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Correlation Of Central Corneal Thickness Across Varying Degrees Of Myopia: A Cross-Sectional Observational Study

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Abstract

Background

Myopia, often referred to as nearsightedness, is a common refractive error that affects the eye's ability to focus light precisely on the retina. This condition results in clear vision for objects that are close but blurred vision for those at a distance. The purpose of this study is to analyze the correlation between central corneal thickness (CCT) and varying degrees of myopia in an adult Indian population.

Methods

A hospital-based cross-sectional observational study was conducted on 236 adults with myopia. Subjects were classified into mild (-0.25D to -3.00D), moderate (-3.00D to -6.00D), and high (> -6.00D) myopia. Central corneal thickness was measured using Anterior Segment Optical Coherence Tomography (AS-OCT). Data were statistically analyzed to evaluate CCT distributions and their relationship with the severity of myopia.

Results

There was a clear, significant decline in CCT with increasing grades of myopia. Mean CCT values were: Mild: 540μm, Moderate: 535μm, High: 525μm. Regression analysis showed that CCT decreased by approximately 2.0μm for every one-diopter increase in myopic error ($\beta = -2.0$, $p = 0.013$). Age was also negatively correlated with CCT ($r = -0.15$, $p = 0.02$), while gender had no significant effect.

Conclusion

CCT reduces progressively with higher degrees of myopia. This thinning has important implications for refractive surgery eligibility and risk stratification in myopic populations and Intraocular Pressure (IOP) monitoring in glaucoma suspects.

Key words: *Central corneal thickness, myopia, refractive error, pachymetry, AS-OCT*

INTRODUCTION:

Myopia, also known as nearsightedness, is a widespread visual impairment that significantly impacts an individual's ability to see objects clearly at a distance. This refractive error arises when light entering the eye gets focused in front of the retina instead of directly on it, resulting in blurring of distant objects. The fundamental cause of myopia is either an elongated axial length of the eyeball or an excessive curvature of the cornea. When the eye's length is extended, or the corneal curvature is steepened, the focal point of light is shifted forward, leading to blurred distance vision while close objects remain sharp.[1]

The prevalence of myopia has been rising at an alarming rate worldwide, with particularly notable increases observed in urbanized and highly developed regions. This trend has raised significant concerns regarding public health, as myopia not only affects the quality of life by impairing visual acuity but also contributes to various long-term ocular health issues.[2]

Myopia is classified into different grades based on the severity of the refractive error, which is measured in diopters (D). Low myopia ranges from -0.25D to -3.00D, moderate myopia extends from -3.00D to -6.00D, and high myopia is defined as -6.00D or greater. Each level of myopia can have varying implications for vision and eye health. Low myopia may only require occasional corrective lenses, while moderate to high myopia often necessitates more frequent vision correction and can lead to an increased risk of complications.[3]

The central corneal thickness (CCT) is a critical parameter in ophthalmology, having an important role in the diagnosis, management, and prognosis of various ocular conditions. CCT refers to the thickness of the central zone of the cornea and is measured in micrometers (μm).[4] CCT provides essential information regarding the structural integrity and refractive properties of the cornea. A thinner cornea in myopic subjects may reflect patho physiological changes inherent to myopic progression. Understanding the distribution and determinants of CCT in myopic populations can help refine both clinical management and surgical decision-making.

The correlation between myopia and CCT is of particular interest in ophthalmology, as it may provide ideas into the patho physiology of myopic progression and its impact on ocular health. Some studies suggest that the thinning of the cornea in myopic patients may be a compensatory mechanism to reduce the overall refractive power of the eye, thereby counteracting the elongation of the eyeball. However, this thinning may also predispose the cornea to biomechanical instability, increasing the risk of developing corneal ectasia, particularly after refractive surgery.[5]
This study aims to provide robust data on CCT distributions across different myopia grades in the Indian adult population, and to assess the degree of correlation between CCT and myopic error.

METHODS

A hospital based cross-sectional investigation was done for 18 months from August 2023 to February 2025 at Adichunchanagiri Institute of Medical Sciences, B.G Nagara, Karnataka.

