Intraoperative Management of Partial Flap during LASIK

A Small Case Series Report

Vikentia J. Katsanevaki, MD, PhD, Nikolaos S. Tsiklis, MD, Nikolaos I. Astyrakakis, OD, Ioannis G. Pallikaris, MD, PhD

Purpose: To report the intraoperative management of incomplete microkeratome LASIK flaps.

Design: Small, retrospective, noncomparative, interventional case series.

Participants: Five outpatients.

Methods: In 5 eyes of 5 patients, the premature stop of the microkeratome resulting from mechanical obstacles resulted in an incomplete flap that would not allow for the completion of the LASIK procedure. After the careful realignment of the partial flaps and the removal of the identified obstacles, the second pass of the microkeratome resulted in flaps of the intended size.

Main Outcome Measures: Final creation of a flap as intended, completion of the procedure, and visual and refractive outcome of the operative eyes.

Results: The second pass of the microkeratome resulted in flaps as planned. All the procedures were completed, and the operative eyes that were followed up for at least 3 months had excellent visual and refractive results.

Conclusions: The second pass of the microkeratome can successfully manage incomplete flaps resulting from microkeratome premature stop as a result of mechanical obstacles. *Ophthalmology 2005;112:1710–1713*

LASIK currently is the most popular surgical method for the photorefractive treatment of ametropias.[1] The creation of the lamellar flap provides refractive stability, fast visual recovery, and minimal pain.[2] The flap, however, also is associated with complications that may significantly affect visual performance or may delay the completion of the LASIK procedure.[3–8]

The incidence of flap-related complications in previous LASIK series is reported to be from 0.3% to 14%, usually depending on the type of the microkeratome used.[5–11] Of the various microkeratome-related complications, partial flaps are the most frequently reported.[3,5–7,11,12] Partial flaps are the result of a premature stop of the microkeratome head during its course and have been reported in up to 5% of cases.[11] If the reflected flap hinge interferes with the ablation zone, the LASIK procedure either must be postponed or the ablation zone must be decreased, a measure that carries the risk of increased likelihood of visual symptoms after the treatment. The manual dissection of the flap can induce irregular astigmatism and should be avoided.[11]

We report 5 eyes of 5 patients complicated with partial flaps involving the treatment zone during myopic LASIK. A second pass of the microkeratome reduced the size of the hinge and allowed us to complete the laser procedure without any further complications.

Case Reports

The 5 procedures were performed between December, 2003, and October, 2004, by 2 of the authors (IGP and VJK). All the patients were scheduled for bilateral myopic corrections starting with the right eye. The early stop of the microkeratomes occurred in only 1 eye of each patient; 4 stops occurred in the left eye and 1 occurred in the right eye after the microkeratome completed 60% to 70% of its intended course. The partial flaps occurred using the Carriazo-Pendular (Schwind Eye-Tech-Solutions, Kleinostheim, Germany) microkeratome in 4 eyes and the Moria M2 (Antony, France) in 1 eye. The Carriazzo-Pendular is the preferred microkeratome in our practice; the incidence rate of partial flaps between the 2 devices correlates well with the frequency of their use. Table 1 (available at http://aaojournal.org) summarizes the demographic and refractive preoperative data of the reported patients.

In all the reported cases, the partial flaps either were the result of mechanical obstacles such as the speculum or the drape pre-

Originally received: November 25, 2004.
Accepted: November 25, 2004. Manuscript no. 2004-343.

From the Vardinoyiannion Eye Institute of Crete, University of Crete School of Medicine, Crete, Greece.

The authors have no conflicts of interest associated with the article.

Correspondence to Vikentia J. Katsanevaki, MD, PhD, Vardinoyiannion Eye Institute of Crete (VEIC), University of Crete School of Medicine, P. O. Box, 1352, 71110 Voutes, Heraklion, Crete, Greece.

