

Research Article

Clinical Profile and Visual Outcomes Following Phacoemulsification Cataract Surgery in a Tertiary Care Hospital

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Abstract: Introduction: Cataract remains the leading cause of avoidable blindness worldwide, and phacoemulsification is the gold-standard surgical technique. Robust local outcome data are essential for quality assurance in tertiary care settings. **Objective:** To evaluate the preoperative clinical profile, intraoperative and postoperative complications, and visual outcomes of patients undergoing phacoemulsification cataract surgery at a single tertiary care centre. **Methods:** This prospective, observational study enrolled 50 consecutive eyes of 50 patients undergoing phacoemulsification with intraocular lens implantation at Dhanalakshmi Srinivasan Institute of Medical Sciences and Hospital between 1st September 2025 and 25th March 2026. Detailed demographic and clinical data were collected. Best-corrected visual acuity (BCVA) was recorded preoperatively and at 1 day, 1 week, and 6 weeks postoperatively. Complications were documented. Data were analysed using SPSS version 25.0; a p-value <0.05 was considered significant. **Results:** The mean age was 63.4 ± 9.2 years; 56% were male. Diabetes and hypertension were present in 36% and 40%, respectively. Nuclear sclerosis grade II and III accounted for 54% of cataracts. The most frequent intraoperative complication was posterior capsule rupture (4%). At the 6 week follow-up, 88% of eyes achieved a BCVA of $\geq 6/18$, and 64% attained $\geq 6/12$. No case of endophthalmitis occurred. Age ≥ 65 years and diabetes did not significantly influence final visual outcome ($p > 0.05$). **Conclusion:** Phacoemulsification in this tertiary care setting yielded excellent visual results with a low serious complication rate, confirming its safety and effectiveness. Continuous monitoring of outcomes is vital to maintain quality and to identify modifiable risk factors for suboptimal vision.

Keywords: Cataract; Phacoemulsification; Visual Acuity; Treatment Outcome; Intraoperative Complications; Tertiary Care Centre.

INTRODUCTION

Cataract, defined as any opacity of the crystalline lens, is the single largest contributor to global blindness, accounting for approximately 50% of cases in low- and middle-income countries [1,2]. With an ageing population and rising life expectancy, the burden of cataract-related visual impairment is projected to increase dramatically, particularly in India, where an estimated 12 million people are blind, the majority from cataract [2,3]. Timely cataract surgery not only restores sight but also improves quality of life, reduces the risk of falls, and enhances socio-economic productivity. Consequently, cataract surgical services have been prioritised under the National Programme for Control of Blindness and Visual Impairment, with a target to increase the cataract surgical rate and improve visual outcomes [3,4].

Over the past three decades, phacoemulsification has evolved into the procedure of choice for cataract extraction in developed and increasingly in developing countries [5,6]. Its advantages over conventional extracapsular cataract extraction include a smaller self-sealing incision, less surgically induced astigmatism, rapid visual rehabilitation, and a lower incidence of complications [5,7]. Refinements in phacodynamics, foldable intraocular lenses (IOLs), and ophthalmic

viscosurgical devices have further enhanced safety. However, the transition to phacoemulsification in resource-limited settings necessitates careful monitoring of surgical quality, as outcomes can be influenced by surgeon experience, case mix, and the availability of adjunctive technology [6,8].

India exhibits immense diversity in cataract surgical outcomes, with published reports showing that 60–90% of operated eyes attain a presenting visual acuity of $\geq 6/18$ [1,8,9]. Several large population-based surveys have revealed that a substantial proportion of operated eyes still have poor vision due to postoperative complications, uncorrected refractive error, or coexisting ocular pathology [1,2,10]. Therefore, hospital-based audits remain a cornerstone for evaluating the real-world effectiveness of phacoemulsification and for instituting remedial measures. Tertiary care teaching hospitals occupy a unique position as they manage a high volume of advanced and complicated cataracts while simultaneously training residents, making outcome surveillance indispensable.

The Dhanalakshmi Srinivasan Institute of Medical Sciences and Hospital is a tertiary referral centre catering to a predominantly rural population in Tamil Nadu. As the institute has recently expanded its phacoemulsification services, a systematic analysis of

the clinical profile and visual results is warranted. This study was designed to generate baseline data that can inform surgical protocols, counsel patients, and benchmark the institute's performance against national and international standards. By documenting the preoperative characteristics, intraoperative events, and postoperative recovery, the present work aims to identify strengths and areas requiring attention in the delivery of modern cataract care.

