

Influence of preoperative patient's spectacles on near vision disturbance after laser *in situ* keratomileusis

Daisuke YAMAGO¹⁾, Hideki MORI²⁾

¹⁾Department of Ophthalmology, Kanagawa Clinic

²⁾Department of Ophthalmology, Tokyo Medical University

Abstract

Purpose : To evaluate the effect of preoperative refractive correction with patient's spectacles on near vision disturbance after laser *in situ* keratomileusis (LASIK).

Subjects and Methods : A total of 1,236 patients (2,472 eyes) underwent LASIK for myopia or myopic astigmatism. Patients were divided into two groups and compared. One group had a preoperative spectacle-corrected visual acuity of 1.0 or above (1.0 or above group) and another group had patient's spectacle-corrected visual acuity below 1.0 (below 1.0 group). At 1 month after LASIK, near vision disturbance was evaluated based on patient interview. Factors influencing near vision disturbance were analyzed using multiple logistic regression analysis.

Results : At 1 month after LASIK, the incidence of near vision disturbance was significantly higher in the below 1.0 group [80/598 eyes (13.4%)] than in the 1.0 or above group [60/1,874 eyes (3.2%)] (odds ratio, 4.67; 95% confidence interval, 3.29 to 6.61; $p < 0.01$). The odds ratio remained significant after adjusting for age, sex, postoperative spherical equivalent, and history of contact lens use (adjusted odds ratio, 5.04; 95% confidence interval, 3.29 to 8.11; $p < 0.01$).

Conclusion : Preoperative under-corrective patient's spectacles may increase the risk of near vision disturbance at 1 month after LASIK.

Introduction

Appropriate correction of refractive error is very important for the management of ametropia. Inappropriate correction not only fails to achieve adequate visual acuity, but may be a cause of asthenopia and near vision disturbance¹⁾. In addition, full-correction for ametropia does not necessarily mean appropriate correction in all cases. When correcting refractive error, it is often necessary to consider carefully the function of accommodation for individual patients²⁾³⁾.

Correction for refractive error is generally conducted using spectacles and contact lenses. In recent years,

with the popularization of laser *in situ* keratomileusis (LASIK), refractive surgery has also become one of the options⁴⁾. While it is obvious that appropriate correction is also important in LASIK, full-correction is done in the vast majority of cases of correction of myopia or myopic astigmatism by LASIK.

For postoperative evaluation of refractive surgery, the major outcome measure is the uncorrected visual acuity. In particular, much effort has been expended in recent years to minimize the aberration. This trend may lead to the risk that full correction is conducted even in patients for whom full-correction is inappropriate, with a danger of postoperative asthenopia or near vision

Received May 19, 2007, Accepted July 24, 2007

Keywords : Laser *in situ* keratomileusis (LASIK), Near vision disturbance, Risk factor, Complication

Corresponding author : Hideki MORI, Department of Ophthalmology, Tokyo Medical University, 6-7-1 Nishishinjuku, Shinjuku-ku, Tokyo 160-0023, Japan

Tel : 03-3342-6111 Fax : 03-3342-9170 E-mail : morihide@ruby.plala.or.jp

disturbance. However, there have been few studies of asthenopia and near vision disturbance after LASIK⁵⁾.

In the present study, we compared the incidence of near vision disturbance after LASIK in patients with under-correction and those with full-correction using the patients' spectacles before surgery. We also analyzed other risk factors of near vision disturbance after LASIK.

Patients and Methods

Patients

A total of 1,236 patients (2,472 eyes) underwent LASIK for myopia or myopic astigmatism at the Department of Ophthalmology of Kanagawa Clinic between January and December 2003. There were 862 male (1,724 eyes) and 374 female (748 eyes) patients with a mean age at surgery of 32.4 ± 7.8 years and a mean preoperative spherical equivalent of -5.2 ± 2.3 diopters.

Surgical techniques

LASIK was conducted using standard procedures. An excimer laser EC5000 (NIDEK Inc., Nagoya, Japan) or Allegret (Wave light Inc., Erlangen, Germany) was used. A microkeratome MK2000 (NIDEK Inc., Nagoya, Japan) or M2 (Moria Japan, Inc., Tokyo, Japan) was used. Emmetropia was defined in principle as the target refraction. Cases of wave-front-guided LASIK were excluded.

Examinations

Postoperative examinations were conducted 1 day, 1 week and 1 month after surgery. The postoperative assessments included visual acuity testing and subjective refraction testing. Assessment of postoperative near vision disturbance was based on the data obtained from patient interviews.

