Complicated Flap Creation With Femtosecond Laser After Radial Keratotomy

Irfan Perente, MD, Canan Asli Utine, MD, MSc,† Hanefi Cakir, MD,‡ and Omer Faruk Yilmaz, MD, Prof Dr**

Purpose: To report a case of laser in situ keratomileusis (LASIK) that used the Intralase femtosecond laser 14 years after radial keratotomy (RK) for residual myopic astigmatism.

Methods: A 39 year-old male patient had undergone a bilateral RK operation for myopic correction. The manifest refraction was −1.25 −3.00 × 175 D, with uncorrected visual acuity (UCVA) of 20/50 and best-corrected visual acuity (BCVA) of 20/20. The central and thinnest pachymetry measurements were 582 and 576 μm, respectively, by Orbscan II.

Results: Intralase was used for LASIK, and initially, a loss of suction was seen during flap formation. The flap could be created again at the same intracorneal plane. During flap lifting, the RK incisions were separated, and one of the RK incisions progressed to the corneal center with the force applied by the blunt spatula. No piece was separated completely from the flap. Excimer laser treatment and flap repositioning could be done without any problems. At the fifth postoperative month, his UCVA was 20/20. All RK incisions seemed well aligned. There was no haze or epithelial ingrowth.

Conclusions: This case showed that the Intralase femtosecond laser not only has no unique benefit as opposed to the mechanical keratome for post-RK eyes but also can lead to serious complications. We recommend that femtosecond laser flap formation not be used in post-RK eyes.

Key Words: femtosecond laser, Intralase, laser in situ keratomileusis, radial keratotomy

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Photorefractive keratectomy (PRK) and laser in situ keratomileusis (LASIK) with mechanical or femtosecond laser keratomes have been used for the correction of refractive errors after radial keratotomy (RK), such as hypermetropia caused by overcorrection or hyperopic shift and myopia caused by undercorrection or myopic progression.[1–10]

Femtosecond lasers are considered to potentially create corneal flaps for LASIK with better predictability than that of mechanical microkeratomes.[11,12]

In this report, a patient who underwent LASIK with the Intralase femtosecond laser (Intralase, Irvine, CA) for residual myopic astigmatism is presented. The disadvantages of using a femtosecond laser for flap creation in corneas with RK incisions are discussed.

CASE REPORT

In August 2005, a 39-year-old male patient applied for the correction of the refractive error in his left eye. He had undergone bilateral RK operation for myopic correction in June 1991. In his first RK operation, 12 radial incisions were made at 100% thickness of the thinnest pachymetric reading. After RK redeepening, bilateral scleral reinforcing with dura mater was performed to slow down the progression of axial myopia in April 1992, because the globe axial lengths were 25.08 and 25.51 mm in the right and left eyes, respectively.

It seemed that the refractive error of the left eye remained stable in this period. The Orbscan II (Bausch and Lomb, software version 3.12; Orbtek, Salt Lake City, UT) measurements were repeated until well-focused and aligned images were obtained, which displayed central flattening of the cornea caused by the RK incisions.

The patient was given detailed information about the LASIK procedure, possible complications, and outcomes of the planned surgery. Signed informed consent was obtained from the patient, according to the Tenets of Helsinki. The pre-RK, post-RK, and pre-LASIK findings are shown in Table 1.

Surgical Intervention

A superior hinged corneal flap was intended with the Intralase femtosecond laser (30 kHz), with an 8.7-mm diameter, 100-μm thickness, and 50-degree hinge angle. During flap formation, the femtosecond laser lost suction and stopped when the intrastromal incision was approximately only one fourth of the whole corneal area. Then, the Intralase device was reprogrammed, and the flap formation procedure was repeated at the same intrastromal plane and was finished without any problems. Absorption of gas bubbles under the flap occurred in 10 minutes, after which the flap–stroma interface was separated by using a blunt spatula. The flap was lifted slowly and carefully, in an attempt not to separate the radial incisions. However, the radial incision at the 1 o'clock meridian broke down, and the spatula at the interface passed through the incision to the corneal surface; the incision progressed centripetally into the central cornea. While we lifted the rest of the flap from the stromal bed, the edges of the radial incisions were separated from each other peripherally for

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From the *Beyoglu Eye Research and Training Hospital, Istanbul, Turkey; the †Yeditepe University Faculty of Medicine, Eye Hospital, Istanbul, Turkey; and the ‡Turkiye Hospital, Eye Clinic, Istanbul, Turkey.

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Reprints: Canan Asli Utine, Guzelbahce sokak No:14/4 Hancioglu apt, Nisantasi, 34365 Istanbul, Turkey (e-mail: cananutine@gmail.com).

