Structured Notes According to

OPHTHALMOLOGY

Revision friendly **Fully Colored Book/Structured Notes**

For Best results, watch the video lectures along with reading notes

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OPHTHALMOLOGY

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Introduction to Ophthalmology

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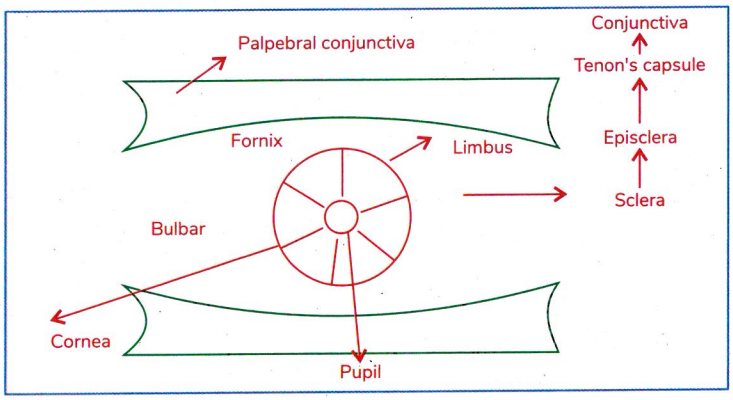
1 INTRODUCTION TO OPHTHALMOLOGY



Sclera and Cornea:

- Sclera is the white part of the eye.
- Sclera continues anteriorly as the cornea.

Iris and Pupil:

- Iris, situated behind the cornea, imparts color to the eye.
- The opening in the Iris is called the pupil.

Limbus:

- Junction between the sclera and cornea.

Episclera and Tenon's Capsule:

- Episclera is above the sclera and is its outermost layer.
- Tenon's capsule lies above the episclera.

Conjunctiva:

- Thin mucous membrane covering the ocular surface.
- Does not cover the cornea.

Parts of the conjunctiva

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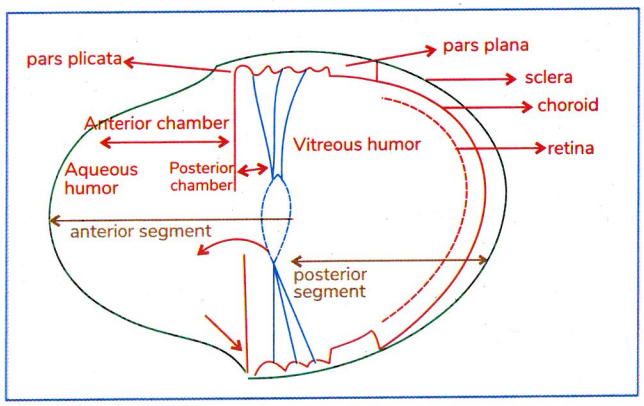
- The bulbar conjunctiva
- The fornix
- Palpebral conjunctiva (the part of the conjunctiva covering the upper lid and the lower lid).



Eye Structures:

- Iris
- Sclera
- Ciliary Body
- Choroid
- Retina

Lens and Suspensory Ligaments:

- Lens situated behind the Iris.
- Supported by suspensory ligaments.

Eyeball Segments:

- Divided into anterior segment and posterior segment.
- Anterior Segment:
  - Further divided into anterior chamber and posterior chamber.
  - Both chambers filled with aqueous humor.
- Posterior Segment:
  - Contains the vitreous cavity.
  - Filled with vitreous humor, a gel-like substance.

Aqueous Humor Formation:

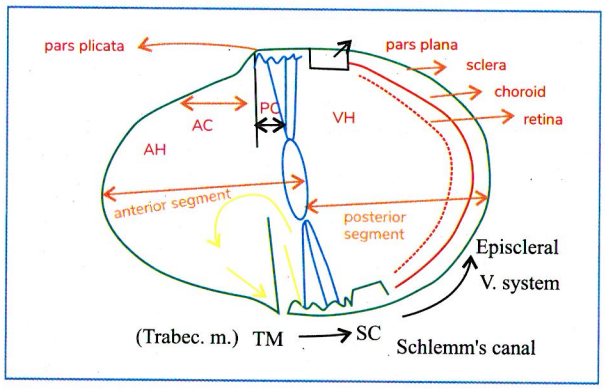
- Aqueous humor formed in the ciliary processes.
- Rough part of the ciliary body known as "pars plicata" where aqueous is produced.
- Plain part of the ciliary body is called "pars plana."

Q. How many ciliary processes are there?

- There are 70 to 75 ciliary processes present in one eye.
- The aqueous after being formed in the ciliary process goes into the posterior chamber and through the pupil, it comes into the anterior chamber. From the anterior chamber it goes into the peripheral space in between the iris and the cornea, the angle of the anterior chamber.

The angle of anterior chamber

- Above the iris lies the cornea and the peripheral space all around is the angle of the anterior chamber. The angle on the inside is all around corresponding to the limbus outside.



- The angle also has channels known as trabecular meshwork. From there, it goes into the Schlemm's canal. It eventually goes into the episcleral venous system. This is how the aqueous is formed and drained.

