Retreatment of Hyperopia After Primary Hyperopic LASIK

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ABSTRACT

PURPOSE: To evaluate factors that influence retreatment results after primary hyperopic LASIK.

METHODS: Restrospective study of 86 eyes of 61 patients that underwent LASIK to correct primary hyperopic spherical equivalent refraction and a second hyperopic retreatment due to undercorrection. All procedures were performed with the Technolas Keracor 217C excimer laser, lifting the preexisting flap for the retreatment. Preoperatively, under cycloplegia, mean spherical equivalent refraction of the series was +3.05±0.99 diopters (D).

RESULTS: At last follow-up, mean spherical equivalent refraction was −0.07±0.50 D. Efficacy of the retreatment procedure was better when the primary LASIK attempted spherical equivalent refraction correction was <+3.00 D ($P<.05$). Safety of retreatment was lower when attempted spherical equivalent refraction correction was >+1.00 D ($P<.05$) and when attempted spherical equivalent refraction correction of both procedures combined was >+4.00 D ($P<.05$).

CONCLUSIONS: Efficacy, safety, and predictability of retreatments secondary to undercorrection after primary hyperopic LASIK may be affected depending on the amount of diopters corrected in the primary procedure, in the retreatment procedure, and in both primary and retreatment procedures combined. [*J Refract Surg.* 2007;23:201-205.]

Laser in situ keratomileusis (LASIK) has been shown to be safe and effective for the treatment of myopia, hyperopia, and astigmatism.[1] Nevertheless, retreatment may be necessary to correct postoperative refractive defects, such as under- or overcorrections, regression, or surgically induced astigmatism, which can be associated with patient dissatisfaction. The incidence of LASIK retreatment is variable, ranging from 5.5% to 28%.[2]

Laser in situ keratomileusis retreatment procedures after primary myopic LASIK have been reported in the literature, showing effective and predictable results.[1,3-5] However, there have been limited studies regarding the outcomes of LASIK retreatment procedures after primary hyperopic LASIK. In those studies, the amount of hyperopia was the main factor that negatively influenced final outcome.[6]

Some questions still remain regarding the efficacy of LASIK retreatment procedures after primary hyperopic LASIK: are the outcomes influenced by the amount of hyperopia treated at primary LASIK, or by the amount of hyperopia treated at the retreatment procedure, or by both (ie, total amount)?

PATIENTS AND METHODS

The records of 61 patients (86 eyes) who had primary hyperopic LASIK and LASIK retreatment for hyperopia (due to undercorrection) were retrospectively analyzed. In patients aged >40 years, the cycloplegic refraction was treated with 5% of undercorrection. Inclusion criteria were age ⩾23 years and stable refraction for >2 years. Exclusion criteria were topographic evidence of keratoconus, active ocular disease, pregnancy, and severe medical pathology.

Different surgeons performed the primary LASIK procedures. Topical anesthesia (tetracaine) and the Moria LSK One microkeratome (Moria, Antony, France) were used in all patients. A nasally hinged corneal flap was created using an H-suction ring, and 100- or 130-µm depth plates. The Technolas Keracor 217C excimer laser (Bausch & Lomb, Rochester, NY) with PlanoScan V2.998, V2.9993, and V2.9997 software for hyperopia was used to perform the corneal ablation, and a 6.0-mm optical zone (with a peripheral transition zone of 9 mm) was programmed in all cases. Flap lifting and identical excimer laser equipment were used in all retreatment procedures, which were performed at a mean of 5 months after primary LASIK. Follow-up was ⩾3 months after the retreatment procedure in 67 of 86 eyes (168.71±124.23 days); the remaining 19 eyes were studied after 1-month follow-up.

VISUAL RESULT AND PREDICTABILITY INDICATORS

The following parameters were analyzed.

