Case Report

Two-year successful results of femto-LASIK in steep and opacified corneas

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ABSTRACT

Background: Flap creation is the most critical step of laser in situ keratomileusis (LASIK). The introduction of the femtosecond laser with its uniform flaps, which enhance the accuracy of LASIK, has decreased the risk of flap-related complications like buttonholes and incomplete flaps. We recommended femtosecond laser-assisted LASIK (FS-LASIK) in the presence of superficial corneal opacities.

Case Presentation: We report a case of a 31-year-old female who reported to the Cornea clinic of the Sohag Center for LASIK and Corneal Surgeries, Sohag, Egypt, complaining of bilateral decreased vision due to refractive error. The uncorrected distance visual acuity (UCDVA) and corrected distance visual acuity (CDVA) were 0.01 and 0.7 (in decimal) with a refractive correction of -3.50Ds/ –3.00Dc × 172° in the right eye and 0.01 and 0.6 with a refractive correction of -1.75 Ds/-6.00Dc ×164° in the left eye, respectively. Slit-lamp examination of the anterior segment showed bilateral superior vascularized corneal scars and a linear superior conjunctival scar suggestive of old trachoma. Corneal tomographic imaging with a Scheimpflug based tomography device (Oculus Inc., Wetzlar, Germany) revealed a symmetrical bow tie with a very steep cornea without other ectatic changes. The patient underwent bilateral FS-LASIK with an excimer laser. No intraoperative complications occurred. She was followed up for two years with serial corneal topographies and stable post-LASIK results and visual outcomes.

Conclusions: FS-LASIK, in the presence of superficial corneal opacities, was safe and effective and induced no complications with special precautions. However, these findings are yet to be confirmed using well-designed clinical studies with larger samples and longer follow-ups.

KEY WORDS

femtosecond laser-assisted laser in situ keratomileusis, fs-LASIK, flap creation, excimer laser, corneal opacity, steep cornea

INTRODUCTION

The femtosecond laser can be effectively used for different ophthalmological procedures with the customization of the corneal flap parameters, such as thickness, diameter, and hinge position. This is considered the main advantage of the femtosecond laser, as it decreases the risk of flap-related complications such as buttonholes and incomplete flaps [1, 2]. Flap creation is the most critical step in laser in situ keratomileusis (LASIK), and the introduction of a femtosecond laser with its uniform flaps has improved the accuracy and reproducibility of LASIK [3].

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Since its introduction in 2001, femtosecond laser technology has continued to evolve, making it the preferred technique for flap creation during most LASIK surgeries [4]. Despite the high safety profile of femtolaser flap creation using femtosecond laser-assisted LASIK (FS-LASIK), corneal opacities affect the efficacy of the technique as it can interfere with the disruption of tissue by the laser, causing gas breakthrough or irregular flaps in hazy corneas [5, 6]. FS-LASIK shares several complications with microkeratome-assisted LASIK; however, there are complications unique to femtosecond laser use, including optical problems and interface- related complications [7].

In this case report, we present the two-year follow-up results of a case of FS-LASIK flap creation with excimer laser ablation in a patient with opacified and steep corneas.

CASE PRESENTATION

A 31-year-old female patient presented to the Cornea clinic of the Sohag Center for LASIK and Corneal Surgeries, Sohag, Egypt. The patient complained of bilaterally decreased vision due to a refractive error.

The measured Snellen visual acuity showed that the uncorrected distance visual acuity (UCDVA) and corrected distance visual acuity (CDVA) were 0.01 and 0.7 (in decimal) with a refractive correction of -3.50Ds/-3.00Dc × 172° in the right eye and 0.01 and 0.6 with a refraction of -1.75 Ds/-6.00Dc ×164° in the left eye, respectively.

