OUT WITH THE OLD, IN WITH THE NEW

Some procedures are falling out of favor, while others show promise for future advances.

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Continued innovation, improvements, and refinements in corneal refractive surgery techniques and technologies have led to ever-improving visual outcomes in recent years. We have experienced the emergence of novel technologies, and with that, some procedures that were once embraced could now be falling out of favor. This article reviews some procedures that may be falling by the wayside and looks ahead to what's new or on the horizon.

OUT WITH THE OLD

One refractive surgical approach that may be in decline is the implantation of corneal inlays. The closing of ReVision Optics, manufacturer of the Raindrop inlay, is one indication of this trend. Another is that some other corneal inlay devices are no longer on the market or have no distribution in some countries. Lastly, controversial long-term outcomes with the Kamra corneal inlay (AcuFocus), particularly regarding corneal topography changes, hyperopic shifts, centration, and biotolerance issues, have discouraged some surgeons from using this approach to presbyopia correction.[1,2] It may be that the use of synthetic inlays is no longer the best way to approach corneal refractive surgery.

A positive response to this negative trend is the promise of using intrastromal human corneal collagen inlays for the correction of small refractive errors and possibly presbyopia. Preliminary studies suggest that implantation of corneal lenticules may be an effective approach to refractive surgery, although long-term data are lacking.[3-5] Some manufacturers, such as Allotex, are now offering human corneal allografts, treated with an excimer laser to correct refractive errors of any type, from presbyopia to myopia to hyperopia and astigmatism.

IN WITH THE NEW

Enhancing corneal stability. Among the exciting innovations in corneal refractive surgery is the possibility of intrastromal refractive surgery. Small-incision lenticule extraction (SMILE) minimizes weakening of the corneal structure in comparison with LASIK. Although more research is needed, surgeons intuitively sense that SMILE creates less biomechanical stress on the cornea and that stability should be improved in comparison with LASIK. Refractive results with myopic SMILE are similar to those with myopic LASIK in current reports, although the procedure is too new to yield long-term data at this time.[6] Given equivalent refractive results, the possibility of using a 2- to 4-mm sidecut incision instead of a 270° corneal flap constitutes an attractive surgical alternative for corneal refractive surgeons.

LASIK Xtra, a term coined by Avedro, is a procedure in which LASIK is combined with CXL. This epithelium-on procedure is performed with less riboflavin imbibition and with reduced time and higher intensity UV light application than with standard CXL. The idea is to enhance long-term stability of the cornea after LASIK.[7] If this procedure lives up to its promise with further study, it could allow us to offer LASIK to patients with up to 12.00 D myopia. Potential drawbacks such as slower visual recovery and deep lamellar keratitis are challenging, but the *gluing* effect of this approach could provide an option to patients with high myopia.

Reduced-time, high-power CXL is also helpful to improve corneal stability after PRK treatments for intermediate and high hyperopia. Another approach to improve stability after hyperopic PRK is the use of larger optical zones. Schwind eye-tech-solutions, for example, suggests the use of these large optic zones for PRK with its Amaris excimer laser system. Such large optical zones cannot be used with LASIK due to limitations imposed by the flap diameter.

Addressing presbyopia. Surgical correction of presbyopia with presbyopic LASIK (presby-LASIK) has been bolstered by evidence of positive outcomes in well-selected cases. Long-term evidence from ray-tracing studies has confirmed the stability of corneal topography changes induced by *PresbyMax*, the term Schwind uses to describe its presby-LASIK platform.[8] The outcomes of presby-LASIK, whether with PresbyMax or with the Presbyond Laser Blended Vision technique (Carl Zeiss Meditec), are generally positive, provided adequate centration is achieved and patient selection is appropriate. Patients must have good dynamic pupillometry, with small photopic pupil size (preferably < 3.5 mm).

With these considerations, presby-LASIK can be an effective option for patients with early or intermediate presbyopia, with low near vision adds, providing excellent results with no visual loss. Hybrid forms of presby-LASIK, with the use of Q-factor customization and micro-monovision, make this a valid option even for advanced presbyopes and patients with monofocal pseudophakic lenses.

Customizing treatments. Customized laser vision correction treatments are still evolving, achieving new levels of accuracy. The recent incorporation of sophisticated

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aberrometry devices, such as pyramid wavefront sensors on the Osiris (CSO) ocular aberrometer, has improved the analysis of total-eye optical performance, offering a huge quantity of objective data. The ability to eliminate specific aberrations together with total higher-order aberrations can serve as a guide for when to use customized treatments in patients with irregular astigmatism.

The combination of diagnostic information from pyramidal aberrometry with new laser software for the correction of irregular corneas, as available on the Amaris and the WaveLight (Alcon) excimer lasers, could pave the way for improved outcomes in customized treatments.

Stabilizing keratoconus. Lastly, the use of corneal refractive surgical techniques to address keratoconus in appropriately selected patients is becoming more popular. If the patient's refractive error is not too great, it is possible to use a combination of topography-guided treatment, excimer laser phototherapeutic keratectomy, CXL, and intrastromal corneal ring segments to strengthen the cornea. Corneas with refractive error less than 2.00 to 4.00 D can be corrected with these methods, but those with larger amounts of error would benefit from intraocular refractive surgery with phakic IOL implantation.

CONCLUSION

As this brief review suggests, we are experiencing major improvements in corneal refractive surgery techniques and technologies. As this progress continues, the excellent outcomes that we can achieve today are the first steps toward even better outcomes in the future. ■

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