

# IOL Selection in Patients with Glaucoma

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This article reviews the different IOL options for use in glaucomatous eyes, the factors that need to be considered when selecting the right lens, and what outcomes patients might expect.

**Cataract surgery provides** an excellent opportunity to enhance the quality of life for patients with glaucoma. Advances in intraocular lens (IOL) technology can now provide greater spectacle independence in selected patients and maximise quality of vision. However, to achieve optimal outcomes, careful consideration and counselling are necessary to match the right IOL technology to a patient's condition and expectations.

It is estimated that approximately one in five people undergoing cataract surgery have glaucoma or ocular hypertension. Both cataracts and glaucoma are conditions that increase with age.<sup>1</sup> Treatment with glaucoma eye drops<sup>2</sup> and filtration surgery<sup>3</sup> may also accelerate cataract development.

It is important to remember that for people with glaucoma and cataract, both conditions need to be adequately addressed. The introduction of cataract surgery combined with minimally invasive glaucoma surgery (MIGS) now allows both conditions to be treated in a single procedure. However, historically, the pathophysiological changes in glaucoma have limited IOL choices for people living with the condition. Fortunately, new presbyopia-correcting IOL technologies are providing greater options for people with glaucoma who wish to reduce their dependence on glasses.

## CHANGES IN GLAUCOMA THAT INFLUENCE IOL SELECTION

Glaucoma is associated with a loss of contrast sensitivity and this loss correlates with the degree of structural and functional glaucomatous damage.<sup>4</sup> Contrast sensitivity may even be affected in early glaucoma and is preferentially lost to a greater extent than visual acuity.<sup>5</sup> Decreased contrast sensitivity can cause visual symptoms and is a common cause of visual complaints, even where visual acuity is normal. In addition, contrast sensitivity decreases with age.<sup>6</sup> This is important when considering IOL selection. Because certain types of IOLs split light, less light reaches the retina and contrast sensitivity is reduced.

As glaucoma patients have impaired contrast sensitivity, special consideration must be given to the impact of the IOL on contrast sensitivity as there is a risk of compromising the quality of vision, especially in low-light conditions.

In addition to contrast sensitivity, there are other changes that can influence IOL performance. Eyes with glaucoma tend to have smaller pupils than non-glaucomatous eyes<sup>7</sup> and this can impair the performance of pupil-dependent IOL technologies. As well as poor pupil dilation, conditions such as pseudoexfoliative glaucoma may be associated with zonular weakness. This can lead to IOL decentration that can impair the performance of presbyopia-correcting IOLs and induce higher order aberrations.

The performance of presbyopia-correcting IOLs is affected by the quality of the tear film and ocular surface. Dry eye and ocular surface disease are more common in patients with glaucoma, especially in those taking multiple medications containing preservatives. Careful attention should be paid to the ocular surface and co-existing dry eye and lid conditions, such as blepharitis, treated pre-operatively. This is critical not only for IOL performance post-operatively but also to obtain the most accurate biometry measurements that will be used for surgical planning and IOL power selection pre-operatively. For patients with intolerance to glaucoma eye drops or where drops are ineffective, I discuss combining cataract surgery with a MIGS procedure to reduce medication burden and to help promote a healthy ocular surface that may in turn lead to better quality vision.

Lastly, glaucoma is a lifelong and potentially progressive condition. Before surgery, I evaluate many clinical factors including the stage of glaucoma, IOP control, adherence with therapy, optic disc appearance, retinal nerve fibre and ganglion cell analyses, visual field loss, risk factors for progression, and co-existing retinal/macular disease, to determine IOL suitability not only now, but in the future.



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Progression after IOL implantation could result in unwanted visual symptoms and compromise quality of vision. For this reason, I avoid multifocal or extended depth of focus (EDOF) IOLs in patients with advanced disease or central visual field defects, as well as those at high risk of progression. Patients must be carefully counselled on the outcomes they can expect and what lens is best suited to their individual circumstances.

