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ORIGINAL RESEARCH

Twelve-Month Outcomes of the Wavefront-Optimized Photorefractive Keratectomy for High Myopic Correction Compared with Low-to-Moderate Myopia

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Purpose: To evaluate the 12-months outcomes of photorefractive keratectomy (PRK) in patients with high myopia (≥ 6.0 diopters, D) compared with low-to-moderate myopia (< 6.0 D).

Patients and Methods: Records of 46 patients (69 eyes) who underwent PRK for myopic and astigmatic correction between October 2015 and December 2018 were reviewed. High myopic eyes (29 eyes) were compared with low-to-moderate myopic eyes (40 eyes). All surgeries were adjunct with 0.02% mitomycin C intraoperatively. Measured outcomes included postoperative uncorrected distance visual acuity (UDVA), corrected distance visual acuity (CDVA), manifest refraction spherical equivalent, corneal haze rate, and any complications.

Results: At 12 months post-PRK, 26 eyes (89.7%) in the high myopia and 39 eyes (97.5%) in the low-to-moderate myopia group had UDVA ≥ 20/20, (p=0.30). Average postoperative logMAR UDVA at 12 months was −0.04 (20/18) and −0.11 (20/15) for the high myopia and low-to-moderate myopia groups, respectively. No eyes in either group had residual refractive errors >1 D. No eyes in both groups developed significant corneal haze at month 12. No eyes had a loss of greater than two Snellen lines of CDVA at 12 months post-surgery. The efficacy and safety indices at 12 months post-surgery were not significantly different between groups (1.06±0.26 vs.1.14±0.27, p =0.25 and 1.14±0.27 vs 1.17±0.26, p=0.60 for low-to-moderate myopia vs high myopia groups, respectively).

Conclusion: PRK with high myopic correction provides excellent refractive outcomes and is safe, compared to those of low-to-moderate myopic correction.

Keywords: corneal haze, high myopia, PRK, refractive surgery, wavefront-optimized

Introduction

Laser vision correction for refractive errors includes two main procedures: laser in-situ keratomileusis (LASIK) and surface treatment. Photorefractive keratectomy (PRK) was the first surface treatment introduced since the late 1980s.[1,2] In this photoablation procedure, the ultraviolet beam generated by a 193 nm argon fluoride excimer laser is irradiated to the corneal stroma, after epithelial removal, to reshape the anterior corneal stroma to correct the ametropia. PRK has been proven to be effective, predictable, and safe for the treatment of low-to-moderate myopia, astigmatism, and hyperopia.[3,4] Compared to LASIK, disadvantages of PRK include pain and discomfort during the early postoperative period, relatively slow visual recovery, increased potential for corneal haze development, longer postoperative

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medication regimen, and myopic regression, especially in patients with high refractive error correction due to the deep stromal ablation.[5] Nevertheless, the advantages of PRK over LASIK include more residual stromal bed (RSB) than LASIK resulting in a lower risk of postoperative ectasia and more residual corneal tissue for retreatment. Additionally, PRK has no risk of flap complications that may occur in LASIK such as irregular surface, flap displacement, diffused lamellar keratitis, epithelial ingrowth, and risk of higher-order aberrations.[6,7]

Excimer laser technology has evolved continuously with the current generation offering faster ablation rates, improved laser delivery algorithms and profiles, and accurate eye-tracking systems; thus, PRK techniques have been improved substantially. The regimens that moderate corneal wound healing, including intraoperative application of mitomycin C (MMC) and postoperative topical steroids, result in a substantially decreased rate of corneal haziness and enhancement surgery. In addition, a bandage soft contact lens can reduce postoperative pain and promote faster epithelialization. PRK has been considered as an alternative treatment option in patients that are not good candidates for LASIK, such as eyes with relatively thin cornea, large pupil size, corneal scar, and those with corneal epithelial pathologies.[8,9] Several studies have demonstrated good outcomes of PRK in the correction of high myopic eyes (more than 6 D).[10–13] The purpose of this study was to investigate the results of PRK in high myopic correction (≥ 6D) compared with low-to-moderate myopic correction (< 6D).

Materials and Methods

This retrospective, comparative study was approved by the Research and Ethics Committee, Faculty of Medicine, Chiang Mai University (study code OPT-2562-06612) and followed the Declaration of Helsinki. The need for written inform consent was waived due to the retrospective design and de-identified nature of data collected with low risk of confidentiality breach.

The medical records of consecutive patients who underwent PRK for myopic and astigmatic correction between October 2015 and December 2018 were reviewed. The recruited patients were stratified into a high myopia group, with a preoperative manifest refraction spherical equivalent (MRSE) of −6.0 diopters (D) or more, and a low-to-moderate myopia group, with a preoperative MRSE of less than −6.0 D. The inclusion criteria were age 18 years or more, refractive stability for at least 1 year before surgery, and aimed for full correction of the refractive errors. The patients who had any ocular pathology, previous ocular surgery, ocular infection or inflammation within 3 months, relevant systemic dermatologic or connective tissue diseases, or pregnancy were excluded.

