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Research Article

Comparison of Visual Acuity Outcomes of Phacoemulsification and Small Incision Cataract Surgery

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Abstract

Background. The visual outcomes of phacoemulsification (Phaco) and manual small incision cataract surgery (MSICS) have been extensively studied, with research indicating that both methods are highly effective in restoring vision. Purpose. This study was aimed at comparing the visual acuity outcomes of the two surgical techniques. Methods. A total of 90 participants were scheduled for cataract surgery at Adetula Opticals & Eye Clinic, Oshodi-Isolo, Lagos State, Nigeria, from June to August 2023. The participants were divided into two groups of 45, a group was scheduled for Phaco (0.92 ±0.65; 6/60-6/36) and SICS (1.32 ± 0.81; 3/60) logMAR. Visual acuities (VAs) were measured pre- and postoperatively. Results. The difference in mean VA pre-op of -0.40 (95% confidence interval (CI): -0.096, -0.71) between the two techniques was statistically significant (p = 0.000). There was no significant difference in the logMAR VAs between the techniques post-operatively (p = 0.06), although the visual outcome with the two methods showed the tendency of a better VA (0.11 ± 0.17 [6/9 - 6/6]) as opposed to that of the other two techniques (0.22 ±0.32; [6/12 - 6/9]). Conclusion. Both techniques have been refined to a point where they provide comparable long-term visual outcomes, making the choice of method dependent on specific patient needs, surgeon expertise, and available resources.

Keywords

Phacoemulsification, Manual Small Incision Cataract Surgery, Logarithm of Minimum Angle of Resolution, Visual Acuity Outcomes, Comparison of Surgical Techniques

1. Introduction

Cataract surgery is a prevalent and essential procedure aimed at restoring vision in patients suffering from cataracts, which is the leading cause of blindness, accounting for 50% of global blindness, and cataract extraction remains the only treatment [1].

Phacoemulsification involves the emulsification of the cataractous lens using ultrasonic vibrations, followed by aspiration of the lens fragments. This technique is performed through a small corneal incision, typically less than 3 mm, which facilitates rapid healing and reduces the risk of post-operative complications [2]. On the other hand, SICS, which evolved from extracapsular cataract extraction (ECCE), uses a slightly larger scleral or corneal incision of approximately 5-7 mm to extract the cataractous lens manually. While SICS is often preferred in settings with limited resources due to its cost-effectiveness and lower dependency on advanced technology [3, 4], it is also associated with a longer recovery time and increased risk of surgically induced astigmatism [5].

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The visual outcomes of these two techniques have been extensively studied, with research indicating that both methods are highly effective in restoring vision. Phacoemulsification is generally associated with better uncorrected visual acuity (UCVA) immediately postoperatively, while both techniques show similar best-corrected visual acuity (BCVA) in the long term [6, 7]. Despite the differences in surgical approach and technology, the advancements in both procedures have led to a convergence in their visual acuity outcomes, making the choice of technique often dependent on other factors such as cost, surgical expertise, and patient-specific considerations [8].

This study was aimed at delving into the comparative visual outcomes of phacoemulsification and MSICS, examining the evidence from various studies to provide a comprehensive understanding of their effectiveness. By exploring the nuances of each technique and their impact on visual acuity, we aim to compare the visual acuity outcomes of the two surgical techniques.

2. Methods

The non-probability convenient sampling method was used for this study. This study was conducted at Adetula Opticals & Eye Clinic, Oshodi-Isolo, Lagos State, Nigeria, from June to August 2023. A total sample of 90 patients consisting of 48 females and 42 males was scheduled for cataract surgery at the study location. These patients were selected based on their fulfillment of the inclusion criteria for the study which were: Patients scheduled for cataract surgery without underlying medical factors that could result in complicated surgical outcomes and are within the study duration at the study location, and aged between 50 and 65 years old, had cataract which ranged from immature to mature cataract. Patients who had traumatic and juvenile cataracts were excluded from the study.

