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Penetrating keratoplasty for corneal ectasia after laser in situ keratomileusis

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PURPOSE. *To improve the visual acuity of patients with progressive keratectasia following laser in situ keratomileusis (LASIK).*

METHODS. *Five eyes of four patients underwent penetrating keratoplasty for ectasia after LASIK. In one patient the second eye was operated on 10 months after the first keratoplasty. The pre- and postoperative refraction, best spectacle-corrected visual acuity, and topographic data were evaluated.*

RESULTS. *The preoperative refraction was –20.0 diopters (D) with high cylindrical values in all eyes at the time of surgery. After penetrating keratoplasty, mean spherical equivalent was –13.08±3.62 (SD) and mean refractive cylinder was –3.87±1.12 (SD). In one eye Urrets-Zavalia syndrome was noted as an early postoperative complication. In the second operated eye of another patient, there had been graft rejection several times. In this patient, frequent steroid use led to secondary glaucoma and he required filtering surgery.*

CONCLUSIONS. *Penetrating keratoplasty is effective and successful in treating iatrogenic keratectasia after LASIK, but these patients need a close and lifelong follow-up to treat late-term complications such as graft rejection and secondary glaucoma. (Eur J Ophthalmol 2008; 18: 695-702)*

KEY WORDS. *Penetrating keratoplasty, Ectasia, Laser in situ keratomileusis*

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INTRODUCTION

Corneal ectasia characterized by the progressive thinning and steepening of the cornea, which has been observed after laser in situ keratomileusis (LASIK), is a rare condition that leads to devastating visual results. Progressive myopia, irregular astigmatism, and loss of best spectacle-corrected visual acuity (BSCVA) are the serious consequences of this disease with similarities to other ectatic disorders of the cornea (1-3). It is usually associated with high myopia, forme fruste keratoconus, irregular corneal thickness, a cornea thinner than 500 µm, a thicker flap, a residual stromal bed less than 250 µm, a great amount of tissue ablation, large optical zone, and enhancement surgery (4, 5). It has also been observed in patients with a calculated stromal bed greater than 250 µm (6, 7), low preoperative myopia (8, 9), and after photorefractive keratectomy (PRK) (10, 11).

We present four patients (all male) with severe keratectasias (average preoperative k reading of 52.54 D), who were treated successfully with penetrating keratoplasty (PKP). All patients were spectacle or contact lens intolerant in the operated eye, refractory to non-transplantation techniques such as Intacs and contact lenses. The preoperative examination included uncorrected visual acuity (UCVA), manifest refraction, best spectacle-corrected visual acuity (BSCVA), cycloplegic refraction, intraocular pressure (IOP), slit lamp examination, and dilated fundus examination. The postoperative follow-up examinations were performed at 1, 3, and 7 days for 1 month, and then every 3 months.

Corneal topography was performed with the Orbscan II

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slit-scanning corneal topography and pachymetry system (Bausch & Lomb, Rochester, NY, USA). The surgical procedure and postoperative treatment was the same for each patient.

METHODS

The patients were operated under general anesthesia. The optical axis was marked and the cornea was trephined using a disposable vacuum trephine system (Barron radial vacuum trephine). The anterior chamber was irrigated with carbachol 0.01% for pupil constriction, and viscoelastic material was injected through the initial opening for protection of the crystalline lens. The recipient corneal preparation was completed with beveled corneal scissors. The donor cornea, trephined previously from the endothelial side by a manual punch (Barron corneal donor button punch), was placed in the recipient bed. Four cardinal interrupted sutures of 10-0 nylon were tied 90° apart. A single running suture was placed and interrupted sutures were added where necessary. After suture tightening, control of astigmatism, and suture adjustment, the operation was ended. All operations were performed by one surgeon (R.B.K.).

The postoperative topical treatment consisted of topical ciprofloxacin 0.3% and prednisolone acetate 0.1% five times a day, tobramycin 0.3% ointment twice a day for 2 weeks. The prednisolone acetate application was tapered in the following weeks with the replacement of fluorometholone 0.1% in the third month. Preservative-free artificial tears (dextran 0.1% and hydroxypropyl methyl cellulose 0.3%) were used continuously. Postoperative short-term systemic prednisolone was used only in Case 4, who required bilateral keratoplasty.

