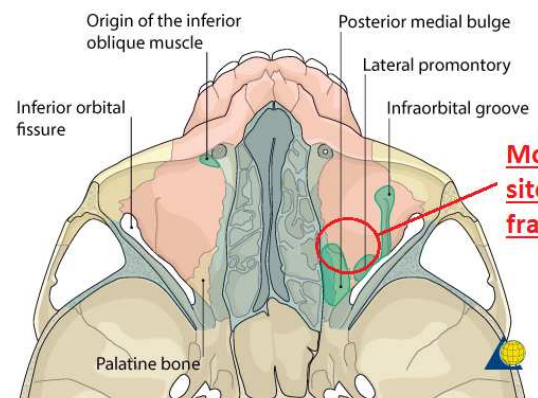




- ▶ Lateral wall: thickest
  - **Frontal process of zygomatic bone**
  - **Greater wing of sphenoid bone**
- ▶ Inferior floor: thin
  - **Maxilla bone**
  - **Zygomatic bone**
  - **Palatine bone**

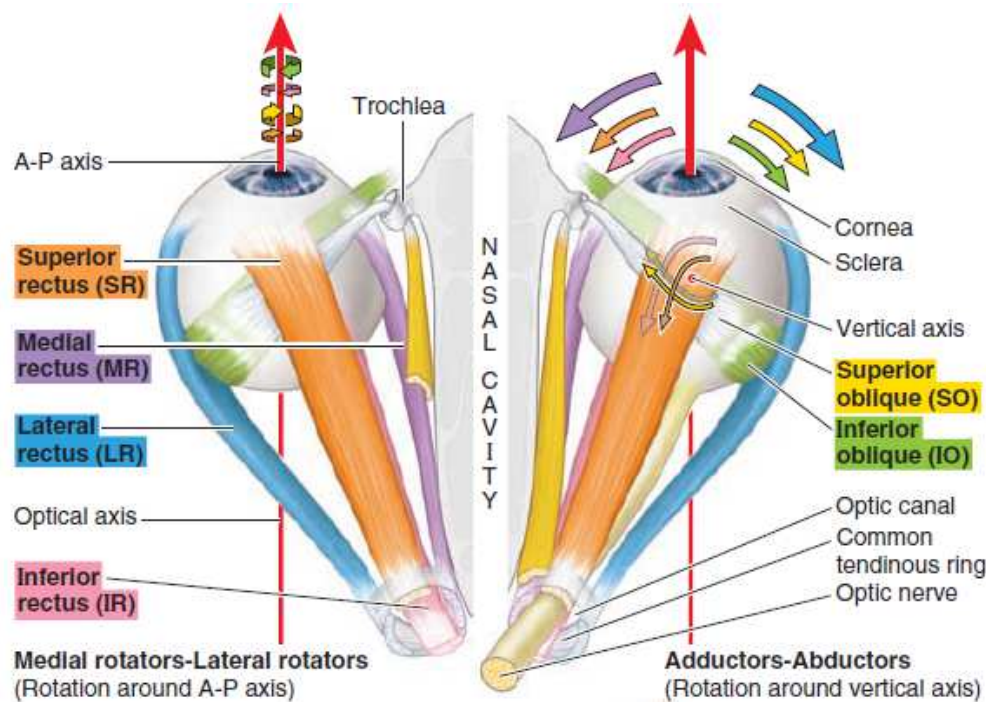
▶ Orbital fractures:

- 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**

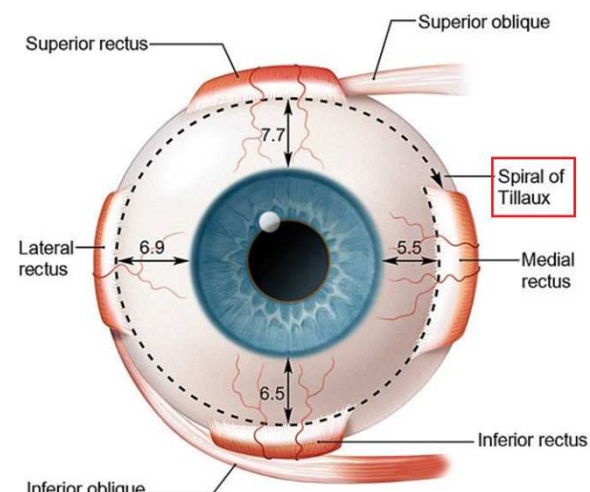
## 2. Muscles of Orbit



- **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



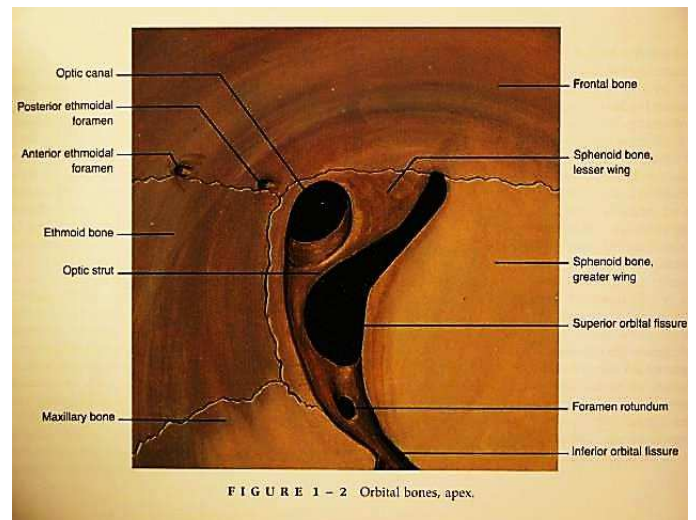
### ► **Actions of extraocular muscles:**

- **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

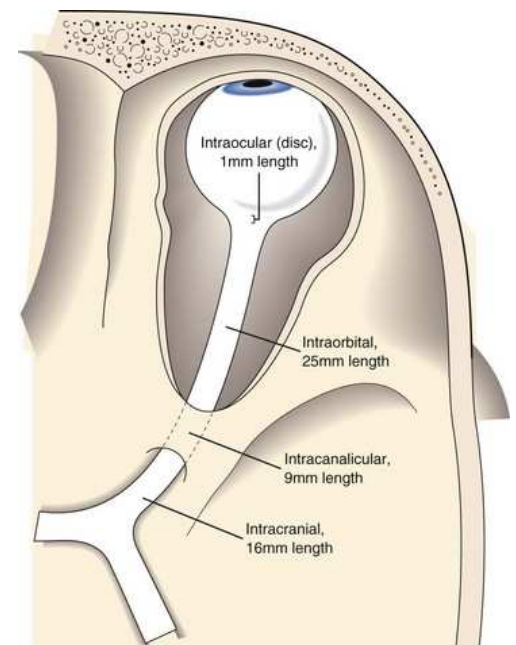
### 3. Apex of Orbit

- ▶ **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



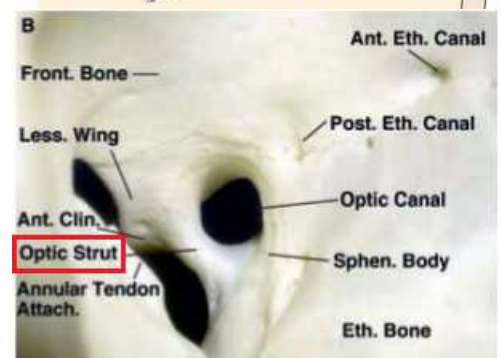
#### a. Optic Canal

- ▶ **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*

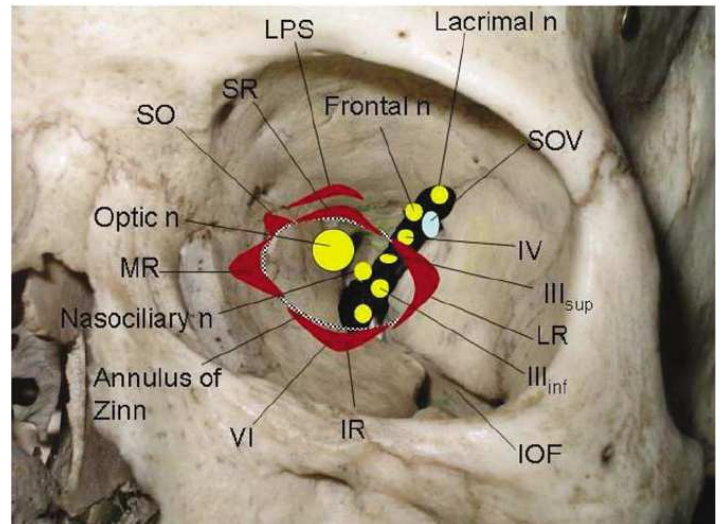
*Relevance: preserved in orbital decompression surgeries as it keeps the eyeball at the right position by supporting the **optic nerve**.*



## b. Superior Orbital Fissure

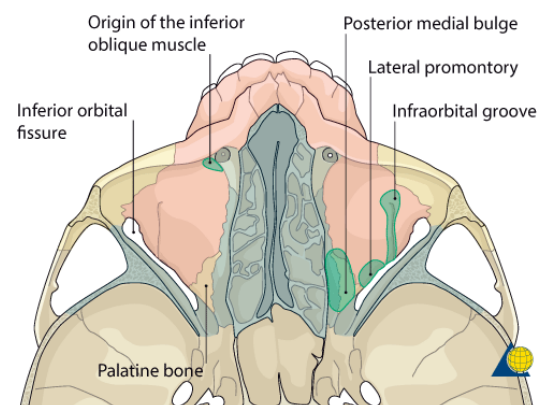
- ▶ **Superior orbital (oblique) fissure:**
  - Located between **greater** and **lesser wings of sphenoid**
  - Divided by **annulus of Zinn** into **extraconal** and **intraconal compartments**
- ▶ **Extraconal compartment** transmits: *LFT SOV*
  - **Lacrimal n. (III)**
  - **Frontal n. (III)**
  - **Trochlear n. (CN IV)**
  - **Superior ophthalmic v.**
- ▶ **Intraconal compartment** transmits: *NASO<sub>2</sub>*
  - **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