Mechanism of vision

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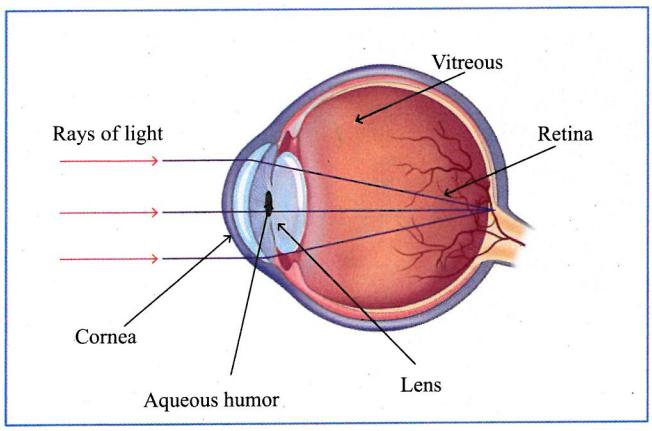

- When parallel light rays fall on the cornea, there is the bending of the light rays or refraction. The refraction occurs in the corneal for the major part but there is also the contribution of the vitreous and aqueous humour. The major refracting surfaces are the cornea and the lens.
- The parallel light rays falling on the cornea are first bent at the cornea and then at the lens. The first point where the parallel light rays fall is situated just behind the lens and is known as the nodal point of the eye (N). At the nodal point, the image becomes inverted and falls on the retina. This image is then made straight by our brain.

Important Information

- **Nodal point:** It is the optical center of the eye. It is also the first focal point that is situated just behind the lens.

Slides that depict the structure of the eye

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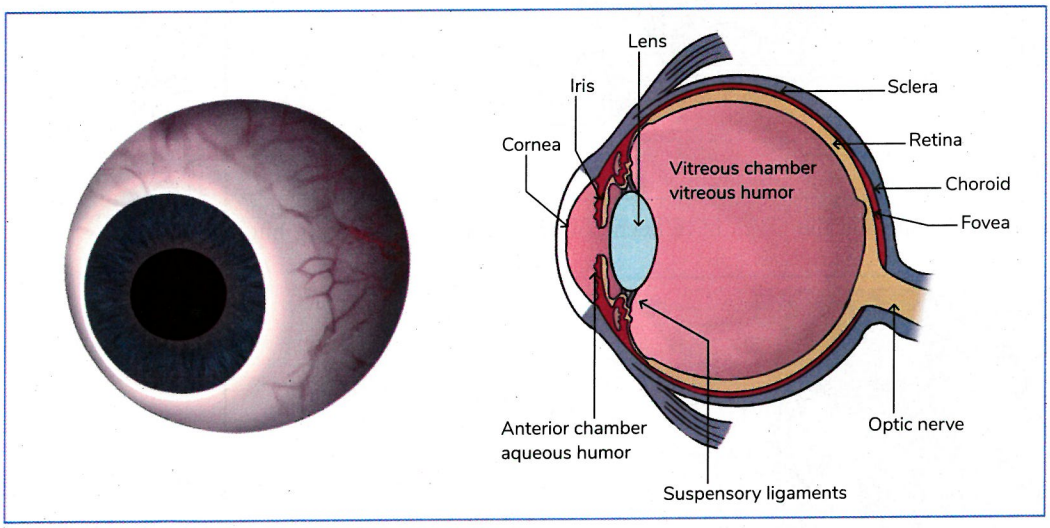
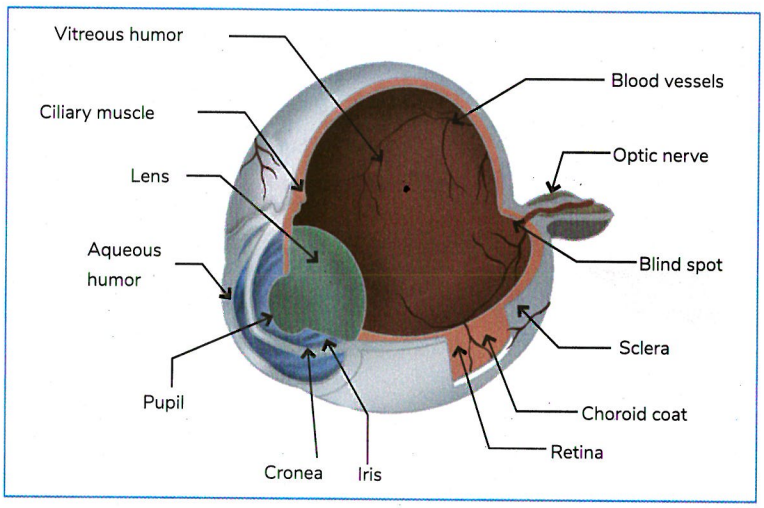
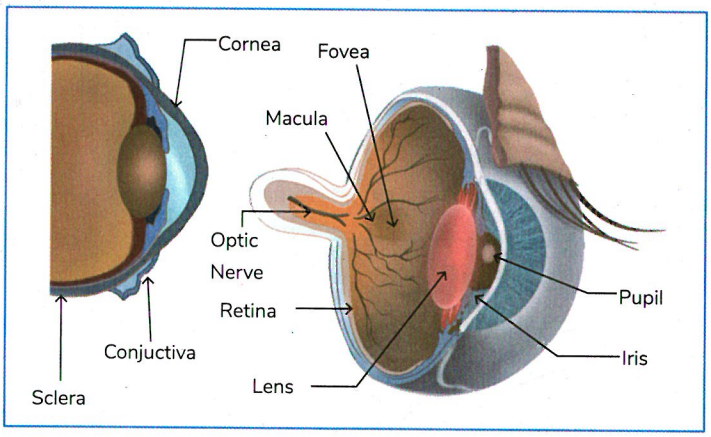


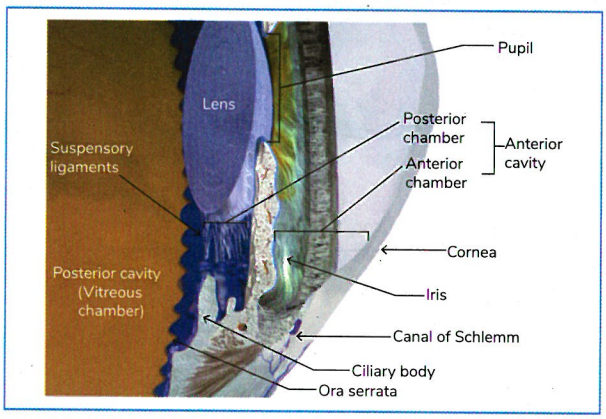
- Eye Shape and Capacity:
  - Shape: Oblate spheroid.
  - Capacity: Varies from 6 to 7 ml.
- Optic Nerve Formation:
  - All nerve fibers from the retina aggregate at the disc.
  - Form the optic nerve.



