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# UNIT 8 ANATOMY OF ORBIT

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## 8.0 OBJECTIVES

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After reading this unit, you should be able to understand:

- the different walls of the orbit, optic canal, orbital openings; and
- the anatomy of extra-ocular muscles.

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## 8.1 INTRODUCTION

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Basic knowledge and anatomy of orbit is essential in the practice of ophthalmology. The bones which form orbit also take part in the formation of skull. An understanding of the action of extra-ocular muscles is dependant upon the orbital origin and ocular insertion of muscles. The arteries, veins and nerves to various ocular and intra-orbital structures come through the bony openings.

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## 8.2 DESCRIPTION OF ORBIT

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There are two orbits situated on either side of nose.

### 8.2.1 Bony Orbit

Shape—Quadrilateral pyramid.

Seven bones take part in the formation of the orbit (Fig. 8.1).

#### Walls of the Orbit

Medial

- Lateral
- Superior
- Inferior

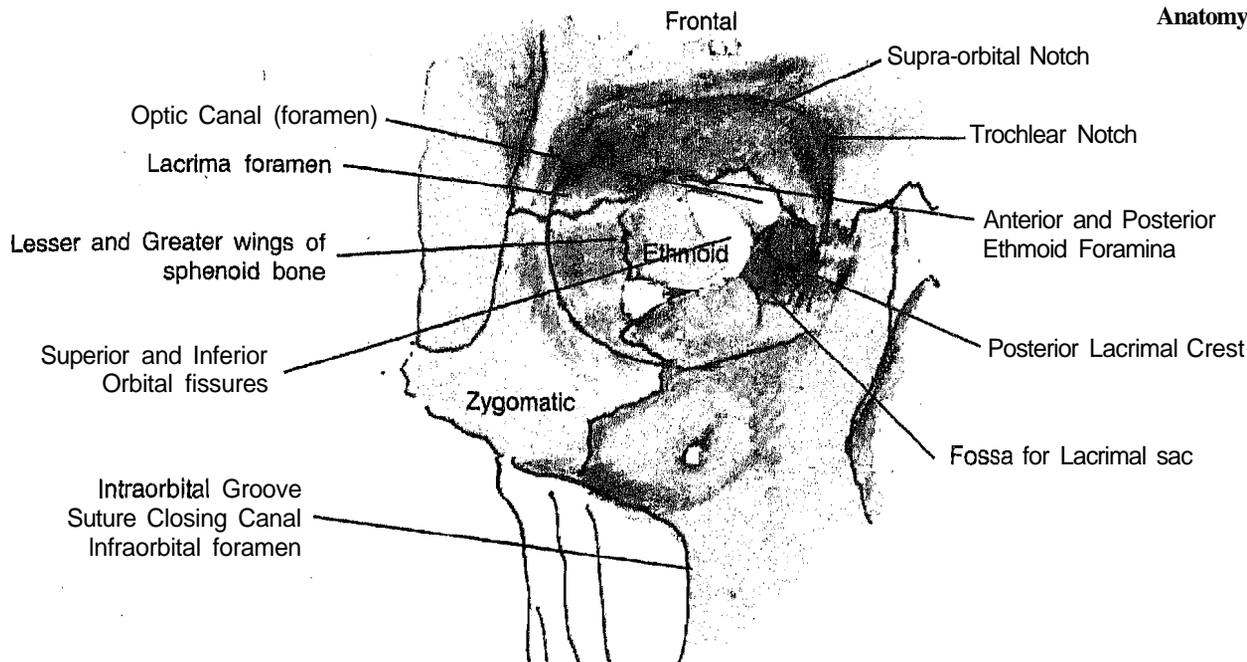


Fig. 8.1: The Bones of the Orbit

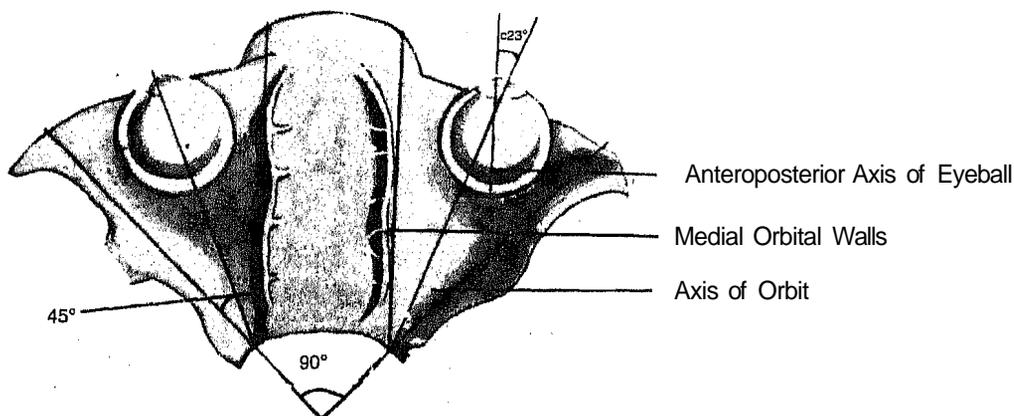


Fig. 8.2: Diagrammatic representation of angles formed by walls of orbit

**Medial Wall of the Orbit**

The medial walls of the orbit are parallel and separated from each other by sinuses. Bones taking part in the formation of medial wall include:

