Kaohsiung Journal of Medical Sciences (2014) 30, 20–24

Available online at www.sciencedirect.com

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journal homepage: http://www.kjms-online.com

ORIGINAL ARTICLE

Correlation between central corneal thickness and myopia in Taiwan

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Received 26 March 2013; accepted 3 June 2013
Available online 24 September 2013

KEYWORDS
Cornea;
Glaucoma;
Myopia;
Taiwan

Abstract The aim of the study was to explore the correlation between central corneal thickness (CCT) and the degree of myopia in Taiwanese adults. A total of 528 individuals were enrolled to undergo myopic laser refractive surgery from January 2004 to December 2006. Preoperative CCT was measured using the Orbscan corneal topography system and refractive status was determined by cycloplegic spherical equivalent. The relationship between CCT and refractive error was investigated by interindividual and intraindividual analyses. Participants had a mean age of 34.8 ± 7.3 years, and 79.9% were female. The mean refractive error was −7.27 ± 2.96 diopters and the mean CCT measurement was 560 ± 35 μm. CCT revealed that there was no association with age. However, CCT was significantly ($p = 0.012$) less in females than in males. The CCT also showed no significant association with refractive error ($p = 0.49$). Among the 67 participants with myopic anisometropia, the mean difference between both eyes was 3.09 ± 1.06 diopters. There was no association between the intereye CCT difference and refractive error ($p = 0.57$). The results remained the same after adjusting for age and sex. In conclusion, there was no correlation between CCT and the degree of myopia among adults in Taiwan. These data might contribute to the ongoing discussion about the role of CCT in the higher incidence of development and progression of glaucoma in myopic individuals.

Conflicts of interest: The authors have no conflicts of interest relevant to this article.

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1607-551X/$36
http://dx.doi.org/10.1016/j.kjms.2013.08.008

Introduction

Myopic individuals may have a higher incidence of primary open angle glaucoma (POAG) [1,2]. Also, severe myopia may be associated with the progression of visual field loss in POAG [3,4]. A thin central corneal thickness (CCT) was found to be a significant risk factor for progression of ocular hypertension to POAG in the Ocular Hypertension Treatment Study [5]. In addition, a thin CCT might be a risk factor for the progression of POAG [6,7]. Both myopia and thin CCT are risk factors for POAG. Thus, if myopia is correlated with CCT, CCT might be connected with the higher incidence of development and progression of glaucoma in myopic individuals.

The relationship between the degree of myopia and CCT was inconclusive in the previous studies, as some reported that CCT was less in myopic eyes [8–10]. If myopic eyes are associated with thinner corneas, this may partly explain why myopic eyes have a higher risk of POAG. Both cornea and lamina cribrosa belong to the ocular coat. The lamina cribrosa is significantly thinner in highly myopic eyes according to histomorphometric studies [11,12], which means that, in a myopic eye, the ocular coat is thinning anteriorly and posteriorly. The lamina cribrosa thickness may be implicated in the pathogenesis of glaucomatous optic neuropathy. As the lamina cribrosa has been found thinner in eyes with glaucoma, thinner lamina cribrosa has been significantly associated with further visual field loss [13,14]. Consequently, in myopic eyes, thin CCTs associated with thin lamina cribrosas may be one possible cause for the higher susceptibility to glaucoma.

However, other studies have shown contradictory results. Some have not found any association between myopia and CCT [15–18]. There has been an increase in both the prevalence and severity of myopia in Taiwan [19]. The two previous studies from Taiwan showed conflicting results for the relationship between myopia and CCT [8,20], and studies investigating the relationship between myopia and CCT by intraindividual comparison are scarce. Therefore, the aim of the present study is to determine whether CCT can be correlated with the degree of myopia in Taiwan by both interindividual and intraindividual analyses.

Methods

This retrospective cross-sectional study was approved by the Institutional Review Board of Cathay General Hospital, Taipei, Taiwan, and was carried out in accordance with the tenets of the Declaration of Helsinki. A total of 528 consecutive patients of Chinese ethnicity, who underwent laser refractive surgery for myopia at the Department of Ophthalmology, Cathay General Hospital, from January 2004 to December 2006, were recruited in this study.

Data regarding age, sex, cycloplegic refraction, CCT, and past medical history were collected from preoperative examinations. Exclusion criteria were history of glaucoma, corneal disease, history of ocular trauma or surgery, and the use of medication or presence of any disease that could possibly affect corneal thickness. Thirty minutes after instillation of three drops of tropicamide 1%, cycloplegic refraction was obtained by an autorefractometer (Topcon KR-7100, Tokyo, Japan). The mean of three successful measurements was taken for analysis. Astigmatism was analyzed in minus cylinders. The cycloplegic spherical equivalent (spherical component + 1/2 cylinder component) was used to calculate the refractive error.

Central corneal thickness was obtained by Orbscan corneal topography system version 3.00 (Orbtek, Inc, Salt Lake City, UT, USA), with an acoustic factor set at 0.92. The Orbscan system is an automatic, noncontact, optical slit-scanning device that provides topographic analysis and pachymetric measurements of the entire cornea [21]. Central corneal thickness was measured by averaging corneal thickness within a 2 mm diameter circle in the center of the cornea. It is more consistently replicable for measuring corneal thickness than ultrasound pachymetry, although Orbscan shows significant bias toward greater corneal thickness measurement [22].

Overall means and standard deviations were computed for all continuous variables. For both univariate and multivariate analyses, continuous variables measured on each eye were compared using a generalized linear model. Between-sex differences were analyzed using the Student *t* test. For intraindividual analyses, a two-tailed paired *t* test was used to determine the difference between the two eyes. A p value of <0.05 was considered statistically significant. All analyses were conducted using the R-statistical package (R Foundation for Statistical Computing, Vienna, Austria; version 2.15.1 for Macintosh).

Results

Interindividual analysis

A total of 528 individuals with a mean age 34.8 ± 7.3 years (range, 21–64 years) were recruited. 422 (79.9%) of the participants were female. Only the right eyes were studied. The mean refractive error was −7.27 ± 2.96 diopters (range, −0.125 diopters to −17.375 diopters) and the mean CCT measurement was 560 ± 35 μm (range, 454–658 μm), as shown in Table 1. Figs. 1 and 2 show the distribution of refractive error and CCT, respectively. There was no correlation between refractive error and sex ($p = 0.71$, generalized linear model), although younger individuals showed a higher degree of myopia ($p = 0.043$, generalized linear model) consistent with the trend for myopia in Taiwan reported by Lin et al. [19]. The mean CCT showed no association with age ($p = 0.69$, generalized linear model), while the mean CCT was significantly less ($p = 0.012$, Student *t* test) in females (558 ± 35 μm) than in males (567 ± 33 μm). The scatter plots in Fig. 3 reveal the correlation between refractive error and CCT. There was no significant correlation between the degree of myopia and CCT ($p = 0.49$, generalized linear model). The result remained the same after adjusting for age and sex.

Intraindividual analysis

Sixty-seven (12.7%) participants had myopic anisometropia, defined as a difference in myopia of at least 2 diopters between the two eyes. The mean myopic anisometropia was 3.09 ± 1.06 diopters ($p < 0.001$; 95% confidence