

## Central corneal thickness and curvature changes in pseudoexfoliation eyes in comparison with normal eyes

S Spoorthy<sup>1\*</sup>, Subhash Chandra<sup>2</sup>

<sup>1</sup>Assistant Professor, Dept of Ophthalmology Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University. B G Nagara, Nagamangala taluk. Mandya District 571448

<sup>2</sup>Post Graduate Resident, Dept of Ophthalmology, Adichunchanagiri Institute of medical sciences, Adichunchanagiri University B G Nagara Nagamangala taluk. Mandya District.571448

Received: 26-06-2020 / Revised: 30-08-2020 / Accepted: 05-09-2020

### Abstract

**Background:** Pseudoexfoliation (PXF) syndrome results in the accumulation of PXF, particularly along the pupillary margin and throughout various structures in the anterior chamber of the eye. Many changes in various structures of the eye are observed secondary to the deposition of pseudoexfoliative material. This study is to observe the corneal curvatural and central corneal thickness changes due to pseudoexfoliation as compared to age related normal individuals without PXF. **Aims and objectives:** To compare central corneal thickness (CCT) and Central Corneal Curvature (CCC) changes in pseudoexfoliation eyes with normal eyes. **Material and methods:** A case control cross-sectional study conducted from January-June 2018 among elderly of 50-80 years, attending Ophthalmology outpatient department of a tertiary care hospital. Elderly patients (50-80 years), with or without PXF, underwent anterior and posterior segment examination, intraocular pressure, subjective refraction and CCT, CCC using AS-OCT. Data entered in MS EXCEL & statistical analysis performed with the help of SPSS 17.0 by using descriptive statistics like mean, percentage and were compared by chi square test. One-way analysis of variance (ANOVA) was used to compare the variables among the three groups. P<0.05 was taken as statistically significant. **Results:** CCT in PXF eyes was thinner (mean 509 +/- 15 microns) when compared to the normal (control) eyes (mean 549 +/- 6 microns). CCT in PXF glaucoma eyes was least (mean 498 +/- 10 microns). Central corneal curvature showed no variation among PXF eyes (mean 43.23 dioptres) and normal eyes (mean 43.58 dioptres). **Conclusion:** PXF eyes shows significantly thinner cornea and normal corneal curvature when compared to control eyes. PXF has no effect on corneal curvature. Further, PXF glaucoma eyes had thinnest CCT.

**Keywords:** central corneal thickness, pseudoexfoliation, central corneal curvature, pseudoexfoliation glaucoma

This is an Open Access article that uses a fund-ing model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided the original work is properly credited.

### Introduction

Pseudoexfoliation syndrome (PES) is an age-related condition characterized by the production and progressive accumulation of a fibrillar extracellular material in ocular tissues.

Accumulation of PXF material at the pupillary margin and throughout various structures in the anterior chamber of the eye is due to defectively silic oxidase like 1 gene.[1] It is an elastic microfibrilopathy involving TGF Beta, oxidative stress and impaired cellular protection mechanism as a key pathogenic factor. Signs suggestive of PXF syndrome are, deposition of PXF on corneal endothelium, over the iris causing rigid pupil and dispersion of pigments, over the anterior lens capsule, in the angles, over the zonules leading to zonular dehiscence and phacodonesis.[1] PXF deposition is also seen in heart, lung, liver, kidney.[1-

#### \*Correspondence

#### Dr. S Spoorthy

Assistant Professor, Dept of Ophthalmology Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University. B G Nagara, Nagamangala taluk. Mandya district 571448

E- mail: [drmedrx2020@gmail.com](mailto:drmedrx2020@gmail.com)

3]Prevalence of PES increases with age.[9]The stages of PES are pre-clinical stage, suspected exfoliation syndrome (pre-capsular stage), mini exfoliation syndrome (superonasal) and classic PES.

