

Ophthalmology

Edition 8.5

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Instructions

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LAYERS AND STRUCTURE OF EYEBALL

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Basic Anatomy of Eyeball

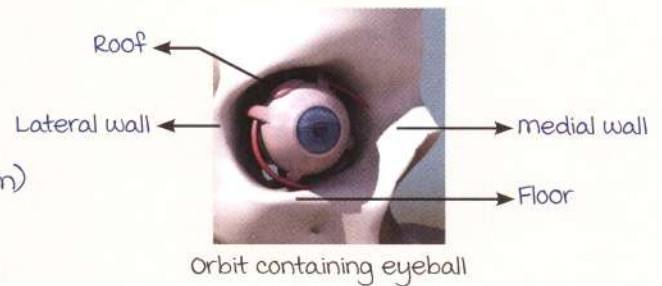
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Shape : Aspherical (Oblate spheroid)

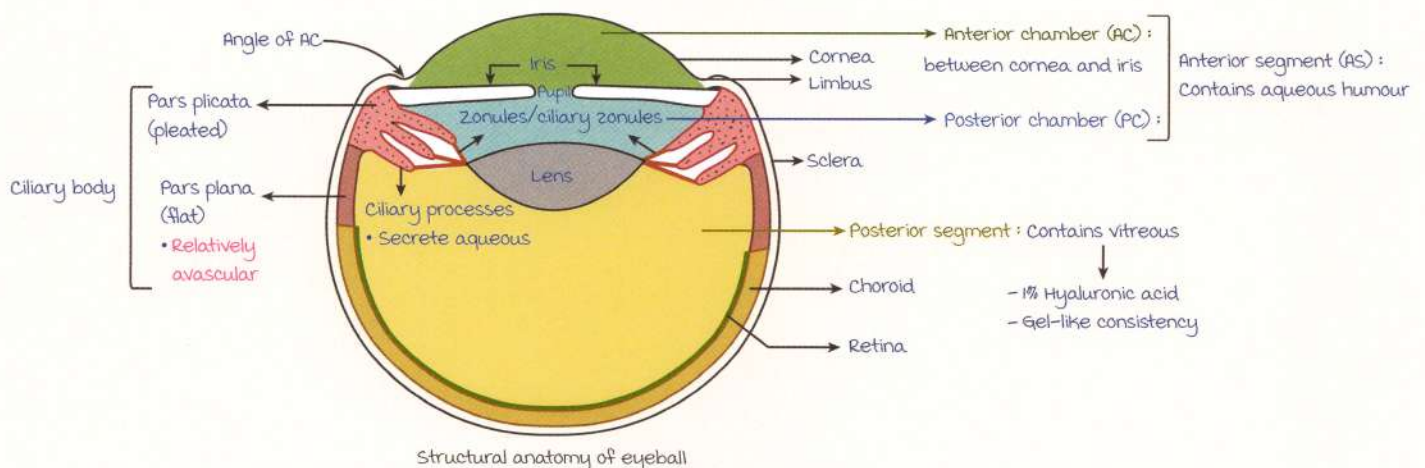
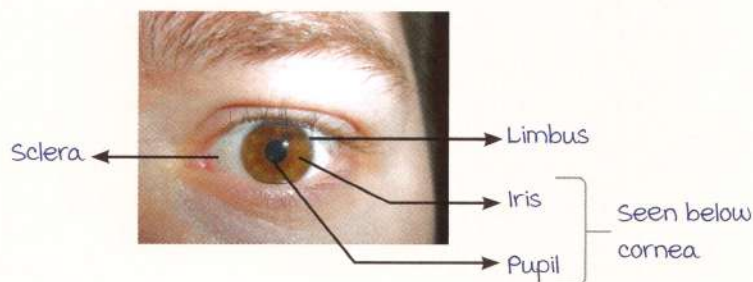
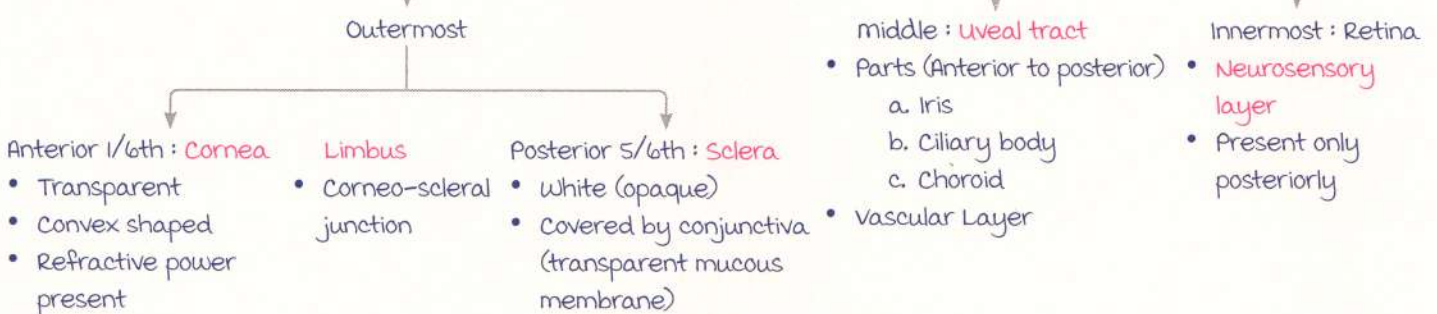
Volume : 6 ml

