

The Correlations between Central Corneal Thickness and Age, Gender, Intraocular Pressure and Refractive Error of Aged 12-60 Years Old in Rural Thai Community

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Objectives: To study the normal Central Corneal Thickness (CCT) and investigate the correlation between CCT and age, gender, intraocular pressure and refractive error.

Material and Method: Population of age 12-60 years old were interviewed with standard questionnaire. Refractive error was measured and graded according to spherical equivalent power. Then intraocular pressure and central cornea thickness were measured by applanation tonometer and ultrasonic pachymeter, respectively. The data were analyzed using T-test, correlation and multivariate linear regression to identify mean CCT and correlation between age, gender, intraocular pressure, and refractive error.

Results: A total of 467 participants were enrolled into the study. One hundred and eighty-six (39.8%) were males and 281 (60.2%) were females. The average CCT was $535.2 \pm 29.9 \mu\text{m}$. The mean CCT of right and left eyes were $535.3 \pm 30.4 \mu\text{m}$, and $535.1 \pm 29.5 \mu\text{m}$, respectively. The multivariate linear regression indicated that increasing in age would decrease the CCT $0.28 \mu\text{m}$ and an increasing of intraocular pressure would increase the CCT $1.4 \mu\text{m}$ statistically significance.

Conclusion: The CCT was independently related to the refractive error and gender. Greater CCT was associated with higher intraocular pressure. Conversely, thinner cornea was correlated with older age group.

Keywords: CCT, Intraocular pressure, Refractive error, Age, Gender

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The measurement of corneal thickness has become increasingly important because of increasing popularity of refractive surgery.

The Central Corneal Thickness (CCT) is different among the population of different ethnic group⁽¹⁻⁴⁾. The majority of the studies on CCT were on Caucasian subjects and many were based on results using optical pachymeters^(1,3-6). Recent studies have suggested that

there was difference between the CCT of Chinese and Caucasian⁽⁷⁻⁹⁾. Besides ethnic factor, a few investigators found that corneal, thickness may correlate with other factors such as age^(1,4), intraocular pressure (IOP)^(1,10-13), corneal curvature⁽⁹⁾ and refractive error⁽¹⁴⁾. However several studies about CCT and factors that other investigators have mentions are still controversy and do not settle conclusively.

The purpose of this study is to know the normative CCT of Thai people and to investigation the factors that may affect the CCT such as age, gender, IOP and refractive error.

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Material and Method

The population of Ban Nayao, Sanam Chaiyakhet district, Chacherngsao province, aged 12-60 years. The subjects were arbitrarily classified into ten age group (12-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54 and 55-60 years). They were interviewed and examined to rule out any corneal disease, corneal scar, previous ocular trauma, previous eyes surgery, long term using any eye drop and poor visual acuity that was not from refractive error. The number of 934 eyes from 467 subjects were studied.

The refractive error was measured with trial lens set and graded according to spherical equivalent power. Biomicroscopy examination was performed with each subject to exclude ocular pathologic features and measure intraocular pressure by using applanation tonometry.

CCT was measured with Nidek, UP1000 ultra-sound pachymetry (Nidek, Gamagori, Japan) by only one investigator. The cornea was anesthetized with topical 0.5% tetracaine hydrochloride. The subject was then placed on the examination chair brought into a face-up position, and was asked to look on a color target. Care was taken to apply the angled ultrasound

probe as perpendicular as possible on the central cornea. The mean CCT of five times measurement was used for this study. After each subject, the probe was disinfected with alcohol after each use.

Statistical Analysis

Using T test, Correlation and Multivariate li-near regression method to investigate mean corneal thickness and correlations between CCT and gender, age, intraocular pressure and refractive error.

Results

The number of participants was 467 subjects, male 186 subjects (39.83%), female 281 subjects (60.17%). The mean \pm SD CCT of the right eye and left eye were $535.30 \pm 30.37\mu\text{m}$ and $535.09 \pm 29.47\mu\text{m}$ respectively and they were significantly correlated. No statistically significant difference was found in the CCT between the right and left eye. The mean CCT of these subjects was $535.19\mu\text{m}$ (Table 1).

