THE RELATIONSHIP BETWEEN CENTRAL CORNEAL THICKNESS AND DEGREE OF AXIAL MYOPIA AMONG PATIENTS ATTENDING SHAHEED DR. ASO TEACHING HOSPITAL

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ABSTRACT

Background

Central corneal thickness (CCT) is an important indicator of corneal health status. Myopia is the refractive state in which parallel rays of light from a distant object are brought to focus in front of the retina in the non-accommodating eye. Since, both cornea and sclera are continuous layers the thinner cornea would also be expected.

Objectives

The aim of this study is to determine whether there is an association between central corneal thickness and degree of axial myopia.

Subjects and Methods

This cross sectional study encompasses 103 patients (203 eyes) of emmetropic control group and 100 patients(197 eyes) of myopic group. The subjects had slit lamp examination for both eyes, including lids, conjunctiva, cornea, anterior chamber, pupil, iris, lens and fundus; best spectacle corrected visual acuity (BSCVA) refraction, and intraocular pressure (TOPCON computerized tonometer). Axial lengths, central corneal thickness, and keratometry reading were measured by a LENSTAR LS900 machine (HAAG-STREIT).

Results

The Mean CCT $\pm$ SD for the emmetropic group was (539.35 ±28.98 μm), and for the axial myopic group (533.22 ±32.27μm). The mean CCT from the two groups showed a statistically significant difference ($p = 0.047$). However there is no significant correlation between mean CCT and the degree of axial myopia ($r = 0.013$, $P = 0.109$).

Conclusion

Central corneal thickness has no statistically significant correlation with degree of axial myopia.

Keywords: *Central corneal thickness, Axial myopia, Optical low-coherence reflectometry, Pachymeter.*

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INTRODUCTION

Thinner CCT was associated with the state of glaucoma damage as indicated by CDR. Axial length and corneal hysteresis was associated with progressive field worsening [1] .

A calculation of intraocular pressure (IOP) by Goldman applanation tonometry (GAT) assumes that central corneal thickness is 520 µm, with minimal normal variation. Following refractive surgery procedures the cornea is both thinner and structurally altered such that IOP is likely to be underestimated [2]. Therefore, with the development of corneal refractive surgery procedures, CCT values are of enormous importance during the pre-operative evaluation of the patients as they influence the decision whether or not to perform surgery, the type of recommended procedure, and rate of postoperative complications [3].

Myopia can be classified by presumptive etiology as axial or refractive. In axial myopia, the eyeball is unusually long. In refractive myopia, the length of the eye is statistically normal, but the refractive power of the eye (cornea and/ or lens) is abnormally excessive [4].

Myopic individuals can be classified into two groups: those with a low amount, sometimes referred to as "school myopia," and those having greater than 6 D, often called "pathologic myopia" [5].

Interplay among corneal power, lens power, anterior chamber depth, and axial length determines an individual's refractive status. All 4 elements change continuously as the eye grows. By the end of the second year, the anterior segment attains adult proportions; however, the curvatures of the refracting surfaces continue to change measurably [6].

The etiologic factors concerning myopia are complex, involving both genetic and environmental factors. Regarding a genetic role, identical twins are more likely to have a similar degree of myopia than are fraternal twins, siblings, or parent and child. However, studies of ethnic Chinese in Taiwan show an increase in the prevalence and severity of myopia over the span of 2 generations, a finding that implies that genetics alone is not entirely responsible for myopia[7].

Some studies have reported that near work is not associated with a higher prevalence and progression of myopia, especially with respect to middle distance activities such as tasks involving video displays. High educational achievements have been strongly associated with a higher prevalence of myopia [8].

We need to know if myopia associated with overall outer eyeball coat thinning, those is the sclera and the cornea and as central corneal have contribute to glaucoma we can figure important clinical fact that can be detected and treated early and effectively.

Aims of study

To determine whether there is an association between central corneal thickness and degree of axial myopia.

SUBJECTS AND METHODS

A cross sectional study was performed at Shaheed Dr. Aso Teaching Hospital, Slemani city, Kurdistan region of Iraq, from January to June 2015. The participants were 'convenience sampling' recruited for checking their vision. They were aged between 18 and 64 years. The study included a control emmetropic group of 203 eyes of 103 subjects with normal visual acuity and spherical equivalent (SE) of zero. The myopic group consisted of 197 eyes of 100 subjects. The study was conducted in accordance with a protocol approved by the scientific and ethics committee at Sulaimani University. Moreover, the oral informed consent was obtained from all individuals and is included in the study.

