ORIGINAL ARTICLE

Eur. J. Anat. 17 (3): 155-158 (2013)

Corneal endothelial cell density and morphology are not correlated with corneal curvature, corneal thickness and gender

Samaneh Delshad

National Institutes of Ophthalmic Sciences, School of Optometry, Petaling Jaya, Selangor, Malaysia

SUMMARY

The aim of this study was to compare the corneal endothelial cell density and morphology between different genders and to investigate the correlation between corneal curvature and corneal thickness with corneal endothelial characteristics in young Chinese adults. The studied parameters included mean endothelial cell density (MCD), coefficient of variation (CV) in the cell size, as well as hexagonal appearance of the cell. Non-contact Specular microscopy (Konan NSP-9900) was performed in 154 subjects (77 male and 77 female), aged 18 to 24. Corneal thickness (CT) and mean of corneal endothelial cell parameters were obtained. Corneal curvature was measured using keratometer (Bausch & Lomb, USA). In males, mean CV was 31.20 ± 3.13%, MCD was 3217 ± 108.04 cells/mm^2 and mean hexagonal appearance of cells was 51.27 ± 2.60%. In females, mean CV was 30.18 ± 2.98%, MCD was 3063 ± 131 cells/mm^2 and mean hexagonal appearance of cells was 53.06 ± 2.97%. Comparing corneal endothelial parameters using Student's t test, there was no significant difference in MCD (p=0.560), CV (p=0.428) and hexagonal appearance of the cell (p=0.169), between genders. Study of the correlation, using Pearson's correlation, showed no significant correlations between corneal endothelial characteristics and corneal curvature and corneal thickness. To conclude, there is no difference in corneal endothelial cell parameters between genders. Moreover, endothelial cell parameters are correlated neither with corneal curvature nor corneal thickness.

Key words: Cornea – Specular microscopy – Endothelial cell density – Morphology

INTRODUCTION

The human corneal endothelial cell is a non-regenerating, predominantly hexagonal cell which covers the posterior surface of the Descemet membrane, and faces the anterior chamber of the eye. The corneal endothelium is metabolically active and plays an imperative role in maintaining the corneal transparency by pumping water from stroma to the aqueous humor, and keeping the stroma in the dehydrated level of 70% of water (Rapuano et al., 2001; Hashemian et al., 2006).

Corneal endothelial cell density and morphology can be analyzed using a specular microscope. The specular microscope has been shown to be reliable and reproducible with appropriate calibration of the instrument (Benetz et al., 1999; Modis et al., 2002; Van Schaick et al., 2005). Non-contact specular microscopes provide a non-invasive method of morphological analysis of the corneal endothelial cell layer. It makes the meas-

Corresponding author: Samaneh Delshad. National Institute of Ophthalmic Sciences, School of Optometry, Lot 2, Lorong Utara B, 46200 Petaling Jaya, Darul Ehsan, Selangor; Malaysia. E-mail: samaneh0008@yahoo.com

Submitted: 20 December, 2012. *Accepted:* 27 March, 2013.

urement of mean cell density (MCD), measurement of variation (CV) in the cell size, as well as hexagonal appearance of the cell. These parameters provide an index of the functional status of the corneal endothelial layer (Hashemian et al., 2006).

The possible influence of the corneal tomographic parameters on the measurement of corneal endothelial cell density has been investigated earlier. In a study involving elderly eyes (age range 48-91 years), significant correlations were noticed between mean endothelial cell density (MCD), corneal thickness and corneal curvature. Consequently, lower MCD value would be expected in thinner and/or steeper corneas. However, there was no difference in MCD between genders (Muller et al., 2004). In another study involving young adults (age range 21-30 years), a significant correlation was noticed between corneal thickness and MCD; nevertheless, no correlation between MCD, gender and corneal curvature was observed (Patel et al., 2009).

Despite the fact that few studies have considered gender, corneal thickness and corneal curvature as factors that may affect the corneal endothelial parameters, little is known about their effects on corneal endothelium cell layer. Besides, in a subset of corneal transplantation studies, the initial assessment of corneal endothelial cell density and morphology can help the practitioners to anticipate the late graft failure after few postoperative years, as it may be originated from low initial endothelial cell density (Nishimura et al., 2010). Therefore, the initial assessment of corneal endothelial cell layer seems significant.

