CASE REPORT

Phacoemulsification with intraocular pinhole implantation associated with Descemet membrane endothelial keratoplasty to treat failed full-thickness graft with dense cataract

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We present a case in which a different approach was used to treat an eye with dense cataract associated with an irregular failed full-thickness corneal graft. After cataract surgery, a foldable intraocular pinhole was implanted in the capsular bag to treat the irregular corneal astigmatism. Next, a Descemet membrane endothelial keratoplasty graft was used to improve transparency in the failed penetrating keratoplasty. This approach addressed the cataract, irregular cornea, and failed graft through a standard 2.2 mm clear corneal phacoemulsification incision, thus avoiding open-sky surgical time and expediting visual rehabilitation.

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Penetrating keratoplasty (PKP) has been widely used to treat advanced keratoconus over the years. It is known that although vision might fully recover initially, graft failure can occur after 20 to 30 years.[1,2] Traditionally, substituting a full-thickness graft is the treatment for such a condition. More recently, with introduction of endothelial keratoplasty, it is possible to salvage a failed graft with the replacement of the endothelium and Descemet membrane by Descemet-stripping automated endothelial keratoplasty (DSAEK) or Descemet membrane endothelial keratoplasty (DMEK).[3,4] These techniques, provide faster visual recovery with less induced astigmatism, preservation of ocular integrity, and no open-sky surgical time.

Anshu et al.[5] have shown that endothelial keratoplasty has a lower rejection rate than PKP and that DMEK has the lowest rate of the two techniques. Also, cataract surgery can be associated with this procedure to treat lens opacity at the time of the corneal surgery.[6] However, this approach is limited by the regularity of the anterior surface of the initial corneal graft. By transplanting only the posterior layers of the graft, existing irregular corneal astigmatism is not treated and vision can still be limited by it after the cornea clears. In such cases, rigid contact lenses might be required; however, when their use is not possible, a full-thickness graft might be required in an attempt to achieve better anterior surface regularity.

We published a new way of addressing corneal irregular astigmatism by using an intraocular pinhole device (Xtrafocus, Morcher GmbH).[7] This device was designed to be implanted in the ciliary sulcus in pseudophakic eyes. It is made of hydrophobic foldable acrylic with a 1.3 mm central opening and no dioptric power.

We present a case of a failed irregular corneal graft associated with dense cataract that was treated using a DMEK graft combined with cataract surgery and implantation of an intraocular pinhole. We believe this is the first reported case in which this approach was used.

CASE REPORT

A 63-year-old woman presented with reports of a progressive decrease of vision in the left eye over the past 2 years. She had a history of PKP in both eyes in the 1980s, to treat advance keratoconus; the PKP was performed elsewhere. The patient remarked that a new graft had to be placed in the right eye 1 year after the initial procedure because of graft failure resulting from endothelial rejection. The uncorrected and corrected vision in the right eye had been much better than in the left eye since the corneal graft surgeries. Although the patient was offered a new PKP in the left eye to improve her uncorrected vision, she refused. Contact lenses had been tested multiple times in the past. Although she reported an improvement in vision, she refused to keep wearing the lenses because of a lack of comfort. The uncorrected distance visual acuity (UDVA) was 20/200 and the uncorrected near visual acuity (UNVA) was Jaeger (J) 2 in the right eye, improving to

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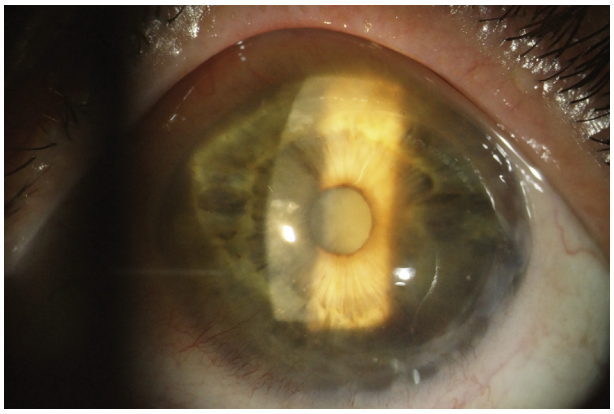

Figure 1. Preoperative biomicroscopy of the left eye.

