Original Article

To Analyze Association between Central Corneal Thickness and Anterior Chamber Depth in Patients with Type 2 Diabetes Mellitus by Optical Biometry

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ABSTRACT

Objective: To determine the anatomical variations in central corneal thickness (CCT) and its association with anterior chamber depth (ACD) in patients with type 2 Diabetes Mellitus and to compare them with non-diabetics.

Study Design: Descriptive Cross-sectional study

Place and Duration of Study: This study was conducted at the Eye OPD and ward of Ruth Pfau Civil Hospital Dow University of Health Sciences, Karachi from January, 2019 till June 2019 for a period of six months.

Materials and Methods: There were 100 patients in the study, among which 50 were diabetics and 50 were non-diabetics. After written consent and history, patients were selected according to inclusion and exclusion criteria. The CCT, and ACD measurements were estimated with the help of Optical Biometer AL Scan Nidek (non-contact method). The comparison of mean CCT and ACD was done between diabetics and non-diabetics.

Results: The difference of CCT was found statistically significant (p value 0.01), whereas comparison of ACD among diabetes and non-diabetics was statistically insignificant (p value 0.22).

Conclusion: The present study showed that CCT was increased in patients with type 2 Diabetes Mellitus as compared to non-diabetics with more than 5 year of duration. However no significant changes and correlation were found between CCT and ACD on optical biometry.

Key Words: Corneal thickness, Non-Diabetes Mellitus, Diabetes Mellitus Type 2, Anterior chamber depth

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INTRODUCTION

The cornea is convex, clear, avascular transparent refracting part of the eye, accounting for approximately 70% (42 of the 58.6 D) of the total refractive power of eyeball, the average dioptric power is 43-45 D. Its horizontal diameter is 11.7 mm and vertical is 10.6 mm anteriorly while posteriorly it is circular and is about 11.7 mm[1.] Corneal hydration and high degree of myopia can affect central thickness [2, 3]. Normal value of CCT (central corneal thickness) globally varies from population to population.

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In European population, the mean CCT was found to be 549 µm, in Asians, it was 518.3 µm and in Pakistanis, it was 503.96 µm[4,5,6]. Normal values of ACD (anterior chamber depth) in Europeans were found to be 3.52±0.28 mm9, where as in Asians 2.9 mm respectively. In Pakistani population the measurement of ACD in emmetropic (normal) eye was, 3.19 ±0.28 mm [7, 8].

T2DM (type 2 diabetes mellitus) is a metabolic disorder characterized by high glucose level. It is caused when the pancreas cannot produce adequate insulin or the resistance of body to insulin occurs, both resulting in raised blood glucose levels[9]. About 382 million people are diagnosed with T2DM all over the world. It is a common cause of blindness and can lead to diabetic retinopathy as well as keratopathy. A component of diabetic polyneuropathy is keratopathy which significantly affects the vision in T2DM patients. Diabetes can also develop corneal abnormalities and changes in intraocular pressure (IOP) [10] According to American Diabetic Association (ADA), people with diabetes mellitus are 40% more likely to suffer from glaucoma and 60% more likely to suffer from cataract than people without diabetes. Thicker corneas, its anatomical changes and association of T2DM can be seen in different studies[11].

The changes in the morphology and metabolism of endothelium of cornea in patients with T2DM are observed in many studies, and the association of diabetes with thicker cornea and other anatomical changes has been observed earlier[12]. Literature shows, many diabetic patients have thicker corneas, less cell density and hexagonality with irregular corneal endothelial cells to be significantly associated with duration of diabetes[13]. Variation in the thickness of cornea is observed in different populations and races. Its measurement is an important parameter and an indicator of corneal health status and refractive surgeries are sometimes dependent on it[14]. CCT is also reported to be associated with duration of diabetes where patients with more than ten years duration of diabetes are more likely to have increased CCT.

