Optimizing Surgical Outcomes With Intraoperative Aberrometry

Wavefront guidance during the cataract procedure can enhance its precision and accuracy.

BY DAN B. TRAN, MD

For more than 40 years, cataract surgeons have developed and refined methods for calculating the IOL's power in order to provide cataract patients with accurate and satisfactory postoperative refractive results. In a benchmark study, researchers concluded that the refractive outcomes in cataract surgery for normal eyes should be within ±0.50 D for 55% of the cases and within ±1.00 D for 85% of the cases.[1] A review of outcomes using common formulas indicates that the largest contributor to errors in refractive outcomes is the IOL's postoperative position, with a mean absolute error of 0.60 D for an eye of average dimensions.[2]

Intraoperative wavefront aberrometry plays a critical role in improving refractive outcomes, particularly in eyes that have previously undergone corneal refractive surgery. WaveTec Vision, the manufacturer of the first intraoperative wavefront aberrometer, ORange, recently introduced the Optiwave Refractive Analysis (ORA) system with increased accuracy across all powers. A new light source and refined optics improve the consistency of the readings, and a reticle provides guidance on the placement of limbal relaxing incisions and toric IOLs. Overall, I have found the ORA to be more consistent and accurate than its predecessor, which allows me to minimize the effects of many surgical variables and to produce the best refractive outcomes possible for my patients.

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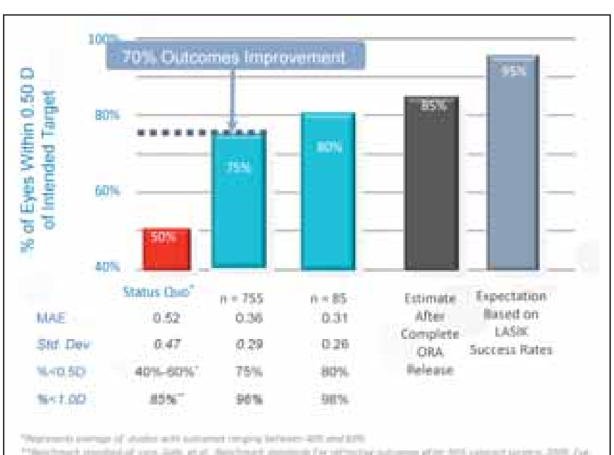

Figure. Evolution of improved refractive outcomes with the ORA system.

Recent data from WaveTec showed that surgeons using the ORA system could achieve ±0.50 D of the intended correction in 80% of the cases (Figure), an improvement from previous ORange version (multicenter data collected by WaveTec). In my private refractive IOL practice, I use the ORA in the following three areas: (1) to manage astigmatism through the place-

TABLE. SUMMARY OF CALCULATED OUTCOMES AFTER REGRESSION ANALYSIS OPTIMIZATION

% Within	Postmyopic	Posthyperopic	All
Within 0.50 D	56%	42%	53%
Within 0.75 D	76%	73%	75%
Within 1.00 D	89%	93%	92%
Absolute Error	0.54 ±0.36	0.64 ±0.32	0.54 ±0.38

ment of a toric IOL and/or limbal relaxing incisions, (2) to optimize spherical equivalent refractive outcomes when implanting an IOL in an eye with a history of corneal refractive surgery, and (3) to optimize spherical equivalent and cylindrical refractive outcomes in cataract and IOL surgery in which I use the LenSx femtosecond laser (Alcon Laboratories, Inc.).

