

# Endothelial Keratoplasty: Shortening the Learning Curve

EK has become the preferred method of treating Fuchs corneal dystrophy and bullous keratopathy.

**BY KENNETH A. BECKMAN, MD**

**E**ndothelial keratoplasty (EK) was first performed in the United States in 2000.<sup>1</sup> It is now becoming the treatment of choice for endothelial cell dysfunction associated with failed penetrating keratoplasty (PKP), Fuchs corneal dystrophy, and bullous keratopathy.<sup>2,3</sup> According to the Eye Bank Association of America website, Fuchs corneal dystrophy was the leading cause of keratoplasty in 2009, with 1,387 PKPs and 8,604 EKs performed. Endothelial disease consisting of Fuchs corneal dystrophy and corneal edema after cataract surgery was the indication for 40% of all keratoplasty procedures. Although 86% of keratoplasty procedures for Fuchs dystrophy were EK, procedures for edema after cataract surgery were fairly evenly split between EK and PKP.<sup>4</sup> EK differs significantly from PKP, and surgeons can find it difficult to transition from PKP to EK. This article describes my technique for EK, with my tips to shorten the learning curve and the procedural time and to increase the success rate.

## INCISION

The surgery may be done using a temporal or superior approach, depending on the surgeon's comfort and any anatomic factor that may compromise a particular approach. Although either a corneal or scleral incision may be used, I prefer the scleral incision for several reasons. A more posterior incision has a minimal astigmatic effect and often requires few if any sutures. Also, I find it is much easier to maintain an adequate air-fill with a scleral incision, which is the key to the procedure. In addition, because the scleral incision is easier to keep airtight, it also allows the luxury of making a slightly longer airtight incision (5.5 mm in my case). It has been

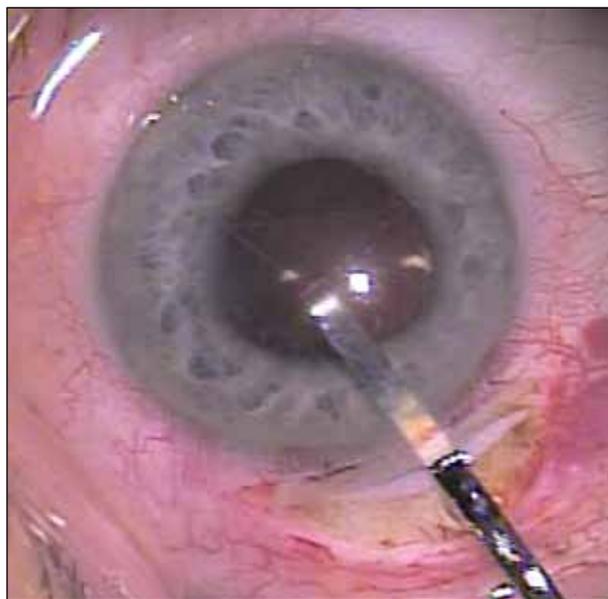
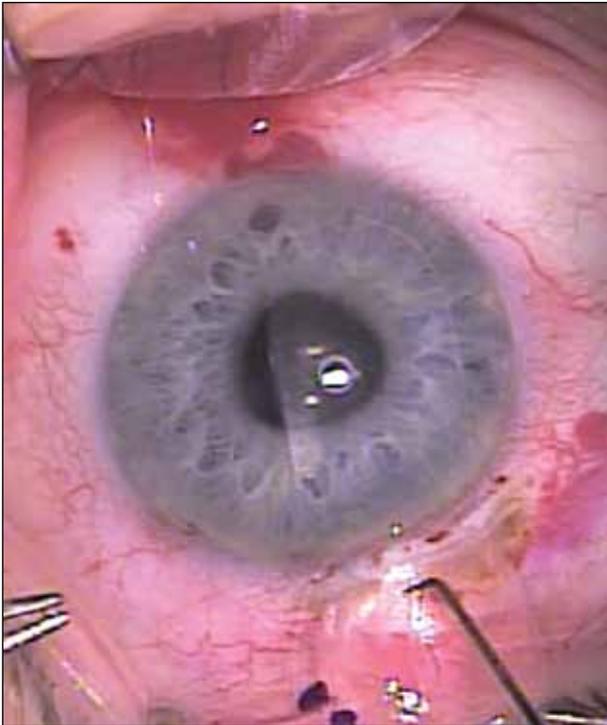


Figure 1. Stripping the corneal endothelium under viscoelastic.