- Efficacy of primary LASIK: percentage of eyes that showed an equal or better postoperative uncorrected visual acuity (UCVA) after the primary procedure compared to preoperative best spectacle-corrected visual acuity (BSCVA).
- Efficacy of retreatment: percentage of eyes that

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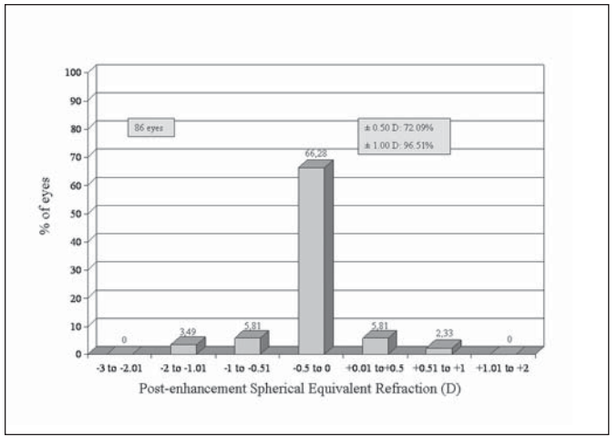

Figure 1. Spherical equivalent refractive outcome following retreatment.

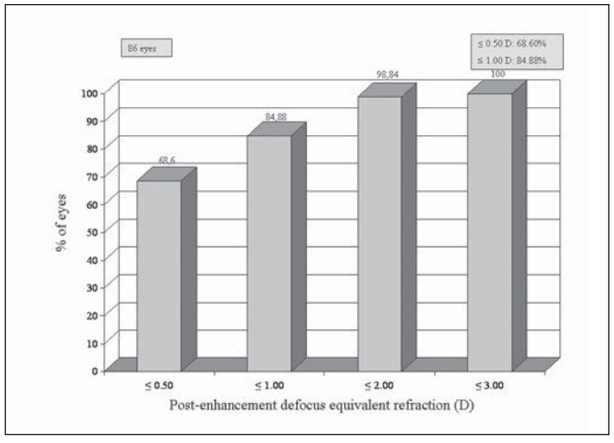

Figure 2. Defocus equivalent following retreatment.

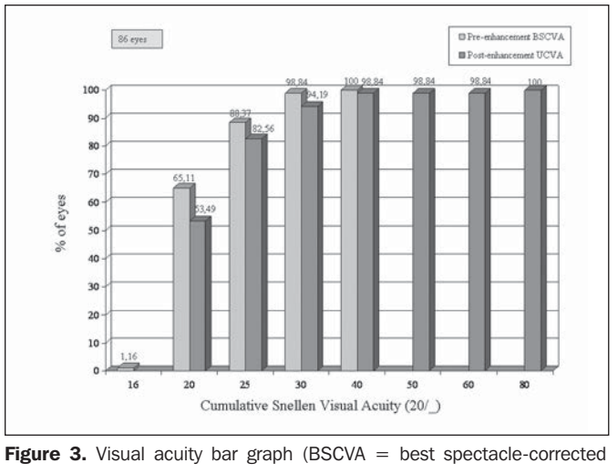

Figure 3. Visual acuity bar graph (BSCVA = best spectacle-corrected visual acuity, UCVA = uncorrected visual acuity).

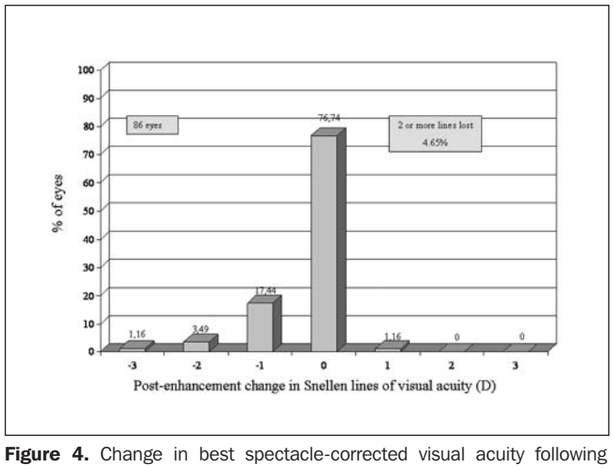

Figure 4. Change in best spectacle-corrected visual acuity following LASIK retreatment.

showed equal or better UCVA after retreatment compared to pre-retreatment BSCVA.

