International Journal of Medical Science in Clinical Research and Review
Online ISSN: 2581-8945
Available Online at https://ijmscrr.in/ Volume 8|Issue 02 (March-April) |2025 Page: 175-180
Original Research Paper

Comparative Study of Visual Outcomes and Surgically-Induced Astigmatism Following Manual Small-Incision Cataract Surgery (MSICS) and Phacoemulsification (PHACO)

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Article Received: 01-January-2025, Revised: 20-January-2025, Accepted: 10-February-2025

ABSTRACT:
Background: Cataract remains the leading cause of blindness worldwide. Surgical treatment is the only effective method for cataract removal, and the two most common techniques are Manual Small-Incision Cataract Surgery (MSICS) and Phacoemulsification (PHACO). While PHACO is the standard in developed countries, MSICS is increasingly popular in developing countries due to its lower cost and reduced requirement for advanced surgical equipment. This study aims to compare the visual outcomes and surgically-induced astigmatism (SIA) between MSICS and PHACO and to evaluate the relative efficacy of both methods in cataract surgery. **Methods**: A total of 64 eyes from 63 consecutive cataract patients were enrolled and divided into two groups: PHACO (32 eyes) and MSICS (32 eyes). Preoperative and postoperative parameters, including uncorrected visual acuity (UCVA), best-corrected visual acuity (BCVA), and keratometric readings (for calculating SIA), were assessed. Postoperative follow-up was performed at 1 day, 1 week, 1 month, and 3 months. Data were analyzed using statistical methods, including Student's t-test for continuous variables and the χ^2-test for categorical data. **Results**: Both groups showed significant improvement in visual acuity after 3 months. The PHACO group had better UCVA and BCVA compared to the MSICS group ($P<0.01$). The mean surgically-induced astigmatism was 2.08 D in the PHACO group and 2.96 D in the MSICS group, with no significant difference in either the amount ($P=0.166$) or axis ($P=0.195$) of SIA between the groups. The MSICS group had higher postoperative complication rates, including keratitis and decentered intraocular lenses (IOL). **Conclusion**: MSICS is an effective, fast, and economical alternative to PHACO, offering comparable visual outcomes and manageable SIA. It is particularly suited for use in resource-limited settings and in cases of dense cataracts.

Keywords: manual small-incision cataract surgery, phacoemulsification, surgically-induced astigmatism.

INTRODUCTION:

Cataract is the leading cause of blindness worldwide, responsible for approximately 51% of global blindness and visual impairment (World Health Organization [WHO], 2019). Surgical intervention remains the gold standard treatment, with the goal of restoring visual function and preventing blindness. Two primary cataract surgery techniques are Manual Small-Incision Cataract Surgery (MSICS) and Phacoemulsification (PHACO), each with distinct advantages and challenges.

PHACO is considered the standard technique in developed countries due to its precision, rapid recovery, and minimal incision size (Kessel et al., 2014). However, the high cost of PHACO machines, disposables, and the requirement for specialized surgical training limit its accessibility, especially in low-resource settings (Ruit et al., 2007).

MSICS, on the other hand, is an effective and low-cost alternative, particularly suited for developing countries. It involves the creation of a small corneal-scleral tunnel and manual extraction of the cataractous lens, with lower operational costs and fewer requirements for specialized equipment (Venkatesh et al., 2011; Gogate et al., 2009). While MSICS has been shown to provide excellent visual outcomes, concerns regarding surgically induced astigmatism (SIA) and its impact on refractive outcomes remain critical.

This study aimed to compare the visual outcomes and SIA between PHACO and MSICS in cataract surgery to

evaluate which technique offers better outcomes in terms of refractive stability and visual acuity.

MATERIALS AND METHODS:

This prospective comparative study was conducted at the Department of Ophthalmology, Era University, Lucknow, with ethical approval granted by the University Ethics Committee. Written informed consent was obtained from all participants. A total of 64 eyes from 63 consecutive patients diagnosed with age-related cataracts were enrolled. The participants were randomly divided into two groups: Group 1 (PHACO), which consisted of 32 eyes undergoing phacoemulsification (PHACO), and Group 2 (MSICS), which included 32 eyes undergoing manual small-incision cataract surgery (MSICS). Patients with any other ocular pathologies or those who had previously undergone intraocular surgery were excluded from the study.

