The Surgical Correction of Hyperopia After RK

These cases pose a variety of challenges.

BY UDAY DEVGAN, MD

CASE PRESENTATION

A 58-year-old man has a history of bilateral eight-cut RK performed in 1986 for the surgical treatment of -5.00 D of myopia. Over the next 2 decades, he became increasingly hyperopic and then underwent successful bilateral LASIK in 1999 to treat +3.00 D of hyperopia in each eye. He now presents to you in 2008 with +2.50 D of hyperopia in each eye that has been stable for 5 years (Figure 1). He desires the surgical correction of his refractive error. How would you proceed?

SURGICAL COURSE

An Overview of the Challenge

Many of the patients who had RK surgery in the 1980s and 1990s develop subsequent hyperopia and, possibly, regular or irregular astigmatism as their corneal curvature continues to flatten. Although excimer laser-based ablations are able to address a degree of this hyperopia, their effectiveness is limited to a narrow range of refractive errors. In addition, it may not be advisable to perform further surgery on an already irregular cornea.

Refractive lens exchange has the ability to safely correct large degrees of hyperopia without inducing further corneal weakness. IOL power calculations, however, can be inaccurate in this subgroup of patients. Moreover, the surgical procedure can be challenging, and the postoperative recovery can be prolonged. The greatest challenge may be the patient's mindset, because these individuals are often intolerant of residual refractive errors.

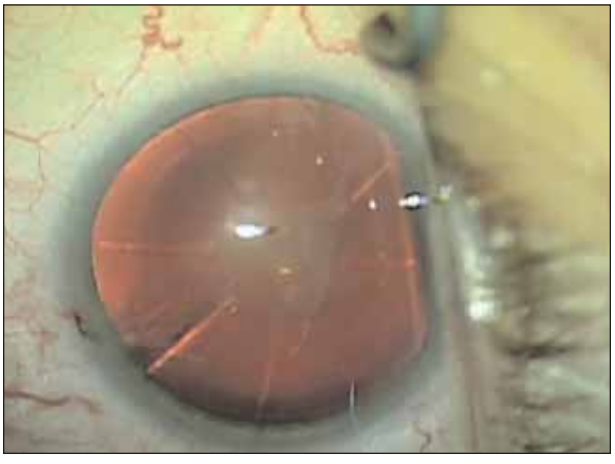

Figure 1. Viewed preoperatively, the eye previously underwent eight-cut RK and LASIK.

Because RK incisions are weak and prone to reopening, any incisions made during cataract surgery must not intersect them (Figure 2). The sudden reopening of an RK incision during phacoemulsification will result in an immediate and excessive outflow of fluid, a shallowing of the anterior segment, and, quite probably, a ruptured capsule. Another challenge in these eyes is that the RK incisions can impair the surgeon's view during critical parts of the procedure such as the capsulorhexis' creation (Figure 3).

In eyes with previous eight-cut RK, the surgeon can make a clear corneal incision between the existing RK incisions. It is very difficult to avoid the RK incisions in eyes with 16 or more cuts unless the surgeon uses a scleral tunnel cataract incision. At the end of these surgeries, I like to paint the entire cornea with fluorescein dye to check for leaks, which I can easily suture while the patient is in the OR (Figure 4).

The RK incisions will swell after even the gentlest cataract surgery and thus induce central corneal flattening and initial hyperopia. Patients will experience fluctuations in their refractive state for many weeks postoperatively, so a mild amount of initial hyperopia is not a cause for concern. Once the postoperative keratometry measurements have returned to their preoperative level, the surgeon can make a fair assessment of any residual refractive error.

If the cornea is actively changing, surgical procedures should be deferred until there is a better level of consistency in the preoperative measurements.

