

## Novel optical approaches drive cornea-based presbyopia correction

**Corneal inlays and refined laser techniques maximize near vision, minimize the loss of distance vision and largely preserve cosmetic appearance.**

Innovative optical concepts, corneal implants and evolving laser techniques are providing surgeons with many choices for presbyopia correction at the corneal plane, clinicians say.

Three distinct optical approaches potentially optimize near vision and minimize loss of distance vision in presbyopia treatment. The three approaches are near power in the pupil center, distance power in the pupil center and the pinhole effect.

"The three different types of inlays with three different mechanisms of action consist of: Flexivue Microlens (Presbia), which creates a bifocal optical system at the nondominant eye of presbyopic, emmetropic patients; Kamra (AcuFocus) that utilizes the pinhole effect, increasing depth of focus; and PresbyLens (ReVision Optics), which changes the anterior curvature of the cornea when placed under a superior hinged lamellar LASIK corneal flap. All the inlays are implanted only in the nondominant eye," Ioannis G. Pallikaris, MD, PhD, OSN Europe Edition Editorial Board Member, said in an interview with *Ocular Surgery News*.

Other options are laser-based, such as femtosecond laser IntraCor (Technolas Perfect Vision). Surgeons may also use a monovision option with conductive keratoplasty.

Cornea-based treatments offer differing and multiple benefits to patients who want presbyopia correction, Dr. Pallikaris said.

"Intracorneal inlays represent the less invasive technique for presbyopia correction and it is the only reversible approach," he said. "Presby-laser creates a multifocal pattern on the surface of the cornea and improves near vision in presbyopic, non-emmetropic patients, also offering customized ablations at various optical zones. Conductive keratoplasty improves near vision in hyperopic, emmetropic patients and offers the advantage of easy repetition if needed."

Patient selection is key in obtaining the best outcomes, Dr. Pallikaris said. A patient's professional life should be taken into consideration when choosing a presbyopia treatment option. A monovision approach should be used in patients whose professions require near vision, such as surgeons and accountants, while a multifocal approach should be used in patients whose professions require distance or night vision, such as drivers and night workers.

New technologies are being developed for each optical approach. In studies, refractive corneal inlays and a pinhole inlay yielded visual outcomes largely comparable to those of new and established laser refractive procedures, according to a presentation by Roger F. Steinert, MD, OSN U.S. Edition Cornea/External Disease Board Member, at the American Society of Cataract and Refractive Surgery meeting in San Diego, U.S.A.

"All of the procedures gave good, clear improvement in uncorrected near acuity," Dr. Steinert said. "The long-term biocompatibility, of course, is going to be the subject of extensive ongoing testing. So far, so good, but time will tell."

### Refractive and pinhole inlays

The PresbyLens provides near power in the pupil center. Placed under a LASIK-like flap, the inlay steepens the corneal curvature and generates plus power in the pupil center.

"The inlay itself does not have intrinsic optical power. Basically, it's the same index of refraction as the cornea, so it's the change in curvature that makes it work," Dr. Steinert said.

The intracorneal Flexivue Microlens provides refractive power from +1.50 D to +3.5 D.

"The center does not have power," Dr. Steinert said. "This means that the distance is through the center for emmetropes, and the peripheral plus power or steepening basically acts like a donut to create plus power through changing the corneal curvature."

The Kamra intracorneal inlay is designed to improve accommodation via the pinhole effect by limiting the amount of light entering the eye and minimizing glare.

The body of the Kamra inlay is fenestrated with 8,400 randomly placed holes to permit the flow of nutrients and minimize excessive incoming light, which can cause glare, Dr. Steinert said.

### **Comparing visual outcomes**

All three corneal inlays yielded favorable results compared to PRK and the IntraCor femtosecond laser-based intrastromal ablation procedure for presbyopia, according to Dr. Steinert. In published studies, the PresbyLens yielded monocular uncorrected near visual acuity of J1 or better in 90% of patients and J2 or better in 100% of patients. The mean uncorrected near visual acuity in the operated eye for Flexivue Microlens improved considerably, from J8 preoperatively to J1 at 6 months for the 32 patients included in recent post-market surveillance studies.

IntraCor offered uncorrected near visual acuity of J1 or better in about 38% of patients, J2 or better in about 54%, J3 or better in about 68% and J5 or better in about 91%, Dr. Steinert said.

"Is J3 really good enough or is it J2 or J1 that makes patients happy? The PresbyLens is probably the strongest of them based on just published results," he said.

Dr. Pallikaris said that all presbyopia treatment options have been aiming for the best near vision without losing distance vision for patients at the pre-cataract age of 45 years to 60 years who have no pre-existing ocular pathologies.

"From this point of view, I consider all these techniques as minimally invasive intermediate procedures, and I believe that the most important factors are the safety, the reversibility and the efficacy rather than the stability," he said.

### **Reversibility, cosmetics**

Refractive inlays and the pinhole inlay are refractively reversible; PRK is not reversible.

"Reversibility of pinholes is attractive but, again, biocompatibility needs to be studied as well as whether there's some impact to the patient from the loss of light getting back to the retina," Dr. Steinert said.

In terms of maximizing available light, refractive inlays and procedures including PRK and IntraCor proved most effective.

Refractive inlays and IntraCor offer rapid visual improvement.

The best cosmetic results are attained with refractive inlays, PRK and IntraCor.

"Again, there are some questions as to whether the pinhole inlays are going to be visible and bothersome or not. Mixed reviews on that," Dr. Steinert said. "The others are essentially invisible."

IntraCor has shown promising results but merits long-term scrutiny, Dr. Steinert said.

"The use of a femtosecond laser in the IntraCor procedure is clearly pretty interesting. It's got everybody's attention. Long-term stability remains to be determined," he said.

Treatment selection should ultimately be based on the patient's individual needs, Dr. Pallikaris said.

"There is no gold standard technique for presbyopia surgery, but there is a gold standard approach for [the] presbyopia patient," he said. "The keys are to be able to use all the available presbyopia surgical treatments, to select the most appropriate for each different case, to understand the necessities of the patient, to discuss with him preoperatively and to try to simulate the outcome as much as possible before operating." – *by Erin L. Boyle and Matt Hasson*

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