Preoperative Evaluation Protocol

All patients underwent complete ophthalmic examinations, including the assessment of preoperative uncorrected and corrected distance visual acuity (UDVA and CDVA [Snellen]), manifest and cycloplegic refraction, corneal topography (WaveLight® Topolyzer® Vario diagnostic device; Alcon Laboratories), corneal tomography (WaveLight® Oculyzer; Alcon Laboratories), wavefront analyzer (WaveLight® Allegretto Analyzer; Alcon Laboratories), pupillometry, slit-lamp biomicroscopy, intraocular pressure (IOP) measurement, and fundus examinations. Soft or rigid contact lenses were removed at least one or two weeks before the preoperative evaluation.

Surgical Planning and Technique

The Alcon's nomogram for myopic correction with the Wavefront Optimized (WFO) profile was used for treatment planning. All PRK surgeries were performed by five ophthalmic surgeons in our refractive center with a standardized surgical protocol and technique. The PRK procedures were performed under topical anesthesia by instillation of topical 0.5% tetracaine hydrochloride. After marking with an 8/9-mm corneal marker, the corneal epithelial layer was removed mechanically by using a hockey blade; then the excimer Laser (Alcon Wavelight® EX500, Alcon Laboratories) was used to precisely reshape the corneal surface. Immediately after excimer laser ablation, a sponge soaked with 0.02% MMC was applied on the stromal bed with varying times for MMC application based on the ablation depth. Next, the stromal bed was irrigated with 30 mL of chilled balanced salt solution. At the end of surgery, one drop of combined moxifloxacin 0.5% and dexamethasone 0.1% was instilled, followed with the application of a soft bandage contact lens.

Postoperative Regimens and Follow-Up Protocol

Postoperative medications of all patients included a topical solution of combined 0.5% moxifloxacin and 0.1% dexamethasone four times/day for 1–2 weeks and 0.1% nepafenac ophthalmic suspension four times/day for 3 days.

Subsequently, topical 0.1% fluorometholone four times a day was prescribed after the topical combined antibiotic-steroid regimen was completed, and then was tapered off over 3 months. Patients were instructed to use frequent non-preserved lubricants and analgesic drugs as needed. The bandage contact lens was removed upon complete epithelialization, usually at one week postoperative.

All patients were followed up at day 1 and 7, and month 1, 3 and 12 postoperatively. At every follow-up visit, all patients were asked to rate the severity of their dry eye symptoms and night vision problems on a 5-point Likert scale from 0 (none) to 5 (severe) and were assessed for the UDVA, and CDVA, and underwent slit-lamp examination. Postoperative MRSE (D), corneal topography, and IOP measurements were evaluated at 1, 3, and 12 months, respectively; dilated fundoscopy was performed at 3 and 12 months. Postoperative complications were assessed including corneal haze, ocular surface problems, and increased IOP ≥ 10 mmHg from baseline or ≥ 21 mmHg. Post-operative corneal haziness was graded based on Fantes's scales: grade 0, completely clear cornea; grade 0.5, trace haze, seen with careful oblique illumination with slit-lamp biomicroscopy; grade 1, more prominent haze, not interfering with visibility of fine iris details; grade 2, mild obscuration of iris details; grade 3, moderated obscuration of iris and lens; grade 4, completely opaque stroma in the area of ablation.[14] The primary outcome was postoperative UDVA, and secondary outcomes were postoperative CDVA, MRSE, corneal haze, and other complications.

Statistical Analysis

Data were recorded in Microsoft Excel and analyzed by using SPSS for Windows (version 22.0, SPSS, Chicago). Postoperative data at the 3-month and 12-month follow-up visits were collected for analysis. In the analysis of VA, Snellen VA was converted to the logarithm of the minimum angle of resolution (LogMAR). Descriptive statistics analysis such as mean and standard deviation or median and range were used for continuous data while percentage and proportion were used for categorical data. The efficacy index was calculated as the ratio of mean postoperative UDVA to mean preoperative CDVA. The safety index was calculated as the ratio of mean postoperative CDVA to mean preoperative CDVA. The postoperative results between the low-to-moderate myopia group were compared to the high myopic group by using *t*-test for data with normal distribution or Mann–Whitney *U*-test with non-normal distribution data. The p-value of < 0.05 was considered as statistically significant.

Results

A total of 154 eyes post-PRK were reviewed; 85 eyes were excluded due to incomplete data (61) and loss of follow-up (22) for the low-to-moderate myopia group, and loss of follow-up (2) for the high myopia group. Sixty-nine myopic eyes (45 cases) were included in the study and divided into two groups; 29 eyes in ≥ 6.0 D group and 40 eyes in < 6.0 D group. Of these, 33 (71%) were females, and the average age was 29.91 ±7.56 (range 18–54). The optical zones of 6 to 7 mm were used. The preoperative baseline characteristics and overall treatment plans and plans for each group are demonstrated in Table 1.

