ORIGINAL ARTICLE

FACTORS AFFECTING PAIN FOLLOWING TRANSEPITHELIAL PHOTOREFRACTIVE KERATECTOMY FOR MYOPIA AND ASTIGMATISM

Miyopi ve Astigmatizma Hastalarında Transepitelyal Fotorefraktif Keratektomi Sonrası Ağrıyı Etkileyen Faktörler

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ABSTRACT

Objective: In this study, to clarify predictive factors related to postoperative pain following T-PRK.

Material and Methods: A detailed medical history was taken and ophthalmological examinations were performed on all patients undergoing T-PRK. The presence of pain preoperatively, the size of the ablation during the T-PRK procedure, postoperative complaints, and the Visual Analogue Scale (VAS) score were recorded on the 1st postoperative day. During the evaluation of postoperative complaints, patients were asked to give a score between 1 and 10 to indicate the severity of their symptoms. Patients with a VAS score of less than 5 on the 1st postoperative day were classified as Group 1, while those with a VAS score of 5 or more were categorised as Group 2. The groups were then compared with regard to patient demographics, preoperative ocular measurements, ablation size during surgery, postoperative complaints and VAS scores on the 1st postoperative day.

Results: A total of 64 patients who underwent T-PRK were enrolled in the study, and 24 patients had VAS score ≥5. Mean VAS score was 2.1 in Group 1 and 7.0 in Group 2, which was significantly higher for Group 2 (p= 0.001). Being under the age of 30 was a predictive factor for higher postoperative pain (p= 0.020). In addition, larger ablation depth, presence of foreign body sensation, and eyelid swelling increased postoperative pain by 2.182 times, 2.667 times and 2.812 times, respectively(p= 0.032, p= 0.004, and p= 0.006, respectively).

Conclusion: The present study demonstrated that almost two out of five individuals who underwent T-PRK experienced from severe pain following the procedure. Our findings demonstrated that younger age below 30 years, larger ablation depth, and symptoms including foreign body sensation and eyelid swelling were predictive factors for severe postoperative pain following the T-PRK procedure.

Keywords: *Astigmatism; Myopia; Pain; T-PRK*

ÖZET

Amaç: Bu çalışmada, T-PRK sonrası postoperatif ağrı ile ilgili prediktif faktörleri açıklığa kavuşturmayı amaçladık.

Gereç ve Yöntemler: T-PRK yapılan tüm hastalardan ayrıntılı tıbbi öykü alındı ve oftalmolojik muayeneler yapıldı. Preoperatif dönemde ağrı varlığı, T-PRK işlemi sırasında ablasyonun boyutu, postoperatif şikayetler ve postoperatif 1. günde görsel analog skala (VAS) skoru kaydedildi. Ameliyat sonrası şikayetler değerlendirilirken hastalardan şikayet şiddetine göre 1 ile 10 arasında bir puan vermeleri istendi. Ameliyat sonrası 1. günde VAS skoru <5 olan hastalar Grup 1, ameliyat sonrası 1. günde VAS skoru ≥5 olan hastalar Grup 2 olarak sınıflandırıldı. Gruplar hastaların demografik özellikleri, ameliyat öncesi oküler ölçümler, ameliyat sırasında ablasyonun boyutu, ameliyat sonrası şikayetler ve ameliyat sonrası 1. günde VAS skorları açısından karşılaştırıldı.

Bulgular: Çalışmamıza T-PRK uygulanan 64 hasta çalışmaya dahil edildi ve 24 hastanın VAS skoru ≥5 idi. Ortalama VAS skoru Grup 1'de 2,1 ve Grup 2'de 7,0 idi ve Grup 2 için anlamlı olarak daha yüksekti (p= 0,001) 30 yaşın altında olmak daha yüksek postoperatif ağrı için prediktif bir faktördü (p= 0,020). Ayrıca, daha büyük ablasyon derinliği, yabancı cisim hissi varlığı ve göz kapağı şişliği ameliyat sonrası ağrıyı sırasıyla 2,182 kat, 2,667 kat ve 2,812 kat artırdı (sırasıyla p= 0,032, p= 0,004 ve p= 0,006).