Slit-lamp examination (RM-8900; Topcon, Tokyo, Japan) showed a normal anterior segment, bilateral superior limbal vascularized corneal superficial opacities (old trachomatous pannus resembling Herbert pits in superior limbus seen as round to oval pigmented areas associated with vascular pannus without a line of lipid deposits), ghost vessels, clear central cornea, and normal corneal diameter. There were no edema and endothelial abnormalities, and the adjacent conjunctiva and sclera were normal. Corneal opacities with bilateral linear tarsal conjunctival scarring resembling the Arlt line were found. No iris abnormalities or lens opacities were observed. Fundus examination was unremarkable. The clinical findings were suggestive of previous trachoma. The family history of ectatic corneal disorders or systemic metabolic disorders, such as diabetes mellitus, was unremarkable. The patient was asked to undergo refractive laser correction. Corneal tomography was performed using a Scheimpflug-based tomography device (Oculus Inc., Wetzlar, Germany), which revealed a symmetrical bow tie with an extremely steep cornea.

The central corneal thickness (CCT) of the right eye was 535 μm, and the CCT of the left eye was 529 μm with normal tomographic maps. The maximum keratometry values were 48.90 D and 53.60 D for the right and left eyes, respectively. Both front and back elevations were within normal values in both eyes, with normal differential maps of elevation data (Figure 1).

LASIK was proposed as a refractive error treatment because we estimated that surface ablation could be

Table 1. Summary of preoperative and postoperative findings in the patient with opacified steep corneas who underwent Femto-LASIK

Parameter	Pre-op; August 2017	Post-op; August 2018	Post-op; September 2019
K_1 (D)	OD: 44.3 OS: 45.2	OD: 41.5 OS: 43.6	OD: 41.1 OS: 42.7
K_2 (D)	OD: 47.0 OS: 49.9	OD: 42.2 OS: 45.3	OD: 42.1 OS: 45.3
K_{max} (D)	OD: 48.9 OS: 53.6	OD: 50.9 OS: 52.0	OD: 49.0 OS: 49.9
TCT (μm)	OD: 536 OS: 529	OD: 432 OS: 441	OD: 435 OS: 442
Pachy Apex (μm)	OD: 540 OS: 539	OD: 443 OS: 450	OD: 444 OS: 448
UCDVA (decimal)	OD: 0.01 OS: 0.01	OD: 0.6 OS: 0.5	OD: 0.6 OS: 0.5
CDVA (decimal)	OD: 0.7 OS: 0.6	OD: 0.7 OS: 0.6	OD: 0.7 OS: 0.6
Refraction	OD: -3.50 Ds/-3.00 Dc × 172° OS: -1.75 Ds/-6.00 Dc × 164°	OD: +0.25 Ds/ -0.75Dc × 172° OS: +0.50 Ds/ -0.75Dc × 4°	OD: +0.25 Ds/ -0.75 Dc × 172° OS: +0.50 Ds/ -0.75 Dc × 4°

Abbreviations: Pre-op, Pre-operative Visit; Post-op, Postoperative Visit; OD, right eye; OS, left eye; K, keratometry reading; max, maximum; D, diopter; TCT, thinnest corneal thicknesses; Pachy Apex, Pachymetry at the apex; UCDVA, uncorrected distance visual acuity in decimal; CDVA, corrected distance visual acuity in decimal; Ds, spherical component of the refraction; Dc, cylindrical components of refraction.

