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CORRELATION OF CENTRAL CORNEAL THICKNESS (CCT) AND INTRAOCULAR PRESSURE (IOP) IN ASTIGMATS

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ABSTRACT Intraocular pressure (IOP) is a critical parameter in the diagnosis and management of glaucoma. Central corneal thickness (CCT), a biomechanical property of the cornea, is known to influence IOP readings. However, the relationship between CCT and IOP in astigmatic individuals remains underexplored, particularly in comparison to emmetropic eyes. The objective of this study is to evaluate the correlation between central corneal thickness (CCT) and intraocular pressure (IOP) in individuals with astigmatism, using emmetropic eyes as a control group. A comparative cross-sectional observational study was conducted at the Eye Clinic of Police Hospital, Abuja, FCT, Nigeria, from January to April 2025. A total of 48 eyes from 26 astigmatic participants and 35 randomly selected emmetropic eyes were assessed. CCT was measured using the SUOER SW-1000 AP pachymeter, and IOP was measured using the Reichert AT550 tonometer. Data were analyzed using SPSS version 25, employing descriptive statistics and Pearson correlation. Ethical approval was obtained from the Federal University of Technology Owerri (FUTO), and informed consent was secured from all participants. It was seen that the mean IOP and CCT in astigmatic eyes were 15.27 ± 2.81 mmHg and 538.06 ± 39.77 µm, respectively. In the emmetropic group, mean IOP was 14.63 ± 1.96 mmHg and mean CCT was 552.71 ± 34.91 µm. A statistically significant moderate positive correlation was found between CCT and IOP in astigmatic eyes ($r = 0.383$, $p = 0.006$), while no significant correlation was observed in emmetropic eyes ($r = 0.126$, $p = 0.468$).In conclusion, central corneal thickness significantly influences intraocular pressure in individuals with astigmatism. These findings underscore the importance of incorporating pachymetry into routine eye examinations to enhance glaucoma risk assessment, particularly in patients with refractive errors.

KEYWORDS : Central Corneal Thickness, Intraocular Pressure, Astigmatism, Glaucoma

INTRODUCTION

The anterior corneal surface contributes about 80% of the dioptric power off the entire eye when it is in its non-accommodated state. It is the major refractive element of the human eye. The cornea is thinner at center and is seen to thicken towards its edges, it has an irregular curvature with uneven thickness all through. The aqueous humor in the anterior chamber of the human eye applies pressure on the cornea which puffs it up, and then gives it its shape. The thickness of the cornea is significant in indicating the health of the cornea, and any form of change could be as a result of different pathologies. Measurement of the cornea thickness is a vital procedure in the assessment of patients with ocular hypertension or glaucoma. The refractive power of the cornea is influenced by the internal and external curvature of its surfaces. Astigmatism is a type of refractive error which is a crucial factor in ascertaining uncorrected visual acuity. It is caused by the eyes cornea or lens having an uneven shape often due to genetics, and can also be the outcome of eye injury, eye surgery, keratoconus or persistent pressure on the cornea from either eyelid or lump. Corneas anterior and posterior surface, contributes largely to refractive astigmatism, its important in determining the axis and refractive astigmatism reduction.

Intraocular pressure is when the fluid of the eye cannot drain appropriately leading to pressure building up. This situation can lead to optic nerve damage. Optic nerve connects the eye to the brain, and also connects the nerve fibers from the retina. Retina is a nerve tissue, which is light-sensitive and it lines the back of the eye.[1]. Intra Ocular Pressure measurement is the foundation in the diagnosis and management of most of the ophthalmology diseases such as glaucoma. Goldmann reported that central corneal thickness could affect the IOP. However, it was reported that this method has some errors in the measurement of IOP as a result of corneal thickness, corneal curvature, or the tear film. [2,3,4]

CCT is the salient indicator of corneal health status. It is a crucial tool in assessing and managing corneal diseases and it evaluates the corneal barrier and endothelial pump function.[5]

CCT, in addition to IOP, is important for assessing glaucoma, taking into account that low CCT will lead to the underestimation of intraocular pressure and impede with the prognosis of glaucoma. In glaucoma, CCT influences intraocular pressure measurement.[6,7]

This study was envisaged to address the sparseness of data regarding the interaction between CCT and IOP in astigmatic individuals. By explaining whether a statistically significant correlation exists and whether this differs from emmetropic or myopic controls, the goal of this research is to refine the clinical approach to glaucoma risk evaluation in patients with refractive irregularities. In the long run, it is anticipated that findings from this investigation will enhance the accuracy of IOP interpretation in astigmatic patients, thereby reducing the likelihood of diagnostic errors and improving overall patient care.

