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# Association of Type 2 Diabetes Mellitus with Central Corneal Thickness and Intraocular Pressure – A Case Control Study

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## ABSTRACT

**Introduction:** Diabetic patients had been proved to have thicker corneas and are commonly associated with primary open-angle glaucoma. Diabetic people have two times increased chance of developing glaucoma compared with non-diabetics

**Aim:** To study the association of central corneal thickness and the intraocular pressure in type 2 diabetic patients and to compare the same with the healthy control subjects.

**Materials and Methods:** This case-control study was conducted with fifty proven type 2 diabetic patients and healthy control. Study participants underwent slit lamp examination, fundus examination, IOP measurement with Applanation tonometer and corneal thickness with OCT. The screening laboratory tests included fasting and postprandial blood sugar and also glycated haemoglobin (HbA1C) levels.

**Results:** Mean age of the patients was 55 in the diabetes group and 57 in the control group. Males were more in the diabetic group and an equal number in the control group. Mean IOP in the control group was  $13.76 \pm 1.74$  and in the test group was  $19.29 \pm 2.38$ . Increase in HbA1C level showed a significant increase in intraocular pressure. Diabetic patients showed a significant increase in corneal thickness. Statistically, a significant difference was observed in the Mean comparison of all variables like HbA1C, corneal thickness and IOP between the diabetic and control group.

**Conclusion:** Adult-onset Diabetes has been proved to be a modifiable risk factor for open-angle glaucoma, and periodic screening will help in the early diagnosis of glaucoma and avoid blindness.

**Key Words:** Type 2 Diabetes Mellitus, Corneal Thickness, Intra Ocular Pressure, Healthy Control

## INTRODUCTION

Diabetes has become a global epidemic problem. It had been estimated that there were 451 million diabetic people in 2017 and this is expected to rise to 693 million 2045.<sup>1</sup> Diabetes can affect both anterior and posterior segment of the eye and can cause significant impairment of vision due to cataract, glaucoma, corneal complications, diabetic retinopathy and maculopathy. Structural changes that occur in the diabetic cornea can predict the systemic complications of diabetes. All the layers of cornea from epithelium to endothelium can be affected by the specific complications related to diabetes. The decreased corneal sensation maybe the early indicator of diabetic neuropathy. Recurrent epithelial erosions, delayed regeneration after injury, corneal ulcers, decreased endothelial

density, stromal oedema is the other corneal manifestations due to diabetes. Due to uncontrolled diabetes, advanced glycation end products accumulate in the corneal stroma leading on to increased corneal thickness. Hence, increased thickness of cornea may indicate the glycemic control of diabetes.

Diabetic people have two times increased chance of developing glaucoma compared with non-diabetics.<sup>2</sup> Several studies had proved that diabetes is a risk factor for glaucoma.<sup>3</sup> The elevated blood glucose level in diabetes may induce an osmotic gradient and attract fluid into the intraocular space resulting in elevated IOP. Diabetic individuals had been proved to have thicker corneas and increased central corneal thickness had been proved to be associated with the onset and progression of glaucoma.<sup>4,5</sup> Hence this study was conducted to evaluate

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the association between adult-onset diabetes, central corneal thickness and Intraocular pressure.

## MATERIALS AND METHODS

This case-control study was conducted in the Department of Ophthalmology, Vinayaka Mission’s Medical College, Karaikal for a period of 6 months from June to December 2019. Institution Ethical Committee approval was obtained (VMMC/OPT/2019). After getting the informed consent, 50 types 2 diabetic patients eligible with our inclusion criteria and 50 healthy control recruited from general population or spouse and relatives of the diabetic patients all belonging to 40-80 years of age were enrolled for the study.

**Inclusion criteria:** Type 2 diabetic patients of both sexes aged between 40-80 years of age were included in the study. Type 2 Diabetes was defined according to the self-reported physician diagnosis and all diabetic patients were under regular medical management. The minimum duration of diabetes was 1 year.

**Exclusion criteria:** Ocular hypertensives, known cases of glaucoma, patients with ocular infections, with a history of previous ocular surgery, corneal opacity and corneal irregularities, diabetic duration less than 1 year were excluded from the study.

All participants in the study were interviewed with the well structured proforma followed by a slit-lamp examination, fundus examination, IOP measurement with Applanation tonometer and corneal thickness with OCT. The screening laboratory tests included fasting and postprandial blood sugar and also glycated haemoglobin (HbA1C) levels.

### Statistical Analysis

Required data were collected and analyzed using SPSS version 21. Continuable variables were analyzed using the student t-test. Categorical variables were analyzed using Pearson chi-square test and Fisher exact test.

## RESULTS

Age of the study population was between 40-80 years with the mean age being  $55.96 \pm 6.92$  for cases and  $57.32 \pm 8.3$  for the control group ( $P = 0.376$ ) (Figure 1).

