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ORIGINAL RESEARCH

Comparative Study of Visual Outcomes between Manual Small Incision Cataract Surgery and Phacoemulsification in Rural Populations

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ABSTRACT

Background: Cataract remains a leading cause of preventable blindness, especially in rural populations with limited access to advanced eye care services. Manual Small Incision Cataract Surgery (MSICS) and Phacoemulsification are two widely practiced surgical techniques for cataract removal, each offering distinct advantages in different resource settings. **Aim:** To compare the visual outcomes, complication rates, and patient satisfaction between MSICS and Phacoemulsification in patients with age-related cataract residing in rural areas. **Material and Methods:** This prospective, comparative observational study was conducted in the Department of Ophthalmology at a tertiary care center serving rural populations. A total of 100 patients with senile cataract were enrolled and randomly allocated into two groups: Group A (MSICS, n=50) and Group B (Phacoemulsification, n=50). Standardized surgical protocols were followed, and patients were evaluated at day 1, week 1, and 6 weeks postoperatively for uncorrected and best corrected visual acuity (UCVA and BCVA), complications, and satisfaction scores. Statistical analysis was performed using SPSS version 26.0 with $p< 0.05$ considered significant. **Results:** The baseline demographic and clinical profiles were comparable between both groups ($p> 0.05$). On day 1 and week 1, UCVA was significantly better in the Phaco group (0.52 ± 0.19 and 0.34 ± 0.14 LogMAR) than in the MSICS group (0.68 ± 0.21 and 0.45 ± 0.18 LogMAR), with $p< 0.001$. At 6 weeks, BCVA remained superior in the Phaco group (0.18 ± 0.07) compared to MSICS (0.22 ± 0.09, $p = 0.03$). A greater proportion of Phaco patients achieved BCVA ≥6/9 (78.00% vs. 64.00%). Complication rates were low in both groups, though minor issues like iris prolapse and corneal edema were slightly more frequent in MSICS. Patient satisfaction was higher in the Phaco group (mean score 4.64 ± 0.49 vs. 4.36 ± 0.58, $p = 0.02$). **Conclusion:** Both MSICS and Phacoemulsification are effective techniques for cataract surgery in rural populations. While Phacoemulsification offers superior early visual outcomes and higher satisfaction, MSICS remains a practical, cost-effective option, especially in settings with limited infrastructure.

Keywords: Cataract surgery, Phacoemulsification, MSICS, Visual outcome, Rural healthcare

INTRODUCTION

Cataract remains the leading cause of reversible blindness globally, particularly in developing countries where access to modern eye care services is limited. In rural populations, the burden is especially high due to delayed diagnosis, limited surgical outreach, and socio-economic constraints. Cataract surgery, therefore, is not merely a clinical intervention but a vital component of blindness prevention programs in such settings. Among the available surgical modalities, Manual Small Incision Cataract Surgery (MSICS) and Phacoemulsification are the two most commonly practiced techniques, each with its own set of advantages and limitations.Manual Small Incision Cataract Surgery has evolved as a cost-effective and efficient technique suitable for high-volume cataract programs. It involves creating a self-sealing sclerocorneal tunnel, through which the nucleus is delivered without the use of ultrasonic fragmentation. The use of rigid PMMA intraocular lenses in MSICS has made it a sustainable choice for low-resource settings, with minimal dependence on expensive equipment. MSICS is particularly useful in cases of mature or brunescent cataracts, where the dense nucleus poses technical challenges for phacoemulsification. The shorter learning curve and greater tolerance for surgical variations make MSICS a viable alternative for surgeons practicing in rural or

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peripheral centers, where sophisticated phacoemulsification machines may not be readily available[1].

Phacoemulsification, on the other hand, represents a technological advancement in cataract surgery. It involves emulsifying the lens nucleus using ultrasonic vibrations and aspirating the lens matter through a small incision, typically 2.2 to 2.8 mm. This technique allows for minimal surgical trauma, faster wound healing, and reduced postoperative inflammation. It also supports the implantation of foldable intraocular lenses, which further enhances postoperative visual quality. In urban and institutional settings, phacoemulsification has become the gold standard. However, the high cost of machinery, consumables, and maintenance limits its widespread adoption in rural areas, especially in developing countries[2].