By T-test showed that there was no significant correlation between CCT and gender ($P=0.24$), (Table 2). There was significant correlation between CCT and age. By linear regression showed that CCT decreased $0.35\mu\text{m}$ per year ($P<0.01$), (Table3). There

Table 1. Central Corneal Thickness and Intraocular Pressure

Characteristic	Number	Minimum	Maximum	Mean	Median	SD
Central Corneal Thickness						
Right eye	467	443	627	535.30	535.00	30.37
Left eye	467	449	629	535.09	535.00	29.47
Total	934	443	629	535.19	535.00	29.91
Intraocular Pressure						
Right eye	467	4.40	24.40	14.48	14.60	3.43
Left eye	467	4.00	29.00	15.97	15.90	3.34
Total	934	4.00	31.6	15.26	15.90	3.46

Table 2. T- test comparing difference of central cornea thickness between genders

Gender	N	Mean \pm SD	T-test	p-value
Male	372	536.6 ± 30.6	1.185	0.24
Female	562	534.2 ± 29.4		

Table 3. Associated factors with cornea thickness by univariate linear regression and multivariate linear regression

Factors	Univariate		Multivariate	
	β	p-value	β	p-value
Age	-0.35	<0.01	-0.28	<0.01
Gender	-2.39	0.24	-3.3	0.10
IOP	1.62	<0.01	1.4	<0.01
Refractive	1.26	0.32	1.63	0.19

was significant correlation between CCT and IOP. By linear regression showed that CCT increased 1.62 μm per mmHg ($P<0.01$), (Table 3). There was no significant correlation between CCT and refractive error. By linear regression showed that CCT increased 1.26 μm per diopter ($p=0.32$), (Table 3).

Associated factors (age, gender, IOP, refractive error) with CCT by multivariable linear regression showed that there were two significant factors, age and IOP. The CCT decreased 0.28 μm per year ($P<0.01$). The CCT increased 1.40 μm per mmHg ($P<0.01$). The remaining factors (gender and refractive error) were not significant ($P>0.05$), (Table 3).

Discussion

In this study, no statistically significant difference in CCT was found between male and female subjects or between the right and left eyes. The CCT is also not correlated with refractive error (spherical equivalent). A significant positive correlation was found between CCT and IOP and a negative correlation between CCT and age.

There was a study found no significant difference in CCT between male and female subjects for Eskimos below the age of 16, but for subjects above 15 years old, male Eskimos had thinner corneas than female Eskimos. But, for Caucasian subjects, male subjects had significantly thicker cornea than female subjects⁽¹⁾. For this study, on the contrary, showed no significant difference in CCT between male and female subjects in any age group and this is the same with the results from the other investigators^(2-4,6,9).

Elsewhere reported a decreasing in CCT with age^(2,9,10,15) but others reported no significant correlation between CCT and age^(2,3,11,12,16). These outcomes of the effects of age and CCT might be due to hormonal changes in female subjects⁽¹⁶⁾. However, many investigators found no significant difference in the CCT between male and female subjects and also,

in this study, hormonal subjects do not explain the decrease in CCT with age for both male and female subjects below the age of 29 years.

Some papers reported significant positive correlation between CCT and IOP^(9,10,12,13,17,18). In this study, CCT and IOP were also significantly correlated which was in agreement with data from recent reports.

We also found the mean CCT of our subjects was 535.19 μm . Others found the mean CCT of their African American, Asian, Caucasian and Hispanic subjects were 535.46, 549.79, 552.59 and 551.10 μm , respectively⁽¹⁷⁾. The mean CCT of Chinese Hong Kong subjects was 575 μm ⁽¹⁶⁾. The mean CCT of Caucasians from two paper were 553 μm and 506 μm , respectively^(19,20). Some reasons for inconsistent results may be the different race, environment, food and instrumentation used. Our study suggest that different ethnic population may have different norms for CCT. So we should use the proper norms of CCT for each population when we want to investigate about the CCT for refractive surgery or corneal diseases.