Moreover, understanding this correlation holds suggestions beyond diagnosis. It may influence post-surgical assessments, especially in patients undergoing refractive surgeries where corneal thickness is altered. It also lays the groundwork for personalized ocular care strategies that consider corneal morphology in clinical guidelines.

The purpose of this study is to examine the correlation between CCT and IOP in individuals with astigmatism, to assess the potential influence of astigmatic corneal topography on the CCT–IOP relationship and to compare the correlation patterns between astigmatic individuals and those with emmetropia. Based on existing evidence, it is hypothesized that a statistically significant positive correlation exists between central corneal thickness and intraocular pressure in astigmatic individuals. The correlation pattern differs significantly from that observed in myopic and emmetropic eyes, likely due to the irregular corneal curvature inherent in astigmatism. The findings of this study have considerable clinical implications, particularly in the early diagnosis and risk stratification of glaucoma. If a distinct correlation between CCT and IOP is identified in astigmatic individuals, it would reinforce the need to adjust IOP interpretation based on CCT measurements in this subgroup. Such adjustment could reduce the risk of over- or under-treatment, especially in borderline IOP cases.

Furthermore, the study could guide future directions in ocular biomechanics research, especially concerning how various refractive

errors affect corneal properties and pressure regulation. Given that CCT is a modifiable parameter particularly in the context of refractive surgery, understanding its relationship with IOP could help refine both surgical planning and postoperative monitoring. This research aspires to bridge an important gap in ophthalmic knowledge, facilitating more individualized, evidence-based care for patients with astigmatism.

MATERIALS AND METHODS

This study employed a comparative cross-sectional observational design to investigate the correlation between central corneal thickness (CCT) and intraocular pressure (IOP) in individuals diagnosed with astigmatism, with emmetropic individuals serving as a control group. The research was conducted at the Eye Clinic of the Police Hospital, Abuja, located in the Federal Capital Territory (FCT), Nigeria. The study period spanned from January to April 2025. Ethical approval was obtained from the Ethical Review Board of the Federal University of Technology Owerri (FUTO). Prior to data collection, all participants provided written informed consent, and the study procedures adhered to the ethical standards outlined in the Declaration of Helsinki for research involving human subjects.

The study population consisted of 26 individuals diagnosed with astigmatism, contributing a total of 48 astigmatic eyes (some participants had data recorded from only one eye). In addition, 35 emmetropic eyes (control group) were randomly selected from individuals with no clinically significant refractive error. Participants were eligible for inclusion if they met the following criteria: Aged between 18 and 58 years, diagnosed with astigmatism or confirmed emmetropia. Provided informed consent for participation in the study.

Participants were excluded from the study if they had any of the following: History of ocular surgery or trauma, diagnosed glaucoma or corneal disease, presence of systemic illnesses known to affect intraocular pressure or corneal structure (e.g., diabetes mellitus, connective tissue disorders).

A convenience sampling method was employed to recruit participants. Individuals who met the inclusion criteria and presented to the clinic during the study period were invited to participate.

Central Corneal Thickness (CCT) was measured using the SUOER SW-1000 AP Ultrasonic Pachymeter. Readings were recorded in micrometers (μm), with care taken to ensure proper alignment, calibration, and repeatability. Intraocular Pressure (IOP) was measured using the Reichert AT550 Non-contact Tonometer. Readings were documented in millimeters of mercury (mmHg). Each participant underwent a comprehensive ocular examination, which included: Assessment of refractive status using standard clinical protocols. Measurement of CCT and IOP in each eye, three readings per eye were taken for both CCT and IOP to ensure accuracy, and the average value was used in the final analysis. Data were recorded for both astigmatic and emmetropic eyes accordingly.

