Original Research Article

Assessment of corneal endothelial cell density and morphology in low and moderate myopic eyes in rural south Indian population

N. Sathish Kumar[1], D. Sundararajan[2*], S. Veluchamy[3]

[1]Assistant Professor, [2]Associate Professor, [3]Senior Resident
Department Ophthalmology, Meenakshi Medical College, Hospital, and Research Institute, Enathur, Kanchipuram, India
[*]Corresponding author email: **eyesurgeon2004@gmail.com**

Abstract

Background: Myopia is a common pathologic change of the eye, especially in Asian countries undergoing rapid development. It is known that Asian people have a higher prevalence of myopia. High levels of myopia are associated with increased risk of cataract, posterior vitreous detachment, retinal tears and retinal detachment, increased risk of choroidal neovascularization, and myopic macular degeneration.

Aim: To describe the corneal endothelial density and morphology in patients of low and moderate myopic in rural south Indian population and the relationship between endothelial cell parameters and other factors.

Materials and Methods: Totally 100 patients were included. Noncontact specular microscopy was performed after taking a history and testing the visual acuity, intraocular pressure measurement, Schirmer's test and routine eye examination by slit lamp microscope. The studied parameters included mean endothelial cell density (MCD), the coefficient of variation (CV), and percentage of hexagonality.

Results: In low myopic eyes the MCD was 2892. 0 ± 146.2/mm^2, the mean CV was 38.4 ± 0.4 and the mean hexagonal appearance of the cell was $53.9\pm0.9\%$. In moderate myopic eyes, the MCD was 35716 ± 142.0 mm^2, the mean CV was $37.9\pm3.4\%$ and mean the hexagonal appearance of the cell was

59.83± 3.6. 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.

Conclusion: The normative data of the corneal endothelium of eyes indicated that statistically, MCD decreased significantly with age. Previous studies have reported no difference in MCD, the percentage of CV, and percentage of hexagonality between genders. Nevertheless, significantly different percentages of CV between genders were presented in this study.

Key words

Cornea, Myopic Eyes, Specular Microscopy, Endothelial Cell Density Morphology.

Introduction

Myopia, a form of refractive error is a leading cause of visual disability throughout the world. In India, uncorrected refractive errors are the most common cause of visual impairment and second major cause of avoidable blindness. Commonly referred to as short-sightedness is a form of refractive error and is a very common cause of visual disability throughout the world. The condition may present as blurred distance vision, eye rubbing and squeezing of the eyes. School myopia commences around 5-15 years of age and tends to stabilize in the late teens and is mainly thought to be idiopathic. High myopia may be associated with myopic macular degeneration, cataract, glaucoma, peripheral retinal changes such as lattice degeneration, retinal holes and tears and retinal detachment. Although, the prevalence of myopia varies by the country, age and by the ethnic group it is a major cause of visual impairment in both the developed and the developing world [1]. The prevalence of myopia has been reported to be as high as 70-90% in some Asian population. Cornea contains 5 layers. In the deepest layer, a monolayer of corneal endothelial cell covers the posterior surface of Descemet's membrane [2]. Corneal endothelium is metabolically active ($Na^+ – K^+$ pump) and responsible for keeping the corneal stroma in its usual hydrated state of 70% water to prevent stromal edema. Nowadays the specular microscope has made the in vivo evaluation of endothelium possible [3]. It measures means cell density (MCD), cell size variations (percentage of coefficient of variation (CV), polymegathism), and cell shape (polymorphism). The specular microscope has been used to establish and compare normative data for endothelium parameters among ethnic groups, as well as gender and age [4]. 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. The non-contact specular microscope provides a non-invasive method of morphological analysis of the corneal endothelial cell layer [5]. It makes the measurement of mean cell density (MCD), measurement of coefficient of variation (CV) in the cell size as well as the hexagonal appearance of the cell. These parameters provide an index of the functional status of the corneal endothelial layer.

Materials and methods

This was a prospective study of 100 patients with mean age of 40.5 (±14.2) years who were examined at the Department of the Ophthalmology at Meenakshi Medical College and Research Institute, Kanchipuram from June 2016 to Januaury 2017. Informed consent was obtained from all subjects for their participation in the study. Patients with previous ocular surgery, trauma, contact lens use history, corneal dystrophy, corneal edema, high intraocular pressure and any other anterior segment disorders affecting the corneal endothelium were excluded from the study.

Results

In low myopic eyes, the MCD was 2892. 0±146.2/mm², the mean CV was 38.± 0.4 and the mean hexagonal appearance of the cell was 53.9± 0.9%. In moderate myopic eyes, the MCD

was 35716 ± 142.0 mm^2, the mean CV was $37.9\pm$ 3.6% and mean the hexagonal appearance of the cell was 59.83 ± 3.4. 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 (**Table – 1, 2**).

Table – 1: Corneal endothelial characteristics in low myopic subjects (N=72).

Parameters	Mean±SD	Range
MCD (cell/mm²)	2892.0±146.2	2630-3450
CV (%)	32.8±0.4	37-43
HC (%)	53.9±0.9	51-59

Table – 2: Corneal endothelial characteristics in moderate myopic subjects (N=28).

Parameters	Mean±SD	Range
MCD (cell/mm²)	3571.6±142.0	2496 -3220
CV (%)	37.9±3.6	32-39
HC (%)	59.83±3.4	54-60

Corneal endothelial cell parameters among different levels of myopia, the MCD and the mean percentage of hexagonal appearance of the cell were significantly different (p<0.05).

In moderate myopic subjects, the MCD and the mean percentage of hexagonal appearance of the cell were lower than low myopic subjects. However, the difference in CV in the cell size was statistically insignificant (P>0.05). Corneal endothelial cell layer with the higher percentage of hexagonal appearance of the cell tends to have less CV in the cell size.

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. The results have shown that with increasing age, MCD and % CV tended to decrease. There were conflicting reports about the relationship between gender. The results of this study have shown that corneal endothelial layer in moderate myopic eyes tends to have less density and hexagonal appearance of the cell compared to low myopic eyes. There are conflicting reports regarding the effects of refractive error on corneal endothelial characteristics [6]. The next mechanism could decrease Na$^+$/K$^+$-ATPase activity, which influences the endothelial pump action and induces the dysfunction of the corneal endothelial cell layer Disturbances in this pump may lead to changes in corneal thickness [7]. It has been suggested that as long as the eye elongate, the corneal endothelial surface area increases. Due to little or no mitotic activity of the corneal endothelial cells after birth, it is likely that the corneal endothelial cells have to floor the enlarged surface. Then, reduced corneal endothelial density is expected [8]. Since corneal endothelial cells have to flatten to conquer the enlarged surface, it is conceivable that the possibility of polymorphism increases subsequently, the percentage of hexagonal appearance of the cells decreases [9]. There are conflicting reports regarding the effects of refractive error on corneal endothelial characteristics. Although few studies have concluded that there are no significant changes in corneal endothelial parameters between different types or degree of refractive error, others have stated adversely [10].

Conclusion

This study proposes that the changes in the density of the corneal endothelial cells and the

percentage of hexagonal appearance of the cells are subjective to the degree of myopia. It would be likely that low myopic eyes have lower MCD and percentage of hexagonal appearance of the cells than moderate myopic eyes. Future researchers should focus on the effects of high myopic refractive error on corneal endothelial cell layer. Although the effects of aging and ethnicity on corneal endothelial cell characteristics are clear, detailed modelling studies are needed, investigating the results of myopia within different age groups and populations in order.

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