Presbyopic Correction for a Wide Range of Patients

Predictable refractive outcomes and unaided distance and near vision are requirements for an effective presbyopia-correcting IOL.

BY D. REX HAMILTON, MD, MS

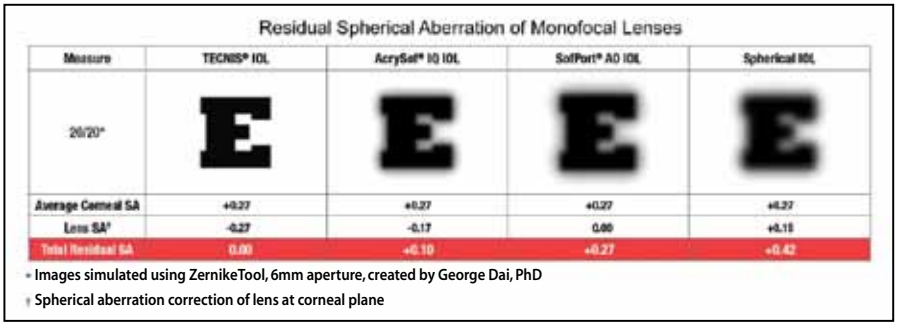
A successful presbyopic correction must not only provide excellent unaided distance and near vision, but it should also afford patients a permanent fix by replacing the aging crystalline lens. Although corneal presbyopic treatments may be an appropriate temporizing measure in younger myopic patients, these techniques cannot provide a lasting presbyopic solution for phakic patients.

In addition to improving quality of vision, presbyopia-correcting IOLs should provide predictable refractive outcomes as well as useful unaided near vision in dim lighting conditions. In my practice, the Tecnis 1-Piece Multifocal IOL (Abbott Medical Optics Inc.) provides the best results for the widest range of patients.

PREDICTABLE REFRACTIVE OUTCOMES

The effective lens position (ELP)—the distance from the anterior surface of the cornea to the IOL's plane—cannot be measured preoperatively but must be estimated with IOL power calculations. It is therefore critical that surgeons track their refractive outcomes and determine a personalized A-constant to correct techniques that may influence the ELP.

For example, the size of the capsulorhexis can significantly affect the ELP. A large capsulorhexis outside the optic will likely cause the IOL to move anteriorly with capsular contraction, leading to a shorter ELP and a myopic refractive



(Both images courtesy of Abbott Medical Optics Inc.)

Figure 1. Simulated images through 6-mm pupillary aperture from various monofocal IOLs with differing amounts of spherical aberration correction. The spherical aberration correction of each lens is referenced to the corneal plane.

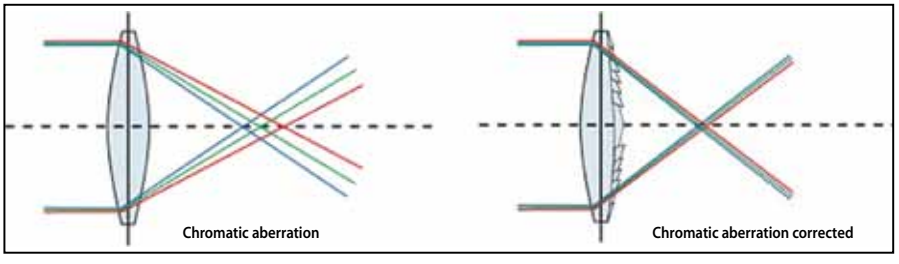


Figure 2. Improved astigmatic focus with chromatic aberration correction.

error. Conversely, a small capsulorhexis that overlaps the optic will likely cause the IOL to move posteriorly, leading to a longer ELP and a hyperopic refractive error.

Although the importance of consistently sized capsulorhexes cannot be overstated (one of the major selling points of femtosecond lasers for cataract surgery), the mechanical flexibility of the IOL itself also plays a major role in the ELP. Accommodating IOLs are, by definition, dynamic structures that move inside the capsular bag. Although they provide a wider and more natural range of vision than stationary multifocal IOLs, these lenses inherently have more variability in ELP. Single-piece multifocal IOLs such as the Tecnis have the least variability in ELP.

