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Effect of Laser-Assisted in Situ Keratomileusis on Endothelial Cell Count

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ABSTRACT

Background: LASIK is a popular refractive surgery for correcting myopia, but its impact on endothelial cell count (ECC) remains uncertain, with potential implications for corneal health.

Objective: To determine the effect of LASIK on ECC in myopic patients.

Methods: A cross-sectional study was conducted at Military Hospital, Rawalpindi, from January to July 2023. A total of 178 myopic patients (38.76% males, 61.24% females; mean age 25.21 ± 8.19 years) underwent LASIK. Baseline and post-procedural ECC were measured using specular microscopy at one week, one month, and three months post-LASIK. Central corneal thickness (CCT) and best corrected visual acuity (BCVA) were also assessed. Data analysis was performed using SPSS version 25, with paired t-tests for comparisons and significance set at $p \leq 0.05$.

Results: Mean ECC decreased from 2897.49 ± 93.52 cells/mm^2 at baseline to 2892.36 ± 94.21 cells/mm^2 at one week, 2846.65 ± 93.80 cells/mm^2 at one month, and 2811.10 ± 90.66 cells/mm^2 at three months post-LASIK ($p < 0.001$). Mean CCT also significantly decreased at all time points ($p < 0.001$).

Conclusion: LASIK significantly reduces ECC, highlighting the need for careful postoperative monitoring of corneal health.

INTRODUCTION

Refractive errors, including myopia, significantly impact individuals' quality of life by impairing visual acuity and making daily tasks challenging (1). Myopia, or near-sightedness, is prevalent among younger populations, with a reported frequency of up to 52% in Pakistan (3). Spectacles are the most common corrective measure for myopia, but they are often associated with a diminished quality of life, especially among younger individuals who find them cumbersome or cosmetically undesirable (4). Laser in-situ Keratomileusis (LASIK) has emerged as a popular alternative to spectacles, offering an effective and relatively safe method to correct refractive errors and improve visual acuity (5). LASIK involves reshaping the cornea using an excimer laser, thereby reducing dependence on corrective lenses. However, despite its efficacy, LASIK is not without risks, with complications such as flap dislocation, incomplete refractive error correction, corneal infection, epithelial ingrowth, and corneal ectasia being reported (6).

Corneal ectasia, a severe and progressive thinning of the cornea, is one of the most concerning complications post-LASIK, as it results in a deterioration of vision rather than its improvement (7). This condition is linked to a reduction in the endothelial cell count (ECC), which serves as a critical factor in maintaining corneal transparency and overall visual function. A decline in ECC can compromise corneal integrity, thus leading to vision loss (7). The potential for corneal ectasia is a significant deterrent for patients considering LASIK, particularly within the Pakistani population, where fear of this complication is a major cause of LASIK refusal (8). While numerous studies have investigated the impact of LASIK on ECC, the findings have been inconsistent, with some studies reporting significant reductions in ECC, whereas others have found no significant changes, highlighting the need for further research (9).

Given the heterogeneous results of prior studies, it remains unclear whether LASIK has a significant effect on ECC. Understanding the implications of LASIK on ECC is crucial, as the integrity of the corneal endothelium is vital for preserving corneal clarity and function. The current study aims to address this gap by evaluating changes in ECC from baseline to three months post-LASIK among a cohort of myopic patients. By comparing pre- and post-operative ECC, this study seeks to provide clarity on the potential impact of LASIK on corneal endothelial health, thereby informing clinical practice and patient counseling regarding the risks associated with this widely utilized refractive surgery technique.

MATERIAL AND METHODS

This cross-sectional study was conducted at the Armed Forces Institute of Ophthalmology (AFIO), Military Hospital, Rawalpindi, from January to July 2023, following approval from the institutional ethical review board, in compliance with the Declaration of Helsinki. The study aimed to determine the effect of Laser in-situ Keratomileusis (LASIK) on endothelial cell count (ECC) among myopic patients. A sample size of 178 was determined using the OpenEpi sample size calculator, with assumptions including a confidence interval of 95%, power of 80%, an anticipated

mean baseline ECC of 2738.7 ± 197 cells/mm^2, and an anticipated mean ECC at three months post-LASIK of 2657.8 ± 188 cells/mm^2 (10).

