



eyeInsights™

Latest Advances in Refractive Cataract Surgery



Mass General Brigham
Mass Eye and Ear



Dear Colleagues,

In the past decade there have been many exciting advancements in refractive cataract surgery. With the latest intraocular lens technology and a variety of lens options available, clinicians can customize treatment and maximize outcomes for each and every patient.

In this issue of *Eye Insights*, part one of our two-part series on cataracts, we describe what makes an ideal candidate for refractive cataract surgery and what pathologies may increase the risk of complications. Preoperative assessment and care are critical in determining the steps needed for successful surgery. Surgeons at Mass Eye and Ear use the latest technologies to provide the best outcomes for patients. Inside, you will also find an overview of the wide range of intraocular lenses (IOLs) available to patients today.

If you feel your patient is a candidate for refractive cataract surgery, we recommend referral to a refractive cataract surgeon for a full evaluation.

A handwritten signature in black ink that reads "Joan W. Miller". The signature is fluid and cursive.

Joan W. Miller, MD

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Is your patient a candidate for refractive intraocular lenses (IOLs)?

When evaluating the patient, it is important to get to know them well. What do they do for a living? Are they retired? What are their visual demands in life? Do they do a lot of nighttime driving or spend a lot of time on the computer? What are their visual priorities?

One critical question to ask is: **After cataract surgery, do you want to accomplish many of your daily tasks with or without glasses?** It is critical to gauge a patient's interest in surgery and set appropriate expectations. The clinician can then customize the implant technology to the patient's desired outcome.

Patient assessment

All patients should undergo a careful pre-operative assessment, including a thorough clinical exam, diagnostic testing, and a goals questionnaire to identify any pre-existing pathology that may preclude a patient from being a candidate for a premium IOL. Ideal candidates for premium lens technology are those without ocular comorbidities. Irregular astigmatism, higher order aberrations (HOAs) or corneal or macular pathology can preclude patients from being good candidates for this technology.

Diagnostic testing

Good quality testing, including but not limited to topography, biometry, OCT imaging, wavefront analysis, tear film analysis, and endothelial cell count for corneal pathology is critical. Testing can be confounded by ocular surface disease, so it is important to optimize the surface prior to performing the diagnostic testing. Patients may need repeat biometry after treating dry eye or other corneal conditions. vitrectomy. In contrast to gene-augmentation therapy, CRISPR/Cas9 genome editing is specific not only to a particular gene, but also to certain mutations in that gene.

Pre-existing pathology that may preclude patients from certain IOLs:

- Optic neuropathy
- Amblyopia
- Retinal pathology preventing "good vision" in an optically clear setting
- Irregular astigmatism (e.g., keratoconus)
- Elevated higher order aberrations
- Corneal scarring or corneal dystrophies such as Fuchs' dystrophy

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Optimizing the ocular surface before surgery

Careful assessment and management of the ocular surface is vital for optimal post operative refractive outcomes. The air-tear film interface is the highest index of refraction and can interfere with preoperative measurements if it is unstable or there is underlying corneal pathology as listed below. Refractive surprises can occur as a result and are often the reason patients are dissatisfied after cataract surgery.

Corneal pathology affecting preoperative measurements due to irregular astigmatism:

- Dry eye
- Anterior basement membrane dystrophy
- Pterygia
- Salzmann's nodular degeneration

Managing patient expectations

With the expanded selection of presbyopia correcting IOLs, it is crucial to educate patients about potential risks and help manage their expectations.

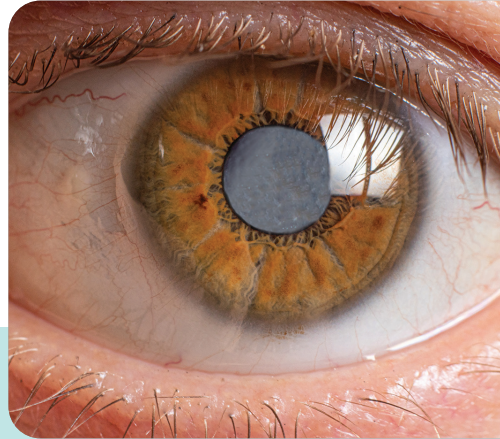
Some patients may still need to wear spectacles post operatively for certain conditions, such as reading fine print or night driving.

Patients who receive the premium lenses should expect time for neuroadaptation and optimization of their ocular surface and be educated on the potential need for a YAG capsulotomy or a laser fine tune for residual refractive error such as astigmatism.

Some IOLs can have risk of halo and glare, but typically once vision is optimized, neuroadaptation is possible for most patients.

Presbyopia-correcting IOL outcomes

If using a presbyopia correcting IOL in a patient with pre-existing pathology, such as early macular pucker, early macular degeneration, or other pathologies, the patient should be counseled about their final visual outcome; particularly, the risk of reduced image quality especially if their comorbidity worsens. The patient should also be made aware that having cataract surgery does not treat those comorbidities, and they may need to undergo further treatment or surgery for those conditions should they progress. The clinician should consult with the patient's retina specialist to confirm the IOL will not interfere with follow up retina care.



Patients may require, for example, a superficial keratectomy prior to cataract surgery to allow for smoothing of their ocular surface to achieve the best biometry measurements. This is a good opportunity to educate patients that treating the ocular surface may be a long-term process towards yielding the best refractive outcome.