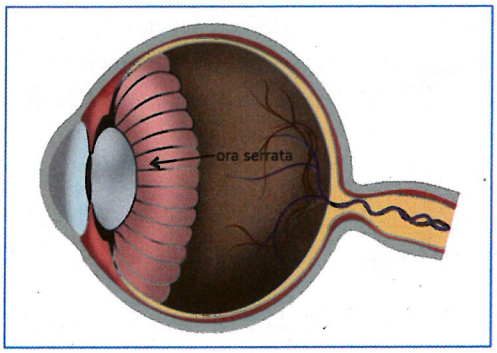
- Blind Spot:
  - A scotoma in the visual field.
  - Properly labeled as the optic disc.
- Reason for Blind Spot:
  - Corresponding to the optic disc.
- Scotoma Definition:
  - Any non-seeing area surrounded by a seeing area is called a scotoma.



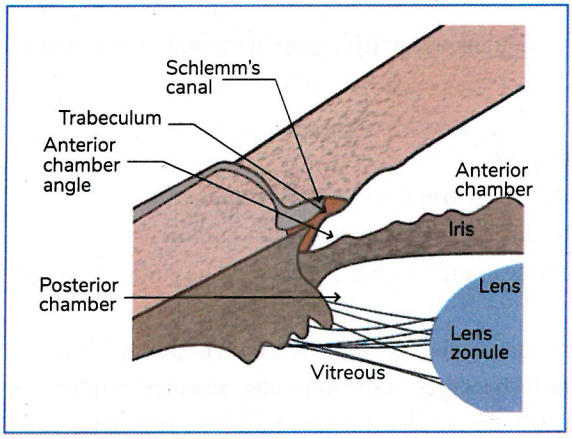
- In the 3D diagram above, the macula and the fovea have been pointed out which is nothing but central retina.



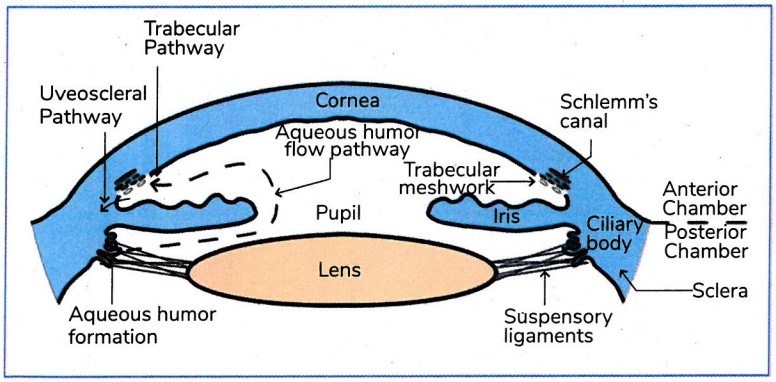
- The diagram above shows the suspensory ligaments, the ciliary processes, the angle, the iris, the canal of Schlemm, and the cornea (making up the angle structure).



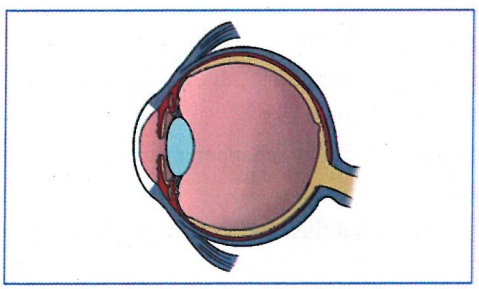
- The retina is the innermost layer but does not extend up to the anterior part and stops at the ciliary body (pars plana). The most peripheral part of the retina is labelled as ora serrata.



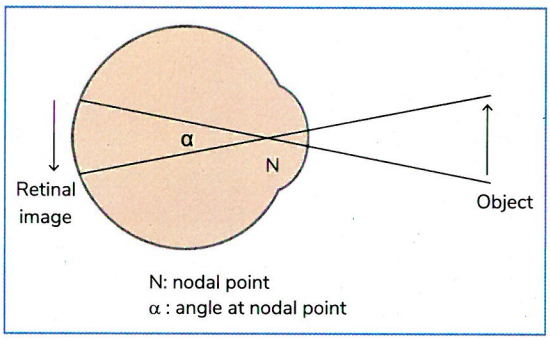
- In the diagram above, the Iris, the anterior chamber, the cornea, and the angle can be seen. The anterior chamber angle has the trabecula. The Schlemm's canal can also be seen.



- The diagram above shows the outflow. The aqueous that is formed in the posterior chamber goes through the pupil into the anterior chamber, and through the trabecular pathway. When it passes through the uveosclera, it is called the uveoscleral pathway.



- In the above-drawn diagram of the eye, the red part represents the vascular layer, the yellow part represents the retina, and the nerve fibres forming the optic nerve can be seen. The outermost blue layer is the sclera. The muscles can be seen to be attached to the sclera. The white part represents the cornea.