Statistical Methods

Collected data were entered and analyzed using IBM SPSS Statistics for Windows, Version 25. The statistical analysis was carried out as descriptive statistics (mean, standard deviation, minimum and maximum values) were used to summarize continuous variables such as IOP and CCT. The Pearson correlation coefficient (r) was calculated to assess the strength and direction of the linear relationship between CCT and IOP within both astigmatic and emmetropic groups. A p-value of <0.05 was considered to indicate statistical significance.

RESULTS

A total of 48 eyes from 26 astigmatic participants and 35 randomly selected emmetropic eyes were analyzed. This section presents the findings of the study conducted to investigate the correlation between central corneal thickness (CCT) and intraocular pressure (IOP) in astigmatic individuals, with emmetropic subjects serving as the control group.

Table 1. Demographic Characteristics of Astigmatic Participants

Age Group (Years)	Frequency	Percentage (%)
18–29	9	34.6%
30–39	6	23.1%
40–49	6	23.1%
50–58	5	19.2%
Total	26	100.0%

A total of 26 individuals with astigmatism participated in the study. As shown in Table 1, the majority of the participants (34.6%) were within the 18–29 years age group. The 30–39 years and 40–49 years age groups each accounted for 23.1% of the sample, while the 50–58 years age group made up 19.2%. This distribution reflects a relatively even representation across adult age ranges, with a slight skew toward younger adults.

Table 2. Gender Distribution of Astigmatic Participants (n = 26)

Gender	Frequency	Percentage (%)
Male	11	42.3%
Female	15	57.7%
Total	26	100.0%

Among the 26 participants with astigmatism, 57.7% were female (n = 15), while 42.3% were male (n = 11), as shown in Table 2. This indicates a slightly higher representation of female participants in the study sample.

Table 3. Summary Statistics of Intraocular Pressure (IOP) and Central Corneal Thickness (CCT)

Group	Mean IOP (mmHg)	SD (IOP)	Mean CCT (μm)	SD (CCT)
Astigmatic	15.27	2.81	538.06	39.77
Emmetropic	14.63	1.96	552.71	34.91

Table 3 presents the mean values and standard deviations (SD) of intraocular pressure (IOP) and central corneal thickness (CCT) in both the astigmatic and emmetropic groups. The mean IOP in the astigmatic group was 15.27 ± 2.81 mmHg, slightly higher than that of the emmetropic group, which had a mean IOP of 14.63 ± 1.96 mmHg.

In contrast, the mean CCT was found to be lower in the astigmatic group (538.06 ± 39.77 μm) compared to the emmetropic group, which recorded a mean of 552.71 ± 34.91 μm. These findings suggest subtle differences in both IOP and corneal thickness between the two groups, which may be relevant when interpreting tonometric measurements in clinical settings.

Table 4. Distribution of Intraocular Pressure (IOP) and Central Corneal Thickness (CCT) in Astigmatic and Emmetropic Eyes

Variable	Group	Mini-mum	25th Percentile	Median	75th Percentile	Maxi -mum
IOP (mmHg)	Astigmatic	10	14	16	17	20
	Emmetropic	10	13	15	16	17
CCT (μm)	Astigmatic	446	514	541	567	669
	Emmetropic	478	519	552	574	609

Table 4 displays the range and distribution percentiles for intraocular pressure (IOP) and central corneal thickness (CCT) in both astigmatic and emmetropic eyes. Among astigmatic eyes, IOP ranged from 10 to 20 mmHg, with a median of 16 mmHg and an interquartile range (IQR) of 14 to 17 mmHg. In comparison, emmetropic eyes had a slightly narrower IOP range of 10 to 17 mmHg, with a median of 15 mmHg and IQR of 13 to 16 mmHg.

For CCT, astigmatic eyes showed a wider distribution, ranging from 446 to 669 μm, with a median value of 541 μm. The interquartile range was 514 to 567 μm. Emmetropic eyes, on the other hand, had CCT values ranging from 478 to 609 μm, with a median of 552 μm and an interquartile range of 519 to 574 μm.

These findings suggest that astigmatic eyes not only tended to have slightly higher IOP values but also exhibited greater variability in corneal thickness compared to emmetropic eyes.