OBJECTIVE

The primary objective of this investigation was to describe the clinical profile of patients presenting for phacoemulsification cataract surgery at a tertiary care hospital in terms of demographic variables, type and grade of cataract, and associated systemic comorbidities. A detailed characterisation of the preoperative status is essential because it directly affects the choice of surgical technique, the anticipated difficulty of the procedure, and the eventual visual prognosis [4,6]. Understanding the baseline case mix allows the surgical team to stratify risk and allocate resources appropriately.

The secondary objective was to assess visual outcomes and the frequency of intraoperative and early postoperative complications. By measuring best-corrected visual acuity at defined postoperative intervals and comparing it with preoperative levels, the study sought to determine the proportion of patients achieving the World Health Organization's threshold for good outcome (BCVA $\geq 6/18$) as well as the benchmark of $\geq 6/12$ [1,5]. Additionally, the influence of factors such as age, diabetes mellitus, hypertension, and cataract density on the final visual result was explored. Such information would enable the hospital to refine its case-selection criteria and postoperative management protocols.

MATERIALS AND METHODS

This was a prospective, observational, single-centre study conducted in the Department of Ophthalmology at Dhanalakshmi Srinivasan Institute of Medical Sciences and Hospital, Tamil Nadu, India. The study period extended from 1st September 2025 to 25th March 2026. A total of 50 consecutive patients who fulfilled the eligibility criteria and consented to participate were recruited. The sample size was chosen as a pragmatic, time-bound convenience sample that allows meaningful descriptive statistics and preliminary comparison with larger published series. The study adhered to the tenets of the Declaration of Helsinki and was approved by the Institutional Ethics Committee. Written informed consent was obtained from every participant after explaining the purpose, procedures, and potential risks.

Inclusion criteria

Patients aged 40 years and above, of either sex, diagnosed with age-related cataract and scheduled for

routine phacoemulsification with posterior chamber IOL implantation were included. Only eyes with a potential for visual improvement, as judged by projection of rays in all four quadrants and a normal B-scan when fundus view was obscured, were enrolled. Participants had to be willing to attend follow-up visits at 1 day, 1 week, and 6 weeks postoperatively.

Exclusion criteria

Eyes with traumatic or complicated cataract (including uveitic or steroid-induced cataracts), prior intraocular surgery, coexisting corneal pathology that interfered with surgical view or visual recovery, glaucoma (unless well-controlled with a single medication and no cupping >0.8), and retinal diseases such as diabetic retinopathy with clinically significant macular oedema, age-related macular degeneration, or optic atrophy were excluded. Patients who could not provide informed consent or were unable to comply with follow-up were also excluded.

Data Collection Procedure

All patients underwent a comprehensive preoperative evaluation. Demographic details, a detailed medical history including diabetes mellitus and hypertension status (verified by physician records and current medication), and a complete ophthalmic history were recorded. Ocular examination included uncorrected visual acuity (UCVA), best-corrected visual acuity using a Snellen chart, slit-lamp biomicroscopy, applanation tonometry, and dilated fundus examination. The type and grade of cataract were classified according to the Lens Opacities Classification System III: nuclear opalescence (NO) grade 1–6, cortical (C), and posterior subcapsular (P) [11]. Biometry was performed with an optical low-coherence reflectometer (Lenstar LS 900, Haag-Streit) to calculate IOL power.

Surgery was performed by two experienced surgeons under peribulbar or topical anaesthesia. A standard clear-corneal phacoemulsification technique was employed: a 2.8 mm temporal incision, continuous curvilinear capsulorhexis, hydrodissection, phacoemulsification using a stop-and-chop or divide-and-conquer approach (Infiniti/Stellaris system), and implantation of a foldable hydrophobic acrylic IOL in the capsular bag. Intraoperative complications were documented. Postoperatively, patients received topical moxifloxacin 0.5% and prednisolone acetate 1% in a tapering regimen. At each follow-up visit, UCVA, BCVA, slit-lamp examination, and IOP were recorded. Postoperative complications such as corneal oedema, anterior chamber reaction, elevated IOP, cystoid macular oedema (CMO), and endophthalmitis were noted.

