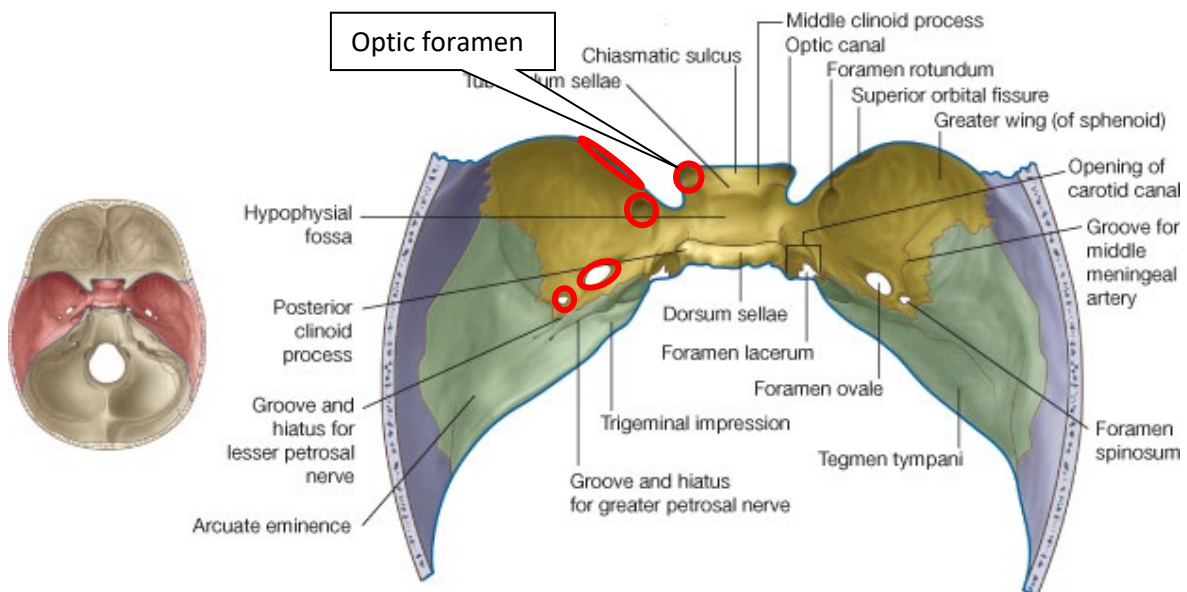
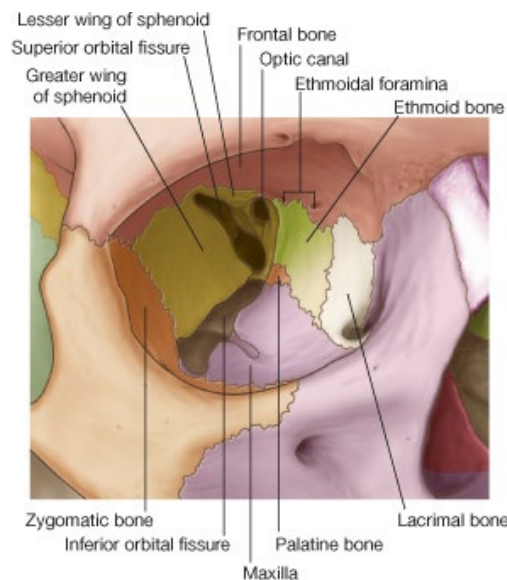


THE ORBIT & EYE

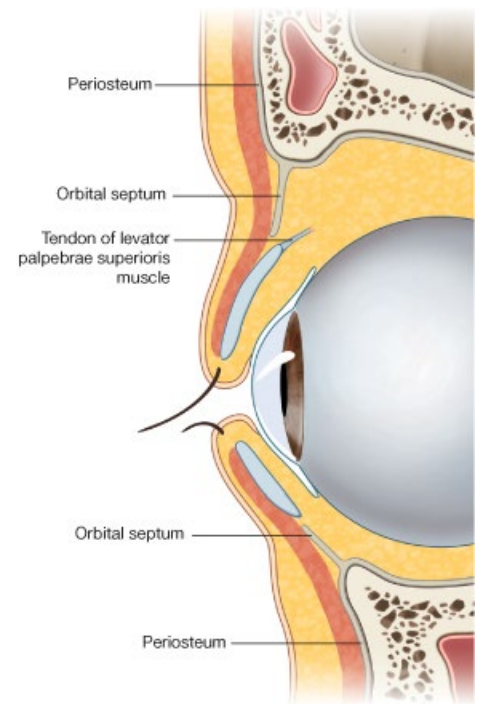
ORBITAL CAVITY

- Composed of several bones
 - The sphenoid bone is perforated with:
 - Optic foramen
 - Superior orbital fissure
 - **Roof:** is formed by **orbital process of the frontal bone**
 - **Lateral wall:** **zygomatic bone**
 - **Medial wall:**
 - **Lacrimal bone**
 - **Ethmoid bone**
 - **Palatine bone** (insignificant, at posterior of medial wall)
 - **Floor:** **maxilla**
-
- Medial wall lies in the sagittal plane
 - Lateral wall diverges outwards as it moves anteriorly.

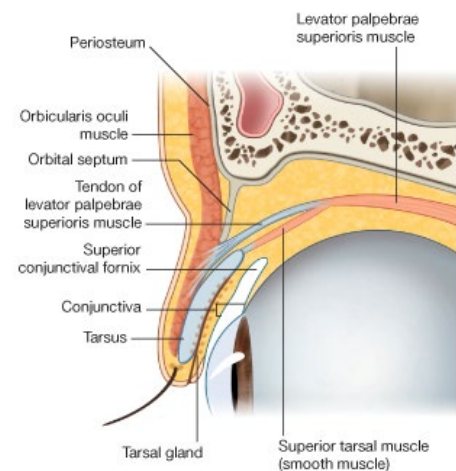


EYELIDS, CONJUNCTIVA & LACRIMAL APPARATUS:

- In cross-section, from outside → inside
 - **Skin**
 - **Orbicularis oculi** (sphincter muscle)
 - **Fibrous tarsal plates**
 - **Conjunctiva**
- These is no subcutaneous fat deep to the skin of the eyelids.
- Skin is devoid of hair, except at eyelashes.
- **Tarsal plates** act to stiffen the eyelids
- Inferior tarsus is attached to the lower orbital margin
- Superior tarsal plate is larger
- **Conjunctiva** is adherent to the deep surface of the tarsal plates.
- **Palprebral fascia** forms an **orbital septum** which attaches each tarsal plate to the orbital margin.
- The **tendon of levator palpebrae superioris** enter the eyelid and attach to:
 - Tarsal plates
 - Orbicularis oculi
- **Levator palpebrae superioris** is supplied by both voluntary & involuntary fibres:
 - Voluntary: **oculomotor nerve (III)**
 - Involuntary: **sympathetic neurons**
- Contraction of the levator palpebrae superioris →
 - Raise upper eyelid
- The eyelid can only be raised properly if both the voluntary and involuntary parts of the muscle are functioning.

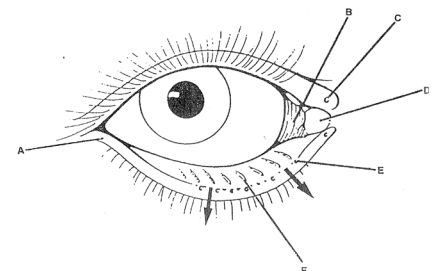


- **Lateral & medial palpebral ligaments** which connect lateral tarsal plate to sides of the orbit.
- **Medial ligament:**
 - Strong
 - Lies in front of the lacrimal sac (apparatus which collects tears)



Glands of the eyelids:

- **Ciliary glands**
 - Directly behind roots of eyelashes
 - When infected cause a red swelling – ‘stye’
- **Tarsal glands**
 - Vertical rows on deep surface of tarsal plates
 - Ducts open onto lid margin