MINIMIZING CYLINDRICAL ERRORS

The current method for selecting an AcrySof Toric IOL (Alcon Laboratories, Inc.) is based on the anterior corneal curvature measured by keratometry and the manufacturer's toric IOL calculator. The amount of cylindrical compensation depends solely on the corneal anterior curvature; it does not take into account the posterior corneal curvature,[3,4] corneal pachymetry, anterior chamber depth, spherical power of the IOL, and estimated lens position (ELP). Goggin et al suggested that this method may not accurately compensate for cylinder, especially when a high-powered toric IOL is used.[5,6] In addition, the common three-step ink-marking procedure used during these lenses' implantation can produce a mean error of 5° in the IOLs' placement.[7]

The ORA helps to minimize some of these errors in compensation by performing power calculations for both the sphere and the cylinder. This aphakic calculation includes the astigmatism induced by the corneal incision and the influence of posterior corneal curvature. The pseudophakic-measurement confirmation made after the toric IOL is rotated into its final position shows the power and axis of the refractive residual cylinder. The toric IOL can be rotated or exchanged intraoperatively, if necessary, to resolve off-axis placement or under- or overestimated effective compensation from corneal cylinder by the toric IOL.

ACHIEVING OPTIMAL OUTCOMES IN POSTKERATOREFRACTIVE SURGERY EYES

Over the past 12 years, more than a dozen studies have explored various methods for managing IOL calculations in postkeratorefractive surgery eyes.[8-16] In essence, they require special consideration because current IOL power formulas need the total power of the cornea, the axial length, the desired postoperative refraction, and the ELP. Corneal refractive surgery changes the natural relationship between the front and back surfaces of the cornea. Surgeons therefore cannot use the keratometric index to calculate the power of the cornea from a measurement of the anterior surface. All of the calculation methods for use after refractive surgery attempt to estimate the total corneal power. With the proper ELP optimized by regression analysis, the ORA can calculate, in real time, the correct IOL power to achieve the desired refractive outcome. My data with using ORange on postLASIK/postPRK eyes were comparable to that of the benchmark study outcomes for normal eyes (Table). Current data being collected for postLASIK/postPRK eyes show a trend toward further improvement in accuracy to target.

USING ORA WITH A FEMTOSECOND LASER

The availability of laser cataract surgery allows more consistency in the size and shape of the capsulorhexis, which in turn leads to a more predictable ELP. Recent data show that surgeons can achieve ±0.50 D of the targeted correction with the LenSx Laser for the implantation of a monofocal SN60WF IOL and multifocal SN6AD1 IOL (both from Alcon Laboratories, Inc.) in more than 90% of cases.

My data for the first 33 consecutive cases of refractive IOL surgery performed with the LenSx laser using a combination of monofocal, presbyopia-correcting and toric IOLs from Bausch + Lomb, Alcon Laboratories, Inc., and Abbott Medical Optics Inc. showed that 88% were within ±0.50 D and 100% were within ±0.75 D of the intended correction, if the IOLMaster 500 (Carl Zeiss Meditec, Inc.) were used alone for IOL selection. With the addition of ORA for power selection and placement of the IOL, the percentage of eyes within ±0.50 D improved to 92%.

In my experience, the ORA guides my final intraoperative choice of IOL, because the preoperative measurements determine the range of IOL powers needed. The system also helps me to position the AcrySof Toric IOL, and it facilitates intraoperative manipulation or enhancement of astigmatic keratotomy incisions created with the LenSx laser to optimize cylindrical correction.

CONCLUSION

Modern IOL surgery has good refractive outcomes. ORA technology works synergistically to improve refractive accuracy to target, allowing the refractive results to be closer to those of laser vision correction. I found the technology to be extremely helpful with astigmatic management and postkeratorefractive surgery IOL power selection. The ORA also gives me an edge in further refining my IOL power selection in normal eyes when other surgical variables are better controlled, as seen in LenSx refractive lens replacement surgery. ■

Dan B. Tran, MD, is the medical director of Coastal Vision Medical Group, with offices in Long Beach and Orange, California. Dr. Tran is also the medical director of NVision Refractive IOL Practice in Newport Beach, California. He is a consultant to Alcon Laboratories, Bausch + Lomb, and WaveTec Vision. Dr. Tran may be reached at danbtran@gmail.com.

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