**IOL OPTIONS AND HOW TO CHOOSE THE RIGHT LENS**

The choice of IOL is one of the most important decisions in cataract surgery as it will influence the quality and range of vision a patient may expect after the procedure. To select the correct lens, we need to understand the benefits, risks, and safety profile of each lens in relation to pre-existing glaucomatous change (and concurrent eye conditions), visual expectations, patient motivation, and occupational/recreational visual needs.

**Monofocal IOLs**

A monofocal IOL is an option for all stages of glaucoma. Providing excellent distance vision when aimed for emmetropia, these lenses require spectacle correction for intermediate and near activities. With greater use of tablets, digital automobile dashboards, and smartphones in everyday life, patients can find this frustrating. Monovision is a way to reduce but not eliminate spectacle dependence,<sup>8</sup> however it is associated with a loss of depth perception and suboptimal vision at intermediate distances.<sup>9</sup> For this reason, suitable patients motivated to reduce their dependence on glasses may be better served with monofocal plus, EDOF, or multifocal IOL technology.

A new type of monofocal is the Tecnis Eyhance (Johnson & Johnson Vision), part of a novel category called 'monofocal plus'. While not meeting the criteria to be categorised as an EDOF IOL, the unique refractive surface design of the Eyhance lens is designed to slightly extend the depth of focus, providing improved intermediate vision compared to a standard monofocal, while maintaining similar distance vision. I was fortunate to have early access to the Toric Eyhance and my patients reported ease with activities such as cooking and using tablet mobile devices. The lens has a low incidence of dysphotopsia and the company reports that it delivers 30% better image

contrast in low light at 5mm compared to a standard monofocal lens. As such, these features would suggest this lens may be safe to use in most patients with glaucoma.

I use monofocal IOLs for patients who are happy to wear spectacles for intermediate or near activities, or if there is (or there is a significant future risk of) advanced or central visual loss where the use of an EDOF or multifocal IOL may further reduce contrast sensitivity and compromise the quality of vision, especially for low-light tasks. For patients with pseudoexfoliation and weak zonules, a standard monofocal may be preferable as IOL power is the same from the centre to the edge and it will induce less aberrations if there is decentration in the future.

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**Toric IOLs**

Patients with glaucoma may have astigmatism, especially if they have undergone trabeculectomy.<sup>10</sup> Toric IOLs can safely and predictably reduce astigmatism and provide better uncorrected vision in patients with glaucoma.<sup>11</sup> Correcting even low levels of cylinder can improve the quality of vision. Toric lenses are available for all types of IOL and can be used in all stages of glaucoma. These lenses can be combined with astigmatically-neutral MIGS procedures but should be used with caution in combined cataract surgery with trabeculectomy because of the unpredictable degree of surgically-induced astigmatism with conventional filtration

surgery.<sup>12</sup> Similarly, caution should be applied when considering toric IOLs in patients with small pupils and zonular weakness due to the risks of misalignment, decentration, and dislocation.

**Extended Depth of Focus IOLs**

Extended Depth of Focus IOLs are an entirely new category of presbyopia-correcting lenses designed to improve range of vision, especially intermediate vision, with few photic phenomena and less loss of contrast sensitivity compared to traditional multifocal IOLs. As such, EDOF IOLs may be an option for people with glaucoma who wish to reduce their dependence on glasses, but otherwise may not be candidates for a multifocal IOL. Unlike multifocal IOLs, which create distinct focal points, EDOF lenses provide a continuous range of high-quality vision from distance into intermediate and even near, although not providing as much near vision as a multifocal. However, targeting the non-dominant eye for -0.5D can enhance binocular near vision for patients who demand superior near vision while retaining good binocular distance vision. EDOF IOLs provide excellent intermediate vision, which is ideal in today's digital lifestyle with increasing use of computers, tablets, and smartphones. These lenses have a low incidence of dysphotopsia and few night vision symptoms.



Figure 1. Johnson & Johnson Vision's Tecnis Symphony.



Figure 2. Alcon's AcrySof IQ Vivity IOL.

IOL DESIGN	DISTANCE VISION	INTERMEDIATE VISION	NEAR VISION	SPECTACLE INDEPENDENCE	LOW LEVELS OF GLARE AND HALOS
Monofocal	✓ ✓ ✓	✓ ✓	✗	✗	✓ ✓ ✓
Extended depth of focus	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓
Multifocal	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓

Table 1. IOL design and visual performance.