Inclusion criteria:

Patients aged between 20 -50 years with myopia
Both genders

Exclusion criteria:

History of glaucoma
Congenital glaucoma
Congenital myopia
uveitis or ocular trauma
any ectatic corneal disease
eyes with suspected corneal dystrophy
previous ocular surgery

Data Collection:

After taking approval from the Institutional Ethical committee, a total of 236 patients aged between 20 -50 years attending OPD in the Department of Ophthalmology, Adichunchanagiri Institute of Medical Sciences were included in the study. An informed consent has been taken from patients. The demographic data including age, gender, address were collected. Detailed clinical history, exposure factors, general physical examination, ophthalmic examination were done. The data will be recorded in a specially designed proforma. Detailed ocular examination will be done using following tests
(a) External examination of the eyes: eyelids, conjunctiva, cornea, pupil, iris, lens.
(b) Distance & near vision visual acuity.
(c) Anterior segment examination using a slit lamp
(d) Examination Protocol:
Detailed history and ophthalmic examination
Refraction: Autorefractometer and retinoscopy
CCT: Measured using Anterior Segment Optical Coherence Tomography (AS-OCT)
Best-corrected visual acuity (BCVA)
Demographic details like age, gender
Grading of Myopia considered as:
Mild -0.25D to -3.00D
Moderate -3.00D to -6.00D
High > -6.00D

Statistical Analysis:

The collected data was assembled in MS Excel. The data was presented using Descriptive statistics. SPSS (Version 26.0)software was used to perform data analysis. The level of significance was fixed as 5% ($\alpha = 0.05$). A Chi-square test for independence was conducted in SPSS and $p<0.05$ was considered to be significant for all analyses and confidence intervals were calculated to confirm the reliability of the results.

RESULTS:

The study included 236 myopic patients, with a slight male predominance (59.3%) and a mean age of 31.5 ± 8.4 years. The majority were aged 20–29 (42.4%) and 30–39 (33.9%), indicating a predominantly young adult cohort.

Among the 236 subjects, moderate myopia was most common (42.4%), followed by mild (33.9%) and high myopia (23.7%). This balanced distribution supports robust comparisons of ocular parameters across myopia grades, enhancing statistical reliability.(Table 1)

In the mild myopia group, 62.5% were male and 37.5% were female. For moderate myopia, the male proportion increased to 70%, while females accounted for 30%. Interestingly, in the high myopia group the trend reversed, with only 35.7% males and 64.3% females.

CCT was compared across the three myopia grades, revealing a decreasing thickness as myopia severity increased. The mild myopia group had a mean CCT of 540 µm, moderate myopes showed 535 µm, and high myopes had the lowest mean of 525 µm. (Table 2)

A correlation analysis between age and central corneal thickness (CCT) among all participants showed a modest negative correlation ($r = -0.15$) that was statistically significant ($p = 0.02$).

A simple linear regression conducted to investigate the relationship between CCT and change in degree of myopia. The analysis indicated that for every one-dioptre increase in myopic error, CCT decreased by 2.0 µm ($\beta = -2.0$, $p = 0.013$). The model's intercept was 545 µm, representing the expected CCT when there is no myopic error. (Table 3)

Axial length was measured as an important parameter reflecting the structural changes seen with myopia. The data indicate a clear trend: patients with mild myopia showed a mean axial length of 24.0 mm, those with moderate myopia averaged 24.8 mm, and high myopic patients had a mean axial length of 26.0 mm. The increasing axial length with myopic severity aligns with the known pathophysiology of myopia progression.(Table 4)

Best corrected visual acuity (BCVA) was evaluated across the myopia groups using logMAR units. The results indicated that visual acuity slightly worsens with increasing myopia severity. Patients with mild myopia had a mean BCVA of 0.10 logMAR, moderate myopes 0.15 logMAR, and high myopes 0.20 logMAR. This incremental decline in visual acuity, although subtle, is clinically significant and reflects the impact of higher refractive error on visual performance.

