

# Patterns of Corneal Endothelialization and Corneal Clearance After Descemet Membrane Endothelial Keratoplasty for Fuchs Endothelial Dystrophy

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• **PURPOSE:** To describe various endothelial migration healing patterns after Descemet membrane endothelial keratoplasty (DMEK), and to determine the contribution of the donor and host endothelium in the clearance of a transplanted cornea.

• **DESIGN:** Nonrandomized, prospective clinical study.

• **METHODS:** In a total of 150 consecutive eyes that underwent DMEK (ie, transplantation of an isolated Descemet graft, for Fuchs endothelial dystrophy), re-endothelialization patterns were studied. Of these eyes, 36 showed a "stromal gap" between the "descemetorhexis edge" and the graft, or (partial) graft detachment. Endothelialization patterns of the host posterior stroma were documented at 1, 3, 6, 9, 12, and 24 months after surgery with Pentacam imaging, specular microscopy, optical coherence tomography, confocal microscopy, and slit-lamp biomicroscopy.

• **RESULTS:** Complete corneal clearance was seen in 28 of 36 eyes (78%) with a stromal gap, or (partial) detachment, progressing from the periphery toward the center; and 27 of 34 eyes (79%) with normal visual potential reached a visual acuity of  $\geq 20/40$  ( $\geq 0.5$ ) or better. In 3 eyes that had the Descemet graft implanted upside-down, a "reversed corneal clearance pattern" was observed (ie, persistent edema where the graft was attached), while the area overlying the detachment cleared. One case that had a "descemetorhexis" performed without endothelial graft implantation showed persistent stromal edema.

• **CONCLUSION:** The presence of donor endothelium in the recipient anterior chamber may be required for endothelial migration and/or recovery of corneal clarity. Re-endothelialization may be associated with massive endothelial migration and some form of cell signaling to draw donor endothelial cells toward the recipient poste-

rior stroma ("homing"). (Am J Ophthalmol 2011;152:543-555. © 2011 by Elsevier Inc. All rights reserved.)

**T**HE ENDOTHELIAL CELL LAYER OF THE HUMAN CORNEA may have limited regenerative capacity.<sup>1-3</sup> Corneal endothelial disorders requiring treatment, most commonly Fuchs endothelial dystrophy and bullous keratopathy, are therefore routinely managed with a corneal transplant, to replace the recipient endothelium by donor tissue.<sup>4-6</sup> Penetrating keratoplasty has been the gold standard until various new concepts for endothelial keratoplasty were introduced in the last decade, popularized as "deep lamellar endothelial keratoplasty" (DLEK) and (femtosecond) Descemet stripping (automated) endothelial keratoplasty (DSEK/DSAEK/FS-DSEK).<sup>4-6</sup> Recently, we described a technique for selective transplantation of an isolated Descemet membrane carrying its endothelium, referred to as Descemet membrane endothelial keratoplasty (DMEK).<sup>7-9</sup> All of these techniques share the basic concept that the donor endothelium restores a normal, balanced stromal hydration, associated with normal corneal transparency, and thus a recovery of the visual acuity of the recipient eye.

Recently, we reported unexpected corneal clearance with visual recovery up to 20/28 (0.7) Snellen and 20/20 (1.0) Snellen in 2 DMEK eyes that showed (near) complete graft detachment in the early postoperative phase.<sup>10-12</sup> Slit-lamp observation suggested that cellular repopulation of the host posterior stroma originated from the recipient peripheral endothelium: in the presence of a clearly detached Descemet graft, both corneas cleared from the periphery toward the center, and re-endothelialization was seen to begin in the corneal quadrant opposite to the position of the graft. This clinical finding may not agree with an incapacity of the host endothelium to regenerate, and would potentially challenge the entire concept of a "keratoplasty" as the preferred treatment method in the management of corneal endothelial disorders.<sup>10-12</sup>

Hence, in the current study we categorized various patterns of "endothelialization" as observed in a series of 36 eyes from a total of 150 DMEK cases to determine how the donor or host endothelium may be involved in the clearance of a transplanted cornea, and to define prerequisites for potential surgical approaches as alternatives to

Accepted for publication Mar 16, 2011.

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