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Original Research Article

Comparative Analysis of Postoperative Visual Outcomes Following Phacoemulsification and Small Incision Cataract Surgery

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Abstract:

Background: Cataract remains a leading cause of visual impairment worldwide, with surgical intervention being the definitive treatment. Phacoemulsification and small incision cataract surgery (SICS) are commonly performed techniques, yet comparative postoperative outcomes require further evaluation.

Aim: To compare postoperative visual outcomes and complication rates following phacoemulsification and SICS in patients with senile cataract.

Methodology: A hospital-based, observational study was conducted on 200 patients (100 per group) at Department of Ophthalmology, Bhagwan Mahaveer Institute of Medical Sciences,Pawapuri, Bihar, India. Patients underwent either phacoemulsification or SICS and were followed for 28 days. Postoperative uncorrected visual acuity (UCVA), best-corrected visual acuity (BCVA), and intraoperative and postoperative complications were recorded. Statistical analysis was performed using independent t-tests and chi-square tests.

Results: Mean UCVA at 28 days was 0.52 ± 0.48 logMAR (~6/18) in the phaco group and 0.61 ± 0.55 logMAR (~6/24) in the SICS group ($p = 0.184$). Normal vision (≥6/18) was achieved in 58% of phaco patients and 50% of SICS patients ($p = 0.256$). Intraoperative and postoperative complication rates were comparable between groups, with no statistically significant differences.

Conclusion: Both phacoemulsification and SICS provide favorable postoperative visual outcomes with similar safety profiles. Phacoemulsification shows a modest, non-significant advantage in early visual recovery, but both techniques remain effective and safe.

Keywords: Cataract, Phacoemulsification, Small Incision Cataract Surgery, Visual Outcomes, Postoperative Complications.

Introduction

Cataract, an almost curable condition with surgical intervention, ranks among the leading causes of visual impairment and blindness worldwide [1]. It remains a major ophthalmological public health concern facing both developed and developing nations. The global burden of cataract-related visual impairment is high, while the prevalence of cataract is continuing to rise in the aging populations even in the regions where access to eye care services has improved [2]. In 2010, it was estimated that one in three blind individuals suffered from cataract-induced blindness and one in six visually impaired individuals had their vision compromised because of cataracts [3]. About 36 million people are estimated to be blind worldwide in recent estimates, with over 12 million cases estimated to be due to cataracts [4]. The socio-economic impact of cataract blindness is more pronounced in developing countries, which account for more than 90% of the DALYs lost due to this condition [5].

Cataract-related visual impairment burden is high in Egypt. According to the World Health Organization, the country has close to 1 million blind people and about three million with some form of visual impairment, and nearly 60% of the visually impaired population suffers from cataract [6]. It goes without saying that such high prevalence necessitates effective, accessible, and affordable surgical interventions that restore vision and improve quality of life. Cataract surgery has significantly evolved over the last decades, with several surgical techniques being developed with the aim of optimizing the visual outcome and minimizing complications. Of these,

phacoemulsification and small incision cataract surgery (SICS) are currently the two most widely used procedures globally.

Phacoemulsification is considered the gold standard for cataract surgery, especially in developed countries, because of the rapid visual recovery and excellent refractive outcomes it can achieve. The technique involves emulsification of the lens using ultrasonic energy through a small incision, followed by removal of the lens and implantation of an intraocular lens. However, despite various advantages such as reduced surgical trauma and quicker postoperative recovery associated with phacoemulsification, high costs of equipment, expensive maintenance, and skilled manpower are also required for this modality [7]. These factors may limit wide acceptance of phacoemulsification in resource-poor environments, where affordability and accessibility become all-important.

By contrast, SICS has become popular in developing countries as a lower-cost alternative to phacoemulsification. The approach involves an incision that is only slightly larger than phacoemulsification and often avoids sutures, so visual rehabilitation is relatively fast. In poor surgical environments, SICS is advantageous when access to advanced technologies may be sparse and the requirement is for high-volume, low-cost cataract surgery. A number of studies in Egypt and other developing countries reported that SICS provided visual outcomes similar to phacoemulsification but was faster and less expensive and better adapted to large-scale programs of cataract surgery [8,9].

