Case Report

Femtosecond-Assisted Elliptical LASIK Flap for the Correction of Post-Arcuate Keratotomy Residual Astigmatism

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Keywords

LASIK · Femtosecond laser · Elliptical flap · Arcuate keratotomy · Astigmatism

Abstract

We report the application of an elliptical femtosecond laser-assisted in situ keratomileusis (LASIK) flap for the management of post-arcuate keratotomy (AK) residual astigmatism. An 82-year-old male was referred to our institute for evaluation of his right eye due to residual regular astigmatism 1 year after AK. On examination, uncorrected distance visual acuity (UDVA) was 20/50 and corrected distance visual acuity was 20/25 (+3.25 –5.50 × 125). Slit-lamp examination revealed two 70-arc length peripheral corneal incisions at the 7.50-mm zone. The patient underwent femtosecond-assisted LASIK for the correction of residual astigmatism. An elliptical LASIK flap was adjusted intraoperatively with a 2-dimension diameter of 7.98 × 6.69 mm in order to avoid intersection of the flap with the AK incisions. The short flap diameter was placed along the meridian of the incisions and the long diameter in the perpendicular meridian, corresponding to the excimer laser astigmatic ablation pattern. No intraoperative or postoperative complications were encountered. Six months postoperatively, UDVA improved to 20/25 with a manifest refraction of pl –0.75 × 5. No AK incision flap-related complications were observed.

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Introduction

Arcuate keratotomy (AK) is a well-established technique for the management of residual astigmatism after penetrating keratoplasty or cataract surgery [1, 2]. It involves the manual or femtosecond-assisted creation of one or more relaxing arc-shaped incisions in the corneal stroma along the steepest corneal meridian [1, 2]. However, the development of astigmatism regression following AK often necessitates lengthening or additional AKs [3]. Different enhancement methods, such as photorefractive keratectomy and laser-assisted in situ keratomileusis (LASIK) have also been proposed [4, 5].

The advent of femtosecond laser in the field of corneal refractive surgery has revolutionized flap creation in LASIK [6]. Femtosecond laser allows the formation of an elliptical flap customized to the ablation profile [7]. Considering the potential complications related to flap creation in the presence of previous incisional surgery, we introduce a femtosecond-assisted method of creating a customized elliptical flap in order to avoid intersection with the existing AK incisions allowing ablation for astigmatic correction. To the best of our knowledge, this is the first report of femtosecond-assisted elliptical LASIK flap creation for the management of post-AK residual astigmatism.

Case Report

An 82-year-old male was referred to our institute for evaluation of his right eye due to residual astigmatism 1 year after AK. AK had been performed for astigmatic correction due to phaco-burn after cataract surgery. On examination, uncorrected distance visual acuity (UDVA) was 20/50 and corrected distance visual acuity was 20/25 (+3.25 –5.50 × 125). Slit-lamp examination revealed two 70-arc length peripheral corneal incisions at the 7.50-mm zone. The topography astigmatic pattern was regular with a minimum corneal thickness of 516 µm (Fig. 1a). A written informed consent was obtained, and the patient underwent femtosecond-assisted LASIK for the correction of residual astigmatism.

The procedure was performed under topical anesthesia. A femtosecond laser Femto LDV Z8 (Ziemer Ophthalmic Systems, Port, Switzerland) was utilized. To avoid intersection of the flap with the AK incisions at 7.50 mm, we decided to use the elliptical flap mode and place the short diameter along the meridian of the incisions and the long diameter in the perpendicular meridian. The ablation pattern was adjusted to remain within the limits of the exposed stromal bed and we took advantage of the elliptical flap shape. A corneal elliptical LASIK flap with a 2-dimension diameter of 7.98 × 6.69 mm and a planned depth of 110 µm, a nasally based 0.6-mm hinge and a 90° side cut angle was created. The flap was lifted using a flap manipulator leading to exposure of the stromal bed. Excimer laser photoablation (+2.75 –4.00 × 123) was performed using the Alcon WaveLight® EX500 laser (WaveLight GmbH, Erlangen, Germany). The interface was then rinsed with balanced salt solution and the flap repositioned. A standard postoperative regimen was prescribed.

No intraoperative or postoperative complications occurred. At 6 months postoperatively, UDVA improved to 20/25 with a manifest refraction of pl –0.75 × 5, and corneal astigmatism was significantly reduced (Fig. 1b, c). No AK incision-related flap complications were encountered (Fig. 2a, b).

Discussion

One of the major advantages of femtosecond laser technology in LASIK is the capability of precisely customizing flap configuration according to surgeon preference and case specifics. Flaps can be customized to the ablation pattern by adjusting flap dimensions, hinge position/length, and side-cut angle [6, 7]. Moreover, they are architecturally planar, thus providing greater predictability in the refractive outcome after ablation [6, 7].

