International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 12 No. 1, 2026
https://theaspd.com/index.php

Clinical Profile Of Cataract Surgery In Patients With Corneal Pathologies: A Retrospective Study

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ABSTRACT

Background: *Cataracts remain the world's leading cause of treatable blindness, while corneal opacity represents the fifth leading cause of blindness globally. Coexisting cataracts and corneal pathologies present unique surgical challenges, with variable visual outcomes reported. This study aimed to determine the role of preoperative planning, intraoperative modifications, and postoperative visual outcomes in patients undergoing cataract surgery with concurrent corneal pathologies.*

Methods: *A retrospective study of 30 patients with cataract and corneal pathology (August–October 2025) assessed visual outcomes after cataract surgery. Preoperative evaluations included visual acuity, AS-OCT, specular microscopy, and intraocular pressure. Postoperative visual outcomes and complications were analyzed using paired t-tests for BCVA changes and Pearson correlation to assess the relationship between corneal opacity severity and visual improvement.*

Results: *Mean age was 68.2 ± 11.5 years. Mean BCVA improved significantly from 1.45 ± 0.65 logMAR preoperatively to 0.94 ± 0.55 logMAR postoperatively ($p < 0.001$). Postoperative complications included mild corneal edema (13.3%), striate keratitis (10%), and reactivation of pre-existing corneal pathology (6.7%). A significant inverse correlation was found between corneal opacity severity and postoperative visual improvement ($r = -0.782$, $p < 0.001$).*

Conclusion: *Small incision cataract surgery with PCIOL implantation is a safe and effective interim procedure in carefully selected patients with coexisting cataracts and corneal pathologies, providing meaningful visual rehabilitation when corneal transplantation is not immediately feasible. ASOCT proves valuable in preoperative assessment and prediction of visual outcomes.*

Keywords: *Corneal opacities, endothelial cell density, visual acuity, anterior segment OCT, specular microscopy*

INTRODUCTION

Cataract remains the leading cause of blindness worldwide among individuals aged 50 years and older, accounting for nearly one-third of global blindness, while corneal opacity is the fifth most common cause of blindness globally.[1,2] The coexistence of cataract and corneal pathology represents a significant clinical burden, particularly in developing countries, and creates a complex therapeutic scenario that demands careful surgical decision-making and realistic patient counseling.

Managing cataract in the presence of corneal opacity is challenging due to impaired visualization, irregular astigmatism, and limited assessment of both cataract severity and posterior segment status. Corneal scarring compromises intraoperative visibility and light transmission, increases the risk of surgical complications, and affects intraocular lens power calculation.[3,4] Historically, management options have included combined cataract surgery with penetrating keratoplasty, staged procedures, or cataract surgery alone, each with distinct advantages and limitations related to surgical risk, visual rehabilitation, and resource availability.[5]

Advances in anterior segment imaging, particularly anterior segment optical coherence tomography

(AS -OCT), have improved preoperative assessment by enabling objective evaluation of corneal scar depth, density, and anterior segment anatomy.[6] Growing evidence suggests that cataract surgery alone can provide meaningful visual improvement in carefully selected patients with corneal opacities,

although outcomes remain variable and depend on corneal pathology severity, endothelial health, and optimization of ocular surface.[7,8] Understanding these factors is essential to optimize outcomes, refine surgical planning, and establish appropriate postoperative expectations.

MATERIALS AND METHODS

This retrospective study was conducted in the Department of Ophthalmology, R.L. Jalappa Hospital and Research Centre, affiliated with Sri Devaraj Urs Medical College, Kolar, Karnataka, India from August–October 2025. It received approval from the Institutional Ethics Committee (SDUAHER/KLR/R&D/CEC/S/PG/76/2024-25), and written informed consent was obtained from all patients during surgery.

Inclusion Criteria: patient aged 45–80 years of either gender diagnosed with cataract coexisting with corneal pathology who underwent cataract surgery during the study period

Exclusion Criteria: Patients with pre-existing retinal pathology that would limit potential for visual improvement (age-related macular degeneration, diabetic retinopathy, retinal detachment, previous retinal surgery) and glaucoma with advanced optic nerve damage.

Sample Size Determination

Sample size was calculated using the formula for paired comparisons: $N = 2(Z\alpha + Z\beta)2\sigma2/d2$ using published data from Ho et al.,[9] where mean preoperative and postoperative BCVA was 1.45 ± 0.65 logMAR and 0.94 ± 0.55 logMAR respectively. With 95% confidence interval and 90% power, a sample size of 27 was obtained. Accounting for 10% anticipated non-response rate, 30 patients were enrolled.