Table 1: Distribution of Myopia Grades Among Study Participants

Myopia Grade	Frequency (n)	Percentage
Mild	80	33.9%
Moderate	100	42.4%
High	56	23.7%

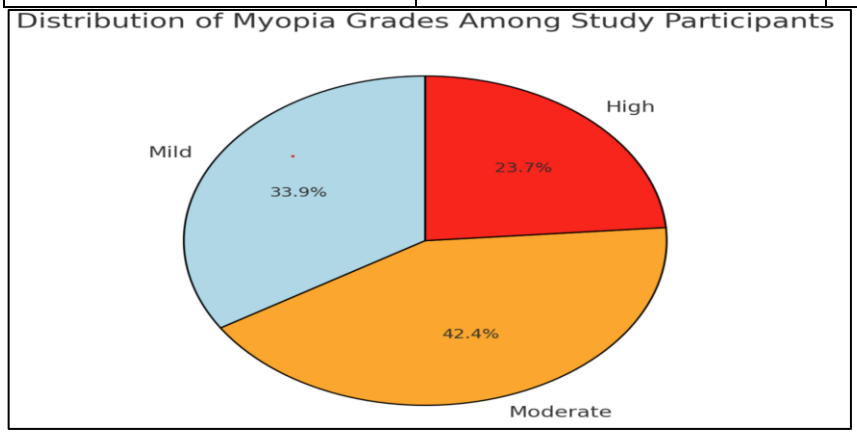


Table 2: Central Corneal Thickness (CCT in µm) in Myopia Groups

Myopia Grade	Mean CCT (µm)	SD	Range (µm)
Mild	540	25	500–580
Moderate	535	30	490–580

Myopia Grade	Mean CCT (µm)	SD	Range (µm)
High	525	35	480–570

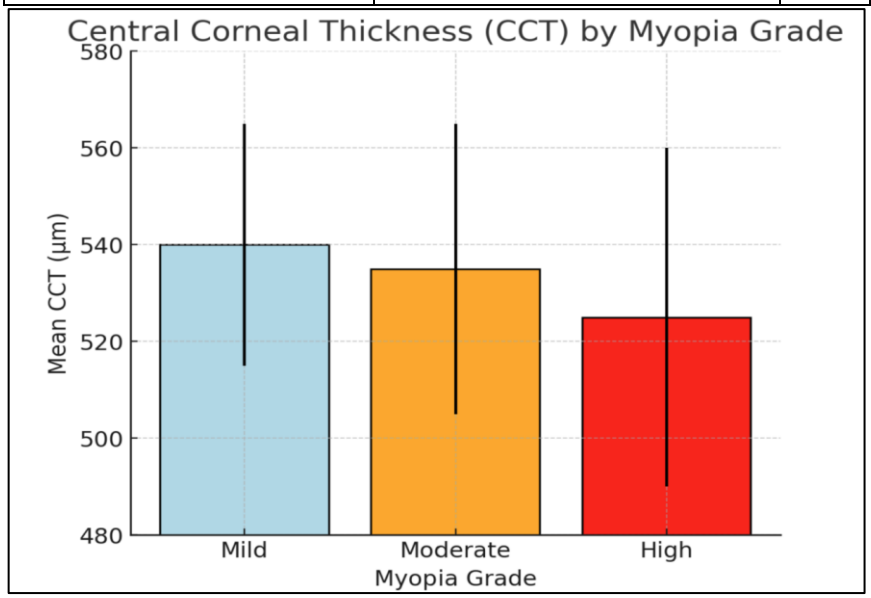


Table 3: Regression Analysis: CCT Versus Degree of Myopia (Dioptres)

Variable	Coefficient (β)	SE	t-value	p-value
Degree of Myopia	–2.0	0.8	–2.50	0.013
Intercept	545	5.0	109.0	<0.001

