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Original Research Article

A comparative study of central corneal thickness in patients with diabetes and without diabetes mellitus

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ABSTRACT

Background: Diabetes mellitus (DM) is becoming increasingly and seriously prevalent lifestyle health problem worldwide. Up to 70% of diabetic patients can develop corneal changes and are also difficult to manage. Several studies were done to find out the morphological changes in cornea in type 2 DM, but the results are highly variable. Central corneal thickness (CCT) is widely considered as a constant parameter, so are measured only once during follow up in our daily clinical practice. Here we study the effect of diabetes over CCT, for a better understanding of the impact of diabetes over CCT.
Materials and Methods: A comparative observational study of one and half years done among 106 diabetes and 106 non diabetic patients between 35 to 75 years old, attending ophthalmology OPD. CCT of both eyes was measured and mean CCT and was compared between diabetic and non-diabetic groups, among different subgroups of diabetic subjects and other parameters.
Results: CCT was thicker among diabetic groups (553.4434um) than non-diabetic groups (549.8491) but was not statistically significant according to our study. But there was statistically significant (p value 0.000165) thickening with increasing grades of diabetic retinopathy (DR) (mild DR (535.4524), moderate DR (543) and PDR (591.5)).
Conclusion: Our study concludes that DM is associated with thicker cornea; hence CCT values can vary with time in DM. So repeated CCT measurements for corrected IOP values is advised and warranted in DM patients for proper management of IOP.

1. Introduction

Due to sedentary lifestyle and population aging, diabetes mellitus is becoming increasingly and seriously prevalent lifestyle health problem worldwide.[1] Diabetes mellitus is characterized by chronic hyperglycemia, which causes increased micro and macro vascular complication, if not managed properly in time, can affect all organs of our body. It can also severely affect ocular tissue, with damage occurring even during the early stages of the disease.[2] Even though diabetic retinopathy is the major and most serious diabetic complication in eye,[3,4] other parts of eye are also affected significantly (30% of diabetic patients).[5] Up to 70% of diabetic patients can develop corneal changes and are also difficult to manage.[2] These include delayed wound healing due to cellular dysfunction,[6] increased risk of infection and stromal fibrosis due to weakening of the epithelial barrier and its improper function,[7] diminished corneal sensation[8] and recurrent corneal erosion due to abnormal adhesions of the corneal epithelium to the underlying basement membrane.[9]

Several studies including- studies by Daniel.H.W.Su and et al,[10] Xiao-Yang Luo and et al[11] and Hoda M. K. Elsobky and et al[12] showed that central corneas tend to be thicker

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in diabetes and hyperglycemia independent of age and IOP levels. But some studies disagree with these observations, like those by Amira El-Agamy and et al[13] and Mm Choo and et al[14] where, they observed no significant association between diabetes and central corneal thickness.

Central corneal thickness (CCT) is widely considered as a constant parameter, so are measured only once during follow up in our daily clinical practice[15] and it ranges from 551 to 565μ. Central corneal thickness can interfere in the accurate intraocular pressure (IOP) reading especially with Goldman applanation tonometry, which is the gold standard for measuring IOP.[16] For every 25 μm increase in CCT, there is 1 mm Hg change in IOP; especially with CCT greater than 550 μm.[17] Thick cornea overestimate IOP and thin cornea underestimate it.[18] IOP is an important treatable and causative risk factor of glaucoma. So, for accurate measurement of IOP, determination of CCT is also important. CCT is also an important parameter in refractive corneal surgery for determining flap size, for assessing cornea for any ectasia post operatively, for assessing corneal diseases like- keratoconus, dystrophies, ectasia and edema, and for assessing donor cornea.

In this study we determine whether diabetes has any effect over central corneal thickness.

2. Materials and Methods

2.1. Research question

Is the central corneal thickness of diabetes mellitus patients thicker than that of non-diabetes mellitus patients?

