



Association of diabetes with central corneal thickness – A prospective study

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Citation this Article: Dr. Varshika Patel, Dr. Sadyaja Smita, Dr. D.K. Shakya, “Association of diabetes with central corneal thickness – A prospective study”, IJMSIR- September - 2023, Vol – 8, Issue - 5, P. No. 170 – 174.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: To evaluate the effect of diabetes on central corneal thickness.

Method: A Prospective observational study with 100 patients, 50 diabetic and 50 non-diabetics subjects was conducted from January 2021 to June 2022 in department of ophthalmology. All subjects underwent routine complete ophthalmological examination, central corneal thickness was measured using ultrasound pachymetry. Random blood sugar estimation was done among diabetic patient and non-diabetic subjects.

Results: The mean central corneal thickness in diabetic subjects was $566.96 \pm 14.16 \mu\text{m}$ as compared to non-diabetics $519.33 \pm 13.64 \mu\text{m}$ and difference between the two groups was clinically significant ($p\text{-value} < 0.0001$). High mean CCT was found in patients with longer duration of diabetes >10 years i.e., 572.12μ and the mean CCT was found to be 565.98μ , among diabetics having duration less than 10 years but the difference was statistically insignificant ($p=0.292$). In this study, Mean central corneal thickness ($565.98 \pm 14.03 \mu\text{m}$) in patients with RBS (≥ 200 mg/dl) was highly significant compared

to mean central corneal thickness ($530.42 \pm 28.56 \mu\text{m}$) in patients with RBS (< 200 mg/dl)

Conclusion: Diabetic subjects showed higher central corneal thickness as compared to non-diabetic subjects and also there was increase in central corneal thickness with increase in duration and uncontrolled diabetes. All diabetic patients need to undergo central corneal thickness assessment before any intraocular surgeries.

Keyword: Diabetes, Central corneal thickness, Ultrasound pachymetry.

Introduction

Diabetes mellitus is a major concern due to its adverse effects on various tissues, including the cornea. India has the largest diabetic populations globally ⁽¹⁾ with retinopathy, cataract, and glaucoma being the main indicators. Diabetic keratopathy can have various presentations, including decreased corneal sensitivity, epithelial disorders, and thickened basement membrane ⁽²⁾ Increased serum glycosylated hemoglobin levels can lead to impaired corneal epithelial barrier function, and advanced glycosylation products accumulate in collagen proteins, leading to increased corneal thickening and biochemical changes. Central corneal thickness (CCT) is

a sensitive indicator of corneal health and serves as an index for corneal hydration and metabolism. Accurate determination of CCT is important in the context of glaucoma diagnosis and management. (3,4)Ultrasound pachymetry is the current standard for corneal thickness measurement. This study evaluated the effect of diabetes mellitus on CCT by comparing the CCT of diabetic and non-diabetic patients and association of CCT with random blood sugar levels. In day-to-day practice, measurement of central corneal thickness and endothelial cell density became a vital step in ophthalmic evaluation, not only in diabetic patients.

Material and methods

The study, conducted from January 2021 to June 2022, was a hospital based prospective observational study in the Ophthalmology Outpatient department at G.R Medical College, Gwalior. The study involved 100 patients, including 50 diabetes mellitus patients and 50 non-diabetic individuals, who provided full consent and were well-informed about the study's purpose. The study involved participants who answered a questionnaire about their demographics, lifestyle risk factors, education level, medical history, ocular history, and medication use. Participants who satisfied any of the following criteria—random glucose levels of 200 mg/dL or above, or patients receiving treatment for diabetes—were labelled as diabetics. CASES and Nondiabetic subjects were defined as CONTROLS. A detailed eye examination was performed, including best corrected visual acuity, slit lamp examination, and dilated funduscopy. Both cases and controls underwent CCT measurement by ultrasonic pachymetry under topical anesthesia.

Inclusion criteria

1. Patients with diabetes mellitus diagnosed according to the criteria written in methodology.
2. Nondiabetic controls.

3. Age group- 30 to 70

Exclusion criteria

1. Diabetes Mellitus with hypertension, thyroid disorder and other systemic diseases.
2. Patients having corneal pathology.
3. Patients who have undergone previous ocular surgeries.
4. Contact lens wearers.
5. non-diabetic individuals with ocular or systemic disease which influences intra-ocular pressure and central corneal thickness.
6. Refusal to participate in studies.

