Photorefractive Keratectomy for Primary Myopia Using NIDEK Topography-guided Customized Aspheric Transition Zone

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ABSTRACT

PURPOSE: To report the outcomes of topography-guided photorefractive keratectomy (PRK) for the treatment of myopia with or without astigmatism using the customized aspheric transition zone (CATz) ablation algorithm.

METHODS: In this study, 335 eyes underwent PRK using the NIDEK Advanced Vision Excimer laser platform (NAVEX). Mean preoperative manifest refraction spherical equivalent was −4.42±3.46 diopters (D) (range: −14.50 to −0.50 D). Mean preoperative sphere was −3.94±3.43 D (range: −13.00 to −1.00 D), and mean preoperative cylinder was −0.96±1.05 D (range: −5.50 to 0.00 D). Refractive outcomes out to 1 year postoperatively were analyzed.

RESULTS: At least 6 months postoperatively, all eyes maintained or gained lines of best spectacle-corrected visual acuity (BSCVA). There was a 51% increase in the eyes that read 20/16 or better uncorrected compared with preoperative BSCVA. At 1 year postoperative, 252/280 (90%) eyes had BSCVA 20/20 or better. Refractive outcomes within ±0.50 D were observed in 223/275 (81%) eyes at 3 months, 228/300 (76%) eyes at 6 months, and 187/280 (67%) eyes at 1 year.

CONCLUSIONS: Topography-guided PRK using CATz for the treatment of low, moderate, and high myopia is safe, effective, and predictable. [*J Refract Surg*. 2009;25: S89-S92.]

Recent studies of topography-guided ablation for the treatment of primary myopia have reported successful outcomes equivalent to those achieved with custom ablation algorithms.[1-3] Topography-guided treatments offer some advantages over whole eye custom ablation algorithms including a higher number of data points from corneal topography, wavefront treatment based on a relatively static optical structure of the eye (the cornea) that does not change over time (such as the physiologic lens), and the treatment of corneal irregularities that may be detrimental to vision. Greater attention is being focused on corneal topography-guided treatments because of these advantages and the incorporation of this option into laser platforms.[1-5]

The addition of aspheric algorithms has proven beneficial compared with conventional algorithms.[6] In this study, we present the refractive outcomes of a topography-guided aspheric ablation algorithm called customized aspheric transition zone (CATz) (NIDEK Co Ltd, Gamagori, Japan) for the treatment of primary myopia.

PATIENTS AND METHODS

In this study, refractive outcomes of 335 eyes that underwent photorefractive keratectomy (PRK) using the CATz algorithm of the NIDEK Advanced Excimer laser platform (NAVEX, NIDEK Co Ltd) were analyzed using chart review. The CATz algorithm uses corneal topography elevation data combined with an aspheric transition zone. Our protocol for the treatment of primary myopic cases using CATz has been described previously.[4] One hundred seventy were right eyes (50.7%), and mean preoperative manifest refraction spherical equivalent (MRSE) was −4.42±3.46 diopters (D) (range: −14.50 to −0.50 D). Mean preoperative sphere was

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Dr Vinciguerra and Mr Bains are consultants to NIDEK Co Ltd. The remaining authors have no proprietary or financial interest in the materials presented herein.

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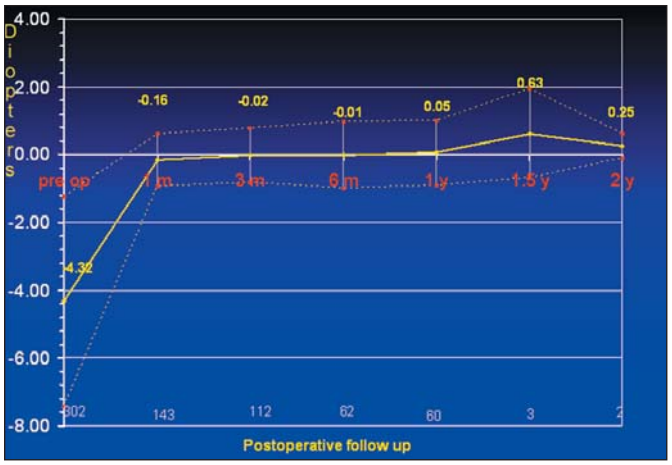

Figure 1. Stability over time for 335 eyes that underwent myopic CATz PRK.

