ISSN (O):2395-2822; ISSN (P):2395-2814

Central Corneal Thickness (CCT) in Diabetic Subjects and its Correlation with Disease Duration and Severity.

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Received: July 2017
Accepted: July 2017

ABSTRACT

Background: Diabetes mellitus (DM) affects the corneal endothelium by altering the function of Sodium Potassium ATP-ase activity, thus causing functional changes in diabetic corneas. Associated structural changes if any are important to be recognized timely since it has multiple clinical implications. A few studies have studied corneal morphological changes, including endothelial morphology and corneal thickness in diabetic subjects but it is still a topic of research and there are not many Indian studies in literature. **Aim:** 1) To analyze central corneal thickness (CCT) in subjects with diabetes mellitus and to compare this with age and sex matched healthy controls. 2) To correlate the association between CCT and duration and severity of diabetes. **Methods:** This was a cross-sectional study conducted in the diabetic patients of the age group of 18-76 years presenting to the Medicine department of the hospital. Eighty six subjects with Type-II DM and eighty six age matched controls were included in the study and were undertaken for CCT measurement by Ultrasonic pachymeter. **Results:** CCT significantly increased in diabetes (559.48±31.29) as compared to controls (534.61±34.55). Positive correlation was found between CCT and disease duration ≥ 10 years, HbA1c≥7 gm% and presence of diabetic retinopathy. **Conclusion:** CCT could assist in early identification of diabetics with higher risk for systemic and ocular complications, thus enabling better control of disease.

Keywords: Diabetes mellitus, Central Corneal Thickness, Pachymetry

INTRODUCTION

Cornea is the most important refractive element in the human ocular system providing 40-45 D of refraction. Corneal thickness is a sensitive indicator of health of cornea and serves as an index for corneal hydration and metabolism. It is also an important indicator of patency of endothelial pump. Normal cornea has a central thickness of 0.52mm and is thicker paracentrally and peripherally.

Diabetes Mellitus (DM) is one of the most common non-communicable diseases in the world today. India and China have the largest diabetic population in the world. With associated microvascular and macrovascular damage, the disease causes multiple Systemic complications and a high mortality rate. DM can affect every structure of the eye. Diabetics develop not only diabetic retinopathy but also corneal endothelial damage and keratoepitheliopathy in the form of SPK, recurrent corneal erosions and persistent epithelial defects.[1,2]

DM affects the corneal endothelium by altering the function of Sodium Potassium ATP-ase activity, thus causing functional changes in diabetic corneas. While functional changes have been well studied, structural changes in diabetic corneas have been topic of research. It is important to identify structural changes in diabetic cornea for multiple reasons; first, these changes might lead to decrease in corneal transparency and further reduce visual acuity; second, increased corneal thickness might modify intraocular pressure measurements and third, intraocular surgery in diabetic patients might lead to corneal edema post-operatively thus leading to prolonged ocular morbidity. It thus becomes important to timely identify structural changes in diabetic corneas; it is further more important to know whether these structural changes have any

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correlation with the duration of disease and disease severity.

Though diabetic retinopathy has been accepted as major cause of blindness worldwide and is an extensive topic of research, there are limited studies on corneal morphological changes in diabetic patients. The study was undertaken with aim to analyze central corneal thickness (CCT) in subjects with diabetes mellitus and to compare this with age and sex matched healthy controls and also to correlate the association between CCT and duration and severity of diabetes. The study helped us to obtain pilot morphological data of CCT in our rural diabetic population.

MATERIALS AND METHODS

Study Design

This cross-sectional study was carried out in the Ophthamology and Medicine Department of BPS Govt. Medical College for Women over a period of three months from July 2016 to September 2016. Patients in the age group 18-76 years were included. Patient with a physician diagnosis of DM and being given anti-diabetic treatment were defined as diabetic (cases) while age and sex matched non-diabetic subjects were defined as controls. Both cases and controls were undertaken for measurement of CCT by ultrasonic pachymetry (TM DGH 555, DGH Technology Inc, PA) under topical anesthesia after taking written informed consent. The average of the last three of the four successive readings of CCT (standard deviation < or =2) was used for the analysis. To keep the procedure uniform, only right eye of each was included.

Non- fasting blood samples were withdrawn from each subject to determine serum glucose and glycosyated haemoglobin (HbA1c).

