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Prospective Observational Study

Comparative Analysis of Manual Small Incision Cataract Surgery (M-SICS) and Phacoemulsification in Camp Settings: A Prospective Study

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Abstract

Context*: Cataract remains a significant cause of blindness globally, especially in developing countries, necessitating effective surgical interventions. Clear corneal phacoemulsification (phaco) and manual small incision cataract surgery (M-SICS) are common techniques employed for cataract extraction.*

Aims*: This study aimed to assess and compare the surgical outcomes of M-SICS and phacoemulsification in camp settings, focusing on, intraoperative complications, and postoperative visual outcomes.*

Methods and Material: *A prospective comparative study was conducted involving 252 cataract patients randomly assigned to either M-SICS or phaco groups. Intraoperative and postoperative complications, and postoperative visual outcomes were meticulously evaluated.*

Statistical analysis used: Chi square and t test were used.

Results: *The phacoemulsification group demonstrated superior visual outcomes on postoperative days 1 and 7 compared to the M-SICS group, accompanied by lower rates of corneal edema and anterior chamber reactions. Phaco group had significantly higher UCVA on postoperative days 1 (75.8%) and 7 (95.3%) compared to M-SICS (56.5% and 76.6%, respectively, $p < 0.01$). However, at 21 days, BCVA was comparable between the groups, with nearly all patients achieving vision ≥ 6/18. M-SICS boasted a significantly shorter mean surgical time compared to phaco (8 minutes and 18 seconds vs. 13 minutes, $p < 0.00001$), with similar intraoperative complication rates. Furthermore, postoperative astigmatism was significantly lower in the phaco group ($p = 0.02$) than the M-SICS group.*

Conclusions: *Phacoemulsification demonstrates superior early postoperative visual outcomes and reduced astigmatism, while M-SICS excels in shorter surgical times without compromising visual acuity. In resource-limited settings, the efficiency and affordability of M-SICS make it the preferred choice, whereas phacoemulsification may be favored in resource-abundant environments.*

Key-words: *MSICS, phacoemulsifications, camps, visual outcome, cataract.*

Key Messages*: In resource-limited settings, the efficiency and affordability of M-SICS make it the preferred choice, whereas phacoemulsification may be favored in resource-abundant environments.*

Introduction

Cataract is the leading cause of blindness worldwide, accounting for more than 18 million cases of bilateral blindness.[1] Most of these blind people live in developing countries.[2] Majority of these surgeries are elective, and a significant number of impoverished rural patients choose to undergo surgery at free camps organized by charities. Phacoemulsification is a common cataract surgery procedure in developed countries, while the technique of cataract removal varies in developing countries.[3] Over the past decade, the most effective and safe cataract removal technique remains controversial. SICS is fast, safe and machine-independent and continues to be the preferred choice for surgeons. In many centers like ours, phacoemulsification is routinely performed, with surgeons performing a clear corneal incision, enlarging the incision, and inserting a rigid IOL, which is more cost-effective than a foldable IOL and is mostly offered at charity camps. In terms of both safety and visual outcome, this study aimed to determine which surgical option—clear corneal phaco emulsification with implantation of a rigid IOL versus SICS—was preferred in these patients.

Study design and Method

The present study was a prospective, comparative, hospital-based study conducted on patients undergoing cataract extraction surgery using M-SICS and Phacoemulsification methods. In this study, 252 consecutive patients scheduled for intraocular cataract surgery were randomly assigned to two groups: the M-SICS group and the Phacoemulsification group.

All the patients in both groups were over the age of 50, with visually significant age-related uncomplicated cataract and no systemic or other ocular comorbidity problems. All patients had a slit lamp examination, and their visual acuity was recorded with a Snellen chart at a 6-meter distance and converted into decimals. Only immature senile cataracts (up to nuclear sclerosis grade 3) were considered in this research. All other types of cataracts were excluded from this study.

Keratometry was performed with an automated keratometer, and axial length was measured using A-Scan ultrasound (Nidek). The power of the intraocular lens was determined using the SRK-T formula.

Following pupil dilation with tropicamide and phenylephrine eye drops, a peribulbar injection (6ml of

injection 2% lignocaine and 4ml of injection 0.05% bupivacaine combined with 1500 IU hyaluronidase) was administered. Preoperatively, the periocular skin area was disinfected with a 5% solution of povidone-iodine. Phacoemulsification was performed via the temporal approach. A phacoemulsification machine (Johnson & Johnson, compact intuitiveTM) with tubing, handpieces, and phaco tips, coaxial irrigation and aspiration were used. A standard phacoemulsification using the stop and chop technique was performed. A rigid Poly Methyl Metha Acrylate (PMMA) intraocular lens with a 5 mm optic was implanted after enlarging the incision to 5 mm. A single suture using 10-0 ethilon was placed to close the wound at the end of the surgery.

