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Central Corneal Thickness Comparison between Primary Open-Angle Glaucoma Patients and Healthy Controls

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Abstract – Glaucoma is a progressive eye disease characterized by optic nerve damage and visual field loss, often associated with elevated intraocular pressure (IOP). Central corneal thickness (CCT) has been identified as a potential factor influencing the measurement and management of IOP. Several studies have investigated the relationship between CCT and glaucoma, highlighting its importance in the diagnosis and management of the disease. Aim: to assess whether there are any significant differences in CCT measurements between open-angle glaucoma patients and normal patients. Material and methods: observational a cross-sectional design to compare CCT between normal individuals and POAG patients, we examined a sample consisting of 20 individuals in the control group and 20 individuals diagnosed with primary open-angle glaucoma (POAG). Corneal pachymetry and a complete eye examination were performed on all patients. Result: In the control group, the average central corneal thickness (CCT) was measured to be 538 µm. On the other hand, in the primary open-angle glaucoma group, the mean CCT was found to be 536 µm, and there was no statistically significant difference in central corneal thickness (CCT) between the primary open-angle glaucoma (POAG) group and the control group (P = 0.8). conclusion: No significant disparity in central corneal thickness (CCT) was observed between individuals diagnosed with primary open-angle glaucoma and normal subjects in our study.

Keywords – Central Corneal Thickness; Norma Patient; Primary Open-Angle Glaucoma; Pachymetry; Comparative Study.

I. INTRODUCTION

Glaucoma is the primary cause of permanent vision loss worldwide, making it the leading contributor to irreversible blindness. (1) It is characterized by the thinning of the retinal nerve fiber layer, leading to visual field loss. (2) In 2013, the estimated prevalence of primary open-angle glaucoma (POAG) among adults aged 40 and older was approximately 3.05%.(3) POAG typically manifests in middle to late adulthood, and the prevalence of glaucoma rises with age. The number of individuals affected by glaucoma increases significantly with advancing age, ranging from approximately 250,000 people aged 40 to 49 years to around 1.5 million individuals aged 70 years or older.(4) Risk factors associated with primary open-angle glaucoma (POAG) include advanced age, family history of the disease, and belonging to the Black or Hispanic/Latino racial or ethnic groups. Certain physical findings, such as elevated intraocular pressure (IOP), reduced central corneal thickness, optic disc hemorrhage, a large

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cup-to-disc ratio in the optic disc, and decreased ocular perfusion pressure, are also indicators of an increased risk of developing POAG.(2, 5, 6)

Timely identification and intervention play a crucial role in preventing vision impairment caused by glaucoma. Research indicates that early diagnosis and treatment of glaucoma effectively reduce the average time from diagnosis to blindness in at least one eye, decreasing it from 23 years to 35 years(7) Central corneal thickness (CCT) measurement has played a significant role in evaluating intraocular pressure (IOP) over the past five decades.(8) The clinical significance of central corneal thickness (CCT) is widely acknowledged in relation to the diagnosis and management of glaucoma, although its exact importance remains subject to debate. Both the American Academy of Ophthalmology guidelines and the Canadian consensus recommendations recommend the inclusion of CCT measurement in the initial assessment of all individuals suspected of having glaucoma or already diagnosed with primary open angle glaucoma (POAG). It is important to consider demographics, environmental factors, glaucoma treatment, and the specific measurement device used, as they can significantly influence CCT. These factors should be taken into account when interpreting the impact of corneal thickness in patients with glaucoma.(9) The Goldmann applanation tonometry does not consider the variation in central corneal thickness, as it assumes a fixed value of 520 µm for all corneas.s (10). The normal range in most studies was between 427-620 µm.(11) Indeed, misdiagnosis can occur when central corneal thickness (CCT) is not taken into account. It has been observed that patients with normal-tension glaucoma tend to have thinner corneas, while those categorized as glaucoma suspects often have thicker corneas. Therefore, considering CCT is crucial in order to accurately diagnose and manage glaucoma, as it can help differentiate between these different subtypes of the disease.(12) An elevated intraocular pressure (IOP) is a crucial risk factor for primary open-angle glaucoma, and its measurement using Goldmann applanation tonometry is known to be influenced by the central corneal thickness (CCT) of the individual.(13) Several research studies have demonstrated a statistically significant difference in CCT between POAG patients and individuals without glaucoma(14) .Consequently, we conducted this study to determine whether there is a statistically significant distinction in central corneal thickness (CCT) between individuals diagnosed with primary open angle glaucoma and normal patient .

