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The State-of-the-Art in Keratoconus Treatments

Leading corneal experts from Europe and around the world share their latest experiences and trends for reshaping ectatic corneas.

Keraring for Post-LASIK Ectasia

This ICRS reduces higher-order aberrations and corrects the refractive error.

BY DOMINIQUE PIETRINI, MD; AND TONY GUEDJ

Post-LASIK ectasia is a rare but devastating condition that usually develops after LASIK in patients with keratoconus and/or an insufficient residual stromal bed. This progressive condition may manifest relatively soon or even years after laser vision correction. It is characterized by increasing degrees of surface distortion and thinning of the cornea, myopia, and irregular astigmatism, potentially leading to substantial loss of visual acuity.

The growing number of LASIK patients manifesting ectasia and searching for treatment has fueled the development of solutions that are safer, more effective, and less invasive than corneal grafting. For the last 5 years, our preferred treatment is femtosecond–laser-assisted implantation of the Keraring intrastromal corneal ring segments (ICRS; Mediphacos, Belo Horizonte, Brazil). It may be used alone or in combination with other treatments such as corneal collagen crosslinking (CXL) to further reinforce the collagen structure of the weakened cornea.

In our experience, Keraring implantation is a safe and effective option for patients with post-LASIK ectasia because it is a minimally invasive procedure that regularizes corneal surface distortions, reduces or eliminates the refractive error, and enhances corneal stability. This is often my technique of choice in patients with keratoconus, pellucid marginal degeneration, and high regular or irregular astigmatism after penetrating keratoplasty. I contraindicate the procedure for patients with mean keratometry (K) readings above 60.00 D, extensive central corneal opacities, severe atopic disease, and those with unrealistic expectations. It is essential to educate our patients about their condition and treatment options. This is especially true for post-LASIK patients because they are psychologically affected by their condition and need realistic information and advice.

RETROSPECTIVE STUDY

We recently conducted a retrospective study in 15 eyes of 15 patients with post-LASIK ectasia treated with the Keraring. The mean age of patients was 38 years, the

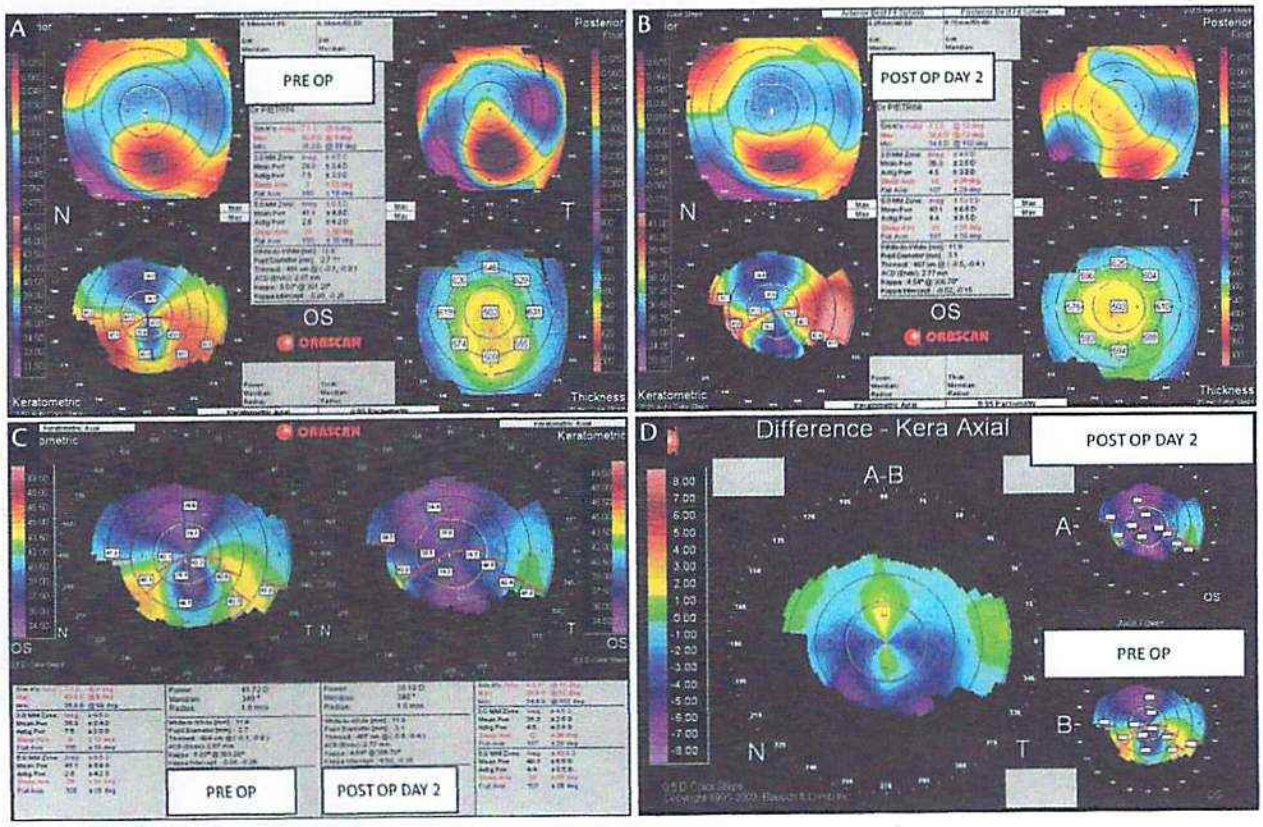

Figure 1. (A through D) This clinical case was treated with a pair of 5-mm Kerarings.