2.2. Objectives of the study

1. To evaluate central corneal thickness in diabetic and non-diabetic patients
2. To compare the central corneal thickness in diabetic and non-diabetic patients
3. To compare central corneal thickness among the sub groups of diabetic patients – patients with no diabetic retinopathy, with non-proliferative diabetic retinopathy and proliferative diabetic retinopathy.

2.2.1. Hypothesis

Diabetes mellitus may be associated with thicker corneas.

2.2.2. Study design

Comparative observational study.

2.2.3. Study population

1. Group 1: Diabetes patients. It is divided in to 3 subgroups:
   (a) Subgroup 1- no diabetic retinopathy
   (b) Subgroup 2- non proliferative diabetic retinopathy
   (c) Subgroup 3- proliferative diabetic retinopathy
2. Group 2: Non diabetic patients

2.2.4. Study duration

One and half years

$$\text{Sample size} n = \frac{\left(z1+\frac{\alpha}{2}+z1-\beta\right)^2 (s1^2+s2^2)}{(\overline{x}1-\overline{x}2)^2}$$

n= 106 in one group

Total sample size 106 X 2= 212

2.2.5. Sampling method

Convenient sampling method

2.3. Inclusion criteria

1. Patients of 35 to 75 years of age.
2. Patients who are diagnosed cases of diabetes mellitus, according to the American Diabetes Association (ADA) recommendation as study group and age and sex matched non diabetic patients.
3. Patients whose records of FBS, PPBS and HbA1c for preceding 9 months are available.

2.3.1. Exclusion criteria

1. Ocular trauma
2. Mature or hyper mature cataract
3. Corneal opacities obscuring view
4. History of any ocular surgery/ laser therapy
5. Pregnant patients
6. Secondary diabetes (acromegaly, Cushing's syndrome)
7. Narrow angle glaucoma
8. Any corneal diseases

2.4. Data collection methods

This observational study will be conducted in diabetes mellitus patients in the age group 35 to 75 years and age and sex matched non diabetic patients attending the ophthalmology and medicine OPD of Azeezia Institute of Medical science & research, Kollam.

Cases will be defined according to the following ADA recommendations:

1. FBS ≥126 mg/dl (7.0 mmol/l). (Fasting defined as no caloric intake for at least 8 h.),
2. Or two-hour plasma glucose ≥ 200 mg/dl (11.1 mmol/l) during an OGTT. The test will be performed as described by the world health organization, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.
3. Or in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose ≥200 mg/dl (11.1 mmol/l).
4. Or HbA1c ≥ 6.5%.

Venous blood will be collected into a test tube containing fluoride (fluoride inhibits glycolysis). HbA1c will be estimated by using nycocard HbA1c kit (USA). Fasting and postprandial plasma glucose will be measured using glucose oxidase peroxidase method using R1 (phosphate buffer, glucose oxidase, peroxidase and phenol, 4-aminoantipyrine) and R2 (phosphate buffer) reagent. Values of HbA1c, FBS, and PPBS of last 9 months will be obtained from patient record.

Duration of diabetes mellitus, history of any ophthalmic surgical intervention, laser therapy, pregnant state, age, sex, occupation, education and socioeconomic status will be obtained by investigator administered questionnaire.

The exclusion criteria's will be picked up by clinical examination and slit lamp examination.

Diabetic retinopathy will be assessed by doing fundus examination by using indirect ophthalmoscope, direct ophthalmoscope and slit lamp biomicroscopic examination with 90D lens after pupillary dilatation with tropicacyl plus or homatropine.

Diabetic retinopathy will be diagnosed using modified early treatment diabetic retinopathy study (EDRTS) scale. [19]

The central corneal thickness will be measured using ultrasound pachymetry after instilling topical anesthetic agent (proparacaine 0.5%). Four consecutive readings will be taken. First reading is used for patient adaptation to procedure. Mean of successive three readings will be considered for analysis and will be calculated as the measured central corneal thickness in microns (μm).

