# Premium IOLs: Clinical Indications and Pearls for Successful Application

Individualized refraction correction increases the chance for spectacle independence with premium IOLs; however, there is no absolute guarantee.

BY TANJA M. RABSILBER, MD; AND GERD U. AUFFARTH, MD

Due to the development of premium IOLs and improvements in calculation formulas, modern cataract surgery—or, as some refer to it, refractive cataract surgery—has made postoperative spectacle independence possible. Particularly in the field of refractive lens exchange, the demand for individualized procedures is great. This article reviews the available premium IOLs, which comprise aspheric, toric, multifocal, and accommodating lenses. Recently, supplementary, or add-on, IOLs were introduced as a new lens in this category. Implanted in the sulcus of a pseudophakic eye, add-on IOLs can correct residual refractive errors including astigmatism and presbyopia.

## ACCOMMODATING AND MULTIFOCAL IOLs

Presbyopia correction is possible with multifocal and accommodating IOLs.[1-3] Commercially available accommodating IOLs have special haptics and designs to induce lens movement with ciliary muscle contraction or relaxation using the optic-shift principle. New developments have overcome the technology's earlier insufficient near addition, with the advantage of reduced photic phenomena compared with multifocal IOLs. A dual-optic IOL (Synchrony; Abbott Medical Optics Inc., Santa Ana, California; Figure 1) needs less optic movement to induce near addition compared with a single-optic IOL. Functional results with this lens have been satisfying and predictable. The Crystalens HD IOL (Bausch + Lomb, Rochester, New York) has achieved a high volume of implantation, especially in the United States; however, its working principle is controversial.

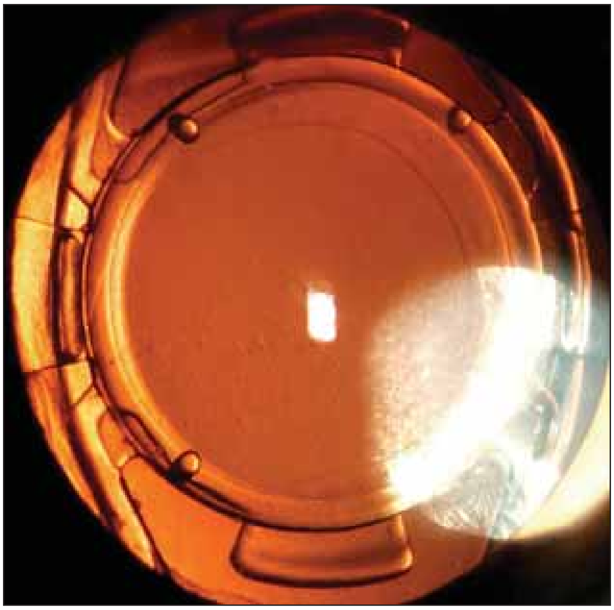

**Figure 1. Less optic movement is needed to induce near vision with the Synchrony.**

Multifocal IOLs developed after the 1980s are rotationally symmetric and based on the principles of diffraction, refraction, or a combination of these principles. Diffractive multifocal IOLs distribute incoming light rays to two principal foci for near and distance vision. Diffractive designs are pupil independent. Refractive multifocal IOLs incorporate different refractive zones that create several pupil-dependent foci. Vision at intermediate distances is better with refractive designs; however, the patient's ability to read small print size at 30 to 40 cm can be limited. Recent developments in multifocal designs, such as foldable, multizonal, progressive, refractive multifocal or aspheric diffractive multifocal IOL models minimize decentration, loss of contrast sensitivity, and glare and halos when combined with today's improved surgical techniques.

Some modern multifocal IOL models combine both optical principles. For instance, the AcrySof IQ Restor (Alcon Laboratories, Inc., Fort Worth, Texas) has an apodized diffractive/refractive optic design and is available with a 4.00 D near addition or the recently introduced 3.00 D near addition. The AT.LISA (Carl Zeiss Meditec, Jena, Germany) is available in three designs and consists of a refractive-diffractive optic surface profile with a 3.75 D near addition.

