Maximizing the Results of DSAEK

DSAEK is the current frontier of endothelial replacement. Maximizing its success is in the surgical details.

BY MARK S. GOROVOY, MD

The adage "less is more" is apropos in many fields of surgery, and it is certainly applicable to corneal transplantation. Focused replacement of the diseased corneal layer(s), rather than wholesale tissue replacement, leads to a more physiological end result. Successful functioning of the cornea relies on both its clarity and shape—a concept that endothelial keratoplasty techniques have exploited.[1] Specifically, Descemet's stripping automated endothelial keratoplasty (DSAEK) has replaced penetrating keratoplasty (PKP) as the procedure of choice for corneal endothelial dysfunction.[2] By eliminating all manual lamellar dissections, DSAEK has improved the technique, consistency, and visual results of corneal transplantation.[3] A more focused procedure, Descemet's stripping endothelial keratoplasty (DSEK), appears to further increase the visual results but at the expense of skill and consistency. DSEK is therefore unlikely to replace DSAEK as the dominant procedure at this time.[4]

The final frontier to achieving the most physiological anatomy in corneal transplantation will be the replacement of surgery with biological remedies to heal diseased endothelium. The future is bright in the battle against common corneal diseases (eg, Fuchs dystrophy, bullous keratopathy, failed grafts, iridocorneal endothelial syndrome) and other less common diseases. DSAEK is the present frontier, however, and with any surgical technique, maximizing success is in the details (Figures 1-11). In this article, I will attempt to address those details.

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EXPECTED SURGICAL OUTCOMES

I counsel my patients that 85% of my DSAEK eyes achieve a BSCVA of 20/40 at 6 weeks, assuming they have no other comorbid ocular disease. By 3 months, 95% of my patients achieve this acuity. Fifteen percent

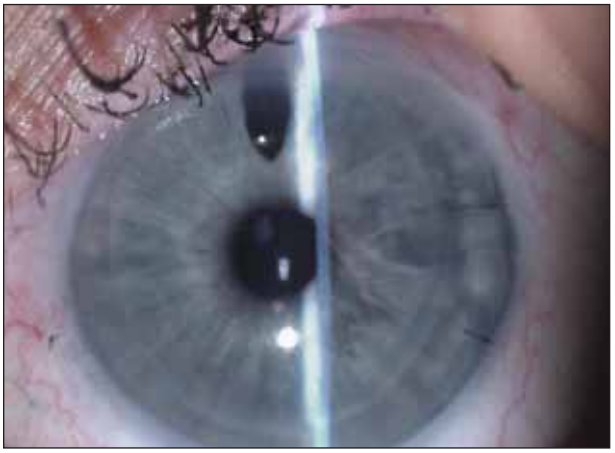

Figure 1. IOL exchange and a sutured PCIOL after DSAEK.

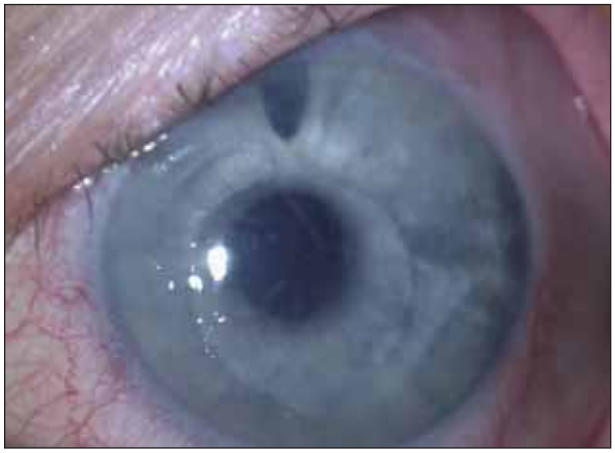

Figure 2. Pseudophakic bullous keratopathy with an ACIOL.