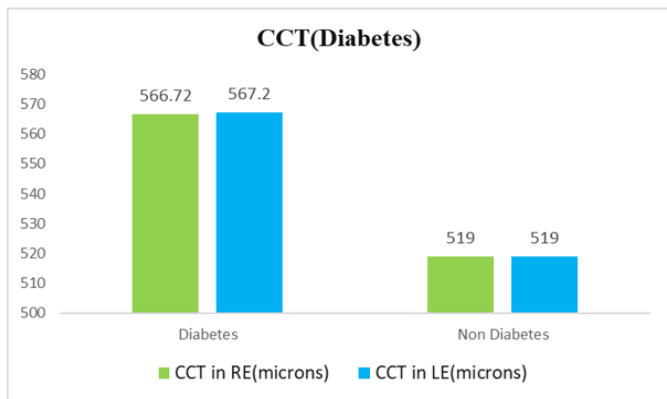
Results

The study examined changes in central corneal thickness in diabetic patients compared to non-diabetic individuals, revealing thicker corneal thickness and distinct endothelial morphology. Diabetes decreases Na⁺-K⁺ ATPase activity, leading to morphological abnormalities and permeability changes. Diabetic and non-diabetic individuals were compared for corneal thickness and endothelium, and the effects of diabetes on other corneal variables were analyzed. The study also examined the association between diabetic and non-diabetic patients with central corneal thickness, Random blood sugar (RBS), and diabetes duration with the help of independent t-test. The study found that diabetic patients have a significantly higher mean age, higher RBS (mg/dl), and higher mean CCT (microns) of right and left eyes compared to non-diabetic patients.

Table: 1 comparison of central corneal thickness Among diabetics and non-diabetics

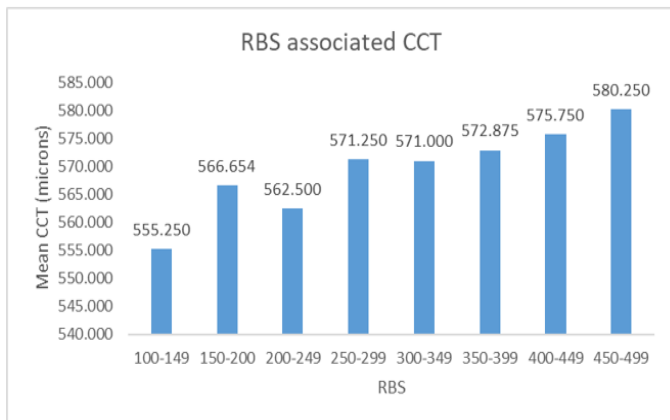
	Diabetes	Non-Diabetes	T	Mean Difference	p-value
Age	55.28±8.46	44.32±10.25	5.834	10.96	<0.0001
RBS (mg/dl)	252.34±83.4	140.3±21.28	9.206	112.04	<0.0001
CCT in RE(microns)	566.72±16.55	519±18.79	13.478	47.72	<0.0001
CCT in LE (microns)	567.2±17.71	519±18.79	13.202	48.20	<0.0001

Graph 1: Central corneal thickness based on diabetes



In Diabetic group, RBS were categorized into 8 groups according to increasing RBS values. The graph shows increasing MEAN CCT VALUE with increasing RBS values. Maximum central corneal thickness was seen in individual with RBS value between 450-499 mg/dl and least central corneal thickness was seen between 100-149 mg/dl.

Graph 2: Increasing CCT with increasing RBS value

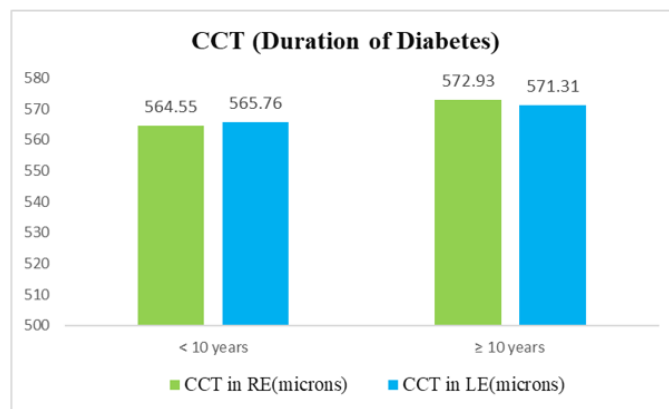


The mean age of diabetic patients with diabetes duration <10 years was 55.76±8.23 years, not significantly different from those with diabetes duration ≥10 years. The mean RBS (mg/dl) of diabetic patients with diabetes duration <10 years was 245.63±67.07 mg/dl, not significantly different from those with diabetes duration ≥10 years. The mean CCT (microns) of right and left eyes in diabetic patients did not show significant difference based on duration of diabetes.

