Long term results for transepithelial and standard photorefractive keratectomy in the treatment of moderate to low myopia and astigmatism

Nesime Setge Tiskaoglu[1], Mustafa Berhuni[1], Cem Ozturkmen[2]

ABSTRACT

Purpose: To evaluate the results of photorefractive keratectomy (PRK) and transepithelial PRK (t-PRK) in moderate and low-grade myopia and astigmatism.

Materials and Methods: The records of 144 eyes of 72 t-PRK and 132 eyes of 66 PRK patients were retrospectively analysed. Pre and postoperative 36-month best corrected visual acuity (BCVA) and refractive errors were recorded. Surgical values as well as post-operative epithelial healing and haze staging were also recorded.

Results: The average age of t-PRK patients was 28.29±6.8 years, and the average age in the PRK patient group was 28.15±5.0 years. The time to epithelial closure was significantly longer in the PRK group compared to the t-PRK group. T-PRK and PRK group showed significant improvement in postoperative BCVA, spherical and cylindrical refraction.

Conclusion: T-PRK and PRK procedure was found to be both effective and safe in our population group.

Keywords: Photorefractive keratectomy, transepithelial photorefractive keratectomy myopia, astigmatism, refractive surgery.

INTRODUCTION

Photorefractive keratectomy (PRK) is a laser surgery procedure used for the correction of refractive errors such as myopia, hyperopia, and astigmatism.[1] PRK is based on the separation of the corneal epithelium and the application of laser ablation to the stroma. While Laser assisted in situ keratomileusis (LASIK) is the most performed surgery there are certain situations where PRK is preferred i.e., patients at higher risk of flap complications, secondary enhancement procedures, patients with thinner corneas, basement membrane dystrophy, as well as surgeon experience.[2] PRK is traditionally performed by manual epithelial debridement with ablation of the underlying surface whereas transepithelial PRK (t-PRK) uses a laser to remove the epithelium with ablation of the underlying surface.[3] The advantages of t-PRK over PRK can be listed as less postoperative pain, shorter epithelial recovery time, and shorter surgery time. Studies comparing PRK to t-PRK have shown both techniques to be safe.[4-8] Few studies have reviewed patient-reported outcomes regarding these two techniques.[9,10]

In this study, we aimed to report the results of our PRK and t-PRK and compare patient demographics between the groups.

MATERIAL AND METHODS

Our study was a retrospective and cross-sectional study carried out at Goznuru Hospital in Gaziantep by a single surgeon (CO). The study was approved by the institutional Ethics Committee (Date: 30/05/2023, decision number:

1- Dr Ersin Arslan Training and Research Hospital, Gaziantep, Türkiye
2. Goznuru Eye Hospital, Gaziantep, Türkiye

Received: 31.01.2024
Accepted: 12.12.2024
TJ-CEO 2025; 20: 88-92
DOI: 10.37844/TJ-CEO.2025.20.14

Corresponding author:
Mustafa Berhuni
Email: mustafaberhuni@gmail.com

244.25.21) and adhered to the Tenets of Helsinki. The records of 144 consecutive eyes of 72 t-PRK and 132 eyes of 66 PRK patients were retrospectively analysed and pre and postoperative 36-month visual acuity and refractive error were recorded. Patients with myopia up to -4.00 diopters and astigmatism up to -2.00 diopters were included in the study. Patients who had undergone PRK surgery in the last 4 years with at least 36 months of follow-up were included in the study. Exclusion criteria for the study were any corneal epithelial surface disease, genetic diseases such as keratoconus, previous ocular surgery, cataracts, glaucoma or retinal disease, and pregnancy. A full ophthalmological examination including slit-lamp biomicroscopy of the anterior and posterior segments, intraocular pressure measurements (Goldmann tonometer), and best-corrected distance visual acuity (BCVA) using Snellen's acuity chart was recorded. Manifest and cycloplegic refractions using an Auto-keratorefractometer KR-8900 by Topcon were also recorded. A topographic evaluation was conducted using the Scheimpflug imaging system (Sirius, CSO, Italy). Pre and postoperative (36th month) BCVA, spherical and cylindrical values were recorded. Surgical parameters ablation time, depth, volume, zone, transition zone, and optical zone were also included in the study. Postoperative epithelial healing duration and haze scoring i.e. Fantes et al.[11], were recorded. All assessments were conducted by the same ophthalmologist (CO). Patients were informed of the different treatment options and after evaluation of the pros and cons of each surgery, patients selected their preferred option.

