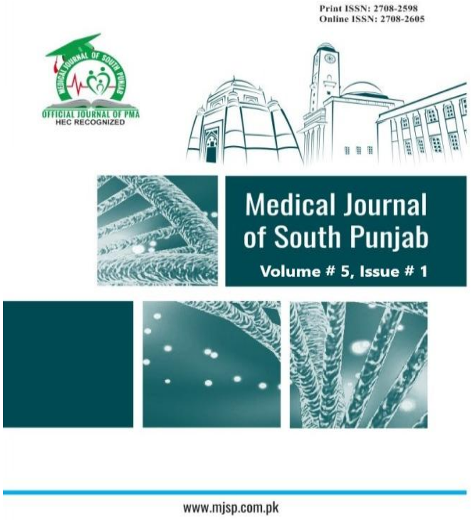
ISSN (E): 2708-2601
ISSN (P): 2708-2598

Medical Journal of South Punjab
Article DOI:10.61581/MJSP.VOL05/02/01
Volume 5, Issue 2, 2024



Exploring the Impact of Surgical Techniques on Postoperative Corneal Astigmatism: A Comparative Study between Phacoemulsification and Small Incision Cataract Surgery

Publication History

Received: Jan, 27, 2024 Revised: May 23, 2024
Accepted: June 01, 2024 Published: June 30, 2024

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Conflict of Interest:

Author(s) declared no conflict of interest.

Acknowledgment:

No Funding received.

Citation: Mannan MA, Anjum KK, Zahid F. Comparison of Incentive Spirometry and Peak Expiratory Flow Meter to Evaluate Cardio-respiratory Parameters after Valvular Surgery. Medical Journal of South Punjab. 2024 June 30; 5(2):61-68.

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An official publication of
Medteach Private Limited, Multan, Pakistan.
Email: farman@mjsp.com.pk, Website: https://mjsp.com.pk/index.php/mjsp

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Original Article

Exploring the Impact of Surgical Techniques on Postoperative Corneal Astigmatism: A Comparative Study between Phacoemulsification and Small Incision Cataract Surgery

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ABSTRACT

Objective: *To compare the post-surgical corneal astigmatism after phacoemulsification and small incision cataract surgery (SICS) on the basis of incision length.*

Methods: *140 participants with age between 45-70 years were divided into two groups, each having 70 patients undergoing cataract surgery by phacoemulsification and small incision. The 70 patients of each group were further divided into two groups, the A group including 35 patients on the basis of incision length of 1.75mm and group B including 35 patients on the basis of incision length of 2.75mm during cataract surgery. All patients were thoroughly examined before and after surgery on the first day, week and sixth week.*

Results: *Mean age of participants was 1.41± 0.494 years. With little complications, both surgical procedures produced outstanding visual results. In patients who had phacoemulsification, the initial visual recovery at the sixth postoperative week was better. Phacoemulsification's MAE for astigmatism was 0.18 ± 0.914 D and for SICS was 0.136 ± 0.962 D. The initial difference with 1.75mm incision showed that there was no significant difference (P=0.172) and with 2.75mm showed phacoemulsification gave better cylindrical output (P=0.007).*

Conclusion: *Both the techniques, phacoemulsification and manual small incision cataract surgery (SICS) have demonstrated their efficacy in achieving excellent visual outcomes for cataract surgery. Phacoemulsification offers the advantage of early visual rehabilitation due to its smaller incision size.*

Keywords: *Astigmatism, Biometry, Cataract, Phacoemulsification, Small Incision Cataract Surgery.*

1. INTRODUCTION

The word cataract refers to the natural crystalline lens continuing to lose some of its clarity, which would be generally caused by growing older. Cataract has become the most significant reason of blindness around the globe, and it is able to be corrected through surgical intervention. Over 11 million eyes are implanted with IOLs each year across the world [1]. Although phacoemulsification is a particularly innovative technique for treating cataracts, occasionally there is no advancement in vision after this technique due to surgically induced astigmatism (SIA) or pre-existing astigmatism (PEA). Pre-existing surgical treatment aims to improve visual acuity (VA) while somehow reducing pre-existing astigmatism (PEA), that can lead to reduced VA and poor visual acuity effectiveness [2].

Efforts have been made to increase the accessibility and affordability of cataract surgery for those in need, increase access to eye care services, train healthcare professionals, and introduce less expensive surgical methods [3]. The current refractive technique aims to produce postoperative emmetropia as well as, the best possible visual outcome and an immediate improvement in function, meaning the improvement of visual function (VF) and the quality of life connected to vision, or VRQOL [4]. Consequently, cataract operations can reduce the morbidity of blindness. To address high volume treatment outcomes in dense cataracts, manual small incision cataract surgery, a kind of extracapsular cataract extraction (ECCE), has been employed. The technique involves creating a self-sealing sclera-corneal tunnel [5]. Phacoemulsification is a further procedure that entails the removal of the nuclear significant portion of a cataractous lens using an aspirating and vibrating ultrasonic handpiece [6]. The types of cataract surgery are ECCE, MSICS, and then phacoemulsification [7].