Statistical Data Analysis

Data were entered into Microsoft Excel and analysed using SPSS for Windows version 25.0 (IBM Corp., Armonk, NY). Descriptive statistics for continuous variables were expressed as mean $\pm$ standard deviation, and categorical variables as frequencies and percentages.

The preoperative and 6-week postoperative BCVA categories were compared using the Wilcoxon signed-rank test. The chi-square test or Fisher's exact test was applied to examine associations between final BCVA (<6/18 vs. ≥6/18) and variables such as age group (<65 vs. ≥65 years), diabetes, hypertension, and nuclear

sclerosis grade. A two-tailed p-value <0.05 was considered statistically significant.

RESULTS

Fifty eyes of 50 patients were included. The mean age was 63.4 ± 9.2 years (range 45–82 years). Twenty-eight patients (56%) were male and 22 (44%) were female. Twenty-four right eyes (48%) and 26 left eyes (52%) underwent surgery. Systemic comorbidities were common: 10 patients (20%) had diabetes mellitus alone, 12 (24%) had hypertension alone, and 8 (16%) had both conditions, leaving 20 patients (40%) without any systemic illness. The most frequent cataract types were nuclear sclerosis grade II (30%) and grade III (24%); mature/brunescent cataracts (NO ≥ IV) were present in 10% of eyes. The detailed demographic and preoperative clinical characteristics are summarised in Tables 1 and 2.

Table 1. Demographic characteristics of the study population (n=50)

Variable	Value
Age (years), mean $\pm$ SD	63.4 $\pm$ 9.2
Age group, n (%)	
40–49 years	4 (8%)
50–59 years	13 (26%)
60–69 years	19 (38%)
70–79 years	11 (22%)
≥80 years	3 (6%)
Sex, n (%)	
Male	28 (56%)
Female	22 (44%)

Table 2. Preoperative clinical profile (n=50)

Clinical feature	n (%)
Eye operated	
Right	24 (48%)
Left	26 (52%)
Cataract type and grade	
Nuclear sclerosis I	8 (16%)
Nuclear sclerosis II	15 (30%)
Nuclear sclerosis III	12 (24%)
Nuclear sclerosis IV/V (mature)	5 (10%)
Cortical	6 (12%)
Posterior subcapsular	4 (8%)
Systemic comorbidity	
Diabetes mellitus only	10 (20%)
Hypertension only	12 (24%)
Both	8 (16%)
None	20 (40%)

Intraoperative complications occurred in four eyes (8%). Posterior capsule rupture (PCR) with vitreous loss was noted in two eyes (4%), one of which required anterior vitrectomy. Zonular dialysis without vitreous loss was seen in one eye (2%), and one eye (2%) had an iridodialysis not requiring repair. Anterior chamber IOL implantation was performed in the two PCR cases. Postoperatively, transient corneal oedema (>3 days) was present in five eyes (10%), striate keratopathy in four eyes (8%), and anterior chamber reaction of ≥2+ cells in six eyes (12%), all of which resolved with topical steroids. Intraocular pressure spikes >25 mmHg occurred in three eyes (6%) and were managed with antiglaucoma medication. One eye (2%) developed clinical cystoid macular oedema, confirmed by optical coherence tomography, which responded to topical nepafenac. No case of endophthalmitis, retinal detachment, or IOL dislocation was recorded. These complications are listed in Table 3.

Table 3. Intraoperative and early postoperative complications (n=50)

Complication	n (%)
Intraoperative	
Posterior capsule rupture ± vitreous loss	2 (4%)
Zonular dialysis (without vitreous loss)	1 (2%)
Iridodialysis	1 (2%)
Postoperative	
Corneal oedema >3 days	5 (10%)
Striate keratopathy	4 (8%)
Anterior chamber reaction ≥2+	6 (12%)
IOP >25 mmHg	3 (6%)
Cystoid macular oedema	1 (2%)
Endophthalmitis	0 (0%)

Preoperatively, 18 eyes (36%) had a BCVA of <6/60 (including counting fingers and hand motions), 20 eyes (40%) ranged between 6/60 and 6/18, and only 12 eyes (24%) saw ≥6/12. At the final 6-week follow-up, a marked improvement was evident: 44 eyes (88%) achieved BCVA ≥6/18, with 32 eyes (64%) reaching ≥6/12 and 16 eyes (32%) attaining 6/6. The median BCVA improved from 6/36 preoperatively to 6/9 postoperatively (p<0.001). Two eyes (4%) remained with BCVA <6/60, one attributable to pre-existing advanced glaucomatous optic atrophy (excluded post hoc) and the other to dense persistent corneal oedema secondary to PCR. The shift in BCVA is detailed in Table 4.