IOP will be determined by a slit lamp mounted Goldmann applanation tonometer.

2.5. Data entry and analysis

Data entry will be done using Microsoft office excel 2016. A p value of ≤ 0.05 will be considered statistically significant.

2.6. Statistical analysis

Chi square, Student's t test.

2.7. Statistical software

MS Excel**,** SPSS version 17.0 was used to analyze data.

After obtaining ethical committee clearance, patients are invited to participate in the study after providing them details regarding the study. Written informed consent is obtained. Subject confidentiality is maintained.

3. Results

Data was entered into Microsoft excel data sheet and was analyzed using SPSS for Windows (Statistical Presentation System Software, SPSS Inc.) version 17.0.

Continuous data was represented as mean and standard deviation.

3.1. Graphical representation of data

MS Excel and MS word were used to obtain various types of graphs such as bar diagram and Pie diagram.

P value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

3.2. Statistical software

MS Excel**,** SPSS version 17.0, Quick P value calculator online software were used to analyze data.

Total number of the study group was 212 in the age group of 35- 75 years, out of them 106 were having DM (50%). Mean age of the study group was 56 +/-11years (youngest was 35 years and oldest were 75years of age). Mean CCT was 515.67+/-29.08 um in right eye (minimum CCT was 479um and maximum were 617 um) and 551.60+/-29.32 um in left eye (minimum CCT was 480um and maximum were 647um). Mean IOP was 17+/-3.47 mmHg in right eye (lowest IOP was 12mmHg and highest were 26mmHg) and 18 +/- 5.65 mmHg in left eye (lowest IOP was 10mmHg and highest were 38 mmHg).Mean true IOP was 16.9+/- 3.66 mmHg in right eye (lowest IOP was 8.9mmHg and highest were 25.6mmHg) and 17.60 +/- 5.82 mmHg in left eye (lowest IOP was 8.5 mmHg and highest were 38.2mmHg). In our study for convenience we are taking the CCT, IOP and true IOP as means of those between right and left eye. The mean CCT was 551.63+/- 28.53 um (minimum mean CCT was 479.5um and maximum were 632um), mean IOP was 17.81 +/- 4.07 mmHg (lowest mean IOP was 12 mmHg and highest were 30mmHg) and mean true IOP was 17.28 +/- 4.22 mmHg (lowest mean true IOP was 9.35 mmHg and highest were 29.6mmHg).(Table 1)

There were 120 female (57%) and 92 males (43%) in our study. Out of the 212 subjects 65 (31%) were less than 50 years and 147 (69%) were above 50 years of age.(Table 2)

Among the total study group diabetic patients constitute 50 % (n= 106 persons).

The mean duration of diabetes mellitus was 8.2+/- 4.2 years (minimum duration was 2 years and maximum was 17 years). The mean FBS value in diabetic group was 146+/-37.4 mg/dl (lowest value was 101mg/dl and highest was 299 mg/dl) and mean PPBS was 184.51+/- 57.33mg/dl (lowest PPBS value was 130mg/dl and highest was 410 mg/dl). The mean HbA1C level was 6.98+/-1.5 (lowest HbA1C level was 5.9 and highest was 14.7). The mean true IOP was 18.78+/- 4.67 mmHg (lowest true IOP was 10.8mmHg and highest were 29.6mmHg). (Table 3).

Out of the 106 diabetic cases in our study females were 55% (58), males were 45% (48). 13(12%) were less than 50 years and 93 (88%) were above 50 years of age. Considering the duration of diabetes 36(33%) were having diabetes for less than 5 years and 70(67%) were having it for more than 5 years. 33(31%) have diabetic retinopathy changes,

73 (69%) don't have diabetic retinopathy changes on fundus examination. Among them 21 had mild DR (64%), 8 (24%) had moderate DR and 4 (12%) had PDR. HbA1C level was high (above 6.5) in 75% (n = 80) and was normal in 25% (n = 26). FBS values were high (>126mg/dl) in 82% (n = 77) and were normal in 23% (n = 24). PPBS values were high (>140mg/dl) in 91% (n = 96) and were normal in 9% (n = 10). Mean true IOP was above 16mmHg in 77% (n = 82) and below 16mmHg in 23 % (n = 24) of diabetic patients. (Figures 1 and 2).