Anterior chamber is a space bounded anteriorly by posterior surface of cornea and posteriorly by pupil and iris, filled with a clear fluid the aqueous humor[15]. The depth of the anterior chamber of the eye varies between 1.5 and 4.0 mm, averaging 3.0 mm. It is deepest centrally and contains approximately 250 µL of aqueous humor. It tends to become shallower at older age and in hypermetropic eyes[16]. Determining the ACD is important in estimating the risk of narrow angle glaucoma. There are various method of measuring ACD, including examination through a slit lamp, ultrasound and Scheimpflug photography. As depth decreases below 2.5 mm, the risk for close angle glaucoma increases. Decrease in anterior chamber depth has also been reported to be associated with the duration of diabetes[17].

The present study was done in order to establish a relevant local population data, to assist in future comparisons and decision making about corneal health. The aim of this study in the given contest therefore was to examine the effects of diabetes type 2 on CCT and ACD, and to compare these with non-diabetic controls.

MATERIALS AND METHODS

It was a clinical cross-sectional study. The data was collected from Eye OPD and ward of Ruth Pfau Civil hospital Dow University of Health Sciences, Karachi. Total number of 100 patients were included, among which 50 were diabetics and 50 were non-diabetics. After written consent and history, patients were selected according to inclusion and exclusion criteria. The CCT, and ACD measurements were estimated with the help of Optical Biometer AL Scan Nidek (non-contact method). The subjects with history of intraocular surgery, trauma, corneal opacity, uveitis, contact lens users and topical steroid drops users were excluded. All data were collected and recorded at Ruth Pfau Civil hospital, DUHS.

RESULTS

The mean comparison of CCT (µm) was done between non diabetic and diabetic subjects. Mean CCT of non-diabetic control was 497.60±34.32 µm and of diabetic patients was 514.58±30.99 µm. Independent two tailed sample t-test at alpha 0.5 was used to compare the mean differences of CCT between two groups. P-value 0.01 was statistically significant as shown in Table 1 and Figure 1.

Table No.1: Comparison of Central Cornel Thickness and Anterior Chamber Depth between Type II Diabetics and Non Diabetics

Parameters 95%	Diabetic (n=50)		Non-Diabetic (n=50)		P-value
Central Corneal Thickness (µm)	Mean	SD	Mean	SD	
	514.58	30.99	497.60	34.32	0.01*
Anterior Chamber Depth (mm)	3.09	0.27	3.17	0.43	0.22

SD- Standard deviation. P-value≤0.05 was considered significant

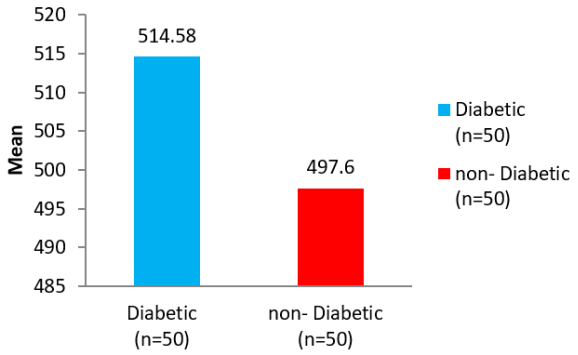

Figure No.1: Showing mean central corneal thickness between Diabetic and Non Diabetic groups

The comparison of mean ACD (mm) was done between non diabetics and diabetics. Mean ACD of non-diabetic individuals was 3.17±0.43mm and of diabetic patients was 3.09±0.27 mm. P-value= 0.22 was statistically insignificant as shown in Table 1 and Figure 2.

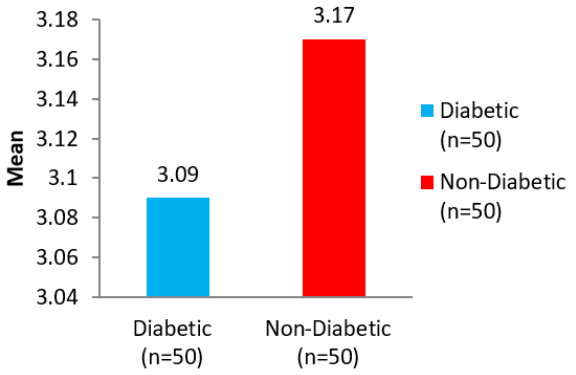

Figure No.2: Mean anterior chamber depth between Diabetics and Non Diabetics

Pearson's correlation analysis was performed between CCT and ACD in diabetic patients. A negative trend was observed in correlation analysis between CCT and ACD among diabetic patients. There was 3.8% negative correlation of ACD with CCT, found statistically non-significant with p-value 0.794 as shown in Figure 3.

