CATARACT SURGERY IN EYES WITH KERATOCONUS

BY KAVITHA R. SIVARAMAN, MD

Know how to approach cataract surgery when corneal ectasia is present.

Eyes with keratoconus have corneal aberrations of varying severity. These abnormalities can affect many aspects of cataract surgery planning and execution. The surgical approach to patients with keratoconus therefore demands careful attention to both the corneal considerations inherent to cataract surgery and the management of patient expectations. Advances in IOL technology and the use of state-of-the-art diagnostic devices can increase surgical success and maximize a patient's visual potential.

The wider availability of topography and tomography is allowing ophthalmologists to identify more patients with mild and subclinical (ie, forme fruste) keratoconus. As a result, cataract surgeons are sometimes diagnosing keratoconus for the first time in patients presenting later in life for an age-related cataract evaluation.

PREOPERATIVE CONSIDERATIONS

► **No. 1: Determine the cause of the change in vision.** Keratoconus is traditionally thought of as a disease that progresses in the first few decades of life, but some forms—classically pellucid marginal degeneration—can present and progress later in life. It is therefore important to determine whether a patient's visual complaints are due to an advancing cataract or progressive corneal ectasia. Cataract surgery will not address ongoing visual changes induced by an unstable cornea. Historical keratometry or topography can help demonstrate corneal stability. If vision worsens despite relative stability of the corneal shape and an otherwise stable examination, a surgeon can be more confident attributing visual decline to an advancing cataract.

On the other hand, if progressive keratoconus appears to be a contributing factor to vision decline, several options are available to address the cornea. Mild, progressive keratoconus in patients who can still achieve good vision with glasses or contact lenses may benefit from CXL before cataract surgery. Patients with advanced keratoconus who are intolerant of or do not benefit from rigid contact lenses may be candidates for deep anterior lamellar or penetrating keratoplasty before cataract surgery.

► **No. 2: Set realistic expectations.** The visual outcomes of cataract surgery in patients with keratoconus depend on the severity of corneal aberration. Those who have good vision with glasses before surgery can often achieve good UCVA with a toric IOL. In contrast, patients who can achieve good vision only with a rigid gas permeable (RGP) or scleral contact lens typically are not ideal candidates for toric or diffractive

IMPLANTING AN ADVANCED TECHNOLOGY IOL IN A KERATOCONIC EYE

CASE NO. 1

A 77-year-old man presented for a cataract evaluation. The patient had no history of contact lens wear or surgery. Preoperative corneal topography and optical biometry are shown in Figures 1 and 2, respectively. The manifest refraction was -4.25 +1.75 x 160° OD and -4.25 + 1.25 x 163° OS.

The patient was counseled extensively that the quality of his vision after cataract surgery and implantation of a toric IOL might not be as good as it was preoperatively. He elected to proceed with surgery. A 15.00 D AcrySof IQ Toric IOL (model SN6AT6, Alcon) was placed in the right eye, and a 16.00 D AcrySof IQ Toric IOL (model SN6AT9) was placed in the left.

At postoperative month 1, the patient's UCVA was 20/20 OD and 20/25 OS.

CASE NO. 2

A 77-year-old man with corneal ectasia presented for a cataract consult for his right eye (Figure 3). The preoperative manifest refraction was -7.75 +10.25 x 158° OD. A +13.50 D IOL was implanted. Postoperatively, the patient's BCVA was 20/50 OD with a refraction of -1.25 +5.75 x 160°. The patient was dissatisfied with his spectacle-corrected vision and intolerant of both rigid gas permeable and scleral lenses. Progressive ectasia was suspected, and a deep anterior lamellar keratoplasty was offered to the patient, who was counseled that a significant hyperopic shift was expected postoperatively. He was advised of the possible need for contact lenses or IOL exchange to achieve optimal vision.

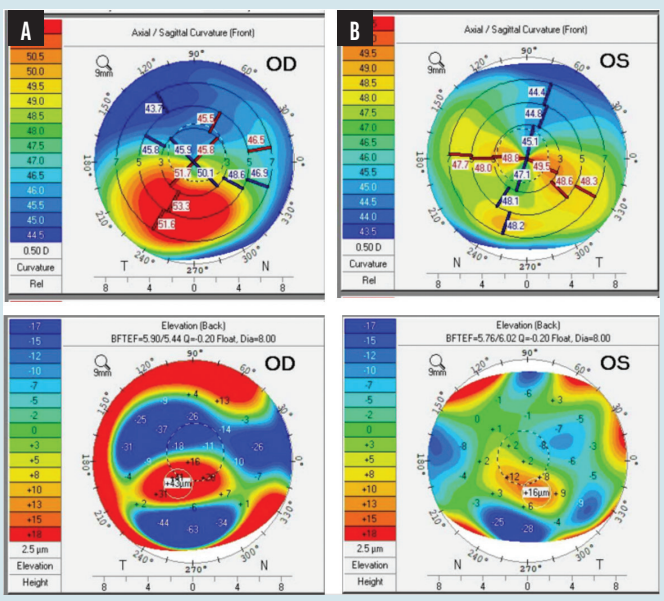

Figure 1. Preoperative corneal topography of the right (A) and left (B) eyes.