Surgical Technique

The Schwind Amaris 500s device was utilized for all surgical procedures. For PRK periorbital skin was sanitized with a 10% povidone-iodine solution. After waiting a minute, a sterile drape was applied and secured to the blepharostat. The cornea was pre-treated with alcohol following topical anaesthesia instillation, a blunt keratome blade knife was then used to scrape the central 9 mm of the cornea, which was then cleaned with a blunt spatula from the centre to the periphery using mechanical corneal debridement. Finally, the standard algorithm of the device was used to perform excimer laser ablation. In t-PRK after sterile preparation the ORK-CAM software of the device was used to remove the corneal epithelium in a 7-9 mm zone, followed by excimer laser ablation. Both methods utilized a minimum 6.5 mm ablation zone. After ablation, in patients with a preoperative decision to utilize mitomycin, a sponge soaked with 0.02% mitomycin-C was applied to the stromal bed for 30 seconds and then removed with a balanced salt solution. A soft bandage contact lens was used until epithelialization was achieved, and antibiotic drops were administered. Patients were monitored daily until epithelialization was achieved, and 0.5% moxifloxacin drops were used 5 times a day. After epithelialization, the therapeutic contact lens was removed, and 1% preservative-free dexamethasone drops were used for 1 month, starting with 4 times a day and gradually reducing the dose. Artificial tears were also used 5 times a day. All medications were discontinued after 1 month, except for artificial tears.

Statistical analysis

Data was analyzed using the Statistical Package for Social Science (SPSS, version 26.0, IBM Corp.). The normality of data was assessed using Kolmogorov–Smirnov test and expressed as Mean ± SD (Standard deviation). The appropriate test (Wilcoxon signed-rank test, Mann–Whitney U test, and Chi-Square test) was used to compare data. P 0.05 was considered statistically significant.

RESULTS

The records of 144 eyes of 72 t-PRK and 132 eyes of 66 PRK patients were retrospectively analysed. The mean age of t-PRK patients was 28.29±6.8 years and the mean age was 28.15 ±5.0 years in the PRK patient group (p: 0.952).

A total of 144 eyes in the t-PRK group and 132 eyes in the PRK group were included in the study. ~~A.~~ In the t-PRK group, 73.6% were male and 26.4 % were female whereas in the PRK group, 69,6% of patients were male and 30.4% were female (p:0.854). There was not statistically significant difference in all preoperative values between PRK and t-PRK patients (Table 1). Intraoperative surgical parameters, epithelial healing, and corneal haze were also significantly different between the groups (Table 2). Mitomycin was used in 4 patients in the t-PRK group.

There was a significant improvement in BCVA, spherical and cylindrical refraction values preoperatively and postoperatively in the t-PRK group and PRK group (p<0.001, p<0.001, p<0.001, p<0.001 respectively) (Table 3).

Table 1. *Demographic characteristics and preoperative values of PRK and t-PRK patients*

Variables	t-PRK (n:144)	PRK (n:132)	p value
Age (years)	28.29±6.8	28.15 ±5.0	0.952
Sex (M/F)	53/19	46/20	0.854*
Pachymetry	533.67± 3.6	544.33±3.6	0.472^
PMSE (D)	-2.39± 0.52	-2.42 ±0.74	0.752^

PRK: Photorefractive keratectomy; t-PRK: transepithelial photorefractive keratectomy; PMSE: Preoperative manifest spherical equivalent; M: Male; K: Female; D: diopter
* Chi square test; ^ Mann–Whitney U test; p bold statistically significant.

