Algorithm for Management of Post-Laser Ectasia

The best treatment is prevention.

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Corneal ectasia is a rare complication but also one of the most feared situations that can occur after uneventful excimer laser surgery.\(^1\)\(^-\)\(^7\) There are predictive factors for ectasia, but it may also occur in patients with no documented risk factors. Ectasia is most common following LASIK;\(^1\)\(^-\)\(^3\) however, cases have been reported following PRK and other corneal refractive procedures, including radial keratotomy and more recently thermal keratoplasty.\(^4\)\(^-\)\(^7\)

Since postoperative ectasia was described by Barraquer\(^8\) and later by Seiler,\(^9\) many reports have been published in an attempt to better understand this process and identify potential risk factors.\(^10\)\(^-\)\(^13\) Ophthalmologists have not yet fully grasped the underlying mechanisms of corneal biomechanics involved in the development of ectasia,\(^14\) and its incidence after LASIK remains unknown, ranging from 0.04% to 0.6% in the literature.\(^15\) Histopathology studies offer conflicting data on whether the creation of a flap is involved in the development of ectasia,\(^15\) but most evidence points to the severing of Bowman’s membrane during flap creation, thus suggesting a different pathology from keratoconus. Rabinowitz et al\(^16\) found that risk factors for keratoconus included a central corneal power of greater than 47.00 D, a difference of 3.00 D when comparing the inferior to superior keratometry reading, and asymmetry greater than 1.00 D in the corneal powers of both eyes.

Predictive factors for ectasia after LASIK and other excimer laser procedures have been identified in detail\(^10\)\(^-\)\(^13\) and include abnormal preoperative topography, high myopia, patients in whom a retreatment was performed (Figure 1), residual stromal bed thickness less than 250 µm, preoperative pachymetry less than 500 µm, preoperative corneal power greater than 47.00 D, abnormal corneal rigidity, and keratoconus suspect or asymmetric cornea. However, LASIK has been performed in patients with forme fruste keratoconus or thin corneas without inducing ectasia. In the absence of documented risk factors, idiopathic ectasia may still occur. For instance, ectasia can still occur if the patient’s residual stromal bed is thicker than 250 µm.

**DIAGNOSIS**

Ectasia typically presents as progressive corneal thinning and steepening, usually inferiorly, with loss of UCVA and possible loss of BCVA. This condition is also associated with increases in myopia and irregular astigmatism. It is important to differentiate a decentered ablation from progressive ectasia (Table 1). With a decentered ablation, a poor result is evident immediately, whereas with ectasia the early result is good. Decentered ablation also presents with early inferior corneal steepening but no secondary increase in visual acuity and no progression; the opposite is true with ectasia. Laser treatment may help to correct a decentered ablation, but it will make ectasia worse.

![Figure 1. Measure the residual stromal bed prior to performing an enhancement.](image-url)
Randleman compared cases of post-laser ectasia occurring before 2002 with a group of 175 controls and found that cases with documented ectasia had more abnormal preoperative topographies (35.7% vs 0%), included patients who were significantly younger (34.4 vs 40 years) and more myopic (-8.53 vs -5.09 D), and who had thinner corneas (521 vs 546.5 µm) and thinner residual stromal beds (256.3 vs 317.3 µm). Based on subgroup logistic regression analysis, abnormal topography was the most significant factor that discriminated ectasia from controls, followed by residual stromal bed thickness, age, and preoperative corneal thickness, in that order. Using a risk factor stratification scale with weighted recognized risk factors, the specificity and sensitivity of cases was 91% and 96%, respectively, in this series.

In another series including more than 9,000 LASIK procedures, Binder reported no cases of ectasia in patients with one or two of the following risk factors: keratometry greater than 48.00 D, central corneal thickness less than 500 µm, and residual stromal bed thickness less than 250 µm. Three cases of ectasia were noted; in these eyes, the only known risk factor was corneal topography.

**ALGORITHM FOR MANAGEMENT**

**Suspicious cases.** Alternative treatment strategies should be devised for patients at risk for ectasia. Such instances include patients with a lack of symmetrical corrective errors, differences in BCVA, and a history of eye rubbing or atopy. New technologies that evaluate corneal biomechanical properties, such as corneal hysteresis and elastometry, will better evaluate the persistence of ectasia in high-risk patients.

Below is a list of treatment options depending on patient characteristics:

- Surface ablation may be considered in patients with thin corneas. Benito-Llopis et al reported good results.
with a follow-up of more than 10 years after surface ablation in patients with corneas thinner than 500 µm.

- Intrastromal corneal ring segments have shown promising results in patients with low myopia.\textsuperscript{19-20}

- Phakic IOls may be implanted in patients with higher ametropia and a deep anterior chamber.

- Thin-flap LASIK with an inverted sidecut may preserve the stromal architecture in patients with thin stromal beds.

- Corneal crosslinking (CXL), which is currently under investigation, may stiffen the cornea and therefore prevent corneal ectasia.\textsuperscript{21-23}

**Progressive ectasia cases.** According to Woodward et al,\textsuperscript{24} the majority of eyes (77%) that developed postoperative corneal ectasia achieved functional visual acuity with rigid gas permeable contact lenses and did not require further intervention. Penetrating or lamellar keratoplasty can usually be postponed or avoided by alternative methods of visual rehabilitation including CXL if the corneal thickness is greater than 400 µm; contact lenses; intrastromal corneal rings if the patient is contact-lens intolerant; or deep lamellar keratoplasty in patients with unsatisfactory visual acuity or if the cornea is too thin (Table 2). Therapies that lower intraocular pressure to minimize corneal bulging may also be indicated.

**CONCLUSION**

By carefully screening patients preoperatively and performing intraoperative pachymetry, it is possible to prevent the occurrence of ectasia; however postoperative ectasia will still develop in some patients who do not present with risk factors. Furthermore, postoperative incidence due to the natural progression of unidentified factors or as-yet unidentified keratoconus will also occur in some patients.

Future developments that may further reduce the incidence of ectasia include enhanced corneal tensile strength measurement and advanced topographic analysis. It is unlikely that ectasia will completely cease to occur, but it is important to remember that the development of ectasia does not constitute malpractice.

**TAKE-HOME MESSAGE**

- Ectasia usually presents as progressive corneal thinning and steepening.

- Carefully screening patients preoperatively and performing intraoperative pachymetry may reduce but not eliminate the occurrence of ectasia.

- The true incidence of post-LASIK ectasia is unknown.

- In the absence of documented risk factors, idiopathic ectasia may still occur.

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