ISSN 3006-2543 (Online)
ISSN 1990-3863 (Print)

AL-SHIFA JOURNAL OF OPHTHALMOLOGY

ASJO

An Open Access, Peer Reviewed, Quarterly Journal of
AL-SHIFA TRUST EYE HOSPITAL

Vol. 21, No. 1, January – March 2025

Indexed in
Index Medicus- EMR
Asian Digital Library
Pak Medinet

Recognized by
Higher Education Commission (HEC), Pakistan
College of Surgeon and Physician (CPSP), Pakistan
Pakistan Medical and Dental Council (PMDC) IP/033

ISSN 3006-2543 (Online)
ISSN 1990-3863(Print)

A
S
J
O

Al-Shifa
Journal of Ophthalmology

Vol. 21, No. 1, January – March 2025

QUARTERLY PUBLISHED

Abstracts available at https://www.asjoalshifaeye.org and http://www.pakmedinet.com/ASJO
Manuscript submission through online platform ejmanager.com

Indexed in Index Medicus -EMR, Asian Digital Library (ADL)
Recognized by Higher Education Commission (HEC), Pakistan
Recognized by College of Surgeon and Physician (CPSP), Pakistan
Recognized by Pakistan Medical and Dental Council (PMDC)

Al-Shifa Journal of Ophthalmology

Editorial inquiries should be addressed to Prof. Dr. Tayyab Afghani, Department of Orbit and Oculoplastics, Al-Shifa Trust Eye Hospital, Jhelum Road Rawalpindi, Pakistan.
Tel: 0092 51 5487821-25, Fax: 0092 51 5487827:
Email:drtayyabafghani@alshifaeye.org ;
Website: www.asjoalshifaeye.org

ORIGINAL ARTICLE

Effect of Duration of Type II Diabetes Mellitus on Intraocular Pressure and Central Corneal Thickness

Sehrish Aslam[1], Naila Obaid[2], Tehmina Nazir Hussain[2], Shumaila Obaid[3], Haseeb Ahmed Khan[4]

Abstract:

Objective: To find out the effect of duration of type II diabetes mellitus on intraocular pressure and central corneal thickness

Methods: A total of 100 diabetic patients were included in the study after taking approval from Ethical Review Committee. Patients were selected for the data collection process in the Eye outpatient department. Slit lamp and retinal examinations were performed on all individuals. The central corneal thickness (CCT) was determined with a Quantel clinical pachymeter, and the intraocular pressure (IOP) was assessed with a Goldman applanation tonometer. Patients were divided into two groups based on the duration of their disease: Group A (diabetes less than 10 years) and Group B (diabetes more than 10 years).

Results: The mean age of patients was 47.1±8.94 years in group A and 72.86±6.04 years in group B. Group A

patients were found to have a mean CCT value of 532.400 ± 12.98 micrometer while Group B patients had a mean CCT of 553.120 ± 13.23 micrometer (p-value <0.05). Mean IOP in group A patients was 18.03 ± 0.749 mmHg and in group B patients was 19.58 ± 1.029 mmHg (p-value <0.05)

Conclusion: Prolonged duration of type 2 diabetes mellitus (disease duration >10 years) has been depicted to be significantly associated with increased Central Corneal Thickness (CCT) and raised Intraocular Pressure (IOP). *Al-Shifa Journal of Ophthalmology 2025; 21(1): 23-28.*

1. *PAF Hospital Mushaf, Sargodha*
2. *Fauji Foundation Hospital Rawalpindi*
3. *Foundation University Medical College FUIC Islamabad*
4. *Al-Baseer Eye Hospital Karachi.*

Originally Received: 05 Sep 2024
Revised: 27 Sep 2024
Accepted: 5 Oct 2024

Correspondence to:
Sehrish Aslam
PAF Hospital Mushaf, Sargodha.
sehrishaslam15@yahoo.com

Introduction:

Diabetes mellitus (DM) develops when the pancreas is unable to produce enough insulin, or when the body becomes insulin resistant, resulting in elevated blood glucose levels. This can cause micro- and macrovascular problems,

resulting in ocular manifestation such as diabetic retinopathy with alterations in corneal thickness and intraocular pressure. Diabetes patients frequently have corneal abnormalities and changes in intraocular pressure. Increased corneal thickness and edema of the cornea indicate corneal dysfunction, but higher IOP has been linked to glaucoma.[1,2,3] Lee et al. studied type 1 and 2 insulin-dependent DM patients and found that those with diabetes for less than ten years had greater corneal morphological abnormalities. Their report was complicated by the fact that the data from the two groups of diabetic individuals were

combined.[4] Choudhari et al. observed no change in CCT in type 2 DM, but identified a considerably higher rate of cell loss in type 1 DM.[5] A recent study found that CCT was considerably higher in the diabetic group, when compared to non diabetic group. Diabetic eye damage has also been linked to a prolonged disease duration and problems managing glucose levels.[6,7] Patients with type 2 diabetes who are unable to obtain effective glucose control with oral medicines are frequently treated with insulin, either alone or in combination with other oral medications.