The presence of pseudoexfoliation (PE) material in the eye is one of the major risk factors for conversion to glaucoma in patients. It is reported by Grodum et al. that glaucoma conversion rate was twice as high in patients with ocular hypertension and PES (54 of 98 patients, 55.1%) as in control patients (27 of 98 patients, 27.6%) matched for age, sex and intraocular pressure (IOP) without PES after the mean of 8.7 years follow-up.[2]Accurate IOP measurement is an important factor in the diagnosis and management of glaucoma, but various sources of error may affect the accuracy of measurements. Central corneal thickness (CCT) is well known and affects the IOP readings. Many studies reported that thicker corneas lead to higher readings and thinner corneas to lower readings.[3] Gordon et al [4] showed that the presence of a thin cornea increased the chance of developing glaucoma, the risk of conversion in those with CCT <555  $\mu$ m being over 3 times higher than in those with corneas >588  $\mu$ m thick. It is well known that the patients with ocular hypertension have thick corneas and the patients with normotensive glaucoma have thin corneas. However, there are controversy reports about the CCT in eyes with PES or PE glaucoma (PEG) than the normal eyes; similar, [1,5-9] lower, [10-13] or higher. [14,15]. Corneal curvature (CC) is another factor affecting the IOP and CCT readings although the exact correlation is unclear. Hence it is of utmost importance to know the effects of PXF on the central corneal thickness and central corneal curvature; which can guide to near accurate measurements of IOP as well as be an effective tool in the diagnosis of glaucoma. Our aim of the study is to compare central corneal thickness (CCT) and curvature (CCC) changes in eyes with pseudoexfoliation, eyes with pseudoexfoliative glaucoma with normal eyes.

**Subjects and Methods:** A case control cross-sectional study conducted from January-June 2018 at the ophthalmology outpatient clinic of a tertiary care hospital, among 80 adults (50-80 years) with or without PXF, divided into control group with 40 normal subjects (without PXF) and the study group with 40 subjects with PES. The case study group were further divided into PES with glaucoma having 10 patients and PES without glaucoma containing 30 patients.

Patients with PXF glaucoma who were not on any anti glaucoma medications (first visit) were selected.

All study subjects underwent anterior and posterior segment examination, IOP by rebound tonometer, axial length (AL) using A-scan, subjective refraction, CCT using AS-OCT and CCC using Keratometer. Patients previously diagnosed with thin cornea, keratoconus, post LASIK surgery, previous intraocular surgery in the eye with PEX, patients on anti-glaucoma medications, with history of ocular trauma, uveitis, corneal scars, lens induced glaucoma and any other ocular pathology that could have led to secondary glaucoma were excluded from our study. This study was done after obtaining ethical committee clearance from the institution as well as written informed consent from the subjects. There was no drug trial done or other modalities of treatment imposed upon these subjects. There is no financial interest nor any conflict of interest  
**Statistical analysis:** Data entered in MS EXCEL & statistical analysis performed with the help of SPSS 17.0 by using descriptive statistics like mean, percentage and were compared by chi square test. One-way analysis of variance (ANOVA) was used to compare the variables among the three groups.  $P < 0.05$  was taken as statistically significant.

## Results

In our study, difference between the CCT in PXF eyes compared to normal eyes were statistically significant ( $p < 0.05$ ). CCT in PXF eyes was thinner (mean 509  $\pm$  15 microns) when compared to the normal (control) eyes (mean 549  $\pm$  6 microns). Mean IOP in both the groups were almost the same- 10 to 16 mm Hg as measured by rebound tonometer. Out of 40 patients with PXF, around 10 patients exhibit glaucomatous optic disc changes secondary to PXF; CCT in these PXF glaucoma eyes was the least (mean 498  $\pm$  10 microns). These patients were not on any anti glaucoma medications and mean IOP ranged between 18 to 23 mm Hg as measured by rebound tonometer. There were no statistically significant differences ( $p > 0.05$ ) between the study and control group with regard to CCC. Mean CCC in PXF eyes was 43.23 dioptres, PXF with glaucoma was 43.12D and normal eyes was CCC=43.58 dioptres). There were no significant differences between the study and control group with regard to AL readings.