Sonuç: Bu çalışma, T-PRK uygulanan her beş kişiden neredeyse ikisinin işlem sonrasında şiddetli ağrı çektiğini göstermiştir. Bulgularımız, 30 yaş altı genç yaş, daha büyük ablasyon derinliği ve yabancı cisim hissi ve göz kapağı şişmesi gibi semptomların T-PRK işlemini takiben şiddetli postoperatif ağrı için öngörücü faktörler olduğunu göstermiştir.

Anahtar Kelimeler: *Astigmatizma; Miyopi; Ağrı; T-PRK*

INTRODUCTION

Corneal refractive pathologies, including myopia and/or astigmatism, result in misplacement of light away from fovea and retina, and deteriorate vision (1). Myopia is a challenging public health problem, and previous epidemiological reports showed that more than 1.5 billion people are affected by myopia today. It is estimated that almost one of third of the world population will suffer from myopia in the 2030s. Additionally, astigmatism, with or without myopia, can cause visual impairment at young people(2). Beyond causing vision problems, myopia with or without astigmatism also has consequences such as inability to perform daily tasks, social isolation, decreased productivity at work and an economic burden on the healthcare system (3). The treatment of myopia and astigmatism involves correcting this abnormal light deviation using refractive surgical methods, including femtosecond laser–assisted laser in situ keratomileusis (LASIK), small incision lenticule extraction (SMILE) and photorefractive keratectomy (PRK) (4, 5).

Transepithelial photorefractive keratectomy (T-PRK) was introduced into ophthalmological practice to reduce complications related to conventional PRK, such as irregular epithelial healing, postoperative pain and corneal haze (6). Fadlallah et al. compared patients undergoing T-PRK and PRK for myopia with and without astigmatism. The authors concluded that, while the success rates of the two techniques were similar, the T-PRK group experienced significantly less pain at 48 hours (7). In another study, Çelik et al. compared the postoperative pain experienced by patients following T-PRK and PRK using the Visual Analogue Scale (VAS). The T-PRK group had significantly lower VAS on postoperative 1st and postoperative 3rd days (8).

Although numerous studies have stated the benefit of T-PRK for pain following myopia with and without astigmatism treatment, none of this research focused on predictive factors which increase pain following T-PRK. In this study, for the first time, we aimed to clarify predictive factors related to postoperative pain following T-PRK.

MATERIAL AND METHODS

The present research was designed in retrospective manner between January 2024 and 2025, and patients who were treated with T-PRK for myopia with and without astigmatism were evaluated for study inclusion. The study received approval from the Institutional Ethical Board of the University of Health Sciences, Dr. Suat Seren Training and Research Hospital, according to the Declaration of Helsinki (Meeting/Decision No. 2024/21-18). Before the surgical intervention, all patients were informed in detail about their disease, alternative treatment modalities, T-PRK technique, success and complications of T-PRK, and follow-up schedule. Also, all patients signed informed consent giving permission for surgery 24 hours prior to procedure. The inclusion criteria were having undergone T-PRK surgery in our hospital for spherical equivalent refractive error of -5.50 D or less, and being aged 18 or over. Patients with a history of corneal or intraocular surgery, unstable refractive pathology, concomitant eyelid or ocular surface disease, keratitis, a history of ocular herpetic disease or any other ocular pathology were excluded from the study. The presence of refractive media opacities, a history of glaucoma or retinal disease, connective tissue disease, coagulopathy, diabetes mellitus or immunological disease were also accepted as exclusion criteria.

In the preoperative period, detailed medical history and ophthalmological examination including refraction, visual acuity, slit-lamp biomicroscopy, dilated fundoscopy, intraocular pressure (IOP), pachymetry, corneal topography (Scansys, Mediworks, Shanghai, China), and anterior segment optical coherence tomography (Cirrus 6000, Zeiss, Dublin, CA) were performed. Age, sex, body mass index, educational status, smoking status, and presence of hypertension were recorded for each patient. In addition, presence of pain in the preoperative era, size of ablation during T-PRK procedure, postoperative complaints (burning, foreign body sensation, tearing, redness, photophobia, eyelid swelling, blurriness) and VAS score were recorded on the postoperative 1st day. During evaluation of postoperative complaints, patients were asked to give a score between 1 and 10 regarding complaint severity (9).

