

## Original Article

# Laser in Situ Keratomileusis Outcomes among Myopic and Myopic Astigmatism Patients with Thin Cornea

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### Abstract

**Purpose:** To evaluate refractive results after laser in situ keratomileusis among patients with thin corneas.

**Patients and Methods:** Three hundred and two eyes from 168 patients with thin corneas undergoing laser in situ keratomileusis in Basir Eye Clinic, Tehran, Iran, were retrospectively studied. We included patients with best corrected visual acuity of better than 6/12, age of more than 18 years, and corneal thickness of less than 499  $\mu\text{m}$ .

**Results:** The mean age of patients was  $30.7 \pm 8.6$  years and the mean preoperative spherical equivalent was  $-4.61 \pm 2.37$  D. The results after at least one year of follow-up were as follow: 86.6 % of patients with low myopia, 71.8 % of patients with mild myopia, 50.0 % of patients with moderate myopia and 51.8 % of patients with high myopia achieved a  $\pm 0.5$  D spherical equivalent postoperatively. General linear model indicated a significant effect for the remaining stromal bed on final uncorrected visual acuity after adjustment for age, sex, and degree of myopia. No important complication occurred.

**Conclusion:** No important complications occurred after laser in situ keratomileusis among myopic patients with corneal thickness of less than 499  $\mu\text{m}$ , and most of the patients achieved satisfactory refractive results.

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## Introduction

Laser in situ keratomileusis (LASIK) is practiced by an increasing number of refractive surgeons. However, certain complications have been indicated including keratectasia. Devastating irreversible keratectasia is one of the most challenging complications of LASIK and has several risk factors such as keratoconus<sup>1-3</sup>, high myopia<sup>3-5</sup> and the low thickness of remaining stromal bed<sup>1</sup>.

The integrity and tensile strength of cornea is linearly related to ablation depth and the degree of myopia, but the actual risk of ectasia occurrence is a matter of question. In the present study we closely monitored patients with thin cornea and thin remaining stromal bed for complications and refractive results and classified them according to their degree of myopia.

## Patients and Methods

Three hundred and two eyes from 168 patients with thin corneas (less than 499  $\mu\text{m}$ ), undergoing LASIK (NIDEK™ EC - 5000) for correction of myopia (spherical myopia, simple, or compound myopic astigmatism), in Basir Eye Clinic, Tehran, Iran, were retrospectively studied. This study was approved by the local ethics committee. All our patients had completed at least one year of follow-up. The preoperative and postoperative ophthalmologic examinations included measurement of visual acuity, slit-lamp bio microscopy, retinoscopy, pachymetry (NIDEK™ UP-1000), topography (CORNEAL MAP-CSQ), and subjective refraction. The refractive data were expressed in spherical and cylindrical errors.

The inclusion criteria for this study were age of more than 18 years, minimum best corrected visual acuity (BCVA) of better than 6/12 and corneal thickness of less than 499  $\mu\text{m}$ . We excluded patients with pupil diameter of more than 6 mm, keratoconus, corneal haze before

operation, corneal dystrophies, severe pterygium, retinal disorders, diabetes, glaucoma, cataract, previous eye surgery, pregnancy, breastfeeding mothers, patients with collagen vascular disorders and patients who have received immune compromising drugs.

The surgical procedure involved pre surgical anesthesia with topical eye drops of tetracaine hydrochloride 0.01 %. The keratectomies were performed using the Moria microkeratome M2. Intraoperative pachymetry was performed in all cases (Ultrasonic pachymeter, DGH Technology, Inc.) after the flap was lifted and flap thickness was calculated by subtracting the stromal bed thickness from total central corneal thickness. The NIDEK EC-5000 CX2 excimer laser was used in all cases.