RESULTS

Results are detailed in Table I.

Case 1

A 32-year-old man underwent a LASIK procedure in the left eye in August 1997. The patient was first seen by us in 1999, where he was diagnosed with ectasia based on topographic findings. In 2002, the BSCVA decreased in the right eye; autorefractometer measurement was not possible and the manifest refraction was over –20.00 diopters (D). PKP was performed on the right eye with a 7.50 mm trephine and 7.75 mm punch size, and no complications were observed. The continuous sutures were removed 30 months later. In July 2006, the patient returned with a complaint of blurred vision in the right eye for 1 week; a moderate graft rejection was diagnosed and successfully treated with hourly application of topical prednisolone acetate 0.1% (Fig. 1).

Case 2

A 27-year-old man had a bilateral LASIK operation for –3.0 sphere in the right and –4.25 sphere in the left eye in 1998. Nine months later, LASIK enhancement was performed. Two years later, the BSCVA in the left eye had decreased significantly and the patient was treated with rigid gas-permeable contact lenses. When the patient was first

TABLE I - RESULTS OF THE FOUR CASES

Case/eye	Preop K readings	Preop UCVA	Preop BCVA	Postop K readings	Postop UCVA	Postop BCVA
1/R	Max: 53.4 (7°) Min: 47.7 (97°)	20/20000	20/2000	Max: 44.9 (47°) Min: 42.5 (137°)	20/800	20/25
2/L	Max: 54.6 (53°) Min: 49.5 (143°)	20/2000	20/400	Max: 41.4 (23°) Min: 40.0 (113°)	20/200	20/30
3/R	Max: 53.4 (147°) Min: 48.8 (57°)	20/20000	20/2000	Max: 37 (116°) Min: 32.7 (26°)	20/2000	20/100
4/R	Max: 58.2 (131°) Min: 53.8 (41°)	20/2000	20/100	Max: 47.4 (172°) Min: 42.8 (82°)	20/800	20/70
4/L	Max: 55.3 (24°) Min: 50.7 (114°)	20/20000	20/2000	Max: 53.7 (51°) Min: 50.8 (141°)	20/800	20/50

UCVA = Ucorrected visual acuity; BCVA = Best-corrected visual acuity

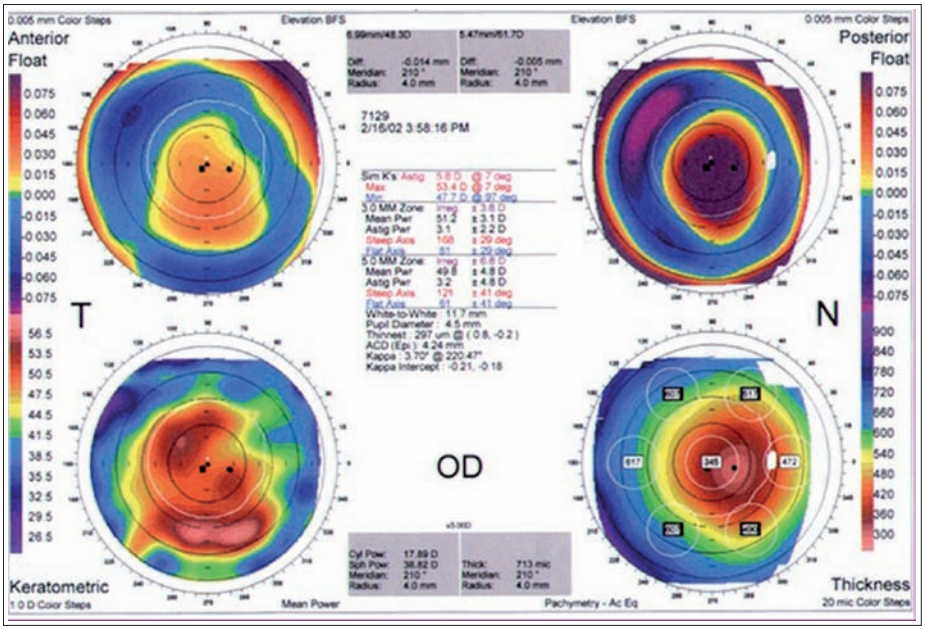


Fig. 1 - (A) *Pre-keratoplasty topography revealing ectasia and decreased best-corrected visual acuity in Case 1.* **(B)** *Post-keratoplasty topography of Case 1.*

