Original Research

A STUDY OF VISUAL OUTCOME OF CATARACT SURGERY IN PSEUDO EXFOLIATION AND TO EVALUATE ITS INTRAOPERATIVE AND POSTOPERATIVE COMPLICATIONS IN TERTIARY HEALTH CARE HOSPITAL

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ABSTRACT

Background: Pseudo-exfoliation is an age-related systemic disorder characterized by deposition of abnormal fibrillar material on ocular tissues, leading to poor pupillary dilatation, zonular weakness, and increased risk of complications during cataract surgery. Cataract extraction in PXF eyes is therefore considered surgically challenging. The present study was undertaken to evaluate the visual outcome of cataract surgery in patients with pseudoexfoliation and to analyze associated intraoperative and postoperative complications.

Methods: This hospital-based observational study was conducted in the Department of Ophthalmology, People's College of Medical Sciences and Research Centre, Bhopal, over 18 months. A total of 58 patients aged ≥50 years with senile cataract associated with pseudoexfoliation were included. Detailed preoperative evaluation included BCVA (Best-Corrected Visual Acuity), intraocular pressure measurement, gonioscopy, slit-lamp examination, and cataract grading. All patients underwent SICS (Small Incision Cataract Surgery). Patients were followed postoperatively on day 1, day 3, and at 1 month for visual outcomes and complications.

Results: The mean age of patients was 68.16 ± 11.70 years, with slight male predominance (51.72%). Poor pupillary dilatation was observed in 36.21% of cases. Intraoperative complications included zonular dialysis (6.8%), posterior capsule rupture (5.1%), vitreous loss (3.4%), and aphakia (1.7%). Early postoperative complications included corneal edema (32.76%), iritis (32.76%), raised intraocular pressure (24.14%), hyphema (8.62%), retained lens matter (5.17%), and IOL decentration (6.90%). At 1 month postoperatively, 91.38% of eyes achieved visual acuity between 6/6 and 6/12. Zonular dialysis showed a significant association with posterior capsule rupture ($p < 0.0001$).

Conclusion: Pseudoexfoliation significantly increases the complexity of cataract surgery because of poor mydriasis and zonular instability. Careful preoperative evaluation, meticulous surgical technique, and appropriate postoperative management can achieve satisfactory visual outcomes, despite higher intraoperative and postoperative complication rates.

Keywords: Pseudoexfoliation Syndrome, Cataract Surgery, Visual Outcome, Zonular Dialysis, Posterior Capsule Rupture, Intraoperative Complications, Post-Operative Complications.

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INTRODUCTION

Pseudoexfoliation syndrome is an age-related systemic disorder characterized by the progressive accumulation of abnormal fibrillogranular extracellular material in both ocular and extraocular tissues. In the eye, this material is most commonly deposited on anterior segment structures, especially the anterior lens capsule,

where it appears as a characteristic central disc, a clear intermediate zone, and peripheral granular ring.[1] Pseudoexfoliation is clinically significant because it is strongly associated with cataract formation, chronic open-angle glaucoma, and increased risk of intra-operative and post-operative complications during cataract surgery.[2]

Cataract surgery in eyes with pseudoexfoliation is considered surgically challenging. Earlier studies reported a five- to ten-fold increase in intraoperative complications in such eyes. The major factors contributing to surgical difficulty are poor pupillary dilatation and zonular weakness. These abnormalities predispose patients to complications such as zonular dialysis, posterior capsular rupture, vitreous loss, shallow anterior chamber, and nucleus dislocation during surgery. Postoperatively, complications including corneal edema, increased intraocular pressure, anterior chamber inflammation, posterior capsular opacification, and intraocular lens (IOL) decentration are more frequently observed.[3]

Clinically, pseudoexfoliative material appears as white dandruff-like deposits over the pupillary margin, iris, corneal endothelium, and trabecular meshwork. Associated ocular findings include pupillary ruff atrophy, pigment dispersion, iris transillumination defects, and elevated intraocular pressure.[4] The prevalence of PXF varies widely across populations, ranging from 1–2% in some Western populations to as high as 38% in Navajo Indians. In India, the prevalence is approximately 3.8% among individuals above 40 years of age.[5]

