New Technique Transforms Corneal Transplantation

Descemet's stripping yields rapid visual recovery and superb refractive results compared with penetrating keratoplasty.

BY MARK S. GOROVOY, MD, AND FRANCIS W. PRICE, JR, MD

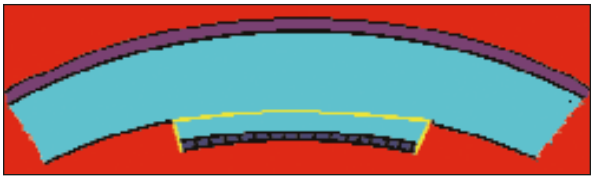
For the past 50 years, penetrating keratoplasty (PKP), or replacement of the full thickness of the cornea, has been the standard of care for patients with corneal endothelial disease. Other than improvements in suturing techniques and tissue quality, corneal transplantation has changed very little.

PKP can produce anatomically clear corneas, but its refractive results are abysmal. A typical corneal transplant patient may not see well for up to 2 years—if ever. Sutures remain in place for a long time, and a ruptured wound is always a serious risk. Patients with bilateral disease often must wait a long time for treatment of their the second eye until problems with their first eye resolve. Recently, however, corneal specialists have begun to replace only the diseased layer of the cornea, rather than its full thickness.

TARGETED REPLACEMENT

Improvements Over PKP

In 1998, Dutch ophthalmologist Gerrit Melles, MD, of Rotterdam, the Netherlands, first described posterior lamellar keratoplasty procedures by which the inside layers of the cornea are replaced through manual dissection.[1] In 2001, Mark A. Terry, MD, of Portland, Oregon, renamed the technique *deep lamellar endothelial keratoplasty*, or *DLEK*.[2] Both options represent improvements over PKP, but they are tedious, highly surgeon-dependent techniques that require extensive manual dissection of the donor tissue and host cornea. Dr. Melles has since developed a way to strip just Descemet's membrane, a procedure that he termed *Descemet's stripping lamellar endothelial keratoplasty*, or *DSLEK*, which does not require manual dissection of a patient's cornea.[3]



(Courtesy of Mark S. Gorovoy, MD.)

Figure 1. A diagram of a patient's cornea is shown following Descemet's stripping automated endothelial keratoplasty.

Automated Endothelial Keratoplasty

Automating endothelial keratoplasty with the Moria ALTK system (Moria, Antony, France) makes the procedure more predictable and reproducible and also improves visual outcomes. The newest version of posterior lamellar keratoplasty has been termed *Descemet's stripping automated endothelial keratoplasty*, or *DSAEK*, or *DSEK* (Figure 1).

We believe that this procedure revolutionizes corneal transplant surgery and that it should become the standard of care for any patient with Fuchs' corneal dystrophy or postcataract corneal decompensation. In fact, we no longer perform standard PKP for the aforementioned conditions. Additionally, DSAEK/DSEK is appropriate for many patients with a failed PKP.[4]

The primary advantages of DSAEK/DSEK compared with PKP and other posterior graft procedures are the speed and degree of visual recovery (Figure 2). Instead of 1 to 2 years, vision usually recovers in 1 to 3 months. In fact, Dr. Gorovoy's data show that approximately 80% of his patients achieve a BSCVA of 20/40 or better within 6 weeks, and more than 90% achieve the same in 3 months. Given that PKP rarely results in good vision, even years

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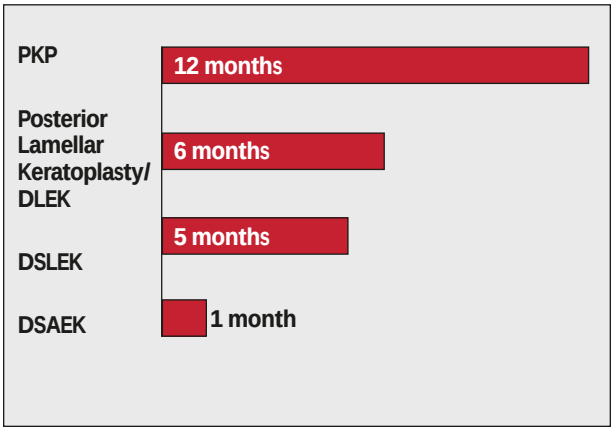

Figure 2. The speed of visual recovery associated with DSAEK/DSEK is much faster than with PKP, DLEK, and DSLEK.

postoperatively, and that the manual dissection technique may achieve the aforementioned visual acuity within 4 to 6 months,[5] DSAEK/DSEK has significantly raised the bar in terms of our expectations of visual recovery.

