

Human Corneal Anatomy Redefined: A Novel Pre-Descemet's Layer (Dua's Layer)

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Purpose

To define and characterize a novel pre-Descemet's layer in the human cornea.

Design

Clinical and experimental study.

Participants

We included 31 human donor sclerocorneal discs, including 6 controls (mean age, 77.7 years).

Methods

Air was injected into the stroma of donor whole globes ($n = 4$) and sclerocorneal discs ($n = 21$) as in the clinical deep anterior lamellar keratoplasty procedure with the big bubble (BB) technique. The following experiments were performed: (1) creation of BB followed by peeling of the Descemet's membrane (DM); (2) peeling off of the DM followed by creation of the BB, and (3) creation of the BB and continued inflation until the bubble popped to measure the popping pressure. Tissue obtained from these experiments was subjected to histologic examination.

Main Outcome Measures

Demonstration of a novel pre-Descemet's layer (Dua's layer) in the human cornea.

Results

Three types of BB were obtained. Type-1, is a well-circumscribed, central dome-shaped elevation up to 8.5 mm in diameter ($n = 14$). Type-2, is a thin-walled, large BB of maximum 10.5 mm diameter, which always started at the periphery, enlarging centrally to form a large BB ($n = 5$), and a mixed type ($n = 3$). With type-1 BB, unlike type-2 BB, it was possible to peel off DM completely without deflating the BB, indicating the presence of an additional layer of tissue. A type-1 BB could be created after first peeling off the DM ($n = 5$), confirming that DM was not essential to create a type-1 BB. The popping pressure was 1.45 bar and 0.6 bar for type-1 BB and type-2 BB, respectively. Histology confirmed that the cleavage occurred beyond the last row of keratocytes. This layer was acellular, measured 10.15 ± 3.6 microns composed of 5 to 8 lamellae of predominantly type-1 collagen bundles arranged in transverse, longitudinal, and oblique directions.

Conclusions

There exists a novel, well-defined, acellular, strong layer in the pre-Descemet's cornea. This separates along the last row of keratocytes in most cases performed with the BB technique. Its recognition will have considerable impact on posterior corneal surgery and the understanding of corneal biomechanics and posterior corneal pathology such as acute hydrops, Descematocele and pre-Descemet's dystrophies.