Table 5. Pearson Correlation Between Central Corneal Thickness (CCT) and Intraocular Pressure (IOP)

Group	Correlation Coefficient (r)	p-value	Interpretation
Astigmatic	0.383	0.006	Moderate, statistically significant positive correlation
Emmetropic	0.126	0.468	Weak, not statistically significant correlation

$p < 0.05$ considered statistically significant

As shown in Table 5, the Pearson correlation analysis revealed a moderate, statistically significant positive correlation between central

corneal thickness (CCT) and intraocular pressure (IOP) in astigmatic eyes (r = 0.383, p = 0.006). This indicates that, in individuals with astigmatism, increases in CCT were associated with corresponding increases in IOP readings, and this relationship was unlikely due to chance.

In contrast, the correlation between CCT and IOP in the emmetropic control group was weak and not statistically significant (r = 0.126, p = 0.468). This suggests that the influence of corneal thickness on intraocular pressure measurements is more pronounced in astigmatic eyes, possibly due to biomechanical differences in corneal structure associated with refractive irregularity.

DISCUSSION

This study investigated the correlation between central corneal thickness (CCT) and intraocular pressure (IOP) in individuals with astigmatism, using emmetropic individuals as the control group. The findings demonstrated a moderate, statistically significant positive correlation between CCT and IOP in astigmatic eyes (r = 0.383, p = 0.006), while no statistically significant correlation was observed in the emmetropic group (r = 0.126, p = 0.468). These findings have important clinical and physiological implications, particularly in glaucoma screening and refractive error management.

The cornea plays a vital role in ocular integrity, refractive power, and pressure dynamics. The average central corneal thickness in healthy adults ranges from 500 to 560 µm, although considerable ethnic and individual variation exists. A study done by La Rosa et al confirms the observation that mean CCT in black patients is lower than mean CCT in white patients. [8].

CCT serves not only as an anatomical barrier but also influences IOP readings, especially when measured with applanation or non-contact tonometers. A thicker cornea offers more resistance, potentially leading to overestimation of IOP, whereas a thinner cornea may be indented more easily, leading to underestimation. Studies have shown that with thick cornea, the tonometer readings were exaggerated than the actual IOP and with thin cornea the readings were falsely lower than the true IOP, thereby manifesting ocular hypertension (OHT) and normal tension glaucoma, respectively.[9] This study reinforces this by showing that corneal thickness influences IOP more significantly in eyes with astigmatism, possibly due to their structural asymmetry or altered biomechanical responses. CCT has been described as the only significant predictor of IOP.[10] Thin central cornea was a well-built predictive factor for the development of glaucoma in subjects with OHT.[11]

Astigmatic axis is an important indicator of most refractive error which in some cases, it is more important than the magnitude of astigmatic power.[12,13]

Although the prevalence of astigmatism has been reported in many studies, fewer studies have investigated the astigmatism axis and corneal astigmatism in addition to the prevalence of astigmatism in a normal population.[14, 15, 16] In this study, astigmatic eyes had a mean CCT of 538.06 µm, slightly lower than that of emmetropic eyes (552.71 µm), and this difference may explain the stronger IOP-CCT correlation seen in the astigmatic group. Although this difference is not large in absolute terms, the variation in CCT (SD = 39.77 µm) among astigmats was higher than in emmetropes (SD = 34.91 µm), indicating greater biomechanical variability. Other studies have also highlighted the need to consider corneal thickness when interpreting IOP.

Other studies have also highlighted the need to consider corneal thickness when interpreting IOP. For instance, Ismaili found a significant correlation between CCT and IOP across different refractive error groups, particularly in non-emmetropic eyes, supporting the conclusion that refractive irregularities amplify the impact of CCT on tonometry. He found CCT to be thicker in hypermetropic patients than in emmetropes, with increasing age, the cornea tends to become thinner. Also, he found out that in the astigmatism group, the CCT values were higher in the corneal keratometric group 42-48D.[17] Nejabat et al. observed that IOP and CCT in healthy Persian school children (6–13 years old) were positively correlated. Their findings revealed that corneal thickness is thinner in Persian children than in most other racial groups. They concluded that additional studies are required to shed light on the basis of these changes as well as the influence of race on these biophysical measurements.[18]