Nevertheless, the decision of whether phacoemulsification or SICS should be performed is very often dependent on several factors, including the surgeon's experience, patient characteristics, availability of resources, and overall healthcare infrastructure. It is critical for clinical decision-making, optimization of care, and rational resource allocation that there be adequate understanding of the comparative effectiveness among these two surgical modalities regarding postoperative visual outcomes.

This study will compare postoperative visual outcomes for phacoemulsification and SICS. This research will give a complete analysis of the effectiveness of both widely used cataract surgery techniques regarding an assessment of uncorrected VA and BCVA in the context of current clinical practice. The results of this study are expected to add significantly to the armamentarium of ophthalmologists, policymakers, and healthcare providers who are working to enhance cataract management and decrease the burden of visual impairment.

Methodology

Study Design: This was a hospital-based, comparative, observational study conducted to evaluate and compare the postoperative visual outcomes following Phacoemulsification and Small Incision Cataract Surgery (SICS) in patients with senile cataract.

Study Area: The study was carried out at the Department of Ophthalmology, Bhagwan Mahaveer Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India.

Study Duration: The study was conducted over a period for one year from January 2024 to December 2024.

Sample Size: A total of 200 patients were included in the study. Patients were equally divided into two groups based on the surgical technique:

- **Group A:** Patients undergoing Phacoemulsification.
- **Group B:** Patients undergoing Small Incision Cataract Surgery (SICS).

Study Population: The study population consisted of patients diagnosed with senile cataract who attended the Department of Ophthalmology for cataract surgery during the study period.

Inclusion Criteria

Patients were included in the study if they met the following criteria:

- Patients with mature or immature senile cataract (Burrato's grade 3–4 cataract opacity).
- Patients without systemic comorbidities that could affect surgery or visual outcomes.
- Patients who provided informed written consent to participate in the study.

Exclusion Criteria

Patients were excluded if they had:

- History of previous ocular surgery in the same eye.
- Coexisting ocular pathology (e.g., glaucoma, diabetic retinopathy, corneal opacity).
- Intraoperative complications requiring conversion to a different surgical technique.
- Systemic conditions contraindicating surgery or affecting wound healing.

Data Collection: Preoperative assessment included detailed history taking both ocular and systemic, along with complete ophthalmologic examination. The BCVA was recorded using the ETDRS charting. Slit-lamp biomicroscopy for anterior segment was conducted and wherever possible, fundus examination was done.

Procedure: All patients received standardized preoperative preparation followed by one of the two surgical techniques based on group allocation. In Group A, phacoemulsification was performed through a 2.5–3.0 mm temporal corneal incision using an ultrasound-based phacoemulsification

system. A continuous curvilinear capsulorhexis-assisted with trypan blue dye when required-was created followed by gentle hydrodissection to separate the cortex from the capsule. The lens nucleus was emulsified and aspirated and a foldable intraocular lens was implanted within the capsular bag. In Group B, SICS was performed using a 6–7 mm self-sealing scleral tunnel incision. Hydrodissection or Sinskey hook was used to prolapse the lens nucleus from the capsular bag, which was delivered through the tunnel using the sandwich technique. A rigid IOL was then implanted in the capsular bag. All patients were followed postoperatively for a period of 28 days during which both intraoperative and postoperative complications were documented. BCVA was reassessed on the 28th postoperative day using ETDRS charts to assess visual recovery.

Statistical Analysis: Data are presented as means ± SD for numerical variables and as percentages for categorical variables. Comparison of means between the two groups was conducted by independent sample t-tests. Categorical data were compared using the χ^2 test. The cutoff value for statistical significance was a p-value < 0.05. Data were analyzed using the IBM SPSS Statistics version 22.0".

Result

Table 1 compares postoperative visual acuity outcomes between the phacoemulsification group and the SICS group, each with 100 patients. The mean postoperative uncorrected visual acuity was slightly better in the phaco group (0.52 ± 0.48 logMAR, approximately 6/18) compared to that of the SICS group (0.61 ± 0.55 logMAR, approximately 6/24), although the difference between them did not reach a significant level (p = 0.184). Similarly, the percentage of patients with normal vision of ≥6/18 was higher in Group A (58%) compared with Group B (50%), but the difference was again not significant (p = 0.256; RR = 1.16, 95% CI 0.897–1.500). Overall, both procedures provided comparable visual outcomes at 28 days postoperatively.