Table 2. *Surgical parameters, epithelial healing and haze staging results of t-PRK and PRK patients*

Variables	t-PRK (n:144)	PRK (n:132)	p value
Ablation time (sec)	26.54± 4.34	10.82 ± 2.99	**<0.001***
Ablation depth (µm)	80.45± 8.56	41.40± 10.45	**<0.001***
Ablation volume (pl)	2829.26± 369.31	838.61± 243.15	**<0.001***
Ablation zone (mm)	7.07± 0.24	7.25± 0.24	**<0.001***
Transition zone (mm)	0.49± 0.16	0.74± 0.19	**<0.001***
Optic zone (mm)	6.58± 0.17	6.52± 0.16	**0.003***
Epithelial closure (days)	3.43± 0.52	4.91± 0.49	**<0.001***
Corneal Haze Stage 0 (n)	66	49	**<0.001***
Corneal Haze Stage 0.5 (n)	6	13	**<0.001***
Corneal Haze Stage 1 (n)	0	4	**<0.001***
Mitomycin use (n)	4	0	**<0.001***

PRK: Photorefractive keratectomy; t-PRK: transepithelial photorefractive keratectomy;
* Mann–Whitney U test; p bold statistically significant.

Table 3. *Preoperative and postoperative refractive and visual results of t-PRK and PRK patients*

		t-PRK (n:144)			PRK (n:132)	
Variables	Preoperative	Postoperative	p value*	Preoperative	Postoperative	p value*
Sphere (D)	-1.15± 0.64	-0.03±0.16	**<0.001**	-2.27±0.84	-0.12±0.27	**<0.001**
min	0	0.30		0	+0.80	
max	-3.25	-0.50		-4.00	-0.50	
Cylinder (D)	-0.37±0.69	-0.10±0.15	**<0.001**	-0.44±0.53	-0.17±0.26	**<0.001**
min	0	0		0	0	
max	-2.00	-0.75		-2.00	-1.00	
BCVA (Snellen)	0.57±0.11	0.90±0.04	**<0.001**	0.46±0.11	1.00±0.00	**<0.001**

PRK: Photorefractive keratectomy; t-PRK: transepithelial photorefractive keratectomy; BCVA: Best corrected visual acuity; D: Diopter
*Wilcoxon signed-rank test; p bold statistically significant

At the postoperative 36-month visit all eyes had a UCVA of 0.9 or more. No permanent adverse effect or complications was experienced in any of the patients.

DISCUSSION

Extensive studies on the different refractive surgery methods are present in current literature.[1-11] In our study similar to previous studies, we showed that both PRK and t-PRK are safe and effective in the treatment of low to moderate myopia and astigmatism.[2-8,12] In a study by Gadde et al. comparing t-PRK and PRK patients using the Amaris excimer laser, version 500 E (Schwind eye-tech-solutions) they found both techniques to be similar in outcome, technique, and safety. In their study although not significant at the end of a 3-month follow up the PRK group had a higher UCVA.[8] Similarly, in our study, there were significant improvements in postoperative BCVA and refraction.

Clinch et al. when comparing mechanical PRK and T-PRK found mechanical PRK to be superior in postoperative outcomes including vision, refraction, epithelial closure, and haze formation.[13] Gadde et al. in their study found a significantly higher corneal haze incidence in the t-PRK group vs. the PRK group.[8] Kaluzny et al. also found the incidence of haze to be higher in the t-PRK group. Similar to previous studies more haze was seen in the t-PRK group but a higher stage was more prevalent in the PRK group.[6] A higher stage in the PRK group could be explained by the use of mitomycin in patients we deemed a high risk which was all in the t-PRK group. An increased ablation time with a consequent increase in energy use has been shown as a possible cause for an increased incidence of haze in t-PRK patients.[14]

Ablation time, depth, volume, and optic zone were significantly higher in the t-PRK group. The ablation zone and transition zone were significantly higher in the PRK group. As theorized in previous studies the use of laser technology in t-PRK leads to a more defined and thus smaller transition zone and ablation area.[6]

Fadlallah et al. as well as Naderi et al. found that epithelial closure was quicker in the t-PRK group which is similar to our study.[7,15] In t-PRK the epithelial zone and the ablation zone are the same size unlike in PRK where the epithelial zone is usually larger than the ablation zone this together with the ablated stromal bed seems to lead to superior healing in t-PRK patients. One of the major strengths of the study is the long-term follow-up

Limitations of our study were the limited number of patients as well as the retrospective design. Relative strengths of the study were the long-term follow-up of 36 months as well as the fact that typical patient load and outcomes in a real-life setting were studied.

