Unilateral corneal ectasia following small-incision lenticule extraction

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We describe a case of unilateral corneal ectasia in a 26-year-old man following small-incision lenticule extraction. The preoperative corneal topography was normal, with a minimum corneal thickness of 511 μm and 513 μm in the right eye and left eye, respectively. Lenticules of 85 μm and 82 μm were fashioned to offer a refractive correction of −3.75 −1.50 × 180 and −3.50 −1.50 × 165 in the right eye and left eye, respectively. Twelve months after small-incision lenticule extraction, the patient presented with early signs of ectasia in the left eye on corneal topography, which had worsened at the 18-month examination. Intrastromal corneal ring segment implantation with corneal collagen crosslinking was performed to arrest further progression and to improve uncorrected distance visual acuity. On the last examination, the corrected distance visual acuity was 20/20^{-2}.

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Iatrogenic corneal ectasia, although rare, is possibly the most dreaded complication following refractive surgery. It has been reported after laser in situ keratomileusis (LASIK) and photorefractive keratectomy.[1–4] Two cases of bilateral ectasia following small-incision lenticule extraction (SMILE, Carl Zeiss Meditec AG) were reported in patients with forme fruste keratoconus.[5,6] We report a case of unilateral ectasia following small-incision lenticule extraction in a patient with normal corneal topography.

CASE REPORT

A 26-year-old man presented to our cornea clinic requesting keratorefractive surgery. The preoperative refractive error was −3.75 −1.50 × 180 in the right eye and −3.50 −1.50 × 165 in the left eye, and the corrected distance visual acuity (CDVA) was 20/20 in both eyes. The patient had no family history of keratoconus. The complete preoperative workup was within normal limits. Scheimpflug imaging (Pentacam, Oculus Optikgeräte GmbH) revealed a normal topography with a maximum keratometry (K) value of 44.9 diopters (D) in the right eye and 45.1 D in the left eye, with minimal thickness of 511 μm and 513 μm, respectively. The anterior and posterior elevation maps were also unremarkable (Figure 1). No significant inferior–superior asymmetry was noted on the curvature maps (Figure 2).

Uneventful femtosecond laser small-incision lenticule extraction was performed. The cap thickness was 110 μm with an optical zone of 6.0 mm and a corneal side cut of 3.0 mm. The lenticule thickness in the right eye and left eye was 85 μm and 82 μm, respectively, with a residual stromal bed (RSB) of 304 μm and 305 μm, respectively (Figure 3).

The immediate postoperative course was uneventful, with an uncorrected distance visual acuity (UDVA) of 20/20 in both eyes at the 1-month examination; this was maintained for 1 year. At 1 year, the patient presented with minimal blurring of vision in the left eye. On examination, the manifest refraction was −1.00 −1.50 × 110. Corneal topography was suspicious for early ectasia; ie, minimal skewing and a few elevated points on the anterior and posterior elevation maps (Figure 4). It was decided to observe the patient at this stage. At the next examination, the manifest refraction had increased to −1.50 −3.50 × 115 in the left eye with a CDVA of 20/30. The right eye continued to maintain plano refraction. A repeat topography at this visit showed

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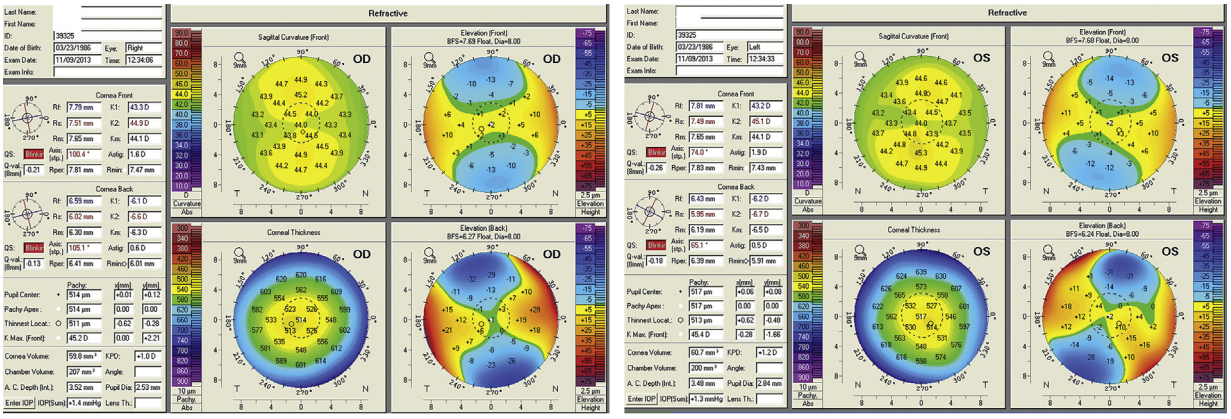