The study materials employed were a Nidek US-4000 Ultrasound A-Scan Biometer, Disinfectant (70% alcohol), and Anesthetics (0.5% Tetracaine Hcl), An automated keratometer was used for keratometry, and Orbiter Acuity System. Based on predetermined criteria or randomization, patients scheduled for cataract surgery were recruited and assigned to either the phacoemulsification group or the small incision cataract surgery group. The axial length and the anterior chamber depth were taken before the surgery using Nidek US-4000 Ultrasound A-Scan Biometer. After the surgery, a follow-up was scheduled after a week to measure and record changes in axial length and anterior chamber depth and the visual acuities (VAs).

Before this study, ethical approval was obtained from the Research and Ethics Committee (REC), Department of Optometry with REC approval number: EC/UBEN/LSC.OPT/23/69.

All procedures performed in this study were by the tenets of the Declaration of Helsinki (2000) for human subjects.

The data obtained from this study were analyzed using the Statistical Package for Social Sciences (SPSS) version 22.0 (SPSS Inc. Chicago, IL, USA). Descriptive statistics (frequencies, percentages, mean, and standard deviation) summarized the variables. Kolmogorov-Smirnov test was used to determine the normality of the distribution of data, the paired t-test was used to determine significant differences between variables before and after cataract surgery while the unpaired t-test compared the variables after phacoemulsification and small incision cataract surgery. Also, measurements of the central spread of data with the standardized skewness and standardized kurtosis (± 1.96) were obtained. 95% confidence intervals (CI) were used to give the plausible values of the parameters of interest. The VAs from the Snellen chart (fractions) were converted to logMAR while the 'hand motion' and 'Counting fingers' were quantified and converted to logMAR units using the Excel Spreadsheet tool [9]. Statistical significance was declared when $p \leq 0.05$.

3. Results

A total of ninety (n = 90) participants consisting of 48 females (53.33%) and 42 males (46.67%) were used for the test, the participants were divided into two groups of 45, a group was scheduled for phacoemulsification surgery and another for small incision cataract surgery. The participants were aged between 40 and 65 years old (Mean age of 53.5 ±4.3 years). The majority of them had immature cataracts, while the remaining had mature cataracts. Table 1 shows the descriptive statistics of measured variables.

Table 1. *The Descriptive statistics of the Visual acuity component (in LogMAR Units).*

Visual acuity	Range	Mean VA ±SD	SE	95% Confidence interval (Mean ±1.96SE)
VA Phaco Pre-op	2.10 - 0.17	0.92 ±0.65	0.097	1.12 - 0.73(n = 45)
VA Phaco Post-op	0.78 - 0.00	0.11 ±0.17	0.025	0.16 - 0.061(n = 45)
VA SICS Pre-op	2.70 - 0.17	1.32 ±0.81	0.12	1.57 - 1.08(n = 45)
VA SICS Post-op	2.10 - 0.00	0.22 ±0.32	0.047	0.31 - 0.12(n = 45)

Pre-op -Pre-operative cataract surgery; Post-op – Post-operative cataract surgery; Phaco-Phacoemulsification, SICS-Small incision Cataract surgery

Kolmogorov-Smirnov Z test performed on the data showed normal distribution (p > 0.05).
Figures 1 & 2 show the frequency of distribution of the Visual acuities of the participants Pre- and Post-operatively.