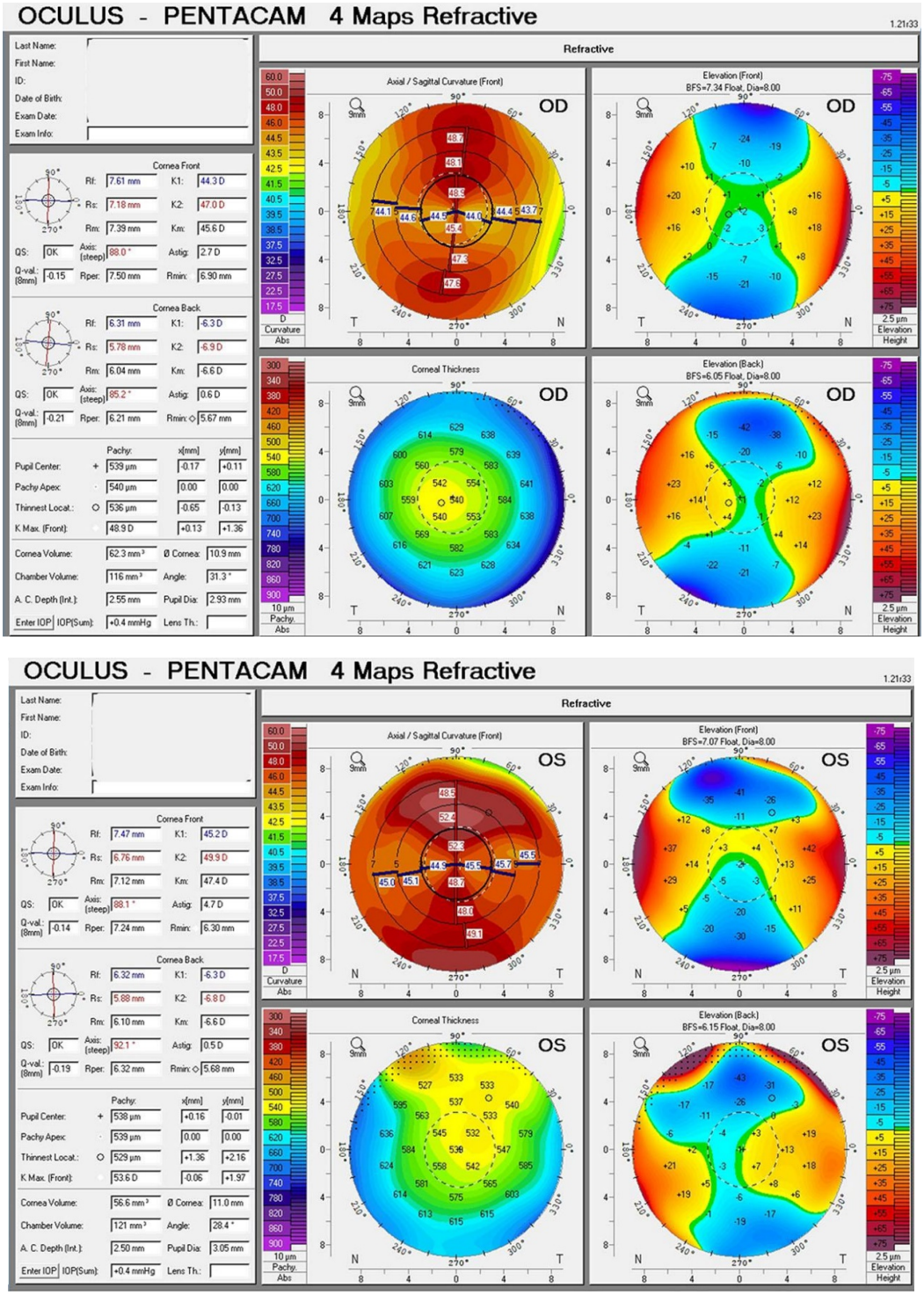

Figure 1. Preoperative corneal tomography of both eyes using scheimpflug-based tomography device (Oculus Inc., Wetzlar, Germany). OD, right eye; OS, left eye.

associated with significant regression of the refractive error, corneal haze, epithelial healing abnormalities, and pain [8, 9]. In addition, there was a higher risk of corneal haze due to the high levels of ultraviolet radiation exposure in the sunny region of southern Egypt [10]. The decision to perform bilateral laser vision correction by FS-LASIK using an excimer laser was made to avoid flap-related complications such as flap buttonholes, which can occur with mechanical microkeratomes [4] in such steep corneas. Following careful explanation, the patient provided signed informed consent according to the institutional ethical guidelines with the approval of