IOL Power Calculations

Whereas RK generally flattens both the anterior and posterior corneal surfaces, hyperopic LASIK steepens only the anterior curvature. The challenge is estimating the true central corneal power. Because post-RK corneas tend to be flat

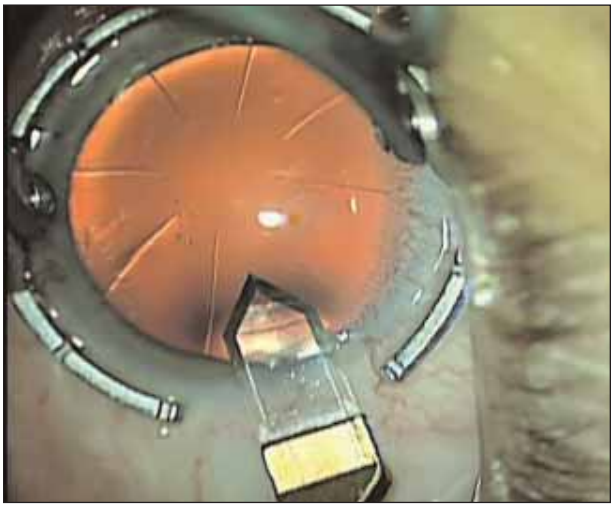

Figure 2. Using a diamond knife, the surgeon creates the main corneal incision between two of the old RK incisions and away from the edge of the LASIK flap.

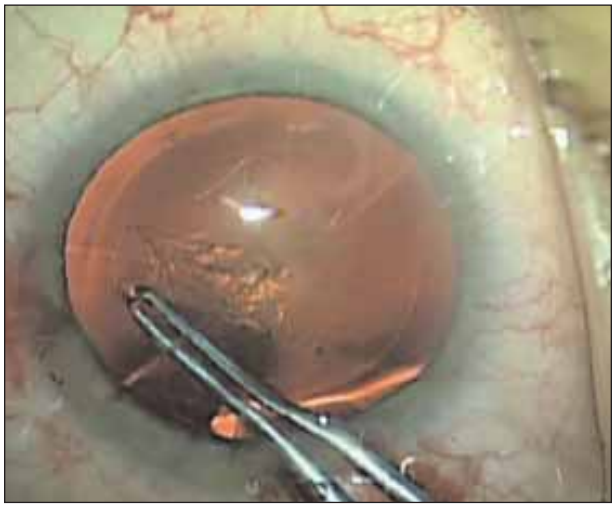

Figure 3. Creating the capsulorhexis can be difficult, because the RK incisions obstruct the surgeon's view.

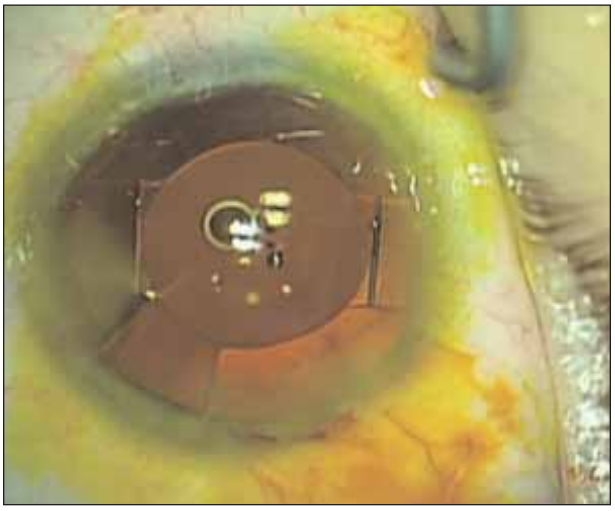

Figure 4. The surgeon paints all of the incisions with fluorescein at the end of surgery to check for leakage.

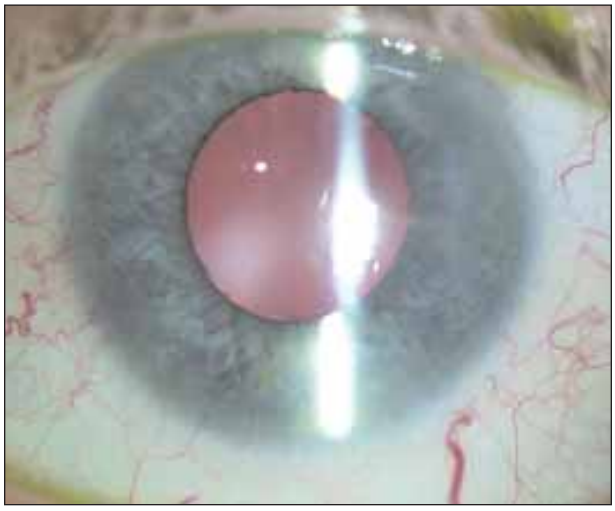

Figure 5. Postoperatively, an accommodating IOL is well positioned in the eye.

centrally, traditional means of measuring the corneal power such as keratometry tend to be inaccurate. I find that corneal topographers and Scheimpflug devices usually provide more accurate measurements of central corneal power, but surgeons must still be careful to err on the side of residual myopia when performing the IOL power calculations.

