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Original Article

Evaluation of Retinal Nerve Fiber Layer Thickness in Patients having Pseudoexfoliation Syndrome

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Abstract

Background: Pseudoexfoliation syndrome (PEX) is a systemic disorder and is characterized by a progressive chronic deposition and accumulation of extracellular grayish-white material in several organs including the eye. PEX can lead to a variety of intraocular problems that affect the eyes, particularly the lens and the trabecular meshwork. PEX also leads to structural changes in the retinal nerve fiber layer (RNFL) that can be detected by optical coherence tomography (OCT).

Aims and Objectives: The aims and objectives of the study are to compare mean RNFL thickness in patients having PEX with normal age-matched controls using spectral domain OCT (SD-OCT).

Materials and Methods: This case–control study was conducted at the Department of Ophthalmology, ASCOMS, Jammu, for 6 months on 88 eyes divided into two groups of 44 subjects each (Group A – subjects with PEX and normal intraocular pressure [IOP] and Group B – subjects with no evidence of ocular pathologies). Complete history and comprehensive ophthalmic examination were carried out in each subject. Statistical analysis of the data was done using the Statistical Packages for the Social Sciences version 19.0.

Results: In both groups, the majority of the participants were in the age group 61–70 years old, and male patients outnumbered female patients in both groups. There was no significant difference in IOP in both groups. Statistically significant differences were detected between the two groups for mean average RNFL thickness ($P = 0.019$) and mean RNFL thickness in the inferior quadrant ($P = 0.014$).

Conclusion: The patients having PEX with normal IOP and other visual fields have thin RNFL as compared to healthy age-matched controls.

Key words: Intraocular problems, Pseudoexfoliation syndrome, Systemic disorder

INTRODUCTION

Pseudoexfoliation syndrome (PEX) is a chronic, age-related systemic disorder of the extracellular matrix that leads to the accumulation of abnormal fibrillary (pseudoexfoliative) material within various ocular tissues,[1] which presents primarily through its characteristic ocular manifestations.[2] PEX is considered an age-related microfibillopathy that affects different systemic organs and is characterized by a progressive chronic deposition and accumulation of extracellular grayish-white material in several organs.[3]

PEX can lead to a variety of intraocular problems, including as phacodonesis, lens subluxation, open-angle glaucoma, corneal endothelial decompensation, and the formation of posterior synechiae. It is typified by the deposition of white, flaky deposits on the lens and iris.[4]

This condition affects the various intraocular structures, particularly the lens and the trabecular meshwork, which are responsible for regulating the flow of fluid in the eye.[5] PEX is more common in individuals over the age of 60 and is often associated with a higher risk of cataract development.[6]

By the age of 15, 29% of patients with unilateral PEX are at risk of developing clinically noticeable PEX in the

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other eye. PEX can exist in a bilateral or unilateral fashion. The most often recognized cause of secondary open-angle glaucoma is pseudoexfoliation glaucoma (PEG), which is significantly linked to elevated intraocular pressures (IOP) in as many as 44% of patients.[7]

In addition to high IOP, a number of pressure-independent variables are the primary risk factors for retinal nerve fiber layer (RNFL) loss and consequent glaucomatous damage in patients with PEX syndrome. Among these include decreased retinal and retrobulbar perfusion, aberrant lamina cribrosa elastic tissue, elevated aqueous humor protein concentration, prominent melanin deposition, and the exfoliating material itself.[7-10]

On the other hand, early structural changes in RNFL secondary to PEX have been reported and these changes can be detected by optical coherence tomography (OCT).[11,12]

Structural damage of the optic nerve head and RNFL in glaucoma may precede functional loss. About 30–50% of retinal ganglion cells may be lost before any visual field changes are detected. Spectral domain OCT (SD-OCT) is a computerized imaging technology that produces high-resolution, quantitative, and reproducible measurements of RNFL and retinal ganglion cell complex and helps in differentiating normal eyes from patients with early glaucoma.[13-15]

The objective of this study is to compare mean RNFL thickness in patients having PEX with normal age-matched controls using SD-OCT.

MATERIALS AND METHODS

This case–control study was conducted at the Department of Ophthalmology, Acharya Shri Chander College of Medical Sciences and Hospital, Jammu, for 6 months, January 2024–June 2024 after approval of the Institutional Ethics Committee. Before conducting the study, written consent was obtained from the subjects.

In the study, 88 eyes were divided into two groups of 44 subjects each.

Group A – Subjects of age more than 40 years with PEX and normal IOP (<21 mmHg), normal optic disc appearance (cup: disc ratio ≤0.3), and normal visual fields were included.

Group B – Subjects of more than 40 years of age with no evidence of ocular pathologies and normal IOP at three different successive measurements.