ISSN 0161-6420/05/$–see front matter
doi:10.1016/j.ophtha.2005.04.032

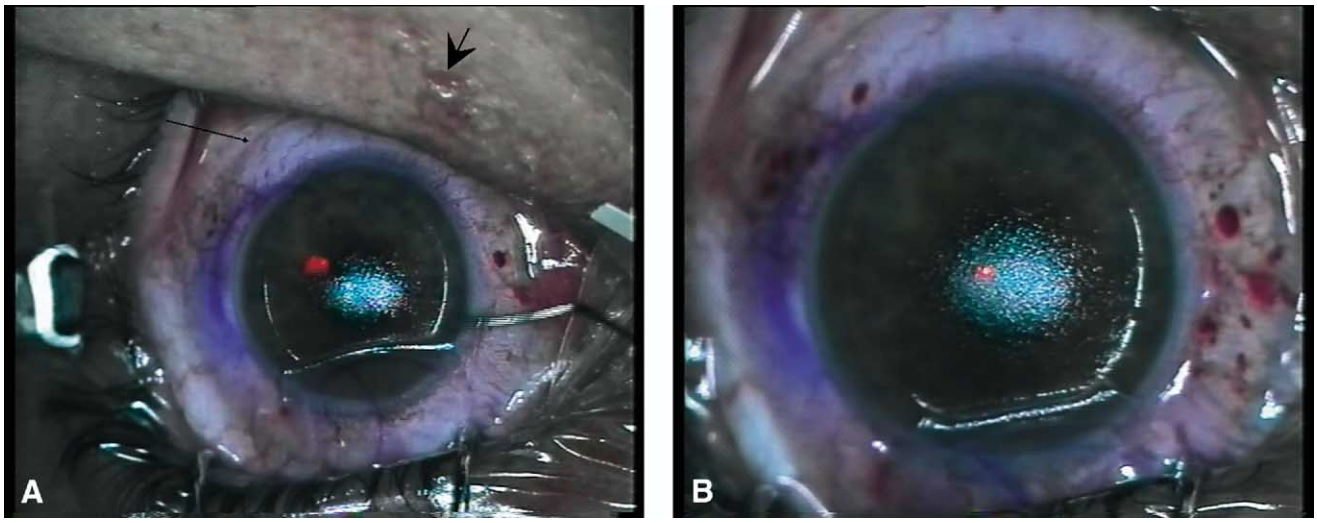

Figure 1. **A**, Partial flap using the Carriazo-Pendular microkeratome. As indicated by the skin trauma from the microkeratome blade (arrowhead), the premature stop of the device was most likely the result of the impingement of the lower lid within the microkeratome's course. Note the mark of suction ring indentation on the conjunctiva (arrow). **B**, The second pass of the same microkeratome achieved the intended size of the hinge without any evident irregularities of the stromal bed.

venting the keratomes to complete their course or because of inadequate exposure of the globe during the cut. We did not identify any suction loss or microkeratome malfunction during the cut in any of the reported cases.

After the partial flaps were lifted, the surgeons evaluated the quality of the dissected stroma. In all cases, the hinges were wide but regular, and there were no signs of irregular dissection of the exposed stroma (Figs 1, 2A). After the inspection, the flaps were repositioned carefully and realigned according to the preoperative corneal marks. As soon as the obstacles on the primary microkeratome course were identified and removed, the same microkeratome was placed back onto the eyes; without any change on the settings or blade exchange, the microkeratome pass was repeated. The second pass of the microkeratome was uneventful in all cases and resulted in flaps of intended size without any apparent irregularities of the stromal bed. All the LASIK procedures were completed with no further sequelae.

The patients were scheduled for follow-up on days 1 and 3 and at 1-, 3-, and 6-month postoperative intervals. The follow-up period of the complicated eyes ranged from 1 to 6 months. Table 2 (available at http://aaojournal.org) summarizes the visual and refractive results of those eyes during the follow-up.

No eye had any vision loss, whereas 2 eyes had a 1-line gain after the treatment. All the reported eyes remained within 0.5-diopter of the attempted correction.

Institutional review board/ethics committee approval was not required for this retrospective study.

Discussion

Partial flaps commonly may complicate LASIK treatments. Any obstruction of the microkeratome head, poor suction