Diabetic people have higher IOP compared to non-diabetic ones. High IOP and diabetes remain risk factors for glaucoma, while some authors disagree.[8,10,11,12,13] Another glaucoma study, the Nurses' Health Study, discovered a link between glaucoma and short-duration diabetic condition, whereas the Los Angeles Latino Eye Study revealed that glaucoma was more common in people with long-duration diabetes.[11,12] There is a need for more research to better understand how diabetes affects the cornea and IOP. Studies on CCT in diabetic individuals either did not include IOP measurements from the same subjects, were not well controlled, comprised people with retinopathy, or were not randomized. Few studies have examined the relationship between corneal metrics and diabetes duration. Additionally, there is a scarcity of research on the impact of glucose control on corneal parameters and IOP. The purpose of our study is to examine CCT and IOP in type 2 diabetic patients and relate any potential association with prolonged duration of disease.

Methodology:

This is a cross sectional prospective study conducted after taking approval from the Institutional Ethical Committee. The research comprised a total of 100 type 2 diabetic patients (having diabetes from the last 10 years) who visited the Eye OPD at the Institute of Ophthalmology, Fauji Foundation Hospital, Rawalpindi, from September 2021 to February 2022. Before enrollment, a comprehensive ophthalmic examination, including a complete medical history, slit-lamp examination, fundus camera retinal examination, and corneal topography was conducted on each subject. Exclusion criteria included past prescription lens use, past glaucoma or pseudo exfoliation, clear history of corneal illness, individuals with extremely dry eyes detected by a tear film breakdown time of fewer than 0.3 seconds, present intraocular inflammation, those who have undergone anterior segmental surgery, having comorbid diseases such as hypertension, and those who have received laser therapy. Patients using any topical medications were also excluded, but soft contact lens wearers were included in the study only if they discontinued contact lens use 24 hours before the examination.

Following selection, patients were then divided into two groups:

Group A (Patients with diabetes mellitus <10 years)

Group B (Patients with diabetes mellitus >10 years)

Slit lamp and retinal examinations were performed on all individuals. When administering medication for type II diabetes, the severity of the condition was noted, the corneal thickness was determined with a Quantel clinical pachymeter, and pressure inside the eye was assessed with a Goldman applanation tonometer after instillation of fluorescein dye and topical anesthetic. Relevant data were entered in a proforma, including the case numbers, name, gender, age, BMI, duration of diabetes mellitus, the thickness of the cornea, and intraocular pressure. To prevent variables and design prejudices, the exclusion criteria were adhered to strictly. Sample size was calculated with the help of WHO sample size calculator taking confidence level of 95%, a total precision (d) of 0.5, Mean of IOP in diabetics of 18.32 and an average standard deviation of the population of 2.52, a population sample dimension of 100 was chosen.[6] Data was

analyzed using a statistical analysis tool (IBM-SPSS V- 23). For quantitative variables such as age, IOP and CCT, Mean +/- SD was calculated. Frequency was computed for qualitative variable such as gender. Pearson correlation coefficient was applied to look at the relationship between CCT and IOP among diabetic patients. Independent sample T test was applied to compare CCT along with IOP among the two groups of diabetic patients with p-value <0.05 being considered statistically significant. Linear regression study was applied to plot the changes in CCT and IOP as the duration of diabetes mellitus increases in the patients.

Results:

Mean ±SD of age of the 100 diabetic patients was 59.98 ±15.00 years having an age range of 19 to 85 years. Out of 100 patients, 53 were males and 47 were females. The mean ± SD of BMI was 26.280±2.05 Kg/m2. The current study evaluated that mean ± SD of central corneal thickness was 542.76 ± 16.68 micrometer while the mean ± SD of intraocular pressure was 18.81 ± 1.18 mmHg. Among the diabetics, 5 of the patients were insulin-dependent while the rest of the patients were not insulin dependent. See Table 1.

