
Laser in situ keratomileusis flap tear during lifting for enhancement in the presence of post-photorefractive keratectomy corneal haze

Michael G. Gressel, MD, Vickie L. Belsole, LPN

A patient who had photorefractive keratectomy for low myopia 6 years earlier had an enhancement by hyperopic laser in situ keratomileusis (LASIK). Moderate reticular corneal haze developed after LASIK. An attempted flap lift 4 months after LASIK resulted in a flap tear at the edge of the zone of corneal haze. Because haze can indicate an area of exuberant wound healing that can result in flap adhesion to the bed, recutting a LASIK flap may be safer than lifting it in the presence of haze.

J Cataract Refract Surg 2004; 30:706–708 © 2004 ASCRS and ESCRS

Treatment of a residual refractive error (ie, enhancement) after laser in situ keratomileusis (LASIK) is often accomplished by lifting the existing flap or by cutting a new flap. Although recutting has yielded acceptable results,^{1–3} authors report that lifting is safer or offers better stability of the refractive error and gives better uncorrected visual acuity (UCVA) than recutting.^{4,5} The main advantage of lifting over recutting is that it prevents new flap-related complications (such as irregular interface surfaces or slivers of tissue created by intersecting planes of dissection resulting from the 2 cuts), free flaps, or macerated flaps.^{3–7} We describe a case in which, in retrospect, recutting might have yielded better results.

Case Report

A 39-year-old woman had photorefractive keratectomy (PRK) in the left eye in June 1996 for myopia (−4.75

diopeters) with the Visx Star laser. The postoperative course was uneventful, and the patient exhibited trace to 1+ reticular corneal haze from 2 weeks through 3 months postoperatively, but no haze 4, 5, 6, 7, and 11 months after surgery. The UCVA 8 months after surgery was 20/30 and the best corrected visual acuity (BCVA), 20/20 with +0.75 +0.75 × 60.

The patient returned in April 2002 with a UCVA of 20/40 and a BCVA of 20/15 with +0.75 +1.00 × 46. No corneal haze was evident. The patient elected to have LASIK enhancement of the previous PRK. This was performed in May 2002 with a Visx Star S3 laser (programmed treatment +0.88 +1.00 × 46) and a Moria M2 microkeratome. The surgery was uneventful with no sign of a thin flap (flap thickness was not measured). Examinations during the first 2 weeks postoperatively were unremarkable. One month postoperatively, 2+ reticular haze was noted in the central 3.0 mm of the anterior corneal stroma. The patient was treated with dexamethasone 0.1% ophthalmic solution 4 times a day for 3 weeks and was instructed to increase the use of artificial tears and ultraviolet light protection. Four months after LASIK, the haze had diminished to 1+, the UCVA was 20/30, and the BCVA was 20/20 with +0.25 +1.25 × 125. Further enhancement with flap lifting was offered.

The inferior edge of the flap was teased free to allow the surgeon to grasp the flap edge with a forceps. The flap was gently peeled back. When the flap was retracted midway, a semicircular tear was noted (Figure 1). The flap was repositioned without further manipulation or dissection. Biomicroscopy showed that the diameter and location of the tear correlated with the zone that had been affected by reticular haze.

Seven months after the torn flap presented, a LASIK flap recut was performed uneventfully with a Carriazo-Barraquer microkeratome (Moria). A Visx Star S4 excimer laser was

Accepted for publication July 25, 2003.

Presented in part as a poster at the ASCRS Symposium on Cataract, IOL and Refractive Surgery, San Francisco, California, USA, April 2003.

The authors have no proprietary or financial interest in any of the methods or materials mentioned.

Correspondence to Michael G. Gressel, MD, Department of Regional Ophthalmology, LN12, Cleveland Clinic Foundation, 5700 Cooper Foster Park Road, Lorain, Ohio 44053, USA.