In the control group, one eye was selected randomly for analysis. Subjects with refractive error >±5 diopters, previous intraocular surgery, trauma or laser treatment, media opacities interfering with visualization and OCT image capturing, retinal pathology, family history of glaucoma, and history of diabetes mellitus or hypertension were excluded.

Subjects with systemic diseases or conditions were also excluded, such as diabetes mellitus, cardiovascular disease, dyslipidemia, renal failure, malignancy, autoimmune diseases, hematological diseases, chronic obstructive pulmonary disease, uncontrolled arterial hypertension, a history of transient ischemic attack or stroke, and a history of smoking as they might affect retinal thickness.

Complete history and comprehensive ophthalmic examination were carried out in each subject. IOP was checked with the Goldmann applanation tonometer. RNFL thickness was measured with an SD-OCT machine (Topcon 3D OCT-1000 Mark II) and circular OCT tomograms were acquired around the optic disc at the diameter of 3.4 mm. RNFL thickness was presented on a circular chart with four equal 90° hour sectors each representing one quadrant displaying RNFL thickness (micrometers) within each sector. Mean RNFL thickness and average RNFL thickness in four quadrants (superior, nasal, inferior, and temporal) were calculated automatically.

All the data were entered on a pre-devised data collection *pro forma*. Statistical analysis of the data was done using the Statistical Packages for the Social Sciences version 19.0. All the data were tested for normality before analysis. Descriptive statistics, that is, means ± standard deviation for quantitative variables (age, RNFL thickness, and IOP) and frequencies and percentages for qualitative variables (gender) were used. Fischer exact test was used for the analysis of qualitative variables between groups. An independent sample t-test was applied to compare the mean difference in RNFL thickness between Group A and Group B. A $P \leq 0.05$ was considered significant.

RESULTS AND OBSERVATIONS

Table 1 depicts the age distribution among study participants in both groups. It was found that in both groups, majority of the participants were in the age group of 61–70 years old, 50% of participants were in the PEX group, and 45.45% were in the control group [Figure 1].

Table 2 depicts the demographic data in both groups. The mean age of study participants in Group A was 63 ± 8.75 years and Group B was 62 ± 6.5 years, respectively. In both groups, male patients outnumbered female patients. Further, there was no significant difference in IOP in both groups.

Table 3 depicts the peripapillary RNFL thickness in both groups. It was found that the mean average peripapillary RNFL thickness was 76.29 ± 11.06 μm, whereas the mean peripapillary RNFL thickness of superior, inferior, nasal, and temporal quadrants was 94.07 ± 16.38 μm, 86.19 ± 19.36 μm, 60.47 ± 13.64 μm, and 61.98 ± 9.91 μm, respectively, in Group A. In Group B, the mean average peripapillary RNFL thickness was 82.56 ± 9.88 μm, whereas the mean peripapillary RNFL thickness of superior, inferior, nasal, and temporal quadrants was 101.19 ± 11.16 μm, 99.56 ± 18.54 μm, 62.46 ± 12.61 μm, and 67.36 ± 11.86 μm, respectively [Figure 2].

In our study, statistically significant differences were detected between the two groups for mean average RNFL thickness ($P = 0.019$) and mean RNFL thickness in the inferior quadrant ($P = 0.014$).

Table 1: Age distribution

Range (years)	PEX group, *n* (%)	Control group, *n* (%)
41–50	4 (9.09)	3 (6.81)
51–60	9 (20.45)	11 (25.0)
61–70	22 (50.0)	20 (45.45)
71–80	7 (15.90)	9 (20.45)
>80	2 (4.54)	1 (2.27)

Table 2: Demographic data (Group wise)

Parameter	PEX (Group A)	Control (Group B)
Age (years), mean±SD	63±8.75	62±6.5 years
Gender (male/female)	38/6	36/8
IOP (mmHg), mean±SD	13.60±2.04	13.19±1.99

SD: Standard deviation, IOP: Intraocular pressure

DISCUSSION

PEX is a complex and age-related systemic disorder characterized by the progressive accumulation and granular deposition of abnormal extracellular whitish

Table 3: Peripapillary retinal nerve fiber layer thickness (group wise)

Quadrant (μm)	PEX (Group A), mean±SD	Control (Group B), mean±SD	*P*
Average	76.29±11.06	82.56±9.88	0.019*
Superior	94.07±16.38	101.19±11.16	0.053
Inferior	86.19±19.36	99.56±18.54	0.014*
Nasal	60.47±13.64	62.46±12.61	0.486
Temporal	61.98±9.91	67.36±11.86	0.071

