



## REFRACTIVE SURGERY

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### ***At Issue:* Lens exchange vs. corneal refractive surgery**

*At Issue* posed the following question to a panel of experts: “For what refractive errors would you consider refractive lens surgery over excimer laser procedures such as LASIK, LASEK or PRK?”

#### **A: Consider age, corneal thickness**

**Noel Alpins, MD:** There are no hard and fast rules defining the refractive boundary where refractive lens exchange (RLE) is implemented in preference to corneal refractive surgery. The decision process is multifactorial, and the principal variable is the refractive error to be treated. Other fundamental issues include the thickness of the cornea, presence of any subclinical keratoconus signs and the age of the patient. The type of laser also has a bearing, as some take away more tissue than others do for the same refractive correction.

Looking at the influence of refractive error, myopia treatment requires an alternative to LASIK when the thinnest point of the cornea measures 480 to 500  $\mu\text{m}$  thick, or the remaining uncut and untreated cornea approaches 250  $\mu\text{m}$ . This can occur anywhere on the scale up to  $-12$  D. PRK or laser epithelial keratomileusis (LASEK) may be an alternative in many situations, but if other factors above come into play then RLE is the preferred choice.

However, PRK or LASEK are not good options for hyperopia, where central corneal thickness is less of an issue. When corrections exceed  $+3$  D or age is greater than 50 years, then the switch to RLE becomes more compelling. Associated astigmatism in excess of 1.5 D with either myopia or hyperopia is likely to require additional LASIK or PRK. This should be performed after the RLE, as the astigmatism is likely to change with the surgical incision and crystalline lens removal.

RLE is recommended when the risk of corneal ectasia is prevalent, such as insufficient corneal thickness or an unsuitable cornea due to a high posterior float or excess asymmetry. Surgeons who use lasers that are less suitable for PRK because of fixed transition zones or excess tissue removal would be required to switch to RLE at a lower refractive correction.

In the end, for each case, one has to weigh all the above factors together to decide whether that patient has crossed a boundary necessitating refractive lens surgery as the safer approach than applying treatment on the cornea.

#### **A: Older candidates preferred**

**Richard J. Duffey, MD:** There is a limit to the amount of flattening or steepening the cornea can undergo and still provide high optical quality visual function. When that limit is exceeded, corneal refractive surgery should be replaced with lens-based refractive surgery. Refractive lensectomy is employed in my practice for hyperopic refractive errors greater than  $+3$  D and myopic refractive errors exceeding  $-10$  D. Of course, corneal thickness, keratometric readings and age can influence these levels. I try to reserve lens replacement surgery (clear lens extraction or RLE) for patients over 45 years old who have already experienced presbyopia. Lensectomy in patients under the age of 40 years is hampered by immediate and complete loss of accommodative amplitude often accompanied by patient dissatisfaction. Under these circumstances, a monovision approach or a multifocal lens implant may offer an advantage, much as it would in the presbyopic patient greater than 45 years of age.

A major issue in refractive lens surgery is the accuracy of IOL powers and target refractions. The Holladay IOL Consultant software combined with the Zeiss IOLMaster for axial length and keratometric measurements have been major improvements to increase the accuracy of these calculations. Theoretically, the excimer laser is accurate down to 0.01 D, whereas implants are manufactured in 0.5 D increments. Refractive accuracy is better with the excimer laser relative to IOLs and patients must be informed of that fact in their preoperative consultation. Close attention must be paid to the accuracy of the IOLMaster for axial length measurements by assuring a clean spike (“Chrysler

Building" appearance), an SNR (surface-to-noise ratio) greater than 1.6 and low variability (less than 0.15 mm) between multiple measurements in the same eye. The IOLMaster axial length measurements tend to be very accurate in these clear lenses.

Keratometry readings also require a high level of accuracy and should be supplemented by topographical mapping. When greater than 0.75 D of corneal astigmatism is present, limbal relaxing incisions are employed to reduce astigmatism to less than 0.5 D in the final postoperative refraction readings. Residual refractive error that is present postoperatively can be managed with limbal relaxing incisions, excimer laser ablation or piggyback lens implantation.

Following refractive lensectomy, posterior capsular opacification and its subsequent visual degradation must be monitored. When high hyperopia exists requiring lens implantation of greater than 34 D, I will elect to do a primary piggyback procedure with the first lens implant placed in the capsular bag and the second in the ciliary sulcus. Rarely do I use multifocal lenses, and then only with a thorough discussion of postoperative halos, glare and the long adaptation period required with this technology. Finally, high myopes have an increased risk of retinal detachment following any IOL procedure and, in my opinion, these patients should undergo a thorough retinal evaluation with a retina specialist preoperatively before proceeding with lensectomy. Likewise, I will allow capsular opacification to progress further in high myopes before recommending YAG capsulotomy, compared to high hyperopes, because of this retinal detachment risk.

### **A: Consider myopia, hyperopia separately**

**Peter S. Hersh, MD, FACS:** In addressing this issue, I think that it is useful to look at myopes and hyperopes separately. For the former, important factors include refractive correction, in general, and its interplay with corneal thickness.