Predisposing risk factors for ocular surface disease:

- Systemic medications
- Sjogren's syndrome
- Contact lens use
- Prior refractive surgery
- Concurrent use of other ophthalmic medications

Types of new refractive IOLs

In the past decade, several new IOL technologies have become available: extended depth of focus (EDOF), multifocal (MFIOL), and light adjustable lenses (LAL). EDOF IOLs offer a range of vision from distance to intermediate. MFIOLs, which are now available as trifocals, offer 3 steps of vision (distance, intermediate and near). The LAL is a monofocal lens that allows for post-operative adjustments based on refraction using a UV light to “lock in” the final desired power.

EDOF
<p>AcrySof IQ Vivity (Alcon Inc., USA) FDA-approved</p> <p>This non-diffractive lens that has proprietary wavefront shaping technology through elevation and curvature change that channels almost all the incoming light through the IOL. Outside the 2.2mm central optic, light is focused for the distance. Inside the 2.2mm central zone, the IOL provides continuous focus up to -1.5 to -2.0D. These changes help focus the central light for near vision as well as maintaining good image quality by not splitting the light as in diffractive IOLs which may reduce the risk for dysphotopsias and higher order aberrations. It offers similar visual outcomes to a monofocal but with an increased range for intermediate vision.</p>
<p>Symfony Plus Optiblu (Johnson & Johnson Inc., USA)</p> <p>This uses InteliLight technology which can reduce the risk of haloes and has improved contrast sensitivity. This technology filters violet light to decrease chromatic aberration without compromising near vision in dim light.</p>
<p>IC-8 (AcuFocus Inc., USA) FDA-approved</p> <p>This small aperture lens allows central light rays to travel through the central aperture and blocks unfocused peripheral light rays via a nondiffractive opaque mask, increasing the depth of focus up to 3.0D and reducing higher order aberrations.^{1,2}</p>
MFIOL
<p>Panoptix (Alcon Inc., USA) First FDA-approved trifocal MFIOL under Alcon Inc., USA</p> <p>This has a diffractive surface on the central 4.5 mm optic, which splits incoming light to add intermediate (+2.17D) and near power (+3.25D). This central diffractive 4.5mm optic allows high light utilization, offering optimized performance in various lighting conditions due to low dependence on pupil size. The anterior surface has negative spherical aberration to compensate for the positive spherical aberration of the average cornea.</p>
EDOF + MFIOL
<p>Synergy (Johnson & Johnson Inc., USA)</p> <p>Incorporating EDOF and MFIOL technology, Synergy combines diffractive features of EDOF and MFIOL to provide good distance vision while providing a continuous range of vision from intermediate to near. The EDOF technology reduces the risk of haloes and dysphotopsia commonly seen by MFIOLs while providing the range of vision MFIOLs can offer. Synergy also offers the InteliLight technology described above.</p>
Monofocal
<p>LAL (RxSight, USA)</p> <p>This monofocal silicone 3-piece lens can be adjusted postoperatively from -2D to +2D sphere and -0.5D to -3D cylinder. Two to four UV-protection light treatments may be necessary to fine tune to the lens prior to “locking in” the final refraction. The patient must wear sunglasses at all times postoperatively until the lens has been locked in. This technology can be particularly useful in patients with high risk for refractive surprises, such as those with a history of post refractive surgery.³</p>

¹ Kohnen T, Suryakumar R. Extended depth-of-focus technology in intraocular lenses. *J Cataract Refract Surg.* 2020;46(2):298-304. doi:10.1097/j.jcrs.0000000000000109

² AcuFocus. The IC-8 IOL: Big Advantages Through Small Apertures. *The Ophthalmologist.* Published online September 9, 2019.

³ Brierley L. Refractive results after implantation of a light-adjustable intraocular lens in postrefractive surgery cataract patients. *Ophthalmology.* 2013;120(10):1968-1972. doi:10.1016/j.ophtha.2013.03.010

Risk factors

In general, cataract surgery is extremely successful, and patients are satisfied with the outcome, especially if they have been counseled on what to expect. Occasionally, residual refractive error may require a secondary procedure (such as a laser vision correction enhancement) or astigmatic correction (such as an arcuate keratotomy) to allow for optimal visual outcome and satisfaction.

Despite optimization of the ocular surface, treatment of residual refractive error, and neuroadaptation, patients are occasionally unable to tolerate specific IOL technology and an IOL exchange can be considered. If a patient is unable to adapt to their IOL, an IOL exchange for a monofocal lens should be offered after an expanded discussion on the risks of a second surgery and loss of presbyopia correction with a monofocal IOL.

Referral guidelines

Consider a referral to a refractive cataract surgery specialist for patients who have had prior refractive surgery including LASIK, PRK or RK, have pre-existing pathology that could render them a borderline candidate for a premium IOL, or require an expanded evaluation and discussion to determine which lens is the best lens for them. Working with a refractive cataract surgeon who has experience with premium lens technologies is beneficial in assessing patient candidacy and lens selection.

Further reading

Kohnen T, Suryakumar R. Extended depth-of-focus technology in intraocular lenses. *J Cataract Refract Surg.* 2020;46(2):298-304. doi:10.1097/j.jcrs.000000000000109

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