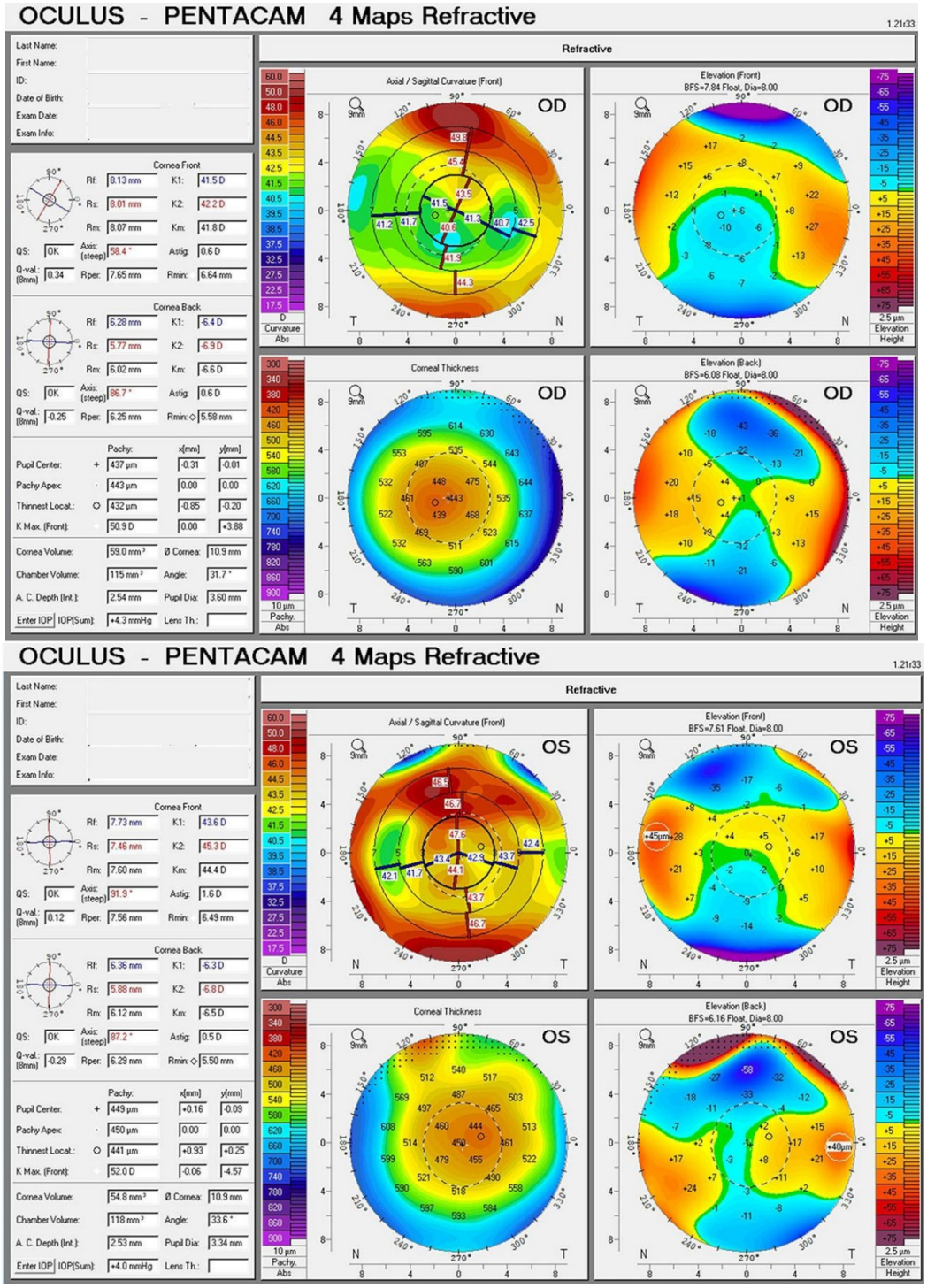

Figure 2. One-year postoperative corneal tomography of both eyes using scheimpflug-based tomography device (Oculus Inc., Wetzlar, Germany). OD, right eye; OS, left eye.

the ethical committee of the center (Sohag Center for Lasik and Corneal Surgeries) and in compliance with the tenets of the Helsinki Declaration.