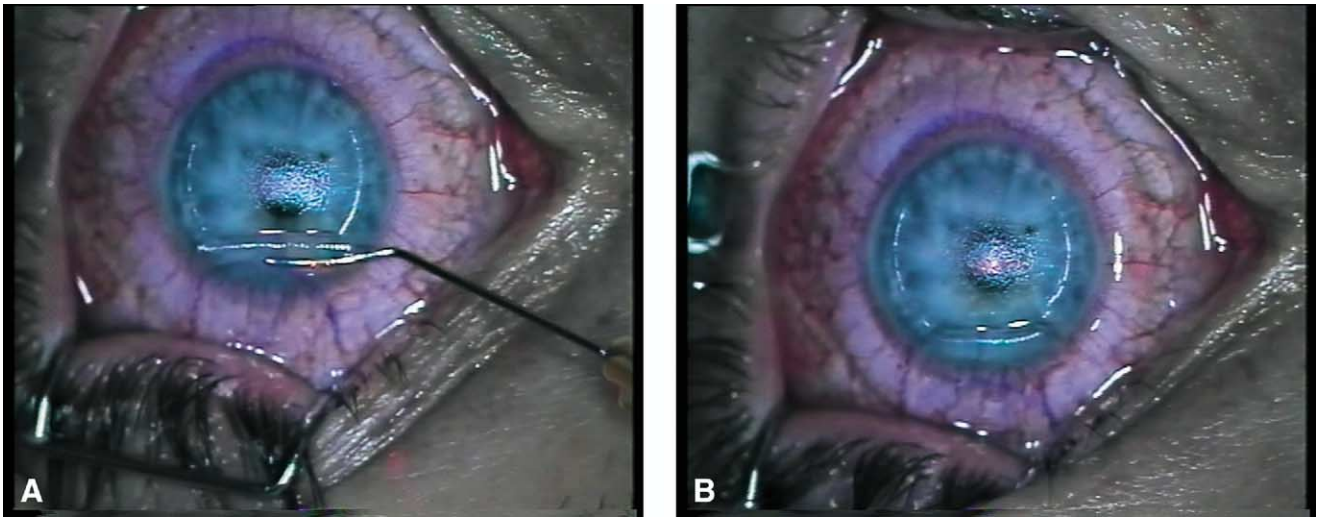

Figure 2. **A**, Slightly temporally decentered partial flap created by Moria M2 because of restricted exposure of the globe. The hinge is impinging on the treatment zone planed at 7 mm. There are no signs of stromal bed irregularities. **B**, Use of a stiffer speculum allowed for better globe exposure and the enlargement of the flap's size after the second pass of Moria M2 microkeratome.

during the cut or malfunction in the motor can potentially interrupt the forward pass of the device and result in an incomplete flap.[3,7,13,14] To our knowledge, there are no other reports in the literature proposing a surgical method for the intraoperative management of partial flaps. The current recommendation for such a complication is to postpone the procedure for a later date.[3–7,12–16] The optimum, safe time to recut a partial flap is unknown. A retreatment should not be attempted earlier than 1 month,[15] and the operative eye must have stable refraction.

Because a partial flap can result from multiple causes, it is the most likely type of intraoperative flap complication. In case of suction loss or malfunction of the microkeratome during the cut, a partial flap can be seen with concomitant irregularities of the stromal bed.[13] Any laser treatment in such cases can lead to induced astigmatism and corneal scaring of the treated eyes.

Most partial flaps, however, are of good quality; the microkeratome is interrupted in the midst of cutting an otherwise normal flap. The premature stop of the microkeratome in the current reported series was to the result of the mechanical obstruction of a properly working device under stable and adequate suction. The incomplete flaps were lifted; the surgeon evaluated the exact hinge size and ensured that the stromal bed was smooth and regular in all cases. The mechanical obstacles on the microkeratome course during the initial procedure were identified and resolved. After the careful realignment of the incomplete flaps, a second pass of the microkeratome succeeded to achieve the required the flap size and allowed for the completion of the procedures (Fig 2).

The potential risk of the microkeratome second pass could be the maceration of the previously cut tissue. Histopathologic studies of postmortem eyes that have undergone LASIK surgery showed that after the creation of a stromal flap, the human cornea never restores its integrity. The corneal healing results in a hypercellular scar at the edges of the flap and a hypocellular scar of unorganized collagen at the interface of the stromal bed (Edelhauser HF. Histopathology of LASIK flaps. Paper presented at: AAO Annual Meeting, October, 2004; New Orleans, Louisiana).

These histopathologic findings correlate well with the current clinical experience. We assume that the depth and extent of the peripheral hypercellular scar that seals the flap edge also determines the possibility of its manual lift on a later date. Previous flaps can be lifted, even years after surgery (confirming that cut lamellae never restore their integrity), but there is a variability in the degree of difficulty for lifting a previous flap (if it can be lifted at all), representing the variability of wound healing response among patients. By definition, a nonuniform scar at the edges of the original flap results in variable local resistance. We assume that the reported tissue maceration when the second microkeratome pass interferes with the pathway of the original flap incision plane[17] may be the cause of these unpredictable and variable mechanical properties at the site of the microkeratome primary cleavage plane.