SICS was performed by prolapsing the nucleus from the capsular bag (with Sinskey Hook or hydrodissection injection) after making a large capsulorrhexis and then extracting it through a 6 mm scleral tunnel using an irrigating vectis. Both the operations were completed with an intracameral injection of vigamox (moxifloxacin). The surgical time was measured from the incision to the end of the intracameral vigamox injection.

The following information was collected for each patient: intraoperative and postoperative complications; presence of corneal edema; visual acuity on postoperative days 1, 7, and 21 (measured with a Snellen chart at a 6-meter distance and converted into decimals); and postoperative refraction.

TABLE 1: BASELINE CHARACTERISTICS

TABLE 1	**Phaco (n=128)**	**SICS(n= 124)**	**chi-square**	**p-value**
Male	65 (50.7%)	67 (54%)	3.84	0.6
Female	63 (49.3%)	57 (46%)		
Age (Mean ± SD)	64.8 ± 9.4	64.2 ± 9.3		
VA (HM or worse)	3.1%	4%	0.1505	0.7
Mean VA (remaining patients)	0.11 ± 0.06	0.076 ± 0.08		

TABLE 2: INTRAOPERATIVE FINDINGS

TABLE 2	**Phaco (n=128)**	**SICS(n= 124)**	**chi-square**	**p-value**
Intraoperative complications	2 PCR 1 PCR + nucleus drop	1 PCR 2 ZD		
Mean surgery time >10 minutes	76.6%	16.12%	3.84	<0.00001

TABLE 3- POST-OPERATIVE FINDINGS (DAY 1 & 7)

TABLE 3	**POST OP DAY 1**		**POST OP DAY 7**	
	Phaco (n=128)	**SICS (n=124)**	**Phaco (n=128)**	**SICS (n=124)**
VA >\= 6\18	97 (75.8%)	70 (56.5%)	122 (95.3%)	95 (76.6%)
VA < 6\18	31 (24.2%)	54 (43.5%)	6 (4.7%)	29 (23.7%)
chi-square	10.52		18.41	
P value	0.001		<0.01	
Post-operative complications Corneal edema Anterior chamber reaction	 4 1	 10 3	 0 0	 4 0

TABLE 4- VISUAL OUTCOME ON POST-OPERATIVE DAY 21

TABLE 4	**Phaco (n=128)**	**SICS(n= 124)**
VA >\= 6\18	128 (100%)	123 (99.2%)
VA < 6\18	0 (0%)	1 (0.8%)

TABLE 5- POST-OPERATIVE DAY 21 REFRACTION

TABLE 5	**Phaco (n=128)**	**SICS(n= 124)**	**2 sample t-test**	**p-value**
Post operative Day 21 Refraction (Spherical) (Mean ± SD)	0.61 ± 0.63	0.72 ± 0.68	−1.331	0.18
Post operative Day 21 Refraction (Cylinder) (Mean ± SD)	0.75 ± 0.52	0.89 ± 0.43	−2.333	0.02

Results

The study included 132 (52.4%) men and 120 (47.6%) women, with no age or gender differences between the two groups. Overall, 124 (49.2%) cataract surgeries were performed with mSICS, and 128 (50.8%) with phacoemulsification. Table 1 shows that both groups had similar basline characteristics. In the phacoemulsification group, three patients had posterior capsule rupture (PCR). Two patients underwent anterior vitrectomy, and PCIOL was placed in the ciliary sulcus. The other patient, who had a nucleus drop, was referred to the retina specialist. In the m-SICS group, one patient had posterior capsule rupture and two had zonular dialysis (ZD). The mean time spent by the surgeon per surgery was 13 minutes in the phacoemulsification group and 8 minutes and 18 seconds in the SICS group. Table 2 indicates that 76.6% of patients in the phacoemulsification group and 16.12% of patients in the SICS group had surgeries lasting more than ten minutes (p value < 0.00001).