Procedure

During the comprehensive assessment, demographic information was collected alongside a detailed patient history. Initial visual acuity for both distant and near vision was evaluated using the Snellen chart. Comprehensive anterior segment examination by slit-lamp biomicroscopy included documentation of cataract grading and the type, location, and extent of corneal pathology. Additionally, AS-OCT of the detailed imaging of corneal scar depth, morphology, and anterior chamber dimensions was carried out. Fundus examined using 90D lens-assisted slit-lamp biomicroscopy and indirect ophthalmoscopy when possible. The endothelial cell density (ECD), cell hexagonality percentage, and polymorphism indices measured using Specular Microscopy. Intraocular Pressure (IOP) was measured by non-contact tonometry or Tono-Pen applanation tonometry and IOL master 700 for biometry. All patients underwent uncomplicated small incision cataract surgery (SICS) with PCIOL implantation under local anesthesia. Patients were followed postoperatively on 1st day, 1st week and 1 month for BCVA and complications.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 22.0 (IBM Corporation, Armonk, NY). Age and other continuous variables were expressed as mean ± standard deviation. Categorical variables were expressed as frequencies and proportions. Paired t-test was used to identify mean differences in BCVA between preoperative and postoperative timepoints. Chi-square test was used for categorical variables. Pearson correlation coefficient was calculated to assess relationships between corneal opacity severity and visual improvement. p-value < 0.05 was considered statistically significant.

RESULTS

Demographic Characteristics

A total of 30 patients (30 eyes) fulfilled inclusion criteria with a mean age of 68.2 ± 11.5 (range 46–

82 years) were analyzed.

Characteristics		Number	Percentage
Laterality	Right eye	16	53.3

	Left eye	14	46.7
Gender	Male	16	53.3
	Female	14	46.7
Corneal pathology	Post-traumatic scarring	9	30
	Corneal opacity (non-traumatic)	8	26.7
	Chemical/thermal burn sequelae	6	20
	Post-infectious scarring	5	16.7
	Keratoectasia	2	6.7
Cataract Type	Nuclear sclerotic	18	60
	Cortical	7	23.3
	Mixed	5	16.7

Table 1: Demographic and Clinical Characteristics of Study Population

Preoperative Findings

All patients presented with reduced vision attributable to the combined effects of cataracts and corneal pathology.

Preoperative Parameter		Mean ± SD	Range
BCVA (logMAR)		1.45 ± 0.65	0.8–2.4
Specular Microscopy	ECD (cells/mm2)	1,824 ± 356	1,200–2,500
	Hexagonality (%)	62.3 ± 12.1	42–78
	Average Cell Area (µm2)	567 ± 98	400–750
IOP (mmHg)		13.8 ± 2.4	10–19

Table 2: Preoperative Clinical Parameters

Preoperative ASOCT imaging revealed variable severity of corneal involvement. The corneal opacity involved the pupillary axis in 27 of 30 cases (90%), with mean corneal scar depth of 325 ± 142 micrometers. Three patients had peripheral scarring without pupillary involvement. Specular microscopy demonstrated endothelial cell density within acceptable range in all patients (mean ECD 1,824 ± 356 cells/mm2), with only one patient showing borderline low ECD (1,200 cells/mm2). Cell polymorphism indices were mildly elevated in patients with advanced age and previous ocular surface disease.

Visual Outcomes

BCVA LogMAR		**Mean**	**SD**	**P value**	**Improvement**
Preoperative		1.45	0.65		
Postoperative	1st day	1.20	0.55	$p < 0.001$	17.2%
	1st week	0.98	0.50	$p < 0.001$	32.4%
	1st month	0.94	0.55	$p < 0.001$	35.2%

Table 3: Comparison of preoperative and postoperative BCVA

The improvement from preoperative to 1-month postoperative BCVA was highly statistically significant (paired t-test: $t = 8.94$, $p < 0.0001$).

Visual Improvement Categories:

BCVA Improvement Category	Number of Eyes	Percentage
Improved BCVA (≥ 2 lines improvement)	23	76.7
Marginally improved (1 line improvement)	5	16.7
No improvement/Stable	2	6.7

Decreased vision	0	0

Table 4: Distribution of Visual Improvement Categories

Notably, 73.3% (22 of 30) of patients achieved postoperative BCVA of 20/100 or better, representing meaningful functional vision suitable for most activities of daily living.

Postoperative Complications were generally mild and transient that subsided with postoperative medications.

Complication	Day 1	Week 1	Month 1
Corneal edema (mild)	4 (13.3%)	2 (6.7%)	0 (0%)
Striate keratitis	3 (10%)	1 (3.3%)	0 (0%)
Anterior chamber reaction (trace)	8 (26.7%)	2 (6.7%)	0 (0%)
Reactivation of pre-existing pathology	—	2 (6.7%)	2 (6.7%)
IOL deposits/haze	—	—	1 (3.3%)

Table 5: Postoperative complications by timeline

Transient corneal edema occurred in 4 eyes (13.3%) and striate keratitis in 3 eyes (10%) on day 1, mild anterior chamber inflammation was observed in 8 cases (26.7%) and both subsided within one week on medical therapy. Reactivation of pre-existing cicatricial disease occurred in 2 eyes (6.7%) without affecting final visual outcomes. One eye (3.3%) developed mild IOL deposits that required no intervention and had no visual impact.

