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Comparison of central corneal thickness (CCT) and intraocular pressure (IOP) in patients with pseudoexfoliation and healthy individuals without pseudoexfoliation

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ABSTRACT

BACKGROUND: The aim of a study was to compare the central corneal thickness (CCT) and intraocular pressure (IOP) in patients with pseudoexfoliation (PXF) and age-matched healthy individuals without PXF.

MATERIAL AND METHODS: This prospective comparative study was conducted at the Medical College Hospital in South India. The study was conducted on 100 patients who were divided into two groups. Patients with PXF were categorized as group 1 (50 patients) and healthy normal individuals without PXF as group 2 (50 patients). Visual acuity was recorded using Snellen's visual acuity chart. Anterior segment examination was done using a slit lamp. Central corneal thickness was measured using ultrasonic pachymetry. Intraocular pressure was measured using Goldmann applanation tonometer and corrected intraocular pressure (IOP) after pachymetry.

RESULTS: In group 1 mean age of patients was 64.76 ± 5.5 years. 18 (32%) were females, 32 (64%) were males. In group 2 mean age was 61.56 ± 5.1 years, with 29 (58%) males and 21 (42%) females. Central corneal thickness was significantly thinner in patients with PXF than in controls. The mean CCT in the PXF group was 536 ± 24 microns and the control group 561 ± 25 microns with a p-value of 0.03, which was statistically significant. Mean corrected IOP in the PXF group was 16.698 ± 6.70 mm Hg, and in the control group was 13.66 ± 2.14 mm Hg with p-value 0.00, which was statistically significant.

CONCLUSION: The study shows that corneas are thinner in patients with PXF as compared to controls. Hence CCT should be done in all the PXF patients, and the corrected IOP should be measured to prevent the false low estimation of IOP.

KEY WORDS: PXF; pseudoexfoliation; IOP; intraocular pressure; corrected IOP; corrected intraocular pressure; CCT; central corneal thickness

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INTRODUCTION

Pseudoexfoliation syndrome (PXF) is a microfibrillopathy with a genetic component. Single nucleotide polymorphism (SNP) of lysyl oxidase 1 gene (*LOXL1*) located on chromosome 15 is responsible for pseudoexfoliation syndrome and glaucoma [1].

Pseudoexfoliation syndrome is characterized by the production and accumulation of extracellular fibrillary material in various body tissues. Characteristic whitish powdery flake material is deposited over several ocular structures, including corneal endothelium, pupillary margin, anterior lens capsule (as shown in Fig. 1), zonules, ciliary body, trabecular meshwork. It is the most common cause of secondary open-angle glaucoma.

PXF diagnosis often requires a careful slit-lamp examination after pupillary dilation, and this condition frequently remains undiagnosed [2].

Central cornea thickness (CCT) is an integral component in the workup of any new patient suspected of having glaucoma. The CCT can be influenced by many factors, including ethnicity, genetics, age, glaucoma treatment, and the subtype of glaucoma. The measurement of CCT by the various devices is also not interchangeable. All these above factors need to be considered in the evaluation of glaucoma.

Goldmann applanation tonometry (GAT) has become the international "gold standard" for IOP measurements. A thick cornea would overestimate IOP, and a thin one would underestimate it.

This study aims to analyze and compare CCT in PXF patients and normal healthy individuals, which is one of the important independent variables in measuring accurate IOP.

MATERIALS AND METHODS

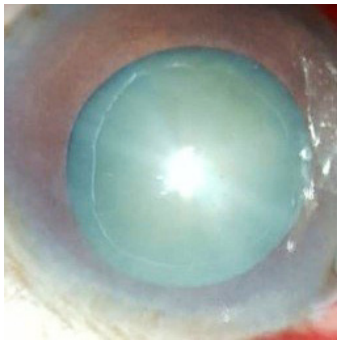

FIGURE 1. Pseudoexfoliation material deposited over the anterior lens capsule

This was a prospective comparative case-control study conducted at a Medical College Hospital in South India. The study was conducted on 100 patients who were divided into two groups. Patients with PXF were categorized as group 1 (50 patients) and healthy normal individuals without PXF as group 2 (50 patients). Written informed consent was obtained from all the patients participating in the study. Visual acuity was recorded using Snellen's visual acuity chart, and anterior segment examination was done using a slit-lamp biomicroscopy.

