

Descemet Membrane Endothelial Keratoplasty (DMEK)

DMEK has dramatically changed the way we treat endothelial dysfunction. Every week, I perform DMEK on the second eye of multiple Fuchs' dystrophy patients after treating their first eye the week before. DMEK provides rapid visual recovery,¹ allowing rapid sequential bilateral surgery,² whereas when penetrating keratoplasty (PK) was the only option, bilateral transplants were typically spaced over a year apart.

Current Indications

The most common type of endothelial dysfunction we treat in the U.S.A. is Fuchs' dystrophy.³ The incidence of endothelial decompensation after cataract surgery has decreased with improved phacoemulsification techniques and intraocular lenses. However, we are seeing an increase in corneal decompensation after glaucoma surgery, particularly aqueous shunts. This is a major concern, because numerous studies have shown that previous glaucoma surgery is the single biggest risk factor for endothelial keratoplasty failure.⁴ The failure risk seems to be associated with the breakdown of the blood aqueous barrier and significantly altered protein levels in the anterior chamber,⁵ which may create a suboptimal environment for endothelial survival. In eyes with low-grade inflammation or breakdown of the blood aqueous barrier and particularly in eyes with aqueous shunts, we should plan on potentially repeating the transplant every 4 to 5 years. Every incision leaves a scar and complicates repeat incisions in the same area. DMEK only requires a 1.8- to 2.8-mm incision, whereas Descemet stripping endothelial keratoplasty (DSEK/DSAEK) requires a 3- to 5-mm incision, and PK incisions exceed 23 mm. So DMEK is the least invasive choice for eyes at increased risk for graft failure.

I currently prefer DSEK over DMEK in eyes with a large iris defect, aphakia, artificial irises, or anterior chamber lenses, because the thin DMEK tissue might fall back into the posterior chamber during unfolding and positioning maneuvers or the endothelium might be damaged by the plastic IOL or artificial iris. Eyes with extensive anterior synechia are problematic, because there is less space to position the graft. Lysing the synechia can be helpful, but they often reform.

DMEK is not contra-indicated in eyes with extensive edema, but poor visualization makes it more challenging. Removing the hazy epithelium, placing air in the anterior chamber for a period of time, and staining the donor longer with trypan blue can improve visibility. Intraoperative OCT is helpful in eyes with very cloudy corneas.

A hallmark of DMEK is the remarkably low risk of immunologic rejection episodes.⁶ Data from prospective, randomized studies show that we can safely reduce steroid strength one month after DMEK to minimize the risk of steroid-associated intraocular pressure elevation in whites (Table 1).^{7,8} African-Americans tend to have a higher risk of immunologic graft rejection,⁹ so we believe it is prudent to maintain strong steroid coverage longer in patients with darker pigmentation.

We prefer for our DMEK patients to keep using a weak topical steroid once-a-day indefinitely. A prospective study showed this is sufficient to prevent rejection episodes, whereas 6% of patients who stopped topical steroids at one year had a rejection episode in the next year.¹⁰ Importantly, 70% of the rejection episodes were asymptomatic and only detected at the planned study exams at 1, 3, 6, and 12 months after stopping steroids, suggesting the importance of routine examinations if steroids are discontinued.¹⁰ Overall, the minimal risk of graft rejection and reduced need for topical steroids after DMEK is an important advantage compared with PK or DSEK/DSAEK.

Advances in Surgical Techniques

Published reports suggest surgeons have less tissue loss than eye bank technicians, but a benefit of the eye bank preparing the tissue is that they assume the risk of tissue loss. Tissue loss is more likely if the donor had diabetes.¹¹ We use surgeon-prepared DMEK tissue and prefer a submerged peeling technique, as do most eye banks.

