

Research Article

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Changes in Corneal Endothelial Cells and Central Corneal Thickness in Pseudoexfoliation Syndrome

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ABSTRACT

Purpose: The aim of the research is to investigate the impact of pseudoexfoliation syndrome (PEX) on corneal endothelial cells and central corneal thickness.

Methods: In this analytic case-control study, the research sample included 60 patients (120 eyes), which was divided into two groups: the PEX group, 30 patients (60 eyes) obtained inclusion criteria and the control group, 30 patients (60 eyes) for result comparison, from patients visiting the ophthalmic clinic at Tishreen University Hospital. PEX degree was assessed using a slit lamp and the morphology of endothelial cells: endothelial cell density (ECD), coefficient of variation (COV), percentage of hexagonal cells (EX%), average cell area (Avg.Cell Area) and central corneal thickness (CCT) were assessed using a specular microscope.

Results: The average of ECD was lower in the PEX group compared with the control group (p-value = 0.0001). The average of EX% was lower in the PEX group compared with the control group (p-value = 0.0001). No statistically significant differences were observed between the research groups in COV values (p-value = 0.9). The Avg.Cell Area was higher in the PEX group compared with the control group (p-value = 0.003). The average of CCT was lower in the PEX group compared with the control group (p-value = 0.04).

Conclusion: Corneal endothelial cells morphology and central corneal thickness are affected in eyes with PEX syndrome, and these changes increase with the severity of PEX.

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Introduction

The pseudoexfoliation (PEX) syndrome is characterized by the production and accumulation of extracellular white amorphous-like material in many tissues and organs [1, 2]. It has been reported that involvement of PEX materials in the anterior segment of the eye developed open-angle glaucoma, cataract with phacodonesis and corneal endothelial cell loss [3,4]. The corneal endothelium is a single layer of hexagonal cells that do not have the ability to regenerate and it performs an essential function of maintaining the hydration of the cornea. The normal density of corneal endothelial cells in adults is approximately 2500 cells/mm² and it is reduced by about 0.6% a year. When the endothelial cells density is reduced to approximately 800 cells/mm², it may lead to corneal decomposition causing corneal edema and loss of corneal transparency, which disrupts vision [5]. Many studies in regard to the association between corneal endothelial cell density (ECD) and PEX have shown that ECD was lower in patients with PEX than in normal subjects, that ECD in PEX glaucoma (PEXG) patients was similar to that in PEX patients without glaucoma [6-9].

The PEX syndrome is often found in patients with glaucoma [10]. The central corneal thickness (CCT) of PEX eyes in glaucoma patients was reported to be thinner than or similar to normal eyes [11,12]. The aim of this study is to compare the corneal endothelial morphology and central corneal thickness between eyes having PEX syndrome and control group by using noncontact specular microscopy.

Materials and Methods

This is an analytic case-control study carried out from 2023 to 2024 at Tishreen University Hospital, Lattakia, Syria. The inclusion criteria for this study were the patients with eyes of pseudoexfoliation syndrome between 40 to 80 years old, both eyes of same patients were included. Patients having acute corneal disease, contact lens wearers, past history of any intraocular surgery or laser treatment, corneal dystrophies, Diabetes mellitus and Glaucoma were excluded.

The research sample included 60 patients (120 eyes) and was divided into two groups: the PEX group, which included 30 patients (60 eyes) with pseudoexfoliation syndrome and the control group which included 30 patients (60 eyes) from ophthalmic clinic attendees without pseudoexfoliation syndrome.

All participants underwent a complete eye examination including detailed medical history, distance visual acuity was measured using Snellen Chart, comprehensive eye examination of anterior segments was conducted, and pseudoexfoliation degree was assessed using a slit lamp, diagnosis of pseudoexfoliation syndrome was made by the appearance of a white, dandruff like material on papillary margin of iris, classical pattern of 3 zones or "Bulls Eye" pattern due to deposition of pseudoexfoliative material on the anterior capsule of lens, gonioscopy, fundus examination, and specular Microscopy. Subsequently, intraocular pressure was measured with a Goldman tonometer, and changes in endothelial cells were assessed using a specular microscope. The following criteria were studied: endothelial cell density (ECD cells/mm²), coefficient of variation (COV), percentage of hexagonal cells (EX%), average cell area (Avg. Cell Area μm²), and central corneal thickness (CCT μm). Three microphotographs were performed for every eye and the average value was calculated.

Results

The research sample included 60 patients (120 eyes), 30 patients (60 eyes) with pseudoexfoliation syndrome and 30 patients (60 eyes) as a control group from ophthalmic clinic attendees of age between 40-80 years old at Tishreen University Hospital, Lattakia, Syria in period between 2023-2024.