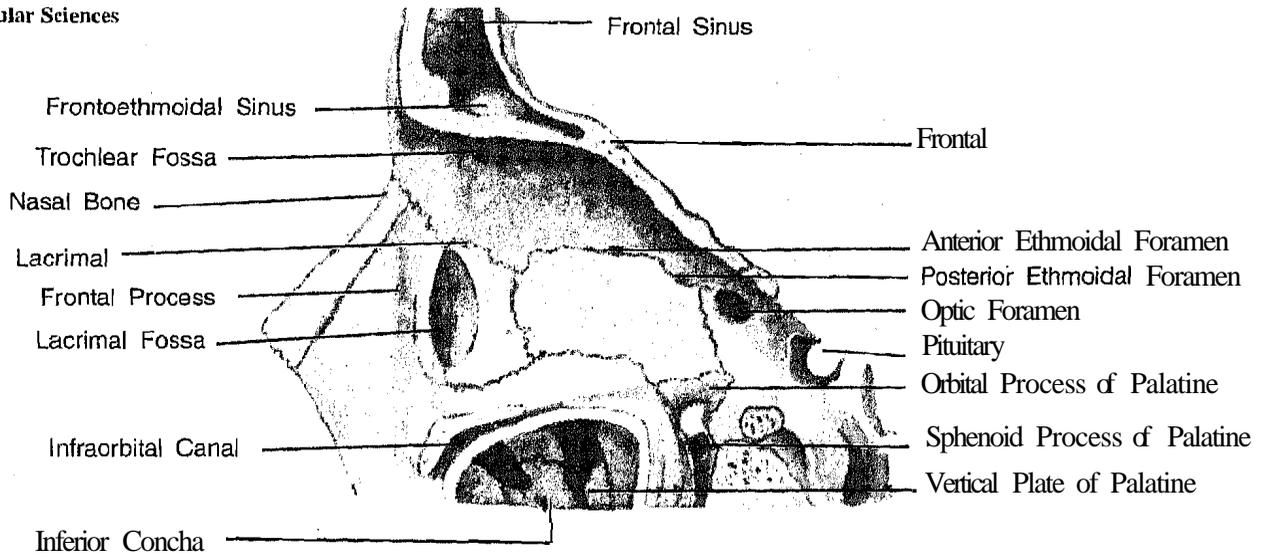
- 1) Ethmoid
- 2) Frontal process of maxilla
- 3) Lacrimal bone
- 4) Sphenoid bone

Most of the medial wall is formed by the ethmoid bone, which is thinnest part of the orbit. Because of this any infection of the ethmoid sinus pass early to the orbit through the ethmoid bone.

**Lateral Wall**

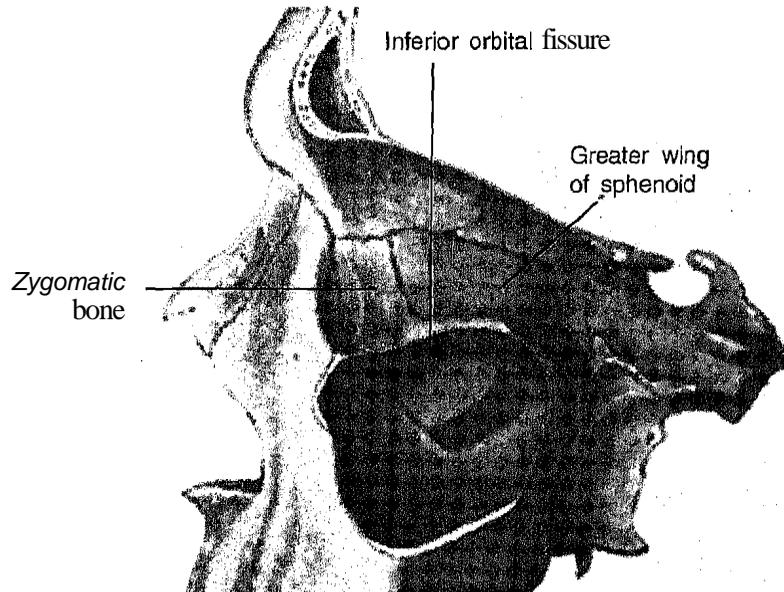
Lateral wall is formed by:

- 1) Zygomatic bone
- 2) Greater wing of sphenoid



**Fig. 8.3: Medial wall of orbit**

Lateral wall is the thickest orbital wall. It separates orbit from middle cranial fossa posteriorly and temporal fossa anteriorly.



**Fig. 8.4: Lateral Wall of Orbit**

**Floor of the Orbit**

Floor of the orbit is composed of three bones:

- 1) Orbital plate of maxilla
- 2) Zygomatic bone
- 3) Palatine bone

Infra-orbital canal passes through the floor of the orbit through which infra-orbital nerve and infra-orbital blood vessels pass.

**Roof of the Orbit**

Roof of the orbit is formed by:

- 1) Frontal bone
- 2) Lesser wing of sphenoid bone

Roof separates orbit from anterior cranial fossa and frontal sinus.

