Research Article

Visual Outcome and Regression Post PRK in High Myopia

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Abstract

Background: Myopia, particularly moderate to severe myopia, is an important cause of visual impairment and may significantly affect daily activities and quality of life. Photorefractive keratectomy PRK is an established corneal refractive procedure for reducing refractive error and dependence on corrective lenses. This study evaluates visual, refractive, functional, and patient-reported outcomes of PRK in patients with myopia.

Methods: This study includes patients with myopia who underwent PRK and were followed for 2 years. Preoperative and postoperative assessments included uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), spherical equivalent (SE), keratometric parameters, functional interference with daily activities, and patient satisfaction. Statistical analysis was performed using appropriate comparative tests with a statistical significance level of 0.05.

Results: A total of 165 patients were included in the study, with an equal distribution of male and female most participants were aged 20-30 years. The mean preoperative spherical equivalent was -7.42; mean preoperative UCVA was improved from 0.05 to 0,82 at 1 month, 0.93 at 6 months, and 0.91 at 2 years. Mean SE was improved to -0.15 at 1 month and remained -0.69 at 2 years, representing a significant long-term improvement. A mean myopic regression of 0.54 occurred between 1 month and 2 years, with clinically significant regression of 0.54% of eyes. Functional difficulty was markedly reduced after surgery, and 93.0% of patients strongly recommended PRK.

Conclusion: PRK provides a substantial improvement in refractive error, visual acuity, functional visual performance, and patient satisfaction with moderate to severe myopia.

Keywords: Efficacy. Myopia, Photorefractive keratectomy, Regression, Refractive error, Visual acuity.

Introduction

Myopia is one of the most common causes of distance impairment worldwide, and its prevalence has increased substantially over recent decades. Global estimates indicate that approximately 30% of the world's population was affected by myopia in 2020, with projections suggesting that nearly 50% of the world's population of the world may be affected by myopia by 2050. High myopia is generally defined as a spherical equivalent refractive error of -6.00 D. Although axial length is also an important parameter in the assessment of severe myopia [1,2]

Myopia is a refractive disorder in which the optical system of the eye focuses parallel light rays in front of the retina when accommodation is relaxed, most commonly because the axial length is excessive relative to the optical power of the eye. Conventional methods for correction of myopia include spectacles, contact lenses, and refractive correction surgeries like photorefractive keratectomy, laser-assisted in situ keratomileusis, and small incision lenticule extraction. Although spectacle and contact lenses effectively improve vision, their use may cause practical, economic, adherence, and psychological barriers, while contact lenses may carry an additional risk of improper handling and ocular infection.[3,4]

Corneal laser refractive procedures have become establish option for myopic eye corrections and myopic astigmatism, with modern techniques usually providing predictable refractive correction and good visual outcomes in approximately selective patient. Compared with LASK, PRK does not require creation of a corneal flap, thereby reducing flap-related complications and preserving a greater amount of anterior corneal tissue. These characteristics make surface ablation particularly relevant with patients with relatively thin corneas, selected corneal topographic characterization, and occupational activities associated with a risk of ocular trauma [5,6]

Photorefractive keratectomy reshapes the anterior corneal tissue using an excimer laser to reduce the cornea's refractive power and improve the focus of incoming light on the retina. Modern PRK has demonstrated favorable visual and refractive outcomes, including patients with moderate to high myopia, although the magnitude of correction and corneal characteristics, postoperative healing and the risk of regression may influence the final result. Recent cohort studies demonstrated high efficacy and safety indices following PRK, indicating its great role in correction of myopic eyes.[7,8]

The indication for PRK has been expanded with advances in corneal topography, wave front analysis, laser ablation profile, and postoperative management. Although PRK has traditionally been used frequently for low to moderate myopia, contemporary evidence supports its use in carefully selected patients with high myopia. Therefore, the present study evaluates the visual and refractive outcomes of PRK in high myopic patients, with particular emphasis on postoperative visual function patient reported impact on quality of life [7,9]