Mean CCT about 4um thicker in diabetic patients than non-diabetic subjects in our study. It was 553.44um in diabetics (standard deviation 28.73) and 549.85um in non-diabetics (standard deviation28.65). But it was not statistically significant at p value <0.5 (P value was 0.18). (Table 4)

There was statistically significant thickening of 24um in CCT with advancing grades of DR according to our study (P value 0.0001). Mean CCT was 535.45+/- 1.39 um in mild DR and 559.16+/-7.46 um in combined moderate DR and PDR subjects. (Figure 3).

Mean CCT was thicker by 7um in diabetic persons above 50 years of age. It was 547+/- 26.78 um in persons below 50 and 554+/- 29.25 um in persons above 50 years of age in our study, but it was not statistically significant (P value 0.24).(Figure 4).

Mean CCT was 552.25+/-28.58 um in females and 555.58+/-29.56 um in males. There was no statistically significant association between CCT and gender in our study (P value 0.27). (Table 5).

Mean CCT found to be thicker with duration of DM. Mean CCT was 552.94 +/-27.34um in less than 5 years of DM and 553.7+/-29.60 um in more than 5 years of DM. P value was 0.44, so was not statistically significant.(Table 6).

Mean CCT thickens with higher values of FBS. Mean CCT was 545.75+/-33.25 um in those with normal FBS and was 555.69+/- 27.08 um in those with high FBS. But it was not significant statistically (P value 0.6). (Figure 5).

The mean CCT was 553.66+/-28.47um in diabetics with PPBS higher than 140mg/dl and 551.1+/-32.61um with normal PPBS values. But this result was not significant statistically (P value 0.3). (Figure 6).

There was statistically insignificant thickening of mean CCT with high HbA1C values (553.96+/-28.29um than 551.84+/-30.57um in those with normal HbA1C; P value 0.37). (Figure 7).

There was no statistically significant association between CCT and DM in our study (P value 0.15). Mean CCT was 548.16+/-33.76um in DM with IOP < 16mmHg and 554.98um+/-27um in diabetics with IOP > 16mmHg. (Table 7).

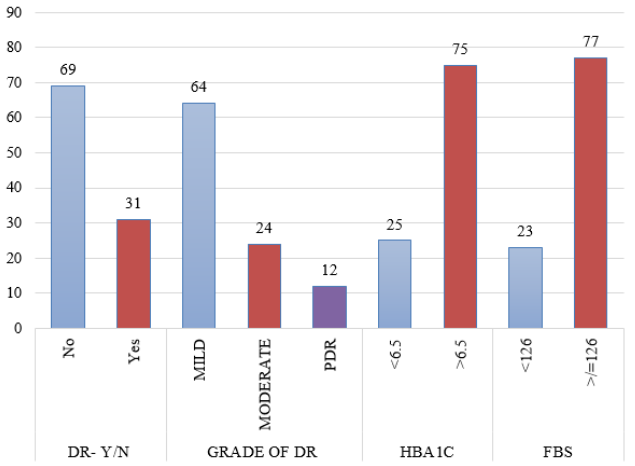

Figure 1: Graphical representation of descriptive details of DM study group

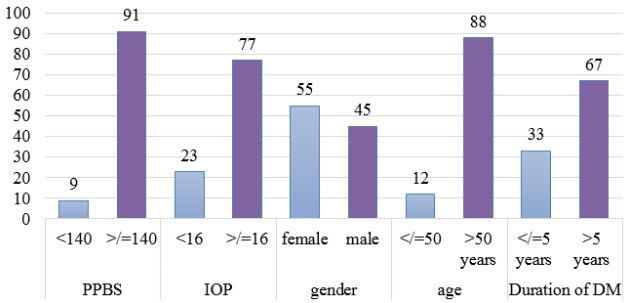

Figure 2: Graphical representation of DM study group.