The plethora of formulas and techniques for calculating IOL power in post-RK patients indicates to me that no single method yields great results. The principle error in calculation is an overestimation of the corneal power, which results in the implantation of an IOL that is too low powered and leaves these patients hyperopic. Because they have typically been myopic their entire lives, they find their postoperative ametropia particularly uncomfortable and bothersome.

Although it was designed to address eyes that have undergone myopic LASIK, I find the Wang/Maloney method of determining central corneal power to be relatively accurate in post-RK eyes (Ktrue = [1.114 X central K on topography] - 6.1). Its utility is likely due to the reduction of corneal power for the IOL calculations, which helps to avoid the postoperative hyperopic surprises that are common in these cases. To calculate the IOL power in an eye that previously underwent hyperopic LASIK, I employ the formula of Samuel Masket, MD, based on the laser spherical equivalent to be the most reliable (IOL power adjustment = [-0.326 X laser spherical equivalent] + 0101).

The patient in this case underwent RK for the treat-

ment of his initial myopia and, later, hyperopic LASIK. It is this combination that made further treatment so challenging. I used a combination of the two aforementioned formulas and then further hedged my bet with a -1.00 D postoperative goal instead of the typical -0.25 D. Even if patients such as this one end up somewhat myopic after surgery, any future corneal changes will likely be further central flattening, which will bring their visual acuity back toward emmetropia.

Choice of IOL

I avoid multifocal IOLs in the eyes of patients such as this one, because their corneas are irregular and an IOL that divides light will further decrease contrast sensitivity. Aspheric IOLs with zero spherical aberration (eg, the Sofport AO lens [Bausch & Lomb, Rochester, NY] and the Afinity Collamer Aspheric IOL [STAAR Surgical Company, Monrovia, CA]) may be a particularly good choice in these cases. These lenses do not induce any positive or negative spherical aberration and thus will not confound the corneal aberrations.

Aspheric lenses with negative spherical aberration such as the Tecnis (Advanced Medical Optics, Inc., Santa Ana, CA) and the AcrySof IQ (Alcon Laboratories, Inc., Fort Worth, TX) would help offset the positive spherical aberration induced by myopic LASIK or myopic RK. They would be less useful in eyes that previously underwent hyperopic LASIK, however, where the cornea tends to have negative spherical aberration.

Perhaps an even better choice would be an accommodating IOL such as the Crystalens Five-O (Bausch & Lomb), because a degree of postoperative hyperopia or a future hyperopic drift could be addressed by the lens' accommodative function.

Further Refractive Adjustment

Because the IOL calculations for RK eyes are estimations at best, it is important to explain to patients that they may have ametropia postoperatively. These individuals may accept residual myopia, because it is useful for their daily activities. In contrast, residual hyperopia tends to blur vision at all distances.

To avoid further changes to the cornea, a piggyback IOL is often the best option for addressing residual hyperopia in pseudophakic post-RK eyes. The surgeon can also exchange the IOL, but doing so may be difficult after capsular contraction has occurred. For small degrees of residual refractive error, laser ablation such as PRK may be successful.

OUTCOME

When calculating the IOL power, I carefully erred on the side of residual myopia in this case. I performed refractive lens exchange with an accommodating IOL and a postoperative goal of -1.00 D. During the surgery, I placed the cataract incisions between the old RK incisions and away from the edge of the LASIK flap. I thoroughly tested the eye with fluorescein to ensure that all incisions were watertight. After a few weeks of healing, the patient achieved a spherical equivalent of plano and sharp uncorrected vision as well as approximately 2.00 D of accommodative amplitude. Because my goal was postoperative myopia of -1.00 D, I was surprised by this outcome. Since the patient achieved a wide range of uncorrected vision, he was pleasantly surprised as well (Figure 5). ■

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