Efficacy

The postoperative cumulative UDVA ≥ 20/20 at 3 months of the low-to-moderate myopic and high myopic groups were 92.5% and 79.3%, respectively (p=0.15). At 12 months, thirty-nine eyes (97.5%) in the low-to-moderate myopia group and twenty-six eyes (89.7%) in the high myopic group had UDVA ≥20/20 (p=0.30). (Table 2) The mean logMAR UDVA at 12 months was −0.11 (20/15) for the low-to-moderate myopia group compared with −0.04 (20/18) for the high myopia group. Figure 1 demonstrates the cumulative postoperative UDVA in each group at 12 months follow-up. The efficacy index at 12-month post-surgery was not significantly different between the groups (1.14±0.27 vs.1.06±0.26, p =0.25 for low-to-moderate myopia and high myopia group) (Table 2).

Predictability

Postoperative MRSE within 0.5 D of emmetropia at 3 months was achieved in 38 eyes (95.0%) of the low-to-moderate myopic group and 27 eyes (93.1%) of the high myopic group. At 12 months, thirty-nine eyes (97.5%) and twenty-eight eyes (96.6%) in the low-to-moderate myopia and high myopia groups were within 0.5 D of emmetropia. (Table 2) All eyes had MRSE within 1.0 D at 12 months postoperative. (Figure 2) Figure 3 demonstrated the correlation between attempted and achieved MRSE at 12-month follow-up visit for overall treated eyes.

Stability

At 12-month postoperative, mean sphere in low-to-moderate and high myopia groups were 0.00 ±0.14 and 0.03 ±0.25 D (p=0.45), and mean cylinder were 0.00 ±0.00 and −0.09 ±0.25 D (p=0.05), respectively. (Table 2) There was no significant difference of the mean MRSE

Table 1 Patients' Demography and Preoperative Baseline Characteristics by Treatment Groups

Variables	Overall (N=69 Eyes)	Low-Mod Myopia (N=40 Eyes)	High Myopia (N=29 Eyes)	p
Age: mean ± SD, years	29.9 ±7.6	29.0 ±7.7	31.2 ±7.4	0.24[a]
Sex: cases (%) Female	33 (73%)	16 (67%)	17 (81%)	0.28[b]
Mean CDVA (logMAR): mean ± SD (range)	−0.05 ±0.05 (−0.10 to 0.10)	−0.06 ±0.04 (−0.10 to 0.00)	−0.03 ±0.06 (−0.10 to 0.10)	0.01[a]
Mean MRSE: mean ± SD (range), D	−5.15 ±1.72 (−1.25 to −8.00)	−3.95 ±1.17 (−1.25 to −5.75)	−6.81 ±0.56 (−6.00 to −8.00)	< 0.001[a]
Mean sphere: mean ± SD (range), D	−4.80 ±1.60 (−1.00 to −7.25)	−3.68 ±1.11 (−1.00 to −5.75)	−6.33 ±0.53 (−5.00 to −7.25)	< 0.001[a]
Mean cylinder: mean ± SD (range), D	−0.72 ±0.72 (0.00 to −3.00)	−0.53 ±0.51 (0.00 to −2.25)	−0.96 ±0.87 (0.00 to −3.00)	0.02[a]
Average K: mean ± SD, D	44.50 ±1.80	44.55 ±1.91	44.54 ±1.58	0.99[a]
CCT: mean ± SD, um	516.55 ±33.08	511.92 ±34.55	505.76 ±100.85	0.72[a]
Ablation depth: mean ± SD (range), um	77.85 ±23.78 (24–125)	63.07 ±18.91 (24–95)	98.24 ±11.50 (75–125)	<0.001[a]
Plan RSB: mean ± SD (range), um	382.48 ±36.79 (305–462)	393.80 ±34.68 (329–462)	366.86 ±34.29 (305–449)	0.002[a]
Duration of MMC: mean ± SD (range), sec	14.42 ±6.02 (8–22)	13.75 ±5.19 (8–18)	15.34 ±7.01 (8–22)	0.31[a]

Notes: [a]The *t*-test was used for statistically comparison. [b]The Fisher's Exact test was used for statistically comparison.
Abbreviations: CCT, central corneal thickness; CDVA, corrected distance visual acuity; Low-mod, low-to-moderate; K, keratometry value; MMC, mitomycin C; MRSE, manifest refraction spherical equivalent; RSB, residual stromal bed.

and cylinder between both groups during the twelve-month follow up period. (Figure 4A and B) No eyes required retreatment surgery.

Safety

The change in Snellen lines of preoperative CDVA and postoperative UDVA at 12 months is demonstrated in Figure 5. At 12 months postoperative, 16 eyes (55.2%) in the high myopic group and 15 eyes (37.5%) in low-to-moderate myopic group gained 1 Snellen line. Ten eyes (34.5%) in the high myopic group and 23 eyes (57.5%) in the low-to-moderate myopic group had no change of Snellen line from the baseline CDVA. There were 2 eyes (6.9%) and 1 eye (3.4%) in the high myopia group which lost 1 and 2 Snellen lines at 12 months, respectively. At 12 months post-PRK, none lost more than 2 lines of Snellen CDVA. The safety index in both groups was not significantly different (1.17±0.26 vs 1.13±0.21, p=0.60 for low-to-moderate and high myopia groups) (Table 2).

