

# Effect of Laser-Assisted in Situ Keratomileusis versus Trans Photo Refractive Keratectomy on Corneal Endothelial Cell Count



Omar Irfan Sheen<sup>1</sup>, Shagufta Parveen<sup>2</sup>, Teyyeb Azeem<sup>3</sup>, Aisha Fawad<sup>4</sup>, Ali Irfan Sheen<sup>5</sup>  
<sup>1-4</sup>Armed Forces Institute of Ophthalmology, Rawalpindi, <sup>5</sup>Mayo Hospital, Lahore

## ABSTRACT

**Purpose:** To compare the effect of Laser-Assisted in Situ Keratomileusis (LASIK) and Trans Photo Refractive Keratectomy Trans-PRK on Corneal Endothelial Cell Count.

**Study Design:** Quasi experimental study.

**Place and Duration of Study:** Armed Forces Institute of Ophthalmology, Rawalpindi, from January 2023 to December 2024.

**Methods:** A total of 150 eyes from 150 patients were divided into two groups; LASIK and Trans-PRK groups with 75 eyes each. Age range was 20-40 years with moderate refractive errors and with no previous disease or surgical history. The study excluded patients who had Fuchs' dystrophy, keratoconus, pregnancy, diabetes, glaucoma, past ocular surgery, trauma or any other corneal and ocular pathology. Endothelial cell count (ECC) was assessed at baseline and at 12 months postoperatively.

**Results:** The ECC in the LASIK group decreased from  $2984 \pm 52$  cells/mm<sup>2</sup> preoperatively to  $2935 \pm 62$  cells/mm<sup>2</sup> at 12 months ( $p < 0.001$ ). In the Trans-PRK group, ECC decreased from  $3011 \pm 39$  cells/mm<sup>2</sup> preoperatively to  $2960 \pm 51$  cells/mm<sup>2</sup> at 12 months ( $p < 0.001$ ). The mean change in endothelial cell count was  $-49$  cells/mm<sup>2</sup> in the LASIK group and  $-51$  cells/mm<sup>2</sup> in the Trans-PRK group at 12 months. There was no statistically significant difference in cell count ( $p = 0.86$ ) at 12 months between the two groups.

**Conclusion:** Both LASIK and Trans-PRK showed a statistically significant reduction in endothelial cell count within groups at 12 months. However, no significant difference was observed between the two procedures, indicating comparable effects on endothelial cell count.

**Keywords:** Astigmatism, Endothelium, Keratomileusis, Laser in Situ, Myopia, Photorefractive Keratectomy, Refractive Surgical Procedures.

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*Correspondence: Omar Irfan Sheen  
Armed Force Institute of Ophthalmology, Rawalpindi  
Email: omarirfan.95@gmail.com*

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## INTRODUCTION

Refractive errors are commonly corrected through

corneal refractive surgical procedures designed to reshape the cornea and achieve emmetropia.<sup>1,2</sup> Among the most widely performed techniques are Laser in Situ Keratomileusis (LASIK) and Photorefractive Keratectomy (PRK), including its surface-ablation variant, transepithelial PRK (Trans-PRK). These procedures utilize an excimer laser to alter corneal curvature and improve refractive outcomes.<sup>3,4</sup>

LASIK involves creation of a corneal flap followed by stromal laser ablation, which allows rapid

visual recovery and minimal postoperative discomfort.<sup>5</sup> In contrast, Trans-PRK is a surface ablation technique in which the corneal epithelium and anterior stromal tissues are removed directly by the excimer laser without flap creation. Because Trans-PRK involves direct ablation of the corneal surface and greater exposure of stromal tissue, it may induce different biomechanical and cellular responses compared with LASIK.<sup>6,7</sup>

Most previous studies have primarily focused on post-operative changes in corneal curvature, epithelial thickness, and visual outcomes following refractive surgery.<sup>8</sup> However, relatively limited attention has been given to the potential effects of these procedures on the corneal endothelium. The corneal endothelium plays a critical role in maintaining corneal transparency by regulating stromal hydration. Reduction in endothelial cell density may compromise long-term corneal health.<sup>7</sup> Since LASIK and Trans-PRK differ in their surgical technique and depth of tissue interaction, their potential effects on corneal endothelial cell parameters may also vary. Therefore, evaluation of endothelial cell density following these procedures is important to assess their safety and long-term impact on corneal integrity.

The corneal endothelium has limited regenerative capacity; therefore, any procedure that may influence ECC warrants careful evaluation. Although excimer laser ablation primarily affects the anterior corneal layers, thermal effects, shock waves, or deeper stromal interactions may theoretically influence endothelial cells.<sup>6</sup> Since LASIK involves stromal ablation beneath a corneal flap, while Trans-PRK removes the epithelium and ablates the anterior stroma directly without flap creation, differences in surgical technique could potentially produce different effects on corneal endothelial parameters.

