With the recent explosion of keratoplasty techniques for the treatment of corneal diseases, determining when to perform cataract surgery in the setting of corneal disease is crucial for appropriate surgical planning. This article discusses considerations for deciding preoperatively whether cataract surgery should be performed before, during, or after endothelial keratoplasty (EK) or deep anterior lamellar keratoplasty (DALK).

SURGICAL CONSIDERATIONS: EK

Air bubble. The creation of an air bubble in the anterior chamber is an essential element of EK techniques including Descemet's stripping endothelial keratoplasty (DSEK), Descemet's membrane endothelial keratoplasty (DMEK), and their respective automated techniques (DSAEK and DMAEK). These air bubbles are cataractogenic, which is of concern in phakic eyes (Figure 1). Price et al reported that 37% of phakic patients undergoing DSAEK subsequently underwent cataract surgery, and that rates of cataract formation and subsequent removal were significantly higher in patients older than 50 years compared with younger patients.1 For more information, see their article on page 26.

Cataract surgery after EK. When cataract surgery is performed after EK, the risk of endothelial cell trauma and resulting graft failure are heightened compared with cataract surgery after penetrating keratoplasty (PKP). The posterior lamellar graft increases the total corneal thickness, decreases the anterior chamber depth, and places the donor endothelium closer to the phacoemulsification tip. Price et al found that 10% of eyes undergoing cataract surgery after DSAEK required repeat EK.1

Because of the risk for cataract development as a result of the anterior chamber air bubble, cataract surgery after EK should be reserved for rare situations. For example, cataract surgery after EK may be a viable option in young pre-presbyopic patients in whom premature loss of accommodation is undesirable or in eyes with endothelial disease in which the corneal view is too poor for safe cataract surgery. In my opinion, combined EK and cataract surgery or cataract surgery before EK is appropriate for the majority of patients.

Combined procedures. The main advantage of combining EK and cataract surgery is patient convenience.
Patients undergo only one surgery, attend fewer appointments, and deal with only one set of postoperative medications. Additionally, combining the procedures reduces costs for patients and insurance companies.

Although a combined surgical procedure is not significantly more complex than EK surgery alone, a few concerns must be addressed, especially for novice EK surgeons. For instance, the surgeon must be prepared for a decreased view secondary to guttae or haze (Figure 2), decreased anterior chamber stability, increased risk of IOL dislocation (intraoperative pupil miosis is often required), increased intraocular inflammation that may lead to increased endothelial cell damage, and a potential risk of problems with the anterior chamber air fill due to air diversion into the vitreous.

There are no hard-and-fast rules to determine when patients should have combined surgery versus cataract surgery alone; however, the patient’s preoperative history and examination are important tools for making this decision. Patients who report blurred vision upon awakening have corneal edema and are more likely to show corneal decompensation after cataract surgery alone. Specular microscopy may show an increased risk for corneal decompensation in severe cases in which the endothelial cell count is low, but this testing modality can be unpredictable in the presence of dense guttae. Corneal pachymetry has been suggested as a method for predicting corneal decompensation. Seitzman et al\(^2\) recommended cataract surgery alone for patients with central corneal pachymetry less than 640 µm. The authors based this recommendation on their visual recovery results and a decreased need for corneal transplantation in this group of patients.

**Target refraction.** The major advantages of cataract surgery before or combined with EK as opposed to cataract surgery before or combined with PKP include improvement in keratometric stability, decreased astigmatism after keratoplasty, and a reduction in IOL power errors due to better refractive outcomes.

The major disadvantages of combined procedures before the availability of EK were the unpredictable nature of keratometry values after PKP and the wide range of IOL implantation refractive errors. Prior to the introduction of EK procedures, poor postoperative refractive results, with as little as 26% of eyes within ±2.00 D of intended target refraction, were reported.\(^3\)

In the largest published review, EK was shown to routinely create a hyperopic refractive shift (range, 0.70 to 1.50 D; mean, 1.10 D) and induce minimal astigmatism (mean, 0.11 D).\(^4\) Taking these refractive considerations into account, surgeons planning cataract surgery before or combined with EK should aim for 1.00 to 1.25 D of myopia to achieve emmetropia.

**SURGICAL CONSIDERATIONS: DALK**

**Combined procedures.** Cataract surgery in the setting of DALK raises different concerns from those associated with EK. Simultaneous cataract surgery and DALK may increase the difficulty of the DALK dissection due to altered visualization from increased corneal edema after phacoemulsification, and decreased chamber stability due to the fresh incisions and pseudophakia. In particular, combining cataract surgery with DALK using the big-bubble technique can create a reduced rate of bubble formation from air escaping through the incisions or into the anterior chamber (Figure 3). The trephination process may also be complicated due to decreased anterior chamber integrity following phacoemulsification. For these reasons, I believe cataract removal either...
Cataract surgery before DALK involves the same refractive instability and unpredictable keratometry values as with PKP; therefore, predicting the lens implant power before DALK can present challenges. Studies of lens power calculations associated with keratoplasty have shown that an effective way of reducing postoperative ametropia is to perform keratoplasty first, followed by lens extraction and IOL implantation at a later date. Flowers et al reported 95% of patients within ±2.00 D of intended postoperative target refraction following PKP and cataract extraction with IOL placement performed secondarily.5

When cataract surgery is performed before DALK, the surgeon should make IOL power calculations using specific postoperative keratometric readings and regression formulas based on analyses of his or her own cases.

Cataract surgery after DALK. Cataract surgery after DALK should have the same predictability as after PKP, given that the suture techniques are similar between the two procedures; however, sutures may be removed sooner in DALK compared with PKP. This means that cataract removal can likely be performed sooner after DALK than after PKP.

Leccisotti et al reported cataract surgery after DALK to be safe, with an improvement of mean spherical equivalent from -8.69 D preoperatively to -0.97 D postoperatively and insignificant endothelial cell loss.6

However, cataract surgery following keratoplasty poses risks to the transplanted cornea, and graft failure is reported in 20% to 60% of eyes in this situation.4

In my experience, cataract surgery after DALK (with all sutures removed) provides the best predictability of refractive error. Donor endothelial cell protection must be optimal during phacoemulsification after DALK. The donor endothelium should be protected with a dispersive ophthalmic viscoelastic device throughout the phacoemulsification process to ensure maximal long-term viability of the graft and excellent refractive predictability.

CONCLUSION

Appropriate preoperative planning in cataract patients requiring lamellar keratoplasty, whether endothelial or anterior lamellar, remains crucial for outcomes in patients with concurrent corneal disease and visually significant cataracts. The main therapeutic goals are to provide patients with the best possible postoperative refractive outcomes while protecting the donor endothelium and ensuring long-term graft survival. To best achieve these goals, the timing of cataract surgery must be individualized to the corneal disease and the particular type of lamellar procedure chosen to restore vision.

Figure 3. Simultaneous cataract surgery and DALK can complicate some of the steps in the DALK technique, such as (A) air bubble injection into the posterior stroma and (B) appropriate dissection to Descemet’s membrane.

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