ARTICLE

Effect of postoperative keratometry on quality of vision in the postoperative period after myopic wavefront-guided laser in situ keratomileusis

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PURPOSE: To determine whether postoperative keratometry is a predictor of patient-reported satisfaction and night-vision phenomena after wavefront-guided myopic laser in situ keratomileusis (LASIK).

SETTING: Optical Express, Glasgow, United Kingdom.

DESIGN: Retrospective case series.

METHODS: Myopic eyes treated with wavefront-guided LASIK were analyzed in this study. All patients completed pre-operative and 1-month postoperative questionnaires, in which the satisfaction with visual outcomes and pre-operative and postoperative night-vision symptoms (glare, halos, starburst, ghosting/double-vision) were rated. Multivariate regression analysis was performed to determine factors associated with questionnaire outcomes.

RESULTS: This study evaluated 8672 myopic eyes of 4602 patients. The mean pre-operative manifest spherical equivalent was −3.72 diopters (D) ± 2.00 (SD) (range −0.50 to −11.00 D) and the mean pre-operative keratometry (K) value was 43.64 ± 1.43 D (38.38 to 49.00). At 1 month after surgery, 93.7% and 99.1% of eyes were within 0.50 D and 1.00 D of emmetropia, and 94.6% and 98.3% of eyes achieved monocular and binocular uncorrected-distance visual acuity(UDVA) of 20/20 or better, respectively. There were 48.7% of eyes that had the flat corneal meridian (minimum K) of 40.0 D or less. Although postoperative keratometry was a significant predictor of patient-reported satisfaction and the change in halo reports in the regression analysis, its relative contribution was very low and accounted for less than 0.50% of the variance explained by either model. Postoperative keratometry was not a significant predictor of a change in reports of glare, starburst, and ghosting or double vision.

CONCLUSION: In this large cohort of patients, postoperative keratometry played a minimal and clinically insignificant role in predicting post-LASIK halo visual phenomena and patient-reported satisfaction.

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Laser in situ keratomileusis (LASIK) is a common elective refractive procedure with high satisfaction rates[1]; however, early postoperative quality of vision symptoms, such as glare and halos at night, are not uncommon.[1–12] Several reports have studied risk factors that could predict postoperative satisfaction and night-vision difficulty. Many variables, such as postoperative visual acuity,[3–10] patient age,[2,4,6,9,10] amount of attempted correction,[3,4,6,8–10,12] postoperative residual refractive error,[2–4,6,8,10] ablation depth,[3,6] pupil

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size,[2–4,6,8,10,12] optical zone/treatment zone,[3,4,6] and others have been evaluated as potential predictors of dissatisfaction.

One factor that has been postulated but not been fully explored is the effect of a very flat postoperative cornea on patient satisfaction/quality of vision after myopic LASIK. Some surgeons believe that a flat postoperative cornea can independently lead to visual degradation and increased incidence of night-vision problems. There are few and contradictory studies on this subject.[2–4,13] An important confounding factor is that flatter postoperative keratometry is closely associated with higher attempted myopic spherical equivalent corrections. The correction of high myopia has been shown to result in lower predictability,[14] lower percentage of patients achieving 20/20 visual acuity,[14] increase in higher-order aberrations,[15,16] and lower patient satisfaction, irrespective of keratometry.

The objective of this study was to determine whether postoperative keratometry is an independent predictor of patient satisfaction and quality of vision in the early postoperative time period in patients having wavefront-guided LASIK for myopia.

PATIENTS AND METHODS

This study was deemed exempt from full review by the Committee on Human Research at the University of California–San Francisco because it used only retrospective, de-identified patient data. All patients provided informed consent to have LASIK.

Stepwise multi-regression analysis was performed to find factors most predictive of patient satisfaction and change in reports of halo, glare, starburst, and ghosting/double-vision.

