Original Article

Comparison of Retinal Thickness between Diabetic Patients without Diabetic Retinopathy and Non-Diabetic Controls Using SD-OCT

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ABSTRACT

Purpose: To compare retinal thickness in diabetic patients without diabetic retinopathy and non-diabetic controls using Spectral Domain Optical Coherence Tomography (SD-OCT).

Study Design: Cross-sectional observational study.

Place and Duration of Study: Diabetic Eye Clinic and General Eye out patient department of Al-Ibrahim Eye Hospital, Karachi from July 2018 to August 2018.

Methods: Patients with type 2 diabetes and non-diabetic healthy control eyes of either gender and age between 20 and 60 years were recruited. Patients with any other systemic and ocular disease affecting retinal thickness were excluded. After initial examination and informed written consent, patients were referred to ocular investigation department for detailed retinal examination and SD-OCT for measuring central retinal thickness. Data were analyzed for continuous and categorical variable using SPSS.

Results: Average Central Retinal thickness was 297±21 and 315±13µm and Central Foveal Thickness was 246±16 and 249±19µm in diabetic and non-Diabetic patients respectively. Quadrant-wise evaluation revealed retinal thickness as follows; nasal 310 and 324µm), temporal (291 and 304µm), superior (297and 316µm) and inferior (292and 314µm) in diabetics and non-diabetics respectively. Retinal thickness was greater at nasal and lesser at temporal regions. Nasal, superior, and inferior thickness was more strongly correlated with each other compared to temporal thickness. Average retinal thickness was significantly correlated with inferior and nasal thickness.

Conclusion: Diabetic patients without DR had thinner central retinal thickness compared to non-diabetic controls, as measured by SD-OCT. Specifically, the average central retinal thickness and central foveal thickness were slightly reduced in diabetic patients.

Key words: Diabetic Retinopathy, Diabetes Mellitus, Optical Coherence Tomography.

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INTRODUCTION

Chronic hyperglycemia in diabetic patients is linked to long-term harmful effects on human body and can lead to organ failure, particularly affecting kidneys, eyes, heart, nerves, and blood vessels.[1] More than 371 million people are suffering from diabetes globally, however half of the patients with diabetes remain undiagnosed and the ratio is increasing with time.[2] Patients who are diagnosed with diabetes before the age of 30 years have 50% risk of Diabetic Retinopathy (DR) after 10 years and 90% after 30 years.[3] A

common consequence of diabetes is diabetic retinopathy, a condition in which the retina, or layer of tissue at the back of the eye, gradually deteriorates.

Studies have shown that there is variation in retinal thickness based on not only age, gender and ethnicity but there are variations in diabetic patients with DR.[4-6]

However, there are variable results shown by different studies. Some studies indicate difference in the average retinal thickness between people with diabetes and those without the disease and others showing no major difference in average retinal thickness among diabetic and non-diabetic patients regardless of age, gender or HbA1c level.[7] Another study conducted in Shanghai Medical Center to evaluate thickness among different retinal layers in diabetic and non-diabetic patients found no difference except a decrease in inner plexiform layer thickness.[8]

As the retinal thickness varies with age, gender and ethnicity, this study was designed to assess the difference in the thickness of retina in diabetic patients and non-diabetic controls.

METHODS

This study included 160 eyes of 40 diabetic (20 males and 20 females) and 40 non-diabetic (20 males and 20 females) individuals. They were recruited through convenient sampling from June to August. Patients with type 2 diabetes and non-diabetic individuals with healthy eyes, either gender and age between 20 and 60 years were included. Patients with problem other than diabetes and type 1 diabetes were excluded. Patients were recruited from diabetic eye clinic for diabetes and general eye OPD for non-diabetic controls. After initial examination and informed written consent, patients were referred to ocular investigation department for evaluating retinal thickness using SD-OCT. Data was collected based on the tenets of declaration of Helsinki. Nine standard ETDRS grid was used for assessment of retinal thickness using SD-OCT.

Data was analyzed using SPSS version 23 and the continuous variables were described as mean and standard deviation while categorical variables were presented as frequency and percentages.

