New-Generation IOLs

The recent introduction of several presbyopia-correcting and aspheric lenses raises questions about IOL selection for glaucomatous eyes.

BY MARK PACKER, MD

During the past 5 years, two new multifocal lenses, one accommodating IOL with its modified design, and four aspheric IOLs have been approved by the FDA. As physicians gain experience with these lenses and patients become aware of their availability, questions necessarily arise about the IOLs' role in individuals with glaucoma or glaucoma suspects as well as the lenses' impact on diagnostic testing.

MULTIFOCAL IOLs

Appropriate or Contraindicated?

Little research is available on multifocal IOLs in glaucomatous eyes. One study in the peer-reviewed literature focuses on the use of a multifocal lens (Array; Advanced Medical Optics, Inc., Santa Ana, CA) in patients with concurrent eye disease.[1] Unfortunately, the researchers did not separate the results by disease. Moreover, they only measured visual acuity and did not assess visual fields or contrast sensitivity. The investigators reported equivalent distance UCVA with the monofocal and multifocal lenses, but they found that near UCVA was better with multifocal IOLs, as one would expect. They also concluded that the lenses' implantation did not compromise the management of concurrent eye disease.

It is fairly well established in the FDA studies of multifocal IOLs that they reduce contrast sensitivity to some extent in healthy eyes. Because glaucoma also decreases patients' contrast sensitivity, one might decide that multifocal IOLs are contraindicated in this population. Many of these patients, however, are keenly interested in presbyopic correction. In the end, our choice whether to implant multifocal IOLs in a patient with glaucoma or a glaucoma suspect will be based on our clinical judgment. Several factors merit consideration in that decision.

Multifocal lenses always involve a tradeoff, and the recently introduced Acrysof Restor IOL (Alcon Laboratories, Inc., Fort Worth, TX) and Rezoom IOL (Advanced Medical Optics, Inc.) are no exception. Patients gain a significant measure of spectacle independence, but they must also adapt to unwanted visual phenomena such as glare and halos in addition to reduced contrast sensitivity.

It may be reasonable to consider a multifocal IOL in a person who has stable glaucoma, well-controlled IOP, normal foveal or parafoveal sensitivity, a cataract requiring removal, and a strong desire for spectacle independence. On the other hand, we cannot know if a patient with uncontrolled, progressive disease will lose central vision and his driver's license due to decreased contrast sensitivity with a multifocal implant at an earlier date than he would have with a standard monofocal lens. Most patients fall somewhere between the two individuals just described, and our decision may come down to their level of motivation for spectacle independence after detailed informed consent.

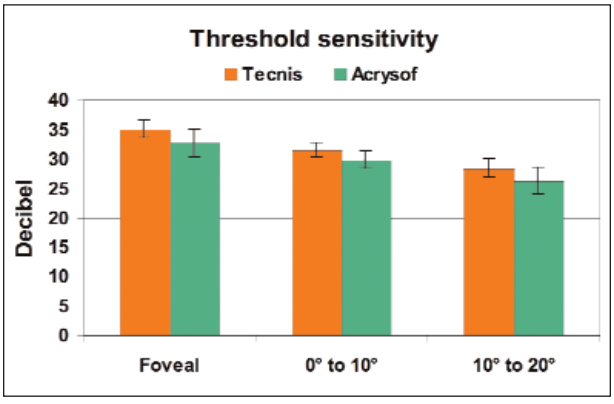

Figure 1. Bellucci[19] compared data (N = 30) on threshold luminance sensitivity in eyes with the Tecnis or the Acrysof SA60AT lens. He found that the foveal threshold, as measured by the Humphrey 30-2 test (Carl Zeiss Meditec, Inc., Dublin, CA), was significantly higher in the Tecnis versus the Acrysof IOL (mean ± SD; 35.06 ±1.45 dB vs 32.61 ±2.43 dB; *P*=.0041). Similarly, the central threshold—calculated as the mean of all measured points within the central 10°—was significantly higher in the eyes with the Tecnis versus Acrysof lens (mean ± SD; 31.41 ±1.29 dB vs 29.66 ±1.44 dB; *P*=.0038). Bellucci calculated the pericentral sensitivity as the mean of all of the measured points located between 10° and 20°. There was also a significant difference between the two lenses with values of 28.33 ±1.52 dB for the Tecnis IOL compared with 26.13 ±2.34 dB for the Acrysof IOL (difference = 2.20 dB, *P*=.0082).

