

Central Corneal Thickness in a Black African Population: A Retrospective Comparative Study of Normal, Ocular Hypertensive and Glaucomatous Eyes (162 Cases)

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Abstract

Introduction: Central corneal thickness (CCT) is an important parameter in the evaluation and monitoring of glaucoma. A thinner cornea may influence intraocular pressure (IOP) measurement and has been associated with an increased risk of glaucoma. The aim of this study was to compare CCT among normal, ocular hypertensive, and glaucomatous Black African patients. **Methods:** This retrospective study was conducted over a 10-month period (January-October 2024) and included medical records of glaucomatous and non-glaucomatous patients who had undergone ultrasonic pachymetry. CCT measurements and baseline clinical data were collected. Only right eyes were included for analysis. Statistical analysis was performed using R software, with a significance level set at $p \leq 0.05$. **Results:** A total of 162 patients (162 eyes) were included: 68 normal subjects, 16 ocular hypertensive patients, and 78 glaucomatous patients. The mean age was 58.06 ± 15.42 years, with a male-to-female ratio of 1.41. The mean IOP was 19.28 ± 6.09 mmHg. The overall mean CCT was 515.7 ± 35.28 μm (range: 423 - 599 μm). Mean CCT was significantly lower in glaucomatous patients compared to ocular hypertensive and normal subjects ($p = 0.0088$). No significant correlation was found between CCT and IOP. **Conclusion:** In this Black African cohort, glaucomatous patients had significantly thinner corneas compared to normal and ocular hypertensive subjects. These findings support the importance of routine CCT assessment in the clinical evaluation of glaucoma in African populations.

Keywords

Central Corneal Thickness, Glaucoma, Ocular Hypertension, Black African Population

1. Introduction

Central corneal thickness (CCT) is an important variable in the clinical evaluation of glaucoma [1]-[3]. CCT influences the measurement of intraocular pressure (IOP). Indeed, a thin cornea leads to an underestimation of IOP, whereas a thick cornea results in its overestimation [1] [4]. Racial variations in corneal thickness have been reported. The corneas of Black Africans and African Americans are said to be thinner than those of Caucasians [3] [5] [6]. This finding has been confirmed by African studies [7] [8]. This may explain the high prevalence of glaucoma among African individuals. Other African studies have shown that CCT is thicker in normal subjects than in glaucomatous patients [9] [10]. The lack of pachymetric studies in our country comparing different groups of normal and glaucomatous subjects justifies our study. The aim of this work was to compare central corneal pachymetry among normal, ocular hypertensive, and glaucomatous Senegalese melanoderm subjects.

2. Materials and Methods

2.1. Data Collection

We conducted a retrospective study from January to October 2024 in the Department of Ophthalmology at the Military Hospital of Ouakam.

We included the medical records of all patients, glaucomatous or non-glaucomatous, who had undergone central corneal thickness (CCT) measurement. We excluded records of patients with corneal pathology, neovascular glaucoma, and childhood glaucoma.

The data collected included: age, sex, intraocular pressure (IOP), gonioscopy findings, fundus examination, CCT, visual field testing, and optical coherence tomography (OCT) results.

Patient records were divided into three groups:

- normal subjects: without ocular hypertension (OHT) or optic disc damage;
- subjects with isolated OHT: without optic disc damage or perimetric abnormalities;
- glaucomatous subjects, regardless of type or stage.

Glaucoma patients were classified into primary open-angle glaucoma (POAG), pigmentary glaucoma, pseudoexfoliative glaucoma (PEXG), chronic angle-closure glaucoma (CACG), and normal-tension glaucoma (NTG). Glaucoma severity was classified according to the Hodapp classification as: early (MD < 6 dB), moderate (MD between 6 and 12 dB), and severe (MD > 12 dB).

CCT was measured using an ultrasonic pachymeter (Ophthalmic Pachymeter*) by the same operator. The device provided the mean of 10 consecutive measurements. Only right-eye data were collected.

2.2. Statistical Analysis

Data were analyzed using R software. A multivariate analysis was performed to compare the results among the three groups. Statistical significance was set at $p \leq 0.05$.