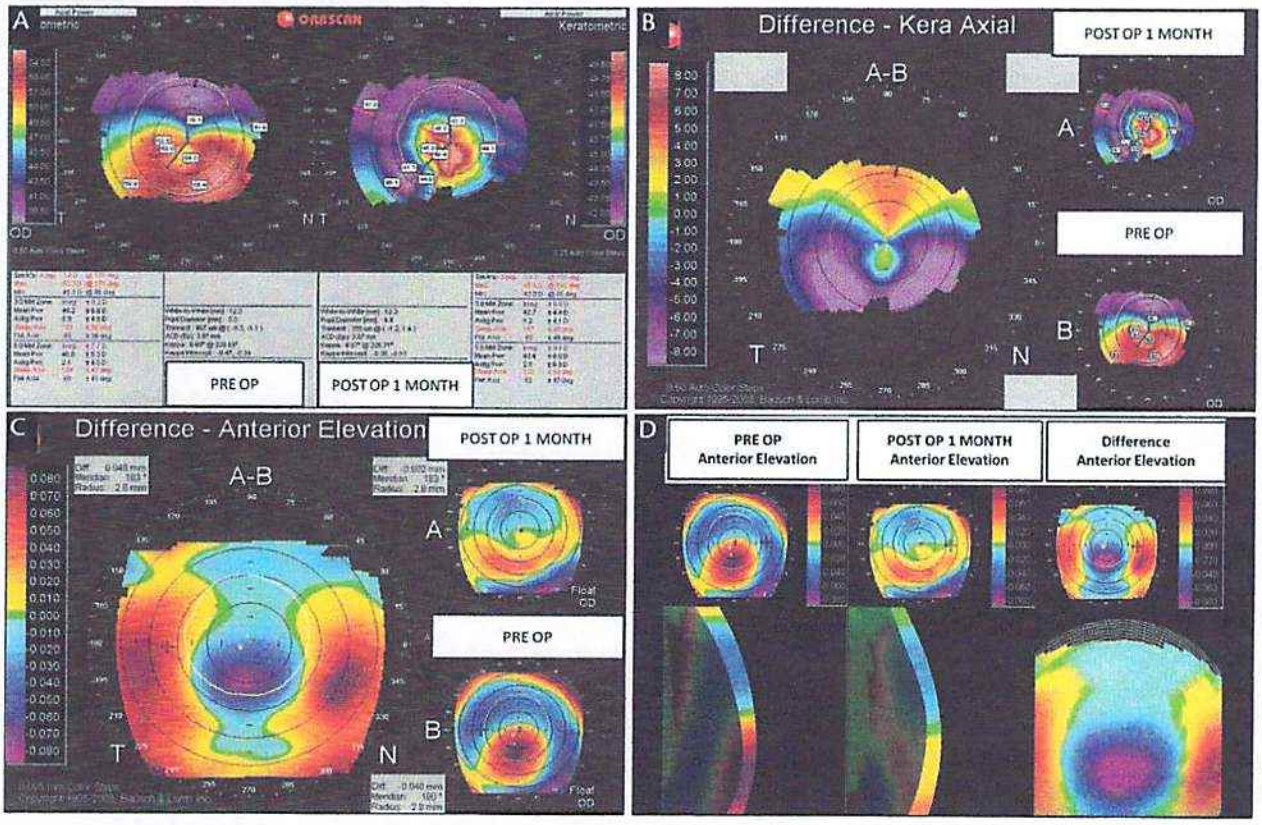

Figure 2. (A,D) This case illustrates the effect of the SI6 on the anterior surface of the cornea.

mean flap thickness was 145 ±16 µm, and the mean residual stromal bed thickness was 302 ±53 µm. The associated reason for the formation of ectasia was form fruste keratoconus in eight patients, insufficient stromal bed thickness in two, and undetermined in five patients.

Patient selection as well as choice of implant size, location, and surgical technique are crucial for good surgical outcomes. All ICRS implantations were performed by the same surgeon (DP) using the same surgical technique. Surgical plans were designed according to the Keraring nomograms (based on shape, extent, and distribution of the corneal ectasia; visual acuity; and aberrometric and manifest refraction values). When necessary, we extrapolated the nomograms and designed a more customized surgical plan. A 5- or 6-mm optical zone implantation tunnel was created with the femtosecond laser (IntraLase, Abbott Medical Optics Inc., Santa Ana, California), and the ICRS was implanted using a standard technique. We used both Keraring models SI5 (5-mm optical zone; Figure 1) and SI6 (6-mm optical zone; Figure 2). Figure 3 depicts OCT images from a patient who was implanted with both the SI5 and SI6 in the same eye.