The choice between MSICS and phacoemulsification becomes more complex in the context of hard nuclear cataracts, which are commonly encountered in underserved rural populations due to late presentation. These cataracts require greater energy for emulsification, increasing the risk of complications such as corneal endothelial damage and posterior capsular rupture. Studies have shown that MSICS is often preferred in such cases due to its ability to handle harder nuclei without the need for high phaco energy, thus preserving corneal clarity and reducing intraoperative complications[3].

Visual outcomes remain a primary metric for evaluating the success of cataract surgery. Parameters such as uncorrected and best corrected visual acuity (UCVA and BCVA), refractive predictability, and patient satisfaction are commonly assessed in postoperative follow-ups. While both MSICS and phacoemulsification aim to restore functional vision, their outcomes may differ in terms of speed of recovery and quality of vision. Phacoemulsification is often associated with more rapid improvement in uncorrected visual acuity due to the smaller incision and lesser induced astigmatism. However, long-term outcomes in terms of BCVA tend to converge between the two techniques[4].

Complication rates also influence the choice of surgical technique. MSICS, though involving a larger incision, has been associated with fewer intraoperative risks in dense cataracts and shorter surgical time in experienced hands. Phacoemulsification, while being gentler on the eye, requires greater surgical expertise and is more susceptible to complications such as wound burn or intraoperative zonular dialysis in poorly dilating pupils or advanced cataracts[5]. Therefore, surgical outcomes are not merely a function of technique but also of case selection, surgeon skill, and infrastructure availability.

Refractive outcomes are an important aspect of visual rehabilitation, especially in populations where postoperative spectacle correction may be delayed or unaffordable. With advancements in biometry and intraocular lens power calculations, both MSICS and phacoemulsification have achieved satisfactory refractive outcomes. However, phacoemulsification offers better precision in achieving target refraction due to controlled astigmatism and central wound location. MSICS, while slightly more variable, remains within acceptable refractive ranges when performed meticulously[6].

In recent years, there has been growing interest in evaluating patient satisfaction alongside clinical outcomes. In rural areas, where patients often resume agricultural or manual work soon after surgery, quicker visual recovery and minimal dependence on spectacles are particularly valued. While phacoemulsification may score higher in urban patients due to faster rehabilitation and better uncorrected vision, studies show that rural patients undergoing MSICS also report high satisfaction, especially when visual expectations are met and the surgery is complication-free[7].

The sustainability and scalability of any cataract surgical technique in rural populations depend on several factors, including cost, training, equipment availability, and community acceptance. MSICS scores well in these domains and has been the backbone of many successful cataract blindness eradication programs. However, with increasing rural access to advanced technologies and trained manpower, phacoemulsification is gradually gaining ground even in remote settings. Nonetheless, the transition is gradual and context-dependent[8].

Barriers to the widespread adoption of phacoemulsification in rural areas include not just economic and technical limitations, but also gaps in training and postoperative follow-up systems. Developing countries face a unique challenge where modern techniques must coexist with traditional approaches to maximize outreach. It is essential to objectively assess visual and refractive outcomes of both techniques in rural populations, where the need for functional visual restoration is often urgent and critical for livelihood[9].

MATERIAL AND METHODS

This prospective, comparative observational study was conducted in the Department of Ophthalmology at a tertiary care hospital serving rural communities, following approval from the Institutional Ethics Committee. The study aimed to compare the visual outcomes of Manual Small Incision Cataract Surgery (MSICS) and Phacoemulsification in patients from rural populations.A total of 100 patients diagnosed with age-related senile cataract were enrolled consecutively from the ophthalmology outpatient department. All patients belonged to rural areas within a 50 km radius of the hospital.

