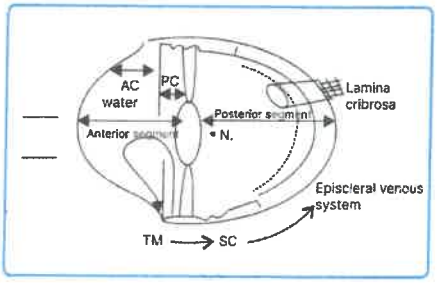
OPHTHALMOLOGY

1 OPHTHALMOLOGY PART-1

Basic Anatomy

00:01:00



- The whole eye is divided into 2 segments:
  1. Anterior: Including the lens and anterior to the lens.
  2. Posterior: Behind the lens.
- The eye's nodal point - the parallel light ray is bent on the cornea and the lens, focusing first on a point just behind the lens.
- Bending is always more on the cornea than on the lens because of 2 factors:
  - More curvature with the anterior surface.
  - Difference in refractive index between air and water.
- Both the cornea and lens are avascular to ensure transparency.
- The aqueous is formed from the ciliary processes and comes to the pupil from the anterior chamber.
- Angle is the peripheral space between the iris and the cornea.
- When the amount of aqueous is higher, the pressure will increase.
- When the pressures are more, it damages the optic nerve, which is known as Glaucoma.

Question-oriented discussion

00:01:56

Q. What are the number of ciliary processes?
Ans. There are 70-75 ciliary processes in a single eye.

Q. What is the normal ocular pressure?
Ans. The normal ocular pressure is 10-21 mmHg.

Q. When the pressure is more, what happens?
Ans. When the ocular pressure is higher, it damages the optic nerve. This condition is known as glaucoma.

Q. What is lamina cribrosa?
Ans. When the optic nerve exits through the eye, and the sclera at the disc is perforated, known as lamina cribrosa.

Q. The nerve fibre of the retina that aggregates at the disc to form.
Ans. Optic nerve

Q. What is the capacity of the orbit?
Ans. It is 30 cc. The orbit is quadrilateral and pyramidal in shape.

Q. What is the axial length of the eye?
Ans. It is around 24 mm.

Q. What is the depth of the anterior chamber?
Ans. 2.4-2.5 mm. 2.5 comes as the definition of anisometropia. Infants are also hypermetropic by 2.5-3 D.

Q. How is the axial length measured?
Ans. Axial length is measured by an A-scan.

Q. Total refractive power of the eye is?
Ans. 58-60 D

Q. Total refractive power of the cornea is?
Ans. 43-45 D

Q. Total refractive power of the lens is?
Ans. 16-17 D

Q. What is the index of the cornea?
Ans. 1.37

Q. What is the index of the lens?
Ans. 1.39. It is maximum at the centre of the lens (1.4-1.41).

Diseases of Lens

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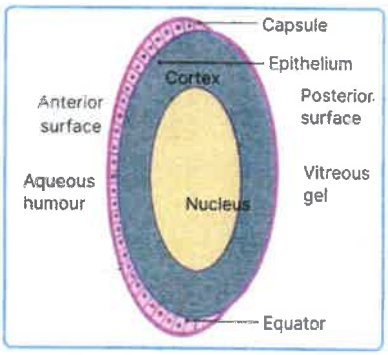


Lens

- The structure of the lens has a single layer of anti-epithelial cells.
- Equatorial cells form the lens fibres.
- It is covered with a very elastic capsule.
- The lens is derived from surface ectoderm.

Q. Which is the thinnest part of the lens?
Ans. The capsule at the posterior pole

Q. Till when are lens fibres formed?
Ans. They are formed throughout life

Q. Which are the youngest fibres?
Ans. Cortexes are the youngest fibres

Q. Where is the lens derived from?
Ans. Surface ectoderm

Physiology

00:08:20

- It is mainly considered dehydrated because any hydration can cause cataracts.
- Avascular
- The lens derives its nutrition from the aqueous humour.