For the Transepithelial Photorefractive Keratectomy (T-PRK) technique, the periorbital skin was cleansed with 10% Povidone-Iodine solution. Proparacaine HCL drops were used for anaesthesia. Corneal epithelium

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ablation was performed using MEL 90 excimer laser software (Carl Zeiss Meditec, Jena, Germany) in an 8 mm zone according to anterior segment optical coherence tomography. Corneal ablation was then performed using an excimer laser with a minimum ablation zone of 6.5 mm. After completing the ablation, balanced salt solution was applied. Finally, a soft bandage contact lens was applied until epithelialisation was achieved. Antibiotic eye drops were administered. Patients were examined daily until epithelialisation was achieved. Drops containing 0.5% moxifloxacin (Vigamox, Alcon Laboratories, Inc., Canada) were administered four times daily. Artificial tears were applied six times daily. Once epithelialisation was complete, the therapeutic contact lens was removed. Following removal of the contact lens, treatment was supplemented with 0.1% fluorometalon (Flarex, Alcon Pharma, Freiburg, Germany) drops. These drops were applied three times a day during the first week. The frequency of the drops was then reduced by one dose per week. After one month, all medications except the artificial tears were discontinued.

To clarify the possible predictive factors associated with pain following the T-PRK procedure, patients were categorized into two groups. Patients with VAS score <5 on 1st postoperative day were classified as Group 1, and patients with VAS score ≥5 on 1st postoperative day were categorized as Group 2. The groups were then compared with regard to patient demographics, preoperative ocular measurements, ablation size during surgery, postoperative complaints and VAS scores on 1st postoperative day. Moreover, multivariate regression analysis was done for significant parameters between the groups to identify predictive factors for pain following the T-PRK procedure.

The Statistical Package for the Social Sciences version 27 (SPSS IBM Corp., Armonk, NY, USA) program was used for statistical assessment. Normality of variable distribution was analyzed with the Shapiro-Wilk test. The independent student t-test or Mann-Whitney U test were performed for comparison of continuous variables. Descriptive parameters are presented as mean ± standard deviation. Categorical variables were analyzed using the $\chi 2$ test. Logistic regression analysis was done to evaluate the parameters that were predicted to be risk factors for postoperative pain. The data were analyzed at 95% confidence level, and a p value of less than 0.05 was accepted as statistically significant.

RESULTS

A total of 64 patients who underwent T-PRK were enrolled in the study, and 24 patients had VAS score ≥5. Mean age was significantly younger (29.9 years vs. 23.2 years, p= 0.001), and male ratio was significantly higher (75% vs. 50%, p= 0.049) in patients with VAS score of ≥5. In contrast measurement of sphere and cylinder, best corrected visual acuity, intraocular pressure, and pachymetry values were similar between the groups (p= 0.733, p= 0.647, p= 0.456, p= 0.646, and p= 0.127, respectively). The preoperative characteristics of the patients are summarised in Table 1.

In total, 8 (20%) patients in Group 1 and 12 (40%) patients in Group 2 experienced from preoperative pain (p= 0.012). Ablation depth was categorized as small for 29 (72.5%) patients and large for 11 (27.5%) patients in Group 1, and as small for eight (33.3%) patients and large for 16 (66.7%) patients in Group 2 (p= 0.002). Postoperative complaints including burning, tearing, redness, and photophobia were not significantly different between the groups (p= 0.127, p= 0.083, p= 0.073, and p= 0.102, respectively). In contrast, foreign body sensation (3.0 vs. 5.0, p= 0.002), eyelid swelling (1.0 vs. 3.5, p= 0.001), and blurriness (4.0 vs. 7.0, p= 0.043) were significantly higher in patients with VAS score ≥5. Moreover, mean VAS score was 2.1 in Group 1 and 7.0 in Group 2, which was significantly higher for Group 2 (p= 0.001) (Table 2).