Site : Orbit (bony cage)

Axial length/Anteroposterior diameter : 24 mm (2.4cm)



Layers



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Aqueous humour :

- Fluid secreted from ciliary processes
- Rate of secretion : $2.3 \mu\text{L}/\text{minute}$
- Function : exerts Intraocular pressure (IOP)
 - measured by Tonometry.
- Aqueous outflow :
 $0.25 \mu\text{L}/\text{min}/\text{mm Hg}$
 - Via angle of AC $\rightarrow$ Depth : 3 mm (2.5 mm - 4.4 mm)
 - measured by tonography

ANATOMY OF CORNEA, ANATOMY OF SCLERA AND ITS PATHOLOGIES

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Neurovascular Supply of Cornea

00:00:30

Blood supply : Avascular → Cornea : Transparent
 Refractive index : 1.376
 Refractive power : +43D to +44D
 (Converging power)

Nerve Supply (Sensory) :

Trigeminal → Ophthalmic → Nasociliary → Cornea

Corneal Blink Reflex : Test of corneal sensation.

Stimulus : Touch cornea with cotton wisp.

Afferent (sensory) : Trigeminal nerve (CN V)

Trigeminal nucleus

Facial nucleus

Efferent : Facial nerve (CN.VI) —X→ Bell's palsy
 (motor) Inability to close eye : Lagophthalmos

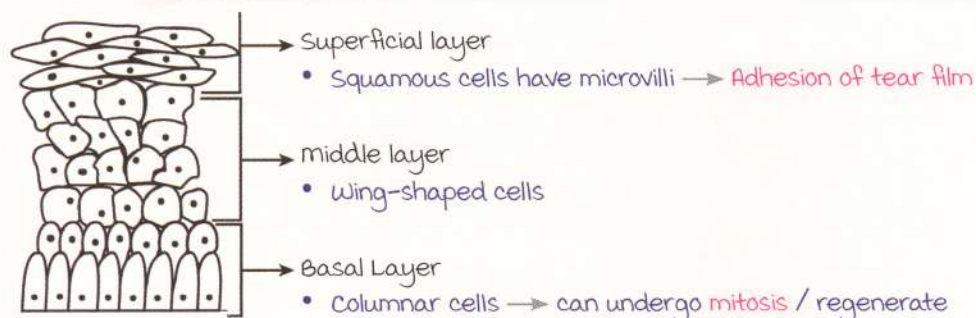
Effector : Orbicularis oculi
 ↓ No blinking → Corneal anaesthesia

Response : Blinking.

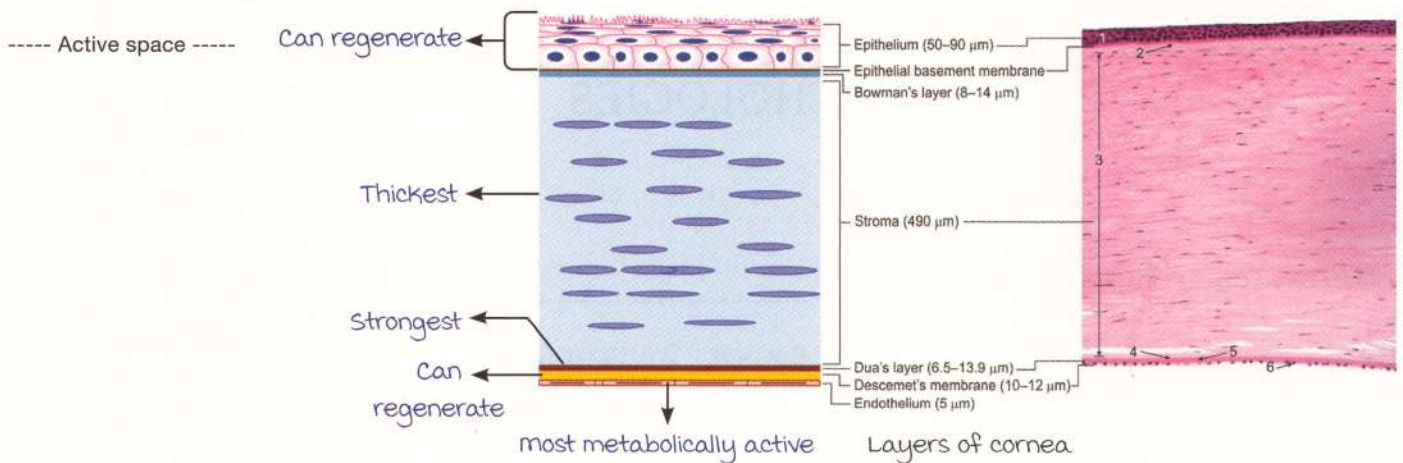
- Causes :
- Herpes Keratitis (m/c)
 - Diabetes
 - Leprosy
 - Topical medications (ex. Timolol)
 - Acanthamoeba Keratitis
 - Contact lens wear
 - Surgical trauma

Layers of The Cornea

00:15:00



Corneal epithelial histology



1. Anterior (Outermost) Layer - Epithelium :

Histology : **Non-keratinized stratified squamous epithelium.**

Note :

With respect to the centre of the eyeball.

