

LASIK With a Thin Flap

The procedure can be safely performed with minimal flap complications and good visual outcomes while minimizing ectasia risks.

BY PAUL J. DOUGHERTY, MD

LASIK is currently the most common form of refractive surgery performed in the US.¹ Although not a high-risk surgery, it does carry some inherent risk to the eye because the procedure can weaken the mechanical strength of the cornea.^{2,3} As surgeons, we are constantly attempting to make LASIK safer for patients by minimizing corneal mechanical instability following surgery. A technique I use to minimize corneal instability is to maximize the amount of residual corneal stroma following laser ablation by intentionally creating a thin flap with the microkeratome.

MANAGING COMPLICATIONS

Ectasia

Perhaps the most dreaded complication of LASIK is corneal ectasia, or iatrogenic keratoconus.⁴⁻⁶ Managing this potentially visually disabling problem is extremely difficult and requires a rigid gas permeable contact lens or corneal transplantation. Other treatments for iatrogenic keratoconus include intracorneal ring segments and stiffening of the cornea with UV light, but no studies prove the long-term effectiveness of these modalities. Post-LASIK corneal ectasia is thought to result from an excessive removal of tissue from the central cornea that makes the residual stroma too thin to preserve corneal integrity. Maintaining a residual stromal bed of 250 μ m may be adequate to prevent ectasia.⁶ Patients at highest risk for the condition are those with thinner corneas (central pachymetry measures less than 550 μ m), high myopes, and patients with large pupils (greater than 6.0mm) because of the greater amount of tissue removed with the excimer laser in these situations.

Thin Flaps

Traditionally, microkeratome manufacturers have offered either a 160- or 180- μ m gap between the plate and the blade for creation of the flap. Some more recently available units have a 130- μ m or smaller gap to achieve a thinner flap. Newer laser microkeratomes can

TABLE 1. THE STUDY'S PARAMETERS

	130 μ m	160 μ m
Mean age (years)	39.4	40.8
Mean cylinder (D)	-1.25	-1.17
Mean BCVA	20/20	20/20
Mean keratometry (D)	44.4	44.1

theoretically create flaps thinner than 130 μ m. The thinner that the microkeratome makes the flap, the less the risk of ectasia is because of the higher amount of residual stromal tissue. Previous reports⁷⁻⁹ imply that thin-flap LASIK (130 μ m or less) may be less safe due to an increased risk of flap complications, including irregular flaps, buttonholes, and microstriae resulting in irregular astigmatism, all of which can affect final visual outcomes. If thinner flaps could be created safely (ie, with no increased risk of flap complications as compared with thicker flaps), more patients would become candidates for LASIK. Furthermore, patients undergoing LASIK—particularly those with high myopia, large pupils, or thinner corneas—could undergo the procedure with less risk of corneal ectasia.

STUDY

My study's aim was to determine if thin-flap LASIK (performed with a 130- μ m microkeratome head) is as visually effective and safe as LASIK using a standard 160- μ m head.¹⁰ I reviewed the charts for 434 eyes of 228 consecutive patients undergoing primary myopic LASIK with a postoperative refractive goal of plano.

The keratectomies employed the BD K-3000 microkeratome (BD Ophthalmic Systems, Franklin Lakes, NJ) with either a 130- μ m (thin flap) or 160- μ m (conventional flap) head. Head size was selected to ensure a

minimum calculated residual stromal bed of 250 μ m following laser ablation. In general, I used the 130- μ m head for eyes with a preoperative central pachymetry of 550 μ m or less and/or a spherical equivalent of -7.00D or higher. The average flap thickness by subtraction pachymetry for the 130- μ m head of the BD K-3000 is 127.8 \pm 21.9 μ m.¹¹ The 160- μ m head was used for all other eyes. According to my data, the average flap thickness by subtraction pachymetry for the 160- μ m head with the BD K-3000 is 150 \pm 20 μ m. All laser ablations used the Nidek EC-5000 excimer laser (Nidek Technologies, Ltd., Fremont, CA) with an optical zone of 6.0 or 6.5mm depending on the patient's scotopic pupil size. I compared the geometric mean¹² of postoperative day 1 Snellen visual acuity in the 130- μ m group to the 160- μ m group using a 2-tailed t-test. All intraoperative and postoperative flap complications were documented and compared between groups.

