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Original Research Article

A Comparative Study of Pre and Post Operative Refractive Error in Cataract Surgery-Phaco Vs Manual SICS in A Tertiary Care Hospital

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Abstract:

Background: Worldwide, cataracts are the primary preventable cause of blindness, and the most common surgical procedures are manual small incision cataract surgery (SICS) and phacoemulsification. While both restore vision effectively, refractive predictability and surgically induced astigmatism (SIA) remain critical determinants of postoperative outcomes.

Objective: To evaluate visual outcomes and pre- and postoperative refractive errors in patients receiving manual SICS and phacoemulsification.

Methods: A retrospective research was carried at the Department of Ophthalmology, Darbhanga, from March 2023 to February 2025. Records of 200 patients (100 phacoemulsification, 100 SICS) were analyzed. Astigmatism, spherical equivalent (SE), pre- and postoperative refraction, and best corrected visual acuity (BCVA) at six weeks were evaluated. SPSS v25 was used to analyze the data, and the t-test and chi-square test were used. A p-value < 0.05 was considered statistically significant.

Results: Both groups were comparable in baseline demographics and preoperative refractive status ($p > 0.05$). At six weeks, mean postoperative SE was closer to emmetropia in the phacoemulsification group (-0.25 ± 0.40 D) compared to SICS (-0.50 ± 0.60 D, $p = 0.01$). Mean postoperative astigmatism was significantly lower with phacoemulsification (-0.75 ± 0.40 D) than SICS (-1.25 ± 0.55 D, $p < 0.001$). BCVA $\geq$ 6/9 was achieved in 88% of phacoemulsification patients versus 76% of SICS patients ($p = 0.03$).

Conclusion: Phacoemulsification provides superior refractive predictability, induces less astigmatism, and results in better visual outcomes compared to manual SICS. However, SICS remains a safe, effective, and cost-efficient technique, particularly suitable for high-volume cataract surgery in resource-limited settings.

Keywords: Lens Replacement Surgery, Ultrasonic Cataract Surgery, Vision Impairment, Irregularly Shaped Cornea, Post-Operative Vision.

Introduction

Nearly 50% of blindness globally is caused by cataracts, making them the most frequent preventable cause of blindness [1]. The World Health Organization (WHO) estimates that over 95 million individuals suffer from cataract-related vision impairment, with low- and middle-income nations—including India—bearing a disproportionately large burden [2]. With the rising life expectancy and ageing population, the demand for cataract surgery is expected to increase significantly in the coming decades [3].

Cataract surgery has undergone remarkable evolution over the last century. Surgical methods have advanced from intracapsular cataract extraction (ICCE) and extracapsular cataract extraction (ECCE) to phacoemulsification and manual small incision cataract surgery (SICS) [4]. SICS and phacoemulsification are both commonly used in India, while manual SICS is favored in environments with limited resources because it is more affordable and can do huge surgical volumes [5].

Visual acuity remains the primary outcome measure following cataract surgery. However, in the current era of "refractive cataract surgery," patients' expectations have shifted beyond just sight restoration to include spectacle independence, better quality of vision, and faster rehabilitation [6]. Refractive predictability—achieving post-operative emmetropia or minimal refractive error—is therefore considered an equally important surgical outcome [7].

The major determinants of post-operative refractive error are accuracy of intraocular lens (IOL) power calculation, surgical technique, incision size, and surgically induced astigmatism (SIA) [8]. Phacoemulsification, with its smaller corneal incision (2.8–3.2 mm), induces less astigmatism compared to manual SICS, which typically requires a larger sclero-corneal incision (5.5–6.5 mm) [9]. Several studies have shown that phacoemulsification provides better refractive predictability and lower post-operative astigmatism [10,11]. However, SICS continues to offer excellent visual outcomes at a much lower cost, making it highly relevant in developing countries [12].

Despite numerous studies comparing visual outcomes of phacoemulsification and manual SICS, there remains a need to evaluate refractive outcomes specifically in Indian tertiary care hospitals, where both techniques are routinely performed. Therefore, the purpose of this retrospective study was to evaluate the relative effects of manual SICS and phacoemulsification on visual rehabilitation by comparing pre- and post-operative refractive error in patients receiving both procedures.

Materials and Method

Study Design and Setting: This comparative study was conducted in the Upgraded Department of Ophthalmology, Darbhanga. The time duration was over a period of two years, from March 2023 to February 2025, and included patients who underwent cataract surgery during this time.

Sample Size: In the study, 200 patients were involved; 100 of them were treated with phacoemulsification, while the other 100 received manual small incision cataract surgery (SICS) with a posterior chamber intraocular lens implant.