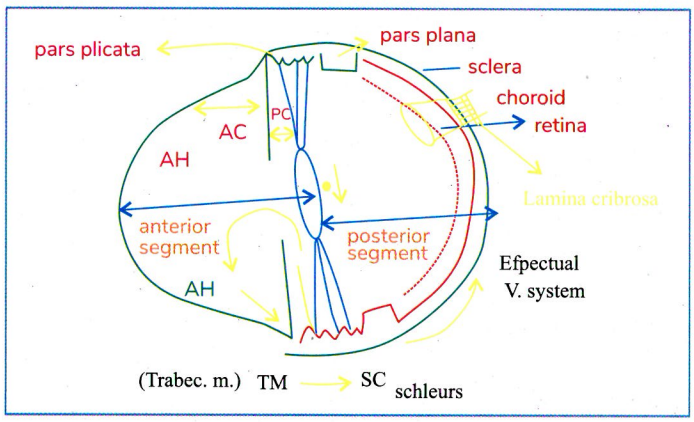
- This diagram shows that when there is an object, the light rays will be going at the nodal point, and an inverted image is then formed at the retina.

Q. Most crucial factor is to focus light rays on the retina? 00:18:53

- The bending of the light rays is more at the cornea. The two main reasons for this are:
  - There is a difference in the refractive index between air and water (aqueous humor).
  - The curvature of the cornea (anterior surface) is another reason. This is why the cornea has more refractive power than the lens.

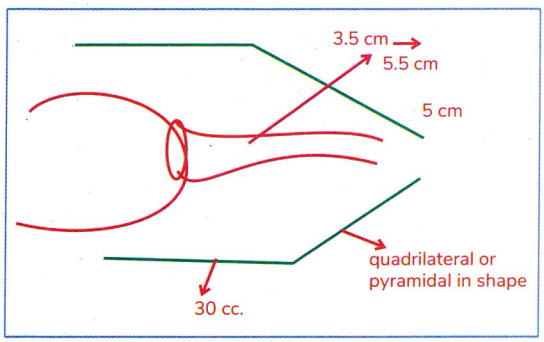
Q. When one is swimming underwater or splashing water on the face and eyes, one cannot see clearly?

- This is because when one is underwater, the media becomes water and water, and there will be less bending of the light rays due to no difference in refractive index. Less refraction will take place, and this will cause less clearer vision.
- The main role of the cornea and the lens is to focus the light rays. The main role of the retina is vision. Because the key role of the cornea and the lens is refraction and for focusing it is important that these remain transparent. This is why both the cornea, and the lens are avascular. These get their nutrition from the aqueous humor.



- The only tissue inside the eye that is circulating is the aqueous humor.
- The pressure in the eye is going to be more when the aqueous humor in the eye is more. This happens when either the aqueous humor is formed more or when it is drained less.
- More aqueous humor in the eye raises intraocular pressure. When this is happening, it presses more on the optic disc. This will lead to damage of the optic nerve or glaucoma.
- However, there are cases when the patient is glaucomatous, but their intraocular pressure is normal (normal tension glaucoma).

- All the nerve fibres have aggregated into the optic disc, crossing the retina, the choroid, and the sclera, and then entering the orbital cavity. Part of the sclera at the optic disc where it is exiting is sieve-like and is called lamina cribrosa.



- The capacity of the orbit is 30 cc.
- The shape of the orbit is quadrilateral or pyramidal. The length of the optic nerve is 3.5 to 5.5 cms (If multiple options from this range is given in the question, then the correct option would be 5 cm).
- The axial length of the eye is 24 mm. The axial length is measured through ultrasound. Ultrasound in the eye can either be A scan or B scan. A scan is used for axial length measurements. When a patient has cataract, the retina or the eye is seen through a B scan, which is used to see the posterior segment of the eye.
- The depth of the anterior chamber which is the area in between the iris and the cornea is 2.4-2.5 mm.

Important Information

- Anisometropia: Difference in between the refractive power of both eyes when > 2.5 D.

Q. What is the refractive status of a newborn or a child/infant?

- An infant is hypermetropic by 2.5 - 3.0 D.
- An infant has a small eye and therefore the refractive error will be hypermetropia.

Basics about the Retina

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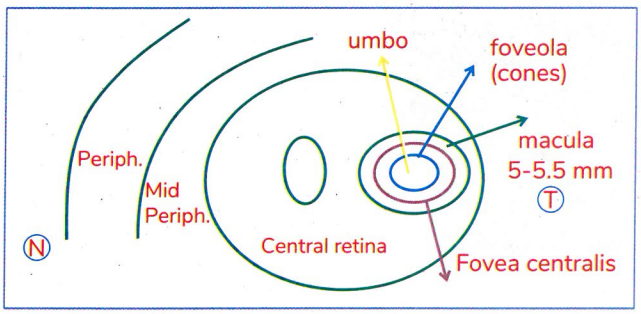
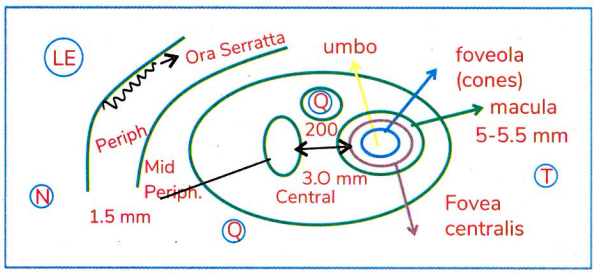
- Retina and Viewing Orientation:
  - When looking straight, viewing into the posterior part of the retina.
  - To look at the periphery, one must go anteriorly toward the pars plana.
  - Therefore, the central part is posterior, and the peripheral part becomes anterior.