Central corneal thickness was measured using ultrasonic pachymetry. Ultrasound pachymetry was used to measure the central corneal thickness by a single observer. After a drop of anesthetic, repeated sets of five readings at the center of the cornea were taken until the standard deviation for the five readings was 5 µm or less.

Intraocular pressure was measured using a Goldmann applanation tonometer. Corrected IOP was measured after doing corneal ultrasonic pachymetry. Gonioscopy was performed to evaluate the angle structures and grade the angle by Shaffers grading. Dilated fundus examination was done, and optic disc changes were documented.

Inclusion criteria

Inclusion criteria were as follows:

- all patients with PXF were included in group 1;
- age-matched healthy individuals without PXF were included in group 2 (control).

Exclusion criteria

Exclusion criteria were as follows:

- previous ocular injury;
- history of ocular surgeries;
- corneal opacity;
- preexisting glaucoma.

RESULTS

This study was conducted on 100 patients, divided into two groups.

Patients with PXF were categorized as group 1 and healthy normal individuals without PXF as group 2. The age and sex distribution of the patients with and without PXF is presented in Tables 1 and 2.

In group 1 (patients with PXF) mean age was 64.76 ± 5.5 years. Among the 50 PXF patients, 18 (32%) were females, 32 (64%) were

Table 1. Age distribution of the patients

Age [years]	Group 1	Group 2
50-59	1 (2%)	16 (32%)
60-69	38 (76 %)	30 (60%)
≥ 70 e	11 (22%)	4 (8%)
Total	50 (100%)	50 (100%)

Table 2. Sex distribution of the patients

	Number	Males	Females
Group 1	50	32 (64%)	18(32%)
Group 2	50	29 (58%)	21(42%)

Table 3. Comparison of mean intraocular pressure distribution among group 1 and group 2

	Number	IOP (mean) [mm Hg]	p-value
Group 1	50	16.66 ± 6.59	0.048
Group 2	50	14.72 ± 1.79	

IOP — intraocular pressure

males. In group 2 (patients without PXF) mean age was 61.56 ± 5.1 years, with 29 (58%) males and 21 (42%) females.

The IOP was measured using Goldmann's applanation tonometer for all the patients. Mean IOP in group 1 was 16.66 ± 6.59 mm Hg compared to the mean IOP of 14.72 ± 1.79 mm Hg in group 2 (Tab. 3). The mean IOP in groups was compared by an independent sample test. It was not statistically significant (p-value = 0.048).

Central corneal thickness was measured using ultrasonic pachymetry in all patients in both groups. The CCT central corneal thickness was divided into ranges and observed for the frequencies in both groups (Tab. 4).

In group 1, 10% of patients had corneas < 500 microns, whereas, in group 2, none had cornea < 500 microns. Hence PXF patients in group 1 had a false low reading of IOP measurement due to thinner corneas.

Mean CCT in group 1 was 0.536 microns, whereas in group 2, it was 0.561 microns. The means were compared with the independent sample test, which showed a comparative p-value of 0.00 (statistically significant, Tab. 5).

Table 4. Central corneal thickness (CCT) distribution in group 1 and group 2

CCT (microns)	Group 1	Group 2
400–450	1 (2%)	0
451–500	4 (8%)	0
501–550	36 (72%)	20 (40%)
551–600	9 (18%)	26 (52%)
601–660	0	4 (8%)
Total	50 (100%)	50 (100%)

Table 5.Comparision of mean central corneal thickness (CCT) among group 1 and group 2

	Number	CCT (mean)	p-value
Group 1	50	536 ± 24 microns	0.00 (< 0.04)
Group 2	50	561 ± 25 microns	

Table 6. Corrected intraocular pressure (IOP) distribution among group 1 and group 2

Corrected IOP [mm HG]	Group1 Frequency (percentage)	Group2 Frequency (percentage)
10–15	25 (50%)	42 (76%)
16–20	14 (28%)	8 (16%)
21–25	7 (14%)	0
26–30	3 (6%)	0
> 31	1 (2%)	0
Total	50 (100%)	50 (100%)

After doing ultrasonic corneal pachymetry and obtaining the central corneal thickness values, corrected IOP was calculated for all the patients.

The corrected IOP distribution was divided into ranges and observed for the frequencies in both groups (Tab. 6).

