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ORIGINAL ARTICLE

EVALUATION OF ASTIGMATISM IN PATIENTS AFTER PHACOEMULISFICATION AND MANUAL SMALL-INCISION CATARACT SURGERY AT KGN-TH, BANNU, KPK

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Abstract

Background: The frequency of cataract-related blindness, underscores the need for cost effective surgical interventions, its adoption in scanty resources setting is hampered by cost and technical challenges. Manually performed small-incision tunnel cataract surgery has become evident as an economical substitute compared to phacoemulisfication but with fewer complications. However, variations in surgical practices exist between high-income and low-income regions, impacting post-operative outcomes.

Objectives: To determine visual rehabilitation, safety, and an effectiveness of phacoemulisfication compared to MSICS in causing astigmatism afterward surgery.

Materials and Methods: This comparative study used non-probability sequential sampling to assess outcomes of MSICS [169 eyes (50.14%)] in Group A and PHACO [168 eyes (49.85%)] in-group B, out of 337 cataract patients. Inclusion Criteria is Adults with lenticular cataract and keratometric astigmatism ≤2.00 D and Exclusion Criteria is History of glaucoma, corneal scarring, prior ocular surgery, or astigmatism >2.00 D.

Results: Results of both techniques indicate comparable improvements in visual acuity, with advantages in intraoperative time and post-operative corrected visual acuity observed in the manually performed small incision tunnel cataract surgery (MSICS) group. Our findings about astigmatism correction at six month was 1.18±0.32D in MSICS surgery group while 1.20±0.22D in PHACO group. Mean intraoperative time for MSICS group was significantly shorter than PHACO group (8.5±3.2 vs 12.5±5.6,p<0.001)

Conclusion: PHACO and MSICS both successfully increase visual acuity, but MSICS has a slight advantage in correcting astigmatism and requires less time during surgery. MSICS is still a useful option, particularly in environments with limited resources, highlighting the necessity of more research to lessen blindness caused by cataracts.

Keywords: UCVA (Uncorrected visual acuity), MSICS (manually performed small incision tunnel cataract surgery), PHACO Phacoemulisfication)

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Introduction:

According to various estimates, 570,000 individuals worldwide are blind from cataracts, with 350,000 of them having visual acuity below [1] Log Mar in Pakistan. Cataracts may be congenital or acquired1 and are one of the most avoidable causes of blindness with numerous modifiable risk factors i.e. exposure to Ultra violate light, high blood pressure, diabetes, body mass index, medications, diet, smoking and socioeconomic status are linked to cataract development with the most significant risk factor is aging. [2] One of the most beneficial options for treating cataracts in developing nations is manually performed tunnel cataract surgery, a subtype of Extra capsular Cataract Extraction, because there is no suture application due to self-sealing incision [3], although phacoemulisfication has gained much popularity in developed nations[4], which faces barriers due to its cost and technical demands. In contrast, manually performed small-incision tunnel cataract surgery has evolved as a reasonable substitute, particularly suitable for mature white cataracts.[5]Studies have shown that manually performed small incision tunnel cataract surgery offers comparable visual outcomes to phacoemulisfication, with fewer complications and lower costs, however phacoemulisfication is recommended over above alternative techniques because of its safety, efficacy and capacity to promote early visual recovery[6]and minimal post-operativeproblems[7-8] however, the main drawbacks are the cost and heat generation that damages the corneal endothelium, and it takes extraordinary surgical talents to

overcome these limitations; otherwise, there would be corneal decomposition and problems with the posterior capsule rupture and dropped nucleus.[9]Cataract surgery is refractive type of surgery as the size, and type of cataract incision should be considered to prevent astigmatism, which is a major cause of poorUCVA after cataract surgery.[10]Surgical procedures, usually depends on the financial status of patients and differ between high-income nations that prefer phacoemulisfication and low-income areas where manually performed small incision tunnel cataract surgery is more common.[11] Ruit et al. in Nepal and Venkatesh *et al.* in India shown that while both strategies yielded comparable results, manually performed small incision tunnel cataract surgery is quicker. According to Gogate et al. phacoemulisfication produced better outcomes six weeks after surgery.

Comparing phacoemulisfication (PHACO) to manually conducted tunnel cataract surgery (MSICS), our study aims to assess the safety, effectiveness, and visual rehabilitation of PHACO in relation to astigmatism following surgery.

Material and Method:

In the ophthalmology unit of the Khalifa Gul Nawaz Teaching Hospital Bannu, Pakistan, a comparative assessment was carried out from January to August 2023. Ocular history was gathered by the researcher, which included the beginning, progression, and length of vision loss as well as any previous prescription drug usage for eye disorders, and any prior eye surgeries. Furthermore, data regarding cardiac conditions, autoimmune disease (including rheumatoid arthritis), diabetes mellitus, hypertension and other relevant health issues were generated. For keratometric measurements an autorefractometer was used and A-scan for lens power calculation. A 6 mm diameter polymethylmethacrylate lens for MSICS and a foldable lens were employed for PHACO. To measure intra ocular pressure preoperatively, Goldman's application tonometer was used, and Snellen's charts were used to obtain an unassisted BCVA. Any corneal disease, pseudo exfoliation, synaechia, Iris atrophy, pupil dilatation, and anterior chamber (AC) depth are all included in a thorough slit-lamp examination. A thorough posterior-segment assessment was conducted using a 90 D lens and indirect ophthalmoscopy.