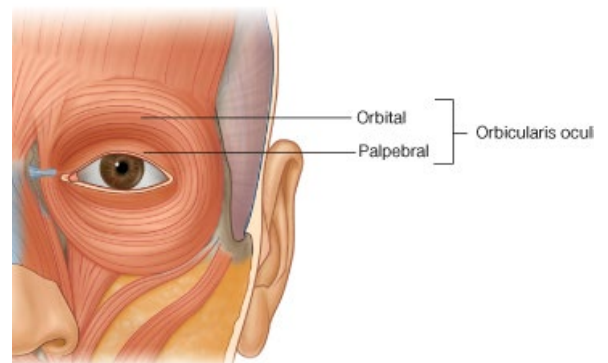
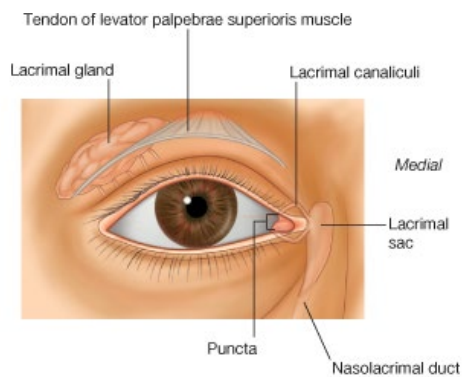
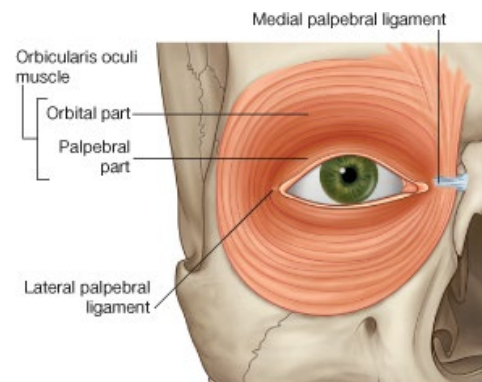
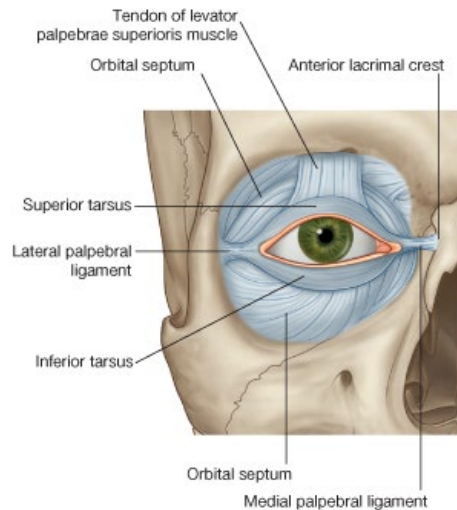


Tarsal glands open along the margin of the eyelid. The lacrimal puncta are located on the lacrimal papillae in the medial canthus. The plica semilunaris and the lacrimal caruncle are also found in the medial canthus of the eye.

- | | |
|--------------------------------|---|
| A Lateral canthus | E Opening of tarsal gland |
| B Plica semilunaris | F Vertical ridges raised by tarsal glands |
| C Lacrimal papilla and punctum | |
| D Lacrimal caruncle | |

Nerves to eyelids:

- Nerve supply to upper lid: **ophthalmic division of trigeminal nerve** (cranial V)
- Nerve supply to lower lid: **infraorbital nerve** (branch of **maxillary division of trigeminal nerve**)
- Branches of the ophthalmic nerve (of trigeminal) to the orbital region include:
 - Palpebral branch of lacrimal
 - Supraorbital
 - Supratrochlear
 - Infratrochlear



Orbicularis oculi:

- Large muscle
- Surrounds eye
- Consists of several parts
- Orbital part:
 - Large & wide
 - Fibres arise from medial palpebral ligament & surrounding bone
 - Sweep round forehead, temple & cheek to reinsert into medial point of origin
 - ***Screws up the eyes for added protection***
- Palpebral part:
 - Also arises from medial palpebral ligament, and loops round eye
 - BUT found entirely within eyelid
 - ***Responsible for closing the eyes when sleeping / blinking***
 - Lies in front of lacrimal apparatus

- Lacrimal part:
 - Arises from behind lacrimal sac and passes laterally into eyelid
 - Δ runs behind the lacrimal apparatus

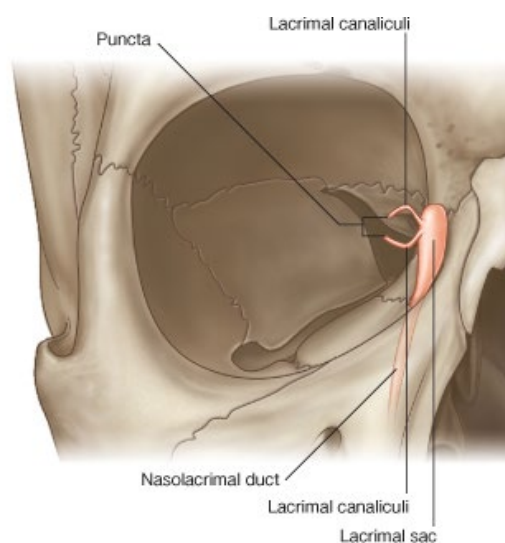
Conjunctiva:

- Lines deep surface of eyelid & exposed surface of eye
- Continuous with anterior epithelium of the cornea
- **Fornices:** the recesses of the conjunctiva above and below where the palpebral part reflects onto the eyeball.
- Conjunctiva is kept moist at all times.

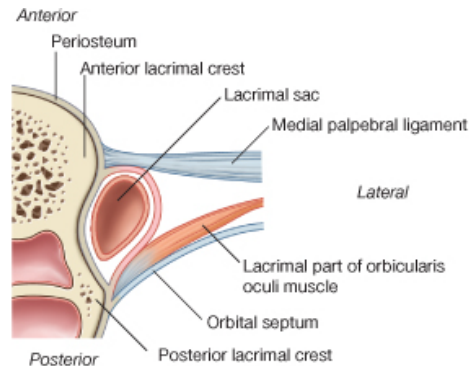
- **Palpebral fissure:** elliptical space between the 2 eyelids.
- The medial and lateral corners of the palpebral fissure are called the **medial & lateral canthus**
- The medial canthus contains:
 - **Lacrimal caruncle** (small red mass)
 - **Plica semilunaris**

Lacrimal gland

- Lies mainly in the orbit
- Does have a small palpebral part which extends into upper lid
- 12+ small ducts from lacrimal gland in upper fornix.
- Lacrimal fluid produced here flows towards medial angle of conjunctival sac
- At the medial canthus there is a small duct called the **lacrimal canaliculus**
- The lacrimal canaliculus is visible on examination – called **lacrimal punctum**
- Punctum opens at a swelling – **lacrimal papilla**
- Tears are drawn through the lacrimal canaliculus into the **lacrimal sac**
- From the lacrimal sac tears are drawn downwards through **nasolacrimal duct** into nasal cavity.
- Secretion of tears by the lacrimal gland is initiated by parasympathetic fibres.

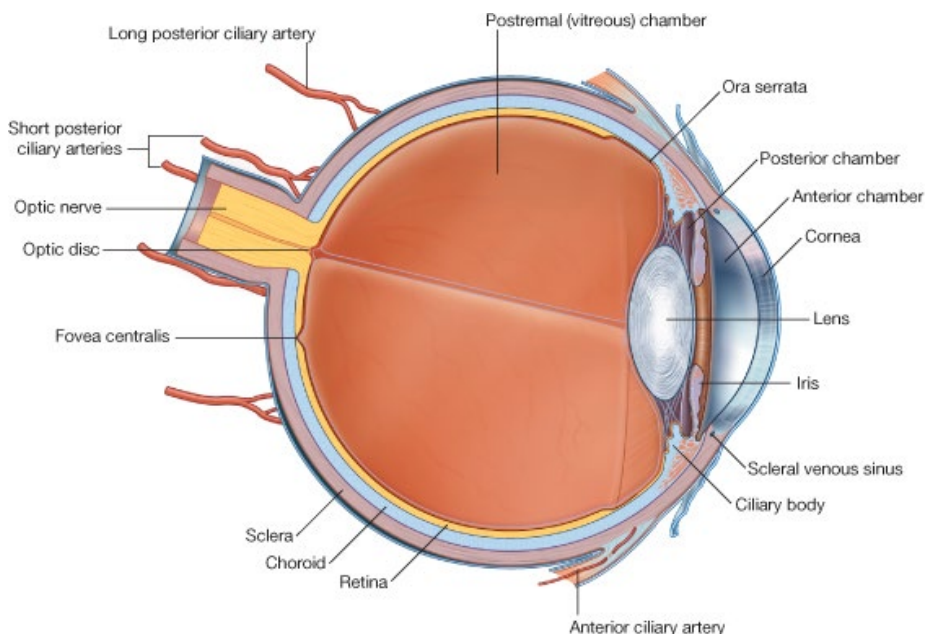


- The palpebral part (in front) of the orbicularis orbis, and the lacrimal part (behind) attach either side of the lacrimal sac.
- Δ contraction of this muscles squeezes the lacrimal sac
- When the muscle relaxes → tears are drawn into the sac → nasolacrimal duct → lateral wall of nose.



EYEBALL:

- Wall of the eye is composed of 3 coats:
 - **Sclera**
 - **Choroid**
 - **Retina**
- The sclera is transparent in front - the **cornea**
- Cornea is continuous with the conjunctiva at its margin
- Behind, the sclera is dense & white
- The cornea has a covering layer of epithelia
- **Posterior limiting lamina** is a layer on posterior surface of cornea which is elastic.
- At its periphery, around the posterior margin of the cornea, the posterior limiting lamina breaks up into bundles with spaces between them
- Δ the posterior limiting lamina becomes a permeable structure – the **pectinate ligament** of the iris.
- The spaces in the pectinate ligament allow aqueous humour from the anterior chamber of the eye to pass into a venous sinus in the sclera.
- Means by which aqueous humour is filtered back into the venous system.
- Damage to this drainage mechanism → glaucoma.