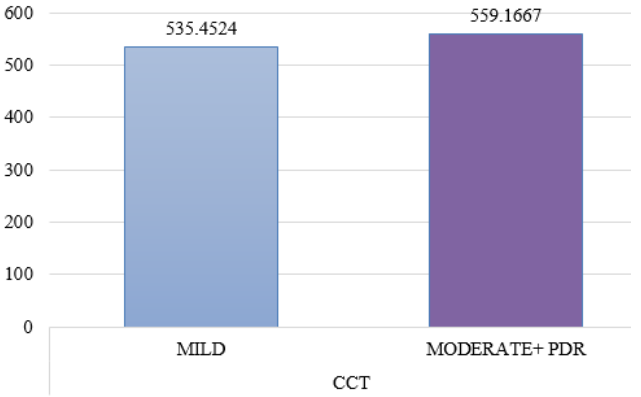

Figure 3: Graphical representation of comparative details between CCT and different grades of DR

Table 1: Descriptive details of the participants of the study

Group	N	Mean	Standard deviation	Minimum	Maximum
Age	212	56.25472	11.01319.	33	75
CCT RE	212	551.6698	29.08403.	479	617
CCT LE	212	551.6085	29.32289.	480	647
Mean CCT	212	551.6392	28.53053.	479.5	632
IOP RE	212	17.43396	3.46962.	12	26
IOP LE	212	18.18868	5.6453.	10	38
Mean IOP	212	17.81132	4.07132.	12	30
True IOP RE	212	16.97406	3.66765.	8.9	25.6
True IOP LE	212	17.60519	5.82142.	8.	38.2
Mean true IOP	212	17.28962	4.22317.	9.35	29.6

Table 2: Descriptive details of the age and gender of the participants**.**

		Frequency	Percent
Gender	Female	120	57
	Male	92	43
Age	</=50 years	65	31
	>50 years	147	69

Table 3: Descriptive details of the diabetic study group

Group	N	Mean	Std. Deviation	Minimum	Maximum
Duration in years	106	8.226415	4.19815.	2	17
FBS	106	146.85	37.39029.	101	299
PPBS	106	184.51	57.33598.	130	410
HbA1C	106	6.975	1.58095.	5.9	14.7
IOP	106	18.7783	4.66596.	10.8	29.6

Table 4: Comparative details between CCT and DM

Variable	Diabetes mellitus	N	Mean	Standard deviation	Standard error	P-value
Mean CCT	Yes	106	553.4434	28.73179.	2.79068	0.18
	No	106	549.8491	28.65054.	2.78279	

Table 5: Comparative details between CCT and gender

Variable	Gender	N	Mean	Standard Deviation	Standard Error	P-value
CCT	Female	58	552.2586	28.58893.	3.75391	0.279292.
	Male	48	555.5833	29.56643.	4.26755	

Table 6: Comparativedetails between CCT and duration

Variable	Duration	N	Mean	Standard Deviation	Standard Error	P-value
CCT	</=5	36	552.9444	27.34483.	4.55747	0.449349
	>5	70	553.7	29.60971.	3.53904	

Table 7: Comparative details between CCT and IOP

Variable	IOP	N	Mean	Standard Deviation	Standard Error	P-value
CCT	<16	24	548.1667	33.76603	6.89246	0.154299
	>/=16	82	554.9878	27.12386	2.99533	