- Total efficacy: percentage of eyes that showed equal or better UCVA compared to preoperative BSCVA.
- Primary hyperopic LASIK safety: percentage of eyes that lost ⩾2 lines (Snellen) of BSCVA after the primary procedure compared to preoperative BSCVA.
- Retreatment safety: percentage of eyes that lost ⩾2 lines (Snellen) of BSCVA after retreatment compared to pre-retreatment BSCVA.
- Total safety: percentage of eyes that lost ⩾2 lines (Snellen) of BSCVA compared to preoperative BSCVA.
- Primary hyperopic LASIK predictability: percentage of eyes within ±1.00 D of the intended correction after the primary procedure.
- Retreatment predictability: percentage of eyes within ±1.00 D of the intended correction after retreatment.

Last spherical equivalent refraction available before retreatment and at last follow-up (after retreatment) were used to calculate these parameters.

Statistical Analysis

Data were entered in a spreadsheet (Excel 97; Microsoft Corp, Redmond, Wash) and imported into statistical software (Epi Info, Centers for Disease Control and Prevention, Atlanta, Ga; and SPSS v6.13 outcomes analysis software, SPSS Inc, Chicago, Ill). Pearson's chi-square test and Fischer's exact test were used to perform the bivariant analyses on qualitative variables. A P value $<.05$ was considered statistically significant.

RESULTS

Sixty-one patients (86 eyes) received primary hyperopic LASIK and hyperopic retreatment (due to undercorrection). The mean age of the 36 women and 25

TABLE 1

Efficacy, Safety, and Predictability of Eyes That Underwent LASIK for Correction of Spherical Equivalent Refraction <3.00 and ⩾3.00 Diopters (D)

Parameter	SE Treated (Mean±SD) (Range) (D)	Efficacy* (%)	Safety† (%)	Predictability‡ (%)
LASIK <3.00 D (n=45)				
Primary LASIK	+2.21±0.49 (+0.88 to +2.88)	37.2	0.0	71.1
Retreatment	+0.99±0.55 (+0.13 to +3.00)	73.8	2.4	95.6
Total	+3.20±0.79 (+1.75 to +5.50)	81.8	2.3	—
LASIK ⩾3.00 D (n=41)				
Primary LASIK	+3.76±0.58 (+3.00 to +4.75)	16.2	2.7	51.2
Retreatment	+1.01±0.44 (+0.38 to +1.88)	54.1	2.7	92.7
Total	+4.77±0.75 (+3.50 to +6.38)	43.9	2.6	—
P value				
Primary LASIK		<.05	<.05	<.05
Retreatment		<.05	.626	.389
Total		<.05	.621	—

**Postoperative UCVA ⩾ preoperative BSCVA.*
†Pre- and postoperative BSCVA >2 lines.
‡±1.00 D.

TABLE 2

Efficacy, Safety, and Predictability of Eyes That Underwent Retreatment for Correction of Spherical Equivalent Refraction <1.00 and ⩾1.00 Diopters (D)

Parameter	SE Treated (Mean±SD) (Range) (D)	Efficacy* (%)	Safety† (%)	Predictability‡ (%)
Retreatment <1.00 D (n=43)				
Primary LASIK	+2.89±1.03 (+0.88 to +4.75)	25.6	2.6	81.4
Retreatment	+0.62±0.19 (+0.13 to +0.88)	64.1	0.0	93.0
Total	+3.51±1.07 (+1.75 to +5.63)	67.4	0.0	—
Retreatment ⩾1.00 D (n=43)				
Primary LASIK	+3.01±0.88 (+1.50 to +4.63)	29.7	0.0	41.9
Retreatment	+1.37±0.42 (+1.00 to +3.00)	65.0	5.0	95.3
Total	+4.38±0.96 (+2.88 to +6.38)	59.5	4.7	—
P value				
Primary LASIK		.632	.246	.048
Retreatment		1.0	.029	.765
Total		.305	.043	—