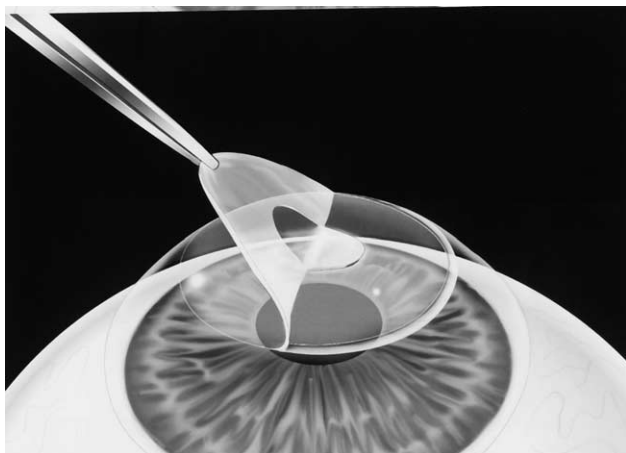


Figure 1. (Gressel) The flap is torn at the edge of the zone of haze.

used to deliver a programmed treatment of $+1.70 +0.87 \times 180$. Three weeks postoperatively, the uncorrected distance acuity was 20/20 and there were no signs of haze or healing problems.

Discussion

We report a surgical complication that is unusual in several respects. The principal risk factors for haze after LASIK in an eye that had previous PRK (secondary LASIK) were not present in this case. Alió et al.⁸ report that haze is most likely to occur after secondary LASIK if the original PRK was performed for high myopia or if the PRK was complicated by regression of the refractive effect or significant haze. The PRK in our case was performed for low myopia and was not followed by an abnormal amount of haze or regression. The degree of haze observed after LASIK in our case was transiently greater than after the original PRK despite the absence of the above risk factors.

Although flap adhesion increases with time after LASIK, it may be possible to lift a flap years after the original procedure.^{5,7} We did not expect to encounter an adhesion between the flap and the underlying bed so soon (4 months) after LASIK. It is suggested that a thin flap can predispose to exaggerated wound healing by increasing epithelial–stromal interactions.^{9,10} Nothing unusual about the flap was evident at the time of LASIK in our case. In retrospect, the only clinical sign that might have warned of an unusual pattern of wound healing was the appearance of moderate (2+) haze after the original LASIK. This conclusion is supported by

the observation that the flap tore at the edge of the zone of haze.

Reticular corneal haze is thought to represent light scattering by compounds such as keratin sulfate and type III collagen deposited in the anterior corneal stroma as part of a wound-healing response to PRK.^{10,11} These substances are produced by cells designated as “activated keratocytes” or “myofibroblasts” that appear within several weeks after the procedure and rapidly increase in number.^{10,11} Histologic studies indicate the persistence of these activated cells for many months after PRK.^{12,13} It is unknown whether there is an upper limit to the duration of keratocyte activation. Late-onset corneal haze after PRK¹⁴ and the long time (6 years) between the PRK and the original LASIK in our case suggest that keratocyte activation or the potential for reactivation may last a long time after PRK.

Haze after LASIK to enhance PRK can be severe,^{9,15} sometimes causing loss of best spectacle-corrected visual acuity. Exacerbation of preexisting haze has been absent^{16–18} to common⁸ in reported series of secondary LASIK. It is recommended that eyes having secondary LASIK receive more prolonged topical corticosteroid therapy than those having primary LASIK to minimize the degree of haze.^{8,9} We do not know whether more aggressive topical corticosteroid treatment after LASIK would have made a difference in the degree of flap adhesion in our case.

Because of the risk for flap-related complications when a LASIK flap is recut, lifting the existing flap is generally preferred for enhancement procedures.^{5,7} Exceptions to this include eyes with excessively small, thin, or buttonholed flaps; eyes in which excessive flap adhesion is expected because of a long interval since LASIK; eyes with previous radial keratotomy or astigmatic keratotomy; and eyes with excessive healing or fibrosis.^{7,19,20} We recommend caution in performing enhancement procedures in eyes that have had LASIK after PRK, especially if increased haze occurred after LASIK. Because of the possibility of unusual flap adhesion in these eyes, we concur with Zadok et al.²¹ that recutting may be safer than lifting the flap for enhancement in the presence of haze.

The question remains whether using PRK rather than LASIK to enhance a previous PRK is the right decision. Recurrent haze tends to develop if PRK is used after a previous PRK that was complicated by

pronounced regression combined with haze.²² Whether LASIK or surface ablation is used to enhance a previous PRK, the surgeon should be mindful of the potential for problematic postoperative haze. It is unclear whether routine use of mitomycin-C (MMC) when enhancing PRK improves visual results. The use of MMC at the time of LASIK in a case like ours, in which no unusual haze or regression occurred after the original PRK, might not be met with universal acceptance.