Participants were recruited using non-probability consecutive sampling. Inclusion criteria encompassed male and female patients aged fourteen years or above, with myopia ranging from -1.00D to -8.00D, a central corneal thickness of at least 250µm, and best corrected visual acuity (BCVA) of ≥ 6/12 (or logMAR ≤ 0.30) sustained for over a year. Patients with a history of previous vision correction procedures, high myopia, astigmatism, keratoconus, previous eye surgery, dry eye disease, active eye infection, or pregnancy were excluded. Informed consent was obtained from all participants, or from parents in cases involving minors, prior to their inclusion in the study.

Baseline characteristics such as age, gender, central corneal thickness, BCVA, duration of myopia, and ECC were recorded. Patients were advised to switch from contact lenses to spectacles two weeks before the LASIK procedure to ensure accurate measurements. Standard preoperative assessments included BCVA using a Snellen chart, with results converted to logMAR for documentation, central corneal thickness measured via ultrasound pachymetry (SunKingdom TM SK-2000AP), and ECC evaluated using specular microscopy (Topcon SP 1 TM).

The LASIK procedures were uniformly performed by a single team of ophthalmologists to minimize operator bias. During the surgery, a corneal flap of 9x9 mm width and 110 µm depth was created using a Moria One Use-plus microkeratome, followed by photo-ablation with an excimer laser (Carl Zeiss Meditec AG MEL 80). Postoperatively, patients were prescribed DexiMox® eye drops every six hours and Tears Natural® eye drops every two hours for one week. Follow-up assessments of BCVA, central corneal thickness, and ECC were scheduled at one week, one month, and three months post-procedure to monitor changes over time.

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 25. Quantitative data were represented as mean ± standard deviation, while qualitative data were expressed in terms of frequency and percentages. Comparisons of baseline and post-procedural measurements of BCVA, central corneal thickness, and ECC were performed using paired t-tests. A p-value of ≤ 0.05 was considered indicative of statistical significance. This methodological approach ensured a comprehensive evaluation of the impact of LASIK on endothelial cell health, providing valuable insights into the procedure's safety profile and potential implications for patient outcomes.

RESULTS

The results of the study included a total of 178 myopic patients who underwent LASIK. The mean age of the participants was 25.21 ± 8.19 years, with 69 males (38.76%) and 109 females (61.24%). The mean duration of myopia among the participants was 5.51 ± 1.76 years. Baseline ocular parameters included a mean central corneal thickness (CCT) of 517.84 ± 8.07 µm, best corrected visual acuity (BCVA) of 0.26 ± 0.05 logMAR, and an endothelial cell count (ECC) of 2897.49 ± 93.52 cells/mm^2.

Table 1 Demographics Parameters

Parameter	Mean ± SD
Age (years)	25.21 ± 8.19
Gender (Male)	69 (38.76%)
Gender (Female)	109 (61.24%)
Central Corneal Thickness (µm)	517.84 ± 8.07
Best Corrected Visual Acuity (logMAR)	0.26 ± 0.05
Endothelial Cell Count (cells/mm²)	2897.49 ± 93.52

Table 2 Comparison of Baseline and Post-LASIK BCVA

Parameter	Mean ± SD	p-value
Baseline BCVA (logMAR)	0.26 ± 0.05	< 0.001
Post-LASIK BCVA (logMAR)	0.003 ± 0.02	< 0.001

Table 3 Comparison of Central Corneal Thickness and Endothelial Cell Count

Parameter	Baseline	Week 1	Month 1
Central Corneal Thickness (µm)	517.84 ± 8.07	407.01 ± 10.73	411.30 ± 9.63
Endothelial Cell Count (cells/mm²)	2897.49 ± 93.52	2892.36 ± 94.21	2846.65 ± 93.80

The comparison of BCVA from baseline to post-LASIK showed a significant improvement, with the mean BCVA reducing from 0.26 ± 0.05 logMAR at baseline to 0.003 ± 0.02 logMAR post-LASIK, demonstrating a statistically significant change ($p < 0.001$). Regarding CCT and ECC, the mean CCT was significantly reduced at one week post-LASIK (407.01 ± 10.73 µm) compared to the baseline (517.84 ± 8.07 µm), and it gradually increased over time but remained significantly lower than the baseline at one month (411.30 ± 9.63 µm) and three months (414.29 ± 11.75 µm) post-procedure ($p < 0.001$ for all comparisons). Similarly, the mean ECC showed a progressive reduction from baseline (2897.49 ± 93.52 cells/mm^2) to one week (2892.36 ± 94.21 cells/mm^2), one month (2846.65 ± 93.80 cells/mm^2), and three months (2811.10 ± 90.66 cells/mm^2) post-LASIK, with all reductions being statistically significant ($p < 0.001$ for all comparisons).