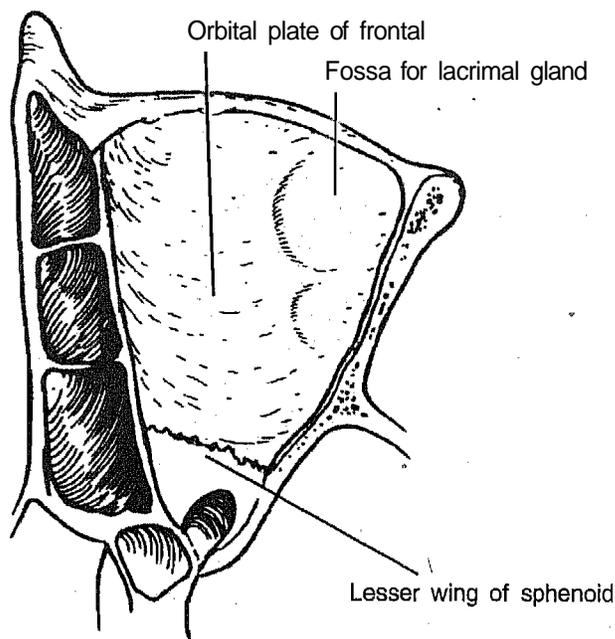


Fig. 8.5: Roof of the orbit as seen from below

### 8.2.2 Optic Canal

Optic canal is situated at the posterior end of the medial wall of the orbit. It is formed by the roots of the lesser wing of the sphenoid bone. It is funnel shaped, the mouth of funnel is anterior.

Structures passing through optic canal is optic nerve and ophthalmic artery.

Length of the optic canal: Roof is 10 to 12 mm long and lateral wall is 5 to 7 mm long.

Diameter of orbital opening of optic canal is 6 to 6.5 mm vertically, 4-4.5 mm horizontally.

### 8.2.3 Superior Orbital Fissure

Superior orbital fissures lie between the roof and lateral wall of the orbit. It is a gap between the lesser and greater wing of the sphenoid. It is comma shaped with a length of 22 mm.

A tendinous ring lies within the superior orbital fissure.

#### Structures Passing through the Superior Orbital Fissure

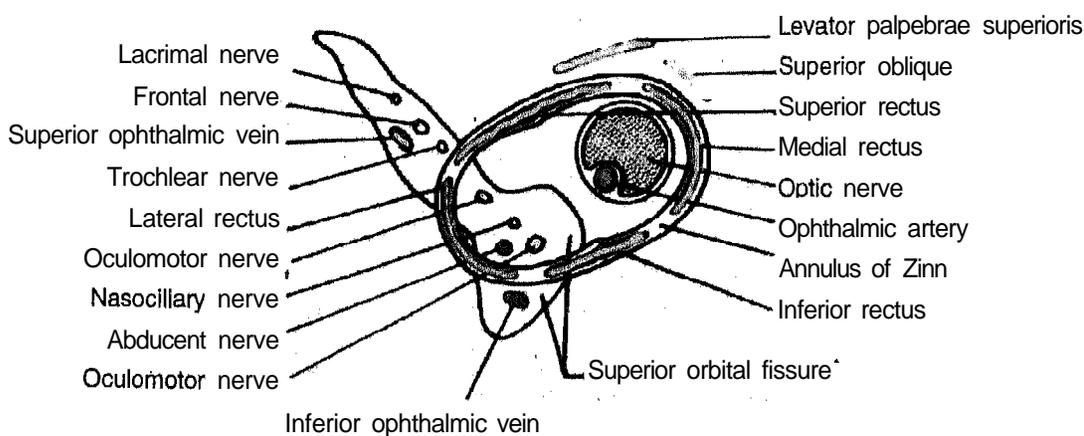


Fig. 8.6: Structures passing through the superior orbital fissure, optic canal, common tendinous ring and origin of extra-ocular muscles

1) Structures passing through the rim include:

- Optic nerve
- Ophthalmic artery
- Superior and Inferior division of the oculomotor nerves
- Nasociliary nerve
- Abducens nerve
- Sympathetic root of trigeminal ganglion

2) Structures passing above the annulus ring:

- Lacrimal Nerve
- Frontal Nerve
- Trochlear Nerve
- Superior ophthalmic vein.

3) Structures passing below the annulus ring:

- Inferior ophthalmic vein.

### 8.2.4 Inferior Orbital Fissure

Inferior orbital fissure is situated between the floor and lateral wall of the orbit.

Structures forming inferior orbital fissure:

**Anteriorly:** Maxilla and orbital process of palatine bone

**Posteriorly:** Orbital surface of the greater wing of sphenoid bone

Structures passing through inferior orbital fissure include:

- 1) Infra-orbital nerve
- 2) Zygomatic nerve
- 3) Communication between inf, Ophthalmic vein and the pterygoid plexus.

### 8.2.5 Periorbita

The surface of the orbit is lined by periosteum called periorbita. It is mostly loosely adherent to the underlying bones. At some points periorbita is firmly fixed to the underlying bone. These points are:

- 1) At the orbital margin
- 2) At the bony junctions
- 3) At various fissures and foramina.

**Check Your Progress 1**

1) Orbit has how many walls?

