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Aspheric IOLs

As the lines between cataract surgery and refractive surgery become more and more blurred, the quest for "perfect" vision continues. In the past, millions of predominantly elderly people with clinically significant cataracts underwent surgery with implantation of a standard, spherical, monofocal IOL and enjoyed miraculous visual recovery. In today's world, the typical cataract patient tends to be younger and more active with higher demands on their vision. With the revolutionary introduction of the presbyopic IOLs over the past few years, we have been able to restore a much wider range of vision to patients after surgery. As such, we have seen a rise in the number of refractive lens or clear lens exchanges for patients without cataracts who want to treat their presbyopia surgically. But for those patients who don't mind wearing reading glasses after surgery and want the crispest distance vision, the monofocal lens is the best option. Enter the new wave of aspheric or wavefront guided IOLs to hit the market over the last few years. These lenses emphasize quality of vision over quantity and have taken the market by storm.

Human Optical System Changes

In order to understand how these new aspheric lenses are beneficial, we need to understand how the eye changes with age. On average, the normal human cornea has some degree of positive spherical aberration that is offset by the negative spherical aberration present in a young crystalline lens. This leads to an optical system with virtually zero spherical aberration and thus optimal image quality. As the lens changes with age to form a cataract, the spherical aberrations becomes more positive, adding to the positive corneal spherical aberrations which leads to a decrease in overall image quality and contrast sensitivity.

Spherical vs. Aspheric

Standard spherical lenses have a constant curvature on their surface that leads to some variation in focus power from the periphery to the center of the lens. These lenses also induce positive spherical aberrations. Aspheric lenses have a variable curvature design allowing constant, optimal focus power from all areas of the lens. This provides the sharpest, most optimal image quality and contrast sensitivity. Because of the superior optics, aspheric lenses are now standard on high-end cameras and surgical microscopes among many other devices. Furthermore, the FDA has labeled these lenses new technology IOLs (NTIOLs) supporting the claims that they provide improved image quality over the standard spherical lenses.

As stated above, the standard monofocal spherical lenses have positive spherical aberration. These lenses will simply add to the positive spherical aberrations already present on most normal corneas and produce decreased image quality. The aspheric lenses have zero or negative spherical aberrations that can offset some of the corneal aberrations to produce better contrast sensitivity. Currently, there are three aspheric IOLs on the US market.

Types of Aspheric IOLs

The zero aberration lens is the SofPort AO (Advanced Optics) silicone IOL (Bausch & Lomb, Rochester, NY). This lens does not add to or offset any spherical aberrations and also is immune to any decentration issues. Therefore, after cataract surgery the patient should be left with some mild positive spherical aberration from the corneal surface. Some people feel that minimal amounts of positive spherical aberrations are beneficial and provide improved depth of focus.

There are two negative aberration lenses that are currently FDA approved. One is the Acrysoft IQ lens (Alcon, Forth Worth, Texas) that is a single piece, natural blue-blocking acrylic IOL that has approximately -0.17 um of spherical aberration. The other one is the Tecnis lens (Advanced Medical Optics, Santa Ana, CA), which comes in both silicone and acrylic designs and has approximately -0.27 um of spherical aberration. The concept behind these lenses are that they can offset the positive spherical aberrations on the cornea to produce a virtual zero spherical aberration optical system to provide the most optimal image quality. Centration of these lenses is critical however, as any tilt or decentration can induce unwanted aberrations such as coma or astigmatism. Clinical

Figure 1. The Sofport AO IOL utilizes both anterior and posterior aspheric surfaces plus a uniform power across the entire lens

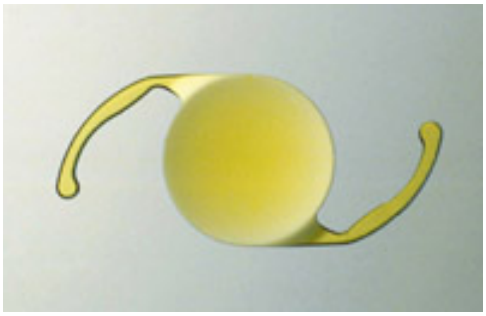

Figure 2. The AcrySof IQ IOL is a natural blue-blocking lens with a posterior aspherical design with negative aberration to offset positive corneal aberration

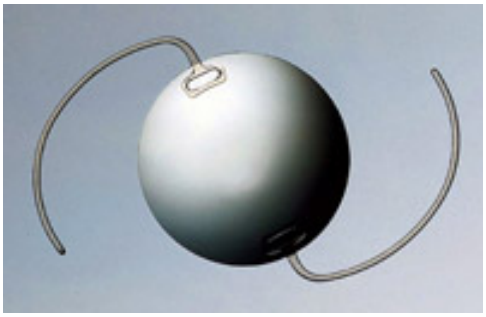

Figure 3. The Tecnis lens comes in both silicone and acrylic designs also producing negative aberration using a modified prolate anterior surface

studies have shown a marked improvement in simulated driving reaction time and nighttime driving with these lenses. Currently, there are many ongoing studies and trials aimed at quantifying the amount of contrast sensitivity and overall image improvement the aspheric lenses can provide.

Which Lens is Best?

So which aspheric lens is the best and how does one decide on the correct lens for each patient? For the vast majority of the population, any one of the three currently approved lenses can provide excellent results. I have used all three and feel that they all perform very well. In certain circumstances however, I may choose one lens over the other. For example, in a post myopic refractive patient who has flattening of the cornea, I usually opt for the Tecnis lens because it provides the most negative spherical aberrations to offset the induced positive spherical aberrations. In a patient where lens centration may be an issue or if depth of field is important to the patient, I may opt for the zero aberration SofPort AO lens. Certainly in patients with advanced diabetic retinopathy, I will use an acrylic lens over the silicone in anticipation of future vitreoretinal surgery. In a post hyperopic refractive patient or highly hyperopic patient with steep keratometry values, there is a decrease in corneal spherical aberration often to the point of negative values. In these patients, a standard spherical lens may be the best choice and one of the few instances where they may outperform the aspherics.

The recent trend towards improved quality of vision and optimal contrast sensitivity through technologically advanced IOLs has been significant and will continue to grow for years to come. I believe the aspheric lenses will soon replace the majority of the spherical lenses in use today to eventually become the predominant implanted monofocal IOLs on the market.

Calendar of the Upcoming Events for PVI Affiliated Doctors:

By invitation only:

07/25/07	Cataract and Lens Grand Rounds PVI, San Francisco, *Dr. Steve Chang*
08/16/07	Cataract and Lens Round Table PVI, San Francisco *Drs. Faktorovich, Chang, Lee*
09/20/07	Glaucoma Grand Rounds PVI, San Francisco, *Dr. Sidney Williams*
10/17/07	Medications Ground Rounds PVI, Peninsula, *Dr. Karen Oxford*
11/15/07	Retina Grand Rounds PVI, San Francisco, *West Coast Retina*
12/13/07	PVI Holiday Dinner Hornblower Yachts, San Francisco *Practice Management Presentation*
01/17/08	Refractive Surgery Grand Rounds PVI, Marin, *Dr. Ella Faktorovich*
02/21/08	Strabismus Grand Rounds PVI, Peninsula, *Dr. Kim Cooper*

General Educational Events:

03/21/08	7th Annual San Francisco Cornea, Cataract, and Refractive Surgery Symposium Ritz Carlton, San Francisco *Invited Guest Faculty*

Sight Gags *by Scott Lee, O.D.*

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