Inclusion and Exclusion Criteria: Patients above 40 years of age with senile cataract and complete preoperative and postoperative records, including refraction and keratometry, were included. Patients with pre-existing ocular diseases such as glaucoma, corneal opacity, pterygium, retinal disorders, or uveitis were excluded. Similarly, cases with traumatic, congenital, or complicated cataracts and those where cataract surgery was combined with other ocular procedures were excluded. Records with incomplete or missing data were also not considered.

Data Collection: The medical records of eligible patients were retrieved from the hospital records section and operation theatre registers. Demographic details such as age, sex, and laterality of the operated eye were noted. Preoperative parameters included uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), keratometry readings, and manifest refraction, which was expressed as spherical equivalent and cylindrical error. Operative notes provided information regarding the type of surgery performed and intraocular lens power implanted. Postoperative evaluation at six weeks included UCVA, BCVA, and refraction. Postoperative refractive error was analyzed in terms of spherical equivalent and surgically induced astigmatism.

Outcome Measures: The primary outcome of the study was to compare preoperative and postoperative refractive error between the phacoemulsification and SICS groups. Secondary outcome measures included the degree of postoperative astigmatism and the proportion of patients achieving a BCVA of 6/9 or better at six weeks.

Statistical Analysis: Microsoft Excel was used to enter the collected data, and SPSS software version 25 (IBM Corp., Armonk, NY, USA) was used for analysis. The independent t-test was used to compare groups for continuous variables like astigmatism and spherical equivalent, which were expressed as mean ± standard deviation. The Chi-square test was used to analyze categorical variables, such as the percentage of patients who achieved BCVA ≥ 6/9. Statistical significance was defined as a p-value of less than 0.05.

Results

Demographic Profile: The study examined 200 patients in total, 100 of whom had manual small incision cataract surgery (SICS) and 100 of whom had phacoemulsification. The mean age of the phacoemulsification group was 58.6 ± 8.4 years, while that of the SICS group was 59.2 ± 9.1 years. The two groups' age distributions appeared to be similar, as evidenced by the fact that their mean ages did not differ statistically significantly ($p = 0.62$). The distribution of genders was comparable among the groups. There were 50 males and 50 females in the SICS group and 52 males and 48 females in the phacoemulsification group ($p = 0.78$). In terms of laterality, there was no significant difference ($p = 0.84$), with 55% of cases in the phacoemulsification group and 53% in the SICS group being right eyes. As a result, the two groups' baseline demographic characteristics were well matched.

Table 1: Demographic profile of study patients

Parameter	Phacoemulsification (n=100)	SICS (n=100)	p-value
Mean age (years)	58.6 ± 8.4	59.2 ± 9.1	0.62
Male/Female	52/48	50/50	0.78
Right/Left eye	55/45	53/47	0.84

Preoperative Visual and Refractive Status: Patients were comparable at baseline, as evidenced by the similar preoperative refractive parameters in the two groups. The phacoemulsification group's mean spherical equivalent (SE) was −1.75 ± 1.20 diopters (D), while the SICS group's was −1.80 ± 1.15 D (p = 0.72). Likewise, there was no statistically significant difference in the mean preoperative astigmatism between the phacoemulsification group (p = 0.95), which was −0.95 ± 0.50 D, and the SICS group (p = 0.55 D). This made sure that any postoperative variations were due to the surgical method and not the refractive variation that existed before the procedure.

Table 2: Preoperative refractive parameters

Parameter	Phacoemulsification (n=100)	SICS (n=100)	p-value
Mean SE (D)	−1.75 ± 1.20	−1.80 ± 1.15	0.72
Mean Astigmatism (D)	−0.95 ± 0.50	−1.00 ± 0.55	0.65

Postoperative Refractive Outcomes: Both surgical groups showed a significant improvement in refractive status at six weeks after surgery when compared to their preoperative values (p < 0.001 for both groups). Intergroup comparison, however, revealed that phacoemulsification patients had improved refractive predictability. The SICS group had a mean postoperative SE of −0.50 ± 0.60 D, while the phacoemulsification group had a mean of −0.25 ± 0.40 D, which was closer to emmetropia. There was a statistically significant difference (p = 0.01). Similarly, the phacoemulsification group had less surgically induced astigmatism. At six weeks, patients who had phacoemulsification had mean postoperative astigmatism of −0.75 ± 0.40 D, while those who had manual SICS had mean postoperative astigmatism of −1.25 ± 0.55 D. This difference was statistically significant (p < 0.001). These findings demonstrate how phacoemulsification's smaller incision size helps to reduce astigmatism and refractive error.

