The orbit

The bony orbit

- The orbit is a four-sided pyramidal shape space whose base lies anterior & its apex posterior
- The base is almost 3.5 X 4 cm & the depth is about 5 cm
- Medial walls are parallel to each other with a 2 cm distance separating them
- Lateral walls diverge laterally at 450 from medial walls thus the lateral walls are 900 at each other
- Orbital axis lies along the center of the orbit & both will also be perpendicular on each other

Orbital margins

The margins of the orbit are strong bones, they are even stronger than its four walls

- Superior: supraorbital arch of the frontal bone
- Lateral: frontal process of zygomatic bone & zygomatic process of frontal bone
- Inferior: zygomatic bone & maxilla
- Medial: frontal process of maxilla & maxillary process of frontal bone

Roof

- Formed by orbital process of the frontal bone completed posteriorly by the lesser wing of sphenoid
- It is concave especially laterally where the lacrimal fossa which accomodates the lacrimal gland lies

Floor

- Formed by the the orbital surface of the maxilla supplemented laterally by the zygomatic
- It slopes upward in the direction of the medial wall
- It contains the infraorbital groove which connects the inferior orbital fissure to the infraorbital canal

Lateral wall

- Formed by the zygomatic bone in front & greater wing of sphenoid behind

Medial wall :

- Formed from in front backwards by: frontal process of maxilla, lacrimal bone, orbital lamina of ethmoid & near the apex by the body of sphenoid
- It is very thin & lies almost vertical
- It separates the orbit from the ethmoidal & spheboidal air cells
- It shows the site of the lacrimal sac which is bounded by anterior & posterior lacrimal crests
- It contains anterior & posterior ethmoidal foramina at its junction with the roof

Relations :

The orbit is bounded :

- Above : anterior cranial fossa & frequently the frontal air sinus
- Medially : sphenoidal & ethmoidal air cells
- Inferiorly : maxillay air sinus
- Laterally : temporal fossa

Anatomy of the eyelids :

The eyelid is composed of five layers:

1- Skin:-

- very thin & moist

2- <u>Subcutaneous tissue</u> :

- lax, scanty & rarely contains any fat
- contains the roots of the eyelashes with the accompanying sebaceous glands "of Zeis" & modified sweat glands "of Moll".
- contains vessels & nerves of the lid

3- <u>Muscular laver</u> :

- consists of the palpebral & lacrimal parts of O. oculi
- palpebral part "discussed"
- lacrimal part connects the lacrimal sac & posterior lacrimal crest to the tarsus
- its posteromedial direction of contraction provides better contact between the eyeball & eyelid & consequently better distribution of tear film, also it dilates the lacrimal sac

4- <u>Tarso-fascial layer</u> :

- is the skeleton of the eyelid
- formed of two layers, the tarsal plate "tarsus" & orbital septum:

***Tarsal plate :**

- tough fibrous layer extends between the medial & lateral palpebral ligaments
- 2.5 X 1 cm in dimensions
- semilunar in shape with the straight edge at the lid margin

***Orbital septum :**

- thin membrane which is continuous with the periosteum of the superior & inferior orbital margins

- the superior one is perforated by the levator palpebrae superioris
- away from this muscle, the tarso-fascial layer forms a complete septum between the superficial compartment of the eyelid which is continuous with the face & deep compartment which is continuous with the orbit

Tarsal glands :

- Are modified sebaceous glands on the deep surface of the tarsus secrete an oily layer to prevent tear overflow at the lid margins

5- <u>Conjunctiva:</u>

- the transparent membrane which lines the lids (palpebral c.) & onto the eyeball (bulbar c.)
- the site of reflection is called the fornix, so we have superior & inferior fornices
- palpebral *c.* differs from the bulbar in being thicker, opaque & more vascular
- modifications in the conjunctiva :

1- lacrimal lake: a shallow bay on the medial angle of the eye bounded laterally by the semilunar fold, it acts as reservoir for lacrimal fluid.

2- semilunar fold: a rudimentary fold in the conjunctiva

3- lacrimal caruncle: a rounded elevation in the lacrimal lake formed of moist skin with fine hairs, sebaceous & sweat glands.

Contents of the orbit :

1- Eyeball

2- Muscles LPS

- four reed
- two oblique

3- Nerves :- motor (III, IV & VI)

- sensory (Va)

4- Vessels : - ophthalmic artery

- ophthalmic veins

5- Fascial modifications : - periorbita

- muscular fasciae

- check & suspensory ligaments

- retrobulbar fat

6- Lacrimal apparatus :- lacrimal gland

- lacrimal sac

- nasolacrimal canal

Muscles o the orbit :

The recti are 4 in number :

- Superior rectus
- Medial rectus
- Inferior rectus
- Lateral rectus

Origin

All the 4 recti arise from a tendinous ring surrounding the medial end of the SOF

Insertion :

The muscles, narrow at their origin broaden as they come forward to be inserted into the sclera anterior to the coronal equator forming a muscular cone around the eyeball

