
Thin Flap LASIK

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ABSTRACT

Purpose: To determine if laser in situ keratomileusis (LASIK) using a 130-micron microkeratome head (thin flap LASIK) is as visually effective and safe as when using a 160-micron head. **Setting:** Dougherty Laser Vision Institute, Camarillo, California. **Methods:** A study was performed comparing postoperative day 1 uncorrected visual acuity and flap complications in eyes undergoing myopic LASIK with a 130-micron head versus a 160-micron head using the BD K-3000 microkeratome. **Results:** The mean preoperative myopia in the 155 eyes of 80 patients in the 130-group was -5.00 ± 2.53 D compared to -3.78 ± 1.73 D in the 279 eyes of 148 patients in the 160-group. The groups were otherwise similar in terms of age, preoperative cylinder, and best-corrected visual acuity (BCVA). The geometric mean postoperative day 1 uncorrected visual acuity (UCVA) was 6/7.5 (20/25) in the 130-micron group compared to 7.8 (20/26) in the 160-micron group. The only flap complication in the series was a single partial flap in the 160-group. **Conclusion:** LASIK with a 130-micron head (thin flap LASIK) is as visually effective and safe as when using a 160-micron head with the BD K-3000 microkeratome.

SYNOPSIS

Thin flap LASIK with a 130-micron microkeratome head was compared to traditional LASIK with a 160-micron head to assess flap complications and early visual outcomes using the BD K-3000 microkeratome.

LASIK for the treatment of refractive errors has been extensively described elsewhere,¹⁻⁴ and is currently the

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most common form of refractive surgery performed in the United States.⁵ While not high-risk, LASIK does carry some inherent risk to the eye because it can weaken the mechanical strength of the cornea.^{6,7} As surgeons, we are constantly attempting to make this surgery safer for patients by minimizing such risk.

One dreaded complication of LASIK is corneal ectasia, or iatrogenic keratoconus.⁸⁻¹⁰ Management of this complication is extremely difficult, requiring a rigid gas permeable (RGP) contact lens or corneal transplantation. Post-LASIK corneal ectasia is thought to result from excessive tissue removal from the central cornea resulting in a residual stromal bed that is too thin to maintain corneal integrity. It is felt that maintaining a residual stromal bed of 250 microns may be adequate to prevent ectasia.¹⁰ Patients at highest risk for ectasia are those with thinner corneas (central pachymetry less than 550 microns), high myopes, and patients with large pupils (greater than 6.0 mm) because of the greater amount of tissue removed with the excimer laser in these situations.

Traditionally, microkeratome manufacturers have offered either a 160- or 180-micron gap between the plate and the blade for creation of the flap. Some newer keratomes have a 130-micron gap to achieve a thinner flap. Theoretically, the thinner that the microkeratome makes the flap, the less the risk of ectasia because of the higher amount of residual stromal tissue. Previous reports¹¹⁻¹³ have implied that thin flap LASIK (130 microns or less) may be less safe for the patient because of 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 (i.e. with no increased risk of flap complications as compared to thicker flaps), more patients would become candidates for LASIK. Furthermore, patients undergoing LASIK—particularly those with high myopia, large pupils, or thinner corneas—could have the procedure performed with less risk of corneal ectasia.

The current study was performed to determine if thin flap LASIK (LASIK performed with a 130-micron microkeratome head) is as visually effective and safe as when using a standard 160-micron head.

	130 μm	160 μm
Mean Age (Years)	39.4	40.8
Mean Cylinder (D)	-1.25	-1.17
Mean BCVA	6/6 (20/20)	6/6 (20/20)
Mean Keratometry	44.4	44.1