In terms of results, there was no statistically significant difference between the groups with respect to mean age, mean preoperative refractive cylinder, BCVA, or keratometry (Table 1). The mean preoperative central corneal pachymetry in the 130- μ m group was 526.8 \pm 35.4 μ m compared to 574.5 \pm 27.8 μ m in the 160- μ m group. The preoperative spherical equivalent in the 130- μ m group of -5.00 \pm 2.53D was significantly higher ($P < .0001$ by ordinal logistic regression analysis) than the -3.78 \pm 1.73D in the 160- μ m group (Figure 1). The geometric mean UCVA on postoperative day 1 was 20/25 in the 130- μ m group and 20/26 in the 160- μ m group. T-testing revealed a statistically significant parallel ($P = .76$) between groups. There

were no immediate postoperative flap complications (including microstriae, macrostriae, diffuse lamellar keratitis, or epithelial ingrowth) in either group. A single partial flap due to a loss of suction occurred in the 160- μ m group. No other intraoperative flap complications happened in either group.

DISCUSSION

Based on my study, I feel strongly that thin flaps can be created as safely as flaps of traditional thickness and result in similar, if not better, visual acuity (Figure 2). For this reason, I have switched to using thin-flap LASIK almost exclusively in my refractive practice. For higher myopia or thinner corneas, I have one particular 130- μ m head that cuts, on average, a 100- μ m flap. For these more difficult cases, I routinely use intraoperative bed pachymetry to verify that there will be at least 250 μ m of residual stromal bed following the laser ablation. If the calculation shows less tissue, I will narrow the optical and transition zones of the laser to leave an adequate bed, or I will abandon LASIK altogether and replace the flap without performing the laser ablation. I then will implant a phakic IOL or wait 3 months and perform LASEK with mitomycin C on these patients. Although I exclusively use the BD K-3000 microkeratome because of its safety profile and reliability in my hands, many manufacturers produce microkeratomes that create thin flaps, including Nidek, Inc. (Fremont, CA), Bausch & Lomb (Rochester, NY), Moria (Antony, France), and Intralase Corp. (Irvine, CA).

The main reason to perform thin-flap LASIK is to decrease the risk of ectasia. The exact incidence of post-LASIK keratectasia is difficult to determine given its infrequency. Pallikaris et al⁴ reviewed the LASIK outcomes for 2,873 eyes without evidence of forme fruste or frank keratoconus to determine the incidence of keratectasia. Only 19 eyes (0.66%) developed the complication during a mean follow-up of 16 months. Five of the 14 patients who developed ectasia did so bilaterally. In my practice, I have seen only two cases of ectasia in more than 13,000 eyes (0.015%). In both instances, neither flap was created with the thin-flap head of my microkeratome.

Multiple factors are associated with corneal ectasia and/or an elevation of the posterior corneal surface after LASIK, including forme fruste keratoconus,^{4,13-16} biomechanical factors,^{9,17}

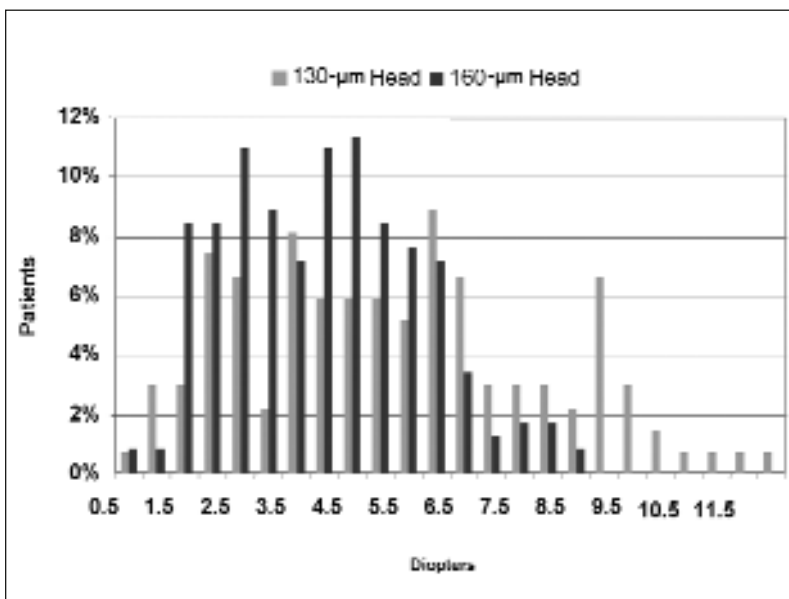


Figure 1. The author evaluated preoperative myopic spherical equivalent between the two study groups.

older age,⁴ high refractive corrections,^{4,18} high IOP,⁵ and residual corneal stromal bed following laser ablation.^{4,16, 18-20}

Multiple investigations have demonstrated that frank or forme fruste keratoconus can lead to ectasia. In a study to determine the incidence of keratectasia, Pallikaris et al⁴ described six eyes with high cylinder and forme fruste keratoconus by topographic and pachymetric findings^{20,21} that developed post-LASIK ectasia and were excluded from the study. Seiler and Quurke¹³ described a patient with forme fruste keratoconus and normal central pachymetry who developed keratectasia after LASIK. Schmitt-Bernard et al¹⁴ reported on a patient with forme fruste keratoconus who underwent bilateral LASIK and developed a significant keratectasia and loss of BCVA.