The fundamental optic effect of PRK is achieved by flattening of the central cornea. The excimer laser removes corneal tissue by photoablation, allowing highly precise reshaping of cornea surface with minimal thermal effect on adjacent tissues the resulting change in corneal curvature is intended to ring the focal point of eye onto the retina and improves acuity [5,10]

This study aims to assess the long-term visual and refractive outcomes of PRK in patients with high myopia, including changes in uncorrected and best-corrected visual acuity, refractive parameters, corneal curvature, patient satisfaction and daily visual function, as well as the rate of postoperative refractive regression.

Materials and methods

This retrospective cohort study included 165 patients (207 eyes with high myopia that attended North Eye Center to evaluate the visual outcome and regression rate following photorefractive keratectomy. Patients were retrospectively reviewed to identify individuals who met the study's inclusion and exclusion criteria. Medical records of patients who underwent the surgery between January 2018 and January 2026 were reviewed in accordance with the tenets of the Declaration of Helsinki.

Eligible patients who aged between 18 and 40 years, with a spherical equivalent ranging from (-6.00D to - 10.00D), and stable refraction between two visits separated by at least one year. The exclusion criteria include: myopia of less than -6.00D OR >-10.00D, corneal ectasia, ocular surface disease, severe dry eye, diabetes, glaucoma, autoimmune diseases, pregnancy, and any previous ocular surgery.

All patients underwent complete preoperative ophthalmic examinations, including slit lamp biomicroscope, dilated fundus examination, Tono-pen tonometry, manifest and cycloplegic refraction, mean keratometry, corneal tomography using Pentacam (Oculus Germany), pachymetry, Uncorrected visual acuity UCVA, and best corrected visual acuity BCVA); soft or rigid contact lenses were removed at least two weeks before the preoperative evaluation.

All 165 patients received the same surgical procedure by one surgeon with a standardized surgical protocol using the SCHWIND AMARIS 500E excimer laser system. Treatment planning is performed using SCHWIND CAM software, which supports a wide range of refractive and therapeutic procedures and integrates diagnostic data for idealized ablation planning. Each patient received tetracaine hydrochloride eye drop (0.5% w/v)10 minutes before the surgery, sterilize the eyelid and eyelashes with 10% povidone iodine, place speculum, apply sterile drape, instill 5%povidine iodine into the eye for 2 minutes then rinse with balanced salt solution BBS. after marking the cornea with the Hoffer Optic zone marker of 6.5 mm, instilling 35% ethanol is instilled for 10 seconds, corneal epithelium is removed by using a hockey blade, then the excimer laser (SCHWIND AMARIS 500E) was used to precisely reshape the corneal surface. Immediately after excimer laser ablation, a sponge soaked with 0.02%mitomycin was applied to the stromal bed for not more than 60 seconds; next, the stromal bed was irrigated with 30 ml of chilled BBS. At the end of the surgery, one drop of moxifloxacin 0.5%, one drop of cyclopentolate 1% were instilled, followed by the application of a soft bandage contact lens.

Post-operative treatment of all patients includes a topical solution of 0.5%moxifloxacin 5 times daily, prednisolone acetate 1%w/v s times daily, tapering it weekly over 5 weeks to reach once daily, preservative-free artificial tears 5 times daily for 2 months, diclofenac potassium sachet twice daily in the first two days. The bandage contact lens was removed after re-epithelialization, usually at one week postoperative. All patients were followed up at day 1,7 and month 1,6,24 postoperatively. At 24 months visit, patients were asked to rate their visual satisfaction and the impact of the surgery on their daily activity like reading, driving, and watching TV, on a 4-point scale,5 point scale, respectively, patient whom already attended the visit before the study started were requested their rating verbally over the phone. Also, spherical equivalents and mean K were recorded and compared with the aimed visual acuity tailored for each patient.