For further analysis we classified patients into four groups according to their severity of myopia; low (less than - 5.95 D), mild (- 6.00 to - 6.80 D), moderate (- 7.00 to - 7.75 D) and severe (more than - 8.00 D) myopia groups. Statistical analysis for the present study was performed using SPSS (Version 15, SPSS Co, Chicago, IL) and measurements of continuous variables in different groups were described as mean, standard deviation, and minimum and maximum values. Comparisons between groups variables were performed using one-way analysis of variance and chi square for means. General linear regression model was used to calculate the independent factors and covariates effects on final uncorrected visual acuity (UCVA), and Bonferroni post-hoc test was also performed. P values less than 0.05 were considered statistically significant.

## Results

In 302 eyes, from 168 patients (46 % male) with mean age of  $30.7 \pm 8.6$  years, which were evaluated in the present study, the mean preoperative refractive values were: mean sphere - 4.04 D  $\pm$  2.2 D (range 0.0 to - 12.0 D), mean

cylinder -  $1.25 \pm 1.27$  (range 0.0 to - 6.50 D), and mean spherical equivalent (SE) -  $4.61 \pm 2.37$  D. The mean BCVA was  $0.92 \pm 0.16$  (range 0.1 to 1.0); 83.1 % of eyes had a BCVA  $\geq 0.9$ . The mean pachymetry was  $480.0 \pm 13.2 \mu\text{m}$  (range 437 to 499  $\mu\text{m}$ ). In all eyes, the mean intra operative values were as follow: mean optical zone  $5.5 \pm 0.2$  mm, mean ablation depth  $67.7 \pm 22.5 \mu\text{m}$ , and mean flap thickness of 110  $\mu\text{m}$ . For further analysis, eyes were divided into 4 groups according to the degree of myopia (Table 1).

Summery of the refractive results are shown in figures 1-3.

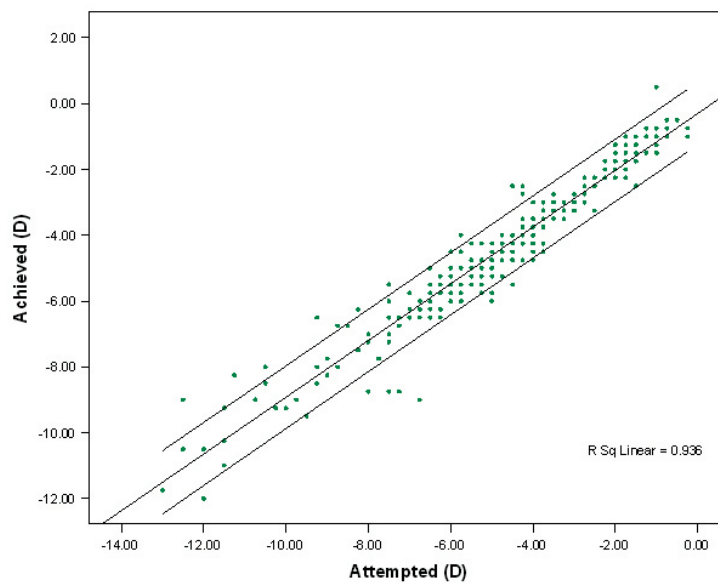
General linear model was used to assess the effect of stromal thickness, degree of myopia, age and sex on final UCVA after at least one year of follow-up, which indicated a significant effect for remaining stromal thickness ( $P < 0.05$ ), degree of myopia ( $P < 0.001$ ) and age ( $P < 0.001$ ). General linear model also indicated a significant effect for the remaining stromal bed on final UCVA after adjustment for age, sex, and degree of myopia.

