Near vision contrast sensitivity after photorefractive keratectomy

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ABSTRACT

Background: To evaluate near vision contrast sensitivity as a measure of visual performance after photorefractive keratectomy (PRK).

Setting: LSU Eye Center, New Orleans, Louisiana.

Methods: Using Holladay Contrast Acuity Test cards, near (reading) vision for five levels of contrast sensitivity was evaluated in a cross section of 53 eyes of 31 patients 25 to 732 days after PRK. Twenty-four normal eyes of 22 myopic patients served as controls.

Results: Near contrast sensitivity decreased at all tested contrast levels for approximately 7 months after PRK and then returned to baseline. This phenomenon paralleled the fluctuation in best corrected distance Snellen acuity.

Conclusions: These preliminary results indicate that Snellen visual acuity and near contrast sensitivity returned to baseline within 1 year after PRK. *J Cataract Refract Surg 1997; 23:192–195*

Visual performance after photorefractive keratectomy (PRK) is commonly evaluated in terms of uncorrected visual acuity, best corrected visual acuity, and number of Snellen acuity lines gained or lost. Contrast sensitivity, a more sensitive measure of visual function than standard Snellen acuity, is also important to evaluate because PRK can produce a multifocal corneal surface and light-scattering anterior stromal haze.[1–6]

Previously reported contrast sensitivity testing after PRK used charts or television monitors viewed at distance. However, because near visual function is at least as important as distance vision in most patients, we sought to investigate near contrast sensitivity in post-PRK patients using the recently introduced Holladay Contrast Acuity Test cards.

Subjects and Methods

A random cross section of 53 eyes of 31 patients that had had PRK with the VISX excimer laser to correct low to moderate myopia (1.00 to 6.00 diopters [D]) served as the study group. Patient selection for PRK was done according to the U.S. Food and Drug Administration (FDA) criteria under an Investigational Device Exemption for the Phase III clinical trial for the excimer laser.

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Best corrected distance Snellen acuity (superimposed on the near contrast acuity data in Figure 1) tended to approximately parallel the 100% contrast near acuity data. A statistically significant correlation between best corrected distance Snellen acuity and near acuity at each of the five contrast levels throughout the follow-up was found. The correlation was greatest for the 100% near contrast level ($r = .65$; $P < .001$) and least for the 6.125% level ($r = .55$; $P < .001$). There was also a smaller but statistically significant negative correlation ($r = -.34$ to $-.44$; $P < .05$) between dioptric correction achieved with PRK and near acuity at each of the five contrast levels throughout the follow-up. In the control group, no correlation was found between manifest refraction or best corrected distance Snellen acuity when compared with near contrast acuity.

Discussion

Photorefractive keratectomy has emerged as a promising technique for reducing myopic refractive error, especially in the range of 1.00 to 6.00 D. One concern, as with any refractive procedure, is the quality of vision after surgery. High-contrast, standard Snellen acuity, which relies on the patient's recognition of familiar letters, represents only one part of the visual performance spectrum. In particular, subtle changes in the optical media due to surgery (e.g., anterior stromal "haze" after PRK) may theoretically affect visual function only under conditions of reduced contrast, glare, or both.[1–6]

Contrast sensitivity results after PRK have been variable, ranging from no detectable change[8–11] to an initial decrease and a return to normal with longer follow-up[3,6,12] to a decrease throughout a follow-up as long as 1 year (Table 2).[11,13,14] This variability may result from differences in excimer laser instrumentation, surgical technique (especially optical zone size), or postoperative medications, as well as differing contrast sensitivity tests and methods.

Our results showed that near contrast sensitivity was decreased at all tested contrast levels for approximately 7 months postoperatively. Furthermore, all contrast levels for near testing were affected to an approximately equal degree. This agrees with the distance contrast testing reported by Dutt and coauthors[14] using the CSV-1000 (Vector Vision) but not with the video distance contrast testing reported by Lohmann et al.,[3,6] in which decreases were confined to the low (5%) contrast range. Finally, we found that the decreased near contrast sensitivity correlated well with the (temporarily) decreased best corrected distance Snellen acuity after PRK.

