

How to Get the Most out of Three Premium IOLs

The aspheric design of this multifocal IOL enhances patients' outcomes.



By Elizabeth A. Davis, MD

As cataract surgeons, we currently have a number of different IOLs to choose from to achieve the best outcome for our patients.

Presbyopic correction is now possible, and I have used all of the presbyopia-correcting lenses available with good results. In most cases, the Tecnis Multifocal IOL (Abbott Medical Optics Inc. [AMO]) is my preferred lens for reasons that are based upon both outcomes and the lens' design (Figure).

MAKING AN ASSESSMENT

In assessing any IOL, I evaluate several factors: ease of implantation, predictability of refractive outcome, quality of vision, range of focus (spectacle independence), patients' satisfaction, side effects, and long-term stability.

The Tecnis Multifocal IOL is based on an aspheric optic design meant to reduce the spherical aberration of an average cornea to zero. The Tecnis Multifocal has a full-diffractive posterior surface, which makes the diffractive optics pupil independent for optimal image quality at all distances under any lighting condition. The optic is made of acrylic and comes in both a one- and three-piece design. Both the 360° posterior square edge and the haptic offset to allow posterior vaulting against the capsule to limit the migration of lens epithelial cells. The frosted edge also minimizes edge glare. I am easily able to deliver the IOL through a self-sealing 2.4-mm incision using the Unfolder Platinum 1 Series Implantation System (for a one piece; AMO) or 2.5-mm incision with the company's Unfolder Emerald Series Implantation System (three piece). Once the IOL is in the bag, I find it centers easily and remains stable long term. I do not spend any significant amount of time manipulating the lens. Nor have I ever had to reposition or explant one.

EXPERIENCE WITH THE LENS

I have used the Tecnis Multifocal IOL for 6 years, as I was one of the investigators in the clinical trial. The results of that trial were outstanding and mirror the outcomes I continue to achieve with my patients today. In that study, 94.6% of subjects implanted bilaterally with the lens reported being satisfied with their vision.¹ Also at 1 year, 92.1% of the subjects had 20/25 or better distance UCVA and saw 20/32 or better at near with distance correction in place (n = 291). More than 86% of subjects reported never wearing glasses, and slightly less than 90% were able to function comfortably without glasses at all distances (96.9% at near, 89.7% at intermediate, and 95.5% at distance).¹ Only 1% always wore glasses, an outcome I find very impressive.

I have not received complaints of poor image quality, which I believe is attributable to the wavefront aspheric design. Good quality of vision is extremely important in my assessment of which IOLs I prefer to



Figure. The Tecnis Multifocal IOL's design is based on an aspheric optic meant to reduce the spherical aberration of an average cornea to zero.

use and is one of the main reasons I select this IOL for my patients.

COUNSELING PATIENTS

All multifocal IOLs inherently reduce contrast and induce some amount of glare and halos. I am careful to counsel all patients that they should anticipate such side effects. Thus far, however, all of my patients have experienced neuroadaptation during several weeks to months that minimizes these symptoms to an acceptable level.

Achieving optimal refractive outcomes with the Tecnis Multifocal IOL requires careful preoperative, intraoperative, and postoperative care. Preoperative preparation requires optimization of the ocular surface, a thorough examination to exclude patients with conditions that would preclude good outcomes, and precise biometry and IOL calculations. As this lens does not correct astigmatism, any corneal cylinder above 0.75 D will need to be treated, and a plan must be made accordingly.

Fortunately, intraoperative implantation is no different with this lens, and for me, there has been no learning curve. With proper preoperative counseling, I do not find postoperative management to be excessively time consuming. I have come to enjoy very accurate refractive predictability and fortunately have not experienced any refractive surprises. My patients have been extremely satisfied with the lens, and as mentioned previously, I have never had a request for explantation.

Lastly, during the 6 years that I have had experience with the Tecnis Multifocal IOL, I have found it to be stable long term. I have not experienced late refractive shifts, and the lens has remained well centered.