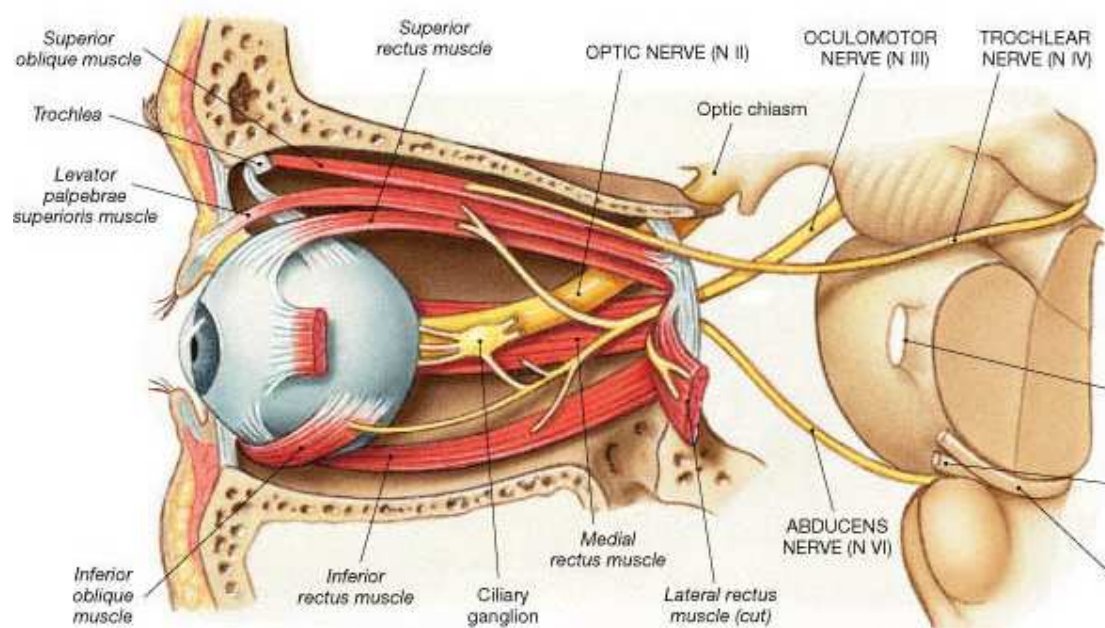
- ▶ **Inferior orbital fissure:**
  - Located between **greater wing** and **maxilla**
  - Connects with **infratemporal** and **pterygopalatine fossae**
- ▶ **Contents:**
  - **Inferior ophthalmic vein** (inferior branch)
  - **Maxillary n. (CN V<sub>2</sub>)** and its branches
  - **Branches of pterygopalatine 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):