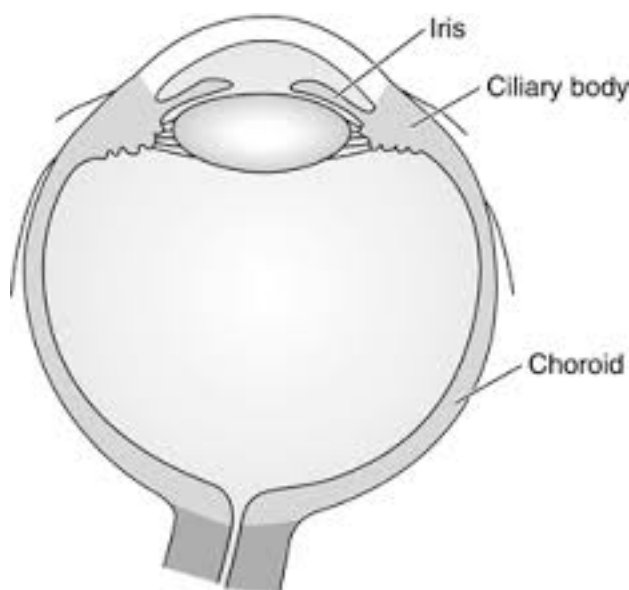


Sclera:

- Sclera is dense
- Optic nerve enters through sclera 3mm to the medial side of the posterior pole
- Optic nerve at this point is still covered by the 3 layers of meninges
- The meninges fuse with the sclera
- Nerve passes through hole in the sclera along with BVs
- Short & long ciliary nerves & BVs also pierce the sclera.

Middle coat of eye: iris & choroid

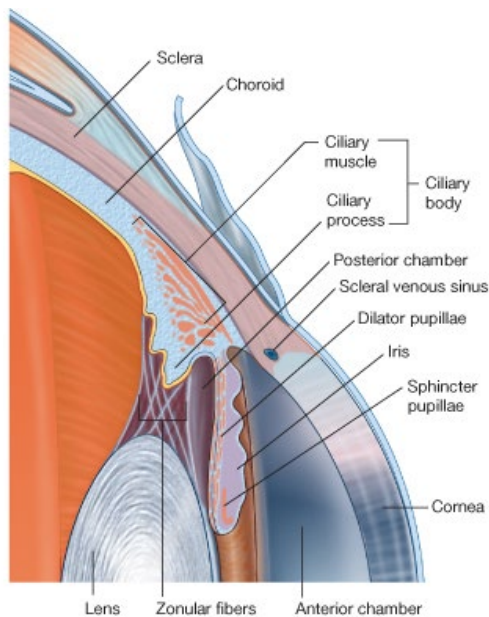
- In front: **iris**
- Behind: **choroid**
- **Ciliary body** lies between the 2



- Ciliary body:
 - Iris attached to anterior surface
 - **Lens** attached to ciliary process
- The outer part of the ciliary body is composed of **ciliary muscle**
- Posterior surface of the ciliary *process* is raised into radial ridges by the **suspensory ligament of the lens** which attaches here.
- **Iris** lies in front of eye:
 - Cornea in front of it
 - Lens posterior to it
- **Anterior chamber** of eye: between cornea & iris
- **Posterior chamber** of eye: between iris & lens
- The anterior and posterior chamber are continuous through the aperture of the iris
- They are filled with aqueous humour.

Aqueous humour:

- Produced by anterior surface of ciliary process in the posterior chamber
- Filtered off into venous sinus of sclera in the anterior chamber



- Periphery of **iris** is attached to:
 - Pectinate ligament
 - Anterior part of ciliary body
- Iris contains pigment – giving it colour

Pupil:

- Aperture of the iris = **pupil**
- Pupil varies in diameter depending on light conditions
- Sympathetic: dilate pupil
- Parasympathetic: constrict pupil

- Muscles of the iris → pupillary constriction / dilation
- Muscles of the ciliary body → lense changes

- It is the **sphincter pupillae (circular)** in the pupillary margin of the iris which constricts the pupil.
- Sphincter pupillae is innervated by parasympathetic fibres which enter the eye through the short ciliary nerves

- **Dilator pupillae (radial)** consists of muscle fibres which radiate outwards from the pupillary margin of the iris.
- Supplied by sympathetic fibres in the long ciliary branches of the nasociliary nerve

- **Ciliary muscle** lies within ciliary body
- Has both radial and circular fibres
- Radiating fibres:
 - Arise from the **scleral spur** (near where cornea joins sclera)

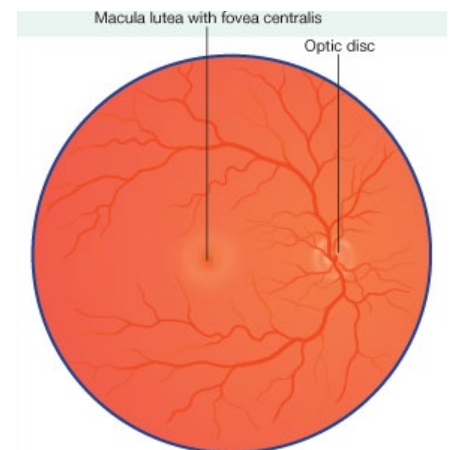
- Radiate back into the ciliary process
- **Circular fibres:**
 - Form a muscular ring near periphery of the iris
- Ciliary muscle is supplied by parasympathetic fibres
- Looking @ something in the distance – **lens is flat:**
 - Suspensory ligaments pull on periphery of lens to keep it flat
- Looking @ something nearby – **lens is relaxed, thick & fat** (natural shape of lens)
 - Ciliary muscles contract:
 - → draws suspensory mechanism of the lens forwards (*i.e. changes position of the lens in the eye*)
 - → reduces the diameter of the rim to which the suspensory ligaments are attached
 - This leads to relaxation of the peripheral pull of the suspensory ligaments on the lens → allowing it to resume its natural thickened state.
- Ciliary muscles Δ contract when shifting gaze from something far away to something near.
- It is accommodated by:
 - Constriction of the pupil (also parasympathetic)
 - Convergence of the eyes.
- The ability to change focus when looking at objects at different distances is called **accommodation.**
- Accommodation Δ consists of the above processes:
 - Contraction of ciliary muscles
 - Pupillary constriction
 - Convergence of eyes.

Choroid:

- The choroid is the largest part of the middle layer of the eye
- **Contains many blood vessels**

Inner layer of the eye – the retina

- Retina can be studied in patients by using an ophthalmoscope
- Ophthalmoscope gives a view of the whole of the back of the retina – the **fundus:**
 - **Optic disc**
 - **Macula lutea**
 - **Retinal arteries**
- **Optic disc:**
 - Found 3mm to the nasal side of the anteroposterior axis of the eye
 - It is where the optic nerve fibres and blood vessels leave the eye
 - Fibres build up into a circular zone as they leave – giving the disc a **‘raised edge’**
 - Central part of the disc is depressed.
- **Retinal arteries:**
 - Central artery of retina enters at the optical disc, and its branches can be clearly seen
 - Retinal veins are also clearly visible (wider vessels than the arteries)
 - Retinal arteries radiating towards the nose are known as ‘nasal arteries’



- Retinal arteries radiating towards the lateral temple are known as 'temple arteries'.
- **Macula lutea:**
 - Lies exactly in the visual axis
 - Small yellow-ish spot
 - It is the area of most distinct vision
 - In the centre of the macula is a small depression – the **fovea centralis**
 - It is at this point that the resolving power of the retina is at its greatest – most accurate central vision.
- ↑ intracranial pressure → margins of the optic disc become swollen.
- This is a useful sign for diagnosis & monitoring
- The retina is the only place in the body where vessels can be directly viewed.
- In patients with **hypertension**:
 - The vessels will often have thick walls and appear rigid
 - Where arteries cross veins they will compress them →
 - Haemorrhage into retina
 - Or white fluffy areas of exudate from vessels
- Diabetes will also give characteristic features of the fundus.

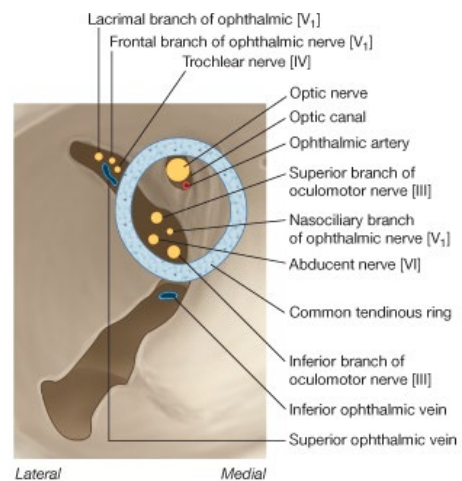
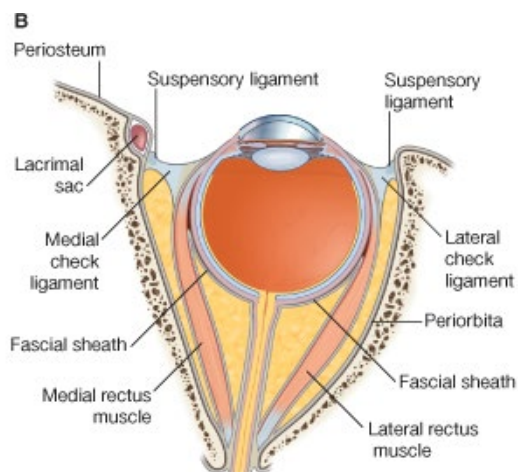
Vitreous humour:

- Contained within the cavity behind the lens
- Jelly consistency
- In front, the posterior surface of the lens and the ciliary processes form a concavity in the jelly – the **hyaloid fossa**
- **Hyaloid canal** is a minute canal which runs from the optic disc to the posterior surface of the lens.
- The hyaloid canal represents the remains of a small branch of the central artery of the retina, which degenerates before birth.
- The vitreous body is condensed superficially to form an envelope – the **vitreous membrane**
- The vitreous membrane is thickened in front to form the **capillary zonule**
- The capillary zonule itself consists of 2 layers:
 - Posterior layer: thin
 - Anterior layer: thick, forming the **suspensory ligament of the lens**
- Suspensory ligament of the lens holds the lens in the hyaloid fossa
- Also maintains tension on periphery of the lens when eye is at rest or focused on a distant object.