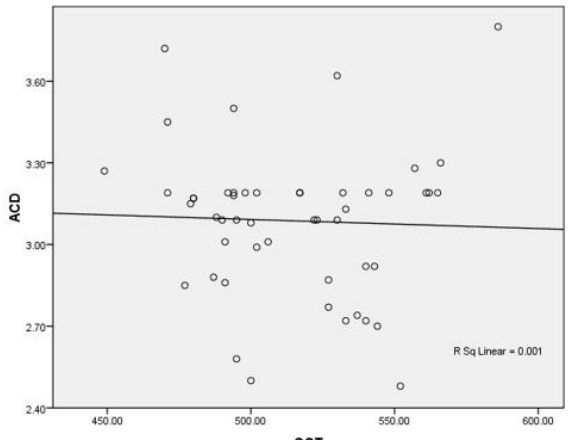

Figure No.3: Correlation analysis of Central corneal thickness with Anterior chamber depth in diabetic patients. (ACD- Anterior chamber depth, CCT- Central corneal thickness)

DISCUSSION

In this study, we have compared ocular parameters like CCT and ACD between diabetics and non-diabetic controls. Increased CCT is a common manifestation of diabetic keratopathy, a manifestation of an altered state of corneal metabolism. Despite the fact that duration of disease had adverse effects but uncontrolled diabetes can have these effects earlier on cornea[18]. In our study, the CCT was found to be significantly greater in diabetics than non-diabetics, p-value=0.01. Similar to our study in 2017, QU Islam and Jahangir S found that CCT was significantly higher in diabetics than non-diabetics (512±32.68 vs 498±28.93 µm) and (567±15.37 vs 532±9.4 µm) respectively[19]. Gupta M et al, in 2016 found significant increase in CCT of diabetics[20].

Similar findings were reported by Mathebula SD et al. in 2015 where the mean central corneal thickness of diabetic patients was reported to be 567.14 µm whereas that of non-diabetic individuals was 531.14 µm[21]. Briggs S et al. in 2016 also reported central corneal thickness to be significantly higher in diabetics than in non-diabetics (539.7±33.6 µm vs. 525.0±45.3 µm, p=0.003). He also found the association of increased CCT with the duration of diabetes more than 10 years[22]. Similarly, Storr-Paulsen A et al. in 2014 found diabetic subjects to have greater central corneal thickness than non-diabetic subjects (538 versus 546 µm, $p < 0.05$)[23]. Contrary to our finding O. Touzeau in 2004 did not find significant correlation of CCT with T2DM.[24]

The association between diabetes and ACD has been reported earlier. In our study the comparison of ACD between diabetics and non-diabetics was found to be insignificantly decreased with p value 0.22. Similar to our study Huseynova T et al. in 2016 did not find any significant difference in the anterior chamber depth of diabetics and controls ($p>0.05$)[25]. Okomoto F, in 2000 found non-significant difference in ACD of diabetics and non-diabetics (3.32mm vs 3.31mm). [25] Contrary to our findings Agrawal & Premnath G in 2015 reported that in patients with controlled diabetes the mean ACD was 2.96+0.21 mm as against 2.50+0.32 mm of patients with poorly controlled diabetes ($p<0.0001$)[26].

Decrease in ACD has also been reported to be associated with the duration of diabetes. Agrawal & Premnath G in 2015 also reported that the mean anterior chamber depth of patients with >5 years duration of diabetes was 2.59+0.42 mm compared to 2.74+0.33 mm of patients with less than 5 years duration of diabetes (P=0.056). The mean ACD of patients with >5 years duration of diabetes was decreased as compared to patients with less than 5 years duration of diabetes [26] Das S et al. in 2017 also concluded that ACD decreases with longer duration of diabetes[27]. Likewise, Costa L et al. in 2015 found diabetic patients to have narrow anterior chamber than healthy controls[28]. The results of above studies are not similar to our study.