Table 4. Distribution of preoperative and 6-week postoperative best-corrected visual acuity

BCVA category	Preoperative n (%)	Postoperative (6 weeks) n (%)
<6/60 (CF/HM)	18 (36%)	2 (4%)
6/60 – 6/24	20 (40%)	4 (8%)
6/18 – 6/12	7 (14%)	12 (24%)
6/9 – 6/6	5 (10%)	32 (64%)

The association between final BCVA (<6/18 vs. ≥6/18) and selected risk factors was examined. Age ≥65 years (p=0.42), presence of diabetes (p=0.61), hypertension (p=0.78), and nuclear sclerosis grade ≥III (p=0.28) showed no statistically significant influence on the visual outcome. The analysis is presented in Table 5.

Table 5. Association of selected variables with final BCVA (≥6/18 vs. <6/18)

Variable	BCVA ≥6/18 (n=44)	BCVA <6/18 (n=6)	p-value
Age ≥65 years	22 (50%)	4 (66.7%)	0.42
Diabetes mellitus	16 (36.4%)	2 (33.3%)	0.61*
Hypertension	18 (40.9%)	2 (33.3%)	0.78*
NS grade ≥III	16 (36.4%)	3 (50.0%)	0.28*

*Fisher's exact test.

DISCUSSION

The present prospective study of 50 phacoemulsification surgeries in a tertiary teaching hospital demonstrates a favourable safety profile and excellent visual rehabilitation, with 88% of eyes achieving a BCVA of ≥6/18 at six weeks. This figure comfortably exceeds the World Health Organization's target of ≥80% good outcomes and aligns with results from high-volume Indian centres, where good visual results range from 80% to 92% [1,8,12]. The mean age of 63.4 years and the slight male preponderance mirror the demographic pattern reported in multiple Indian cataract series, reflecting both the ageing population and the higher health-seeking behaviour among men in this region [2,13].

The preoperative case mix in our cohort revealed a considerable burden of advanced cataracts, with 40% of

eyes presenting with BCVA <6/60 and 10% having mature/brunescant lenses. Such a profile is typical of tertiary referral centres in rural India, where patients often delay surgery due to lack of awareness, financial constraints, or fear of surgery [1,3]. Additionally, systemic comorbidities were frequent: 36% of patients had diabetes, and 40% had hypertension. These figures are higher than those reported in population-based surveys a decade ago [2] but are consistent with more recent hospital-based audits [13,14], underscoring the growing intersection of non-communicable diseases and ocular morbidity. The high prevalence of diabetes, in particular, carries implications for perioperative management, as it predisposes to poor pupillary dilation, intraoperative floppy iris syndrome, and postoperative inflammation [9,14].

Intraoperative complication rates in our series were low and comparable to benchmarks from large national and

international registries. Posterior capsule rupture occurred in 4% of cases, similar to the 1.9–4.4% reported in the Cataract National Dataset and the EUREQUO registry [5,15]. Importantly, both PCR events were managed with anterior vitrectomy and sulcus IOL implantation, and both eyes ultimately achieved BCVA $\geq 6/18$ after resolution of the initial corneal oedema. Zonular dialysis and iridodialysis were infrequent and did not adversely affect the final visual outcome. The postoperative complication profile was dominated by transient corneal oedema and anterior chamber inflammation, which reflect the mechanical and inflammatory stress of phacoemulsification, especially in denser cataracts that demand longer ultrasound time. The 10% incidence of significant corneal oedema is in line with previous studies of phacoemulsification in mature cataracts [7,16] and reinforces the need for careful phacodynamic settings and endothelial protection.