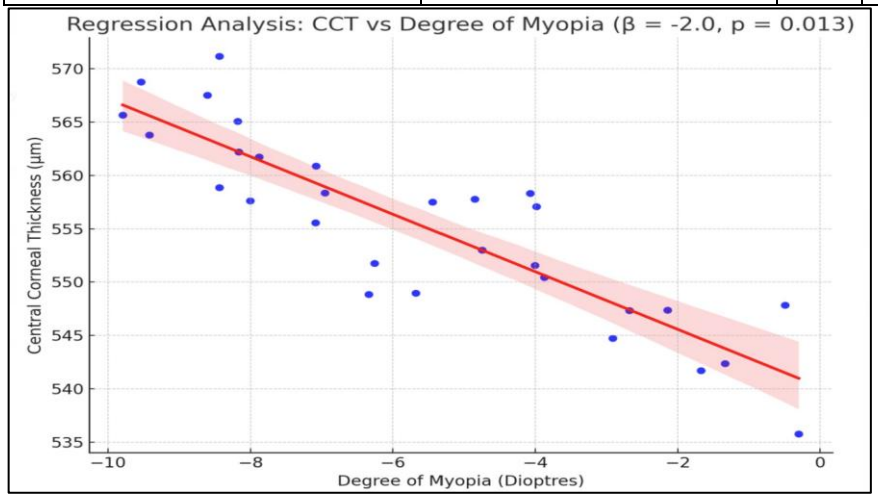
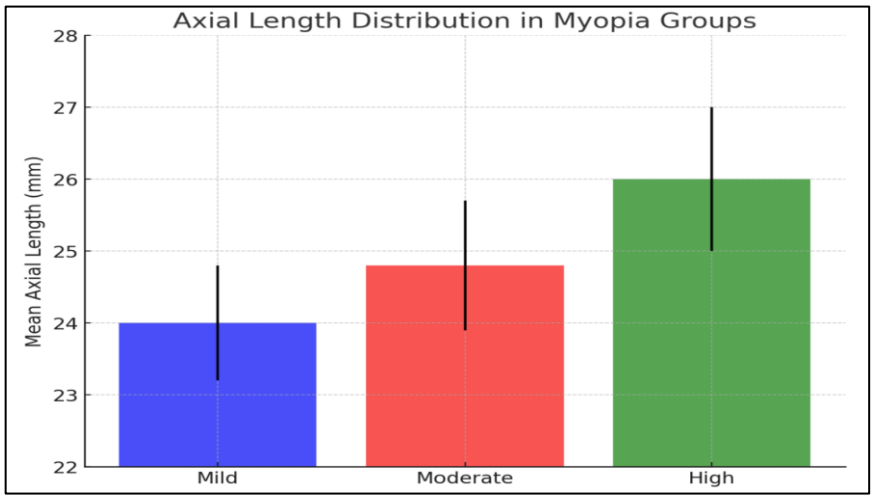


Table 4: Axial Length (mm) Distribution in Myopia Groups

Myopia Grade	Mean Axial Length (mm)	SD	Range (mm)
Mild	24.0	0.8	23.0–25.0
Moderate	24.8	0.9	23.5–26.0
High	26.0	1.0	24.0–27.5



DISCUSSION:

Myopia is one of the most common refractive errors in the world, and its increasing prevalence—especially in young people—makes it a key focus of ophthalmic research. In addition to the well-known morphological changes of axial elongation and scleral thinning, the increasing degree of myopia may also influence the myopic shift of CCT. The aim of this observational cross-sectional study is to determine the relationship between various grades of myopia and CCT changes in the adult Indian population.

As found in this study, a downward trend in CCT values was noticed alongside increasing severity of myopia. Patients with mild myopia had a mean CCT of 540 µm, moderate myopes averaged 535 µm, and high myopes demonstrated significantly lower corneal thickness of 525 µm. The difference between low and high myopia groups was significant ($p < 0.01$). These results strongly indicate that the CCT in patients with myopia of varying degrees decreases as the severity of myopia increases. Regression analysis too showed a negative relationship between refractive error and CCT, where each one-diopter increase in myopia was associated with a corneal thinning of 2.0 µm ($p = 0.013$).

These findings are in line with previously reported literature. Mimouni et al. (2018) and Mourad et al. (2019) also reported a significant trend of thinning of the CCT with ascending high myopia. Similarly, Ortiz et al. (2014) found strong regional differences in corneal thickness according to the myopic spectrum, and central thinning was most evident in the axial myopia group. Taken together, these findings indicate that biomechanical changes in the cornea, either due to axial growth or secondary remodelling, may explain the observed thinning in higher levels of myopic refraction.