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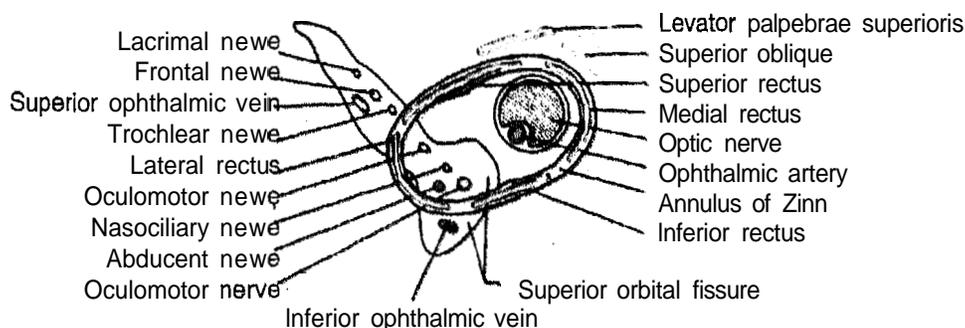
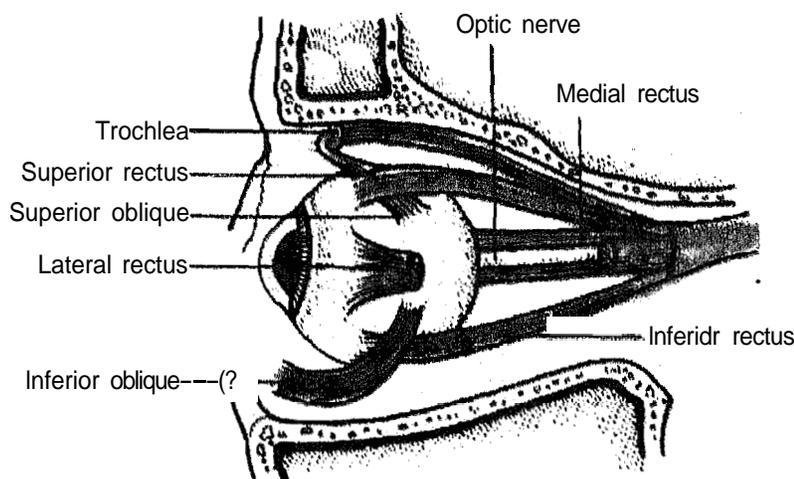
2) How many bones take part in the formation of orbit?

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 .....  
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**8.3 EXTRA-OCULAR MUSCLES**

The eyeball is suspended within the orbit by extra-ocular muscles. There are six extra-ocular muscles in each eye which include:

- 1) Medial rectus
- 2) Lateral rectus
- 3) Superior rectus
- 4) Inferior rectus
- 5) Superior oblique
- 6) Inferior oblique



**Fig. 8.7: Structures passing through the superior orbital fissure, optic canal, common tendinous ring and origin of extra-ocular muscles**

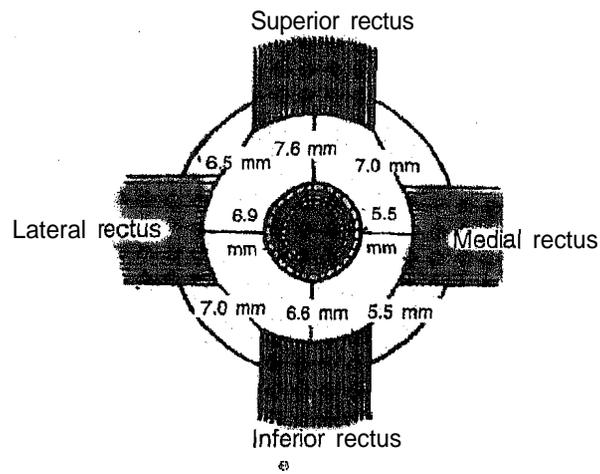


Fig. 8.8: Insertion of recti

The 4 recti muscles pull the eye back into the orbit and the two oblique muscles pull the eye away from the orbit.

### Medial Rectus Muscles

Its length is 40 mm and thicker than other extra-ocular muscles.

**Origin:** Common tendinous ring situated within the superior orbital fissure, Inserted to sclera.

**Insertion:** 5.5 mm posterior to the limbus.

**Nerve Supply:** Inferior division of the Oculomotor Nerve.

**Blood Supply:** Medial muscular branches of the ophthalmic arteries.

**Action:** Medial rectus muscle is a pure adductor. It pulls the eyeball medially. Its direct antagonist muscle is the lateral rectus muscle which pulls the eye laterally.

### Lateral Rectus Muscle

Lateral rectus muscle is situated at the lateral side of orbit.

**Length:** 40.5 mm

**Origin:** Common Tendinous ring situated at the superior orbital fissure.

**Insertion:** Inserted into scleral temporally at about 6.9 mm from the limbus.

**Nerve Supply:** Abducent (6th) cranial nerve.

**Blood Supply:** Lacrimal artery and lateral muscular branches of the ophthalmic arteries.

**Action:** It is a pure abductor. It pulls the eyes away from the midline.

### Superior Rectus Muscle

Situated superior to the eyeball.

**Length:** 42 mm.

**Origin:** Tendinous ring situated at the superior orbital fissure.

**Insertion:** To the superior scleral 7.7 mm posterior to the limbus.

**Nerve Supply:** Superior division of the oculomotor nerve.

**Blood Supply:** Lateral muscular branches of the ophthalmic artery.

**Action:** Primary: superior rectus muscle elevates the eyeball. Other action is adduction and intortion.

**Inferior Rectus Muscle**

Inferior rectus muscle is situated at the inferior part of the orbit.

**Length:** 40 mm. It is shortest of the rectus muscles.

**Origin:** Common tendinous ring and optic foramen

**Insertion:** Attached to inferior part of sclera at about 6.6 mm posterior to limbus.

In its primary position inferior rectus muscle forms an angle of 23° to the optical axis.

**Nerve Supply:** Inferior division of the oculomotor nerve.

**Blood Supply:** Medial muscular branches of the ophthalmic artery.

**Action:** Primary action to depression and other actions are extorsion and adduction.

**Superior Oblique Muscles**

Superior oblique muscle is the longest and thinnest muscle of the orbit.