GETTING THE BEST RESULTS

To achieve the best results with the lens, it is important to choose appropriate candidates. Certainly, patients should desire reduced dependence on glasses and contact lenses. They should understand not only the risks of cataract surgery in general but the potential side effects of the lens, including reduced contrast, glare, and halos. Either patients should have minimal corneal astigmatism, or the surgeon should have an appropriate method to manage astigmatism. Accurate preoperative keratometric and biometric measurements are critical, and ocular surface disease must be aggressively treated. Intraoperatively, safe and precise surgery goes without saying. Thorough cortical cleanup is particularly important to minimize any capsular opacity that could interfere with the lens' performance. I center the lens on the pupillary axis and find this leads to good visual outcomes. Managing expectations continues into the postoperative period,

although with proper preoperative counseling, this is not time consuming or onerous.

CONCLUSION

For me, the Tecnis Multifocal IOL has been a great lens for patients desiring reduced spectacle dependence after cataract surgery. The clinical results with this lens demonstrate high satisfaction and functionality among patients. Personally, I have been extremely pleased.

Elizabeth A. Davis, MD, is an adjunct clinical assistant professor of ophthalmology at the University of Minnesota and a partner and medical director of the Surgery Center at Minnesota Eye Consultants, Minneapolis. She is a consultant to Abbott Medical Optics Inc. Dr. Davis may be reached at (952) 888-5800; eadavis@mneye.com.

1. Tecnis Multifocal Foldable Acrylic Intraocular Lens [package insert]. Santa Ana, CA: Abbott Medical Optics Inc.; 2009.

An aspheric design and 3.00 D add have improved visual results and boosted the lens' popularity.



By Eric D. Donnenfeld, MD, and Allon Barsam, MD

Presbyopia-correcting IOLs are one of the most important transforming factors in the practice of anterior segment ophthalmology, and the AcrySof IQ Restor (Alcon Laboratories, Inc.) diffractive multifocal lens is the most commonly implanted presbyopia-correcting IOL in the United States. This technology offers patients visual rehabilitation for functional distance, reading, and intermediate vision. The surgeon's selection of patients, meticulous attention to detail, and optimization of postoperative results are the keys to successful outcomes with this lens.

OPTICS

The central 3.6 mm of the surface of the AcrySof IQ Restor IOL consists of 12 apodized diffractive optic rings with the +4.00 D model and nine rings with the +3.00 D model (Figure 1). The periphery of the lens is a traditional distance refractive optic. Apodization improves the distribution of light energy to the retina. The diffractive step height from the center of the lens toward the periphery is gradually reduced and blended.

This improves the quality of patients' vision and reduces light scatter, aberrations, and visual disturbances.

The optical profile of the AcrySof IQ Restor lens equally distributes energy between the two primary images at near and far for pupils that measure up to 3.6 mm. As the pupil becomes larger, more light is transferred to the far lens power. Near tasks generally require higher illumination, and the pupil constricts for near tasks with the accommodative reflex. Patients performing distance tasks, such as driving at night, benefit from the distance-dominant periphery of the lens when the pupil is larger. Patients with very large pupils may have less reading ability at near, especially in dim illumination, but benefit from improved distance vision.

INTERMEDIATE VISION

The 3.00 D add gives patients better vision at intermediate distances, whereas the 4.00 D add provides better near vision with less emphasis on intermediate vision. The introduction of the 3.00 D add increased the lens' working distance, allowing patients to perform more midrange visual tasks such as reading computer monitors, handheld devices, and cars' dashboards, and it preserves function for near activities. The defocus curve of the AcrySof IQ Restor IOL +3.0 D provides improved functional vision compared with the +4.0 D lens (Figure 2). In the past, surgeons combined different



Figure 1. AcrySof IQ Restor IOL +3.0 D.

multifocal IOLs to obtain functional midrange vision.

The bilateral implantation of the AcrySof IQ Restor IOL +3.0 D improves visual summation and patients' quality of vision. The aspheric design, which has improved contrast sensitivity and reduced dysphotopias, has further improved visual results and increased the lens' popularity.

CONVERSATIONS WITH PATIENTS

The first step in dealing with presbyopic patients seeking IOL surgery is to set realistic expectations preoperatively. We always talk to patients about common concerns such as glare, halos, quality of vision, residual refractive error, and the need for enhancements. Chair time spent with them before surgery pays dividends later. Telling a patient preoperatively that he or she may have glare and halos with a multifocal IOL sets an expectation and avoids his or her perceiving these occurrences as complications.

