Management of Unpredictable Post-PRK Corneal Ectasia with Intacs Implantation

Mohammad Naser Hashemian, MD1 • Mahdi AliZadeh, MD2
Hassan Hashemi, MD1,3 • Firoozeh Rahimi, MD4

Abstract

Purpose: To present the clinical features, biomechanical properties and management of a patient who developed unilateral corneal ectasia after photorefractive keratectomy (PRK)

Case report: The patient was a 24-year-old man without any obvious preoperative risk factor for ectasia who underwent bilateral PRK. Four years after keratorefractive surgery, the patient presented with loss of visual acuity (VA) in his right eye. Pentacam findings were persistent with corneal ectasia and Ocular Response Analyzer measurements showed differences in signal shape between two eyes. A single piece intrastromal segment ring was implanted and ceased the progression of ectasia until now.

Conclusion: Corneal ectasia after PRK is extremely rare and can occur without tangible risk factors. Differences between signal shapes in Ocular Response Analyzer and abnormal measurements may be useful in detecting high risk patients. Intacs implantation appeared to improve ecstatic progressive changes and patient's symptoms.

Keywords: Photorefractive Keratectomy, Corneal Ectasia, Ocular Response Analyzer, Intacs Implant

Introduction

Corneal ectasia is a rare but serious complication after refractive surgery. The time for its clinical onset can be from months or years after surgery. Possible risk factors for the development of ectasia following excimer laser have been identified in the literature. These include high myopic correction, forme fruste keratoconus, and thin residual stromal bed.1 However, the etiology and biomechanical changes that induce ectasia after refractive surgery remain unknown.2

The authors would report a case of unilateral ectasia after bilateral photorefractive keratectomy (PRK).

Case report

A 24-year-old man presented for refractive surgery to our hospital in January 2004. The manifest refraction was -2.75 sph. in both eyes. Pachymetry was 527 micrometers in the right eye and 554 micrometers in the left eye. Preoperative topography exhibited a round pattern with Sim-k values 43.26/43.81 in the right eye and 554 micrometers in the left eye. Preoperative topography exhibited a round pattern with Sim-k values 43.26/43.81 in the right eye and symmetric bowtie with 41.94/42.34 in the left eye (Figure 1). All topography indices were normal in both eyes and Kpi was 0% bilaterally.

1. Associate Professor of Ophthalmology, Eye Research Center, Farabi Eye Hospital, Tehran University of Medical Sciences
2. Resident in Ophthalmology, Eye Research Center, Farabi Eye Hospital, Tehran University of Medical Sciences
3. Noor Ophthalmology Research Center, Noor Eye Hospital
4. Professor of Ophthalmology, Eye Research Center, Farabi Eye Hospital, Tehran University of Medical Sciences

Correspondence to: Mahdi AliZadeh, MD
Eye Research Center, Farabi Eye Hospital, Tehran, Iran, Tel:+98 21 55414941-6, Email: alizadehm@razi.tums.ac.ir

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Figure 1. A: Right eye preoperative topography showing round pattern, with a central k-reading of 43.4. B: Left eye preoperative topography showing bowtie pattern with a central k-reading of 42.5.
Medical and familial histories were unremarkable. Retinoscopy, slit-lamp examination, IOP and funduscopic examination all were normal bilaterally.

The patient underwent bilateral PRK in February 2004. The epithelium removed by application of diluted alcohol (20% concentration) to the corneal surface. Excimer laser ablation was performed with the NIDEK EC5000 slit beam excimer laser. Optical zone of ablation was 6 mm and blend zone was 1.5 mm. Central ablation depth was 49.7 micrometer in the right eye and 39.7 micrometer in the left eye.

Three months following the PRK, the uncorrected visual acuity (UCVA) was 20/20 in both eyes with manifest refraction +0.25-0.25@70 in the right eye and plano in the left eye.

The patient had no complaint until one year ago (4 years after refractive surgery) when he returned to our clinic complaining of blurred vision in his right eye. The UCVA was 20/50 with manifest refraction +1.5-2.5@70 in the right eye and 20/20 in the left eye. A sheimpflug measurement system using a Pentacam revealed island of elevation above the best-fit-sphere in the right eye. Keratoconus indices were abnormal and corneal thickness progression was also abnormal (Average=2.3). Residual corneal thickness in 3 mm central zone was 495 micron and Keratometric power was 40.9/43.7 (Figure 2). Pentacam indices and corneal thickness progression were normal in left eye and residual corneal thickness in 3 mm central zone was 521 micron.

In reviewing the predisposing factors for ectasia, there were no obvious risk factors and history of eye rubbing was not detected. Assessment of both cornea with Ocular Response Analyzer (Reichert Ophthalmic Instruments) was done postoperatively (Figure 3).

Hysteresis and corneal response factor in both eyes were low (average hysteresis 6.8 in right eye and 6.7 in left eye and average corneal resistance factor (CRF) 6.7 in right eye and 7.0 in left eye).