Impact on Visual Field and Diagnostic Testing

A clinical situation cropping up now and sure to become more frequent in the near future is the diagnosis of glaucoma in patients who received the Array lens. When these individuals begin to develop progressive visual field loss and visual compromise, we will need to determine if their IOLs should be exchanged for another type of lens. The major questions are (1) is the multifocal IOL causing or contributing to their problem and (2) how do multifocal IOLs affect automated perimetry?

Research comparing the visual fields of glaucoma patients with monofocal versus multifocal lenses would be helpful. The only study I found in the literature compared the visual fields of patients who had received either of two different multifocal IOLs.[2] It is a start, but much additional research is needed. At present, some clues may be found in the literature on the effect of cataract and cataract surgery on visual field testing.

Cataracts depress an automated visual field fairly uniformly.[3] Cataract extraction results in a statistically significant improvement in visual acuity and foveal threshold in most eyes with glaucoma. In eyes with mild or moderate glaucomatous damage, the mean deviation often improves significantly after cataract removal, but improvement is less predictable in eyes with severe or end-stage damage. The pattern and corrected pattern standard deviations may be reliable indicators of glaucomatous damage in eyes with cataracts.[4]

A cataract does not produce a dense scotoma on automated perimetry. Because it does produce relative scotomata, however, actual glaucomatous visual field defects may be hidden to some extent. When a central, dense scotoma is present before surgery in two or fewer meridians, the patient may well achieve a substantial improvement in postoperative visual acuity.[5]

Although the mean logMAR BCVA improves significantly after cataract surgery, the average change in mean deviation is not significant. There is, however, a strong correlation between the change in foveal sensitivity and the change in mean deviation postoperatively. There is no relationship between the change in visual acuity or initial mean deviation and the change in mean deviation. Thus, although there is an improvement in BCVA after cataract surgery, the changes in the visual field as a whole are negligible.[6]

Another unknown is whether and how multifocal IOLs affect advanced imaging technologies.

ACCOMMODATING IOLs

At present, the only accommodating IOL available in the US is the Crystalens (Bausch & Lomb, Rochester, NY), but others such as the dual-optic Synchrony lens (Visiogen, Inc., Irvine, CA) are under investigation. The Crystalens is an option to consider for patients with glaucoma or glaucoma suspects who strongly desire a presbyopia-correcting IOL. In the FDA study, subjects exhibited equivalent contrast sensitivity after receiving the accommodating lens or a monofocal lens. In essence, the Crystalens is a monofocal lens that creates pseudoaccommodation, although its mechanism of action remains the subject of debate. The IOL may move within the eye to some degree, change its conformation, or simply increase the depth of focus by virtue of its relatively small optic located posteriorly in the eye. Regardless, this IOL does not compromise patients' contrast or threshold sensitivity.

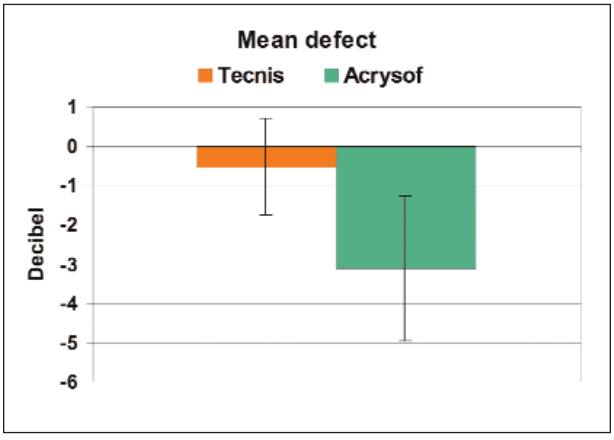

Figure 2. In Belluci's study,[19] the mean defect in the entire central 30° was -0.53 ±1.22 dB versus -3.12 ±1.84 dB with the Tecnis and Acrysof IOLs, respectively (difference = 2.59 dB, *P*=.0013).

