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Central corneal thickness in primary open angle glaucoma, normal tension glaucoma, and ocular hypertension: A clinical study in semi urban areas

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Abstract
Background and Objective: Glaucoma encompasses a wide range of illnesses characterized by the gradual damage to the optic nerve. It causes distinct structural alterations in the optic disc, resulting in a particular pattern of permanent vision field impairments. The present study seeks to determine the central corneal thickness in persons diagnosed with normal-tension glaucoma, primary open angle glaucoma, ocular hypertension, as well as in healthy individuals.
Materials and Methods: This study is a prospective observational study that collected data from patients diagnosed with normal tension glaucoma, primary open-angle glaucoma, and ocular hypertension. The current study has a sample size of 100 patients. The study was carried out in the Department of Ophthalmology, Sambhram Institute of Medical Sciences, located in Kolar, Karnataka, India. This survey was done from December 2019 to November 2019. This study was conducted following clearance from the institute's ethics committee and obtaining signed agreement from the parents. All the specimens were gathered and their measurements recorded.
Results: This study included a cohort of 100 patients, with ages ranging from 42 to 78 years. The average age, shown by the mean ± standard deviation, was 57.12±9.17 years. The distribution of patients based on age group is as follows: 19 patients were between the ages of 40 and 49, 48 patients were between the ages of 50 and 59, 20 patients were between the ages of 60 and 69, and 13 patients were over the age of 70. This study included a cohort of 100 patients, consisting of 63 males and 37 females. This study found a correlation between age and sex groups. Among males, the highest number of patients were in the age category of 50-59 years, while among females, the highest number of patients were also in the age group of 50-59 years. The statistical analysis revealed a strong connection between age and sex group. The study found no disparities between genders and no significant correlation with age.
Conclusion: The results of this randomized comparison investigation showed that the CCT of OHT patients was much greater than that of controls and POAG patients, while it was much lower for normal-tension glaucoma patients. Both controls and patients with primary open angles do not vary statistically.

Keywords: Corneal thickness, ocular hypertension, glaucoma, and ophthalmology

Introduction
Glaucoma is a condition that affects the optic nerve and is characterized by particular changes in the appearance of the optic disc and visual field abnormalities. It is often, but not always, accompanied with increased intraocular pressure [1, 2]. While there are additional factors at play, the intraocular pressure stands out as the most significant risk factor due to its unique ability to be pharmacomodulated. Precise measurement of the intraocular pressure is crucial, not only for categorization purposes, but also for the effective clinical treatment of individuals with glaucoma. Therefore, it is crucial to ensure that the IOP values are obtained using a method that is exceedingly precise [1-3].
Goldmann Applanation Tonometry (GAT) is often regarded as the most reliable method for measuring intraocular pressure. Ehlers and colleagues' investigation, along with several others, has demonstrated that the precision of applanation tonometry is influenced by the central corneal thickness [4-6]. A decrease in corneal thickness of 0.45 mm may result in an underestimating of the intraocular pressure measured in the Ophthalmology Section by up to 4.7 mmHg. Conversely, an increase in corneal thickness of 0.59 mm could lead to an overestimation of 5.2 mmHg when the real IOP is 20 mmHg.

Consequently, persons with thick corneas may exhibit erroneously elevated IOP measurements when utilizing GAT, whereas those with thin corneas may display lower readings [5-7].

Corneal thickness is a crucial variable that must be considered when determining the target intraocular pressure levels for managing diagnosed cases of glaucoma and during subsequent monitoring. 55.9% of patients experienced notable changes in their measurements, while 20.2% of patients had significant changes in their outcomes. These changes prompted improvements to the glaucoma treatment strategy [6-8]. The researchers determined that the central corneal thickness had a notable impact on the clinical treatment of patients diagnosed with glaucoma and those who were suspected of having glaucoma. The purpose of this study was to examine the central corneal thickness in individuals with normal tension glaucoma, primary open angle glaucoma, ocular hypertension, and normal participants in our population. Additionally, the study aimed to investigate how CCT affects the clinical care of glaucoma patients [9-11].

