Is Peripheral PresbyLASIK a Center-distance Technique?

To the Editor:

I read with interest the article by Pinelli et al\(^1\) referring to the correction of presbyopia creating a multifocal corneal surface, which appeared in the May 2008 issue of the *Journal of Refractive Surgery*. The authors suggest two techniques: central presbyLASIK, with a central disk for near vision and a peripheral ring for distance vision; and peripheral presbyLASIK, with a central disk for distance vision and a mid-peripheral ring for near vision.

In the current study,\(^1\) they analyze the results of peripheral presbyLASIK in hyperopic presbyopic patients. This treatment, designed to create a multifocal cornea in a 6.5-mm diameter zone by combining a positive ablation performed over a 6.5-mm zone and a negative ablation performed over an optical zone \(\geq 5\) mm, produces emmetropia in the central area and myopia of the mid-peripheral ring. The multifocality would be provided by the expected myopic ring between the 5- and 6.5-mm optical zone.

The sequence of ablations they propose for the correction of 1.00 diopter (D) of hyperopia and 2.00 D of addition (presbyopia) is: phase 1 (ablation for distance): sphere +1.00 at the 6-mm optical zone; phase 2 (ablation for near): sphere +2.00 at a 6.5-mm optical zone; and phase 3 (for central emmetropia): sphere −2.00 at the 5- and 5.5-mm optical zones (two sub-phases). They also provide data of a transition zone of 9.2 mm. The authors’ hypothesis is that after phases 1 and 2, the center of the cornea would be myopic, and after phase 3 the center would return to emmetropia, creating a myopic multifocal ring between the 5- and 6.5-mm optical zone.

However, multifocality as planned may not have been achieved.

The postoperative topography depicted in Figure 1 shows a central cornea with a dioptic power of approximately 47.00 to 48.00 D, at the 5-mm zone 45.00 D, at the 5.5-mm zone 44.00 D, at the 6-mm zone 43.00 D, and at the 7-mm zone 42.00 D. How can the peripheral part of the cornea be for near vision, as the corneal power is less than the central power? From this topography, the only way to balance distance and near vision is to assume the patient is emmetropic or \(-0.25\) D for distance at the periphery, and more myopic centrally where the corneal power is greatest. In this case, it seems the treatment created an overcorrected center with 47.00 D (it would help to know the preoperative K-readings), and the induced negative spherical aberration reported by the authors would help the patient’s distance vision.

A possible explanation for the disagreement between treatment design and topographical observations can be found by analyzing the spherical aberration induction for myopia and hyperopia by the same laser platform reported by other authors. Llorente et al\(^2\) found that the spherical aberration induced after hyperopic treatment was higher than that induced after myopic treatment. Considering that in the peripheral multifocal LASIK (PML) approach the hyperopic component (spherical equivalent refraction + addition) is always higher than the myopic component (−addition), we estimated a postoperative central myopia of approximately \(-0.86\) D with emmetropization at 5-mm pupils, indicating that the PML approach is another version of the suggested central presbyLASIK, not peripheral presbyLASIK. In our opinion, there is unnecessary tissue removal due to the myopic phases designed for central emmetropization, and the operation is excessively long and complicated with a minimum of four consecutive ablations for a single treatment.

Another concern is the transition zone of 9.2 mm, which is large. In hyperopic corneas, white-to-white diameter and flap size were smaller than in myopic corneas. Taking the hinge into account, some laser spots may ablate the hinge producing some aberrations.

Several mechanisms are involved in the accommodation process, among others a myosis of the pupil leading to an enhanced depth of focus (due to less transversal deviation at the retinal plane) and a bilateral symmetrical convergence.

Our hypothesis is that a myopic central part of the cornea will help reading ability and can be compensated with negative spherical aberration to approach emmetropia at the periphery.

In a paper analyzing corneal topographical changes after hyperopic LASIK,\(^3\) we created multifocality by inducing negative spherical aberration. Presbyopic hyperopic patients may benefit from induced negative spherical aberrations; however, the induced aberrations depend on several factors (loss of efficiency of the laser spot, K-reading, optical zone) and are not achieved in a precalculated attempted way.

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REFERENCES

Letters to the Editor

Reply:

We thank Dr de Ortueta for his interest and comments regarding our article; however, we believe he misunderstood the basis of peripheral presbyLASIK treatment. In this technique, a central area of approximately 5.0 mm is created for far vision and the mid-peripheral area, between 5.0 and 6.5 mm, is for near vision. However, this concept does not necessarily imply that the postoperative central cornea shows higher dioptic power than the peripheral cornea.