The mean ± SD of age in Group A patients was 47.10 ± 8.94 years and in Group B patients was 72.86 ± 6.04 years (p-value <0.05). The mean ± SD of CCT in Group A was 532.40 ± 12.98 micrometer while in Group B was 553.12 ± 13.23 micrometer (p-value <0.05). The mean ± SD of IOP in Group A was 18.03 ± 0.749 mmHg and Group B was 19.58 ± 1.02 mmHg. (p-value <0.05). Independent sample T test revealed that increased CCT and raised IOP was found with longer duration of diabetes mellitus with p value <0.05. See Table 2.

Pearson correlation coefficient showed a significant relationship between CCT and IOP in the diabetic patients (p-value <0.001). See Table 3.

Linear regression analysis revealed a linear relationship for both CCT and IOP when compared to the duration of diabetes mellitus indicating that more prolonged exposure of the disease results in thicker corneas and raised intraocular pressure. See Figure 1,2.

Table 1: Clinic-demographics of diabetic patients n=100

Demographics	Mean±SD
Age (years)	59.98 ±15.00
Gender (male: female)	53±47
BMI (Kg/m2)	26.280±2.05
CCT (µm)	542.76 ± 16.68
IOP (mmHg)	18.81 ± 1.18

Table 2: Comparison of age-adjusted intraocular characteristics according to Independent sample t- test n=100

Intraocular characteristics	Mean±SD Group A (Diabetes duration <10 years) n=50	Mean±SD Group B (Diabetes duration >10 years) n=50	P Value
Age (years)	47.10± 8.94	72.86± 6.04	<0.001
CCT (µm)	532.400 ± 12.98	553.120 ± 13.23	<0.001
IOP (mmHg)	18.03 ± 0.749	19.58 ± 1.029	<0.001

Table 3: Association between CCT and IOP in diabetic patients according to Pearson correlation coefficient test n=100

Correlations	Central corneal thickness (µm)	Intraocular pressure (mmHg)
Pearson correlation coefficient	.325**	.325**
2- tailed significance	<0.001	<0.001
Number	100	100