**Origin:** Superior oblique muscle originates From the orbital apex just medial to the optic foramen. It runs forward towards the junction of the medial and roof of the orbit and passes through fibro-cartilagenous portion of the orbit called Trochlea. Then the superior oblique muscle angles posteriorly, inferiorly and laterally and insert into posterior superior quadrant of the globe behind the equator.

**Nerve Supply:** Trochlear (4th cranial) nerve.

**Blood Supply:** Superior muscular branches of the ophthalmic arteries.

**Action:** Primary action is intorsion. Other actions include depression and abduction.

**Inferior Oblique Muscles**

Inferior oblique muscle is the only extra-ocular muscle originating from the front of the orbit plate of maxilla a little behind the inferior orbital margin.

Actions of Extraocular Muscles in Primary Position of Gaze			
Muscle	Primary action	Secondary action	Tertiary action
Medial rectus	Adduction	—	—
Lateral rectus	Abduction	—	—
Superior rectus	Elevation	Intorsion	Adduction
Inferior rectus	Depression	Extorsion	Adduction
Superior oblique	Intorsion	Depression	Abduction
Inferior oblique	Extorsion	Elevation	Abduction

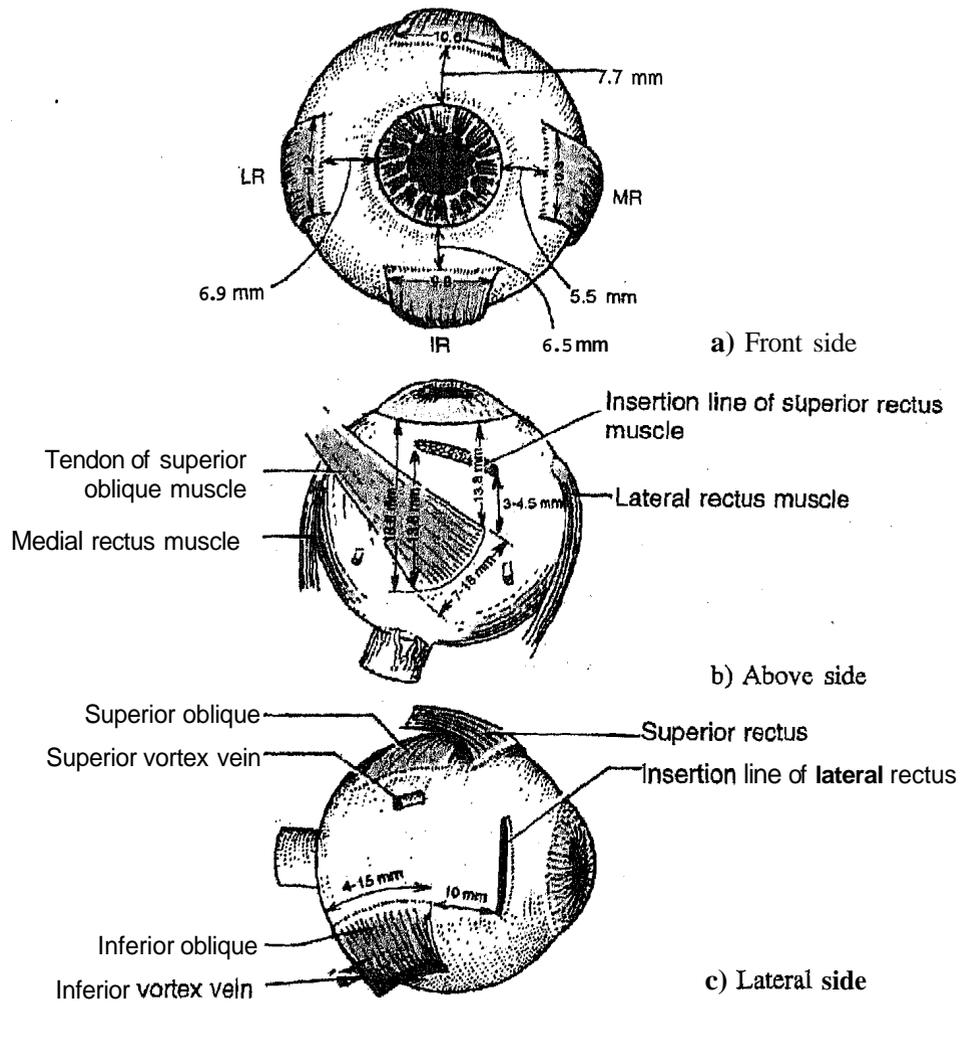


Fig. 8.9: Insertion Lines of the extra-ocular muscles in the Sciere

**Insertion:** Back and lateral aspect of the globe behind the equator. The angle formed between the optical axis of the globe and the insertion of inferior oblique muscle is 50°.

**Nerve Supply:** Inferior division of oculomotor nerve.

**Blood Supply:** Infra-orbital artery and medial muscular branches of the ophthalmic artery.

**Action:** Primary action is intorsion and other actions are elevation and abduction.

**Check Your Progress 2**

1) Mention names of extra-ocular muscles.

2) Which extra-ocular muscle helps in the elevation of eyeball?

## 8.4 NERVES AND VASCULAR SUPPLY OF ORBIT

Various structures in the orbit have different nerves supply (sensory and motor) as well as fed by different branches of ophthalmic artery.

### Sensory Nerves of the Orbit

Orbit is mainly supplied by ophthalmic nerve and its branches.