Postoperative Complications

During the follow-up period, there was no significantly increased IOP in any group. A mild degree corneal haze was found in 19 eyes in the low-to-moderate group and 11 eyes in the high myopic group at 1 month post-PRK; this eventually resolved with time. At 12 months post-surgery, only one eye in the low-to-moderate myopic group and two eyes in the high myopic group had a persistent grade 1 corneal haze with UDVA ≥ 20/20 in all eyes. None developed late-onset corneal haze. (Table 3) Dry eye symptoms and night vision problems were reported in both groups at 1 month after surgery, but symptoms' score gradually decreased over time. More eyes in the high myopia group had significant night vision problems compared with the low-to-moderate myopic group at month 3 and 12 (Table 3).

Discussion

This study demonstrated that twelve-month outcomes of high myopic correction by PRK were effective and safe compared with those of low-to-moderate myopia. The efficacy index and safety index of PRK were excellent for both groups. Although the 12-month, postoperative UDVA ≥ 20/20 was higher in the low-to moderate myopia than in the high myopia group, there was no significant difference. All eyes achieved UDVA ≥ 20/40 at 12-month postoperative. In term of stability, the mean MRSE at 12 months neared emmetropia in both treatment groups, and was almost identical to findings at one month

Table 2 Postoperative Refractive Outcomes Compared Between Low-to-Moderate and High Myopic Groups

Postoperative Data	Month 3			Month 12		
	Low-Mod	High	*p*	Low-Mod	High	*p*
Efficacy: UDVA (eyes, %)						
≥ 20/10	4 (10.0)	2 (6.9)	1.00[a]	6 (15.0)	2 (6.9)	0.45[a]
≥ 20/16	35 (87.5)	14 (48.3)	<0.001[a]	35 (87.5)	16 (55.2)	0.01[a]
≥ 20/20	37 (92.5)	23 (79.3)	0.15[a]	39 (97.5)	26 (89.7)	0.30[a]
≥ 20/25	40 (100.0)	28 (96.6)	0.42[a]	39 (97.5)	26 (89.7)	0.30[a]
≥ 20/32	40 (100.0)	28 (96.6)	0.42[a]	40 (100.0)	28 (96.6)	0.42[a]
≥ 20/40	40 (100.0)	29 (100.0)	0.42[a]	40 (100.0)	29 (100.0)	0.42[a]
Efficacy index	1.11 ±0.29	1.03 ±0.23	0.24[b]	1.14 ±0.27	1.06 ±0.26	0.25[b]
Predictability: MRSE (eyes, %)						
± 0.25 D	38 (95.0)	25 (86.2)	0.23[a]	38 (95.0)	24 (82.7)	0.12[a]
± 0.50 D	38 (95.0)	27 (93.1)	1.00[a]	39 (97.5)	28 (96.6)	1.00[a]
± 0.75 D	38 (95.0)	29 (100.0)	0.51[a]	40 (100.0)	28 (96.6)	0.42[a]
± 1.00 D	40 (100.0)	29 (100.0)	0.51[a]	40 (100.0)	29 (100.0)	0.42[a]
Stability (mean ± SD)						
MRSE (D)	−0.05 ±0.23	0.01 ±0.24	0.19[b]	0.00 ±0.14	−0.01 ±0.27	0.89[b]
Sphere (D)	−0.02 ±0.21	0.05 ±0.23	0.10[b]	0.00 ±0.14	0.03 ±0.25	0.45[b]
Cylinder (D)	−0.05 ±0.15	−0.07 ±0.24	0.62[b]	0.00 ±0.00	−0.09 ±0.25	0.05[b]
Safety (eyes, %)						
Lost 2 lines	1 (2.5)	0 (0)	1.00[a]	0 (0)	1 (3.4)	0.42[a]
Lost 1 line	0 (0)	3 (10.3)	0.07[a]	1 (2.5)	2 (6.9)	0.57[a]
Unchanged	25 (62.5)	16 (55.2)	0.62[a]	23 (57.5)	10 (34.5)	0.09[a]
Gained 1 line	12 (30.0)	10 (34.5)	0.80[a]	15 (37.5)	16 (55.2)	0.22[a]
Gained 2 lines	2 (5.0)	0 (0)	0.51[a]	1 (2.5)	0 (0)	1.00[a]
Safety index	1.13 ±0.27	1.09 ±1.20	0.44[b]	1.17 ±0.26	1.13 ±0.21	0.60[b]

Notes: [a]The Fisher's Exact test was used for statistical comparison. [b]The *t*-test was used for statistical comparison.
Abbreviations: Low-mod, low-to-moderate myopia; MRSE, manifest refraction spherical equivalent.