20/60 with +3.00 −1.25 × 30. UCDVA in the left eye was counting fingers with no improvement with refraction. Anterior segment biomicroscopy showed a clear, well-centered corneal graft in the right eye with grade II nuclear lens opacity. The left eye had an edematous irregular graft associated with 360-degree thinning of the graft–host junction and dense cataract (Figure 1).

Fundoscopy of the right eye showed an attached retina with posterior vitreous detachment. The cup-to-disc ratio was 0.3. Lens opacity hindered posterior examination in the left eye; thus, a B-scan was performed, which showed no abnormality other than total vitreous detachment. The central corneal thickness, assessed using an ultrasound pachymeter (500 Pachette, DGH Technology, Inc.), was 626 µm in the right eye and 774 µm in the left. Corneal tomography (Pentacam HR, Oculus Optikgeräte GmbH,) showed an irregular and steep graft in the left eye with diffuse edema. The anterior corneal astigmatism was 18.3 diopters (D) according to simulated keratometry (Figure 2).

Scheimpflug image analysis showed a protruded graft with thinning of the graft–host junction. Biometry using optical laser interferometry (Lenstar, Haag-Streit AG) showed an elongated left eye (axial length [AL] 25.48 mm) with a very deep anterior chamber (5.11 mm). The intraocular lens (IOL) power calculation using the Holladay 1 formula recommended a −9.0 D monofocal acrylic IOL. After a discussion of the pros and cons, the patient gave informed consent for cataract removal with implantation of an intraocular pinhole in the capsular bag; the plan was to leave the ciliary sulcus open in case secondary implantation was needed to correct the implant power. This was to be followed by DMEK graft placement under the failed PKP. A neodymium:YAG laser inferior peripheral iridotomy was performed 1 day before surgery.

A single superonasal 2.2 mm clear corneal incision peripheral to the original graft–host junction was created. Trypan blue 0.1% was used to stain the anterior capsule. A capsulorhexis was performed with a diameter of approximately 5.5 mm in the usual manner. This was followed by phacoemulsification using the surgeon's preferred technique. After cortex removal, the bag was reinflated with a cohesive ophthalmic viscoelastic device (sodium hyaluronate 1.0% [Healon]). The intraocular pinhole was implanted in the capsular bag using an IOL cartridge (D cartridge, Alcon Laboratories, Inc.) through the same unenlarged incision used for cataract surgery (Figure 3).

Next, acetylcholine chloride (Miochol) was administered to promote pupil constriction. Two additional side-port incisions were created. Descemetorhexis was performed under air inside the previous graft, with care not to disturb the posterior aspect of the graft–host junction. A graft from a 61-year-old donor, which had been prestripped and pre-"F"-stamped to warrant right-side-up graft insertion, was then punched to 7.75 mm with a Barron corneal punch (Katena Products, Inc.). After Descemet peeling, the graft was stained with trypan blue 0.1% for 2 minutes and loaded in a glass pipette (Geuder AG). Graft implantation was performed through the main phacoemulsification incision, with unfolding and centration of the graft completed in less then 2 minutes (Figure 4).

Air was used to fixate the graft. Interrupted 10-0 nylon sutures were placed in the main incision and in the side ports. Intraocular pressure (IOP) was elevated to approximately 40 to 50 mm Hg for 10 minutes, and surgery was completed after pressure was reduced to physiologic levels, leaving a total air fill in the anterior chamber. Two hours after surgery, the patient was checked and the air bubble was above the inferior peripheral iridotomy; the IOP was 20 mm Hg, and the patient was discharged. On the following day, the patient had a 30% air fill of the anterior chamber and a very edematous cornea with an IOP of 14 mm Hg. Moxifloxacin–dexamethasone 0.1% (Vigadexa) drops every 2 hours were then prescribed. Five days later, the patient returned with worsening of the corneal edema. Anterior-segment optical coherence tomography (Visante, Carl Zeiss Meditec AG) was performed and showed a subtotal graft detachment with inferior edge curling (Figure 5).