3. Results

3.1. Population Characteristics

A total of 162 patient records (162 eyes) were included. The sample consisted of 95 men (58.64%) and 67 women (41.36%), with a sex ratio of 1.41. The mean age of the study population was 58.06 ± 15.42 years (range: 18 - 85 years). The sample included 68 (42%) normal subjects, 16 ocular hypertensive subjects (9.9%), and 78 (48.1%) glaucomatous patients (**Table 1**).

Table 1. Characteristics of the study population.

	n (%)
Total	162 (100)
Genre	
Male	95 (58.64)
Female	67 (41.36)
Age group (year)	
<30 ans	14 (8.64)
30 - 40	12 (7.41)
40 - 50	14 (8.64)
50 - 60	36 (22.22)
60 - 70	48 (29.63)
70 - 80	35 (21.61)
80 - 85	3 (1.85)
Diagnosis	
Normal	68 (42)
OHT	16 (9.9)
POAG	62 (38.3)
PEXG	10 (6.2)
CACG	3 (1.8)
Pigmentary glaucoma	2 (1.2)
NTG	1 (0.6)

The mean IOP of the population was 19.28 ± 6.09 mmHg. The mean IOP was higher in ocular hypertensive patients (22.06 ± 6.11 mmHg) than in glaucomatous patients (21.39 ± 6.14 mmHg) and normal subjects (16.20 ± 6.12 mmHg). This difference was statistically significant ($p = 0.0003296$).

3.2. Central Corneal Thickness

The mean CCT of the study population was 515.7 ± 35.28 μm (range: 423 - 599 μm) (**Figure 1**). The relationship between age and CCT revealed a statistically significant but weak negative correlation ($r^2 = 0.053$, $p = 0.002986$; **Figure 2**).

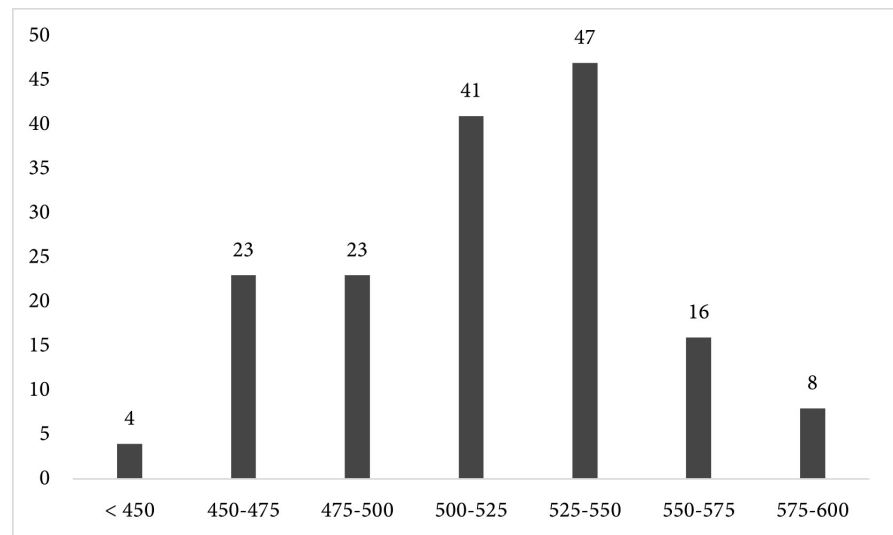


Figure 1. Distribution of the CCT.

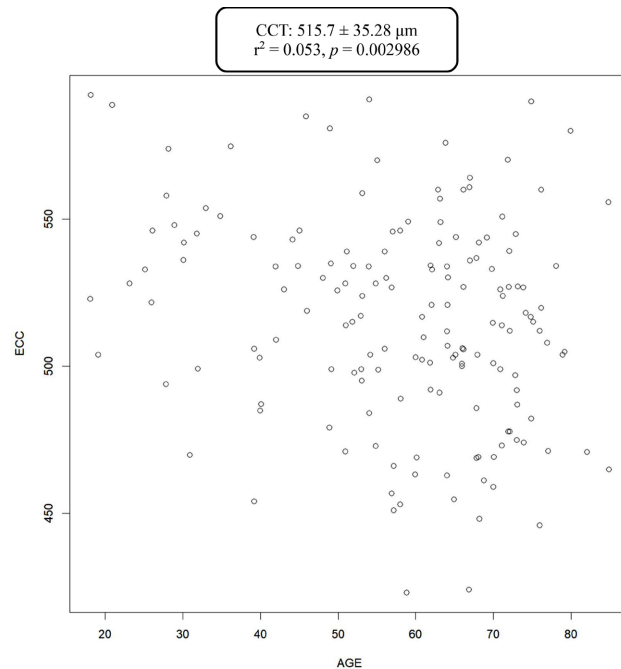


Figure 2. Relationship between age and CCT.

