

The Role of the FS Laser in DSEK

The goal of femtosecond laser-assisted DSEK is to achieve a quality of vision comparable to or better than DSAEK.

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Full-thickness penetrating keratoplasty (PKP) has been the preferred corneal transplantation technique since the procedure was first described in 1905 by Eduard Zirm.¹ Today, PKP generally results in clear corneal grafts, with a graft survival rate of up to 72% at 5 years.² However, the procedure is frequently complicated by refractive imperfections and wound healing problems.

A significant number of patients may experience high irregular astigmatism and ametropia that cannot be optically rehabilitated with spectacles. Wound healing after PKP is often unstable and may lead to infection, vascularization, and wound dehiscence with risks for long-term graft survival. In 2005, the femtosecond laser was introduced to corneal transplantation surgery. This device is now used for lamellar and penetrating cut patterns and for posterior lamellar keratoplasty.

Several endothelial keratoplasty procedures, including posterior lamellar keratoplasty, nonmechanical posterior lamellar keratoplasty using the femtosecond laser, deep lamellar endothelial keratoplasty, Descemet's stripping endothelial keratoplasty (DSEK), Descemet's stripping automated endothelial keratoplasty (DSAEK), femtosecond laser-assisted DSEK, and Descemet's membrane endothelial keratoplasty, allow selective replacement of the diseased endothelial layer, retaining the healthy recipient anterior corneal stroma. Endothelial keratoplasty techniques result in rapid visual rehabilitation and minimal change in corneal astigmatism.³

FEMTOSECOND LASER-ASSISTED DSEK

In a previous *in vitro* study, we showed that the femtosecond laser can prepare a posterior lamellar disc (PLD) from whole donor eyes.⁴ Endothelial cell viability was not affected; preparation of the PLD with the laser resulted in minimal endothelial cell damage ($3.4\% \pm 3.5$).⁴ However, we should still be concerned with preventing cell loss that may be related to traumatic insertion techniques.

In December 2005, we performed the first femtosecond laser-assisted DSEK in a human eye (Figure 1).⁵ This was followed by a series of 20 patients with Fuchs endothelial dys-

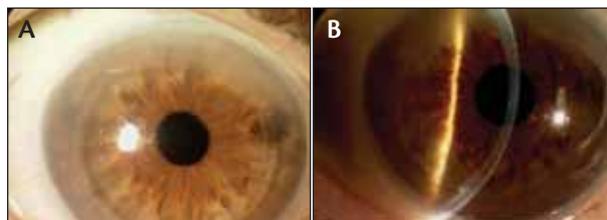


Figure 1. Slit-lamp photography 1 month after the authors' first femtosecond laser-assisted DSEK (A). The cornea is clear, and the posterior lamellar disc is well positioned (B).

trophy ($n = 11$) or aphakic/pseudophakic bullous keratopathy ($n = 9$).⁶ The PLD was prepared with the 30-kHz IntraLase femtosecond laser (Abbott Medical Optics Inc., Santa Ana, CA). The intended depth of the horizontal lamellar cut was $400 \mu\text{m}$, and the diameter was 9.5 mm . We used a raster spot pattern with an energy level of $1.4 \mu\text{J}$. In this first prospective series, the average BCVA improved from 20/110 at baseline to 20/57 at 6 months, and 50% of patients with normal visual potential showed an improvement of two lines or more. In a recent prospective randomized multicenter study, part of the Dutch Lamellar Corneal Transplantation Study (DLCTS), we evaluated femtosecond-assisted DSEK ($n = 36$) versus PKP ($n = 40$).⁷ At 12 months, the percentage of eyes with refractive astigmatism less than or equal to 3.00 D was higher in the femtosecond-assisted DSEK group compared with the PKP group (86.2% vs 51.3%; $P < .004$). Mean postoperative BCVA was $20/70 \pm 2$ lines in the femtosecond laser-assisted DSEK group and $20/44 \pm 2$ lines in the PKP group ($P < .001$). However, the difference in gain in BCVA between the two groups was not significantly different. Similar to DSAEK, the spherical equivalent was more hyperopic in the femtosecond-assisted DSEK group postoperatively because the button is thicker peripherally and thinner in the center (Figure 2). Topographic astigmatism was $1.58 \pm 1.20 \text{ D}$ in femtosecond-assisted DSEK eyes versus $3.67 \pm 1.80 \text{ D}$ in PKP eyes ($P < .001$).

