

CORNEAL ANATOMY AND PHYSIOLOGY – CLINICAL IMPORTANCE

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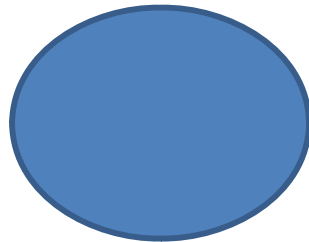
WHAT IS CORNEA?

- Transparent avascular structure
- Anterior $1/6^{\text{th}}$ part of fibrous coat

CORNEAL DIMENSIONS

- **DIAMETER**

- *Anterior surface of cornea is elliptical with an average horizontal diameter of 11.7 mm and vertical diameter of 11 mm.*
- *Posterior surface of cornea is circular with an average diameter of 11.5 mm.*



- **CLINICAL IMPORTANCE OF DIMENSION:**

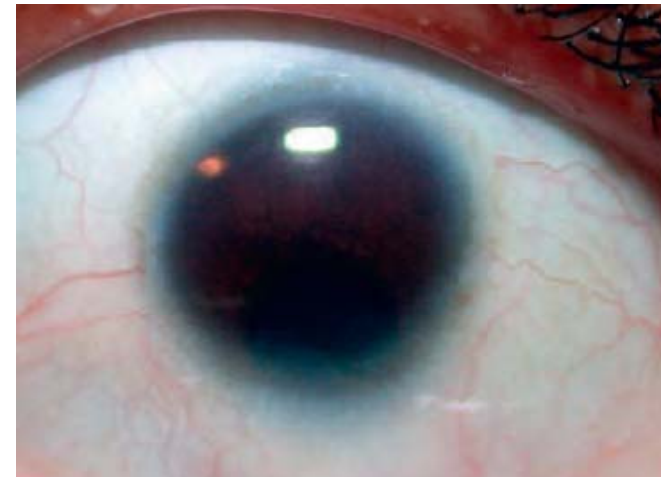
- **Megalocornea** - the horizontal diameter of cornea is of adult size at birth or 13 mm or greater after the age of 2 years.

- Marfan's syndrome,
- Apert syndrome
- Ehlers-Danlos and Down syndromes.
- D/D – Buphthalmos, Keratoglobus



- **Microcornea** - the horizontal diameter is less than 10 mm since birth.

- Isolated anomaly (rarely) or
- in association with *nanophthalmos* or *microphthalmos*.



CORNEAL DIMENSIONS

- DIAMETER
- **THICKNESS**
 - *Thickness of cornea in the centre varies from 0.5 to 0.6 mm while at the periphery it varies from 1 to 1.2 mm.*

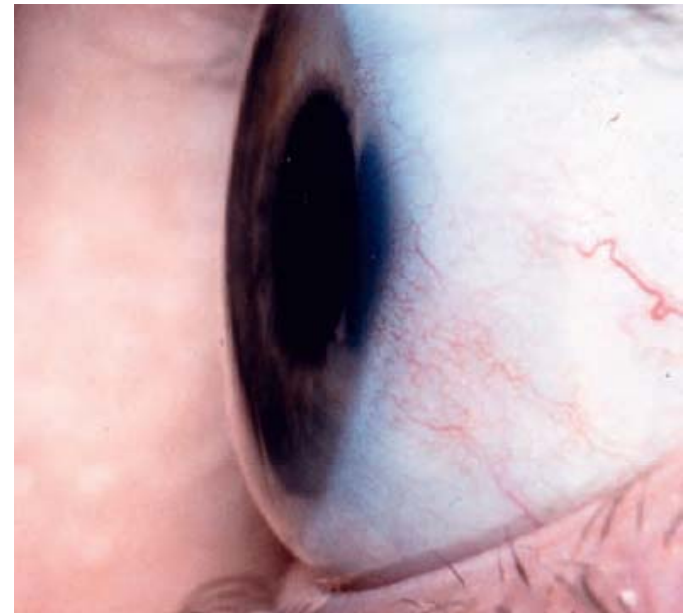
CORNEAL DIMENSIONS

- DIAMETER
- THICKNESS
- **RADIUS OF CURVATURE**
 - The central 5 mm area of the cornea forms the powerful refracting surface of the eye. The anterior and posterior radii of curvature of this central part of cornea are 7.8 mm and 6.5 mm, respectively.