Methodology: Non-probability sequential sampling

Study Design: Comparative study

Place & duration: Eye department KGN-TH, Jan 2023 to Aug 2023

Sample Size: 337 cataract patients divided into two groups

Sample Technique:

A non-probability sequential sampling procedure was used and the study utilized a comparative design to assess the outcome of MSICS and PHACO intervention in cataract surgery.

Participant Selection:

The research comprised 337 eyes from 337 participants who had cataract surgery.MSICS was performed to 169 patients in group A, whereas Phaco was performed to 168 patients in group B.

Confidence level was set at 95% to find out the sample size using WHO calculator.

Inclusive Criteria:

- Adults of any gender.
- Diagnosis of lentigular cataract.
- Keratometric astigmatism of 2.00 D or below.

Exclusive Criteria:

- Glaucoma
- Corneal scarring
- Ocular surgeries or
- Astigmatism greater than 2.00 D.

3. Surgical Techniques:

Group-A cataract surgery patients operated with a minimal incision technique. In MSICS, epitome was performed more skillfully using conjunctival scissors, allowing conjunctiva and tenon's capsule to be separated individually, and wet field cautery was used to stop blood following sterilizing, draping, and applying a wire speculum. A crescent blade was used to make a frown incision for wound formation, around 1 to 2 mm from the limbus. The incision's exterior breadth was around 6–6.5 mm, in accordance with the nucleus's anticipated size. Using a bevel-up crescent blade, the incision was dissected forward 1–1.5 mm into a clean cornea.

Phacoemulisfication cataract surgery was performed on Group-B. After sterilization, topical anesthetic medication administration, and the use of a wire or universal speculum, a corneal tunnel of 2 mm in length and 3 mm in width was made in the upper temporal quadrant using a disposable ophthalmic 3.2mm keratome. A 15° disposable ophthalmic micro vitreoretinal knife was then used to make side ports. After that, enough ophthalmic viscoelastic was inserted into the anterior chamber of the eye to flatten the anterior capsule in advance of a future appropriate capsulorhexis procedure. If necessary, a bent 24 G needle and cystotome were used to accomplish curvilinear capsulorhexis and the treatment was completed with a 6mm broad capsulorhexis using capsulorhexis forceps and a 27-G flat tip cannula was utilized for the hydro dissection procedure. Standard tips for phacoemulisfication systems with a 15° bevel fitted to the phacoemulisfication hand piece were used for all patient procedures. The divide and conquer tactic was employed in certain instances to dismantle the nucleus.

Outcome Measures:

- Primary Outcome: Correction of astigmatism.
- Secondary Outcomes: Improvement in visual acuity,

Authorship Contribution: [1,5]Substantial contributions to the conception or design of the work; or the acquisition, Data analysis, Literature review, [2]Drafting the work or revising it critically for important intellectual content, [3,4,6]Final approval of the version to be published, Topic Selection & Supervision

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incidence of comorbidities, and intraocular pressure.

Data Collection:

- Information was gathered regarding pre-operative features and post-operative results.
- Astigmatism, intraocular pressure, and visual acuity were measured using standardized assessment instruments.

Statistical Analysis:

Surgical results and participant characteristics were summarized using descriptive statistics. Group-A and Group-B results were compared using inferential statistics such t-tests, chi-square tests, and Fisher exact tests. In order to test the hypothesis, a significance threshold of 0.05 was used.

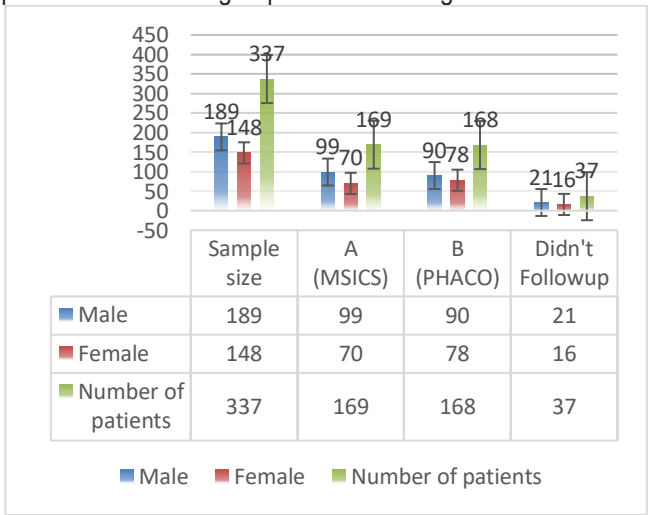
Ethical Considerations:

Ethical approval was obtained from institutional review board. Prior to being enrolled in the study, participants gave their informed consent.