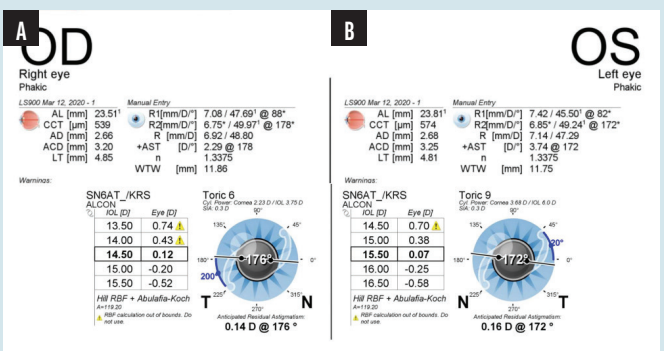

Figure 2. Preoperative optical biometry of the right (A) and left (B) eyes.

A

		OD Right eye		OS Left eye	
Measuring mode	Mode	Phakic		Phakic	
Axial length	AL	24.26 mm	±0.023 mm	24.29 mm	±0.026 mm
Cornea thickness	CCT	556 µm	±1.2 µm	610 µm	±0.7 µm
Aqueous depth	AD	2.40* mm	±0.001 mm	2.37 mm	±0.006 mm
Anterior chamber depth incl..	ACD	2.96* mm	±0.000 mm	2.98 mm	±0.006 mm
Lens thickness	LT	4.31* mm	±0.000 mm	4.76 mm	±0.017 mm
Retina thickness	RT	200** µm	±0.0 µm	200** µm	±0.0 µm
Flat meridian	K1	43.86* D @ 65°*	±0.251 D	40.53 D @ 110°	±0.123 D
Steep meridian	K2	51.92* D @ 155°*	±0.267 D	41.49 D @ 20°	±0.158 D
Astigmatism	AST	8.06* D @ 155°*	±0.1°	0.96 D @ 20°	±1.8°
Keratometric index	n	1.3375		1.3375	

B

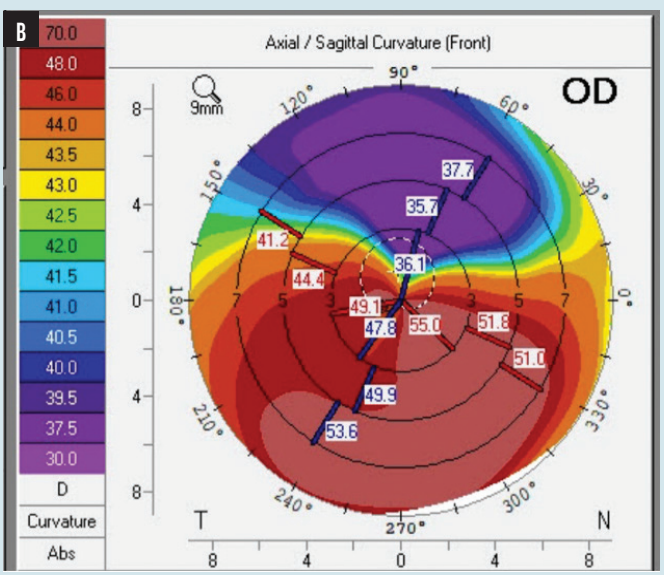

Figure 3. Preoperative biometry (A) and corneal tomography (B) of the right cornea.

multifocal IOLs, although exceptions may exist. I explain to patients that the rigid lens fills in the irregularities on the surface of the cornea, which cannot be replicated with an intraocular implant. It is therefore difficult to compete with the quality of vision they achieve with an RGP contact lens. Patients must be aware before cataract surgery that they will likely need to have their lenses refit after cataract surgery to achieve the best possible vision.

Regardless of whether they have keratoconus, patients should not be promised glasses-free vision after cataract surgery. It's also important to remind patients that their visual outcomes may not be comparable to what they've been told by friends or family members with normal corneas undergoing cataract surgery.

► **No. 3: Select an appropriate IOL.** I generally avoid multifocal diffractive IOLs in patients with clinically evident keratoconus. Other advanced technology IOLs, however, may be considered for some individuals with keratoconus (see Case No. 1 in the sidebar for an example). Key considerations for advanced technology IOLs in this population include the following:

- Is the keratoconus progressive? Consider a period of observation to ensure stability.
- Is the patient habituated to an RGP or scleral contact lens?
- Are the magnitude and axis of astigmatism reproducible across multiple modalities?
- Is the patient likely to need a penetrating keratoplasty or deep anterior lamellar keratoplasty in the future?
- How steep is the mean keratometry reading?

One newer option is the Apthera IC-8 small-aperture IOL (Bausch + Lomb). This lens creates a pinhole effect that can improve the quality and range of vision in keratoconus patients for whom a diffractive IOL is contraindicated. It should be noted that the IOL is approved for up to 1.50 D of corneal astigmatism, so the use of this IOL in keratoconus patients with higher astigmatism would be considered off-label.