Bilateral FS-LASIK using a wavefront-guided ablation technique was performed during the same session and following topical anesthesia, and a 90 μm thickness flap was created using IntraLase (iFS laser, 150 KHz, Abbott Medical Optics Inc., Santa Ana, CA, USA) to preserve more residual stromal bed thickness. The Femtosecond laser parameters for corneal flap creation included a superior hinge orientation, a flap diameter of 9.00 millimeters

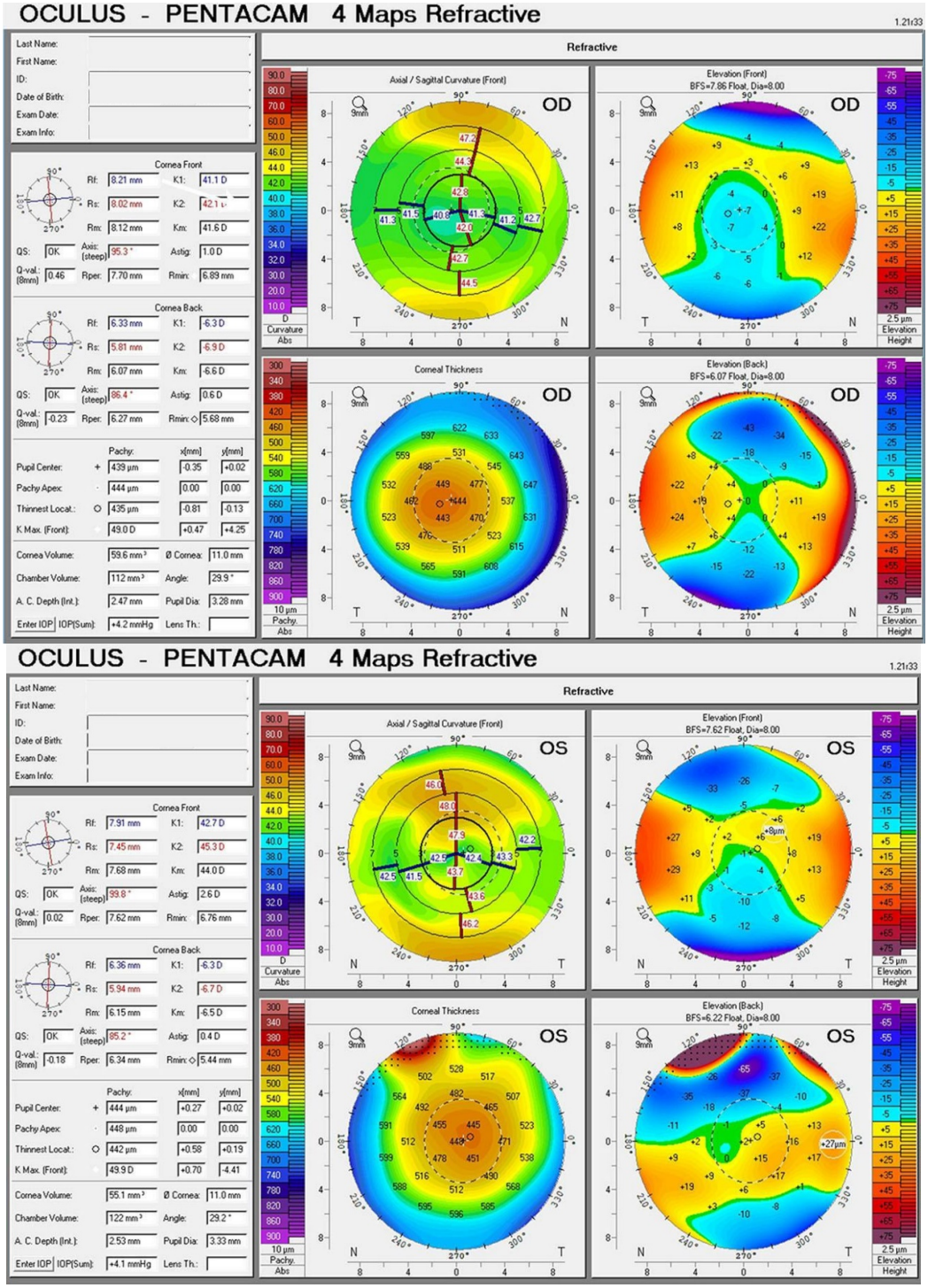

Figure 3. Two-year postoperative corneal tomography of both eyes using scheimpflug based tomography device (Oculus Inc., Wetzlar, Germany). OD, right eye; OS, left eye.