EXTRAOCULAR STRUCTURES

- Eye in the orbit is surrounded by a fascial sheath
- Fascial sheath separates the eyeball from the orbital muscles and fat
- Eyeball diameter: 2.5cm
- Cornea is much more curved than the globe of the eye.
- Posteriorly, the fascial sheath fuses with the dura over the optic nerve
- Each extraocular muscle must pierce the sheath to insert into the sclera.

- The extraocular muscles pierce the sheath close to the equator of the eye, and the sheath continues up over the muscles for a short distance.
- Near their point of attachment the **medial and lateral rectus muscles** are attached to the bony walls of the orbit by small fascial attachments – **check ligaments**
- Check ligaments:
 - Stabilise the eye in the orbital cavity
 - Resist compression of the eye when the EO muscles contract



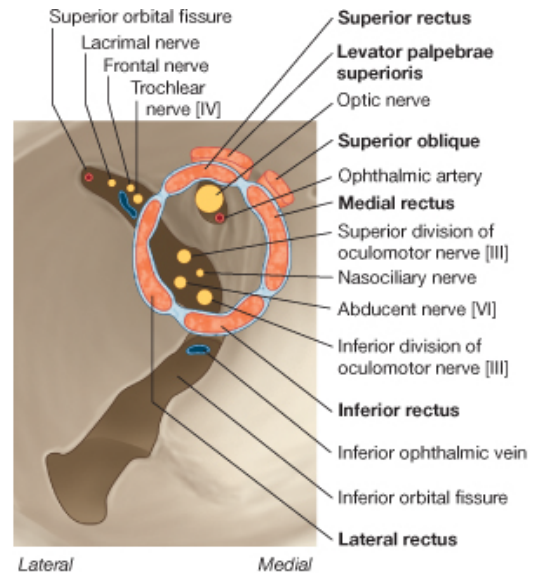
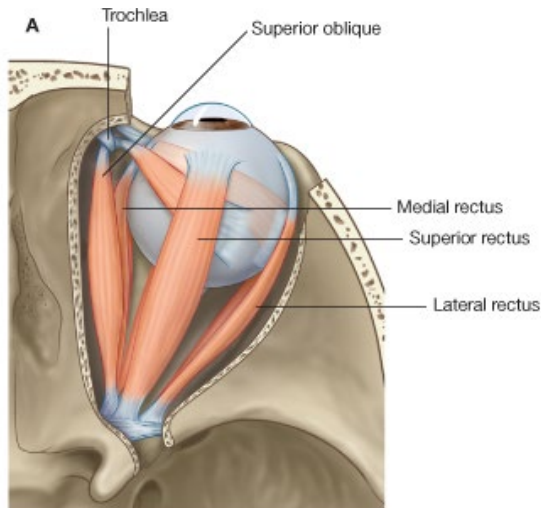
Inside the common tendinous ring:

- Optic canal (optic nerve [II] + ophthalmic artery)
- V1 nasociliary branch
- CNIII (superior + inferior branch of oculomotor nerve)
- CNVI (abducens)

Outside the common tendinous ring:

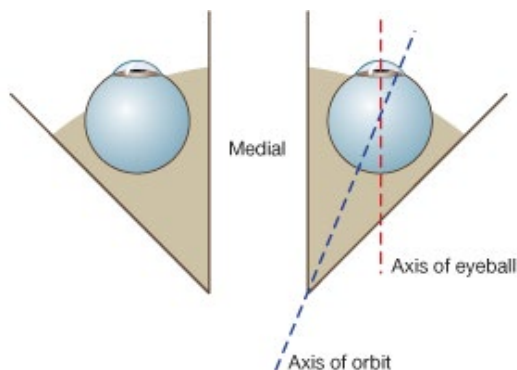
- CNIV (trochlear)
- V1 frontal + lacrimal branches
- Superior + inferior ophthalmic veins

- Tendinous ring surrounds the apex of the orbit, enclosing:
 - Optic foramen
 - Medial part of superior orbital fissure
- **4** muscles arise from this tendinous ring, and insert into the front of the coronal equator of globe of eye:
 - **Lateral rectus muscle**
 - **Medial rectus muscle**
 - **Superior rectus muscle**
 - **Inferior rectus muscle**
- Pass forwards from tendinous ring, forming a cone around the eye.



- **2 oblique muscles** also arise from the bony orbit, outside the cone of muscle:
 - **Superior oblique**
 - **Inferior oblique**
- **Superior oblique:**
 - Arises from bone above the tendinous ring
 - Travels along upper border of medial rectus
 - Passes through fibrous pulley – **trochlea** (attached to roof of bony orbit)
 - Changes direction, travels posteriorly, and inserts **behind the coronal equator** of the eye.
- **Inferior oblique:**
 - Arises from anterior section of orbital floor
 - Runs backwards to insert into the eye **behind the coronal equator**
- The **levator palpebrae superioris** arises from bony orbit above superior rectus, and inserts into the upper eyelid (causing it to rise)

VISUAL AXIS AND FUNCTION OF THE EO MUSCLES:



- When looking directly forwards at a distant object, the **visual plane** lies in the *sagittal plane*

- This visual plane is Δ parallel with the medial wall of the orbit but not the lateral wall.
- The **axis of the orbit** does not correspond with the visual plane when looking directly forward.
- Only when the eye is turned laterally does the visual plane correspond with the orbital axis, and Δ with the line of pull of the superior and inferior recti.
- Δ the superior and inferior recti only pull powerfully up/down on the eye when the eye is looking laterally.
- When the eye is looking *medially / directly forwards*, their superior/inferior recti tend to cause **torsion** of the eyeball, instead of elevation and depression.
- Torsion = rotation of eyeball around transverse anteroposterior axis.
- When the eye is facing *medially*, it is the **obliques** which carry out elevation and depression.
- Because the obliques insert behind the coronal equator of the eye:
 - Superior oblique \rightarrow depression of eye
 - Inferior oblique \rightarrow elevation of eye
- When the eye is directed more *laterally*, the obliques tend to cause **intorsion**.
- Δ When the eye is looking directly forwards, elevation and depression are combined actions of obliques & superior/inferior recti.
- To separate the actions of the obliques and superior/inferior recti, the patient must look medially & laterally, and follow an object up and down in these positions.
- **Look laterally: S + I rectus do up/down**
- **Look medially: S + I oblique do up/down**

	Medial	Directly forwards	Lateral
Lateral rectus	<i>Abduction</i>	<i>Abduction</i>	<i>Abduction</i>
Medial rectus	<i>Adduction</i>	<i>Adduction</i>	<i>Adduction</i>
Superior rectus	<i>Torsion</i>	<i>Torsion</i>	<i>Elevation</i>
Inferior rectus	<i>Torsion</i>	<i>Torsion</i>	<i>Depression</i>
Superior oblique	<i>Depression</i>	<i>Intorsion</i>	<i>Intorsion</i>
Inferior oblique	<i>Elevation</i>	<i>Intorsion</i>	<i>Intorsion</i>

Testing the functions of individual muscles:

Lateral / medial rectus	Patient looks directly forwards, then looks towards their nose and away from it.
Superior/inferior recti + obliques	Patient looks directly forwards then looks up and down
Superior/inferior recti	Patient looks laterally, then looks up and down
Superior/inferior obliques	Patient looks medially, then looks up and down

When the eye is *medially* positioned:

- **Elevation/depression:** *obliques*
- **Torsion:** *superior/inferior recti*

When the eye is *laterally* positioned:

- **Elevation/depression:** *superior/inferior recti*
- **Intorsion:** *obliques*

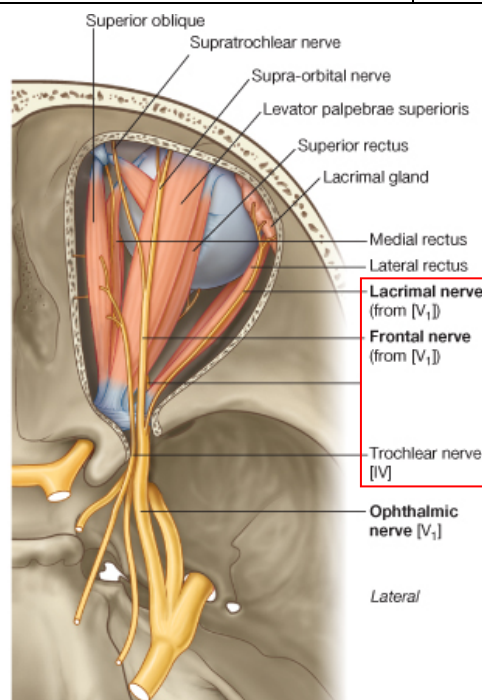
NEUROVASCULAR STRUCTURES OF THE ORBIT

- Enter/leave the orbit through either the:
 - Optic foramen
 - Superior orbital fissure
- Structures entering through optic foramen or medial part of superior orbital fissure lie within the cone of recti muscle
- Structures passing through lateral part of superior optic fissure lie outside the cone of muscle.