For each participant, a complete data regarding personal details, age, gender and residency were recorded. Furthermore, the subjects had slit lamp examination for both eyes, including lids, conjunctiva, cornea, anterior chamber, pupil, iris, lens and fundus (Subjects with previous eye surgery, glaucoma, diabetes mellitus, corneal dystrophy, subclinical keratoconus or other acute or chronic diseases possibly affecting the corneal thickness were excluded; none of them had previous contact lens wear), best spectacle corrected visual acuity(BSCVA), refraction(NIDEC RT-5100 refractor, Japan), and intraocular pressure (IOP)(TOPCON computerized tonometer CT-80, Japan). Axial lengths (AL), central corneal thickness, and keratometry reading (K) were measured using LENSTAR LS900 machine (HAAG-STREIT, Switzerland, 2011). To be mentioned, the LENSTAR is easy to use as an automatic non-contact based on optical low coherence reflectometry along visual axis to record the five needed value. These measurements took place while the patients were seated upright.

Statistical analysis

Data were analyzed using SPSS version 21.0 for Windows. The distributions of CCT measurements for myopic and emmetropic eyes were inspected using histograms. For investigating the relationship between CCT and degree of axial myopia, the arbitrary groupings of myopic spherical equivalent (SE) from -0.125 to -12.625D were used. Student's *t* test was used to compare means from two independent groups. A *P* value of less than 0.05 indicated statistical significance. The correlation between spherical equivalent and CCT was investigated using Pearson correlation coefficient and was shown in the Scatter plot.

RESULTS

A total of 197 eyes of 100 myopic patients and 203 eyes of 103 emmetropic controls were recruited.

The myopic groups consisted of 55 (55%) females and 45 (45%) males (table 1). The mean age of the patients was 28 ± 9.5 years (ranging between 18–64 years), median 26 years. The mean IOP was 17.54±2.07mmHg, and the mean axial length was (23.9 ± 1.04) mm; the mean myopic spherical equivalent was –1.5 ± 1.5 D (range -0.125 to -12.625 D) (Table 2), the distribution of the myopic SE is shown in Figure1.

For the control emmetropic group, there were 49 (47.8%) females and 54 (52.2%) males, the mean age of whom was 36.6 ± 10.13 years (ranging between 18–60 years), the median was 37 years. The mean IOP of subjects was 16.67±2.44 mmHg, and the mean axial length was (23.2 ± 0.78) mm.

The histograms for the distributions of CCT in the myopic and the control emmetropic group are shown in Figures 2 and 3. Both distributions appeared similar and approximately followed the normal distribution curve with the mean CCT for the axial myopic group being a 533.22 ± 32.47µm while it was 539.35 ± 28.98 µm for the emmetropic group. There was a statistically significant difference between the mean CCT and mean IOP in the eyes with axial myopia compared to the eyes in the emmetropic group ($P = 0.047$; 0.001 respectively). But there was no significant correlation between CCT and the degree of axial myopia ($r = 0.013$, $P = 0.109$) as shown in Figure 4. Furthermore, there is no significant correlation between corneal thickness and axial length ($r = 0.073$, $P = 0.304$) as shown in Figure 5.

Note that there is no significant association between CCT and the degree of axial myopia as shown in figure 5.

Table 1. Demographic features of myopic patients and control group.

	Myopics (no.)	Percentage	Control (no.)	Percentage
Gender				
Male	45	45.00	54	52.42
Female	55	55.00	49	47.58
Age groups				
15 to 30	59	59.00	31	30.09
31 to 50	32	32.00	58	56.31
51 to 70	9	9.00	14	13.59
Residency				
Urban	64	64.00	48	46.60
Suburban	26	26.00	23	22.33
Rural	10	10.00	32	9.70
Total	100	100	103	100

Table 2. Mean central corneal thickness (CCT), Mean axial length (AL), and Mean spherical equivalent in patients and control group.

