

# Comparison of anterior segment parameters and corneal endothelial changes in patients with pseudoexfoliative glaucoma and pseudoexfoliation syndrome

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## Abstract

**Aim:** The aim of this study is to evaluate the changes in anterior chamber morphology and corneal endothelium in patients with pseudoexfoliation syndrome (PEX) and pseudoexfoliative glaucoma (PEXG) and to determine the differences according to the control group.

**Material and Methods:** 61 eyes of 61 PEX patients, 56 eyes of 56 PEXG patients and 46 eyes of 46 healthy subjects were included in the study. Measurement of intraocular pressure (IOP) was taken and axial length (AL), K1, K2, central corneal thickness (CCT), white-to-white distance (WTW), anterior chamber depth (ACD), pupil diameter (PD) by optical biometry and endothelial cell density (ECD), polimegatism (CV), pleomorphism (HEX) and average cell area (AVG) by specular microscope were taken of all the patients. Evaluation among the groups were made by ANOVA test, and  $p < 0.05$  was considered significant.

**Results:** The mean age of PEX, PEXG and control group were  $63.79 \pm 6.62$ ;  $62.71 \pm 10.73$ ;  $63.43 \pm 10.58$  years respectively ( $p > 0.05$ ). There were no statistically significant differences among the groups in terms of IOP, AL, K1, K2, WTW, ACD ( $p > 0.05$ ). Pupil diameter values were lower in the PEX group. CCT and endothelial cell counts were found to be higher in the control group compared to the other groups, while no significant difference was found between PEX and PEXG groups. AVG results were found to be significantly higher in the PEXG group than in the control group ( $p < 0.05$ ). No difference was observed among the groups when CV and HEX values were examined.

**Conclusion:** In our study, no significant difference was observed among the groups in terms of the IOP, AL, K1, K2, WTW, ACD, while corneal thickness and endothelial cell density were observed to be lower in PEX and PEXG groups compared to the healthy individuals.

**Keywords:** Pseudoexfoliation syndrome; anterior segment parameters; pseudoexfoliative glaucoma; specular microscopy findings.

## INTRODUCTION

Pseudoexfoliation syndrome (PEX) is a systemic disease generally seen in elderly patients, and it is characterized by the accumulation of fibrillary extracellular material in the eye and in various tissues (1). The gray-white pseudoexfoliation material can accumulate in the anterior segment, the lens capsule, the iris pigment epithelium, the ciliary epithelium and the trabecular region (2,3). In addition, corneal endothelium changes such as decreased cell density, high coefficient of variation in cell size and low percentage of hexagonal cell have also been reported as a result of the accumulation in corneal endothelium (4) (5). Diagnosis of PEX is made biomicroscopically when typical exfoliation material is observed on iris or on the

anterior lens (6).

It has become possible to obtain detailed information thanks to technological devices developed in the anterior segment imaging in recent years. Anterior segment parameters such as central corneal thickness (CCT), anterior chamber depth (ACD), axial length (AL), keratometry values, white-to-white (WTW) distance can be evaluated with non-contact biometric devices (7,8). It is also possible to evaluate the endothelial cell density (ECD) and shape characteristics of corneal endothelial cells by specular microscopy.

The aim of this study is to compare the anterior segment data and corneal endothelial changes of patients with

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pseudoexfoliative glaucoma (PEXG) and PEX syndrome to the healthy control group and to evaluate the differences.

## MATERIAL and METHODS

Our prospective study includes 61 eyes of 61 patients with PEX, 56 eyes of 56 patients with PEXG and 46 eyes of 46 healthy subjects who were admitted to Erzincan Binali Yildirim University Medical Faculty, Department of Ophthalmology. Three groups were formed in the study. In biomicroscopic examination, patients with pseudoexfoliation in the anterior chamber and with normotensive PEX without glaucoma were considered as group 1, patients with PEXG being followed in our clinic on anti-glaucomatous drugs were considered as group 2 and healthy individuals were reported as group 3. Written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki and Ethics Committee approval was obtained.

The best corrected visual acuity, intraocular pressure (IOP) measurement, examination of the anterior segment and fundus with biomicroscope, and an ophthalmological examination including gonioscopy examination of the angle were performed in all subjects. Front segment parameters were evaluated with optical biometry device (AL-Scan Optical Biometer NIDEK, Japan); and AL, K1, K2, CCT, WTW, ACD and pupil diameter measurements were performed. Endothelial cell density (ECD), polymegathism (CV), pleomorphism (HEX) and average cell area (AVG) were measured by corneal endothelial specular microscopy (CEM-530 Specular Microscope, NIDEK) and the results were evaluated. Patients with previous ophthalmic surgery, trauma, uveitis, contact lens use, and with a history of DM were excluded from the study.

Statistical analysis was performed with SPSS version

21.0 (SPSS, Chicago, IL, ABD) software package. Equality of variances was checked by the Levene's test. The comparison among the groups was done by ANOVA test, and when significant difference was observed, the pair-wise comparisons were made by Tukey post hoc test. (P value <0.05 was considered significant.)

## RESULTS

The mean age was  $63.79 \pm 6.62$  years in group 1 which consists of 30 women and 34 men; the mean age was  $62.71 \pm 10.73$  years in group 2 which consists of 26 men and 30 women and the mean age was  $63.43 \pm 10.58$  in group 3 which consists of 22 men and 24 woman, and no significant difference was observed between the groups in terms of age and gender ( $p > 0.05$ ).