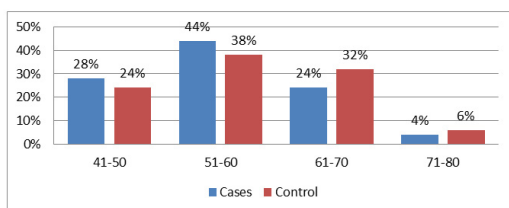


Figure 1: Age Distribution of Patients Studied.

Males were more (30) than females (20) in group 1 (diabetic patients) while it was equal in group 2 (control group) which was statistically insignificant (Figure 2).

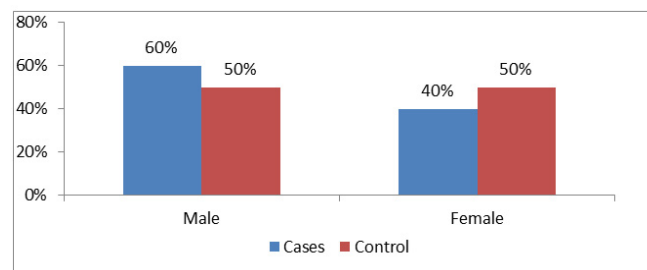


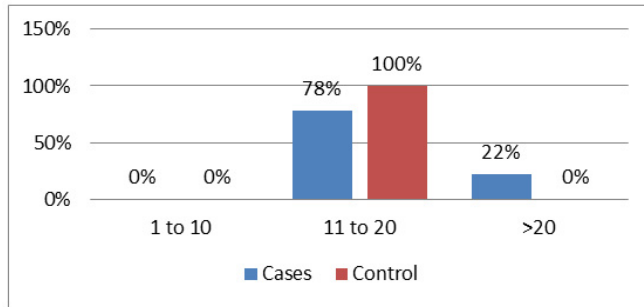
Figure 2: Gender Distribution of Patients Studied.

There was a significant difference in the blood sugar levels between the two groups ( $P=0.001$ ). Out of 50 diabetic patients, 32 had FBS below 100 mg/dl; 17 had value between 100-140 mg/dl and one patient had FBS above 140 mg/dl whereas FBS of all control group individuals was below 100 mg/dl. Similarly, all 50 in the control group showed PPBS values less than 200 mg/dl whereas out of 50 cases in the diabetic group, 29 had PPNS less than 140 mg/dl; 19 had the range between 140-200 mg/dl and 2 of them had value more than 200 mg/dl ( $p=0.05$ ). HbA1C was less than 6.5% for 42 patients in the diabetic group, 8 had the value between 6.5 to 8% whereas it was less than 6.5% for all individuals in the control group. Hence there was a significant statistical difference between the two groups ( $P=0.003$ )– Table 1

Table 1: Distribution of Glucose Parameters in Both Groups

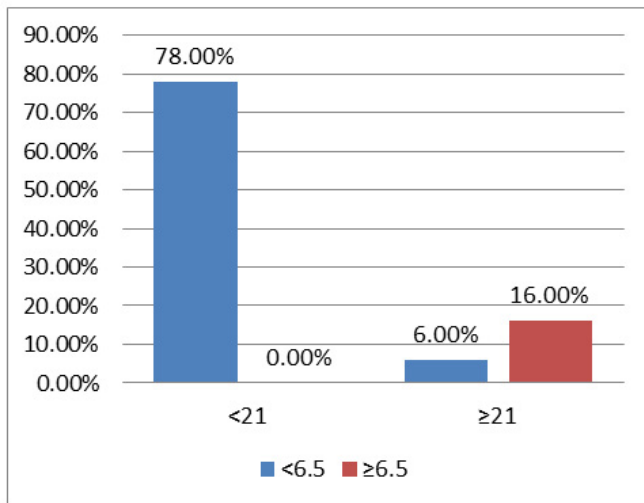
Variables	Cases (N=50)		Control (N=50)		P-value	
	N	%	N	%		
FBS (mg/dl)	<100	32	64	50	100	<0.001
	100-140	17	34	0	0	
	>140	1	2	0	0	
PPBS (mg/dl)	<140	29	58	50	100	<0.05
	140-200	19	38	0	0	
	>200	2	4	0	0	
HbA1C%	<6.5	42	84	50	100	0.003
	6.5-8	8	16	0	0	
	>8	0	0	0	0	

Intraocular pressure also showed a significant difference between the two groups ( $P=0.001$ ). Mean IOP in the control group was  $13.76 \pm 1.74$  mmHg and in the test group was  $19.29 \pm 2.38$  mmHg.



