

Research Article

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Corneal Endothelial Cells and Central Corneal Thickness in Pseudoexfoliation Patients

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ABSTRACT

Objective: Investigating the impact of pseudoexfoliation syndrome on changes occurring in corneal endothelial cells and central corneal thickness, while assessing the influence of the degree of pseudoexfoliation on endothelial cell changes.

Methods: In this analytic case-control study (Cross Sectional), the research sample included 60 patients (120 eyes) from the ophthalmic clinic attendees at Tishreen University Hospital in Latakia during the period 2023-2024.

Results: The average corneal endothelial cell count was lower in the pseudoexfoliation group (2218.91 ± 311.5 cells/mm²) compared to the control group (2559.82 ± 290.7 cells/mm²) with a (p-value of 0.0001). The average percentage of hexagonal cells was lower in the pseudoexfoliation group (48.55 ± 14.9 %) compared to the control group (62.32 ± 9.7 %) with a (p-value of 0.0001). No statistically significant differences were observed between the research groups in terms of average cell volume change coefficient with a (p-value of 0.9). The average cell area was higher in the pseudoexfoliation group (487.92 ± 71.3 μm²) compared to the control group (419.94 ± 72.2 μm²) with a (p-value of 0.003). The average central corneal thickness was lower in the pseudoexfoliation group (515.93 ± 41.9 μm) compared to the control group (544.22 ± 26.6 μm) with a (p-value of 0.04). We observed increased changes in corneal endothelial cells and central corneal thickness with an increase in the degree of pseudoexfoliation.

Conclusion: Corneal endothelial cells and central corneal thickness are affected in patients with pseudoexfoliation syndrome, and these changes increase with severity of pseudoexfoliation.

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Introduction

Pseudoexfoliation syndrome (PEX) is an age-related complex systemic disorder of the extracellular matrix affecting the eye and visceral organs [1,2]. It leads to a change in the composition of the aqueous humor and increases the intensity of the flare and this results from the breakdown of the blood-water barrier add to that by transmission electron microscopy, large clumps of typical pseudoexfoliation material were found adhering to the corneal endothelium and masses of pseudoexfoliation material were incorporated into the posterior descemet's membrane [3]. This may lead to premature damage to the corneal endothelium and resulting complications in eye surgery and due to the importance of corneal lining in stabilizing the functioning and safety of the cornea and studying the factors affecting it is critical in modern eye surgeries and maintaining the integrity of the lining prevents from many serious ocular complications after surgeries [4]. It was important to study the impact of Pseudoexfoliation on endothelial cell changes and central corneal thickness by examining with the Specular Microscope device, taking into account the degree of Pseudoexfoliation that found in patients

Materials and Methods

Study Design

Analytic case-control study (Cross Sectional). Duration of the study :12 months between 1/3/2023 and 29/2/2024. In this study the research sample included 60 patients (120 eyes) and the study was divided into two groups: the PEX group, which included 30 patients (60 eyes) with pseudoexfoliation syndrome from the ophthalmic clinic attendees at Tishreen University Hospital in Latakia during the period 2023-2024 and the control group included 30 patients (60 eyes) from ophthalmic clinic attendees without pseudoexfoliation syndrome for result comparison.

Inclusion Criteria

Patients with pseudoexfoliation syndrome, aged between 40 and 80 years, after obtaining informed consent. Exclusion criteria: any previous ocular surgical intervention, any active eye infection, eye trauma, any corneal disease (such as corneal thinning, corneal dystrophy and degeneration, and corneal ulcers), severe or untreated dry eyes, pregnancy, wear contact lenses, any previous laser procedure, people with diabetes, increased ocular pressure more than 22 mm hg. Detailed medical history was obtained, distance visual acuity was measured, comprehensive eye examination of

anterior segments was conducted, and pseudoexfoliation degree was assessed using a slit lamp, this was done by observing the presence of PEX deposits on the anterior capsule of the lens, on the edges of the pupil, and on the surface of the iris. They are classified according to the degree of their deposition as follows: None for no PEX materials, Mild for PEX materials on part of the pupillary border, Moderate for PEX materials on the entire pupillary border, and Severe for PEX materials on the entire pupillary border and the iris surface [5]. 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 count, cell volume change coefficient, percentage of hexagonal cells, average cell area, and central corneal thickness.