Pseudoexfoliation is now recognized as a systemic disorder, with deposits identified in organs such as the heart, lungs, kidneys, and blood vessels.[6] Despite advances in surgical techniques and the availability of adjunctive devices such as capsular tension rings and iris retractors, cataract surgery in PXF patients continues to require meticulous preoperative evaluation and careful intraoperative management to achieve satisfactory visual outcomes.[6-8]

Aims and Objectives

The aim of the present study was to evaluate the visual outcome of cataract surgery in patients with pseudoexfoliation syndrome and to assess the intraoperative and postoperative complications associated with cataract surgery in these patients. The study also aimed to evaluate the anterior segment changes seen in eyes with pseudoexfoliation, including pupillary abnormalities, pseudoexfoliative deposits, and zonular weakness, in order to better understand the surgical challenges and outcomes associated with this condition.

MATERIALS AND METHODS

Study Design: This was a hospital-based observational study conducted in the Department of Ophthalmology at Peoples College of Medical Sciences and Research Centre, Bhopal, over a period of 18 months from March 2024 to September 2025. The study included patients aged 50 years and above, of either sex, who were clinically diagnosed with senile cataracts associated with PXF (Pseudoexfoliation Syndrome). Patients willing to undergo cataract surgery and adhere to regular postoperative follow-up were enrolled in the study to evaluate visual outcomes and associated intraoperative and postoperative complications.

Inclusion and Exclusion Criteria: The study included patients aged 50 years and above, of either sex, who had senile cataracts with clinical evidence of pseudoexfoliation syndrome and were willing to undergo cataract surgery with regular postoperative follow-up. Patients younger than 50 years; cataracts of developmental, juvenile, or traumatic origin; cataract patients without pseudoexfoliation; individuals with a history of previous intraocular surgery such as glaucoma surgery; posterior segment pathologies including retinal detachment or macular degeneration; and patients with uncontrolled diabetes mellitus or hypertension were excluded from the study.

Sample Size Calculation: A sample size of 58 cases was calculated using the formula:

$N = p(1–p)z^2/e^2$,

Where

- P = 0.0095 (proportion of PXF in rural Central India)
- z = 1.96 (Z-score for 95% confidence)
- e = 0.025 (allowable margin of error)

Data Collection Procedure: Data collection was carried out through detailed preoperative, intraoperative, and postoperative evaluation of all enrolled patients. Patients were admitted one day prior to surgery and underwent a comprehensive ophthalmic assessment, including best-corrected visual acuity using Snellen's chart, intraocular pressure measurement by applanation tonometry, gonioscopy graded according to Shaffer's classification, slit-lamp biomicroscopy for detection of pseudoexfoliative material, and cataract grading using the LOCS (Lens Opacities Classification System). Pupillary dilatation was graded as poor, moderate, or good based on pupil size after pharmacologic dilatation. All surgeries were performed by a single surgeon using SICS (Small Incision Cataract Surgery) with appropriate modifications in cases of small pupils or zonular weakness. Intraoperative findings such as poor pupillary dilatation, zonular dialysis, posterior capsule rupture, vitreous loss, and use of surgical adjuncts were recorded. Postoperatively, patients were followed on day 1, day 3, and at 1 month to assess visual acuity, intraocular pressure spikes, corneal clarity, corneal edema, iritis, hyphema, retained lens matter, IOL decentration, and other complications using slit-lamp examination. Demographic details including age, gender, education, and occupation were also collected, and all findings were systematically documented for analysis of visual outcomes and associated complications.