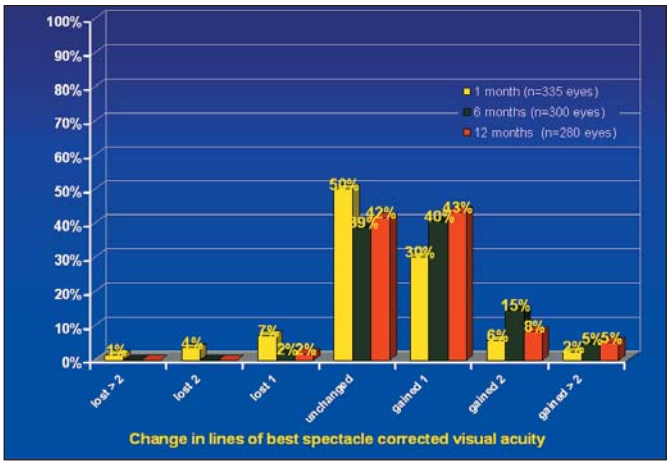

Figure 2. Safety over time for 335 eyes that underwent myopic CATz PRK.

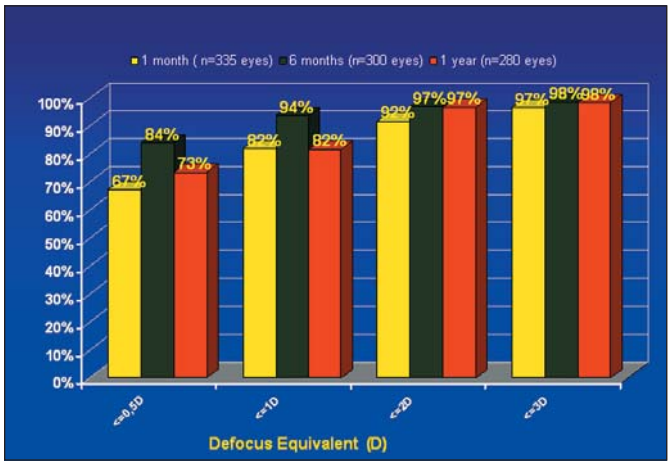

Figure 3. Defocus equivalent over time for 335 eyes that underwent myopic CATz PRK.

−3.94±3.43 D (range: −13.00 to −1.00 D), and mean preoperative cylinder was −0.96±1.05 D (range: −5.50 to 0.00 D).

Preoperative examination included general and ophthalmic medical history, uncorrected visual acuity (UCVA), best spectacle-corrected visual acuity (BSCVA), manifest refraction (pushing plus method), cycloplegic refraction, pupillometry, endothelial microscopy, slit-lamp microscopy, tear film testing using the Schirmer I/II "break-up time" test, Pascal Dynamic Contour tonometry (Ziemer Ophthalmic Systems AG, Port, Switzerland), corneal topography with CSO (CSO, Florence, Italy), pachymetry using the Pentacam (Oculus Inc, Dutenhofen, Germany), and a dilated retinal examination. All patients underwent NIDEK OPD-Scan aberrometry (NIDEK Co Ltd). All patients signed an informed consent and received oral supplements containing amino acids starting 1 week after surgery until re-epithelialization was complete. Exclusion criteria were active systemic or ocular diseases, tear film defects, topographic and aberrometric features suspicious of forme fruste keratoconus, history of corneal or intraocular surgery, women who were pregnant or breastfeeding, and unstable refraction defined as >0.50-D change in MRSE over the previous 12 months.

The surgical technique incorporating intraoperative smoothing using a masking fluid has been published previously.[4] All patients underwent a complete ophthalmologic examination at 1 day, 1 week, and 1, 3, 6, 12, 18, and 24 months postoperatively. At 1-day and 1-week follow-up, UCVA was measured and slit-lamp examination was conducted. From 1 month postoperatively, patients underwent the same examinations as preoperatively with the exception of cycloplegic examination, ultrasound pachymetry, and a dilated retinal examination, unless clinically warranted. Refractive data were managed with Datagraph Med software (Datagraph, Wendelstein, Germany).

