Despite improvements in the refractive and anatomic results of penetrating keratoplasty (PKP), high post-PKP ametropia sometimes still occurs. Post-PKP ametropia can take the form of a high degree of spherical or cylindrical error or both.

Distortion of the topographic symmetry of the host cornea is one factor that may lead to a poor result. If the indication for PKP was keratoconus or pellucid marginal degeneration, the host cornea may be asymmetric; in this case, even a flawless PKP can have a poor astigmatic outcome. Suture adjustment may result in a good corneal shape initially but when the sutures are removed the graft tends to take the shape of the host.

The refractive characteristics of the donor graft can also contribute to an ametropic outcome. The cornea must be transparent, with a dense and regular endothelium and high endothelial cell count, and we must be sure that the donor had no known eye diseases. Even so, there are things we may not know regarding the refractive state of the donor cornea: Is the donor button flat, or is it steep? Was the overall corneal diameter small or large?

Another factor is the method used to cut the donor button. We can now cut donor buttons from the exterior side using an artificial anterior chamber. However, use of this device requires a large corneoscleral rim. If the donor tissue is supplied with only a narrow corneoscleral rim, it may be necessary to cut the donor button with a punch from the endothelial side, resulting in decreased accuracy of the cut, with the possibility of a less accurate refractive outcome.

A fourth factor is the level of surgical experience with suturing the graft. However, even surgeons with extensive PKP experience can have a poor result. In my own patients, sometimes the astigmatic outcome is good—less than 1.00 D or perhaps 0.50 D. In other patients, post-PKP astigmatism can be high.

A number of options exist for managing high ametropia after PKP. Incisional relaxation techniques include arcuate and transverse incisions, wedge resection, and trapezoidal keratotomy. Selective suture removal may correct astigmatism. Compression sutures are a reversible option in the event of late changes in refraction. In general, these manual procedures can have variable results in post-PKP eyes.

Another approach is reinforcing the cornea with intrastromal corneal ring segments, such as the Keraring (Mediphacos, Belo Horizonte, Brazil). I have recently performed one such case with a femtosecond laser (IntraLase; Abbott Medical Optics, Inc., Santa Ana, California). The patient’s astigmatism was greater than 12.00 D; the corneal graft was 15 years old. The intrastromal corneal ring segments decreased astigmatism by 2.00 to 3.00 D, and BCVA improved by one line. I am waiting for long-term results.

Some authors have described LASIK with a mechanical microkeratome to correct ametropia after PKP. Although these procedures yield improved refractions and clear grafts postoperatively, they may adversely affect corneal biomechanics. Even in eyes that have not undergone PKP, microkeratome-based procedures lower corneal hysteresis and corneal resistance factor.

LASIK with a mechanical microkeratome weakens the cornea. Because eyes with keratoconus already have weakened corneas (our own studies have shown that keratoconic eyes have low corneal hysteresis) LASIK with a microkeratome further weakens the structure. Additionally, part of the host cornea is cut along with the graft tissue when a mechanical microkeratome is used. The flap dimensions cannot be forced to stay within the limits of the transplant, as they can with a femtosecond laser. This results in distribution of forces across the boundaries of the corneal graft.

We should not perform LASIK in eyes with keratoconus or forme fruste keratoconus. I believe we should not perform blade-based LASIK in a patient with a corneal transplant because of severe keratoconus. The procedure will change the biomechanics of the host cornea.

IntraLASIK May Reduce Post-PKP Ametropia

Initial experience with this technique in eyes after penetrating keratoplasty is promising.

BY RACIHA BERIL KÜÇÜMEN, MD
cornea and weaken the graft, possibly leading to recurrent keratoconus or ectasia.

Femtosecond laser software is sophisticated, so we now have a device capable of creating a LASIK flap that lies entirely within the borders of a corneal graft. This makes IntraLASIK—that is, LASIK with femtosecond laser flap creation using the IntraLase—potentially a promising treatment option for residual ametropia after PKP.

We reported IntraLASIK results in three patients with postkeratoplasty ametropia. No intra- or postoperative complications were seen, and we concluded that IntraLASIK is an accurate and promising method for correcting postkeratoplasty ametropia. Since those three initial cases, we have used the same technique in additional patients; results will be reported in a subsequent publication.

IntraLASIK is not for every patient with ametropia after PKP. We use it only when the patient has very high astigmatism and ametropia, when glasses or contact lenses cannot be tolerated, and when the patient is unhappy with his quality of life. We wait until all PKP sutures are removed and ensure that the refraction is stabilized and there is no evidence of wound dehiscence or graft rejection. The graft must be stable, with good topography and biomechanics.

The surgeon can visualize the location and dimensions of the flap borders and adjust them using the IntraLase software. The localization of the flap is the most important aspect of the procedure. The flap must be slightly smaller than the diameter of the graft, and one must be careful that the edge of the transplant is not cut. Flap depth is also set at this time, depending on central corneal pachymetry.

In our series, the mean flap diameter was 7.93 mm and the mean flap depth 113.33 µm. A superior hinge was used in all cases, and the flap was created using a raster pattern.

After application of the femtosecond laser, the vacuum ring is removed. We waited 15 to 20 minutes for the cavitation bubbles to dissipate. Our current laser now has the ability to create a pocket to facilitate the clearing of the bubbles; however, that modality was not available in earlier cases. After the waiting period, the patient is taken to the Allegretto excimer laser (WaveLight AG, Erlangen, Germany), and the flap is lifted (Figure 1). This is the most challenging part of the procedure. In a normal IntraLASIK patient, the flap can be lifted in seconds, but in these cases one must work slowly and patiently. This is because the borders of the flap are adjacent to the transplant border, and there is a lot of fibrosis.

Once the flap is lifted, the stromal bed is measured with ultrasound pachymetry, and laser ablation is performed. Because ametropia is high in these patients, and because we do not want to risk too much thinning of the graft, it is not usually possible to correct all of the ametropia. When the level of astigmatism is high (eg, 10.00 D), the degree of error may be beyond what the laser can correct.

The first patient in whom I used this technique, in 2003, now has almost 6 years follow-up. At his most recent visit last October, his UCVA was 0.5, an improvement of two lines from his pre-IntraLASIK status. His UCVA improved from 0.05 before the surgery to 0.2 at his latest visit. His astigmatism before IntraLASIK was -8.50 D of cylinder. At the latest visit, it was -4.50 D, which was almost half the preoperative level. That was my aim: I knew the laser was not capable of correcting more than 5.00 or 6.00 D of astigmatism, and there is always some regression. My goal in these patients is to lower the ametropia to an acceptable level.

I have been asked, why not do customized ablation? We choose a standard ablation because of the high lower-order errors in these patients. How can we obtain a reliable wavefront image through these highly aberrated corneas? Also, with the small optical zones required in these patients because of the size of the corneal button, correcting higher-order aberrations is not practical.

It should be noted that IntraLASIK must be undertaken with care in post-PKP patients. Waiting times for corneal transplants can be long. We should not do a procedure that may damage the transplant under the assumption that we can simply perform a second transplant. Additionally, the risk of graft rejection increases with every repeat graft, so it is best to avoid reoperations.

Despite these cautions, IntraLASIK is a promising technique for the correction of high ametropia after PKP. We look forward to reporting a larger series of our patients in the future and to hearing the results of other centers employing this procedure.

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