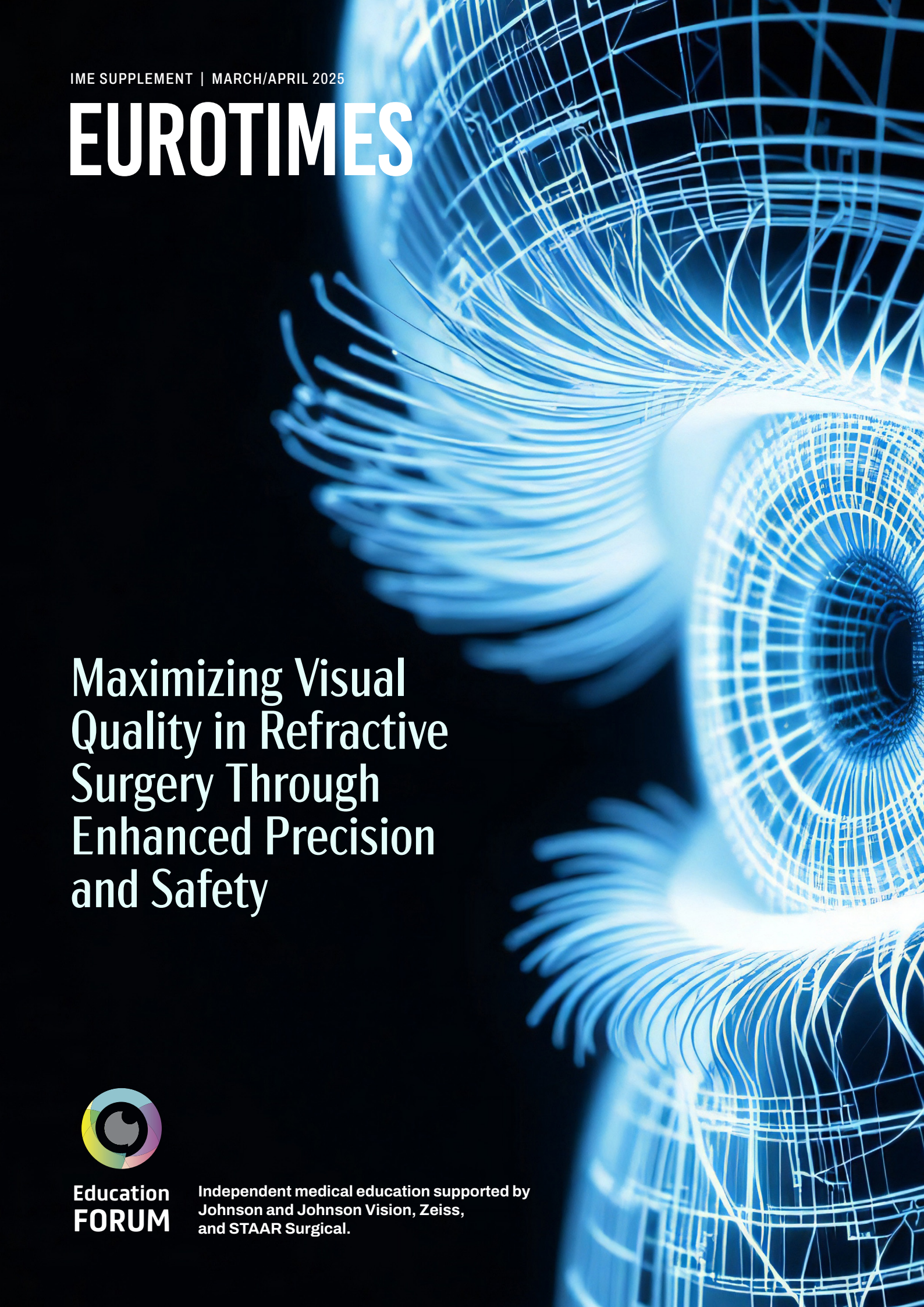
IME SUPPLEMENT | MARCH/APRIL 2025

EUROTIMES



Maximizing Visual Quality in Refractive Surgery Through Enhanced Precision and Safety

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ESCRS Clinical Trends in Refractive Surgery

BY THOMAS KOHNEN, MD, PhD, FEBO

Refractive surgery is revolutionary, allowing patients to see clearly while reducing or eliminating dependence on spectacles and contact lenses. Understanding practice patterns in refractive surgery may help ophthalmologists expand the reach of these procedures and improve quality of life for more patients.

Since 2020, the number of corneal refractive procedures performed per surgeon has increased by an average of 36 annually.