Improving uncorrected visual acuity while lowering surgically induced astigmatism (SIA) to emmetropia and increasing patient satisfaction are some of surgery's main goals. During cataract surgery, the type, length, and location of incisions as well as the suturing techniques can affect SIA and astigmatism [8]. Advanced cataract surgery aims to improve unaided visual acuity while minimizing surgery-related complications [9].

SICS and phaco have astigmatism differences between 0.3 and 0.5 diopters, but the price difference is substantial. A larger incision is preferable for removing some cataracts, such as those with extremely subluxated lenses, very hard cataracts, or poor endothelium counts, even if 99.9% of the time it may be possible to remove a cataract with a tiny incision [10,11].

As the patient wants to be able to see without glasses following surgery, cataract surgery is regarded as being equal to refractive surgery [12]. The degree of astigmatism has a significant impact on the quality of vision, and both surgical technique and surgeon skill are crucial. Depending on the procedure used and the surgeon's expertise, surgically induced astigmatism (SIA) can occur in anywhere between 7.50 and 75% of patients. In addition, 25% to 30% of eyes have astigmatism that requires correction (>2 D) [13].

In this study, we are comparing post-surgical corneal astigmatism after phacoemulsification and small incision cataract surgery (SICS) on the basis of incision length of 1.75mm and 2.75mm.

2. METHODOLOGY

This was a longitudinal study conducted at Superior University, Lahore. The study was approved by the Institutional Ethical Committee. All procedures were performed after obtaining expressed written consent from patients.

The patients aged between 45 and 70 years, encompassing both genders and having either phacoemulsification surgery or small incision cataract surgery was included. Specifically, patients with incision sizes ranging from a minimum of 1.75 to a maximum of 2.75 were considered. Furthermore, the study involved patients with uncomplicated bilateral immature senile cataract graded as 3 or less, where the best-corrected visual acuity (BCVA) in either eye was below 0.50. Patients with mature, hypermature, complicated, congenital, and traumatic cataracts associated with other ocular comorbidities, injuries, or previous ocular surgeries were not considered in the study. We also excluded patients with uveitis, pterygium, glaucoma, endophthalmitis, corneal infections, or any type of fundus abnormality. These exclusion criteria were implemented to ensure a homogenous and well-defined patient group for the study, focusing specifically on uncomplicated bilateral immature senile cataracts within the specified age range.

There were two groups, N=70 patients undergone the cataract surgery by phacoemulsification and N=70 patient undergone the cataract surgery by small incision. The 70 patients of phacoemulsification and small incision cataract surgery were further divided into two groups. The groups included 35 patients each on the basis of incision position of 1.75mm and 2.75mm during cataract surgery. Each patient received a thorough examination, and visual acuity was recorded on the LogMAR chart. The anterior and posterior examinations were examined using a slit lamp. Autorefractometer and keratometer tests were used to determine astigmatism. Patients were checked out 1-3 and 4-6 weeks after surgery performed by a team of surgeons, respectively. Slit lamp examination, autorefractometer testing, and keratometry testing were done, and the uncorrected and best corrected visual acuities were recorded. As a result, the results of astigmatism caused by phacoemulsification and small incision cataract surgery were compared using extended depth of focus lenses in both techniques, and the surgically induced astigmatism was computed from pre and postoperative keratometric data.

Data entry and analysis were performed using Statistical Package for Social Sciences version 26. A descriptive analysis was performed to characterize the patient's demographic profile and clinical outcomes. Normality of the data was assessed using the Shapiro-Wilk test, and since all data were found to be non-normally distributed, non-parametric tests were employed. Visual outcome and cylindrical error at each follow of both groups was conducted using Friedman's test. Mann-Whitney U Test was used to compare outcomes of each group on basis of incision length. A P value of < 0.05 was considered significant.

3. RESULTS

The study included 140 patients. There were two groups formed from the participants. Out of these 140 patients, 70 underwent short incision cataract surgery in group A, while 70 underwent phacoemulsification in group. 82 (58.6%) were male and 58 (41.4%) were female. The mean ± standard deviation was 1.41± 0.494. All participants were between ages of 45-70 years. The mean ± standard deviation was 1.99± 0.791 years.

The Shapiro-Wilk test was used to determine whether the data were normal. Analysis revealed a significance value of <0.05, indicating that the data were not distributed normally.