Attachment is more challenging with DMEK than DSEK, so we make a peripheral iridotomy (to prevent pupil block) and leave a larger air bubble in the eye after DMEK. The tissue can be inserted with a variety of glass pipettes or IOL inserters. I prefer a closed IOL inserter system because it provides more control and can fit through a smaller incision. The plunger in the IOL inserter should form a water-tight seal so that when the cartridge is introduced into the anterior chamber, the scroll does not migrate backward into the larger cavity of the cartridge.

The donor tissue naturally curls up with the endothelium facing outward and is usually inserted that way. Various maneuvers can be used to uncurl and position the tissue.¹² Busin developed a trifold method in which the donor Descemet's membrane faces outward.¹³ The trifold can be pulled into the eye or inserted with an IOL inserter. The trifold counteracts the natural tendency of the tissue to curl endothelium-outward. This facilitates correct positioning and allows successful use of younger donor tissue, which often scrolls more tightly.

The tissue must be correctly oriented with the endothelium facing the anterior chamber. Orientation can be ascertained with the aid of various asymmetric marks or by observing which way the tissue curls using a hand held slit beam¹⁴ or intraoperative OCT.

The co-axial view through the operating microscope provides little appreciation of the donor location relative to the posterior corneal surface or the iris. This can be important when placing a needle into the eye to inject an air bubble to secure the donor tissue in place. Intraoperative OCT provides a better understanding of the donor shape and position within the eye although any blood in the anterior chamber can interfere with the signal.

Summary

Compared with other keratoplasty procedures, DMEK offers substantial advantages, including rapid and predictable visual recovery, better quality of vision,¹⁵ less higher order aberrations, reduced risk of immunologic graft rejection, less need for topical steroids, less risk of steroid-induced IOP elevation, and a smaller surgical incision. Overall, DMEK is a tremendous advance for patients with endothelial dysfunction.

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Table 1

Cumulative probability of a rejection episode and of intraocular pressure (IOP) elevation (defined as IOP \geq 24 mm Hg or an increase of \geq 10 mm Hg over the baseline preoperative IOP) during the first year after Descemet membrane endothelial keratoplasty by Kaplan Meier analysis. Patients used prednisolone acetate 1% 4-times-a-day for one month and then were randomized to fluorometholone 0.1%, loteprednol etabonate 0.5%, or prednisolone acetate 1% at dosing frequencies of 3-times-a-day for the second and third months, twice a day the fourth month, and once-a-day months 5 through 12.

	Rejection Episode (%)	IOP elevation (%)
Prednisolone acetate 1%	0%	24%
Fluorometholone 0.1%	0%	11%
Loteprednol etabonate 0.5%	1.4%	8%

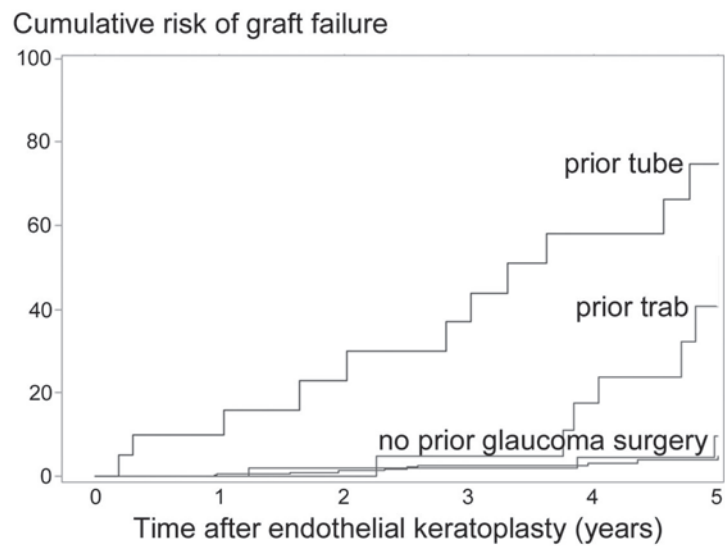


Figure 1: Effect of the preoperative glaucoma status on the cumulative probability of endothelial keratoplasty failure over 5 years.⁴