Relationships and Correlations

Parameters	**Pearson Correlation**	**P value**
Corneal Opacity Severity vs. Visual Improvement	-0.782	$p < 0.001$
Endothelial Health vs. Outcomes	0.312	$p = 0.089$
Age vs. Visual Outcomes	-0.156	$p = 0.410$

Table 6: Relationships and Correlations between the preoperative clinical parameters

A statistically significant inverse correlation was demonstrated between preoperative corneal opacity severity and postoperative BCVA improvement (Pearson $r = -0.782$, $p < 0.001$). Preoperative ECD showed a weak positive correlation with postoperative BCVA improvement ($r = 0.312$, $p = 0.089$), suggesting a trend toward better outcomes in patients with higher preoperative ECD, though this did not reach statistical significance in this cohort. Patient's age showed no significant correlation with postoperative visual improvement ($r = -0.156$, $p = 0.410$), indicating that age alone was not a limiting factor for favorable visual outcomes.

DISCUSSION

The near-equal laterality and gender distribution aligns with published series on cataract surgery in eyes with corneal opacity, where no consistent laterality bias is noted and mild male predominance is often linked to higher trauma exposure.[9,10]

Post-traumatic corneal scarring was the most common etiology (30%), consistent with reports from developing regions identifying trauma and post-infectious scarring as leading causes of corneal opacity, while chemical/thermal injuries reflect regional and occupational variability; keratoectasia remains relatively uncommon in mixed cohorts.[11]

Nuclear sclerotic cataract predominated (60%), mirroring general cataract epidemiology and similar complex-eye studies, supporting the concept that visual impairment in these patients is multifactorial and justifies cataract intervention despite corneal pathology.

Studies in patients with combined cataract and corneal pathologies report similarly poor baseline vision that significantly improves after surgery despite corneal issues. Also the lower preoperative ECD aligns with other reports where corneal disorders reduce endothelial reserve, a critical factor for surgical risk and postoperative corneal clarity.[12] Studies show that preoperative ECD and hexagonality are predictive of postoperative outcomes and cell loss; lower values often correlate with higher cell loss or corneal edema risk.[13] Cataract surgery in eyes with corneal opacities shows similar preoperative ECD and visual impairment patterns. Corneal endothelial parameter ranges (ECD, hexagonality) and postoperative dynamics in phacoemulsification patients have been documented, noting lower baseline values correspond with increased surgical risk.

This study demonstrates 76.7% of patients achieving ≥2 lines of visual improvement and 73.3% achieving postoperative BCVA of 20/100 or better provide evidence supporting surgery in this complex patient population. The mean BCVA improvement from 1.45 to 0.94 logMAR is consistent with published literature, specifically mirroring the outcomes in their large series. This consistency strengthens confidence in the generalizability of the findings.[7]

Anterior segment OCT permitted precise documentation of corneal scar depth, morphology, and relationship to the pupillary axis. This imaging correlated with intraoperative visibility challenges and contributed to predicting final visual potential. The strong inverse correlation ($r = -0.782$, $p < 0.001$) between corneal opacity severity and visual improvement supports using ASOCT findings to counsel patients regarding realistic postoperative expectations.

While not formally quantified in this study, clinical observation suggests that patients with pre-existing dry eye or ocular surface disease who received preoperative ocular surface optimization achieved better postoperative outcomes.

The inverse correlation between corneal opacity severity and visual improvement outcomes ($r = -0.782$, $p < 0.001$) represents a critical finding for preoperative counseling. This relationship has been demonstrated in previous literature but is reconfirmed in our cohort.

The two patients (6.7%) who demonstrated no significant postoperative visual improvement had extensive corneal scarring extending deeply into the stroma (>500 micrometers) with dense reflection patterns on ASOCT. These cases illustrate the optical limitations of anterior segment pathology—even with successful cataract removal, severe corneal scarring fundamentally limits light transmission and optical quality.

The 6.7% reactivation rate of pre-existing corneal pathology in post-chemical burn cases due to the inflammatory stimulus of surgery can unmask or temporarily exacerbate cicatricial disease in susceptible individuals. This finding underscores the importance of aggressive perioperative anti-inflammatory therapy in patients with previous chemical injury or Stevens-Johnson syndrome.

Limitations

This study is limited by a small sample size, short postoperative follow-up, and its retrospective design, which may reduce statistical power and introduce selection bias. Longer-term, prospective, multicenter studies are needed to validate outcome stability and late complications. Additionally, the absence of refractive outcome analysis, patient-reported satisfaction measures, and a control or comparative surgical group limits assessment of visual quality and relative effectiveness of different management strategies.

CONCLUSION

Small incision cataract surgery with intraocular lens implantation is a safe and effective option for selected patients with coexisting cataract and corneal pathology, achieving visual improvement in 76.7% of cases with a favourable complication profile. It serves as a viable interim strategy when corneal transplantation is high-risk or not immediately feasible.

Optimal outcomes depend on meticulous preoperative evaluation using advanced imaging, careful assessment of endothelial reserve, ocular surface optimization, and refined intraoperative techniques such as trypan blue staining and contact lens–assisted visualization. These findings support cataract surgery as a meaningful visual rehabilitation option in this complex patient population, warranting further validation through larger prospective studies with longer follow-up.

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