In present study the Pearson's correlation analysis was performed between CCT and ACD in diabetics and non-diabetics. A negative correlation was observed between CCT and ACD with non-significant p-value=0.794 in diabetic patients. Slezkina I et al. in 2014, found ACD to be negatively associated with CCT in diabetic patients ($p<0.05$) [17]. Suraida AR and associates in 2018, found ACD to be significantly narrow when they performed the correlation between the considered ocular factors in diabetic patient[29]. Premnath and associates in 2018 found that diabetic patients with more than five year duration and poor glycemic control had narrow anterior chamber with increased CCT[26].

The present study was done in order to establish a relevant local data to assist in future comparisons and decision making about corneal health. Changes in corneal thickness in type II Diabetes Mellitus patients has prognostic value in different refractive surgeries. This study will provide the useful data about variation in different ocular parameters among type II Diabetes Mellitus patients which can help in assessing early manifestation of diabetic keratopathy that may become a problem leading to visual impairment. It is recommended that diabetic patients should undergo routine laboratory investigations for blood glucose level and ocular examination including assessment of corneal

structure for early detection and prevention of diabetic keratopathy.

CONCLUSION

We found increased CCT in patients with type 2 Diabetes Mellitus as compared to non-diabetics with more than 5 year of duration. However no significant correlation was found between CCT and ACD on optical biometry. Early diagnosis and screening the diabetic patients from local population and advising them for better control of diabetes will be helpful to prevent the ocular manifestation and visual impairment This study will provide a useful addition to the research data benefiting the clinical health professionals.

Author's Contribution:

Concept & Design of Study:	Shazia Fahmi
Drafting:	Shazia Fahmi, Hira Ahmed
Data Analysis:	Talat Samreen
Revisiting Critically:	Asma Aijaz, M.S Fahmi
Final Approval of version:	Shazia Fahmi