- Retina consists of the following.
  - Central retina
  - Mid Peripheral retina
  - Peripheral retina

Central retina

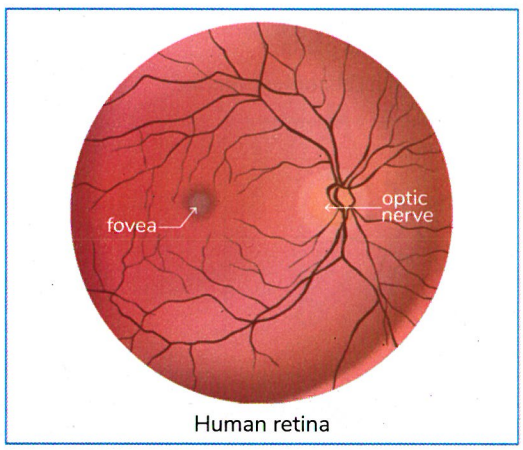
- **Two major structures are present here,**
  - The optic disc, from where the nerve is existing and,
  - The macula, which is responsible for the central vision. Macula is 5 to 5.5 mm. It is also known as Macula Lutea because it is yellowish in colour.
  - Inside the macula lies the most sensitive part of the retina, the fovea centralis. Inside it lies another area, known as a foveola (it only has cones). There is a small depression at the center, the umbo. N in the diagram shows the nasal part and T shows the temporal part.



→ The disc is nasal, and the macula is temporal. When a patient is being examined, he is standing in front; the eye being examined, according to the diagram is, therefore, the left eye.

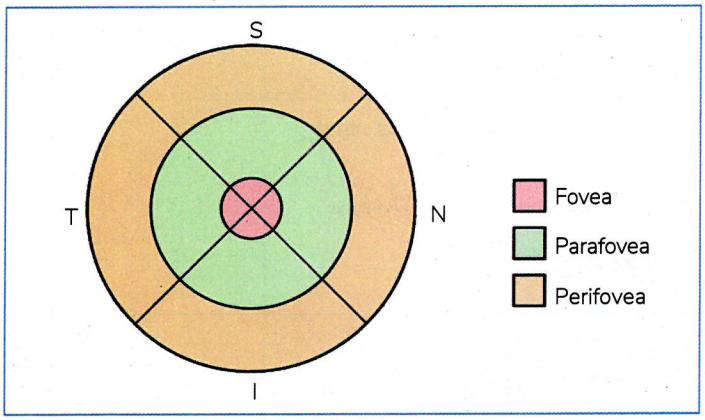
Characteristics of Retinal Structures

- Ora Serrata: The most peripheral part of the retina. It is serrated in appearance.
- Fovea: The thinnest part of the retina.
- The distance of the disc from the fovea is 2 DD or 3.0 mm.
- Central Retina: Responsible for central vision.
- Peripheral Retina: Responsible for peripheral vision.
- Optic Disc:
  - The optic disc does not contribute to vision.
  - Corresponds to the physiological scotoma, known as the blind spot.
- Vision Testing Methods:
  - Central Vision: Checked through visual acuity charting.
  - Peripheral Vision: Assessed through perimetry or peripheral vision field charting tests.



Human retina

- A blind spot is an absolute scotoma and is a negative scotoma. Absolute scotoma means under any condition (even if the size of the object is changed), the patient will not be able to see it. Negative scotoma means that it is an empty space and positive scotoma means that there is a black patch in front of the eyes.



Instruments to Examine the Retina

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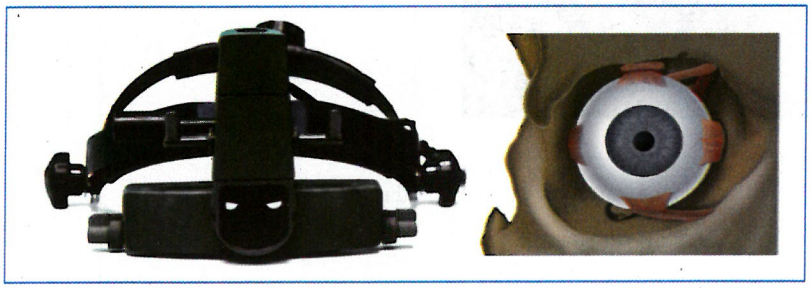
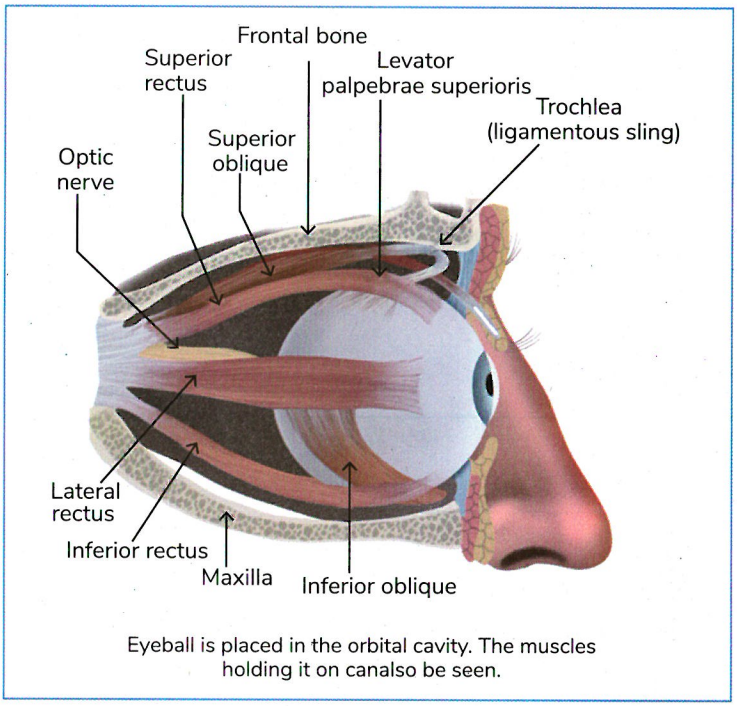
- The retinoscope is an instrument that is used for doing the refraction of the eye.
- The retina is examined through an ophthalmoscope or a fundoscopy. Fundus is everything that is seen through the pupil.