TABLE 1. Pre-RK, Post-RK, and Pre-LASIK Findings of the Left Eye of the Patient

Phase	Refractive Error	UCVA	BCVA	Keratometry	Central/Thinnest Pachymetry
Pre-RK	−7.00 (−1.75@180)	CF 1.5 m	20/20	42.00D@90°, 43.25D@180°	561 μm/559 μm (US pachy)
Early post-RK	UNK	20/25	UNK	35.00D@90°, 37.50D@180°	UNK
Post-RK (fourth mo)	UNK	20/80	UNK	40.00D@90°, 38.25D@180°	UNK
Early post-RK redeepening	UNK	20/20	UNK	34.00D@90°, 36.50D@180°	UNK
Post-RK deepening (fourth mo)	UNK	20/25	UNK	39.00D@90°, 37.25D@180°	UNK
Pre-LASIK	−1.25 (−3.00@175)	20/50	20/20	38.40D@92°, 35.40D@2°	582 μm/576 μm (Orbscan)

Pre-RK and post-RK data were obtained from the previous clinic.
UNK, unknown.

2–3 mm. No triangular piece was separated completely from the flap. The obtained stromal bed was clean and dry.

Laser treatment was done with a VISX S4 excimer laser (Santa Clara, CA) with 160-mJ/cm^2 laser fluence and 10.0-Hz pulse frequency. Refractive correction of −1.25 −3.00 × 180 D was performed. After the laser, flap edges and the RK incisions were positioned into their correct places on the stromal bed. There was no loss of tissue from the corneal flap.

Postoperatively, topical ofloxacin 0.3% (Exocin; Allergan, Mougins, France) and prednisolone acetate 1% (Pred Forte; Allergan) drops were used.

Postoperative Course

At the fifth postoperative month, his uncorrected visual acuity (UCVA) was 20/20. Orbscan II examination revealed a well-centered ablation pattern; central and thinnest corneal thicknesses were 487 and 476 μm, respectively. On slit-lamp examination, the flap was found to be properly placed on the stromal bed, and all RK incisions seemed to be well aligned. There were iron deposits around the radial incision at the central cornea, but the optic axis was clear. There was no haze or epithelial ingrowth.

DISCUSSION

Successful outcomes have been reported in the management of both post-RK myopia and hyperopia by LASIK.[5,10] However, this treatment has some limitations. In relatively destabilized corneas with 16 or 32 RK incisions, the LASIK procedure with suction may cause overcorrection and should be avoided.[13] In the present patient, there were a total of 12 RK incisions. Also, LASIK should not be performed in corneas in which epithelial inclusion cysts are present in the RK incisions. After LASIK, these epithelial cells could migrate in the flap–stroma interface and lead to irregular astigmatism, loss of best-corrected visual acuity (BCVA), and even flap melting and amputation.[4,14] Thus, to avoid severe and persistent epithelial ingrowth after LASIK in these eyes, surface ablation with prophylactic mitomycin C was recommended.[15] Also, recent reports indicate that mitomycin C can prevent and treat subepithelial fibrosis and haze in eyes with previous refractive surgery including RK and PRK.[16,17]

RK incisions never heal completely. In the LASIK procedure, the lamellar cut perpendicular to these incisions could cause separation of the incisions and division of the flap into triangular pieces,[13,18] even if LASIK is performed 5–15 years after RK, and clinically, there are no epithelial cysts in the incisions.[19] A thick flap may render separation less likely. The femtosecond laser works by focusing the laser pulses next to each other precisely at desired depths and creating an intracorneal resection plane by photodisruption. Thus, it has been thought that femtosecond lasers would be useful in reducing the RK incision–related flap complications.[20] Also, Binder[21] reported on his 1000 consecutive cases that the effect of preoperative corneal curvature had no effect on flap dimensions created by the Intralase, except eliminating physical complications associated with mechanical flap creation.

In the present patient, because the RK operation was performed 14 years ago, we considered that the wound healing mechanism was complete and the biomechanical balance between the incisions had been stabilized. We found no epithelial inclusion cysts in RK incisions. Because the keratometry readings were flatter than 40.00 D, it was thought that problems could occur with the maintenance of the microkeratome vacuum, a small flap, incomplete flap, or buttonholing. For these reasons, LASIK with Intralase flap formation was planned. However, in our case, the femtosecond laser device lost suction during the initial laser application, which could be caused by the biomechanical instability of the globe even 14 years after RK. A flap was eventually formed at the same intracorneal plane. Formation of a 100-μm-thick flap was intended by Intralase, but intraoperative pachymetry was not performed; therefore, the real thickness of the flap may not be 100 μm.

Despite using special flap holding techniques that have been developed to reduce the tendency of separation of radial incisions or progressive tears by pulling forces,[19] the flap tore, probably because the lamellar cut by femtosecond lasers are created only by separation of the corneal lamellae with gas bubbles; also, all of the stromal fibers at the flap interface are not readily cut. Munoz et al[20] have also reported that, in their case series, of 11 post-RK eyes that had surgery with an Intralase femtosecond laser, a separation of at least 1 radial incision was seen in all eyes at flap lifting.

In conclusion, this case showed that the femtosecond laser does not eliminate the most common complication of the mechanical keratome for post-RK eyes. Even though this is only 1 case and the affected eye had no central corneal haze, epithelial ingrowth, or irregular astigmatism or loss of BCVA, these symptoms could be seen with this type of complication. Therefore, we recommend that femtosecond laser flap formation

not be used in post-RK eyes, on the basis of the complications we encountered and the reported relative safety of PRK with mitomycin C in these eyes.[16]

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