**Postoperative UCVA ⩾ preoperative BSCVA.*
†Pre- and postoperative BSCVA >2 lines.
‡±1.00 D.

TABLE 3

Efficacy, Safety, and Predictability of Eyes That Underwent LASIK and Retreatment for Correction of Combined Spherical Equivalent Refraction <4.00 and ≥4.00 Diopters (D)

Parameter	SE Treatment (Mean±SD) (Range) (D)	Efficacy* (%)	Safety† (%)	Predictability‡ (%)
Total correction <4.00 D (n=47)				
Primary LASIK	+2.34±0.61 (+0.88 to +3.50)	37.0	0.0	78.7
Retreatment	+0.78±0.33 (+0.13 to +1.50)	68.9	0.0	97.9
Total	+3.12±0.61 (+1.75 to +3.88)	78.7	0.0	—
Total correction ≥4.00 D (n=39)				
Primary LASIK	+3.70±0.71 (+2.13 to +4.75)	14.7	2.9	41.0
Retreatment	+1.25±0.54 (+0.38 to +3.00)	58.8	5.9	89.7
Total	+4.95±0.61 (+4.00 to +6.38)	44.8	5.4	—
P value				
Primary LASIK		<.05	.246	<.05
Retreatment		.184	.02	.037
Total		<.05	.059	—

**Postoperative UCVA ≥ preoperative BSCVA.*
†Pre- and postoperative BSCVA >2 lines.
‡±1.00 D.

men was 41.3±10.54 years (range: 23.9 to 59.41 years) (18 eyes of 12 patients were aged 21 to 30 years, 23 eyes of 15 patients were aged 31 to 40 years, 24 eyes of 20 patients were aged 41 to 50 years, and 21 eyes of 14 patients were aged >50 years).

Preoperatively, mean cycloplegic spherical equivalent refraction (sphere-cylinder/2) was +3.05±0.99 D (range: +0.88 to +5.63 D), mean cycloplegic spherical refraction was +3.84±1.01 D (range: +1.50 to +6.25 D), mean astigmatism was −1.59±1.19 D (range: 0.00 to −5.50 D), and mean keratometry was 42.73±1.28 D (range: 40.00 to 45.00 D). Mean UCVA was 0.36±0.23 (range: 0.05 to 1.00), and mean BSCVA was 0.89±0.14 (range: 0.30 to 1.20).

Mean time between primary LASIK and the retreatment procedure was 166.24±118.58 days (range: 50 to 831 days).

Before retreatment, the mean cycloplegic spherical equivalent refraction was +1.09±0.51 D (range: +0.13 to +3.00 D), mean cycloplegic spherical refraction was +1.59±0.60 D (range: +0.75 to +3.75 D), mean astigmatism was −1.00±0.55 D (range: 0.00 to −2.75 D), and mean keratometry was 44.58±1.57 D (range: 40.87 to 48.25 D). Mean UCVA was 0.73±0.19 (range: 0.20 to 1.00), and mean BSCVA was 0.90±0.13 (range: 0.50 to 1.20).

Efficacy, safety, and predictability are shown in Tables 1-3. Table 1 compares patients with preoperative attempted spherical equivalent refraction correction <3.00 D to patients with preoperative attempted spherical equivalent refraction correction ≥3.00 D. Table 2 compares retreatment of <1.00 D to ≥1.00 D. Table 3 compares combined spherical equivalent refraction correction <4.00 D to spherical equivalent refraction correction ≥4.00 D. As expected, the low hyperopia group (spherical equivalent refraction <3.00 D) obtained better results when compared to the high hyperopia group (spherical equivalent refraction ≥3.00 D) ($P<.05$).