seen by us in 2000, he stated that his vision had decreased progressively and he was contact lens intolerant, and corneal ectasia was diagnosed clinically and topographically. PKP was performed on the left eye and no intraoperative and postoperative complications were observed (Fig. 2).

Case 3

A 25-year-old man was diagnosed with degenerative myopia. A bilateral LASIK operation was performed for –9.00 spherical corrections on both eyes. One year later, corneal ectasia was suspected and the patient was treated with rigid gas-permeable contact lenses. When the patient was seen by us in June 2001, PKP was performed on the right eye, and no intraoperative complications occurred. Urrets-Zavalia syndrome was observed and treated successfully with antiglaucomatous medication during the early postoperative period. Twenty months later, the refraction was adequately improved (Fig. 3).

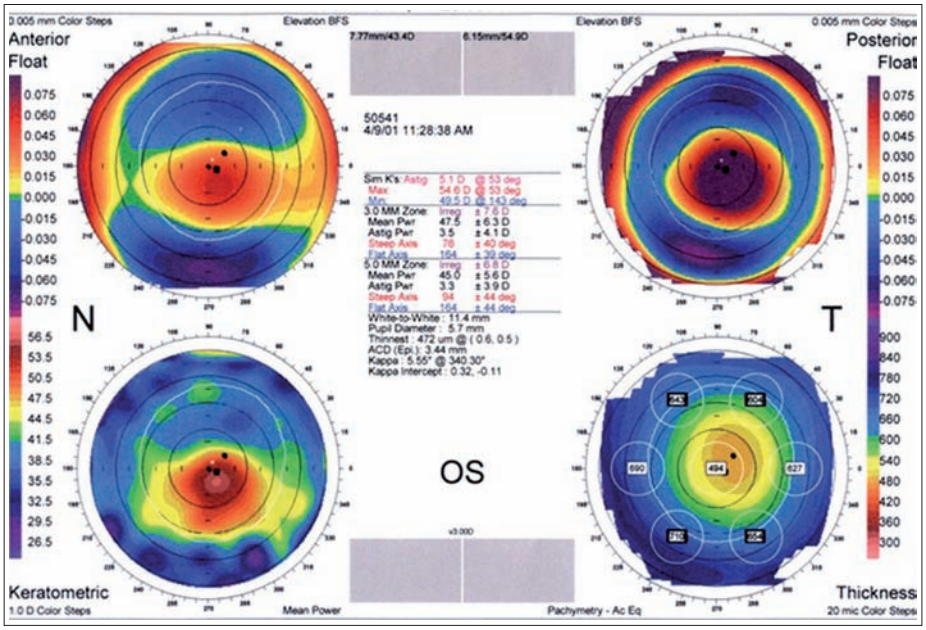
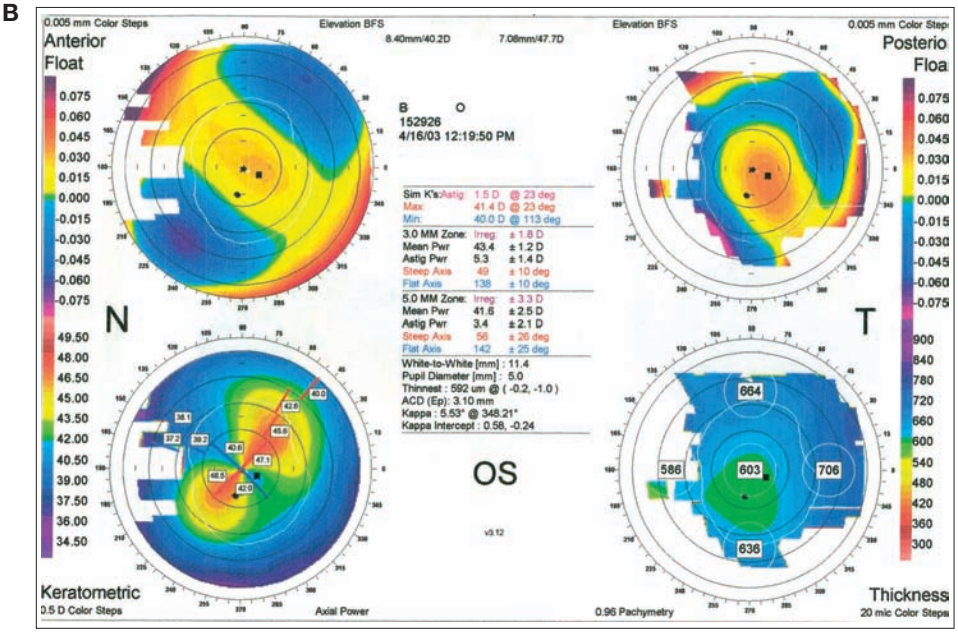
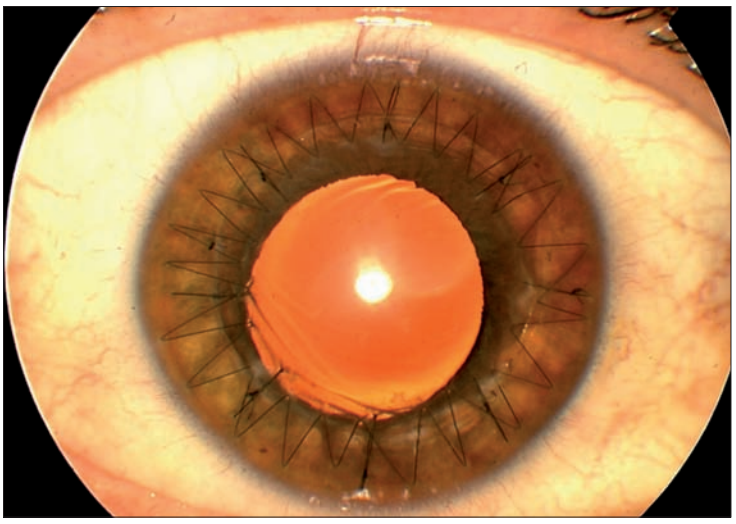