(mm), a side-cut angle of 90°, and a hinge angle of 90°. The parameter values for the femtosecond laser energy were slightly higher than the defaults of the device to allow flap separation in the opacified cornea with a bed energy level of 0.95 microjoules (μJ) and a side-cut energy level of 0.98 μJ. After flap creation, the flap was uneventfully lifted using a spatula in both eyes without any resistance, and ablation was performed using an excimer laser device (VISX STAR S4, Abbott Medical Optics Inc., Santa Ana, CA, USA) in combination with wavefront-guided treatment (CustomVue platform, AMO VISX S4, Santa Clara, CA, USA). Postoperative treatment included topical antibiotic

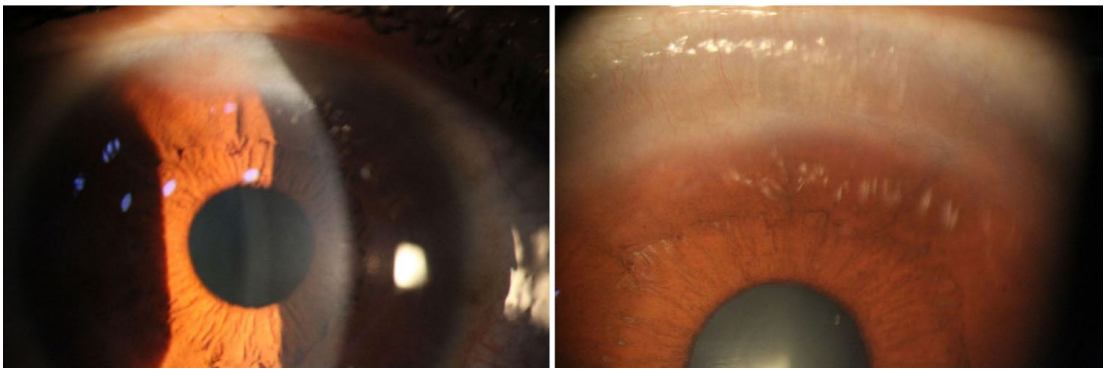

Figure 4. Postoperative slit-lamp photos of both corneas at the end of two years showing a superior vascularized pannus with a clear central cornea. note herbert pits at the right superior limbus presenting as round to oval pigmented areas associated with vascular pannus without a line of lipid deposit.

eye drops (Gatifloxacin 0.3% [Zymar; Allergan, Madison, NJ, USA] 5 times daily for 1 week), topical steroid eye drops (prednisolone acetate 1% [Pred Forte eye drops; Allergan, Inc, Irvine, CA, USA] 5 times daily for 1 week), and lubricant eye drops with systemic non-steroidal anti-inflammatory drugs.

The patient was followed up for 24 months. Follow-up was scheduled every 6 months at the center from August 2017 to August 2019. During each follow-up visit, the patient was evaluated for visual, refractive, and topographic outcomes. In the 24th postoperative month, UCDVA, CDVA, and postoperative refraction in the right eye were 0.6, 0.7, and +0.250Ds/ -0.75Dc × 172°, respectively. While UCDVA, CDVA, and postoperative refraction in the left eye were 0.50, 0.6, and +0.50 Ds/ -0.75Dc × 4°. A summary of the preoperative and postoperative findings is presented in Table 1. Postoperative corneal tomography revealed bilateral central flattening. The keratometry readings with Kmax were reduced: 49.00 D and 49.90 D in the right and left eyes, respectively, during the last follow-up. Both front and back elevations were within normal limits in both eyes with normal differential maps of elevation data (Figure 2 and Figure 3). Two-year postoperative slit-lamp examination findings of both corneas showed old superior vascularized pannus (Herbert pits) with a clear central cornea (Figure 4). Because of the potential risk of postoperative ectasia in this steep cornea, the patient was followed up for two years with serial corneal topographies with stable post-FS-LASIK results and stable visual outcomes.