Controlling ectasia by decreasing corneal biomechanical strength through a deep lamellar keratectomy is the principle behind hyperopic automated lamellar keratoplasty.²²⁻²⁴ Creating a deep keratectomy causes the remaining posterior central cornea to bulge forward and increase the anterior corneal surface's radius of curvature and resulting myopia. I have seen cases of progressive ectasia with a loss of BCVA in eyes that have undergone hyperopic automated lamellar keratoplasty.

Although thin-flap LASIK can decrease the risk of ectasia by minimizing the biomechanical weakening of the cornea and maximizing residual corneal tissue following laser ablation, there are few studies focusing on thin-flap LASIK. Lin²⁵ demonstrated the safety and effectiveness of the procedure when he reported a retrospective study of 1,131 eyes that underwent LASIK with a Nidek EC-5000 excimer laser and Nidek MK-2000 microkeratome (Nidek, Inc.) with a 130- μ m head. In this study, the average flap thickness by subtraction pachymetry was $87.3 \pm 15.4 \mu\text{m}$. Seventy percent of the eyes had a postoperative UCVA of 20/25 or better, and 95% saw 20/40 or better despite the large number of high myopes in the study with a preoperative BCVA poorer than 20/20. Nine hundred and twenty-two eyes (82%) achieved within one line of their preoperative BCVA. Only seven eyes (0.6%) were noted to have flap striae. No irregular flaps or buttonholes were observed.

Chayet²⁶ reported thin-flap LASIK results for 168 eyes using a Nidek MK-2000 microkeratome (Nidek, Inc.)

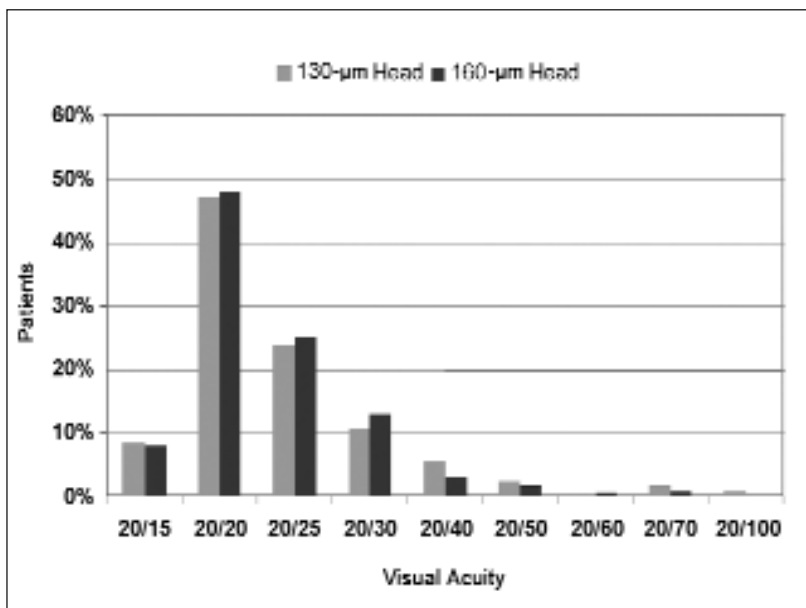


Figure 2. On day 1 postoperatively, patients with thin flaps have similar if not better visual acuity compared with patients with traditional flaps.

with a 120- or 130- μ m head. The mean flap thickness in the 120- μ m group was $103.1 \pm 14.5 \mu\text{m}$. The mean flap thickness in the 130- μ m group was $110.7 \pm 19.3 \mu\text{m}$. No flap complications were seen in either group.

My study¹⁰ was the first published in the peer-reviewed literature that demonstrates that thin-flap LASIK is as safe and effective as conventional LASIK. In fact, there were fewer flap complications in the thin-flap group than in the conventional-flap group. In addition, the visual outcomes on postoperative day 1 were slightly better in the 130- μ m group despite their having a statistically significantly higher level of preoperative myopia than the 160- μ m group. This finding might relate to thinner flaps' having less flap edema in the early postoperative period and thus recovering more quickly.

CONCLUSION

Creating thinner flaps without increasing flap-related complications may benefit those who are not currently good candidates for LASIK using traditional 160- or 180- μ m flap technology because their corneas are too thin relative to their level of myopia and pupil size. Some of these patients may now safely undergo LASIK with a thinner flap while maintaining a 250- μ m residual stromal bed. Patients who are currently candidates for LASIK performed with traditional 160- or 180- μ m microkeratome heads can also benefit from the added safety of the thin-flap LASIK procedure. My colleagues and I cur-

rently recommend thin-flap LASIK for any patient with borderline corneal thickness or myopia greater than -5.00D (an estimated 3.3% of the US population²⁷). ■

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