The use of refractive IOLs, more specifically phakic IOLs, to correct myopia and compound myopic astigmatism associated with keratoconus is gaining popularity. The efficacy, predictability, and safety of most current phakic IOL designs have allowed many surgeons to extend indications for these lenses to include eyes with keratoconus. In a time when patients are turning their attention to lens-based options for refractive correction, it is no surprise that phakic IOLs are a major trend in the refractive market.

I prefer phakic IOLs to spectacles in these patients not only because they can correct myopia and compound myopic astigmatism but also because their intraocular placement provides magnificent retinal image quality. This article outlines the use of phakic IOLs in stable, progressive, and advanced keratoconus. Figure 1 depicts a flow chart of keratoconus treatments.

**STABLE KERATOCONUS**

The rate of disease progression in keratoconus varies from patient to patient. However, almost any eye with significant myopia or myopic astigmatism in which keratoconus has been stable for more than 2 years, as documented by manifest refraction and corneal topography, can benefit from phakic IOL implantation. One caveat is that the eye must have a BCVA that is acceptable to the patient. For the most part, implanting a phakic IOL into an eye with stable keratoconus is straightforward, and results are typically outstanding.
In patients in whom keratoconus is progressing, phakic IOLs are not beneficial unless the pathologic cornea is stabilized. This usually can be achieved with corneal collagen crosslinking (CXL; Figure 2) or implantation of intrastromal corneal ring segments (ICRS). After one or both of these treatments, the phakic IOL can be implanted secondarily to correct residual refractive error.

In advanced keratoconus in which visual acuity is unacceptable and the patient is intolerant to rigid contact lenses, deep anterior lamellar keratoplasty (DALK) with baring of Descemet's membrane is the best option, followed 3 to 6 months after suture removal with enhancement if necessary, either with laser refractive surgery or phakic IOL. In my experience, in 59% of patients, no secondary procedure is needed. I implant a phakic toric IOL to correct residual refractive error in approximately 17% of advanced keratoconus patients in whom I have performed DALK (Figure 3). I elect to per-

**PROGRESSIVE, ADVANCED KERATOCONUS**

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**TAKE-HOME MESSAGE**

- Phakic IOLs can provide fast rehabilitation and a wide range of correction of stable refractive error, including myopia and compound myopic astigmatism in patients with keratoconus.
- For phakic IOLs to have any benefit, the pathologic cornea must be stabilized.
- For correction of ametropia after corneal grafts, this author selects the toric ICL more often than LASIK because it has better predictability.
Phakic IOLs may also be implanted after CXL, ICRS implantation, or DALK.

form LASIK instead in approximately 14% of these patients, and in about 8% of cases a second laser enhancement is necessary. I choose the toric ICL for correction of ametropia after corneal grafts (STAAR Surgical, Monrovia, California) slightly more often than LASIK because it has a better predictability.

We recently conducted a study in 23 eyes of 17 patients with stable keratoconus, a clear central cornea, and intolerance to rigid contact lens. All patients had a BCVA of 20/40 or better, manifest refraction spherical equivalent between -4.00 and -15.00 D, and a stable manifest refraction for at least 1 year. Additional inclusion requirements were an endothelial cell count greater than 2,200 cells/mm² and an anterior chamber depth of at least 2.7 mm as measured from the endothelium.

In each eye, a posterior chamber toric ICL was implanted through a clear corneal incision. Twelve months postoperatively, UVCA was 20/40 or better in 90% of eyes and 20/20 or better in 55%. Additionally, 20% of eyes gained 2 or more lines of BCVA. We concluded that the toric ICL is a safe, effective, and predictable treatment for myopic astigmatism associated with stable keratoconus. Longer-term follow-up is necessary in a larger cohort of patients to ensure that results are stable as the disease progresses.

CONCLUSION

Keratoconus commonly presents during patients’ second decade of life, with gradual progression in most eyes. In such cases, phakic IOLs can provide fast rehabilitation and a wide range of correction of stable refractive error, including myopia and compound myopic astigmatism. When a toric ICL is used to correct compound myopic astigmatism, the only differences in technique from a spherical ICL are marking the axis on which the lens will be implanted and properly aligning the lens inside the eye (Figure 4). Phakic IOLs may also be implanted after CXL, ICRS implantation, or DALK.

This tool has found a niche in the refractive market because it does not weaken the cornea nor compromise the quality of vision, it is highly predictable, and it can be removed or exchanged. ■

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gical correction of presbyopia. Because presbyopia is progressive, it is reasonable to expect a decreased surgical effect over time. This procedure also has high technology requirements and a demanding surgical technique. When it is performed as an intrastromal ablation procedure, larger flaps than those used in standard LASIK and other femtosecond-assisted surgeries are required. One must be sure that no aberrations are induced by these larger flaps, such as by wrinkles or folds.

The preoperative examination must be flawless, and patients must be informed that presby-LASIK can produce the same visual symptoms as multifocal IOLs, such as halos and glare at night, decreased contrast sensitivity, and possibly blurred distance vision. However, patients can be told that contrast sensitivity should return to normal levels after 3 to 6 months. When a cataract develops, the presence of this multifocal cornea can make IOL power calculation difficult. However, new programs using elevation topography are being developed to overcome this difficulty. In any case, miscalculation can be corrected with a wavefront ablation that erases multifocality and allows the power of the IOL to predominate.6

CONCLUSION

Presby-LASIK is a safe and effective alternative for the surgical correction of presbyopia. It is better suited for young presbyopes in whom the risk for intraocular surgery is high. It is also indicated in the presence of other refractive defects, particularly astigmatism. The greatest advantage of this procedure is that it can be reversed, for which I use CustomVue (Abbott Medical Optics Inc., Santa Ana, California) corneal ablation.7

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