All LASIK records without patient identifiers were extracted from the Optical Express electronic database by use of the following criteria: primary wavefront-guided LASIK performed between July 2013 and December 2014; refractive target emmetropia; pre-operative manifest spherical equivalent (SE) between −0.50 diopters (D) and −12.00 D; completed 1-month postoperative examination with the availability of both pre-operative and postoperative keratometry measurements; and completed pre-operative and postoperative questionnaires. Keratometry was measured by a trained technician with the use of an automated device (auto keratometer/tonometer RK-T 7770; NIDEK Co Ltd.). The average of 3 readings per eye was recorded.

All treatments were performed with the use of the Star S4 IR excimer laser system (Abbott Medical Optics) with a wavefront-guided ablation profile (Advanced CustomVue; Abbott Medical Optics). For all treatments, the optical zone diameter was 6.0 mm with an 8.0 mm transition zone. For patients with astigmatism, the minor axis of the elliptical ablation was 6.0 mm. Corneal flaps were created with the use of a femtosecond laser (Intralase iFS or FS-60, Abbott Medical Optics). Surgeries were performed by 19 surgeons in 33 surgical centers.

Patients were asked to complete a questionnaire pre-operatively and at the 1-month postoperative examination; it was self-administered and used a password-protected and secure computer terminal in an isolated area of the clinic. The questionnaire was derived from the Joint LASIK Study Task Force[1] and assessed patient-reported outcomes and satisfaction. Night-vision phenomena, such as glare, halo, starburst, and ghosting/double vision were rated on a discrete scale from 1 (no difficulty) to 7 (severe difficulty). Patients were asked to rate their night-vision symptoms both before surgery with their distance correction and unaided 1 month after the LASIK procedure. The difference between pre-operative and postoperative scores (change in symptoms) was used for analysis. Table 1 lists the questions from the patient questionnaire.

Statistical Analysis

A series of multivariate regression models were developed in an effort to predict patient-reported postoperative satisfaction and the change in reports of glare, halo, starburst, and ghosting/double vision. Various explanatory variables (demographics, pre-operative and postoperative clinical data, and outcomes of questionnaire) were examined, and a stepwise, generalized linear approach to model creation was used. Relevant covariance between explanatory variables was also tested. Once a best-fit model was selected for each response variable, flat postoperative corneal meridian (Kmin) was added to the model to test for statistical significance and relative model contribution. An unpaired Student t test was used for comparison of independent groups of eyes. Postoperative flat corneal meridian was used for all calculations and tables. One-month flat and steep corneal meridians were strongly correlated ($r = 0.98$), and it was not necessary to perform calculations individually for each variable. Data tabulation and statistical operations were performed with SAS software (version 9.3, SAS Institute, Inc.) and Excel software (version 7.0, Microsoft Corp.).

RESULTS

In this study, 8672 eyes of 4602 patients met inclusion criteria. Demographics and basic outcomes are summarized in Table 2. The mean age of the study population was 33.3 ± 9.5 years. Of all eyes, 93.7% (8124 eyes) were within 0.50 diopters (D) of emmetropia, 94.6% (8207 eyes) achieved monocular uncorrected-distance visual acuity (UDVA) of 20/20 or better, and 98.3% (4524 patients) of patients achieved binocular UDVA of 20/20 or better. Loss of 2 or more lines of corrected-distance visual acuity (CDVA) was observed in 0.5% (43 eyes) of eyes. Figure 1 shows the distribution of pre-operative and postoperative flat corneal meridian (Kmin). After surgery, 48.7% (4225 eyes) of

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Table 1. Pre-operative and postoperative questions used in regression analysis.

Pre-operative Questions

- ○ Think about your vision during the last 4 weeks. Please rate the degree of difficulty you experienced with each of the following symptoms while wearing your glasses or contact lenses.
- ○ (All symptoms rated on discrete scale between 1 (= no difficulty) to 7 (= severe difficulty):
  - Starburst (around lights)
  - Glare
  - Halo (rings around lights)
  - Double-vision and ghost images

Postoperative questions

- ○ Thinking about your vision during the last week, how satisfied are you with your vision (without the use of glasses or contact lenses)?
  - Very satisfied
  - Satisfied
  - Neither satisfied nor dissatisfied
  - Dissatisfied
  - Very dissatisfied
- ○ Think about your vision during the last week. Please rate the degree of difficulty you experienced with each of the following symptoms without wearing your glasses or contact lenses.
- ○ (All symptoms rated on discrete scale between 1 (= no difficulty) to 7 (= severe difficulty):
  - Starburst (around lights)
  - Glare
  - Halo (rings around lights)
  - Double-vision and ghost images
  - Dry eyes

eyes had Kmin 40.0 D or less, and 6.0 % (517 eyes) had Kmin 37.0 D or less.