For the past 9 years, the ESCRS has conducted an annual survey to gain insight into clinical trends in various fields of ophthalmology. More than 3,000 respondents completed the ESCRS Clinical Trends Survey in 2023, which included questions about refractive surgical volume and procedure type, ocular surface evaluations, and the incidence of postoperative dry eye disease.

SURVEY RESULTS

The annual refractive surgery volume has fluctuated over the past years. Interestingly, an 8-year data trend showed a decreased volume around the height of the COVID-19 pandemic in 2020. Surgical volume increased every year thereafter but has still not reached the volume that was seen in 2016. Since 2020, the number of corneal refractive procedures performed per surgeon has been increasing by an average of 36 procedures annually.

When asked what the majority of their corneal refractive procedures were, 25% of 2023 ESCRS Clinical Trends Survey respondents indicated it was standard ablation, followed by wavefront-optimized (19%), wavefront-customized (17%), and topography-guided (17%) ablation. Only 10% of respondents selected femtosecond laser intrastromal lenticule extraction, and 13% of respondents selected other. Further, respondents reported on average to be preforming 123 corneal refractive procedures, 48 femtosecond intrastromal lenticule extractions, and 16 phakic IOL procedures in 2023.

Ocular surface optimization is an important component of the preoperative process to ensure success with refractive procedures. More than half (59%) of 2023 ESCRS Clinical Trends Survey respondents reported systematically checking the ocular surface during the preoperative refractive surgery examination in all cases, which is 11% higher than those who check during the preoperative cataract surgery examination (Figure 1). Postoperatively, on average 15% of patients experience dry eye after laser vision correction and 5% experience symptoms after femtosecond intrastromal lenticule extraction, respectively.

Are you systematically checking the ocular surface in you preoperative refractive surgery examination?

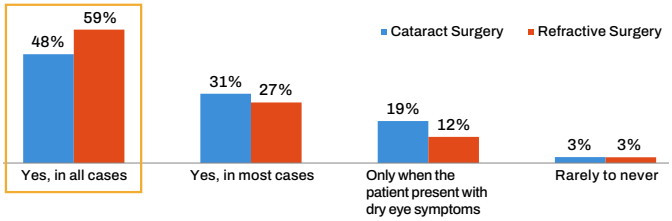

Figure 1. In 2023, 59% of respondents to the 2023 ESCRS Clinical Trends Survey systematically checked the ocular surface during the preoperative refractive surgery examination.

CONCLUSION

The data ESCRS collects through the annual ESCRS Clinical Trends Survey provides valuable insights. The results discussed in this article highlight a slight increase in annual refractive surgery volume, which hopefully will continue. Further, it is a useful guide to initiate change and move the field of ophthalmology forward.

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FINANCIAL DISCLOSURE: NONE

Maximizing Visual Quality With Today's Refractive Surgery

BY POOJA KHAMAR, MS, FCRS(NN), PhD

Refractive surgery has evolved from a focus on achieving 20/20 visual acuity to provide patients with exceptional depth of focus and visual quality at all distances. Today's patients, often professionals with high visual demands such as pilots, athletes, and IT specialists, expect more than just sharp vision—they seek a "wow factor" that supports their dynamic lifestyle, enhances their quality of life, minimizes recovery time, and ultimately addresses their unique needs.

To meet heightened patient expectations, it's crucial to leverage emerging technologies and refined surgical techniques. One example is femtosecond intrastromal lenticule extraction.

To meet heightened patient expectations, it's crucial to leverage emerging technologies and refined surgical techniques.

CURRENT AND EMERGING APPROACHES

Corneal refractive surgery has seen significant innovation in the past decade, particularly with advancements in lenticule extraction procedures. Recently, lower laser energy levels and new benchmarks for safety, precision, and patient satisfaction have translated into advanced lenticule designs, smoother interfaces, reduced tissue disruption, and faster visual recovery. Additionally, simplified procedural protocols help deliver remarkable visual outcomes on day 1. Patients today often achieve 20/20 or better vision immediately postoperatively, with minimal ocular scatter and smoother corneal interfaces.

RECOMMENDATIONS TO MAXIMIZE OUTCOMES

To maximize visual outcomes after femtosecond intrastromal lenticule extraction, several key surgical factors must be considered, including (1) laser energy and precision, (2) spot size and distance, (3) lenticule shape, and (4) biomechanical integrity, including management of dry eye.

Laser Energy and Precision

Lower energy levels contribute to a better quality of vision on day 1 and help decrease the incidence of stromal corneal edema on postoperative days 1 through 7 (Figure 1).