Inclusion Criteria

- Age between 50 and 80 years
- Presence of visually significant, operable age-related cataract in at least one eye

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- Willingness to undergo surgery and provide written informed consent
- Residence in rural area as per government classification

Exclusion Criteria

- Presence of any ocular comorbidity (e.g., glaucoma, diabetic retinopathy, corneal opacity)
- History of previous intraocular surgery
- Traumatic or complicated cataracts
- Systemic conditions affecting vision recovery (e.g., uncontrolled diabetes mellitus)

Sample Distribution

The 100 patients were randomly divided into two equal groups of 50 each:

- **Group A:** Underwent Manual Small Incision Cataract Surgery (MSICS)
- **Group B:** Underwent Phacoemulsification

Randomization was performed using computer-generated random numbers.

Surgical Procedure

All surgeries were performed by experienced ophthalmic surgeons using standardized protocols under peribulbar anesthesia:

- **MSICS:** A 6.5–7 mm sclerocorneal tunnel was constructed, nucleus was delivered using viscoexpression or irrigating vectis, followed by implantation of a rigid PMMA intraocular lens.
- **Phacoemulsification:** A 2.8 mm clear corneal incision was made, nucleus emulsification performed using divide-and-conquer technique, followed by foldable acrylic intraocular lens implantation.

Postoperative care was identical for both groups and included topical antibiotics and steroids tapered over 4 weeks.

Data Collection and Outcome Measures

Patients were followed up at postoperative day 1, week 1, and at 6 weeks. Visual acuity was assessed using the Snellen chart and converted to LogMAR for statistical comparison. Intraoperative and postoperative complications were noted. The primary outcome measure was Best Corrected Visual Acuity (BCVA) at 6 weeks. Secondary outcomes included uncorrected visual acuity, intraoperative complications, and patient satisfaction.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 26.0. Categorical variables were expressed as frequencies and percentages, and continuous variables as mean ± standard deviation. Comparisons between groups were made using the Chi-square test for categorical variables and independent sample t-test for continuous variables. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Baseline Demographic and Clinical Profile of Patients

The demographic and preoperative clinical characteristics were comparable between the MSICS (Group A) and Phacoemulsification (Group B) groups. The mean age of patients in Group A was 66.12 ± 7.45 years, while that in Group B was 65.44 ± 6.98 years (p = 0.58), indicating no significant age-related bias in group allocation. The gender distribution was similar in both groups, with males slightly outnumbering females in Group A (28/22) and an almost equal male-to-female ratio in Group B (26/24) (p = 0.68). Laterality of the operated eye (right vs. left) was balanced across both groups, with no statistical difference observed (p = 0.71). Additionally, the mean preoperative Best Corrected Visual Acuity (BCVA) was comparable in both groups, being 1.22 ± 0.34 LogMAR in the MSICS group and 1.19 ± 0.37 LogMAR in the Phaco group (p = 0.66), suggesting an equal level of baseline visual impairment among participants.

Table 2: Postoperative Visual Acuity (Uncorrected and Best Corrected)

Postoperative visual recovery differed significantly between the two surgical techniques. On postoperative day 1, the mean Uncorrected Visual Acuity (UCVA) was significantly better in the Phacoemulsification group (0.52 ± 0.19 LogMAR) compared to the MSICS group (0.68 ± 0.21 LogMAR) with a p value < 0.001. This trend continued at week 1, where the Phaco group maintained superior UCVA (0.34 ± 0.14) compared to the MSICS group (0.45 ± 0.18), again statistically significant (p< 0.001). At the 6-week follow-up, both groups showed substantial improvement in BCVA. However, the Phaco group achieved marginally better final BCVA (0.18 ± 0.07 LogMAR) than the MSICS group (0.22 ± 0.09 LogMAR), which was statistically significant (p = 0.03), although the clinical difference may be modest. These results suggest that while both surgeries improve vision, phacoemulsification offers more rapid and slightly superior visual rehabilitation.

Table 3: Distribution of BCVA at 6 Weeks (Snellen Equivalent)

A more granular analysis of visual outcomes at 6 weeks revealed that a higher percentage of patients in the Phaco group achieved excellent vision (Snellen ≥6/9), with 78.00% reaching this level compared to 64.00% in the MSICS group (p = 0.12). Although not statistically significant, this trend favors phacoemulsification. Additionally, 30.00% of patients in Group A and 20.00% in Group B had moderately good vision (6/12–6/18), while a small proportion of patients in both groups had suboptimal outcomes (<6/18), with slightly higher occurrence in the MSICS group (6.00%) compared to the Phaco group (2.00%). These findings reaffirm that phacoemulsification

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tends to yield better final visual acuity, though both techniques are effective in restoring functional vision.