The endothelial cell density was significantly lower in the PEX group (2218.91±311.5 cells/mm²) than in control group (2559.82±290.7 cells/mm²) (P-value=0.0001).

Table 1: ECD Values between PEX and Control Groups

ECD cells/mm ²	PEX	Control group	P-value
Mean±SD	2218.91±311.5	2559.82±290.7	0.0001
Min-Max	1578 – 2853	2105 – 3050	

There was no significant difference between the coefficient of variation in the PEX group (32.62±3.8) and that in the control group (31.85±3.6) (P-value=0.9).

Table 2: COV Values between PEX and Control Groups

COV	PEX	Control group	P-value
Mean±SD	32.62±3.8	31.85±3.6	0.9
Min-Max	29.7 – 38.1	27.8 – 34.5	

There was a significant difference between the percentage of hexagonal cells in the PEX group (48.55±14.9%) compared with (62.32±9.7%) in control group (P-value=0.0001).

Table 3: EX% Values between PEX and Control Groups

EX%	PEX	Control group	P-value
Mean±SD	48.55±14.9	62.32±9.7	0.0001
Min-Max	31.3 – 62.4	44 – 87	

Avg. Cell Area values were significant higher in PEX eyes (487.92±71.3 μm²) than (419.94±72.2 μm²) in control group (P-value=0.003).

Table 4: Avg. Cell Area values between PEX and control groups

Avg. Cell Area	PEX	Control group	P-value
Mean±SD	487.92±71.3	419.94±72.2	0.003
Min-Max	439 – 557	348 – 489	

The central cornea was significantly thinner in the PEX group (515.93±41.9 μm) compared with control group (544.22±26.6 μm) (P-value=0.04).

Table 5: CCT Values between PEX and Control Groups

CCT	PEX	Control group	P-value
Mean±SD	515.93±41.9	544.22±26.6	0.04
Min-Max	489 – 549	508 – 562	

Discussion

In this present study, we found statistically significant lower ECD in PEX eyes (2218.91±311.5 cells/mm²) compared to normal subjects (2559.82±290.7 cells/mm²). This can be explained by the fact that the PEX material settles on the corneal endothelium, penetrating it towards Descemet membrane, which leads to cut the connections between endothelial cells, which stimulates chemotactic activity and increases the production of cytokines which in turn leads to acceleration of programmed cell death locally at the level of affected corneal endothelial cells, causing their loss [13]. Our results agreed with Kenji Inoue et al as they found a decrease in ECD in PEX eyes compared with control group (P-value=0.003) [7]. In accordance with our study the average of ECD was lower in PEX group (2212.60±12.34 cells/mm²) compared with control group (2588.06±286.54 cells/mm²) as well as Takanori Aoki et al (P-value=0.02) [14,15].

We found that the average of EX% was lower in PEX patients (48.55±14.9%) compared with (62.32±9.7%) with (P-value=0.0001). This can be explained by the loss of the regular shape of hexagonal remaining endothelial cells that occurs as part of a compensation mechanism due to the loss of corneal endothelial cells [13]. Our study agreed with Jayadatt Patel et al while Kenji Inoue et al didn't find any statically significant difference between study groups for EX% values, this can be as a result that they included pseudoexfoliation glaucoma patients in their study groups [7-14].

For COV values we didn't find a statically significant difference between the study groups (P-value=0.9) and we agreed with Kenji Inoue et al by that [7]. On the other hand, Avg. Cell Area values were higher in PEX patients than control group (487.92±71.3 μm²) and (419.94±72.2 μm²) in respect with (P-value=0.003), as it was the same result with Jayadatt Patel et al [14]. It is believed that this occurs as a compensation mechanism for the decrease in the number of corneal endothelial cells, so the cell increases its area to fill the empty spaces.

When studying CCT values, corneas tended to be thinner in PEX eyes (515.93±41.9 μm) compared with control group (544.22±26.6 μm) with (P-value=0.04). That can be explained that PEX syndrome changes or distorts the structure of corneal endothelial cells Keratocytes (responsible for regulating collagen production and maintaining the studied space between these fibers), it also affects proteoglycans and glycoaminoglycans in the extracellular matrix (responsible for controlling Corneal osmotic pressure), this causes a decrease in corneal hydration and a decrease in its thickness [9]. As Kenji Inoue et al approved [7]. While we disagreed with Jayadatt Patel et al and that may be due to difference in groups number and ethnicity [14].

Conclusion

Our study showed that in pseudoexfoliation syndrome, endothelial cell density and the percentage of hexagonal cells are reduced. However, average cell area was increased and the corneal thickness decreased. Therefore, we as ophthalmologists must be careful in conducting cataract surgery, use of high viscosity viscoelastics and use of soft shell technique should be emphasized.

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