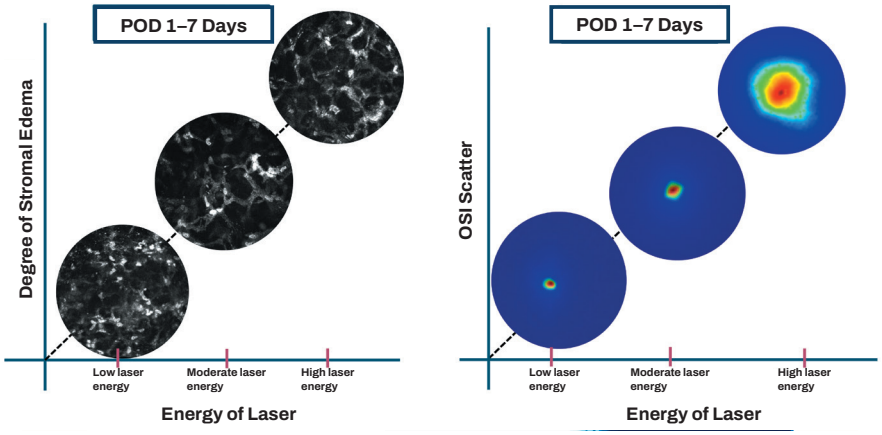

Figure 1. Lower energy levels decrease the degree of stromal edema and increase the postoperative quality of vision on day 1. [Courtesy of Dr. Khamar]

Spot Size, Distance, and Ease of Dissection

In addition to low energy (40 to 45 nJ), a small spot-size ratio of about 1 μm translates to minimal thermal damage and a smooth corneal surface, enabling a more predictable healing process. Tissue bridges are eliminated, and the dissection technique is easier. In many cases, the lenticule may be removed with a simple pressure exerted extraction of lenticule (PEEL) technique (Figure 2). After precise delineation of the posterior and anterior planes, the lenticule is grasped and advanced parallel to the limbus. Continuous tangential traction is exerted during the PEEL technique, and the lenticule is peeled from the stroma and examined for its entirety.

The benefits of a streamlined technique include postoperative day 1 visual acuity of 20/20 logMAR or better, improved objective scatter index on postoperative day 1, a smooth interface, and minimal distortion of the Bowman layer. Another advantage is that a manual cyclorotation adjustment can help reduce the risk of residual astigmatism and further improve refractive accuracy, especially in eyes with high astigmatism.

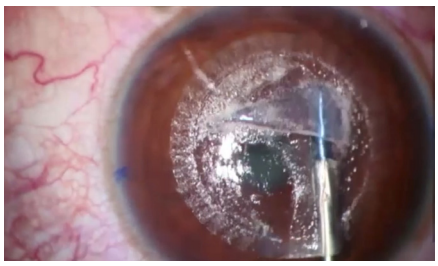

Figure 2. The PEEL technique for lenticule extraction. [Courtesy of Dr. Khamar]

Lenticule Shape and Impact on Outcomes

The creation of a biconvex lenticule may reduce the change in corneal curvature compared to a traditional plano-convex lenticule shape. This leads to better preservation of the sphericity and spherical aberration after surgery compared to that of a customized topography-guided laser ablation correction.[1] This not only enhances visual quality, including night vision, but also maintains depth of focus, which is particularly beneficial for eyes with low myopia and early-stage presbyopia.

Biomechanical Integrity

A biconvex-shaped lenticule also better preserves peripheral corneal nerves and leads to faster corneal nerve regeneration versus a traditional plano-convex lenticule shape. This helps maintain the tear film optics, creates better tear film stability, and reduces the risk of dry eye symptoms and other postoperative complications. Additionally, postsurgical epithelial remodeling is much more regular compared to a traditional refractive surgery procedure, reducing the risk for regression.

MEETING PATIENT EXPECTATIONS

Refractive surgery patients have unique demands and high expectations. Those with mild to moderate myopia particularly prioritize rapid recovery, sustained visual quality, and functional depth of focus. Many patients report dissatisfaction when they struggle with near-to-distance vision transitions, even when their overall vision is clear. Addressing these subtleties is key to patient satisfaction.

Preserving the natural spherical aberration and corneal sphericity with emerging femtosecond intrastromal lenticule extraction techniques and technologies may help ensure patients experience seamless transitions

between near and distance vision. This is especially critical for patients in the age range of pre-presbyopia (ie, 38 to 50 years of age) who often face challenges with near vision after surgery. Studies show that maintaining depth of focus comparable to emmetropic eyes may offer these patients a clear edge in visual quality without compromising long-term outcomes.[1]

CONCLUSION

Refractive surgeons have shifted their focus from correcting refractive errors to optimizing visual quality and patient satisfaction. Innovations in femtosecond intrastromal lenticule extraction that incorporate low energy, a small spot size and distance, simplify dissection, preserve peripheral corneal nerves, and facilitate faster corneal nerve regeneration. Overall, offering safe, precise, and effective solutions that cater to the diverse demands of modern refractive surgery patients.