The Friedman's test was employed, at baseline, prior to the procedure, the mean visual acuity was measured at 0.831 ± 0.199. Subsequent to phacoemulsification, the mean visual acuity improved to 0.226

± 0.152 on 6th week of phacoemulsification. The data indicates a significant improvement in visual acuity following the phacoemulsification procedure (P=0.00).

Prior to the SICS procedure, the mean visual acuity was reported as 0.884 ± 0.178. By Week 6 postoperatively, the mean visual acuity showed continued improvement from day 1, reaching 0.280 ± 0.196. These findings suggest that the SICS procedure has a significant positive impact on improving visual acuity (P=0.00).

At baseline, before the procedure, the mean cylindrical error was 0.831 ± 0.199. Following the phacoemulsification procedure, the mean cylindrical error decreased to 0.275 ± 1.304 on Day 1 postoperatively. By Week 1 postoperatively, the mean cylindrical error slightly increased to 0.314 ± 1.155. However, by Week 6 postoperatively, the mean cylindrical error decreased further to 0.182 ± 0.914. These findings suggest that phacoemulsification has a significant impact on reducing cylindrical error, as evidenced by the decrease in mean values from baseline to different postoperative time points.

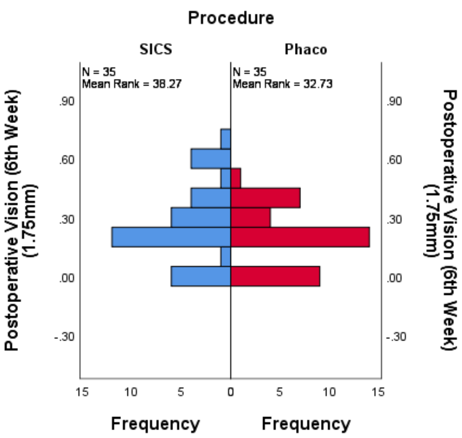

Figure 1: Comparison of Visual Outcome with 1.75 incision length between groups

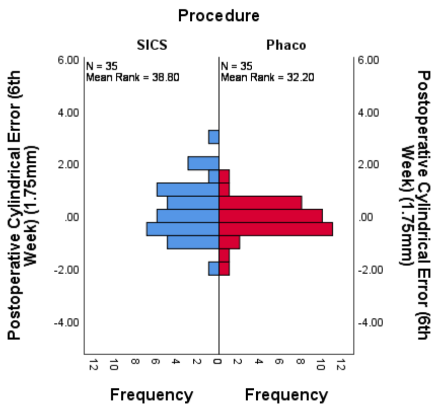

Figure 2: Comparison of Cylindrical Error with 1.75 incision length between groups

At incision length of 2.75mm, for Visual Outcome, the p-value was 0.743 and for Cylindrical Error, the p-value was 0.007. Based on the Mann-Whitney U test results, there is no significant difference in visual outcome between the groups being compared and in cylindrical error there is statistically significant difference between the groups, indicating that the two groups differ in terms of their visual outcome and cylindrical error values.

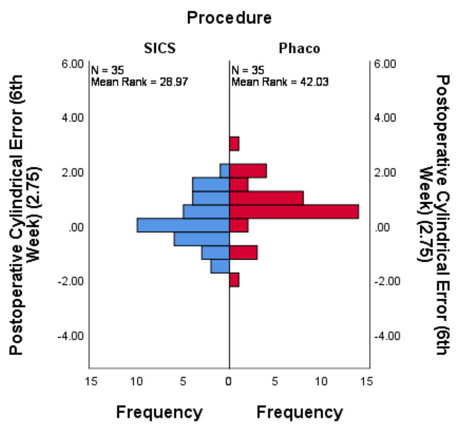

Figure 3: Comparison of Cylindrical Error with 2.75 incision length between groups

Table 1: Descriptive Statistics of Group undergoing Phacoemulsification and SICS on basis of Visual Outcomes and Cylindrical Error

	Phacoemulsification			
	Mean	**±Standard Deviation**	**Friedman's Test Value**	**P-Value**
Baseline	0.831	±0.199		

Vision				
Postoperative vision (Day 1)	0.467	±0.218	177.138	0.00
Postoperative vision (Week 1)	0.353	±0.184		
Postoperative vision (Week 6)	0.226	±0.152		
	SICS			
	Mean	**±Standard Deviation**	**Friedman's Test Value**	**P-Value**
Baseline Vision	0.884	±0.178	181.158	0.00
Postoperative vision (Day 1)	0.544	±0.260		
Postoperative vision (Week 1)	0.437	±0.228		
Postoperative vision (Week 6)	0.280	±0.196		
	Phacoemulsification			
	Mean	**±Standard Deviation**	**Friedman's Test Value**	**P-Value**
Baseline Cylindrical Error	0.831	±0.199	28.692	0.00
Postoperative Cylindrical Error (Day 1)	0.275	±1.304		
Postoperative Cylindrical Error (Week 1)	0.314	±1.155		
Postoperative Cylindrical Error (Week 6)	0.182	±0.914		
	SICS			
	Mean	**±Standard Deviation**	**Friedman's Test Value**	**P-Value**
Baseline Cylindrical Error	0.831	±0.199	24.081	0.000
Postoperative Cylindrical Error (Day 1)	0.043	±1.445		
Postoperative Cylindrical Error (Week 1)	0.107	±1.215		
Postoperative Cylindrical Error (Week 6)	0.136	±0.962		