Satisfaction and Night-Vision Symptoms

Of all patients, 95.6% (4400 patients) were satisfied or very satisfied, 2.6% (120 patients) were neither satisfied nor dissatisfied, and 1.8% (83 patients) were dissatisfied or very dissatisfied with their visual outcomes. The mean scores for postoperative night-vision phenomena were as follows: glare 1.96 $\pm$ 1.28, halo 1.89 $\pm$ 1.29, starburst 1.94 $\pm$ 1.31, ghosting/double vision 1.39 $\pm$ 0.89. The percentage of patients having postoperative score for night-vision symptoms 5 or higher was 4.9% (225 patients) for glare, 5.6% (258 patients) for halo, 5.5% (253 patients) for starburst, and 1.8% (83 patients) for ghosting and double vision.

When difference between pre-operative and 1-month postoperative scores was calculated, 87.2% (4013 patients) of patients had glare within 2 units of their pre-operative score, 10.7% (492 patients) had glare worse by more than 2 units, and 2.1% (97 patients) had improvement in glare by more than 2 units. With the use of the same criteria, the following was the change in the remaining night-vision symptoms: halo, worse 10.7% (492 patients), unchanged 87.6% (4031 patients), improved 1.7% (78 patients); starburst, worse 11.2% (515 patients), unchanged 86.8% (3995 patients), improved 2.0% (92 patients), ghosting/double vision, worse 4.1% (189 patients), unchanged 94.3% (4340 patients), improved 1.6% (74 patients). Figure 2 plots the percentage of patients with postoperative symptoms increased by more than 2 units, stratified by pre-operative manifest SE (Figure 2, *A*) and postoperative flat corneal meridian (Figure 2, *B*).

Postoperative Keratometry and Attempted Correction

Table 3 shows the mean postoperative Kmin compared between eyes with night-vision symptoms worse than that before surgery and those that had unchanged or better visual phenomena scores. Data are further stratified by pre-operative manifest spherical equivalent (SE). Most of the sub-categories do not show statistically significant difference in Kmin between eyes with unchanged/better symptoms and eyes with worse symptoms. There are only a few sub-categories that show statistically significant difference in Kmin, but the difference was clinically small (less than 0.20 D).

Similar analysis is presented in Table 4, in which postoperative Kmin is compared between eyes that

Table 2. Population characteristics (n = 8672 eyes).

	Mean ± SD/Percentage of Eyes	Median	Range
Age	33.3 ± 9.5	31	18 to 67
Male/female ratio	46.9%/53.1%	—	—
Preoperative characteristics			
MSE (D)	−3.72 ± 2.00	−3.38	−0.50 to −11.00
Sphere (D)	−3.30 ± 1.98	−3.00	−0.25 to −10.75
Cylinder (D)	−0.83 ± 0.80	−0.50	0.00 to −6.00
UDVA (logMAR)	0.97 ± 0.38	861.00	0.10 to 1.60
CDVA (logMAR)	−0.07 ± 0.05	−0.08	−0.20 to 0.22
Keratometry (D)			
Flat meridian	43.16 ± 1.44	43.25	37.75 to 48.75
Steep meridian	44.12 ± 1.51	44.00	39.00 to 50.00
Mean keratometry	43.64 ± 1.43	43.63	38.38 to 49.00
Postoperative characteristics			
MSE (D)	+0.04 ± 0.31	0.00	−2.25 to +4.75
Sphere (D)	+0.14 ± 0.31	0.00	−2.25 to +4.75
Cylinder (D)	−0.19 ± 0.24	0.00	−2.75 to 0.00
UDVA (logMAR)	−0.08 ± 0.08	−0.08	−0.18 to 1.00
CDVA (logMAR)	−0.09 ± 0.06	−0.08	−0.30 to 0.40
Keratometry (D)			
Flat meridian	40.10 ± 1.85	40.25	32.25 to 46.75
Steep meridian	40.77 ± 1.88	40.75	33.25 to 47.25
Mean keratometry	40.44 ± 1.85	40.50	32.88 to 47.00
MSE within 0.50 D	93.7%	—	—
MSE within 1.00 D	99.1%	—	—
UDVA 20/20 or better	94.6%	—	—
UDVA 20/40 or better	99.7%	—	—
CDVA loss of 2 lines or more	0.5%	—	—