Table 2. Summary of published studies including contrast sensitivity testing after PRK.

Study*	Year	Eyes	Preoperative Myopia (D)	Laser	FDA Study Group	Optical Zone Size (mm)	Contrast Sensitivity Test	Glare Test	Follow-up* (Months)	Results
Eiferman[10]	1991	6	−4.0 to −8.0	Taunton	IIA	5.8	Vistech	Mentor	3, 6	Normal CS and GT
Lohmann[6]	1991	69	−2.0 to −7.0	Summit	NA	4.0	(Video)	ND	Periodic to 18	Initial loss of 5% CS, normal by 14 weeks
Sher[9]	1991	31	−4.0 to −12.0	Taunton	II/IIA	5.2 to 6.0	Pelli-Robson/ Vistech MCT 8000	ND	3	Normal CS
Seiler[16]	1991	26	−1.0 to −9.0	Summit	NA	3.5	ND	Humphrey	12	Impaired GT
Sher[8]	1992	16	−8.0 to −14.0	VISX	IIA	5.5 to 6.0	Vistech MCT 8000	ND	6	Normal CS
Ficker[13]	1993	81	−1.0 to −10.0	Summit	NA	4.5 and 5.0	Pelli-Robson	ND	12	Decreased CS
Lohmann[3]	1993	10	−2.0 to −10.0	Summit	NA	4.0	(Video)	ND	3, 12	Decreased 5% CS at 3 months, normal at 12 months
Piebenga[11]	1993	52 with N_2 purge; 17 without N_2 purge	−1.0 to −6.0	VISX	III	5.0	Vector Vision CSV-1000	Mentor	6, 12	Decreased CS with purge; normal CS without purge; GT normal for all
Dutt[14]	1994	47	−1.5 to −6.0	Summit	III	5.0	Vector Vision CSV-1000	Mentor	6, 12 (12 only for GT)	Decreased CS (with and without pupil dilation); GT normal (medium glare)
Ambrosio[12]	1994	22	−5.0 to −20.0	Meditec	NA	5.0	Static and dynamic	Mentor	1, 3, and 6	Recovered static CS for low and moderate myopia by 6 months; decreased dynamic CS for all at 6 months; GT normal for all
Present	1994	53	−1.0 to −6.0	VISX	III	6.0	Holladay near test	ND	Cross section to 24	Decreased CS up to 7 months

Follow-up = interval between PRK and testing; CS = contrast sensitivity; GT = glare testing; NA = not applicable; ND = not done
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Taken together, these data indicate that near contrast sensitivity after PRK, as measured using the Holladay test cards, seems to approximately parallel the best corrected distance Snellen acuity. As shown by the positive correlation between individual measurements, patients who lost best corrected acuity tended to be the same ones who had near contrast sensitivity loss. This is not surprising given that both are letter optotype acuity measurements. In the absence of a glare source, we would expect the contrast acuity to decrease similarly at each contrast level, provided we are still above threshold, similar to the findings with cataracts. In the presence of glare or at contrasts lower than 6.125%, nearer threshold, we would have seen a greater change.

Although the current study was meant as a limited pilot study, it would have been informative to have simultaneously measured distance contrast by various test methods to corroborate our findings at near. In addition, providing a glare source during contrast sensitivity testing may be the best method for detecting the effect of subtle anterior segment opacities or other imperfections affecting visual performance.[3,15,16] Other limitations of this study include the cross-sectional (rather than longitudinal) design. Also, because the Holladay near contrast sensitivity cards were not available prior to PRK treatment in either eye for most patients, a comparison of preoperative with postoperative measurements was not possible. Finally, an objective method of rating corneal transparency at the time of examination would have proven useful for comparison with acuity and contrast sensitivity results (subjective ratings using a slitlamp are difficult and may be unreliable for evaluating post-PRK haze[5]).

In conclusion, our preliminary results indicate that the long-term Snellen visual acuity and near contrast sensitivity appear to return to baseline after PRK; however, contrast testing sensitivity (for both near and distance) after PRK deserves further evaluation.

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