

OphthalmologyTM ROUNDS

AS PRESENTED IN THE
ROUNDS OF THE DEPARTMENT
OF OPHTHALMOLOGY
AND VISION SCIENCES,
FACULTY OF MEDICINE,
UNIVERSITY OF TORONTO

Advances in Refractive Surgery

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In recent years, refractive surgery has undergone significant technological advances that have led to enhanced safety, predictability, and patient satisfaction. In the past, the goal was to achieve an uncorrected visual acuity that was similar to the best-corrected acuity with contact lenses or glasses. Today, there is the potential for improving best-corrected acuity, as well as overall quality of vision. Over a 20-year period, excimer laser surgery of the cornea has evolved from a series of experiments in animals to >5 million clinical procedures. Advancements in laser vision correction and the evolution of other procedures (eg, phakic implants and refractive lens exchange) allow most patients the potential to be free of optical aids for distance vision and innovations are also being developed to help with near vision.

Refractive surgery patients are different from typical patients coming into the office. They are healthy, active, working people who don't have the time or inclination to sit in a waiting room. Because laser vision correction, phakic intraocular lenses (IOLs), and refractive lens exchange are elective procedures, these patients are selective about where to go for them. Respecting their time and any anxieties about refractive procedures are vital to the success of an eye-care professional. How well the office manages the patient's experience – from the first phone call to the last follow-up visit – will determine how rewarding refractive surgery will be for the patient and for the practice. This issue of *Ophthalmology Rounds* explores innovations in refractive surgery, patient selection, counseling, and postoperative care.

Indications

Patients selected for refractive surgery should be ≥18 years old with a stable refractive error. There is one exception to this rule: if the patient desires refractive surgery to qualify for an occupation (eg, a firefighter or a police officer), it doesn't matter if the refraction changes slightly from year to year. He/she will not be removed from an occupation just because, several years after qualifying, they refract at -1.00 diopters (D). The refractive indications for laser in situ keratomileusis (LASIK), advanced surface ablation (ASA), collagen shrinkage procedures, phakic IOLs, and refractive lens exchange are listed in Tables 1 and 2.

Laser vision correction

Although each refractive surgeon has his/her own upper and lower limits, the range of correction for LASIK and ASA is approximately +5.00 D to -10.00 D. Astigmatism between -0.25 D and -6.00 D may also be laser-corrected. Options in laser vision correction for both LASIK and ASA include either a standard or custom ablation (Figure 1). The best quality of vision and best-corrected visual acuity is achieved with a custom ablation that may be accomplished by an aspheric ablation, a wavefront-guided ablation, or a topographically-linked ablation.

An aspheric ablation uses keratometry readings to adjust the energy delivered to the mid-peripheral cornea so that a more prolate corneal curvature is achieved.¹ This curvature resembles the normal cornea, which is steeper in the centre and flatter on the periphery. This reduces the induction of spherical aberration and improves the quality of night vision.

A wavefront-guided ablation attempts to reduce higher-order aberrations such as coma, trefoil, and spherical aberrations that can affect quality of vision.² In general, patients with a low incidence of higher-order aberrations do well with an aspheric ablation,³ while those with a high incidence of higher-order aberrations do better with a wavefront-guided ablation.

A topographically-linked ablation corrects irregular corneas with resultant improvement in best-corrected spectacle acuity.⁴ Unlike wavefront-imaging that measures 150 to 250 refractive points of the eye, a topographic system can measure over 22,000 points on the cornea. Linking this data to the laser has the capability of improving best-corrected spectacle acuity in patients with keratoconus, forme-fruste keratoconus, and other forms of irregular astigmatism.

Recent improvements in outcomes after ASA (Figure 2) have been achieved with the development of flying spot lasers that produce a smoother ablation, larger optical and transition zones that fool the corneal healing response, cooling techniques (eg, ice) that decrease inflammation,⁵ and



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