I was astounded to learn that my personalized A-constant using optical biometry was 119.9. I use a 5.5-mm corneal capsulorhexis marker that, when traced inside the eye, results in a 5-mm capsulorhexis. This overlaps the IOL, leading to a posterior shift and a longer ELP. After the patient fixates on the microscope light and I am satisfied with the centration based on a Purkinje image, I nudge the IOL slightly posteriorly, seating the lens farther back against the posterior capsule. Since personalizing my A-constant, my results have been extremely consistent, with nearly 90% of the first 30 eyes achieving ± 0.50 D of the intended target.

Surgeons must realize that current-generation IOL formulas become unreliable at the extremes of axial length, particularly for long eyes. The refractive target should be more myopic in these eyes, as the ELP tends to be farther posterior than the formulas predict.

USEFUL UNAIDED NEAR VISION IN DIM LIGHT

Most people use their near vision in environments that are relatively dim. As the pupil enlarges in a dimly lit setting, the optics degrade because more spherical aberration diminishes contrast sensitivity. Several features of the Tecnis 1-Piece Multifocal IOL counteract these issues to maximize the amount of incoming light that forms an image.

The lens fully compensates for corneal spherical aberrations by minimizing the loss of contrast sensitivity, which is critical for a diffractive multifocal platform that, by design, loses about 18% of incoming light to scatter (Figure 1). Chromatic aberration steals incoming light much the way spherical aberration does, except that the former is not dependent on the size of the pupil. The high Abbe number of the IOL's acrylic material minimizes chromatic aberration and focuses the maximum amount of incoming light to stigmatic focus, independent of the wavelength (Figure 2). The Tecnis' combination of full spherical aberration correction and a high Abbe number results in a 30% improvement in contrast sensitivity when compared with IOLs that have lower spherical and chromatic aberration correction.[1] Additionally, the Tecnis does not filter blue light. Short-wavelength visible light is important for vision in dim light, because the rods and shorter-wavelength cones have lower thresholds of sensitivity than the longer-wavelength cones.[2]

INTERMEDIATE VISION

The intermediate range of vision required for computer use is a common weakness among the multifocal IOL platforms available in the United States. The Tecnis provides intermediate vision and reading speed equivalent to and in some cases superior to that provided by other multifocal IOL designs.[3,4] In my practice, about 15% of patients who have a Tecnis 1-Piece Multifocal IOL sit closer to the computer than they would prefer. I advise them to adjust the font size and/or resolution and turn up the brightness for several weeks. If these changes do not improve their intermediate vision, I recommend +1.00 D reading glasses. I find that, because patients are delighted with all other aspects of the IOL, they willingly accept this compromise, especially if they are aware before surgery that they may still require glasses for some tasks. Because the difficulties with unaided near vision in dim light that occur frequently with other multifocal IOL platforms are not correctable, in my experience, a high percentage of patients are dissatisfied with these IOLs.

CONCLUSION

The ideal presbyopic solution is lenticular, affords patients excellent unaided distance and near vision, and offers predictable refractive outcomes. In my opinion, the Tecnis 1-Piece Multifocal IOL outperforms all other presbyopia-correcting IOLs. ■

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1. Zhao H, Piers PA, Mainster MA. The additive effects of different optical design elements contributing to contrast loss in pseudophakic eyes implanted with different aspheric IOLs. Paper presented at: The 27th Congress of the ESCRS; September 4-8, 2009; Barcelona, Spain.
2. Mainster MA, Turner PL. Blue-blocking IOLs decrease photoreception without providing significant photoprotection. *Surv Ophthalmol.* 2010;55(3):272–289.
3. Davis E. Real-world performance of multifocal IOLs. *Cataract & Refractive Surgery Today*. October 2010 (suppl):3–4.
4. Hutz WW, Eckhardt HB, Rohrig B, et al. Intermediate vision and reading speed with Array, Tecnis, and Restor intraocular lenses. *J Refract Surg.* 2008;24(3):251–256.