

*Research Article***Correlation between central corneal thickness, anterior chamber depth and corneal curvature.**

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Anatomy and physiology of the cornea :

Cornea is the transparent, anterior one-sixth of the outer coat of the eyeball, and, along with the precorneal tear film, forms the major refracting surface of the eye and serves as a barrier between the environment and the inside of the eye. Microscopically, the cornea is composed of 6 layers from front to back: ⁽¹⁾

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|--------------------|--------------------------------|
| 1- Epithelium. | 4- Dua's layer (pre-descemet). |
| 2- Bowman's layer. | 5- Descemet's membrane. |
| 3- Stroma. | 6- Endothelium. |

The cornea consists of the 50 µm thick epithelium, the 450-500 µm thick stroma and the endothelium. The epithelium and the stroma are divided by the epithelial basement membrane and the 8-10 µm thick Bowman's layer posterior to BM. Furthermore, between the stroma and the endothelium is Dua's layer and Descemet's membrane. On average, the cornea is thinner centrally (500-550 µm) than peripherally (600-700 µm).⁽²⁾

Epithelium:

It is composed of non-keratinized, non-secretory, stratified squamous epithelium which is 4–6 cell layers in thickness (40–50 µm).⁽³⁾

Corneal epithelial cells undergo orderly involution, apoptosis and desquamation. Complete turnover of corneal epithelial cells occurs in about 7–10 days, with the deeper cells eventually replacing the desquamating superficial cells. The most superficial cells of the corneal epithelium form an average of 2-3 layers of flat, polygonal cells. Extensive apical microvilli and microplicae characterize their cell membranes, which in turn are covered by a fine, closely apposed, charged glycocalyceal layer.⁽⁴⁾

Bowman's layer:

The uppermost part of the corneal stroma is Bowman's layer, which is an acellular, nonorganized array of fibrils of collagen types I, III, V, and VI, and is about 8-12 µm thick. It develops from processes of the superficial mesenchymal cells of the corneal stroma and connects to the adjacent basement membrane through anchoring fibrils and plaques.⁽⁵⁾

Normally, epithelial damage occurs readily without the involvement of Bowman's layer. This provides evidence of its relative toughness. Bowman's layer does not regenerate and significant damage or surgical removal of this layer results in a permanent loss. If damage does occur to Bowman's layer, fibrous scar tissue is laid down and results in an opacity, which tends to decrease in density with time. However, in such cases the anterior stroma becomes more compact and loses its cellularity to form a pseudo-Bowman's layer.⁽⁶⁾

Stroma:

The stroma makes up about 90% of the thickness of the cornea and is relatively acellular, with only 3–10% of the volume

consisting of stromal keratocytes. Structurally, the stroma is composed of tightly packed parallel collagen fibrils that have a small, uniform diameter.⁽⁷⁾ Other extracellular matrix components can be found in the stroma such as glycosaminoglycans and fibronectin. There is a global as well as a local organization of the fibrils that are regular in size and shape and aligned within individual lamella.⁽⁸⁾

Dua's Layer (DL):

It is also called Pre-Descemet layer. It is around 10 µm thickness lying between the stroma and Descemet's membrane.⁽¹⁾

Histologically, the DL is made of 5 to 8 thin lamellae of tightly packed collagen bundles running in longitudinal, transverse, and oblique directions. The DL is primarily composed of collagen I. Immunohistologically, collagen V is weakly positive in both DL and stroma. Collagens IV and VI are more positive in DL compared with the corneal stroma. The intensity of staining for proteoglycans lumican, mimecan, and decorin was similar in the DL and corneal stroma. Cluster of differentiation 34 (CD34) was negative in the DL, confirming the lack of keratocytes in DL.⁽¹⁾

Descemet's membrane

It is the basement membrane of the corneal endothelium which gradually increases in thickness from birth (3 µm) to adulthood (8–10 µm). Histological analysis reveals it to be stratified into a thin (0.3 µm) non banded layer adjacent to the stroma, an anterior banded zone (2–4 µm), and a posterior amorphous, non-banded zone (>4 µm), the latter of which can represent up to two-thirds of the thickness of the membrane and is laid down over time.⁽⁹⁾

Descemet's membrane is composed primarily of collagen types IV and VIII and laminin but also contains fibronectin. Rupture of Descemet's membrane results in the penetration of aqueous humor into the corneal stroma and consequent stromal edema. Descemet's membrane does not regenerate after endothelial cells recover the ruptured area.⁽¹⁰⁾

Endothelium

The endothelium is a thin monolayer of polygonal cells covering the posterior surface of Descemet's membrane and is in contact with the

aqueous humor. It is approximately 5 µm in depth and 20 µm in diameter. It consists of a uniform thickness layer of cells that spans the entire posterior corneal surface and fuses with the cells of the trabecular meshwork.⁽¹¹⁾

Corneal Innervation

The nerve fibers in the human cornea are mostly sensory, but also autonomic nerves exist. The sensory innervation derives from the ophthalmic and maxillary branch of the trigeminal nerve. Anatomically, the corneal sensory nerves can be divided into the stromal, the sub-basal and the intraepithelial.⁽¹²⁾

Blood Supply of the Cornea

Although the normal human cornea is avascular, it relies on components of the blood to remain healthy. These components are supplied by tiny vessels at the outermost edge of the cornea as well as components supplied by end branches of the facial and ophthalmic arteries via the aqueous humor and tear film.⁽¹³⁾

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