Statistical Analysis: All collected data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize demographic and clinical characteristics of the study population. Categorical variables such as gender, age group, cataract grade, pupillary dilatation, intraoperative complications, and postoperative complications were expressed as frequencies and percentages. Continuous variables, including age, were presented as mean ± standard deviation along with minimum and maximum values. Associations between categorical variables were analyzed using the chi-square (χ^2) test. All statistical tests were two-tailed, and a p-value of less than 0.05 was considered statistically significant.

RESULTS

Variable	Category	Number (n)	Percentage (%)
Age Group	50–59 years	17	29.31
	60–69 years	13	22.41
	70–79 years	18	31.03
	80–89 years	10	17.24
Gender	Male	30	51.72
	Female	28	48.28
Table 1: Demographic Profile of Study Population (n = 58)			
Mean age: 68.16 ± 11.70 years **Range:** 51–89 years			

Table 1 illustrates the demographic distribution of the study population. The majority of patients belonged to the 70–79 years age group (31.03%), followed by 50–59 years (29.31%). The mean age was 68.16 ± 11.70 years, indicating that pseudoexfoliation syndrome was predominantly seen in elderly individuals. Males constituted 51.72% of the study population, while females accounted for 48.28%, showing a slight male predominance.

Variable	Category	Number (n)	Percentage (%)
Systemic Comorbidity	DM only	16	27.59
	HTN only	19	32.76
	DM + HTN	14	24.14
	None/Not recorded	9	15.52
Laterality	Unilateral	33	56.90
	Bilateral	25	43.10
Table 2: Systemic Comorbidities and Laterality of Disease			

Table 2 observes the systemic comorbidities and laterality among study subjects. Hypertension alone was the most common systemic illness (32.76%), followed by diabetes mellitus alone (27.59%). Nearly one-fourth of patients had both diabetes and hypertension. Unilateral involvement was more common (56.90%) than bilateral involvement (43.10%), indicating that pseudoexfoliation frequently affects one eye at presentation.

Variable	Category	Number (n)	Percentage (%)
Cataract Grade	Hypermature	23	39.66
	Mature	13	22.41
	Nuclear cataract	14	24.00
	Nuclear cataract + PSC	8	13.70
PXF Deposits	Pupillary margin	25	43.10
	Lens capsule + Pupillary margin	15	25.80
	Lens capsule + Pupillary margin + Iris	10	17.20
	Iris + Pupillary margin	6	10.30
	Cornea + Pupillary margin	2	3.40
Table 3: Cataract Grade and Location of Pseudoexfoliative Deposits			

Table 3 demonstrates the distribution of cataract grades and pseudoexfoliative deposits. A hypermature cataract was the most common presentation (39.66%), suggesting delayed presentation of a cataract in

pseudoexfoliation syndrome. The most frequent site of pseudoexfoliative material deposition was the pupillary margin (43.10%), followed by combined lens capsule and pupillary margin involvement.

Variable	Category	Number (n)	Percentage (%)
Pupillary Dilatation	Poor (2–4 mm)	21	36.21
	Moderate (5–6 mm)	37	63.79
Shaffer Gonioscopy Grade	Grade 2	2	3.40
	Grade 3	26	44.00
	Grade 4	30	51.00

Table 4: Pupillary Dilatation and Gonioscopy Findings

Table 4 illustrates preoperative pupillary dilatation and gonioscopy findings. Poor pupillary dilatation was observed in 36.21% of cases, indicating increased intraoperative difficulty in a significant proportion of patients. Grade 4 Shaffer gonioscopy was the most common finding (51%), followed by Grade 3 (44%).

Variable	Number (n)	Percentage (%)
Zonular dialysis	4	6.80
Posterior capsular rupture (PCR)	3	5.10
Vitreous loss	2	3.40
Aphakia	1	1.70
Viscomydriasis used	39	67.24
Sphincterotomy performed	19	32.76

Table 5: Intraoperative Complications and Interventions

Table 5 observes the intraoperative complications and interventions among study subjects. Zonular dialysis was the most common intraoperative complication (6.8%), followed by posterior capsular rupture (5.1%). Viscomydriasis was the most frequently employed intervention (67.24%) for inadequate pupillary dilatation, while sphincterotomy was required in 32.76% of cases.