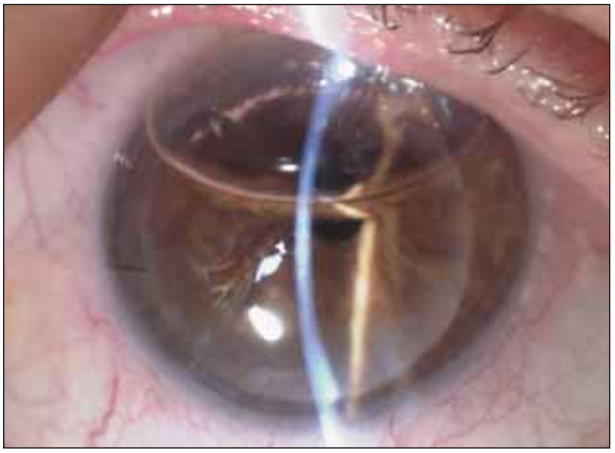

Figure 3. A rebubbled donor 1 day later.

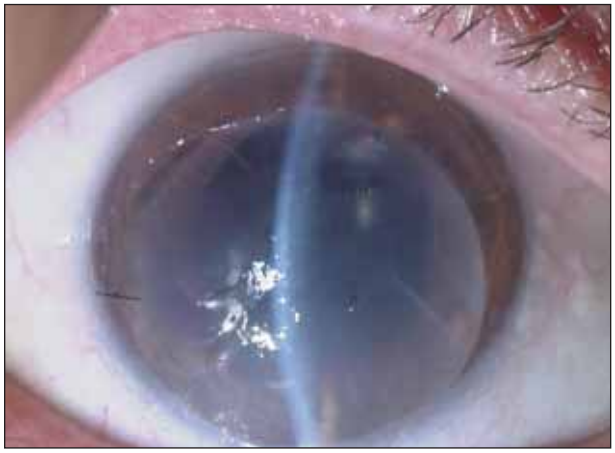

Figure 4. A dislocated donor.

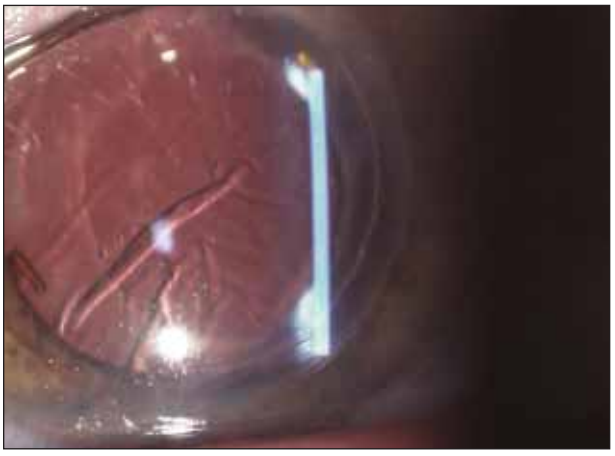

Figure 5. Poor BSCVA secondary to the donor's straie.

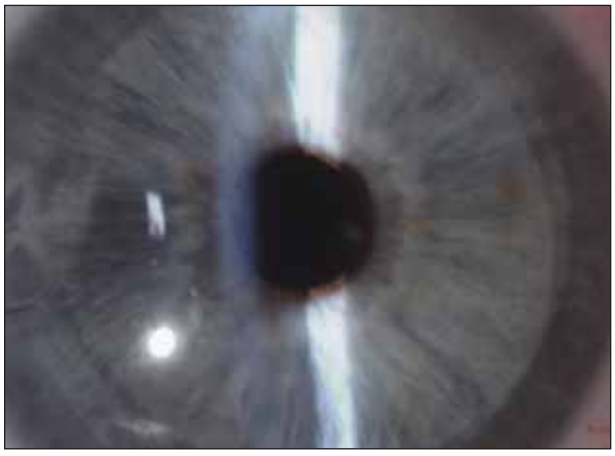

Figure 6. After DSAEK. This happy patient saw 20/40 at 6 weeks.

will reach 20/20, and 90% of these patients will see 20/30 or better by 6 months. These patients' postoperative BSCVA continues to improve with each passing year, which indicates active favorable interface remodeling. I thoroughly investigate patients who are not hitting those early milestones and do not have obviously compromised clarity for common comorbid diseases such as cystoid macular edema and serous macular detachment. I advise these individuals to delay DSAEK surgery on their second eye until their first eye's visual function is equal or better than that of the unoperated eye. Frequently, patients schedule surgery on their second eye in the early postoperative weeks, even if their new Snellen acuity is less than that of the virgin eye. This trend indicates that Snellen measurements do not always fairly represent visual quality.