Results

In our study we have included 60 patients, 32 males and 28 females. The age range of the study participants was between 40 and 80 years, with a mean age of 63.78±6.3 years. No statistically significant differences were observed between the research groups in terms of sex and age groups.

Table 1: The Average Values of the Corneal Endothelial Cell Count in the Sample

ECC cells/mm ²	PEX	CONTROL	P-value
Mean ±SD	2218.91±311.5	2559.82±290.7	0.0001
Min - Max	1578 - 2853	2105 - 3050	

There are statistically significant differences between the two research groups regarding the average values of the corneal endothelial cell count which was the lower in the PEX group 2218.91±311.5 compared to the control group 2559.82±290.7 With (p-value=0.0001).

Table 2: The Average Values of Percentage of Hexagonal Cells in the Sample

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

There are statistically significant differences between the two research groups regarding the average values of percentage of hexagonal cells which was the lower in the PEX group 48.55±14.9 compared to the control group 62.32±9.7 With (p-value=0.0001).

Table 3: The Average Values of Cell Volume Change Coefficient in the Sample

CV	PEX	CONTROL	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 are no statistically significant differences were observed between the research groups in terms of average cell volume change coefficient with (p-value of 0.9).

Table 4: The Average Values of the Average Cell Area in the Sample

Average Cell Area μm ²	PEX	CONTROL	P-value
Mean ±SD	487.92±71.3	419.94±72.2	0.003
Min - Max	439 – 557	348 - 489	

There are statistically significant differences between the two research groups regarding the average cell area was higher in the PEX group (487.92±71.3 μm²) compared to the control group (419.94±72.2 μm²) with (p-value of 0.003).

Table 5: The Average Values of the Central Corneal Thickness in the Sample

CCT μm	PEX	CONTROL	P-value
Mean ± SD	515.93±41.9	544.22±26.6	0.04
Min - Max	489 - 549	508 - 562	

There are statistically significant differences between the two research groups regarding the average central corneal thickness was lower in the pseudoexfoliation group (515.93±41.9 μm) compared to the control group (544.22±26.6μm) with (p-value of 0.04).

Table 6: The Average Values of the Corneal Endothelial Cell Count with the Degree of Pseudoexfoliation

The degree of pseudoexfoliation	Mean± SD cells/mm ²	P-value
Mild	2316.2±277.4	0.0001
Moderate	2190.9±287.1	
Severe	1975.3±192.9	

There are statistically significant differences regarding the average values of the corneal endothelial cell count depending on the degree of pseudoexfoliation, which decreased with increasing degree.

Discussion

In our study, we found that the average corneal endothelial cell count was lower in the pseudoexfoliation group (2218.91±311.5 cells/mm²) compared to the control group (2559.82±290.7 cells/mm²) with a (p-value of 0.0001). This can be explained by that PEX material can settle on the corneal endothelium and penetrates it in the direction of the descemet's membrane . This then breaks the connections between hexagonal endothelial cells to activating a plethora of signaling pathways, which increases the synthesis of cytokines and chemokines Therefore, the local apoptosis of corneal endothelial cells is accelerated [6-8]. Our study agreed with the study of Kenji Inoue et al And also with the study of Jayadatt Patel et al and Takanori Aoki et al. [5]. The average percentage of hexagonal cells was lower in the pseudoexfoliation group (48.55±14.9%) compared to the control group (62.32±9.7%) with a (p-value of 0.0001). This can be explained as part of the compensatory mechanism for the loss of endothelial cells the characteristic hexagonal shape of the remaining cells are lost [6]. Our study agreed with the study of Jayadatt Patel et al and our study differed with the study of Kenji Inoue et al and the reason for this difference may be because patients with pseudoexfoliation glaucoma were included in their study [7,8]. There were no statistically significant differences were observed between the research groups in terms of average cell volume change coefficient with a (p-value of 0.9). Our study agreed with the study of Kenji Inoue et al. [7].