The results of this study underscore the need for integrating CCT measurement into routine ocular examinations, especially in patients with refractive errors such as astigmatism. While IOP remains a cornerstone in glaucoma diagnosis, its isolated use without corneal thickness adjustment may lead to diagnostic inaccuracies. This is particularly critical in astigmatic patients where corneal curvature may introduce further bias into tonometric readings. The results of this study underscore the need for integrating CCT measurement into routine ocular examinations, especially in patients with refractive errors such as astigmatism. While IOP remains a cornerstone in glaucoma diagnosis, its isolated use without corneal thickness adjustment may lead to diagnostic inaccuracies. This is particularly critical in astigmatic patients where corneal curvature may introduce further bias into tonometric readings.

In clinical practice, failure to correct for CCT could result in either overtreatment (if IOP is overestimated) or under treatment (if IOP is underestimated), both of which carry risks. Overtreatment could expose patients to unnecessary pharmacologic or surgical interventions, while under treatment may allow silent progression of glaucomatous optic neuropathy.

Moreover, this study opens avenues for further research into the regional or meridional corneal thickness profiles in astigmatic patients. Since corneal thickness may not be uniform across the surface in high astigmatism, mapping peripheral CCT could enhance our understanding of how these eyes respond to pressure or trauma.

Despite its relevance, this study is subject to certain limitations. The sample size, though adequate for correlation analysis, limits broader generalizability. The use of non-contact tonometry, while non-invasive and widely accepted, is less sensitive than Goldmann applanation tonometry, especially in irregular corneas. In addition, biomechanical properties like corneal hysteresis and corneal resistance factor were not measured, which might have offered more insight into the complex interaction between IOP and corneal structure.

Future studies should consider: Including larger and more diverse populations across ethnic groups, Utilizing Ocular Response Analyzers (ORA) or Corvis ST devices to measure biomechanical properties alongside CCT, Investigating correlations in other refractive error subgroups, such as hyperopes and myopes, for comparative insight.

CONCLUSION

This study demonstrated a statistically significant positive correlation between central corneal thickness (CCT) and intraocular pressure (IOP) in astigmatic individuals, a relationship not observed in emmetropic controls. These findings underscore the importance of accounting for corneal thickness when interpreting IOP measurements in patients with astigmatism. The variability in corneal structure inherent to astigmatism appears to magnify the biomechanical influence of CCT on tonometric readings, which has direct implications for the diagnosis and management of glaucoma in this population.

Incorporating pachymetry into routine clinical evaluation particularly in individuals with refractive errors could enhance the accuracy of glaucoma screening and reduce the risk of misdiagnosis. Given the widespread prevalence of astigmatism globally, the findings contribute to the growing body of evidence emphasizing personalized ocular assessment over generalized diagnostic thresholds.

Future research involving larger and more ethnically diverse populations, as well as advanced corneal biomechanics measurements, is recommended to further elucidate the interaction between corneal structure and intraocular pressure. Such efforts will be critical in refining clinical protocols and improving patient outcomes in ocular hypertension and glaucoma care.

REFERENCES

1. Alqurashi, A. H., Afifi, O. K., Jabr, H. F., & Aljuaid, H. A. A (2018). Comparative study of central corneal thickness, mean keratometry and astigmatism in persons with and without refractive errors in Taif. International Journal Of Community Medicine And Public Health, 5(2), 416–421. doi.org/10.18203/2394-6040.ijcmph20175932
2. Salim, S., Linn, D. J., Echols, J. R., Netland, P. A. (2009). Comparison of intraocular pressure measurements with the portable PT100 noncontact tonometer and goldmann applanation tonometry. Clin Ophthalmol, 3:341-4. doi: 10.2147/opth.s5537
3. Whitacre, M.M., Stein, R.A., Hassanein, K. (1993). The effect of corneal thickness on applanation tonometry. Am J Ophthalmol, 115(5):592-6. doi: 10.1016/s0002-9394(14)71455-2

