

## ORIGINAL ARTICLE

# THE COMPARISON OF TRANSEPITHELIAL VERSUS CONVENTIONAL PHOTOREFRACTIVE KERATECTOMY

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## ABSTRACT

**Introduction :** Photorefractive keratectomy (PRK) is the first choice in treating myopia for eyes with mildly irregular and/or thin corneas because it preserves corneal integrity. A laser-assisted method for epithelial removal, termed Transepithelial PRK (T-PRK), was introduced as an alternative to conventional PRK, which gives a smoother corneal surface than that achieved with mechanical ablation of the epithelium in conventional PRK.

**Objective:** To compare emmetropization between patients treated with T-PRK and conventional PRK.

**Methods:** This study was an observative comparative analytic study with case-control study design. Myopic eyes treated by T-PRK (study group) were compared with variable-adjusted eyes treated by conventional PRK (control group), from year 2015-2018 at Dr. YAP Eye Hospital Yogyakarta. Patients were divided into 3 groups based on the degree on myopia; mild (spherical minus 0-3D), moderate (4-6D), and severe ( $\geq 7D$ ). Emmetropization within 1 month follow-up and treatment time were analyzed.

**Results:** In all of the cases reviewed, the total percentage of patients treated with T-PRK who reached emmetropization within 1 month follow-up was 21.51% (17/79 eyes), with 33.34% (9/27 eyes) in mild, 28.57% (6/21 eyes) in moderate, and 6.45% (2/31 eyes) in severe myopia group; compared to the control group which was 22.78% (18/79 eyes) ( $p=0.848$ ), with 48.14% (13/27 eyes) in mild, 15% (3/20 eyes) in moderate, and 6.25% (2/32 eyes) in severe myopia group. Treatment time in the study group was relatively faster compared to the control group.

**Conclusions:** The study group showed slightly better result in treating moderate myopia within 1 month follow-up. Treatment time was relatively faster compared to the control group.

**Keywords:** photorefractive keratectomy, transepithelial, subepithelial, myopia

## INTRODUCTION

Myopia is a common refractive error in the literate countries and is related to education and different level of occupational groups. Some educational institutions request good or even best visual acuity such as military academy, vocational school, etc. Optimal refractive correction was mandatory for those candidates. One of the modalities to correct myopia is photorefractive keratectomy (PRK)<sup>(1)</sup>.

In the late 1990s, PRK popularity started decreasing after the emerge of laser in situ keratomileusis (LASIK), which offered a painless spherocylindrical error correction with fast

visual recovery and no clinically significant haze. However, the most feared adverse events of LASIK include flap-related complications, both intraoperatively and years later. Thus, in this respect, PRK is safer because there is no flap involved. It is the first choice for eyes with mildly irregular and/or thin corneas because it preserves corneal integrity<sup>(2)</sup>.

*Transepithelial PRK* (T-PRK) a laser-assisted method for epithelial removal, was introduced as an alternative to conventional PRK<sup>(3)</sup>. In this method, epithelial removal was performed in a phototherapeutic keratectomy (PTK) mode, giving a smoother corneal surface than that achieved with mechanical ablation of epithelium. However, because of the curvature of the cornea, the energy of the incident laser beam on the cornea periphery is reduced as a result of the oblique incidence of laser rays on the periphery and the longer distance the beam must travel. This leads to some loss of laser energy, resulting in uneven epithelial removal and, subsequently, irregular healing<sup>(2)</sup>.

This paper reports 79 myopic eyes, with or without astigmatism, that had T-PRK. We compared emmetropization reached within 1 month follow-up and treatment time between T-PRK and a variable-adjusted control group that had conventional PRK.

## **METHODS**

### **1.) Patient Populations.**

This retrospective study was performed at Dr. YAP Eye Hospital Yogyakarta. The data was taken from medical records between January 2015 and February 2018. Patients with a total of 79 myopic eyes on each study and control group were divided into 3 groups based on the degree of myopia; mild (spherical minus 0 – 3 D), moderate (minus 4 – 6 D), and severe (minus  $\geq 7$  D) myopia. Those in study group had T-PRK, whereas patients had conventional PRK in control group. Both groups were matched for range of age and degree of refractive error. We used 10 years range of age group to match the potential of myopia progression in each groups, as stated in the previous study by Kleves<sup>(4)</sup> regarding adult myopia. In that study the age groups were divided based on 5 years range of age group, but because in this study we used 10 years range because of the less amount of study subjects compared to study by Kleves<sup>(4)</sup>.