Preoperatively, the mean UCVA was 1.9, which increased to 6.64 postoperatively. BCVA substantially improved after ICRS implantation, increasing from 5.4 preoperatively to

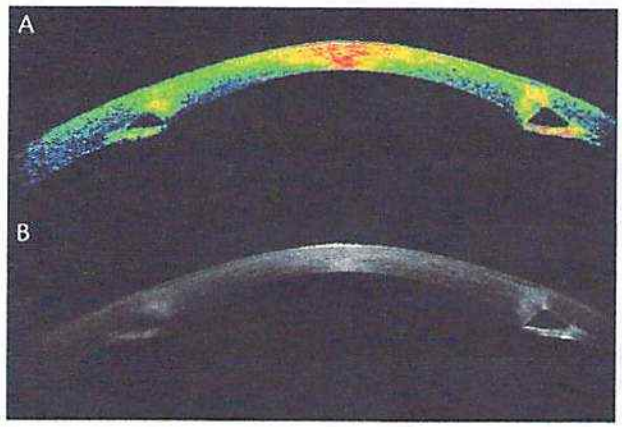

Figure 3. (A, B) OCT images of a patient implanted with a combination of a 5- and a 6-mm Keraring, illustrating the versatility of the ICRS.

7.93 postoperatively. Patients had a mean K reading, taken with the Orbscan (Bausch + Lomb, Rochester, New York), of 46.00 D preoperatively, which improved to 43.10 D postoperatively. The maximum K readings pre- and postoperatively were 52.23 D and 48.00 D, respectively. Corneal astigmatism also decreased after ICRS implantation.

At 2 years postop, the root-mean-square for the decrease in higher-order aberrations was 59% and 69%

for vertical coma. Higher-order aberrations continued to decrease over time and explain the substantial gain in UCVA and BCVA.

CONCLUSION

Our study showed that implantation of the Keraring increased not only the quantity but also the quality of vision in post-LASIK ectasia patients. On average, patients gained 4 lines of UCVA and 2.5 lines of BCVA, decreased their corneal astigmatism by 2.50 D, and reduced their higher-order aberrations by 50%. The maximum topographic K value was reduced by 4.00 D. Additionally, patient satisfaction was extremely high, with no complications. ■

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Keraring Implantation Followed by Surface Ablation

Combining treatments may provide synergistic results in select cases.

BY MARIA CLARA ARBELAEZ, MD

Modern corneoplastics procedures may be synergistically combined to achieve the best possible outcomes in selected cases. Implantation of intrastromal corneal ring segments (ICRS) such as the Keraring (Mediphacos, Belo Horizonte, Brazil) has been shown to be a safe and effective technique to produce substantial degrees of corneal flattening (ie, myopic correction) and topographic regularization (ie, astigmatic correction). As an additive technique, ICRS implantation carries inherent advantages including reversibility, adjustability, and preservation of the cornea's natural prolate profile. The corneal response to ICRS implantation is influenced by variations in the biomechanical properties of individual corneas, and therefore the refractive predictability of ICRS implantation as a standalone procedure may not be up to our patients' requirements.

In recent years, the safety, accuracy, and reproducibility of ICRS implantation has greatly improved by the advent of stromal tunnel creation with femtosecond lasers such as the Femto LDV (Ziemer Group, Port, Switzerland). This new form of tunnel creation allows consistently excellent centration, depth, and symmetry in the position of the ICRS. Results after excimer laser procedures are also more accurate now than ever before. The level of precision we are able to achieve is in large part due to the sophisticated ablation profiles derived from modern topography- and wavefront-guided platforms.

Despite these advances, several patients are still contraindicated for photoablative procedures, including those with large refractive errors, thin corneas, and suspect or documented corneal ectatic disorders. Phakic IOL implantation is also known to be a safe, effective, and predictable refractive technique, but many patients are ineligible or unwilling to undergo an intraocular procedure. This is especially true in our part of the world, where patients tend to prefer extraocular procedures. Corneal collagen crosslinking (CXL) with riboflavin and ultraviolet-A (UV-A) light strengthens and stabilizes the ectatic cornea and has been successfully applied in combination with ICRS implantation or surface ablation in select keratoconus patients.

STUDY OF TWO COMBINED TECHNIQUES

Over the last several years in our practice at Muscat Eye Laser Center in Oman, we have developed substantial experience, allowing us to discover the potential benefits and limitations of technologies such as the Keraring. We have investigated potential benefits of combining techniques in refractive and keratoconic cases that cannot be adequately resolved with one treatment. Hence, we are currently conducting two prospective clinical studies combining Keraring implantation and surface ablation techniques in select refractive and keratoconic patients.

Keraring and wavefront-guided LASEK treatment for refractive patients. Highly myopic patients ineligible for phakic IOL implantation who have insufficient corneal thicknesses for LASIK or LASEK may be treated with Keraring implantation followed by corneal wavefront-guided LASEK if they have no corneal ectatic alterations.

Keraring implantation allows us to produce substantial corneal flattening (up to 10.00 D), depending on the implant thickness used. A particular advantage of the Keraring system is the ability to independently modulate the intended correction of sphere and cylinder by select-