Right after the eye pad was removed on the first postoperative day, uncorrected visual acuity was assessed. At Post-Operative Day-1, a significant difference in visual acuity was seen between the two groups (p value <0.01). A higher percentage of participants in the phacoemulsification group (75.8%) had vision categories of 6/18 or better as compared to the SICS group (56.5%) (due to surgical incision size, surgically induced astigmatism, and corneal edema due to greater manipulation during surgery). In the phacoemulsification group, four patients experienced corneal edema; one patient had increased anterior chamber reactions as a result of postoperative uveitis, while ten patients experienced corneal edema; and three patients experienced increased anterior chamber reactions in the SICS group.

When corrected visual acuity was assessed and compared once more at Post-Operative Day-7, a statistically significant difference in the two groups' visual acuities was discovered. 95.3% of patients in the phacoemulsification group had a vision category of 6/18 or better, compared to 76.6% in the SICS group (p value< 0.01). Four patients in the SICS group still had corneal edema, but none of the patients in the phacoemulsification group experienced anterior chamber reactions or corneal edema, as shown in Table 3.

When best corrected visual acuity (BCVA) was examined, there was no discernible difference between the two groups; the initial disparity between them equalized after 21 days. After 21 days, nearly every participant in both groups had a visual result of 6/18 or better, as seen in Table 4.

As seen in Table 5, at 21 days, there was no significant difference between the groups (p = 0.18). Spherical correction depends on preoperative biometry and the computation of IOL power.

Despite enlarging the wound up to 5 mm to insert a rigid IOL in phacoemulsification, the postoperative astigmatism in the phacoemulsification group was lower than that in the SICS group, with a significant difference (p = 0.02) observed in the post-operative cylindrical corrections at 21 days between the two groups.

Discussion

Cataract being the most common cause of visual impairment in developing countries, many studies are still being undertaken to conclude which surgical technique is most suited for high volume surgeries.[4] Many hospitals organize high-volume, short-duration cataract surgery camps in rural areas, particularly during the winter months, to address the significant backlog of preventable blindness in India resulting from untreated cataracts. In such community services, surgical options that are faster, more secure, and yield good visual outcomes are preferred. Another challenge faced by camp surgeons is maintaining hygiene and ensuring post-operative compliance, particularly due to the high volume of surgeries performed and the demographic of mostly elderly and uneducated patients. It takes constant supervision and extreme caution on the part of the caregiver to ensure adherence to the follow-up schedule, medication, and hygiene.[5] Thus, this prospective study was conducted to evaluate the impact of cataract surgery on the visual outcomes of individuals who underwent two different M-SICS and Phacoemulsification techniques in a camp setting.

Regarding age, there was no significant difference between the groups. The mean age of the two study groups was 64, consistent with findings from other studies where the mean ages of patients were slightly over 60, such as those by Sharma D et al. and Kanski JJ et al.[6],[7] The gender distribution of the different groups showed little variation in this study (mean women, n = 120, and men, n = 132 in both groups), which is consistent with the findings of other studies like Javed U et al.[8]

In 2015, Gogate et al. published a meta-analysis comparing the safety, effectiveness, and costs of SICS and phacoemulsification. Eleven comparative studies totaling 76,838 eyes with cataract surgery were analyzed for this review. Between techniques, the UCVA of 6/18 and the BCVA of 6/18 were comparable (P = 0.373 and P = 0.567, respectively). Between techniques, the BCVA of 6/9 was comparable (P = 0.685). Comparable UCVAs of 6/60 and BCVAs of 6/60 were found for both aided and unaided vision (P = 0.317 and 0.126, respectively). Endothelial cell loss during surgery (P = 0.298), intraoperative complications (P = 0.964), and postoperative complications (P = 0.362) did not differ statistically. The phacoemulsification group had more eyes with a UCVA of 6/9 (P = 0.040) and statistically significantly less astigmatism (P = 0.005). The SICS average time was less than that of phacoemulsification, and it cost less than one-half of phacoemulsification.[9]

The surgically induced astigmatism, cost, intraoperative challenges and complications, postoperative complications, and visual outcome of manual sutureless small incision cataract surgery (SICS), planned extracapsular cataract extraction, and phacoemulsification were compared by Gamal Mostafa Abo El Maaty et al(2014) and Ruit S et al. [10],[11] These studies supported our findings, which showed a significant difference between the two groups in terms of visual acuity on postoperative days 1 and 7 ($p<0.01$). Participants in the phacoemulsification group had a better proportion of Vision Category 6/18 or better on the 1st and 7th post-operative days compared to the SICS group.