CDVA = corrected-distance visual acuity; MSE = manifest spherical equivalent; UDVA = uncorrected-distance visual acuity

had 20/20 or better UCVA or CDVA and those that did not achieve 20/20, and also between patients who were satisfied and those who were dissatisfied with visual outcomes. A similar trend is seen, with most of the sub-categories not showing a statistically significant difference in postoperative Kmin.

Regression Analysis

Table 5 summarizes variables that were statistically significant predictors in each model and the proportion of variance explained by each variable.

A decrease in patient satisfaction was associated with older age, higher pre-operative refraction, worse postoperative UDVA, increase in complaints of dry eye, flatter postoperative corneal curvature, and various interactions with other quality of vision (QOV) changes. The role of Kmin was minimal, accounting only for 0.3% of variability explained by this model.

The most important factors affecting the change in night-vision complaints were the interactions with other QOV changes and the level of pre-operative visual phenomena. The regression model only considered the pre-operative to postoperative change in QOV symptoms. When considering only the level of symptoms after surgery, patients who indicated more symptoms before surgery were more likely to have symptoms after surgery. There were other significant predictors in the change in night-vision phenomena, such as patient age, pre-operative refraction, and postoperative UDVA (Table 5), but only a small percentage of variance was explained by these variables. Of all models predicting the change in night-vision complaints, flat corneal meridian (Kmin) was statistically significant in the change in halo complaints; however, Kmin was responsible only for 0.1% variance explained.

Various interactions between QOV changes were responsible for the highest portion of variance explained in each model (Table 5). Typically, change in one type of visual phenomena was associated with a similar change in the other visual disturbances. There

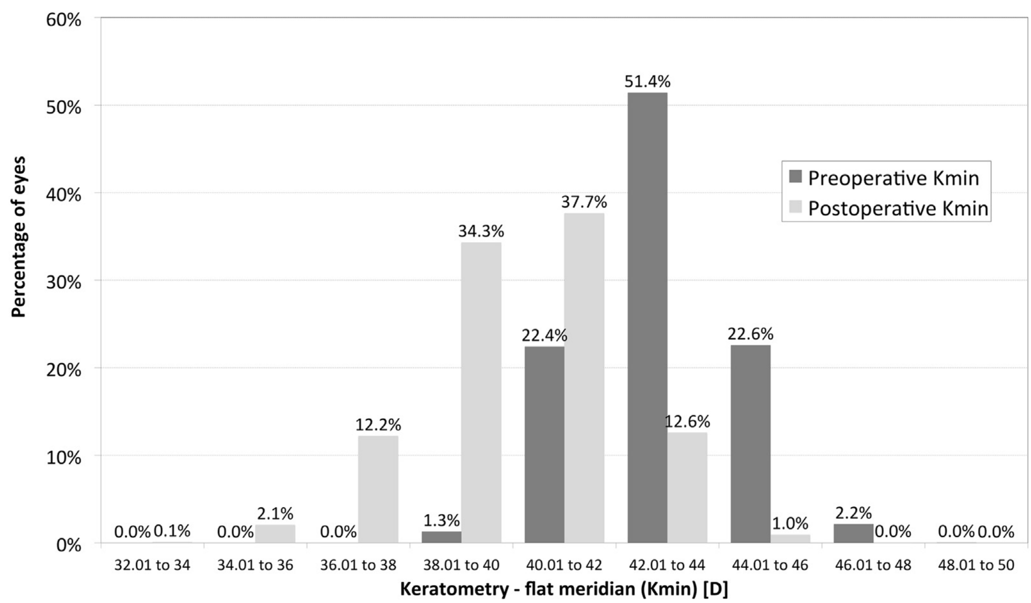

Figure 1. Distribution of pre-operative and postoperative keratometry (Kmin = flat corneal meridian).

