

Keratoectasia: a Dreaded Complication of LASIK

New insights in its prevention and management.

BY SHACHAR TAUBER, MD

With LASIK still the most popular form of refractive surgery, it behooves refractive surgeons to keep updated on potential complications, even those that remain quite rare. Those involved with performing this type of surgery must understand the risk factors, prevention, early diagnosis, and treatment of LASIK complications. Keratoectasia, although quite uncommon, is a serious complication that has severe implications for the patient's vision (Figure 1).

PREOPERATIVE SCREENING

I divide ectasia into the preoperative risk factors for developing it. Screening patients preoperatively for their susceptibility to ectasia involves a careful examination for evidential markers.

Changing Refraction

First, I examine the stability of the patient's refraction. Someone who presents with a refraction or keratometry that has changed significantly needs his refractive stability evaluated over several months. If he is in his early 20s, he may be a premature keratoconus patient. One should be concerned about contact-lens or spectacle intolerance due to unstable refractions as well as a BCVA of less than 20/20 if no ophthalmic pathology is evident.

Suspicious Medical History

A history of atopic dermatitis or chronic conjunctivitis, although not necessarily a risk factor for ectasia after LASIK, is reason enough to further work up a patient before considering treating him with refractive surgery.

(All images courtesy of William Trattler, MD.)

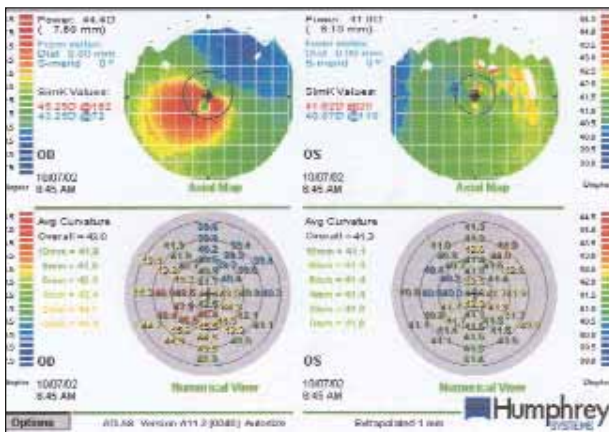


Figure 1. Computerized videokeratography of a patient's eyes after myopic LASIK shows inferior steepening of his right eye, consistent with keratoectasia.

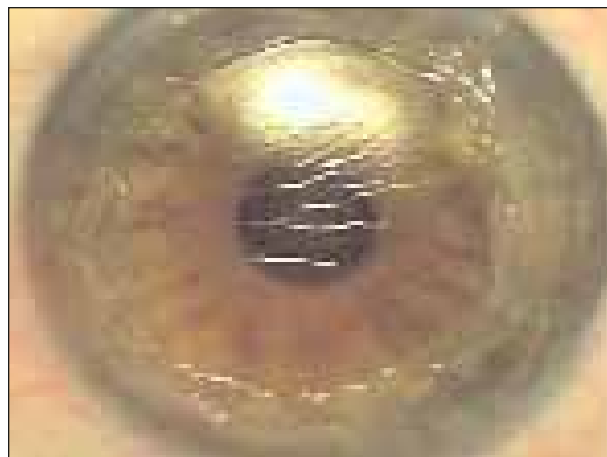


Figure 2. An eye that has undergone previous LASIK has had its epithelium removed to receive surface ablation.

Chronic eye rubbing also denotes a poor refractive surgery candidate.

Type of Refraction

Work performed by Doyle Stulting, MD, and others showed that ectasia is extremely rare in low myopia.¹ Among risk factors they identified for developing ectasia were refractions greater than -8.50D, a residual stromal bed, and evidence of forme fruste keratoconus.

“The most important thing for the refractive surgeon to know is the parameters of his devices.”

