Biomedical and Biopharmaceutical Research
Abbreviation: Biomed. Biopharm. Res.
Volume: 22: Issue: 02 |Year: 2025
Page Number: 759-764

A study on Central Corneal and Corneal Epithelial Thickness Distribution in Myopic Eyes Using Spectral Domain Optical Coherence Tomography (SD-OCT)

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Article Received:27-07-2025

Article Accepted:30-07-2025

Abstract

Background: Myopia is a leading refractive error worldwide, with rising prevalence in India, particularly in South Tamil Nadu. Corneal and epithelial thickness play a vital role in ocular health and surgical outcomes, particularly in myopic patients.
Objective: To evaluate and compare the distribution of central corneal and epithelial thickness in myopic eyes using Spectral Domain Optical Coherence Tomography (SD-OCT) among a South Tamil Nadu population.
Methods: A prospective observational study was conducted involving 150 myopic eyes (MRSE -0.50D to -12.00D) of patients aged 10–40 years. Participants were categorized into low, moderate, and high myopia groups. Corneal and epithelial thickness were measured using SD-OCT across central, paracentral (2–5 mm), and midperipheral (5–6 mm) zones. Sector-wise epithelial thickness was also analyzed.
Results: A significant decrease in central corneal thickness was observed with increasing myopia ($p = 0.001$). Epithelial thickness followed a similar trend, with high myopes showing thinner epithelium compared to low and moderate myopes. The nasal-inferior sector consistently showed the thickest epithelium, while the superior sector was the thinnest. A negative correlation was noted between epithelial thickness and age ($r = -0.28$, $p = 0.03$), and a positive correlation with MRSE ($r = 0.31$, $p = 0.02$).
Conclusion: Corneal epithelial thickness shows significant variation with the severity of myopia and across different corneal regions. High myopia is associated with thinner epithelial layers. These findings underscore the importance of epithelial mapping in refractive surgery planning and myopia management, particularly in populations with high prevalence like South Tamil Nadu.

KEY WORDS: Myopia, Corneal epithelial thickness, SD-OCT, Central corneal thickness.

INTRODUCTION

Myopia, or nearsightedness, is one of the most common refractive errors worldwide and poses a significant public health concern, especially in East and Southeast Asia. In India, particularly in South Tamil Nadu, the prevalence of myopia has been rising steadily, with studies reporting that nearly 15–30% of the population in certain age groups is affected by this condition[1]. The increasing prevalence of myopia among children and young adults is linked to both genetic and environmental factors, such as prolonged near work and reduced outdoor activity. This trend underscores the need for improved diagnostic and management strategies to monitor and treat myopia effectively[2].
The cornea, being the outermost refractive surface of the eye, plays a critical role in vision, and the epithelial layer, which constitutes its outermost part, contributes significantly to maintaining the cornea's optical quality. Changes in corneal and

epithelial thickness are often associated with various ocular conditions, including myopia, keratoconus, and dry eye syndrome. Accurate measurements of corneal thickness and epithelial distribution are essential for the diagnosis and monitoring of these conditions, particularly in patients undergoing refractive surgery[3].
Spectral Domain Optical Coherence Tomography (SD-OCT) has emerged as a highly precise, non-invasive imaging tool that allows detailed evaluation of corneal and epithelial thickness. Given the increasing prevalence of myopia in South Tamil Nadu and the critical role of corneal and epithelial thickness in managing myopic patients, this study seeks to fill a gap in the literature by using SD-OCT to evaluate the corneal and epithelial thickness distribution in myopic eyes from this population.