The Tecnis Symphony (Johnson & Johnson Vision) is an EDOF IOL that elongates focus, resulting in an increased depth of field. It is designed to provide a full range of continuous vision while maintaining high image contrast. Using proprietary achromatic technology, this lens corrects chromatic aberration to enhance image contrast, an important feature for patients with glaucoma. A study comparing contrast sensitivity between EDOF and multifocal IOLs found contrast sensitivity in mesopic and photopic conditions to be similar<sup>13</sup> while a separate meta-analysis showed that patients receiving EDOF IOLs had better contrast sensitivity than those receiving multifocal IOLs.<sup>14</sup> Similarly, a comparative study of four types of IOL found contrast sensitivity with the Tecnis Symphony to be comparable to a monofocal.<sup>15</sup> Another consideration in the use of presbyopia-correcting IOLs in patients with glaucoma is the impact on visual field sensitivity. A study comparing the Tecnis Symphony to bifocal and monofocal IOLs found that Symphony had little influence on visual field sensitivity, compared to bifocal IOLs that showed a decrease in visual field sensitivity.<sup>16</sup> As the Tecnis Symphony uses diffractive technology, halos and glare are a theoretical concern, but fortunately the incidence of dysphotopsia is low.

The AcrySof IQ Vivity (Alcon) is the first non-diffractive EDOF IOL that aims to deliver an extended focal range and has been shown to have a monofocal-like visual disturbance profile. Light is not split or distributed to several focal points, allowing for the entire light energy to be used. In a prospective, randomised, controlled trial of 220 subjects bilaterally implanted with either the AcrySof IQ Vivity IOL or a monofocal IOL, the AcrySof IQ Vivity group had superior intermediate and near vision compared to the monofocal control group without degradation of distance vision. The incidence of bothersome visual disturbances in the Vivity group was low or similar to the monofocal group, with only 1% of patients bothered very much by halos. To date, there is limited clinical data on the performance of the AcrySof IQ Vivity in glaucomatous eyes. My research has examined the visual outcomes, spectacle independence, and patient-reported satisfaction with bilateral Vivity IOLs implants, compared to bilateral monofocal IOL insertion, in patients with glaucoma. We found that bilaterally implanted Vivity IOLs provided excellent distance vision and better intermediate and near vision compared to monofocal IOLs in patients with glaucoma. Spectacle independence and patient satisfaction was significantly higher in patients who received a Vivity IOL. Photic phenomena were rare and seldom bothersome.

I offer EDOF technology to patients who have early to moderate, stable glaucoma with only peripheral field defects and

absolutely no loss of sensitivity in the central 10 degrees. Patients with secondary glaucoma or co-existing retinal pathology are poor candidates and may be better managed with a monofocal IOL.

### Multifocal IOLs

Multifocal IOLs provide distance, intermediate, and near vision with a high level of independence from glasses. However, as mentioned, these lenses split light and reduce contrast sensitivity which could theoretically impair the quality of vision in eyes with glaucoma, especially in low light level settings. While new generation multifocal IOLs have improved light transmission and less impact on contrast sensitivity than older generations, these lenses should be used with caution and on an individual basis for people with glaucoma. There is limited data on the use of multifocal IOLs in glaucomatous eyes and existing studies are small.<sup>17</sup> As such, I tend to restrict the use of these lenses to patients with primary angle closure, ocular hypertension, and stable pre-perimetric or early glaucoma.

## “The introduction of MIGS has enabled us to simultaneously address both cataract and glaucoma in a single procedure”

### CONCLUSION

For people with glaucoma and cataract, these are exciting times. The introduction of MIGS has enabled us to simultaneously address both cataract and glaucoma in a single procedure. For many people, this allows them to reduce their medication burden or even stop taking glaucoma eye drops. Now, with refractive cataract surgery and new IOL technology, we can also reduce dependence on glasses by correcting presbyopia and/or astigmatism at the time of lens extraction. Ultimately, these interventions help us maximise a patient’s quality of vision and improve their quality of life. 

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