was a particularly strong correlation between change in glare, halos, and starburst complaints, with the mean correlation coefficient of 0.72 ($P < .01$). Correlation between change in ghosting/double-vision and all the other visual disturbances was slightly weaker but still statistically significant (mean correlation coefficient 0.45, $P < .01$). Increase in night-vision phenomena was also associated with the decrease in patient-reported satisfaction.

DISCUSSION

To improve patient-based outcomes of refractive surgery, there are ongoing attempts to identify risk factors of dissatisfaction with laser vision correction. In this study, the predictors of postoperative dissatisfaction or night-vision phenomena were those commonly reported in the literature, that is, pre-operative refraction,[4,6,17] achieved UDVA,[5,7,9,10] age,[1,3,4,6] increase in dry eye symptoms,[1] as well as interactions with all the other QOV changes. The change in night-vision phenomena was mostly affected by the pre-operative level of visual symptoms and various interactions with other questionnaire responses. A significant portion of patients had no symptoms pre-operatively, and therefore a slight increase was observed in this group, whereas patients with higher pre-operative visual symptoms reported greater fluctuation of the change in their symptoms.

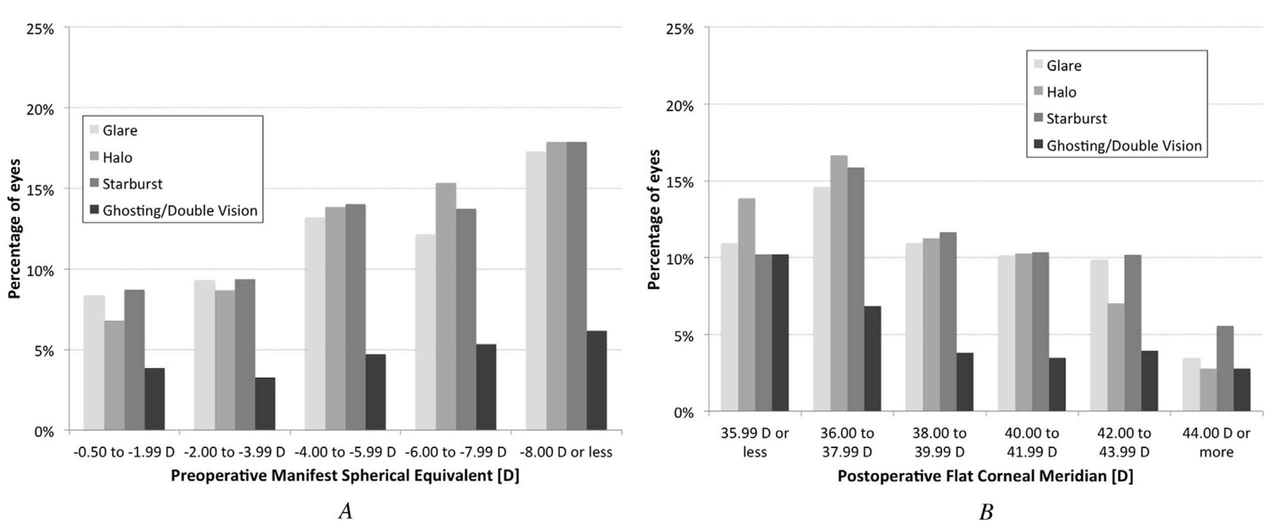

Figure 2. Percentage of patients with postoperative night-vision symptoms increased by more than 2 units, stratified by pre-operative manifest spherical equivalent (*A*) and postoperative flat corneal meridian (*B*).

Table 3. One-month postoperative minimum keratometry (Kmin) and change in night-vision phenomena.