3- Oblique muscles :

a) Superior oblique :

Origin :

- from the bone just above the optic canal

Insertion :

- The muscle passes forward in the junction between the roof & medial wall of the orbit to reach the anterior part of the orbit as a thin tendon which hooks around the trochlea "pulley" which is attached in the roof of the orbit above the lacrimal crest.
- From this pulley the tendon returns postero-laterally to be inserted into the sclera deep to SR tendon behind the equator of the globe

b) Inferior oblique :

Origin:

- from the orbital surface of the maxilla lateral to the lacrimal groove

Insertion :

- the muscle is located below the eyeball, passes postero-laterally below IR to be inserted in the sclera beneath LR

* The recti will move the globe :

- SR superiorly + nasally (elevation +adduction)
- IR inferiorly + nasally (depression +adduction)
-MR nasally (adduction)
- LR temporally (abduction)

* The oblique muscles move the globe :

-SO inferiorly + temporally (depression + abduction)
-IO superiorly + temporally (elevation + abduction)

Nerve supply of ocular muscles :

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Motor nerves of the orbit :

1- Oculomotor n. :

- enters the orbit through the SOF as superior & inferior branches
- the superior branch crosses over the optic n. under SR supplying it & passes medial to it to terminate in the undersurface of LPS
- the inferior branch crosses below the optic n. to supply

GSE to MR, IR, & 10

GVE to sphincter pupillae & ciliary muscle "parasympathetic" with a relay in the ciliary ganglion, this component reaches the globe via branch to IO

2- Trochlear n.:

- the smallest of all cranial nerves, enters the orbit through the SOF being the highest of all nerves entering the orbit
- lies in the roof of the orbit medial to the frontal n.
- supplies SO at its posterior 1/3

3- Abducent n.:

- enters the orbit through the SOF inferior to all nerves
- enters the ocular surface of LR supplying it

N.B .

The above three motor nerves have a communication with Va in the cavernous sinus which make them able to carry the proprioceptive sensation from the muscles they supply.

Sensory nerves of the orbit

- the ophthalmic division of trigeminal nerve "Va" is the smallest of

the three divisions of V nerve, it is entirely sensory

- from the semilunar ganglion, Va leaves forward in the lateral wall of the cavernous sinus together with motor nerves of the orbit with which it forms some communication
- it divides into its three terminal division short of the way to the SOF after it gives the tentorial branch to the tentorial dura
- the three divisions of Va, namely the lacrimal, frontal & nasociliary nerves enter the orbit through the SOF to supply its contents
- in addition to the orbit & its contents, Va supplies

  *some skin of the face & scalp

  *some mucous membranes of the nasal cavity & paranasal sinuses
- ALL STRUCTURES WHICH ENTER THROUGH THE S.O.F DO WITHIN THE CONE OF MUSCLES

  "THROUGH THE '1'ENDINOUS RING" EXCEPT {LACRIMAL N., FRONTAL N., TROCHLEAR N. & THE OPHTHALMIC

1- Lacrimal nerve

- the smallest of Va branches, passes over the LR muscle
- half its way in the orbit it receives contribution from the zygomaticotemporal branch of Vb supplying it with parasympathetic component from the pterygopalatine ganglion to the lacrimal gland
- it supplies the gland with sensory & parasympathetic supply, together with the lateral '/2 of the upper lid & its conjunctiva

2- Frontal nerve :

- the largest of Va branches, passes between LPS & the roof of the orbit
- in the middle of the orbit it divides into its terminal branches :

*the supraorbital n.; leaves the supraorbital notch (or foramen), supplies the lateral part of the skin of the forehead & the anterior 1/2 of the scalp up to the vertex

*the supratrochlear n.; lies medial to the former, it leaves the orbit above the trochlea of SO to supply skin of the middle of the forehead below the hairline

3- Nasociliary nerve :

- enters through the muscle cone & crosses the optic nerve from lateral to medial
- passes under the SR & LPS, the nerve is directed to the medial wall of the orbit where it divides into its principal branches; the posterior ethmoidal, anterior ethmoidal & infratrochlear nerves

Branches:

1- sensory root of ciliary ganglion ; runs on the lateral aspect of the optic nerve to enter the ganglion

2- long ciliary nerves ; pierce the sclaera to supply the eyeball with sensation

3- posterior ethmoidal nerve ; enters the corresponding foramen to supply sensation to the posterior ethmoidal & sphenoidal air cells.