**Table 1: showing the comparison of CCT and CCC of PXF eyes and the normal eyes.**

Groups	Central corneal thickness (micrometer)	Corneal curvature(diopetre)
Control groups (n=40)	549+/-6	43.58d
Pxf eyes (n=40)	509+/-15	43.23d
Pxf glaucoma eyes (n=10)	498+/-12	43.12d

## Discussion

Glaucoma is a sight threatening progressive condition and is irreversible unless there is early diagnosis, effective management, regular monitoring of the progression and careful handling of the risk factors. Pseudoexfoliative glaucoma is one of the secondary glaucomas that could be managed effectively if IOP is carefully controlled. IOP is in turn dependent on many factors, the contributions of corneal thickness and curvature is highly controversial.[5-9] [10-15]. In our study, CCT in PXF eyes was thinner (mean 509 +/- 15 microns) when compared to the normal (control) eyes (mean 549 +/- 6 microns). CCT in these PXF glaucoma eyes was the least (mean 498 +/- 10 microns). Mean central corneal curvature in PXF eyes was 43.23 dioptries; PXF with glaucoma was 43.12D and normal eyes 43.58 dioptries. The finding of the PXF group displaying a significantly thinner CCT mean of 509  $\mu$ m compared with the control group is similar to the study conducted by A C Ventura, [17] where CCT was significantly higher in ocular hypertensive cases and thinner in PXF eyes ( $p \leq 0.001$ ). Also, study conducted by Martin Bechmann et al, [19] CCT was significantly thinner in PXF (mean 493 +/- 33  $\mu$ m,  $p < 0.0001$ ).

In the study done by Ozcura et al, [18] mean CCT was significantly thinner in PXF eyes than in control eyes whereas there was no difference in CCT between PE glaucoma (PEG) and control eyes. This suggests the need to estimate CCT in PXF cases to avoid underestimating IOP that might mislead in initiation of treatment particularly in ocular hypertension with PXF. On contrary, in study of Ibrahim F et al; [16] the mean CCT 546.4 microns was not significantly different than the control eyes (mean 542.9 microns). Another study by Hepsen et al [5] reported that CCT was not significantly different than the control eyes. In our study the mean CCC showed no significant variation between the PXF eyes (mean CCC=43.21D) and normal eyes (mean CCC=43.58D). No significant curvatural changes were found even in the PXF glaucoma cases (mean CCC=43.12D). Our results were consistent with Ozcura et al [18] study, where there was no difference in mean CCC in the PES and control groups. In 22 unilateral PE eyes, mean CCC and K readings were insignificant. On contrary,

Ibrahim F et al study [16] showed PXS eyes had significantly steeper CCC in both normotensive PXS eyes (mean CCC=44.6D) and pseudoexfoliation glaucoma (PEXG) eyes (mean CCC=44.0 D). Hepsen et al [5] reported that CCC was significantly steeper in PES eyes than in control eyes. The limitations of our study were a small sample size, gender effects are not included and results may vary for PXF glaucoma with higher IOP.

## Conclusion

PXF eyes show significantly thinner cornea and normal corneal curvature when compared to control/normal eyes. PXF has no effect on corneal curvature. Further, PXF glaucoma eyes had thinner CCT than PES without glaucoma. Hence it is mandatory to estimate the CCT in PXF Eyes with or without glaucomatous changes prior to initiation of treatment. Future research could focus on undertaking a study with a larger cohort of participants in order to establish whether this was a representative finding of the greater PXF population.

## References

1. Arnarsson A, Damji KF, Sverrisson T, et al. Pseudoexfoliation in the Reykjavik Eye Study: prevalence and related ophthalmological variables. *Acta Ophthalmol Scand.* 2007;85:822–827.
2. Grodum K, Heijl A, Bengtsson B. Risk of glaucoma in ocular hypertension with and without pseudoexfoliation. *Ophthalmology.* 2005;112:386–390.
3. Doughty MJ, Zaman ML. Human corneal thickness and its impact on intraocular pressure measures: a review and metaanalysis approach. *Surv Ophthalmol.* 2000;44:367–408.
4. Gordon MO, Beiser JA, Brandt JD, et al. The Ocular Hypertension Treatment Study: baseline factors that predict the onset of primary open-angle glaucoma. *Arch Ophthalmol.* 2002;120:714–720.