Researchers like Indra T. Mahayana et al. also reported that, at one month and six months, respectively, there was no statistically significant difference in the visual outcome between the two groups ($p = 0.10$).[12] In their study, V. Ramalakshmi et al. demonstrated that the visual outcomes in the MSICS and phacoemulsification groups were similar.[13] When used by trained professionals, both are equally safe and efficient at producing better visual results. In terms of visual acuity at post-operative day 21 ($p = 0.000$) and post-operative spherical correction at day 21 ($p = 0.18$), our study found no significant differences between the two groups. After 21 days, nearly every participant in both groups had a visual outcome of 6/18 or better. Due to the enlargement of the incision for the insertion of a rigid IOL, the post-operative astigmatism following phacoemulsification in our study was higher compared to these studies, but there was still a significant difference between the two groups' post-operative cylindrical correction at day 21 ($p = 0.02$).

In a study conducted in Nepal, the visual outcomes of patients who underwent phaco with rigid and foldable IOLs through incisions of 5 mm and 2.5 mm, respectively, were compared. The study found no significant difference in the visual outcomes between the two groups, but the foldable IOL's cost—which was roughly eight times that of the rigid IOL—was the main focus.The post-operative visual outcomes were comparable

in our investigation.[14]

According to a study by Devendra et al., the phaco group's average operating time was 16 minutes, whereas the SICS group's was 10 minutes.[15] Similar to this, in our study, the average amount of time a surgeon spent on a procedure was 13 minutes for the phacoemulsification group and 8 minutes and 18 seconds for the SICS group. Gogate et al.'s research demonstrated that a shorter SICS length reduces the backlog of cataract patients.[16]

Ruit et al. reported that in cases of advanced cataracts, manual SICS is faster than phacoemulsification. They also noted that phacoemulsification machines require consumable parts (phacoemulsification tips, sleeves, and tubing) and continuous maintenance, making manual SICS significantly less expensive to perform than phacoemulsification.The operating microscope is the only high-priced piece of equipment in mSICS.[17] Additionally, Singh et al. demonstrated that mSICS sterilization methods are more widely available and less expensive than phacoemulsification.[18] Phacoemulsification has a steep learning curve, expensive equipment requirements, high consumable costs and the need for expensive foldable lenses to maximize the benefits associated with the small incision. Despite these facts, phaco surgery is becoming more and more popular in the developing world, and many patients are willing to pay a higher price for it. In developing countries, phacoemulsification is performed with the implantation of foldable as well as rigid IOLs to meet demand and make it affordable to people of all socioeconomic levels.

According to a study conducted in a hospital setting by one of the leading ophthalmologists in South India, almost 95% of patients who underwent small incisional cataract surgery had a best corrected visual acuity of at least 6/18, and the incidence of post-operative problems was incredibly low.19 In our study, there were similar intraoperative complications across the two groups; however, there were greater postoperative complications in the SICS group than in the phacoemulsification group.

It is evident that both phacoemulsification and SICS emerge as effective techniques for cataract surgery, each presenting distinct advantages and considerations. Phacoemulsification demonstrates superior visual acuity outcomes at the 1st and 7th post-operative days, attributed to its smaller incision size, lower surgically induced astigmatism, and reduced manipulation of the anterior chamber, thus minimizing post-operative corneal edema. However, both techniques yield comparable results in terms of BCVA at post-operative day 21. Notably, the larger incision associated with SICS leads to higher surgically induced astigmatism, resulting in significant differences in post-operative cylindrical refraction. A notable drawback of phacoemulsification is its higher cost, which encompasses expenses related to consumable components and maintenance of the phacoemulsification machine. Conversely, SICS offers a more cost-effective alternative, being less reliant on

advanced technology and potentially faster than phacoemulsification. These findings underscore the importance of considering patient needs, resource availability, and surgical outcomes when selecting the appropriate technique for cataract surgery.

Conclusion

Both techniques, manual small incision cataract surgery (SICS) and phacoemulsification in camp settings, are highly effective, yielding excellent visual outcomes and low complication rates. While phacoemulsification demonstrated a slight advantage in inducing less astigmatism, both methods showed comparable visual results overall, emphasizing their safety and efficacy in skilled hands. However, considering practical factors such as procedure duration, cost-effectiveness, and technological requirements, SICS emerges as a preferred option, particularly in resource-limited settings. While phacoemulsification remains a viable alternative, with its quicker procedure time, lower cost, and reduced dependency on advanced technology, SICS offers a promising solution for addressing cataract-related visual impairment in such environments.

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