Outside the cone of muscle:

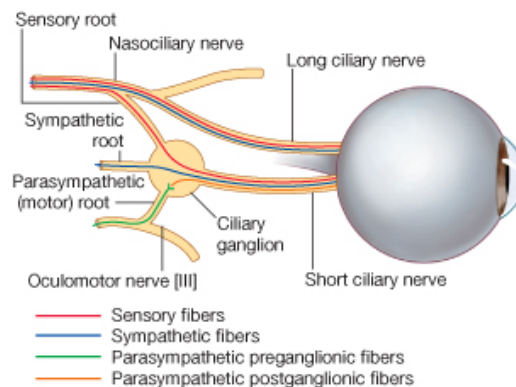
- Lie just deep to the periosteum of the roof of the orbital cavity
- I.e. remove the frontal bone on top of orbit, and the underlying periosteum, and these are the first structures you see
- Enter through lateral part of superior orbital fissure, and lie above the levator palpebrae superioris.
- **3 nerves**
 - **Lacrimal nerve (V_i)**
 - **Frontal nerve (V_i)**
 - **Trochlear nerve (IV)**
- The lacrimal and frontal nerves are both branches of the **ophthalmic division of V cranial nerve**
- The ophthalmic division of the cranial nerve V is entirely sensory, Δ the lacrimal and frontal nerves are entirely sensory.
- The trochlear nerve (IV) is entirely motor

Lacrimal (V₁)	Branch of ophthalmic (V)	Sensory	Sensory impulses from conjunctiva & eyelids
Frontal (V₁)	Branch of ophthalmic (V) Itself divides into supraorbital & supratrochlear nerves.	Sensory	Skin from side of eye upwards, over the scalp to the top of the head.
Trochlear nerve (IV)	Small thread-like nerve	Motor	Superior oblique

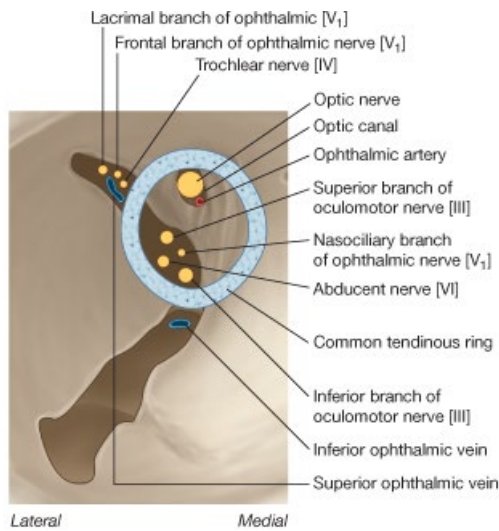


Inside the cone of muscle:

- Pass through optic foramen and the medial side of the superior orbital fissure:
 - **Optic nerve (II)**
 - **Oculomotor nerve (III)**
 - **Abducent nerve (VI)**
 - **Nasociliary nerve (V_i)** – branch of ophthalmic division of V
- **Optic nerve (II):**
 - Passes through optic foramen
 - Reaches eyeball 3mm medial of posterior pole
 - Forms the **optic disc** at point where it inserts into interior of the eye.
- **Nasociliary nerve (V_i):**
 - Passes through superior orbital fissure
 - Branch of ophthalmic division of V
 - Entirely sensory
 - Passes *above* the optic nerve → medial wall of orbit
 - Carries sensation from:
 - Surface & bridge of nose
 - Air sinuses of ethmoid bone
 - Nasociliary nerve gives off the:
 - **Long ciliary nerves**
 - **Short ciliary nerves**
 - **Long ciliary nerve:**
 - Sensory to eyeball
 - Sympathetic innervation to the eye (→ pupillary dilation)
 - **Short ciliary nerve:**
 - **Sensory fibres + postgang. parasympathetic + sympathetic fibres**
 - Pass through the **ciliary ganglion** (without synapsing)
 - Sensory: pass through short ciliary nerve → ciliary ganglion → join nasociliary nerve.
 - Ciliary ganglion Δ appears to hang from nasociliary nerve, on lateral side of optic nerve.
 - **Short ciliary nerves** are the only nerves of eye with postganglionic parasympathetic fibres in them.



- **Oculomotor nerve (III):**
 - Enters through superior orbital fissure
 - Divides into **2 divisions** which supply **all the extraocular muscles except superior oblique** (IV) and lateral rectus (VI)
 - Also carries **preganglionic parasympathetic** fibres from the brain:
 - Parasymp. fibres leave the oculomotor nerve and jump into ciliary ganglion
 - *Synapse*
 - Postganglionic parasymp. fibres pass into the eye within short ciliary nerves
 - Cause contraction of ciliary muscles & pupillary constriction.
- **Abducent nerve (VI):**
 - Enters through superior orbital fissure
 - **Motor to lateral rectus**



Muscle	Nerve supply
Superior oblique	Trochlear nerve (IV)
Lateral rectus	Abducent nerve (VI)
Medial rectus Superior rectus Inferior rectus Inferior oblique Levator palpebrae superioris	Oculomotor nerve (III)

- Damage to cranial nerves III, IV or VI can Δ lead to paralysis of one of the extraocular muscles → strabismus (abnormal alignment of eye).

Summary of sympathetic innervation to the eye:

- Sympathetic nerves in the head and neck accompany arteries – most arteries in the head and neck are joined in their course by ‘hitch-hiking’ sympathetic fibres.
- Preganglionic symp. leaves thoracic spinal cord
- Ascend in sympathetic trunks to upper cervical sympathetic ganglion
- *Synapse*
- Postganglionic sympathetic fibres travel along **carotid arteries**
- Travel within nasociliary branch of ophthalmic branch (V) into the orbit

- Within the orbit they either:
 - Pass directly to eye in long ciliary nerve
 - Pass without synapse through ciliary ganglion → short ciliary nerve
- There is clearly a long course between the origin of symp. in thoracic spinal cord, and the supply to the eye.
- Δ lesions anywhere along course can disrupt sympathetic supply to the eye.
- → **inability of the eye to dilate** (constant pupillary constriction)

Summary of parasympathetic innervation to the eye:

- Parasymp. fibres leave the **oculomotor nerve** and jump into ciliary ganglion
- *Synapse*
- Postganglionic parasymp. fibres pass into the eye within short ciliary nerves
- Compression of the oculomotor nerve in the brain → interrupted parasympathetic supply → **inability to constrict eyeball** (constant dilation).
- Oculomotor nerve may be compressed by head injury → swelling & oedema of the brain.

BLOOD SUPPLY TO THE ORBIT:

- Arterial blood supply is via **ophthalmic artery** (branch of **internal carotid** immediately after it leaves the cavernous sinus).
- Enters through the optic foramen
- Lies below the optic nerve in the foramen
- Spirals around to lateral side of optic nerve
- Supplies many branches to:
 - Muscles
 - Eyelids
 - Conjunctiva
 - Other orbital structures

Branches of the ophthalmic artery

- **Anterior and posterior ethmoidal arteries**
 - Pass through foramen of the same name in the medial wall of the orbit
 - Supply mucous membrane of ethmoidal air sinuses & root of nose
- **Central artery of the retina**
 - Passes into the substance of the optic nerve
 - Enters the eye within the optic nerve
 - Only artery to the retina Δ blockage → complete blindness.
- Venous drainage of the eye is mainly into the cavernous sinus
- Veins from the face & forehead also drain → orbital cavity → cavernous sinus
- No valves in these veins – blood flow can be in either direction.

APPLIED ANATOMY OF THE EYE & ORBIT

FRACTURES

- Fractured orbits are common.
 - Often fracture of the zygomatic bone
 - → 'seeing double' (diplopia)
 - Diplopia results because either:
 - Suspensory ligament, holding the eye in its horizontal plane, is no longer fixed.
 - Fractured bone obstructs movement of the rectus muscle
- 'Blow-out' fractures can occur if a hard ball hits the eye
 - → increased pressure in the orbital cavity
 - → fracture of thin bones which make up the medial & inferior walls of the orbital cavity

INFECTIONS

- Foreign bodies can often lodge in the superior fornix (under upper eyelid)
 - May damage the cornea → **corneal abrasion**
 - May lead to **corneal ulceration**
- Infections of the conjunctiva → **conjunctivitis**
- Infections of the cornea and ciliary body are more serious – **iridocyclitis**
- **Cataract** is a developing opacity of the lens.
- If the lens becomes completely opaque it will need to be surgically removed.

