**Cornea overview**

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**CORNEA:**

**Embryology**

- Corneal epithelium is derived from surface ectoderm
- Corneal stroma, descement mem, bowman’s layer, endothelium is derived from fibrous layer of mesoderm lying anterior to the optic cup.

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**CORNEA**

- Transparent, avascular tissue.
- Anterior 1/6 of the outer fibrous coat of the eyeball.
- 11-12mm horizontally, 10-11mm vertically.
- Corneal thickness at the center 0.52mm, at the periphery is 0.7mm.
- Ant. & posterior radius of curvature is 7.8mm & 6.7mm respectively.
- Net refractive power +43D, refractive index = 1.37.

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**HISTOTOGY**

**Epithelium**

- Composed of stratified squamous epith.
- 5% of total corneal thickness (50-90micrometer thick).
- 5-6 layers of cells, deepest is basal cells, next 2-3 layers is wing or umbrella cells & most superficial is surface cells.
- Entire epith. is replaced by 6-8 days.

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**Fig. 2.1. Microscopic structure of cornea.**
Basal layers
- tall columnar polygonal shaped cell
- palisade like manner
- forms the germinal layers of the epith
- firmly joined by desmosomes & maculae occludentes
- tight intercellular junctions accounts for epith. transparency & its barrier function

Wing cells:
- 2-3 layers of polyhedral shaped cells

Surface cells:
- most superficial, desmosome & maculae occludens are more numerous
- cell wall has microvilli which plays an important role in tear film stability

Bowman’s membrane:
- Consists of acellular mass of condensed collagen fibrils
- 8-14 micro m thick
- Resistance to infection & injury. Once destroyed it doesn’t regenerate

Stroma
- 0.5mm thickness
- Constitutes 90% of total thickness
- Consists of collagen fibrils (lamella) & cells embedded in hydrated matrix of proteoglycans

Descemet’s membrane:
- Strong homogenous layer
- It is made up of collagen, glycoprotein & no elastic fibers visible by electron microscope
- 3-4 microns at birth & 10-12 microns in young adults
- Resistant to infection, injury, chemical agents
- Unlike Bowman’s meml when destroyed it can regenerate
- Appears to end at anterior limit of the trabecular meshwork at Schwalbe’s line

Lamellae
- Becomes continuous with scleral lamellae at the limbus
- Parallel arrangement of lamellae allows easy dissection & also implicated in the corneal transparency

Cells = keratocytes, macrophages, histocytes, lymphocytes
**Endothelium**

- Single layers of flat polygonal cells, appears as mosaic
- Cell density of endoth. is 6000 cells/mm$^2$ at birth, 2400-3000 cells in young
- Defect left by dying cells is filled by polymegathism of remaining cells
- Corneal decompensation occurs when cell counts becomes <500 cells/mm$^2$

**BLOOD SUPPLY:**

- Avascular
- Small loop derived from the anterior ciliary vessels invade its periphery for about 1mm & provide nourishment

**NERVE SUPPLY:**

- Derived from long ciliary nerves branch of nasociliary nerve
- It connect with conjunctival nerves to form a pericorneal plexus of the nerves
- 60-80 myelinated trunks from the pericorneal plexus enters the cornea & in the stroma it lose their myelin sheath & form a stromal plexus
- Most passes anteriorly and forms a subepithelial plexus
- Fibers penetrate the bowman’s mem. lose their schwann’s sheath, divide under basal layer of epith & extend bet cells of all layers of epith & forms a intraeipth plexus
- Highest near the centre & decreases towards periphery
- Absent nerves in post part of cornea, descemet mem, endothelium
Physiology of cornea

- Two primary physiological functions of cornea
  - To act as a major refracting medium
  - To protect the intraocular contents

Corneal transparency

- Transparency is the quality or state of transmitting light without appreciable scattering so that bodies lying beyond are entirely visible
  - It is of paramount importance for the cornea to satisfy the basic physiologic function as a major refracting medium, for a clear retinal image

Factors affecting corneal transparency

- Physical/anatomical factors
  - Uniform and regular arrangement of the corneal epithelium
  - Peculiar arrangement of the stromal lamellae
  - Corneal avascularity

- Physiological factors
  - Relative state of corneal dehydration

- Cellular factors
  - Normal epithelium is transparent due to homogeneity of its refractive index
  - The basal cells are firmly joined laterally to each other and anteriorly to the wing cells by desmosomes and maculae occludentes
  - This accounts for its transparency and barrier function
  - Normal precorneal tear film also plays an important role in maintaining the transparency
  - Conditions associated with tear film abnormalities and/or corneal epithelial abnormalities may result in loss of its transparency

Arrangement of the stromal lamellae - Two theories

- Maurice theory (1957)
  - Uniform collagen fibrils are arranged in a regular lattice so that a scattered light is destroyed by the usual interference
  - As long as these fibrils are regularly arranged in a lattice, separated by less than a wavelength of light (4000 to 7000 Å), the cornea will remain transparent
  - Loss of transparency will result if this regular arrangement is altered by stromal edema or mechanical stress

- Theory of Goldman et al. (1968)
  - Lattice arrangement is not a necessary condition for stromal transparency
  - Cornea is transparent because the fibrils are small in relationship to the light and do not interfere with the light transmission unless they are larger than 1 ½ of a wavelength of light (2000 Å)
Physiological factors

- Relative state of corneal dehydration maintained by barrier effects of epithelium and endothelium and the active bicarbonate pump of the endothelium

Cellular factors affecting transparency

- Corneal fibroblast (keratocytes) are important in maintaining transparency as they are source of stromal collagen, and proteoglycans

- Most of the enzymes required for the changes in the matrix are present in them

Source of nutrients

- Solutes (glucose and others) enter cornea by either simple diffusion or active transport through aqueous humor and by diffusion from perilimbal capillaries

- Oxygen is derived directly from air through the tear film by epithelium