Table 1. Corneal endothelial cell density of the subjects analyzed (cells/mm²)

	Total	Female	Male
Mean	3286	3063	3217
SD	111	131	108
Maximum	3405	3225	3405
Minimum	2863	2863	2951

Table 2. Coefficient of variation in cell size in the subjects analyzed (%)

	Total	Female	Male
Mean	31.27	30.18	31.20
SD	3.02	2.98	3.13
Maximum	35.73	34.11	35.73
Minimum	26.67	26.67	27.98

Comparing corneal endothelial cell parameters among different genders using independent Student's t test, there was no significant difference in MCD (p=0.560), mean CV (p=0.428) and mean of hexagonal appearance of the cell (p=0.169) between female and male.

This study aims to compare the corneal endothelial cell characteristics between genders and investigate the correlation of corneal curvature and corneal thickness with endothelial cell characteristics.

MATERIALS AND METHODS

A prospective study was carried out and a total of 154 eyes (only right eye) from 154 subjects aged 18 to 24 years old. None of them had previous contact lens, or ocular or/and systemic disease, or/and surgery history. Informed consent was obtained from all subjects followed by a comprehensive ocular examination. Thorough ocular examinations were carried out to exclude cases with best corrected visual acuity of worse than 20/20 in each eye and any ocular pathology.

A non-contact specular microscope (Konan NSP-9900) was used by a single examiner to assess the central corneal thickness and corneal endothelial cell parameters. The procedure for endothelial cells analysis was as follows: three images from the central cornea were captured of at least 80 contiguous cells, and were manually marked with a mouse by the examiner for analysis by a built-in software program.

The computer automatically evaluated, calculated and displayed the mean cell density (MCD) (cell/mm²), coefficient of variation (CV) in cell size and percentage of hexagonal cells. In addition, corneal curvature was measured using keratometer (Bausch & Lomb, USA), and three times measurements were taken. The mean of each

Table 3. Hexagonal appearance of the cell in the subjects analyzed (%)

	Total	Female	Male
Mean	52.88	53.06	51.27
SD	3.42	2.97	2.60
Maximum	56.51	56.51	54.13
Minimum	48.18	49.57	48.18

Study of relation between factors, using Pearson's correlation, showed that there are no significant correlations between corneal endothelial cell parameters and corneal curvature and corneal thickness. Table 4 summarizes the study of correlation between factors.

Table 4. Study of correlation between factors

	CT	Corneal curvature
MCD	p = 0.077; *r*= 0.13	p=0.036; *r*=0.24
CV	p = 0.056; *r*= 0.43	p=0.067; *r*=0.24
Hexagonal cells	p = 0.083; *r*= 0.11	p=0.028; *r*=0.17

variable was used for further analysis.

Data were analyzed using SPSS statistical program (version 20). Mean differences, standard deviation and correlation between observations were assessed. Normality of data was checked using Shapiro-Wilk test. Mean of different variables between genders tested using independent Student's *t* test. A probability of 0.05 was considered statistically significant.

RESULTS

Characteristics of corneal endothelial cells were studied in 154 eyes (77 male and 77 female) of young Chinese adults with mean age 21.7±1.87 years old. Males had the mean age of 20.22±1.22 years old, mean corneal curvature of 7.52±0.21 mm and mean corneal thickness of 521.7±29.3 µm. In females, the mean age, mean corneal curvature and mean corneal thickness were 20.13±1.52 years old, 7.82±0.19 mm and 528.1±26.1 µm, respectively. Table 1, 2 and 3, present the specular microscopy findings of corneal endothelial cell density and morphology in total, female and male subjects.

DISCUSSION

The function of corneal endothelium in modifiability of stromal hydration level and preserving the corneal transparency is well understood. This function is executed by active metabolic pumps in the corneal endothelium, which persistently removes the fluid out of the corneal stroma (Sheng et al., 2002).

Assessment of corneal endothelial cell density and morphology provides important information on corneal endothelial function and viability, and become an acceptance factor in practice and research to provide valuable information on the layer (Hashemian et al., 2006; Sheng et al., 2002).

Corneal endothelial morphology can be measured with various instruments such as contact specular microscope, non-contact specular microscope and confocal biomicroscope. Non-contact specular microscopy found to be more patient friendly and less hazardous regarding corneal epithelial damage and infection transmission (Sheng et al., 2002; Hashemian et al., 2006). As a result, it has been widely used in studies of corneal endothelial cell density and morphology (Sheng et al., 2002; Urban et al., 2002).

Few studies have been discussed on the relationship of corneal curvature, corneal thickness and gender with corneal endothelial cell density and morphology. Decision regarding corneal endothelial cell characteristics differ based on gender, should be based on normative data derived from the underlying population. This study provides data on endothelial cell characteristics in a selected sample of Chinese eyes in Malaysian population.

