CXL for the Treatment of Post-LASIK Ectasia

This management strategy may arrest or delay disease progression, but longer-term results are needed.

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Keratectasia is a rare but sight-threatening complication that is characterized by progressive central or inferior corneal steepening and severe refractive changes, loss of visual acuity, and thinning of the corneal stroma after LASIK. Since it was first described in 1998 by Seiler et al,[1] several reports of post-LASIK keratectasia have been published.[2,3] This condition seems to be a multifactorial entity associated with thin corneas, thin residual stromal bed thickness, enhancement treatments, and preoperative abnormalities such as forme fruste keratoconus.[4] Keratectasia is unpredictable and can appear even in eyes treated according to current refractive surgery guidelines. This makes it difficult to prevent iatrogenic ectasia.

It is important to diagnose this condition at an early stage to achieve or maintain good visual acuity and avoid the need for severe invasive procedures such as a keratoplasty.

Because keratectasia formation appears similar to that of other ectatic conditions of the cornea such as keratoconus, similar treatments have been used to address post-LASIK ectasia. Unfortunately, the treatment options for iatrogenic keratectasia are mostly inefficient. Gas-permeable contact lenses have been used to induce corneal surface regularity and achieve good BCVA, but they do not halt the ectasia.[5] Intrastromal corneal ring segments (ICRSs) can provide refractive adjustment, improve visual acuity, and decrease contact lens intolerance in patients with corneal ectasia.[5] Lamellar and penetrating keratoplasty are the only curative methods available; however, such invasive methods should be reserved for patients with advanced stages of corneal cloudiness and scarring.[6]

CXL TREATMENTS

Corneal collagen crosslinking (CXL) with riboflavin and ultraviolet-A (UV-A) light exposure was introduced in 1997 by Spörl.[7] He found that the treatment strengthened corneal biomechanical stability by increasing the crosslinks between and within stromal collagen fibers, thereby increasing their stiffness. Soon after CXL was shown to increase the rigidity of the cornea, surgeons started to use it in the treatment of keratoconus. Several studies have shown the ability of CXL to reduce the need for keratoplasty in the treatment of keratoconus in most cases.[8,9] Considering the similarities between post-LASIK keratectasia and keratoconus, it is logical to assume that one can use CXL as a treatment option in the former when there is disease progression.

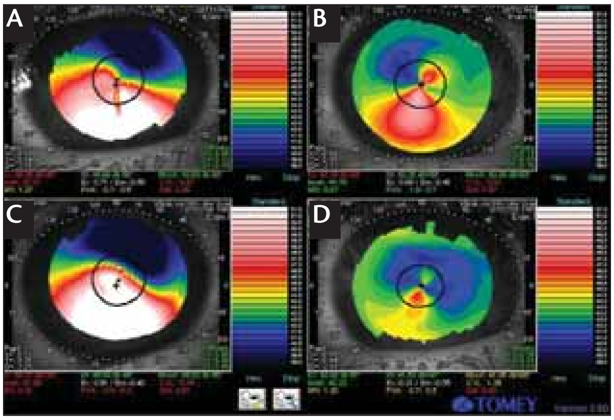

Figure 1. Corneal topography of a patient with bilateral post-LASIK ectasia. The right eye was treated with CXL and the left eye was not. (A) The right and (B) left eyes 2 years after CXL; (C) preoperative corneal topography of the right and (D) left eyes.

CXL should be performed in the operating theater under sterile conditions. The ocular surface is first anesthetized with a topical agent (eg, proxymethacaine 0.5%), followed by mechanical corneal debridement to allow penetration of riboflavin into the corneal stroma. To photosensitize and saturate the cornea, topical 0.1% riboflavin isotonic solution is applied every 5 minutes for 30 minutes. Next, the cornea is exposed to UV-A radiation (370 nm) with a surface irradiance of 3 mW/cm^2 for 30 minutes. During this time, riboflavin should be applied every 5 minutes to ensure the required concentration and to keep the cornea from drying out. Afterward, the corneal surface should be washed thoroughly with balanced saline solution. A bandage contact lens soaked in antibiotics (eg, levofloxacin 5 mg/mL) should be applied and remain in place until epithelial closure is complete.

Postoperative therapy should consist of application of topical preservative-free antibiotics and lubrication six times a day. A rescue pain medication should be prescribed to the patient. It is necessary to examine the patient daily until complete reepithelialization. Follow-up examinations should assess objective and manifest refraction, UCVA and BCVA, slit-lamp biomicroscopy, corneal pachymetry, and corneal topography at regular intervals. At a later date, refractive correction can be discussed with the patient; however, the first step is fitting gas permeable contact lenses.

CHALLENGES

In CXL, the crosslinking of collagen fibrils occurs mainly in the anterior two-thirds of the cornea.[10] Therefore, because the LASIK flap does not contribute to the mechanical stability of the cornea, CXL may not be as effective, and perhaps not as lasting, for post-LASIK ectasia as it is for the treatment of keratoconus.