The downside to the IOL is that it corrects presbyopia less predictably than a multifocal lens. In the FDA study of the Crystalens, approximately 25% of subjects were free of their spectacles, and around 50% rarely wore glasses. In contrast, more than 80% of subjects receiving the Acrysof Restor lens never wore glasses in its FDA study. The figure was nearly 80% in a similar study of the Rezoom lens. Of course, the Crystalens is not associated with the dysphotopsia common to multifocal lenses.

My colleagues and I have found that the accommodating lens is especially successful in patients in their 50s and 60s and in high myopes. This IOL may be an appropriate choice in glaucoma patients who want a chance at spectacle independence without the tradeoff of decreased quality of vision. We do not expect the Crystalens to affect automated perimetry, because—with the standard best-spectacle correction and near add used in a visual field test—the lens functions in essentially the same way as a spherical monofocal IOL.

DISCUSSION

By Thomas W. Samuelson, MD

Choosing an IOL for patients with glaucoma is somewhat more complex than for individuals with otherwise healthy eyes. In his article, Mark Packer, MD, summarizes some of the important issues pertaining to IOL selection in patients with glaucoma. My own strategy is to consider three important lens-related variables: (1) biocompatibility; (2) sphericity; and (3) presbyopic correction.

BIOCOMPATIBILITY

The two most commonly employed biomaterials for IOLs are hydrophobic acrylic and silicone. Although the biocompatibility of the early silicone lenses was suboptimal, more recent generations of silicone may be the most biocompatible material. Overall, I believe that both hydrophobic acrylic and silicone offer superb biocompatibility, and the surgeon's preference will dictate the choice of lens material. The bulk of the data suggests that hydrophobic acrylic and silicone are superior to PMMA.

SPHERICITY

Dr. Packer nicely reviews the concept of spherical aberration. Specifically, in youthful individuals, the positive asphericity of the cornea is countered by the negative asphericity of the crystalline lens. With age and progressive opacification, the crystalline lens loses some of its negative asphericity, resulting in a net positive spherical aberration of the optical system.

In the past, the IOL was often additive to this positive spherical aberration. The availability of aspheric IOLs such as the Tecnis (Advanced Medical Optics, Inc., Santa Ana, CA), Acrysof IQ (Alcon Laboratories, Inc., Fort Worth, TX), and Sofport AO (Bausch & Lomb, Rochester, NY) more favorably influences the spherical aberration equation but to varying degrees. The Tecnis lens possesses the most negative sphericity, the Acrysof IQ IOL somewhat less, and the Sofport AO lens has neutral sphericity. As a result, these lenses may enhance visual function. For example, studies have suggested that the Tecnis IOL improves contrast sensitivity in otherwise healthy eyes undergoing cataract surgery. Although an as yet unproven hypothesis, one could reasonably surmise that glaucoma patients—known to have reduced contrast sensitivity relative to individuals without the disease—would be particularly good candidates for aspheric IOLs.

PRESBYOPIC CORRECTION

I have enthusiastically implanted both multifocal and, to a lesser extent, accommodating IOLs in normal eyes. I will also implant such lenses in eyes with early glaucoma, but I have been reluctant to implant them in eyes with significant visual field loss.

Dr. Packer touches on many of the important issues relevant to this topic. My primary concern pertains to the tradeoff in visual quality these IOLs require. For example, as Dr. Packer suggests, most studies indicate that multifocal IOLs reduce contrast sensitivity to some degree. Patients with otherwise healthy eyes tolerate this mild reduction well and consider it a small price to pay for their increased independence from spectacles.