SD: Standard deviation, *significant at P ≤ 0.05

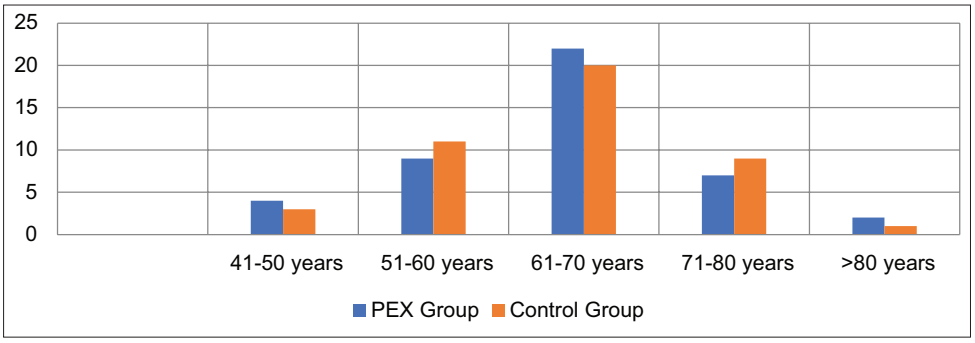

Figure 1: Age distribution

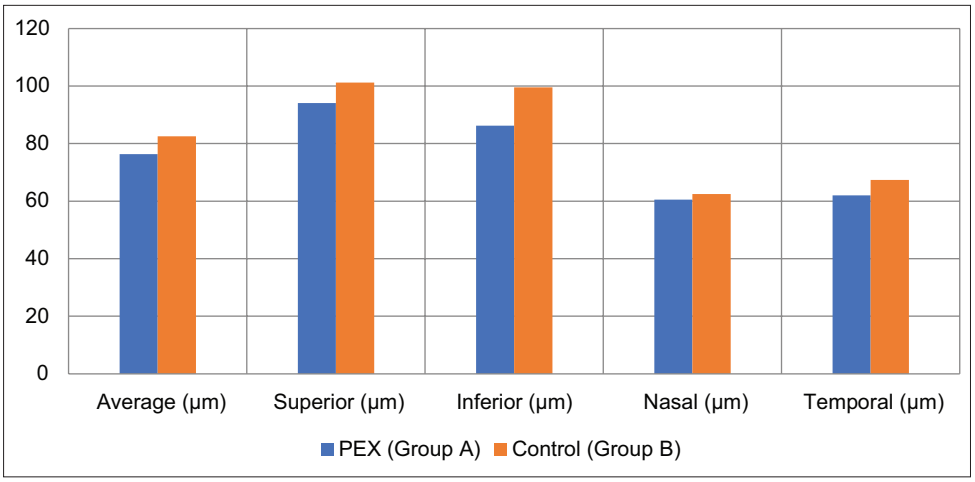

Figure 2: Mean peripapillary retinal nerve layer thickness in both groups

pseudoexfoliative material (PXM) in various intraocular and extraocular tissues. PXM is composed of amyloid, laminin, collagen, elastic fibers, and basement membrane, and the same material seen in ocular tissue has been shown in other parts of the body, such as the heart, liver, kidneys, lungs, cerebral meninges, vessel walls, and skin, indicating PEX is a diffuse disease with ocular and systemic manifestations.[16,17]

The prevalence of PEX increases markedly with age. It is estimated that up to 20% of the over 60 population may be affected.[13]

It was found that in both groups, majority of the participants were in the age group 61–70 years old, 50% of participants were in the PEX group, and 45.45% were in the control group. In both groups, male patients outnumbered female patients. Further, there was no significant difference in IOP in both groups. In a similar study conducted by Rao *et al.*, it was demonstrated that the prevalence of PEX increases markedly with age.[18] Similar results were found in the study conducted by Nawaz *et al.*[19] A male preponderance between 53.3% and 60% with mean ages between 56.2 and 73.9 years was reported by Ozmen *et al.* and Mohamed.[7,9]

In our study, significantly thinner mean average peripapillary RNFL thickness (76.29 μm vs. 82.56 μm) and mean RNFL thickness in the inferior quadrant (86.19 μm vs. 99.56 μm) was observed in the patients having PEX with normal IOP as compared to the age-matched healthy adults using SD-OCT. The results of our study are in concordance with a similar study conducted by Yasmeen *et al.* where in thinning of the average peripapillary and inferior quadrant was reported in patients having PEX syndrome.[20] Further, Nawaz *et al.* also reported the thinning of the same quadrants in the patients having PEX syndrome.[19]

CONCLUSION

It was concluded in our study that the patients having PEX syndrome with normal IOP and other visual fields have thin RNFL as compared to healthy age-matched controls. Further, routine ophthalmology assessment and follow-up of PEX patients with SD-OCT may help in the early diagnosis of PEX glaucoma.

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ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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