Central Corneal Thickness of Diabetic Patients in Yaoundé: Case Control Study

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Abstract

Background: To compare central corneal thickness (CCT) values measured in diabetic eyes and compare the CCT values in normal patients without diabetes. **Methods:** A total of 83 diabetic patients and 83 non-diabetic patients were prospectively enrolled in this comparative case series. CCT was measured using a Topcon CT-1P non-contact automated pachymeter, and values were compared. **Results:** Mean age was 57 ± 11 years, with a range of 23 and 80 years. The mean CCT was 508.87 ± 35.83 μm for diabetic patients and 513.41 ± 37.22 μm for non-diabetic patients. There was no statistically significant difference between the CCT of diabetic patients compared to non-diabetic patients ($p = 0.260$). We did not find a significant correlation between the CCT of diabetic patients and clinical characteristics of diabetes. However, there was a positive and statistically significant linear correlation between the CCT of diabetic patients and intra ocular pressure (IOP). **Conclusion:** The mean CCT in diabetic patients was lower than in non-diabetic control patients, although there was no statistically significant difference.

Keywords

Cornea Central Thickness, Diabetic Retinopathy, Diabetes, Intra Ocular Pressure

1. Introduction

Diabetes is a major public health problem. The number of people with diabetes mellitus in sub-Saharan Africa is projected to increase from 19.4 million in 2019 to 47.1 million by 2045 [1]. In Cameroon, the prevalence of this disease is 4.7% [2]. Diabetic retinopathy is the leading cause of blindness in adults under 45 years of age in industrialized countries [3]. Diabetic keratopathy (including tear

film changes, corneal epithelial abnormalities, neurotrophic keratopathy, and delayed healing) is commonly overlooked and underdiagnosed by practitioners [4] [5]. Changes in CCT of diabetic patients have been described in the literature [6]. Some studies have shown that an increase in CCT was associated with an increase in HbA1c level [7] [8]. The aims of this study were to evaluate the influence of diabetes on CCT in Cameroonian diabetic patients.

2. Materials and Method

In this hospital-based case-control study, we prospectively assessed the CCT thickness of 166 patients (83 with type 2 diabetes mellitus, and 83 without diabetes as controls) between November, 2020 and July, 2021 in the ophthalmology department of the University Teaching Hospital of Yaounde. This study was approved by the institutional ethics committee. The study was in accordance with the tenets of the Declaration of Helsinki. Written and signed informed consent was obtained from each patient after an explanation of the procedure. All patients underwent a comprehensive ocular examination including visual acuity, slit-lamp biomicroscopy, and intraocular pressure measurement.

Participants with corneal pathologies, history of ocular surgery, or infection or inflammation of the ocular surface were excluded from the study. General parameters (type of diabetes, duration of evolution, glycated hemoglobin level, current treatments, and co-morbidities were obtained from the patient's file. Measurement of CCT was done with a non-contact pachymeter (Topcon CT-1P). Three consecutive automatic measurements were made and the average was taken as the CCT to be analyzed.

3. Statistical Analysis

Qualitative variables were presented by numbers and frequencies. Quantitative variables were described by the mean ± standard deviation when the distribution was normal, or the median (interquartile range) when the distribution was asymmetric. Association between variables was completed using the odds ratio. Differences between proportions were analyzed using contingency tables and by applying the Chi-2 or Fischer test when the theoretical number of people in a cell was less than 5. The ANOVA test was used for qualitative and quantitative variables between them, and the Pearson test for quantitative and quantitative variables. Differences were considered statistically significant for values of $p < 0.05$.

4. Results

A total of 166 patients (332 eyes) were included in our study. It consisted of 83 diabetic patients (cases) matched with 83 non-diabetic patients (controls). The mean age was 57 ± 11 years (range 23 - 80 years). All participants had type II diabetes. The duration of diabetes was less than 10 years in 63 (75.91%) participants. The mean glycated hemoglobin level was 9.12% ± 8.85%. Glycated hemoglobin level was ≥7% in 47 patients (61.44%). Diabetic retinopathy was present in 14

(8.43%) participants and was distributed as follows: 12 (7.22%) non-proliferative retinopathy and 2 (1.21%) severe proliferative retinopathy. Mean IOP varied significantly from 16.97 ± 3.23 in diabetic patients to 16.17 ± 4.16 in the control group (p = 0.019). In the diabetic group, CCT was <527 μm in 92 (54.9%) eyes (Table 1). The mean CCT was 508.87 ± 35.83 μm in diabetic group (range 349.00 - 628.00 μm). In the control group, the mean CCT was 513.41 ± 37.22 μm (range 407.00 - 621.00 μm) (Table 2). Although the mean CCT of diabetic patients was lower than that of non-diabetic patients, the difference was not statistically significant (p = 0.26) (Table 3). There was a negative (r = −0.11) but not significant (p = 0.338) correlation between CCT and duration of diabetes progression (Figure 1). There was a positive (r = 0.06) but not significant (p = 0.550) correlation between CCT and glycemic control level (Figure 2). There was no significant correlation between the CCT and diabetic retinopathy. There was a significant (p < 0.001) positive correlation (r > 0) between CCT and intraocular pressure (IOP) (Figure 3).

