ANATOMY AND PHYSIOLOGY OF CORNEA AND SCLERA

DR. Faizur Rahman
Associate Professor
Peshawar Medical College
Peshawar
CORNEA

• Forms anterior 1/5th of the eyeball.
• Clear transparent tissue with smooth shining surface.
• Anterior surface is convex and elliptical.
• Horizontal diameter is 12mm and vertical diameter is 11.5mm.
• Posterior surface is concave and circular with diameter of 11.5mm.
CORNEA

- Thickness in center is 0.5mm and in periphery is 1mm.
- Radius of curvature of anterior surface is 7.8mm and posterior surface is 6.5mm.
- Refractive Power of cornea is 43D.
- Refractive index is 1.33.
It consists of five layers:
- Epithelium.
- Bowman’s membrane.
- Stroma.
- Descemet’s membrane.
- Endothelium.
Epithelium

- **Non-keratinized Stratified Squamous**: 50-90µm thick.
- **Basal layer**: single columnar, mitotically active, few organelles.
- **Wing cells**: 2 or 3 layers of polygonal cells.
- **Superficial cells**: Flat cells, double layer. Desmosomalous attachment, tight junctions microplicae & microvilli.
- Replaced every 7 days.
Bowman’s layer

• Acellular condensed collagen fibers.
• 8-14\(\mu\)m thickness.
• Not regeneratable.
Stroma

- 90% of corneal thickness.
- Collagen fibers: Lamellae, Proteoglycan.
- Cells: Keratocytes, Macrophages, Lymphocytes
- Regeneratable.
Descemet’s membrane

• 10-12µm thick.
• Produced by Endothelium.
• Basement membrane.
• Ends at limbus - Schwalbe’s line.
Endothelium

- Single layer of hexagonal cells.
- Indivisible.
- At birth 4000----5000 cells/mm².
- Minimum number is 400-700 cells/mm².
BLOOD SUPPLY:
• A vascular.
• Anterior ciliary vessels.
• No lymphatics.

NERVE SUPPLY: Sensory.
• Ophthalmic division of trigeminal nerve---- Nasociliary nerve ---- long ciliary nerve.
  Limbus----Sclera----Precorneal plexus----Stromal plexus----Subepithelial plexus----Intraepithelial plexus.
Physiology

- Refracting surface.
- Protection of intraocular contents.
- Absorption of drugs.
Endothelium

- Barrier function: epithelium vs endothelium.
- Active pumps: Na/K ATP’ase.
  Bicarbonate dependent.
  Carbonic anhydrase.
- Passive diffusion: Supplementary.
Metabolism

• Sources: Oxygen/Glucose.
• Path ways:
  Glycolitic pathway.
  Kreb’s cycles.
  Pentose pathway.
Transparency

• Regularity of stromal structures:
  Fibers of regular diameter, arranged in lattice, interfibrilar distance less than a wavelength of light.
• Avascularity.
• Non-medulated nerve ending.
• Relative dehydration:
  Active transport of electrolytes out of endothelium into AC – water follows (Na-K ATPase)
  Evaporation from the corneal surface – little part.
Corneal hydration

• Stromal swelling pressure.

• Barrier function of Epithelium/Endothelium.

• Active pump.

• Evaporation from corneal surface.

• Intraocular pressure.
SCLERA

Posterior 5/6\textsuperscript{th} of eyeball.

**Thickness:**
- Posteriorly 1mm.
- At muscular insertions 0.3mm.
- Equator 0.6mm.
- At corneoscleral junction 0.8mm.
Coverings and Attachments

- Anteriorly: Conjunctiva.
- Posteriorly: Connected by delicate connective tissue to fascial sheath of eyeball.
- Muscle attachments.
Perforations

- Posterior scleral foramen - Lamina cribrosa.
- Anterior aperture for ciliary arteries—Recti muscles.
- Middle aperture for vortex veins.
- Posterior aperture for long & short ciliary nerves & V.
- Canal of schlemm.
Episclera

• Outermost layer.
• Loose connective tissue—Tenon’s capsule.
• Rich blood supply—Anterior ciliary vessels.
Scleral Stroma

- Collagen fibers—Irregularly arranged.
- Elastic fibers, melanocytes, fibroblasts.
Lamina Fusca

• Innermost layer contain collagen fibers and melanocytes.

