

The **corneal epithelium** consists of five to six layers of nucleated cells that can be subdivided functionally and morphologically into three zones:

- **Superficial cells** are approximately 50 μm in frontal diameter and approximately 5 μm thick. About one-seventh of these cells are lost by desquamation within 24 h. Before detachment, the cytoplasm and nucleus undergo changes in their optical characteristics.
- **Intermediate cells** are 50 μm in diameter and 10 μm thick. These cells form a contiguous polygonal, wing-shaped pattern (wing cells).
- **Columnar basal cells** have a flat basal surface adjacent to Bowman's membrane, a frontal height of approximately 20 μm , and a frontal diameter of 8–10 μm . Like endothelial cells, they can be quantified accurately because of their defined location in relation to the basement membrane (Fig. 3.1).

Bowman's membrane – which is clearly distinct histologically from the epithelial basement membrane – is 10–16 μm thick and remains amorphous on light microscopy. Its location on *in vivo* confocal microscopy is well defined by the subepithelial plexus (SEP).

The **stroma** accounts for some 90% of total corneal volume. Ninety-five percent of the stroma consists of amorphous ground substance (glycoproteins, glycosaminoglycans: keratan sulfate and chondroitin sulfate) and collagen fibers. The remaining 5% of stromal volume is accounted for by cellular structures known as keratocytes, which are specialized fibroblasts.

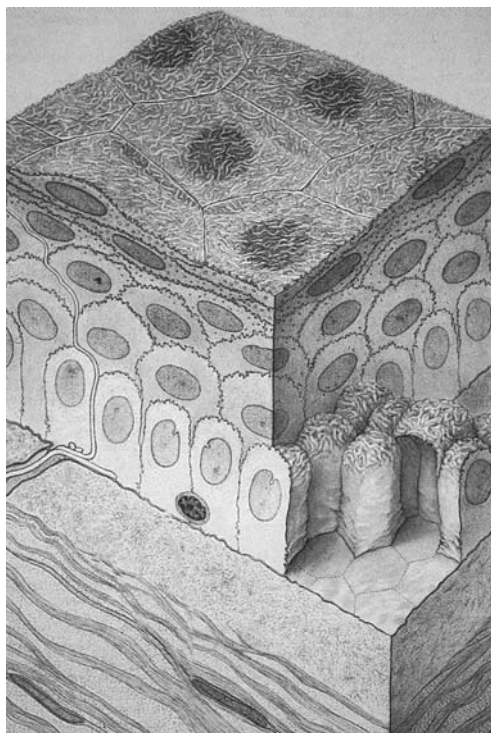


Fig. 3.1 Schematic illustration of the corneal epithelium and upper corneal stroma

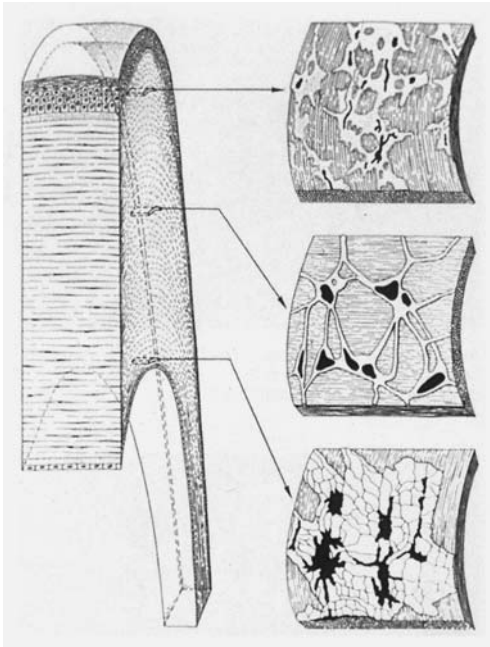


Fig. 3.2 Schematic illustration of the layered structure of the human cornea. The differently shaped keratocyte nuclei can be distinguished on in vivo confocal microscopy (adapted from Krstić RV. *Human Microscopic Anatomy: An Atlas for Students of Medicine and Biology*. Berlin, Heidelberg, New York: Springer-Verlag, 1991 [39])

Besides the nerves, their irregularly shaped nuclei are the only well-defined sources of scattered light in corneal stroma detected on confocal microscopy. Their widely branching cytoplasmic extensions are not visible in the healthy cornea (Fig. 3.2).

The cornea is the most densely innervated tissue in the human body. It is supplied by the terminal branches of the ophthalmic nerve in the form of 30–60 nonmyelinated **ciliary nerves**. In the limbus region these are seen as whitish, filigree-like structures; their complex stromal and epithelial branchings are not visible by slit-lamp microscopy but are relatively clear on confocal microscopy.

Like Bowman's membrane, **Descemet's membrane**, which should be regarded as the basement membrane of the endothelium, remains amorphous on light microscopy. It is 6–10 μm thick. On confocal microscopy it is defined optically by the easily identifiable endothelial cells.

The **endothelium** consists of about 500,000 hexagonal cells approximately 20 μm in diameter and 5 μm thick and with large, flattened central nuclei. The high concentration of cell organelles is indicative of very intensive metabolic activity.