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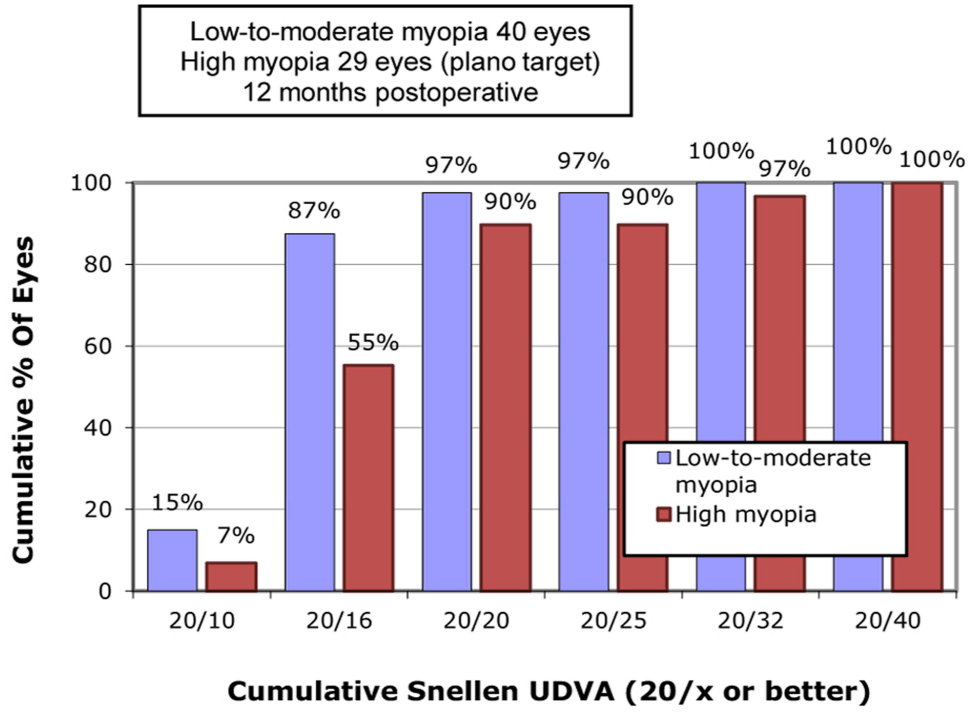

Figure 1 Postoperative cumulative uncorrected distance visual acuity (UDVA) at month 12, comparison between low-to-moderate myopia and high myopia groups.

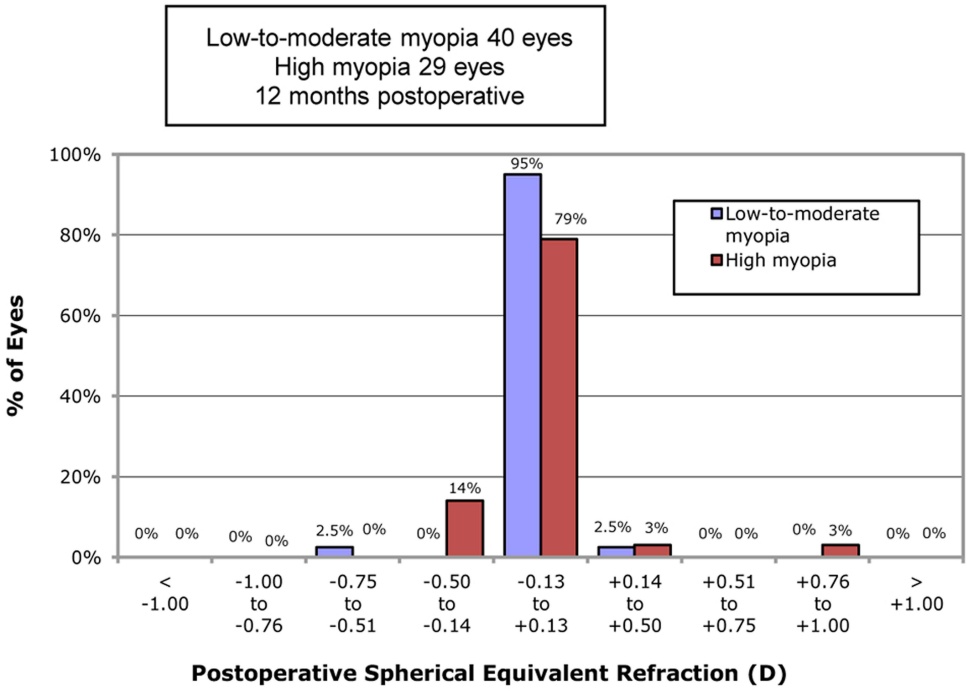

Figure 2 Postoperative spherical equivalents refraction at month 12, comparison between low-to-moderate myopia and high myopia groups.

postoperatively. Enhancement surgery was not required in either group.

After the introduction of PRK for myopia treatment, an early study of PRK results on highly myopic eyes (> 10D) found a high proportion of myopic regression and severe corneal haze.[15] Another long-term study also reported myopic regression of 2 D for eyes which had undergone PRK with an ablation depth of 130 um or more.[16] Thus,