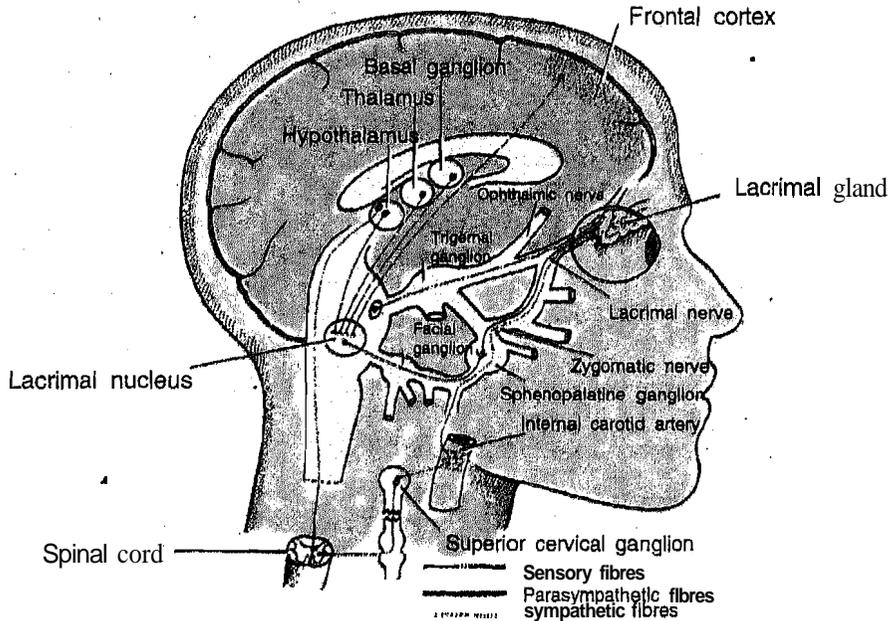


Fig. 8.10: Ocular parasympathetics bulbar outflow

### Ophthalmic Nerve

Ophthalmic nerve is the 1st division of the trigeminal nerve. It is divided into frontal, lacrimal and nasociliary nerve in the cavernous sinus and enters the orbit through superior orbital fissures.

**Lacrimal Nerve:** It enters the orbit through superior orbital fissure above the annular tendinous ring. Parts supplied by lacrimal nerve includes:

- 1) Conjunctiva,
- 2) Temporal part of the lid.

**Frontal Nerve:** Like lacrimal nerve frontal nerves enter the orbit through superior orbital fissure above the tendinous ring. Within the orbit it is divided into supratrochlear and supra-orbital nerves.

Structures supplied by supra orbital nerves include:

- Upper Eye Lid
- Forehead
- Scalp'

Structures supplied by supra-trochlear nerves include:

- Forehead
- Conjunctiva
- Upper Lid

**Nasociliary Nerves:** Nasociliary nerve enters the orbit through the tendinous ring situated within the superior orbital fissure. This nerve supply sensory innervation to the eye.

**Branches of the Nasociliary Nerves**

- 1) Branches to the sensory root of the ciliary ganglion.
- 2) Long ciliary nerve: These are two long ciliary nerves. These nerves pierce the posterior part of the sclera and pass within the space between choroid and sclera and supply to iris, ciliary body and cornea. These nerves also carry sympathetic fibres to the pupillary muscles.

**Ciliary Ganglion:** Ciliary ganglion is reddish-gray polygonal body situated at the posterior orbit about 1 cm from the optic foramina between the optic nerve and lateral rectus muscle.

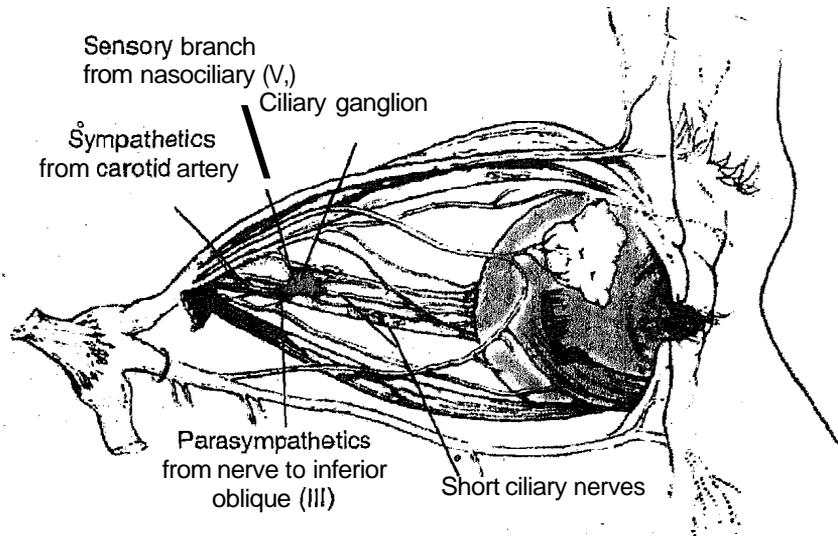
Ciliary ganglion receives three so called roots and rami:

- 1) The long or sensory root from nasociliary ,nerve
- 2) The short or parasympathetic root from the nerve to the inferior oblique
- 3) The sympathetic roots from sympathetic plexus

The parasympathetic fibres coming from the nerve to the inferior oblique muscle synapse in the ganglion. Rest of the fibres (sensory and sympathetic fibres) pass through the ganglion give origin to postganglionic parasympathetic fibres.

Postganglion parasympathetic fibres are supplied to ciliary body and iris. These fibres control accommodation and pupillary constriction.

