CORRELATION BETWEEN CENTRAL CORNEAL THICKNESS AND DEGREE OF HYPEROPIA

By

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ABSTRACT

Background: The transparent cornea forms the anterior portion of the outer casing of the eye and has the dual functions of protecting the inner contents of the eye as well as providing about two thirds of the eye's refractive power.

Objectives: The purpose of this study was to evaluate the correlations between central corneal thickness and degree of hyperopia in adult populations.

Patients and Methods: This was a prospective cross-sectional, observational study conducted in Ophthalmology Department, Al-Azhar University Hospitals, were divided equally into two groups according to their ages: Group 1 included patients with age range from 20-37, and group 2 consisted of patients aged 42-56. Each group contained 15 males and 15 females. Approval of Al-Azhar University ethics committee was obtained for the study. The nature and methodology involved in the study were explained to the patient and informed consent were obtained.

Results: The results of the current study showed that the range of central corneal thickness (CCT) in group 1 was 512-631 um with mean ± SD of 570.87 ± 25.31. In group 2, CCT ranged from 530 to 694 um with mean ± SD of 567.37 ± 30.89. In addition, there was no significant correlation between CCT and age in either group. The present study delineated that the mean ± SD of refraction of both groups was 3.91 ± 1.20 and 3.17 ± 1.01 respectively. The median of cylinder in both groups was -1.5 and -1 respectively, and the median of axis was 75 and 92.5 respectively. Significant association between CCT and refraction could not be noticed in both groups besides the non-significant association between CCT with either cylinder or axis in them.

Conclusion: Among adult subject with age range 20-60, central corneal thickness did not correlate with age change. Degree of hyperopia did not affect central corneal thickness of adult subjects. Central corneal thickness did not correlate with degree of intraocular pressure in hyperopic adults with normal IOP.

Keywords: Central Corneal Thickness, Hyperopia.

INTRODUCTION

The cause is an imperfection of the eyes. Often it occurs when the eyeball is too short, or the lens or cornea is misshapen. Risk factors include a family history of the condition, diabetes, certain medications, and tumors around the eye. It is a type of refractive error. Diagnosis is based on an eye exam (Kaiser Peter et al., 2014). Hyperopia primarily affects young children, with rates of 8% at 6 years and 1% at 15 years. It then becomes more common again after the age of 40, affecting about half of people (Castagno et al., 2014).

Central corneal thickness is an important indicator of health status of the cornea especially of corneal endothelial pump function, it is also has value in refractive surgery (Shalini et al., 2017).
CCT can be assessed by means of many instruments, including specular microscopy, ultrasound pachymetry, ultrasound biomicroscopy (UBM), slit-scanning corneal topography, the Scheimpflug system (Pentacam), optical biometry, and optical coherence tomography (OCT) (Al-Mezaine et al., 2008).

The Pentacam combines a rotating Scheimpflug camera with a static camera to acquire multiple photographs of the anterior eye segment. The Scheimpflug camera rotates along with a monochromatic slit-light source around the optical axis to obtain the slit images. This rotating system performs a corneal scan from zero to 180 and each of the photographs is an image of the cornea at a specific angle. The static camera is placed in the center to detect the pupils contours and control fixation. Analyses of corneal pachymetry, corneal wavefront aberrations, densitometry and the complete anterior chamber are also provided by the Pentacam (Wegener and Laser-Junga, 2009).

The aim of this study was to evaluate the correlations between central corneal thickness and degree of hyperopia in adult populations presenting to the outpatient ophthalmology clinics of Al-Azhar University Hospitals.

PATIENTS AND METHODS

This was a prospective cross-sectional, observational study conducted in Ophthalmology Department, Al-Azhar University Hospitals, Cairo, Egypt. A total of 60 eyes were recruited from Al-Azhar University Hospitals outpatient clinic. They were divided equally into two equal groups according to their age; Group 1 included patients with age range from 20-37 and Group 2 consisted of patients aged 42-56. Each group contained 15 males and 15 females.

Approval of Al-Azhar University ethics committee was obtained for the study. The nature and methodology involved in the study were explained to the patient and informed consents were obtained.

Inclusion criteria:
- Errors of refraction: +2D: +6D and cylinder less than 2D.
- Healthy and clear cornea.

Exclusion criteria:
- Patients below 20 or above 60.
- Errors of refraction below +2D or above +6D.
- Unhealthy and opacified cornea.
- Glaucomatous patients.
- Patients with previous corneal surgeries.

