Presbyopia-Correcting IOL Selection in Patients With Glaucoma: An Update

What factors must be considered when evaluating the evolving lens options for use in glaucomatous eyes?



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Surgeons today have access to a wealth of presbyopia-correcting IOL options, and the range of available technologies continues to expand. Over the past decade, a variety of premium IOL designs have come to market, with newer platforms developed to extend the range of spectacle-independent vision, reduce dysphotopsias, and address quality of vision. Traditionally, the unique characteristics of glaucomatous eyes have complicated the selection and use of premium IOLs. Recent evolutions, however, are making these technologies more accessible to patients with glaucoma.

Currently, many options are available for enhancing range of vision beyond standard monofocal IOLs. Accommodating IOLs, which rely on forward movement and/or optic flexing, have minimal effect on contrast sensitivity, as no light is split, stretched, or lost. However, these lenses have not yet gained wide adoption due to limited efficacy and variable effective lens position with current technologies.

Nonaccommodating IOLs, which occupy the majority of presbyopia-correcting IOLs implanted today, can be categorized into multifocal or extended depth of focus (EDOF) designs. Although most current multifocal IOLs are trifocal lenses that utilize diffractive optics, EDOF mechanisms include diffractive optics, wavefront shaping, spherical aberration induction, and small-aperture pinhole designs. Furthermore, enhanced *monofocal plus* lenses, although not quite EDOF technologies in performance, can provide some vision beyond classic monofocal optics.

There is often a trade-off to the range of vision gained with advanced technology IOLs, namely diminished contrast sensitivity and quality of vision, and an increased risk of dysphotopsias. For patients with glaucoma and already reduced contrast sensitivity, the potential for further compromise of quality of vision is particularly concerning, as this can lead to poorer low contrast visual acuity and increased difficulty with low-light tasks.

This article provides an update on IOL selection for glaucomatous eyes, focusing primarily on new lenses that have entered the North American market.

GLAUCOMA AND IOL CONSIDERATIONS

Glaucoma results in a reduction in contrast sensitivity at low spatial frequencies, which typically exacerbates the loss of contrast sensitivity that occurs naturally with age.[1] This reduction in contrast sensitivity has been shown to be correlated with progression of disease through structural and functional measures.[2] This association may be most prominent between full-thickness macular measures or central visual field parameters and contrast sensitivity at 6 cycles per degree.[3] As a result, implanting a presbyopia-correcting IOL that may diminish contrast sensitivity in an already compromised system at risk of progressing raises concerns.

Other concerns regarding the use of multifocal IOLs in glaucomatous eyes exist, including a loss in mean deviation on standard automated perimetry size III and size V[4] and wavy artifacts on OCT imaging, which could complicate the ongoing monitoring of diseased eyes.[5] Additionally, patients with glaucoma may be more likely to have smaller pupils,[6] and pupil-dependent technologies such as refractive multifocal IOLs may not perform as well in pupils smaller than 3.5 mm.[7]

Patients with glaucoma due to pseudoexfoliation (PXF) syndrome are also at risk for intraoperative complications secondary to weakened zonules, poor dilation, and postoperative lens decentration. This can lead to the underperformance of presbyopia-correcting IOLs and induce additional optical aberrations and refractive errors. We are therefore cautious about using presbyopia-correcting IOLs in eyes with PXF syndrome. In fact, even decentration of aspheric monofocals may increase higher-order aberrations. Thus,

we prefer to use aspherically neutral IOLs in patients with PXF syndrome.

MODERN MULTIFOCAL IOLS AND IMPACT ON CONTRAST SENSITIVITY

Several Cochrane reviews have shown that, although multifocal IOLs may provide greater range of vision than monofocal IOLs, they may also cause more halos, more glare, and—most notably for patients with glaucoma—reduced contrast sensitivity.[8,9] Recently, a technology report by the AAO also concluded that presbyopia-correcting IOLs improve range of vision with less spectacle dependence but are associated with increased visual phenomena and decreased mesopic contrast sensitivity.[10] Although these studies were not performed in glaucomatous eyes, it stands to reason that the effects may be pronounced in patients with glaucoma and a preexisting reduction in contrast sensitivity.