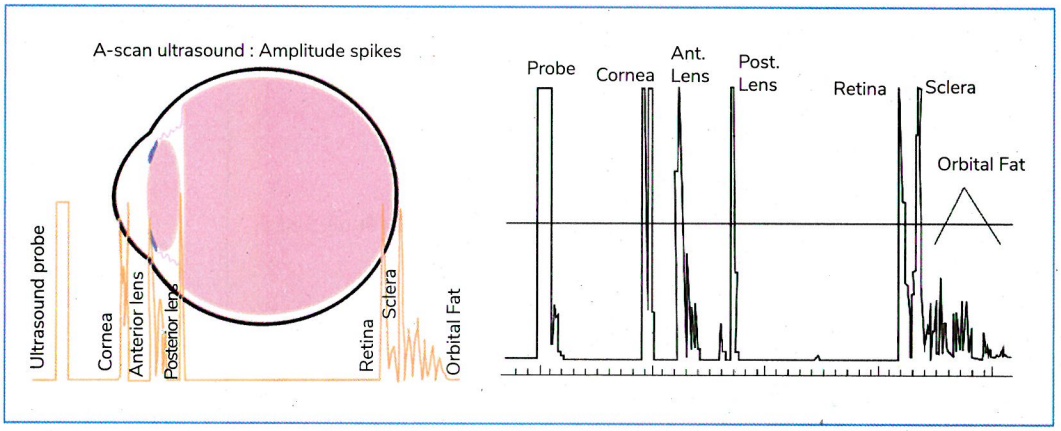
Direct Ophthalmoscope

Indirect Ophthalmoscope

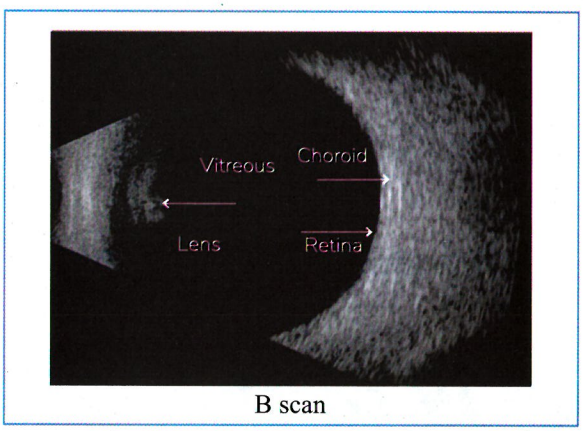




Eyeball is placed in the orbital cavity. The muscles holding it on canalso be seen.



- Axial length is measured through an A-scan ultrasound. The peaks show the length from the cornea to the posterior sclera.



B scan

- The slide above shows a B-scan, showing the lens, vitreous, choroid, and retina. This is used to see structures behind the lens, the posterior segment of the eye.

Arterial supply of the eye

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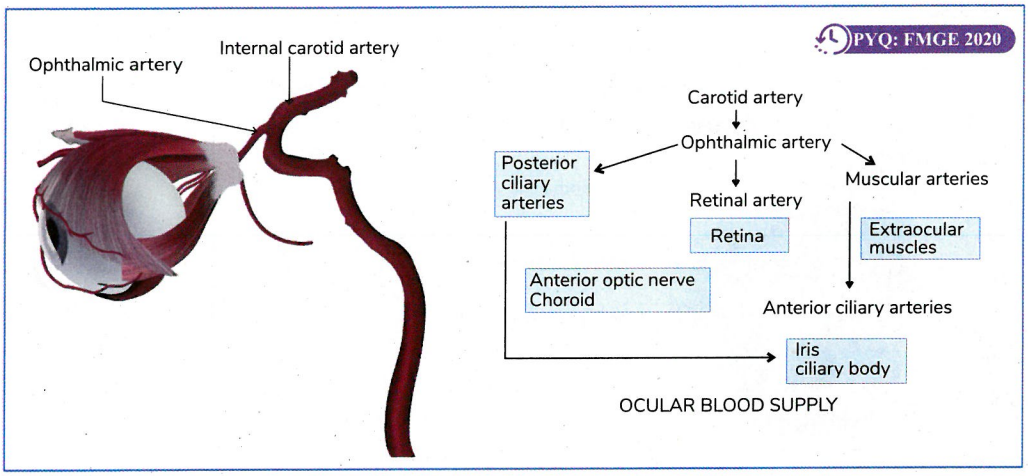
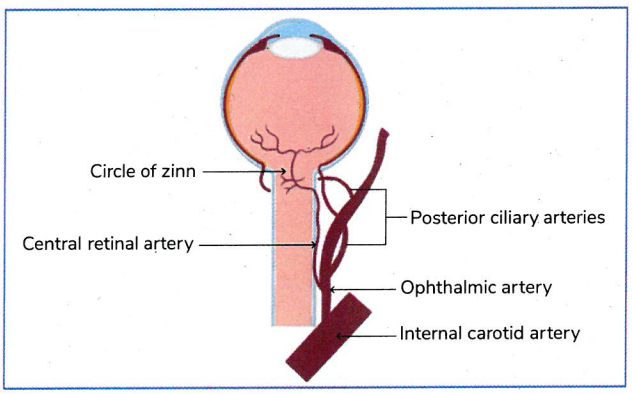


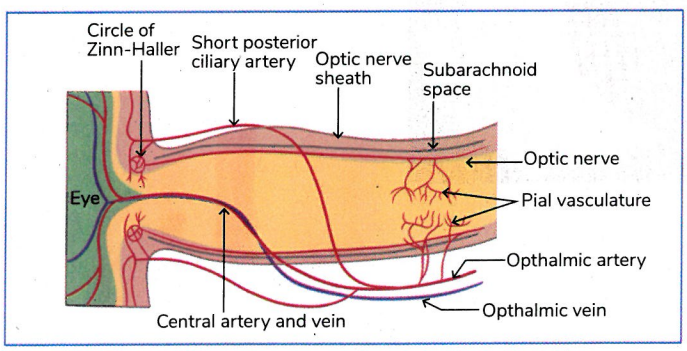
- The main artery supplying blood to the eye is the ophthalmic artery. The ophthalmic artery is a branch of the internal carotid artery.