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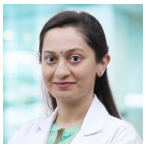

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Hyperopia: A New Era in Refractive Surgery

BY GLENN I. CARP, MBBCH, FCOPHTH(SA)

Hyperopia has long presented challenges for refractive surgeons, not only due to the anatomical and biomechanical complexities of the cornea but also because of the distinct expectations and demands of patients with hyperopia. These individuals are often older, presbyopic, and highly motivated to achieve clear vision at all distances without dependence on spectacles and contact lenses. This article explores the evolving landscape of corneal refractive treatments for hyperopia, focusing on advancements, challenges, and promising outcomes with both LASIK and femtosecond intrastromal lenticule extraction.

HOW TO APPROACH HYPEROPIC CORRECTIONS WITH LASIK

Patients with hyperopia are particularly sensitive to even minor residual refractive errors and may not tolerate postoperative regression or optical aberrations as well as those with myopia. This sensitivity demands precision in surgical planning, execution, and patient communication regarding realistic outcomes. Two important considerations for hyperopic LASIK treatments are centration and the amount of refractive error that can be safely treated.

A retrospective study of 60 consecutive patients with 2.50 D or more of hyperopia showed the best place to center the LASIK treatment is the coaxially sighted corneal light reflex, or the visual axis.[1] In the study, eyes were divided into two groups. One group had a small pupil offset (i.e., the distance between the entrance pupil centre and the corneal vertex was < 0.25 mm), and the other group had a large pupil offset (i.e., the distance between the entrance pupil centre and the corneal vertex was > 0.55 mm). Interestingly, results were similar between both groups, supporting evidence that treatment centration on the visual axis rather than the pupil centre is best.

Hyperopic ablations naturally induce central steepening, causing the epithelium to thin centrally and thicken peripherally in a compensatory manner (Figure 1).[2] The second consideration with hyperopic LASIK is the amount of hyperopia that can be treated safely. Therefore, it is crucial to avoid excessive hyperopic steepening and apical syndrome, the latter of which is characterized by epithelial breakdown when the central corneal thickness falls below 26 μm.

Treatment centration on the visual axis rather than the pupil centre is best.

Advanced imaging techniques such as epithelial mapping with B-scan ultrasound enable surgeons to monitor these changes and plan treatments safely. Special attention must be paid to outlier cases where flat corneas can have a thin epithelium, and some steep corneas have a thick central epithelium and it may be possible to further steepen the cornea.

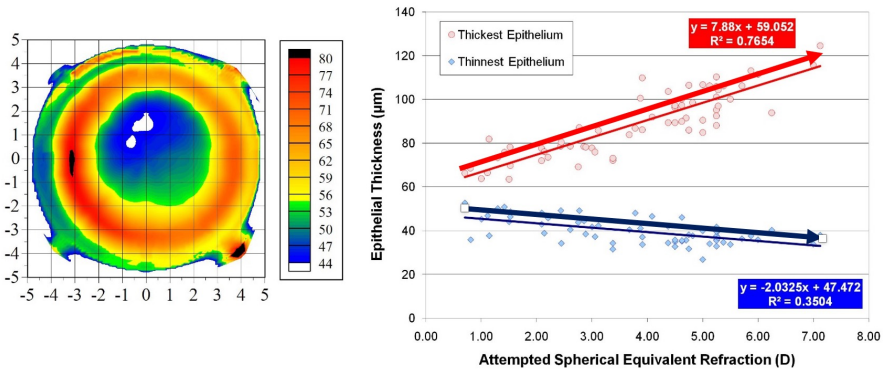

Figure 1. The higher the attempted hyperopic correction, the thinner the central epithelium and the thicker the peripheral epithelium.[2] [Courtesy of DZ Reinstein]

In 2017, Reinstein et al illustrated this point, where about 800 patients with high hyperopia (maximum 9.75 D) were followed for 2 years after hyperopic LASIK. About 70% of patients were within ±0.50 D of the target refraction, and 90% were within ±1.00 D, demonstrating an excellent safety profile.[3]

This research highlights that when treatments are centered on the visual axis and epithelial thickness is respected, hyperopic LASIK treatments are both safe and effective.

HOW TO APPROACH HYPEROPIC CORRECTIONS WITH LENTICULE EXTRACTION

Hyperopic femtosecond intrastromal lenticule extraction has promising outcomes. Studies indicate that the procedure achieves a higher degree of stability and less regression than LASIK. A multicenter study of 323 eyes showed about 80% of patients were within ±0.50 D of the target refraction and 93% were within ±1.00 D at 12 months postoperatively.[4] There was less regression with the procedure compared to hyperopic LASIK, likely due to biomechanical differences in how the cornea responds to the procedures which results in a larger effective optical zone.