Variables	Myopic patients	Control	P-value
Mean CCT (µm)	533.22 ±32.27	539.35 ±28.98	
Mean AL (mm)	23.9 ± 1.04	23.2 ± 0.78	0.047
Myopic spherical equivalent (D)	0.125-12.625	0.56-3.35	

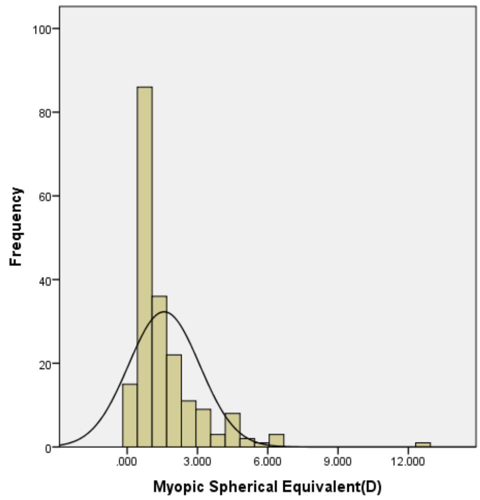

Figure 1. The distribution of spherical equivalent in myopic group.

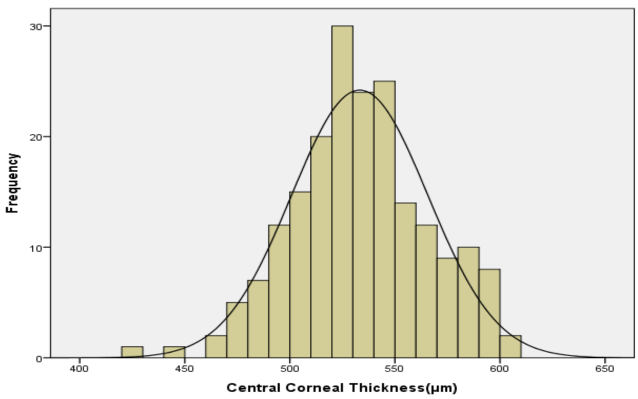

Figure 2. The distribution of central corneal thickness in myopic group.

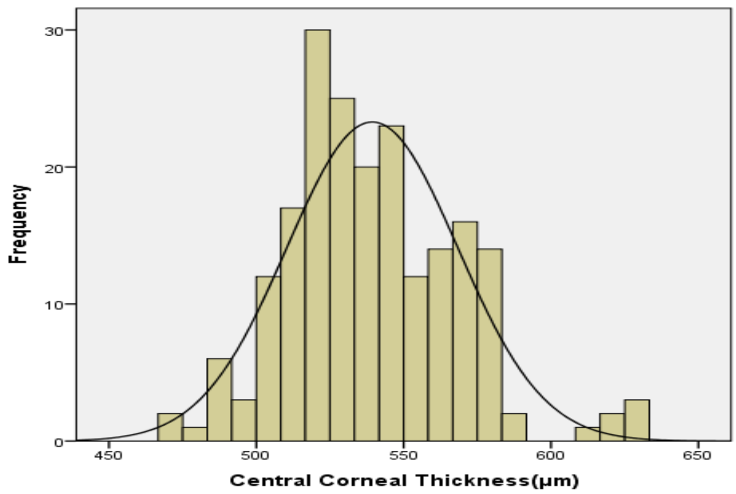

Figure 3. The distribution of central corneal thickness in the emmetropic group.

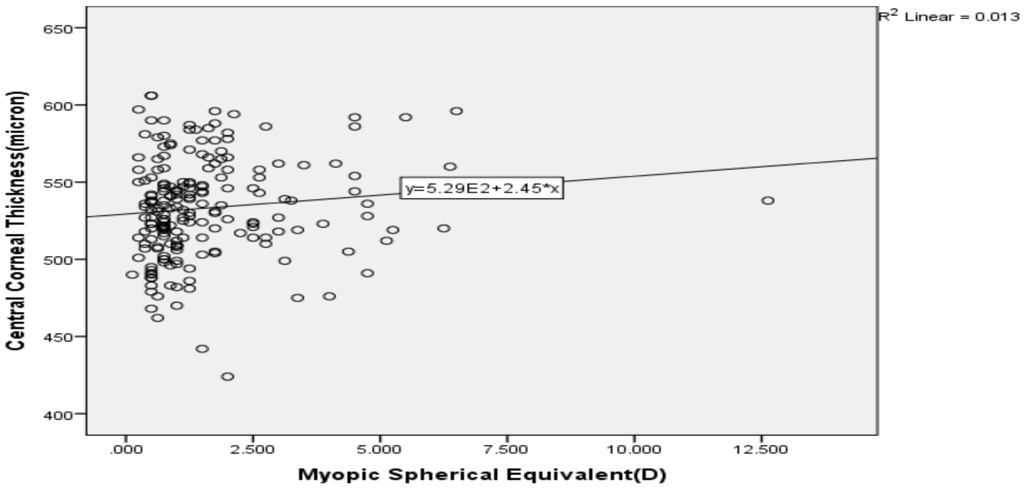

Figure 4. The association between central corneal thickness and myopic spherical equivalent (The degree of axial myopia).