Statistical analysis

The patients were divided into two groups. One

group had full-corrective patients' spectacles with preoperative corrected visual acuity of 1.0 or above (1.0 or above group) and another group had under-corrective patients' spectacles with a preoperative corrected visual acuity below 1.0 (below 1.0 group). The incidence of near-vision disturbance was compared in the two groups. To evaluate the effect of spectacles' correction on the occurrence of near-vision disturbance at 1 month after surgery, multiple logistic regression analysis was conducted and the odds ratio was calculated after adjusting for confounding risk factors. Apart from spectacles' correction, other risk factors considered were age (over 45 years), postoperative over-correction (postoperative spherical equivalent $+0.5$ D or above), male gender, and no history of contact lens use. Variables were entered into the regression model by the stepwise method. Categorical variables were presented as percents (%) and compared by the χ^2 test. Continuous variables were expressed in means \pm standard deviation (SD) and compared by the student *t*-test.

Results

In the comparison of baseline characteristics, the proportion of males was significantly high in the 1.0 or above group. In addition, the proportion of subjects with no history of hard or soft contact lens use was significantly higher in the below 1.0 group (Table 1).

The incidence of near vision disturbance at 1 week after LASIK was 8.8% (218 of 2,472 eyes) in all patients. The incidence of post-LASIK near vision disturbance was 5.0% (94 of 1,874 eyes) in the 1.0 or above group and 20.7% (12 of 598 eyes) in the below 1.0 group, and was significantly higher in the below 1.0 group (odds ratio : 4.95 ; 95% confidence interval : 3.72-6.59 ; $P < 0.01$).

The incidence of near vision disturbance at 1 month after LASIK was 5.7% (140 of 2,472 eyes) in all patients.

Table 1. Comparison of baseline factors

Background factor		≥ 1.0 group <i>n</i> = 1,874	< 1.0 group <i>n</i> = 598	<i>P</i> Value
Gender : number (%)	Male	1,325 (71.1)	339 (66.7)	0.043
	Female	539 (28.9)	199 (33.3)	
Age : number (%)	≥ 45 years	166 (8.9)	52 (8.7)	0.28
	30-44 years	939 (50.1)	279 (46.7)	
	< 29 years	769 (41.0)	267 (44.6)	
History of SCL use : number (%)	No	224 (12.0)	266 (44.5)	< 0.01
History of HCL use : number (%)	No	10 (5.4)	143 (24.9)	< 0.01
Preoperative SE : Number (%)	> -10.0 D	54 (3.1)	17 (3.1)	0.21
	$-6.01 \sim -10$ D	543 (31.2)	184 (33.9)	
	-3.0 D ~ -6.0 D	858 (49.3)	274 (50.5)	
	< -3 D	284 (16.3)	68 (12.5)	

*SCL : soft contact lens ; HCL : hard contact lens ; SE : spherical equivalent

The incidence of post-LASIK near vision disturbance was 3.2% (60 of 1,874 eyes) in the 1.0 or above group and 13.4% (80 of 598 eyes) in the below 1.0 group, and was significantly higher in the below 1.0 group (odds ratio : 4.67 ; 95% confidence interval : 3.29 to 6.61 ; P<0.01) (Figure 1).

At one month after surgery, there were no significant differences in spherical equivalent and uncorrected visual acuity between the two groups (Table 2).

In multiple logistic regression analysis, under-corrective patients' spectacle remained a significant risk factor after adjusting for age (over 45 years), male gender, postoperative spherical equivalent (+0.5 D or above), and no history of contact lens use (odds ratio : 5.04 ; 95% confidence interval : 3.13 to 8.11). The odds ratios for other risk factors were in the order of 6.45 (95% confidence interval : 3.94 to 10.56) for age 45 years of

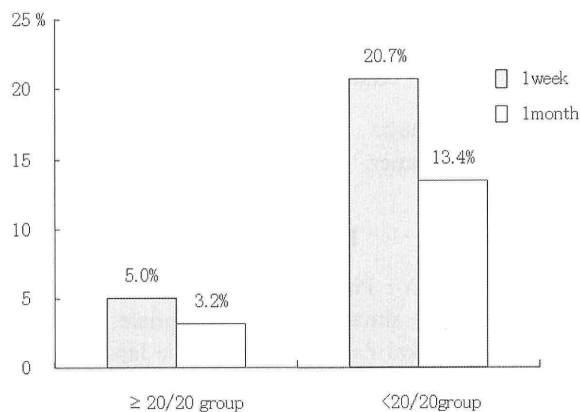


Fig. 1 Comparison of incidence of near vision disturbance

above, 3.65 (95% confidence interval : 1.59 to 8.42) for postoperative over-correction, 2.22 (95% confidence interval : 1.31 to 3.74) for the male gender, and 1.76 (95% confidence interval : 1.09 to 2.84) for no history of contact lens use (Table 3).