In our article, Figure 1A shows the ablation profile of each phase of peripheral multifocal LASIK, which agrees with the topography shown on the right of this figure. When studying this type of topography map, we take into account that we are treating hyperopic patients for whom the postoperative cornea is hyper-prolate (i.e., higher dioptic power in the center than in the periphery), which produces a negative change of peripheral corneal asphericity and therefore an induction of negative spherical aberration, as Dr de Ortueta suggests. However, our experience with photorefractive keratectomy has demonstrated that the induction of spherical aberration only is not enough to provide good near visual acuity for the presbyopic patient, but it is necessary to produce different refractive areas on the cornea.

Regarding the comments about the excessively long and complicated operation and the unnecessary removal of tissue, we agree with Dr de Ortueta but we have to consider that this is the first systematic prospective clinical study on peripheral presbyLASIK. Until now, presbyLASIK techniques have been empirical and intuitive, based only on refractive data, but the second generation of these treatments will be more scientific, with specific patient selection criteria, based on corneal geometry and optical analysis models that can predict the visual outcome and avoid wrong indications.

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REFERENCES


Modified Astigmatism Correction Nomogram

To the Editor:

I would like to congratulate Carvalho et al on their article reviewing their use of limbal relaxing incisions (LRI) to reduce astigmatism at the time of cataract surgery, which appeared in the May 2007 issue of the Journal of Refractive Surgery. This report further documents the safety and efficacy of this surgical technique, lending support to similar studies within the literature.

Carvalho et al report a statistically significant reduction in the mean topographic astigmatism in patients receiving LRI compared to their control group. They further note no appreciable difference in best spectacle-corrected visual acuity between the two groups. This, along with a lack of other discernable complications, led the authors to conclude that this technique is a safe and relatively forgiving approach to help reduce pre-existing astigmatism at the time of lens-based surgery; a conclusion that I strongly endorse.

I would like to comment on their finding that the intended level of astigmatism reduction was consistently less than their achieved surgical reduction when using LRI. The authors note several possible reasons for the consistent trend toward undercorrection, which include improper identification of the steep meridian, incorrect calibration of the blade, oblique positioning of the blade rather than a perpendicular apposition to the limbus, and the timing of the incisions during the case as it relates to the intraocular pressure of the globe. I agree completely with these assertions, and in my experience, the most frequent cause of undercorrection relates either to poor centration of the incisions over the steep meridian—as the authors properly point out, a marked loss of effect can occur with as little as a 5° error—or placement of the incisions too far peripherally; for optimal effect I have found that incisions must be placed in clear corneal tissue and not in the true surgical limbus.

Finally, I would note that the authors used a nomogram that I had developed some years ago to be used specifically in conjunction with phaco surgery. It was intentionally designed to be conservative in nature to avoid overcorrection, especially in the older age population that one would typically encounter at the time of cataract surgery. More recently, I have come to use a slightly more aggressive version of this nomogram that utilizes pachymetry measurements—as opposed to an empiric blade depth of 600 microns—and adjustable blade depth settings (“NAPA” Nomogram). An adjustable micrometer diamond blade specifically designed for this technique is set to 90% of the thinnest pachymetric reading obtained over the intended incision site. This “NAPA” nomogram and use of pachymetry have further refined our results.
yielding less of a tendency toward undercorrection. Moreover, this modification has proven to be particularly useful in patients receiving presbyopia-correcting implants, with refractive lens exchange, and in conjunction with phakic intraocular lens implantation—procedures wherein refractive accuracy is at an utmost premium.

As the authors further point out, any nomogram may require customization for a given surgeon’s personal technique and instrumentation, particularly with regard to the type of knife that is used.

I again thank Carvalho and associates for their contribution to the literature substantiating the safety and efficacy of LRI as a means by which pre-existing astigmatism may be managed at the time of lens-based surgery.

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REFERENCES
Letters to the Editor

What About LASEK?

Reply:

We thank Dr Massimo Camellin for his letter, which appeared in the May 2008 issue of the Journal of Refractive Surgery.¹ We would like to clarify that 1977-2007: Commemorating the ISRS/AAO and Global Refractive Surgery² was written to document the history of the International Society of Refractive Surgery of the American Academy of Ophthalmology (ISRS/AAO) and the individuals who contributed significantly and/or were prominently involved in the formation and growth of the ISRS from its early formation with Drs Jose I. Barraquer, Richard C. Troutman, Miles H. Friedlander, and Casmir A. Swinger to the eventual merger with the AAO. The book was not intended to be a history of refractive surgery techniques and variations.

Due to the fact that many of the individuals involved with the Society, also made important contributions to the field, the book of course in many ways paralleled the development of refractive surgery. We recognize that Dr Camellin made important contributions to the field of refractive surgery with his pioneering work in the development of the techniques and instruments used in the variant of photorefractive keratectomy, laser epithelial keratomileusis (LASEK). These techniques are still popular with many surgeons and thousands of patients have benefited from the LASEK procedure and its variations.

We both would indeed be very pleased to have Dr Camellin more involved in the activities of the ISRS/AAO, as his contributions deserve merit and are important to the history of refractive surgery.

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REFERENCES