II. AIM OF STUDY:

To assess whether there are any significant differences in CCT measurements between open-angle glaucoma patient and normal patient.

III. MATERIAL AND METHODS:

3.1Study design:

This study employed a cross-sectional design to compare CCT between normal individuals and POAG patients. Pachymetry, a non-invasive method for measuring CCT, was used in this study. Participants were seated comfortably, and topical anesthetic eye drops were administered to reduce discomfort during the measurement process. A pachymeter device, calibrated and validated for accuracy, was used to measure the central corneal thickness of both eyes for each participant. Three consecutive measurements were taken for each eye, and the average of these measurements was recorded to minimize measurement variability.

3.1.1 inclusion criteria were set to include adults aged 40 years or older as participants in the study. This age restriction was chosen to focus on the population most commonly affected by primary open-angle glaucoma (POAG) and to ensure a consistent age range across both the POAG and normal groups.

3.1.2 exclusion criteria were established to ensure that the study groups were as homogeneous as possible. Individuals with a history of ocular surgery, such as corneal refractive surgery or cataract extraction, were excluded to eliminate the potential influence of surgical interventions on central corneal thickness (CCT). Ocular surgeries can alter corneal structure and affect CCT measurements, thus introducing confounding variables into the study.

Additionally, individuals with known corneal pathology, such as corneal dystrophies or degenerations, were excluded. These conditions can directly impact corneal thickness and may not reflect the typical CCT values observed in either the POAG or normal group. By excluding individuals with corneal pathology, the study aimed to ensure that the measured CCT values would be representative of the general population without additional confounding factors.

Excluding individuals with such ocular diseases helped to maintain a clearer comparison between the POAG and normal groups, focusing specifically on the potential differences in CCT associated with POAG. The analysis of age distribution revealed distinct patterns between the control group and the primary open-angle glaucoma (POAG) group.

3.2Data collection:

The study included a POAG group consisting of twenty patients diagnosed with primary open-angle glaucoma. The participants were enrolled from Tripoli Teaching Eye Hospital based on established diagnostic criteria for POAG. This ensured that the patients in the POAG group had a confirmed diagnosis of primary open-angle glaucoma according to recognized clinical guidelines To establish a comparison, a normal group of twenty individuals was selected from the general population ,These individuals had no history or clinical evidence of glaucoma, ensuring that they represented a healthy population without the presence of the disease.

All participants included in the study underwent a comprehensive set of tests to assess their ocular health. These tests included measuring their best corrected visual acuity, conducting slit lamp bio microscopy to rule out any corneal abnormalities, performing applanation tonometry to measure intraocular pressure, conducting gonioscopy to examine the angle of the eye, conducting dilated fundus examination to assess the back of the eye, and performing stereoscopic examination of the optic discs and nerve fiber layer using a volk +90D lens with the slit lamp. For glaucoma patients, automated perimetry using the 24-2 program of the Humphrey field Analyzer was conducted prior to dilation. Additionally, the central corneal thickness was measured in both eyes of all participants.

3.3Statistical analysis:

To analyze the data, we utilized the statistical software SPSS (Statistical Package for the Social Sciences) version (27). To compare the mean CCT between the glaucoma patient group and the normal patient group, an independent samples t-test was performed. The results indicated a statistically significant difference in mean CCT between the two groups ($t(df) = -2.35(78)$, $p = 0.021$).