4. DISCUSSION

Patients' quality of life and visual performance are greatly enhanced after having cataract surgery, which is a transformative process. Phacoemulsification stands out as the most often used surgical procedure for cataract surgery among the different ones that are accessible. SICS, or small-incision cataract surgery, is a different treatment approach that gives equally impressive outcomes and is skillfully executed. Modern cataract surgery places a strong emphasis on minimizing postoperative astigmatism and promoting fast visual recovery. Surgeons prioritize making small, clean corneal or scleral tunnel incisions to accomplish these objectives. The primary goals of modern cataract surgery are to minimize astigmatism caused by the surgery and to ensure a quick recovery of vision.

In a study by Gogate et al., the efficacy and safety of two cataract surgery methods—phacoemulsification and small-incision cataract surgery (SICS)—were compared. The results demonstrated that both procedures were successful in restoring eyesight to cataract patients. The study discovered that in the sixth post-operative week, 98.4% of patients in the phacoemulsification and SICS groups had best-corrected visual acuity (BCVA) of 6/18 or greater. Phacoemulsification was reported to improve uncorrected visual acuity (UCVA) in a higher percentage of patients than SICS. These findings suggest that even if both procedures are safe and effective, phacoemulsification may have a slightly higher likelihood of delivering superior visual outcomes in terms of UCVA [(14)]. Studies comparing best-corrected visual acuity (BCVA) and uncorrected visual acuity (UCVA) have demonstrated that phacoemulsification (PHACO) and small-incision cataract surgery (SICS) are equally effective treatments. In these studies, the outcomes of the two vision rehabilitation techniques have often been comparable [(15)]. The first postoperative day showed no appreciable visual change between phacoemulsification and small-incision cataract surgery (SICS), according to Singh et al.'s study. This indicates that both techniques are equally effective in delivering comparable visual outcomes soon after surgery [16]. In line prior to the study, findings revealed that there was a significant difference in visual outcome on follow ups between phacoemulsification and small incision cataract surgery.

In a study by El Sayed et al, it was discovered that phacoemulsification (phaco) cataract surgery has a very low incidence of post-operative astigmatism. This shows that when compared to other surgical methods, phaco has an advantage in reducing astigmatism [17]. In a research, individuals who received either phacoemulsification (phaco) or small-incision cataract surgery (SICS) did not significantly differ in their post-operative visual acuities. However, the study found that when rigid intraocular lens (IOL) implantation was done in the SICS group as opposed to phaco with rigid IOL implantation, post-operative astigmatism was significantly higher in the SICS group [18]. Another study reported by Iqbal et al also revealed slightly greater levels of astigmatism in the small-incision cataract surgery (SICS) group compared to the phacoemulsification (phaco) group [19], which is consistent with the findings from Mahayana et al. The phaco group had a mean astigmatism of 0.98 D, while the SICS group had a mean astigmatism of 1.45 D, according to Mahayana et al [20]. Furthermore the study revealed statistically significant results on basis of cylindrical error showing phacoemulsification giving better outcome.

In a study conducted by Kumari R in 2020, the researchers demonstrated that the visual outcomes achieved with phacoemulsification and small incision cataract surgery (SICS) were comparable. Both techniques were found to be equally safe and effective in the hands of skilled surgeons, resulting in favorable visual outcomes [21]. In line with their findings, the study similarly found no discernible difference between the phacoemulsification and SICS groups in the distribution of Vision Category at the sixth week post-operative period, with a p-value of 0.000. This suggests that the two groups' visual results a month after surgery were comparable. These findings highlight the same effectiveness of phacoemulsification and SICS in achieving positive visual outcomes. It implies that either procedure can be used, with the right surgical abilities, to provide cataract surgery patients with the best visual outcomes.

5. CONCLUSION

Excellent visual outcomes can be achieved with either manual small incision cataract surgery (SICS) or phacoemulsification. While SICS offers a sutureless procedure with a small incision, phacoemulsification's smaller incision allows for a quicker visual recovery. This study shows that both approaches result in comparable visual outcomes when used with extended depth of focus (EDOF) intraocular lenses (IOLs).

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