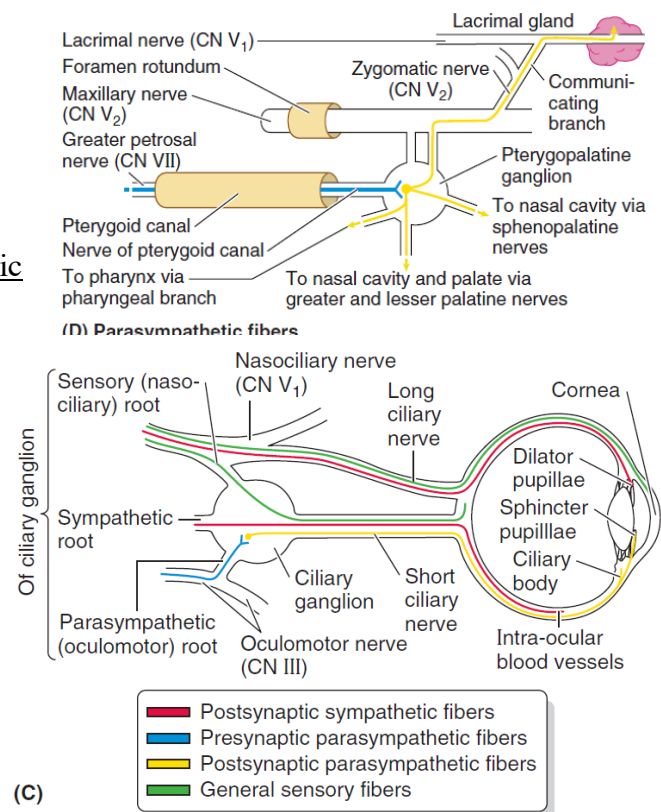
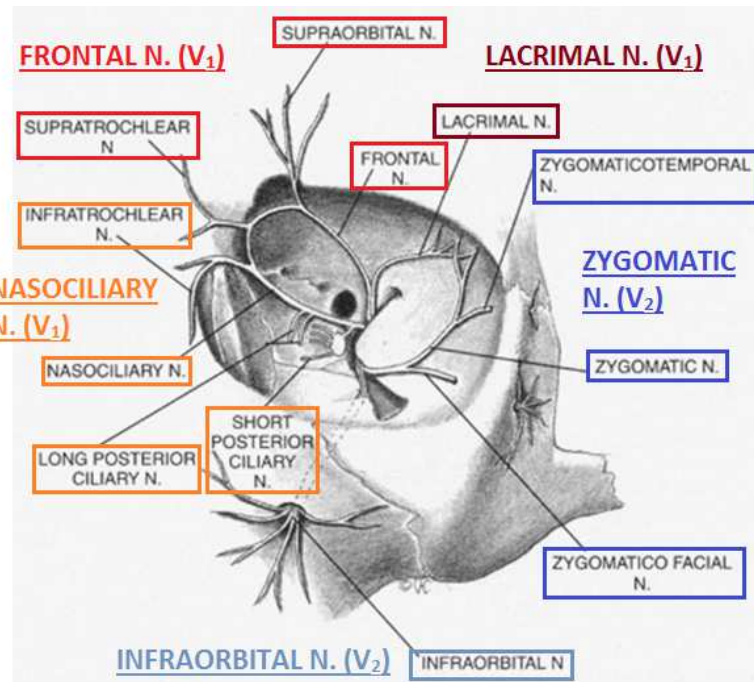
- ☐ Enters orbit through **extraconal superior orbital fissure**
- ☐ Supplies **superior oblique** only

#### ► Abducens n. (CN VI):

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

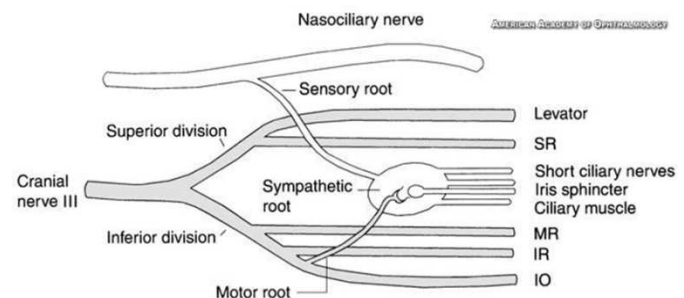
## b. Sensory Nerves

- ▶ **Ophthalmic n. (CN V<sub>1</sub>)** divides into three divisions before entering orbit
- ▶ **Frontal n. (V<sub>1</sub>):**
  - Enters orbit via **extraconal superior orbital fissure**
  - Runs superomedially
  - **Supraorbital n.** exits through supraorbital notch → face
  - **Supratrochlear n.** → face
- ▶ **Lacrimal n. (V<sub>1</sub>):**
  - Enters orbit via **extraconal superior orbital fissure**
  - Runs superolaterally
  - Joined by communicating branch from **zygomatic n. (V<sub>2</sub>)** to carry parasympathetic fibres from pterygopalatine ganglion
  - Provides general sensory innervation to lacrimal gland
- ▶ **Nasociliary n. (V<sub>1</sub>):**
  - 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