IV. Result:

In the control group, the mean age was 50 years and the mean age of primary open angle glaucoma patient was 54 years .To determine the mean central corneal thickness (CCT) for each participant, the values from the right and left eyes were averaged. This approach was adopted as no statistically significant difference was found in CCT values between the right and left eyes. parametric testing was employed for this analysis. In the control group, a comparison of CCT between the two eyes revealed no significant difference ($P = 0.80$).

In the primary open-angle glaucoma (POAG) group, a similar non-significant difference was observed in the central corneal thickness (CCT) between the right and left eyes ($P = 0.98$).

The mean central corneal thickness in the control group was 538µm. In the primary open-angle glaucoma group, the mean CCT was 536 µm, shown in table (1). These findings suggest that the mean central corneal thickness did not significantly differ between the two groups. This was further confirmed by parametric testing using the independent T- test, which indicated no statistically significant difference in mean CCT measurements in primary open-angle glaucoma patients.

There was no statistically significant difference in central corneal thickness (CCT) between the primary open-angle glaucoma (POAG) group and the control group ($P = 0.8$). To further explore the CCT subgroups, a range of 10 µm was used, and the distribution of participants in each subgroup was analyzed (Table 2). In the POAG group, the maximum number of patients belonged to the central corneal thickness subgroup of 561-570µm.

In terms of gender distribution, the control group consisted of 40 % males and 60 % females, while the POAG group had 50 % males and 50% females. Shown in table 3 Our study show no significant statistical difference in the distribution of central corneal thickness between males and females in the control group) $P = 0.39$) and the glaucoma group ($P= 0.38$).

Study groups	CCT				
	N	Mean	SD	min	Max
Normal	20	538	34.6	486	618
POAG	20	536	28.7	474	582

Table (2): show Distribution of central corneal thickness

Mean central corneal thickness	*control*	*Glaucoma group*
450-460	0	0
461-470	0	0
471-480	0	1
481-490	1	0
491-500	1	1
501-510	3	0
511-520	2	1
521-530	3	4
531-540	5	2
541-550	0	2
551-560	2	1
561-570	0	6
571-580	1	0
581-590	0	2
591-600	0	0
601-610	1	0
611-620	1	0

Table (3): showing demographic distribution of the patient included in the current study:

Age group	control		primary open angle glaucoma	
	Male	female	male	female
40-50	3	7	2	6
51-60	3	4	5	2
61-65	2	1	3	2
Total	8	12	10	10

V. Discussion

Several previous studies have examined the relationship between Goldmann Applanation Tonometry and central corneal thickness (CCT), demonstrating that CCT can impact the accuracy of applanation tonometry(15). As a result, various formulas have been developed to adjust intraocular pressure (IOP) measurements based on CCT. Ehlers and Hansen .(16) In our study, we found a central corneal thickness of 533um in The normal control group, this result similar to other study show that CCT values among normal individuals without glaucoma vary and are normally found to be 540±30 µm. (8) In contrast, a study conducted in rural central India discovered that the average central corneal thickness was 514 µm, which was lower than the measurements observed in our study.. In our study, there was no significant difference between the central corneal thicknesses of normal group compared to that of primary open angle glaucoma. Similar observations were reported in study done in south India. (13). Nevertheless, Aghaian E et al. conducted a study where they found a statistically significant decrease in the average central corneal thickness among individuals diagnosed with open-angle glaucoma compared to the measurements observed in the normal population.(17). In our study, there were no notable variations in central corneal thickness between males and females. This finding aligns with previous studies conducted by Sanchís-Gimeno, which also reported no statistically significant differences in central corneal thickness between males and females. (18) Another study done on Tunisian population with similar findings concluded that both age and sex of the patient do not have any significant influence on central corneal thickness (CCT).(19)

VI. Conclusion:

No significant disparity in central corneal thickness (CCT) was observed between individuals diagnosed with primary open-angle glaucoma and normal subjects in our study.

VII. Conflict of Interest:

There are no conflicts of interest associated with this research study. There is no financial or personal relationships with individuals or organizations that could potentially bias or influence the findings and interpretations presented in this paper. The study was conducted with full adherence to ethical guidelines and scientific integrity, ensuring the objectivity and impartiality of the results.

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