These results indicate that LASIK significantly impacts the ECC and CCT, suggesting the need for careful monitoring of these parameters during the early postoperative period. The detailed tabulated data provides a comprehensive view of the observed changes in BCVA, CCT, and ECC over the follow-up period.

DISCUSSION

The present study evaluated the impact of Laser in-situ Keratomileusis (LASIK) on endothelial cell count (ECC) and central corneal thickness (CCT) in myopic patients, revealing significant reductions in both parameters over a three-month follow-up period. The findings demonstrated that while LASIK effectively improved best corrected visual acuity (BCVA), it also led to a progressive and statistically significant decrease in ECC from baseline to three months post-procedure, which aligns with some previous reports (10). These results are particularly relevant given the critical role of the corneal endothelium in maintaining corneal transparency and overall ocular health. The observed reduction in ECC raises concerns about potential long-term implications for corneal integrity, especially in the context of complications such as corneal ectasia, which has been linked to endothelial damage (7).

The significant improvement in BCVA observed post-LASIK in this study is consistent with existing literature, which has consistently reported high success rates in terms of visual acuity enhancement following LASIK (19). This underscores the efficacy of LASIK as a preferred alternative to spectacles or contact lenses for myopia correction, particularly among younger individuals who often seek refractive surgery for cosmetic reasons and to improve quality of life (4). However, the decline in CCT noted immediately post-LASIK, followed by a gradual recovery that did not return to baseline levels by the three-month mark, is a noteworthy finding. Similar trends have been reported in other studies, such as those by Kubravi et al., indicating that LASIK may cause persistent changes in corneal thickness, which could have implications for corneal biomechanics and the risk of ectasia (20).

In contrast to some studies that reported no significant changes in ECC post-LASIK, the current study found a consistent reduction in ECC at all post-operative time points. This discrepancy may be attributed to differences in study design, patient populations, or LASIK techniques used, suggesting that the impact of LASIK on ECC might be more variable than previously thought (21, 22). The study conducted by El-Din Mahmoud et al. similarly reported significant reductions in ECC among diabetic patients undergoing LASIK, highlighting that certain subgroups may be at higher risk for endothelial cell loss post-procedure (10). This variability underscores the importance of individualized patient assessment and the need for further research to clarify which factors contribute most significantly to post-LASIK endothelial changes.

The study's strengths include its focus on a well-defined cohort with clear inclusion and exclusion criteria, as well as its use of standardized measurement techniques and consistent surgical protocols, which minimized operator bias. However, there were several limitations that should be considered when interpreting the findings. The relatively short follow-up period of three months limits the ability to assess long-term effects of LASIK on ECC and CCT, and the exclusion of patients with astigmatism or high myopia may limit the generalizability of the results. Additionally, the study did not include a control group of patients who did not undergo LASIK, which could have provided a clearer context for the observed changes in ECC and CCT.

Future research should aim to include longer follow-up periods to evaluate the durability of the endothelial and corneal changes observed in this study. It would also be beneficial to investigate the effects of LASIK on ECC in diverse populations, including those with different severities of myopia and other refractive errors, to better understand the broader applicability of these findings. Moreover, exploring the role of adjunctive measures, such as corneal cross-linking, in mitigating the adverse effects of LASIK on the endothelium may offer valuable insights into improving patient outcomes. In clinical practice, it is recommended that patients undergoing LASIK, particularly those with pre-existing corneal conditions, be closely monitored for changes in ECC and CCT to promptly identify and manage any potential complications.

CONCLUSION

In conclusion, LASIK significantly improves visual acuity in myopic patients but is associated with a notable reduction in endothelial cell count and central corneal thickness, which could have implications for corneal health and the risk of complications like ectasia. These findings underscore the importance of careful preoperative assessment and postoperative monitoring of ECC and CCT in patients undergoing LASIK, particularly those with predisposing factors for endothelial damage. Clinicians should consider these risks when recommending LASIK and ensure that patients are adequately informed about the potential implications for long-term corneal integrity and visual outcomes. Enhanced understanding and vigilant follow-up can help optimize patient safety and improve overall healthcare outcomes in refractive surgery.

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