• CLINICAL IMPLICATION OF CURVATURE

❑ Cornea plana

- bilaterally cornea is comparatively flat since birth
- associated with microcornea.
- usually results in marked astigmatic refractive error
- rare anomaly

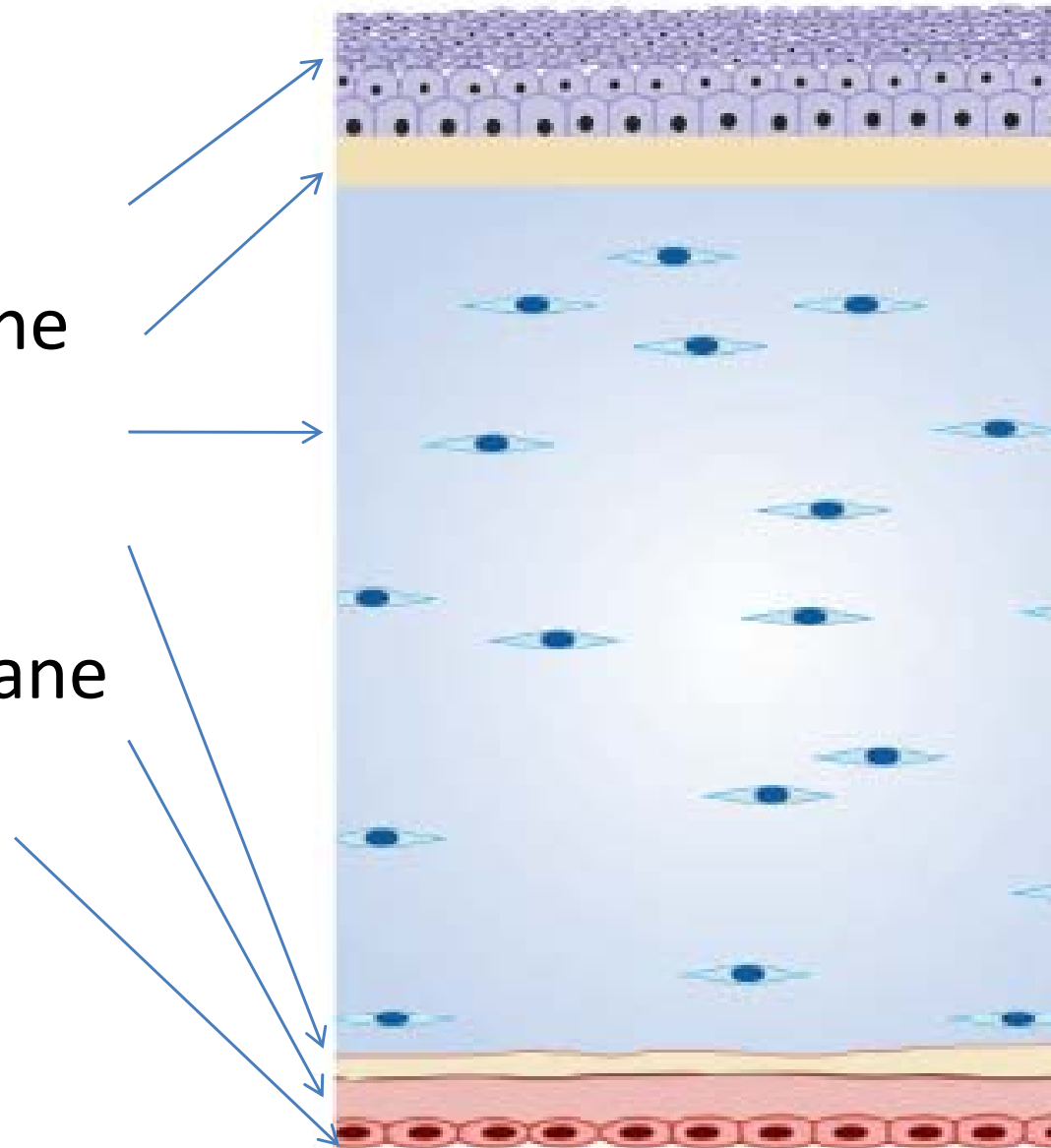


CORNEAL DIMENSIONS

- DIAMETER
- THICKNESS
- RADIUS OF CURVATURE
- **REFRACTIVE POWER**
 - *Refractive index of the cornea is 1.376.*
- **REFRACTIVE INDEX**
 - *Refractive power of the cornea is about 45 dioptres, which is roughly three-fourth of the total refractive power of the eye (60 dioptres).*

CORNEAL HISTOLOGY

- Layers of cornea
 1. Epithelium
 2. Bowman's membrane
 3. Stroma
 4. Dua's layer
 5. Descemet's membrane
 6. Endothelium





EPITHELIUM

- Stratified, squamous, non-keratinising
- 5-7 layers
- Basal cells layer
- Wing cell layer
- Flattened cells
- Regular shedding of superficial Epithelial cells with basal cells proliferation.
- Tight junctions – Allows transparency, barrier function
- Palisade of vogt - constitute the limbal stem cells which amplify, proliferate, and differentiate





❖ BOWMEN'S LAYER

- Acellular mass of condensed collagen fibrils
- about 12 mm in thickness
- binds the corneal stroma anteriorly with basement membrane of the epithelium.
- It is not a true elastic membrane but simply a condensed superficial part of the stroma.