The hyperopic femtosecond intrastromal lenticule geometry is unique (Figure 2). Its extraction preserves the anterior structural integrity of the cornea and results in a larger effective optical zone and reduced peripheral stromal expansion and contributing to better optical quality and long-term stability.[4]

CONCLUSION

The future of hyperopic corneal refractive surgery lies in a deeper understanding of corneal biomechanics and epithelial behavior. While challenges such as regression and apical syndrome remain, adherence to best practices, including centering the treatment on the visual axis and carefully monitoring the epithelial profile can mitigate risks and improve outcomes.

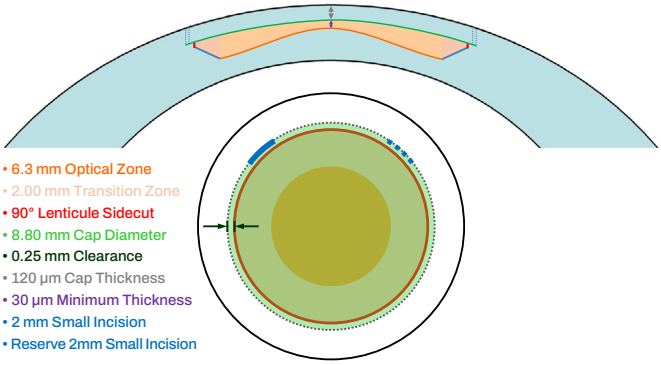

Figure 2. Specifications of the hyperopic SMILE lenticule geometry. [Courtesy of DZ Reinstein]

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New Horizons With Modern Phakic IOLs

BY ROBERT EDWARD ANG, MD

Phakic IOLs have undergone a significant evolution over the past few decades, driven by advances in lens technology and an enhanced understanding of patient needs. Today, phakic IOLs can provide a robust solution for myopic correction, particularly moderate to high myopia. The current landscape of phakic IOLs expands the refractive surgeon's approach to vision correction.

MODERN PHAKIC IOL OPTIONS

Phakic IOLs are designed for placement in both the anterior chamber and posterior chamber. However, the most common type of phakic IOL is a posterior chamber design.

Today, phakic IOLs can provide a robust solution for myopic correction, particularly for moderate to high myopia.

The first foldable posterior chamber phakic IOL was made from Collamer. Since its introduction in the early 1990s, posterior chamber phakic IOL technology has matured significantly. The most recent innovation, a phakic IOL designed with a 360° port in the centre of the lens optic to facilitate aqueous flow, eliminate the need for a peripheral iridotomy before surgery, reducing the risk of pupillary block and anterior capsular cataracts.[1] The effectiveness of the lens design is demonstrated by a high level of postoperative visual acuity, refractive predictability, and stability in both the published literature and US FDA clinical

trials.[1,2] Most patients achieved a UCVA close to or better than their preoperative BCVA, and 90% of patients achieved refractive outcomes within ±0.50 D of the target refraction. Additionally, safety data suggest reduced rates of anterior subcapsular cataract and pupillary block relative to earlier models of the same phakic IOL without a central port.

A BROAD TREATMENT RANGE

Historically, phakic IOLs were a solution for patients with myopia and myopic astigmatism beyond the range of excimer lasers and for those who did not qualify for laser vision correction procedures, such as eyes with a thin or irregular cornea and an insufficient residual stromal bed thickness. Indications for phakic IOLs now have grown. Although standards vary by geographic location and phakic IOL model, these lenses may now be used to treat lower amounts of myopia with up to 6.00 D of astigmatism.

Patients may range in age from 21 to 60 years. Phakic IOLs are also suitable for use with an anterior chamber depth as small as 2.8 to 3.0 mm, depending on the country. They should not be used, however, in eyes with a narrow angle, pupillary block, pigment dispersion, irregular astigmatism, cataract, and a low corneal endothelial cell count.

Postoperative complications, which include an inflammatory reaction, are rare and typically associated with an inappropriate vault (i.e., the distance between the implant and the natural lens). This risk can be minimized with proper phakic IOL sizing.

SURGICAL GUIDELINES

Achieving optimal results with phakic IOLs requires adherence to meticulous surgical protocols. A 2024 consensus statement on phakic IOL patient selection, preoperative assessment, lens selection, and effective placement techniques suggested several best practices and surgical guidelines for optimizing outcomes with phakic IOLs.[3] There was unanimous agreement that manifest refraction is the most important parameter in determining phakic IOL power. Other accurate refractive power calculation parameters include true anterior chamber depth, keratometry, and to a lesser extent back vertex distance, corneal thickness, and contact lens over-refraction.