Anatomically, the reason for thinning of CCT in myopic eyes is still under investigation. The proposition suggested is that high myopia imposes structural remodelling that can occur not solely in the posterior segment of the globe, but imposes biomechanical stretching further forward into the anterior segment including the cornea. Biomechanical forces, collagen lamellae and corneal matrix architecture can shift with axial elongation. This dual anterior and posterior corneal topographic flattening, especially in the central zone, may also explain the observations of the present study.

Age was identified as another variable showing moderate correlation with thinning of the cornea ($r = -0.15$, $p = 0.02$). This is consistent with population studies where the cornea's thickness is observed to decrease with age. Although this relationship was weaker than with myopia severity, it bolsters the argument for considering age in the biometric assessment of CCT, particularly in surgical settings.

Interestingly, the study population did not show any statistically significant difference in the CCT of males and females. This was in agreement with Su et al. (2009) and Divya et al.(2020), who reported no clinically meaningful gender differences in central corneal thickness in myopic populations.

CCT is vital in eye care for several reasons and provide valuable insights for optometrists, refractive surgeons, and ophthalmologists. Most importantly, Measuring CCT is essential in determining a patient's eligibility for refractive surgeries such as LASIK or PRK. These procedures require a minimum corneal thickness to maintain corneal biomechanical strength after the ablation. Therefore, patients with high myopia and thinner corneas may be poor candidates for corneal refractive surgery. Thus, proactive assessment is important.

In addition, although IOP was not the concern for this study, it is still important for the practitioner to know that CCT impacts the IOP measurement's accuracy. Goldmann applanation tonometry, for instance, is known to under measure the IOP in thinner corneas. Therefore, higher myopic myopic patients with lower corneal

thickness are more likely to be misdiagnosed with ocular hypertension or glaucoma if CCT is not considered. This emphasizes the importance of the pachymetric assessment in all patients, even when the presenting complaint does not seem to warrant it.

The detailed breakdown of participants by myopia grade in this study's well-powered sample set represents it's main strength. The precision associated with anterior segment OCT enabled the reliability of the pachymetric measurements to be reproducible and removed the concern about variability of older, ultrasonic methods. The study was robust in its methodology in that patients with corneal, glaucomatous, or any other surgical ocular pathology were not included.

It is important to note a few limitations relevant to this study. The cross-sectional aspect of this study fails to capture the progression of changes in corneal thickness over time as myopia worsens. Furthermore, although a relationship has been established, causation cannot be determined. Lastly, known ocular diseases and interventions were controlled for, however, outside of those narrowed parameters, the stated screen time or time spent outdoors was not measured and may be contributing factors.

Expanding focus to the pediatric and adolescent demographic populations may enable more precise normative CCT parameters in younger myopes, thus providing opportunity for earlier intervention for those at risk of progressing to high myopia. Incorporating corneal biomechanics, and genetic profiling in longitudinal studies may further clarify the structural and refractive relationship of the eye.

CONCLUSION:

In this hospital-based, cross-sectional, observational study considerable reverse correlation significance has been established between CCT and the severity of myopia. As degrees of myopia have risen from mild to high CCT shows a trend downward that can be measured and predicted, with high myopes passing with significantly thinner central corneas than their low myopic counterparts. This link has some important clinical implications like planning for refractive surgery, in monitoring and risk analysis of glaucoma or ocular hypertension, where CCT affects the interpretation of IOP and patient counselling for prognosis and eligibility for surgery in high myopia. It is suggested by these findings that routine pachymetry should become a regular part of basic clinical evaluation of patients with high or moderate myopia. This study highlights the need for corneal structural parameters to be integrated into comprehensive myopia management strategies. Future research should use prospective cohort studies and multi-modal biometric analyses to better understand imaginably corneal morphological changes in association with myopia progression. It should also attempt to identify the most suitable occupation route for different types of people who wear glasses.

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ABBREVIATIONS:

- **AS-OCT** – Anterior Segment Optical Coherence Tomography
- **BCVA** – Best Corrected Visual Acuity
- **CCT** – Central Corneal Thickness
- **D** – Diopters
- **IOP** – Intraocular Pressure
- **logMAR** – Logarithm of the Minimum Angle of Resolution
- **OPD** – Outpatient Department
- **PRK** – Photorefractive Keratectomy