Multivariate regression analysis revealed that sex, preoperative pain, and blurriness were not risk factors for postoperative pain following T-PRK (p= 0.694, p= 0.143, and p= 0.593, respectively). However, being under the age of 30 was a predictive factor for higher postoperative pain (p= 0.020). In addition, larger ablation depth, presence of foreign body sensation, and eyelid swelling increased postoperative pain by 2.182 times, 2.667 times and 2.812 times, respectively (p= 0.032, p= 0.004, and p= 0.006, respectively). The multivariate regression analysis of factors associated with postoperative pain following T-PRK is presented in Table 3.

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Table 1. Comparison of patient demographic data according to VAS scores

	VAS score <5 (n:40)	VAS score ≥5 (n:24)	P value
Age (years)*	29.9 ± 6.8	23.2 ± 5.1	0.001 [a]
Sex, n (%)			0.049 [b]
Male	20 (50.0%)	18 (75.0%)	
Female	20 (50.0%)	6 (25.0%)	
Sphere (D) **	-2.10 (-2.95 / -1.19)	-2.95 (-3.00 / -1.75)	0.733 [c]
Cylinder (D) **	-0.75 (-1.00 / -0.25)	-0.80 (-1.25 / - 0.5)	0.647 [c]
Best corrected visual acuity (logMAR) **	-0.03 (-0.07 / -0.01)	-0.02 (-0.05 / -0.01)	0.456 [c]
Intraocular pressure (mmHg) *	15.8 ± 2.9	16.0 ± 1.9	0.646 [a]
Pachymetry (µm) *	555.1 ± 28.2	568.5 ± 30.5	0.078 [a]
BMI (kg/m^2) *	29.7 ± 4.2	27.9 ± 4.4	0.127 [a]
Hypertension, n (%)	2 (5.0%)	-	NA
Education status, n (%)			0.904 [b]
Illiterate - Primary school	3 (7.5%)	2 (8.3%)	
High school - University	37 (92.5%)	22 (91.7%)	
Smoking status, n (%)	7 (17.5%)	4 (16.7%)	0.932 [b]

*mean ± standard deviation, **median (IQR) VAS: visual analog score, BMI: body mass index, NA: not applicable, a: independent student t-test, b: χ2 test, c: Mann - Whitney u test

Table 2. Comparison of operation-related data between groups

	VAS score <5 (n:40)	VAS score ≥5 (n:24)	P value
Preoperative pain, n (%)	8 (20.0%)	12 (50.0%)	0.012 [b]
Ablation depth, n (%)			0.002 [b]
Small	29 (72.5%)	8 (33.3%)	
Large	11 (27.5%)	16 (66.7%)	
Postoperative complaint **			
Burning	2.5 (2.0 – 4.0)	4.0 (1.3 – 6.0)	0.127 [c]
Foreign body sensation	3.0 (2.0 – 4.0)	5.0 (3.3 – 8.0)	0.002 [c]
Tearing	3.0 (3.0 – 4.0)	4.0 (2.3 – 7.0)	0.083 [c]
Redness	4.0 (3.0 – 5.0)	4.5 (4.0 – 5.8)	0.073 [c]
Photophobia	4.0 (2.0 – 6.0)	5.0 (3.0 – 8.0)	0.102 [c]
Eyelid swelling	1.0 (0 – 2.0)	3.5 (1.0 – 5.0)	0.001 [c]
Blurriness	4.0 (3.0 – 5.0)	7.0 (4.0 – 8.0)	0.043 [c]
VAS score *	2.1 ± 0.9	7.0 ± 1.8	0.001 [a]

*mean ± standard deviation, **median (IQR), VAS: visual analog score, a: independent student t-test, b: χ2 test, c: Mann - Whitney u test

DISCUSSION

Myopia with or without astigmatism is a common health problem, and surgical treatment is an option for myopia and/or astigmatism treatment. T-PRK is a well-defined surgical technique for the management of myopia with or without astigmatism with acceptable success and complication rates (10,11). However, postoperative pain is an undesirable outcome of T-PRK, resulting in a deterioration in quality of life, loss of productivity, and increased hospital admissions. We believe that identifying the factors that cause pain following T-PRK is important for informing patients, preventing pain and managing it effectively. Thus, this study was conducted for the first time to identify factors associated with pain following T-PRK. Our findings revealed that age <30 years, deeper ablation during