The best candidates for the AcrySof IQ Restor IOL (and the patients that less-experienced surgeons should begin with) are hyperopes and higher myopes who have significant cataracts and minimal astigmatism and who are motivated to reduce their dependence on spectacles for near and distance. Emmetropes, and especially low myopes, may feel that their distance or near vision was better prior to surgery and should be counseled accordingly. Patients do best with bilateral implantation, and the second cataract surgery should be performed within 1 month of the first.

SURGICAL CONSIDERATIONS

In general, all cataract surgery—and specifically premium IOL surgery—requires the careful selection and counseling of patients as well as a precise surgical technique. The optics of presbyopia-correcting lenses require exact centration, necessitating a well-centered capsulorhexis and high zonular integrity to achieve optimal visual results. Recent advances in technology with laser cataract surgery may permit greater centration and consistent sizing of the capsulorhexis that could enhance refractive outcomes with presbyopia-correcting IOLs.¹ Accurate biometry with the IOLMaster (Carl Zeiss Meditec, Inc.) or the Lenstar LS 900 (Haag-Streit AG) and control of astigmatism are also essential to maximizing outcomes. Because the lens constant must be carefully personalized to the individual surgeon, tracking postoperative results is imperative to refine surgical outcomes.

When implanting the AcrySof IQ Restor IOL, we do not expect patients to be fully functional until the second IOL is in place, and we tell patients this preoperatively. Bilateral implantation and an adequate neuroadaptive period are

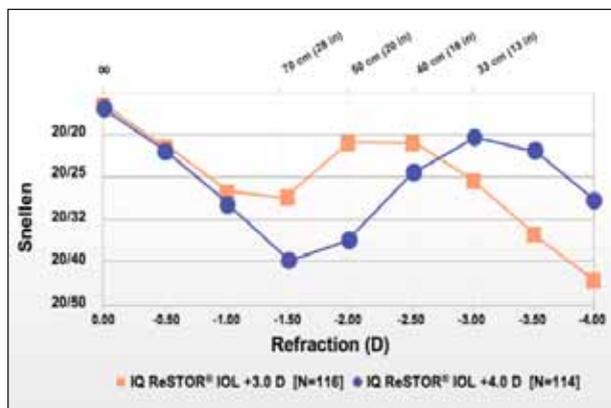


Figure 2. Binocular defocus curves from the clinical trial comparing the AcrySof IQ Restor IOL +3.0 D and +4.0 D illustrate that patients achieved a wider range of 20/25 or better intermediate vision with the former lens.

critical for the procedure's success. In the rare instances when a patient is extremely unhappy after surgery on his or her first eye, we refrain from operating on the second eye until the first surgical result has been optimized. In general, we do not consider explanting a lens until residual refractive error, ocular surface disease, cystoid macular edema, and capsular opacification have been addressed. We do not recommend implanting the AcrySof IQ Restor IOL in patients with unrealistic expectations, significant ocular surface disease (unless treated), irregular corneas, or maculopathy.

Patients are incredibly sensitive to small refractive errors with presbyopia-correcting IOLs, so surgeons must be willing and able to treat them. Astigmatism of greater than 0.50 D in a symptomatic patient requires surgical planning.

CONCLUSION

With attention to residual refractive error, the ocular surface,² cystoid macular edema, and the posterior capsule, surgeons can improve appropriate patients' quality of vision with the AcrySof IQ Restor IOL. The technology has enhanced the quality of life of many pseudophakic patients by reducing or eliminating their need for spectacles. As physicians' comfort with multifocal lenses improves in the coming years, these IOLs should become more popular, both with cataract and refractive surgeons and their patients.

Allon Barsam, MD, MRCOphth, is a corneal, cataract, and refractive surgery fellow at Ophthalmic Consultants of Long Island in Rockville Centre, New York. He acknowledged no financial interest in the products or companies mentioned herein. Dr. Barsam may be reached at abarsam@hotmail.com.

Eric D. Donnenfeld, MD, is a professor of ophthalmology at NYU and a trustee of Dartmouth Medical School in Hanover, New Hampshire. Dr. Donnenfeld is in private practice with Ophthalmic Consultants of Long Island in Rockville Centre, New York. He is a consultant to Alcon Laboratories, Inc. Dr. Donnenfeld may be reached at (516) 766-2519; eddoph@aol.com.