Table: 2 Comparisons of central corneal thickness based on duration

Duration of Diabetes	< 10 years	≥ 10 years	T	Mean Difference	p-value
Age	55.76±8.23	53.93±9.28	0.669	1.83	0.507
RBS(mg/dl)	245.63±67.07	271.47±119.87	-0.96	-25.84	0.342
CCT in RE(microns)	564.55±16.29	572.93±16.32	-1.6	-8.38	0.117
CCT in LE (microns)	565.76±18.14	571.31±16.4	-0.97	-5.55	0.336

Graph 3: Central corneal thickness based on duration (diabetic patients)



Discussion

Central Corneal thickness and Diabetes

According to Math S.S. et al. (5) mean central corneal thickness of diabetic patients was significantly higher than mean central corneal thickness of non-diabetic patients. It was also observed in this study that mean central corneal thickness (566.96 ± 14.16) of diabetic patients was significantly higher than to non-diabetic patients of mean central corneal thickness (519 ± 13.64). The similar results were observed with previous literature studies whose findings are described as under:

	Diabetes	Non diabetes
Lee JS et al. ^[6]	588.2 ± 2.7	567.8 ± 3.8
El-Agamy Amira et al. ^[7]	545.61±30.39	539.42±29.22
Claramonte PJ et al. ^[8]	571.96 ± 26.81	544.89 ± 35.36
Luo XY et al. ^[9]	545.3 ± 33.7	544.8 ± 33.8
Math S.S et al. ^[5]	558.4 ± 24.71	524.33 ± 14.26
Present Study	566.96 ± 14.16	519 ± 13.64

McNamara et al. (10) found that central corneal thickness (CCT) changes are caused by hyperglycemic effects,

decreased lactate production, increased pump function during hypoxia, and sorbitol accumulation, leading to morphological and permeability changes.

Diabetes and RBS

A study by Luo XY et al.⁽⁹⁾ found that hyperglycemia was linked to thicker central corneas in Chinese adults. The study found that mean random blood sugar (252.34 ± 83.4) was higher in diabetic patients compared to mean random blood sugar (140.3 ± 21.28) of non-diabetic patients. They also stated that current RBS level was perfect predictor for CCT measurement. In this study, mean central corneal thickness ($565.98 \pm 14.03\mu\text{m}$) in patients with RBS (≥ 200 mg/dl) was highly significant compared to mean central corneal thickness ($530.42 \pm 28.56 \mu\text{m}$) in patients with RBS (< 200 mg/dl). ($p \leq 0.0001$).

Duration of Diabetes

Out of 50 diabetics, 37 had diabetes of < 10 years duration with mean duration being 7.42 ± 3.82 years and 13 had diabetes of duration > 10 years. CCT tends to increase with duration of diabetes. High mean CCT was found in patients with longer duration of diabetes > 10 years i.e., 572.12μ and the mean CCT was found to be 565.98μ , among diabetics having duration less than 10 years but the difference was statistically insignificant ($p = 0.292$). Yasser et al.⁽¹⁾ and Choo et al.⁽¹¹⁾ also concluded that there was no significant correlation between CCT and duration of diabetes. It was also observed that 27.03% patients with duration of diabetes (< 10 years) have controlled RBS (< 200 mg/dl) level whereas 38.46% of patients with duration of diabetes (≥ 10 years) have controlled RBS < 200 mg/dl. But there was no statistically difference between the central corneal thickness between the two groups. ($p = 0.4436$).

Similarly, Busted et al.⁽¹²⁾ showed that the diabetic corneal thickness was significantly thicker than the normal

corneal thickness, but there was no significant relation between central corneal thickness of diabetes and the diabetes duration. This study also concluded that duration of diabetes did not have significant impact on mean central corneal thickness and RBS level. However, some studies like Lee JS et al.⁽⁸⁾ and Math S.S et al.⁽⁷⁾ observed that duration of diabetes (≥ 10 years) has significant impact on central corneal thickness compared to duration of diabetes (< 10 years) which contradict with this study.

Conclusion

The study highlights the importance of measuring corneal thickness (CCT) in diabetic patients, particularly for refractive surgery, donor tissue evaluation, and long-term contact lens use. Accurate IOP measurements can help identify patients at higher risk of severe complications, enabling more accurate treatment. The CCT in diabetics signifies overall functional and morphological status of cornea. A simple non-invasive test in form of pachymetry might help in identification of those patients with DM who could be at higher risk of developing severe systemic and ocular complications, enabling better control of disease.

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