The ophthalmic artery is divided into three main branches.

1. **Posterior ciliary arteries**: These supply the short and long; the short one will supply the choroid and optic nerve; the long one will go to the iris and the ciliary body.
2. **Retinal artery**
3. **Muscular arteries**: The muscular arteries supplying the extraocular muscles are anterior ciliary arteries.



- In the slide above, the internal carotid artery can be seen. The ophthalmic artery originates from the internal carotid artery. The ophthalmic artery gives out one branch as the posterior ciliary artery. The short posterior ciliary artery will supply and the long one will further move anteriorly. The central retinal artery is another branch of the ophthalmic artery which pierces the optic nerve and goes through it to enter the eye.



- Part of the optic disc is supplied by the anastomosis of the short posterior ciliary artery which is supplying the choroid and retina. This anastomosis is called the circle of Zinn-Haller, and is supplying an area of the optic disc.

Venous Drainage

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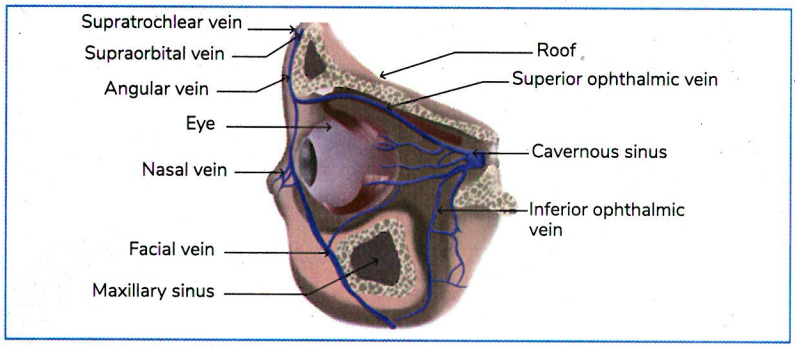

- In the slide above, the superior ophthalmic vein and the inferior ophthalmic vein can be seen draining into the cavernous sinus.

SYNOPSIS

DISEASES OF LENS

Diseases of Lens - Part 1

1. Structure of the Lens
2. Nucleus and its Parts
3. Physiology
   - 3.1 Pump Leak Theory
4. Lens Protein
5. Cataract
   - 5.1 Acquired Cataract
   - 5.2 Anatomically
   - **5.3 Maturity** — **Good to Know**
6. Etiological
   - 6.1 Free Radical Scavenger
   - 6.2 Subcapsular
   - **6.3 Metabolic Cataract** — **Good to Know**
   - 6.4 Complicated Cataract/Secondary Cataract
   - 6.5 Toxic Cataract
   - 6.6 Traumatic Cataract
   - 6.7 Radiation cataract
   - **6.8 Presensile Cataract Associated with Systemic Diseases** — **Good to Know**
   - **6.9 Clinical Features** — **Good to Know**
   - 6.10 Fincham's Test
7. Treatment of the Cataract
   - 7.1 ICCE (Intracapsular Cataract Extraction)
   - **7.2 ECCE (Extracapsular Cataract Extraction)** — **Good to Know**
   - 7.3 SICS (Small Incision Cataract Surgery)
8. **Manual SICS** — **Good to Know**
   - 8.1 Phacoemulsification
   - 8.2 MICS
   - 8.3 FLACS (Femto LaserAssisted Cataract Extraction)
9. Local Anaesthesia
   - 9.1 Peribulbar and Retrobulbar Anesthesia
10. Different Types of IOLS
    - 10.1 Plate Haptic Lens
    - 10.2 Posterior Chamber IOL (PC IOL)

10.3 Some Specific IOLS

11. Biometry

11.1 Formulas **Good to Know**

Diseases of Lens - Part 2

1. Complications of Cataract Surgery
2. Operative Complications
   - 2.1 PC Tear
   - 2.2 Expulsion Haemorrhage
   - 2.3 UGH Syndrome
   - 2.4 Descemet's Membrane Detachment
3. Post-Operative
   - 3.1 Acute Postoperative
4. Questions Asked
   - 4.1 Chronic Postoperative

5. Posterior Capsular Opacification (PCO) / after Cataract /Secondary Cataract **Good to Know**

- 5.1 Displacement of IOLs
- 5.2 Cystoid Macular Edema (CME)
- 5.3 Anterior Capsular Contraction and Fibrosis
- 5.4 Dysphotopsia
- 5.5 Refractive Surprise

6. Congenital Cataract
   - 6.1 Etiology
   - 6.2 Types of Congenital Cataracts
   - 6.3 Clinical Features
   - 6.4 Serum Analysis
   - 6.5 Urine Analysis
   - 6.6 Treatment
7. Congenital Rubella Syndrome
   - 7.1 Ocular Features of Rubella
   - 7.2 Differential Diagnosis of Salt & Pepper Fundus
8. Subluxation of Lens