	Outermost layer	Innermost layer
Cornea	Lies anteriorly	Lies posteriorly
Retina	Lies posteriorly	Lies anteriorly

2. Bowman's Membrane :

- Not a true basement membrane → not stained by PAS (Periodic Acid Schiff reagent)
- Acellular → **Cannot regenerate** → Heal by scar formation → Corneal opacity → LOV (Loss of vision)

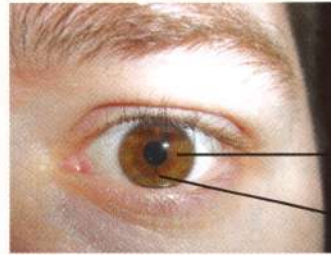
Corneal opacities :

Opacity	Pupillary margin behind Opacity (macroscopic)	Iris details behind opacity (microscopic)	Distribution of visible light
Nebular (faint)	Visible	Visible	maximum mild opacity → Diffraction ↑↑ Distortion of image
macular	Visible	Not visible	-
Leukomatous (most dense)	Not visible	Not visible	minimum Dense opacity → Light rays → don't cross opacity ↑↑ loss of vision

3. Stroma :

- Thickest corneal layer (90% of corneal thickness)
- Composition :
 - Type I collagen fibres
 - Glycosaminoglycans (GAGs) : **Keratan Sulfate (m/c)**

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Pupillary margin

Iris details

Structures behind the cornea

4. Dua's Layer / Pre-Descemet's membrane :

Strongest corneal layer

5. Descemet's membrane :

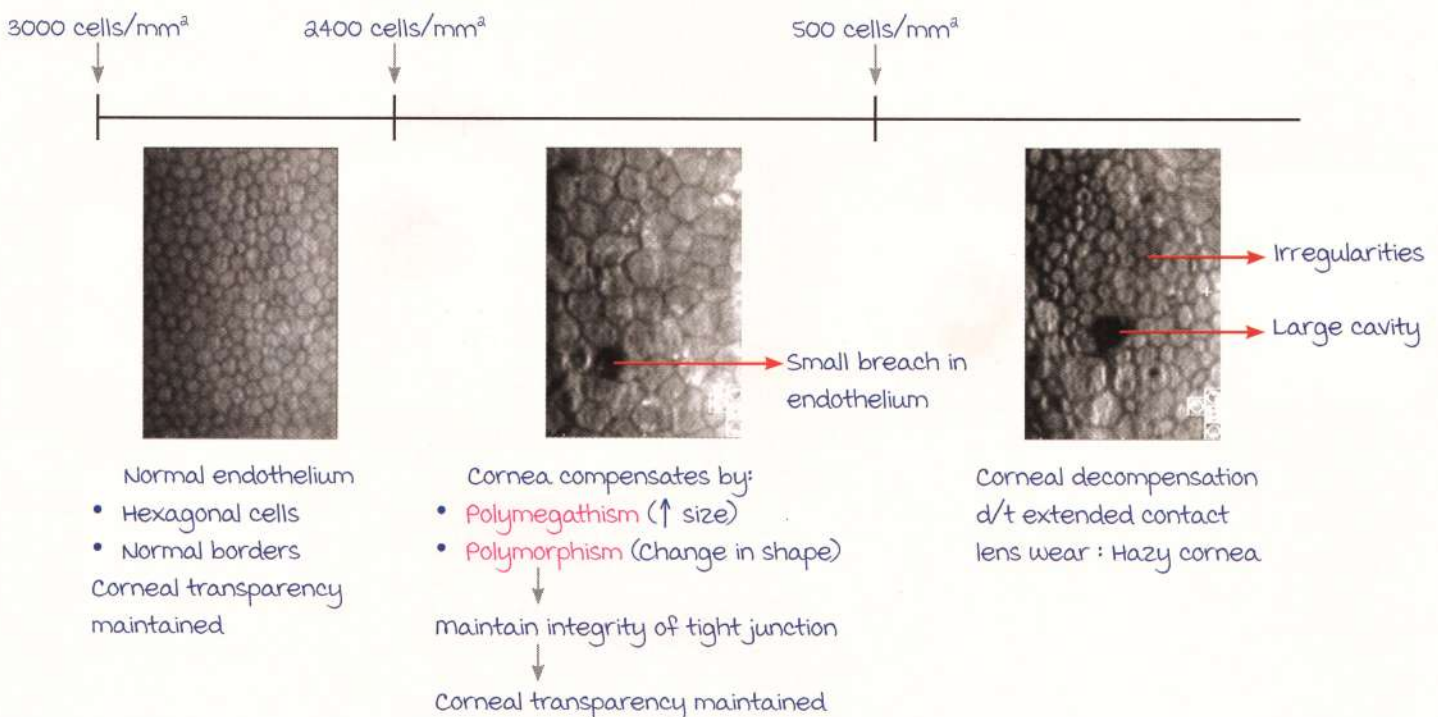
- Secreted continuously by underlying endothelial cells → **Can regenerate**
- **Schwalbe's line** : Peripheral termination (at limbus) near anterior position of trabecular meshwork.