Q. What is the primary metabolism of the lens?
Ans. It is anaerobic. 80% of glucose is metabolised anaerobically.

Cataract

00:08:51

- Any opacity that hinders optical homogeneity.
- **Classification**
  1. Congenital cataracts
  2. Acquired cataracts

Acquired Cataract

- Senile
- Metabolic
- Complicated
- Toxic

- Traumatic
- Radiational
- Associated with systemic diseases (presenile cataracts)

Senile Cataract

Senile cataracts are:

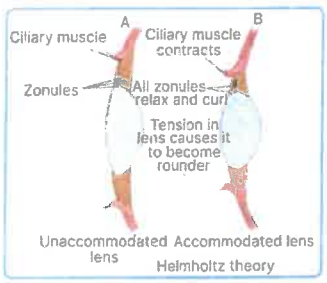
1. Cortical cataracts
2. Nuclear cataracts
3. Subcapsular cataracts

- **Cortical Cataract:** Also called Cuneiform cataract.
- **Posterior Subcapsular**
  - → It is the most common complicated and radiational cataract.
  - → It causes maximum diminution of vision.
  - → Caused by:
    - Busulfan
    - Steroids
    - Chloroquine

- **Nuclear Cataract**
  - → It is a central opacity.
  - → It may lead to day blindness or diminution of vision more in the daytime.
  - → Second sight of old age is improvement in near glasses.
  - → Sclerosis is the cause of nuclear cataracts.
  - → It is more of insoluble proteins and less of soluble proteins.
  - → Accumulation of more insoluble proteins and pigments (Melanin and Urochrome) deposition leads to sclerosis, which causes hardening.
  - → Hardening causes an increased refractive index of the lens, thus leading to more refractive power of the lens.
  - → Most common complication of hyper-mature nuclear sclerotic cataract is the subluxation of the lens.
  - → Most common complication of subluxation will be Trauma.

Process of Accommodation

- Accommodation is the contraction of ciliary muscles which causes relaxation of the zonules.
- When the zonules relax, there is a mild increase in the curvature of the anterior surface of the lens. This is known as Helmholtz's theory of accommodation.



Hypermature or Morgagnian Cataract

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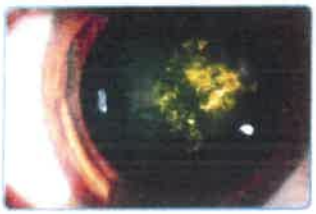
- MC complication- Phacolytic glaucoma is the leakage of lens protein blocking the trabecular meshwork due to the hypermature cataract.
- There is wrinkling of the capsule and leakage of the lens.
- During surgery, if the capsule is not visible properly trypan blue dye can be used to delineate the anterior capsule.

Christmas Tree Cataract

- These are needle-like opacities that are coloured.
- It is seen in Myotonic Dystrophy.
- The ocular features of Myotonic Dystrophy are:
  - Ptosis
  - Low intraocular pressure

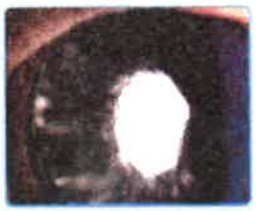


- Pre-senile cataract
- Pigmentary Retinopathy

Diabetic Cataract

PYQ: FMGE 2023

- It is a presenile and metabolic cataract.
- It is a snowflake or snowstorm cataract.
- It is more common in Type 1.
- A diabetic patient develops cataracts due to sorbitol accumulation in the lens.
- Sorbitol is very hyperosmotic and will imbibe water.
- The enzyme NADPH-dependent aldose reductase is responsible.
- Frequent change of glasses is not due to diabetic cataracts.
- Diabetes itself can be a cause of frequent changes of glasses
- Fluctuating Refractive Errors occur in hyperglycemic patients because of myopic shifts. This is due to swelling that in turn increases the curvature.
- Vice versa, in case of hypoglycemia, we observe hypermetropic shift (towards lesser curvature).



Shield Cataract

- It is a presenile cataract seen in Atopic dermatitis.

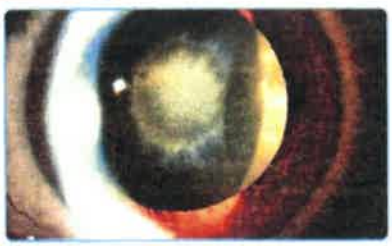
Oil Droplet Cataract

- It is a metabolic cataract.
- It is seen in Galactosemia.
- Caused due to the deficiency of GPUT (Galactophosphate Uridyl Transferase)
- It is reversible.

Chalcosis

PYQ: FMGE 2023

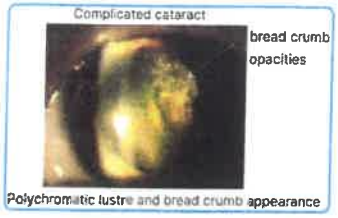
- It is the golden-brown copper deposition in the Descemet's membrane known as the Keyser Fischer (KF) ring.
- It starts superiorly and inferiorly and later becomes a circle.
- All patients with neurological complications of Wilson's disease will have a KF ring.
- Only 65-67% of patients with Hepatic involvement can have a KF ring.
- Sunflower cataract is a feature of Chalcosis.



