INNOVATIONS IN TORIC IOLS


Several options for astigmatism-correcting lenses are in development, many of which are available and widely successful outside of the United States.

BY KOURTNEY HOUSER, MD; AND DANIEL OFORI, MD

Maximizing visual outcomes after cataract surgery requires proper management of astigmatism. About 30% of cataract patients have greater than 0.75 D of corneal astigmatism,[1] and it has been observed that surgically correcting as little as 0.50 to 0.75 D of astigmatism can greatly improve distance and near visual acuity as well as high- and low-contrast sensitivity compared to spherical correction alone.[2] Surgical options for managing astigmatism at the time of cataract surgery include peripheral corneal relaxing incisions (PCRIs) and implantation of toric IOLs. PCRIs are inexpensive and effective but can be unpredictable and limited in the degree of astigmatism they correct.[3] Toric IOLs can correct a larger range of preoperative corneal astigmatism and avoid many of the potential complications of PCRIs.[3]

Toric IOLs now available in the United States provide excellent astigmatic correction for many patients, but they offer a limited range of correction and may rotate after implantation. Many new technologies are in development, and many others are currently used with great success outside of the United States. If they become available here, these advances could both extend the population of patients to whom we can offer astigmatic correction and maximize the stability of correction and visual outcomes.

IN THE UNITED STATES

The two monofocal astigmatism-correcting IOLs most commonly implanted in the United States, Acrysof IQ Restor Toric (Alcon) and Tecnis Toric 1-Piece (Johnson & Johnson Vision), correct 1.50 to 6.00 D of cylinder at the IOL plane and come in spherical powers ranging from 6.00 to 34.00 D and 5.00 to 34.00 D, respectively.[4] The enVista toric IOL (Bausch + Lomb) is a recently introduced lens available to correct 1.25 to 5.75 D of cylinder at the IOL plane in spherical powers ranging from 6.00 to 30.00 D. The STAAR Toric IOL (STAAR Surgical) is another monofocal toric lens but is limited in its cylindrical correction to either 2.00 or 3.50 D at the IOL plane. Presbyopia-correcting toric IOLs are more limited, with only 1.50 to 3.75 D of cylindrical power correction at the IOL plane available with the multifocal AcrySof Restor (Alcon) and the extended depth of focus Symfony Toric (Johnson & Johnson Vision). The Trulign Toric IOL (Bausch + Lomb) is an accommodating IOL that can correct 1.25 to 2.75 D of cylinder. These options leave patients on both ends with inadequate astigmatic treatment options.

The Light Adjustable Lens (RxLAL, RxSight) is an innovative IOL that allows correction of residual spherical and cylindrical errors after postoperative refraction has stabilized. The silicone optic contains a light-activated photoinitiator and mobile silicone macromers that polymerize upon activation, eliciting a shape change and subsequent predictable change in refractive power of the lens. The RxLAL can correct up to 2.00 D of hyperopia, myopia, and astigmatism.[5,6] The lens can be adjusted several times, and a lock-in treatment is performed after the desired refractive outcome is achieved. The RxLAL is FDA approved but not yet commercially available in the United States.

OUTSIDE OF THE UNITED STATES

Toric IOLs available outside the United States offer a wider range of astigmatic and spherical correction than lenses currently available in the United States. The T-flex (Rayner), AT Torbi 709M (Carl Zeiss Meditec), and Lentis Tplus (Oculentis) are available in wider ranges, with astigmatic correction as low as 0.25 D at the IOL plane with the available Lentis Tplus and extending up through 12.00 D with the AT Torbi 709M and the Lentis Tplus. Spherical correction is similarly broader, with ranges spanning -10.00 D through 35.00 D.

Extended ranges of cylindrical and spherical power are available in many multifocal toric IOLs as well, including the Lentis Mplus toric (Oculentis).

This breadth gives patients with low levels of corneal astigmatism the option of potentially more predictable and stable correction with a toric IOL compared to a PCRI. Also, patients with higher levels of corneal astigmatism or those requiring a wider range of spherical correction can be treated. The combination of these expanded options with multifocality is particularly exciting because even low levels of astigmatism can significantly degrade image quality and lead to patient dissatisfaction.

"THESE ADVANCES COULD BOTH EXTEND THE POPULATION OF PATIENTS TO WHOM WE CAN OFFER ASTIGMATIC CORRECTION AND MAXIMIZE THE STABILITY OF CORRECTION AND VISUAL OUTCOMES."

The innovative design of the Precizon Model 565 (Ophthec) offers both increased stability and greater tolerance of misalignment. This hydrophilic acrylic aspheric IOL has a closed-loop haptic configuration and a transitional conic toric surface that provides consistent toric power from the center of the optic to the periphery. The lens seems to be more resistant to rotation and to a decrease in astigmatic correction when rotation does occur.[7-9]

The Sulcoflex (Rayner) features specially designed posterior haptic angulation for ciliary sulcus placement. It can therefore be used as a piggyback implant to correct residual corneal astigmatism and some degree of spherical error in pseudophakic patients. The Sulcoflex represents an additional option for patients who desire spectacle independence and have residual astigmatism after cataract surgery.