6. Posterior (Innermost) Layer Endothelium :

- **most metabolically active** layer
- Endothelium with zona occludens → prevents entry of aqueous into cornea → **maintains transparency**

↓
If injured/breached → Edema of cornea → **Haze/opacity.**

Specular microscopy : Findings depending upon cell count.



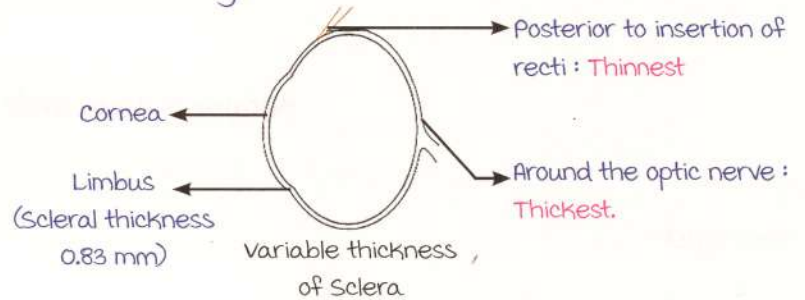
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Sclera

00:52:00

Outermost covering of posterior 5/6th of eyeball**Anatomy :**

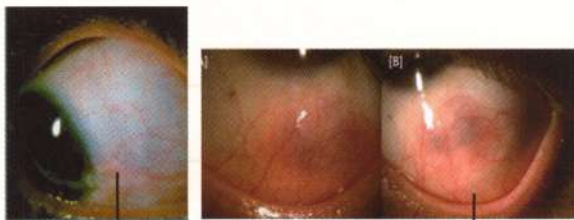
Colour : white → d/t Irregular arrangement of collagen fibres.

**Layers**

- Episclera :**
 - Outermost layer
 - Highly vascular : 2 plexuses
 - Superficial
 - Deep : near sclera proper
 - merges with Tenon's capsule : around 3 mm posterior to limbus.
- Sclera proper :**
 - Avascular
 - Collagen fibres
- Lamina fusca :**
 - Innermost layer.

Pathologies :**Scleral pathologies**

1. Scleritis (misnomer) :
Inflammation of the deep vascular plexus of the episclera.



Bluish/violaceous hue
(in severe cases)

- Redness remains : inflamed deep vessels do not constrict in response to vasoconstrictors

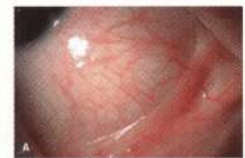
Vasoconstrictor test
Principle : pharmacological reversal of inflammation induced vasodilation
Reagent : 2.5% phenylephrine eye drops

2. Episcleritis :

- Inflammation of the Superficial vascular plexus
- Cause : Idiopathic (m/c)



Reddish hue

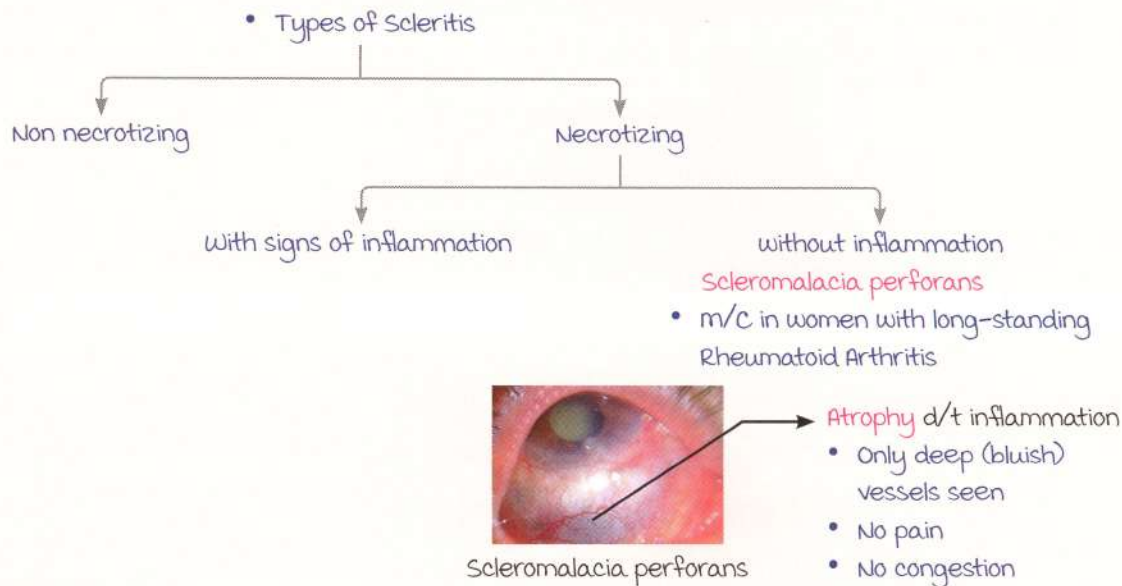


Before test



After test : Redness disappears blanching occurs (superficial vessels constrict)

- management :
 - Self resolving, resolves fast.
 - Supportive : NSAIDs, low dose steroids.



Limbus

01:07:50

Corneo-scleral junction that contains stem cells

Limbal Stem Cells/Pluripotent Cells (LSC) :

- Ability to **differentiate** (e.g., into conjunctival, corneal, scleral cells, etc.)
- Universal marker of stem cell : **CD34**.
- Specific marker of limbal stem cell : **ABCG2**.