1. Kránitz K, Takacs A, Miháitz K, et al. Femtosecond laser capsulotomy and manual continuous curvilinear capsulorhexis parameters and their effects on intraocular lens centration. *J Refract Surg.* 2011;27(8):558-563.
2. Donnenfeld E, Solomon R, Roberts CW, et al. Cyclosporine 0.05% to improve visual outcomes after multifocal intraocular lens implantation. *J Cataract Refract Surg.* 2010;36:1095-1100.

Because of the lens' hinged design, YAG capsulotomy is associated with special considerations.



By Christopher E. Starr, MD

For patients who desire a greater depth of field while maintaining excellent quality of vision, free of optical artifacts, the Crystalens (Bausch + Lomb) is an obvious choice. The only FDA-approved accommodating IOL in the United States, it provides accommodation by shifting its anteroposterior position in response to vitreous pressure changes after contraction and relaxation of the ciliary muscle.¹

Patients implanted with the Crystalens have an improvement over monofocal IOLs in uncorrected near, intermediate, and distance visual acuity² and improved image quality over multifocal IOLs for objects at intermediate distances.³ The Crystalens model HD demonstrates improved optical performance at close object distances compared with its model AT predecessor, without a loss of distance vision.⁴ The latest advance over the HD model is the Crystalens AO, suitable for patients who want a lens with excellent aspheric optics to enable optimal visual acuity for a wide range of distances and exceptional clarity at intermediate distances. The Crystalens AO IOL does not induce any spherical aberration and optimizes the benefit of depth of focus produced by the positive spherical aberration inherent in the cornea (Figure). As with other presbyopia-correcting lenses, bilateral implantation enhances visual acuity outcomes.

Posterior and anterior capsular opacification are common occurrences after IOL implantation. Capsular opacification, when significant, can greatly limit a patient's visual outcome and hinder his or her daily activities. Since it can occur with any type of IOL—including premium ones—a patient is immune.

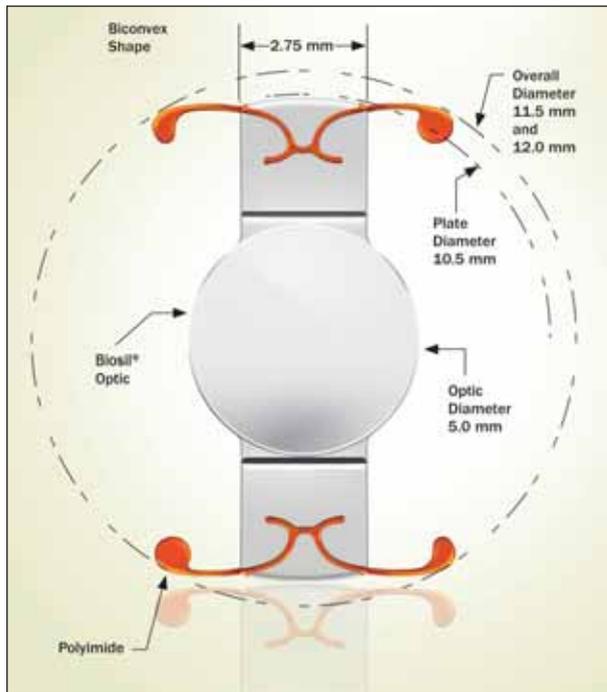


Figure. The Crystalens AO is aberration free.

With today's presbyopia-correcting IOLs, patients and surgeons have heightened sensitivity to even subtle capsular opacification and contraction. As a premium IOL surgeon, it is important to remain vigilant for visual changes, even at an early postoperative stage. Although capsular opacification can occur in any patient regardless of lens type or surgical technique, some intraoperative and postoperative strategies may help reduce this risk.

In cases with the Crystalens, I recommend making the capsulorhexis slightly larger than the optic (5.5-6 mm is ideal) to allow unrestricted forward accommodative movement and reduce the risk of anterior capsular phimosis and contraction. When implanting the Crystalens, I routinely perform thorough cortical removal as well as anterior, posterior, and equatorial capsular polishing with a silicone- or polymer-tipped I/A device. A variety of dedicated capsule polishers can also accomplish this important task.