The average BCVA in our femtosecond-assisted DSEK series was lower compared with our DSAEK series (unpublished data). Twelve months after DSAEK, the aver-

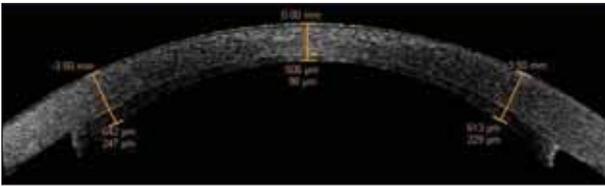


Figure 2. The thickness of the PLD 1 month after femtosecond-laser assisted DSEK using optical coherence tomography (Visante OCT; Carl Zeiss Meditec, Jena, Germany).

age BCVA was 20/32. Possible explanations for this difference in outcome are the quality of the interface at the stromal side of the PLD as prepared by the femtosecond laser and an increase in interface haze due to activation of keratocytes, resulting in more scatter. However, 3-year follow-up data in the femtosecond-assisted DSEK group shows an increase in BCVA up to 20/45 (Figure 3). This suggests that the quality of the interface may improve with time.

For endothelial disease, DSAEK is currently the gold standard because it leaves the anterior corneal surface intact, resulting in minimal change in induced astigmatism and fast visual recovery.⁸ In the past, high levels of endothelial cell loss (ranging from 50% to 60% after 6 to 12 months) were seen using a forceps technique to insert the PLD.⁹ However, recent insertion modifications using glides have decreased cell loss to 25%.¹⁰

In femtosecond-assisted DSEK, the goal is to improve the quality of the interface to achieve a quality of vision comparable to or better than DSAEK. Current research is directed toward the use of noncontact femtosecond laser technology with real-time optical coherence tomography to cut thin (< 100 μm) PLDs. In the near future, eye banks will produce custom-designed corneal grafts based on specifications provided by the corneal surgeon. The laser preparation of the donor tissue is automated and thereby reduces the technical difficulties and risks involved with the peroperative manual dissection of shaped and lamellar grafts. This will allow eye banks to control the quality of grafts after the femtosecond laser procedure, enhancing quality management of corneal transplantation.

Descemet's membrane endothelial keratoplasty is a difficult technique with high rates of dislocation and primary graft failure during the learning curve. Randomized clinical trials should provide us with evidence on whether the potential advantages of Descemet's membrane endothelial keratoplasty—faster visual recovery and better visual outcomes than DSAEK—outweigh the established safety and efficacy profile of DSAEK.¹¹

CONCLUSION

The field of corneal transplantation surgery is moving rapidly toward refractive outcomes more typical of

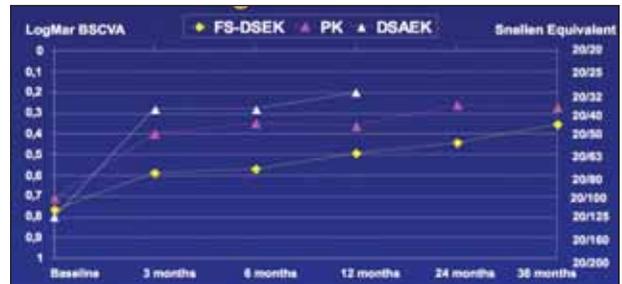


Figure 3. BCVA after femtosecond laser-assisted DSEK, PKP, and DSAEK.

refractive and cataract surgery. In 5 years, we might be applying outcome parameters, such as patients' satisfaction with UCVA to measure success after transplantation surgery. ■

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