A somewhat predictable hyperopic shift of approximately 1.50 D occurs in DSAEK eyes postoperatively and then seems to stabilize by 3 months. I highly recommend compensating for this secondary hyperopia in phakic patients with either staged or simultaneous lenticular surgery. I also recommend selecting a non-aspheric or zero-aberration IOL to avoid increasing the negative corneal asphericity the DSAEK donor induces (similar to the recommendations for eyes having undergone hyperopic LASIK or PRK). Refractive laser correction is successful in patients who request spectacle-free vision, but I recommend taking a conservative approach and delaying this enhancement until 1 year postoperatively to maximize their refractive stability.

PATIENTS' SELECTION

Fuchs' dystrophy causes visual disability that is incongruent with patients' Snellen acuity. Individuals with Fuchs' dystrophy should be counseled similarly to those with posterior subcapsular cataracts—that is,

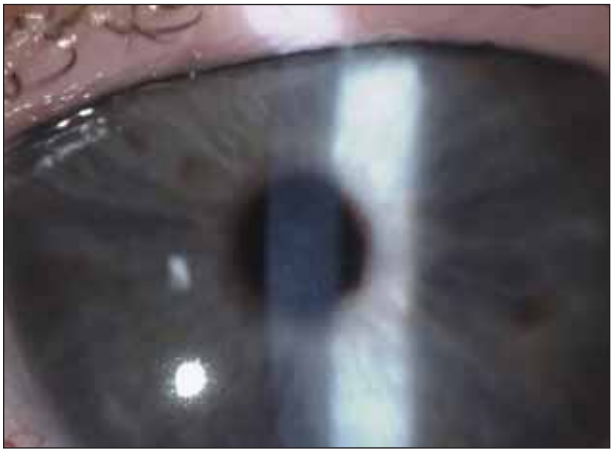

Figure 7. Second eye of patient in Figure 6, 20/40 and requesting surgery.

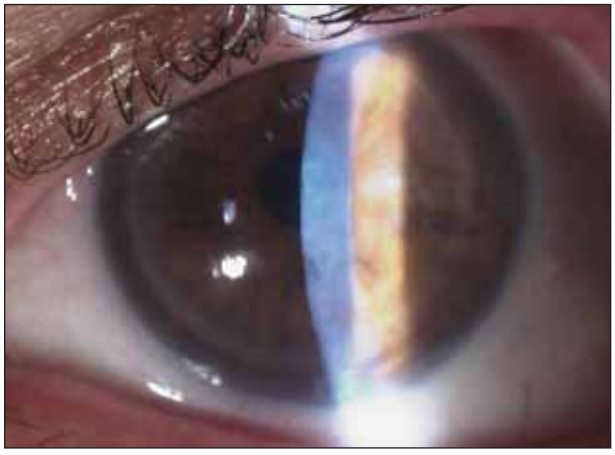

Figure 8. Postoperative subepithelial scarring.

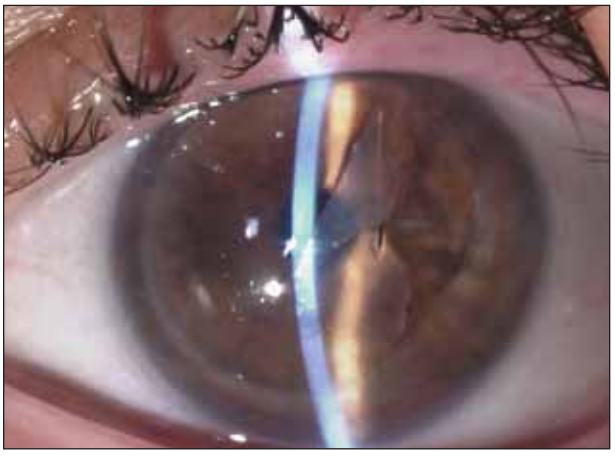

Figure 9. Stripping of postoperative scarring in same patient.