► **No. 4: Calculate the IOL power.** IOL calculation is not a perfect science, even in eyes with normal corneas. Accurately predicting the ideal lens power becomes increasingly difficult with increasing corneal aberrations. Many patients with keratoconus use RGP contact lenses, which can induce significant corneal aberrations. It is therefore important to demonstrate stable keratometry after discontinuation of contact lens wear to ensure biometry is measuring the patient's true corneal shape.

The risk of a hyperopic surprise from unadjusted biometry increases with increasing corneal steepness, as described by Koch and colleagues.[1] One strategy is to aim progressively more myopic as the mean keratometry increases.[1] Another option is to use a keratoconus-specific formula such as the Kane keratoconus formula,[2] which accounts for the aberrations inherent to a keratoconic cornea, alleviating the need for a myopic fudge factor.

Surgeons should exercise caution before implanting a low-powered IOL based on steep keratometry in an eye that may ultimately need a penetrating keratoplasty or deep anterior lamellar keratoplasty. Eyes in this situation will have a significant reduction in mean keratometry after an eventual keraroplasty and thus become highly hyperopic (see Case No. 2 in the sidebar for an example).

Caution is also warranted when implanting toric IOLs in the eyes of patients who are habituated to an RGP or scleral contact lens. Even with topography that is otherwise amenable to toric IOL implantation, their unaided vision is often inferior to what can be achieved with a hard contact lens that vaults over the irregular cornea. Once a toric IOL has been implanted, hard contact lenses can be more challenging to fit owing to the added cylinder in the IOL plane.

Lastly, although it is possible to achieve success with toric IOLs in the setting of keratoconus, both surgeons and patients should recognize that it is possible to neutralize refractive astigmatism but still end up with a spherical refractive error requiring corrective eyewear. It is preferable to discuss this possibility preoperatively versus postoperatively.

► **No. 5: Know when to make a referral.** Whether they know it or not, most cataract surgeons have already operated successfully on patients with mild keratoconus. Certain scenarios, however, may warrant a referral to a cornea specialist who commonly performs cataract surgery on keratoconic eyes. Consider making a referral in the following situations:

- Patients with unrealistic refractive expectations;
- Patients who want a premium IOL but whose candidacy is questionable;
- Patients with severe keratoconus who may benefit from a keratoplasty; and
- Patients who are suspected to have progressive ectasia.

INTRAOPERATIVE CONSIDERATIONS

► **No. 1: Modify the surgical approach if necessary.** Cataract surgery in the presence of mild keratoconus is typically routine. A modified surgical approach is sometimes required in eyes with more advanced disease. In these situations, the incisions are less likely to seal on their own with stromal hydration. Be prepared to place a suture in the main incision and/or sideport incisions. If a suture is required to achieve watertight wound closure, it is best to leave it in place for several weeks before attempting removal.

► **No. 2: Prepare for an obstructed view.** The vector forces in an aberrated cornea are different than in a normal one. If the cone is steep and distorts my view, I coat the cornea with a dispersive OVD and add a few drops of balanced salt solution to even out

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the peaks and valleys. This technique also decreases the need for an assistant to rinse the cornea periodically with balanced salt solution.

POSTOPERATIVE CONSIDERATIONS

► **No. 1: Counsel patients about returning to hard contact lenses.** It can take a while to achieve refractive stability, particularly when sutures are required for wound closure. Counsel patients planning on resuming contact lens wear postoperatively to wait 4 to 6 weeks before being refit.

► **No. 2: Prepare patients for the possibility of having worse UCVA postoperatively.** Patients who have keratoconus, high mixed astigmatism, and good UCVA preoperatively can end up with worse UCVA after cataract surgery with monofocal IOL implantation. The best explanation I've heard is from my partner Michael Snyder, MD, who has noted that, even though the crystalline lens is dysfunctional, it still has different properties than an artificial lens. In other words, the natural cataractous lens can mask some of the aberrations of a highly abnormal cornea in ways that an artificial lens can't.

I counsel patients that the goal of surgery is to improve their vision with glasses or contact lenses but that it's hard to predict whether their unaided vision will be better or worse than it was before surgery. This is an important concept to discuss, even though it can be a difficult one for patients to grasp.

CONCLUSION

Corneal aberrations due to keratoconus can pose multiple challenges when approaching cataract surgery. Taking the pre-, intra-, and postoperative considerations outlined here into account can help lay the groundwork for successful surgery and good visual outcomes. ■

1. Koch DD. The enigmatic cornea and intraocular lens calculations: the LXXIII Edward Jackson Memorial Lecture. *Am J Ophthalmol*. 2016;171:xv-xxx.
2. Kane JX, Connell B, Yip H, McAlister JC, Beckingsale P, Snibson GR, Chan E. Accuracy of intraocular lens power formulas modified for patients with keratoconus. *Ophthalmology*. 2020;127(8):1037-1042.

KAVITHA R. SIVARAMAN, MD
- Medical Director, Cincinnati Eye Institute
- Cochair, Clinical Governance Board, Cincinnati Vision Partners
- *CRST* Section Editor, Fundamentals in Five
- ksivaraman@cvphealth.com
- Financial disclosure: None