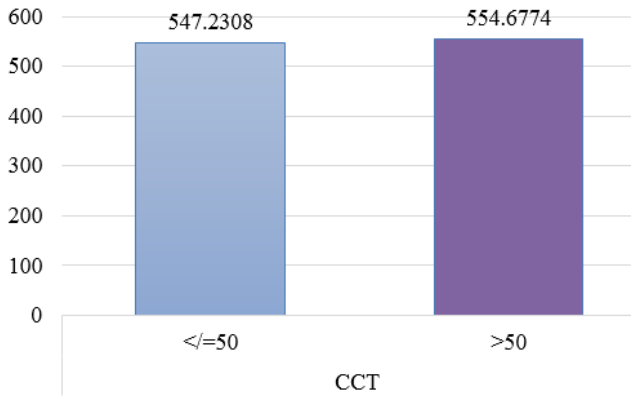

Figure 4: Graphical representation of comparative details between CCT and different age group.

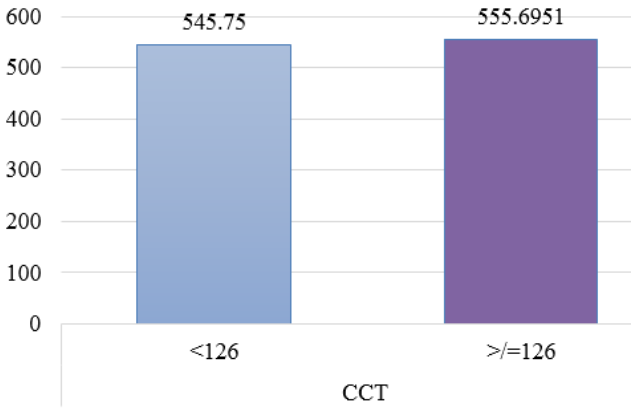

Figure 5: Graphical representation of comparative details CCT and FBS

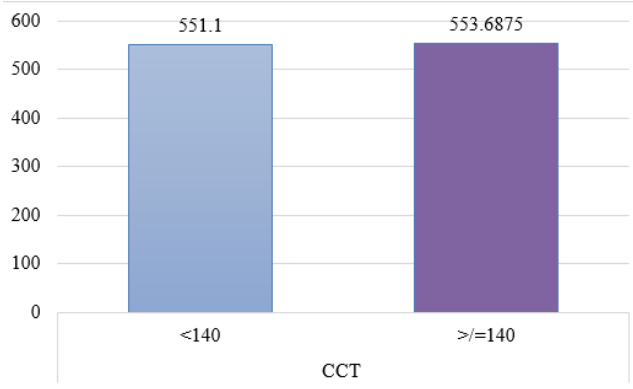

Figure 6: Graphical representation of comparative details of CCT with PPBS.

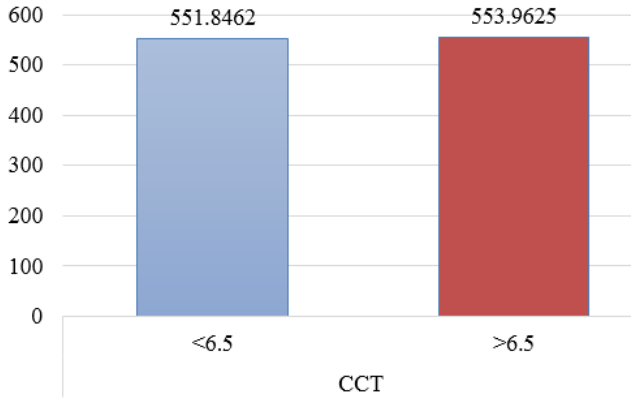

Figure 7: Graphical representation of comparative details of CCT and HbA1C

4. Discussion

This observational study was conducted among 106 diabetes mellitus patients and similar number of non-diabetic patients with in the age group 35 to 75 years (total 212 subjects). Out of them, majority were female; female- 120 (57%), male- 92(43%). Mean age of study population was 56 +/- 11years. For convenience mean CCT and mean true IOP of that of right and left eye was taken for this study. Mean CCT was 551+/-28um and mean true IOP was 17+/-4mmHg in our study.