Each Patient was subjected to the following:
- History taking.
- BCVA (using Snellen's visual acuity chart).
- IOP measurement (using Goldmann applanation tonometer).
- Slit lamp examination of the anterior segment.
- Auto refractometer testing for refraction measurement, KR-800; Topcon Medical Systems, Inc., Fukuoka, Japan was used.
- Pentacam Corneal Topography for the assessment of CCT. At the time of
study, the machine used Pentacam Software V1.20r87.

Statistical analysis:
Data were collected, revised and entered to the Statistical Package for Social Science (SPSS) program (version 23; Inc., Chicago, IL). The qualitative data were presented as numbers and percentages and compared between the two groups using Chi-square test. While quantitative data were presented as mean, standard deviations and ranges and compared between the two studied groups using Independent t-test when the data were parametric and Mann-Whitney test when the data were non parametric. Also Spearman correlation coefficients were used to assess the correlation between two quantitative variables in the same group. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant at the level of < 0.05.

RESULTS

Age of group I was ranged from 20 to 37 years with mean ± SD of 27.37±5.80, while in group II age ranged from 42 to 56 year with mean ± SD of 47.97 ± 4.04. The two groups were matched in gender which was 50% males and 50% females (Taele 1).

Table (1): Age and gender distribution among patients of group I

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Groups</th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Mean ± SD</td>
<td>27.37 ± 5.80</td>
<td>47.97 ± 4.04</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>20 – 37</td>
<td>42 – 56</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>15 (50.0%)</td>
<td>15 (50.0%)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>15 (50.0%)</td>
<td>15 (50.0%)</td>
</tr>
</tbody>
</table>

There was no statistically significant difference found between the two studied groups regarding degree of hyperopia, CCT, affected eye and IOP with p-value > 0.05 (Table 2).
Table (2): Refraction, cylinder, axis CCT, eye affected and IOP level among patients of group I

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Groups</th>
<th>Group I</th>
<th>Group II</th>
<th>Test value</th>
<th>P-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. = 30</td>
<td>No. = 30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refraction</td>
<td>Mean ± SD</td>
<td>3.91 ± 1.20</td>
<td>3.49 ± 1.06</td>
<td>1.422*</td>
<td>0.161</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>2 – 6</td>
<td>2 – 5.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder</td>
<td>Median (IQR)</td>
<td>-1.5 (-2 – -0.5)</td>
<td>-1 (-1.63 – -0.5)</td>
<td>0.828*</td>
<td>0.400</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>-2 – -0.5</td>
<td>-2 – -0.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axis</td>
<td>Median (IQR)</td>
<td>75 (20 – 155)</td>
<td>92.5 (52.5 – 102.5)</td>
<td>0.842*</td>
<td>0.400</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>10 – 175</td>
<td>10 – 180</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCT</td>
<td>Mean ± SD</td>
<td>570.87 ± 25.31</td>
<td>567.37 ± 30.89</td>
<td>0.480*</td>
<td>0.633</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>512 – 631</td>
<td>530 – 649</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye</td>
<td>OD</td>
<td>16 (53.3%)</td>
<td>15 (50.0%)</td>
<td>0.067*</td>
<td>0.796</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>OS</td>
<td>14 (46.7%)</td>
<td>15 (50.0%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IOP</td>
<td>Mean ± SD</td>
<td>12.20 ± 1.40</td>
<td>12.77 ± 1.59</td>
<td>1.465*</td>
<td>0.148</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>10 – 16</td>
<td>10 – 16</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There was no statistically significant correlation found between CCT and degree of hyperopia in group I and also in group II with p-value > 0.05 (Table 3).

Table (3): Correlation of CCT with the other studied parameters among patients of group I and group II

<table>
<thead>
<tr>
<th>Parameters</th>
<th>CCT</th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>P-value</td>
<td>r</td>
</tr>
<tr>
<td>Refraction</td>
<td>0.165</td>
<td>0.382</td>
<td>0.067</td>
</tr>
<tr>
<td>Cylinder</td>
<td>-0.308</td>
<td>0.153</td>
<td>-0.129</td>
</tr>
<tr>
<td>Axis</td>
<td>0.122</td>
<td>0.580</td>
<td>0.024</td>
</tr>
</tbody>
</table>

DISCUSSION

For a healthy cornea, the Central Corneal Thickness (CCT) varies between 0.49 mm to 0.57 mm. CCT has a very important role in glaucoma. CCT results in under estimation of the true Intraocular Pressure (IOP) and thicker CCT results in over estimation of IOP (Kalikivayi et al., 2018). In addition, CCT is important in assessing eligibility in refractive surgery candidates where it is used to exclude those in danger of postoperative ectasia (Hashmani et al., 2017). Thus, accurate measurement of CCT is an essential procedure for patients undergoing LASIK, glaucoma treatment along with diagnosing corneal ectasia conditions, it is essential to know the normative data of the population.
to further plan the clinical treatment for a given patient. Documented differences between various refractive groups may contribute to the ongoing research in the field of glaucoma and LASIK (Kalikivayi et al., 2018).