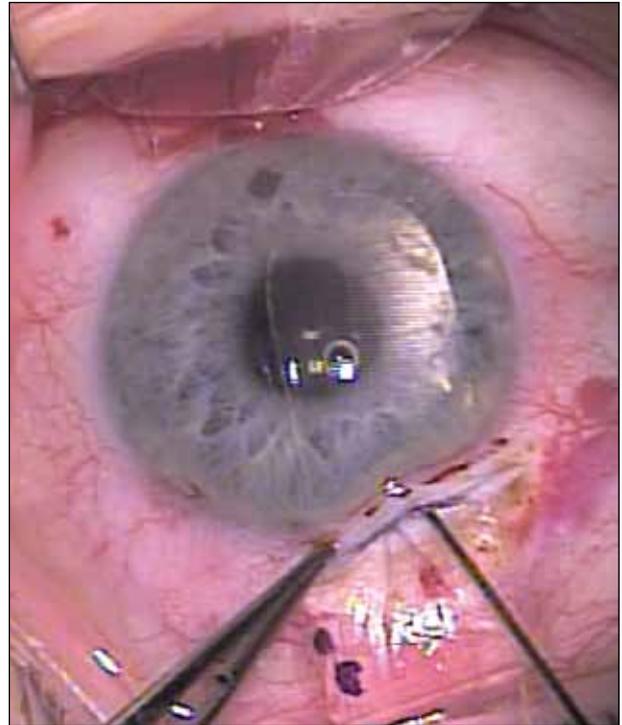
reported that smaller incisions may be associated with increased endothelial damage in the donor graft.<sup>1</sup>

## ENDOTHELIAL REMOVAL

Once the 5.5-mm-wide scleral tunnel is created, I enter the eye with a keratome. Next, I inflate the chamber with a cohesive viscoelastic. Initially, there was some concern over the potential for interface viscoelastic either to limit the ability of the donor button to attach or to cause postoperative haze. In my experience, adequate removal of the viscoelastic has prevented these problems. In contrast, I found that creating an additional



**Figure 2.** Initiating the insertion of the donor button with a bent 30-gauge needle.



**Figure 3.** Inserting the donor button with a bent 30-gauge needle.

port for the use of an anterior chamber maintainer, which is no longer necessary with the use of a viscoelastic, required an additional opening in the eye, making it more difficult to obtain an airtight seal.

The reverse Sinsky instrument is then used to score the endothelium at a diameter at least 0.5 mm smaller than the size of the donor button. Next, I use the endothelial stripper instrument to peel the endothelium and remove it from the eye (Figure 1). Trypan blue can be instilled either prior to scoring or after the endothelial removal to identify any endothelial remnants.

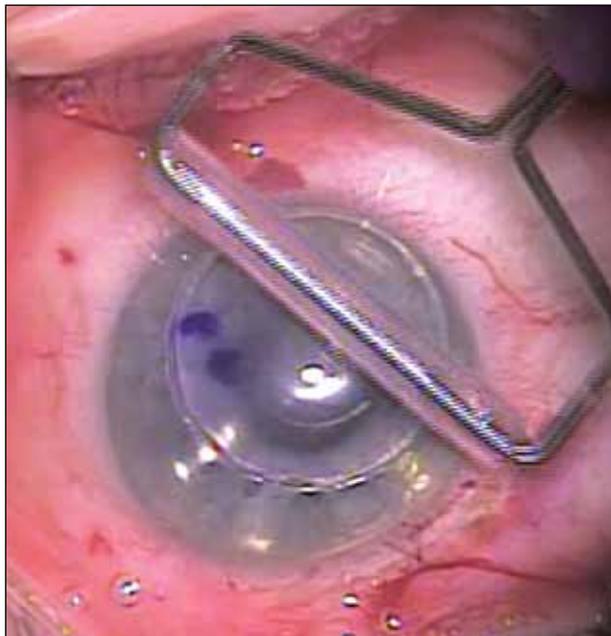
Before removing the viscoelastic, I place a paracentesis port at the 6-o'clock position with the keratome. This is usually airtight and almost never requires a suture. Next, I use a 0.12 forceps and scissors to place an iridectomy inferiorly. The iris tissue is then repositioned and rarely bleeds significantly. The iridectomy allows me to keep a complete air-fill at the end of the case. I find that a small laser iridotomy may not be adequate, because the surface tension created by the air bubble seems not to allow enough aqueous to flow through the iridotomy to prevent pupillary block. (I will discuss this point further later in the article.) I also typically place a paracentesis port, which may be used for air insertion, about 2 clock hours away from the main incision. The viscoelastic is then removed with I/A.