**Correlation is significant at the 0.01 level (2- tailed)

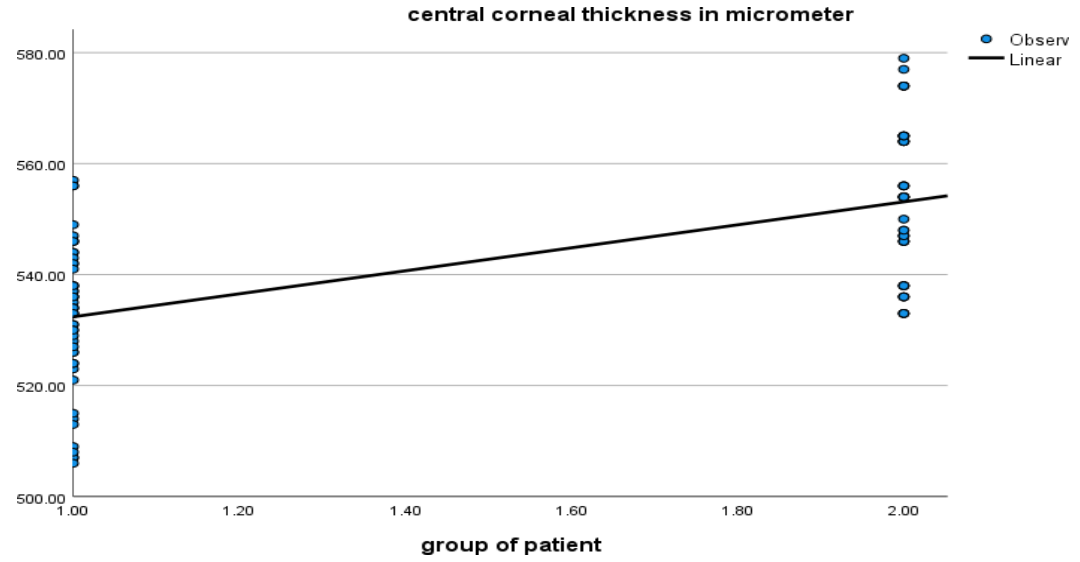

Figure 1: Plotting of CCT to compare both groups of diabetic patients

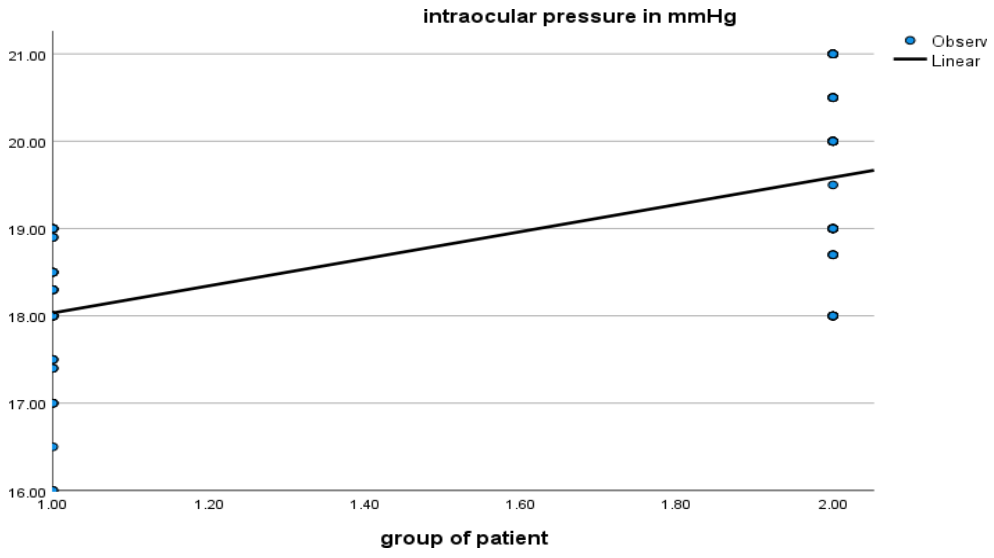

Figure 2: Plotting of IOP to compare both groups of diabetic patients

Discussion:

According to our study, the mean ± SD of CCT in Group A was 532.40 ± 12.98 micrometer while in Group B was 553.12 ± 13.23 micrometer (p-value <0.05). The mean ± SD of IOP in Group A was 18.03 ± 0.749 mmHg and Group B was 19.58 ± 1.02 mmHg. (p-value <0.05). Independent sample T test revealed that increased CCT and raised IOP was found with longer duration of diabetes mellitus with p value <0.05.

According to our study, the primary evaluation of the association between IOP and CCT in type 2 diabetic patients was significant according to Pearson correlation coefficient. Linear regression analysis revealed a linear relationship for both CCT and IOP when compared to the duration of diabetes mellitus indicating that more prolonged exposure of the disease results in thicker corneas and raised intraocular pressure which is supported by a study published by Shih and his colleagues who found that diabetes and hyperglycemia are associated with thicker CCT.[14] This association is important because thicker or thinner central corneas may lead to either overestimation or underestimation of IOP, which is a crucial risk factor for glaucoma. In fact, every 25 µm increase in CCT was associated with a 1 mm Hg change in IOP. Moreover, the study found that patients with diabetes had higher IOP, steeper corneal curvature, and shorter axial length compared to those without diabetes.[9] These findings highlight the importance of considering CCT when interpreting IOP measurements in patients with diabetes. Future research should investigate employing a dynamic contour tonometer to assess IOP in a comparable approach. Our study solely reports measured CCT and IOP on the same patients based on diabetes duration.

IOP was subsequently evaluated in our study using two duration categories: <10 years and >10 years. It has been depicted that IOP in patients having diabetes >10 years was significantly raised.

Researchers have proposed many explanations for observed changes in CCT and IOP, as well as their potential interrelationships in diabetic patients' eyes. It has been proposed that increased IOP leads the eye to have more cross-linking of collagen through the glycation process, which enhances the rigidity of the cornea and sclera to resist the damaging effect of increased IOP.[7,8,9,15] The rigidity then translates into higher IOP values. Sorbitol accumulates within the diabetic corneal endothelium cells and a decrease in Na+/K+ ATPase activity promote malfunction of the corneal endothelial cell layer, resulting in corneal hydration and higher CCT readings. Thus, corneal thickness provides indirect information on the function of the endothelial layer. This relationship should be investigated further on a sample of type II diabetes people using a tonometer that is unaffected by corneal factors.[4,15,16]

However, Al-Sereiti et al. found that patients with diabetes who had autonomic neuropathy had normal intraocular pressure. Autonomic denervation has been linked to peripheral diabetic neuropathy. It has been proposed that in autonomic neuropathy, the pupil/iris diameter is reduced, which enhances aqueous drainage and lowers the IOP.[17]

Conclusion:

Our study concluded that the duration of diabetes with type 2 mellitus has been depicted to be significantly associated with raised intra-ocular pressure. Overall, the relationship between CCT and IOP in diabetics is complex and multifaceted. Further research is needed to fully understand the implications of this association for glaucoma diagnosis and management. Additionally, evaluation of corneal endothelial structure might be advantageous in diabetic patients with daily assessments to stop the visual disability in the early period and for early intervention.