The data that had been collected were analyzed using appropriate statistical methods to describe frequencies and proportions of different variables. Descriptive statistics were used to summarize the sociodemographic and other characteristics of the participants, while the paired t-test was used to explore the effectiveness of the PRK procedure. SPSS version 26 was used for this purpose.

Before data collection, ethical approval was obtained from the KHCMS Research Ethics Committee. (No, issued in). Verbal informed consent was obtained from all participants before questionnaire administration. Participant confidentiality and anonymity were maintained throughout the study.

Results

A total of 165 patients who underwent photorefractive keratectomy (PRK) were included in the study. Nearly half of them were male; the most reported age group was 20-30 years, and about 48 % of the patients had both eyes involved. Details are shown in Table 1.

Table 1: Baseline characteristics of studied eyes

Characteristics	Groups	No (%)
Age groups	<20 years	20 (12.1)
	20-30 years	104 (63.1)
	>30 years	41 (24.8)
Involved eye	Right eye	55 (33.3)
	Left eye	31 (18.8)
	Both eyes	79 (47.9)
Sex	Male	83 (50.3)
	Female	82 (49.7)

The mean refraction was -7.27 ± 1.67, ranging from -9.00 to -6.25. The mean spherical equivalent was -7.42 ± 0.75, ranging from -10.12 to -6.00. The mean keratometry was 43.67 ± 1.53, ranging from 39.62 to 47.75. The mean UCVA was 0.048± 0.034, ranging from 0.001 to 0.250. The mean BCVA was 0.532 ± 0.256, ranging from 0.060 to 1.000. Details are shown in Table 2.

Table 2. Baseline pre-operative Clinical and Refractive Characteristics of the Studied Eyes

Variables	Minimum	Maximum	Mean ± SD
Sphere	-9.00	-6.25	-7.27 ± 1.27
Spherical equivalent	-10.12	-6.00	-7.42 ± 0.75
Flat keratometry (k1)	38.50	47.00	43.12 ± 1.55
Steep keratometry (k2)	40.25	48.75	44.30 ± 1.66
Mean keratometry	39.62	47.75	43.67 ± 1.53
Uncorrected visual acuity (UCVA)	0.001	0.250	0.048 ± 0.034
Best corrected visual acuity (BCVA)	0.060	1.000	0.532 ± 0.256

There was an obvious improvement in refractive status after PRK of the studied patients, which is demonstrated by the statistically significant p-value level of ¸0.001in all the three follow up period 1 month, 6 months, and 2 years. Furthermore, the mean pre-operative sphere was -7.42, which indicates severe myopia. Subsequent improvement in the mean spherical equivalent all over the three follow-up periods by +7.27, +6.78, and 6.73 consequently supports this fact of major improvement of refractive status. Details are shown in Table 3.

Table 3. Changes in Mean Spherical Equivalent from Baseline pre-operative to 2 Years After Photorefractive Keratectomy

Time	Mean ±SD	Mean difference from baseline	P value (paired t-test)
Baseline SEQ (pre-operative) no=244	-7.42±0.75		
Post-operative SEQ 1 month (no=205)	-0.15±0.90	+7.27	<0.001
Post-operative SEQ 6 months (no=149)	-0.64±0.92	+6.78	<0.001
Post-operative SEQ 2 years (no=200)	-0.69±0.80	+6.73	<0.001

The mean pre-operative keratometry was 43.67, which decreased to 41.55 2 years after surgery with a mean reduction of 2.12 in comparison to pre-operative values. The p-value of <0.001 indicates a statistically significant decrease in corneal curvature. Details are shown in Table 4.