Table 4: Intraoperative and Postoperative Complications

Both surgical techniques demonstrated a low incidence of complications, though some differences were noted. Intraoperative posterior capsular rent occurred in 4.00% of MSICS cases and 2.00% of phaco cases (p = 0.55), suggesting a slightly higher risk during MSICS, though not statistically significant. Iris prolapse was observed in 3 patients (6.00%) in the MSICS group and none in the Phaco group (p = 0.08), potentially attributable to the larger incision size in MSICS. Corneal edema on postoperative day 1 was more frequent in Group A (10.00%) than in Group B (4.00%), though this did not reach statistical significance (p = 0.24). Transient intraocular pressure (IOP) spikes were also more common in the MSICS group (6.00% vs. 2.00%, p = 0.30). Overall, complication rates were low and manageable, with no significant difference between groups, though Phacoemulsification demonstrated a slightly safer postoperative profile.

Table 5: Patient Satisfaction at 6 Weeks

Patient-reported satisfaction scores reflected the trends in visual outcomes. The mean satisfaction score was significantly higher in the Phaco group (4.64 ± 0.49) than in the MSICS group (4.36 ± 0.58), with a p value of 0.02. Moreover, a higher proportion of patients rated their satisfaction at the highest level (score 5) in the Phaco group (72.00%) compared to the MSICS group (56.00%), although this difference was not statistically significant (p = 0.09). These findings indicate that faster visual recovery and slightly superior final vision in the Phaco group likely contributed to greater patient satisfaction.

Table 1: Baseline Demographic and Clinical Profile of Patients (n = 100)

Parameter	Group A: MSICS (n=50)	Group B: Phaco (n=50)	*P* value
Mean Age (years)	66.12 ± 7.45	65.44 ± 6.98	0.58
Gender (Male/Female)	28 / 22	26 / 24	0.68
Laterality (Right / Left Eye)	27 / 23	25 / 25	0.71
Mean Pre-op BCVA (LogMAR)	1.22 ± 0.34	1.19 ± 0.37	0.66

Table 2: Postoperative Visual Acuity (Uncorrected and Best Corrected)

Visual Acuity Measure	Group A: MSICS (Mean ± SD)	Group B: Phaco (Mean ± SD)	*P* value
UCVA at Day 1 (LogMAR)	0.68 ± 0.21	0.52 ± 0.19	<0.001
UCVA at Week 1 (LogMAR)	0.45 ± 0.18	0.34 ± 0.14	<0.001
BCVA at 6 Weeks (LogMAR)	0.22 ± 0.09	0.18 ± 0.07	0.03

Table 3: Distribution of BCVA at 6 Weeks (Snellen Equivalent)

BCVA (Snellen Equivalent)	Group A: MSICS (n=50)	Group B: Phaco (n=50)	*P* value
≥6/6 – 6/9	32 (64.00%)	39 (78.00%)	0.12
6/12 – 6/18	15 (30.00%)	10 (20.00%)	
<6/18	3 (6.00%)	1 (2.00%)	

Table 4: Intraoperative and Postoperative Complications

Complication Type	Group A: MSICS (n=50)	Group B: Phaco (n=50)	*P* value
Intraoperative Posterior Capsular Rent	2 (4.00%)	1 (2.00%)	0.55
Iris Prolapse	3 (6.00%)	0 (0.00%)	0.08
Corneal Edema (Day 1)	5 (10.00%)	2 (4.00%)	0.24
Transient IOP Spike	3 (6.00%)	1 (2.00%)	0.30

Table 5: Patient Satisfaction at 6 Weeks

Satisfaction Score (1–5)	Group A: MSICS (n=50)	Group B: Phaco (n=50)	*P* value
Mean Satisfaction Score	4.36 ± 0.58	4.64 ± 0.49	0.02
Highly Satisfied (Score 5)	28 (56.00%)	36 (72.00%)	0.09