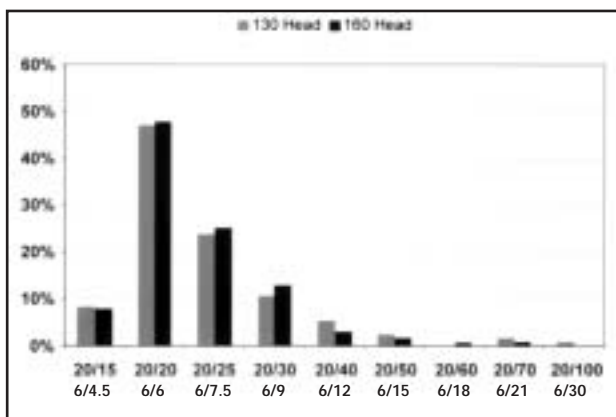


Fig. 1 Comparison of preoperative myopic spherical equivalent between groups

PATIENTS AND METHODS

A chart review was performed on 434 eyes of 228 consecutive patients undergoing primary myopic LASIK with a postoperative refractive goal of plano. One surgeon performed all surgeries.

The keratectomies were performed using the BD K-3000 microkeratome (BD Ophthalmic Systems, Waltham, Massachusetts) with either a 130-micron (thin flap) or 160-micron (conventional flap) head. Head size was selected to ensure a minimum calculated residual stromal bed of 250 microns following laser ablation. In general, the 130-micron head was used for eyes with preoperative central pachymetry of 550 microns or less and/or spherical equivalent of -7.00 diopters or higher. The average flap thickness by subtraction pachymetry for the 130-micron head of the BD K-3000 is 127.8 ± 21.9 microns.¹⁴ The 160-micron head was used for all other eyes. The average flap thickness by subtraction pachymetry for the 160-micron head with the BD K-3000 is 150 ± 20.0 microns.¹⁵

All laser ablations were performed with the Nidek EC-5000 excimer laser (Nidek Technologies, Ltd., Fremont, California) with an optical zone of 6.0 or 6.5 mm depending on scotopic pupil size.

The 130-micron group was compared with the 160-micron group in terms of geometric mean¹⁶ in postoperative day 1 Snellen visual acuity using a 2-tailed

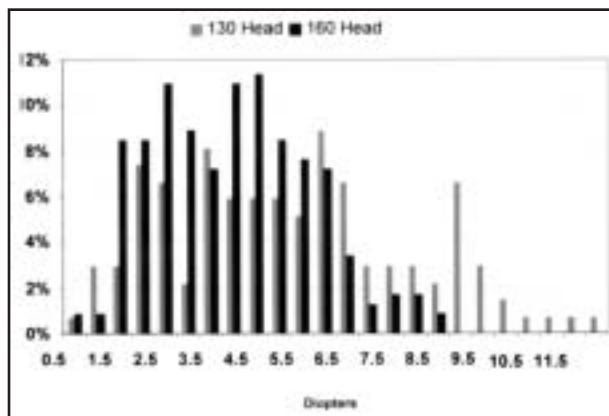


Fig. 2 Comparison of postoperative uncorrected visual acuity between groups

t-test. All intraoperative and postoperative flap complications were documented and compared between groups.

RESULTS

There was no statistically significant difference between the groups with respect to mean age, mean preoperative refractive cylinder, best-corrected vision, or keratometry (Table I). The mean preoperative central corneal pachymetry in the 130-micron group was 526.8 ± 35.4 microns compared to 574.5 ± 27.8 microns in the 160-micron group.

The preoperative spherical equivalent in the 130-micron group of -5.00 ± 2.53 diopters was significantly higher ($P < 0.0001$ by ordinal logistic regression analysis) than the -3.78 ± 1.73 diopters in the 160-micron group (Fig. 1).

Geometric mean UCVA on postoperative day 1 was 6/7.5 (20/25) in the 130-micron group and 7.8 (20/26) in the 160-micron group. T-testing revealed a statistically significant parallel ($P = 0.76$) between groups (Fig. 2).

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 loss of suction was seen in the 160-micron group. No other intraoperative flap complications including thin flaps, epithelial defects, buttonholes, or irregular flaps were seen in either group.

DISCUSSION

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 the infrequency of this dreaded complication. Pallikaris and colleagues⁸ reviewed LASIK outcomes on 2,873 eyes

without evidence of form fruste or frank keratoconus to determine the incidence of keratectasia. Only 19 of these eyes (0.66%) developed ectasia with a mean follow-up of 16 months. Five of the 14 patients who developed ectasia did so bilaterally.