RESULTS

Mean age of the patients was 36.25 years (range 20-59). There were equal number of males and females in each group. Mean average retinal thickness was 297±21µm and 315±13µm in diabetics and non-diabetics respectively. Similarly, mean foveal thickness was 249±19 and 246±16µm in diabetics and non-diabetics respectively. Quadrant-wise retinal thickness is shown in Table 1. Mean foveal thickness was 260µm and 237µm in males and females respectively. Average retinal thickness was 305.5µm in males and 282µm in females. Table 2 shows the Pearson bivariate correlation of predictor variables. It shows that nasal, superior, and inferior thickness are more strongly correlated with each other compared to temporal thickness. Average retinal thickness was significantly correlated with inferior and nasal thickness.

Table 1: *Quadrant Wise Retinal Thickness among Study Participants.*

Quadrant	Diabetic	Non-Diabetic	P value
Nasal	310 ±17	314 ± 14	<0.001
Temporal	291 ± 31	304 ± 14	0.016
Superior	297 ± 20	306 ± 14	<0.001
Inferior	292 ± 19	314 ± 13	<0.001

DISCUSSION

This particular study shows that diabetic patients without DR had thinner central retinal thickness compared to non-diabetic controls, as measured by SD-OCT.

Table 2: *Pearson bivariate correlation of predictor variables.*

Variable		Average Thickness	Nasal Thickness	Temporal Thickness	Superior Thickness	Inferior Thickness
1	Average Thickness	1	0.42**	0.16	0.20	0.33**
2	Nasal thickness	0.42**	1	0.59**	0.77**	0.89**
3	Temporal thickness	0.16	0.59**	1	0.62**	0.58**
4	Superior thickness	0.20	0.77**	0.62**	1	0.82**
5	Inferior thickness	0.33**	0.89**	0.58**	0.82**	1

*Significance in Pearson Correlation with a p-value less than 0.05. **Significance in Pearson Correlation with a p-value less than 0.01

Our results are consistent to a study conducted at Romania which showed that retinal thickness in patients with diabetes was thinner than the non-diabetic subjects.[9] Study conducted at Spain showed that macular thickness remained the same in both diabetic and non-diabetic patients.[10]

Regarding gender difference it was seen that retinal thickness in diabetic patients was different in males and females.[11] According to our results, males had thicker retina as compared to the females.

In contrast to this another research showed that longer duration of diabetes was related with mild increase in retinal thickness.[12] Singapore epidemiology study revealed contrasting results indicating increased macular thickness in patients with diabetes versus non-diabetics.[13]

The variable results in these studies might be caused by age, gender, ethnicity, HbA1C and blood sugar levels which can have effects at molecular level.[14]

If we see the quadrant-wise analysis, a Chinese study showed that retinal thickness was greater in nasal quadrant as compared to the other quadrants.[15] Instead of average retinal thickness, a local study measured retinal nerve fiber layer thinning in diabetic patients which can have an overall effect on the average retinal thickness.[16]

It is evident from the results that whether thickness is significantly increased or decreased, there is statistically significant difference between the diabetic patients and non-diabetic individuals.[17] According to a Chinese study, the average retinal thickness in individuals with and without diabetes was found to be identical, regardless of age, gender, or HbA1c levels.[18] However, a study conducted in Gujarat, India, discovered that retinal thickness varies with age in a healthy population, showing a decrease as age increases.[19] Interestingly, a Spanish study also observed a statistically significant decrease in retinal thickness among diabetic patients over an 8-year follow-up, with the exception of the temporal quadrant.[20]

Limitations of this study are cross-sectional design, excluding older patients who are more likely to have diabetes-related retinal changes and geographical and ethnic limitations as the study was conducted in a specific geographical location with a potentially homogeneous population. Although, HbA1c levels, age, and gender are mentioned, other confounding factors such as duration of diabetes, lifestyle factors, and medication use were not discussed, which could impact retinal thickness.

CONCLUSION

Diabetic patients without DR had thinner central retinal thickness compared to non-diabetic controls, as measured by Spectral Domain Optical Coherence Tomography (SD-OCT). Specifically, the average central retinal thickness and central foveal thickness were slightly reduced in diabetic patients. Quadrant-wise analysis revealed that the retinal thickness was consistently greater in the nasal region and lesser in the temporal region in both diabetic and non-diabetic patients.

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Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board **(ISO-AIEH/01)**.

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Authors Designation and Contribution

Qasim Muhammad; Assistant Professor Optometry: *Concepts, Design, Literature search, Data acquisition, Data analysis, Statistical analysis, Manuscript preparation, Manuscript editing, Manuscript review.*

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