4. Shimmyo, M., Ross, A. J., Moy, A., Mostafavi, R. (2003). Intraocular pressure, Goldmann applanation tension, corneal thickness, and corneal curvature in Caucasians, Asians, Hispanics, and African Americans. Am J Ophthalmol, 136(4):603-13. doi: 10.1016/s0002-9394(03)00424-0
5. Broman, A. T., Congdon, N.G., Bandeen-Roche, K., Quigley, H. A. (2007). Influence of corneal structure, corneal responsiveness, and other ocular parameters on tonometric measurement of intraocular pressure. Journal of Glaucoma, 16(7):581-588. doi: 10.1097/ijg.0b013e3180640f40
6. Gab-Alla, A.A. (2021). Reversal of Myopic Correction for Patients Intolerant to LASIK. J Ophthalmol, 7113676. doi: 10.1155/2021/7113676
7. Argus, W. A. (1995). Ocular hypertension and central corneal thickness. Ophthalmology, 102(12):1810-2. doi: 10.1016/s0161-6420(95)30790-7
8. La Rosa, F. A., Gross, R. L., Orengo-Nania, S. (2001). Central Corneal Thickness of Caucasians and African Americans in Glaucomatous and Nonglaucomatous Populations. Arch Ophthalmol, 119(1):23–27. doi:10.1001/archopht.119.1.23
9. Ko, Y.C., Liu, C.J., Hsu, W.M. (2005). Varying effects of corneal thickness on intraocular pressure measurements with different tonometers. Eye (Lond), 19(3):327-32. doi: 10.1038/sj.eye.6701458
10. Casson, R.J., Abraham, L.M., Newland, H.S., Muecke, J., Sullivan, T., Selva, D., Aung, T. (2008). Corneal thickness and intraocular pressure in a nonglaucomatous Burmese population: the Meiktila Eye Study. Arch Ophthalmol, 126(7):981-5. doi:10.1001/archopht.126.7.981
11. Puspendu, D., Ruma, D., Praveer, K., Shrivastava, A. M. (2016). A clinical study on the correlation between axial length, intraocular pressure and central corneal thickness in myopic eyes. International Journal of Contemporary Medical Research, 3(4):1141-1144
12. Fotouhi, A., Hashemi, H., Yekta, A.A., Mohammad, K., Khoob, M.K. (2011). Characteristics of astigmatism in a population of schoolchildren, Dezful, Iran. Optom Vis Sci, 88(9):1054-9. doi: 10.1097/OPX.0b013e318221727d
13. Mandel, Y., Stone, R.A., Zadok, D. (2010). Parameters associated with the different astigmatism axis orientations. Invest Ophthalmol Vis Sci, 51(2):723-30. doi: 10.1167/iovs.09-4356
14. Hashemi, H., Khabazkhoob, M., Yekta, A., Jafarzadehpur, E., Emamian, M.H., Shariati, M., Fotouhi, A. (2012). High prevalence of astigmatism in the 40- to 64-year-old population of Shahroud, Iran. Clin Exp Ophthalmol, 40(3):247-54. doi: 10.1111/j.1442-9071.2011.02635.x
15. Fan, D.S., Rao, S.K., Cheung, E.Y., Islam, M., Chew, S., Lam, D.S. (2004). Astigmatism in Chinese preschool children: Prevalence, change, and effect on refractive development. Br J Ophthalmol, 88:938–41. DOI: 10.1136/bjo.2003.030338
16. Huynh, S.C., Kifley, A., Rose, K.A., Morgan, I., Heller, G.Z., Mitchell, P. (2006). Astigmatism and its components in 6-year-old children. Invest Ophthalmol Vis Sci, 47(1):55-64. doi: 10.1167/iovs.05-0182
17. Ismaili, M. (2025). The Importance of the Correlation between CCT and Corneal Curvature in Refractive Surgery. International Journal of Biomedicine, 15(2):299-304. doi:10.21103/Article15(2)_OA5
18. Nejabat, M., Heidary, F., Talebnejad, M.R., Salouti, R., Nowroozzadeh, M.H., Masoumpour, M., Mahdaviazad, H., Tajbakhsh, Z., Keshtkar, M., Jamali, H., Khalili, M.R., Movahedan, H., Roustaei, N., Gharebaghi, R. (2016). Correlation between Intraocular Pressure and Central Corneal Thickness in Persian Children. Ophthalmol Ther, 5(2):235-243. doi: 10.1007/s40123-016-0063-5