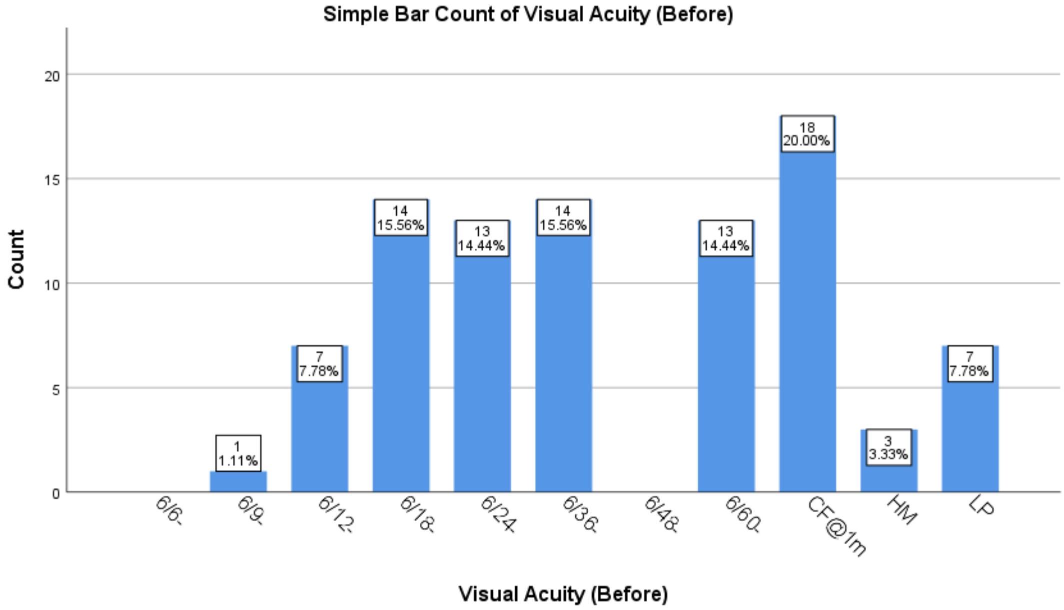

Figure 1. *The Visual acuities of participants before cataract surgery.*

The difference in mean VA pre-op of –0.40 (95% CI: –0.096, -0.71) between Phaco (0.92 ± 0.65) and SICS (1.32 ± 0.81) logMAR was statistically significant (Unpaired t-test: t = 2.16, df = 88, p = 0.011).

The mean difference in VA Phaco of 0.81 between pre-op and post-op was significant (Paired t-test: t = 9.06, df = 44, p = 0.000). Similarly, the mean difference in VA SICS of 1.11 between pre- and post-operation was significant (t = 10.6, df = 44, p = 0.000).