5. Discussion

The aims of this study were to measure CCT in patients with type 2 diabetes and to look for factors that correlate with CCT changes. The mean glycated hemoglobin was 9.12% ± 8.85%. This shows how poorly diabetes is managed in our

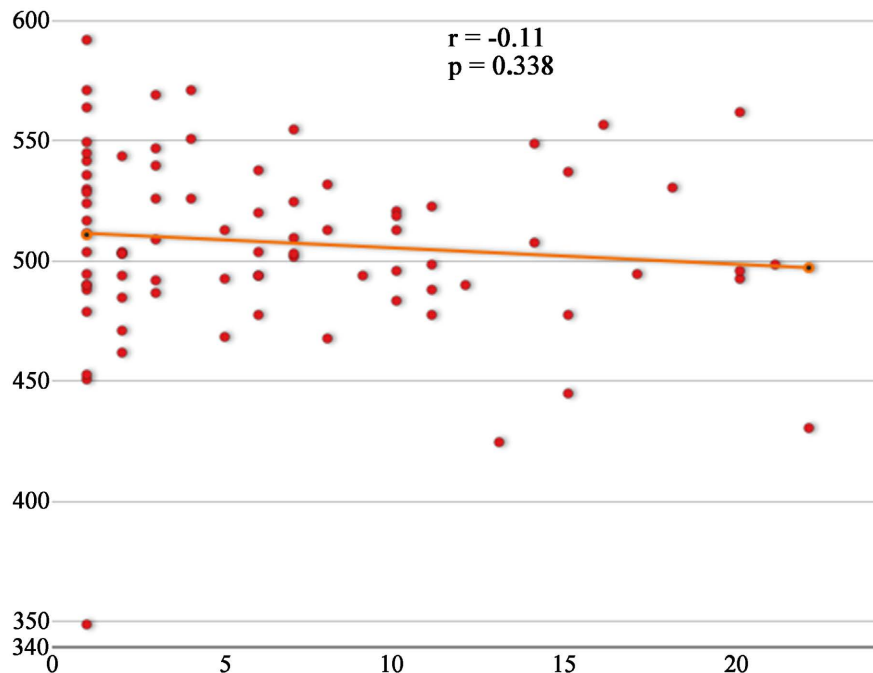**Table 1.** Diabetic central corneal thickness in diabetic group.

CCT (μm)	Number (n)	Frequency (%)
<527	92	54.9
[527 - 560]	72	43.9
>560	2	1.22
Total	166	100

Table 2. Comparison of CCT of diabetic patients and control.

Variables	Case N = 166 n (%)	Control N = 166 n (%)	Total N = 332 n (%)	OR (IC 95%)	P-value
CCT (μm)					
<527	92 (54.9)	76 (45.8)	166 (50.3)	1.0 (0.7 - 1.4)	0.171
[527 - 560]	72 (43.9)	85 (51.2)	157 (47.6)	0.7 (0.5 - 1.0)	0.133
>560	2 (1.22)	5 (3.0)	7 (2.1)	0.3 (0.0 - 1.8)	0.202

Table 3. Comparison of the mean CCT of diabetic patients and control.

| Variables	Diabetes (N = 166) Mean ± SD	Non-Diabetes (N = 166) Mean ± SD	P-value
CCT (μm)	508.87 ± 35.83	513.41 ± 37.22	0.260

Figure 1. Central corneal thickness and duration of diabetes.
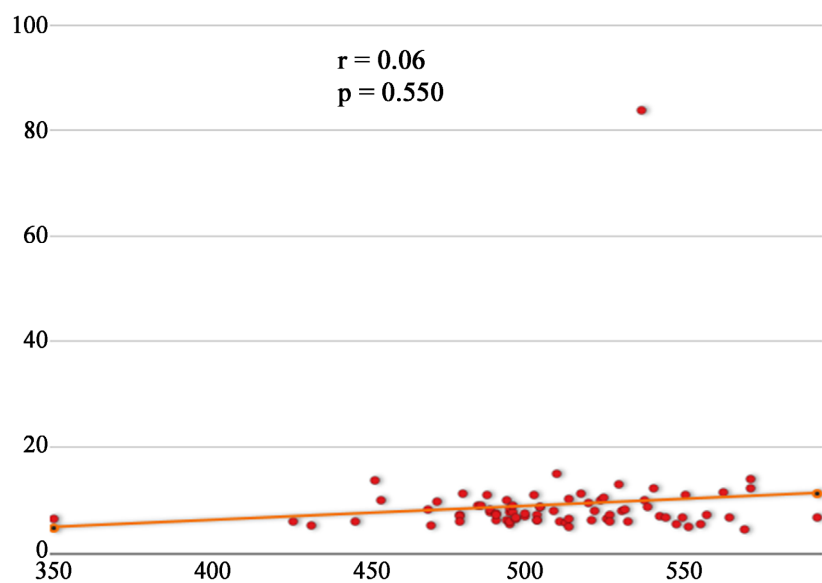
Figure 2. Central corneal thickness and glycemic control level.