SQUINT / STRABISMUS

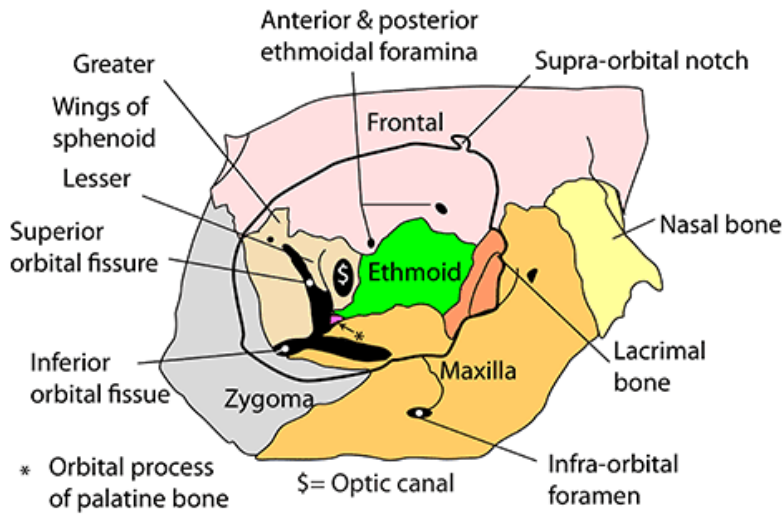
- Squint / strabismus is a deviation of the eyes such that their axes are no longer parallel with each other.
- The normal exception is when the eyes converge to look normally at a close object.
- Squint may be the result of:
 - Lesion of one of the cranial nerves which supplies the EO muscles
 - Problem localised to the muscle itself
- Squints can be in any direction, but they are frequently horizontal
 - Eyes looking towards each other: convergent squint
 - Eyes looking away from each other: divergent squint
- The **oculomotor nerve (III)** supplies the voluntary part of the levator palpebrae superioris and all the other EO muscles (except the lateral rectus & superior oblique).
- The oculomotor nerve also carries parasympathetic fibres which:
 - Constricts the pupil
 - Acts on the ciliary muscle during the accommodation reflex
- Δ oculomotor nerve lesion →
 - Unopposed sympathetic action on the dilator pupillae muscle → permanently dilated pupil.
 - Inability to accommodate to close object
 - Closure of the upper eyelid (as loss of voluntary part of the levator palpebrae superioris – and the involuntary part is on its own inadequate)
 - Unopposed action of the lateral rectus muscle → abduction of the eye.
 - Because eye is abducted, the superior oblique muscle can only **intort** the globe

- Oculomotor nerve lesions are often partial
- CNIII palsy:
 - Ptosis
 - Mydriasis
 - Down + out eye position
- The **abducens nerve (VI)** innervates the lateral rectus muscle
- Lesion of this nerve Δ leads to an inability to abduct the eye on the side of the lesion.
- Attempts at abduction may \rightarrow double vision as the unaffected eye abducts, but the affected one fails to do so.
- Lesions of **trochlear nerve (IV)** are extremely rare on their own.
- Trochlear nerve supplies the superior oblique, causing depression of the eyeball (as it inserts behind the coronal equator of the eye)
- Δ a lesion would lead to an inability to look downwards towards the nose \rightarrow difficulty walking down stairs
- **HORNERS SYNDROME** results from a disruption of the sympathetic trunk
- E.g. if a lung tumour invades the sympathetic trunk (in thorax or neck of 1st rib)
- E.g. poorly placed anaesthetic into the sympathetic trunk
- \rightarrow unopposed parasympathetic activity:
 - Constricted pupil
 - Hot, flushed, dry face (i.e. loss of sympathetic vasoconstriction and sweating)
 - Drooping of eyelid (loss of sympathetic innervation of involuntary portion of levator palpebrae superioris – voluntary supply is insufficient on its own).

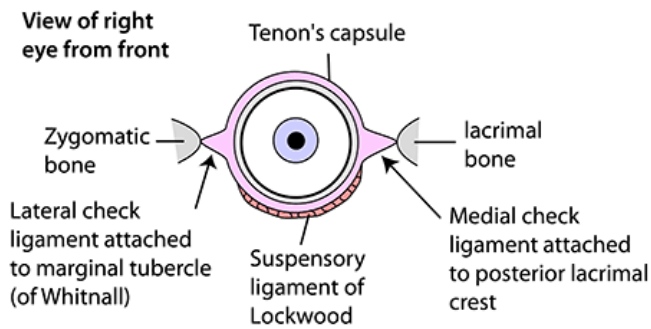
ADDITIONAL NOTES FROM LECTURE:

- Vascularity of the **conjunctiva** decreases towards the front of the eye
- **Cornea:**
 - Layered structure
 - Highly organised
 - Fibrils are smaller than the wavelength of light - Δ cornea is transparent
 - Contains no BVs or lymphatics
- In the eye, the **sympathetic NS** is responsible only for **pupillary dilation**
- **Accommodation** – constriction of the pupil + ciliary muscle action – is all due to **parasympathetic**
- **Short ciliary nerves** are the only nerves of eye with postganglionic parasympathetic fibres in them.
- Lens is **avascular** and **asensory**

EYE - BONES OF RIGHT ORBIT



EYE - FASCIAL COVERINGS



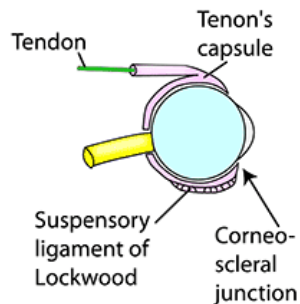
TENON'S CAPSULE (Fascia bulbi)

- Fascial sheath of eye
- Bursa behind the eyeball
- Inner layer blends with sclera
- Outer layer pierced by tendons & it extends back along them

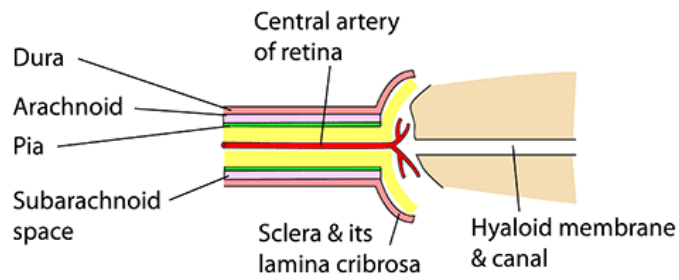
Note:

There is not normally any posterior displacement of the eyeball because of the following factors:

- Medial/lateral check ligaments
- Presence of orbital fat
- Forward pull of 2 oblique muscles



EYE - OPTIC NERVE & ITS COVERINGS



OPTIC NERVE

- 3cm in orbit
- Blood supply
 - Intracranial portion - Anterior cerebral artery
 - Posterior 2cm in orbit - Ophthalmic artery
 - Anterior 1cm in orbit - Central artery of retina

COVERINGS

FIBROUS

- Sclera (nearly avascular)
- Canal of Schlemm (drains aqueous)
- Cornea (anteriorly is stroma between Bowman's membrane, posteriorly is Descemet's membrane)

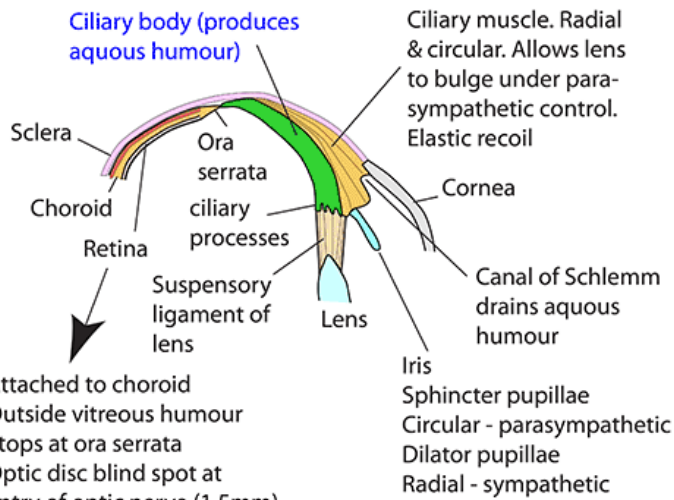
VASCULAR

- Choroid (thin, pigmented, capillaries & 4-5 venae vorticosae)
- Ciliary body and muscle
- Iris