PREOPERATIVE CORNEAL MAPPING AND PACHYMETRY

All the aforementioned conditions require further investigation. I would not necessarily rule out performing LASIK in these patients, but I would proceed cautiously. I will not perform LASIK on a patient who cannot stop rubbing his eyes. Likewise, I reject LASIK for those whose preoperative mean keratometry is above 47.20D or whose central corneal pachymetry is less than 500 μ m, regardless of their prescription in either case. I will instead recommend surface ablation to those patients. I have been performing more surface ablation in recent years, because I have become less tolerant of the potential risks of LASIK (Figures 2 and 3). Furthermore, I do not feel that new technology, such as the Intralase FS laser (Intralase Corp., Irvine, CA) has sufficiently alleviated those risks to make me more comfortable performing LASIK than surface ablation.

I use keratometry and topography to rule out any suspicion of forme fruste keratoconus. A difference in inferior and superior steepening of more than 1.50D might indicate an irregular cornea. If I see topographic or keratometric evidence of irregular astigmatism, or if I cannot correct the patient to 20/20 despite a normal preoperative examination, then I will choose surface ablation.

INTRAOPERATIVE PRECAUTIONS

The most important thing for the refractive surgeon to know is the parameters of his devices. I am extremely nervous when asked to try a new microkeratome, because I do not know how it will cut in my hands. It behooves each surgeon to measure and keep track of the thickness of the flap in every LASIK case. I use the Moria 1 disposable microkeratome unit (Moria, Antony, France), with which I produce flaps from 90- to 135 μ m.

I always use the thickest flap I have ever created as a basis for calculating a patient's ablation depth and amount of residual stroma. I will plan to leave 300 μ m in the stromal bed after laser application as opposed to the FDA's recommended 250 μ m for a primary LASIK procedure.

To calculate the residual stromal bed, I measure the stromal depth before ablating it and then postoperatively subtract the amount that the laser indicates it has removed from the central cornea. Subtraction technology is currently the best way to measure flap thickness, although a more direct method would be preferable. I make sure to include these data in the patient's chart so that, if he returns for an enhancement, I know the postoperatively calculated stromal bed.

Also on the subject of enhancements, surgeons must review any available surgical notes preoperatively so that they know the original ophthalmologist's intent. When it is time to relift the corneal flap to perform the enhancement, the surgeon needs to know (1) how much tissue is available and (2) how much he is going to remove in order to calculate the residual stromal bed. For example, if 350 μ m of tissue is available after measuring under the flap, calculating the ablation for 120 μ m will certainly leave less stromal tissue than the FDA's recommendation of 250 μ m, and the surgeon will have to abort the procedure. Aborting a procedure is a difficult chore for a surgeon, but preoperative planning can avoid it. If planning reveals that the flap is thicker than anticipated, then the surgeon's best option is to put the flap back down. The literature supports laser surface ablation treatments on the flap itself for such patients at a later date,² which is an important option to remember.

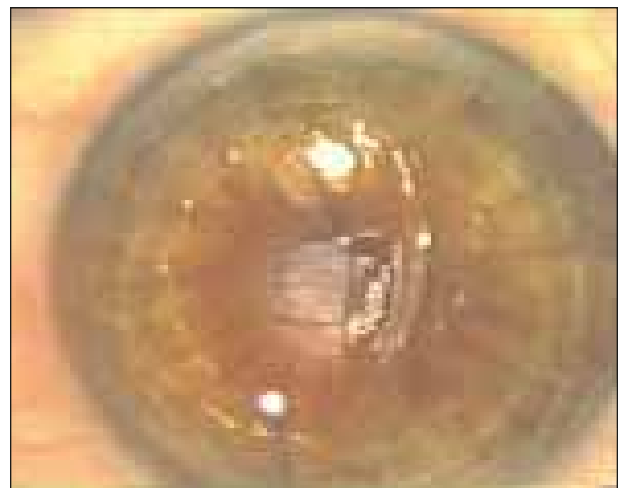


Figure 3. The epithelium is being removed in preparation for surface ablation.