Because no healing response is involved, the intraoperative second pass of the microkeratome does not carry the same risks. If the device is functioning properly, the suction ring is replaced exactly at its original location on the eye, and the initial flap is carefully realigned, the second pass of the microkeratome would be expected to penetrate the corneal stroma through the route of least resistance, that is, at the incision plane of the first pass of the device. The remaining conjunctival edema (Figs 1, 2) immediately after the initial use of the microkeratome guides the secondary placement of the suction ring at the same location as with its primary use. Before deciding to perform a second pass of the microkeratome, it is critical to exclude any microkeratome malfunction, suction loss, or stomal bed irregularities at the primary cut. If the used microkeratome allows for selection of the hinge positioning, the hinge must be aimed in the same orientation as in the primary cut so that the second pass does not result in a free cap.

In summary, the intraoperative second pass of the microkeratome seems to address adequately the problem of incomplete flaps resulting from primary microkeratome pass mechanical obstacles. Such an attempt not only allows for the completion of the LASIK procedure but also prevents secondary treatment-related complications such as flap maceration[17] during a second pass at a later date. Although the small number of eyes reported herein does not allow us to come to definite conclusions, the preliminary experience of such an attempt is encouraging: the second pass of the microkeratome enlarged the flap size in all cases and the treated eyes had excellent refractive and visual results. The immediate recut technique reported herein was applied only when the cause of partial flaps was obstruction coming usually from the lid. All the flaps were of good quality with a smooth and regular stromal bed. Future experience may establish this method as a safe surgical method for the intraoperative management of such partial flaps.

References

1. Pallikaris IG, Papatzanaki ME, Stathi EZ, et al. Laser in situ keratomileusis. Lasers Surg Med 1990;10:463–8.
2. Talamo JH. In discussion of: El Danasoury MA, El Maghraby A, Klyce SD, Mehrez K. Comparison of photorefractive keratectomy with excimer laser in situ keratomileusis in correcting low myopia (from −2.00 to −5.50 D): a randomized study. Ophthalmology 1999;106:420–1.
3. Jacobs JM, Taravella MJ. Incidence of intraoperative flap complications in laser in situ keratomileusis. J Cataract Refract Surg 2002;28:23–8.
4. Tham VM, Maloney RK. Microkeratome complications of laser in keratomileusis. Ophthalmology 2000;107:920–4.
5. Lin RT, Maloney RK. Flap complications associated with lamellar refractive surgery. Am J Ophthalmol 1999;127:129–36.
6. Stulting RD, Carr JD, Thompson KP, et al. Complications of laser in situ keratomileusis for the correction of myopia. Ophthalmology 1999;106:13–20.
7. Clinch TE. In discussion of: Gimbel HV, Anderson Penno EE, van Westenbrugge JA, et al. Incidence and management of intraoperative and early postoperative complications in 1000 consecutive laser in situ keratomileusis cases. Ophthalmology 1998;105:1847-8.
8. Maloney RK. In discussion of: Gimbel HV, van Westenbrugge JA, Anderson Penno EE, et al. Simultaneous bilat-

eral laser in situ keratomileusis: safety and efficacy. Ophthalmology 1999;106:1467-8.
9. Waring GO III, Carr JD, Stulting RD, et al. Prospective randomized comparison of simultaneous and sequential bilateral laser in situ keratomileusis for the correction of myopia. Ophthalmology 1999;106:732–8.
10. Gimbel HV, Basti S, Kaye GB, Ferensowicz M. Experience during the learning curve of laser in situ keratomileusis. J Cataract Refact Surg 1996;22:542–50.
11. Pallikaris IG, Katsanevaki VJ, Panagopoulou SI. Laser in situ keratomileusis intraoperative complications using one type of microkeratome. Ophthalmology 2002;109:57–63.
12. Ito M, Hori-Komai Y, Toda I, Tsubota K. Risk factors and retreatment results of intraoperative flap complications in LASIK. J Cataract Refact Surg 2004;30:1240–7.
13. Melki SA, Azar DT. LASIK complications: etiology, management and prevention. Surv Ophthalmol 2001;46:95–116.
14. Holland SP, Srivannaboon S, Reinstein DZ. Avoiding serious corneal complications of laser assisted in situ keratomileusis and photorefractive keratectomy. Ophthalmology 2000;107:640–52.
15. Rao SK, Padmanabhan P, Sitalakshmi G, et al. Timing of retreatment after a partial flap during laser in situ keratosmileusis [letter]. J Cataract Refact Surg 1999;25:1424–5.
16. Jabbur NS, Myrowitz E, Wexler JL, O'Brien TP. Outcome of second surgery in LASIK cases aborted due to flap complications. J Cataract Refact Surg 2004;30:993–9.
17. Tekwani NH, Chalita MR, Krueger RR. Secondary microkeratome-induced flap interference with the pathway of the primary flap. Ophthalmology 2003;110:1379–83.