Lowes Syndrome

- It is characterized by Posterior Lenticonus apart from cataract.
- It is also called Oculo-cerebrorenal syndrome.
- Anterior Lenticonus is seen in:
  - Alport's Syndrome

- Waardenburg Syndrome.
- It is more common in males.
- The Oil globule reflex is seen on Slit lamp examination on retro-illumination.



Complicated Cataract

- It is either due to anterior segment disease or posterior segment disease.
- Most commonly it is the posterior subcapsular.
- The pathognomonic feature is Polychromatic lustre.
- The appearance is Breadcrumb appearance.

Rosette-Shaped Cataract

- It is due to blunt trauma.
- It starts from the Posterior cortex.

Iridodialysis

- It has a D-shaped pupil.
- It is a feature of blunt trauma.

Vossius Ring

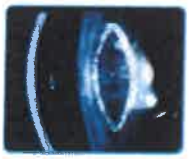
- It is a feature of blunt trauma.
- It is situated on the Anterior capsule of the lens.

Blue Dot Cataract

- It is the most common congenital cataract.
- It is a feature of Down syndrome.

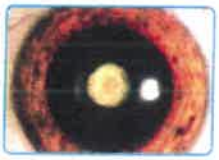
Lamellar Cataract

- It is the most common congenital cataract that causes marked diminution of vision.
- The visual activity is markedly reduced.
- Associated with Vitamin D deficiency.
- Riders (additional opacities) are a feature of Lamellar cataracts.
- Can also be caused by Rubella.

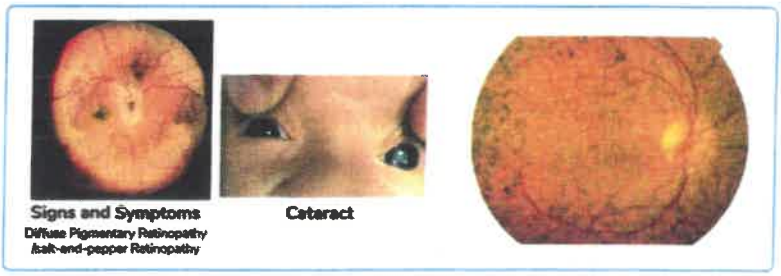


Posterior Polar Cataract

- It has an onion-peel appearance.
- It is a very tricky cataract surgery because of the high risk of posterior capsular tear.



Congenital Rubella Syndrome



- **Triad**
  a. Cataract
  b. Heart defects
  c. Deafness
- Most common type of cataract- Nuclear pearly cataract
- Salt and pepper fundus is the most common ocular feature.
- The most common features are:
  1. Microphthalmos: Any axial length of <21mm or the axial length is <19mm at the age of 1 year.
  2. Rubella Keratitis: There can be an angle anomaly leading to impaired drainage and glaucoma.

Treatment of Cataract . 00:29:27

- There is no medical treatment.
- The only treatment is surgery.

1. ICCE (Intracapsular Cataract Extraction)

- The whole lens, along with the whole capsule, is removed.
- Cryoextraction is the best method.
- The only indication of ICCE is the subluxation of the lens, especially for >9 clock hours of subluxation.
- This surgery is contraindicated in children due to the adhesion with the anterior hyaloid membrane known as the Weigert's ligament which is going to pull on the membrane that can be a risk of Retinal detachment.

2. ECCE (Extracapsular Cataract Extraction)

PYQ: INICET 2021
PYQ: FMGE 2023

- The non-fundable IOLS are PMMA (Polymethyl methacrylate).
- Foldable IOLS are generally made up of silicone acrylic and hydrogel.
- Hydrophobic acrylic has the least chance of posterior capsule opacification.


Extracapsular Cataract Extraction (ECCE)

3. Small Incision Cataract Surgery

- The incision length is 5-5.5mm.
- Advantages
  - The incision is small
  - No sutures
  - Negligible postoperative Astigmatism

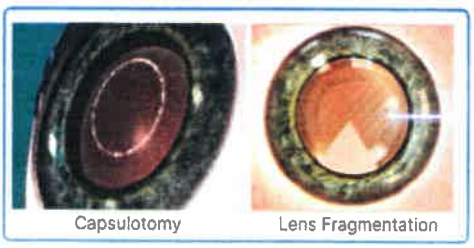
4. Phacoemulsification

- The incision length is 2.75-3.2mm.
- The frequency of Phaco Probe is around 40KHz.
- Generally, foldable IOLS are used.