**Table 1: Patients’ pre and postoperative data in four groups based on the degree of myopia.**

Group	SE Pre Operation	SE Post Operation	Pachymetry	Ablation Depth	Final UCVA (Median)
Less than - 5.95 D	- 3.5 $\pm$ 1.4 D	- 0.091 $\pm$ 0.44 D	479.9 $\pm$ 13.4 $\mu\text{m}$	59.8 $\pm$ 18.9 $\mu\text{m}$	6/6
- 6.00 to - 6.80 D	- 6.2 $\pm$ 0.25 D	- 0.15 $\pm$ 0.75 D	479.7 $\pm$ 12.0 $\mu\text{m}$	86.3 $\pm$ 10.3 $\mu\text{m}$	6/66
- 7.00 to - 7.75 D	- 7.2 $\pm$ 0.21 D	- 0.30 $\pm$ 0.90 D	484.16 $\pm$ 9.42 $\mu\text{m}$	92.6 $\pm$ 13.6 $\mu\text{m}$	6/7.5
More than - 8.00 D	- 9.7 $\pm$ 1.4	- 0.89 $\pm$ 0.93 D	478.6 $\pm$ 15.6 $\mu\text{m}$	95.5 $\pm$ 18.6 $\mu\text{m}$	6/8.5

All patient were followed and their refractive values after one year (range 12 to 14 months) were as follows: mean sphere -  $0.36 \pm 0.03$  D, mean cylinder  $0.52 \pm 0.03$  D, and mean SE -  $0.59 \pm 0.04$  D; 86.6 % of low myopia group, 71.8 % of the mild, 50.0 % of the moderate and 51.8 % of the high myopia group achieved a  $\pm 0.5$  D SE postoperatively.

No complication like corneal ectasia was noted in any of the treated eyes during the 1 year follow-up. This was evaluated clinically by refraction and keratometry and mainly using Orbscan and corneal topography. Overcorrection ( $SE > 0$ ) was observed in 14 patients (4.6 %) after one year.



**Figure 1: Attempted versus achieved refractive results 1 week post operation.**

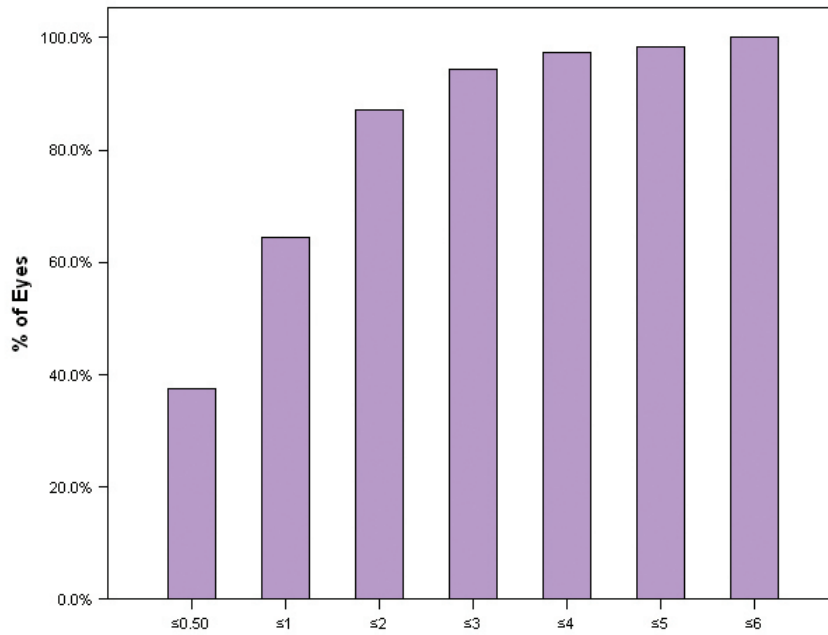


Figure 2: Postoperative defocus equivalent refraction (D) .