Discussion

The results of the present study showed that even at 1 month after LASIK, the incidence of near vision disturbance was significantly higher in the below 1.0 group compared to the 1.0 or above group. The odds ratio remained high even after performing multiple logistic regression analysis adjusting for the known causes of post-LASIK near vision disturbance such as age and postoperative over-correction. These results prove that under-corrective spectacles represent an independent risk factor of post-LASIK near vision disturbance. The adjusted odds ratio of preoperative under-corrective spectacles was high, surpassing that of postoperative spherical equivalent +0.5 D or above (odds ratio : 3.65) and comparable to that of age 45 years or above (odds ratio : 6.44). The reason why under-corrective spectacles represent a risk factor for post-LASIK near vision disturbance is not apparent in the present study. Moreover, there is no report documenting the relationship between the preoperative correction status with spectacles and post-LASIK near vision disturbance.

However, we speculate several possible causes. For myopia in general, the near point of accommodation becomes farther in case of full-correction compared to under-correction, therefore the accommodation power

Table 2. Comparison of refraction and uncorrected visual acuity at 1 month after LASIK

		≥ 1.0 group n=1,874	< 1.0 group n=598	P Value
spherical equivalent : number (%)	>0.5D	272 (19.7)	77 (17.4)	0.23
	0.01~0.5D	545 (39.4)	182 (41.1)	
	-0.5~0D	366 (26.5)	132 (29.8)	
	< -0.5D	199 (14.4)	52 (11.7)	
Uncorrected visual acuity : number (%)	≥ 1.5	979 (64.0)	318 (64.4)	0.92
	1.0~1.2	447 (29.2)	145 (29.4)	
	≤ 0.9	104 (6.8)	31 (6.3)	

Table 3. Adjusted odds ratios of various risk factors

Risk factor	Adjusted odds ratio	95% CI	P Value
Age (>45 years)	6.44	3.94-10.56	<0.01
Correction by spectacle (under-correction)	5.04	3.13-8.11	<0.01
Postoperative SE (>0.5D)	3.65	1.59-8.42	<0.01
Gender (male)	2.22	1.31-3.74	<0.01
History of CL use (No)	1.76	1.09-1.84	0.01

SE : spherical equivalent ; CL : contact lens ; CI : confidence interval

required to focus is greater in case of full-correction when performing near work⁶⁾. For this reason, in case of under-corrective spectacles, the accommodation power required to focus is abruptly increased after full-correction LASIK. This factor is a plausible cause of postoperative near vision disturbance in under-correction subjects. Furthermore, accommodation deficiency is common in healthy young individuals⁷⁾, and we cannot exclude the possibility that the group of under-corrective spectacles may contain subjects with accommodation deficiency including feebleness of accommodation such that full correction cannot be achieved. Although our study proved that preoperative under-corrective spectacles has a high risk of postoperative near vision disturbance, the cause, especially the association with function of accommodation, has to be elucidated. In addition, although 1-month postoperative data were used in the present analysis, the long-term clinical course is required more consideration.

In the present study, no history of contact lens use was identified to be a risk factor of near vision disturbance. Consequently, a combination of under-corrective spectacle and no history of contact lens use would further increase the risk of near vision disturbance. From the results of logistic regression analysis, the risk of a person with under-corrective spectacles and no history of contact lens use can be calculated by multiplying the odds ratios of two independent risk factors (5.03×1.75), reaching a markedly high odds ratio of 8.80. It is well known that, in general, individuals who wear spectacles to correct myopia tend to manifest near vision disturbance when changing to correction by contact lenses⁸⁾. When switching from spectacles to contact lenses, the distance between the lens and the cornea is reduced and the magnitude of accommodation is consequently increased, causing near vision disturbance⁹⁾. This further increases in magnitude as the refractive power increases in the case of myopia. Applying the same mechanism, it is possible to speculate that subjects with no history of contact lens use may develop near vision disturbance easily even in the case of LASIK. Therefore, caution must be exercised for individuals with under-corrective spectacles and no history of contact lens use because they are at high risk of near vision disturbance, particularly when full-correction is obtained by LASIK. Furthermore, ophthalmologists should be aware that the risk of near vision disturbance is further measured in subjects with marked myopia. On the other hand, since a history of contact lens use reduces the risk of near vision disturbance, it may be expected that the risk of near vision disturbance decreases in individuals with under-corrective spectacles if they have a history of contact lens use. However, the odds ratio for near vision disturbance in individuals with under-corrective spectacles

with a history of contact lens use is $5.03 \times 1/1.75 = 2.87$, which is still high, and caution is required.

