Descemet-stripping automated endothelial keratoplasty (DSEK) has become the procedure of choice to treat corneal endothelial dysfunction. The technique involves replacing the diseased host endothelium with a graft consisting of a thin layer of posterior stroma, Descemet membrane, and endothelium. In comparison to penetrating keratoplasty (PK), DSEK confers quicker visual and structural recovery with absence of corneal surface incisions or sutures, and limits astigmatism. DSEK has been proved to successfully achieve favorable visual acuity and graft clarity in bullous keratopathy, posterior polymorphous dystrophy, and failed PK grafts. This article discusses various DSAEK surgical techniques, short- and long-term post-surgical results, complications, and comparisons with other types of keratoplasty. With the advent of Descemet membrane endothelial keratoplasty (DMEK), in which only Descemet membrane is transplanted, visual rehabilitation may be attained sooner.

**Keywords**
Descemet-stripping automated endothelial keratoplasty (DSEK), Descemet-stripping endothelial keratoplasty (DSEK), corneal transplantation

**Technique**
**Donor Dissection**
In DSAEK, the graft is dissected with a microkeratome. In a randomized, prospective, double-masked clinical trial, Price et al. found that manually dissected grafts and eye bank pre-cut grafts possessed similar endothelial cell loss, visual and refractive outcomes, and detachment rates. 

**Indications**
DSEK/DSEK has been described to successfully achieve favorable visual acuity and graft clarity in bullous keratopathy secondary to Fuch’s dystrophy, cataract surgery, posterior polymorphous dystrophy, iridocorneal endothelial (ICE) syndrome, and failed PK grafts. Although visual rehabilitation after DSAEK is quicker than with PK, the endothelial cell loss is higher (20–57% at six-month and one-year follow-up). 

Various studies reported best-corrected visual acuity (BCVA) >20/40 (logMAR 0.3) ranging from 28 to 100% at six-months1,12,14,15,16 and 66 to 100% at one-year.1,5,14 BCVA >20/25 (0.1) was also noted to range from 0 to 20% at both six months12,14,15,16 and one year.1,5

Grafts stored with anterior lamellar corneal tissue (ALCT)-on corneas had less endothelial damage and edema than those stored without the stroma for 24 hours in Optisol GS. This is thought to be due to the
Bowman layer barrier preventing edema and a loose Descemet membrane that could easily detach from stroma. Central anterior cap thickness of pre-cut grafts were compared and found to be dependent on depth plate, eye bank, and pre-dissection thickness. As with laser in situ keratomileusis (LASIK) flap thickness, thicker corneas led to deeper cuts. Thickness and curvature coefficient derived from the graft thickness profile are known to alter refractive shift.

Femtosecond laser is another modality used to cut DSAEK grafts. The laser performed deep posterior stromal ablations to achieve accurate, intended measurements of corneal thickness and diameter of corneal buttons in an ex vivo study. Femtosecond-cut grafts are purported to produce minimal change in refractive astigmatism and cause a mild hyperopic shift in refraction.

Surgical Technique and Donor Positioning

In DSAEK, the diseased endothelium is replaced with a graft consisting of a thin layer of posterior stroma, Descemet membrane, and endothelium. Atraumatic graft insertion is one of the main challenges. The techniques involve pushing or pulling the graft into the anterior chamber. Initially, graft insertion was performed using McPherson forceps to position a folded donor posterior corneal disk into a taco-like formation over a plastic glide into the recipient anterior chamber. Busin described a technique in which the donor tissue is pulled into the anterior chamber with a microincision forceps through the opposite limbus to reduce trauma to the graft and limit endothelial loss compared with forceps insertion. Using a 10-0 monofilament suture on a long straight needle to pull the graft through is another technique that was found to have similar post-operative visual acuity, complications, and endothelial cell counts compared with forceps-assisted DSAEK. Needle graft insertion techniques are also cost-effective. Intraocular lens cartridges have also been used in ex vivo studies, where the graft is ‘rolled’ into a compact shape to avoid compressive, deleterious forces that occur from folding. Modifications of the glide and forceps techniques to reduce endothelial injury during insertion are currently under investigation.

Roughening the host peripheral stromal edges has demonstrated better graft adherence. Pre-soaking the grafts in balanced salt solution (BSS) has also significantly reduced graft detachment rates in DSAEK patients. LASIK rollers have been used to center donor grafts and remove interface fluid. Others have shown that air-fluid exchange can be used to control anterior chamber pressure and effectively tamponade the graft against the host stroma.

Combined Procedures

Combined procedures or ‘triple procedures’ include concomitant cataract extraction and intraocular lens (IOL) implantation with DSAEK. Intraocular lens calculations can be performed with consideration of the expected hyperopic shifts (1.25–1.50 diopters) that occur with DSAEK. In Fuchs’ dystrophy patients, statistical comparison of post-operative visual acuity showed no significant difference between those who underwent DSAEK only and those who had a triple procedure. The DSAEK-only group showed a larger hyperopic shift from the pre-operative spherical equivalent than the triple procedure group. No significant difference in endothelial cell loss between the two groups was noted. Iatrogenic graft failure or primary graft failure was defined as persistent post-operative corneal edema that failed to clear within two months in a well-apposed graft. This was not observed in either of the groups. Case reports of a triple procedure in Fuchs’ dystrophy patients involving anterior chamber IOL implantation have been successful in patients with an anterior chamber depth >3mm.
calcification).\(^{10,12}\) Decentered grafts with full-thickness corneal layers at one edge, or chronic stromal changes from chronic corneal edema.\(^{11,13}\) Cases of epithelial downgrowth have been treated successfully with lenticule exchange, mechanical scraping, and irrigation and aspiration of residual epithelial cells.\(^{14,15}\)

Other complications include pupillary block, steroid-induced glaucoma, suprachoroidal hemorrhage, infectious donor-to-host transmission of fungal pathogen, cystoid macular edema, and retinal detachment. Air bubble trauma to endothelial cells has also been described in an ex vivo study.\(^{17}\)

### Conclusion

Descemet membrane endothelial keratoplasty (DMEK) is under investigation.\(^{20}\) This procedure involves implantation of isolated Descemet membrane and endothelial cells in the host cornea through a self-sealing, 3.5mm clear corneal incision. A study of 50 DMEK procedures by Ham et al. conveyed promising results: >95% had BCVA better than 20/40 (>0.5); 75% had BCVA better than 20/25 (>0.8). They also showed faster visual rehabilitation (within one to three months) and less refractive shift.\(^{18}\) As these procedures are refined with innovative advances in tissue handling, the sole replacement of cultured endothelial cells, with faster visual rehabilitation, may be soon.\(^{19}\)