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Evaluation of Central Corneal Thickness and Corneal Endothelial Cell Parameters in Pseudoexfoliative Glaucoma

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Abstract

Background: The characteristics of corneal endothelium in patients with pseudoexfoliation (PEX) have been unclear. This study aimed to evaluate the corneal endothelial cell density and morphology in eyes diagnosed with this syndrome at our institution.

Objective: To measure central corneal thickness and corneal endothelial cell parameters in pseudoexfoliative glaucoma.

Methods: Ocular examination in all patients was performed with slit lamp examination, gonioscopy with Goldmann two mirror indirect gonioscope and dilated fundus examination using +90 D lens.

Results: No significant differences were found in the demographic parameters (age and sex) among the patients of two groups. Mean CCT value was significantly lower in PXG group 556.4+28.95 than in control group (572.5+19.91). Mean percentage of Hexagonal cells and the coefficient of variation in PXG group (2239.5+254.33), (50.9+2.47) and (37.6+2.09) were also found to have statistically significant difference compared to control group (2554.2+164.65), (56.1+4.06) and (34.4+2.15).

Conclusion: The study confirms the existence of significant difference in various corneal morphometric parameters in PXG patients.

Keywords: Pseudoexfoliative glaucoma; Ocular examination; Eyes

Introduction

The cornea, with the anterior chamber and lens, refracts light, with the cornea accounting for approximately two-thirds of the eye's total optical power [1,2]. In humans, the cornea has a diameter of about 11.5 mm and a thickness of 0.5-0.6 mm in the center and 0.6-0.8 mm at the periphery. The cornea has no blood supply; it gets oxygen directly through the air. Oxygen first dissolves in the tears and then diffuses throughout the cornea to keep it healthy [3]. Corneal endothelial morphology and central corneal thickness (CCT) are important parameters for evaluating the cornea; particularly in the case of refractive surgery assessment [4-6]. Key corneal endothelial morphology parameters include the endothelial cell density (ECD), and the coefficient of variation of cell area (CV/polymegathism). Both of these measures can be affected by a broad range of disorders, such as contact lens complications [7,8], glaucoma [9,10], dry eye [11], and diabetes mellitus [12,13]. Furthermore, it is predictable that a normal healthy endothelium will have low CV values [14]. The conventional method to estimate ECD is by using slit-lamp biomicroscopy [15,16]; however, a disadvantage of this technique is that it is a manual assessment that requires subjective interpretation by the observer [17].

Measurement of central corneal thickness (CCT) has a very important value in glaucoma patients, if the central cornea is thinner then it suggests that the intraocular pressure is falsely low [18]. Patients classified as glaucoma suspects have been reported to have a higher CCT than individuals with chronic open angle glaucoma or healthy individuals with 42% of glaucoma suspects having a CCT of greater than 585 μm [19-21]. In children the reported central corneal thickness ranges from roughly 540 μm at 6 to 23 months of age to approximately 550 to 560 μm for older children, with thinner central corneal thickness reported in white compared with black children [22].

Pseudoexfoliation glaucoma accounts for approximately 25% of all open angle glaucomas worldwide [23]. The prevalence of pseudoexfoliation glaucoma as reported by population-based surveys from South India vary between 7.5 and 13% [24,25]. Pseudoexfoliation glaucoma has a more serious clinical course and a worse prognosis than primary open angle glaucoma [26,27].

This study was done to evaluate central corneal thickness and corneal endothelial cell parameters in pseudoexfoliative glaucoma.

Methodology

After obtaining the ethical clearance from the Institutional Ethical Committee, this hospital based prospective observational comparative

study, was done to evaluate central corneal thickness and corneal endothelial cell parameters in pseudoexfoliative glaucoma. After obtaining informed consent from the patients, ocular examination in all patients was performed with slit lamp examination, gonioscopy with Goldmann two mirror indirect gonioscope and dilated fundus examination using +90 D lens. The IOP was recorded with a Goldmann Applanation Tonometer. Visual Field Assessment (VFA) was performed using Humphrey's Field Analyser (HFA-II). Optical coherence tomography (OCT) for retinal nerve fibre layer (RNFL) was performed with ZEISS CIRRUS HD-OCT. The corneal endothelial parameters and central thickness were studied with TOPCON SP-1P Non-Contact Specular Microscope. The readings were taken by a single examiner.

The patients were seated at the instrument with the chin on the chin rest and the forehead against the forehead band. When the endothelium was in proper focus the instrument automatically took a picture of the endothelium. The parameters measured were central corneal thickness (CCT), endothelial cell density (ECD), percentage of hexagonal cells (HEX), and coefficient of variation of cell area (CV).

Statistical Package for Social Sciences (SPSS Ver. 20) and Microsoft Excel were used to analyze the data obtained. A p value of <0.05 was considered significant.

Results

The demographic characteristics of the participants are summarized in Tables 1, 2 and 3. The mean ages in control group and PXG group were 73.6 year and 74.8 year respectively. No significant differences were found in between age and sex among the patients of two groups (Figures 1-3).