Multifocal IOLs that have more recently emerged include the AcrySof IQ PanOptix IOL (Alcon), the FineVision IOL (Beaver-Visitec International), the Acri.LISA IOL (Carl Zeiss Meditec), and the Tecnis Synergy IOL (Johnson & Johnson Vision). These modern multifocal lenses appear to be associated with fewer side effects related to contrast sensitivity loss and visual disturbances than their predecessors, but concerns surrounding these risks remain.

EVIDENCE FOR MULTIFOCAL IOLS IN GLAUCOMATOUS EYES

A paucity of data on the potential of multifocal IOLs in glaucomatous eyes still exists, with most studies consisting of small sample sizes.[11] One early study demonstrated a benefit of multifocal IOL implantation in eyes with previous disease and found that concerns of potential visual disturbances were not as disruptive as previously thought.[12] More recently, a small study assessing visual function in patients with preperimetric glaucoma and perimetric glaucoma implanted with multifocal IOLs showed that nondiseased eyes had statistically better monocular distance UCVA and distance BCVA as well as better low contrast visual acuity than glaucomatous eyes.[13] Additionally, patients with glaucoma had more difficulty driving at night. The differences between nondiseased eyes and eyes with preperimetric glaucoma were not statistically significant.

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EDOF IOLS

EDOF IOLs provide an extended range of vision into the intermediate range but not as much near vision as multifocal IOLs. Some surgeons aim for micro monovision by targeting the nondominant eye slightly myopic (ie, -0.50 D) to enhance binocular near vision while retaining good binocular distance vision with overlapping focal zones that are well tolerated by the patient.

The Tecnis Symfony is a diffractive EDOF IOL that provides more of an elongated focal zone as opposed to multiple distant focal points as in a classic multifocal IOL. In a meta-analysis, study investigators found that this EDOF IOL had an increased risk of contrast sensitivity loss and halos compared with monofocal IOLs but had better contrast sensitivity than multifocal IOLs.[14] A 2018 comparative analysis showed no significant difference in contrast sensitivity between the Tecnis monofocal and Tecnis Symfony.[15] Therefore, the Tecnis Symfony is of particular interest for patients with underlying conditions that may affect contrast sensitivity. However, due to the diffractive design of this platform, halos and glare are still potential concerns.

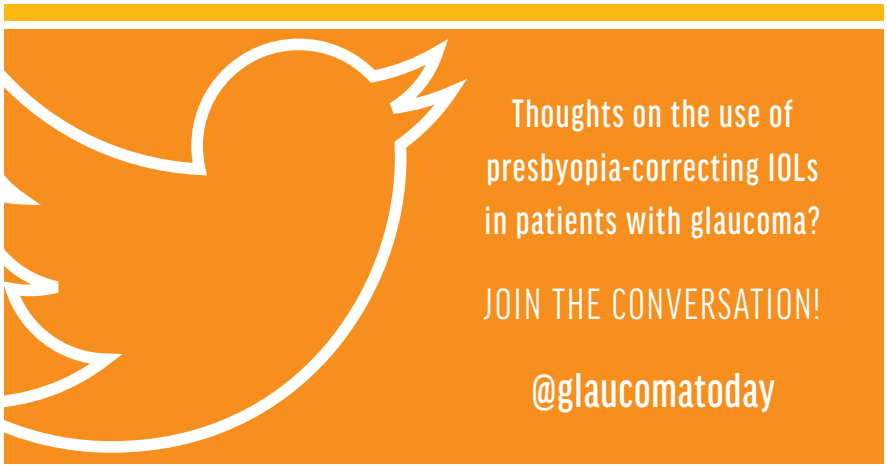
The recently FDA-approved AcrySof IQ Vivity (Alcon) is an EDOF IOL that features wavefront-shaping (or X-WAVE) technology. The Vivity IOL uses nondiffractive optics to provide distance and intermediate vision, and it has been found to have a visual disturbance profile similar to that of a monofocal IOL.[16] Reductions in monocular mesopic contrast sensitivity have been observed with increasing spatial frequency, although binocular contrast sensitivity is not significantly different from that with a monofocal IOL. With fewer associated visual disturbances, this lens may have a greater role in patients with comorbidities, although its impact on contrast sensitivity requires further study.