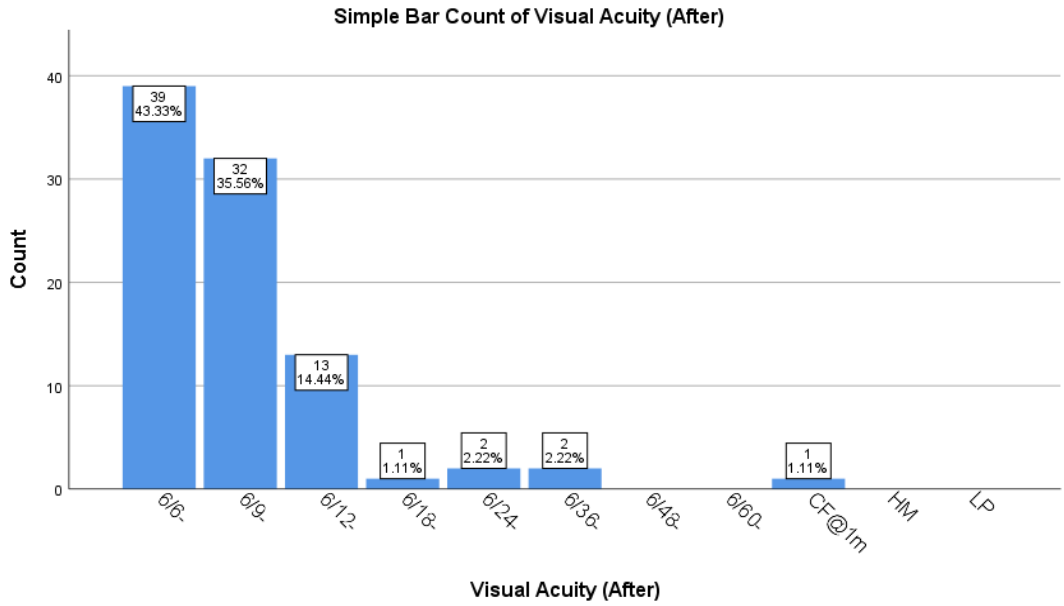

Figure 2. *The Visual acuities of participants after cataract surgeries.*

The difference in mean VA post-operation of 0.10 (95% CI: –0.21, 0.00) between Phaco (0.11 ± 0.17; 6/9 - 6/6) and SICS (0.22 ± 0.32; 6/12 - 6/9) was not significant (p = 0.06).

The difference in mean VA before cataract surgeries between males and females of –0.17 (95% CI: 0.14, –0.49) was not significant (Unpaired t-test: t = –1.05, df = 88, p = 0.30). In the same vein, the difference in mean VA post-op between males and females of –0.014 (95% CI: 0.095, –0.122) was not significant (p = 0.81). Table 2 shows the distribution of visual acuities among males and females.

***Table 2**. The distribution of Visual acuities by gender.*

Gender Cum Surgery	Mean VA ±SD (LogMAR Unit)	SE	95% Confidence interval (Mean VA ±1.96SE)
VA Pre-op Phaco & SICS Males (n = 42)	1.03 ±0.71	0.11	1.25 - 0.81
VA Pre-op Phaco & SICS Females (n = 48)	1.20 ±0.79	0.11	1.42 - 0.98
VA Post-op Phaco & SICS Males (n = 42)	0.16 ±0.18	0.03	0.22 - 0.10
VA Post-op Phaco & SICS Females (n = 48)	0.17 ±0.31	0.04	0.25 - 0.092

4. Discussion

Visual acuity is the primary parameter used to access the visual outcome of any form of intervention for any challenge of the visual system. Visual acuity (VA) is a measure of the ability of the eye to distinguish shapes and the details of objects at a given distance. Visual acuities from the Snellen Chart as well as 'counting fingers' and 'hand motion' were converted to logMAR units for statistical analysis, using appropriate conversion tools.

Previous studies have shown the conversion of 'counting fingers' between 1.85 to 2.6 logMAR and 'hand motion' between 2.3 to 3.0 logMAR units, and 2.7 logMAR for ‘light perception’ (LP), respectively [9-14]. For this study, the conversion of Moussa and colleagues [9] was adopted, that is, CF was 2.1, HM, 2.4, and LP, was 2.7 logMAR units. These made the comparable analysis carried out to ascertain the effect of the surgical techniques on the visual acuity, and the gender-related differences in visual outcome pre- and post-operatively much easier.

The visual outcomes of phacoemulsification and manual small incision cataract surgery (MSICS) have been widely debated and studied. Both techniques have their proponents and specific advantages, contributing to a nuanced understanding of their efficacy and application. The difference in pre-and post-operative logMAR visual acuity with Phaco and SICS was significant (p = 0.000), which demonstrates that the techniques greatly improved the visual acuity outcomes [15-18]. In this study, there was no significant difference in the logMAR Visual acuity between Phaco and SICS postoperatively (p = 0.06), although the visual outcome with Phacoemulsification showed the tendency of a better VA (0.11 ±0.17; 6/9 - 6/6) as against that of SICS (0.22 ±0.32; 6/12 - 6/9). This was consistent with the report of Riaz *et* al. [3]. The visual outcome of the surgical techniques, which was uncorrected visual acuity (UCVA) was accessed a week after surgery. Singh *et al*. [19] reported that the mean VA of 0.43 ± 0.27 for the Phaco group and 0.47 ±0.24 for the SICS group was not significant. This is consistent with the present study which also reported that the difference in mean VA post-operatively between the two techniques was not significant (p = 0.06). Other studies also align with the aforementioned claims [20, 21]. Surya and Sunariasih [22] reported also that the uncorrected Visual acuity (UCVA) did not produce a significant difference between the techniques. The majority of the participants only reported for the first follow-up, probably because they were comfortable and satisfied with the visual outcome of the surgery, and this explains the major limitation encountered in this study. Gender had no significant effect on the mean VA pre-and post-operatively, and this was consistent with the claims of Singh *et al*. [19, 23] but Rono and Nirghin [24] reported that gender had an effect on the visual outcome over time of the cataract surgical techniques. Lundqvist *et al.* [25] studied gender-related differences in vision outcomes for 5 years and reported that a significantly larger proportion of women had a more than 0.1 logMAR reduction of the better-seeing eye ($p = 0.013$), males had better best-corrected VA (BCVA) of their better eye than females in fifteen repeated measures of visual perception. More women (53.3%) came for cataract surgery, which explains that women form a majority of the population that seeks health intervention at Adetula Hospital, and this was consistent with the report of Rono and Nirghin [24].

