Descemet's Membrane Endothelial Keratoplasty (Dmek): The Thinner, The Better

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Abstract:

Descemet membrane endothelial keratoplasty (DMEK) is the most recent step forward in the evolution of endothelial keratoplasty towards thinner grafts and more natural, anatomic corneal restoration. It gives a better anatomical outcome accompanied by quick recovery compared to earlier procedures. Though technically difficult and requiring finer surgical precision, DMEK has the potential to become the first line treatment for corneal endothelial disorders because of no need for special equipment and low cost.

Keywords: keratoplasty, DMEK, Descemet membrane endothelial keratoplasty, posterior lamellar keratoplasty.

Introduction:

For almost 100 years, penetrating keratoplasty (PK) was the mainstay of therapy for patients with corneal endothelial disorders.1 That changed in 1998 with the introduction of posterior lamellar keratoplasty (PLK), 2-4 later popularized in the United States as deep lamellar endothelial keratoplasty (DLEK).5-7 Since there was manipulation only at the inner aspect of cornea, it resulted in less frequent complications commonly encountered with penetrating keratoplasty(PK) like suture related complications, astigmatism, wound healing etc. But while effective, DLEK ultimately proved too technically challenging for widespread adoption. So, the surgery was simplified, giving rise to Descemet stripping (automated) endothelial keratoplasty (DS(A)EK).8-11 Still, few patients after DS(A)EK achieved best corrected visual acuities (BCVAs) exceeding 20/25. Stroma-less graft was the solution, arriving in 2006 in the form of Descemet membrane endothelial keratoplasty (DMEK).12-14 With a transplant composed solely of isolated Descemet membraneand its endothelium, DMEK reduced the graft thickness by 75 % compared to DS(A)EK, from 80 microns to nearly 20 microns. Almost 80 % of patients reached ?20/25 within six months after surgery. Recently, DMEK has been refined into a standardized 'no-touch' procedure, ready for the typical corneal surgeon in any clinical setting and at low cost. Compared to its predecessors (PK, DSEK, DLEK etc), DMEK provides better and faster visual recovery, usually with no additional complications. It is therefore destined to become the first-line option for corneal endothelial disorders worldwide.

Preoperative Preparation of the DMEK Graft:

The initially described DMEK graft harvesting technique consisted of stripping Descemet membrane from a corneo-scleral rim submerged in saline (scuba technique). This method was proven safe and reproducible, with <5 % tissue loss due to inadvertent tearing, and no significant endothelial cell damage.15-19 Recently, the process was upgraded to a 'no-touch' procedure, making the preparation both safer and easier. To add to it, the anterior portion of the corneas left over from creating the DMEK grafts (with the Descemet membrane stripped off, but otherwise intact) can be used for deep anterior lamellar keratoplasty (DALK). This added benefit applies only to DMEK, because DS(A)EK preparation also has some of the posterior stroma in the graft , which leaves them less suitable for transplant.

DMEK Surgical Technique

The standardized no-touch technique for DMEK was published by Dapena et al. in 2011.20 A 3.0 mm clear-cornea tunnel incision is made at the 12 o'clock position with a slit knife, followed by the creation of three side-ports using a surgical knife at 10:30, 1:30, and 7:30 (right eye) or 4:30 (left eye). Under air, the recipient's Descemet

membrane is first scored 360 degrees then stripped from the posterior stroma using a reversed Sinskey. The DMEK graft is thoroughly rinsed with balanced salt solution, and stained twice with trypan blue 0.06 % to enhance its visibility in the recipient anterior chamber. Already curled into a roll due to the inherent elastic properties of the membrane itself, the graft may be nudged into a 'double roll' configuration by applying a flow of BSS directly across its surface. After staining, the DMEK double-roll is sucked into a custom-made glass pipette , then injected into the recipient anterior chamber through the 12 o'clock incision 'hinge down' so that the double roll faces upward. Once the graft has been inserted, its orientation can be checked (and verified as properly 'hinge down') through the use of the Moutsouris sign, whereby the tip of a 30G cannula, positioned atop the edge of the graft, will turn blue if it is embraced by an upward facing roll. If the tip does not turn blue, then the roll must be facing down, and therefore the graft is upside down, which can be corrected by gently flushing it within the anterior chamber. With the graft properly oriented, it may be unfolded by injecting a small air bubble in between the double rolls, then stroking the surface of the cornea to move the bubble and spread out the graft (Dapena technique). Once it has been fully unfolded, the graft is fixed against the recipient posterior stroma by completely filling the anterior chamber with air for a period of one hour. Afterwards, the air fill is reduced to 30-50 %, and the patient is instructed to remain supine for 24 hours.