Age (years)	Normal		PXG	
	No.	age%	No.	%age
60-69	28	35.0	25	31.3
70-79	27	33.8	28	35.0
≥ 80	25	31.3	27	33.8
Total	80	100	80	100

Table 1: Age distribution of study groups.

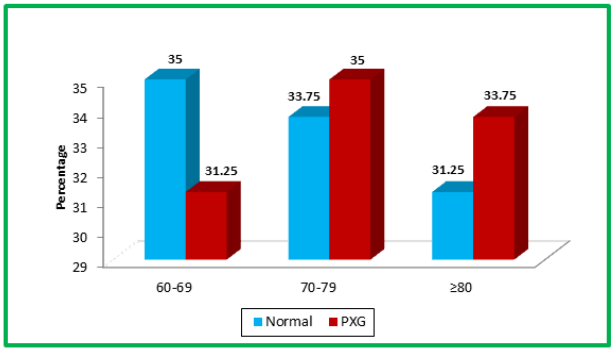

Figure 1: Age distribution of study groups.

Group	Mean	SD	Range	P-value
Normal	73.6	8.68	60-93	0.416#
PXG	74.8	9.89	60-94	
#: Statistically Non-significant Difference (P-value<0.05)				

Table 2: Showing mean age (years) in two groups.

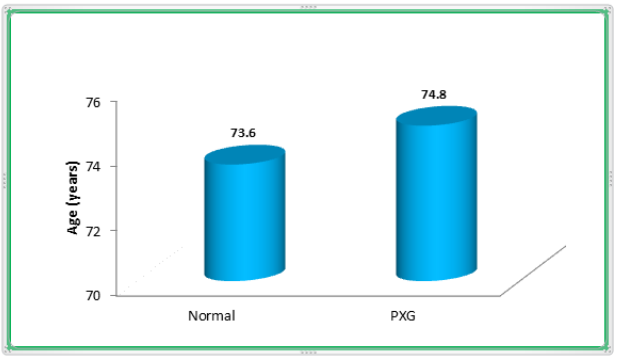

Figure 2: Showing mean age (years) in two groups.

Gender	Normal		PXG		P-value
	No.	age%	No.	age%	
Male	41	51.3	43	53.8	0.752#
Female	39	48.8	37	46.3	
Total	80	100	80	100	
#: Statistically Non-significant Difference (P-value<0.05)					

Table 3: Gender distribution of study groups.

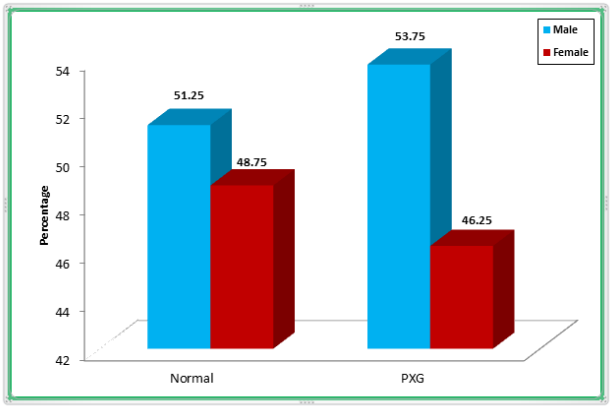

Figure 3: Gender distribution of study groups.

The mean CCT (μm) value was significantly lower in PXG group than in control group (Table 4 and Figure 4).

Group	Mean	SD	Range	P-value
Normal	572.5	19.91	531-621	<0.001*
PXG	556.4	28.95	494-652	
#: Statistically significant Difference (P-value<0.05)				

Table 4: Comparison based on Central Corneal thickness (CCT) in two groups (µm).

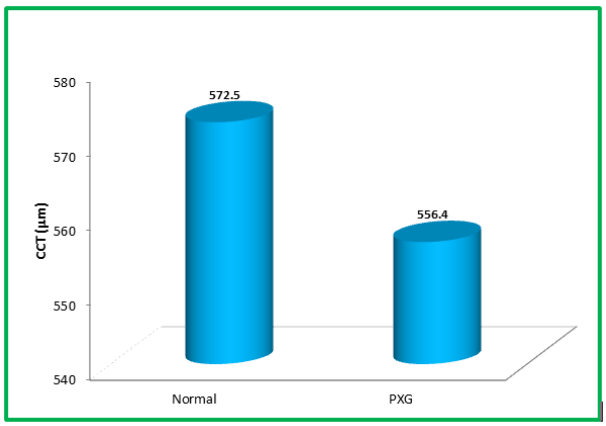

Figure 4: Showing central corneal thickness (CCT) in two groups.

ECD (cells/mm^2) in PXG group was significantly lower compared to control group (Table 5 and Figure 5).

Group	Mean	SD	Range	P-value
Normal	2554.2	164.65	2168-3191	<0.001*
PXG	2239.5	254.33	1440-2815	
#: Statistically significant Difference (P-value<0.05).				

Table 5: Showing comparison based on endothelial cell density in two groups (cells/mm^2).