The present study seeks to determine the Central Corneal Thickness in persons diagnosed with normal-tension glaucoma, primary open angle glaucoma, ocular hypertension, as well as in healthy individuals.

Materials and Methods

This study is a prospective observational study that collected data from patients diagnosed with normal tension glaucoma, primary open-angle glaucoma, and ocular hypertension. The current study has a sample size of 100 patients. The study was carried out in the Department of Ophthalmology, Sambhram Institute of Medical Sciences, located in Kolar, Karnataka, India. This survey was done from December 2019 to November 2019. This study was conducted following clearance from the institute's ethics committee and obtaining signed agreement from the parents. All the specimens were gathered and the measurements recorded.

Inclusion Criteria

- POAG patients have an uncontrolled IOP > 21 mmHg.
- NTG patients have an IOP < 21 mmHg during the initial visit.
- Ocular hypertension glaucoma.

Exclusion Criteria

- Secondary Glaucomas.
- H/O Intraocular Surgery.
- Coronal Pathology.

Results

A study will be undertaken in the Department of Ophthalmology, Sambhram Institute of Medical Sciences, Kolar, Karnataka, India, involving 100 patients who are attending the hospital.

Table 1: Age distribution

Sr. No.	Age Group	Number
1.	40-49 Years	20
2.	50-59 Years	47
3.	60-69 Years	22
4.	>= 70 Years	11
5.	Total	100

Among a cohort of 100 patients, the age spanned from 42 to 78 years, with an average age of 57.12±9.17 years. Based on age groups, there were 20 patients aged between 40-49 years, 47 patients aged between 50-59 years, 22 patients aged between 60-69 years, and 11 patients aged beyond 70 years.

Table 2: Sex distribution

Sr. No.	Age Group	Number
1.	Males	62
2.	Females	38
3.	Total	100

Out of a sample size of 100 individuals, 62 were male and 38 were female.

Table 3: Distribution of study groups

Sr. No.	Groups	Number
1.	Normal	35
2.	NTG	19
3.	POAG	30
4.	OHT	15
5.	Total	100

Out of the total cases examined, 35 were classified as Normal, 19 as NTG, 30 as POAG, and 15 as OHT.

Table 4: Major management adjustments following an IOP modification

	Significant of changes		Total
	NO	YES	
NTG	12	5	20
POAG	20	10	29
OHT	9	8	15
Total	43	21	64

Table 4 indicated that there were notable alterations in glaucoma patients once intraocular pressure was adjusted for central corneal thickness. Out of the total cases, 21 exhibited significant changes in measurements. Among these instances, 66.67% showed the highest level of significant measurement changes within the OHT group. Furthermore, there was a statistically significant difference between the study groups and a substantial change in the measurements.

Table 5: Significance of variations in outcome following IOP modification

	Significant of outcome changes		Total
	No	Yes	
NTG	22	0	20
POAG	25	2	29
OHT	14	3	15
Total	59	5	64

Table 5 demonstrated the impact of adjusting IOP for CCT on the outcome changes in glaucoma patients. Out of them, 5 instances exhibited substantial changes in their outcomes. Among these cases, 26.67% showed the most significant changes in measurements within the OHT group. Furthermore, there was a statistically significant difference between the study group and the significance of the changes in the outcome.

Discussion

Recent research indicates that patients with normal tension glaucoma have a thinner central corneal thickness compared to individuals without the condition. On the other hand, individuals with ocular hypertension have a larger CCT compared to control subjects. In this work, we establish a correlation between central corneal thickness and normal-tension glaucoma controls [10-12]. This study aims to compare the central corneal thickness of patients with normal tension glaucoma to that of controls, primary open-angle glaucoma, and ocular hypertension. The goal is to analyze the variations in CCT among these populations and assess the impact of CCT on glaucoma diagnosis and care, particularly in relation to intraocular pressure measurements [11-13].