The sensory root coming through nasociliary nerve supply afferent fibres to sympathetic fibres to the ocular blood vessels.



**Fig. 8.11: Contributions to the ciliary ganglion**

**Maxillary Nerve:** Maxillary nerve is the second division of the trigeminal nerve. Branches of the maxillary nerve that enters the orbit include:

- 1) **Infra Orbital Nerves:** This nerve passes through the infra-orbital canal and supply sensory fibres to skin of cheek and side of the nose.
- 2) **Zygomatic Nerve:** Within the orbit it is further divided into zygomatico facial nerve and zygomaticotemporal nerve.

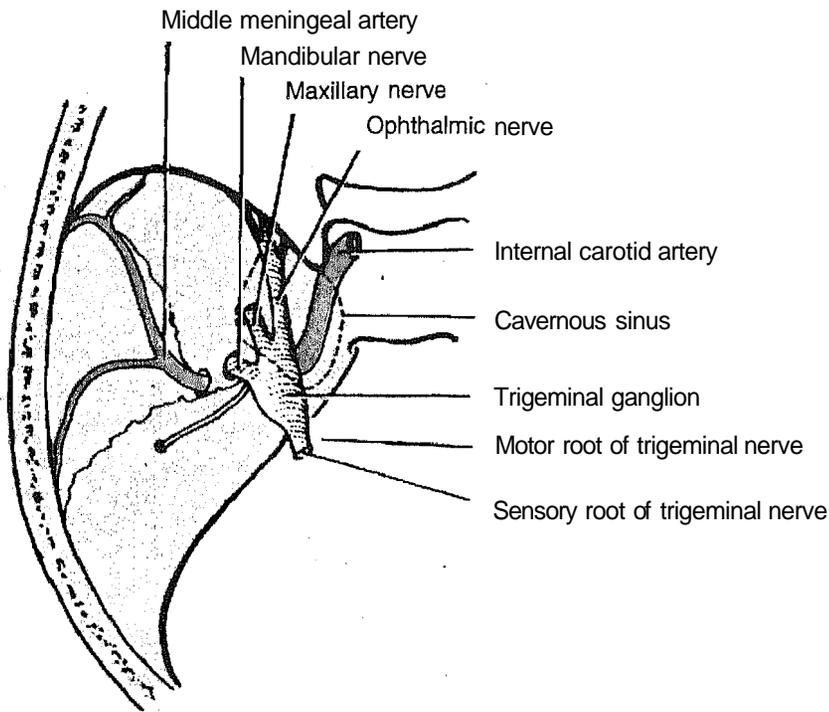


Fig. 8.12: Superior view of the middle cranial fossa showing three divisions of trigeminal nerve near the trigeminal ganglion

- 3) **Abducent Nerve:** It is the 6th cranial nerve. It enters the orbit through superior orbital fissure within the tendinous ring. Abducent nerve supply to lateral rectus muscle.
- 4) **Trochlear Nerve:** It is the 4th cranial nerve. It enters the orbit through superior orbital fissure arteries the tendinous ring. It supplies to superior oblique inuscle.

**Blood Supply to Orbit**

**Ophthalmic Artery:** It is a branch of internal carotid artery. It enters the orbit through the optic canal along with optic nerve.