A *B*

Figure 1. Preoperative Scheimpflug imaging showing unremarkable corneal topography in the right eye (*A*) and left eye (*B*).

definitive signs of ectasia in the left eye; ie, an inferotemporal cone, maximum K of 51.4 D, and elevated points on anterior and posterior elevated maps (Figure 5).

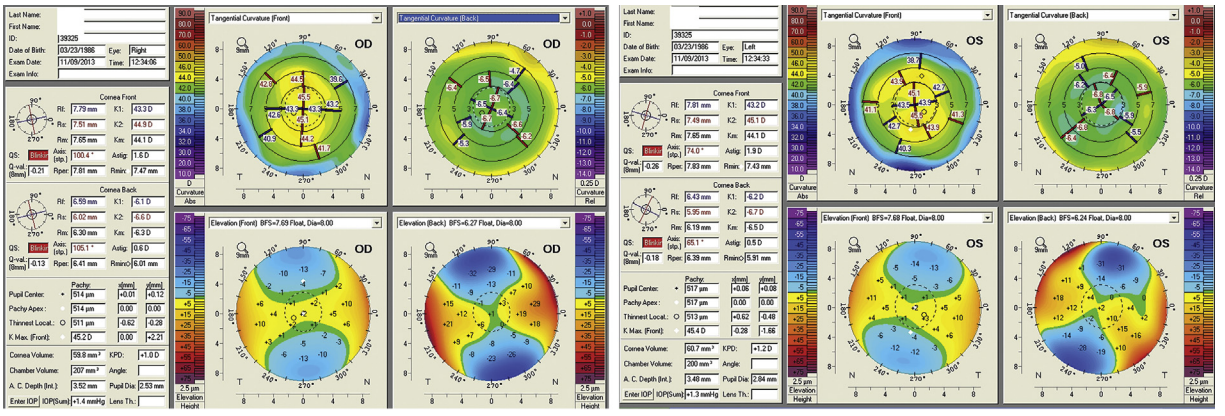
Two weeks later, intrastromal corneal ring segments (ICRS) (Keraring, Mediphacos Ltda.) were implanted and combined with collagen crosslinking in the left eye to arrest the progression of ectasia and to improve the UDVA. Three months later, the CDVA had improved to $20/20^{-2}$ with a manifest refraction of -0.75 -1.75×100 (Figure 6).

DISCUSSION

Small-incision lenticule extraction is the most recent development in the field of keratolenticular refractive procedures. Femtosecond laser photoablative incisions are used to create an intrastromal lenticule. The lenticule is then extracted from within the corneal stroma by creating and lifting a hinged flap (femtosecond lenticule extraction; FLEx, Carl Zeiss Meditec AG) or by extricating it using a small corneal incision (small-incision lenticule extraction).

Iatrogenic corneal ectasia is one of the most dreaded complications of corneal refractive surgery. Flap creation and tissue removal can weaken the biomechanical properties of the cornea.[7,8] The biomechanical properties are affected least in small-incision lenticule extraction, a flapless technique involving the concept of tissue subtraction (which is different from tissue ablation with an excimer laser).

Wu et al.[9] studied the corneal biomechanical properties following small-incision lenticule extraction and femtosecond laser–assisted LASIK and noticed that the decrease in biomechanical strength was significantly less in the small-incision lenticule extraction group. The biomechanical strength is greater in the anterior and peripheral cornea due to increased intralamellar collagen branching. The flapless lenticule extraction causes reduced disruption of peripheral collagen fibers compared with LASIK, thereby contributing to a more stable postoperative outcome. Moreover, the anterior cornea with integrated collagen



A *B*

Figure 2. Curvature maps showing no significant inferior superior asymmetry in the right eye (*A*) or left eye (*B*).