### **2.) Surgical Technique.**

All T-PRK and conventional PRK procedures were done by experienced surgeons. The standard preoperative procedure for both groups was the same, included preoperative examination of a complete ophthalmological status, central corneal thickness and keratometry reading, and Schirmer test. Preoperative medication were also given to both groups, included

the administration of 5 mg of oral Clobazam, 50 mg of oral Diclofenac Potassium, 1 drop of Tetracaine 2%, and 1 drop of Chloramphenicol 0.25%. The eye was then given topical anesthesia, clean aseptically, and was inserted with Lieberman eyelid speculum. The fellow eye was occluded. Two minutes later, mechanical epithelial debridement of the central cornea, which was previously marked with a 7.5 mm epithelial trephine, was accomplished using a rotating soft brush, followed by a myopic photo ablation performed using the Excimer Technolas T217 P.

In the study group, the epithelium and stroma were ablated in a single step using the TPRK software (Technolas T217 P 100), which based on a spherical ablation profile, that can automatically consider the ablation volume of the epithelium. It takes into account the difference in epithelial thickness between the center and the periphery of the cornea and delivers different ablation energies to the epithelium and stroma.

After photo ablation, a merocel sponge soaked in Mitomycin-C 0.02% solution was applied to the corneal stroma for one minute and was irrigated using 30 mL of balanced salt solution. A bandage contact lens was placed on the cornea afterwards. At the end of the procedure, all patients received the same post-operative medications which were Gatifloxacin eyedrop, Fluorometholone 0.1% eyedrop, artificial tears, oral Levofloxacin, oral Diclofenac Potassium, oral Diaepam, and oral vitamin C. The duration of the surgery was recorded, started from the placement of the eyelid speculum and ended after the bandage contact lens was placed.

### **3.) Postoperative Care and Follow-up.**

Patients did a follow-up at day 1 after the procedure, 1 week, 2 weeks, 1 month, 2 months, and 3 months. The components of the follow-up was uncorrected distance visual acuity (UDVA), corrected distance visual acuity (CDVA), manifestation of refraction, and postoperative pain. All patients' bandage contact lens was kept in place until full corneal re-epithelization occurred. Patients were treated with steroid (Fluorometholone sodium 2%) afterwards. This study was limited to note the number of the patients that reached emmetropization on 1 month follow-up. Emmetropization is defined as visual acuity equal to 6/6 on Snellen chart examination.

### **4.) Statistical Analysis.**

The patients' preoperative and postoperative characteristics were analyzed using repeated-measures analysis of variance. Statistical analysis was performed using SPSS software (version 23.0, SPSS, Inc.). Correlations between preoperative and postoperative independent

variables were determined using Pearson correlation coefficient. A *P* value less than 0.05 was considered statistically significant.

## RESULTS

The study group and the control group each comprised 79 eyes. Table 1 shows the preoperative characteristics of the patients.

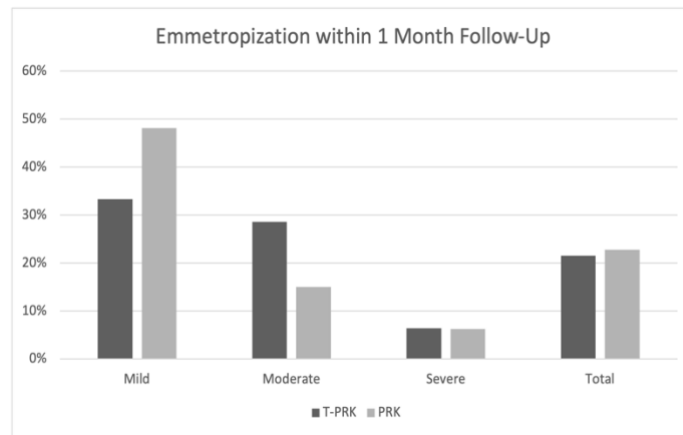
**Table 1.** Preoperative Characteristics of Study Subjects

Characteristics	T-PRK	PRK
Gender (n)	42	42
Female	17	17
Male	25	25
Age (n)	42	42
≤ 20 yo	15	15
21 – 30 yo	18	18
31 – 40 yo	3	3
41 – 50 yo	4	4
> 50 yo	2	2
Degree of Myopic Eyes (n)	79	79
Mild (0 – 3 D)	27	27
Moderate (4 – 6 D)	21	20
Severe (≥ 7 D)	31	32

From Table 1 above, we could see that the preoperative characteristics of the patients in both groups were almost similar to each other at the component of age groups and the degree of myopia.