- It shows considerable resistance to infection
- Once destroyed- not regenerate leaving opacities



❖ **STROMA** (*substantia propria*)

- Thickest layer about 0.5 mm
- 2 components
 - Collagen fibrils(lamellae)
 - » Lamellar arrangement
 - » 200-250 layers
 - » Each parallel to each other
 - » Ant. 1/3rd- oblique orientation
 - » Post. 2/3rd- alternate layer perpendicular to each other
 - Parallel arrangement helps in transparency & easy intralamellar dissection in keratoplasty

❖ DUA'S LAYER

(Pre–Descemet's membrane)

- Discovered in 2013 by Dr Harminder Dua, an Indian ophthalmologist working in Great Britain
- about 15 micrometer thick
- Acellular structure which is very strong and imprevious to air



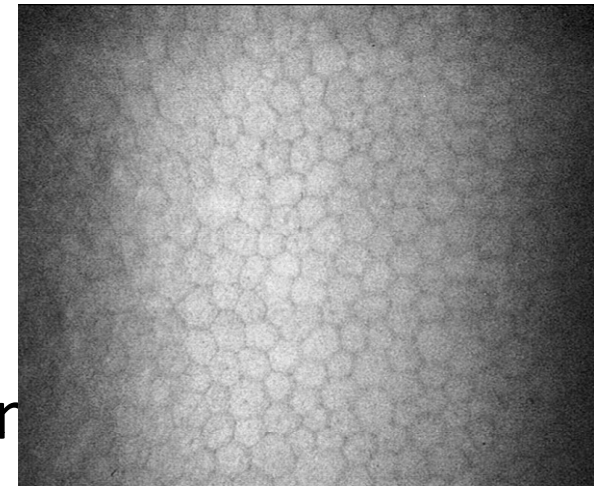
❖ DESCOMET'S MEMBRANE

- Posterior elastic lamina
- Produced from endothelium
- Thickness varies at different ages
- Resistant to trauma
- Ends at schwalbe's line
- Can regenerate once damaged



❖ ENDOTHELIUM

- Hexagonal cells-mosaic pattern
 - Hemidesmosomes
- Cell density
- Polymegathism
- Evaluated by specular microscopy – cell density is around 3000 cells/mm² in which decreases with advancing age.
- The human endothelium cells do not proliferate - the cell loss with age is compensated by enlargement (polymegathism) and migration of neighbouring cells.