Complication	Number (n)	Percentage (%)
Corneal edema	19	32.76
Raised IOP	14	24.14
Hyphema	5	8.62
IOL decentration	4	6.90
Retained lens matter	3	5.17
Irregular pupil (1 month)	19	32.76
Aphakia	1	1.70

Table 6: Early and Late Post-Operative Complications

Table 6 demonstrates the postoperative complications observed during follow-up. Corneal edema was the most common early postoperative complication (32.76%), followed by raised intraocular pressure (24.14%). At the 1-month follow-up, irregular pupils remained the most common persistent complication, whereas most transient complications resolved within the first postoperative week.

Visual Acuity Category	Pre-Operative n (%)	POD 1 n (%)	POD 3 n (%)	1 Month n (%)
6/6–6/12	0 (0)	1 (1.72)	37 (63.79)	53 (91.38)
6/18–6/36	0 (0)	45 (77.59)	20 (34.48)	4 (6.80)
6/60 or worse	58 (100)	12 (20.69)	1 (1.70)	1 (1.70)

Table 7: Visual Acuity Outcomes Following Cataract Surgery

Table 7 illustrates the progressive improvement in postoperative visual acuity following cataract surgery in pseudoexfoliation patients. Preoperatively, all patients had visual acuity of 6/60 or worse. By postoperative day 3, 63.79% achieved visual acuity between 6/6 and 6/12, and by 1 month, 91.38% attained good visual outcomes, indicating successful visual rehabilitation despite the higher surgical risk associated with pseudoexfoliation syndrome.

DISCUSSION

PXF is an age-related disorder commonly encountered in elderly patients undergoing cataract surgery. Careful preoperative slit-lamp evaluation is essential because

PXF may be overlooked in routine cataract screening. Identification of pseudoexfoliative deposits, poor pupillary dilatation, phacodonesis, and zonular weakness is important for anticipating surgical difficulty. Histopathologically, PXF material is an abnormal fibrillar extracellular protein produced from basement membrane metabolism and has also been reported in extraocular tissues, suggesting a systemic disorder.[2,4]

In the present study, the mean age was 68.16 ± 11.70 years, with the majority of patients belonging to the 70–79 years age group. A similar age distribution was reported by Vybhavi et al., Chauhan et al., and Pracheeet al.[9,10,11] This supports the established concept that PXF is predominantly a disease of advanced age.

Gender distribution was nearly equal, with slight male predominance (51.72%). Similar findings were observed by Chauhan et al. and Deepa et al., whereas Avramides et al. reported female predominance.[9,12,13] These differences may reflect geographic and demographic variations rather than true biological differences.

Systemic comorbidities were common in the present study, particularly hypertension and diabetes mellitus. These vascular disorders may contribute to impaired endothelial recovery, postoperative inflammation, and IOP fluctuations. Bilateral involvement was observed in 43.10% of patients, supporting the concept that PXF is essentially bilateral but often asymmetrical clinically. Hammer et al. demonstrated ultrastructural involvement even in clinically unaffected fellow eyes.[14]

A hypermature cataract was the most common cataract type observed, indicating delayed presentation. Similar findings were reported by Deepa et al., and Alfaiate et al.[12,15] Advanced cataracts increase surgical complexity because of dense nuclei and fragile zonules. The most common location of pseudoexfoliative deposits in this study was the pupillary margin, followed by lens capsule involvement. Similar anterior segment distribution has been described by Hemalatha et al., Chauhan et al., Deepa et al., and Moreno et al.[8,9,12,16] Pupillary margin deposits correlate strongly with poor mydriasis and iris sphincter atrophy.