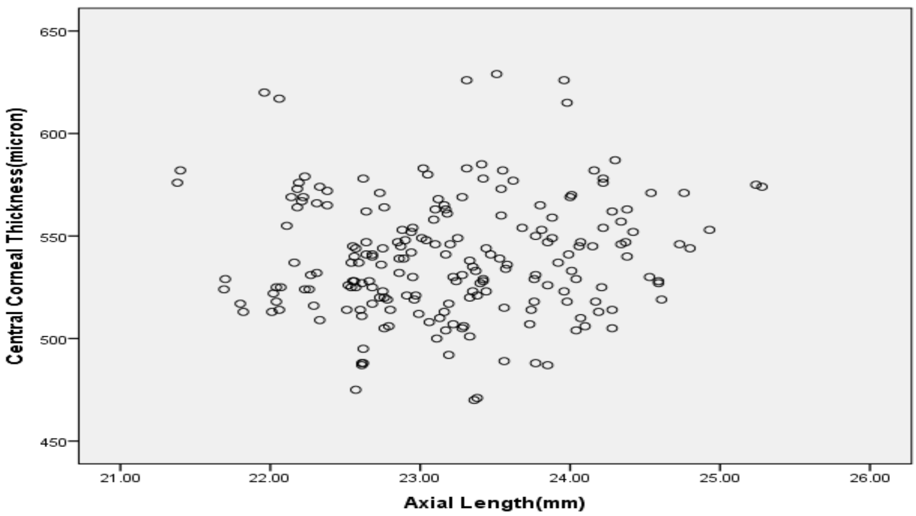

Figure 5. The correlation between central corneal thickness and axial length.

DISCUSSION

The eyeball elongates during myopia progression, in which the higher the progression of myopia, the thinner the cornea is expected to be according to a simple 'stretching theory'. An emmetropic eye could then be compared to a sphere, and a myopic eye to a prolate spheroid [9]. Stretching mainly affects posterior sclera of myopic which is thinner than emmetropia but there is no significant difference in equatorial scleral thickness [10].

Nevertheless, the results of the present study cannot be completely explained by 'stretching theory'. Indeed, the study found that the cornea was thinner in myopic eyes (6.13μm), but there was no statistically significant association between CCT and the degree of axial myopia. Other studies also disclosed similar outcomes with other populations in the Middle East namely Saudi Arabia and Israeli [11, 12].

A significant body of evidence has previously analyzed the correlation between the central corneal thickness and the degree of myopia, as briefed in table 2. In Liu's series [13] no correlation was noticed between central corneal thickness and the degree of myopia in contact lens wearers. In contrast, Tokoro and co-workers found the myopic cornea to be 0.018 mm thinner than the normal controls [14]. Likewise, Von Bahr discovered a thinner cornea in high myopic eyes [15].

Furthermore, there is no significant correlation between corneal thickness and axial length; these measurements are in remarkable agreement with Ehlers and Shimmyo's observation in that the relation between corneal thickness and axial length are insignificant based on evidence derived from in vivo human studies [16, 17] .Likewise the central corneal thickness did not correlate with axial length in Price's series. [18]

In both Liu's and Price's series, however, the corneal thickness were measured in contact lens wearers. Since Long-term contact lens wear appears to decrease the entire corneal thickness, this might partially explain the lack of correlation between corneal thickness and myopia.

Racial variations in mean CCT have been reported in several ethnic groups. A population based study of Greenland Eskimos by Alsbirk was conducted on 839 persons without corneal abnormalities as well as a sample of 98 Danes in Greenland the study conducted that the mean CCT of male Eskimos (518 μm) was significantly less than the mean CCT of the control group of male Caucasians (542 μm), using optical pachymetry.