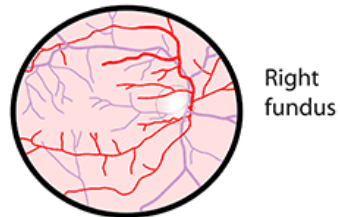
NERVOUS

- Retina

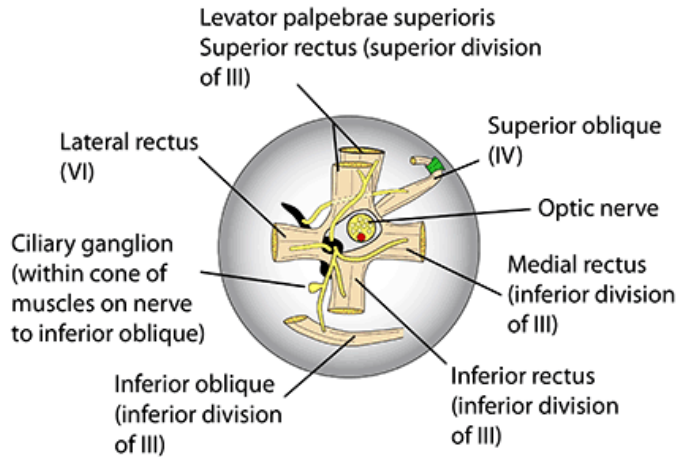
EYE CILIARY BODY AND ANTERIOR EYEBALL



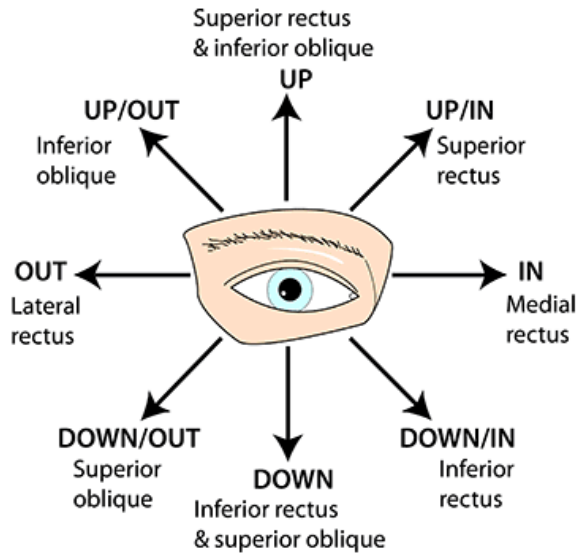
- Attached to choroid
- Outside vitreous humour
- Stops at ora serrata
- Optic disc blind spot at entry of optic nerve (1.5mm)
- Macula lutea - 3mm lateral to disc. Has central pit (fovea) with cones only
- Rods for dim light and no colour
- Cones for colour. Very sensitive
- Fundus is what is seen with ophthalmoscope at back of eye
- Blood supply: central artery of retina. Central veins to superior ophthalmic veins



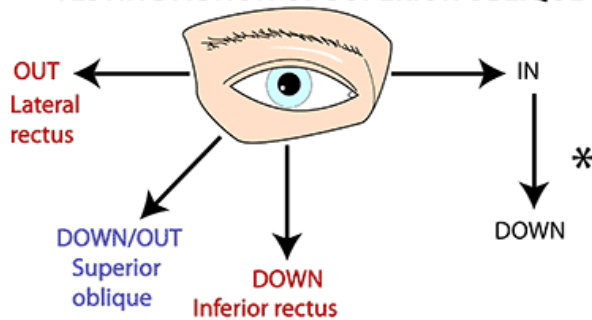
VIEW INTO RIGHT ORBIT - EXTRINSIC EYE MUSCLES



Eye movements produced by the action of single or combinations of extrinsic eye muscles of the right eye



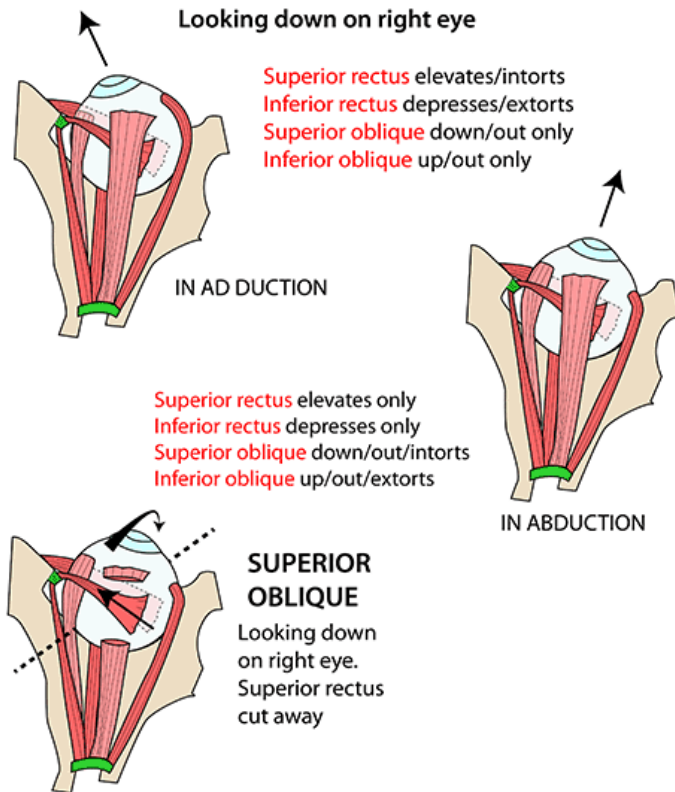
TESTING ACTION OF SUPERIOR OBLIQUE



We know that the isolated action of superior oblique is to turn the eye downwards & outwards. BUT lateral rectus & inferior rectus, acting together, could achieve the same action. By asking the patient to first look inwards (to negate the action of lateral rectus) & then downwards* (inferior rectus is largely disabled when the eye is turned in) we test the isolated downward action of superior oblique

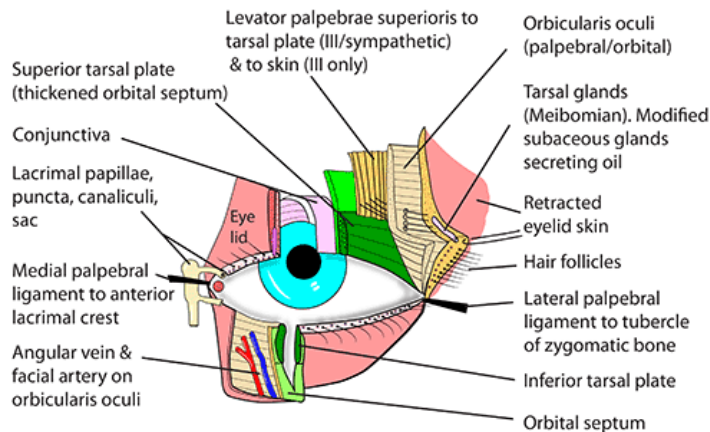
EYE - TORSION

Because of the oblique angle of the orbit and the way that the muscles attach distal to the equator of the eye there is a tendency for some of the muscles to twist the eye in addition to its main action. This torsion, which can be internal (intorsion) or external (extorsion), is important as it counteracts the tilting movements of the head. The degree of twisting for any one muscle is determined by whether the eyeball is abducted or adducted



The action of **SUPERIOR OBLIQUE** is to pull its attachment to the globe upwards and medially. This will turn the cornea/eye downwards and outwards. Similarly the inferior oblique does the opposite, turning the cornea/eye upwards and outwards. The dotted line indicates the axis on which the eye "rotates" which is at right angles to the line of pull

EYE - EXPLODED VIEW OF LEFT EYELIDS



Orbital septum: Anterior lacrimal crest and margins of orbit

Tarsal plates: Fibrous thickening of orbital septum

Meibomian glands: In tarsal plates, modified sebaceous glands secreting oil

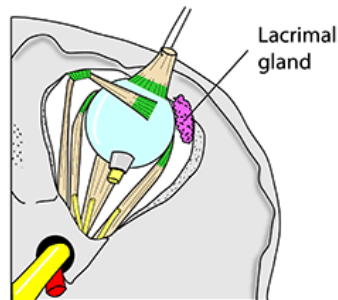
Blood supply: Of lids - palpebral branches of ophthalmic artery

Nerves: Upper skin/conjunctiva - lacrimal, Supra-orbital, supra- & infratrochlear