The mean CCT was $516.38 \pm 35.38 \mu\text{m}$ in women and $515.28 \pm 35.52 \mu\text{m}$ in men. There was no statistically significant difference between sexes ($p = 0.4103$).

The cornea was thinner on average in the glaucomatous group, with a mean CCT of $511.62 \pm 35.52 \mu\text{m}$. The mean CCT was $518.37 \pm 35.49 \mu\text{m}$ in ocular hypertensive patients and $521.13 \pm 35.49 \mu\text{m}$ in normal subjects. The difference among the three groups was statistically significant ($p = 0.008799$; **Table 2**).

Table 2. Mean age, PIO and CCR in each group.

Group	Mean age (year)	IOP (mmHg)	CCT (μm)
Normal	52.95 ± 15.5	16.20 ± 6.12	521.13 ± 35.49
OHT	54.93 ± 15.34	22.06 ± 6.11	518.37 ± 35.49
Glaucoma	63.12 ± 15.49	21.39 ± 6.14	511.62 ± 35.52
p		0.0003296	0.008799

There was no statistically significant correlation between IOP and CCT ($p = 0.3482$).

The mean CCT in the glaucoma subgroups was as follows: POAG ($512 \pm 35 \mu\text{m}$), PEXG ($502 \pm 33 \mu\text{m}$), CACG ($493 \pm 61 \mu\text{m}$), pigmentary glaucoma ($476 \pm 33 \mu\text{m}$) and NTG $580 \mu\text{m}$ (**Table 3**).

Table 3. Characteristics of the subgroups.

Subgroups	Mean age (year)	IOP (mmHg)	CCT (μm)
POAG (62)	61.98 ± 15.46	21.36 ± 6.18	512 ± 35
PEXG (10)	69.6 ± 15.47	22.5 ± 6.53	502 ± 33
CACG (3)	60.33 ± 15.71	26 ± 5.78	493 ± 61
Pigmentary glaucoma (2)	53.5 ± 14.35	25.5 ± 5.03	476 ± 33
NTG (1)	80	18	580
OHT (16)	54.93 ± 15.34	22.06 ± 6.11	518.37 ± 35.49
Normal (68)	52.95 ± 15.5	16.20 ± 6.12	521.13 ± 35.49
p			0.001248

According to glaucoma severity, the mean CCT was $508.09 \pm 36.83 \mu\text{m}$ in early glaucoma, $519.88 \pm 36.15 \mu\text{m}$ in moderate glaucoma, and $505.54 \pm 36.64 \mu\text{m}$ in severe glaucoma (**Table 4**).

Table 4. CCT depending on the stage of glaucoma.

Stage of glaucoma	Mean age (year)	IOP (mmHg)	CCT (μm)
Early glaucoma (n = 11)	64.63 ± 15.62	18.9 ± 5.81	508.09 ± 36.83
Moderate glaucoma (n = 18)	67.52 ± 15.68	20.11 ± 6.25	519.88 ± 36.15
Severe glaucoma (n = 31)	57.77 ± 15.46	21.64 ± 6.18	505.54 ± 36.64

4. Discussion

It has been shown that a thin cornea is a risk factor for glaucoma and for disease progression [11] [12]. Several authors have also demonstrated that African subjects have thinner corneas compared to Caucasians [3] [7] [13]. In our context, few studies have investigated corneal pachymetry in Senegalese melanoderm subjects. This led us to conduct the present study, which included 162 patient records consisting of 68 normal subjects, 16 ocular hypertensive subjects, and 78 glaucomatous patients. Ndiaye-Sow *et al.*, in their study on central corneal thickness (CCT) in Senegalese melanoderm subjects, included 117 patients (234 eyes) with primary open-angle glaucoma (POAG) [8]. Ouffoue *et al.* included 273 records consisting of 115 normal subjects, 49 ocular hypertensive subjects, and 109 glaucomatous patients [10].