A class of IOL much anticipated in the United States is the trifocal, which can be combined with astigmatic correction. Examples include the AT Lisa trifocal toric 939MP (Carl Zeiss Meditec), Alsafit trifocal toric VF (Alsanza), Acriva Trinova toric (VSY Biotech), and FineVision toric (PhysIOL). A recent meta-analysis found trifocal lenses to have a clear advantage over bifocal lenses in terms of intermediate vision, with no detrimental effect on distance or near vision and a trend toward an advantage in terms of near vision with the AT Lisa trifocal toric.[10] Another trifocal with toricity available outside the United States is the AcrySof IQ PanOptix toric (Alcon), which provides a similar advantage in intermediate vision compared with bifocal lenses.[11]

The AT Lara toric 929MP (Carl Zeiss Meditec) is an extended depth of focus IOL available with toric correction. It provides yet another option for patients desiring distance, intermediate, and near vision after lens extraction who have corneal astigmatism. This lens promises a wider range of focus and fewer visual side effects than multifocal IOLs.

The IC-8 IOL (AcuFocus) uses small-aperture optics to extend depth of focus, providing distance, intermediate, and near vision. This one-piece hydrophobic acrylic lens is intended for monocular implantation in the nondominant eye. Up to 1.50 D of astigmatism is very well tolerated, resulting in minimal degradation of UCVA.[12] A unique advantage of this technology compared with toric IOLs is that its pinhole effect can correct some irregular astigmatism.

An adjustable technology in development, the Perfect Lens (Perfect Lens), uses refractive index shaping (RIS) with a femtosecond laser to modify the hydrophilicity and refractive indices of a standard implanted IOL.[6,13] The RIS change can optimize postoperative results by adjusting the spherical power or toricity of an IOL or adding or removing multifocality. The RIS technology can potentially be applied to many commercially available acrylic IOLs. In addition, there is no restriction on how long after surgery the adjustment can be made, and there seems to be no limit on how many adjustments can be performed.

CONCLUSION

Technological innovations are expanding the number of patients who can be effectively treated with toric IOLs. These advances are also producing IOLs that are more tolerant of preoperative measurement errors and allow postoperative correction of these errors without incisional surgery. As available IOL technologies expand, surgeons and their patients will have access to more reliable and modifiable options for minimizing refractive error and maximizing visual outcomes after cataract and lens replacement surgery. ■

1. Hoffmann PCP, Hutz WW. Analysis of biometry and prevalence data for corneal astigmatism in 23,239 eyes. *J Cataract Refract Surg*. 2010;36:1479-1485.
2. Lehmann RP, Houtman DM. Visual performance in cataract patients with low levels of postoperative astigmatism: full correction versus spherical equivalent correction. *Clin Ophthalmol*. 2012;6:333-338.
3. Rigi M, Al-Mohtaseb Z, Weikert MP. Astigmatism correction in cataract surgery: toric intraocular lens placement versus corneal relaxing incisions. *Int Ophthalmol Clin*. 2016;56(3):39-47.
4. Lee BS, Chang DF. Comparison of the rotational stability of two toric intraocular lenses in 1273 consecutive eyes. *Ophthalmology*. 2018;125:1325-1331.
5. Ford J, Werner L, Mamalis N. Adjustable intraocular lens power technology. *J Cataract Refract Surg*. 2014;40(7):1205-1223.
6. Wang L, Houser K, Koch DD. Intraocular lens power calculations. In: Yanoff M, Duker JS, eds. *Ophthalmology*. Edinburgh: Elsevier Saunders; 2019:342-348.
7. Menezes C, Rodrigues P, Lemos J, et al. Rotational stability and tolerance for misalignment of Precizon toric IOL. Paper presented at: the ESCRS Annual Meeting; September 13-17, 2014; London, United Kingdom.
8. Kim MJ, Yoo YS, Joo CK, et al. Evaluation of optical performance of 4 aspheric toric intraocular lenses using an optical bench system: influence of pupil size, decentration, and rotation. *J Cataract Refract Surg*. 2015;41(10):2274-2282.
9. Jung NY, Lim DH, Hwang SS, et al. Comparison of clinical outcomes of toric intraocular lens, Precizon vs Tecnis: a single center randomized controlled trial. *BMC Ophthalmol*. 2018;18:292.
10. Xu Z, Cao D, Chen X, et al. Comparison of clinical performance between trifocal and bifocal intraocular lenses: a meta-analysis. *PLoS One*. 2017;12(10):e0186522.
11. Lee S, Choi M, Xu Z, et al. Optical bench performance of a novel trifocal intraocular lens compared with a multifocal intraocular lens. *Clin Ophthalmol*. 2016;10:1031-1038.
12. Dick HB, Piovella M, Vukich J, et al. Prospective multicenter trial of a small-aperture intraocular lens in cataract surgery. *J Cataract Refract Surg*. 2017;43:956-968.
13. Sahler R, Bille JF, Enright S, et al. Creation of a refractive lens within an existing intraocular lens using a femtosecond laser. *J Cataract Refract Surg*. 2016;42:1207-1215.

KOURTNEY HOUSER, MD
- Hamilton Eye Institute, University of Tennessee Health Science Center, Memphis, Tennessee
- kourtney.houser@gmail.com
- Financial disclosure: None

DANIEL OFORI, MD
- Hamilton Eye Institute, University of Tennessee Health Science Center, Memphis, Tennessee
- dofori@uthsc.edu
- Financial disclosure: None