Phacoemulsification is often considered the gold standard in cataract surgery, particularly in developing countries where resources are abundant. This technique employs ultrasonic energy to emulsify the lens, allowing for a smaller incision and generally leading to faster postoperative recovery and less induced astigmatism [26]. Studies have consistently shown that phacoemulsification results in superior uncorrected visual acuity (UCVA) shortly after surgery, which can be a significant benefit for patients seeking quick visual rehabilitation [6, 7]. However, the best-corrected visual acuity (BCVA) achieved at longer follow-ups does not differ significantly between phacoemulsification and Manual SICS [3, 4].

MSICS, on the other hand, is highly valued for its cost-effectiveness and suitability in resource-limited settings. The technique involves a larger incision compared to phacoemulsification but does not require expensive equipment or consumables. Despite the larger incision, studies have shown that MSICS can produce visual outcomes comparable to phacoemulsification. For instance, both methods provide similar BCVA outcomes at six to eight weeks post-surgery, reflecting the skill and advancements in surgical techniques and postoperative care [4, 8, 26]. Moreover, the lower cost and high success rate of MSICS make it a viable option for large-scale cataract management programs, especially in developing countries [6].

One of the critical factors contributing to comparable visual outcomes is the standardization of surgical techniques and improvements in intraocular lens (IOL) technology. Modern IOLs used in both phacoemulsification and MSICS are designed to provide excellent refractive outcomes, which helps in achieving high-quality visual acuity regardless of the surgical method [3]. Additionally, advancements in postoperative care, such as effective management of inflammation and infection, have played a significant role in ensuring good visual outcomes for both techniques [27].

Another consideration is the experience and expertise of the surgeons performing these procedures. Highly skilled surgeons can achieve excellent results with both techniques, further blurring the lines between the visual outcomes of phacoemulsification and MSICS [4]. The training and proficiency of the surgeon are crucial determinants of success, underscoring the importance of surgical expertise in cataract surgery outcomes.

In conclusion, while phacoemulsification may offer some advantages in terms of quicker visual recovery and less induced astigmatism, MSICS remains a highly effective and practical alternative, particularly in settings where cost and resource availability are major considerations. Both techniques have been refined to a point where they provide comparable long-term visual acuity outcomes, making the choice of method dependent on specific patient needs, surgeon expertise, and available resources.

Abbreviations

Phaco	Phacoemulsification
MSICS	Manual Small Incision Cataract Surgery
VAs	Visual Acuities
ECCE	Extracapsular Cataract Extraction
UCVA	Uncorrected Visual Acuity
BCVA	Best Corrected Visual Acuity

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Author Contributions

Eghosasere Iyamu: Conceptualization, Data curation, Formal Analysis, Supervision, Writing – original draft

Clinton Ifeanyi Okechukwu: Data curation, Investigation, Methodology, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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