Multiple factors have been implicated in corneal ectasia and/or elevation of the posterior corneal surface after LASIK. Form fruste keratoconus,^{8,17-20} biomechanical factors,^{13,23} increased patient age,⁸ high refractive corrections,^{8,21} high intraocular pressure,⁹ and residual corneal stromal bed following laser ablation^{8,20-23} have all been implicated. Biomechanical factors and high refractive corrections are both risk factors for ectasia and are directly related to residual corneal stromal bed following laser ablation.

Multiple studies have demonstrated frank or form fruste keratoconus can lead to ectasia. In his study to determine the incidence of keratectasia, Pallikaris and colleagues⁸ described 6 eyes with high cylinder and form fruste keratoconus by topographic and pachymetric findings^{24,25} that developed post-LASIK ectasia and were excluded from the study. Seiler and Quurke¹⁷ described a patient with form fruste keratoconus with normal central pachymetry who developed keratectasia after LASIK. Schmitt-Bernard and colleagues¹⁸ reported a patient with form fruste keratoconus who underwent bilateral LASIK and developed significant keratectasia and loss of best-corrected vision.

Controlled ectasia by decreasing corneal biomechanical strength through a deep lamellar keratectomy is the principal behind hyperopic automated lamellar keratoplasty (ALK).²⁶⁻²⁸ Creating a deep keratectomy causes the remaining posterior central cornea to bulge forward causing an increased radius of curvature of the anterior corneal surface and resulting myopia.

While we know that 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, few studies focusing on thin flap LASIK have been reported. Lin³¹ demonstrated the safety and effectiveness of thin flap LASIK 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 with a 130-micron head. In this study, the average flap thickness by subtraction pachymetry was 87.3 +/- 15.4 microns. Seventy percent of the eyes had postoperative uncorrected vision of 6/7.5 (20/25) or better and 95% saw 6/12 (20/40) or better despite the large number of high myopes in the study with poorer than 6/6 (20/20) preoperative best-corrected vision. Nine hundred and twenty-two eyes (82%) achieved within one line of their preoperative best-corrected acuity. Only 7 eyes (0.6%) were noted to have flap striae. No irregular flaps or buttonholes were noted.

Chayet³² reported thin flap LASIK results on 168 eyes using a Nidek MK-2000 microkeratome with 120-micron or a 130-micron head. The mean flap thickness in the 120-micron group was 103.1 +/- 14.5 microns. The mean flap thickness in the 130-micron group was 110.7 +/- 19.3 microns. No flap complications were seen in either group.

The current study is the first to demonstrate 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 postoperative day 1 visual outcomes were slightly better in the 130-micron group despite their having a statistically significant higher level of preoperative myopia than the 160-micron group. This might possibly relate to thinner flaps having less flap edema in the early postoperative period allowing for quicker visual rehabilitation.

Thin flap LASIK minimizes risk of ectasia by minimizing biomechanical weakening of the cornea as well as by increasing the amount of residual corneal stromal bed following laser ablation. Creating thinner flaps without increasing flap complications may benefit two groups of patients.

The first group that might benefit from the thin flap LASIK technique is the one with patients who may not currently be good candidates for traditional 160- or 180-micron flap technology LASIK because of corneas that 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 250 microns of residual stromal bed.

The second group that may benefit from this technique is comprised of patients who are currently candidates for LASIK performed with traditional 160- or 180-micron microkeratome heads. These patients, particularly those with -5.00 or more diopters of myopia, can also benefit from the added safety of the thin flap LASIK procedure's increased amount of residual stromal tissue following laser ablation. We currently recommend thin flap LASIK for any patient with borderline corneal thickness or myopia greater than -5.00 diopters. The Snyderker Curve²⁹ estimates that 3.3% of the US population has myopia of -5.00 diopters or greater. Given the current US population of 285.3 million people,³⁰ up to 9.4 million Americans over -5.00 diopters could potentially benefit from thin flap technology. □

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