Given that, this study was designed to evaluate the correlations between central corneal thickness and degree of hyperopia in adult populations.

This study enrolled a total of 60 eyes divided equally into two groups of patients according to their age. Group 1 included 30 eyes of patients with age range from 20-37 and mean ± SD of 27.37 ± 5.80. Group 2 consisted of 30 patients aged 42-56 with mean ± SD of 47.97 ± 4.04. Each group contained 15 males and 15 females.

The results of the current study showed that the range of CCT in group 1 was 512-631 with mean ± SD of 570.87 ± 25.31. In group 2 the CCT ranged from 530 to 694 with mean ± SD of 567.37 ± 30.89. In addition, there was no significant correlation between CCT and age in either group.

Valdez-García et al. (2017) described the distribution of the CCT measurements on a healthy Hispanic sample population and its correlation with age. There was no correlation registered between CCT and the age when analyzed with the Anderson–Darling Shapiro–Wilk, and Kolmogorov–Smirnov . A positive correlation between CCT and age was observed in the group <20 years.

The present study delineated that the mean ± SD of refraction of both groups was 3.91 ± 1.20 and 3.17 ± 1.01 respectively. The median of cylinder in both group was (-1.5,-1 respectively) and the median of axis was (75, 92.5) respectively. Significant association between CCT and refraction could not be noticed in any group besides the non-significant association between CCT with either cylinder or axis in both groups.

Similarly, Prasad et al. (2011) studied the CCT in a large population of normal eyes undergoing refractive surgery to assess the relationship of 2 variables, age and refraction, with CCT. They found that CCT did not correlate with either age or refraction.

By the same way, Kalikivayi et al. (2018) compared the central corneal thickness between myopes, hyperopes and emmetropes of different age groups. They reported that there were no statistically significant differences between the CCT’s of myopic, hyperopic and emmetropic eyes for different age groups and no significant correlations between CCT and the amount of spherical equivalent in hyperopes and myopes.

Koucheki et al. (2010) evaluated the correlation of CCT with refractive error in a group of patients eligible for laser keratorefractive surgery. They noticed that refractive indices (Sphere, cylinder and axis) did not show any significant correlation with CCT in the whole group or different subgroups.

Chen et al. (2009) examined the relationship between CCT, refractive error, corneal curvature, anterior chamber depth and axial length in normal Taiwanese Chinese adults. Their results confirmed that CCT was not associated with refractive error, corneal curvature, anterior chamber depth and axial length.
Thus CCT is an independent factor unrelated to other ocular parameters.

Iyamu et al. (2013) studied the relationship between CCT and axial length (AL) in adult Nigerians. The average CCT and AL were 547.0 ± 29.5 μm and 23.5 ± 0.70 mm, respectively and the association between CCT and AL was not significant.

In a cross sectional observational study of Abbas et al. (2018), showed that no significant relation was found between refractive errors and CCT.

The difference in results among studies could be related to different sample sizes, different devices used to measure CCT, or human error in obtaining accurate results.

Regarding IOP in the present study, it was nearly the same in both age groups. Also, there was no significant correlation between CCT and IOP in both groups.

Similarly, the study of Iyamu and Osuobeni (2012) showed no correlation between CCT and IOP. In addition, CCT was not significantly influenced by corneal curvature and corneal diameter. The study of İnceoğlu et al. (2018) confirmed that corneal-compensated IOP (IOPcc) was independent from CCT.

However, Vijaya et al. (2010) reported a positive association between CCT and intraocular pressure among Indian population. Also Kamath et al. (2017) found that IOP was higher in normal subjects who had thicker corneas as measured by Goldmann Applanation tonometry. Cairns et al. (2019) reported a positive correlation between CCT and IOP in a cohort of keratoconic patients.

The study of Avitabile et al. (2010) stated that IOP values were correlated with CCT but the discrepancy between RT and GAT values was not related to CCT and was related to the refractive error.

