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Corneal Changes in Myopia in a Tertiary Centre in South India

Authors
Dr Gincy Thomas[1], Dr Padma B Prabhu[2], Dr Prasannakumary.C[3*], Dr Jyothy.P.T[4], Dr Charmaine B Solomon[5]
[1]Senior Resident, Dept. of Ophthalmology, Government Medical College, Kozhikode, Kerala
[2,3]Associate Professor, Dept. of Ophthalmology, Government Medical College, Kozhikode, Kerala
[3]Professor, Dept. of Ophthalmology, Government medical College, Kozhikode, Kerala
[4]Assistant professor, Dept. of Ophthalmology, Government Medical College, Kozhikode, Kerala
*Corresponding Author
Dr Prasannakumary.C
Associate Professor, Dept. of Ophthalmology, Government Medical College, Kozhikode, Kerala, India

Abstract
Aim: *To analyze central corneal thickness and corneal endothelial cell changes in young myopes.*
Methods: *Study conducted for a period of 12 months in 168 myopic eyes with age less than 30 years. Ocular examination including visual acuity, anterior segment examination, axial length and refraction was done. Corneal endothelial cells and central corneal thickness were assessed with specular microscope and axial length measured with A scan ultrasonography.*
Results: *Out of 168 eyes 125 had myopia less than 6 dioptre (D) sphere and 43 had myopia more than 6 D sphere. There is significant increase in axial length and decrease in mean cell density and central corneal thickness (p 0.00) in high myopes while the changes in hexagonality (p 0.99) and co-efficient of variation (p 0.25) were insignificant.*
Conclusion: *In high myopia as the eyeball elongates central corneal thickness and mean endothelial cell density decreased. These factors should be assessed before performing anterior segment surgeries.*
Keywords: *Myopia, Corneal endothelial cell density, Specular microscope, Corneal thickness, Axial length.*

Introduction

Corneal endothelium, the posterior layer of the cornea is a monolayer of polygonal cells of neural crest origin. At birth the endothelium consists of approximately 4000 to 5000 cells/mm2. The critical endothelial cell density, averages between 300 and 500 cells/mm2 to maintain pump function[1]. According to a study done by Rao et al [2] about corneal endothelial cell density decreases with age in normal Indian eyes. Speedwell observed a mean corneal endothelial cell density of 4252 cells/mm2 in infants[3]. The number of corneal endothelial cells in healthy eyes decreases at the rate of approximately 0.5% per year[4].

Corneal endothelial cell density and morphology can be analysed with specular microscopes which makes the measurement of mean cell density (MCD), coefficient of variation (CV) in the cell size and hexagonality of the cells. They provide an index of the functional status of corneal endothelial layer [5].

It has been suggested that in myopia as the eye elongate, the corneal endothelial surface area increases[6]. As corneal endothelial cells have little or no mitotic activity they have to flatten to floor the enlarged surface[7]. Then, reduced corneal endothelial density, increased polymorphism and decreased hexagonality is expected. Much studies are not available based on corneal endothelial cells and myopia. We aim to evaluate corneal endothelial cell density and morphology in young myopes.

Methods

A cross sectional study was conducted for a period of 12 months in ophthalmology department in 168 myopic eyes with age less than 30. The study was conducted after getting instituitional ethical committee approval. They were sub classified as those with myopia less than 6 dioptre sphere and more than 6 D sphere. Patients with previous history of ocular trauma, ocular surgery, corneal dystrophy, glaucoma, systemic diseases like diabetes mellitus and age more than 30 years were excluded. After taking informed consent ocular examination including visual acuity (Logmar), anterior segment examination and refraction was done. Corneal thickness and endothelial cell density and morphology were assessed with specular microscope and axial length measured with A scan ultrasonography. Data were analyzed using PASW 18 software. Mean of central corneal thickness (CCT), mean cell density (MCD), coefficient of variation (CV), hexagonality (HEX) between groups were tested by independent *t*-test. A probability of 0.05 was considered statistically significant.

Results

We evaluated 168 myopic eyes which were subclassified as those with myopia less than 6 Dsphere and more than 6 Dsphere Distribution of gender and amblyopia. Among the groups are given in table 1.