Table 4: Mean keratometry before and 2 years after PRK

Time	Mean ±SD	Mean differences from baseline preoperative	P Value (Paired t-test)

Pre-operative mean K (no=238)	43.67±1.53		
Post-operative mean K 2 years (no=198)	41.55±1.50	-2.12	<0.001

There was a sustained statistically significant improvement of both UCVA and BCVA throughout the 2-year follow-up period of PRK, with a mean improvement of UCVA of +0.77 and BCVA of +0.88 in comparison with pre-operative values, which was demonstrated by a significant P value of <0.001. Details are shown in Table 5.

Table5: Changes in UCVA and BCVA following PRK during 2-year follow-up

Time	UCVA (mean ±SD)	BCVA (mean± SD)	Mean differences	P value (paired t-test)
Pre-operative (no=234)	0.05 ± 0.03	0.53 ± 0.26		
Post-operative 1 month (no=207)	0.82 ± 0.18	0.96 ± 0.08	+0.77	<0.001
Post-operative 6 months (no=146)	0.93 ± 0.11	0.99 ± 0.04	+0.88	<0.001
Post-operative 2 years (no=200)	0.91 ± 0.13	0.98 ± 0.05	+0.86	<0.001

The safety index was 1.04, indicating that the post-operative BCVA was slightly better than the pre-operative values, reflecting an excellent safety value. On the other hand, the efficacy index was 0.92, which means the post-operative UCVA reached 92% of the pre-operative BCVA. These indicate that the PRK is both safe and effective. Details are shown in Table 6.

Table 6: Post-operative safety and efficacy indices.

Performance indices	Value
Safety index	1.04
Efficacy index	0.92

The mean preoperative spherical equivalent (SEQ) was −7.42, indicating high myopia before PRK. At 1 month postoperatively, the mean SEQ improved significantly to −0.15 D ($p < 0.001$), indicating near-emmetropic correction. At the 2-year follow-up, the mean SEQ was −0.69, which remained significantly improved compared with the preoperative value ($p < 0.001$). The mean improvement from preoperative SEQ to the 2-year postoperative value was 6.73 D ($p < 0.001$). However, a mean myopic regression of 0.54 D was observed between 1 month and 2 years postoperatively ($p < 0.001$). PRK produced a substantial and statistically significant correction of high myopia, with most of the refractive improvement maintained at 2 years. Details are shown in Table 7.

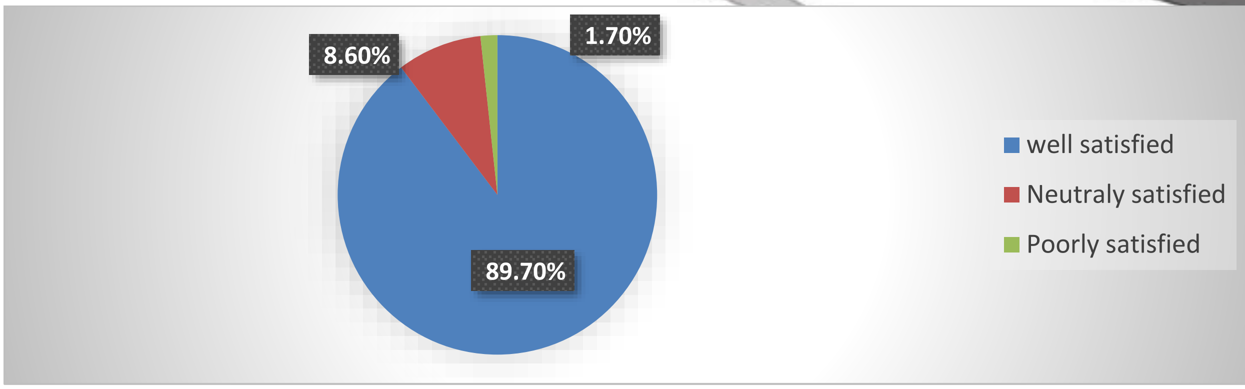
Table 7: Regression rate of operated eyes through 2 years post-PKR.