In Pakistan, the demand for refractive surgery is steadily increasing, particularly in tertiary care centers. However, local data regarding the long-term safety of these procedures on corneal endothelium is limited. Variations in patient characteristics, environmental factors, surgical techniques, and postoperative care may influence outcomes, highlighting the need for region-specific evidence. Therefore, this study was conducted at a tertiary care ophthalmic center to compare the effects of LASIK and Trans-PRK on corneal endothelial cell count over a 12-month period, to provide locally relevant evidence regarding the endothelial safety profile of these commonly

performed refractive procedures. Such data may assist clinicians in procedure selection and contribute to informed decision-making for patients undergoing refractive surgery.

## METHODS

This was a quasi-experimental study conducted to evaluate the effects of LASIK and Trans-PRK on corneal ECC and morphology. The research was conducted at Armed Forces Institute of Ophthalmology, Rawalpindi, between January 2023 and December 2024 and approved by the institutional ethical review board (**Reference number 304/ERC/AFIO**). Informed consent was obtained from all participants prior to enrolment in the study. The patient follow-up was at 12 months after surgery. Convenient sampling technique was used. The research included participants aged 20 to 40 years, who were divided into two groups: LASIK and Trans-PRK group. The sample size was calculated using OpenEpi online calculator (version 3) using a formula comparing two means, taking endothelial cell density as the primary outcome variable. Using a confidence level of 95% and power of 80%, the minimum required sample size was calculated to be 75 eyes per group. Each eye was considered an independent unit of analysis. Patients with myopia or astigmatic refractive errors of up to -6.0 Dioptres spherical equivalent (SE) and stable refraction for one year were included. Detailed pre-operative workup included topography, tomography along with anterior and posterior segment examination on slit lamp. Endothelium evaluation was done with a specular microscope (Topcon SP-3000P, Topcon, Japan). ECC was recorded by taking an average of three readings. The study excluded patients who had Fuchs' dystrophy, keratoconus, pregnancy, diabetes, glaucoma, past ocular surgery, trauma or any other corneal and ocular pathology. In the LASIK group, flap was created with a Femtosecond laser (Alcon Wave Light FS200, Alcon, Switzerland) followed by flap lifting and ablation with the help of excimer laser (Alcon Wave Light EX500, Alcon, Switzerland). In the Trans-PRK group, transepithelial mode was chosen for epithelium ablation according to epithelial map followed by stromal ablation as per the refractive error data, all done with the excimer laser (Alcon Wave Light EX500, Alcon, Switzerland). This was followed by Mitomycin C, 0.02% application for 20 seconds. All procedures were carried out under standard operating protocols. ECC was the main

outcome measure to compare between pre-operative baseline and post-operative follow-up at 12 months. All data collection points began before surgery and at 12 months post-operatively to measure corneal ECC (cells/mm<sup>2</sup>) along with ocular health status. The data was analysed by IBM-SPSS version 23. The statistical evaluation included descriptive statistics for baseline and post-operative data including mean, standard deviation and range. The research evaluated pre-operative and post-operative ECC within each group by conducting paired t-tests. Independent t-tests analysed the mean differences in ECC between LASIK and Trans-PRK groups. A p value of < 0.05 was considered significant.

## RESULTS

The participants in the LASIK and Trans-PRK groups had comparable mean ages with  $p = 0.63$ . The proportion of male patients was slightly higher in both groups but remained similar overall, with 56% in the LASIK group and 55% in the Trans-PRK group ( $p = 0.88$ ). Comparison of baseline refractive error between the two groups also showed no statistically significant difference as presented in Table 1.

The ECC diminished after surgery in both LASIK and Trans-PRK groups when comparing pre-operative results to measurements at 12 months post-operatively. The LASIK procedure had a baseline ECC of  $2984 \pm 52$  cells/mm<sup>2</sup> which decreased to  $2935 \pm 62$  cells/mm<sup>2</sup> at twelve months ( $p < 0.001$ ). The Trans-PRK group showed a pre-operative ECC of  $3011 \pm 39$  cells/mm<sup>2</sup> which decreased to  $2960 \pm 51$  cells/mm<sup>2</sup> at 12 months ( $p < 0.001$ ). This reduction in each group was statistically significant; however, the magnitude of change was not clinically significant.

**Table 1:** Baseline characteristics of LASIK Group and Trans-PRK Group.

Characteristic	LASIK Group (n=75)	Trans-PRK Group (n=75)	p-value
Age (years) (Mean $\pm$ SD)	30.5 $\pm$ 6.2	31.1 $\pm$ 6.4	<b>0.63</b>
Gender (Male)	42 (56%)	41 (55%)	<b>0.88</b>
Refractive Error (D) (Mean $\pm$ SD)	-4.0 $\pm$ 2.0	-3.75 $\pm$ 2.0	<b>0.83</b>

The mean change in ECC was -49 cells/mm<sup>2</sup> in the LASIK group and -51 cells/mm<sup>2</sup> in the Trans-PRK group at 12 months. Inter-group comparison showed no statistical significance with  $p > 0.05$ .