Table 1: Distribution of gender and amblyopia

	Myopia <6 D	Myopia >6 D	Total	P value
Gender Male	79(78.2%)	22(21.8%)	101	
Female	46(68.7%)	21(31.3%)	67	
Amblyopia	5(16.7%)	25(83.3%)	30	0.000

Out of 168 eyes 30 (17.85%) had amblyopia and 83.3% (N-25) amblyopic eyes had myopia >6 Dsph. Age, visual acuity (VA), best corrected visual acuity (BCVA) and spherical equivalent (SPH) wise distribution is given in table 2.

Table 2: Distribution of Age, visual acuity (VA), best corrected visual acuity (BCVA) and spherical equivalent (SPH)

	<6 D Myopia		>6D Myopia		
	MEAN	SD	MEAN	SD	P value
AGE	17.42	6.60	16.67	7.22	0.53
VA	0.53	0.27	1.06	0.16	0.00
BCVA	0.025	0.07	0.32	0.19	0.00
SPH	-2.27	1.52	-8.62	1.97	0.00

In myopes <6 Dsph mean age was 17.42 and mean spherical equivalent was -2.27. In myopes >6 Dsph mean age is 16.67 and mean spherical equivalent is -8.62. Relation between mean cell density (MCD), coefficient of variation (CV) and hexagonality (HEX) of corneal endothelial cells, central corneal thickness (CCT) and axial length (AXL) of eye were analysed with independent T test and is given in table 3

Table 3: Relation between MCD, CV hexagonality (HEX), central corneal thickness and axial length.

	<6D Myopia		>6D Myopia		
	Mean	SD	Mean	SD	P value
MCD	3203.90	309.92	2951.09	373.19	0.00
CV	27.37	2.11	26.49	2.35	0.25
HEX	63.84	10.50	63.84	11.93	0.99
CCT	524.36	20.23	505.51	36.71	0.00
AXL	23.74	0.79	26.22	0.73	0.00

Mean cell density and central corneal thickness were low in high myopes and this change was statistically significant. Mean axial length in groups with myopia < 6 D was 23.74 while in high myopes it is 26.22. Coefficient of variation and hexagonality did not show any significant variation among the two groups.

The distribution of cases based on axial length AXL, corneal thickness CCT and coefficient of variation CV in groups with myopia <6 Dsphere (1) and myopia >6Dsphere (2) is represented in boxplot in figure 1,2,3 respectively.

Figure 1: Relation between axial length and degree of myopia

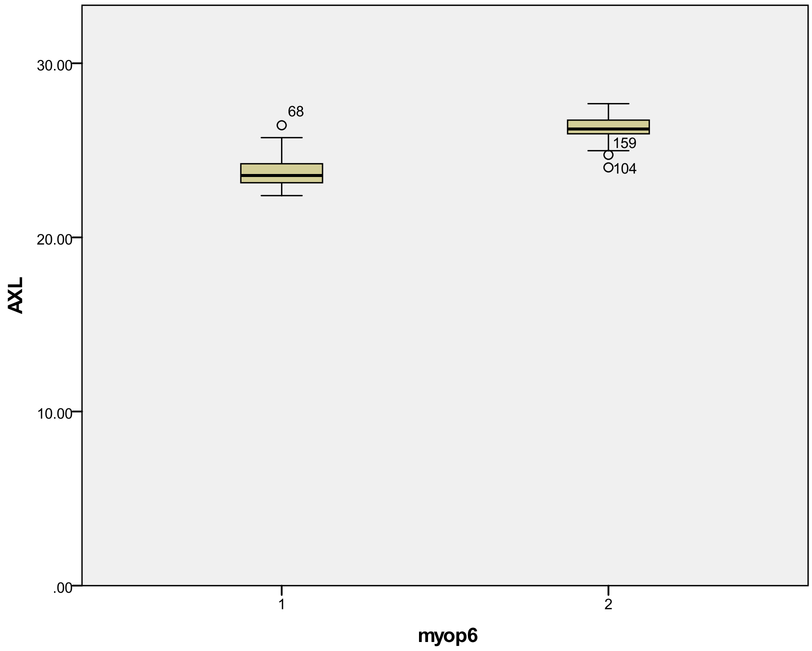


Figure 2: Relation between central corneal thickness and degree of myopia.