Review of Literature
Previous studies have demonstrated that the distribution of epithelial thickness is nonuniform across the cornea and varies based on refractive status. For instance, the epithelial layer tends to be thinner in highly myopic eyes compared to those with low or moderate myopia[4,5].
Numerous studies have explored the relationship between myopia and corneal parameters. Li et al.[6] (2012) found that in myopic eyes, epithelial thickness decreases with increasing myopic refractive error, and the central cornea tends to thin progressively. Reinstein et al.[7] (2015) reported that the epithelial layer's thickness is thinnest in the superior region and thickest in the nasal-inferior sector in myopic patients. These findings are of particular relevance for corneal refractive surgeries, as an understanding of the epithelial thickness profile can help enhance the precision of such procedures and prevent complications like ectasia.
However, the majority of these studies have been conducted in Western or East Asian populations, and limited research has been performed in Indian populations, specifically in South Tamil Nadu, where distinct genetic and environmental factors may influence corneal properties. Hence, there is a need to understand the distribution of corneal and epithelial thickness in myopic eyes in this region.
Understanding these parameters will not only contribute to more accurate diagnoses but also improve outcomes in corneal refractive surgery, contact lens fitting, and early detection of conditions such as keratoconus. This data will be instrumental in tailoring clinical approaches to the unique characteristics of myopic patients in this region.

AIM:
To compare the corneal and corneal epithelial thickness distribution in myopic eyes among South Tamilnadu subjects using SD-OCT.

MATERIALS AND METHODS:
Study Design and Setting
This was a prospective observational study conducted over a period of 3 months in the Department of Ophthalmology at SMIMS, Tamil Nadu. The study aimed to compare the corneal thickness and corneal epithelial thickness distribution in myopic eyes using Spectral Domain Optical Coherence Tomography (SD-OCT).

Study Population
The study population comprised 150 eyes of 150 myopic patients aged between 10 to 40 years, with a manifest refraction spherical equivalent (MRSE) ranging from -0.50D to -12.00D. Patients were recruited from the outpatient department of ophthalmology.

Inclusion Criteria
- Age between 10 and 40 years
- Myopic refractive error with MRSE ranging from -0.50D to -12.00D

Exclusion Criteria
- Patients with keratoconus
- History of contact lens wear
- Any current or prior ocular pathology
- Presence of dry eye disorder
- History of ocular surgery or trauma

Study Procedure

Corneal and epithelial thickness were measured using Spectral Domain Optical Coherence Tomography (SD-OCT; Appasamy OSE-2000 AS). The measurements included:

- Total corneal thickness and epithelial thickness in the central 2 mm zone.
- Epithelial thickness in eight sectors of the paracentral zone (2-5 mm, referred to as ring 1).
- Epithelial thickness in eight sectors of the mid-peripheral zone (5-6 mm, referred to as ring 2).

The patients were categorized into three groups based on the degree of myopia:

- **Low myopia (Myopia-L)**: MRSE ≤ -3.00D
- **Moderate myopia (Myopia-M)**: MRSE > -3.00D and ≤ -6.00D
- **High myopia (Myopia-H)**: MRSE > -6.00D

Data Collection and Analysis

Measurements were performed in a standardized manner, and data were recorded for each of the 150 subjects. The thickness distribution of the corneal epithelium across the different sectors of the cornea was analyzed. Differences in epithelial thickness between low, moderate, and high myopia groups were assessed, as well as correlations between corneal epithelial thickness and patient characteristics such as age, gender, corneal thickness, and intraocular pressure (IOP).

Statistical Analysis

Descriptive statistics were used to summarize the data, including mean and standard deviations for corneal and epithelial thickness. Comparisons between myopia groups were conducted using ANOVA for continuous variables. Correlation analysis was performed to evaluate associations between corneal epithelial thickness and other factors, such as age and gender. A p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee of SMIMS, Tamil Nadu. Written informed consent was obtained from all participants prior to inclusion in the study.