I also use an extended postoperative drop regimen in which topical steroids and nonsteroidal anti-inflammatory drugs are continued for 6 to 8 weeks rather than the standard 4 weeks. I have found that, when these preventive measures are used with the newer Crystalens models, the rates of significant capsular opacification have decreased dramatically. With the current model's aspheric optics and modified surgical techniques, opacification rates in my practice are very low and are on par with those for monofocal acrylic IOLs.

THE UNIQUE CASE OF THE CRYSTALENS

Although capsular opacification is a risk associated with all IOL types, there are clinical manifestations unique to accommodating IOLs like the Crystalens. With a monofocal IOL, capsular opacification is usually visually significant when it occurs centrally in the posterior capsule. It reduces vision by clouding the capsule, with symptoms tantamount to a second cataract. In such monofocal IOL patients, the opacification is best treated by creating a central posterior opening in the capsule using a YAG laser to clear the visual axis.

With the Crystalens, simple central posterior capsular opacification can occur and blur vision.⁵ Albeit uncommon, other scenarios are also possible due to the dynamic nature of the Crystalens. As an accommodating IOL, the Crystalens has hinges at both of its optic-haptic junctions that permit the forward movement required for accommodation. Due to this unique mechanism of action, anterior, posterior, and even peripheral (equatorial) capsular opacification are possible. Asymmetric capsular contraction can lead to severe lens tilt and result in asymmetric vaulting, also known as the "Z syndrome," which features a significant induction of astigmatism and refractive shifts.⁶

CAPSULAR CONTRACTION SYNDROMES

Special considerations and strategies must be employed when performing a YAG capsulotomy on a Crystalens patient. First, the surgeon must identify the predominant areas of opacification and contraction and their effect on the patient's vision and refractive status. With the Crystalens, there are three types of capsular contraction syndromes to look for. The first, anterior capsular contraction syndrome, can result in a hyperopic refractive shift and decreased accommodative amplitude. The second is posterior capsular contraction syndrome with a myopic refractive shift. The third is Z syndrome, in which asymmetric posterior and/or anterior contractile force leads to one haptic's vaulting forward and the other's vaulting posteriorly. This often results in induced astigmatism along the IOL's long axis.⁶

To correctly identify and treat capsular contraction, it is critical to maximally dilate the pupil to see as far peripherally along the haptics as possible. Once identified, each of these clinical scenarios is easily and effectively treated with selective YAG capsulotomy.

ROLE OF YAG CAPSULOTOMY

In monofocal IOL patients with PCO, it is common practice to remove the central opacity by making a large cruciate-shaped opening with the YAG laser. In these patients, the aim is to clear the posterior capsule to ensure all the opacity in the visual axis is removed. With the Crystalens' smaller optic (5 mm), care has to be taken to avoid extending the

opening of the posterior capsule beyond the edge of the optic. Such an error may induce posterior migration of the lens, resulting in a hyperopic shift or lens tilting with resultant astigmatism. In cases of posterior capsular contraction syndrome, the surgeon should make a controlled, small, round, central opening of approximately 3 mm in the posterior capsule using the minimal laser power required. A circular pattern tends to be better controlled and has less risk of peripheral extension than crossed or cruciated laser patterns. It is also important to posteriorly offset the YAG (150-250 μm) to minimize any damage or dings to the aspheric silicone optic.

Some surgeons fear capsulotomies in Crystalens patients because of the risk of a shift in the refractive power of the eye and/or an unpredictable result. Based on my clinical experience, I have adopted the opposite view. I have found that YAG capsulotomy's outcomes are highly predictable and provide immediate visual improvements in almost all cases. Also, knowing that a less-than-perfect refractive outcome can be reversed or improved with a simple, minimally invasive and appropriately timed YAG capsulotomy is comforting to me as a surgeon. Consistent with my view, a recent study presented at the ESCRS 2011 meeting in Vienna reported that performance of a special YAG capsulotomy improves the mobility of the IOL and offsets surgically induced astigmatism.⁷

I recently had a patient who was implanted with the Crystalens bilaterally. This man enjoyed 20/15 uncorrected distance visual acuity and 100% spectacle independence for 2 years but was now complaining of poor vision. His visual acuity was 20/125 uncorrected, and he had an obvious Z syndrome with 2.00 D of induced astigmatism. Minutes after I performed a selective YAG capsulotomy, his visual acuity improved to 20/20, and he was again thrilled with his outcome (as was I).