Site : Limbal basal epithelial cells forming **Palisades of Vogt** (elevations & crypts).

Deficiency of LSC : **Pterygium**

- Caused by environmental factors
- Rx: Excision and autograft with limbal stem cells

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ANATOMY OF UVEA, ACCOMMODATION WITH ITS ANOMALIES

Components of uvea :

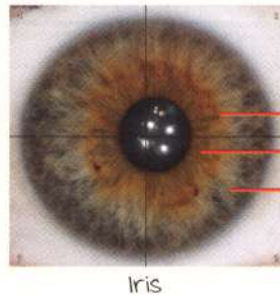
		Part of uvea	Inflammatory condition
Iris		Anterior uvea	Anterior uveitis
Ciliary body	Pars plicata		
	Pars plana	Intermediate uvea	Intermediate uveitis
Choroid		Posterior uvea	Posterior uveitis

Iris

00:01:50

Anatomy :

- ↑ Vascular.
- Pigmented (d/t melanocytes).
- Thickness : variable.

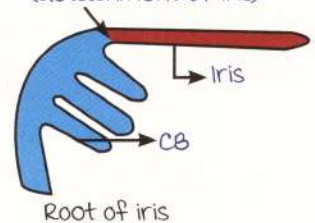


a. Thickest part:

Collarette: Boundary b/w
Pupillary zone of iris
Ciliary zone of iris

b. Thinnest part :

Root : Site of iridodialysis (detachment of iris)



muscles of Iris :

	Sphincter pupillae	Dilator pupillae
Function	miosis (constriction of pupil)	mydriasis (dilatation of pupil)
Autonomic Nerve Supply	Parasympathetic control (inhibitory) ↓ via Oculomotor nerve ↓ Inferior branch (to inferior oblique muscle) ↓ Short ciliary nerve (Post ganglion)	Sympathetic (excitatory) control Hypothalamus ↓ 1° Spinal cord : Cilio-spinal budge (C8-T1) ↓ Crossing lung parenchyma ↓ 2° Superior (SCG) Cervical ganglion ↓ 3° Along internal carotid artery Long ciliary nerve
Final nerve supply		Resection of Pancoast tumor : Risk of damage to SCG fibres ↓ Loss of sympathetic supply to eye

Note :

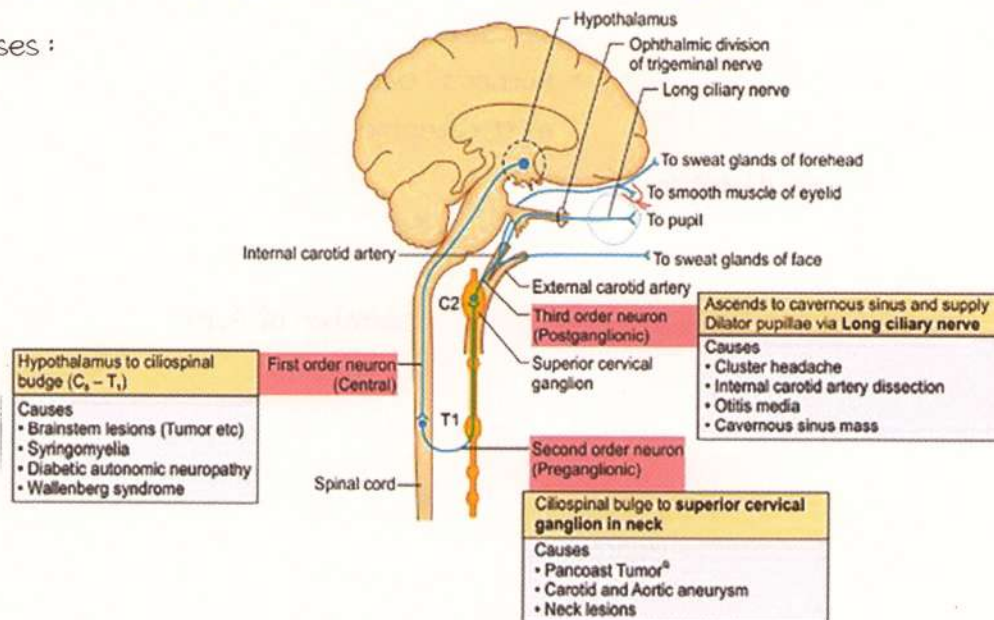
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- Parasympathetic cranial nerves : III, VII, IX, X.
- Oculomotor nerve
 - Superior branch : Supplies
 - Superior rectus
 - Levator palpebrae superioris
 - Inferior branch : Supplies
 - Inferior rectus
 - Inferior oblique

Horner's Syndrome (HS) :

Oculosympathetic palsy (paralysis of sympathetic supply).

Causes :



Clinical features :

Mnemonic : **HI MAPLE**

- Heterochromia Iridis (HI) :**
I/L hypochromia.
- Only in Congenital Horner's.
- Inferior eyelid elevation :** Paralysis of inferior tarsal muscle.
(Analogous to Muller's muscle in upper eyelid).
- Miosis :** Paralysis of dilator pupillae → constriction occurs.
- Anhidrosis :** Absence of I/L sweating.
- Ptosis :** Drooping of upper eyelid : D/t paralysis of **Muller's muscle**.
- Loss of ciliospinal reflex**
- Relative enophthalmos** (ptosis + inferior eyelid elevation → sunken appearance of eyeball → not true enophthalmos).



