Challenging Cases

Refractive

Refractive Lens Exchange for High Myopia

BY MARK PACKER, MD

CASE PRESENTATION

A 29-year-old white female presented for a complimentary refractive screening and declared that she was tired of her contact lenses and glasses, which she referred to as “way too thick.” She had a history of corneal neovascularization due to contact lens wear, and her optometrist had informed her that she might need to stop wearing lenses soon. The patient was in good health except for mild hypothyroidism, for which she took Synthroid (Abbott Laboratories, Inc., North Chicago, IL), and a history of knee surgery.

Examination revealed high myopia, with a correction of -14.75 +0.50 X 45 OD and -15.75 +0.75 X 135 OS. The patient’s BCVA measured 20/20 OU. Her scotopic pupil size measured 6 mm OU with the Colvard Pupillometer (OASIS Medical, Inc., Glendora, CA). Her corneal pachymetry was 503 µm OU, and the slit-lamp examination was unremarkable. Ophthalmoscopic examination with scleral depression demonstrated bilateral posterior vitreous detachment and no evidence of any predisposing retinal lesions.

HOW WOULD YOU PROCEED?

1. Given the patient’s refractive error, pupil size, and pachymetry measurements, would you consider corneal refractive surgery?
2. Would you advise the patient to await FDA approval of phakic IOLs, which were not available in the US at the time of her presentation?
3. Would you consider performing refractive lens exchange?

SURGICAL COURSE

I discussed surgical options with the patient, including LASIK, PRK, phakic lens insertion, and refractive lens exchange. Given her degree of correction, I explained that corneal refractive surgery would likely lead to the complications of corneal ectasia, dysphotopsia, and a loss of BCVA. Although I thought that a phakic IOL was perhaps her best option, such a lens was not yet available in the US. For those reasons, I felt that refractive lens exchange would be a good alternative, although I recognized that implanting a multifocal lens could result in dysphotopsia and decreased contrast sensitivity. At the time, no accommodative IOL was yet available in the US.

I explained to the patient that refractive lens exchange in high myopia is associated with an increased risk of retinal detachment. In a critical review of the pertinent literature, Sanders estimated the incremental risk at 3.3% over 7 years. I thought that the absence of predisposing peripheral retinal lesions and the presence of posterior vitreous detachment in this case improved those odds. The procedure is not controversially risky in the long term for high myopia.

After careful consideration, the patient decided to proceed with bilateral refractive lens exchange with implantation of the Array multifocal IOL (Advanced Medical Optics, Inc., Santa Ana, CA). The axial length measurements with the IOI aster (Carl Zeiss Meditec, Inc., Dublin, CA) were 26.0 mm OD and 25.6 mm OS. The Array multifocal IOL was selected because of its ability to provide good refractive outcomes and minimize dysphotopsia and contrast sensitivity loss. The surgery was uneventful, and the patient was satisfied with the outcome at her postoperative visit.

Figure 1. The author constructed microincisions of 2 mm in length, each with an internal diameter of 1.2 mm and an external diameter of 1.4 mm.
lin, CA) were 28.65 mm OD and 29.00 mm OS. Corneal topography with the EyeSys Corneal Analysis System (Tracey Technologies, Houston, TX) revealed simulated keratometry of 43.49 X 44.23 @ 71° OD and 43.77 X 44.23 @ 66° OS. The horizontal white-to-white with the IOLMaster frame grabber measured 12 mm OU, and the phakic lens thickness was estimated as 4.29 mm OU. The Holladay IOL Consultant with the Holladay 2 formula (Holladay Consulting, Inc., Bellaire, TX) predicted that the bilateral implantation of 6.00-D SA40N (Array) IOLs would yield postoperative spherical equivalent refractions of -0.92 D in the patient's right eye and -1.64 D in her left. Because 6.00 D is the lowest power available for the Array, I elected to perform bilateral in-the-bag implantation. I explained to the patient her possible need for a postoperative enhancement by means of either LASIK or piggyback IOL insertion.

Two principle surgical considerations in a highly myopic eye are the maintenance and control of a deep anterior chamber, both to protect the capsular bag and to stabilize the vitreous base. I therefore chose to perform bimanual microincisional phacoemulsification, because this technique facilitates operation within a more nearly closed system. I first operated on the patient's right eye. After administering topical anesthesia, I extracted the crystalline lens via two trapezoidal incisions of 1.2-mm internal diameter, 1.4-mm external diameter, and 2.0-mm length. I constructed the incisions with the Fine Stealth Para Trap Diamond Knife (Mastel Precision, Inc., Rapid City, SD) (Figure 1). After exchanging aqueous for viscoelastic (Viscoat; Alcon Laboratories, Inc.), I completed the capsulorhexis with the Ikeda II forceps (American Surgical Instruments Corporation, Westmont, IL). I have found that these specially designed forceps facilitate the reliable, repeatable initiation and completion of a capsulorhexis through a 1.2-mm incision (Figure 2). In my experience with microincisional surgery, hydrodissection may be performed without any change in technique, and there is ample room for viscoelastic to egress through the incisions as I inject BSS under the capsulorhexis rim.