DISCUSSION

The low incidence of complications (epithelial abrasion, flap buttonholes, free caps, irregular cuts, and dry eye) in addition to various flap fashioning options (flap thickness, flap diameter, hinge position, and hinge length) have increased the popularity of FS-LASIK [11]. There are also some disadvantages of Femtosecond laser flap creation such as increased cost and technical problems [12].

In this case report, we present the two-year follow-up results of a case of FS-LASIK in a patient with an opacified and markedly steep cornea. The decision was to correct the refractive error using an excimer laser, given the challenge of creating a flap in a steep cornea without flap complications such as buttonholes and irregular cuts. The solution was to create a flap using a femtosecond laser to avoid these flap-related complications because of the precision of the created flap thickness with superior safety over the microkeratome [13]. In the study by Zhou et al. [14]. Femtosecond laser-created flaps were found to be uniform with a smaller standard deviation.

Superior vascularized corneal scars were a major concern in our patient, especially with the use of a femtosecond laser, which necessitates corneal transparency to avoid gas breakthrough or irregular flaps [15]. The parameter values of the femtosecond laser energy were slightly higher than the defaults of the device, with a bed energy level of 0.95 μJ and a side-cut energy level of 0.98 μJ, which allowed a complete flap separation while minimizing the risk of a vertical gas breakthrough associated with opacified corneas [16]. Kymionis et al. [17] successfullycreated a flap using a femtosecond laser for a case with corneal stromal haze. Corneal stromal opacities represent an obstacle for stromal photodisruption; however, they found that corneal stromal haziness may have a minimal effect on FS-LASIK, allowing for uneventful flap creation. The long follow-up period was a strength of this study, which confirmed the safety of FS-LASIK in opacified corneas. The main limitation was that it involved only one case, and this necessitates further well-designed studies to prove the effectiveness of this procedure.

CONCLUSIONS

FS-LASIK in the presence of superficial corneal opacities may be safe and effective, with no complications if special precautions are taken. However, these findings are yet to be confirmed using well-designed future clinical research studies with more samples and a longer follow-up.

ETHICAL DECLARATIONS

Ethical approval: Ethical approval was obtained from the ethical committee of the center (Sohag Center for Lasik and Corneal Surgeries).
Conflict of interest: None.