Table 3: Postoperative refractive outcomes at 6 weeks

Parameter	Phacoemulsification (n=100)	SICS (n=100)	p-value
Mean SE (D)	−0.25 ± 0.40	−0.50 ± 0.60	0.01
Mean Astigmatism (D)	−0.75 ± 0.40	−1.25 ± 0.55	<0.001

Postoperative Visual Outcomes: Both surgical techniques resulted in significant improvement in postoperative best corrected visual acuity (BCVA). In the phacoemulsification group, 88% of patients achieved a BCVA of 6/9 or better at six weeks, compared to 76% in the SICS group. The difference between the two groups was statistically significant (p = 0.03). A slightly higher proportion of SICS patients remained in the 6/12 to 6/18 category (18%) compared to the phacoemulsification group (10%). A small number of patients in both groups (2% in phacoemulsification and 6% in SICS) had a BCVA of 6/24 or worse due to coexisting posterior segment pathology that was not evident preoperatively.

Table 4: Postoperative BCVA at 6 weeks

BCVA category	Phacoemulsification (n=100)	SICS (n=100)	p-value
≥ 6/9	88	76	0.03
6/12 – 6/18	10	18	
≤ 6/24	2	6	

Discussion

Cataract surgery remains the most commonly performed ophthalmic surgical procedure worldwide and the refractive outcome is considered one of the most important parameters of success. In recent decades, advances in surgical techniques have significantly improved predictability of postoperative visual and refractive outcomes [13]. In this retrospective study, we compared refractive errors and visual outcomes following phacoemulsification and manual small incision cataract surgery (SICS) in a tertiary care hospital in Bihar.

Our demographic data showed that the two groups were comparable in terms of age, sex distribution, and laterality, thereby reducing the likelihood of confounding demographic factors. The mean age in both groups was around 59 years, which is in line with the age profile reported in previous Indian studies where the majority of cataract cases present in the sixth and seventh decades of life [14,15].

In terms of preoperative refractive status, both groups demonstrated similar spherical equivalent and astigmatic values, ensuring a fair baseline comparison. This finding is consistent with previous trials, which also showed no significant differences in preoperative refractive characteristics between the two surgical groups [16].

Postoperatively, our study revealed that phacoemulsification provided superior refractive outcomes compared to SICS. The mean spherical equivalent in the phacoemulsification group was closer to emmetropia (−0.25 D) than in the SICS group (−0.50 D), and this difference was statistically significant. These results corroborate earlier reports where phacoemulsification was associated with more predictable refractive outcomes due to the smaller incision size and controlled intraocular lens (IOL) placement [17,18].

Astigmatism remains an important determinant of visual rehabilitation after cataract surgery. Our data demonstrated that surgically induced astigmatism was significantly lower in the phacoemulsification group (−0.75 D) compared to SICS (−1.25 D). The higher astigmatism in SICS is attributable to the larger sclero-corneal tunnel incision, a finding that has been consistently reported in literature [19]. While SICS offers the advantage of lower cost and shorter surgical time, the trade-off is a greater likelihood of induced astigmatism compared to phacoemulsification.

In terms of visual outcomes, we found that 88% of phacoemulsification patients achieved BCVA ≥ 6/9, compared to 76% in the SICS group. This statistically significant difference highlights the visual superiority of phacoemulsification. Similar outcomes have been reported by Gogate et al. and Ruit et al., who noted that a higher proportion of patients achieved excellent visual acuity with phacoemulsification compared to SICS [20,21]. However, it is noteworthy that both techniques achieved good visual rehabilitation, supporting the relevance of SICS in resource-limited settings where phacoemulsification may not be universally available.

Another important observation was that a small subset of patients in both groups failed to achieve optimal visual outcomes despite successful surgery. This was attributed to pre-existing posterior segment pathologies, which could not be detected preoperatively due to media haze. This finding underscores the importance of thorough postoperative evaluation and counseling regarding realistic expectations.

Overall, our study demonstrates that while both phacoemulsification and manual SICS are effective in restoring vision, phacoemulsification provides better refractive predictability, less astigmatism, and higher chances of achieving BCVA ≥ 6/9. Nonetheless, manual SICS continues to be a safe, effective, and affordable alternative in developing countries, particularly for high-volume cataract surgery programs.

Conclusion

Both phacoemulsification and manual small incision cataract surgery (SICS) are effective surgical techniques for the management of senile cataract. In our retrospective study, patients undergoing phacoemulsification achieved superior refractive predictability, lower surgically induced astigmatism, and a higher proportion of best corrected visual acuity (BCVA) of ≥ 6/9 at six weeks compared to SICS. However, SICS still provided significant visual rehabilitation and remains a valuable technique in resource-limited settings due to its lower cost and feasibility for high-volume cataract surgery. Thus, while phacoemulsification offers better refractive outcomes, SICS continues to be a safe and effective option for addressing the cataract burden in developing countries.

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