Heterochromia

could be

(R) eye hypochromic (L) eye hyperchromic
 (Horner's confirmed clinically)

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Note :

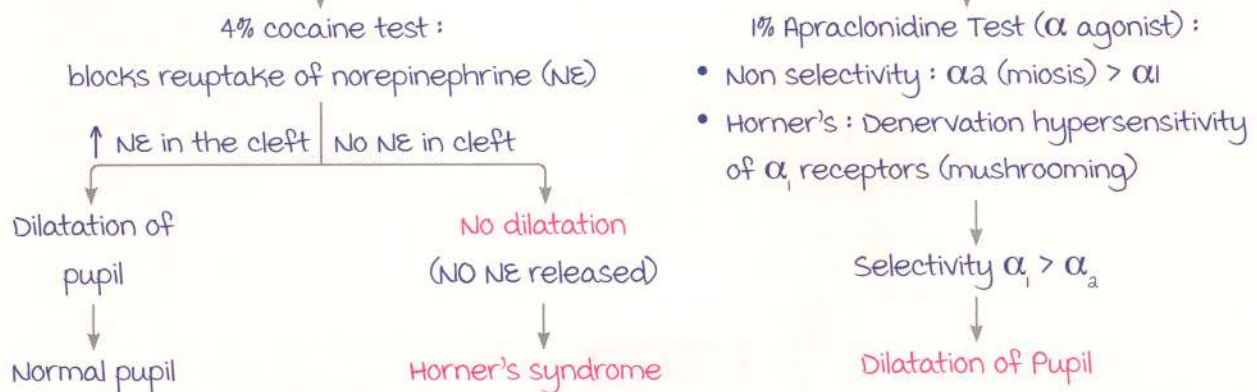
- muller's muscle / superior tarsal muscle. ← Elevation of eyelid
- LPS (supplied by CN III). ←



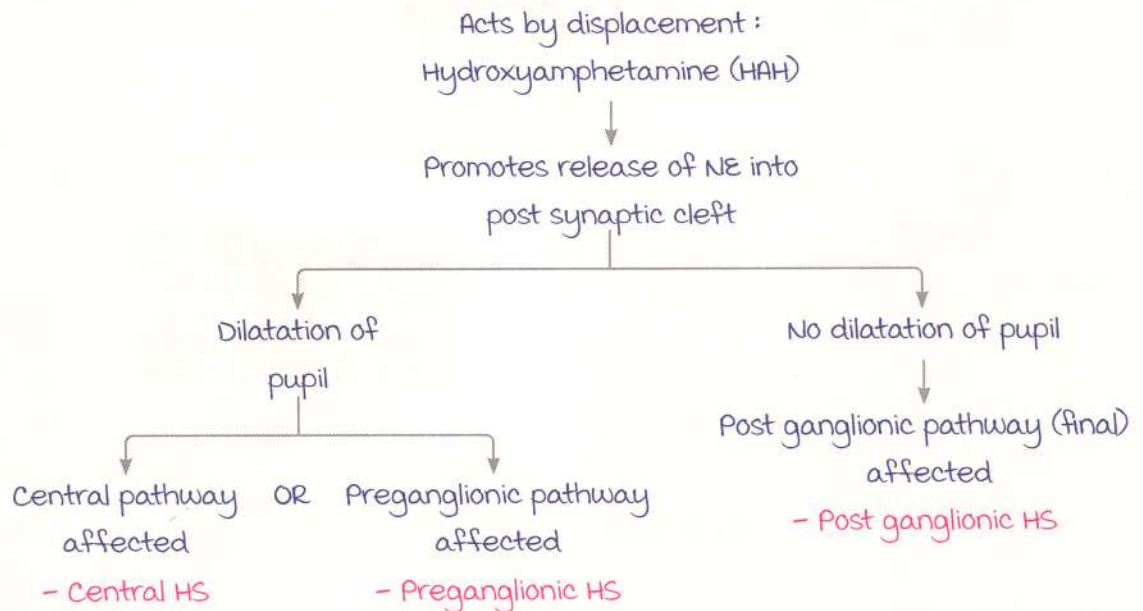
Relative enophthalmos with right eye ptosis

Diagnosis :

1. Detection of Horner's Syndrome



2. Localisation of lesion : 1% amphetamine test



Note :

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Causes of mydriasis : (ITS COME)	Causes of miosis (HI COPS)
Internal ophthalmoplegia Tonic pupil (Holmes adie pupil) Sympathomimetics Closure angle glaucoma Oculomotor 3rd nerve palsy → pupil can not constrict Mydriatics (Atropine/homatropine/tropicamide) Belladonna Poisoning	H-Horner syndrome Hemorrhage (Pontine) I-Iridocyclitis (anterior uveitis) C-Clonidine Carbolic acid O-Organophosphates, Opioid (morphine) P-Parasympathomimetic drugs (Phenothiazine/pilocarpine) S-Sleep Sedatives (Barbiturates)

