Artikel Asli/*Original Articles*

Effect of Time of Measurement on Central Corneal Thickness in a Sample of Young Myopes
(Kesan Masa Pengukuran ke Atas Ketebalan Kornea dalam Satu Sampel Miop Muda)

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ABSTRACT

The aim of this study was to determine the effect of time of measurement on central corneal thickness in young myopes. Seventy healthy myopic subjects (non contact lens wearers) were involved in this study with mean age of 22.43 ± 1.76 years. Subjective refraction was determined using cross-cylinder technique, corneal curvature was measured using keratometer (Shin-Nippon) and central corneal thickness (CCT) was determined using specular microscope (Topcon SP-3000P). The CCT was measured in the morning (between 8 to 11 am) and in the afternoon (between 2 to 5 pm). The results showed that the mean of refraction for all subjects was -2.59 ± 1.85 DS and mean of cornea curvature was 7.74 ± 0.25 mm. Mean CCT in the morning was 517 ± 37 μm and 516 ± 36 μm in the afternon. Statistical analysis showed no significant difference between both measurements (T = 1.713 and P = 0.091). Correlation analysis showed insignificant correlation between CCT and refractive error (r = -0.078, p > 0.05) and CCT with corneal curvature in the horizontal meridian (r = 0.014, p > 0.05) and at vertical meridian (r = 0.029, p > 0.05). This study concluded that there is no significant effect of time of measurement on CCT in young myopes.

Keywords: Corneal thickness; myopia; corneal curvature; young adults; contact lens

ABSTRAK

Kajian ini dijalankan bertujuan untuk mengkaji kesan masa pengukuran ke atas ketebalan kornea sentral (CCT) dalam kalangan populasi miop muda. Seramai 70 orang subjek (bukan pemakai kanta sentuh) terlibat dalam kajian ini dengan purata umur 22.43 ± 1.76 tahun. Pengukuran yang dilakukan meliputi refraksi subjektif menggunakan teknik silinder silang, kelengkungan kornea menggunakan keratometer (Shin-Nippon) dan pengukuran CCT menggunakan spekular mikroskop tidak sentuh (Topcon SP-3000P). Pengukuran CCT dilakukan pada waktu pagi (antara 8 sehingga 11 pagi) dan petang (antara 2 sehingga 5 petang). Keputusan kajian menunjukkan purata nilai kesalahan refraksi adalah -2.59 ± 1.85DS, purata nilai kelengkungan kornea adalah 7.74 ± 0.25 mm dan nilai purata CCT adalah 517 ± 37 μm pada waktu pagi dan 516 ± 36 μm pada waktu petang. Hasil analisis kajian ini menunjukkan tiada perbezaan signifikan yang berlaku kepada CCT pada waktu pagi dan petang (T = 1.713 , P = 0.091). Ujian kolerasi menunjukkan hubungan yang lemah antara CCT dengan ralat refraksi (r = -0.078, p > 0.05) dan CCT dengan kelengkungan kornea pada meridian melintang (r = 0.014, p > 0.05) dan meridian menegak (r = 0.029, p > 0.05). Kajian ini menyimpulkan bahawa tiada kesan masa pengukuran keatas ketebalan kornea dikalangan populasi miop muda.

Kata kunci: Ketebalan kornea; miopia; kelengkungan kornea; dewasa muda; kanta sentuh

INTRODUCTION

Corneal thickness measurements are indicative of corneal metabolic status, as they provide an index of the corneal hydration status. Such measurement provide important information to clinicians on the physiological status of the cornea and its association to diseases, trauma or contact lens wear (Ehlers et al. 1975). A healthy human cornea experiences hypoxia daily during sleep. The cornea can tolerate a reduction of the partial oxygen pressure at the epithelial surface from 155 mmHg to 55 mmHg when the eyelids are closed for some length of time (Fatt et al. 1974). During sleep, corneal metabolisme is altered which causes

accummulation of lactate in the stroma and followed by an osmotic influx of water. The changes is expressed by mild oedema, 4% thickening and sensitivity reduction (Millodot 1972). Other factors contribute minimally to these responses such as hypotonicity of tears, lowered tears pH and raised corneal temperature (Brennan & Coles 2017). The cornea is reputed to return to its normal thickness approximately 2-3 hours after awakening (Harper et al. 1996). Du Toit et al. (2009) found that corneal thickness increases during night sleep for 6 to 8 hours and decreases after getting up and going back to the original thickness within 2 hours.

Myopia is a common cause for visual impairment among young population in Asia. Estimates of the proportion of myopia in the young population in Asia ranged from 30% to 65% (Wong et al. 2016). With the increasing rates of myopia, myopia control technique such as Orthokeratology and refractive surgery such as LASIK, have become quite popular in Asia. Measurements of corneal thickness is crucial in these treatments as it provides information about the corneal stability and shape and its contribution to ocular power and aberrations of the eye. Most reports indicate that central corneal thickness range is from 490-560 μm in the normal population with many factors affecting the values such as race, gender, age, refractive status, corneal curvature and intra ocular pressure (Alsbirk 1978). Mohd-Ali et al. (2009) have demonstrated lower central corneal thickness (CCT) values in high myopic subjects (> -4.00D) than lower ones in a sample of young myopes in Kuala Lumpur.