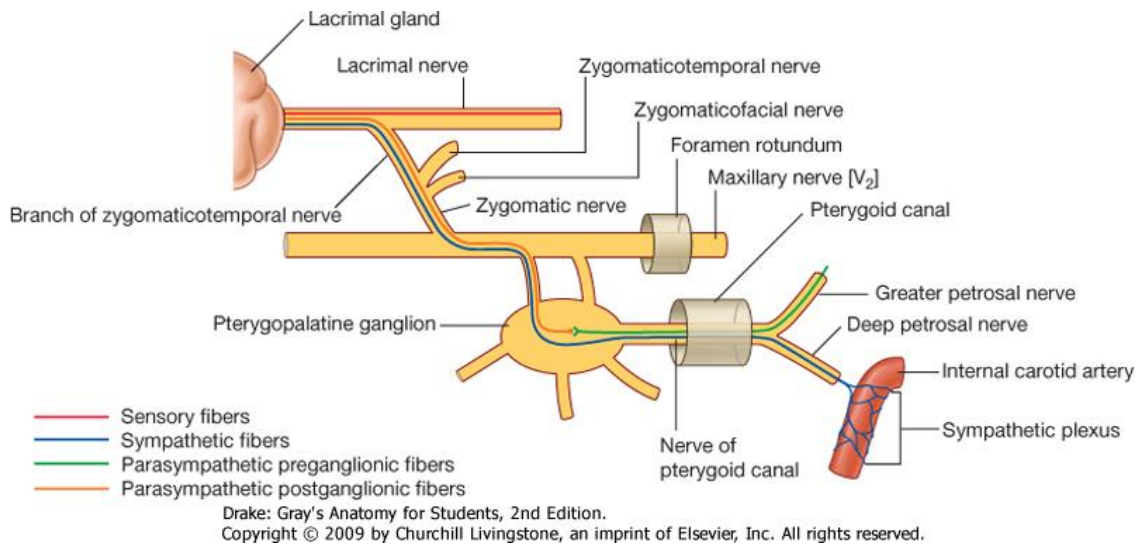
Lower skin/conjunctiva - infra-orbital

LACRIMAL GLAND

Looking down into right orbit

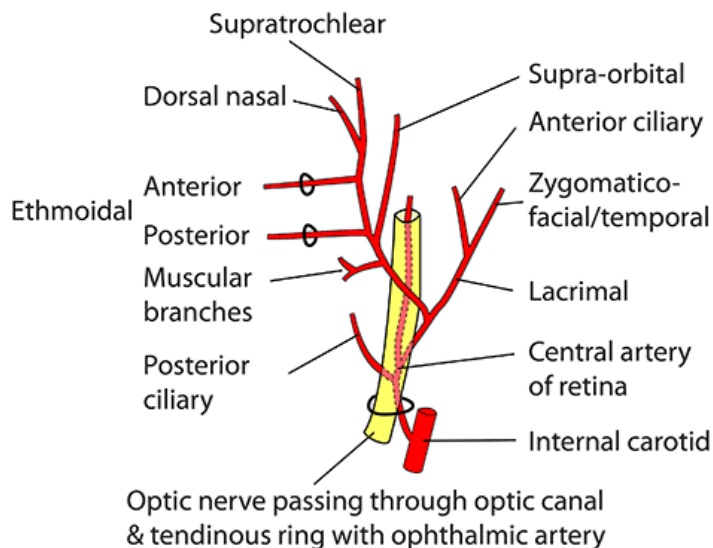


- Serous gland
- In lacrimal fossa (lateral roof of orbit)
- 10-12 ducts draining into lateral/superior fornix of conjunctiva
- Tears swept medially by progressive lid closure
- Nerve supply - secretomotor. Superior salivary nucleus to facial nerve to greater petrosal nerve to pterygo-palatine ganglion to zygomatic branch of maxillary division of trigeminal (Vb) to zygomaticotemporal nerve to connecting branch in orbit to lacrimal nerve (Va) to gland
- Blinking achieved by palpebral part of orbicularis oculi (no tear spill)
- Screwing up achieved by orbital part of orbicularis oculi (tear spill and squeezes lacrimal sac)
- Lacrimal sac lies between anterior & posterior lacrimal crests with palpebral fibres of orbicularis oculi inserting into its walls to draw it open & suck in tears
- Lacus lacrimalis (lacrimal lake) lies above it.
- Nasolacrimal duct is 2cm long, drains into inferior meatus of lateral wall of nose & its mucosal folds are valvular to stop air ascending

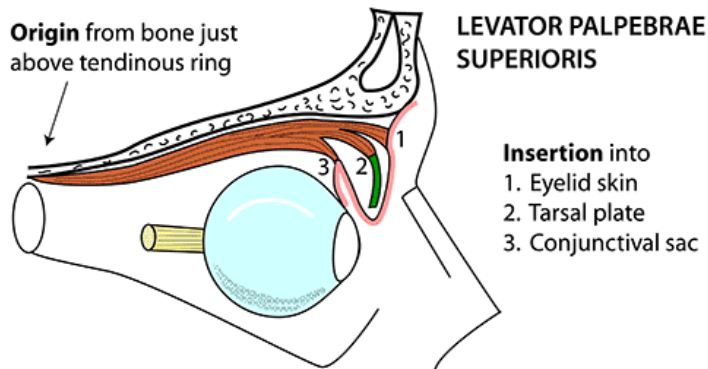


- **The parasympathetic secretomotor nerve supply** is from facial nerve. The preganglionic fibers are carried by **great petrosal nerve & nerve of pterygoid canal** to reach pterygopalatine ganglion (sphenopalatine ganglion). The postganglionic fibers leave the ganglion and join the maxillary nerve where they pass into its zygomatic branch and the zygomaticotemporal nerve. Then, they reach the lacrimal gland within the lacrimal nerve.
- **The sympathetic postganglionic nerve supply** is from the internal carotid plexus and travels in the **deep petrosal nerve**, nerve of pterygoid canal, maxillary nerve, zygomatic nerve, zygomaticotemporal nerve, and finally lacrimal nerve.

EYE - RIGHT OPHTHALMIC ARTERY (viewed from above)



LEVATOR PALPEBRAE SUPERIORIS

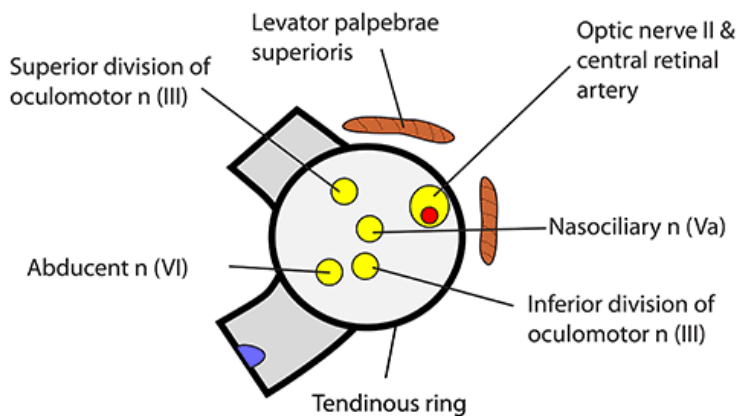
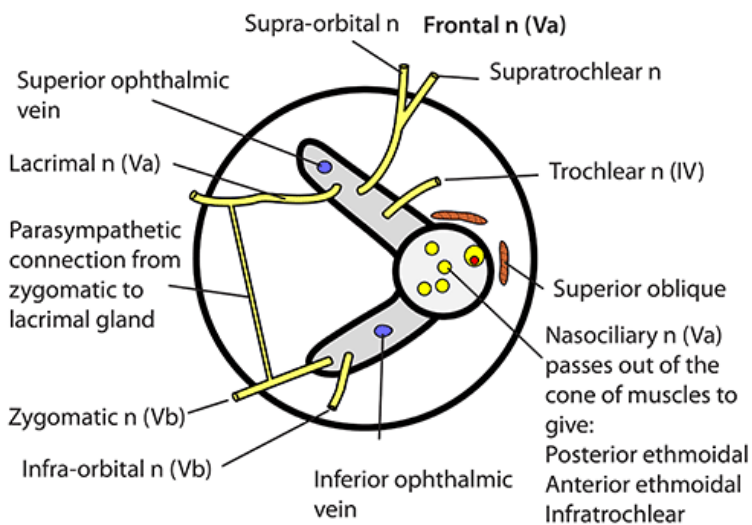


Nerve supply:

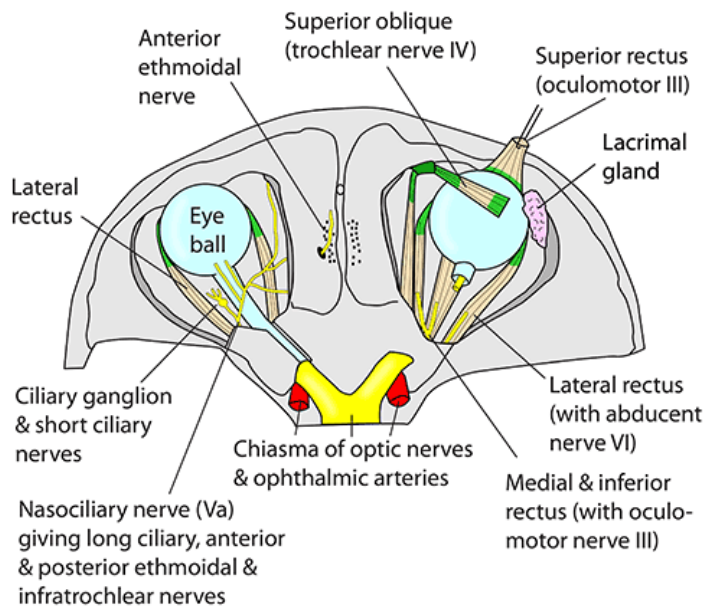
- **III (oculomotor)** to all three insertions (somatic) so defect gives complete ptosis
- **Sympathetic** to tarsal plate only (autonomic) so defect gives only partial ptosis

Note: For the muscle to function correctly both somatic and sympathetic supply must be intact

EYE - STRUCTURES PASSING THROUGH RIGHT SUPERIOR/INFERIOR ORBITAL FISSURES



EYE - ORBITS FROM ABOVE



Note:

- Medial orbital walls are parallel
- Lateral walls are at right angles
- Orbital fascia is the periosteum of orbit which is continuous with dura over optic nerve