The different heterogeneous reports of Chua et al. (2014); Farvardin et al. (2017) that CCT among hyperopic patients did not show any significant correlation with age, indices of refraction and IOP.

In the same point of view, Gros-Otero et al., (2011) found that the mean central corneal thickness was 548.21 μm with no statistical association was found between central corneal thickness values and variables of age, refractive error, axial length and gender.

Ismaili et al. (2019) found no correlation with age. However, they reported a negative correlation between the CCT and the IOP.

Sng et al. (2016) revealed a significant association between increased CCT and younger age, male sex, and higher IOP but not glaucoma.

The results of Hawng et al. (2012) also showed that in univariate analysis, a thicker CCT was associated with a higher IOP, a longer axial length (AL), and a younger age but in multivariate analysis there was no significant correlation between CCT and AL.

Linke et al. (2011) evaluated the relationship between the thinnest point in corneal thickness and the refractive state, keratometry, age, sex, and the ocular size among refractive surgery candidates including hyperopic, myopic eyes and high astigmatism. They found that refractive state, mean keratometry, and
age had a statistically significant on the thinnest point in corneal thickness. Sex and the ocular size had no effect.

Lanza et al. (2015) compared corneal pachymetry values measured by three different optical devices: Orbscan II, Pentacam HR and Sirius in healthy eyes. They delineated that the measurement of CCT by Sirius and Pentacam HR provides similar results. By contrast, the results obtained by Orbscan II are different from those obtained from both Sirius and Pentacam HR.

It is mandatory to report the limitation of the current study which included small sample size. The study indeed did not include all age groups and did not assess the difference in CCT according to gender.

CONCLUSION

Among adult subject with age range 20-60, central corneal thickness did not correlate with age change. Degree of hyperopia did not affect central corneal thickness of adult subjects. Central corneal thickness did not correlate with degree of intraocular pressure in hyperopic adults with normal IOP.

REFERENCES


الإرتباط بين سمك القرنية المركزى ودرجة طول النظر

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قسم طب وراحنة العين، كلية الطب، جامعة الأزهر، القاهرة

خلفية البحث: تتشكل القرنية الشفافة الجزء الأساسي من الغلاف الخارجي للعين ولديها وظائف مزدوجة لحماية المحتويات الداخلية للعين وكذا توفر حوالي ثلثي قوة انكسار العين.

الهدف من البحث هو تقييم الإرتباط بين سمك القرنية المركزى ودرجة طول النظر في البالغين.

المريضى وطرق البحث: كانت هذه دراسة استطلاعية مستعرضة قائمة على الملاحظة أجريت في قسم طب وراحنة العين في مستشفيات جامعة الأزهر. وقد تم تقسيم المرضى بالتساوي إلى مجموعتين وفقا لأعمارهم: المجموعة الأولى شملت المرضى الذين تتراوح أعمارهم بين 20-37 عاماً، والمجموعة الثانية من المرضى الذين تتراوح أعمارهم بين 42-56 عاماً. وتضمن كل مجموعة 15 ذكر و 15 إناث. قد تم الحصول على موافقة لجنة الأخلاقية بجامعة الأزهر من أجل الدراسة. تم شرح طبيعة ومنهجية المشاركة في الدراسة للمريض وتم الحصول على موافقة مستنيرة.

نتائج البحث: أظهرت نتائج الدراسة الحالية أن نطاق سمك القرنية المركزى في المجموعة الأولى كان 512-631.5، والمجموعة الثانية كان سمك القرنية المركزى يتراوح من 530 إلى 694. بالإضافة إلى ذلك، لم يكن هناك ارتباط كبيراً بين سمك القرنية المركزى والعمر في أي من المجموعتين. وأوضحت الدراسة الحالية أن متوسط الانكسار مرن كلا المجموعتين كان 3.91 ± 1.20 و 3.17 ± 1.01 على التوالي. وكان متوسط اللابوية في كلا المجموعتين -1.5 و -1 على التوالي، وكان متوسط المحور 75 و 92.5 على التوالي. ولم يكن هناك ارتباط كبيراً بين سمك القرنية المركزى والعيب الأكسارى في كلتا المجموعتين إلى جانب الأرتباط غير الهام بين سمك القرنية المركزى مع إما اللابوية أو المحور فيها.
The conclusion: There is no correlation between central corneal thickness and the age of patients between 20 and 60 years. The corneal thickness remains constant regardless of age. There is no effect of long-term exposure to environmental factors on central corneal thickness. Patients with myopic pressure have higher central corneal thickness than normal patients.