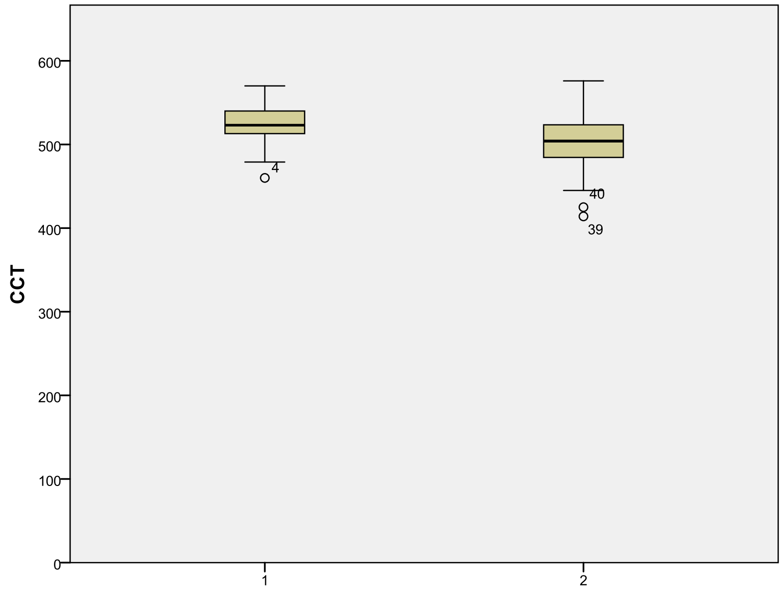
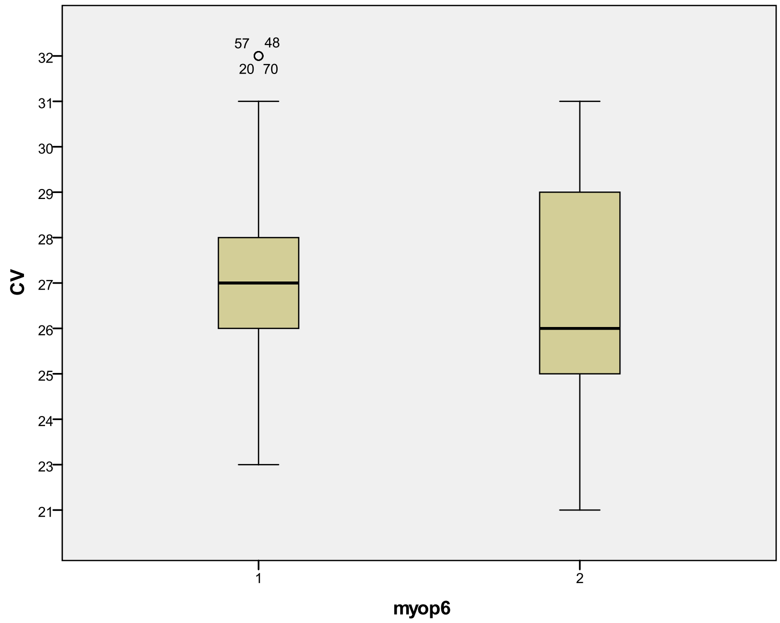


Figure 3: Box plot showing coefficient of variation and degree of myopia.



Discussion

Myopia or nearsightedness is an optical condition of the non accommodating eye in which parallel rays of light entering the eye are brought to a focus anterior to the retina.

Murthy *et al.*,[8] assessed the prevalence of refractive error and related visual impairment in school going children 5-15 years of age, in an urban population in New Delhi and reported a prevalence of 7.4% of myopia. In the study, conducted in 2001, the prevalence of myopia at an urban location (Delhi) was 7.45% and 4.1% at a rural location (Mahmoodnagar in Andhra Pradesh)[9].

In myopia as the axial length increases there occurs changes in the posterior segment and anterior segment of the eye. High myopia, usually more than -6 Dsphere associated with degenerative changes in retina and vitreous is defined as pathological myopia. A study done by Jose. M. Celorio et al[10] showed that out of 218 patients with myopia of 6D or more, 72 [33%] had lattice degeneration. However, there occurs a group among the high myopes where significant retinal or vitreous changes may not be present. The degenerative changes in the eyeball as eye elongates can also be reflected in the corneal endothelium. Only very few studies have been conducted based on the relationship between refractive error and corneal endothelium. In our study we assessed the cellular level changes in corneal endothelium in myopia.