The patients we have treated for post-LASIK ectasia with CXL usually had further decreased visual acuity in the first postoperative month. An increase in myopia within the same period could explain the loss of lines of UCVA, but its probable cause is modification of the corneal shape following the crosslinking process. Three months after CXL in these patients, induced myopia diminished and visual acuity recovered.

Unlike other surgical methods such as ICRSs, which correct only the subjective refraction, CXL has the ability to arrest the disease progression of keratoconus and may offer a new option for treating—or at least delaying the progression of—post-LASIK ectasia. But there are some disadvantages to CXL that we must consider. First, there is no long-term experience. Although the 6-year results of CXL for the treatment of keratoconus indicate a stabilization or improvement in the disease state, this result might be diminished in post-LASIK ectasia. In the meantime, we are monitoring our patients with the intention to provide long-term follow-up when it becomes available.

There are few reports of repeated CXL in the same eye.[9] Further complications are rare; however patients should be selected carefully for retreatment. The complications of CXL include keratitis, scarring,[11] and permanent haze.[12] CXL has bactericidal and fungicidal properties,[13] so corneal infection derived from the procedure is unlikely.

TAKE-HOME MESSAGE

- Post-LASIK ectasia is a multifactoral entity associated with thin corneas and residual stromal beds, enhancements, and preoperative corneal abnormalties.
- Most treatment options are insufficient; however, the use of CXL as a therapy for keratectasia is promising when there is disease progression.

CONCLUSION

Iatrogenic keratectasia remains a complication with high variability and little published data, making it difficult to diagnose and treat. Ectasia can present quickly after refractive surgery, but it can also appear long afterward. The most important factor in the management of iatrogenic keratectasia is to monitor refractive patients regularly, even well after the laser procedure, in order to diagnose and treat this complication as quickly as possible.

CXL has shown promising results for the treatment of post-LASIK keratectasia, but we await long-term results in a greater number of patients in randomized studies to confirm its efficacy and durability. ■

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1. Seiler T, Koufala K, Richter G. Iatrogenic keratectasia after laser in situ keratomileusis. *J Refract Surg.* 1998;14(3):312-317.
2. Kymionis GD, Tsiklis N, Karp CL, et al. Unilateral corneal ectasia after laser in situ keratomileusis in a patient with uncomplicated photorefractive keratectomy in the fellow eye. *J Cataract Refract Surg.* 2007;33(5):859-861.
3. Ou RJ, Shaw EL, Glasgow BJ. Keratectasia after laser in situ keratomileusis (LASIK): evaluation of the calculated residual stromal bed thickness. *Am J Ophthalmol.* 2002;134(5):771-773.
4. Randleman JB, Woodward M, Lynn MJ, Stulting RD. Risk assessment for ectasia after corneal refractive surgery. *Ophthalmology.* 2008;115(1):37-50.
5. Winkler von Mohrenfels C, Salgado JP, Khoramnia R. Keratectasia after refractive surgery [published online ahead of print November 24, 2010]. *Klin Monbl Augenheilkd.*
6. Salgado JP, Khoramnia R, Lohmann CP, Winkler von Mohrenfels C. Corneal collagen crosslinking in post-LASIK keratectasia [published online ahead of print August 1, 2010]. *Br J Ophthalmol.*
7. Spoerl E, Huhle M, Kasper M, Seiler T. Increased rigidity of the cornea caused by intrastromal cross-linking. *Ophthalmology.* 1997;94(12):902-906.
8. Wollensak G. Crosslinking treatment of progressive keratoconus: new hope. *Curr Opin Ophthalmol.* 2006;17(4):356-360.
9. Raiskup-Wolf F, Hoyer A, Spoerl E, Pillunat LE. Collagen crosslinking with riboflavin and ultraviolet-A light in keratoconus: long-term results. *J Cataract Refract Surg.* 2008;34(5):796-801.
10. Kohlhaas M, Spoerl E, Speck A, et al. A new treatment of keratectasia after LASIK by using collagen with riboflavin/UVA light cross-linking. *Klin Monbl Augenheilkd.* 2005;222(5):430-436.
11. Koppen C, Vryghem JC, Gobin L, Tassignon MJ. Keratitis and corneal scarring after UVA/riboflavin cross-linking for keratoconus. *J Refract Surg.* 2009;25(9):S819-823.
12. Raiskup F, Hoyer A, Spoerl E. Permanent corneal haze after riboflavin-UVA-induced cross-linking in keratoconus. *J Refract Surg.* 2009;25(9):S824-828.
13. Koller T, Mrochen M, Seiler T. Complication and failure rates after corneal crosslinking. *J Cataract Refract Surg.* 2009;35(8):1358-1362.