CORNEAL BLOOD SUPPLY

- Avascular
 - Sub-conjunctivally - small loops derived from the anterior ciliary vessels for about 1 mm.
- Advantages:
 - Transparency
 - Graft failure less common

CORNEAL NERVE SUPPLY

- Long ciliary nerve – branch of trigeminal nerve
- Stromal plexus, subepithelial plexus, intraepithelial plexus
- No nerves in centre, posterior cornea

CORNEAL PHYSIOLOGY

- Primary physiological functions:
 1. to act as a major refracting medium
 2. to protect the intraocular contents
- by maintaining its transparency and regular replacement of its tissues.

- CORNEAL TRANSPARENCY

1. *Peculiar arrangement of corneal lamellae (lattice theory of Maurice).*
2. *Peculiar refractive index of corneal lamellae with variation less than 200 nm (Goldmann and Benedek theory).*
3. *Avascularity of cornea.*
4. *Relative state of dehydration (78% water content),*
5. *Swelling pressure (SP) of the stroma.*
6. *Corneal crystallins, i.e, water soluble proteins of keratocytes*

- METABOLISM OF CORNEA

- ***Most actively metabolizing layers*** - epithelium and endothelium
 - Epithelium being 10 times thicker, requires more supply of metabolic substrates
- *Endothelium requires oxygen and glucose for metabolic activities and proper functioning of Na⁺ - K⁺ATPase pump.*
- *Epithelium can metabolize glucose both aerobically and anaerobically*

– ***Source of nutrients for cornea are:***

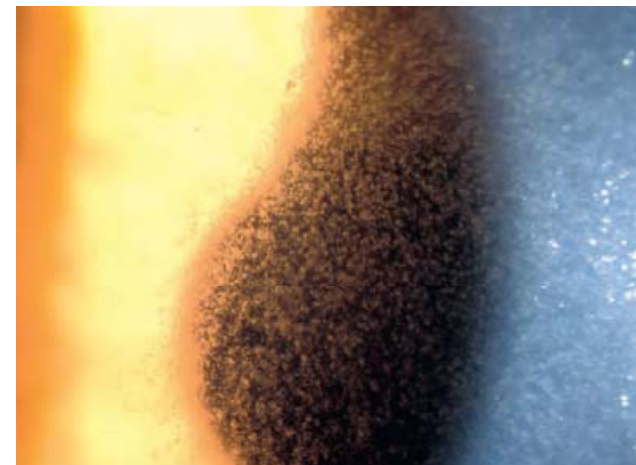
1. *Solutes (glucose and others)*

- by simple diffusion or active transport through aqueous humour and
- by diffusion from the perilimbal capillaries

2. *Oxygen is derived directly from air through the tear film*

- active process - by the epithelium
- from the perilimbal capillaries (eyelids are closed)
- deeper corneal layers through the aqueous humour.

- corneal hypoxia may occur with over wear of contact lenses – due to interference of getting oxygen from air by epithelium.



- **ANOMALIES OF CORNEAL TRANSPARENCY**

1. *Anterior embryotoxon* - congenitally broad limbus superiorly
2. *Posterior embryotoxon* - *thickening and* anterior displacement of Schwalbe's line.
3. *Congenital corneal opacity* - scarring of corneal stroma
 - congenitally in isolation
 - in association with Lowe's syndrome, Axenfeld's anomaly, Rieger's syndrome and Peter's anomaly.
4. *Sclerocornea* - *cloudy cornea*, which may be peripheral or diffuse.
5. *Dermoids* - *at inferotemporal limbus* and are round, dome shaped, and pink to white to yellow in colour

- ***Differential diagnosis of neonatal cloudy cornea.***

- **S**clerocornea
- **T**ears in Descemet's membrane
- **U**lcer
- **M**etabolic conditions
- **P**osterior corneal defect
- **E**ndothelial dystrophy
- **D**ermoid.

TOPIC FOR NEXT LECTURE

KERATITIS

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