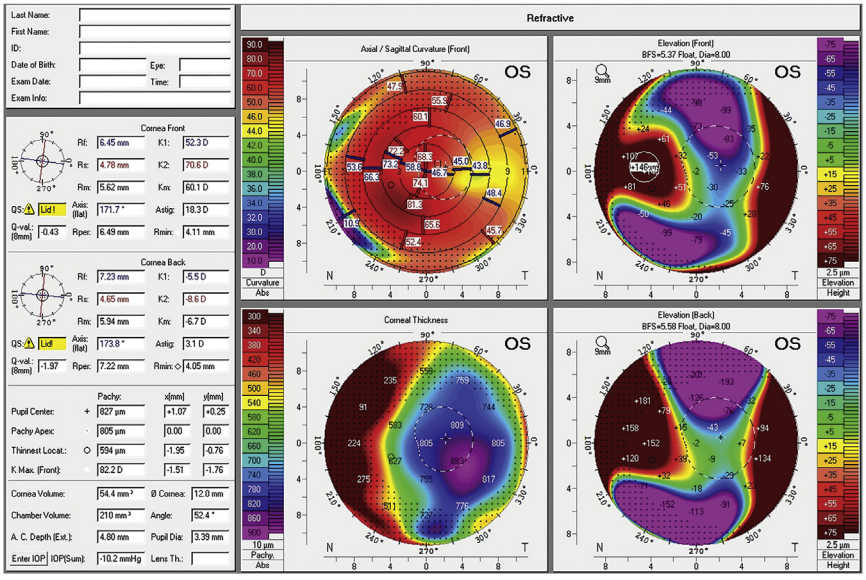

Figure 2. Scheimpflug corneal tomography shows a very irregular left cornea.

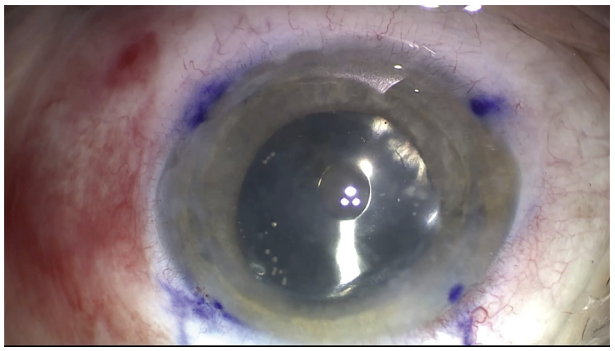

Figure 3. Intraocular pinhole implanted in the capsular bag. Note the overlapping edges of the anterior capsulorhexis.

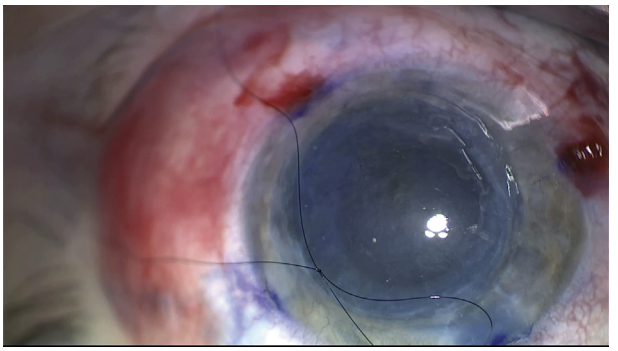

Figure 4. The DMEK graft opened in the anterior chamber before air tamponade (DMEK = Descemet membrane endothelial keratoplasty).

A re-bubble was performed on the same day under the operating microscope, and more sutures were placed to ensure a proper wound sealing. Three days later, a 50% air-filled anterior chamber was noted with a partially exposed intraocular pinhole. At this visit, the cornea was much clearer. The patient's UDVA was 20/100, and the IOP was 15 mm Hg. Twenty-one days after the original surgery, the patient returned reporting significant improvement in vision. The UDVA was 20/60, the UNVA was J3, and the corrected distance visual acuity was 20/40 with -3.00 -6.00×120. Dexamethasone 0.1% (Maxidex) 4 times a day was prescribed, and the moxifloxacin was stopped. By 3 months after surgery, the UDVA had improved to 20/40 and the UNVA to J2 (Figure 6). The CDVA was 20/30 with -4.00 -6.00×130. The endothelial cell count was 1571 cells/mm^2.

DISCUSSION

Endothelial keratoplasty has revolutionized the treatment of corneal endothelial disfunction. By selectively replacing endothelium and preserving the anterior layers of the cornea, globe integrity is preserved, less astigmatism is induced, the wound size is decreased, and the visual rehabilitation is faster. Previous PKP failures are traditionally addressed by replacing the entire graft; however, newer studies[3,4] have shown the safety and efficacy of salvaging the graft with a DSAEK or DMEK graft. However, when endothelium dysfunction is associated with irregular corneal astigmatism resulting from surface irregularity, the advantages of endothelial keratoplasty might not compensate for the limited vision imposed by this condition. Rigid contact lenses can be used; however, intolerance to the lenses and difficulty in handing them can negate their benefits.

