CHAPTER 7

Preoperative Considerations for Cataract Surgery and Improving Refractive Outcomes

This chapter includes related videos.

This chapter includes a related activity.

This chapter includes case studies.

Highlights

- Modern intraocular lenses (IOLs) are typically made of either acrylic or silicone, are foldable and injectable, and have a biconvex aspheric optic with a square posterior edge.
- IOL-based strategies for correcting presbyopia include pseudophakic monovision, multifocal IOLs, extended depth of focus IOLs, and accommodating IOLs. Toric platforms of presbyopia-correcting IOLs are available.
- Approximately 40% of cataract surgery patients have 1.00 diopter (D) or more of preoperative keratometric astigmatism. Over 85% of adults have posterior corneal astigmatism that introduces against-the-rule corneal astigmatism.
- Modern IOL power formulas incorporate advanced optics, artificial intelligence, and/or ray tracing to improve accuracy. These formulas, along with improvements in optical biometers and the ability to measure posterior corneal curvature, allow surgeons to target refractive results more effectively through cataract surgery.

Intraocular Lens Technology

In addition to removing a cloudy lens, today's cataract surgeons can effectively correct refractive error and in some cases provide presbyopia correction with image clarity at multiple foci (distance, intermediate, and/or near). Improvements in preoperative biometry, surgical techniques and instrumentation, IOL technology and power calculations, and postoperative enhancement options have all yielded more accurate refractive outcomes following cataract surgery. Successful refractive cataract surgery requires informed discussion of lens options with the patient to determine what lens technology and refractive target would be most appropriate to achieve their goals. However, the surgeon is also responsible for identifying and discussing any ocular comorbidities that may limit lens selection, such as the need to consider zonular instability for a lens that requires careful alignment or centration for proper effect (Case Study 7-1).

CASE STUDY 7-1 Refractive target selection.
Courtesy of Karen Christopher, MD.
Available at: aao.org/

IOLs have undergone remarkable development in the decades since their introduction. For a discussion of the history of IOL design and development, see the Introduction in this volume. For additional detailed clinical discussion of IOLs and surgical presbyopia correction, see BCSC Section 3, *Clinical Optics and Vision Rehabilitation*, and Section 13, *Refractive Surgery*. For a discussion of cataract surgery and IOL selection in pediatric cases, see BCSC Section 6, *Pediatric Ophthalmology and Strabismus*.

Intraocular Lens Characteristics

Modern posterior chamber IOLs (PCIOLs) typically have the characteristics presented in Table 7-1. Foldable IOLs allow for a smaller incision size, which minimizes surgically induced corneal astigmatism and decreases postoperative wound complications. Injectable IOLs (either manually loaded into the injector cartridge or preloaded by the manufacturer) reduce IOL exposure to possible ocular surface contamination. Both silicone (which is hydrophobic) and acrylic (which can be either hydrophobic or hydrophilic) IOLs are suitable for most patients.

Because silicone oil can adhere to the surface of a silicone IOL (Fig 7-1), the surgeon may prefer to use an IOL made of other material in patients who will likely later require vitrectomy with silicone oil injection (eg, those with proliferative diabetic retinopathy or retinal detachment in the fellow eye). In addition, postoperative optic calcification of hydrophilic acrylic IOLs has been associated with exposure to air or gas. In patients who will be undergoing future intraocular surgeries that require the intraoperative use of gas (eg,

Table 7-1 Modern IOL Characteristics

Characteristic	Benefit
Foldable	Allows for a smaller incision
Injectable	Minimizes IOL exposure to ocular surface contamination
Aspheric optic	Improves contrast sensitivity by minimizing spherical aberration
Square posterior optic edge	Minimizes PCO
Biconvex optic	Allows for a thinner optic (and a smaller incision)
Acrylic or silicone material	Higher index of refraction allows for thinner optic

IOL = intraocular lens; PCO = posterior capsule opacification

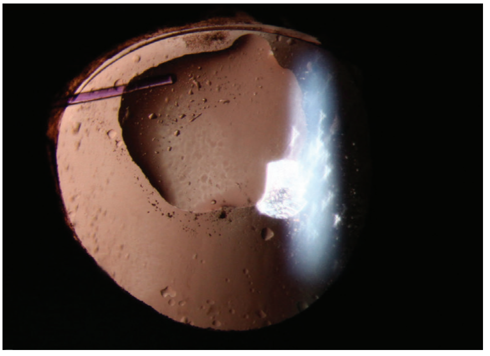

Figure 7-1 A large silicone oil droplet is adherent to the posterior surface of this 3-piece silicone intraocular lens (IOL). *(Courtesy of Christopher Kirkpatrick, MD, and Anna Kitzmann, MD. Photographer: Toni Venckus, CRA. Available at https://webeye.ophth.uiowa.edu/eyeforum/atlas/pages/silicone-oil-drop-IOL.htm)*

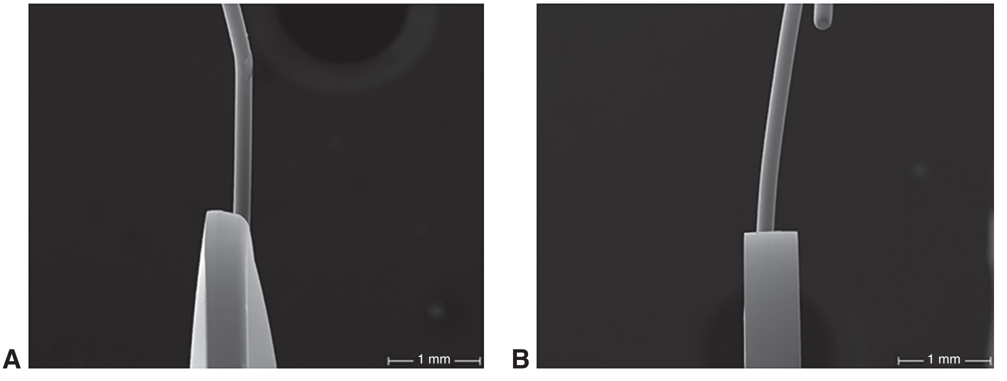

Figure 7-2 IOL design. **A,** An IOL with a round anterior optic edge and a square posterior optic edge. **B,** An IOL with square anterior and posterior optic edges. *(Reproduced with permission from Werner L. Intraocular lenses: overview of designs, materials, and pathophysiologic features.* Ophthalmology. *2021;128(11):e74–e93.)*

endothelial keratoplasty, vitrectomy), considering a different material may be advisable. Nd:YAG laser capsulotomy is not effective in treating this opacification, which may require IOL explantation.

IOL optic geometry has evolved from earlier plano-convex models to newer biconvex designs. The addition of a square posterior optic edge has reduced posterior capsule opacification (PCO) by blocking cell migration behind the optic (Fig 7-2). For more discussion of IOL design and PCO, including photos and illustrations, see BCSC Section 3, *Clinical Optics and Vision Rehabilitation.*

Most corneas have some degree of positive spherical aberration. Older IOL designs were spherical, which added positive spherical aberration to the eye's optical system and so decreased contrast sensitivity. Newer IOLs are aspheric, with zero or varying degrees of negative spherical aberration (ranging from 0 to –0.27 µm) to offset any positive spherical aberration of the cornea and thus improve contrast sensitivity. Note that corneas with prior *hyperopic* laser in situ keratomileusis (H-LASIK) or photorefractive keratectomy (PRK) treatments often have *negative* spherical aberration, and that surgeons should consider IOLs with zero spherical aberration for these eyes so as to not worsen the existing negative spherical aberration. In any eye, a decentered IOL that has any positive or negative spherical aberration will