Femtolaser Cataract Surgery

PYQ: FMGE 2020

- Latest
- It involves:
  - Incision
  - Capsulotomy
  - Lens fragmentation.
- The pulse duration is 10^{-15} sec.
- The wavelength is 1054 nm.


Capsulotomy Lens Fragmentation

IOL Powers

PYQ: INICET 2021

- For shorter eyes - Hoffers.
- For longer eyes - SRK/T

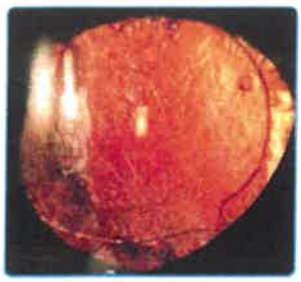
- Post Lasik - Haigis
- SRK Formula is P = A-2.5L - 0.9K (L is the axial length, K is the keratometry readings, and A is a constant).
- The ideal time for operating a child with a congenital cataract is after 1 month.
- It is done to avoid any formation of amblyopia and is operated on as soon as feasible.

Complications after Cataract Surgery 00:37:37

1. Endophthalmitis

- Is the most dangerous complication.
- Intravitreal antibiotic injections are the treatment of choice for Endophthalmitis.
- For antifungal, intravitreally allowed is Amphotericin B and Voriconazole. These are used only when the vision is better than hand movement.
- For less than or equal to hand movement Pars plana Vitrectomy is done.
- Causes
  - Immediate Acute onset: Staphylococcus epidermidis
  - Late onset: Propionibacterium acnes or fungal
- The features
  - Hypopyon
  - Corneal hysteresis
  - Corneal oedema
  - No fundal glow
  - The vision is decreased
  - Pain and congestion

2. Posterior Capsular Opacification



PYQ: FMGE 2023

- The most common long-term/ late onset complication.
- Elschnig pearls, a Soemmerring ring, or just a diffused opacity.
- Hydrophobic acrylic IOL has minimum chances of PCO.
- The treatment of choice after the cataract is NdYAG Laser Posterior Capsulotomy.
  - The wavelength of NdYAG is 1064 nm.
  - Peripheral Iridectomy is another indication of NdYAG and is done with the Abraham lens.

Subluxation of Lens

- It is due to trauma.
- A golden crescent is seen, which is typical for the diagnosis of subluxation of the lens.
- The other causes are:
  - Marfan's syndrome
  - Homocystinuria
  - Weill-Marchesani syndrome
  - Ehlers Danlos syndrome
  - Hyperlysinaemia
  - Sulfite oxidase deficiency
- The direction of Marfan's is Superotemporal ectopia lentis.

PYQ: FMGE 2020

- In Homocystinuria, it is Inferonasal.
- In Weill-Marchesani, it is Downward and forward subluxation.

Glaucoma

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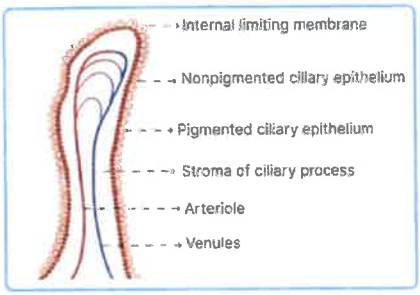
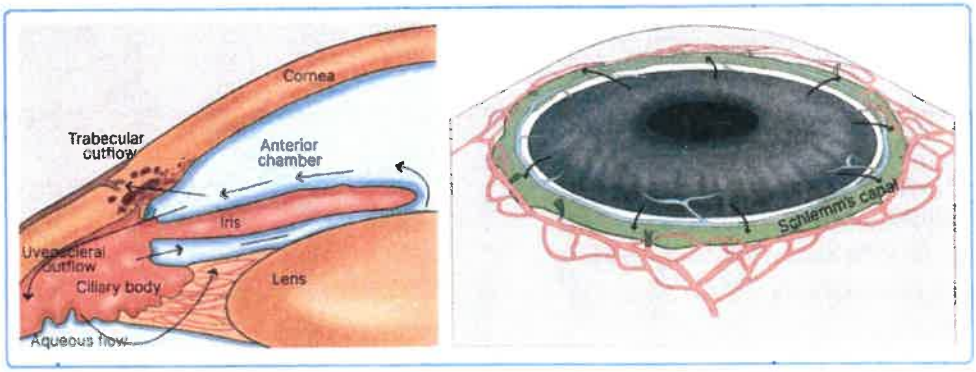