Table 1: Visual acuity outcome in the two groups

Variable	Phacoemulsification (Group A) (n = 100)	SICS (Group B) (n = 100)	P (RR; 95% CI)
Visual acuity (logMAR), mean ± SD			
Post surgery (UCVA, D+28)	0.52 ± 0.48 (~6/18)	0.61 ± 0.55 (~6/24)	0.184
Normal vision (≥6/18) at D+28 %	58.0% (58/100)	50.0% (50/100)	0.256 (RR = 1.16; 95% CI 0.897–1.500)

Table 2 presents the incidence of intraoperative complications among patients undergoing phacoemulsification (Group A) and small-incision cataract surgery (SICS) (Group B), with 100 patients in each group. Pupil-related complications such as rhexis issues, dialysis, or updrawn pupils occurred in 1% of Group A and 3% of Group B patients (p = 0.621). Aphakia or posterior capsular rupture (PCR) was noted in 11% of phacoemulsification cases versus 14% of SICS cases (p = 0.521). Nucleus drop occurred in 7% of Group A and 9% of Group B (p = 0.604). IOL drop was seen in 5% of phaco cases and 4% of SICS cases (p = 0.734). Hyphema was rare, occurring in 1% of Group A and 2% of Group B (p = 0.562). Overall, intraoperative complication rates were comparable between the two surgical approaches, with no statistically significant differences.

Table 2: Incidence of intraoperative complications

Complication	Phacoemulsification (Group A) (n=100) n (%)	SICS (Group B) (n=100) n (%)	P
Pupil rhexis, dialysis, updrawn	1 (1.0%)	3 (3.0%)	0.621 (Fisher)
Aphakia / PCR	11 (11.0%)	14 (14.0%)	0.521
Nucleus drop	7 (7.0%)	9 (9.0%)	0.604
IOL drop	5 (5.0%)	4 (4.0%)	0.734
Hyphema	1 (1.0%)	2 (2.0%)	0.562 (Fisher)

Table 3 compares the incidence of postoperative complications between patients undergoing phacoemulsification (Group A) and those undergoing small-incision cataract surgery (SICS) (Group B), with 100 patients in each group. The frequency of posterior capsular opacification (PCO) was similar in both groups (10% vs. 9%; p = 0.812). Persistent corneal edema occurred in 39% of Group A and 42% of Group B patients (p = 0.673). Endophthalmitis was reported in 8% of phacoemulsification cases and 10% of SICS cases (p = 0.617). IOL decentration rates were also comparable (21% vs. 19%; p = 0.724). Uveitis occurred infrequently, with no significant difference between groups (3% vs. 5%; p = 0.721). Overall, postoperative complication rates were broadly similar between the two surgical techniques.

Table 3: Incidence of postoperative complications			
Complication	**Phacoemulsification (Group A) (n=100) n (%)**	**SICS (Group B) (n=100) n (%)**	**P**
PCO	10 (10.0%)	9 (9.0%)	0.812
Persistent corneal edema	39 (39.0%)	42 (42.0%)	0.673
Endophthalmitis	8 (8.0%)	10 (10.0%)	0.617
IOL decentration	21 (21.0%)	19 (19.0%)	0.724
Uveitis	3 (3.0%)	5 (5.0%)	0.721isher)

Discussion

The current study showed that postoperative visual acuity was marginally better in the phacoemulsification group, with a mean UCVA of 0.52 logMAR (≈6/18) compared to 0.61 logMAR (≈6/24) in the SICS group on day 28. Although this difference did not achieve statistical significance (P = 0.184), this trend is in agreement with previous reports that phacoemulsification offers marginally faster visual recovery early in the postoperative period. Ruit et al. (2007) [10] concluded similarly, in that both phacoemulsification and MSICS achieved excellent visual outcomes, although phacoemulsification offered marginally superior early visual rehabilitation. Another study by Naik and Amrute in 2019 [11] determined similarly that visual outcomes were comparable between phacoemulsification and SICS, with only marginal advantage for phacoemulsification in early postoperative vision. In our study, a normal vision of 6/18 or better was achieved by 58% in the phaco group against 50% in the SICS group, reflecting a moderate superiority for phacoemulsification in support of the results suggested by Ali et al. in 2019 [12], who found no statistically significant difference in best-corrected visual acuity between the two techniques at three months postoperatively."