RESULTS

Manifest refraction spherical equivalent over time changed from −0.16 D at 1 month to 0.05 at 1 year after PRK (Fig 1). The rate of change over the first 6 months was 0.025 D/month (Fig 1). One month after surgery, 40 (12%) eyes lost one or more lines of BSCVA (Fig 2). All eyes maintained or gained lines of vision 6 months or later after surgery (Fig 2). Defocus equivalent, which proportionally weighs the effect of residual cylinder on the refraction, is plotted in Figure 3. Three months after surgery, there was a 33% increase in the number of eyes that read 20/20 or better without correction compared with preoperative BSCVA (Fig 4; Table). A 51% increase was noted in eyes that read 20/16 or better compared with preoperative BSCVA (see Fig 4). Refrac-

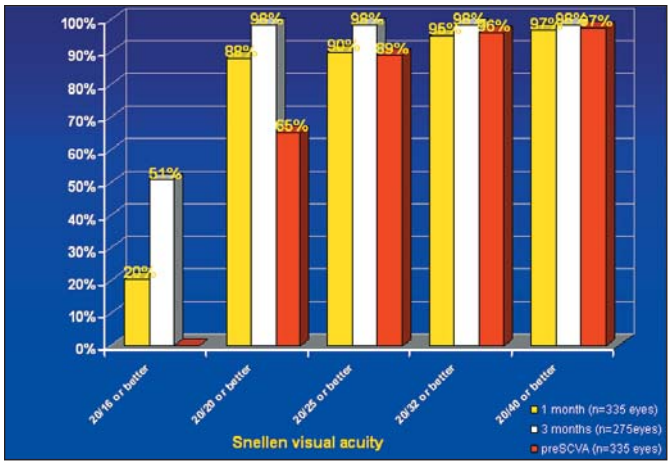

Figure 4. Preoperative best spectacle-corrected visual acuity (preSCVA) compared with postoperative uncorrected visual acuity over time for 335 eyes that underwent myopic CATz PRK.

TABLE

Uncorrected Visual Acuity at 6 Months and 1 Year Postoperatively of Eyes That Underwent Customized Aspheric Transition Zone Photorefractive Keratectomy

	No. Eyes (%)		
	Uncorrected Visual Acuity		
	20/12.5	20/16	20/20
6 months (n=300)	15 (5)	135 (45)	150 (50)
1 year (n=280)		123 (41)	177 (59)

tive outcomes are plotted in Figure 5: 223/275 (81%) eyes at 3 months, 228/300 (76%) eyes at 6 months, and 187/280 (67%) eyes at 1 year were ±0.50 D. Figure 6 plots the attempted versus achieved MRSE.

DISCUSSION

One-year follow-up data indicate that topography-guided treatment for myopia with or without astigmatism was predictable, safe, and efficacious. The rate of mean MRSE was nearly plano at 1 year (see Fig 1). A significant number of eyes gained lines of UCVA compared with preoperative BSCVA (see Fig 4). Loss of BSCVA was minimal, with only 2 (2%) of 300 eyes losing one line of BSCVA at 6 months and no loss of BSCVA 1 year after PRK.

One-year outcomes from this study indicate stability of the procedure with no regression and trace haze (data not shown). Despite the high myopia (up to −14.50 D) treated in this study, we found little incidence of haze even in the higher treatments. Higher myopic treatments have been linked to haze postoperatively. This may be due in part to the more physiologic corneal curvature after CATz treatment[6] and our previously described protocol of smoothing.[4] The trace haze in the large cohort of eyes was a result of the reduced repetition rate of 10 Hz during smoothing, which reduced heat building.[4]

The refractive outcomes in this trial and previous reports show that PRK using CATz is effective for the reduction of myopia with or without astigmatism.[4] For example, the attempted versus achieved MRSE shows a relatively tight grouping of points despite the high myopic treatments (see Fig 6). The outcomes in this study are similar to those reported for PRK using ocular wavefront data. A recent investigation of PRK[7] with