### **CORNEAL DONOR PREPARATION AND INSERTION**

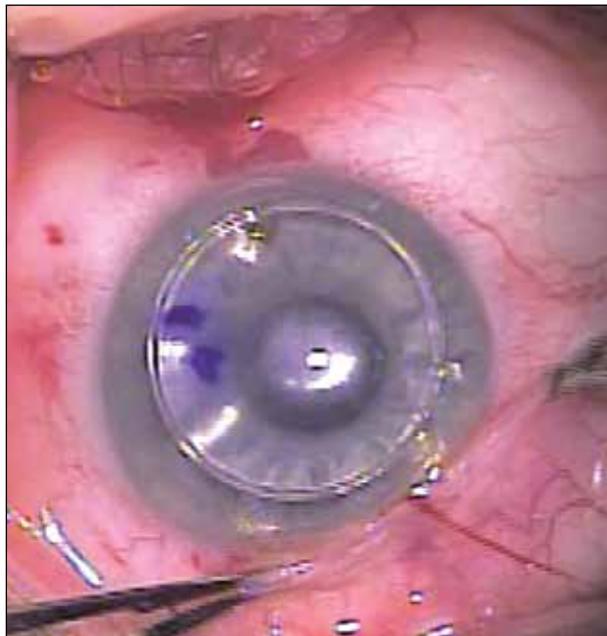
The donor corneas that I use are typically pre-cut at our local eye bank. Opinions vary as to the optimal thickness of the button. I find that the ultra-thin tissue tends to be more difficult to manipulate, so I feel concern about damaging the endothelium during insertion. I prefer a thickness of approximately 150  $\mu\text{m}$ , as this is easy to manipulate and still provides a good optical result. I recommend using a vacuum trephine when punching the donor button to ensure good centration. A decentered button may leave a rim of extra stromal tissue, which will need to be excised.

I then enlarge the incision to 5.5 mm. A Sheets glide is placed in the anterior chamber. The donor cornea is brought to the field. A small amount of viscoelastic is placed on the Sheets glide just outside the incision and on the endothelial surface of the donor. The donor button is then placed endothelial side down on the bed of viscoelastic. I use a bent 30-gauge needle on a syringe containing balanced salt solution to push the donor button into the anterior chamber (Figures 2 and 3). After removing the Sheets glide, I inflate the chamber with balanced salt solution.

There are many other means of insertion, including folding with forceps, injectors, and pull-through



**Figure 4.** A corneal roller is used to center the donor button and remove fluid from the interface.



**Figure 5.** Closing the conjunctiva with the graft in position and a complete air-fill.

techniques with a suture or forceps. I initially used the folding with forceps technique. Among the problems I noted was ensuring that the button did not flip over when unfolding. This may be prevented by keeping the top layer of the folded button longer than the bottom layer with a slight overhang, but it may be difficult to be certain when the patient's cornea is cloudy and visualization is poor. Moreover, it may be difficult to unfold the button at all, particularly with shallow chambers and ACIOLs. I have had cases where the button did not unfold but merely drifted into the angle while still folded. I then needed to unfold the button manually, which increased the endothelial risk. The use of injectors can work well, but it adds to the cost of the procedure.

#### **AIR-BUBBLE MANAGEMENT AND THE GRAFT'S POSITIONING**

Because the button is inserted in an open fashion, minimal unfolding of the edges is required, and the risk of the button's flipping over is negligible. At this point, a suture can be placed at the wound to facilitate the air bubble's placement, but this step may not be necessary. I then use a small cannula on a syringe filled with air to inflate the chamber. The tip of the cannula needs to be placed under the button and can be inserted through either the original wound or the paracentesis. If there is significant reflux of air during inflation, sutures can be placed. I often apply a small amount of viscoelastic over the wounds to create a barrier to air reflux, which usually suffices.

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**“Many surgeons may create a corneal venting incision in the interface, but I no longer feel this is necessary.”**

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Once a firm air-fill is obtained, the donor button is found pressed against the host cornea. I then roll a corneal roller over the corneal surface (Figure 4) to help center the donor button and remove any fluid from the interface. Many surgeons may create a corneal venting incision in the interface, but I no longer feel this is necessary. In my experience, even if a small amount of fluid is in the interface, it does not affect adherence when I use a complete air-fill. If the button does not move freely with the roller, a 27- or 30-gauge needle with a bent tip on a syringe filled with air can be inserted through the paracentesis to pull the button centrally. Injecting air during this step maintains the air-fill and keeps the eye firm.

The complete air-fill has been the most significant change in my EK technique to improve my outcomes. In the past, I left a complete air-fill for 20 minutes and then removed about half of the air. The problem I had with this technique was that, if too much air were left in, the patient could develop pupillary block. If too little air were left in, the cornea could detach. With

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the iridectomy’s placement, the risk of pupillary block was removed. Leaving a complete air-fill dramatically decreases the likelihood of button detachment. I have not found patients to have IOP problems on postoperative day 1. If the patient has already undergone a vitrectomy, has had a trabeculectomy, or has a tube shunt, the iridectomy is not necessary when leaving a complete air-fill. With the complete air-fill, the pressure from the air fill does not need to be very high to successfully attach the donor button.

I conclude the case by closing the conjunctiva with bipolar cautery (Figure 5), followed by subconjunctival injections of a steroid and antibiotic. I then apply one drop of atropine and brimonidine as well as an antibiotic and steroidal drop. The patient lies supine in the

recovery room for 30 minutes before sitting up. He or she is instructed to remain supine as much as possible until the postoperative visit the next day. Typically, a large air bubble remains, and I then instruct the patient to lie supine as much as possible for the first few days.

## CONCLUSION

EK has become the standard of care for the surgical treatment of Fuchs corneal dystrophy and bullous keratopathy. The steps described herein can shorten the learning curve for this procedure, leading to quicker surgeries and better outcomes. ■

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