Aspiration alone was sufficient to remove the lens from the capsule without the application of ultrasound. I employed a 30° bevel, 20-gauge phaco tip and an open-ended, 45° bevel irrigator (Duet Bi-M anual System; MicroSurgical Technology, Redmond, WA) with the Infiniti Vision System (Alcon Laboratories, Inc.). For me, one extremely beneficial aspect of bimanual surgery has been the ability to use the stream of irrigation fluid to move material, and, in this case, I washed the subincisional epinucleus and cortex out of the bag in this manner (Figure 3).

Once the bag was clean, I removed the phaco tip from the eye and continued to maintain the chamber with irrigation while I injected viscoelastic (Provisc; Alcon Laboratories, Inc.) into the bag. I then constructed a 2.8-mm, clear corneal, temporal incision with the Fine 3-D diamond knife (Rhein Medical, Tampa, FL) and inserted the IOL with the Unfolder (Advanced Medical Optics, Inc.) (Figure 4). I have found constructing a new incision for IOL insertion to be a superior option to enlarging the pre-existing microincisions. In my experience, the 2.8-mm incision has sealed beautifully, because it is minimally manipulated. After removing viscoelastic with coaxial silicone tip I/A (Alcon Laboratories, Inc.), I tested the incisions with fluorescein to ensure self-sealability. I...
employed the same technique when operating on the patient’s left eye, and surgery for both eyes was accomplished within 5 days.

**Outcome**

One day after surgery on the patient’s right eye, her UCVA measured 20/20+2 at distance and J1 at near OD with the Logarithmic Visual Acuity Chart 2000 “New ETDRS” at 16 inches (Precision Vision, Inc., La Salle, IL). I conducted the postoperative examination for the patient’s left eye on the same day as the surgery for her convenience. Her UCVA measured 20/30+2 at distance. When she returned 3 weeks later, the patient was very happy and reported “clearer vision every day.” Her UCVA measured 20/15 OD and 20/20-1 OS at distance and J2 OD and J3+2 OS. Binocularly, she was able to read 20/15 at distance and J1++ (20/16 equivalent) at 16 inches. Her manifest refraction measured -0.25 +0.25 X 67 (20/15) OD and -0.25 +0.25 X 50 (20/15) OS.

**Discussion**

Refractive lens exchange has become an important modality in my practice for correcting ametropia and presbyopia. Often discussed as particularly beneficial for presbyopic hyperopes, the procedure can succeed equally well in high myopes, as illustrated by this case. Accurate biometry and IOL power calculation represent critical elements in successful refractive lens exchange. Optical biometry (eg, partial coherence interferometry, IOLM aster) offers an important advantage in highly myopic and staphylomatous eyes, because it measures the distance to the fovea, wherever it lies. The Holladay 2 formula increases accuracy by taking into account seven variables (including keratometry, horizontal white-to-white distance, anterior chamber depth, phakic lens thickness, axial length, age, and refractive error) to determine the effective lens position. Meticulous surgical techniques—including the construction of a round, centered capsulorhexis that completely overlies the edge of the IOL optic and careful cortical cleanup—enhance outcomes by ensuring IOL centration, minimizing edge glare, and reducing the incidence of posterior capsular opacification.

It is interesting to note that this patient fared better than predicted by the Holladay 2 formula. Nevertheless, she was prepared to undergo an enhancement procedure if one had been necessary. I have found that piggyback IOLs offer a consistent approach to adjusting spherical equivalent, whereas LASIK represents a better choice in the presence of residual astigmatism. It is my impression that the Holladay 2 formula somewhat underestimates the power of the lens implant required in cases of high myopia but may slightly overestimate the power in high hyperopia. Be that as it may, I have found inserting a secondary piggyback IOL into the sulcus to be more predictable than implanting two IOLs primarily. For either approach, I have had success with the AQ 5010 IOL (STAAR Surgical Company, Monrovia, CA) because of its 6.3-mm optic and 13.5-mm overall length.

Surgeons will not have the full benefit of microincisional phacoemulsification until FDA-approved IOLs become available that can fit through these incisions. Nonetheless, I find that this procedure offers tangible intra- and postoperative benefits, despite my having to construct a larger incision for IOL insertion. I have attempted to enumerate some of these advantages in this article.

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