Discussion

Patients enrolled in our study had mean age of 74.8 year which is comparable to previously published reports [24,25,28]. There are conflicting reports of gender differences in pseudoexfoliative glaucoma [29,30], however in our study there was no significant difference in gender distribution of the disease. There are a number of studies that describe the reduction of endothelial cells with age because these cells appear to have little or no possibility of dividing after birth. The loss of these cells involves an increase in size and a reduction of hexagonicity [31,32]. In our study the mean corneal endothelial cell density per mm^2 was 2239.5 ± 254.33 which was similar to previous reports and showed a statistically significant difference against the normal group 2554.2 ± 164.65 [33-35]. The mean percentage of hexagonal cells in PXG eyes in our study was 50.9 ± 2.47 which was in accordance to previous studies as 54.9 ± 10.9 [35], 56.4 ± 7.5 [35], 57.1 ± 7.1 [36].

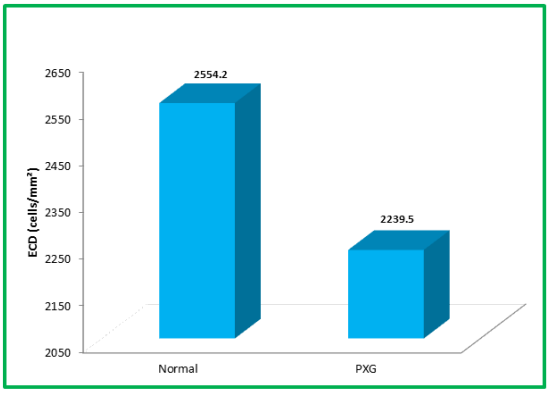

Figure 5: Showing endothetial cell density (ECD) in two groups.

The mean percentage of Hexagonal cells showed a statistically significant difference between the two groups (Table 6 and Figure 6).

Group	Mean	SD	Range	P-value
Normal	56.1	4.06	48-63	<0.001*
PXG	50.9	2.47	45-57	
#: Statistically significant Difference (P-value<0.05)				

Table 6: Showing mean percentage of Hexagonal cells in two groups.

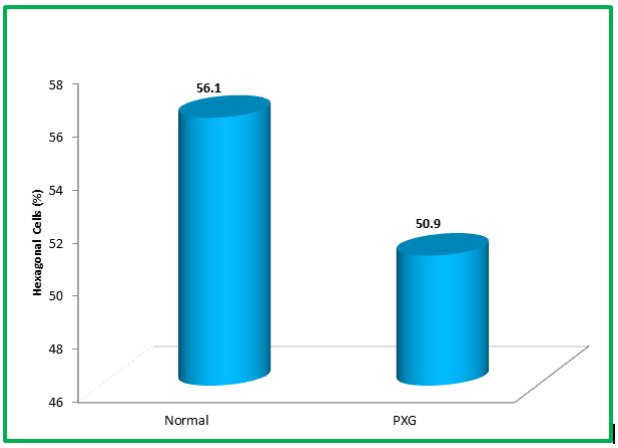

Figure 6: Showing mean percentage of Hexagonal cells in two groups.

The coefficient of variation between the two groups also showed statistically significant difference as depicted in Table 7 and Figure 7.

Group	Mean	SD	Range	P-value
Normal	34.4	2.15	30-42	0.002*
PXG	37.6	2.09	34-44	

#: Statistically significant Difference (P-value<0.05)

Table 7: Comparison based coefficient of variation in two groups.

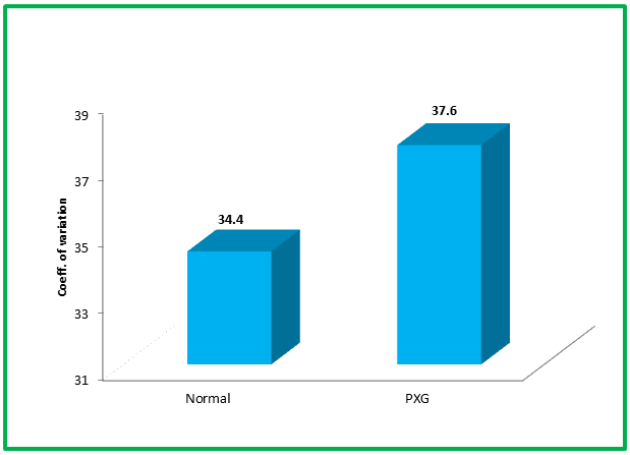

Figure 7: Showing coeffiecient of variation in two groups.

The mean central corneal thickness in PXG patients has been reported as 493 ± 33 [37], 507 ± 25 [38], 528 ± 30 [39] which was comparable to our study group 556.4 ± 28.95. In our study there was a significant difference in the CCT in PXG patients compared to the normal group 572.5 ± 19.91.

Conclusion

The study thus confirms the existence of significant difference in various corneal morphometric parameters in PXG patients. Identifying these alterations in these patients prior to surgical procedure like cataract or trabeculectomy must lead to consider measures to minimize intra surgical endothelial loss and avoid post-surgery corneal decompensation. Also we should evaluate IOP in PXS eyes in consideration of CCT and carefully observe patients with glaucoma associated with PXS.

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