To date, no published study has reported the outcomes of EDOF IOLs implanted in glaucomatous eyes.

A DIFFERENT KIND OF MONOFOCAL

The Tecnis Eyhance (Johnson & Johnson Vision) is a "refractive" monofocal IOL that does not meet the full EDOF criteria but provides some additional intermediate vision with a power change over the central optic. The Eyhance has a visual disturbance profile that is similar to that of a standard monofocal IOL and a contrast sensitivity profile similar that of an aspheric IOL.[17] Thus, although the Eyhance provides a more limited range of vision than other IOLs in this review, it provides additional intermediate vision and, with its contrast performance, appears suitable for all patients with glaucoma. We often target mini monovision with this lens (ie, -1.00 D in the nondominant eye).

Monofocal IOLs that leave some residual positive spherical aberration in the eye, such as the spherical aberration–neutral enVista (Bausch + Lomb) and the AcrySof IQ monofocal (Alcon), may slightly increase the range



of intermediate vision compared with an IOL that attempts to fully correct spherical aberration.

CONCLUSION

As presbyopia-correcting IOLs continue to evolve and improve in technology and design, an increasing number of lenses may be appropriate for implantation in glaucomatous eyes in the future. However, more studies are required to evaluate this possibility. As a principle, every patient should be given consideration for a presbyopia-correcting IOL, with the known potential increase in visual disturbances and contrast sensitivity loss. Ultimately, our job as physicians is to enhance patients' quality of life, which involves reducing their dependence on glasses if desired. However, adhering to the principle of *primum non nocere*, we must be careful not to further compromise quality of vision. Most notably, contrast sensitivity loss is the main concern when considering presbyopia-correcting IOLs in patients with glaucoma. Furthermore, it is essential to consider the long-term risk of progression and quality of vision down the road.

Modern multifocal IOLs have improved light transmission and minimized contrast sensitivity loss compared with older generations, whereas EDOFs have an improved side effect profile. Enhanced monofocal IOLs differ little from standard monofocal IOLs in terms of downsides. These increasingly available technologies provide patients with comorbid diseases such as glaucoma more treatment options to consider.

We suggest avoiding the use of multifocal and EDOF IOLs in patients with advanced disease and/or central visual field defects, those who are at high risk for glaucomatous progression, and those with a heavy medication load. These patients have significant visual disabilities and may be at an increased risk of progressing. However, enhanced monofocal IOLs could be considered in all disease states, considering the excellent safety profile of these lenses.

Multifocal IOLs may be considered in cases of ocular hypertension, glaucoma suspects, or mild glaucoma that has been stable for some time. EDOF IOLs such as the Symfony have been found to yield less contrast sensitivity loss than multifocal IOLs and thus could be considered for a wider range of patients with glaucoma, including up to moderate disease. The Vivity may also be considered in this setting, although more data on contrast sensitivity loss with this IOL are needed.

Ultimately, IOL selection should depend on the patient's interest in reducing their spectacle dependence, their risk tolerance, their visual expectations and needs, the severity of their glaucoma, and their medication load. Whenever presbyopia-correcting IOLs are used in patients with glaucoma, every effort should be made to clearly manage patient expectations for their visual outcomes and possible contrast sensitivity loss. ■

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- Financial disclosure: Consultant (Alcon, Bausch + Lomb, Beaver-Visitec International, Carl Zeiss Meditec, Johnson & Johnson Vision)

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