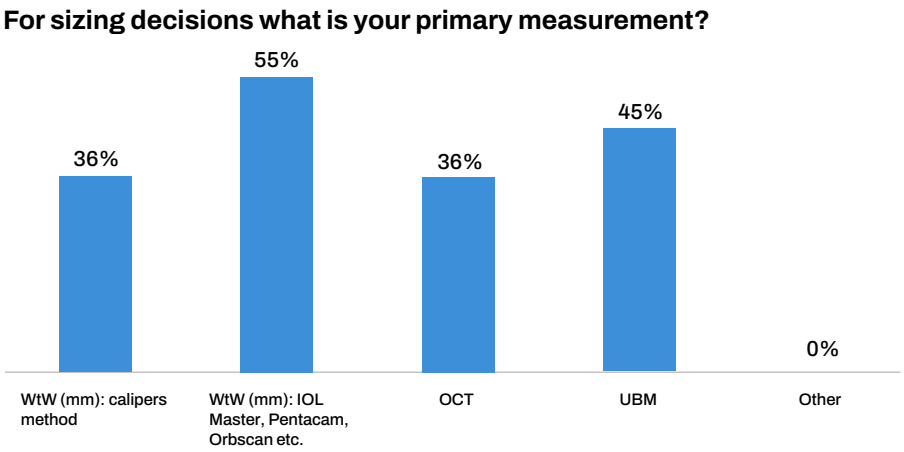

Figure 1. A 2024 consensus statement on phakic IOL use showed considerable variation in the approach to phakic IOL sizing. Abbreviations: WtW = white-to-white; UBM, ultrabiomicroscopy

While techniques such as white-to-white measurements and ultrasound biomicroscopy are widely used, there was no consensus on a single approach to lens size selection (Figure 1), highlighting the importance of developing individualized nomograms for consistent results.[3]

Determining the postoperative vault, which is the distance between the ICL and the natural lens, is crucial. If the vault is too high, it may lead to elevated intraocular pressure and angle closure glaucoma. If the vault is too low, there is an increased risk of anterior subcapsular cataract formation.[4] It's important to note that the vault changes over time. There is a dynamic and natural change of the vault the first month after surgery, but it typically decreases slightly over the long term.[4]

Certain guidelines may be considered as best practices for phakic IOL implantation and early stages of postoperative care. Preoperatively, the eye is prepped in the same fashion as cataract surgery and fully dilated. Patient sedation may be used as needed, and the toric positioning is marked if a toric phakic IOL is used. Intraoperatively, a small nasal incision (1 mm) is made for the addition of xylocaine/lidocaine and antibiotics. A temporal main incision is used for lens delivery, where the lens should be injected under a viscoelastic. During insertion, the haptics are positioned first distally through a nasal incision, then proximally through the main incision. Centration and positioning of the lens are verified, and the viscoelastic is flushed from the anterior chamber.

Any adjustment to the phakic IOL's position should be made as early as possible in the postoperative period. Intraocular pressure is the most important measurement after phakic IOL surgery. Additionally, the vault is checked at every postoperative visit, as well as the uncorrected and corrected distance visual acuity and manifest refraction. Any adverse events or patient dissatisfaction are discussed with patients, and eye drops are prescribed if needed. The endothelial cell density must be measured for at least 3 months postoperatively.

CONCLUSION

Phakic IOLs have transformed the refractive surgery landscape, offering a safe, effective, and patient-friendly option for a broad range of patients (Table 1). Phakic IOL surgery is not difficult, but it requires excellence at every stage. Modern phakic IOL technology and surgical techniques fit well into our armamentarium for refractive surgery, ensuring that we meet the expectations of our patients.

Benefits of Modern Phakic IOLs:

- Proven long-term safety and effectiveness
- Removable lens implant
- Treat a wide range of refractive correction
- Rare complications and adverse effects
- High patient satisfaction

Table 1. Highlight summary of the main benefits of modern phakic IOLs. [Courtesy of Dr. Ang]

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Strategies for Patient Selection and Communication

BY BÉATRICE COCHENER-LAMARD, MD, PhD

Ophthalmologists continuously refine their strategies to align surgical techniques with patient expectations. One significant challenge lies in matching the right procedure to a patient's visual needs, lifestyle, and personality while addressing their concerns and achieving optimal outcomes. Selecting the surgical procedure should be based on balancing benefits with risks. The risk:benefit ratio should be always in favor of benefit with minimal risk, depending on ametropia, corneal morphology, age, and quality of life conditions.