Conclusion

CCT was found to be independent of refractive error and there was no significant relation with gender. Greater CCT was associated with higher intraocular pressure but thinner cornea correlated with older age groups.

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ความสัมพันธ์ระหว่างความหนาตรงกลางของกระจกตากับอายุ เพศ ความดันลูกตา และความผิดปกติของสายตาของคนชนบทไทยในช่วงอายุ 12 ถึง 60 ปี

มานะพล เล็กสกุล, พจน์ เอมพันธุ์, บัณฑิต นวนพรัตน์สกุล, ศรันย์ บำรุงสวัสดิ์, ทศพล ตระกูลมุงกิจการ, จิรเดช เจริญวานิชวิศิษฐ์, ธนันต์ ตระกูลพัทวงศ์, ปานเทพ สุขแสงทอง, อธิภัทร์ ใจประสาท, มนสิทธิรัตน์ นันทพัฒน์, ตฤณ สุดประเสริฐ

วัตถุประสงค์: เพื่อศึกษาค่าปกติของความหนาตรงกลางของกระจกตาและวิเคราะห์ความสัมพันธ์ระหว่างความหนาตรงกลางของกระจกตา กับอายุ เพศ ความดันลูกตา และความผิดปกติของสายตา

วัสดุและวิธีการ: ประชากรในช่วงอายุ 12 ถึง 60 ปี จะถูกสัมภาษณ์เกี่ยวกับข้อมูลที่ต้องการศึกษาตามแบบสอบถาม วัดค่าความผิดปกติของสายตาและบันทึกเป็นหน่วยของ spherical equivalent power จากนั้นจะวัดความดันลูกตาและค่าความหนาตรงกลางของกระจกตาด้วยเครื่องวัดความดันลูกตาแบบ applanation tonometer และเครื่องวัดความหนาของกระจกตาด้วยคลื่น ultrasound ตามลำดับ ข้อมูลที่ได้จะนำมาวิเคราะห์โดยใช้ T-test, correlation และ multivariate linear regression เพื่อที่จะหาค่าเฉลี่ยของค่าความหนาตรงกลางของกระจกตา และความสัมพันธ์กับอายุ เพศ ความดันลูกตา และความผิดปกติของสายตา

ผลการศึกษา: ประชากรที่นำมาศึกษามีจำนวน 467 คน เป็นชาย 186 คน คิดเป็นร้อยละ 39.8 และเป็นหญิง 281 คน คิดเป็นร้อยละ 60.2 โดยพบว่ามีค่าเฉลี่ยความหนาตรงกลางของกระจกตาเท่ากับ 535.2 ± 29.9 ไมครอน ค่าเฉลี่ยความหนาตรงกลางของกระจกตาข้างขวาและข้างซ้ายเท่ากับ 535.3 ± 30.4 ไมครอน และ 535.1 ± 29.5 ไมครอน ตามลำดับ จากการวิเคราะห์โดยใช้ multivariate linear regression พบว่าอายุที่เพิ่มขึ้นจะทำให้ค่า ความหนาตรงกลางของกระจกตาลดลง 0.28 ไมครอนต่อปี และค่าความดันลูกตาที่เพิ่มขึ้นจะทำให้ค่าความหนา ตรงกลางของกระจกตาเพิ่มขึ้น 1.4 ไมครอนต่อมิลลิเมตรปรอท อย่างมีนัยสำคัญ

สรุป: ค่าความหนาตรงกลางของกระจกตาไม่มีความสัมพันธ์กับค่าความผิดปกติของสายตาและเพศ ค่าความหนาตรงกลางของกระจกตาที่เพิ่มขึ้นมีความสัมพันธ์กับค่าความดันลูกตาที่สูงขึ้น ในทางกลับกัน ความหนากระจกตาที่บางลงมีความสัมพันธ์กับกลุ่มประชากรที่มีอายุมากขึ้น