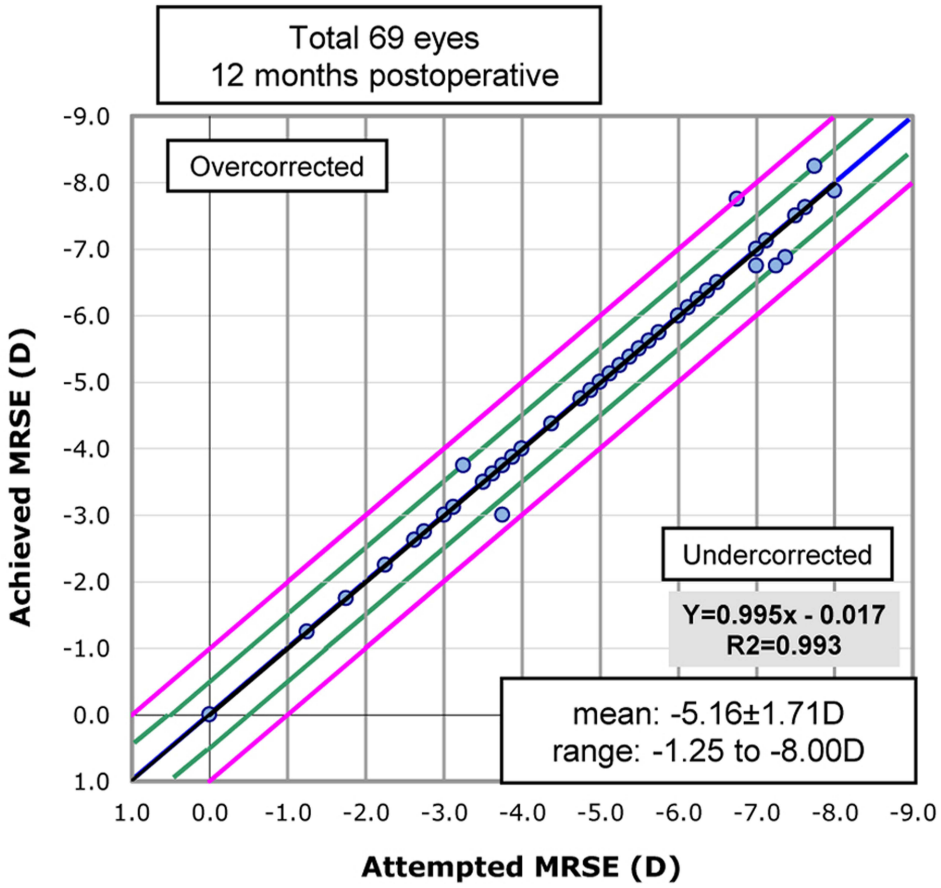

Figure 3 The attempted versus achieved manifest refraction spherical equivalents (MRSE) in all treated eyes.

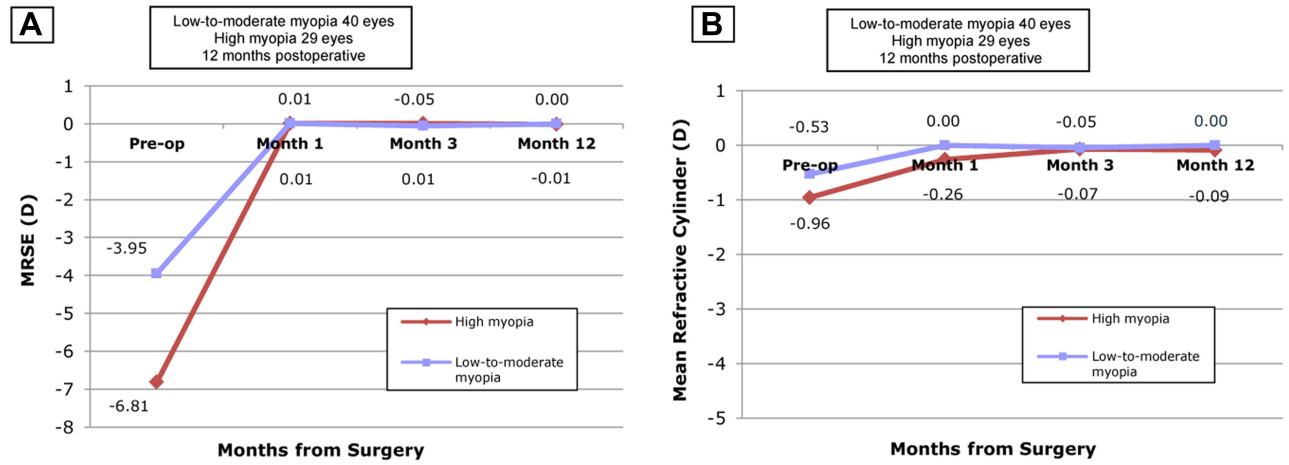

Figure 4 Mean preoperative and postoperative manifest refraction spherical equivalent (**A**), and refractive cylinder (**B**) during 12 months.
Abbreviation: MRSE, manifest refraction spherical equivalent.

regression of refractive correction and the development of corneal haze are major drawbacks of this surface ablation procedure.