DISCUSSION

The baseline demographic profile in the present study demonstrated no significant differences between the MSICS and Phacoemulsification groups in terms of age (66.12 ± 7.45 vs. 65.44 ± 6.98 years), gender distribution (28/22 vs. 26/24), laterality (27/23 vs. 25/25), and mean preoperative BCVA (1.22 ± 0.34 vs. 1.19 ± 0.37 LogMAR), with p values > 0.05 in all categories. This indicates that both groups were demographically comparable at the outset, allowing for an unbiased comparison of surgical outcomes. These observations align with those reported by Thulasiraj et al. (2003)[10], who found that demographic uniformity between MSICS and phacoemulsification groups in community-based studies is critical to avoid selection bias and ensure statistical validity.

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In the current study, the phacoemulsification group showed significantly better UCVA on postoperative day 1 (0.52 ± 0.19 LogMAR) and at week 1 (0.34 ± 0.14), compared to the MSICS group (0.68 ± 0.21 and 0.45 ± 0.18, respectively), with $p < 0.001$ at both time points. At 6 weeks, BCVA was also marginally better in the Phaco group (0.18 ± 0.07) compared to the MSICS group (0.22 ± 0.09), with a significant p value of 0.03. These findings are supported by Bourne et al. (2004)[11], who reported faster and better visual recovery in phacoemulsification patients, attributing it to smaller incisions and reduced surgical trauma, particularly evident in early postoperative follow-up.

Further analysis of final visual acuity distribution in Snellen equivalents revealed that 78.00% of patients in the phacoemulsification group attained a BCVA of ≥6/9 compared to 64.00% in the MSICS group, though not statistically significant ($p = 0.12$). Additionally, 6.00% of MSICS patients had BCVA <6/18 compared to 2.00% in the phaco group. These trends suggest that phacoemulsification yields more favorable visual outcomes overall. Similar observations were made by Natchiar et al. (2002)[12], who found superior final vision quality and less induced astigmatism in phaco patients, especially in those with shorter axial lengths and higher preoperative refractive error.

Intraoperative and postoperative complications were low in both groups, with no statistically significant differences. However, iris prolapse (6.00% vs. 0.00%), corneal edema (10.00% vs. 4.00%), and transient IOP spikes (6.00% vs. 2.00%) were slightly more common in the MSICS group. These findings are consistent with a study by Lundström et al. (2012)[13], which reported that while overall safety is high for both techniques, the larger wound in MSICS may predispose patients to anterior segment instability and inflammation, especially in high-volume rural settings.

Patient satisfaction at 6 weeks was notably higher in the phacoemulsification group, with a mean satisfaction score of 4.64 ± 0.49 versus 4.36 ± 0.58 in the MSICS group ($p = 0.02$). Furthermore, 72.00% of phaco patients rated their experience with the highest score compared to 56.00% in the MSICS group. This is in agreement with the results of Sharma et al. (2013)[14], who emphasized that rapid rehabilitation, minimal postoperative discomfort, and improved cosmetic outcomes in phacoemulsification contribute to superior patient-reported satisfaction levels in both urban and rural cohorts.

Despite the advantages observed with phacoemulsification, MSICS still offers a valuable alternative, particularly in resource-limited settings. It demonstrated a commendable final BCVA (0.22 ± 0.09 LogMAR), high satisfaction (mean score 4.36), and manageable complication rates, making it suitable for high-volume cataract campaigns. This aligns with the conclusions of Pal et al. (2010)[15], who noted that MSICS can deliver cost-effective and clinically comparable results to phacoemulsification when performed by skilled surgeons in under-resourced areas.

CONCLUSION

This study demonstrates that both Manual Small Incision Cataract Surgery (MSICS) and Phacoemulsification are effective in restoring vision among rural cataract patients, with phacoemulsification offering slightly superior early visual outcomes and higher patient satisfaction. However, MSICS remains a valuable alternative due to its low cost, shorter surgical time, and suitability for dense cataracts. The choice of technique should be guided by patient profile, surgeon expertise, and available infrastructure to ensure optimal outcomes in rural eye care settings.

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