	Glare			Halo		
	Same or Better Than Pre-op	Worse Than Pre-op		Same or Better Than Pre-op	Worse Than Pre-op	
Preoperative Manifest Spherical Equivalent (D)	Postop Kmin ± SD	Postop Kmin ± SD	*P*	Postop Kmin ± SD	Postop Kmin ± SD	*P*
−0.50 to −1.99	41.50 ± 1.40	41.51 ± 1.37	.79	41.47 ± 1.37	41.57 ± 1.41	.15
−2.00 to −3.99	40.65 ± 1.44	40.60 ± 1.45	.25	40.64 ± 1.45	40.61 ± 1.43	.54
−4.00 to −5.99	39.48 ± 1.46	39.29 ± 1.48	.002	39.45 ± 1.44	39.33 ± 1.51	.05
−6.00 to −7.99	38.24 ± 1.37	38.15 ± 1.46	.34	38.26 ± 1.4	38.13 ± 1.42	.14
−8.00 D and less	37.19 ± 1.58	37.46 ± 1.44	.10	37.24 ± 1.66	37.41 ± 1.32	.31

Kmin = flat corneal meridian

The contribution of postoperative keratometry in predicting patient satisfaction and change in halo complaints was minimal, whereas postoperative Kmin was not a significant predictor of the change in glare, starburst, and ghosting/double-vision. The proportion of variance explained by keratometry when predicting patient satisfaction and the change in halo complaints were 0.3% and 0.1%, respectively. Although Kmin entered both models as a statistically significant independent predictor, it is unlikely that such small portion of variance explained by this variable has any clinical relevance. Interestingly, for the sub-category of patients with the highest preoperative manifest SE (−8.00 D or less), in which the most significant flattening of corneal surface is expected, the postoperative Kmin was slightly steeper in patients who had increase in night-vision symptoms, compared with those in whom night-vision symptoms were the same or better than before surgery. Although this difference was not statistically significant, one would expect flatter cornea to be associated with increased night-vision disturbances. However, the difference in Kmin became more obvious when satisfaction scores were evaluated. In the sub-category of eyes with pre-operative manifest SE −8.0 D or less, the patients who were satisfied with their visual acuity had the mean postoperative Kmin 37.25 ± 1.52 D, whereas dissatisfied patients had steeper mean postoperative Kmin (38.04 ± 1.42 D). This difference of 0.79 D was statistically significant (P = .02). A possible explanation is that patients with steeper corneas might have been undercorrected, which affected postoperative visual acuity and satisfaction.

One of the first published studies evaluating the relationship between keratometry and patient satisfaction after myopic LASIK was the retrospective study of Bailey et al.[3] In a logistic regression model, preoperative minimum corneal curvature was found to be a significant predictor for recommendation of the procedure to a friend. In univariate analysis, authors found an association between pre-operative minimum corneal curvature and starbursts and postoperative minimum and maximum corneal curvature and halos. However, when more variables were entered into the logistic regression model, pre-operative and postoperative keratometry were not significant predictors of night-vision phenomena. The variable that was found to be a significant determinant of glare, halo, and starburst was the ablation depth. One of the limitations of the study of Bailey et al.[3] was a low response rate to the questionnaire. Only 604 of 2100 originally approached patients completed the survey, which could have introduced bias.

Saragoussi et al.[13] also found some relationship between flatter keratometry and night-vision symptoms The authors concluded that pre-operative myopia greater than 4.50 D and a postoperative keratometry flatter than 8.44 mm (≈40.00 D for refractive index of 1.3375) were risk factors for having night-vision symptoms after laser vision correction for myopia. A limited sample (111 patients) was analyzed in this study, and it is unclear what statistical methods were used to come to this conclusion.

The study of Pop and Payette[4] also considered corneal curvature as one of the possible predictors of QOV after myopic ablation, but only pre-operative keratometry was evaluated in this study. The authors concluded that pre-operative keratometry was not a statistically significant predictor of night-vision complaints. There were 795 patients included in this study (1488 eyes) and followed for up to 12 months. Attempted spherical correction was among prime risk factors, and it was associated with night-vision complaints at every postoperative visit.