Table 1. Demographic Data and Preoperative Records of the Reported Patients

Characteristic	Patient No./Complicated Eye									
	1/Left		*2/Right*		*3/Left*		*4/Left*		*5/Left*	
Age (yrs)	23		27		24		48		27	
Gender	M		F		M		F		M	
Eye	R	L	R	L	R	L	R	L	R	L
Manifest refraction (D)	−7.75 sph −0.75 cyl ×15	−6.75 sph −1.5 cyl ×150	−6.75 sph	−6.25 sph	−7.75 sph −0.75 cyl ×5	−7.75 sph −1.0 cyl ×175	+2.5 sph −0.5 cyl ×5	+2.5 sph	−6.75 sph −1.25 cyl ×170	−6.00 sph −1.5 cyl ×15
BCVA	20/16	20/16	20/20	20/20	20/50	20/20	20/20	20/20	20/25	20/25
Corneal pachymetry (μm)	615	615	562	567	534	534	580	567	555	556
Flat K	41.23	41.72	43.27	43.20	41.91	42.02	40.83	41.22	41.09	40.92
Steep K	42.04	42.37	43.75	43.90	43.42	43.50	41.86	41.70	42.84	42.58
Microkeratome used	Moria M2		CB 130		CB 130		CB 130		CB 130	

BCVA = best-corrected visual acuity (in Snellen lines); CB = Cariazzo-Barraquer pendular microkeratome; cyl = cylinder; D = diopters; F = female; K = keratometric value in diopters; L = left; M = male; R = right; sph = sphere.

Table 2. Preoperative Records of the Reported Patients

Time Point		Patient No./Complicated Eye									
		1/Left		*2/Right*		*3/Left*		*4/Left*		*5/Left*	
Last follow-up		6 mos		6 mos		3 mos		3 mos		3 days	
		R	L	R	L	R	L	R	L	R	L
Day 1	UCVA	20/32	20/63	20/40	20/20	20/50	20/32	20/80	20/25	20/32	20/25
Day 3	UCVA	20/25	20/25	20/40	20/16	20/40	20/25	20/63	20/20	20/25	20/25
	UCVA	—	—	20/20	20/16	20/40	20/20	20/40	20/16	20/20	20/20
1 mo	Manifest refraction (D)	—	—	−0.25 sph −0.5cyl	−0.25 sph	Plano	Plano	−0.75 sph	Plano	Plano	Plano
	BCVA	—	—	20/20	20/16	20/40	20/20	20/20	20/16	20/20	20/20
3 mos	UCVA	20/16	20/16	20/20	20/16	—	—	20/32	20/16	—	—
	Manifest refraction	+0.5 sph −0.25 cyl ×45	+0.75 sph	−0.25 cyl ×100	−0.25 sph	—	—	−0.75 sph −0.75 cyl ×100	Plano	—	—
	BCVA	20/16	20/16	20/20	20/16	—	—	20/20	20/16	—	—
	UCVA	—	—	20/20	20/16	—	—	—	—	—	—
6 mos	Manifest refraction	—	—	−0.25 ×100	−0.25	—	—	—	—	—	—
	BCVA	—	—	20/20	20/16	—	—	—	—	—	—
	Line gain/loss	0	0	0	+1	+1	0	0	+1	+1	+1

BCVA = best-corrected visual acuity (in Snellen lines); cyl = cylinder; D = diopters; L = left; R = right; sph = sphere; UCVA = uncorrected visual acuity.
—, not available.