References

- Özdamar A, Aras C, Bahçecioglu H, Sener B. Secondary laser in situ keratomileusis 1 year after primary LASIK for high myopia. *J Cataract Refract Surg* 1999; 25:383–388
- Agarwal A, Agarwal A, Agarwal T, et al. Laser in situ keratomileusis for residual myopia after primary LASIK. *J Cataract Refract Surg* 2001; 27:1013–1017
- Jacobs JM, Sanderson MC, Spivack LD, et al. Hyperopic laser in situ keratomileusis to treat overcorrected myopic LASIK. *J Cataract Refract Surg* 2001; 27:389–395
- Domniz Y, Comaish IF, Lawless MA, et al. Recutting the cornea versus lifting the flap: comparison of two enhancement techniques following laser in situ keratomileusis. *J Refract Surg* 2001; 17:505–510
- Davis EA, Hardten DR, Lindstrom M, et al. LASIK enhancements; a comparison of lifting to recutting the flap. *Ophthalmology* 2002; 109:2308–2313
- Peters NT, Iskander NG, Gimbel HV. Minimizing the risk of recutting with a Hansatome over an existing Automated Corneal Shaper flap for hyperopic laser in situ keratomileusis enhancement. *J Cataract Refract Surg* 2001; 27:1328–1332
- Rubinfeld RS. Discussion of paper by Davis EA, Hardten DR, Lindstrom M, et al. *Ophthalmology* 2002; 109:2313–2314
- Alió JL, Artola A, Attia WH, et al. Laser in situ keratomileusis for treatment of residual myopia after photorefractive keratectomy. *Am J Ophthalmol* 2001; 132:196–203
- Artola A, Ayala MJ, Pérez-Santonja JJ, et al. Haze after laser in situ keratomileusis in eyes with previous photorefractive keratectomy. *J Cataract Refract Surg* 2001; 27:1880–1883
- Wilson SE, Mohan RR, Hong J-W, et al. The wound healing response after laser in situ keratomileusis and photorefractive keratectomy; elusive control of biological variability and effect on custom laser vision correction. *Arch Ophthalmol* 2001; 119:889–896
- Krueger RR, Binder PS, McDonnell PJ. The effects of excimer laser photoablation on the cornea. In: Salz JJ, ed, *Corneal Laser Surgery*. St Louis, MO, Mosby, 1995; 11–44
- Hanna KD, Pouliquen YM, Savoldelli M, et al. Corneal wound healing in monkeys 18 months after excimer laser photorefractive keratectomy. *Refract Corneal Surg* 1990; 6:340–345
- Binder PS, Anderson JA, Rock ME, Vrabcic MP. Human excimer laser keratectomy; clinical and histopathologic correlations. *Ophthalmology* 1994; 101:979–989
- Lipshitz I, Lowenstein A, Varssano D, Lazar M. Late onset corneal haze after photorefractive keratectomy for moderate and high myopia. *Ophthalmology* 1997; 104:369–373; discussion by JH Talamo, 373–374
- Lazaro C, Castillo A, Hernandez-Matamoros JL, et al. Laser in situ keratomileusis enhancement after photorefractive keratectomy. *Ophthalmology* 2001; 108:1423–1429; discussion by SN Rao, PA Majmudar, 1429
- Özdamar A, Sener B, Aras C, Aktunç R. Laser in situ keratomileusis after photorefractive keratectomy for myopic regression. *J Cataract Refract Surg* 1998; 24:1208–1211
- Agarwal A, Agarwal A, Agarwal T, et al. Laser in situ keratomileusis for residual myopia after radial keratotomy and photorefractive keratectomy. *J Cataract Refract Surg* 2001; 27:901–906
- Comaish IF, Domniz YY, Lawless MA, et al. Laser in situ keratomileusis for residual myopia after photorefractive keratectomy. *J Cataract Refract Surg* 2002; 28:775–781
- Dada T. Secondary LASIK [letter]. *J Cataract Refract Surg* 2002; 28:205
- Durrie DS, Aziz AA. Lift-flap retreatment after laser in situ keratomileusis. *J Refract Surg* 1999; 15:150–153
- Zadok D, Maskaleris G, Garcia V, et al. Outcomes of retreatment after laser in situ keratomileusis. *Ophthalmology* 1999; 106:2391–2394
- Pietilä J, Mäkinen P, Uusitalo H. Repeated photorefractive keratectomy for undercorrection and regression. *J Refract Surg* 2002; 18:155–161