Tahzib et al.[2] also assessed the effect of keratometry. Functional outcomes and patient satisfaction were analyzed in 142 patients after LASIK for myopia. The authors found no correlation between pre-operative or postoperative keratometry and satisfaction or

Table 3. (Cont.)

Starburst			Ghosting/Double Vision		
Same or Better Than Pre-op	Worse Than Pre-op		Same or Better Than Pre-op	Worse Than Pre-op	
Postop Kmin ± SD	Postop Kmin ± SD	*P*	Postop Kmin ± SD	Postop Kmin ± SD	*P*
41.45 ± 1.37	41.60 ± 1.42	.03	41.47 ± 1.38	41.65 ± 1.42	.04
40.65 ± 1.44	40.61 ± 1.45	.46	40.61 ± 1.44	40.73 ± 1.44	.05
39.47 ± 1.44	39.30 ± 1.5	.007	39.41 ± 1.46	39.35 ± 1.53	.42
38.25 ± 1.39	38.15 ± 1.44	.26	38.20 ± 1.43	38.21 ± 1.33	.92
37.20 ± 1.62	37.44 ± 1.39	.14	37.29 ± 1.55	37.38 ± 1.43	.63

night-vision symptoms. The only variables that were correlated to night-vision symptoms and night-driving were postoperative visual acuity, postoperative spherical equivalent, and postoperative cylinder.

One of the hypotheses of why a flatter cornea could be associated with visual degradation is that optical quality of the cornea is reduced as the asphericity becomes more oblate after myopic LASIK.[18,19] The natural shape of the cornea is prolate—steepest centrally and becoming progressively flatter in the periphery. Induction of oblate non-natural cornea is associated with increase in various higher-order aberrations.[18] Therefore, corneas that are flatter prior to myopic LASIK or that become significantly flattened after LASIK might be at higher risk of developing unwanted side effects such as glare, halos, starburst, and subsequent decrease in patient satisfaction.[3,18] It is also important to remember that studies that found association between corneal curvature and satisfaction with myopic LASIK[3,13] were published more than 10 years ago. Substantial improvements were achieved in wavefront-guided and wavefront-optimized laser technology over the past decade, including attempts to preserve prolate corneal shape and minimize induction of higher-order aberrations.

In the current study, we did not aim to find a cut-off point for postoperative keratometry, beyond which patients should not be treated. It has been generally accepted that excessive corneal flattening should be avoided, and the borderline for postoperative keratometry was previously established as 34.00 D.[20,21] There were only 7 patients in our data-set with cornea flatter than 34.0 D. Surprisingly, they all were "very satisfied" or "satisfied" with visual outcomes, and none of them experienced severe difficulty with glare, halo, starburst, and ghosting. It is impossible to draw any conclusion from such a small sample, so we are unable to comment whether the cut-off point of 34.0 D is reasonable. Nevertheless, because of limitations in corneal tissue removal when treating high myopia, there are not many patients who will naturally fall into the subcategory of patients with postoperative cornea flatter than 34.0 D.

Table 4. One-month postoperative minimum keratometry (Kmin) and postoperative visual acuity/satisfaction.

	Postoperative UDVA			Postoperative CDVA			Satisfaction With Vision		
	20/20 Or Better	Worse Than 20/20		20/20 Or Better	Worse Than 20/20		Very Satisfied/ Satisfied	Neither/ Dissatisfied/ Very Dissatisfied	
Preoperative Manifest Spherical Equivalent (D)	Postop Kmin ± SD	Postop Kmin ± SD	*P*	Postop Kmin ± SD	Postop Kmin ± SD	*P*	Postop Kmin ± SD	Postop Kmin ± SD	*P*
−0.50 to −1.99	41.50 ± 1.38	41.55 ± 1.51	.82	41.50 ± 1.39	41.67 ± 1.48	.67	41.51 ± 1.39	41.31 ± 1.31	.26
−2.00 to −3.99	40.63 ± 1.44	40.72 ± 1.54	.49	40.63 ± 1.44	40.42 ± 1.87	.39	40.63 ± 1.44	40.58 ± 1.51	.68
−4.00 to −5.99	39.4 ± 1.46	39.3 ± 1.69	.47	39.40 ± 1.47	39.21 ± 1.47	.48	39.42 ± 1.46	38.97 ± 1.55	.001
−6.00 to −7.99	38.24 ± 1.41	37.94 ± 1.43	.04	38.22 ± 1.40	37.59 ± 1.56	.01	38.21 ± 1.41	38.15 ± 1.46	.79
−8.00 D and less	37.32 ± 1.51	37.27 ± 1.58	.80	37.31 ± 1.51	37.22 ± 1.72	.78	37.25 ± 1.52	38.04 ± 1.42	.02