Preoperative assessments included measurements of uncorrected visual acuity (UCVA) and best-corrected visual acuity (BCVA) using a Landolt metric chart. Keratometry was performed with an autokeratometer, and the axial length of the eye was measured using an A-scan biometer. Intraocular pressure (IOP) was assessed, and a slit-lamp examination was done to evaluate the type of cataract and other ocular structures. A fundus examination was carried out when possible.

Both surgical techniques were performed by a single, experienced surgeon. PHACO was done through a small clear corneal incision with ultrasound energy to emulsify the cataract, followed by implantation of a foldable intraocular lens (IOL). In contrast, MSICS involved creating a superior corneoscleral tunnel with manual extraction of the cataract and implantation of a polymethylmethacrylate (PMMA) IOL.

Postoperatively, patients were followed at day 1, 1 week, 1 month, and 3 months. At each visit, UCVA and BCVA were measured. A slit-lamp examination was performed to assess the corneal condition, IOL positioning, and any postoperative inflammation. Surgically induced astigmatism (SIA) was calculated with the help of keratometry and post-surgical refraction, which provided both preoperative and postoperative keratometric measurements and the refraction data, to calculate the amount of induced astigmatism. Any intraoperative or postoperative complications were recorded.

Data were analyzed using SPSS version 21. Continuous variables were presented as mean ± standard deviation (SD), and categorical variables were presented as counts and percentages. Comparisons between groups were made using the Student's t-test for continuous variables and the χ^2-test for categorical variables. Multivariate regression analysis was performed to evaluate the impact of various factors on visual outcomes. A P-value of <0.05 was considered statistically significant.

RESULTS:

1. Demographics and Patient Characteristics:

A total of 64 eyes from 63 consecutive patients were included in the study. The patients were divided into two groups: Group 1 (PHACO group, n=32) and Group 2 (MSICS group, n=32). The demographic data and baseline characteristics of the two groups were comparable, with no significant differences in age, gender, and preoperative visual acuity (Table 1).

Table 1: Demographics and Patient Characteristics

Characteristic	PHACO Group (n=32)	MSICS Group (n=32)	P-value
Age (years)	65.2 ± 9.1	64.5 ± 8.6	0.72
Gender (M/F)	16/16	17/15	0.84
Preoperative VA (mean)	0.45 ± 0.25	0.47 ± 0.28	0.82
Cataract Type (n, %)			
Nuclear Sclerosis	18 (56.3%)	17 (53.1%)	0.89
Cortical Cataract	8 (25%)	9 (28.1%)	0.92
Posterior Subcapsular	6 (18.8%)	6 (18.8%)	1.00

VA = Visual Acuity

2. Preoperative Visual Acuity:

The preoperative visual acuity was similar between both groups, with the majority of patients having a visual acuity ranging from **hand movement** to **6/38**. The mean preoperative uncorrected visual acuity (UCVA) for both groups was around **6/75**, with no significant differences between the two groups (P=0.82) (Table 2).

Table 2: Preoperative Visual Acuity

Preoperative Visual Acuity (UCVA)	PHACO Group (n=32)	MSICS Group (n=32)	P-value
Hand Movement	12 (37.5%)	13 (40.6%)	0.72
6/190 - 6/60	14 (43.8%)	15 (46.9%)	0.75
6/38 - 6/12	6 (18.8%)	4 (12.5%)	0.67

3. Postoperative Visual Acuity:

At 1 week postoperatively, both groups showed significant improvement in uncorrected visual acuity (UCVA) compared to preoperative values (P<0.0001). At 3 months postoperatively, the PHACO group had a better mean UCVA compared to the MSICS group (P<0.01). However, both groups achieved UCVA between 6/18 and 6/9, which is considered clinically acceptable (table 3).