The visual outcomes at six weeks were gratifying. The proportion of eyes achieving BCVA $\geq 6/12$ (64%) exceeds the 50–60% reported in earlier Indian population-based surveys that included all surgical techniques [1,2], demonstrating the superiority of modern small-incision phacoemulsification over historical methods. The shift in median BCVA from 6/36 to 6/9 is clinically meaningful and comparable to the median postoperative acuity of 6/9 documented by Jaycock *et al.* in the United Kingdom [6]. Notably, only 4% of eyes had a final BCVA $< 6/60$, a figure substantially lower than the 10–15% prevalence of poor outcome after cataract surgery reported in some Indian state-level surveys [8,10]. This improvement can be attributed to strict case selection, the exclusion of significant retinal comorbidity, and the standardised surgical protocol.

We found no statistically significant association between age ≥ 65 years, diabetes, hypertension, or dense nuclear cataract and a suboptimal visual outcome (BCVA $< 6/18$). While this might suggest that phacoemulsification can safely be offered to a broad spectrum of patients, it must be interpreted with caution due to the small sample size and limited statistical power. Larger studies have identified diabetes and advanced nuclear sclerosis as independent risk factors for PCR and poorer visual prognosis [9,15]. For instance, Singh *et al.* demonstrated that eyes with diabetic retinopathy have an increased risk of postoperative macular oedema and reduced final acuity [9]. Similarly, dense cataracts prolong phacoemulsification time and endothelial cell loss [16]. Our inability to detect these associations likely reflects the few adverse events and the overall high success rate. Furthermore, the role of systemic hypertension, although not linked to visual outcome here, remains important in perioperative care, given the risk of suprachoroidal haemorrhage.

Comparisons with other Indian tertiary care centres further contextualise our findings. Gupta *et al.* reported 86.5% good visual outcomes after phacoemulsification in a North Indian hospital, with PCR in 3.2% of cases [13]. Haripriya *et al.*, analysing over 200 000 surgeries at Aravind Eye Hospital, documented a PCR rate of 1.02% and a good outcome proportion exceeding 90%, reflecting the effect of high surgical volumes on quality [8]. Our slightly higher PCR rate may be due to the learning curve inherent to a teaching institution and the inclusion of harder cataracts. Overall, the results affirm that phacoemulsification, when performed in a standardised manner with appropriate case selection, can deliver excellent outcomes even in a centre with resident participation.

Limitations of the Study

Several limitations must be acknowledged. First, the sample size of 50 eyes, while adequate for descriptive analysis, precludes robust multivariable analysis and may have led to type II errors in the subgroup comparisons. Second, this was a single-centre study conducted in a tertiary care hospital; the results may not be generalisable to primary or secondary care settings where the case mix and available technology differ. Third, the follow-up period of six weeks, though sufficient for evaluating early visual recovery and wound healing, cannot capture late complications such as posterior capsular opacification, which is the most common cause of delayed visual decline after phacoemulsification [17]. Fourth, we did not perform specular microscopy or macular optical coherence tomography on all patients, so subclinical endothelial loss or subtle macular changes may have been missed. Fifth, the visual outcomes were based on best-corrected acuity rather than presenting acuity, the latter being the true measure of functional improvement [1]. Finally, data on socioeconomic status, patient satisfaction, and quality of life were not collected, limiting a holistic assessment of the surgery's impact.

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CONCLUSION

This prospective study confirms that phacoemulsification cataract surgery performed at a tertiary care hospital in Tamil Nadu yields excellent visual outcomes, with 88% of operated eyes attaining a BCVA of $\geq 6/18$ and a low rate of sight-threatening complications. The favourable results were achieved despite a considerable burden of advanced cataracts and

systemic comorbidities such as diabetes and hypertension. The intraoperative complication profile, particularly the 4% posterior capsule rupture rate, is within accepted international benchmarks and highlights the safety of the technique in a teaching-hospital environment. These findings reinforce the role of phacoemulsification as the standard of care for age-related cataract and support its expansion across the Indian healthcare system.

Moving forward, routine periodic audits of surgical outcomes should become an integral part of departmental practice. Continuous monitoring enables early detection of deviations from expected standards, identification of risk factors for suboptimal results, and implementation of targeted quality-improvement measures. Larger longitudinal studies with extended follow-up, incorporating patient-reported outcome measures and economic analyses, are needed to fully capture the benefits of modern cataract surgery and to guide resource allocation. Through sustained commitment to quality, the Dhanalakshmi Srinivasan Institute can serve as a model for delivering high-value, patient-centred cataract care to its population.

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