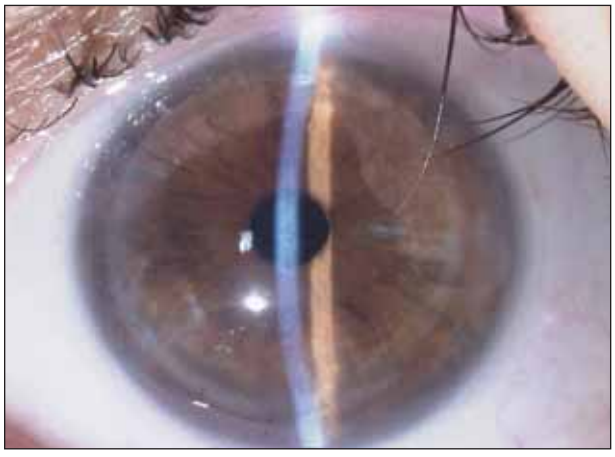

Figure 10. Postoperative result of 20/25 in the same patient.

allow the patient to decide when to request surgery based on his or her symptoms, not a specific acuity measurement. My experience is that even the most dense guttata plaques without frank edema reduce Snellen acuity to the 20/50 range. If the acuity is significantly worse than 20/50, I diligently seek to identify other pathology that will need additional treatment, or at the very least, I counsel the patient regarding appropriate expectations. Allowing frank bullous keratopathy to develop will induce subepithelial fibrosis that may require debridement and potentially slow the pace of visual recovery. With few exceptions, I strongly recommend against performing DSAEK in phakic eyes, even ones with clear lenses.

Patients with pseudophakic bullous keratopathy should receive a well-positioned PCIOL. I strongly suggest replacing all ACIOLs with PCIOLs prior to performing DSAEK. My preference is a sclerally sutured PCIOL in eyes without capsular support. Aphakic eyes without obvious IOL contraindications see better with a secondary PCIOL sutured to the sulcus or sclera. Also, iris repair is often helpful in aphakic eyes that have large-sector iridectomies.

In an eye with a glaucoma shunt, it is crucial to locate the device prior to performing DSAEK. If the shunt is located too anteriorly, it will impede the donor's unfolding and damage the endothelium. The surgeon may need to reposition the shunt deeper in the anterior chamber, behind the iris or pars plana. The length of a shunt is rarely a problem if its position is deep enough.

Patients who have had a failed PKP usually respond well to DSAEK if their prefailure visual acuity was good. DSAEK will not improve vision that was poor prior to a graft's failure or secondary to regular or irregular refractive issues, so those patients are better served with repeat PKP. Attention to preexisting issues in the anteri-

or segment is vital to operative anatomical success. Interestingly, greater clinical experience has shown that the success of repeat DSAEK procedures is comparable to that of primary surgeries, even in late-term failures years out.[5]

SURGICAL DETAILS

That "the devil is in the details" is an inescapable fact of surgery. Maximizing the potential of any procedure involves solid surgical fundamentals as well as avoiding the pitfalls.

The Donor

There is no longer a difference in quality between surgeon-cut versus eye bank-cut donor tissue. The thickness of donor corneas has no relationship to postoperative BSCVA, in spite of some false innuendos that suggested otherwise.[6] I believe this misinformation originates from two false assumptions. The first is that light that travels through thicker corneas is diminished by a longer stromal path. This hypothesis is clearly false, as evident in normal corneas (480-640 µm) without increased thickness secondary to edema and in DSAEK eyes (500-900 µm).[6] The second assumption is that since the advent of DSEK, the thinnest of all possible donors results in the best BSCVA; therefore, thinner should be better. This observation is similar to the outcomes seen with big-bubble deep anterior lamellar keratoplasty. Procedures that leave bare Descemet's membrane, totally devoid of residual stroma, whether it be a 1- or 100-µm layer, will have the smoothest interface and result in the best BSCVA. Any residual stroma, regardless of thickness, will undergo stromal-stromal interface remodeling that results in a rougher interface than a stromal-Descemet's interface. Modifications to donor harvesting that produce very thin donors (≤ 75 µm) are pointless. The range should be 100 to 150 µm, but the exact measurement is less important than expected. In fact, I cut all my donor corneas without any pre- or postcutting measurements!

As described previously, the size of the donor cornea is unrelated to posttransplant BSCVA. The central cornea must have the guttata removed and covered by a reasonably centered donor (a perfectly circular donor is also not a requirement). Even though it results in irregular donor shapes, thick donor edges from decentered cuts should be recut to avoid epithelial implantation. Descemet's stripping can be skipped if no guttata is present (this is recommended in failed PKP eyes to avoid reducing the wound's integrity). Peeling the pupillary Descemet's membrane without mechanical scraping avoids central stromal excoriations, which can result in interface scars and reduced BSCVA. My typical donor size is 8.75 to 9.0 mm.