Patience is key when undertaking the correction of capsular opacification in Crystalens patients. The rule of thumb is to wait at least 3 months before performing a selective YAG capsulotomy. As refractive shifts can occur after the capsulotomy, it is important to avoid undertaking a laser vision enhancement or astigmatic keratotomy until after a YAG capsulotomy has been performed and the refraction has stabilized. Keep in mind that, after a YAG capsulotomy, an IOL exchange is much more challenging to perform.

ADDITIONAL SURGICAL AND CLINICAL PEARLS FOR THE CRYSTALENS

Visual outcomes with the Crystalens can be optimized by creating a centered, round capsulorhexis of 5.5 to 6 mm and ensuring that the haptics are in the fornix/equator of the capsular bag. Too large a capsulorhexis may cause the lens to vault anteriorly, and an eccentric or small capsulorhexis

could precipitate capsular contraction and initiate the Z syndrome. One must ensure that the lens rotates freely in the bag during I/A and that all of the viscoelastic is evacuated from the capsular bag. The optic should lie posteriorly and be flush with the posterior capsule at the conclusion of the case to maintain the proper effective lens position. Wound leaks and hypotony in the early postoperative period may cause the Crystalens to vault anteriorly and result in a myopic shift or tilt. Watertight wound closure eliminates this problem, and I recommend having a low threshold for suture placement.

I have adopted a strategy of cycloplegia for the first 1 to 2 weeks postoperatively and end each case with a drop of atropine. By keeping the pupil cyclopleged, the optic remains posteriorly, the chamber remains deep, and refractive outcomes are more highly predictable. Another strategy that has optimized outcomes and patients' satisfaction in my practice is aiming for plano in the dominant eye and -0.50 D in the nondominant eye. This is by no means monovision; it is "blended" vision in which stereopsis is maintained and near vision is reinforced. Lastly, I have also had great success with the combination of a Crystalens in the dominant eye and a Tecnis Multifocal IOL (Abbott Medical Optics Inc.) in the nondominant eye, a "best-of-both-worlds" approach, which is ideal for certain patients.

CONCLUSION

As the first and only accommodating IOL in the United States, the Crystalens is a true game changer in surgeons' phaco-refractive armamentarium. By understanding the unique dynamics between the capsular bag and this novel IOL as well as the surgical pearls and clinical strategies outlined herein, surgeons and patients will enjoy optimal outcomes with the Crystalens. ■

Christopher E. Starr, MD, is an assistant professor of ophthalmology at Weill Cornell Medical College in New York and is the director of the refractive surgery service, director of the residency program, and director of the cornea, cataract, and refractive surgery fellowship. He acknowledged no direct financial interest in the products or companies mentioned herein. Dr. Starr may be reached at cestarr@med.cornell.edu.

- Coleman DJ. On the hydraulic suspension theory of accommodation. *Trans Am Ophthalmol Soc.* 1986;84:846-868.
- Cumming JS, Colvard DM, Dell SJ, et al. Clinical evaluation of the Crystalens AT-45 accommodating intraocular lens: results of the FDA clinical trial. *J Cataract Refract Surg.* 2006;32(5):812-825.
- Kim MJ, Zheleznyak L, Macrae S, et al. Objective evaluation of through-focus optical performance of presbyopia-correcting intraocular lenses using an optical bench system. *J Cataract Refract Surg.* 2011 Jul;37(7):1305-1312.
- Hovanesian JA. FDA study results of the Crystalens HD IOL: contrast sensitivity and near vision compared to the predecessor lens. Poster presented at: The American Academy of Ophthalmology Annual Meeting, October 24-27, 2009; San Francisco, CA.
- Hsu I, Jardim D, Soloway BD, Starr CE. The role of posterior capsule opacification with the Crystalens accommodating IOL. Poster presented at: The Association for Research in Vision and Ophthalmology, May 2005; Fort Lauderdale, FL.
- Jardim D, Soloway BD, Starr CE. Asymmetric vault of an accommodating intraocular lens implant. *J Cataract Refract Surg.* 2006;32(2):347-350.
- Reese J, Tomalla M. Nine months results after Crystalens HD implantation- combined surgery; intrastromal presbyopia correction and reconversion by Crystalens HD implantation. Paper presented at: The European Society of Cataract & Refractive Surgeons Annual Meeting, September 18, 2011; Vienna, Austria.