The average cell area was higher in the pseudoexfoliation group ($487.92 \pm 71.3 \mu\text{m}^2$) compared to the control group ($419.94 \pm 72.2 \mu\text{m}^2$) with a (p-value of 0.003). This can be explained as part of the compensatory mechanism for the loss of endothelial cells, where the cell increases its area to fill the resulting space. Our study is consistent with the study of Jayadat Patell et al. [8].

The average central corneal thickness was lower in the pseudoexfoliation group ($515.93 \pm 41.9 \mu\text{m}$) compared to the control group ($544.22 \pm 26.6 \mu\text{m}$) with a (p-value of 0.04). This may be due to corneal keratocytes damage which affects Central Corneal Thickness. Keratocytes, which help regulate collagen production and spacing in the cornea, in addition to extracellular matrix (ECM) proteoglycans and glycoaminoglycans, which dictate corneal osmotic pressure, may be altered in a way that reduces corneal hydration and thickness [9]. Our study agreed with the study of Kenji Inoue et al and our study differed from the study of Jayadatt Patel et al This may be due to the difference in the number of the sample studied, as 110 eyes of patients with PEX were studied, as well as the difference in the ethnic type of the sample. Our study also differed from the study of Takanori Aoki et al and the difference may be attributed to the inclusion of cases of pseudoexfoliation glaucoma in the research sample, eye drops to lower intraocular pressure and the difference in their corneal pachymetry device, as the AS OCT Topcon, Tokyo, Japan device was used in their study[5,7,8]. We noticed that there were statistically significant differences that decreased with increasing degree of pseudoexfoliation with regard to the average values of the corneal endothelial cell count [5]. Our study agreed with the study of Takanori Aoki et al where the corneal endothelial cell count decreased with the increase in the degree of pseudoexfoliation.

Conclusion

Corneal endothelial cells and central corneal thickness are affected in patients with pseudoexfoliation syndrome, and these changes increase with severity of pseudoexfoliation.

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References

1. Lesiewska H, Ukaszewska Smyk A, Odrowąż Sypniewska G, Krintus M, Mańkowska Cyl A, et al. (2017) Chosen Vascular Risk Markers in Pseudoexfoliation Syndrome: An Age-Related Disorder. *Journal of Ophthalmology* 5231095.
2. Naumann GOH, Schlotzter Schrehardt U, Kuchle M (1998) Pseudoexfoliation syndrome for the comprehensive ophthalmologist. Intraocular and systemic manifestations. *Ophthalmology* 105: 951-968.
3. Wang L, Yamashita R, Hommura S (1999) Corneal endothelial changes and aqueous flare intensity in pseudoexfoliation syndrome. *Ophthalmologica* 213: 387-391.
4. Schlotzter Schrehardt UM, Dorrfler S, Naumann GOH (1998) Corneal endothelial involvement in pseudoexfoliation syndrome. *Arch Ophthalmol* 111: 666-674.
5. Aoki T, Kitazawa K, Inatomi T (2020) Risk Factors for Corneal Endothelial Cell Loss in Patients with Pseudoexfoliation Syndrome. *Sci Rep* 10: 7260.
6. Vaiciulienė R, Rylskytė N, Baguzytė G, Jasinskas V (2022) Risk factors for fluctuations in corneal endothelial cell density (Review). *Exp Ther Med* 23: 129.
7. Inoue K, Okugawa K, Oshika T, Amano S (2003) Morphological study of corneal endothelium and corneal thickness in pseudoexfoliation syndrome. *Jpn J Ophthalmol.* 2003 May-Jun 47: 235-239.
8. Patel D J, Patel DM, Vaghela DM, Raval DR (2019) Assessment of Corneal Endothelial Changes in Patients of Pseudo Exfoliation Using Non-Contact Specular Microscopy. *Journal of Current Medical Research and Opinion* 2: 327-330.
9. Palko JR, Qi O, Sheybani A (2017) Corneal Alterations Associated with Pseudoexfoliation Syndrome and Glaucoma: A Literature Review. *J Ophthalmic Vis Res.* 2017 Jul-Sep 12: 312-324.

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