## MIX AND MATCH

Mix and match, or custom match, enhances the strengths and reduces the weaknesses of two multifocal technologies implanted in the same patient. By combining the optical principles of two different lens models, visual acuity is optimized for all distances. A prerequisite is that the distant-dominant eye is determined before surgery. Some surgeons find benefit in custom-matching a refractive and a diffractive design, such as the ReZoom and Tecnis (both by Abbott Medical Optics Inc.), or implanting the 3.00 and 4.00 D near additions of the same multifocal IOL, such as the AcrySof IQ Restor or the M-flex (Rayner Intraocular Lenses, Ltd., East Sussex, London).

The Lentis Mplus (manufactured and distributed by Oculentis GmbH, Berlin, and Topcon, Rotterdam, Netherlands; Figure 2) features a new approach in multifocal IOL technology. This lens combines an aspheric, asymmetric distance-vision zone with a sector-shaped near-vision zone (3.00 D), allowing seamless transition between the zones.

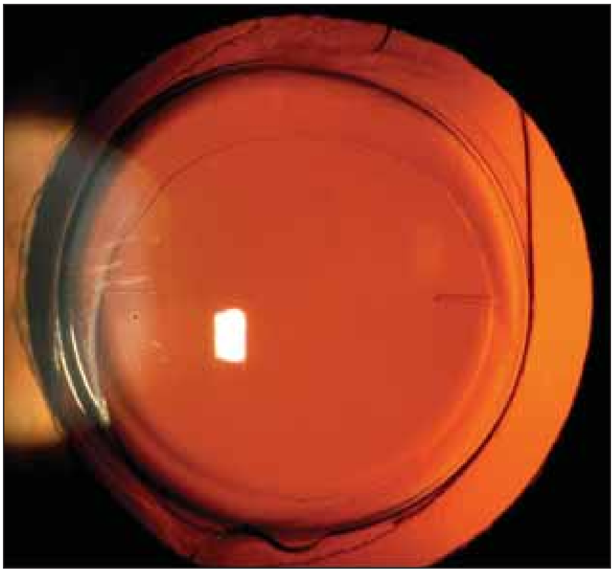

**Figure 2. The Mplus combines a distance zone with a near zone.**

The design principle of the surface-embedded sector segment makes the Mplus independent of pupil size. Clinical findings have been promising so far and led to Conformitée Européenne (CE) approval in March 2009. Halo and glare effects are rarely reported, and patient satisfaction is high.

Whatever lens is chosen, due to the multifocal IOL principle of separating light to different foci, the patient must learn to adapt to the visual perception; the possible reduced contrast sensitivity; and the induced photic phenomena, especially at night. Thus, detailed informed consent prior to surgery is mandatory.

To determine which multifocal IOL type best fits the personal needs of the patient, distance preferences must be clarified preoperatively, especially because there are individual differences in near vision preferences that range between 30 and 70 cm. For more information on patient selection, see *Choosing Patients for Premium Lenses*, page 62.)

**TAKE-HOME MESSAGE**

- Recent developments in multifocal designs minimize decentration, loss of contrast sensitivity, and glare and halos.
- To determine the multifocal IOL technology best suited for an individual, distance preference must be clarified preoperatively.
- Presbyopic patients with more than 1.50 D of astigmatism may benefit from a toric multifocal IOL.
- Premium IOLs allow individualized refractive correction.

## TORIC IOLs

Patients with corneal astigmatism of at least 1.00 or 1.50 D can benefit from toric IOLs.[4-7] The use of such IOLs in patients with high astigmatism after penetrating keratoplasty is especially rewarding, because the reduction of high astigmatism (10.00 D or more) results in great patient satisfaction postoperatively.