environment. The incidence of diabetic retinopathy in our study (8.43%) was lower as compared to 35% reported recently in the sub-Saharan region [9]. The mean IOP varied significantly from 16.97 ± 3.23 mmHg in diabetic patients to 16.17 ± 4.16 in non-diabetic patients (p = 0.019). This higher mean IOP in diabetic patients was also reported by Briggs *et al.* [10]. Corneal thickness changes are thought to be the earliest detectable pathological manifestation in the diabetic eye, although diabetic retinopathy is the most common ophthalmic complication of diabetes [11]. In this study, the mean CCT of diabetic patients was thin
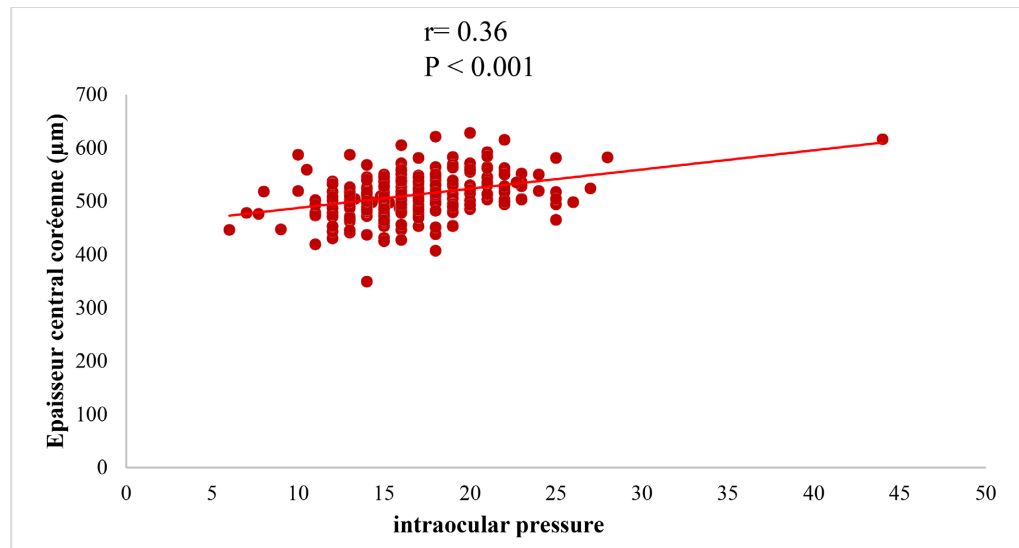
Figure 3. Central corneal thickness and Intra ocular pressure.

(508.87 ± 35.83 μm) as compared to that of non-diabetic patients (513.41 ± 37.22 μm). This difference was not statistically significant (p = 0.26). Our results are consistent with several previously published studies [12]. Corneas of diabetic patients are thinner than those of non-diabetic patients. This may be due to the electrolytic disorders caused by an unbalanced diabetes as explained in the literature. In Diabetic patients, there is a hyperosmolarity of the aqueous humor which will lead to osmotic phenomena with water streaming out of the corneal tissues. This leads to corneal dehydration responsible for corneal thinning [12]. However, several other studies have found that diabetes is associated with a significant increase in CCT [6] [13]. The mechanisms that may induce morphological changes in the cornea of diabetic patients involve the polyol pathway. Activation of aldose reductase will lead to an accumulation of sorbitol in the corneal endothelial cells. A decrease in Na^+/K^+ ATPase activity will lead to dysfunction of the corneal endothelial cell layer, leading to corneal hydration which results in an increase in CCT. There was a negative but not statistically significant correlation between CCT and duration of diabetes. CCT decreased with the duration of diabetes. The origin of this decrease remains unclear. However, Lee *et al.* found a significant increase in CCT in diabetic patients older than 10 years compared to diabetic patients younger than 10 years [14]. The duration of diabetes and the HbA1c level was not found to have any statistically significant effect on these parameters (p > 0.05) [15]. Comparing the CCT between patients with HbA1c level < 7.5% and those with HbA1c > 7.5%, we found a positive but not statistically significant correlation. This is in agreement with some authors such as Panagiota *et al.*, El-Agamy and Alsubaie, who also found no statistically significant correlation between CCT and blood glucose control [16] [17]. There was no correlation between diabetic retinopathy and CCT in our series. Our results are in agreement with those of Toygar *et al.* [18] and El-Agamy and Alsubaie [17], and contrary to Taşli *et al.* who reported a statistically significant increase in

CCT in diabetic patients compared to controls (p = 0.001) [19]. There was a significant positive correlation between the CCT of diabetic patients and IOP (p = 0.019). Although, there was no statistically significant difference between the CCT of diabetic patients compared to control patients, the IOP in diabetic patients was significantly elevated compared to control patients, suggesting the effect of diabetes on the development of hypertonia or glaucoma.

6. Conclusion

In the present study, the central thickness of the cornea did not vary significantly between type 2 diabetic patients and the control group. There was a significant positive correlation between the CCT of diabetic patients and IOP. Clinical parameters such as duration of diabetes, diabetic retinopathy, and HbA1c level were not significantly correlated with CCT.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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