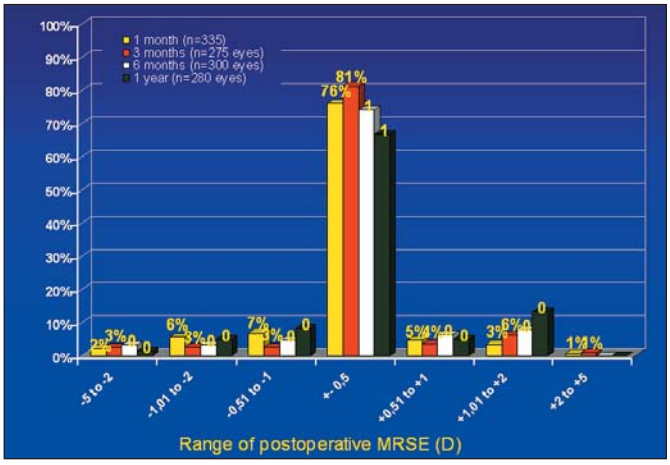

Figure 5. Refractive outcome over time for 335 eyes that underwent myopic CATz PRK.

a smaller sample size of 25 eyes and lower range of preoperative myopia (up to −6.00 D) reported that 94% of eyes had UCVA of 20/20 or better 6 months postoperatively, which is similar to our results of 95% (Table). Another study[8] with a lower preoperative mean MRSE (−3.99 vs −4.42 D in our study) of 44 eyes undergoing wavefront-guided PRK reported that 40% of eyes had UCVA of 20/16 6 months postoperatively, which is slightly lower than our result of 45% (Table). Despite the comparatively larger sample size and the higher range of refractive error treated in our study, PRK using CATz still achieved efficacy that was equivalent to or better than wavefront-guided PRK.

Safety at least 6 months after CATz PRK was similar to that reported for previous studies of wavefront-guided LASIK. For example, 2% of 120 eyes that underwent LASIK for myopia up to −9.50 D using wavefront-guided

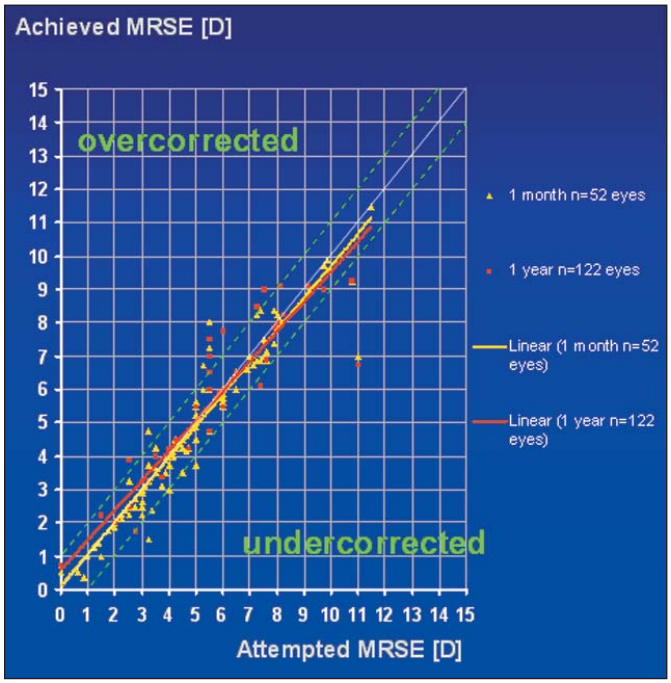

Figure 6. Scatterplot of attempted versus achieved manifest refraction spherical equivalent (MRSE) for eyes that underwent myopic CATz PRK. The resulting refraction is well clustered within 1.00 D of range, with few over- or undercorrected eyes.

LASIK with NAVEX experienced a one-line loss of BSCVA 6 months or later.[9] The loss of one or more lines of BSCVA with wavefront-guided PRK has been reported to be between 0.7% and 2%; however, these studies included a smaller treatment range compared with the present study.[8,10] There was no loss of BSCVA 6 months or later in this study (Fig 2).

One concern with PRK for the treatment of higher ranges of refractive error (>8.00 D) is regression over time. In this study, stability was demonstrated by 6 months, with a mean refractive shift of <0.05 D from 3 to 6 months. Little change was noted in the first 3 months after PRK (see Fig 1). Comparison with results from previous studies of PRK show a 0.50-D difference between 1 and 6 months postoperative.[10] The incorporation of aspheric algorithms and our smoothing technique may play a role in minimizing loss of BSCVA and fast and stable visual recovery reported here because of the maintenance of the physiologic corneal profile postoperatively.[6] The finding of the lack of haze and regression despite the high range of myopia treated is unique with respect to the current literature on PRK. Ideally, a contralateral, randomized eye study could address some of the questions raised herein.

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