Parameter	Result	P-value
Mean preoperative SEQ	-7.42	
Mean SEQ at 1 month	−0.15	<0.001*
Mean SEQ at 2 years	-0.69	<0.001†
Mean change: Preoperative to 2 years	6.73 D	<0.001
Mean refractive regression: 1 month to 2 years	−0.54 D	<0.001
Regression rate‡	54.5%	

* Comparison between preoperative and 1-month postoperative SE.
† Comparison between preoperative and 2-year postoperative SE.
‡ Regression is defined as a myopic shift of **≥0.50 D** between 1 month and 2 years postoperatively.

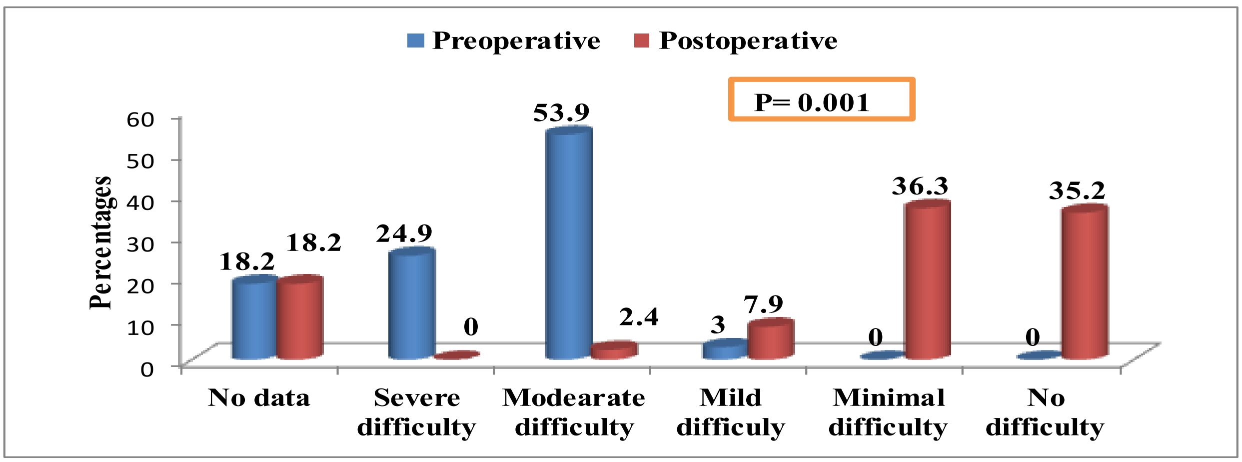
About 90.0% of the patients reported overall satisfaction with the PRK operation, whereas 8.6% reported neutral overall satisfaction. Details are shown in Figure 1.

Figure 1. Overall satisfaction of the patients with PRK surgery.



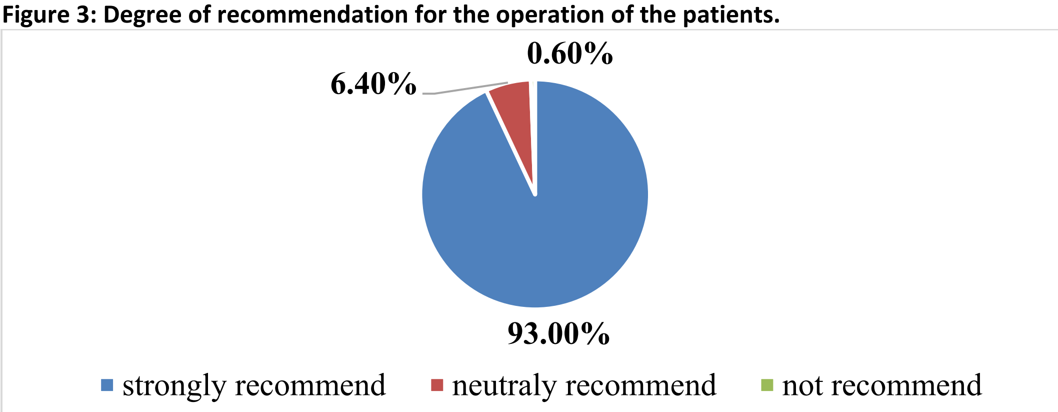
The results indicate a significant postoperative improvement in functional ability, with a clear shift from predominantly moderate and severe difficulty before surgery to minimal or no difficulty after surgery. The complete resolution of severe difficulty and the marked increase in patients reporting minimal or no difficulty, together with the statistically significant P-value (0.001), suggest that the surgical intervention was highly effective in reducing functional impairment and improving patients' daily functioning. Details are shown in Figure 2