Post-corneal incisional surgery LASIK enhancement has been associated with an increased risk of intraoperative and postoperative complications, such as incision dehiscence, epithelial breakthrough, suction loss, irregular flap, and flap tear [8, 9]. Corneal scarring in keratotomy incisions may complicate femtosecond laser-assisted flap creation, as fibrotic tissue could create a low-resistance pathway or trap gas bubbles, impede perforation of laser pulse energy, and anchor the flap to the underlying stromal bed. These risks are, therefore, an important consideration when creating a femtosecond-assisted LASIK flap in the setting of previous corneal incisional surgery.

Herein, we describe an efficient femtosecond-assisted LASIK elliptical flap creation for the management of post-AK residual astigmatism. Since AK had been performed for astigmatic correction due to phaco-burn after cataract surgery, we preferred to avoid deepening the original AK or performing an additional one, considering that the result would be less predictable. Photorefractive keratectomy could be another option, but LASIK seems to have better results in hyperopic astigmatic eyes [10]. The main concept of our approach was the customization of the elliptical flap in order to avoid intersection with the existing arc-shaped incisions, minimizing the possibility of complications observed when LASIK is performed after incisional surgery. In particular, flap parameters were intraoperatively adjusted so as to place the short diameter along the meridian of the incisions and the long diameter in the perpendicular meridian, corresponding to the excimer laser astigmatic ablation pattern. With this method, no intraoperative or postoperative complications were encountered, and the patient's astigmatism was significantly reduced with respective improvement of his UDVA.

In conclusion, the approach of femtosecond-assisted LASIK elliptical flap creation demonstrated efficiency and safety for the management of post-AK residual astigmatism. Long-term follow-up to determine the benefits and limitations of our method is required.

Statement of Ethics

Written informed consent for this case report was obtained from the patient.

Disclosure Statement

None of the authors has any conflicts of interest to disclose.

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Author Contributions

N.V.: writing and reviewing. M.A.G.: reviewing and rewriting. G.A.K.: writing and reviewing. E.S.: reviewing. G.D.K.: design of the work, analysis, interpretation, reviewing.

References

- 1 Böhrringer D, Dineva N, Maier P, Birnbaum F, Kirschkamp T, Reinhard T, et al. Long-term follow-up of astigmatic keratotomy for corneal astigmatism after penetrating keratoplasty. *Acta Ophthalmol*. 2016 Nov;94(7):e607–11.
- 2 Oshika T, Shimazaki J, Yoshitomi F, Oki K, Sakabe I, Matsuda S, et al. Arcuate keratotomy to treat corneal astigmatism after cataract surgery: a prospective evaluation of predictability and effectiveness. *Ophthalmology*. 1998 Nov;105(11):2012–6.
- 3 Bayramlar H, Karadag R, Cakici O, Ozsoy I. Arcuate keratotomy on post-keratoplasty astigmatism is unpredictable and frequently needs repeat procedures to increase its success rate. *Br J Ophthalmol*. 2016 Jun;100(6):757–61.
- 4 Kapadia MS, Krishna R, Shah S, Wilson SE. Arcuate transverse keratotomy remains a useful adjunct to correct astigmatism in conjunction with photorefractive keratectomy. *J Refract Surg*. 2000 Jan-Feb;16(1):60–8.
- 5 Güell JL, Vazquez M. Correction of high astigmatism with astigmatic keratotomy combined with laser in situ keratomileusis. *J Cataract Refract Surg*. 2000 Jul;26(7):960–6.
- 6 Kymionis GD, Kankariya VP, Plaka AD, Reinstein DZ. Femtosecond laser technology in corneal refractive surgery: a review. *J Refract Surg*. 2012 Dec;28(12):912–20.
- 7 Slade SG. The use of the femtosecond laser in the customization of corneal flaps in laser in situ keratomileusis. *Curr Opin Ophthalmol*. 2007 Jul;18(4):314–7.
- 8 Perente I, Utine CA, Cakir H, Yilmaz OF. Complicated flap creation with femtosecond laser after radial keratotomy. *Cornea*. 2007 Oct;26(9):1138–40.
- 9 Haft P, Yoo SH, Kymionis GD, Ide T, O'Brien TP, Culbertson WW. Complications of LASIK flaps made by the IntraLase 15- and 30-kHz femtosecond lasers. *J Refract Surg*. 2009 Nov;25(11):979–84.
- 10 Frings A, Richard G, Steinberg J, Druchkiv V, Linke SJ, Katz T. LASIK and PRK in hyperopic astigmatic eyes: is early retreatment advisable? *Clin Ophthalmol*. 2016 Mar;10:565–70.

Fig. 1. Preoperative (a), 6 months postoperative (b), and difference topographic map of the right eye showing astigmatism improvement after femtosecond LASIK with an elliptical flap.

Fig. 2. a, b Slit-lamp photography showing the femtosecond-assisted elliptical flap taking into account the arcuate keratotomy incisions.