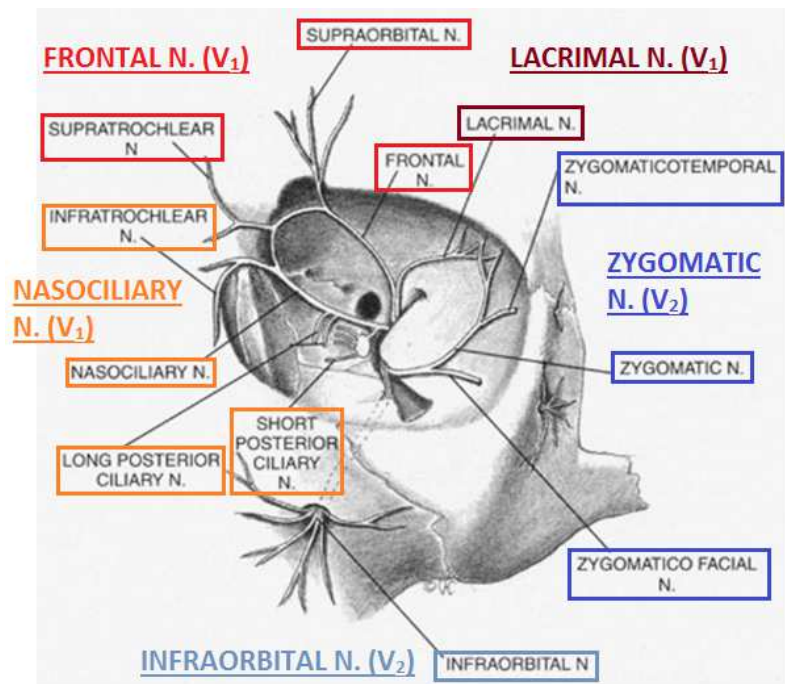


*\*Note that the sympathetic and parasympathetic fibres in ciliary ganglion and short ciliary n. are contributed by a **separate sympathetic root** from the carotid plexus and **n. to inferior oblique (III)** respectively.*

*\*\*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 V<sub>1</sub>) involvement.*



- ▶ **Zygomatic n. (V<sub>2</sub>):**
  - Enters orbit via **inferior orbital fissure**
  - Runs laterally
  - **Zygomaticofacial n.**
    - face
  - **Zygomaticotemporal n.**
    - face
- ▶ **Infraorbital n. (V<sub>2</sub>):**
  - Enters orbit via **inferior orbital fissure**
  - Runs along **infraorbital groove** and eventually exits onto the face via **infraorbital canal**

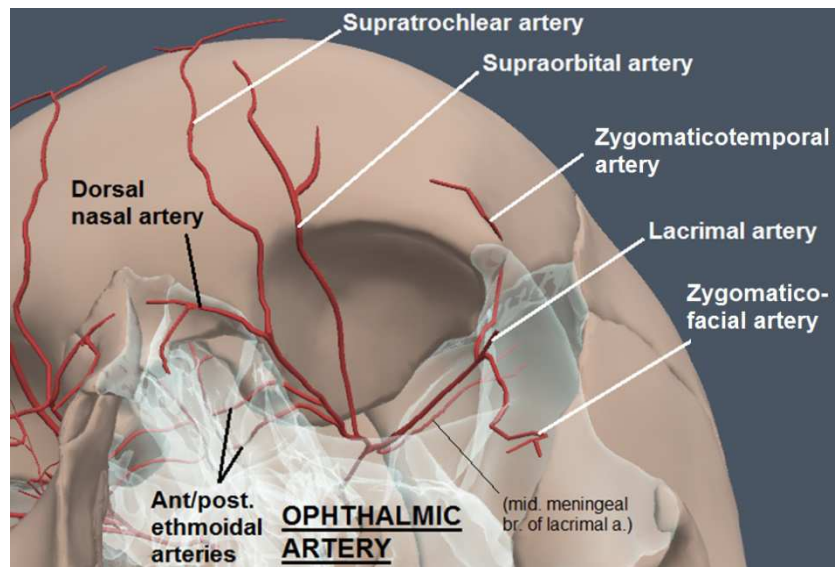


## 5. Vasculature of Orbit

- ▶ 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

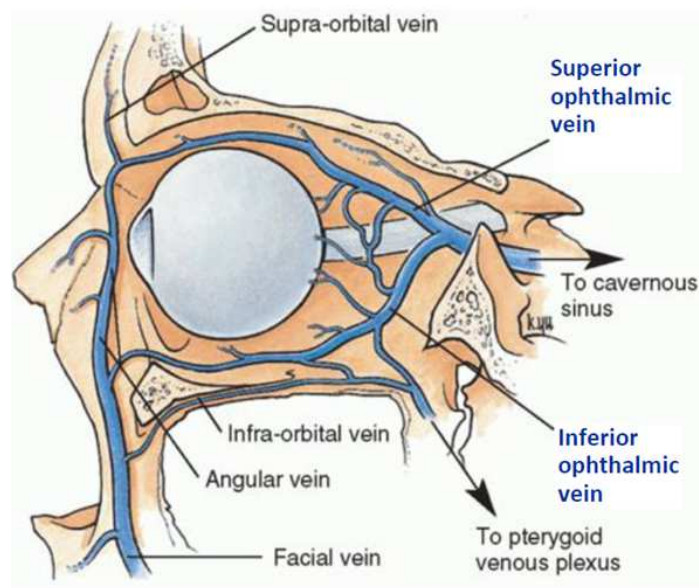
► **Orbital branches** supplying the orbit and surrounding structures:

- 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:**

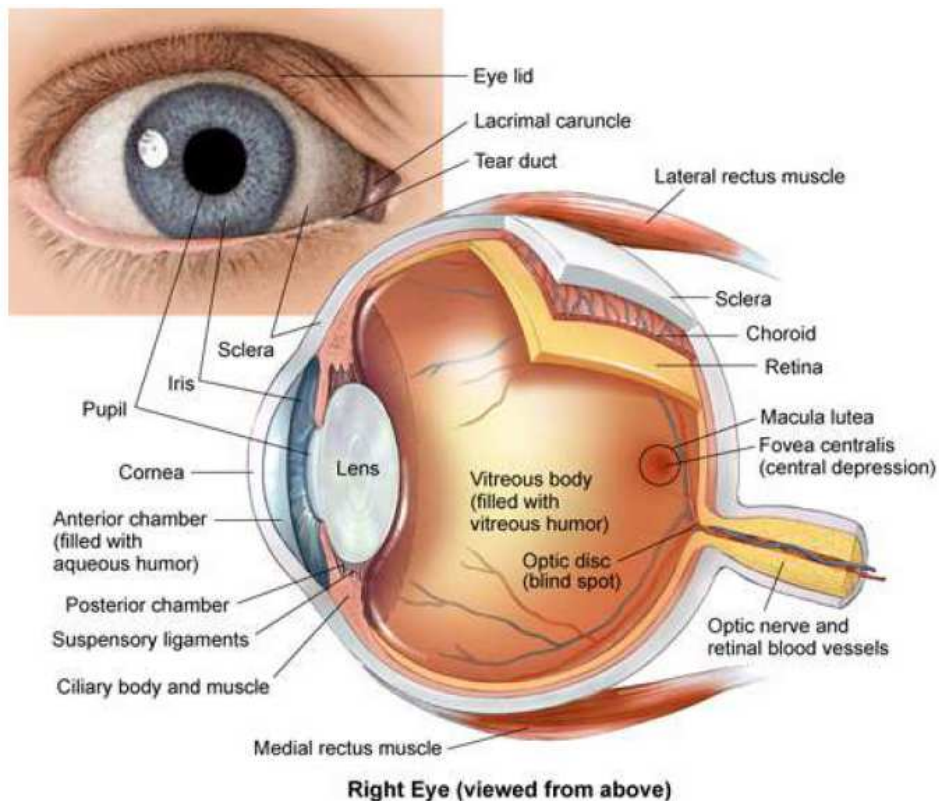
- Connects with supraorbital and angular veins
- Passes across superior part of orbit
- Leaves orbit through **superior orbital fissure** between greater and lesser wings of sphenoid to drain into **cavernous sinus** in the cranial cavity



► **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

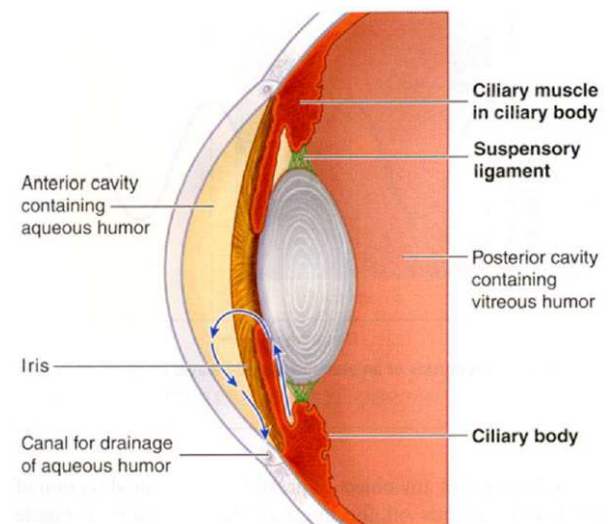


- ▶ **Eyeball** lining divided into three layers:
  - Outer layer: **sclera + cornea**
    - Fibrous in nature
    - **Sclera** opaque due to irregular arrangement of collagen
    - **Cornea** transparent due to regular collagen arrangement
  - Middle layer: **choroid + iris + ciliary body**
    - Vascular, 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,