5. Hepsen IF, Yağcı R, Keskin U. Corneal curvature and central corneal thickness in eyes with pseudoexfoliation syndrome. *Can J Ophthalmol.* 2007;42:677–680.
6. Rüfer F, Westphal S, Erb C. Comparison of central and peripheral corneal thicknesses between normal subjects and patients with primary open angle glaucoma, normal tension glaucoma and pseudoexfoliation glaucoma. *Klin Monatsbl Augenheilkd.* 2007;224:636–640.
7. Detorakis ET, Koukoulas S, Chrisohood F, et al. Central corneal mechanical sensitivity in pseudoexfoliation syndrome. *Cornea.* 2005;24:688–691.
8. Ventura AC, Bohnke M, Mojon DS. Central corneal thickness measurements in patients with normal tension glaucoma, primary open angle glaucoma, pseudoexfoliation glaucoma, or ocular hypertension. *Br J Ophthalmol.* 2001;85:792-795
9. Yağcı R, Eksioğlu U, Midillioglu I, et al. Central corneal thickness in primary open angle glaucoma, pseudoexfoliative glaucoma, ocular hypertension, and normal population. *Eur J Ophthalmol.* 2005;15:324–328.
10. Gorezis S, Christos G, Stefaniotou M, et al. Comparative results of central corneal thickness measurements in primary open-angle glaucoma, pseudoexfoliation glaucoma, and ocular hypertension. *Ophthalmic Surg Lasers Imaging.* 2008;39:17–21.
11. Aghaian E, Choe JE, Lin S, et al. Central corneal thickness of Caucasians, Chinese, Hispanics, Filipinos, African Americans, and Japanese in a glaucoma clinic. *Ophthalmology.* 2004;111:2211–2219.
12. Inoue K, Okugawa K, Oshika T, et al. Morphological study of corneal endothelium and corneal thickness in pseudoexfoliation syndrome. *Jpn J Ophthalmol.* 2003;47:235–239.
13. Bechmann M, Thiel MJ, Roesen B, et al. Central corneal thickness determined with optical coherence tomography in various types of glaucoma. *Br J Ophthalmol.* 2000;84:1233–1237.
14. Puska P, Vasara K, Harju M, et al. Corneal thickness and corneal endothelium in normotensive subjects with unilateral exfoliation syndrome. *Graefes Arch Clin Exp Ophthalmol.* 2000;238:659–663.
15. Stefaniotou M, Kalogeropoulos C, Razis N, et al. The cornea in exfoliation syndrome. *Doc Ophthalmol.* 1992;80:329–333.
16. Ibrahim F, Hepsen MD, Ramazan Yağcı MD, Urğcan Keskin MD. Corneal curvature and central corneal thickness in eyes with pseudoexfoliation syndrome, *Canadian Journal of Ophthalmol.* 2007;42(5): 677-680
17. Ventura ACS, Böhnke M, Mojon DS Central corneal thickness measurements in patients with normal tension glaucoma, primary open angle glaucoma, pseudoexfoliation glaucoma, or ocular hypertension *British Journal of Ophthalmology* 2001;85:792-795
18. Özcürü, Fatih MD Aydın, Sayime MD Dayanir, Volkan MD. Central Corneal Thickness and Corneal Curvature in Pseudoexfoliation Syndrome With and Without Glaucoma *Journal of Glaucoma:* 2011 ; 20 (7): 410–413
19. Bechmann M, Thiel MJ, Roesen B. Central corneal thickness determined with optical coherence tomography in various types of glaucoma *British Journal of Ophthalmology* 2000;84:1233-1237

**Source of Support:** Nil

**Conflict of Interest:** Nil