Detailed eye examination was done including best corrected visual acuity, slit lamp examination of anterior segment and dilated fundoscopy. Patients with history of ocular trauma, any ocular surgery, any corneal pathologies, contact lens wearers, glaucoma, chronic use of any topical medication, and systemic history of hypertension were excluded.

Statistical Analysis

All statistical analysis was done with the help of SPSS Software (version20.). Continuous variables were evaluated by using independent t test and proportions using Chi-square test. P value of <0.05 has been considered statistically significant.

RESULTS

We studied 86 subjects with diabetes as cases and 86 as controls. It was found that CCT was significantly increased in diabetes (559.48±31.29) as compared to controls (534.61±34.55) [Table 1]. Positive correlation was found between CCT and disease duration ≥ 10 years, HbA1c≥7 gm% and presence of diabetic retinopathy [Table 2-4]. CCT was also significantly increased with duration and severity of disease. Thus, Diabetics in our population had increased CCT as compared to non-diabetics.

Table 1: Mean CCT comparision of diabetics and controls.

CCT (MEAN)	Controls	Cases (All)	p
	534.61±34.55	559.48±31.29	<0.0001

Table 2: Mean CCT comparison of diabetics with disease duration less and more than 10 years.

CCT (MEAN)	Duration <10	Duration >10	p
	552.54±29.11	576.54±30.45	0.001

Table 3: Mean CCT comparison of diabetics with HbA1C less than and more than 7gm%.

CCT (MEAN)	HbA1C<7	HbA1C>7	p
	543.85±23.32	564.44±32.01	0.009

Table 4: Mean CCT comparison of diabetics with and without retinopathy.

CCT (MEAN)	Non-DR	DR	p
	553.54±28.07	588.20±16.73	<0.0001

DISCUSSION

Ocular changes in diabetic patients have been well reported. Prolonged abnormal glucose metabolism leads to alterations in the epithelium, stroma and endothelium of the cornea. CCT, which reflects the metabolic state of cornea, is also influenced by glycaemic status.

In our present study, CCT measurements in the diabetic patients were found to be significantly higher than the normal subjects. This is in accordance with the studies reported by Busted N et al who found that diabetic corneas were significantly thicker than the normal corneas in a sample size of 81 diabetic subjects.3 Ozdamar Y et al in 2010 also reported that the CCTs of diabetic patients were thicker than that of normal subjects.[4]

We also found positive correlation between CCT and disease duration ≥ 10 years, HbA1c≥7 gm% and presence of diabetic retinopathy. Su DH et al conducted a study on 3280 Malay adults studying the effects of age, duration of DM, mean HbA1c level and fasting blood sugar level on CCT and found that hyperlycaemia was associated with thicker central corneas. They also stated that current HbA1c level was perfect predictor for CCT measurement.[5]

Sorokhaibam R et al in 2015 also reported an increase in CCT in diabetic population and also suggested complementing CCT findings with the condition of the endothelial cells.[6] N McNamara et al. stated that CCT changes were due to hyperglycaemic effects on the cornea which directly inhibits the corneal endothelial pump.[7] Other possible mechanisms for swelling include reduced

corneal lactate production and increased endothelial pump function during corneal hypoxia. Intracellular accumulation of sorbitol, which acts as an osmotic agent leads to swelling of endothelial cells. The Kreb's cycle slows down with a consequent reduction in ATP production which is necessary for endothelial pump function. This eventually results in morphological and permeability changes in the cornea.

Recent studies suggest advanced glycosylated end products act as cross linking agents to increase the covalent bond in corneal stroma and eventually its thickness. Kumari.R et al. found similar results; mean CCT in diabetics (564.541±24.56) more than mean CCT in non-diabetics (519.453±25.98).[8] However the mean CCT was not significantly related to the duration and severity of disease.

CONCLUSION

CCT is pivotal in refractive surgeries, glaucoma work-up, donor tissue evaluation prior to keratoplasty and long term contact lens users.[9] The CCT in diabetics signifies overall functional and morphological status of cornea. As positive correlation was found between disease duration and CCT, 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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How to cite this article: Dabas R, Sethi S, Garg M, Aggarwal R, Lamba S, Bhattacharjee A, Tandon A. Central Corneal Thickness (CCT) in Diabetic Subjects and its Correlation with Disease Duration and Severity. Ann. Int. Med. Den. Res. 2017; 3(5):OT04-OT06.

Source of Support: Nil, **Conflict of Interest:** None declared