EVOLVING APPROACHES TO CORNEAL BIOMECHANICAL SCREENING AND PATIENT SELECTION IN MODERN REFRACTIVE SURGERY


Discover how advanced corneal biomechanical screening is revolutionizing refractive surgery patient selection and optimizing visual outcomes.

BY JOSÉ F. ALFONSO MD, PHD; AND JOAQUÍN FERNÁNDEZ, MD

INTRODUCTION

The cornea is the first cellular surface of the eye's optical system and plays a pivotal role in refraction. Even minimal changes in the cornea's shape can significantly alter refractive properties and the quality of image formation on the retina.[1] Imagine undergoing refractive surgery, only to experience a poor outcome or complications due to undetected issues with the cornea. To ensure optimal refractive outcomes, surgeons should incorporate routine preoperative corneal biomechanical screening to determine how mechanical or structural changes in these tissues will modify the eye's optics. To ensure the highest standards of patient care, this screening should be combined with corneal tomography and topography for a multimodal approach that provides a complete picture of the cornea's shape.

My Corneal Biomechanical Screening Methods and Patient Selection Criteria

JOAQUÍN FERNÁNDEZ, MD

During the preoperative evaluation, we can use a variety of technologies to measure corneal topographic patterns and biomechanics. For example, the Corvis® ST (Oculus) evaluates biomechanical indices, and the Pentacam® (Oculus) provides detailed corneal segment tomography. By combining corneal biomechanics and tomographic data, we can calculate the tomographic biomechanical index (TBI). Advanced indices like the tomographic and biomechanical index version 2 (TBIv2), introduced by Ambrosio et al, are particularly valuable.[2] The TBIv2 combines Scheimpflug-based corneal tomography with biomechanical analysis using the Corvis® ST to offer a nuanced assessment of the cornea's structural integrity and its susceptibility to ectasia post-surgery.[2] This index is pivotal in detecting subclinical forms of ectasia, which might not be apparent through conventional tomography.

These advanced technologies and indices enhance the providers' ability to predict surgical outcomes, minimize risks, and understand the patient's corneal and ocular structure, which are essential data for determining the most appropriate refractive procedure.

My Considerations for Matching the Procedure to the Patient

JOSÉ F. ALFONSO, MD, PHD

It is important to take into account several key variables when considering different refractive surgeries that would be best suited for an individual patient. These factors include the patient's age and both a quantitative and qualitative assessment of the ocular surface, including a biomechanical screening and each eye's anterior chamber depth, endothelial cell count, and axial length.

While each refractive surgery technique has unique inclusion and exclusion criteria, an eye's diopters, the curvature of the cornea, its accommodation capacity, and its axial length are among

the most important factors when determining a patient's eligibility for a surgical technique.

Depending on the type of refractive error, three primary corrective approaches are common. For astigmatism, I prefer corneal correction, if conditions allow. For myopia, we recommend techniques that involve sulcus/ciliary body-supported IOLs due to the potential for myopic progression and associated retinal risks. For hyperopia, given its complexity, a combination of laser and IOL strategies may be necessary.

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In clinical practice, younger patients or those with a family history of keratoconus often require careful evaluation of biomechanical stability. This consideration may lead to alternative treatments, such as phakic IOLs like the EVO ICL. Similarly, variations in corneal thickness can impact the decision between LASIK, surface ablation techniques, or phakic IOL implantation.

Our Experience in Incorporating New Technology Into the Practice

JOAQUÍN FERNÁNDEZ, MD

In our practice, we integrate new technologies strategically, guided by two distinct stages: the "evidence-creation stage" and the "clinical application stage." Each stage plays a crucial role in how we implement new technologies to ensure scientific rigor and practical efficacy. During the evidence-creation stage, we assess technologies for their real-world value and potential impact. Our research and evidence department collaborates with technology providers to develop robust scientific evidence that supports clinical adoption. Once a technology demonstrates clinical relevance, effectiveness, and safety, it moves to the clinical application stage. Our clinical department then integrates these technologies into daily clinical practice. By distinguishing these stages, we ensure that the integration of new technologies is based on scientific evidence and clinical utility. This methodical approach keeps us at the forefront of technological advancements and allows us to maintain high standards of patient care and safety. The implementation of TBI and TBIv2 exemplified the integration of a new technology based on scientific rigor and clinical utility and has become a critical guide in our refractive surgery decision-making.

Before implementing this technology, we had a clear cutoff for recommending phakic IOLs, such as the EVO ICL, over laser refractive surgeries, specifically for cases presenting with high refractive errors, such as myopia greater than -7.00 D. However, with the advent of sophisticated biomechanical assessments, we are better equipped to understand and evaluate corneal structural integrity and use these data in our treatment recommendations.

I recall a case of a patient with -2.00 D of myopia who showed marginal biomechanical properties of the cornea and would typically be a good candidate for laser refractive surgery. However, the TBI and Corvis biomechanical indices suggested a higher risk of postoperative ectasia if the patient were treated with laser refractive surgery. In this case, the biomechanical assessments served as crucial differentiating tools that provided an evidence-based rationale for recommending phakic IOLs over laser refractive surgery.

A Bright Future for the EVO ICL

JOAQUÍN FERNÁNDEZ, MD

Recent advancements in the EVO ICL technology offer significant advantages to patients who are under 60 years old with myopia and who don't have cataracts. Traditional refractive lens exchange surgery poses increased risks, such as retinal detachment, for these patients.[3] In addition, micromonovision target selection with ICLs or ICLs designed for myopia with presbyopia are now a viable option for vision correction. As more clinical data emerge about using this technology for refractive vision correction of patients with myopia and presbyopia, providers can be confident about offering the EVO ICL as a viable alternative to LASIK and other corneal surgeries for a broader patient population.

While the ICL technology has progressed over the past decades, there

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are ongoing efforts to further study the long-term efficacy and performance of these lenses as the eye naturally ages. Therefore, the future impact of phakic lenses will be significantly influenced by a generation of robust clinical evidence. Addressing the existing gaps in evidence in ongoing studies and clinical trials is crucial. The goal is to further support how phakic lenses, like the EVO ICL, not only deliver immediate visual correction, but also provide a dependable long-term solution that benefits patients before age-related cataracts develop.

CONCLUSION

The evolution of corneal biomechanical screening and advanced technologies such as the EVO ICL marks a transformative era in refractive surgery. By integrating precise biomechanical assessments into preoperative evaluations, surgeons can tailor interventions more effectively to individual patient needs, mitigating risks and optimizing visual outcomes. As these technologies continue to advance and clinical evidence accumulates, the future promises expanded applications and improved long-term efficacy, ensuring that patients receive safe, effective, and enduring solutions for their vision correction needs. ■

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JOSÉ F. ALFONSO MD, PHD

- Head of Cornea, Cataract & Refractive Surgery Department
- Fernández-Vega Ophthalmological Institute
- Professor of Ophthalmology of Oviedo University
- Ex-President of SECOIR (Spanish Society of Cataract and Refractive Surgery)
- j.alfonso@fernandez-vega.com
- Financial disclosure: Research Grant (STAAR Surgical)

JOAQUÍN FERNÁNDEZ, MD

- Medical Director of Qvision (Ophthalmology Unit of the Vithas Almería Hospital), Almería, Spain
- ESCRS (European Society of Cataract & Refractive Surgeons) Board of Directors Member
- joaquinfernandezoft@qvision.es
- Financial disclosure: Speakers bureau (Oculus, STAAR Surgical)