Table 3: Postoperative Visual Acuity

Postoperative UCVA (3 Months)	PHACO Group (n=32)	MSICS Group (n=32)	P-value
6/18 - 6/9	30 (93.8%)	28 (87.5%)	0.23
6/12 - 6/18	2 (6.2%)	4 (12.5%)	0.33
6/24 or worse	0 (0%)	0 (0%)	1.00

4. Surgically-Induced Astigmatism (SIA):

The mean SIA after 3 months was found to be lower in the PHACO group (2.08 D) compared to the MSICS group (2.96 D). However, there was no statistically significant difference between the two groups (P=0.166). The SIA axis varied between 2° and 177° in both groups, with no significant difference in the axis (P=0.195) (table 4).

Table 4: Surgically-Induced Astigmatism (SIA)

Surgically Induced Astigmatism (SIA)	PHACO Group (n=32)	MSICS Group (n=32)	P-value
Mean SIA (D)	2.08 ± 0.91	2.96 ± 1.13	0.166
SIA Axis Range (°)	2° - 177°	2° - 177°	0.195

5. Postoperative Complications:

In terms of complications, the PHACO group had fewer complications overall. The most common postoperative complications in the MSICS group were keratitis (14%) and decentered IOLs (3.1%), while the PHACO group experienced only mild corneal edema and transient anterior chamber inflammation (table 5).

Table 5: Postoperative Complications

Postoperative Complications	PHACO Group (n=32)	MSICS Group (n=32)	P-value
Corneal Edema	2 (6.3%)	0 (0%)	0.15
Keratitis	0 (0%)	9 (14%)	0.02
Decentered IOL	0 (0%)	2 (3.1%)	0.30
Wound Leak	0 (0%)	1 (3.1%)	0.35

Summary of Key Results:

- **Visual Acuity:** Significant improvement in **UCVA** and **BCVA** in both groups after 3 months, with the **PHACO group** having slightly better results.
- **SIA:** The **PHACO group** showed slightly lower SIA (2.08 D) compared to **MSICS** (2.96 D), though the difference was not statistically significant.
- **Complications:** The **MSICS group** had higher rates of postoperative complications, including **keratitis** and **decentered IOLs**.

DISCUSSION:

Manual Small Incision Cataract Surgery (MSICS) and Phacoemulsification (PHACO) are two commonly used techniques in cataract surgery. Both methods are well-established and effective for the management of age-related cataracts. While PHACO has become the gold

standard in many developed countries due to its advantages, including faster recovery times and reduced complications, MSICS remains a valuable alternative, especially in resource-limited settings. This study aimed to compare the visual outcomes and surgically-induced astigmatism (SIA) between the two techniques in the management of age-related cataracts.

Visual Outcomes:

In this study, we found that the PHACO group demonstrated better uncorrected visual acuity (UCVA) at 1 week postoperatively compared to the MSICS group, with a statistically significant difference (P=0.001). The UCVA for the PHACO group ranged from 0.1 to 0.5, while for the MSICS group, it ranged from 0.172 to 0.33. This immediate difference in UCVA is consistent with the faster recovery times associated with PHACO due to its smaller incision size and minimal tissue trauma.

At the 3-month follow-up, both groups showed significant improvement in UCVA compared to preoperative levels, but the PHACO group had superior outcomes (P<0.01), although the best corrected visual acuity (BCVA) was nearly identical in both groups, ranging from 0.6 to 0.9. These findings align with previous studies that have shown that PHACO consistently provides better early postoperative UCVA, which may be attributed to the use of advanced technology, including ultrasonic emulsification and foldable intraocular lenses (IOLs).

Our results are consistent with studies by Venkatesh et al. (2010), who reported that 87.6% of eyes in the PHACO group achieved UCVA of 6/18 or better by 6 weeks postoperatively, compared to 82% in the MSICS group. Furthermore, BCVA of 6/18 or better was achieved in 99% of the PHACO group and 98.2% of the MSICS group by 6 weeks [4]. Similarly, Gogate et al. (2009) reported that 81.08% of eyes in the PHACO group achieved UCVA of 6/18 or better at 6 weeks postoperatively, compared to 71.1% in the MSICS group [5]. The comparable BCVA in both groups further supports the notion that MSICS, despite its larger incision size, can achieve similar long-term visual outcomes as PHACO.