We presented a case in which a failed full thickness irregular corneal graft was associated with a dense nuclear cataract in a 63 year-old patient. After cataract was removed using the standard phacoemulsification technique, an intraocular pinhole was implanted in the capsular bag as a primary lens. Due to the long axial length and high corneal curvature, the calculated IOL power was -9.0 D. However, lens power calculation can be challenging in eyes with irregular corneas and an unpredictable result is often encountered. Thus, we decided to address, along with the corneal graft, the cataract and irregular astigmatism at a first stage while keeping the ciliary sulcus open and free for a new implant in case it was needed at a later time. That way, after clearing of the edematous graft and decreasing aperture size, the IOL power could be better guided with the help of subjective refraction. Also, by doing that, if a full thickness graft is needed in the future IOL power adjustments can be performed more easily by implanting a secondary IOL in the sulcus.

This intraocular pinhole device was designed to be implanted as a secondary "lens" in the ciliary sulcus in pseudophakic eyes. Thus, it has a slightly larger overall diameter (14.0 mm) than most IOLs to allow better sulcus centration. However, because of its slim profile, it was easy to place in the capsular bag as a sole implant. It also has very thin, well-polished haptics to prevent uveal tissue damage, and the capsular bag accommodated the haptics well. Surgery was uneventful, and a well-centered DMEK graft with a well-placed intraocular pinhole was achieved.

Graft detachment is known to occur more frequently when endothelial keratoplasty is performed under a

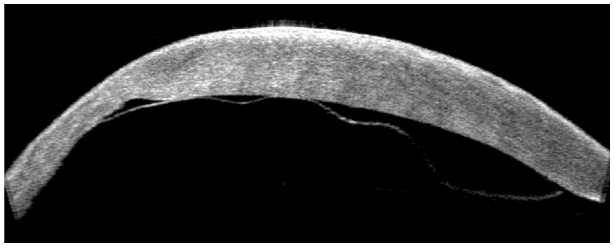

Figure 5. Anterior segment optical coherence tomography. Note the large graft detachment involved almost the entire graft.

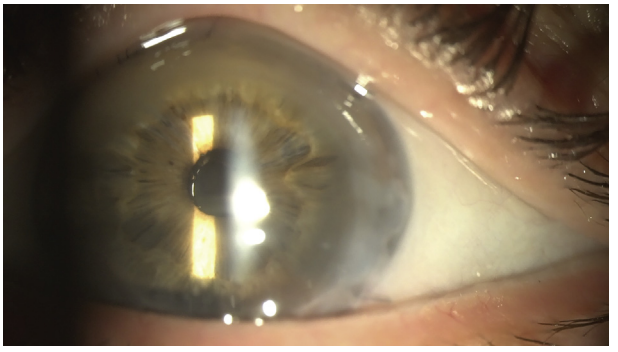

Figure 6. Three-month postoperative biomicroscopy. Note the resolution of corneal edema and the well-centered intraocular pinhole.

previous PKP; the incidence is as high as 36%.[4] In our case, the graft had to be re-bubbled 5 days after surgery because of an extensive graft detachment with curling of the inferior edge. Full attachment occurred 3 days after the air in the anterior chamber had totally absorbed.

By using a small-aperture device, we minimized the impact of higher-order aberrations caused by the irregularity of the previous graft and increased image quality. Combining this device with a DMEK graft visually rehabilitated the eye in a safer and more predictable method of regrafting. The presence of the central opening of the intraocular pinhole did not interfere with the air bubble in terms of its size or displacement into the posterior chamber. Surgery was performed through small incisions without enlarging the original main phacoemulsification incision.

Further studies are needed to address the long-term safety and stability of this technique. In addition, combining it with an endothelial graft might result in a different rate of endothelial cell loss. However, our initial good results in treating irregular corneal astigmatism with the intraocular pinhole led us to expand its applications. We believe this technology can be combined with other procedures to improve visual rehabilitation in challenging scenarios such as the one we describe here.

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Disclosures: *Dr. C.L.C. Trindade holds a patent for the intraocular pinhole device and has a license contract with Morcher GmbH. None of the other authors has a financial or proprietary interest in any material or method mentioned.*

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