With DSAEK/DSEK, we expect to achieve refractive results very similar to the patient's preoperative refraction instead of an unknown spherical outcome with potentially severe regular or irregular astigmatism. For that reason, we can also treat the patient's second eye much earlier than with PKP, a change that greatly improves the quality of life for these patients.

The procedure is performed through a small intraoperative incision instead of an open-sky, 7- to 9-mm, circular corneal incision, which carries an increased risk of suprachoroidal hemorrhage.

PREPARING THE DONOR CORNEA FOR DSAEK/DSEK

Proper preparation of the donor tissue is essential. For this procedure, the donor cornea must have a sufficiently large scleral rim to allow fixation with an artificial anterior chamber. We recommend that surgeons request from their eye bank a corneal/scleral button at least 16mm in diameter.

The posterior lamellar donor button should comprise endothelium, Descemet's membrane, and 100 to 200µm of stromal tissue. If the donor button is too thin, it will be difficult to manipulate; if it is too thick, optical quality may be compromised.

The surgeon may perform lamellar dissection of the donor cornea by hand with corneal dissection blades, but the incidence of perforation is much lower with microkeratome dissection. The ALTK system comes with a 300-µm head for the Carriazo-Barraquer CBm microkeratome (Moria) (Figure 3). Using the microkeratome, the surgeon removes an anterior lamellar cap of tissue. It may be advisable to have a 350-µm head available as well, because the thickness of donor corneas varies widely and one may encounter a donor cornea with a thickness of 700µm or more.

Once the surgeon dissects the donor cornea, he transfers it to a standard cutting block (Figure 4) and punches it with a trephine, endothelial side up. We prefer a 9-mm trephine, which provides more endothelial cells for transplantation as well as better centering during surgery.

PATIENT PREPARATION AND DONOR INSERTION

Our techniques diverge somewhat. Each of us will explain how we perform this aspect of the surgery, which is done under a retrobulbar block or topical anesthesia.

Dr. Gorovoy's Technique

I place a 9-mm trephination mark on the cornea with methylene blue dye, central to the limbus, to outline the area of Descemet's I want to strip. I make three 1-mm paracentesis wounds around the limbus and a 3-mm keratome incision in the clear cornea temporally. Using an irrigating Descemet's stripper through the

Figure 3. The surgeon dissects donor corneas using Moria's ALTK system with the Carriazo-Barraquer CBm 300-µm head.

Figure 4. The surgeon transfers the donor cornea to a punch block, endothelial side up.

limbal paracentesis, the membrane is scored and partially stripped close to 360º on the trephination mark (Figure 5). Through the clear corneal incision, I use a cataract I/A handpiece to aspirate the entire scored, partially peeled membrane. Descemet's membrane peels off in much the same way as a capsulorhexis, although it is more adherent. After stripping Descemet's membrane, I enlarge the clear corneal incision to 5mm.

I coat the endothelial side of the donor tissue with Healon (Advanced Medical Optics, Inc., Santa Ana, CA) and fold it in a 40/60 overfold (with the endothelium on the inside). Then, I insert it into the anterior chamber with a forceps (Figure 6). Two 10–0 nylon sutures are usually sufficient to close that corneal wound. As I deepen the chamber with BSS, the tissue unfolds by itself with the stromal side up, although additional manipulation is sometimes required. I achieve good centration with irrigation or finger blotting at the limbus on a soft eye to move the donor tissue into place. Once the donor tissue is centered, I put a large air bubble in the anterior chamber and leave it for 30 minutes to 1 hour (Figure 7). During this time, the patient remains in the recovery room, on his back, looking up. Finally, I release about half the air from the air bubble at the slit lamp to avoid pupillary block, and then I discharge the patient.

I find that about one in four patients may need a second air bubble, which can be easily injected with a syringe under topical anesthesia in an office-based OR during the first postoperative week . Most eyes clear up within a day after receiving the second air bubble, although some of the most challenging eyes (those with abnormal irides, shunts, or previous transplant surgery) may require another air bubble for the donor tissue to fully adhere.

Dr. Price's Technique

My routine practice is to make a 5-mm scleral tunnel incision temporally into the clear cornea. I outline the area of planned Descemet's removal with a Price Hook (Moria No. 19091) that fits the recessed orbital area well. After scoring Descemet's membrane, I irrigate the anterior chamber with trypan blue ophthalmic solution (Visionblue; DORC International, Zuidland, the Netherlands). The dye stains the membrane along its edges and allows better visualization so I can avoid leaving small portions or tags. I remove or strip off the central Descemet's membrane with an I/A tip or an instrument that looks like a small garden hoe (Moria No. 19077). A continuous infusion system (Moria No. 19092) of BSS helps maintain the anterior chamber and minimizes the stress placed on the zonular apparatus in addition to minimizing trauma to the iris, lens, and peripheral cornea.