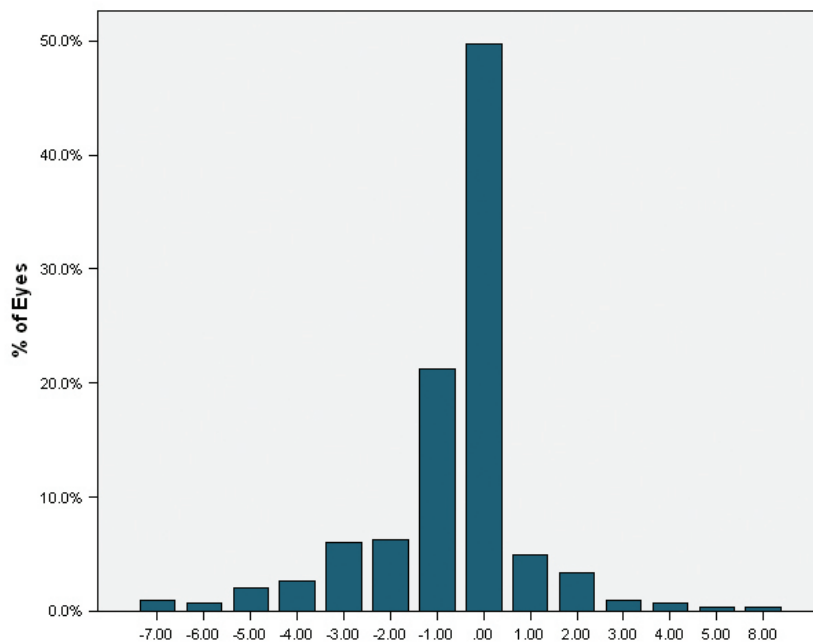


Figure 3: Changes in Snellen lines of visual acuity after one year.

**Discussion**

This study indicated that we can achieve satisfactory refractive results by thinner flaps among patients with thin cornea and therefore we may assume the actual clinical risk of keratectasia is too low to be an obstacle for LASIK treatment among this group of patients. Pallikaris et al. <sup>6</sup> reported an incidence of 0.66 % for ectasia

among 2873 eyes, with no evidence of keratoconus or subclinical keratoconus, undergoing LASIK with a follow-up period of over 4 years. They found no ectasia among patients with residual corneal bed thickness of greater than 325 μm. Although, some surgeons advocate leaving more than 300 μm of residual bed thickness <sup>7</sup>, and to avoid corneas of

thinner than 500  $\mu\text{m}$ <sup>8</sup> our results indicated no keratectasia among patients with thin cornea who previously were considered as high risk patients. In agreement with our findings Djodeyre et al.<sup>9</sup> in their recent study on 282 myopic eyes with a normal preoperative topographic pattern and postoperative thin cornea ( $< 400 \mu\text{m}$ ), who had at least 3 years of follow-up after LASIK, indicated that the procedure was effective, safe, and predictable provided that preoperative topography was normal and the residual stromal bed thickness was  $> 275 \mu\text{m}$ . Also Kymionis et al.<sup>10</sup> studied 124 eyes from 63 patients who had a preoperative central corneal thickness of less than 500  $\mu\text{m}$  and completed at least one year of follow-up. They found that refractive laser surgery using either LASIK or PRK methods, in patients with thin corneas, was a safe and predictable technique for myopic refractive corrections, and no intraoperative complications were found<sup>9</sup>. Kremer et al.<sup>11</sup> evaluated the clinical outcome of wavefront-guided laser in situ keratomileusis for the treatment of moderate to high myopia associated with a thin cornea. They found that the procedure was safe in eyes with moderate to high myopia with relatively thin corneas ( $< 498 \mu\text{m}$ ). Hashemi et al.<sup>12</sup> in their study of seventy-one eyes from 56 patients with myopia from - 1.50 to - 8.75 diopters (D), and corneal thickness of 451 to 499  $\mu\text{m}$  reported that one month after surgery, 45 patients (76.3 %) were very satisfied or satisfied with their operated eyes. In the present study similar to many previous studies we found that thin flap LASIK is a safe and effective procedure with satisfactory and stable results<sup>13,14</sup>. It should be noted that in spite of significant refractive improvements among our patients, we still found that the remaining stromal bed

was a significant factor which influenced the refractive results, especially in patients with higher degree of myopia, even when we adjusted the results for age, sex, and degree of myopia using a linear regression model.

### Conclusion

No important complications occurred after laser in situ keratomileusis among myopic patients with corneal thickness of less than 499  $\mu\text{m}$ , and most of the patients achieved satisfactory refractive results.

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## Footnotes and Financial Disclosures

### Conflict of Interest:

The authors declare no conflict of interest with the subject matter of the present manuscript.