The slightly better visual outcomes with phacoemulsification could be explained by the smaller size of incision and less surgically induced astigmatism, similar to previous studies, which demonstrated that phacoemulsification generally causes less postoperative corneal edema and quicker visual recovery than SICS (Devendra et al., 2014; Singh et al., 2009) [13,14]. However, SICS remains an excellent alternative, especially in developing countries, due to its shorter operative time, lower cost, and less reliance on expensive machinery (Gogate, 2010; Bhargava et al., 2014) [15,16]. Our data support that, as intraoperative complication rates were similar between the two groups, with minor pupil-related events in 1% of phaco and 3% of SICs, and capsule-related complications in 11% and 14%, respectively. A similar safety profile was reported by Ruit et al. (2007) [10] and Zia and Syed (2010) [17], who reported low posterior capsular rupture and nucleus drop rates in both types of surgery.

Similarly, the postoperative complications in the present study also occurred at comparable frequencies. PCO was seen in about 10% of patients in both groups, consistent with the published rates for modern cataract surgery (El-Shafy et al., 2015) [7]. Persistent corneal edema was a little higher in the SICS group (42%) compared to that in the phaco group (39%), indicating that the incision size influences early corneal recovery, though not to a significant difference. Postoperative uveitis, decentration of the lens, and endophthalmitis were infrequent and similarly distributed, reinforcing the notion of a broadly equivalent safety profile for both procedures (Ali et al., 2019; Naik & Amrute, 2019) [12,11].

Several studies have pointed out that SICS is cost-effective and practical in high-volume or rural settings. Gogate (2010) [15] underlined that SICS reduces the surgical time and overall cost, which can be nearly half of what would be required for phacoemulsification without compromising the visual outcomes of phaco. Devendra et al. (2014) [13] also reported that the operative time for SICS was shorter (10 minutes) compared to phacoemulsification (16 minutes) and thus suggested SICS as suitable in outreach programs where efficiency is important. Singh et al. (2009) [14] further emphasized the advantage of SICS: sterilization requirements and the equipment were also more accessible in low-resource settings, making SICS an attractive alternative with no compromise on patient safety and postoperative visual results. In tune with these observations, our study confirms that both surgical techniques can be safely and effectively performed, with phacoemulsification offering a slight advantage in early visual acuity, but not enough to outweigh the logistical and economic advantages of SICS in certain contexts.

The interesting finding is that while phacoemulsification may show marginally better early visual rehabilitation, the long-term results after the two types of surgery are generally comparable. Thus, Ruit et al. (2007) [10] and Naik and Amrute (2019) [11] suggested that both phaco and SICS provide similar extents of uncorrected and best-corrected visual acuity three months or later in the postoperative period. As such, early gains in the visual recovery of patients seem to diminish with the passage of time. Our outcomes evidenced this trend whereby the modest early advantages of phacoemulsification did not result in a statistically significant disparity either in final visual acuity or the percentage of normal vision achieved.

Overall, the results support that both phacoemulsification and SICS are effective surgical modalities for the management of cataracts. While phacoemulsification may be associated with slightly faster early improvement in vision, most likely related to reduced incision size and astigmatism, SICS is comparable in providing long-term visual outcomes with advantages in cost, surgical time, and accessibility. The similar incidence of intraoperative and postoperative complications further supports the safety of both procedures. These findings are in agreement with the general literature, which states that decisions regarding phacoemulsification versus SICS should not be exclusively based on the outcomes of vision but also on resource availability, patient demographics, and surgical expertise.

Conclusion

The comparison of postoperative outcomes after phacoemulsification versus small-incision cataract surgery indicates that both procedures result in generally favorable visual recovery with similar safety profiles, although phacoemulsification exhibits a slight improvement in uncorrected vision at one month. The differences in best-corrected and uncorrected visual acuity did not reach statistical significance, as did the proportion of functional vision achieved, indicating that both surgical techniques are also similarly efficacious. Similarly, the intraoperative and postoperative complications were comparable, with no significant differences among a wide variety of surgical or inflammatory complications, indicating that both techniques are equally safe, provided their execution is done under standard clinical conditions. Overall, the results suggest that while phacoemulsification may have some minor advantages for early visual clarity, both techniques remain dependable options, and selection between them can validly be predicated on surgeon expertise, resource availability, and patient-specific issues without significant outcome differences.

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