Ciliary Body

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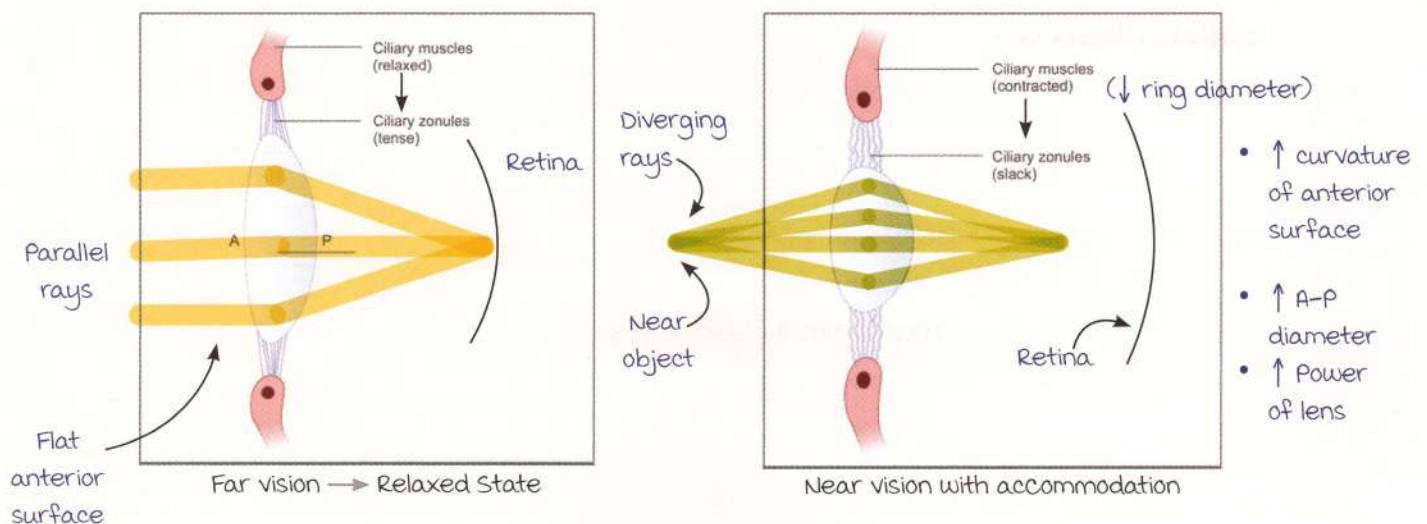
Functions :

- Secretion of aqueous through ciliary processes.
- Pars plana : Site of entry into vitreous cavity (Relative avascularity → ↓ chances of bleeding).
- Accommodation :
 - Contraction of ciliary muscles → ↑ power of lens → Helps in near vision.
 - Relaxation of zonules.

Note :

Components of near reflex :

- Accommodation.
- Convergence (Inward movement of both eyes).
- Miosis.



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Anomalies of Accommodation :

Presbyopia :

Physiological insufficiency of accommodation → Difficulty in near vision
(eg : using phones, reading newspaper).

Onset : Around 40 yrs of age.

Rx : Spectacles (+) → Convex (converging)

- Progressives > D-bifocals >>> Executive lenses.

- Power depend on age.

a) At 40 yrs → +1 D required.

b) Every additional 5 yrs → + 0.5 D added to power.

Types of Spectacles

monofocal lenses :
For patients only needing
near vision lenses

for patients already using
glasses for far vision

Progressive lenses

Advantages:

- Cosmetically appealing d/t seamless transition of lens
- Covers near, intermediate and far vision

No power in peripheries
§
Power restricted to
centre hourglass
configuration



Restricted field of view

Bifocals1. D-Bifocals

Disadvantages

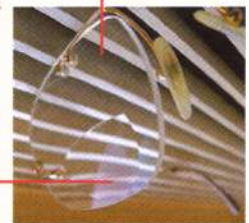
- Cosmetically unappealing
- No provision for intermediate vision

2. Executive bifocals

Obsolete in most cases except in pediatric aphakia.

Far vision

Near vision



D Bifocals

Far vision

Near vision

Pupil bisected by
line b/w lens

Spasm of accommodation :

Continuous state of contraction of ciliary muscles

Loss of far vision (Pseudomyopia)

Treatment : Cycloplegia (Relaxation of ciliary muscles)

- Drugs → mydriatics § cycloplegics :

- Atropine, Homatropine, Cyclopentolate.

- Tropicamide (Not used due to very weak cycloplegic effect).

ANATOMY OF RETINA

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Retina - Innermost Layer of Eye

00:00:20

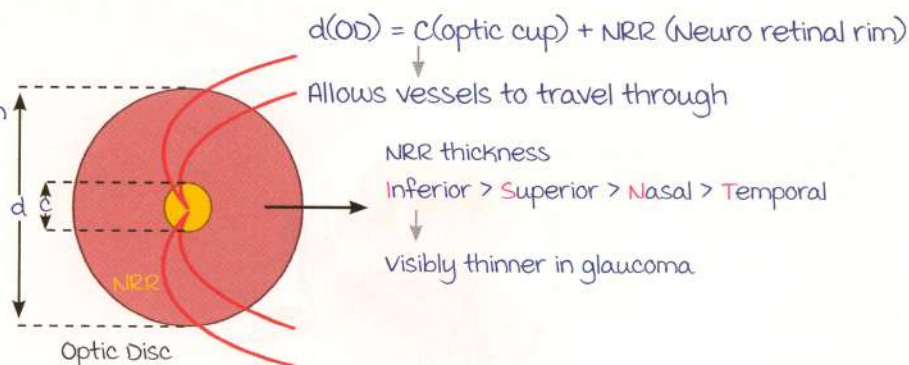
Neurosensory layer.