Furthermore, we identified the male gender as a risk factor of post-LASIK near vision disturbance. It remains unknown why males are more susceptible to near vision disturbance. Gender difference of accommodation function and environmental factors including the duration of visual display terminal work may be involved in the background.

Conclusion

The present study proved that preoperative used under-corrective spectacles is an independent risk factor of post-LASIK near vision disturbance. Other independent risk factors identified were the male gender and no history of contact lens use. It is important to realize that the occurrence of post-LASIK near vision disturbance is associated with many factors other than age and postoperative over-correction.

Acknowledgement

Daisuke Yamago and Hideki Mori contributed equally to this paper.

References

- 1) Miyamoto Y : Prescription of spectacles and contact lenses and situation of inappropriate spectacles. *Nihon Ishikai Zasshi (Journal of the Japan Medical Association)* **92** : 285-290, 1984 (in Japanese)
- 2) Kajita M, Suzuki S, Kato K : Essential knowledge of accommodation and issues of correction by spectacle. *Shikaku no Kagaku (Vision Science)* **23** : 26-31, 2002 (In Japanese)
- 3) Kajita M : Correction of refractive error viewing from reflective accommodation function compatible with aging and living environment. *Shikaku no Kagaku (Vision Science)* **22** : 2-6, 2001 (In Japanese)
- 4) Migneco MK, Pepose JS : Attitudes of successful contact lens wearers toward refractive surgery. *J Refract Surg* **12** : 128-133, 1996
- 5) Wu G, Xie L, Yao Z : Muscular asthenopia and eccentric ablation after photorefractive keratectomy. *J Refract Surg* **17** : 380-382, 2001
- 6) Sagara Y, Kajita M, Kato K : Temporal measurement of accommodation function by notebook computer. *Nippon Ganka Gakkai Zasshi (Japanese Journal of Ophthalmology)* **107** : 380-387, 2003 (In Japanese)
- 7) Chrousos GA, O'Neill JF, Lueth BD, Parks MM : Accommodation deficiency in healthy young individuals. *J Pediatr Ophthalmol Strabismus* **25** : 176-179, 1988
- 8) Iwasaki T, Tawara A : Eyestrain induced by stereogram on 3-D display differences between types of

correction. Nippon Ganka Gakkai Zasshi (Japanese Journal of Ophthalmology) **106**: 404-410, 2002
9) Tokoro T, Muramatsu T, Okuyama F: Accomoda-

tion of myopic eyes when wearing spectacles. Nihon Gankogaku Gakkaishi (Journal of Ophthalmological Optics Society of Japan) **8**: 27-31, 1987 (In Japanese)

laser *in situ* keratomileusis 術後の近見障害における 手術前の常用眼鏡の影響

山 子 大 助¹⁾ 森 秀 樹²⁾

¹⁾神奈川クリニック眼科

²⁾東京医科大学眼科学講座

【要旨】 LASIK 術前の常用眼鏡による矯正状態が、術後の近見障害に与える影響について検討した。

対象および方法: 対象は LASIK を施行した近視または近視性乱視 1,236 例 2,472 眼、男性 862 例女性 372 例、術前の常用眼鏡による視力が 1.0 以上の者 (1.0 以上群) と 1.0 未満の者 (1.0 未満群) に分けて比較検討した。LASIK 術後 1 か月の近見障害の有無を自覚症状に基づき調べ、近見障害に与える影響はロジスティック回帰を用いて分析した。

結果: 術後 1 ヶ月目における近見障害の発生率を 1.0 未満群と 1.0 以上群で比較すると、それぞれ 80 眼/598 眼 (13.4%) と 60 眼/1,874 眼 (3.2%) であり 1.0 未満群で有意に高かった。(オッズ比 4.67: 95% 信頼区間 3.29-6.61; $p < 0.01$)

このオッズ比は、年齢、性別、術後等価球面度数、CL 装用歴の有無で補正しても有意であった。(補正リスク比 5.04: 95% 信頼区間 3.13-8.11; $p < 0.01$)

結論: 術前の常用眼鏡が低矯正であると、術後近見障害が起きるリスクが高いことが示された。

〈キーワード〉 laser *in situ* keratomileusis (LASIK)、近見障害、危険因子