Fig. 2 - (A) *Pre-keratoplasty topography of Case 2.* **(B)** *Post-keratoplasty topography of Case 2.*



Case 4

A 36-year-old man with degenerative myopia underwent an uneventful bilateral LASIK operation; the patient had enhancement surgery in both eyes for an unknown residual refraction in 1999. When the patient was seen by us in 2001, corneal ectasia was diagnosed bilaterally. PKP was performed on the left eye, and after the removal of the sutures the myopia increased continuously. With suspected late wound dehiscence, suture revision with eight 10-0 nylon interrupted single sutures was performed. Between 2002 and 2004, graft rejection occurred three times in the right eye and the patient had to be treated thoroughly with systemic and topical steroids, which led to secondary open-angle glaucoma that was resistant to medical treatment. Trabeculectomy with mitomycin C application was performed in the right eye and IOP returned to normal levels. In the last examination 48 months after the first PKP, BSCVA had improved (Figs. 4 and 5).



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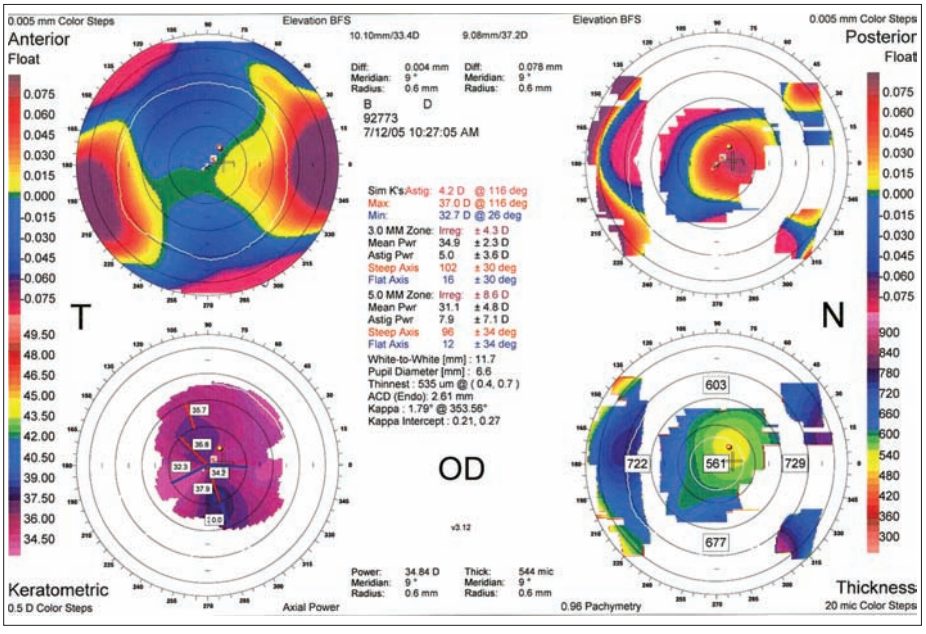


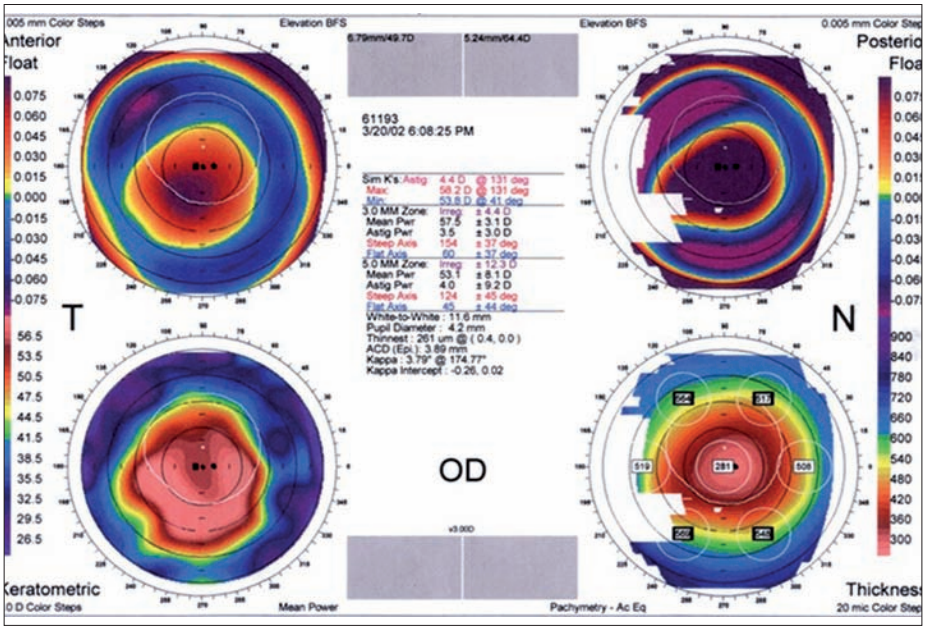
Fig. 3 - (A) *Clear corneal graft with continuous and single sutures 12 months postoperatively in Case 3.* **(B)** *Post-keratoplasty topography of Case 3.*

DISCUSSION

We describe four patients who developed corneal ectasia after LASIK and required PKP. BSCVA improved from 20/2000 to 20/63 or 20/30 in all patients. In Cases 1 and 3, BSCVA was identical with the pre-LASIK values. In Case 2, there was a reduction of two lines in the post-PKP period compared to pre-LASIK value. In Case 4, there were three lines and two lines loss in the right and left eye, respectively.