4- infratrochlear nerve ; leaves the orbit below the trochlea of SO to supply the medial $^{1}/_{2}$ of the upper lid & its conjunctiva together with the skin of the bridge of the nose

5- anterior ethmoidal nerve;

- leaves the orbit through the anterior ethmoidal foramen
- supplies the anterior & middle ethmoidal air sinuses
- enters the floor of ACF & courses over the cribriform plate
- enters the nasal cavity through the nasal slit on each side of crista galli

- supplies mucous membranes of the anterosuperior $^{1}/_{4}$ of the lateral wall of nasal cavity & upper part of nasal septum
- leaves the nasal cavity between the nasal bone & cartilage as the external nasal nerve which supplies the middle of the skin of external nose below the bridge

The optic nerve :

- is the 2nd cranial nerve
- wholly sensory
- enters the back of the eyeball just medial to its posterior pole
- its medial fibers transmit image from nasal side of the retina (temporal field)
- its lateral fibers transmit image from temporal side of the retina (nasal field)
- decussation of nasal fibers occur in optic chiasma so each eye will see the opposite $^{1}/^{2}$ of visual field
- the nerve is crossed inside the orbit by many structures like the ophthalmic artery, nasociliary nerve, some motor nerves ...
- ciliary ganglion lies on its lateral side

Arterial supply of the orbit ;

- the ophthalmic artery, branch of ICA just after it leaves the cavernous sinus, enters the orbit through the optic canal
- it is directed in the orbit from lateral to medial across the optic nerve

<u>Branches</u> :

1- Branches to the eyeball :

- central artery of the retina
- long & short posterior ciliary branches
- anterior ciliary branches

2- Branch with each of the sensory nerves of the orbit; taking its course & destination

3- Muscular branches; with the motor nerves of the orbit supplying ocular muscles & give the anterior ciliary arteries

*The central artery of retina :

- pierces the optic n. near the middle of its intraorbital course supplies the distal 1/3 of the optic nerve & the whole retina
- its damage leads to total blindness of that eye with optic atrophy

*The short posterior ciliary arteries:

- pierce the back of sclera near the optic nerve
- supply the choroid

*The long posterior ciliary arteries: pierce the back of sclera near the optic nerve pass between the sclera & choroid to the iris

*Anterior ciliary arteries:

- branches of muscular arteries
- pierce the sclera near the cornea
- end in the greater arterial circle of the iris

Venous drainage of the orbit:

1- Superior ophthalmic vein :

- formed at the supraorbital foramen by union of the supraorbital & supratrochlear veins
- has the same course & branches of the ophthalmic artey
- joined by the inferior ophthalmic vein at the medial end of SOF - enters the cavernous sinus after leaving the orbit

2- Inferior ophthalmic vein:

- formed in the floor of the orbit by union of muscular veins
- communicates with pterygoid venous plexus through the inferior

orbital fissure

- empties in the SOV at the medial end of SOF
- sometimes empties directly in the cavernous sinus

Fasciae of the orbit :

1- Periorbita :

- the double-layered dura mater of the cranial cavity enters the orbit with the optic nerve
- the fibrous coat remains with the nerve & the endosteal layer leave the fibrous layer to form the periosteal layer of the orbit (periorbita)
- unlike in the cranial cavity, periorbita could be easily stripped from bones of the orbit
- the site where the two dural layers diverge in the orbit represents the site of complete separation of the orbital from cranial cavities

2- Muscular fasciae :

- fascia covering ocular muscles
- muscular fascia of MR thickened at certain site to be attached to the posterior lacrimal crest forming the "medial check ligament"
- the same thing occur in LR fascia & attaches it to the zygomatic bone *forming* the "lateral check ligament"
- these two thickenings fuse with fasciae of 10 & IR to form the hammock-like sling on which the eyeball rests "suspensory ligament of the eyeball"

3- Retrobulbar (orbital) fat :

A fixed-sized cushion of fatty tissue on which the globe rests with a fixed position of its center.

The lacrimal apparatus :

1- Lacrimal gland :

- an oval gland occupies the superolateral part of the orbit "lacrimal fossa"
- it is pierced by LPS muscle which incompletely divides it into orbital part which remains in the roof of the orbit partially invested by fascia of SR & LR muscles, & palpebral part which projects inside the upper eyelid with its deep surface in relation to the conjunctiva
- ducts of the gland are 6-10 in number all empty in the superior f6mix of conjunctiva
- supplied by lacrimal branch of ophthalmic artery drained by lacrimal v. which empties in the superior ophthalmic v.
- supplied by lacrimal nerve which carries autonomic component derived from the zygomaticotemporal branch of Vb

2- Lacrimal canaliculi:

- open in the eyelids as the lacrimal puncta whose openings are directed toward the lacrimal lake
- course over the corresponding eyelids, the puncta open in the lacrimal sac
- they collect tears from the lake to the sac

3- Lacrimal sac:

- it is the upper dilated end of nasolacimal duct
- measures 0.5 X 1 cm
- receives the lacrimal canaliculi separately
- lies in front of the lacrimal part of orbicularis oculi & behind the medial palpebral ligament
- contraction of the lacrimal part of O. oculi dilates the sac making

negative pressure which sucks tears from the lake by the canaliculi

4- Nasolacrimal duct:

- extends from the lacrimal sac downward, backward & laterally towards the inferior nasal meatus
- transmits tears from the sac to the nasal cavity
- is about 2 cm long