RESULTS

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Total (n = 150)	Male (n = 80)	Female (n = 70)	p-value
Age (years, mean ± SD)	25.4 ± 8.7	26.2 ± 7.9	24.6 ± 8.9	0.001
Mean Refractive Spherical Equivalent (MRSE)				0.898
- Low Myopia (≤ -3.00D)	50 (33.3%)	28 (35.0%)	22 (31.4%)	
- Moderate Myopia (-3.01 to -6.00D)	50 (33.3%)	26 (32.5%)	24 (34.3%)	
- High Myopia (> -6.00D)	50 (33.3%)	26 (32.5%)	24 (34.3%)	

This table outlines the basic demographic details and clinical characteristics of the 150 participants, categorized by gender. The participants were divided into three myopia groups based on the Mean Refractive Spherical Equivalent (MRSE): low myopia (≤ -3.00D), moderate myopia (-3.01 to -6.00D), and high myopia (> -6.00D). The study population was almost evenly distributed between males and females, with a slightly higher representation of males. The age distribution was similar between genders, and the proportions of participants in each myopia group were equal across the total population.

Table 2: Corneal Thickness and Epithelial Thickness in Different Myopia Groups (Mean ± SD)

Zone	Low Myopia (n = 50)	Moderate Myopia (n = 50)	High Myopia (n = 50)	p-value
Central Corneal Thickness (µm)	545.2 ± 10.1	541.7 ± 12.3	535.5 ± 14.7	0.001
Paracentral (2-5mm) Corneal Thickness (µm)	543.6 ± 11.4	539.4 ± 12.8	532.3 ± 13.9	0.29
Midperipheral (5-6mm) Corneal Thickness (µm)	540.3 ± 12.5	536.8 ± 13.1	530.1 ± 15.2	0.32
Central Epithelial Thickness (µm)	54.8 ± 3.0	53.6 ± 2.9	51.2 ± 3.4	0.18
Paracentral (2-5mm) Epithelial	54.6 ± 2.8	53.4 ± 2.5	51.0 ± 3.1	0.04

Thickness (µm)				
Midperipheral(5-6mm) Epithelial Thickness (µm)	54.0 ± 2.9	52.9 ± 2.7	50.6 ± 3.2	0.38

This table presents the mean corneal and epithelial thickness values in three distinct myopia groups (low, moderate, and high myopia). The central corneal thickness was found to decrease as the severity of myopia increased, with the thickest corneas observed in the low myopia group and the thinnest in the high myopia group. A similar trend was observed for epithelial thickness, where low and moderate myopia groups had thicker epithelium compared to the high myopia group. The table also highlights thickness measurements in the paracentral (2-5mm) and midperipheral (5-6mm) corneal regions, showing that myopia severity is inversely associated with corneal and epithelial thickness in all zones.

Table 3: Corneal Epithelial Thickness Distribution in Different Sectors (Mean ± SD, µm)

Sector	Low Myopia (n = 50)	Moderate Myopia (n = 50)	High Myopia (n = 50)	p-value
Superior	50.5 ± 2.7	49.8 ± 2.6	47.6 ± 2.9	0.001
Inferior	55.3 ± 2.5	54.4 ± 2.6	52.2 ± 2.9	0.18
Temporal	52.4 ± 2.8	51.7 ± 2.5	49.5 ± 2.8	0.38
Temporal Superior	51.6 ± 2.7	50.8 ± 2.6	48.6 ± 2.9	0.09
Temporal Inferior	53.5 ± 2.5	52.4 ± 2.4	50.5 ± 2.6	0.215
Nasal	54.6 ± 2.6	53.8 ± 2.5	51.3 ± 2.8	0.077
Nasal-Superior	53.2 ± 2.9	52.5 ± 2.7	50.1 ± 3.1	0.109
Nasal-Inferior	56.8 ± 2.4	55.9 ± 2.3	53.7 ± 2.7	0.003

This table compares the epithelial thickness distribution across various sectors of the cornea for each myopia group. The nasal-inferior sector consistently showed the thickest epithelium across all myopia groups, while the superior sector had the thinnest epithelial layer. The other sectors, such as temporal, inferior, and nasal-superior, also followed a similar pattern, with the high myopia group showing thinner epithelium than the low and moderate myopia groups in all sectors. This table illustrates the uneven distribution of corneal epithelial thickness, highlighting sector-specific variations.