Published reviews concerning corneal ectasia emphasize the pre-existing risk factors causing ectasia and how it may occur; there is some information on histologic findings of the removed corneal button but this does not elaborate on the prognosis of the eye after PKP (7, 9, 12). Our results confirm that PKP is successful in treating severe corneal ectasia after LASIK, but the treatment of the patient may last for the rest of his or her life owing to potential postoperative complications. Subsequently, the elimination of pre-LASIK patients with even very small risk

A



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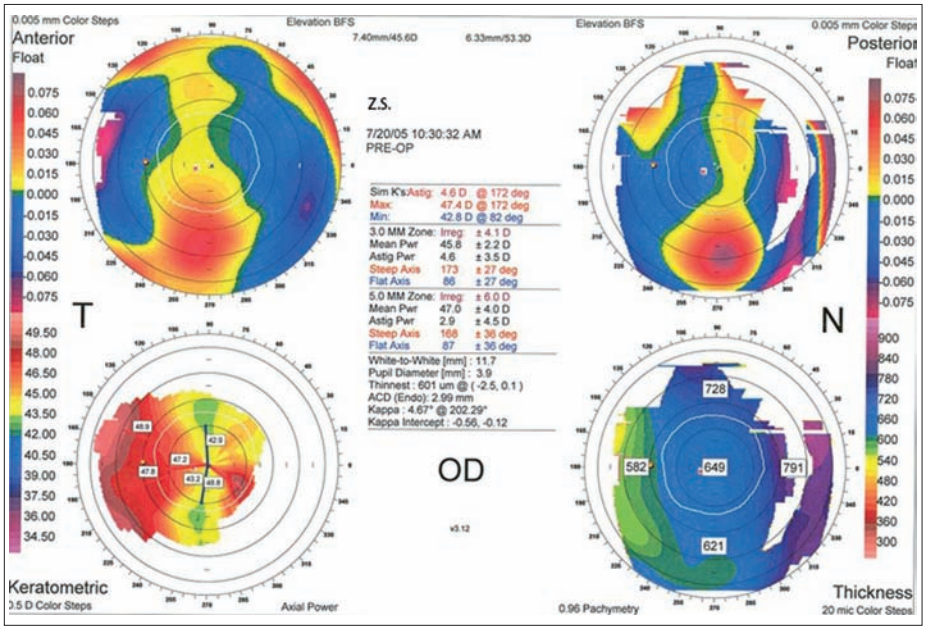


Fig. 4 - (A) *Pre-keratoplasty topography of the right eye in Case 4.* **(B)** *Post-keratoplasty topography of the right eye in Case 4.*

rates becomes mandatory. Recently, Tabbara and Kotb suggested a grading system that may identify high-risk individuals before LASIK is performed (13).

In his review, Binder (7) stated that 19 of 85 eyes had one or more enhancement procedures. In our case series, two patients (four eyes) had enhancement surgery. The undercorrection may not only be the result of insufficient laser treatment but also unforeseen ectasia. LASIK enhancement is a contraindication in cases with undercorrection. Perhaps enhancement should only be performed on rare occasions where treatment of LASIK complications is unavoidable.

Our results indicate adequate prognosis and satisfactory refractive outcomes of PKP for corneal ectasia after LASIK. The delayed wound healing and dehiscence in one case suggest suture removal as late as possible. The serious long-term complications were graft rejection and steroid-induced glaucoma. The occurrence of graft rejec-