CORNEAL COLLAGEN CROSSLINKING WITH RIBOFLAVIN

By Brian S. Boxer Wachler, MD

A new treatment for keratoconus increases collagen by applying a one-time-only topical dose of riboflavin drops to the cornea and exposing the cornea to a low amount of ultraviolet A (UVA) light using a goggle-type device.¹ The activated riboflavin enhances corneal strength and integrity by increasing collagen crosslinking, as proven experimentally and published in the peer-reviewed literature.^{2,3}

This riboflavin/UVA therapy has been safe thus far. There have been no reported complications in the crystalline lens or retina due to the limitation of UVA transmission through the cornea. In a 3-year study of patients with actively progressing keratoconus, the pattern of increasing mean keratometric values was not only halted, but it was also reversed and flattened by a mean of 2.00D. That result persisted during the 3-year follow-up period.¹

MY EXPERIENCE

In early January 2004, my colleagues and I began using riboflavin/UVA treatments in patients with compromised corneal integrity. We named the modified procedure *C3-R* (*corneal collagen crosslinking with riboflavin*). The causes of reduced corneal integrity in our treated patients included LASIK-induced ectasia and keratoconus. To our knowledge, these C3-R procedures represent the first riboflavin/UVA treat-

ments performed in North America for keratoconus, and our C3-R treatments combined with the prior and simultaneous placement of Intacs (Addition Technology, Inc., Des Plaines, IL) constitute the first-ever such treatments. The C3-R treatment is a one-time, 30-minute procedure. To date, we had to repeat the treatment in only one patient who had advanced, progressive LASIK-induced ectasia.

In virtually all of our patients who had progressive corneal steepening from both keratoectasia and keratoconus, progression has halted. In those with prior Intacs placement whose corneal steepening has continued to progress due to active keratoconus, we have observed the same halting pattern. In some cases, we saw not only stabilization but also a reversal of corneal steepening as early as 1 day postoperatively that persisted on subsequent follow-up visits. In cases of Intacs insertion for keratoconus followed immediately by C3-R treatment on the same day, we observed more than 10.00D of corneal flattening in some cases, a greater degree of flattening than with Intacs alone (Figure 1). There is variability with the flattening on a case-by-case basis.

CONCLUSION

C3-R treatments, both alone and combined with Intacs implantation, are allowing patients better and easier contact-lens fittings (rigid gas permeable and soft toric) as well as improved vision and comfort. The ability to permanently strengthen the inherently weakened cornea is a major advance in the management of these cases. C3-R treatments provide real hope for many patients with keratoectasia and keratoconus. My colleagues and I are currently compiling longer-term results of the procedure.

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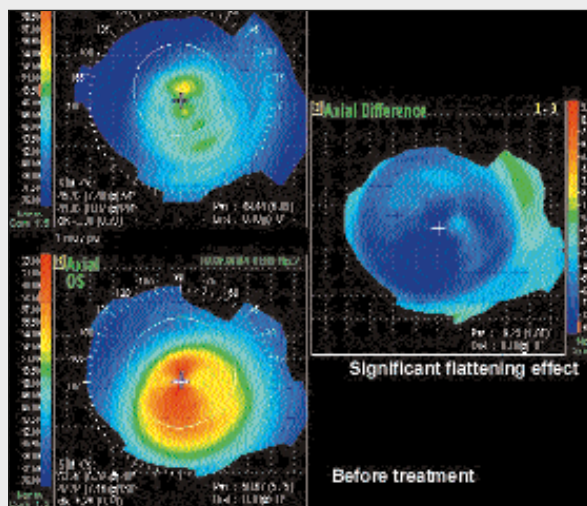


Figure 1. Combining corneal collagen crosslinking with riboflavin and the placement of Intacs produced 10.00D of corneal flattening in this case of keratoconus.