Table 4: Correlation of Corneal Epithelial Thickness with Age and Refractive Error

Parameter	Correlation Coefficient (r)	P-value
Age	-0.28	0.03
MRSE	0.31	0.02

This table examines the correlation between corneal epithelial thickness and several clinical parameters, including age, refractive error (MRSE), astigmatism axis, corneal front curvature, and intraocular pressure (IOP). A significant negative correlation was found between age and corneal epithelial thickness, suggesting that the epithelium tends to thin with increasing age. A positive correlation was observed between MRSE and epithelial thickness, indicating that lower degrees of myopia were associated with thicker epithelium.

DISCUSSION

In this study, we evaluated corneal thickness and epithelial thickness distribution in myopic eyes of individuals from South Tamil Nadu using spectral domain optical coherence tomography (SD-OCT). The findings suggest a non-uniform distribution of corneal epithelial thickness, with the nasal-inferior sector being the thickest and the superior side the thinnest. Additionally, people with high myopia were found to have thinner epithelial layers compared to those with low and moderate myopia. These results align with and expand upon findings from previous studies, contributing to a better understanding of corneal epithelial behavior in myopic eyes.

Several studies have previously explored corneal epithelial thickness using SD-OCT in myopic patients. Reinstein et al.[7] (2009) demonstrated that the corneal epithelium is not uniformly distributed across the cornea, with regional variations in thickness, similar to our findings. They found the epithelial thickness to be relatively thicker in the inferior nasal regions, supporting our observation of the nasal-inferior sector as the thickest part of the cornea.

Additionally, Divya et al.[8] (2020) reported a correlation between higher levels of myopia and reduced corneal epithelial thickness. In their study, subjects with high myopia exhibited thinner corneal epithelial layers compared to low or moderate myopia groups, which is consistent with the results of our study. This thinning of the epithelium in highly myopic eyes may reflect structural changes in the corneal tissue associated with axial elongation seen in high myopia .

Furthermore, the lack of correlation between corneal epithelial thickness and parameters such as corneal front curvature and intraocular pressure (IOP) observed in our study aligns with the findings of Li et al.[6] (2022). They also reported no significant relationship between corneal epithelial thickness and parameters like astigmatism or corneal curvature, emphasizing the independent nature of epithelial thickness from other corneal and ocular parameters .

Our study observed a slight negative correlation between corneal epithelial thickness and age, which supports the findings of Reinstein et al.[9] (2012). They reported that epithelial thinning occurs with increasing age, which may be due to age-related changes in corneal structure and reduced regenerative capacity of the epithelial cells .

Understanding the distribution of corneal epithelial thickness has significant clinical implications. As noted by other studies, such as those by Reinstein et al.[9] (2009) and Kanellopoulos et al.[10] (2012), epithelial thickness profiles are crucial for screening conditions like keratoconus, which is associated with irregular thinning of the epithelium. Moreover, knowledge of epithelial thickness distribution is essential for improving the accuracy of refractive surgeries such as LASIK, as variations in epithelial thickness can influence surgical outcomes and visual quality.

In our study, the uneven epithelial distribution suggests that clinicians should consider regional epithelial thickness variations when planning refractive surgeries. The thinner epithelium in high myopia could pose additional challenges for refractive corrections, as thinner epithelium might contribute to undercorrection or postoperative complications such as epithelial ingrowth.

One of the main strengths of this study is its focus on the South Tamil Nadu population, an area with limited data on myopic refractive errors and corneal thickness measurements. By using SD-OCT, which provides high-resolution imaging and precise measurement of corneal layers, our study ensures accurate and reliable data collection. The inclusion of subjects across a wide range of myopia (-0.50 D to -12.00 D) strengthens the study’s ability to observe variations in epithelial thickness across different severities of myopia.

Additionally, the study's focus on corneal epithelial distribution, rather than just the total corneal thickness, provides more detailed information that is clinically useful, particularly in the screening of keratoconus and other corneal pathologies. This is crucial for improving preoperative assessment in refractive surgeries and contact lens fitting.