8.1 Etiologies Subluxation of Lens **Good to Know**

9. Question Asked
   - 9.1 Clinical Features
   - 9.2 Treatment

2 DISEASES OF LENS PART -1

Structure of the Lens

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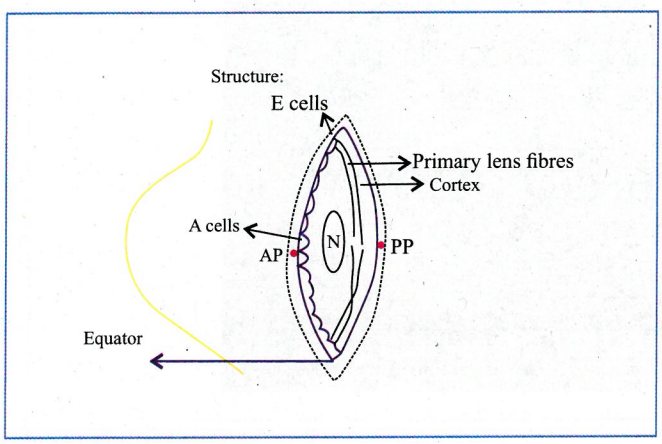
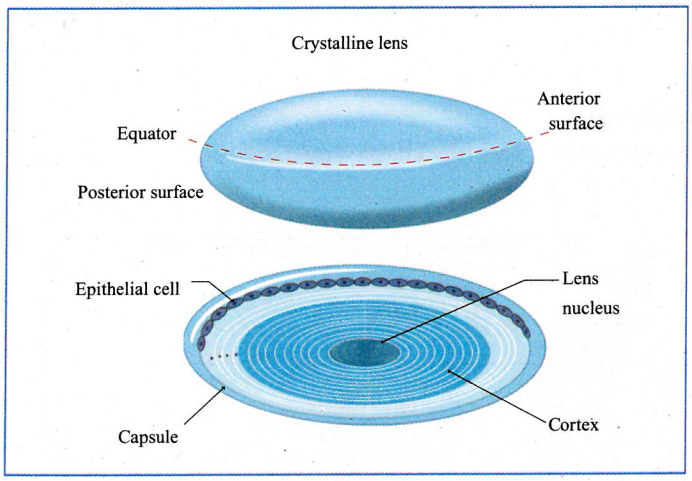


- Lens -Biconvex shape
- Diameter- 9-10 mm (< 9mm- Microphakia)
- Power of lens - +16 - +17 Diopters
- The capsule is mainly type 4 collagen and has no elastic tissue.
- It is the thickest basement membrane of the body.
- Refractory index of lens- 1.39 (Maxium index- centre of lens 1.40-1.41)
- It has a single layer of anterior epithelial cells that consists of A cells and E cells. The E cells give rise to lens fibres.
- The posterior epithelial layer during embryonic development transforms into lens fibres, which are known as primary lens fibres.
- The plane where the anterior and posterior surfaces meet is where the equator lies and the diameter of the same is called the equatorial diameter.



Nucleus and its Parts

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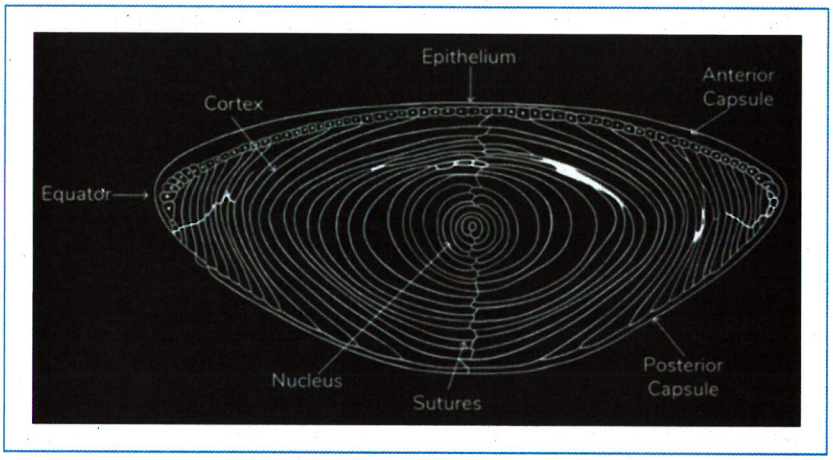
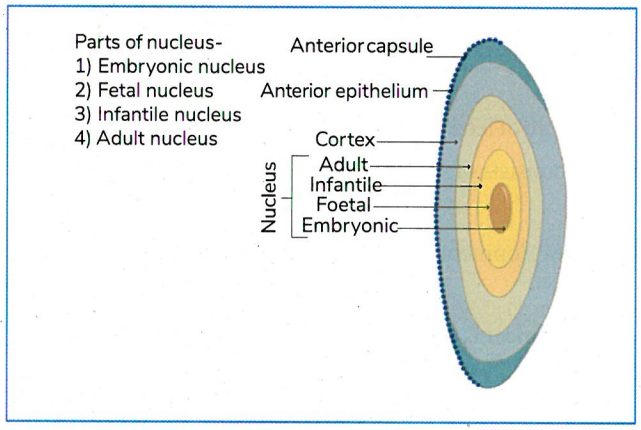
- The first part to be formed in an eye is the nucleus which lies at the centre.
- Depending on the time period of formation:
  - Embryonic (0-3 months)

- Foetal (3-8 months)
- Infantile (Pre-puberty)
- Adult (Post-puberty)



- Sutures - Microscopic gaps between the lens fibres forming a zigzag line.
  - When seen from the anterior surface - straight Y
  - When seen from the posterior surface - inverted Y



- Capsule:
  1. It contains no elastic tissue.
  2. Thickest part of the lens is the pre-equatorial part.
  3. Thinnest part of the lens is the capsule at the posterior pole (thickness - 4 microns).
- The best way to examine a lens is through the slit lamp.