At final follow-up after the retreatment procedure, the mean cycloplegic spherical equivalent refraction was −0.07±0.50 D (range: −1.50 to +1.50 D), mean spherical refraction was +0.11±0.52 D (range: −1.25 to +1.75 D), mean astigmatism was −0.38±0.37 D (range: −1.50 to 0.00 D), and mean keratometry was 44.58±1.57 D (range: 40.87 to 48.25 D). Mean UCVA was 0.85±0.15 (range: 0.25 to 1.00), and mean BSCVA was 0.90±0.13 (range: 0.35 to 1.00) (Figs 1 and 2).

In three eyes (two patients), a significant punctate keratitis was found; one eye lost ≥2 lines of BSCVA. Peripheral interface epithelization was found in three eyes (three patients) (Figs 3 and 4).

DISCUSSION

This is the largest study to report the results of primary hyperopic LASIK and hyperopic LASIK retreatment (due to undercorrection). Other authors have re-

ported hyperopic LASIK retreatment results, but the primary procedure was myopic LASIK.[1,3,4] Hersh et al[2] previously reported 291 LASIK retreatments, but only 1 eye was hyperopic preoperatively. Mulhern et al[5] presented a series of 17 retreatments after hyperopic LASIK. However, the series is not comparable to ours, because it includes 7 retreatments due to decentration and 2 due to interface epithelization, conditions that were not present in our cases. Moreover, the series included retreatments due to overcorrection.

Patients aged ≥40 years who undergo myopic LASIK are at increased risk of requiring retreatment.[2] Hyperopic patients are expected to experience the same, but mainly due to the fact that young patients can easily compensate for hyperopic residual defects because of the accommodation that these patients present.

Recent studies report that, although both techniques are safe and effective, lifting the primary flap may be preferable compared to recutting a new flap in LASIK retreatment procedures.[7-9]

Retreatment procedure predictability and total safety decreased with increasing retreatment spherical equivalent (≥1.00 D compared to <1.00 D). Total efficacy, safety, and predictability decreased with increasing hyperopia (ie, the amount of hyperopia treated at the primary hyperopic LASIK and at the retreatment procedure).

This is a retrospective study, therefore, some of the data could have been different if additional follow-up had been done.

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Management of Superior Pellucid Marginal Degeneration With a Single Intracorneal Ring Segment Using Femtosecond Laser

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ABSTRACT

PURPOSE: A 26-year-old man with superior pellucid marginal corneal degeneration associated with poor visual acuity due to irregular astigmatism was treated with single-segment intracorneal ring insertion.

METHODS: Preoperatively the patient's uncorrected visual acuity (UCVA) was 0.05, best spectacle-corrected visual acuity (BSCVA) was 0.15, and manifest refraction was −4.50 × 85 in the left eye. The flattest meridian (K1) measured was 38.50×90 and the steepest meridian (K2) was 51.10×30.

RESULTS: Three months postoperatively, UCVA was 0.15, BSCVA was 0.4, and manifest refraction was −2.50 × 90.

CONCLUSIONS: The use of single Intacs with femtosecond laser to treat superior pellucid marginal corneal degeneration improved visual acuity. [*J Refract Surg.* 2007;23:205-208.]

Pellucid marginal corneal degeneration is a progressive noninflammatory ectatic disorder involving the inferior cornea in a crescentic fashion. The involved area, which is located 1 to 2 mm from the corneoscleral limbus, is 1 to 2 mm in width, and usually extends from the 4 o'clock to the 8 o'clock meridians.[1] Although pellucid marginal corneal degeneration is classically described as an inferior entity, superior pellucid marginal corneal degeneration has

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