Poor pupillary dilatation was observed in 36.21% of eyes, while the remaining showed moderate dilatation. No patient had good dilatation. Similar observations were made by Chauhan et al. and Kaushik et al.[17,9] PCR (Posterior Capsular Rupture) and other intraoperative complications were slightly more frequent in poorly dilating pupils, although statistical significance was not demonstrated ($\chi^2 = 0.23$, $p = 0.89$). Timely intraoperative measures such as viscomydriasis and sphincterotomy may have reduced complication rates.

The gonioscopy profile showed predominantly Shaffer grade 3 and grade 4 angles. Although not directly correlated with postoperative IOP rise, pseudoexfoliative material in the trabecular meshwork may predispose to secondary open-angle glaucoma and postoperative IOP fluctuations.

Intraoperative complications included zonular dialysis (6.8%), posterior capsule rupture (5.1%), vitreous loss (3.4%), and aphakia (1.7%). Viscomydriasis was performed in 67.24% and sphincterotomy in 32.76% of cases. Similar complication rates have been reported by Hemalatha et al., Kaushik et al., Chauhan et al., Deepa et al., and Joshi et al.[8,17,9,12,18]]

A significant association was observed between zonular dialysis and posterior capsule rupture. PCR occurred in 75% of eyes with zonular dialysis, while none of the eyes without zonular weakness developed PCR ($\chi^2 = 42.1$, $p < 0.0001$). Similar findings were described by Kaushik et al., Assia et al., and Shingleton et al., emphasizing that zonular instability is a major predictor of capsular complications.[17,19]

Postoperative complications included corneal edema (32.76%), iritis (32.76%), irregular pupil (32.76%), raised IOP (24.14%), hyphema (8.62%), IOL decentration (6.90%), retained lens matter (5.17%), and aphakia (1.7%). Corneal edema was the most common early complication, similar to studies by Hemalatha et al., Chauhan et al., Deepa et al., and Dwivedi et al.[8,9,12,20] These complications were mostly transient and resolved within the first postoperative week.

At the 1-month follow-up, persistent complications were mainly structural, including an irregular pupil and mild IOL decentration. One aphakic patient was advised secondary scleral-fixated IOL implantation. Despite these complications, visual outcomes improved progressively over time.

Preoperatively, most patients had severe visual impairment, with hand movements being the most common presenting visual acuity (62.07%). On post-operative day 1, most eyes achieved vision between 6/18 and 6/36. By postoperative day 3, 63.79% achieved visual acuity between 6/6 and 6/12, and by 1 month, 91.38% achieved visual acuity between 6/6 and 6/12. Similar favourable outcomes were reported by Kaushik et al., Chauhan et al., Deepa et al., Pranathi et al., and Chandrasekharan et al.[17,9,12,21,22]

The present study confirms that pseudoexfoliation significantly increases the complexity of cataract surgery because of poor pupillary dilatation, zonular weakness, and higher intraoperative and postoperative complication rates. However, with careful preoperative evaluation, appropriate intraoperative modifications, and close postoperative follow-up, satisfactory visual outcomes can still be achieved in the majority of patients.

Limitations

The present study had certain limitations, including a short postoperative follow-up period of one month, which limited assessment of long-term complications such as posterior capsular opacification, late IOL decentration, and glaucoma progression. Detailed corneal endothelial evaluation was not performed in all

patients due to limited availability of specular microscopy, and advanced imaging modalities like AS-OCT was not routinely used. Additionally, financial constraints prevented the routine use of advanced surgical adjuncts such as capsular tension rings and pupil expansion devices, which may have influenced surgical outcomes.

CONCLUSION

Pseudoexfoliation increases the complexity of cataract surgery due to poor pupillary dilatation, zonular weakness, and a higher risk of intraoperative and postoperative complications such as zonular dialysis, posterior capsule rupture, vitreous loss, IOP spike, corneal edema, hyphema, retained lens matter, and IOL decentration. Despite these challenges, most patients showed significant improvement in visual acuity by postoperative day 3 and at 1 month. Careful preoperative assessment, meticulous surgical technique, prompt management of complications, and adequate postoperative care are essential for achieving satisfactory visual outcomes in patients with pseudoexfoliation.

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