There have been some studies considering corneal thickness and corneal curvature as two factors which may affect the corneal endothelial cell parameters. In the current study, the results showed no significant correlation between corneal curvature and corneal thickness with endothelial cell characteristics. As it was supported earlier by Change et al. (2001) and urban et al. (2002) on the studies of correlation of these factors, they have not found any statistical correlation between corneal curvature and corneal thickness with corneal endothelial cell characteristics.

Besides, there were contradictory results about the relationship between gender and endothelial cell characteristics. Many studies have not found any statistical differences between them (Laing et al., 1976; Hirst et al., 1980; Matsuda et al., 1985; Landesz et al., 1995; Hashemian et al., 2006, Akiko et al., 2009), few have been stated differently. Padilla et al. (2004) have found that females have greater MCD than males, and Narumon et al. (2008) have concluded that females have higher CV than males. Nevertheless, none of them have stated that the quality of corneal endothelium was different between genders. The results of this study have shown that there are no differences in corneal endothelial cell parameters between genders.

In sum, the existence disparity of correlation between gender and endothelial parameters in various populations can conclude that the establishment of normative data on the corneal endothelium in each ethnic group is important. Data gathered may help in the assessment of endothelial function of the individuals in that specific population.

DECLARATION

The author of this study declares that has no commercial association with or financial assistance from any company whose products have been used and named in this study.

REFERENCES

Akiko H, Miho S, Kinnichi T, Yuka MK, Ryo A, Yoshihiro H (2009) Central corneal thickness in Japanese children. *Jpn J Ophthalmol,* 53: 7-11.

Benetz BA, Diaconu E, Bowlin SJ, Oak SS, Laing RA, Lass JH (1999) Comparison of corneal endothelial image analysis by Konan SP8000 noncontact and Bio-Optics Bambi systems. *Cornea*, 18: 67-72.

Chang SW, Tsai IL, Huc FR, Linc L, Shih YF (2001) The cornea in young myopic adults. *Br J Ophthalmol,* 85: 916-920.

Hashemian MN, Moghimi S, Fard MA (2006) Corneal endothelial cell density and morphology in normal Iranian eyes. *BMC Ophthalmol*, 6: 9.

Hirst LW, Ferris FL III, Stark WJ, Fleishman JA (1980) Clinical specular microscopy. *Invest Ophthalmol Vis Sci*, 19: 2-4.

Laing RA, Sandstrom MM, Berropsi AR (1976) Changes in corneal endothelium as a function of age . *Exp Eye Res*, 22: 587-594.

Landesz M, Siertsema JV, Van Rij G (1995) Comparative study of three semiautomated specular microscopes. *J Cataract Refract Surg*, 21: 409-416.

Matsuda M, Yee RW, Edelhauser HF (1985) Comparison of the corneal endothelium in an American and a Japanese population. *Arch Ophthalmol,* 103: 68-70.

Modis L, Langenbucher A, Seitz B (2002) Corneal endothelial cell density and pachymetry measured by contact and non-contact specular microscopy. *J Cataract Refract Surg*, 28: 1763-1769.

Müller A, Craig JP, Grupcheva CN, McGhee CN (2004) The effects of corneal parameters on the assessment of endothelial cell density in the elderly eye. *Br J Ophthalmol,* 88: 325-330.

Nishimura JK, Hodge DO, Bourne WM (1999) Initial endothelial cell density and chronic endothelial cell loss rate in corneal transplants with late endothelial failure. *Ophthalmology*, 106: 1962-1965.

Patel HY, Patel DV, McGhee CN (2009) Identifying relationships between tomography-derived corneal thickness, curvature, and diameter and in vivo confocal microscopic assessment of the endothelium in healthy corneas of young adults. *Eye,* 23: 270-278.

Rapuano CJ (2001) Excimer laser phototherapeutic keratectomy. *Curr Opin Ophthalmol,* 12: 288-293.

Sheng H, Bullimore MA (2007) Factors affecting corneal endothelial morphology. *Cornea*, 26: 520-525.

Urban B, Bakunowicz Lazarczyk A, Kretowska M (2002) Corneal endothelium in children and adolescents with myopia. *Klin Oczna*, 104: 381-383.

*Van Schaick W, Van Dooren BT, Mulder PG, Volker-Dieben HJ (*2005) *Validity of endothelial cell analysis methods and recommendations for calibration in Topcon SP-2000P specular microscopy. Cornea, 24:* 538 *-544.*