Although the literature concerning this topic is virtually nonexistent, my gestalt tells me that patients with otherwise compromised visual systems should receive an IOL that maximizes the quality of their vision. Indeed, if such patients desire a greater degree of spectacle independence, I generally recommend monovision using aspheric IOLs. This approach can achieve maximal visual quality and best-corrected vision. Much of the time, the patient may also enjoy spectacle independence by the time-tested monovision strategy. When conditions require their maximal visual potential, however, spectacles are an easy option for achieving BCVA.

CONCLUSION

Recent generations of IOLs offer superb biocompatibility, minimize spherical aberrations, and, when appropriate, provide multifocality. Selecting the best lens for individuals with glaucoma may significantly enhance their quality of life.

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ASPHERIC IOLs

A number of studies have demonstrated that the aspheric Tecnis lens (Advanced Medical Optics, Inc.) enhances contrast sensitivity in healthy eyes.[7-14] More recently, peer-reviewed published clinical studies have also supported a reduction of spherical aberration and superior functional vision with the AcrySof IQ lens (Alcon Laboratories, Inc.) when compared with spherical IOLs.[15-18]

In 2002, Roberto Bellucci, MD, presented data demonstrating that the Tecnis lens enhances threshold sensitivity[19] (Figures 1 and 2). This finding implies that an aspheric lens might be a particularly suitable choice for patients with compromised visual fields.

The Tecnis IOL entered the US market approximately 5 years ago. More recently, the Acrysof IQ, Sofport AO (Bausch & Lomb), and the Afinity Collamer Aspheric CQ2015A (STAAR Surgical Company, Monrovia, CA) IOLs received FDA approval. The Tecnis lens provides -0.27 µm of spherical aberration compared with -0.20 µm with the Acrysof IQ IOL and -0.01 µm with the

Afinity Collamer Aspheric lens. The Sofport AO lens is aberration neutral (Z[4,0] = 0). Surgeons may now use corneal topographers to ascertain an eye's corneal spherical aberration and then choose which of the three lenses will yield their preferred degree of postoperative spherical aberration.

An important consideration for the general applicability of aspheric IOLs involves the range of spherical aberration in the cornea. In the design study of the Tecnis, investigators determined that approximately 90% of the patient population would demonstrate a benefit from the IOL's implantation.[20] In other words, the distribution of corneal spherical aberration found in the study population clustered around the mean such that 10% of subjects would demonstrate the same or greater absolute value of spherical aberration after the implantation of the modified prolate IOL than they would have after the implantation of a spherical IOL. Regardless of the precise proportion of outliers, it is clear that the further customization of the IOL could potentially benefit a wider population.

One approach to customization entails the selection of patients based on their preoperative corneal spherical aberration. On the other hand, a limitation of the selection process remains corneal aberrations (particularly astigmatism and trefoil) induced by surgery with IOL implantation.[21] Nevertheless, selection is capable of enhancing results,[22] and both wavefront-corrected and aspheric IOLs represent a significant trend in refractive cataract surgery. A challenge of customization is determining the desired postoperative state.[23]

The Tecnis Multifocal IOL (Advanced Medical Optics, Inc.) is currently in clinical trials. Like the Tecnis lens, the multifocal platform improves contrast sensitivity.[24] As with other multifocal designs, however, some degree of unwanted visual phenomena, including glare and halos, will be possible.

CONCLUSION

Knowing the expected effect of cataracts and cataract surgery on automated perimetry in individuals with glaucoma can improve our ability to interpret visual field examinations. Until prospective studies on new IOL technologies' effects on the glaucomatous eye and diagnostic testing become available, however, we will have to rely on our best judgment and our clinical experience when determining which lens to implant. Regardless, it is prudent to obtain new baseline visual fields approximately 6 months after patients undergo cataract surgery and IOL implantation, as Richard Lewis, MD, of Sacramento, California, has pointed out.[25]

A discussion of presbyopic correction and aspheric lenses should be a part of the expanded informed consent for patients with cataracts. After describing the options that are available, surgeons should provide a recommendation based on the patient's health, lifestyle, and goals. ■

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