Knowledge of naturally occuring diurnal variation in parameters of the cornea is relevent to any clinical or research applications that require precise measurement of the cornea. Differences in time of measurement of corneal thickness in the clinic may provide significant difference in values which later may interfere with the management or intervention prescribed. The aim of this study was to determine the effect of time of measurement on CCT amongst young myopic subjects in Kuala Lumpur. Earlier studies (Micahel et al. 2009; Read & Collins 2009) have shown significant diurnal variation in CCT measurements, with the largest change upon awakening. This study plans to investigate the differences in CCT measurements when taken in the morning and afternoon in the Optometry clinic. The outcome of this study will provide better understanding about changes in corneal thickness with time in the local population.

EXPERIMENTAL METHODS

Subjects in this study consisted of 70 young myopic population in Kuala Lumpur (55 females, 15 males). The inclusion criteria include VA of 6/9 (Snellen) or better with correction, non-contact lens wearer and free from ocular and systemic disease. The protocol of the study was approved by Ethical Committee, Hospital Universiti Kebangsaan Malaysia and informed consent was obtained from all subjects.

All measurements were conducted on both eyes at the Optometry Clinic, Faculty of Health Sciences, Universiti Kebangsaan Malaysia. Measurement of refractive status was conducted using subjective refraction with cross cylinder and visual acuity (VA) was taken using Snellen chart at 6 m. Measurement of corneal curvature was taken using keratometer (Shin-Nipon, Japan). Central corneal thickness (CCT) was measured using non-contact specular microscope (Topcon SP-3000P). Measurements were taken in the morning (9-11 a.m) and evening (2-5

p.m). Three readings were taken each time and the mean was calculated.

The data were analyzed using paired Student's t-test to evaluate the difference in CCT between morning and evening. Pearson Correlation was used to determine the relationship between CCT with corneal curvature and refractive error. Statistical significance was assumed at $p < 0.05$ level.

RESULTS

A total of 70 subjects were involved in this study, but only the results of the right eye were analysed and reported. The mean age of all the subjects were 22.43 ± 1.76 years. The subjects consisted of 15 males and 55 females young myopic subjects. The racial distribution was 57 Malays, 9 Chinese, 1 Indian and 3 others. The subjects' demographic data are shown in Table 1.

Mean refractive error was -2.59 ± 1.85 DS and mean keratometer reading was 7.74 ± 0.25 mm. Mean CCT in the morning was 517 ± 37 μm and 516 ± 36 in the afternoon. Statistical analysis showed no significant change betwen both readings (T = 1.713, P = 0.091). Poor correlation was noted between CCT with refractive error and between CCT with keratometer reading. The mean value data are shown in Table 2.

TABLE 1. Demographic feature of subjects

	Malays (n = 57)	Chinese (n = 9)	Indian (n = 1)	Others (n = 3)
Male (n = 15)	11(73.3%)	3 (20%)	0 (0%)	1 (6.7%)
Female (n = 55)	46 (83.6%)	6 (11%)	1 (1.8%)	2 (3.6%)
Age/Year	22.49 ± 0.23	23.22 ± 0.22	22.00	19.00
Refractive error /DS	-2.34 ± 1.72	-4.19 ± 1.97	-2.75	-2.42 ± 2.50
Cornea curvature /mm	7.82 ± 0.25	7.86 ± 0.20	7.93	7.91 ± 0.18

TABLE 2. Mean value of data in this study

	N	Min	Max	Mean	SD
Age/Year	70	19	26	22.43	1.76
Spherical equivalent/DS	70	-6.50	-0.50	-2.59	1.85
Horizontal corneal curvature/mm	70	7.25	8.58	7.83	0.24
Vertical corneal curvature/mm	70	7.09	8.38	7.64	0.26
CCT in the morning/μm	70	443	598	517	37
CCT in the evening/μm	70	443	592	516	36

DISCUSSION

This study determines the impact of time of measurement on CCT in young myopic subjects. The results showed insignificant effect of the time of measurement on CCT of the subjects, which indicates insignificant change of CCT

during day time that may not influence the measurement. Read and Collins (2009) reported small but significant diurnal variation occurs in the regional thickness and the shape of the anterior and posterior cornea and the largest changes in the cornea were evident upon waking. Harper et al. (1996) measured changes in CCT over 48 hour period and showed an increase in corneal thickness during sleep and decreased after waking. However, no significant change was noted during day time. In a more recent study, Sharifipour et al (2016) investigated diurnal variations in intraocular pressure (IOP), central corneal thickness (CCT) and macular (CMT) and retinal nerve fiber layer (RNFL) thickness in diabetic and normal individuals. The results for the normal subjects showed highest values at 9 a.m and slight decreased during the day. The authors concluded that the changes found between 9 a.m and 6 p.m were not significant and probably do not affect the interpretation of measurements.

Statistical analysis in this study revealed poor correlation between CCT and corneal curvature with the level of myopia. The results support the findings described earlier by Cho and Lam (1999) who examined 151 subjects of age 10 to 60 years using ultrasound pachymetry and found that CCT significantly correlated with intra ocular pressure but not with refractive error or corneal curvature. Shimmyo et al. (2003) examined more than 1000 subjects to determine differrences in CCT, corneal curvature and intra ocular pressure in 4 different races. The authors found significant correlation between CCT and corneal curvature with thinner cornea being steeper and thicker cornea being flatter.

In summary, the results of this study showed insignificant change of CCT during day time (9 a.m to 5 p.m). Nevertheless future study with larger number of subjects and wider range of refractive error is needed to confirm these findings.

CONCLUSION

This study concludes that time of measurement during day time has insignificant impact of CCT values. Measurements of CCT can be conducted in the morning or afternoon for the purpose of diagnosis and management of patients.

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