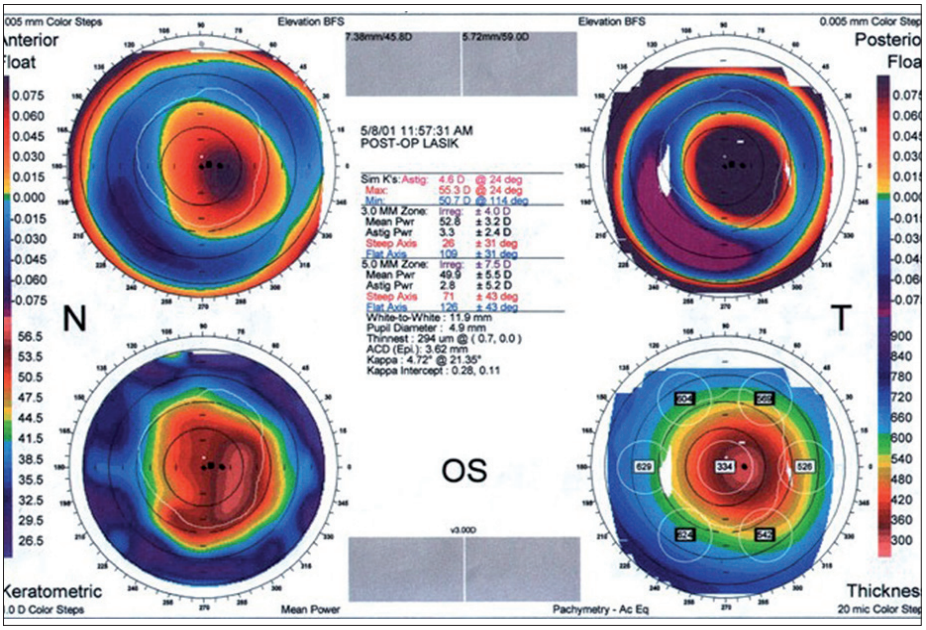
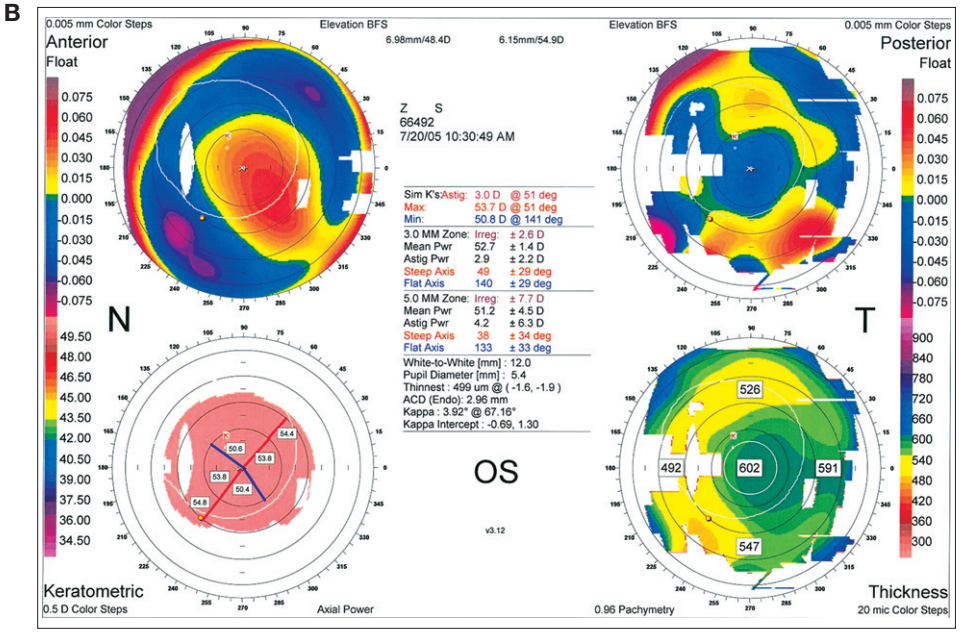


Fig. 5 - (A) *Pre-keratoplasty topography of the left eye in Case 4.* **(B)** *Post-keratoplasty topography of the left eye in Case 4.*



tions even after 4 years and its possibility to be recurrent suggest close lifelong follow-up. In spite of these complications, our patients were satisfied with the visual and refractive results of PKP compared to their post-LASIK corneal ectasia period.

An alternative method to consider is deep anterior lamellar keratoplasty (DALK), which minimizes the risk of donor tissue rejection as the endothelium is preserved during the removal of the anterior layers. But while DALK offers the advantage of retaining the endothelium, the procedure involves a lengthy learning curve. Furthermore, DALK can entail some unique complications, such as postoperative wrinkles or the microperforation of Descemet membrane, as well as interface haze (14). It should be noted that all surgery in the cases discussed in this study took place between 2000 and 2002, when the lamellar keratoplasty procedure was generally approached with much caution owing to problems of interface and irregularities. The big-

bubble technique, which increased the success rate of DALK, was first described in 2002 by Anwar and Teichmann (15), and adequate postoperative BCVA results were only published after the surgeries in this study were performed (16-18).

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