In group 1, 11 patients (22%) had high IOP > 20 mm Hg, whereas in group 2, all patients had normal IOP < 20 mm Hg.

Corrected IOP among both groups was compared and analyzed by an independent sample test. The mean corrected IOP in group 1 was 16.698 ± 6.70 mm Hg, whereas, in group 2, it was 13.66 ± 2.14 mm Hg. The difference was statistically significant with a p-value of 0.003 (< 0.04) (Tab. 7).

Gonioscopy was performed using Goldmann 3 mirror lens. Shaffers grading was used to grade the angles, which showed open angles in all patients.

Table 7. Comparision of mean corrected intraocular pressure (IOP) among group 1 and group 2

	Number	Corrected IOP (mean) [mm Hg]	p-value
Group 1	50	16.69 ± 6.70	0.003
Group 2	50	13.66 ± 2.14	

Dilated fundoscopy performed in group 1 showed 11 patients with the cup — disc ratio of > 0.6 with corrected IOP > 21 mm Hg — suggested pseudoexfoliative glaucoma (PXG).

DISCUSSION

Glaucoma is the primary cause of irreversible blindness. World Health Organization (WHO) statistics indicate that glaucoma is the second leading cause of blindness. Pseudoexfoliation is the most common cause of secondary open-angle glaucoma.

Blue Mountains eye study showed that the incidence of glaucoma in eyes with PXF is nine times higher. They are associated with thinner corneas, which leads to a false low IOP [3].

Corrected IOP measurement is crucial in diagnosing and managing glaucoma, but invariably, various errors may affect the accuracy of measurements.

Various studies reported that thicker corneas lead to false high IOP and thinner corneas to false low IOP [4]. Gordon et al. [5] reported that a thin cornea was a risk factor for developing glaucoma. The risk of conversion in patients with CCT < 555 µm was over three times higher than in patients with corneas > 588 µm thick.

In our study, the mean age of patients with PXF was 64.76 ± 5.5 years. Among the 50 PXF patients, 18 (32%) were females, 32 (64%) were males. In patients without pseudoexfoliation mean age was 61.56 ± 5.1 years. In this group, 29 (58%) were males, and 21 (42%) were females.

A study conducted by Krysik et al. showed that the mean age of the study group was 73 ± 7.8 years (range:49–88 years), and that of the control group was 69 ± 9.3 years. 7 (range: 45–84 years). There was no statistically significant difference concerning gender and age between both groups (p > 0.05).

In our study, among the 50 PXF patients, 18 (32%) were females, and 32 (64%) were males. Thus, our study noted male preponderance similar to the studies done by Nishat et al. [8], where the male: female ratio in the PXF group was 1.7:1 and in the PXG group was 2.6:1.

In a study performed by Mccarty al. [9], 46% of PXF patients were men in the urban population, and 48% were men in the rural population. These results were similar to those obtained in our study, where the majority were males.

Spoorthy et al. found that in PXF eyes, CCT was thinner compared to the control eyes (statistically significant — p < 0.05) [10]. The resultss of a study conducted by Brindavolu et al. were similar — the CCT was thin in PXF group and PXG group [11].

In our study, the mean IOP in the group with PXF was 16.66 +/-6.59 mm Hg, in the control group — 14.72 +/- 1.79 mm Hg. The mean IOP before adjusting for CCT value was almost similar in both groups (p-value = 0.048, the difference was not statistically significant).

CCT measurement in both groups was statistically significant (p-value = 0.00): patients with PXF had significantly thinner corneas; hence, false low IOP measurements were recorded. The difference in corrected IOP after CCT correction among the two groups was statistically significant too. (p-value = 0.03).

A study conducted by Priyadarshini et al. found that the mean IOP was similar in both eyes of the control group. In the PXF group, the mean IOP was 13.1 mm Hg and 13.2 mm Hg in the right and left eyes. There was an increase of about 3.1 mm Hg in the corrected IOP of both eyes, which was statistically significant (p-value = 0.000) [12].

CONCLUSION

Our study shows that CCTs are thinner in patients with PXF as compared to controls without PXF. CCT should be performed in all patients with PXF and corrected IOP should be measured to prevent the false low estimation of IOP.

The early detection of glaucoma and its progression can be prevented by measuring CCT and corrected IOP in all patients with PXF.

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Conflicts of Interest

None declared.

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