CONCLUSION

Compared with PRK, epithelial closure time is shorter in the t-PRK group. While corneal haze was more in the t-PRK group at lower stages, it was more in the PRK group at advanced stages. T-PRK and PRK procedure was found to be both effective and safe in our population group.

Conflict of interest

Authors declared no conflict of interest

Acknowledgement

None

REFERENCES

1. Kim TI, Alió Del Barrio JL, et al. Refractive surgery. Lancet. 2019;393(10185):2085-2098.
2. Shortt AJ, Allan BD, Evans JR. Laser-assisted in-situ keratomileusis (LASIK) versus photorefractive keratectomy (PRK) for myopia. Cochrane Database Syst Rev. 2013;(1):CD005135.
3. Shapira Y, Mimouni M, Levartovsky S, et al. Comparison of Three Epithelial Removal Techniques in PRK: Mechanical, Alcohol-assisted, and Transepithelial Laser. J Refract Surg. 2015;31(11):760-766.
4. Jun I, Yong Kang DS, Arba-Mosquera S, et al. Clinical outcomes of mechanical and transepithelial photorefractive keratectomy in low myopia with a large ablation zone. J Cataract Refract Surg. 2019;45(7):977-984.
5. Yildirim Y, Olcucu O, Alagoz N, et al. Comparison of visual and refractive results after transepithelial and mechanical photorefractive keratectomy in myopia. Int Ophthalmol. 2018;38(2):627-633.
6. Kaluzny BJ, Cieslinska I, Mosquera SA, et al. Single-Step Transepithelial PRK vs Alcohol-Assisted PRK in Myopia and Compound Myopic Astigmatism Correction. Medicine (Baltimore). 2016;95(6):e1993.

7. Fadlallah A, Fahed D, Khalil K, et al. Transepithelial photorefractive keratectomy: clinical results. J Cataract Refract Surg. 2011;37(10):1852-1857.
8. Gadde AK, Srirampur A, Katta KR, et al. Comparison of single-step transepithelial photorefractive keratectomy and conventional photorefractive keratectomy in low to high myopic eyes. Indian J Ophthalmol. 2020;68(5):755-761.
9. Wang J, Rieder EA. A Systematic Review of Patient-Reported Outcomes for Cosmetic Indications of Botulinum Toxin Treatment. Dermatol Surg. 2019;45(5):668-688.
10. Sachdev GS, Ramamurthy S, Dandapani R. Comparative analysis of safety and efficacy of photorefractive keratectomy versus photorefractive keratectomy combined with crosslinking. Clin Ophthalmol. 2018;12:783-790.
11. Fantes FE, Hanna KD, Waring GO, et al. Wound healing after excimer laser keratomileusis (photorefractive keratectomy) in monkeys. Arch Ophthalmol. 1990;108(5):665-675.
12. Yilmaz BS, Agca A, Taskapili M. Comparison of Long-Term Visual and Refractive Results of Transepithelial and Mechanical Photorefractive Keratectomy. Beyoglu Eye J. 2022;7(2):121-125.
13. Clinch TE, Moshirfar M, Weis JR, et al. Comparison of mechanical and transepithelial debridement during photorefractive keratectomy. Ophthalmology. 1999;106(3):483-489.
14. Reinstein DZ, Archer TJ, Gobbe M. Change in epithelial thickness profile 24 hours and longitudinally for 1 year after myopic LASIK: three-dimensional display with Artemis very high-frequency digital ultrasound. J Refract Surg. 2012;28(3):195-201.
15. Naderi M, Jadidi K, Mosavi SA, et al. Transepithelial Photorefractive Keratectomy for Low to Moderate Myopia in Comparison with Conventional Photorefractive Keratectomy. J Ophthalmic Vis Res. 2016;11(4):358-362.