Gross Anatomy :

1. Optic Disc (OD) :

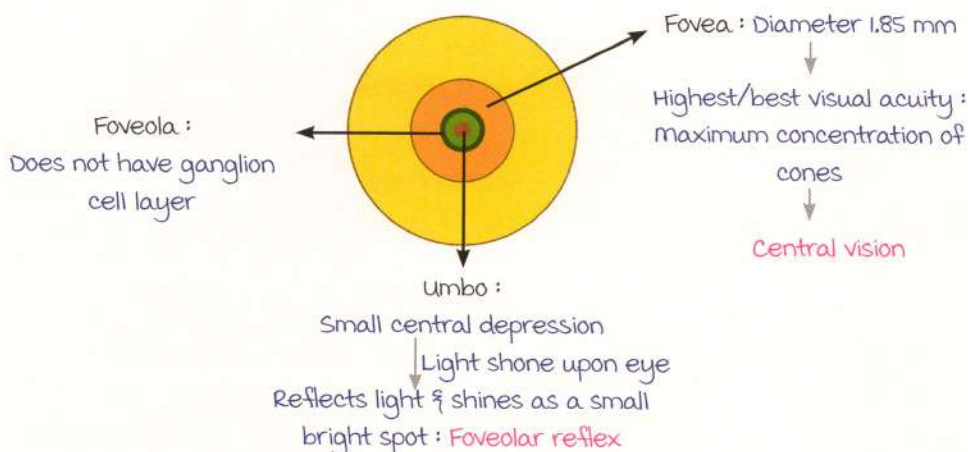
- AKA **Blind Spot** of mariotte (Rods & cones absent).
- All layers of retina terminate at OD (except nerve fibers).
- 1st part / Only visible part / Intra-ocular part of optic nerve (ON).
- Point in the retina where ON leaves eyeball.
- Appearance :

- Shape : Vertically oval
- Diameter : 1.5mm / 1500μm
- Normal c/d ratio : → 0.3



2. macula Lutea :

- Yellowish spot
- Temporal to OD
- Diameter: 5.5mm



3. Ora Serrata (OS) :

- Anterior termination of retina
- Indicates junction between ciliary body and choroid.
- Significance : Helps determine **site of intra-vitreal injection**.

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OCULAR ROUTES OF DRUG ADMINISTRATION, BLOOD SUPPLY OF EYE AND EMBRYOLOGY OF EYE

Routes of Ocular Drug Administration

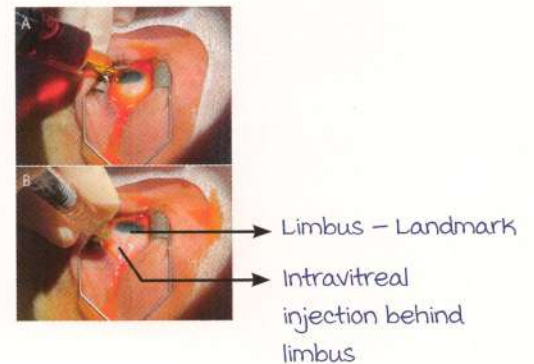
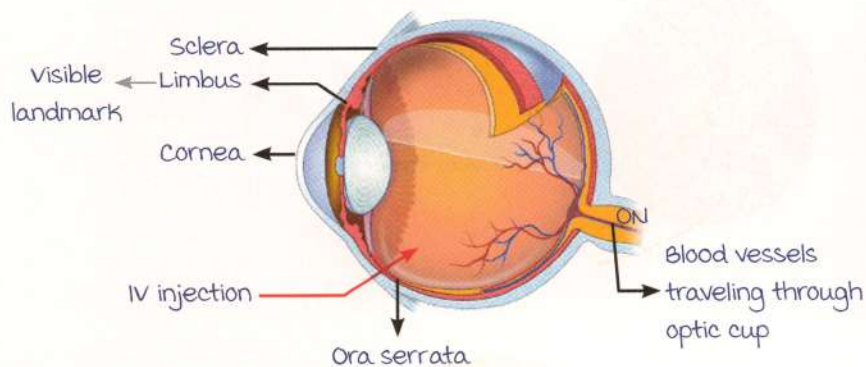
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I. Intravitreal Injection :

Site :

Condition of Lens	Site of intravitreal injection
Aphakia (absence of lens)	3 mm posterior to limbus
Pseudophakia	3.5 mm posterior to limbus
Phakia (normal crystalline lens)	4 mm posterior to limbus

- Pierces : Sclera and pars plana



Procedure : using speculum, open eyes

↓
Sterilize sclera infero-temporally

↓
Ask patient to look upwards/inwards

↓
mark site of injection using caliper

↓
Injection with 30G needle is inserted through sclera with slow, twisting movements to reach vitreous.