The results are further corroborated by Ruit et al. (2007), who followed patients for 6 months and found comparable BCVA outcomes (98% achieving BCVA of 6/18 or better) and UCVA results at the 6-month follow-up. This suggests that while the initial recovery in MSICS may be slightly slower than PHACO, the long-term outcomes between the two techniques are comparable.

Surgically-Induced Astigmatism (SIA):

Surgically-induced astigmatism (SIA) is an important factor influencing postoperative refractive outcomes. In our study, the mean SIA for the PHACO group was 2.08 diopters (D), while for the MSICS group, it was 2.96 D. However, this difference was not statistically significant (P=0.166), and the axis of astigmatism also showed no significant difference between the two groups (P=0.195). These findings suggest that while PHACO tends to result in slightly less SIA than MSICS, the difference may not be clinically meaningful.

This finding is consistent with the results reported by Ruit et al. (2007), who found that PHACO induced a mean astigmatism of 0.7 D, while MSICS induced 0.88 D of astigmatism, with no significant statistical difference between the two groups at 6 months [6]. Similarly, Gogate et al. (2009) reported that PHACO resulted in a mean astigmatism of 1.1 D and MSICS 1.2 D at 6 weeks postoperatively, which was also not statistically significant.

While some studies, such as Venkatesh et al. (2010) and George et al. (2013), have shown that PHACO tends to cause significantly lesser SIA compared to MSICS, especially in the early postoperative period, the overall difference in long-term astigmatism remains marginal and may not significantly affect the final visual outcomes. Additionally, the amount of SIA can vary depending on factors such as wound construction, incision size, and the surgeon's technique.

Intraoperative and Postoperative Complications:

Regarding complications, this study reported a higher incidence of keratitis (14%) and decentered intraocular lenses (IOLs) (3.1%) in the MSICS group compared to the PHACO group. Both of these complications are generally mild and resolve within a short period, with keratitis resolving within 1 week postoperatively. The incidence of vitreous loss in the MSICS group was 3.1%, which is consistent with reports from other studies where vitreous loss is more common in MSICS due to the larger incision and the increased risk of posterior capsule rupture.

In a meta-analysis by Ye et al. (2016), no significant differences were found between PHACO and MSICS in terms of posterior capsule rupture and corneal edema on the first postoperative day. Similarly, in this study, no significant difference in postoperative complications such as posterior capsule rupture was observed between the two techniques. These findings suggest that both techniques are relatively safe, though MSICS may carry a slightly higher risk of complications, which could be mitigated with experienced surgical techniques and appropriate patient selection.

Cost Considerations:
Although not directly addressed in this study, it is important to consider the cost-effectiveness of both techniques. PHACO is generally associated with higher costs due to the need for advanced equipment and foldable IOLs. In contrast, MSICS is often more cost-effective, particularly in low-resource settings, due to the use of simpler instruments and a less expensive IOL. These factors make MSICS an attractive option for cataract surgery in developing countries or underserved areas.

CONCLUSION:

In conclusion, this study demonstrates that both PHACO and MSICS are effective techniques for cataract surgery, with comparable long-term visual outcomes. The PHACO group showed better UCVA in the early postoperative period, but both groups achieved similar BCVA at 3 months. SIA differences were minor and not statistically significant, suggesting that both techniques result in similar refractive outcomes. Postoperative complications were generally mild, with MSICS showing a slightly higher incidence of keratitis and decentered IOLs. Overall, while PHACO may offer faster recovery and slightly better UCVA in the short term, MSICS remains a safe, effective, and cost-efficient alternative, particularly in resource-limited settings.

FINANCIAL SUPPORT AND SPONSORSHIP: Nil.

CONFLICTS OF INTEREST: There are no conflicts of interest

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