Also, the mean central corneal thickness was (550±33 μm) in Price's series of Eight hundred ninety-six eyes in 450 patients. In Aghaia series were particularly interested in highlighting the variations in CCT among Asian subpopulations and comparing them with other racial groups. The mean unadjusted CCT of selected eyes was (542.8± 37.3 μm).

The mean CCT of Caucasian (562.8± 31.1 μm), Hispanic (563.6± 29.1 μm), African American (524.8± 38.4 μm), Chinese (569.5±31.8 μm), Filipino (559.0± 24.9 μm), Japanese (538.5± 29.6 μm). These observations are further evidence that the racial variation in CCT is, in fact, present. More importantly, all Asian groups are not comparable with respect to mean CCT. On average, Japanese patients have CCT less than those of other Asian racial groups. Yet, African Americans continue to have the smallest mean CCT when compared with their peer races. This might be one potential explanation for the wide spread of glaucoma among individuals of African American descent. Thus, CCT is important in the diagnosis and treatment of glaucoma, because having low CCT may lead to underdiagnosis and undertreatment of glaucoma, whereas a high CCT can lead to overdiagnosis and overtreatment of glaucoma summarized by table 2 .

Table 2. Overview of previously published papers with information on myopia and central corneal thickness

Authors	Year	Country	No. of subject (myopia)	Method of measurement	CCT- myopia relationship
Pedersen et al.	2005	Denmark	105 (48)	Optical	No correlation
Hani et al.	2006	Saudi Arabia	158(982)	US	No correlation
Lifshitz et al.	2003	Israel	408	US	No correlation
Liu et al.	2000	China	30	Orbscan	No correlation
Von Bahr	1956	Sweden	125 (12)	Optical	Thinner when >-4 diopters
Ehlers et al.	1975	Denmark	101	Optical	No correlation
Shimmyo et al.	2004	USA	1,084	US/IOLmaster	No correlation
Price et al.	1999	USA	450	US	No correlation
Cho et al. [19]	1999	China	151	US	No correlation
Alsbirk et al. [20]	1978	Greenland	325	Optical	Thinner when myopic
Kunert et al. [21]	2003	India	615	US/Orbscan	Thicker in high myopic
Chang et al. [22]	2001	Taiwan	216	US	Thinner when high myopic
Srivannaboon [23]	2002	Thailand	280	US/Orbscan	Thinner when high myopic
Touzeau et al. [24]	2003	France	95	Orbscan	Thinner when myopic
Martola et al. [25]	1968	USA	121	Optical	No correlation
Hansen [26]	1971	Denmark	113	Optical	No correlation
Fam et al. [27]	2006	Singapore	714	Orbscan	No correlation
Aghaian et al. [28]	2004	USA	801	US	No correlation

In regard with the technique of measurement, this study implemented LENSTAR LS900 (HAAG-STREIT), an automatic non-contact machine based on optical low coherence reflectometry. In a prospective, comparative study done by Wassia and coworkers on thirty-two eyes of 32 subjects with no known ocular disease; it was concluded that subjects with healthy corneas, slit-lamp optical coherence tomography (SL-OCT), specular microscopy, and Orbscan (with correction factor) can be used interchangeably with US pachymetry in certain clinical settings. The four modalities showed significant linear correlations with one another, any one can be used in a certain clinical setting [29].

Overall, studies using slit-lamp-based optical pachymetry reported marginally lower CCT values (530±29 µm) compared to ultrasound based studies (544±34 µm), but the authors attributed this difference to the type of individual studied (nonsurgical vs. presurgical patients) rather than the technique itself. The mean CCT is very similar to the normal emmetropic eyes in our study which was 539.35 ± 28.98 µm.

Finally and interestingly, our study observed that IOP measurement in myopic was slightly higher than emmetropic (0.87mmHg) which was very highly significant statistically (*P*=0.001).

Regarding limitation it is worth mentioning that the examination of patients was carried out in a very limited time in the morning (9-12); therefore, and like other cross sectional studies, the present study cannot demonstrate the impact of the variation in some confounding factors, such as diurnal variation, on the central corneal thickness.

We recommend measuring CCT for all Myopics during glaucoma assessment, and further study regarding variation of CCT by comparing physiological versus pathological myopia.

The study concludes that CCT has no significant correlation with degree of axial myopia however there is a statistically significant difference regarding CCT values in axial myopia from emmetropia

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Conflict of Interest

Authors declares no conflict of interest

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