Advantages of DMEK

* Great Visual Results
* Quick Recovery
* Use of inexpensive techniques
* Increased availability
* Decrease crowding of the anterior chamber

Complications:

1) ***Graft detachment:*** Most common complication following all forms of endothelial keratoplasty

2) ***Allograft Rejection:*** Two years after DMEK, the allograft rejection rate is ?1 %. This is considerably lower than the reported rate after PK (5-15 % in 'low-risk' cases), and also lower than after DS(A)EK (10 %).

3) ***Secondary Glaucoma:*** Most important potential complications after any form of corneal transplantation. Reported rates after PK and DS(A)EK commonly range from 15-35 %, but sometimes as high as 60 % depending on the patient population and the steroid regimen.

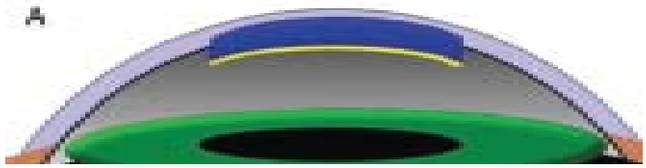
But because the risk of allograft rejection after DMEK is relatively low, a lighter, less intense, steroid schedule is possible.

Future Directions

Reports have been accumulating of corneas with detached grafts (after both DMEK and DS(A)EK) that nevertheless clear.When these corneas are viewed with specular and confocal microscopy, endothelial cells are clearly visible populating the recipient's posterior stroma. The prevailing speculation is that endothelial migration is responsible for this phenomenon, either by the donor cells, or host cells, or both.68-70 If widespread cell migration does indeed occur, then a simplified procedure, tentatively named "free-DMEK" or "Descemet Membrane Endothelial Transfer" (DMET)-in which the donor tissue is merely injected into the recipient anterior chamber after descemetorhexis-could be effective in the management of corneal endothelial disease.71 The advantages of this surgery, even over DMEK, would be enormous: perfect anatomical restoration, complete visual recovery, elimination of virtually all intra- and post-operative complications associated with endothelial keratoplasty, and an enormous reduction in the required surgical skills. Pending further study, DMET has the potential to become the preferred "no-keratoplasty" treatment for corneal endothelial disorders.

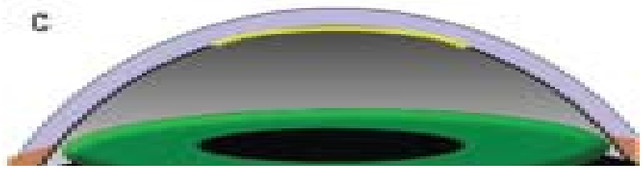
History of DMEK

o 2002, Melles et al published a possible technique for transplanting DM and endothelium.



A) DEEP LAMELLAR ENDOTHELIAL KERATOPLASTY.

B) DESCEMET'S STRIPPING AUTOMATED ENDOTHELIAL KERATOPLASTY (DSAEK).



C) DESCEMET'S MEMBRANE ENDOTHELIAL KERATOPLASTY.

o 2006, Melles published a case of a patient achieving 20/20 vision at week 1 with DMEK.

o 2007, Art Giebel presented the SCUBA technique at AAO for harvesting the graft.

o 2009, Francis Price presented results of DMEK indicating they may be superior to DSAEK.

Fig: Donor tissue preparation for DMEK

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