There was no statistically significant association between CCT and DM according to our study. But mean CCT was thicker in diabetic patients compared to non-DM and it was 553.44 +/- 28.73 um in DM and 549 .84 +/- 28.65 um in non-DM. Our findings agree with the findings of Sudhir and et al study conducted among 1191 DM and 121 non-DM cases, who also observed no significant association between DM and CCT.[20] In a similar study conducted by Mm Choo and et al among 100 diabetic and 100 non-diabetic patients, also showed Type II diabetes causes no significant alteration in central corneal thickness.[14] But according to a study conducted by Ozdamar Yasemin and et all in with 100 DM and 145 non-DM patients, diabetic patients had thicker central corneas when compared with nondiabetic patients (mean CCT 564±30um in DM groups, 538±35um in non-DM group and P value was 0.001).[21] Daniel H.W. Summed and et al,[10] Kenji Inoue and et al[22] and J Siribunkum and et al,[23] Claramonte P. J and et al,[24] J S Lee and et al[25] and A M Roszkowska and et al[26] also reported that there was significant thickening of cornea in diabetic patients as compared to non-diabetic patients in their studies.

There was statistically significant association between CCT and higher grades of DR according to our study (P value 0.000165). Mean CCT was 535.45+/-6.38 um in mild DR and 559.1667 +/- 25.86 um in moderate DR+ PDR combined together. This findings were similar to the findings of Ruchi Dabas and et al in their study conducted

among 86 DM cases and 86 non- DM controls, where mean CCT was found to be significantly thicker in DM with DR (mean CCT was 588.20+/-16.73um in DM with DR and 553.54+/-28.07 um in DM without DR: P value 0.0001).[27] Arjun Baidya and et all found similar results in their study conducted among 124 DM cases and 65 controls(mean CCT was 572.13±17.50 um in PDR patients compared to 553.78±8.80 um in NPDR patients and showed a statistically significant association)(24). But Ozdamar and et al,[21] OKAN TOYGAR,[19] Kenji Inoue and et al[22] and Amira El-Agamy and et al[13] found no significant association of CCT with different grades of DM.

Among our diabetic study group 13 were below 50 years and 93 were above 50 years. Older persons with DM had thicker corneas than younger DM, but it was not statistically significant according to our study (mean CCT was547+/-26um in less than 50 years and it was 559+/-25 um in more than 50 years of age. These findings are in agreement with J.Gros-Otero and et al findings in their study.[28,29] According to Solani D. Mathebula and et al mean CCT was significantly thicker in older DM cases in their study among 65 DM cases and 50 healthy controls.[30] Strobbe and et all also got similar findings in their study in contrast to our observations.[31]

Among the 106 diabetic patients in our study, 58(55%) were females and 48(45%) were males. There was no statistically significant association between gender and CCT in our diabetic study group. Mean CCT was 552.25+/-28.58 um in females and 555.58 +/-29.56 um in males. These findings agree with Nikhil S Choudhari and et al's observation in their study conducted among 196 cases (84 males and 112 females; mean CCT was 527 ± 34um in males and 525 ± 33um in female) where also, there was no significant association between CCT and gender in DM (P = 0.63, two-tailed t-test).[32] Allan Storr-Paulsen and et al,[33] Lekskul M and et al,[34] Eghosasere Iyamu and et al[35] and Strobbe and et all's observations also agree with our findings.[31] But James D Brandt and et all reported that female gender was associated with thicker central corneas according to their study.[36] In contrast Mitsugu Shimmyo and et all reported a significant thinning of CCT in females as per an observational retrospective cross-sectional study conducted among 1976 eyes.[37]

Mean duration of diabetes in our diabetic patients' group was 8 years, 36 had diabetes for less than 5 years and 70 had it for more than 5 years. We found no significant association between mean CCT and duration. Mean CCT was 552.94+/-27.34um in group having DM for less than 5 years and 553.7 +/- 29.6 um in group having DM for more than 5 years. Handan Canan AND et al's study findings were similar in this perceptive, which was conducted among 96 DM cases.[38] Rashmi Kumari and et al also agree with our this findings with their study results conducted among 50 DM and 50 non- DM subjects (mean CCT was 576.89 ±16.87um in persons with monger duration of DM and it was 548.76 ±25.78 um in persons with shorter duration of DM, but this difference was not statistically significant (P value =0.115)).[39]