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Sridhar MS. Anatomy of cornea and ocular surface. Indian J Ophthalmol 2018;66(2):190-00.
2. Sanchis-Gimeno JA, Casanova J, Lleó-Pérez A, Rahhal MS, Ruiz-Torner A. Morphometric study of the hyperopic central cornea. Eur J Anat 2019; 5(2):77-81.
3. Sanchis-Gimeno JA, Casanova J, Alonso L, Rahhal SM, Torner AR, Soriano FM. Assessment of central corneal thickness in extreme myopic eyes. Eur J Anat 2019;7(1):15-8.
4. Suzuki S, Suzuki Y, Iwase A, Araie M. Corneal thickness in an ophthalmologically normal Japanese population. Ophthalmol 2005;112(8): 1327-36.
5. Tayyab A, Masrur A, Afzal F, Iqbal F, Naseem K. Central corneal thickness and its relationship to intra-ocular and epidemiological determinants. JCPSP 2016;26(6):494-7.
6. Sanhermelando MV, Lleó A, Alonso L, Rahhal MS, Gil de Tejada TH, JA SG. Repeatability of central corneal thickness and ocular anterior chamber depth measurements with the Orbscan topography system. Eur J Anat 2019;6(2):59-64.
7. Humayun S, Fawad A, Humayun Q, Arzoo S, Ishaq M. Screening Thresholds for the Corneal Tomography in a Myopic Pakistani Population. JCPSP 2019;29(2):128-32.
8. Valdez-García JE, Hernandez-Camarena JC, Lozano-Ramírez JF, Zavala J, LoyaGarcía D, et al. Correlation of age, corneal curvature and spherical equivalent with central corneal thickness. Revista Mexicana de Oftalmología 2017;91(4):172-6.
9. American Diabetes Association. Classification and diagnosis of diabetes: standards of medical care in diabetes—2018. Diabetes Care 2018;41 (Supplement 1):S 13-27.
10. Seuring T, Archangelidi O, Suhrcke M. The economic costs of type 2 diabetes: a global systematic review. Pharmacoeconomics 2015; 33(8): 811-31.
11. Donath MY, Shoelson SE. Type 2 diabetes as an inflammatory disease. Nature Reviews 2011; 11(2):98.
12. Sayin N, Kara N, Pekel G. Ocular complications of diabetes mellitus. World J Diabetes 2015;6(1): 92-108.
13. Lee JS, Oum BS, Choi HY, Lee JE, Cho BM. Differences in corneal thickness and corneal endothelium related to duration in diabetes. Eye 2006;20(3):315-8.
14. Bamdad S, Bolkheir A, Sedaghat MR, Motamed M. Changes in corneal thickness and corneal endothelial cell density after phacoemulsification cataract surgery: a double-blind randomized trial. Electronic Physician 2018;10(4):6616-23.
15. Avtar R, Srivastava S. Modeling the flow of aqueous humor in posterior chamber. e-J Science & Technol 2015;10(4) 00-00
16. Bhardwaj V, Rajeshbhai GP. Axial length, anterior chamber depth-a study in different age groups and refractive errors. J Clin Diagn Res 2013;7(10): 2211-2.
17. Slezkina I, Mineeva L, Kabanov A, Shubin L. Correlation of biometric indicators, refraction and intraocular pressure with blood glucose level in patients with diabetes mellitus type 2. Investigative Ophthalmol Visual Sci 2014;55(13):4394-5.
18. Gao F, Lin T, Pan Y. Effects of diabetic keratopathy on corneal optical density, central corneal thickness, and corneal endothelial cell counts. Experimental Therapeutic Med 2016;12(3): 1705-10.
19. Shifa PN. Effect of diabetes mellitus on central corneal thickness–A comparative study. Pak J Ophthalmol 2017;33(3):127-31.
20. Gupta M, Pandey AN, Tyagi R. A study of corneal changes–endothelial cell density (ECD) and central corneal thickness (CCT) in type-2 DM in relation to HbA1c levels and compare it with healthy individuals. Ind J Clin Experimental Ophthalmol 2016;2(2):123-7.
21. Mete A, Corneal endothelial and central corneal thickness changes in patients with uncontrolled type II diabetes mellitus. Turkiye Klinikleri J Ophthalmol 2018;27(2):135-9.

22. Briggs S, Osuagwu UL, AlHarthi EM. Manifestations of type 2 diabetes in corneal endothelial cell density, corneal thickness and intraocular pressure. J Biomed Res 2016;30(1): 46–51.
23. Storr-Paulsen A, Singh A, Jeppesen H, Norregaard JC, Thulesen J. Corneal endothelial morphology and central thickness in patients with type II diabetes mellitus. Acta Ophthalmologica 2014; 92(2):158-60.
24. Touzeau O, Levet L, Borderie V, Bouchard P, Laroche L. Anterior segment of the eye and diabetes mellitus. J francais d'ophtalmol 2004; 27(8):859-70.
25. Okamoto F, Sone H, Nonoyama T, Hommura S. Refractive changes in diabetic patients during intensive glycaemic control. British J Ophthalmol 2000;84(10):109 7-102.
26. Premnath G, Agrawal S. Study of impact of diabetes mellitus on anterior chamber depth as detected by partial coherence laser interferometry. J Marine Med Soc 2015;17(1):53.
27. Das S, Vishwanandha NR, Subhashini M, Mahadevan K. A study on the angle of anterior chamber in relation to duration of diabetes mellitus and stages of diabetic retinopathy. Ind J Clin Experimental Ophthalmol 2017;3(3):270-3.
28. Costa L, Passos I, Pires G, Proença R, Amado D, Ferreira J. Variation of accommodative process and anterior chamber parameters in diabetic patients. Acta Ophthalmologica 2016;94.
29. Suraida AR, Ibrahim M, Zunaina E. Correlation of the anterior ocular segment biometry with HbA1c level in type 2 diabetes mellitus patients. PloS one 2018;13(1):e0191134.