Chang S W et al[6] evaluated corneal curvature, corneal thickness, axial length specular microscopy and fluorophotometry, on 216 young myopes,of mean age 22.2 (SD 4.2) years. They observed that eyes with more myopia had longer axial length ($r = -0.90$, $p < 0.001$) as well as less corneal endothelial density ($r = 0.20$, $p = 0.037$). The corneas were thinner in more myopic eyes ($r = 0.16$, $p = 0.021$).

Delshad S, Chun J M[11] compared the corneal endothelial cell density and morphology in young, low(n=78; 21.22±1.51 years) and moderate (n=78; 21.82±1.40 years) myopic Chinese adults in Malaysian Chinese population using non-contact specular microscopy. They observed that in low myopic eyes the mean cell density was 3063.0±176.2/mm^2, while in moderate myopic eyes it was 2961.6±159.0/mm^2. The mean coefficient of variation was 33.4±4.0% in low myopes and 33.9±3.6% in moderate myopes. The mean hexagonality of the cell was 57.9±2.7 in low myopes and 56.2±4.7% in moderate myopes. There were statistically significant differences in MCD (P<0.000) and hexagonal appearance of the cell (P<0.005) between low and moderate myopic eyes. According to their study the corneal endothelial cell layer in more myopic eyes tends to have less MCD and cell hexagonality compared to lower myopic eyes. Nevertheless, there is no significant difference in CV between low and moderate myopic eyes.

Occurrence of amblyopia in myopia is not common because these patients even when not corrected have the opportunity of having adequate stimulus for development of vision from near objects unless myopia is of high order resulting in blurred vision even for near objects giving rise to ametropic amblyopia. A study was conducted by Prakash P[12] regarding amblyopia in myopia. Unilateral high myopes from the ages of 3 years to 26 years with at least spherical equivalent of 5.0 dioptres was studied and he noted amblyopia in 5% cases of myopia. Dhan Krishna Sen[13] studied amblyopia associated with unilateral high myopia without strabismus and analysed the correlation of the degree of myopia with the depth of amblyopia and found that, though there was a suggestion of higher degrees of myopia being associated with severe degrees of amblyopia, it failed to attain statistical significance (x2=523 for 2 DF, 0-05<p<0.10).

The present study included 168 myopic eyes of patients less than 30 years of age. In myopes <6 Dsph mean age was 17.42, with mean visual acuity 0.53, mean best corrected visual acuity 0.025 and mean spherical equivalent -2.27. In myopes >6 Dsphere mean age was 16.67, with mean visual acuity 1.06, mean best corrected visual acuity0.32 and mean spherical equivalent -8.62. Data analysed with independent t test and showed significant decrease in visual acuity and best corrected visual acuity in high myopia. (p 0.00).

The incidence of amblyopia among low and high myopes was analysed with chi square test and revealed that there is statistically significant incidence of amblyopia in high myopes compared to low myopes. (P 0.00)

The present study also showed significant changes in corneal endothelial mean cell density, central corneal thickness and axial length of eye in high myopes. In myopes <6 Dsph MCD was 3203.90, mean CV 27.37 , mean hexagonality 63.84, mean central corneal thickness 524.36 and mean axial length 23.74. In myopes >6 Dsph MCD 2951.09, mean CV 26.49, mean hexagonality 63.84, mean central corneal thickness 505.51, mean axial length 26.22. In high myopes mean corneal endothelial cell density and central corneal thickness are low and this change was statistically significant (p 0.00). There was no statistically significant difference in hexagonality (p 0.99) and CV (p 0.25) among the groups.

Conclusion

Assessment of corneal endothelial cell density and morphology provides important information on corneal endothelial function. Our study shows significant changes in corneal endothelial cells in myopes particularly of higher degree of myopes. Intra ocular and refractive surgeries[8,9] can also cause significant corneal endothelial morphological changes . Therefore assessment of corneal endothelium in myopes is important before any refractive or intraocular surgeries so that one can predict future corneal complications in these patients.

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