Simultaneous Collagen Cross-Linking With Photorefractive Keratectomy or IntraLase LASIK

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Laser-assisted in situ keratomileusis (LASIK) and photorefractive keratectomy (PRK) have been recognized to cause weakening of the structural integrity of the cornea by 14% to 33%.1-4 As a result, iatrogenic ectasia after laser refractive corneal surgery has become a troublesome and unpredictable problem for many corneal refractive surgeons and patients. With the increasing number of eyes undergoing LASIK and PRK, there may be a corresponding increase in the number of corneas that will suffer mechanical fatigue resulting in ectasia.

Corneal cross-linking with riboflavin, generally known as CXL, was first used in 1998 to treat keratoconus.2 It has been investigated extensively and has been shown clinically to arrest the progression of post-LASIK ectasia as well as keratoconic ectasia.2-11 With its minimal cost and simplicity and with proven positive clinical outcomes, corneal cross-linking can be regarded as a useful approach to reduce the incidence of postlaser corneal refractive surgery ectasia. The use of CXL has gradually increased and there are currently more than 400 centers around the world performing this procedure.

CXL may also be considered for prophylactic use at the time of corneal refractive surgery because virtually any patient can be treated with cross-linking to reduce the chance of future development of the above conditions. Patients with thinner-than-normal corneas, steeper-than-normal corneas, against-the-rule astigmatism, and especially those with slightly irregular corneal astigmatism shown by asymmetry on corneal topography should be considered for CXL at the time of surgery. The ophthalmic community is starting to see the benefits and minimal risks of prophylactic treatment using CXL and this procedure is now beginning to be offered as a stand-alone procedure or in conjunction with corneal laser refractive surgery (PRK and LASIK). Recent advances in ultraviolet (UV) delivery systems have made it possible to reduce the CXL time to a few minutes. This has increased the practicality of the use of CXL at the time of PRK and LASIK to strengthen the surgically weakened normal cornea and extend the use of these refractive procedures to marginally thin or somewhat asymmetrical corneas. Prophylactic CXL during PRK and LASIK surgery has the added efficiency of being able to apply the riboflavin when the stroma is already exposed after laser treatment, eliminating the need to remove the epithelium just for the treatment. With the appropriate UV light source and riboflavin formulation, the cornea can be prophylactically cross-linked in just a few minutes at the end of a laser corneal refractive procedure.

There may be a slight corneal flattening effect from CXL that would slightly affect the refractive outcome of a corneal refractive procedure and this will have to be studied with a large database. There appears to also be a beneficial refractive stabilizing effect that may be most apparent in hyperopic LASIK corrections as reported by Kanellopoulos, but not yet published. He found less regression of the correction after hyperopic LASIK in eyes that had CXL than in the contralateral eye that did not have CXL.

The Procedure

The procedure of prophylactic CXL, in essence, is cross-linking at the conclusion of the corneal refractive surgery laser application. The riboflavin solution is applied for the prescribed time directly to the stromal bed after the PRK or LASIK treatment is complete (Figure 11A-1). After rinsing the riboflavin off of the stroma, the LASIK flap is replaced and the UVA light is applied for the prescribed time. For PRK, the UV light is applied before or after rinsing and before the bandage contact lens is applied. Not rinsing keeps the UVA absorption more anterior in the stroma. The recovery is very much the same for PRK or LASIK. With PRK, the re-epithelialization may take a few hours longer. Only one treatment is required.

With most systems in use for therapeutic cross-linking, there is a 30-minute riboflavin (0.1% in 20% dextran) soak time after the epithelium has been removed and then typically 30 minutes of UVA exposure at a 3 mW/cm² irradiance. There are newer systems with higher irradiance and