Three case scenarios shared by Drs. Khamar, Carp, and Ang are reviewed in this article to illustrate the importance of tailoring approaches to patient communication and selecting the right procedure for each patient. *The comments with each case are derived of remarks from all faculty.*

Personalize the discussion with recommendations that are relatable to the patient's lifestyle, professional demands, and long-term visual goals.

CASE 1: LOW MYOPIA (Submitted by Dr. Khamar)

A 35-year-old jeweler is interested in refractive surgery. On examination, his refraction is -1.50 -0.25 X 40° (6/6) OD and -1.50 -0.25 X 170° (6/6) OS. Corneal topography is normal (Figure 1) with a corneal thickness of 570 µm. The patient shares he is a sharpshooter and wants to achieve spectacle independence with perfect vision.

For this meticulous and highly demanding patient, the primary goal is precision. While this patient could achieve great visual outcomes with multiple procedures, including, PRK, LASIK, and lenticule extraction, LASIK provides rapid visual recovery. Lenticule extraction may achieve similar results to LASIK, but visual quality may not be 20/20 on day 1, and the speed of recovery depends on factors such as learning curve and proper energy settings.

When the risk of postoperative dry eye is considered, it may sway one to recommend lenticule extraction. The procedure has a lesser impact on the ocular surface during the first postoperative year.

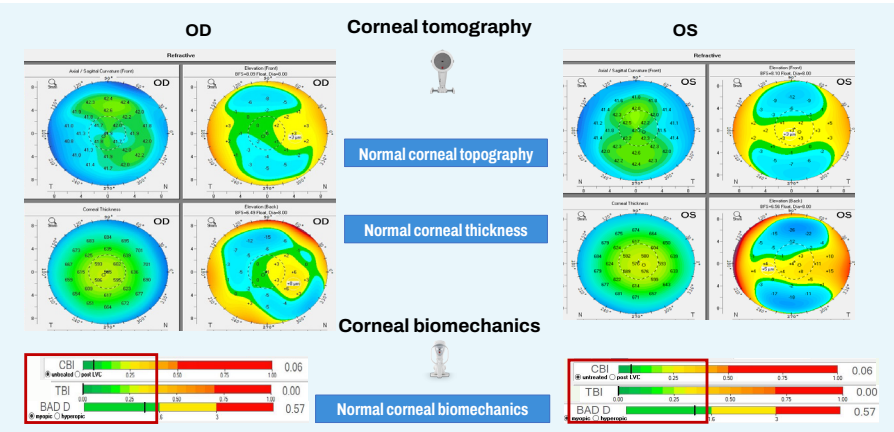


Figure 1. The anterior segment examination showing a normal corneal topography, corneal thickness, and corneal biomechanics in the right and left eyes. [Courtesy of Dr. Khamar]

CASE 2: MODERATE MYOPIA (Submitted by Dr. Carp)

A 38-year-old primary school teacher presents with a refraction of -5.25 -0.50 x 11° OD and -5.25 -1.00 x 168° OS. The pre-operative examination found a corneal profile suitable for either corneal refractive surgery or phakic IOL implantation (Figure 2). Topography and tomography are normal and pachymetry readings are 566 µm OD and 568 µm OS. She is accustomed to glasses and contact lenses.

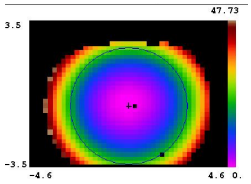
Again, there is no absolute choice for this patient, who could achieve good visual outcomes with LASIK, lenticule extraction, and phakic IOL implantation. A phakic IOL has several benefits, including removability and preservation of corneal integrity for future procedures such as cataract surgery. On the other hand, a corneal refractive surgery such as lenticule extraction for higher corrections may be associated with corneal weakening but may provide better nighttime vision because of a large scotopic pupil. Most surgeons prefer corneal surgery for -8.00 D of myopia and no risk factors. What

could be debated in this case, however, is the patient's age. At 38 years old, presbyopia may become a factor. Mini-monovision may be useful in this case.