Prior to insertion, the posterior donor tissue is folded over on itself like a taco with a 40/60 overfold, with the endothelial side inward. This technique allows a 9-mm donor button to be inserted through a 5-mm scleral

(Courtesy of Mark S. Gorovoy, MD.)

Figure 5. The surgeon scores and strips the Descemet's membrane on the recipient.

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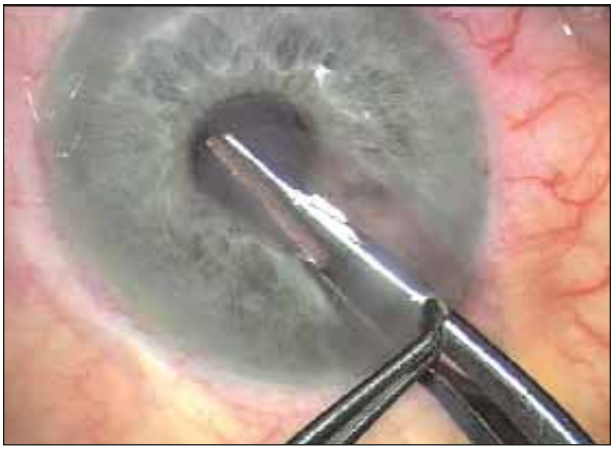
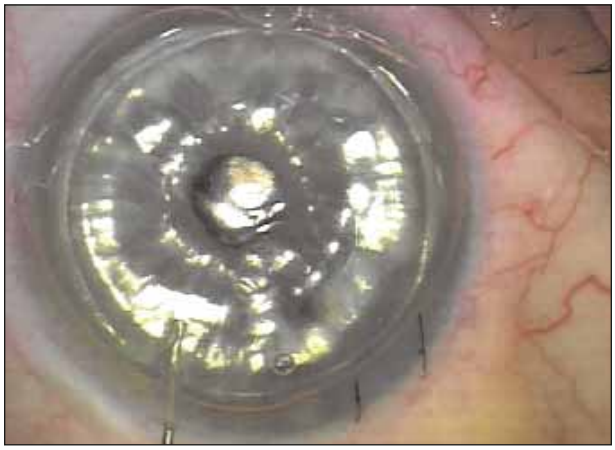


Figure 6. The donor corneal tissue is folded similarly to the shape of a taco and is inserted into the recipient's eye.



(Courtesy of Mark S. Gorovoy, MD.)

Figure 7. An air bubble is injected into the recipient's anterior chamber.

tunnel incision. I place a small amount of viscoelastic on the endothelial side before folding it to help protect it. I grasp the folded tissue with a special Goosey forceps (Moria No. 19090) and place the tissue into the eye through the scleral tunnel incision. Air injected into the anterior chamber helps unfold the donor tissue, with the endothelial side downward. The air also presses the donor tissue up against the patient's cornea. I allow the air to completely fill the anterior chamber so that the eye is firm for 8 minutes, and then I remove the majority of the air so the eye will not experience pupillary block.

The biggest challenge with DSAEK/DSEK, is a dislocation of the donor tissue in the early postoperative period. My colleagues and I have greatly reduced the donor detachment rate by draining fluid from the donor/recipient graft interface while the eye is completely filled with air.[6] I use a 15º blade to make four incisions at the 3-, 6-, 9-, and 12-o'clock positions in the midperipheral cornea overlying the donor tissue.

If the donor tissue does become detached, I can reposition it by injecting another air bubble. In our last 100 cases, the incidence of secondary air injection to reattach an unexplained donor dislocation was 1%. Our rate of primary donor failure was also 1%.

POSTOPERATIVE CARE

The course of postoperative care for DSAEK/DSEK is similar to that for PKP. Patient rejection of the graft is always a possibility. Because DSAEK/DSEK eliminates most ocular surface-related problems, however, graft survival rates may be better than with PKP. When failure does occur, the graft is much easier to replace than after a failed PKP. Other than rejection, the primary postoperative concern with DSAEK/DSEK is elevated IOP related to antirejection steroid therapy.

Although our techniques are slightly different, we have both found the results of DSAEK/DSEK to be so superior to penetrating keratoplasty as to render that procedure obsolete for patients with endothelial failure. We strongly encourage other surgeons to take a course in posterior grafting surgery and begin the real but relatively short learning curve for this procedure. ■

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