• Perichoroidal space.
Blood Supply:-

• Relatively avascular but anterior to the insertions of the recti muscles, the anterior ciliary arteries form a dense episcleral plexus. The posterior part of the sclera receives small branches from the long and short posterior ciliary arteries.

Nerve Supply:-

• Ciliary nerves—long and short.
Functions of Sclera

• Protects the intraocular contents from trauma and mechanical displacement.
• Preserve the shape of the eyeball.
• Provide a rigid insertion for extraocular muscles.
Embryology

- Corneal epithelium forms from the surface ectoderm.
- Bowman’s membrane is formed from mesenchyme.
- Stroma is formed from mesenchyme.
- Endothelium is derived from the neural crest.
- Descement’s membrane is synthesized by the endothelial cells.
Embryology

• Sclera is formed from a condensation of the mesenchyme outside the optic cup.
• It first forms near the future insertion of the rectus muscles.
Congenital disorders of cornea

• Megalocornea.
• Microcornea.
• Keratoglobus.
• Posterior keratoconus.
• Cornea plana.
• Sclerocornea.
• Dermoid & dermolipoma.
• Keractasia.
Microcornea

- Very rare, hereditary, unilateral or bilateral
- Corneal diameter is 10 mm or less
- Shallow anterior chamber but other dimensions are normal

Ocular associations
- Glaucoma, cataract, cornea plana, leukoma and iris abnormalities

Associated systemic syndromes
- Turner, Ehlers-Danlos, Weill-Marchesani and Waardenburg
## Megalocornea

<table>
<thead>
<tr>
<th>Systemic associations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Marfan, Apert, Ehlers-Danlos and Down syndromes</td>
<td></td>
</tr>
<tr>
<td>Osteogenesis imperfecta</td>
<td></td>
</tr>
<tr>
<td>Renal carcinoma and mental handicap</td>
<td></td>
</tr>
</tbody>
</table>

- Very rare, hereditary, bilateral
- Corneal diameter 13 mm or more
- Very deep anterior chamber
- High myopia and astigmatism
- Occasionally lens subluxation
Keratoglobus

- Bilateral protrusion and thinning of entire cornea
- Associations: Leber congenital amaurosis and blue sclera
- Onset usually at birth
Sclerocornea

- Very rare, usually bilateral
- Peripheral opacification and vascularization of cornea
- ‘Scleralization’ makes cornea appear smaller
Cornea plana

- Very rare, bilateral severe decrease in corneal curvature
- Hypermetropia and shallow anterior chamber

Ocular associations
- Glaucoma, microcornea, microphthalmos, and Peters anomaly
Keratectasia

- Very rare, usually unilateral
- Severe corneal opacification and protruberance
- Probably caused by intrauterine keratitis
Slit-lamp biomicroscopy

- Diffuse illumination.
- Direct focal illumination.
- Lateral illumination.
- Retro-illumination.
- Specular reflection.
- Sclerotic scatter.
Signs of corneal disease

A. Superficial:

- Punctate epithelial erosions.

Superior; Vernal disease, superior limbic keratoconjunctivitis, floppy eyelids poorly fitting contact lenses.

Interpalpebral; Dry eyes, diminished corneal sensation, exposure to UV.

Inferior; Lower lid margin disease, corneal exposure, rosacea, toxicity from drops.
Signs of corneal disease

- Punctate epithelial keratitis: viral infections.
- Epithelial oedema: Endothelial decompensation and acute high IOP.
- Filaments: Keratoconjunctivitis sicca, superior limbic keratoconjunctivitis, recurrent erosion syndrome, eye patching, corneal exposure, diminished corneal sensation, HZO, midbrain strokes and essential blepharospasm.
- Pannus.
Signs of corneal disease

B. Stromal:

- Infiltrates: contact lens wear, marginal keratitis, infectious keratitis.
- Oedema: Disciform keratitis, keratoconus, Fuchs dystrophy, surgical damage.
- Vascularization.
Signs of corneal disease

C. Descement’s membrane:

• **Breaks:** Corneal enlargement, birth trauma, keratoconus.

• **Folds:** Surgical trauma, ocular hypotony, stromal inflammation and oedema.
THANK YOU