This study included a sample of 100 patients, with ages ranging from 42 to 78 years. The average age, shown by the mean ± standard deviation, was 57.12±9.17 years. Based on age category, there were 19 patients aged between 40-49 years, 48 patients aged between 50-59 years, 20 patients aged between 60-69 years, and 13 patients aged beyond 70 years. This study included a sample size of 100 patients, consisting of 63 males and 37 females [13-15]. This study found a correlation between age and sex groups. Among males, the highest number of patients was observed in the 50-59 age group, while among females, the highest number of patients was also observed in the 50-59 age group. The statistical analysis revealed a strong connection between age and sex group. The study found no disparities between genders and no statistically significant correlation with age. The study found that 36% of cases were classified as Normal, 20% as NTG, 29% as POAG, and 15% as OHT. The study included 352 individuals as controls, 13 patients with ocular hypertension, and 30 patients with primary open-angle glaucoma [14-16].

This study found that there was no statistically significant link between gender and study group. The study found that the average age for males was 56.92±8.77 years, and for females was 57.46±9.94 years, with the standard deviation included. Statistical analysis indicated that there was no significant difference in the mean values between males and females [15-17]. In this study, the average age in the OHT group was slightly greater than in the NTG, POAG, and normal groups, as indicated by the mean ± SD age. However, the statistical analysis revealed that the difference in means between the groups was not significant. Patients with Ocular Hypertension were notably younger compared to those with Primary Open-Angle Glaucoma, but the age distribution in patients with Normal-Tension Glaucoma was similar to that observed in the Coptic Retinitis Pigmentosa group. The present investigation did not find any notable disparity among NTG, POAG, and Controls [18-20].

This study found that there was no statistically significant correlation between the study groups and the reclassification of study groups. The observed discrepancy exhibited statistical significance. There were no significant changes in result observed in any of the patients in the NTG group. In contrast, 3.57% of patients in the POAG group and 25% of patients in the OHT group saw significant changes in outcome [19-21]. An appreciable alteration in the result was noted in 6.45% of the total glaucoma cases. There was a considerable difference that was proven through statistical analysis. Several research have examined the correlation between central corneal thickness and Goldman application tonometry. It has been conclusively demonstrated that CCT has a significant impact on the accuracy of applanation tonometry. Subsequent formulations have been devised to rectify the intraocular pressure for central corneal thickness [20-22].

The Early Manifest Glaucoma Trial found that there is a direct correlation between a 10% change in disease development and a 1mmHg change in intraocular pressure throughout follow-up. 8.5% of the individuals involved in the study opted to modify their medication, 2.1% chose to delay or include laser therapy, and 3.2% decided against undergoing glaucoma surgery. One of the drawbacks of the study was the absence of a long-term follow-up to provide ongoing support for the clinical conclusions about the management of these differences utilizing CCT corrected IOP [22-24]. Glaucoma patients were classified based on their intraocular pressure adjusted for central corneal thickness. NTG patients were reclassified as POAG patients in 22.7 percent of cases, whereas OHT patients were categorized as Normal in 25 percent of cases. According to a study conducted by Copt RP, around 25% of individuals with normal tension glaucoma and ocular hypertension were incorrectly diagnosed. Additionally, 31% of individuals initially diagnosed with NTG were later reclassified as having primary open-angle glaucoma, while 56% of individuals with OHT were categorized as having normal eye pressure [25-27].

Conclusion

Based on a randomized comparison investigation, we have shown that patients with normal-tension glaucoma have a notably lower central corneal thickness compared to both controls and patients with primary open-angle glaucoma. Conversely, patients with ocular hypertension have a significantly larger CCT than both controls and POAG patients, as indicated by this study. There is no statistically significant difference between patients with primary open-angle and the control group. Because of the influence of intraocular pressure on central corneal thickness measurement and the use of an applanation tonometer, the primary constraint in accurately diagnosing and monitoring glaucoma patients is the misdiagnosis of primary open-angle glaucoma patients as normal-tension glaucoma patients, and the misdiagnosis of normal patients as ocular hypertension patients, leading to incorrect management. The measurement of corneal central thickness is crucial for ophthalmologists to accurately diagnose and manage glaucoma and glaucoma suspects, especially when a patient's corneal thickness deviates greatly from the normal range.

Funding

None.

Conflict of Interest

None.

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