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2. Wollensak G, Spoerl E, Seiler T. Stress-strain measurements of human and porcine corneas after riboflavin-ultraviolet-A-induced cross-linking. *J Cataract Refract Surg.* 2003;29:1780-1785.
3. Wollensak G, Wilsch M, Spoerl E, Seiler T. Collagen fiber diameter in the rabbit cornea after collagen crosslinking by riboflavin/UVA. *Cornea.* 2004;23:503-507.

TREATING ECTASIA AFTER LASIK

Diagnosing ectasia after LASIK is critical, because these patients tend to have wonderful early postoperative results and only schedule a return visit when they have problems. One hopes that they will see their operating surgeon, because he has all their data. My staff and I strongly encourage our patients to return to us if they experience a postoperative problem. We tell them that their data are important to us. We always take postoperative topographic measurements with an Orbscan topographer (Bausch & Lomb, Rochester, NY) at 1 month and measure the pachymetry at 3 months. We record both of these calculations in the patient's chart. If we see myopia developing, we follow it for 1 to 2 months while taking serial topographies and refractions to make sure the refraction is stable. I become very suspicious if the patient's BCVA is less than it was in the preoperative or early postoperative period. A patient who becomes myopic, who develops some astigmatism, and whose BCVA drops to 20/30 is a big concern.

"Making the diagnosis is important because it is very tempting to automatically enhance an eye."

Making the diagnosis is important because it is very tempting to automatically enhance an eye. In following such an individual, I use the Orbscan topographer and examine the posterior float, which I use as a tie-breaker rather than an absolute determination. I rely on other clinical and historical findings to give the diagnosis much more weight than an abnormally elevated posterior float from the patient's Orbscan.

Once I have diagnosed ectasia, I inform the patient and advise him about his treatment options. I explain that my goal is to improve his BCVA. This is a critical time for the operating surgeon, who has earned the trust of and developed a good rapport with the patient. On the other hand, a surgeon whom the patient has sought for a second opinion must spend time with the patient and deal with his anger, disappointment, and shock at the situation, even if he understood the risks. A patient who has to revert to using contact lenses will almost always resist this treatment, because he underwent refractive surgery to eliminate this dependence. The surgeon must be cognizant, empathetic, and supportive of the patient's duress, but he must also be firm in delivering his advice. I tell the patient that contact lenses are

likely his best option, because they have the highest likelihood of improving his visual acuity to a satisfactory level.

MANAGING IOP

In my early management of ectasia, in addition to using a contact lens, I will lower the patient's IOP with a beta-blocker (Betimol; Santen Inc., Napa, CA) once or twice per day if the patient tolerates it. If an IOP component is furthering the ectasia, the beta-blocker may retard or limit it. I think this approach is worth a trial early on. This type of beta-blocker usage has had few case reports,³ but it has been impressive in very mild cases of ectasia. Certainly, full-blown keratoectasia will not respond to IOP lowering.

Finally, if the patient cannot tolerate contact lenses, I will explore every possible means of treating the ocular surface to make this modality viable. For patients who simply cannot wear a contact lens, intrastromal corneal ring segments (Intacs; Addition Technology, Inc., Des Plaines, IL) are a very interesting option. I am planning to use them for several patients to treat their ectasia. Although the available literature on Intacs is early, it seems to support their use as a modality for ectasia once contact lenses have failed,⁴ and I think the approach is definitely worth a try. The only other alternative is corneal transplantation, which is a last resort because of the intraocular nature of the procedure and the long-term immunological and postoperative care those patients need.

Also, I am looking forward to the work of Theo Seiler, MD, PhD, in Dresden, Germany, and Brian Boxer Wachler, MD, in Los Angeles with regard to using corneal collagen crosslinking riboflavin (see Corneal Collagen Crosslinking With Riboflavin). This modality seems very promising in keratoconus and should be quite applicable to ectatic eyes. It may allow us to remedy this thankfully rare but devastating complication. ■

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