Limitations of our study were that it was a single center study. Further multiple centered studies should be conducted for clinical implication.

References:

1. Alam, S., Hasan, M. K., Neaz, S., Hussain, N., Hossain, M. F., & Rahman, T. (2021). Diabetes Mellitus: Insights from Epidemiology, Biochemistry, Risk Factors, Diagnosis, Complications, and Comprehensive Management. *Diabetology*, *2*(2), 36–50. https://doi.org/10.3390/diabetology2020004
2. Tan, S. Y., Mei Wong, J. L., Sim, Y. J., Wong, S. S., Mohamed Elhassan, S. A.,

Tan, S. H., Ling Lim, G. P., Rong Tay, N. W., Annan, N. C., Bhattamisra, S. K., &Candasamy, M. (2019). Type 1 and 2 diabetes mellitus: A review of the current treatment approach and gene therapy as a potential intervention. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *13*(1), 364–372. https://doi.org/10.1016/j.dsx.2018.10.008

3. Lucier, J., & Weinstock, R. S. (2022, June 9). *Diabetes Mellitus Type 1*. Nih.gov; StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK507713/
4. Lee JS, Oum BS, Choi HY, Lee JE, Cho BM. Differences in corneal thickness and corneal endothelium related to duration in Diabetes. Eye. 2005, 15;20(3):315–8.
5. Choudhari NS, George R, Sathyamangalam RV, Raju P, Asokan R, Velumuri L, et al. Long-term change in central corneal thickness from a glaucoma perspective. Indian J Ophthalmol. 2013;61(10):580–4.
6. Biswas S, Raman R, Koluthungan V, Sharma T. Intraocular Pressure and Its Determinants in Subjects With Type 2 Diabetes Mellitus in India. J Prev Med Pub Health. 2011;44(4):157–66.
7. Siegfried CJ, Shui Y-B, Bai F, Beebe DC. Central corneal thickness correlates with oxygen levels in the human anterior chamber angle. Am J Ophthalmol. 2015;159(3):457–462.
8. Matsuoka M, Ogata N, Matsuyama K, Yoshikawa T, Takahashi K. Intraocular pressure in Japanese diabetic patients. Clin OphthalmolAuckl NZ. 2012;6:1005–9.
9. Oriowo OM. Profile of central corneal thickness in diabetics with and without a dry eye in a Saudi population. Optom St Louis Mo. 2009;80(8):442–6.
10. Clark CV, Mapstone R. The prevalence of diabetes mellitus in the family history of patients with primary glaucoma. Doc Ophthalmol Adv Ophthalmol. 1986, 28;62(2):161–3.
11. Chopra V, Varma R, Francis BA, Wu J, Torres M, Azen SP, et al. Type 2 diabetes mellitus and the risk of open- angle glaucoma the Los Angeles Latino Eye Study. Ophthalmology. 2008;115(2):227–232.
12. Arora VK, Prasad VN. The intraocular pressure and diabetes-a correlative study. Indian J Ophthalmol. 1989;37(1):10–12.
13. Tielsch JM, Katz J, Quigley HA, Javitt JC, Sommer A. Diabetes, intraocular pressure, and primary open-angle glaucoma in the Baltimore Eye Survey. Ophthalmology. 1995;102(1):48–53.
14. Shih KC, Lam KS, Tong L. A systematic review on the impact of diabetes mellitus on the ocular surface. Nutr Diabetes. 2017 Mar 20;7(3):e251. Doi: 10.1038/nutd.2017.4. PMID: 28319106; PMCID: PMC5380897.
15. Memarzadeh F, Ying-Lai M, Azen SP, Varma R Los Angeles Latino Eye Study Group. Associations with intraocular pressure in Latinos: the Los Angeles Latino Eye Study. Am J Ophthalmol. 2008;146(1):69–76.
16. Zhang K, Zhao L, Zhu C, Nan W, Ding X, Dong Y, Zhao M. The effect of diabetes on corneal endothelium: a meta- analysis. BMC Ophthalmol. 2021 Feb 10;21(1):78. Doi: 10.1186/s12886-020-01785-3. PMID: 33568093; PMCID: PMC7874671.
17. al-Sereiti MR, Turner P, Gale EA. Intraocular pressure and pupillary responses in patients with diabetes mellitus. Postgrad Med J. 1991;67(785):250–251.

Authors Contribution

Concept and Design: Shumaila Obaid
Data Collection / Assembly: Naila Obaid
Drafting: Tehmina Nazir Hussain
Statistical expertise: Haseeb Ahmed Khan
Critical Revision: Sehrish Aslam