Figure 2: Preoperative and postoperative daily activity interference of patients.



Most of the patients 93.0% strongly recommended the operation to others for PRK. Details Shown in Figure 3.

Figure 3: Degree of recommendation for the operation of the patients.



Discussion

The demographic characteristics of the studied patients in this study showed that most of them were young, aged 20-30 years old, with almost equal sex distribution of male and female, which reflects the typical age group seeking refractive surgery and glasses independence. Similar patterns were reported by Bokhary KA in Saudi Arabia and Kotb M from Egypt in 2021, and this can be explained by the fact that this age is typical for occupational demand and cosmetic reasons as well as spectacle independence, making the PRK mostly carried out for this age group.[11,12]

The clinical baseline characteristics reveal that most of the patients were suffering from moderate to severe myopia with relatively preserved corrected visual acuity, making them good candidates for the PRK procedure. These findings are consistent with other studies carried out by Mounir A, Miraftab M, and Fadlallah A in Egypt, Iran, and Germany, respectively, all of which reported similar preoperative refractive profiles and emphasized that careful preoperative selection of patients with stable refractive error and adequate corneal thickness is essential for the best outcome of PRK [13,14]

In this study a significant reduction in keratometry was obtained after PRK suggesting effectiveness of this procedure in thinning the curvature of cornea and subsequent correction of the visual error similar result were reported in Egypt, Iran, and Germany by Mounir A, Miraftab M, and Fadlallah A respectively with slight differences in values of correction of keratometry which is mostly attributed to attributed to variation in preoperative refractive error, laser platforms, optical zone diameter, and surgical technique used by each surgeon. [13,14]

The study also demonstrated a marked improvement in patients' functional activity after surgery, with most patients reporting minimal or no difficulty in performing daily visual activities. similar results in improving daily quality of live have been demonstrated in studies from Chin, Italy, and Turkey, where enhanced visual performance, reduced dependence on corrective lenses where enhanced visual performance, reduced dependence on corrective lenses, and improved contrast sensitivity were reported [15-17]

The efficacy index of 0.092 indicates an excellent functional effectiveness of PRK, and it is comparable to values reported in Germany and China, which attributed these favorable outcomes to advanced excimer laser technology, individualized treatment planning, and improved postoperative management, all of which enhance refractive predictability while minimizing the unwanted side effects [18-20]

Finally, approximately 90% of patients in this study were satisfied with the surgical outcome, reflecting the excellent visual and refractive result achieved after the PRK. Similar satisfaction has been reported by other international studies by both Bokhary KA in Saudi Arabia in 2022 and Hashmani N. in Pakistan in 2017, highlighting that accurate refractive correction and rapid visual rehabilitation are principal determinants of post-operative satisfaction and improve quality of life, as 92% and 95% respectively was the satisfaction levels of both studies [11,21]

Conclusion

This study concluded that PKR is a safe and predictable procedure for correction of moderate to severe myopia, resulting in significant improvement in refractive error, visual acuity, functional visual performance, and patient satisfaction with stable outcomes over a 2-year follow-up period.

Recommendation

Photorefractive keratotomy should continue to be considered a reliable option for appropriately selected patients. Further multicenter studies with longer follow-up periods and the inclusion of patient-reported quality of life measures are recommended to validate these findings.

Conflict of interest: none.

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