- Glaucoma is damage to the optic nerve by the effect of raised intraocular pressure on the optic nerve head.
- Most of the aqueous humour is formed from the non-pigmented ciliary epithelium.
- Through sodium and potassium, ATP is pumped, and this process is called secretion.
- Ultra filtration and diffusion also contribute to the formation of aqueous humour.
- Hypersecretory glaucoma occurs due to more formation of aqueous humour- seen in Epidemic dropsy.
- The rate of formation of aqueous humour is 2-3 microlitres/min.

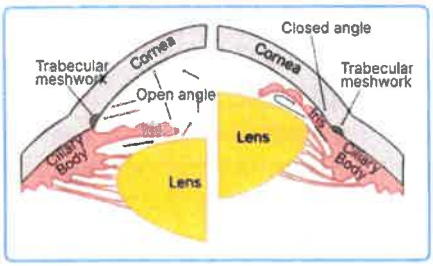
Outflow of Aqueous



- Two major types of aqueous are:
  1. Uveoscleral: 10%
  2. Conventional: 90%

PYQ: FMGE 2020

- Open-angle Glaucoma (OAG): When there is a blockage in the trabecular meshwork, and there is impaired drainage.
- Angle Closure Glaucoma (ACG): Any cause of the Pupillary block so that there is a push that abates the space between the Iris and Cornea, and there is impaired drainage.
- Glaucoma is a group of conditions that have in common- A chronic progressive optic neuropathy that results in characteristic morphological changes at the optic nerve head and in retinal nerve fibre layer. IOP is a key modifiable factor.



Classification of Glaucoma

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1. **Congenital Glaucoma**

PYQ: NEET PG 2021

- It can either be true congenital (the child is born with the problem).
  - It can be infantile (less than 3 years of age).
  - Juvenile (from 3 years to adolescence).
- Buphthalmos is the feature of true congenital and infantile disease because the sclera stretches only up to 3 years.

2. **Acquired Glaucoma** - they can be:

PYQ: NEET PG 2021, 2023

- Primary: can be open angle or angle closure.
- Secondary: can also be open angle or angle closure.

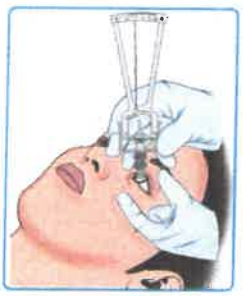
1. **Primary open-angle Glaucoma** - blockage in the trabecular meshwork.

PYQ: NEET PG 2019

- **Risk factors:**
  i. Increased Intraocular Pressure (IOP)
  ii. Age of more than 40 years
  iii. Positive family history
  iv. High Myopia
- **Clinical Features:**
  i. IOP changes
  ii. Fundus changes
  iii. Visual field defects

IOP Changes

Schiotz Tonometer



- It is an indentation tonometer where the cornea is indented.
- IOP changes:
  - The normal intraocular pressure is 10-21 mm of Hg.
  - The normal diurnal variation is up to 5mm of Hg.
  - IOP is recorded more in the morning due to the higher steroid levels in the morning hours.

Normal-Tension Glaucoma

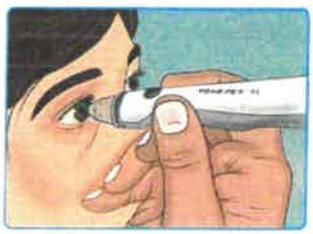
- The IOP is normal. It is within the range of 10-21mm.
- There are fundus changes due to the damage in the nerve.
- Visual field defects are present.
- It is based on the vascular theory that there is some impaired blood supply to the nerve.

Ocular Hypertension

- The IOP is more.
- Fundus is normal.
- There are no visual field defects.

Goldmann Perimetry

- It is an applanation tonometer.
- It is based on the Imbert-Fick law which says that any pressure is equal to the force applied to the area (P = F/A).
- The area in the Goldmann is fixed (diameter of 3.06mm).
- It is more reliable.
- Indentation is more reliable because readings of Schiotz depend on the sclera rigidity of the patient.
- In a thick cornea, the cornea is overestimated.
- In a thin cornea, the cornea is underestimated.



Tonopen

- It is the choice of tonometer for children.
- This can be used in the scarred and irregular cornea.

Non-Contact Applanation

- It is known as a Pulsair tonometer or air puff.