## DISCUSSION

In the present study, a comparable decline in corneal endothelial cell count was observed in both groups, with Trans-PRK showing a slightly greater reduction than LASIK. However, the magnitude of this decrease remained small. Previous studies have generally reported no statistically significant differences between pre-operative and post-operative endothelial parameters following refractive surgery.<sup>7</sup> Many researches have demonstrated comparable efficacy and safety profiles for both procedures, although endothelial health has not always been specifically evaluated.<sup>9</sup> Long-term evidence suggests that refractive procedures have minimal impact on corneal endothelium. One study reported an endothelial cell loss of approximately 5.3% over nine years following LASIK and PRK; however, the annual rate of decline was comparable to that seen in normal corneas.<sup>7</sup> Furthermore, endothelial cell count remained similar between PRK and LASIK groups without significant changes over time.

Another study has noted refractive outcome variations between procedures, reporting a tendency toward overcorrection in Trans-PRK and under correction in LASIK, potentially related to better unaided visual acuity observed in the Trans-PRK group.<sup>8</sup> In our study, both LASIK and Trans-PRK demonstrated comparable treatment efficacy, although Trans-PRK showed a slightly greater effect on endothelial cell density.

A potential advantage of Trans-PRK over LASIK lies in its preservation of corneal structural integrity, as it avoids the creation of a corneal flap. As suggested by Wu et al, the absence of flap formation may reduce biomechanical alterations within the cornea.<sup>9</sup> Consistent with our findings, most previous studies have reported no clinically significant differences in endothelial parameters before and after refractive procedures.<sup>10</sup>

The use of Mitomycin-C (MMC) during PRK has also been evaluated extensively. Several studies have shown that intraoperative MMC does not significantly affect corneal endothelial cell count.<sup>11,12</sup> Evidence indicates that MMC can be safely and effectively used to prevent postoperative corneal haze following Trans-PRK in myopic patients.<sup>13</sup> Nevertheless, some authors recommend cautious use in highly myopic eyes.<sup>14</sup>

Overall, refractive surgery procedures exert minimal effects on the corneal endothelium.

Experimental data suggest that stromal laser ablation performed within approximately 200  $\mu\text{m}$  of the endothelium may induce structural endothelial changes and amorphous deposits on Descemet's membrane, although such effects are rarely encountered in routine refractive surgery.<sup>10</sup> Long-term studies have demonstrated minimal endothelial alterations even up to ten years after LASIK.<sup>15</sup>

Special considerations have also been described in patients with corneal dystrophies. In individuals with posterior polymorphous corneal dystrophy, PRK has been reported to be safe when the endothelial cell count exceeds 2000 cells/ $\text{mm}^2$ .<sup>16</sup> Conversely, unfavorable outcomes have been described in Avellino dystrophy and Fuchs endothelial corneal dystrophy following LASIK.<sup>17</sup> In general, LASIK has been widely performed for the correction of myopia, with most studies reporting stable endothelial cell counts, although isolated reports have noted transient postoperative declines.<sup>10</sup>

The study does not account for the physiological endothelial cell decline and changes associated with age which can be a confounding factor on the results. The measurement discrepancies of specular microscopy were not considered which can affect the endothelial cell counts. The assessment of long-term changes in endothelial cell count is restricted by the short follow-up duration. The current study utilized a sufficient sample size for statistical purposes, yet researchers might achieve better representation of the general population and identify unknown variables if the sample size was increased.

## CONCLUSION

Both LASIK and Trans-PRK resulted in a comparable reduction in corneal ECC at 12 months post-operatively. Despite achieving statistical significance, the degree of endothelial cell loss was minimal and clinically insignificant, with no anticipated impact on corneal endothelial function or corneal transparency.

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**Patient's Consent:** Researchers followed the guidelines set forth in the Declaration of Helsinki.

**Conflict of Interest:** Authors declared no conflict of interest.

**Ethical Approval:** The study was approved by the Institutional review board/Ethical review board (304/ERC/AFIO)

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### **Authors Designation and Contribution**

Omar Irfan Sheen; PGR: *Concepts, Design, Literature search, Data acquisition, Data analysis, Statistical analysis, Manuscript preparation, Manuscript editing, Manuscript review.*

Shagufta Parveen; Consultant Ophthalmologist: *Concepts, Design, Literature search, Manuscript review.*

Teyyeb Azeem; Consultant Ophthalmologist: Consultant Ophthalmologist: *Concepts, Design, Literature search, Manuscript review.*

Aisha Fawad; Consultant Ophthalmologist: Consultant Ophthalmologist: *Concepts, Design, Literature search, Manuscript review.*

Ali Irfan Sheen; House Officer: *Data analysis, Statistical analysis, Manuscript preparation, Manuscript editing, Manuscript review.*