With advanced excimer laser technology, the reported outcomes of PRK have improved.[8,10,17–19] However, in high correction of myopia (> 6 D), postoperative corneal haze is still one of the major causes of decreased CDVA, glare and halos, irregular astigmatism, and myopic regression.[20,21] Corneal stromal fibrosis (referred clinically as corneal haze) following PRK is caused by an

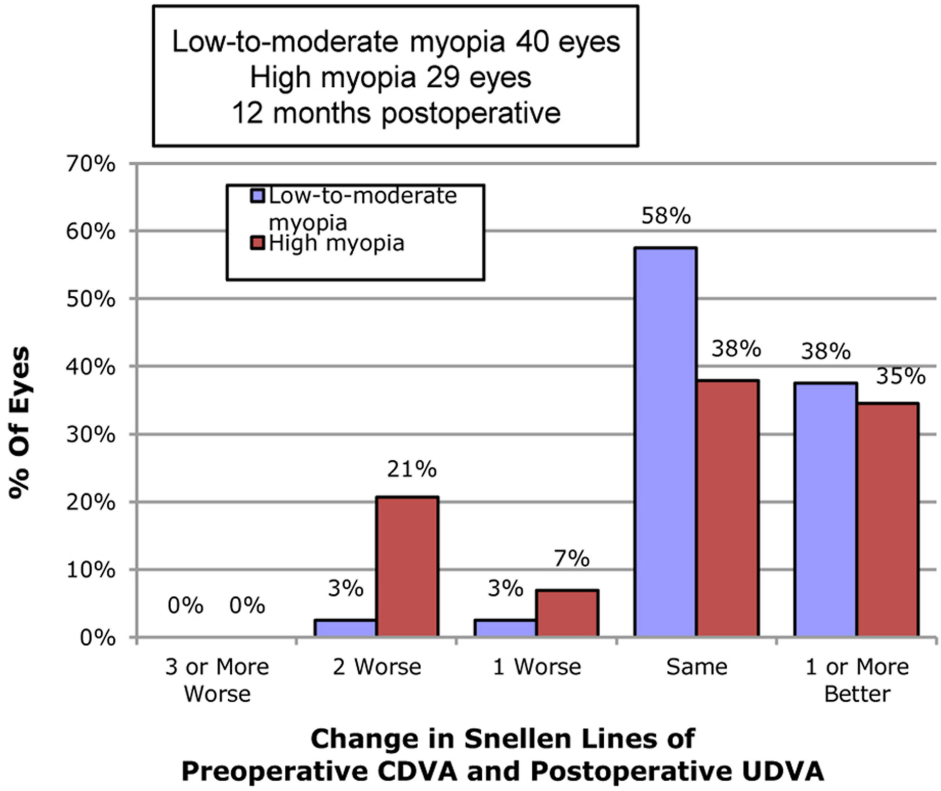

Figure 5 Change in Snellen lines of preoperative CDVA and postoperative UDVA at 12 months.
Abbreviations: CDVA, corrected distance visual acuity; UDVA, uncorrected distance visual acuity.

exacerbation corneal wound healing response where a large number of myofibroblasts are generated. Risk factors for corneal haze development include high myopia, high astigmatism, hyperopia, ultraviolet light exposure, prior corneal surgery, and possibly genetic influences, whereas increased aging may have protective effects.[22] The use of MMC, an alkylating agent, has been shown to be effective in preventing of corneal haze formation after PRK by inhibiting the mitosis of myofibroblast progenitors, thus decreasing maturation of these cells that produce stromal fibrosis.[23–26]

With more understanding in corneal wound healing, as well as an adjunctive treatment with MMC, the refractive outcomes of PRK procedures have improved, even in high refractive errors correction.[10,11,13,19] Mifflin et al reported excellent 12-month outcomes of PRK with MMC in high myopic correction (≥ 6 D): postoperative UDVA ≥ 20/20 was achieved in 93% to 100%.[13] Another study on three-year outcomes of PRK with MMC for high myopia (> 6 D) also showed excellent refractive outcomes without significant change of the higher-order aberrations (HOA) and mesopic contrast sensitivity compared to baseline.[10] In accordance with previous studies, our study confirmed that PRK adjunct with MMC for high myopia (≥ 6 D) correction provided very good results.

In this study, the postoperative corneal haze incidence was low, and all eyes had a mild degree of corneal haze. This might be due to the lower laser energy used in the PRK technique with manual epithelial removal in this study, compared to the transepithelial PRK that uses more excimer laser ablation time for epithelial removal. In addition, we also applied MMC intraoperatively to all eyes. According to a recent review, the most commonly used protocol, MMC 0.02% for 30 seconds after PRK, effectively decreased corneal fibrosis, especially in eyes with > 6 D of myopia, without significant long-term corneal or systemic side effects.[27] However, the reported MMC dosage varied among studies, and application time increased with the amount of myopic correction, up to a maximum duration of 2 min.[10,11,13,24] Hashemi et al reported that the use of 0.02% MMC for 10 sec per diopter of correction provided stable three-year visual outcomes with no complication for high myopia correction (> 6D).[10] Compared with other studies, the duration of MMC application in our study was relatively short. Although there is no consensus on the optimal MMC dosage, potential long-

Table 3 Comparison of Postoperative Complications Between Low-to-Moderate and High Myopia