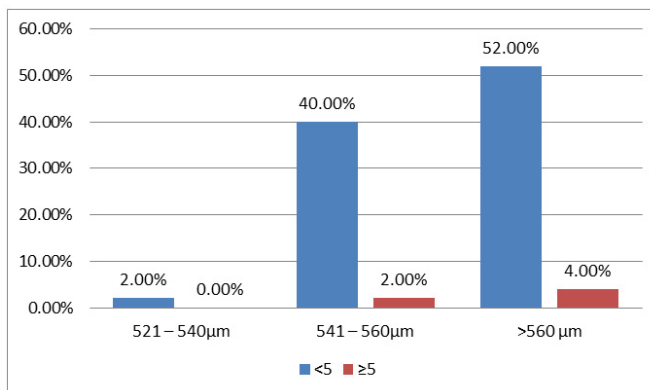
**Figure 3:** IOP Distribution Among Cases And Control Group.

Among the diabetic patients, an increase in HbA1C level showed a proportionate increase in intraocular pressure and it is statistically significant ( $P < 0.0001$ ) (Figure 4).



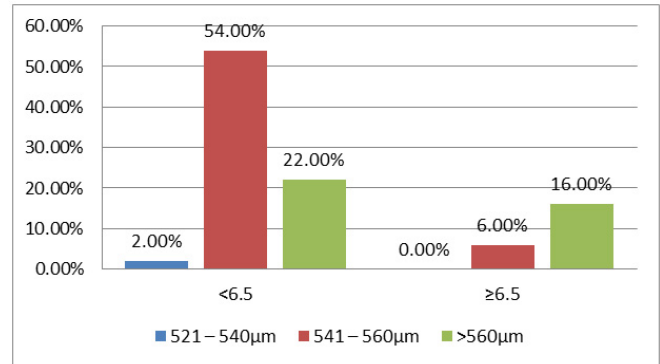
**Figure 4:** HbA1C with IOP for Diabetic cases.

Duration of diabetes did not show a significant association with the corneal thickness (P-value 0.911) (Figure 5)



**Figure 5:** Diabetic Duration Vs Corneal Thickness.

The diabetic group showed a statistically significant increase in corneal thickness compared to the control group ( $P = 0.026$ )



**Figure 6:** HbA1C% with Corneal Thickness for Diabetic Patients.

Finally, this study showed a statistically significant difference in the Mean comparison of all variables like HbA1C, corneal thickness and IOP between the diabetic and control group ( $P = 0.001$ )

## DISCUSSION

Glaucoma is the second leading cause of blindness in the world, according to WHO. Glaucoma is a progressive optic neuropathy mainly caused by increased intraocular pressure leading on to the gradual death of retinal ganglion cells ultimately causing optic atrophy and permanent blindness.<sup>6</sup> Type 2 Diabetes is a risk factor for primary open-angle glaucoma (POAG), which had been proved by many epidemiologic studies. Chopra V et al. in Los Angeles Latino Eye Study on Diabetes and the risk of Open-angle glaucoma concluded that the presence and the longer duration of type 2 DM were independently associated with the higher risk of having Open-angle Glaucoma.<sup>7</sup> In a cohort study among the diabetic population about the glaucoma incidence suggested the incidence of primary open-angle glaucoma was higher in diabetic population (1.1/1000 patients) compared to the non-diabetic group (0.7/1000 patients).<sup>8</sup>

IOP was higher in those with the high serum glucose levels ( $P < 0.001$ ) and high glycosylated haemoglobin concentration.<sup>9</sup> The relationship between intraocular pressure and type 2 diabetes mellitus and found that the IOP was increased in subjects with diabetes as compared to the controls, especially among those with poor glycemic control.<sup>10</sup> Matching with these previous reports, in this study also there was a significant association between HbA1C and intraocular pressure in the diabetic group. Effect of chronic hyperglycemia on intra ocular pressure in patients with diabetes mellitus was studied by VS Hatolkar et al. and they found that the diabetic patients had elevated IOP and those subjects with poor glycemic control were more prone to develop increased intraocular pressure.<sup>11</sup> Diabetic patients had a high postprandial IOP than their baseline values.<sup>12</sup>

Duration of diabetes did not show a positive correlation to the corneal thickness in my study but diabetic patients showed a statistically significant increase in corneal thickness.<sup>13</sup> All patients in the control group had corneal thickness less than 540 µm with intraocular pressure less than 21 mmHg. All the diabetic patients in this study showed an average increase in the thickness of the cornea and elevated IOP compared to the healthy control group. It matches with S Biswas et al. study on the intraocular pressure distribution and the factors affecting IOP in subjects with type 2 diabetes mellitus in India. After adjusting all the variables, they concluded that elevated central corneal thickness was associated with raised IOP in type 2 DM.<sup>14</sup>

## CONCLUSION

Diabetic patients were found to have thicker cornea and raised intraocular pressure compared to healthy control subjects and hence diabetes had been proved to be a modifiable risk factor for glaucoma. Since the prevalence of glaucoma is more among the diabetic population, it is advisable to measure their IOP routinely at regular intervals for early diagnosis of glaucoma and to prevent needless blindness.

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