Anterior segment parameters evaluated by optical biometry are shown in Table 1. There were no statistically significant differences among the groups in terms of IOP, AL, K1, K2, WTW, ACD ( $p > 0.05$ ). Pupil diameter values were lower in the PEX group. CCT values were  $518.32 \pm 37.83$ ;  $525.18 \pm 35.06$ ;  $537.63 \pm 39.47$  in PEX, PEXG and control group respectively while it was found significantly higher in the control group compared to PEX group ( $p < 0.05$ ).

When the endothelial changes were examined by specular microscope (Table 2), ECD was found  $2491.12 \pm 317.53$ ;  $2461.94 \pm 418.66$ ;  $2704.36 \pm 385.92$  in PEX, PEXG and control group respectively. Endothelial cell counts were significantly higher in the control group compared to the other groups ( $p < 0.05$ ), while no significant difference was found between PEX and PEXG groups. AVG results were found to be significantly higher in the PEXG group than in the control group ( $p < 0.05$ ). No difference was observed among the groups when CV and HEX values were examined.

**Table 1. Optical low Coherence Reflectometry (biometry) results of Group 1, Group 2 and Group 3**

	PEX	PEXG	Control	P	P PEX-PEXG	P PEX-Control	P PEXG - Control
AL (mm)	23.15±0.65	23.14±1.21	23.09±1.07	0.944	P>0.05	0.953	0.959
K1	44.06±1.51	43.91±1.75	43.38±1.99	0.122	0.905	0.137	0.309
K2	44.79±1.82	44.70±1.70	44.14±1.95	0.157	0.962	0.187	0.312
CCT(µm)	518.32±37.83	525±35.06	537.63±39.47	P<0.05	0.623	P<0.05	0.240
ACD (mm)	2.95±0.37	3.06±0.40	3.01±0.31	0.280	0.281	0.736	0.778
WTW (mm)	11.65±0.42	13.46±13.6	11.56±0.38	0.366	0.460	0.998	0.486
PD (mm)	5.32±1.31	6.14±1.09	5.80±1.42	P<0.05	P<0.05	0.151	0.418

Data are expressed as mean ± standard deviation. PEX: pseudoexfoliation syndrome, PEXG: pseudoexfoliative glaucoma AL: Axial Length, CCT: central corneal thickness, ACD: anterior chamber depth, WTW: white-to-white limbus length, PD: pupil diameter

**Table 2. Specular microscopy results of group 1, group 2 and group 3**

	PEX	PEXG	Control	P	P PEX-PEXG	P PEX-Control	P PEXG - Control
ECD (mm <sup>2</sup> )	2491.12±317.53	2461.94±418.66	2704.36±385.92	P<0.05	0.913	P<0.05	P<0.05
AVG (mm <sup>2</sup> )	406.39±53.99	421.87±93.35	382.06±57.25	P<0.05	0.488	0.207	P<0.05
CV (%)	30.89±4.66	30.83±3.15	30.95±4.67	0.998	0.998	0.997	0.990
HEX (%)	65.46±6.23	67.19±4.74	66.69±5.16	0.208	0.229	0.512	0.900

ECD: Corneal endothelial cell density, AVG: average cell area CV: polimegatism, HEX: Hexagonality

## DISCUSSION

PEX is an age-related disease characterized by the progressive accumulation of a extracellular fibrillary material in many intraocular and extraocular tissues. It is not exactly known how the pseudoexfoliation material is formed and what it is composed of. There are studies that recognize PEX as a general disorder of the basement membrane and immunohistochemical studies support this theory (2,9).

ACD is one of the important parameters used in the diagnosis and follow-up of glaucoma. In a study conducted by Bartholomew et al., patients with pseudoexfoliation and without pseudoexfoliation were compared and no significant difference was found between the two groups in terms of ACD (10). Similarly, no significant difference was found among the 3 groups in terms of the ACD value in our study.

CCT is a clinically important factor in the evaluation of IOP. In the previous studies, different findings were obtained related to CCT in patients with PEX and PEXG. In most of the studies, CCT levels were found to be similar in eyes with PEX and in normal eyes (11-13). However, in some studies, a CCT measurement of lower or higher values was reported in eyes with PEX compared to the normal eyes (14-15). In our study, the CCT was significantly lower in eyes with PEX than in the control group, but no difference was found compared to the PEXG group.

In a study conducted by Inoue et al., the corneal endothelial morphology of 21 patients with PEX (7 glaucomatous, 14 non-glaucomatous) and 30 control patients were examined. ECD was reported significantly lower in the PEX group compared to the control group. There was no significant difference between these two groups between AVG and HEX (15). However, in our study, AVG results were significantly higher in the PEX group compared to the control group, while there was no significant difference among the groups in terms of CV and HEX values.

Pseudoexfoliation may also affect the values of AL. In the study conducted by Ozcura et al., PEX patients, PEXG patients and healthy controls were compared and no significant difference was found among the groups in terms of K1, K2 and AL values (16). In another study conducted by Kaygisiz et al., the K1, K2, and AL values in PEX, PEXG and healthy controls were compared and no significant difference was observed among the groups (17). Similar results were obtained in our study.

PEX can also affect the pupil diameter. In a study conducted by Aravind and his colleagues, ocular parameters of 930 PEX patients and 476 control patients were compared and it was found that the PD was significantly lower in the PEX group (18). In our study PD values were found lower in the PEX group and higher in the PEXG group.

## CONCLUSION

The limitations of our study are the small number of

patients, topical antiglaucoma drug usage by the patients diagnosed with PEXG and potential of these drugs to affect the ocular parameters. In conclusion, pseudoexfoliation was found to be effective on anterior segment parameters, especially on CCT, PD, ECD and AVG. Further studies are needed involving a larger number of patients in order to better understand the changes in anterior chamber parameters in PEX patients.

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