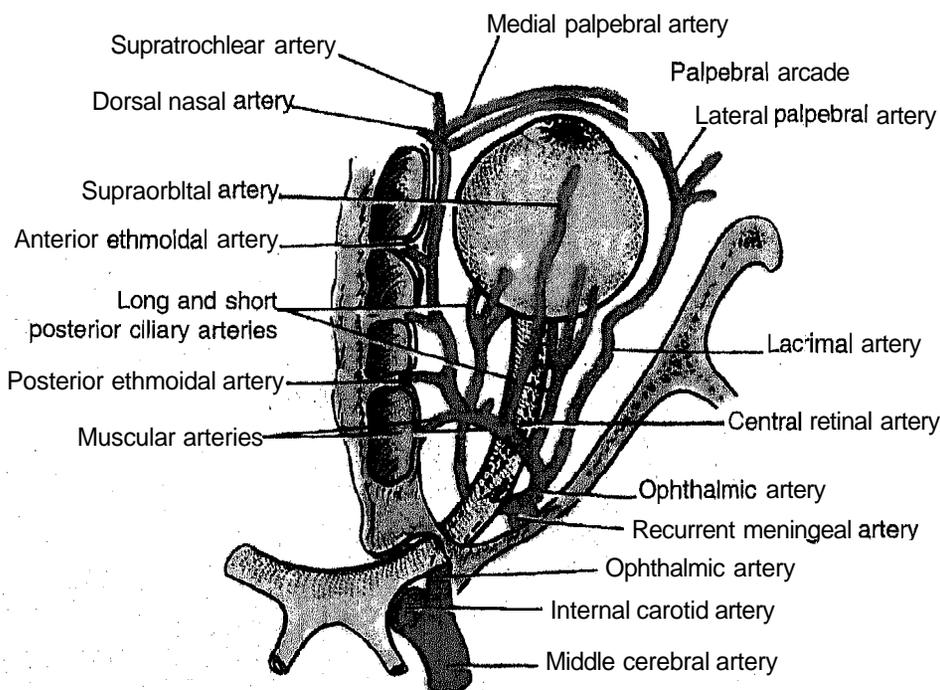


Fig. 8.13: Ophthalmic artery and its branches

**Branches of Ophthalmic Artery**

- 1) Central Retinal Artery: This branch of ophthalmic artery arise close to optic canal. At about 10 mm from the globe, central retinal artery pierces the optic nerve and reads the crater of the nerve. At the papilla the central retinal artery emerge and supply while of retinal and inner parts of choroid and some part of the optic disc.
- 2) Ciliary artery: These are about 10 to 20 short posterior ciliary arteries. These arteries pierce the scleral and supply post part of the globe including choroid.
- 3) Long posterior ciliary artery: These are two long posterior ciliary arteries. These arteries pass through the sclera and choroid and supply to ciliary body, and anastomose with anterior ciliary arteries to form major arterial arch of the iris,
- 4) Lacrimal artery: Supplies to eye lids, lateral part of conjunctiva.
- 5) Anterior and posterior ethmoidal artery to ethmoidal air cells.
- 6) Supra-orbital artery: To upper eye lid, sclera and levator muscle.

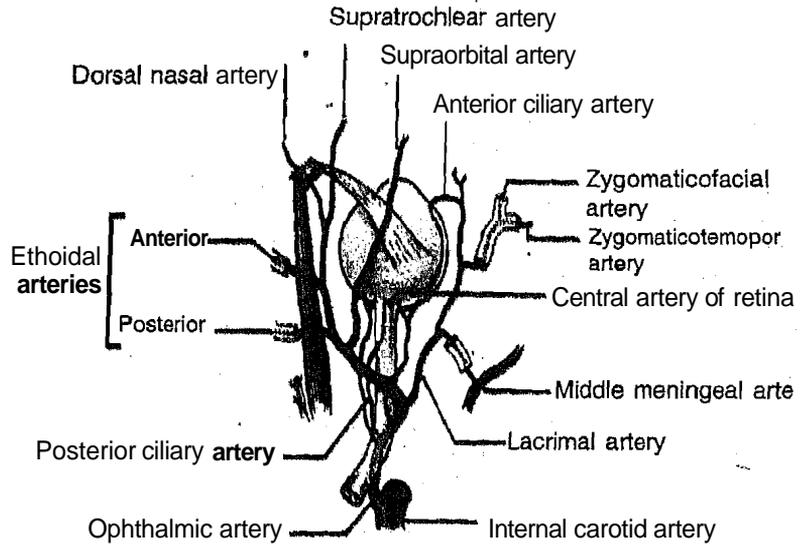


Fig. 8.14: Arterial supply

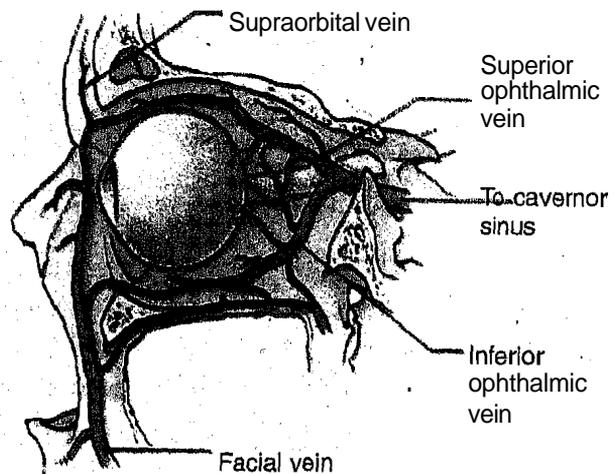


Fig. 8.15: Venous return

- 7) Muscular branches of ophthalmic artery: Muscular branches to all extra-ocular muscles. From the muscular branches anterior ciliary artery arises. There are 7 anterior ciliary arteries.
- 8) Medial Palpebral Arteries: Supply to lids.
- 9) Infraorbital Arteries: Supply to inferior rectus, inferior oblique muscles, lacrimal sac, lacrimal gland and face.

### Orbital Veins

The orbit is drained mainly by 2 veins:

- 1) Superior ophthalmic vein
- 2) Inferior ophthalmic vein.

**Superior Ophthalmic Vein:** Superior Ophthalmic vein is formed by the union of angular vein and supra-orbital vein. It passes out of the orbit through superior orbital fissure.

Veins draining into superior ophthalmic vein includes:

- 1) Central retinal vein
- 2) Anterior ciliary vein
- 3) Superior vortex vein

### Inferior Ophthalmic Veins

This is formed from a venous network situated on the floor of the orbit. Anteriorly it communicate with facial vein. This exits from orbit through superior orbital fissure.

Lymphatic Drainage of Orbit:

Lymphate of eye lids: Drains into Preocular nodes.

Lymphatics from medial aspect of lid drains to submandibular nodes.

(No lymph nodes and lymphatic vessels present in the orbit)

### Check Your Progress 3

Central retinal artery is a branch of .....

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## 8.5 LET US SUM UP

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In this unit you have learnt that orbit is a bony opening. It has 4 walls. 7 bones take part in the formation of orbit. Eyeball is suspended within the orbit with the help of extra-ocular muscles. In next block you will learn about ocular physiology and biochemistry.

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## 8.6 ANSWERS TO CHECK YOUR PROGRESS

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### Check Your Progress 1

- 1) Four walls
- 2) Seven bones

### Check Your Progress 2

- 1)
  - Superior rectus
  - Inferior rectus
  - Medial rectus
  - Lateral rectus
  - Superior oblique
  - Inferior oblique
- 2) Superior rectus and inferior oblique.

### Check Your Progress 3

Ophthalmic artery.