A rigid gas permeable contact lens was fitted in the right eye without success and the comfort was not acceptable. The ectasia progressed in right eye during 6 months follow-up and the patient’s refraction changed to +5.50-5.00@63. In July 2008, a single piece intrastromal segment ring (0.45 mm thickness) was implanted inferiorly in the right eye. The incision was made at 8 o’clock to place the segment in the region of the corneal cone (Figure 4). No inadvertent event occurred during implantation procedure.

Three months post-implantation, the refraction was +0.75-2.5@70, the best corrected visual acuity (BCVA) was 20/20 without any glare and visual symptom. The patient’s follow-up shows stable refraction up to now.
Figure 2. A: Pentacam maps of the right eye 4 years after PRK
Figure 2. B: Pentacam maps of left eye 4 years after PRK
Discussion
To our knowledge this is one of the first cases with corneal ectasia that occurred after PRK without any obvious preoperative risk factor for ectasia. Corneal ectasia is a complication of refractive surgery that can have a devastating effect on visual function. The occurrence of ectasia after refractive surgery, particularly PRK, is rare (about 1/3000) and characterized by progressive corneal thinning with topographic changes and loss of BCVA.\textsuperscript{3}

In almost all cases with ectasia after refractive surgery, identifiable preoperative risk factors (familial history, prior eye trauma or topographic indices abnormalities) have been found, but only few cases without any risk factor have been reported after LASIK.\textsuperscript{4}

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**Figure 3.** Ocular response analyzer showing the differences in signal amplitude between right ectatic eye and left nonectatic eye

**Figure 4.** Right eye slit-lamp view demonstrates Intacs implant in inferotemporal region.
Although there is no reported case of ectasia after PRK without identifiable risk factor, cases of ectasia after this procedure increased during the 2000s after repopularization of PRK.\(^4,5\) Our case had no preoperative findings, suggestive of forme-fruste keratoconus, including high astigmatism, steep central cornea, thin cornea and BCVA less than \(\frac{20}{20}\), keratoconus in the fellow eye, low corneal thickness and familial history for ectasia, deep corneal ablation during procedure and mechanical trauma after that.\(^5\) 

There are reports suggesting that biomechanical factors of cornea might predict ectasia in patients who are at risk to develop corneal ectasia.\(^6\) Assessment of corneal biomechanics with Ocular Response Analyzer can be done and give us some information about the risk of corneal ectasia. In our case, PRK might have diminished the corneal hysteresis (CH) and CRF in both eyes, but probably might have diminished the CH more in the right eye than in the left eye, and more modification in the ectatic eye (diminished spikes than in the normal post-PRK eye).\(^6,7\) According to our findings, biomechanics results such as corneal response factor and CH can show asymmetry in unilateral post-PRK ectasia and probably if it is present before keratorefractive procedures, it might have a predictive value.

There are different methods for management of corneal ectasia and most patients can regain functional visual acuity (VA) with appropriate managements. These include observation, spectacle correction, rigid gas permeable contact lens, collagen cross-linking, intra corneal segment ring (Intacs) and corneal transplantation.

Rigid gas permeable contact lenses remain the mainstay of treatment, however when necessary, other techniques can be used.\(^5\)

Collagen cross-linking procedures using riboflavin as a photosensitizer followed by UV-A exposure can be effective in corneal stability and advocated by some authors. Initial reports showed that collagen cross-linking can halt the progression of Keratoconus by stiffening the corneal stroma.\(^9\) Collagen cross-linking procedures may prove to be effective for ectasia after refractive surgery particularly LASIK. Riboflavin-UVA corneal cross-linking increases the biomechanical stability of the cornea and may thus be a therapeutic means to arrest and partially reverse the progression of LASIK-induced iatrogenic keratectasia.\(^9\) Woodward et al. reported that BCVA results in eyes with collagen cross-linking were \(\frac{20}{30}\) or better over the first 6 months.\(^5\)

According to previous reports from implantation of Intacs after refractive surgery, this procedure appears safe.

There has been reports that shows implantation of Intacs segment improves progressive myopia and astigmatism in eyes with corneal ectasia after LASIK.\(^11\) Pokroy et al. showed that implantation of a single Intacs segment inferiorly appeared to improve progressive myopia and regular and irregular astigmatism in eyes with corneal ectasia after LASIK.\(^12\) Although there is low experience with implantation of Intacs for post-PRK ectasia, this procedure can be done if patient does not tolerate hard contact lens. Many studies report good early outcomes with Intacs, however in other studies acceptable VA was not achieved.\(^6,11,12\)

In our case, treatment with single Intacs yielded an excellent outcome, but this acceptable outcome is limited by relatively short follow-up of the presented patient.

**Conclusion**

Corneal ectasia can occur after PRK even without any identifiable risk factor. Ocular Response Analyzer measurements can be different in post-PRK ectasia and abnormal findings in this measurement can be a risk factor for ectasia. The combination of topography with Ocular Response Analyzer can assist the refractive surgeon in diagnosing subtle corneal abnormalities and diagnosis of high risk patients for postoperative ectasia. If the patient can not tolerate non-invasive managements such as hard contact lens, Intacs implantation alone or in combination with cross-linking is a good alternative treatment modality and may replace or defer corneal transplantation.

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References