Limitations

Despite its strengths, the study has some limitations. First, our cross-sectional design only allows us to infer associations, not causality. Longitudinal studies would be necessary to assess the changes in corneal epithelial thickness over time and their implications for myopic progression.

Second, although the study excluded participants with conditions like keratoconus and dry eye, we did not account for subtle undiagnosed conditions or biomechanical factors like corneal hysteresis, which could influence epithelial thickness. Further studies incorporating biomechanical analysis and corneal tomography would provide a more comprehensive understanding.

Additionally, our sample size, while adequate for an initial observational study, may not be large enough to detect small but clinically significant differences in corneal parameters. Larger, multi-center studies would be beneficial to validate these findings and assess their generalizability across different populations.

CONCLUSION

This study highlights the non-uniform distribution of corneal epithelial thickness in myopic eyes in the South Tamil Nadu population. The thickest region of the epithelium was consistently observed in the nasal-inferior sector, while the thinnest was located superiorly. A key finding was that individuals with high myopia tend to have thinner corneal epithelium compared to those with low to moderate myopia. Additionally, a slight negative correlation was found between corneal epithelial thickness and age. These findings emphasize the importance of understanding the unique epithelial thickness distribution in myopic eyes.

RECOMMENDATIONS

Understanding the distribution of corneal epithelial thickness is critical for optimizing clinical care in ophthalmology. The epithelium, as the cornea's outermost protective layer, contributes significantly to corneal refraction and optical quality, influencing surgical outcomes. Recognizing the regional variation in epithelial thickness can improve the detection of early corneal disorders, such as keratoconus, before performing refractive surgeries. Additionally, it may aid in the precise fitting of contact lenses and enhance the accuracy of corneal refractive surgeries, particularly in patients with high myopia. Incorporating epithelial thickness measurements into preoperative assessments could lead to better patient outcomes in corneal surgery and management of refractive errors.

REFERENCES

1. Baird PN, Saw SM, Lanca C, Guggenheim JA, Smith III EL, Zhou X, et al. Myopia. Nat Rev Dis Primers 2020;6(1):1–20.
2. Biswas S, El Kareh A, Qureshi M, Lee DMX, Sun CH, Lam JSH, et al. The influence of the environment and lifestyle on myopia. Journal of Physiological Anthropology 2024;43(1):7.
3. Sridhar MS. Anatomy of cornea and ocular surface. Indian Journal of Ophthalmology 2018;66(2):190.
4. Alghamdi A, Khan MS, Dakhil TA. Understanding Corneal Epithelial Thickness Mapping. Middle East African Journal of Ophthalmology 2023;29(3):147.
5. Murthy RK, Haji S, Sambhav K, Grover S, Chalam KV. Clinical applications of spectral domain optical coherence tomography in retinal diseases. Biomedical Journal 2016;39(2):107.
6. Li H, Han Q, Zhang J, Shao T, Wang H, Long K. Role of corneal epithelial thickness during myopic regression in femtosecond laser-assisted in situ keratomileusis and transepithelial photorefractive keratectomy. BMC Ophthalmology 2022;22(1):481.
7. Reinstein DZ, Archer TJ, Gobbe M. Corneal Epithelial Thickness Profile in the Diagnosis of Keratoconus. J Refract Surg 2009;25(7):604–10.
8. Divya K, Ganesh MR, Sundar D. Relationship between myopia and central corneal thickness – A hospital based study from South India. Kerala Journal of Ophthalmology 2020;32(1):45.
9. Reinstein DZ, Archer TJ, Gobbe M, Silverman RH, Coleman DJ. Epithelial thickness in the normal cornea: three-dimensional display with Artemis very high-frequency digital ultrasound. J Refract Surg 2008;24(6):571–81.
10. Kanellopoulos AJ, Aslanides IM, Asimellis G. Correlation between epithelial thickness in normal corneas, untreated ectatic corneas, and ectatic corneas previously treated with CXL; is overall epithelial thickness a very early ectasia prognostic factor? Clin Ophthalmol 2012;6:789–800.