Pearls for successful toric IOL implantation include accurate biometry, corneal topography, IOL power calculation, and axis marking preoperatively, and careful IOL alignment intraoperatively. Specific parameters based upon exact biometry are essential for the calculation of a toric IOL and best accomplished absent any manipulation of the eye (eg, drops, pressure measurements). If individual values strongly

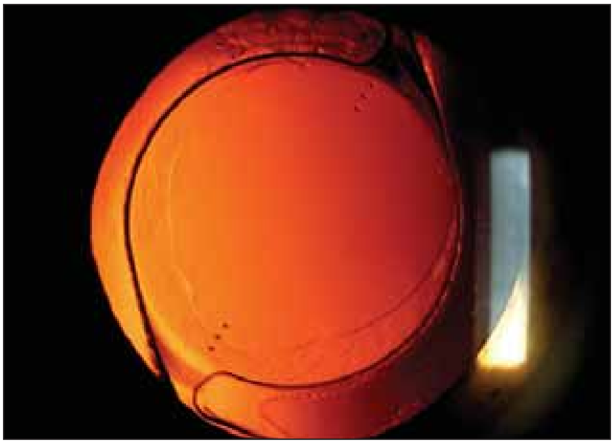

**Figure 3. The AcrySof Toric corrects from 1.00 to 6.00 D of astigmatism.**

deviate from each other, it is recommended that biometry be repeated at a later time. Exact keratometry values in contact lens wearers are achieved only if patients abstain from using their contacts for at least 2 weeks prior to the measurement.

In addition to subjective refraction, corneal topography can be helpful to evaluate the type of astigmatism and to exclude further pathology (eg, keratoconus). In some cases, topography is requested for power calculation by some IOL manufacturers. For toric IOL power calculation, data must be entered into the appropriate form and either faxed to the manufacturer or performed online at www.acrysoftoric-calculator.com, www.rayner.com/raytrace, or www.oculentis.com. The surgeon receives IOL suggestions and the corresponding target refraction. Delivery often includes two lenses, one acting as a standby IOL that is sent back to the manufacturer following surgery. Furthermore, the location of the clear corneal incision must be accounted for because it induces additional flattening after surgery.

Preoperatively marking the cylinder axis when the patient is seated is important for the correct placement of the lens into the capsular bag and optimal correction. Cyclorotation of the eye can occur when the patient is positioned lying down. Such rotation can also be related to the anesthesia.

There are different possibilities for axis marking. For example, the horizontal axis can first be marked at the limbus with a sterile surgical pen at 0º and 180º. Then, marking takes place at 90º or the 12-o'clock position. Various instruments are available for exact marking, including horizontal axis markers and a measuring ring manufactured by Geuder AG (Heidelberg, Germany). Accurate lens position alignment after implantation is facilitated by manufacturer-provided drawings or overlays. A microscope that incorporates axis markers was recently introduced by Carl Zeiss Meditec, and others are on the way.

**Figure 4. The M-flex T is a multifocal toric IOL.**

In Europe, toric IOLs can be divided into two groups, those with a fixed cylinder correction and those that allow customized correction of higher astigmatism exceeding 10.00 D.

The STAAR Toric (Monrovia, California) silicone plate-haptic IOL comes with a fixed cylinder of either 2.00 or 3.50 D, corresponding to a corneal astigmatism correction of 1.54 or 2.30 D, respectively.

The AcrySof Toric IOL (Figure 3) is a one-piece hydrophobic acrylic lens with an optic diameter of 6 mm and a total length of 13 mm. The lens contains a blue-light filter. In Europe, it is available in seven models, the SN60T3 through T9, which correct 1.50 D to 6.00 D of cylinder at the IOL plane in 0.75 D increments.

The MicroSil Toric MS 6116 TU (HumanOptics, Erlangen, Germany) is a three-piece foldable silicone lens with PMMA haptics that feature a special Z-form. The overall diameter is 11.6 mm and the optic diameter 6 mm. HumanOptics also manufactures individually calculated lenses, such as the MicroSil MS 614 T, with an optic diameter of 6 mm and an overall diameter of 14 mm. The haptics of this IOL are C-shaped. All HumanOptics lenses are available with a blue-light filter.