Pre op spherical aberration

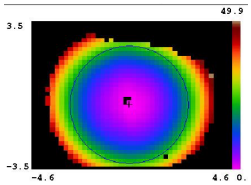
Spherical Aberration	-4.21 µm

Total Aberrations
RMS: 7.63 µm



Spherical Aberration	-4.64 µm

Total Aberrations
RMS: 7.62 µm



Pupil size

	OD	OS
Dark	7.70 mm	8.11 mm
Scotopic	7.11 mm	7.12 mm
Mesopic	5.37 mm	5.61 mm

Figure 2. Preoperative examination measurements including spherical aberration and pupil size. [Courtesy of Dr. Carp]

CASE 3: HIGH MYOPIA (Submitted by Dr. Ang)
A 38-year-old with high myopia (-8.00 -0.75 x 180° OD and -9.00 -0.50 x 5° OS), normal corneal topography (Figure 3), dry eye symptoms, and fluctuating vision from many years of soft contact lens use presents for a refractive surgery evaluation. His uncorrected distance visual acuity is counting fingers OU, and best corrected distance visual acuity is 20/25 to 20/20 OU. Pachymetry is within a normal range (518 μm OD and 506 μm OS).

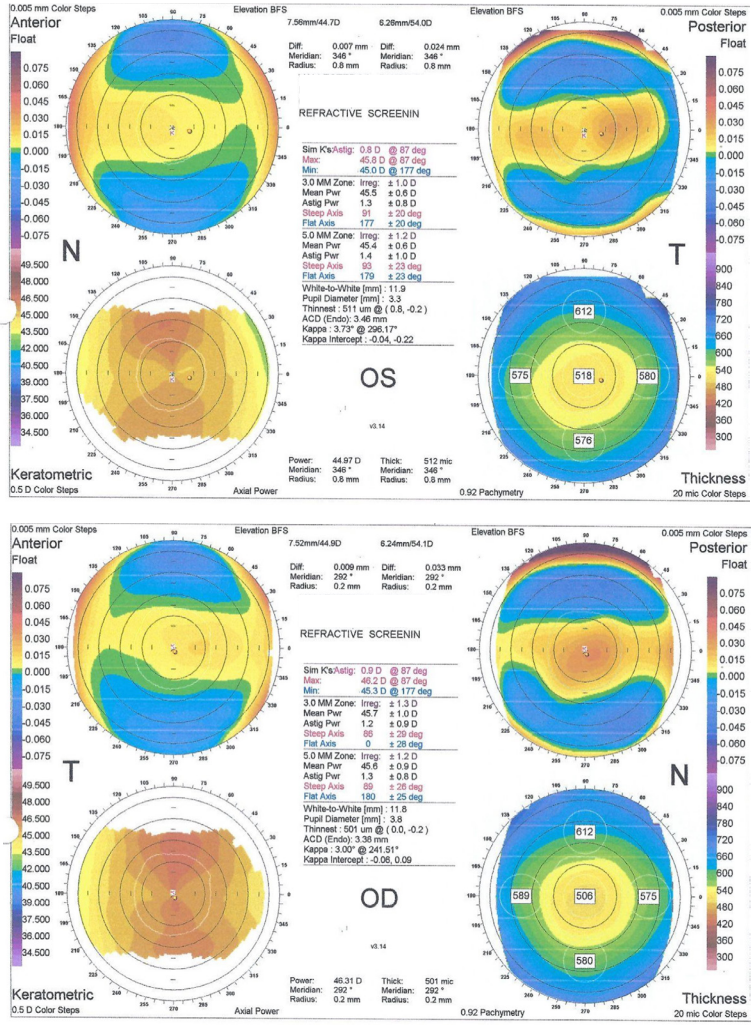


Figure 3. A normal corneal topography was found on the preoperative examination of a patient presenting with high myopia. [Courtesy of Dr. Ang]

In this case, posterior chamber phakic IOL implantation was the preferred concept. The patient's high refractive error and history of poor visual satisfaction necessitated a solution that prioritized optical quality and long-term stability. LASIK or lenticule extraction would both require substantial tissue removal, posing a higher risk of biomechanical decompensation and induced aberrations. Since the patient is 38 years old, a phakic IOL with an extended depth of focus design may be considered, at least in the nondominant eye.

PATIENT COMMUNICATION

Effective communication is crucial in achieving patient satisfaction. Several strategies are useful to help patients feel comfortable with their surgical options. First, address common objections such as surgical risks, fear, recovery times, and procedure longevity. Citing evidence-based data may alleviate patient fears. Second, simplify complex concepts with visual aids such as diagrams or digital tools to help patients understand their treatment options. Third, personalize the discussion with recommendations that are relatable to the patient's lifestyle, professional demands, and long-term visual goals. Fourth, set realistic expectations and remain transparent about potential outcomes and limitations to prevent future dissatisfaction. Lastly, encourage questions and create an open environment where patients feel comfortable discussing their concerns.

CONCLUSION

A tailored approach to refractive surgery that meets a patient's unique needs is only part of the equation for delivering excellent outcomes. Maintaining clear, empathetic communication is also crucial to exceed patient expectations. Balancing technical excellence with a deep understanding of patient psychology ensures not only visual success but also a truly patient-centered experience.

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