In regard to attempted correction, certainly myopia over 12 D to 14 D may make laser refractive surgery potentially problematic. This is more from the fear of poor predictability and visual outcome than from a visual function/higher-order aberration viewpoint. Indeed, a randomized study of LASIK and PRK for high myopia showed similar predictability and visual outcome for treatments of -6 D to -14 D. Of note, in this study, higher correction was not an independent risk factor for poorer results in either the uncorrected visual acuity or loss of best corrected visual acuity outcomes. Indeed, 70% of patients were 20/40 or better uncorrected, with virtually all other patients being undercorrected by more than 1 D, suggesting that results would be better still with a simple nomogram adjustment. Moreover, there was little difference between LASIK and PRK for all outcomes studied. Even with the older broad-beam laser system used in this study, only 4% of PRK eyes suffered more than mild haze; likely this is much less with current laser systems and, in some situations, with the use of adjunctive mitomycin-C.

Thus, from a strictly refractive viewpoint, I think that we have good evidence of safety and efficacy up to 14 D for both PRK and LASIK, given that the surgeon leaves the corneal thickness in a range minimizing, if not totally precluding, the risk of ectasia. If residual corneal thickness is problematic, then refractive lens surgery may be preferred.

Increased attempted correction in LASIK and PRK may increase higher-order aberrations and decrease visual function, however. In recent work, we found an increase in spherical aberration (towards a more oblate profile) within the optical zone with increased correction. Similarly, others have shown an increase in adverse optical side effects with increased correction and greater corneal flattening. Moreover, higher corrections may preclude a large treatment diameter because of corneal thickness considerations, and may thus make greater edge effects more likely, especially in patients with large pupils. Thus, degree of correction and pupil size might suggest a preference for refractive lens surgery in some instances. Here the risks of adverse optical sequelae of corneal surgery need to be weighed against potential complications of lens surgery.

In regard to hyperopia, many of the aforementioned considerations also apply. The effective range for good hyperopia outcomes is less than for myopia, however. Thus, for eyes over 5 D to 6 D, lens surgery may be the preferred option. Since the average age of the hyperopic refractive surgery patient is older than the myope (53 years vs. 41 years in my practice), often these patients will have incipient crystalline lens changes. Thus, the decision to do lens surgery in preference to corneal surgery is made all the easier.

### **References:**

- Hersh PS, Brint SF, et al. PRK versus LASIK for moderate to high myopia: A prospective randomized study. *Ophthalmology*. 1998;15:1512-1522.
- Hersh PS, Fry KL, et al. Spherical aberration after LASIK and PRK. *J Cat Refract Surg*. 2003;11:2096-2104.

## **A: Evaluate each on case-by-case basis**

**Thomas F. Neuhann, MD:** I prefer lens surgery – phakic implants and RLE – whenever the patient’s motivation is adequately strong and laser surgery cannot achieve the goal.

For myopia I will opt for lens surgery whenever I cannot achieve the refractive goal by laser surgery because of the following factors: a corneal bed thickness of less than 270 µm, which leaves a safety margin for re-treatment; a corrected zone of at least the diameter of the scotopic pupil; and a flattening of the cornea to not more than 34 D.

For hyperopia the limiting conditions are, besides the two first, a steepening not beyond 48 D and a total correction not exceeding 4 D.

For people with a remaining accommodative lifetime of valuable extent (which may be very subjective) and a deep enough anterior chamber (2.8 mm from posterior corneal surface to anterior lens surface), I prefer a phakic lens implant. My current choice is the ICL (STAAR) for IOL dioptric powers between –16 D and +10 D. Beyond that range, the Artisan/Verisyse (Ophtec/Advanced Medical Optics) IOL is my choice.

For people with less than a sensible accommodative lifetime and/or a shallow anterior chamber (generally the higher hyperopic patient), I recommend RLE.

The question of the risk for retinal detachment in highly myopic eyes with lens exchange surgery is the main obstacle to general acceptance of that option in the (pre-) presbyopic high myope. While this highly controversial topic cannot be discussed in depth in this context, I would strongly state that there is no evidence that the dogma of increased detachment risk after lens exchange with modern technique in high myopes is true. All existing scientific evidence suggests that for contemporary surgical techniques the assumption of such increased risk has no demonstrable basis. This includes our own data in about 2,500 eyes with greater than 27 mm of axial length (to be published).

In high hyperopes the RLE option has the additional advantage of creating the often so greatly needed space in the anterior segment.

While refractive lens surgery – additive or replacing – is certainly not to be regarded as trivial, there is, just as certainly, no scientifically based reason for exaggerated skepticism. The best guideline is, not surprisingly, a very individual evaluation of chances and risks on a case-by-case basis. There is no general “king’s way,” only an individual one.

It must not be forgotten: Refractive surgery in general – and certainly the lens option – is not good for ametropia(s). It may be very good for certain individual ametropes, which is a subtle but extremely important difference.

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