Rayner's T-flex 573T is a foldable, injectable, one-piece, hydrophilic acrylic IOL with an overall diameter of 12 mm and an optic diameter of 5.75 mm. The T-flex 623T is slightly larger, with a 0.5 mm larger optic and overall diameter. The patented haptic design provides a stable IOL position, even under stress from outside forces, such as during capsular

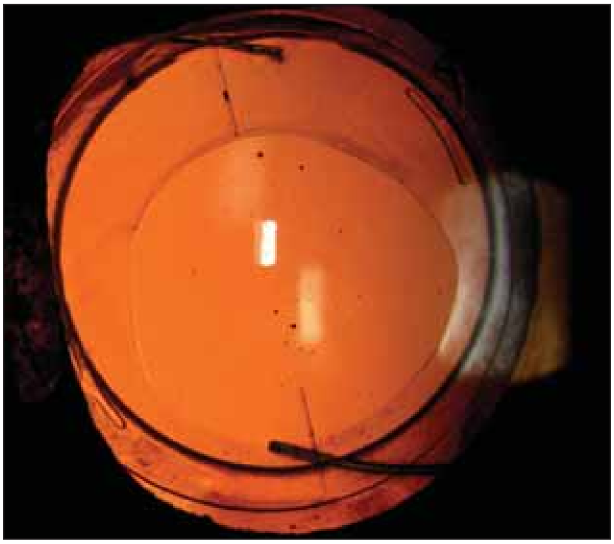

Figure 5. The Add-On supplementary IOL.

contraction. In addition to standard lenses, an extended power range is available for up to 11.00 D of cylinder correction. Zeiss offers a bitoric model, the AT.Comfort 646 TLC, which can be implanted after microincision cataract surgery. The Lentis Tplus LU-312 T and LU-313 T models are available for up to 12.00 D of customized cylinder correction and are also manufactured with a blue-light filter upon request.

## COMBINATION MULTIFOCAL AND TORIC IOLs

In presbyopic patients with more than 1.50 D of astigmatism, toric multifocal IOLs are a good option. The first model was Rayner's M-flex T (Figure 4), based on a multizonal refractive aspheric optic technology with either four or five annular zones, depending on the IOL base power. The lens was first implanted at the University of Heidelberg in June 2006. Like the monofocal T-flex, it is made of a hydrophilic acrylic material and features a 360° sharp optic edge to prevent posterior capsular opacification. The lens is available in two sizes, a 5.75-mm optic with 12 mm overal diameter and a 6.25-mm optic with 12.5 mm overall diameter. The special power range offers cylinders from 1.00 to 1.50 D and 2.50 to 6.00 D in 0.50 D steps.

Two other combination multifocal-toric IOL models are now available, the AT.LISA Toric 466TD and the Mplus Toric, the latter of which will officially be launched at the upcoming World Ophthalmology Congress (WOC) meeting in Berlin.

## ADDITIVE MONOFOCAL, MULTIFOCAL, AND TORIC IOLs

The Sulcoflex (Rayner Intraocular Lenses, Ltd.) and the Add-On (HumanOptics AG; Figure 5) can be implanted in the sulcus of pseudophakic eyes. These supplementary IOLs, available in monofocal, multifocal, and toric versions, offer the possibility to correct residual refractive errors after cataract or refractive surgery. Supplementary IOLs are a good option in cases of dynamic refraction changes, such as after penetrating keratoplasty, because they can be explanted or exchanged easily.

## CONCLUSION

A variety of sophisticated premium IOLs is available, allowing individualized refraction correction and the potential for spectacle independence. However, the patient should be informed preoperatively that there is no absolute guarantee of spectacle freedom. Patient selection, informed consent, and realistic expectations remain important parameters for a successful postoperative result. ■

*Gerd U. Auffarth, MD, is the Acting Chairman, Department of Ophthalmology, University of Heidelberg, Germany. Professor Auffarth is a member of the* CRST Europe *Editorial Board. He states that he has no financial interest in the products or companies mentioned; however, the International Vision Correction Research Center of the University of Heidelberg has received research grants from all companies mentioned except STAAR Surgical. He may be reached at tel: +49 6221 566624; fax: +49 6221 568229; e-mail: ga@uni-hd.de.*

*Tanja M. Rabsilber, MD, practices at the International Vision Correction Research Centre, Department of Ophthalmology, University of Heidelberg, Germany. Dr. Rabsilber states that she has no financial interest in the products or companies mentioned; however, the International Vision Correction Research Center of the University of Heidelberg has received research grants from all companies mentioned except STAAR Surgical. She may be reached at e-mail: tanja.rabsilber@med.uni-heidelberg.de.*

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