CDVA = corrected distance visual acuity; Kmin = flat corneal meridian; UDVA = unaided distance visual acuity

Table 5. Statistically significant predictors in multi-regression analysis and proportion of variance explained by each variable.

Model	Postoperative Satisfaction With Visual Acuity	Change in Glare Complaints	Change in Halo Complaints	Change in Starburst Complaints	Change in Ghosting/ Double-Vision Complaints
R^2 (*P* Value)	0.20 (<.01)	0.69 (<.01)	0.66 (<.01)	0.71 (<.01)	0.45 (<.01)
Variables					
Age	10.6%	—	—	0.1%	0.1%
Pre-operative refraction	4.6%	0.9%	1.1%	0.8%	0.2%
Postoperative UDVA	18.1%	0.6%	1.0%	0.8%	1.9%
Dry eye complaints	13.0%	2.3%	0.5%	1.5%	3.6%
Interactions with other QOV changes	53.4%	60.7%	66.9%	66.0%	25.4%
Preoperative score for each phenomena	—	35.5%	30.4%	30.8%	68.8%
Postoperative flat corneal meridian (Kmin)	0.3%	—	0.1%	—	—

QOV = quality of vision; UDVA = uncorrected distance visual acuity

This study had a few limitations. The first one is the short follow-up, and unwanted night-vision symptoms have been shown to improve beyond 1-month follow-up.[22,23] However, the advantage of using early postoperative data is that symptoms are at their peak, potentially making differences in studied variables more pronounced. If postoperative keratometry was not a predictor of patient satisfaction on the 1-month visit, it would be unlikely to be so on subsequent visits in which symptoms tend to improve.

Another limitation of this study was that postoperative keratometry was measured with an automated device, and such measurement can be overestimated after myopic excimer laser ablation.[24–27] The traditional way of estimating postoperative keratometry is 0.80 D of change in corneal curvature for every diopter of myopia treated.[20] On the other hand, some studies suggest that the change in keratometry might not be constant and linear. Specifically, Leng et al.[28] found that with smaller amounts of refractive correction, there is a larger per-unit change in measured keratometry than with larger amounts of correction. Per-unit change in keratometry for every diopter of attempted myopia correction is also higher for custom LASIK compared with conventional. Likewise, Moshirfar et al.[29] found that the change in keratometry for every diopter of myopic refractive correction decreased as the amount of refractive change increased, the change was more variable with lower amounts of correction, and it followed a nonlinear relationship. The use of a more precise way of measuring postoperative keratometry, such as corneal topography, could have been beneficial, but it was not possible in this retrospective study.

In conclusion, in the sample of 8672 eyes, the contribution of postoperative keratometry in determining patient satisfaction or night-vision complaints after wavefront-guided myopic LASIK was minimal. Various other factors as well as interactions with other QOV changes were responsible for increase in patient dissatisfaction or night-vision sensitivity.

WHAT WAS KNOWN

- Higher attempted correction can result in lower predictability and an increase in quality of vision symptoms after myopic LASIK.
- There is a strong covariance between higher attempted correction and flatter postoperative corneal curvature, but it is unclear whether postoperative keratometry independently predicts quality of vision.

WHAT THIS PAPER ADDS

- In a large cohort of patients, a very weak and probably clinically insignificant relationship was found between postoperative keratometry and patient satisfaction and the change in reports of halo after myopic LASIK.
- There was no association between postoperative keratometry and the change in reports of glare, starburst, ghosting, or double-vision.

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