**Table 2.** Emmetropization within 1 Month Follow-Up

Degree of Myopic Eyes	T-PRK	PRK	<i>P</i> value
Mild	9/27 (33.34%)	13/27 (48.14%)	
Moderate	6/21 (28.57%)	3/20 (15.00%)	
Severe	2/31 (6.45%)	2/32 (6.25%)	
Total	17/79 (21.51%)	18/79 (22.78%)	0.848



**Figure 1.** Comparison of Emmetropization between Study Groups

In all of the cases reviewed, as seen in Table 2 and Figure 1, the total percentage of patients treated with T-PRK who reached emmetropization within 1 month follow-up was 21.51% (17/79 eyes), with 33.34% (9/27 eyes) in mild, 28.57% (6/21 eyes) in moderate, and 6.45% (2/31 eyes) in severe myopia group; compared to the control group which was 22.78% (18/79 eyes) ( $p=0.848$ ), with 48.14% (13/27 eyes) in mild, 15% (3/20 eyes) in moderate, and 6.25% (2/32 eyes) in severe myopia group.

**Table 3.** Treatment Time

Parameter	T-PRK	PRK
Total Treatment Time (min)	2,779	2,783
Mean Treatment Time (min)	35.17	35.22

From Table 3 above, the total time needed for the T-PRK group for 79 patients was 2779 minutes, with mean treatment time was 35.17 minutes. In PRK group, the total time needed was 2783 minutes, with mean treatment time was 35.22 minutes. From that results we could see that treatment time needed for T-PRK procedure was slightly shorter than conventional PRK procedure.

## DISCUSSIONS

In previous studies, transepithelial PRK was stated to be an effective procedure to correct irregular astigmatism after keratoplasty or radial keratotomy<sup>(5,6)</sup>. It had also been found to be a good option for immediate retreatment of LASIK flap complications<sup>(7)</sup>. In other studies also showed that T-PRK was better than conventional PRK regarding epithelial healing time, postoperative pain, safety and efficacy indexes, and visual acuity recovery<sup>(8,9)</sup>.

In our study, the T-PRK group (study group) and the conventional PRK group (control

group) had comparable preoperative characteristics of the study subjects. Even though there were no statistical difference in the results of the study, the study group had almost the same time of epithelial healing as seen in the comparable percentage of the emmetropization status reached both in every group of myopia and in the total amount of study subjects.

Previous study reported that T-PRK could cause more intense inflammatory response and a greater increase in backscattering of light associated with increased keratocyte activation and myofibroblast transformation after laser-epithelial ablation<sup>(10)</sup>. Other study reported that in T-PRK, the precise, smooth, and regular epithelial ablation by the laser was equal in diameter to the ablated zone and was thus smaller than the mechanical - removed epithelium<sup>(11)</sup>. The stromal bed was also more uniform with no epithelial islands centrally and there was a smoother peripheral progression in the study group than in the control group<sup>(12)</sup>. Our results agree with those reported by Ghoreishi *et al.* study<sup>(12)</sup> in which epithelial healing, postoperative pain, visual outcomes, and complications were equivalent between mechanical epithelial debridement and alcohol epithelial debridement. Alcohol which was used was usually in the form of 20 % Ethanol, applied using a 9 mm well for 10 seconds, followed by epithelial removal using a spatula<sup>(13)</sup>. Epithelial debridement using alcohol was avoided in some study due to the potential toxicity towards limbal stem cells, more aggressive postoperative pain, slower healing time of corneal haze, and slower visual recovery<sup>(2,14)</sup>.

In this study, there were 21.51% and 22.78% of the eyes in the study and control group respectively that achieved emmetropiation within 1 month follow up. The cause of this result might be because of the short period of cut-off point of time at the follow-up, which was 1 month postoperative. At the previous study, although a complete epithelial healing could be achieved in 3 days postoperative<sup>(13)</sup>, the visual acuity was constantly stabilized between 3 months<sup>(15)</sup> and 12 months<sup>(13)</sup> postoperative follow-up.

The study subjects also reported less treatment / procedure time and discomfort compared to those in the control group. This shorter amount of procedure time was reported to decrease dehydration of the corneal stroma<sup>(2)</sup> and was believed to give a better surgical outcome.

This study have several limitations. Firstly, a longer follow-up period (at least 6 months) is needed to comprehensively evaluate visual acuity and the other ophthalmological status of the study subjects. Secondly, no objective photographs were taken, even though the same observer was masked to surgical technique when assessing epithelial healing, some bias might occurred. The strengths of our study include a large sample size, comparable preoperative characteristics between study and control group, and no reports pertaining adverse events in patient associated by any of the treatment methods.

## CONCLUSIONS

In conclusion, this study highlighted the advantages of T-PRK technique over conventional PRK. Both groups showed almost the same result in emmetropization reached at 1 month follow-up. The study group showed slightly better result in treating moderate myopia within 1 month follow-up. Treatment time was relatively faster compared to the control group. Transepithelial PRK seems to be a safe and effective technique for treatment of mild to moderate myopia. A randomized prospective study with a longer follow-up period is required to confirm and strengthen the results of the current study.

## FINANCIAL DISCLOSURES

None

## CONFLICT OF INTERESTS

None

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