Figure 11. An eye patient with poor centration of the donor.

Wound Size

Although I prefer a 3.2-mm clear corneal wound, typically, a 5-mm wound is ideal to reduce endothelial cell loss from the donor's insertion with forceps.[7] Many of the insertional devices require a similarly sized wound. The goal is safe insertion, and the incision's size has minimal, if any, effect on BSCVA, although it does have an effect on the donor's endothelial counts.

The Air Bubble

The tension of the air bubble is the most critical step in the adhesion of the corneal donor, as well as the cause of the most harm. For example, pupillary block is the most dreaded preventable complication and the most common etiology of permanent visual loss. Failed DSAEKs can safely be repeated, but the sequelae of optic atrophy and loss of iris function with synchiaie are often irreversible in the setting of an acute block.

My technique involves creating an air bubble in the entire anterior chamber, leaving it for 1 hour, and then burping the bubble at the slit lamp until it clears the bottom of the pupillary edge. I do not send the patient home until I am 100% sure of the bubble-pupil relationship. I then instruct the patient not to bend over for 24 hours to prevent the residual bubble from migrating behind the pupil and causing a limited iris-corneal touch.

Centration

Surgical centration of the donor cornea is an important surgical step, although perfect centration is not necessary. The centration of the donor tissue should be enough to ensure sufficient coverage of the pupil and no angle touch. Manipulating the donor's position

can induce striae in the donor, which will diminish the visual outcome. I prefer limbal ballottement to position the donor, but many times I will rotate the donor into place through venting incisions. This step, aside from the donor's unfolding, requires the most patience and experience. I never manipulate the graft from the endothelial side.

Rebubbling

Even in the best hands, donor dislocations will occur; the goal is less than 5% in routine cases. Although donor dislocations are not an emergency, as the donor is bathed in its natural environment, I typically perform immediate rebubbling in the office and repeat the same last steps as in the original surgery. While rebubbling may affect cell counts from increased manipulations, if done properly, it will not adversely affect the graft's clarity. I find that grafts that are very edematous on day 1, even if they appear well centered, are actually dislocated, and I am quick to rebubble. By the next day, I expect significant clearing.

CONCLUSION

Even the most experienced corneal surgeons must overcome the learning curve in order to master this new procedure. Undertaking an OR course and obtaining a mentor are very helpful in mastering the DSAEK technique. The basics of DSAEK are constant, yet there are several surgical variations on each step of the procedure, not unlike phacoemulsification, with its multiple iterations of nuclear disassembly. The surgical steps of stripping, donor insertion and unfolding, centration, and air bubbling must be performed precisely. The obvious rewards of a successful DSAEK procedure to both the patient and the surgeon have resulted in its replacing PKP as the new standard of care for endothelial corneal disease—in less than 5 years! ■

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curvature in all cases, but the transplant exchange induced a variable refractive change at the posterior corneal surface. Researchers concluded that, when managing DSEK cases with poor visual outcomes, secondary DMEK may lead to full visual rehabilitation, as in primary DMEK.[8]

DMAEK

Researchers described the surgical technique and possible outcome of DMAEK. They claimed the procedure combines the "superior vision potential" of DMEK with the "easier insertion and manipulation" of DSAEK. They added that DMEK has a steep learning curve in terms of the tissue's preparation and that there is a risk of tissue loss.[9]

In a prospective, nonrandomized study, 24 eyes that underwent DMAEK and 22 eyes that underwent DMEK were evaluated for corrected distance acuity, full visual field testing, and pupillary size. Investigators used slit-lamp photographs to measure the inner and outer diameters of the DMAEK stromal ring. Additionally, patients completed a questionnaire rating postoperative symptoms and visual complaints. Mean postoperative follow-up time was 5 months in the DMAEK and 14 months in the DMEK group. At follow-up visits, mean visual acuity was 20/25 in the DMAEK group and 20/20-3 in the DMEK group. The mean central opening of the DMAEK stromal ring was 5.6 X 5.5 mm. The incidence of visual field defects (including visual complaints of glare, halos, light sensitivity, and night driving difficulties) was comparable between groups ($P > .1$). A larger scotopic pupil was not associated with an increased incidence of visual field defects in either group ($P = .3$).[10] ■

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