Mean FBS was 146.85 +/-37.39 mg/dL, mean PPBS was 184.51 +/- 57.33 mg/dL and mean HbA1C was 6.975 +/-1.5885. In our study we found not significant association between mean CCT and high FBS, PPBS and HbA1C values (P values 0.06, 0.39 and 0.37 respectively). Mean CCT with high FBS values (>126mg/dL) was 555.69+/-27.08 um and with normal FBS value (<126mg/dL) was 545.75+/-33.25um in our study group. Mean CCT was 553.68+/-28.47um in those with high PPBS (>140mg/dL) and 551.1+/- 32.61um in those with normal PPBS (<140mg/dL). Those with high HbA1C values had mean CCT of 553.96+/-28.29um and those with normal HbA1C had mean CCT 551.84 +/- 30.57 um. Rashmi Kumari and et al agree with these findings in her study done in 50 DM and 50 non DM controls, where mean CCT was 548.12 +/-21.7um in those with normal HbA1C and 568.22 +/-18.5um in those with high HbA1C(P value =0.231, statistically not significant).[39] Yasemin Ozdamar and et al also stated no significant association between CCT and HbA1C as per a study conducted among 100 DM and 145 healthy controls.[21] Allan Storr-Paulsen also reported that HbA1c did not have any impact on the CCT.[33] But according to Su and et al[10] there was significant correlation between corneal thickness and the higher HbA1C and reported that cornea was thicker with high HbA1C.

Mean CCT found to be high in those with IOP > 16 mmHg, but was not statistically significant in our study (P value 0.15). Mean CCT was 554.98+/- 27.12um in those having IOP more than 16 mmHg and 548.16+/-33.76 in those with IOP less than 16 mmHg. Handan Canan and et al reported similar results in their study done among 96 DM patients (P = 0.241,no significant association between IOP and mean CCT in DM).[38] But in an instance Okan Toygar and et al stated that there was significant association between CCT and IOP in DM in a study conducted among 160 DM and 52 non DM cases (P < 0.01).[40] These findings are similar to Anselm Hennis and et al[41] and DiZhao and et al[42] observations in their study.

5. Conclusion

Cornea is the major refractive surface of eye, even subtle changes in it can seriously affect the optical clarity. CCT is an important parameter for glaucoma. IOP is very significantly affected by its value while measuring with Goldmann applanation tonometry (and Goldmann applanation tonometry is the gold standard for measuring IOP). CCT is also an important factor for refractive surgeries, donor tissue evaluation prior to keratoplasty and in long term contact lens users. Many studies were done in the field of ocular manifestations of diabetes

mellitus, including the effect of DM in CCT and observed both positive and negative correlation between the same. This study is a small effort to determine if there is any relationship between diabetes and CCT in type 2 DM and normal persons. And our study concluded no significant association between central corneal thickness and CCT. But there was statistically significant association between CCT and different grades of DR as per our study. Even though mean CCT was thicker with high FBS, PPBS, HbA1C values and higher IOP, it was not statistically significant. Females showed a statistically insignificant thinning compared to males in our DM study groups. Age and duration of DM also showed no association with mean CCT. Many related studies were done in the past, but with inconsistent results. It may be because of the large standard deviation of mean CCT in our population and may be due to effect of age, sex, ethnicity, and ocular and systemic diseases over the CCT (but many are not proven satisfactorily). Hence, a more detailed evaluation and research is needed in this area for a better understanding of effect and pathogenesis of DM over CCT for better assessment of diabetic cornea.

6. Conflicts of interest

None.

7. Conflict of Interest

None.

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