Eye (%)	Month 1			Month 3			Month 12		
	Low-Mod	High	*p*	Low-Mod	High	p-value	Low-Mod	High	*p*
Dry Eye Symptoms Score: eyes (%)									
None	3 (7.5)	4 (13.8)	0.32[a]	6 (15.0)	2 (6.9)	0.45[a]	14 (35.0)	6 (20.7)	0.28[a]
Grade 1–2	20 (50.0)	9 (31.0)	0.14[a]	21 (52.5)	15 (51.7)	1.00[a]	20 (50.0)	12 (41.4)	0.63[a]
Grade 3–5	17 (42.5)	16 (55.2)	0.34[a]	13 (32.5)	12 (41.4)	0.46[a]	6 (15.0)	11 (37.9)	0.05[a]
Average score	1.90	2.34	0.26[b]	1.73	2.07	0.58[b]	1.25	1.69	0.09[b]
Night Vision Symptoms Score: eyes (%)									
None	11 (27.5)	9 (31.0)	0.79[a]	25 (62.5)	9 (31.0)	0.02[a]	20 (50.0)	11 (37.9)	0.34[a]
Grade 1–2	15 (37.5)	7 (24.2)	0.30[a]	12 (30.0)	10 (34.5)	0.80[a]	19 (47.5)	11 (37.9)	0.47[a]
Grade 3–5	14 (35.0)	13 (44.8)	0.46[a]	3 (7.5)	10 (34.5)	0.01[a]	1 (2.5)	7 (2.5)	0.001[a]
Average score	1.78	1.97	0.56[b]	0.68	1.62	0.01[b]	0.73	1.17	0.03[b]
Corneal Haziness Score: eyes (%)									
None	21 (52.5)	18 (62.1)	0.47[a]	30 (75.0)	25 (86.2)	0.37[a]	39 (97.5)	27 (93.1)	0.57[a]
Grade 1	19 (47.5)	11 (37.9)	0.11[a]	10 (25.0)	4 (13.8)	0.37[a]	1 (2.5)	2 (6.9)	0.57[a]
Grade 2–3	0 (0)	0 (0)	0.11[a]	0 (0)	0 (0)	0.37[a]	0 (0)	0 (0)	0.57[a]
Average score	0.48	0.38	0.47[b]	0.25	0.14	0.37[b]	0.03	0.07	0.57[b]

Notes: [a]The Fisher's Exact test was used for statistical comparison. [b]The *t*-test was used for statistical comparison.
Abbreviation: Low-mod, low-to-moderate myopia.

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term adverse effects of this antifibrotic agent on corneal stroma and corneal endothelial cells remains a concern for surgeons who should take a more cautious in using this anti-fibrotic agent.

When comparing PRK with LASIK, previous long-term studies reported that both procedures were effective and safe for moderate-to-high myopia (6 to 10 D). LASIK had a slightly better efficacy, predictability, and lower enhancement rate,[28] while haze was still a problem in PRK for myopia > 10 D.[21] Recent PRK outcomes have been excellent for high myopic (>6 D) correction compared to femtosecond laser-assisted LASIK (F-LASIK).[29,30] Moreover, PRK induced less HOA than F-LASIK.[30,31] Compared to our previous study on F-LASIK outcomes with the same excimer laser machine and treatment profile (WFO), the efficacy of PRK in this present study for both treatment groups are slightly better than those of F-LASIK.[32] Additionally, PRK may be safe in high myopic patients who are not a good candidate for LASIK; the risk of corneal ectasia may be substantially increased due to the deep stromal alteration.[9] In addition, results of PRK for high myopic correction (≥ 8D) was comparable with phakic intraocular lens (PIOL) implantation. Although PIOL was better than PRK in terms of quality of vision, PRK was an alternative in patients with inadequate anterior chamber depths.[33,34]

Another drawback of PRK compared to LASIK is postoperative pain particularly for the first 72 hours due to epithelial removal.[35] Bandage soft contact lenses speed the epithelialization and pain relief after PRK. Medications commonly used post-PRK include lubricants, topical corticosteroids, topical and oral NSAIDs, and oral analgesic drugs. Our postoperative regimens were sufficient for pain control in most cases, and none developed steroid-induced ocular hypertension.

In terms of safety, we explored three eyes in the high myopia group which lost a Snellen line at 12- month after surgery and found that all had dry eye. With follow-up at 24 months, all eyes gained UDVA equal to the preoperative CDVA. This supported the safety of high myopic correction by PRK. Even though a higher proportion of patients with high myopic correction had dry eye symptoms and night vision problems after PRK than those with low-to-moderate myopia, most of them had mild symptoms.

Some limitations need to be addressed. First, because the study is retrospective in nature, some data might be missing. Second, a larger sample with long-term study is required for assessment of the refractive stability and other postoperative complications. Last, the quality of vision, such as contrast sensitivity and higher-order aberrations, was not assessed. However, all high myopic patients were satisfied with their surgical results. Therefore, further studies are needed.

Conclusion

This study supports the hypotheses that one-year results of PRK for high myopic correction (6–8 D) have excellent refractive outcomes and are safe compared to those of low-to-moderate myopic correction. PRK offers an excellent option for high myopia patients who have limitations for other refractive surgeries, such as LASIK and PIOL. However, long-term outcomes such as efficacy, stability and complications of PRK in high myopic correction are warranted.

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Disclosure

The authors report no conflicts of interest in this work.

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