The mean age in our series was approximately 58 years. This was comparable to the findings of Ndiaye-Sow (56 years) [8] *et al.* and Tolesa (59.3 years) [14]. In contrast, Ouffoue [10] and Lawani [15] reported lower mean ages in their studies (44 and 41 years, respectively). The male predominance observed in our study has also been reported by other authors [8] [10].

In our series, POAG was the most frequent type of glaucoma (38.3%), followed by pseudoexfoliative glaucoma (PEXG) (6.2%). In Tolesa's study, PEXG accounted for 41.4% of cases, followed by POAG (25.9%) and chronic angle-closure glaucoma (CACG) (17.3%) [14]. Most other African studies have primarily included POAG patients in their cohorts [7] [8] [10] [15].

The mean CCT in our study was $515.7 \pm 35.28 \mu\text{m}$. Similar results were reported in Ethiopia ($518 \pm 39.97 \mu\text{m}$) [14] and Uganda ($516.19 \pm 39.95 \mu\text{m}$) [16]. Other authors in sub-Saharan Africa found slightly higher but still relatively thin corneal thicknesses ranging between 525.40 and 533 μm [8] [10] [15]. These findings support the literature indicating that Black African subjects generally have thinner corneas [3] [6].

The variation of CCT with age remains controversial. Some authors have reported a significant decrease in CCT with advancing age [3] [14] [17]. We did not find such a relationship, in agreement with other studies [18] [19].

There is no consensus regarding sex-related differences in CCT. In our series, CCT was slightly thicker in women ($516.38 \pm 35.38 \mu\text{m}$) than in men ($515.28 \pm 35.52 \mu\text{m}$), but this difference was not statistically significant. Similar observations have been reported in other studies [11] [14] [15]. In contrast, Ndiaye-Sow [8] and Eballe [20] reported thicker corneas in men in their series.

In our cohort, the glaucomatous group had the thinnest corneas, followed by ocular hypertensive subjects and normal subjects, with a statistically significant difference. Contrary to what has been described by some authors, the ocular hypertensive group did not have the thickest CCT in our study. In Ouffoue's series, glaucomatous patients had the thinnest corneas, followed by normal subjects and ocular hypertensive subjects [10].

In the POAG group, the mean CCT was 512 μm . This value is close to those

reported in Ethiopia (506.69 μm) [14] and South Africa (506 μm) [21]. However, other authors have reported higher CCT values in POAG patients, ranging from $518.61 \pm 33.05 \mu\text{m}$ to $525.40 \pm 39.63 \mu\text{m}$ [8] [10]. It has been described that patients with pseudoexfoliation syndrome or PEXG tend to have thinner corneas [3] [22] [23]. We found a mean CCT of 506 μm in the PEXG group, which is close to the value reported by Ventura in Switzerland (507 μm) [24]. In Tolesa's Ethiopian series, the PEXG group had a mean CCT of 520.48 μm , which may be explained by the higher mean age of patients in that group [14]. The CACG and pigmentary glaucoma groups had particularly thin mean CCT values of $493 \pm 61 \mu\text{m}$ and $476 \pm 33 \mu\text{m}$, respectively. Data on corneal thickness in pigmentary glaucoma are scarce in the literature due to the small sample sizes in most cohorts. Patients with CACG have been reported to have thinner CCT compared to controls [3] [14] [25].

In our series, patients with severe glaucoma had thinner corneas ($505.54 \pm 36.64 \mu\text{m}$). However, we were unable to perform a detailed analysis of CCT according to glaucoma severity.

Our study has limitations, including the relatively small sample size and the limited number of ocular hypertensive and secondary glaucoma cases.

5. Conclusion

At the end of our study, we can conclude that Senegalese melanoderm subjects, similar to other African populations, have, on average, relatively thin corneas. Our findings are consistent with the existing literature. We recommend systematic central corneal pachymetry as part of the assessment of melanoderm subjects suspected of having glaucoma or ocular hypertension.

Author Contributions

The conceptualisation, supervision and critical review were carried out by Dr Alassane BA and Dr Said Dit Malobé SECK. Data collection and analysis, manuscript drafting and the literature review were carried out by Dr Alassane BA. All authors have read and approved the published version of the manuscript.

Conflicts of Interest

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

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