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REFERENCES

1. Marino G, Santhiago M, Wilson S. Femtosecond Lasers and Corneal Surgical Procedures. Asia Pac J Ophthalmol (Phila). 2017;6(5):456-64. doi: 10.22608/APO.2017163 pmid: 28780779
2. Ye MJ, Liu CY, Liao RF, Gu ZY, Zhao BY, Liao Y. SMILE and Wavefront-Guided LASIK Out-Compete Other Refractive Surgeries in Ameliorating the Induction of High-Order Aberrations in Anterior Corneal Surface. J Ophthalmol. 2016;2016:8702162. doi: 10.1155/2016/8702162 pmid: 27818792
3. Farjo AA, Sugar A, Schallhorn SC, Majmudar PA, Tanzer DJ, Trattler WB, et al. Femtosecond lasers for LASIK flap creation: a report by the American Academy of Ophthalmology. Ophthalmology. 2013;120(3):e5-e20. doi: 10.1016/j.ophtha.2012.08.013 pmid: 23174396
4. Kymionis GD, Kankariya VP, Plaka AD, Reinstein DZ. Femtosecond laser technology in corneal refractive surgery: a review. J Refract Surg. 2012;28(12):912-20. doi: 10.3928/1081597X-20121116-01 pmid: 23231742
5. Tomita M, Chiba A, Matsuda J, Nawa Y. Evaluation of LASIK treatment with the Femto LDV in patients with corneal opacity. J Refract Surg. 2012;28(1):25-30. doi: 10.3928/1081597X-20111213-01 pmid: 22185466
6. Seider MI, Ide T, Kymionis GD, Culbertson WW, O'Brien TP, Yoo SH. Epithelial breakthrough during IntraLase flap creation for laser in situ keratomileusis. J Cataract Refract Surg. 2008;34(5):859-63. doi: 10.1016/j.jcrs.2007.12.043 pmid: 18471647
7. Perez-Straziota C, Randleman JB. Femtosecond-assisted LASIK: Complications and Management. Int Ophthalmol Clin. 2016;56(2):59-66. doi: 10.1097/IIO.0000000000000105 pmid: 26938338
8. Margo JA, Munir WM. Corneal Haze Following Refractive Surgery: A Review of Pathophysiology, Incidence, Prevention, and Treatment. Int Ophthalmol Clin. 2016;56(2):111-25. doi: 10.1097/IIO.0000000000000112 pmid: 26938342
9. Ripa M, Betts B, Dhaliwal S, Wang K, Pouly S, Chen D, Mifflin M. Survey of Postoperative Pain in Photorefractive Keratectomy Using Topical versus Oral Nonsteroidal Anti-Inflammatory Drugs. Clin Ophthalmol. 2020;14:1459-1466. doi: 10.2147/OPTH.S255441 pmid: 32546954
10. Mounir A, Mostafa EM, Ammar H, Mohammed OA, Alsmman AH, Farouk MM, et al. Clinical outcomes of transepithelial photorefractive keratectomy versus femtosecond laser assisted keratomileusis for correction of high myopia in South Egyptian population. Int J Ophthalmol. 2020;13(1):129-34. doi: 10.18240/ijo.2020.01.19 pmid: 31956581
11. Torky MA, Al Zafiri YA, Khattab AM, Farag RK, Awad EA. Visumax femtolasik versus Moria M2 microkeratome in mild to moderate myopia: efficacy, safety, predictability, aberrometric changes and flap thickness predictability. BMC Ophthalmol. 2017;17(1):125. doi: 10.1186/s12886-017-0520-5 pmid: 28716114
12. Cosar C, Gonen T, Moray M, Sener A. Comparison of visual acuity, refractive results and complications of femtosecond laser with mechanical microkeratome in LASIK. Int J Ophthalmol. 2013;6(3):350-5. doi: 10.3980/j.issn.2222-3959.2013.03.18 pmid: 23826532
13. Chen S, Feng Y, Stojanovic A, Jankov MR, 2nd, Wang Q. IntraLase femtosecond laser vs mechanical microkeratomes in LASIK for myopia: a systematic review and meta-analysis. J Refract Surg. 2012;28(1):15-24. doi: 10.3928/1081597X-20111228-02 pmid: 22233436
14. Zhou Y, Tian L, Wang N, Dougherty PJ. Anterior segment optical coherence tomography measurement of LASIK flaps: femtosecond laser vs microkeratome. J Refract Surg. 2011;27(6):408-16. doi: 10.3928/1081597X-20101029-01 pmid: 21117541
15. Zhang ZY. Effect of corneal opacity on LASIK flap creation with the femtosecond laser. J Refract Surg. 2012;28(7):450; author reply -1. doi: 10.3928/1081597X-20120701-08 pmid: 22767162
16. Salomao MQ, Wilson SE. Femtosecond laser in laser in situ keratomileusis. J Cataract Refract Surg. 2010;36(6):1024-32. doi: 10.1016/j.jcrs.2010.03.025 pmid: 20494777
17. Kymionis GD, Liakopoulos DA, Grentzelos MA, Skatharoudi CA, Panagopoulou SI. Uneventful Femtosecond Laser-assisted Flap Creation in a Patient With Postoperative PRK Corneal Haze. J Refract Surg. 2015;31(9):638-9. doi: 10.3928/1081597X-20150821-01 pmid: 26352571