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Table 3. Multivariate analysis of factors associated with the development of postoperative pain

	Odds ratio	95% CI	P value*
Age (<30 years vs >30 years)	0.780	0.633 – 0.962	0.020
Sex	1.565	0.168 – 14.627	0.694
Preoperative pain	0.165	0.015 – 1.839	0.143
Ablation depth	2.182	1.344 – 3.303	0.032
Foreign body sensation	2.667	1.379 – 5.158	0.004
Eyelid swelling	2.812	1.338 – 5.912	0.006
Blurriness	1.155	0.681 – 1.958	0.593

CI: Confidence interval, *Logistic regression analysis

the procedure, foreign body sensation and eyelid swelling were predictive factors for postoperative pain following T-PRK.

The impact of age on postoperative pain is a controversial issue, and the correlation between age and postoperative pain is still under investigation. Vand Dijk and colleagues evaluated the importance of age for four common surgeries including spinal surgery, knee or hip replacement, and laparoscopic cholecystectomy by analyzing data from 11510 patients. The authors concluded that postoperative pain severity decreased significantly with increasing age (12). Henzler et al. reviewed the risk factors for postoperative pain following ophthalmic surgery and found that age was not a predictive factor (13). In contrast, Ghanem et al. investigated the risk factors for postoperative pain following keratoconus surgery in 135 patients. The authors concluded that severe pain decreased with increasing age (14). Similarly, we found patients with age >30 years old had significantly less pain following the T-PRK procedure. We believe that decreased sensitivity of the peripheral sensory nervous system with age plays a role in this result.

To our knowledge, previous studies have not intensively investigated the association between ablation depth and postoperative pain following T-PRK. However, Munnerlyn and colleagues emphasized the correlation between larger ablation size during PRK and increased postoperative recovery period and postprocedural pain (15). In another study by Al-Mohaimeed, ablation depth increased with increasing myopia severity, which resulted in significantly higher complications (16). In this study, significantly higher postoperative pain after T-PRK with regards to VAS score was present in patients with larger ablation depth. We hypothesize that deeper ablation can cause more inflammation, which may cause significantly higher pain.

Postoperative symptoms following ocular surgeries may decrease patient quality of life and postoperative pain. Porela-Tiihonen and colleagues analyzed the predictive factors for pain after cataract surgery, and the authors claimed that foreign body sensation and itching were the most common symptoms with potential roles in postoperative pain following cataract surgery (17). In another study, Dell and colleagues stated that many ophthalmologists ignored patient symptoms which cause pain following ocular surgeries (18). In the present study, foreign body sensation and eyelid swelling were predictive factors for postoperative pain following T-PRK. We believe that evaluating patients following T-PRK in terms of eyelid swelling and foreign body sensitivity and initiating treatment immediately for patients exhibiting symptoms will reduce postoperative pain.

Although this is the first research to demonstrate risk factors for postoperative T-PRK pain, the present study involves some limitations. First of all, the study included a relatively small patient number from one center and analyzed the experience of one surgeon. However, in studies involving more than one surgeon and more than one center, differences in surgeons' experience, in preoperative evaluation techniques and in postoperative follow-up schemes may negatively affect the standardization of results. Also, the lack of information about the long-term results of T-PRK on patient postoperative pain and quality of life is accepted as another limitation for this study. Lastly, this study did not analyze medications used for pain and symptoms following T-PRK or the cost of these medications, which could be the subject of further

prospective studies.

CONCLUSION

The present study demonstrated that almost two out of five individuals who underwent T-PRK suffered from severe pain following the procedure. Our findings demonstrated that younger age below 30 years, larger ablation depth, and symptoms including foreign body sensation and eyelid swelling were predictive factors for severe postoperative pain following the T-PRK procedure. We believe that considering these risk factors when providing patient information and during the procedure, as well as when making treatment arrangements after the procedure, will be effective in controlling pain following T-PRK.

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The authors declare that they have no conflict of interest to disclose

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