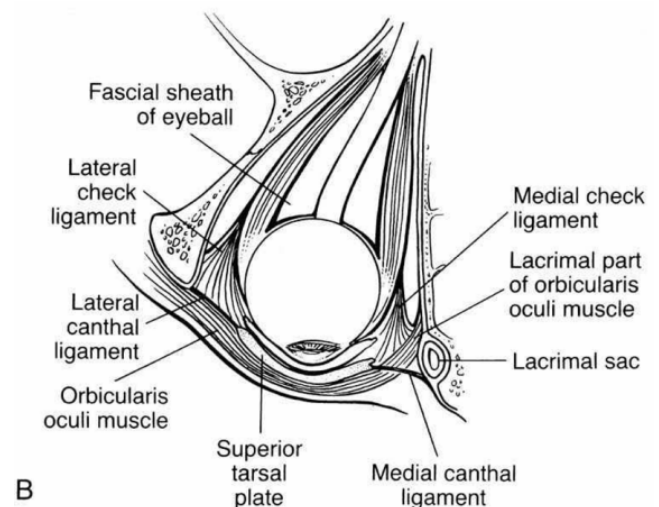
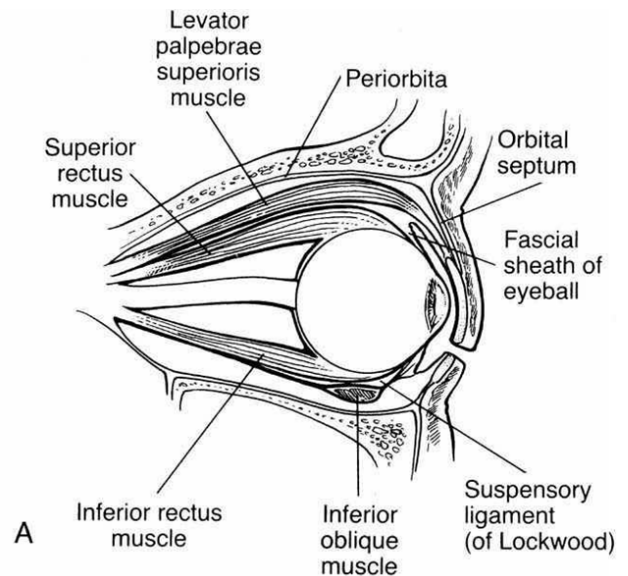
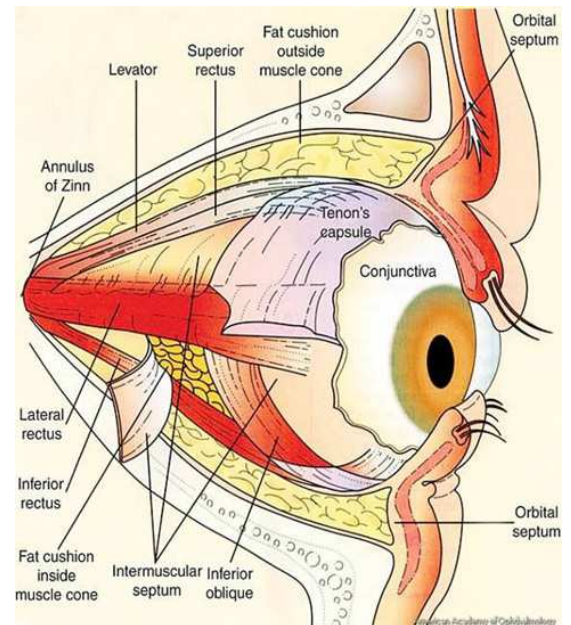
- Fusion with muscle sheaths of inferior rectus and inferior oblique
- Sheath of inferior rectus expanded to attach to

**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



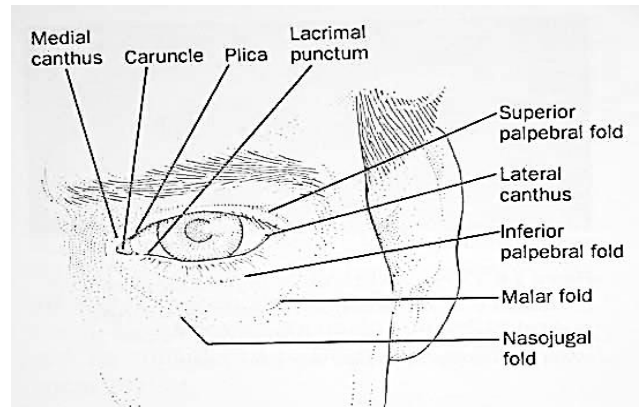
## C. Anatomy of Eyelids

### ► 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

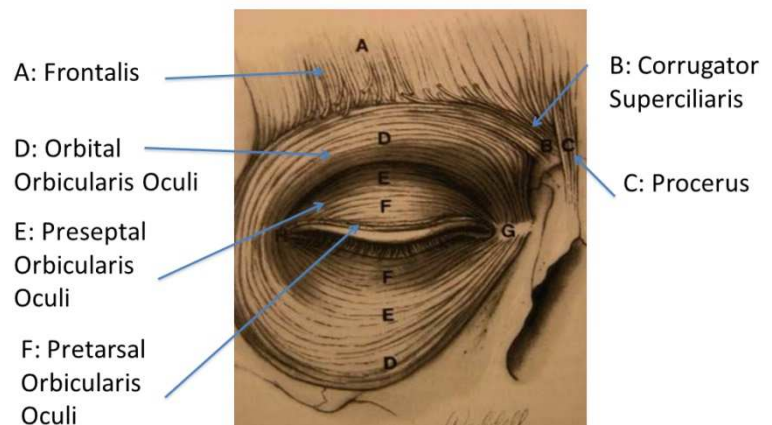
### ► Surface anatomy:

- **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:

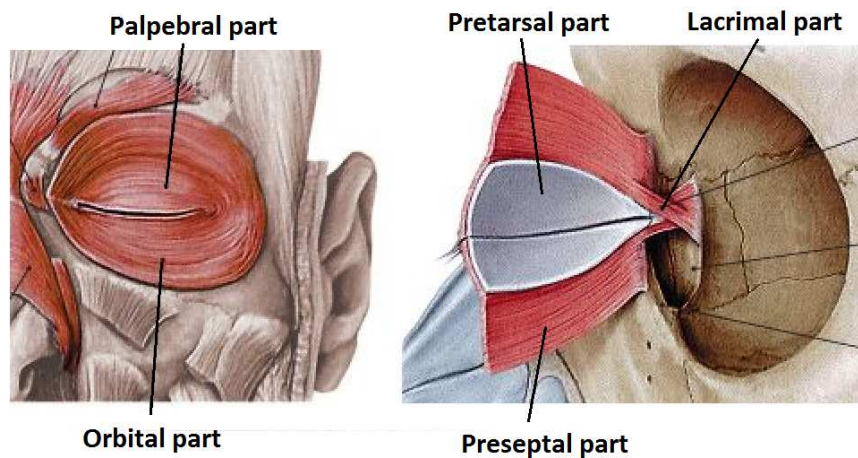
- **Frontalis** draws skin on forehead and upper eyelid upwards
- **Corrugator supercilii** draws skin above eye inferomedially
- **Procerus** draws skin on forehead inferiorly
- **Orbicularis oculi** form concentric rings around the eye



- ▶ 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.**

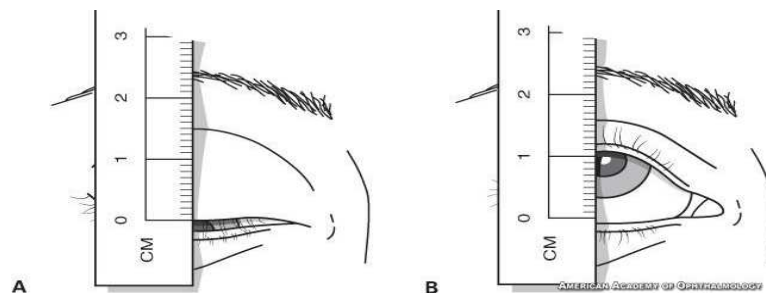


► **Levator palpebrae superioris (LPS):**

- 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

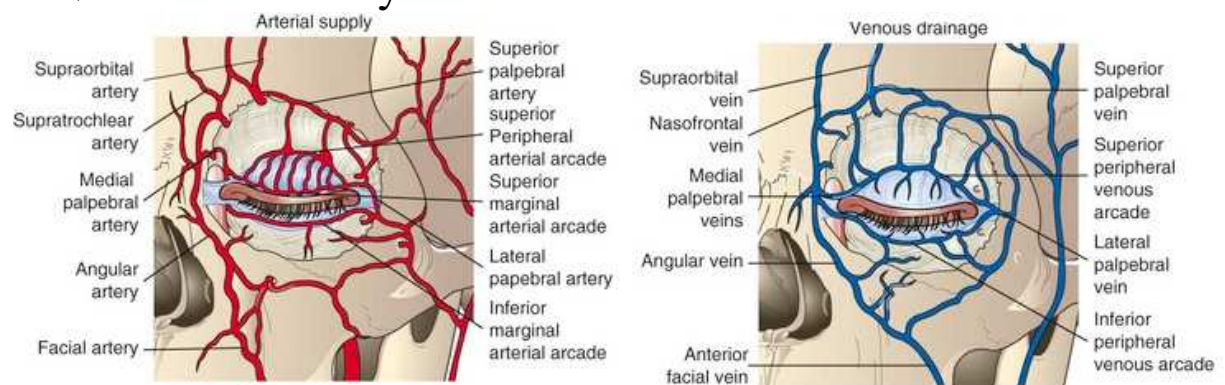
### 3. Conjunctiva

- ▶ **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**

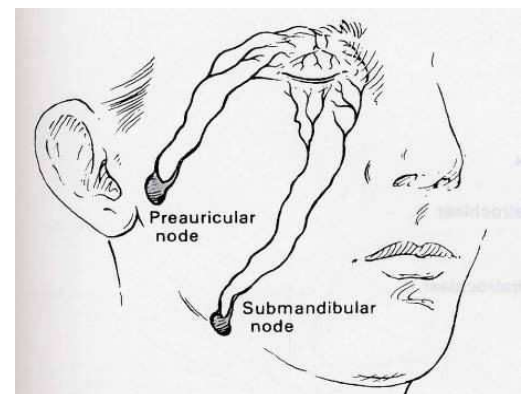
### 4. Innervation

- ▶ 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. (V<sub>1</sub>)
- ▶ 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