Results:

Participant Characteristics:

My study involved the recruitment of 337 patients, who were split into two groups. In Group B, there were 90 (53.5%) males and 78 (46.4%) women, but in Group A, there were 70 (41%) women and 99 (59%) men.37 patients lost to follow up i.e. 21(10.9%) patients in manually performed small incision tunnel cataract surgery group and 16 (9.4%) patients in phacoemulisfication group as shown in Figure .



	Sample size	A (MSICS)	B (PHACO)	Didn't Followup
Male	189	99	90	21
Female	148	70	78	16
Number of patients	337	169	168	37

Figure I: Participants Characteristics

The average age of participants was 47 ± 15.7 years and the age distribution was identical between the two groups, with the majority of patients lying between the ages of 18 to 80 years. 100 (29.6%) hypertensive and 200 patients (59.3%) without hypertension and 10 patients (2.9%) with diabetes mellitus are included in the research population as shown in (Table 1).

Table 1. Demographic and Clinical Features of Group A and Group B

Characteristics	Category	Group A (n)	Group B (n)	P-Value
Age (yrs)				0.142 ǂ
18-40 yrs	Mean±SD	95 ± 1.85	85 ± 1.50	
41-80 yrs	Mean ± SD	84 ± 1.56	73 ± 1.85	
Gender				
Male	N (%)	99 (59%)	90 (53.5%)	0.354
Female	N (%)	70 (41%)	78 (46.4%)	
Vision Before Surgery				
3/60 and worse	N (%)	76 (45%)	66 (39%)	2.37

Independent sample t-test, chi-square test

Visual Acuity and Astigmatism:

Compared to 75% of patients in group B, 60% of patients in group A had UCVA better than or equivalent to 6/18. The initial difference was nearly equalized in four months, and six months later, 90% of patients in group B had better than or equal to 6/18, whereas 85% of patients in group A had the same score. By comparing visual acuity (Log Mar) before and after the procedure there is significant improvement. After surgery, the mean SIA for the two groups was comparable at three and six months: 1.20± 0.32 D for group A at three months and 1.18± 0.32 D at six months, and 1.20± 0.22 D for group B at three months and 1.20 ± 0.22D at 6 months. There was no statistically significant change, as seen in (**Error! Reference source not found.**).

Intraoperative Time:

The mean intraoperative time for MSIC was significantly shorter than for PHACO (MSIC: 8.5 minutes ± 3.2 vs. PHACO: 12.5 ± 5.6 minutes, p < 0.001.These results demonstrate advantages in terms of shorter intraoperative time in MSICS and superior post-operative corrected visual acuity (Table 2).

Table 2. Comparison of surgical outcomes in Group A and Group B

Time Point / Surgical Outcome	Group A	Group B	P Value
Astigmatism (D)			
1st Postoperative Day	1.23 ± 0.32 D	1.23 ± 0.22 D	0.9
1st Month	1.22 ± 0.32 D	1.21 ± 0.22 D	
3 Months	1.20 ± 0.32 D	1.20 ± 0.22 D	
6 Months	1.18 ± 0.32 D	1.20 ± 0.22 D	
Surgical Outcomes			
Best Corrected Visual Acuity (Log Mar)	0.8267 ± 0.13 (Preop)	0.900 ± 0.15 (Preop)	<0.000*
	0.020 ± 0.04 (Postop)	0.0133 ± 0.13 (Postop)	
Intraocular Pressure (IOP) mmHg	15.6 ± 1.4 (Preop)	16.3 ± 1.6 (Preop)	0.07
	16.2 ± 0.7 (Postop)	16.5 ± 1.3 (Postop)	
Surgery Duration (minutes)	8.5 ± 3.2	12.5±5.6	<0.001*

Complications:

Both techniques demonstrates similar rates of intraoperative complications as shown in (Table 3) except anterior chamber reaction are more common in MSICS group 71(47.3%) compared to Phaco group 55(36.6%) which is highly significant (p=0.000). Posterior capsule rupture occurred in 2 (1.3%) of the patient eyes in the MISC group and 5 (3.0%) of the patients eyes in the PHACO group, with no statistically significant difference (p = 0.681). One eye (0.6%) in the PHACO group couldn't receive an intraocular lens due to inadequate capsule support. Vitreousprolapse is seen in 2% of the Phacopatients. Post operation hyphenate is more common in MSICS group.

Table 3. Complications In interventional Groups

Complications	Interventional Groups Group A	Group B	Total	p-value
Posterior capsule rent (rupture)	2(1.2%)	5(3.0%)	7 (2.3%)	0.681
Corneal edema	2(1.2%)	35(21%)	37(12.3 %)	0.681
Vitreous prolapse	0(0%)	3(2%)	3 (1%)	0.185
Corneal Striation	3(1.7%)	5(3%)	8 (2.7%)	0.721*
A/C Reaction	71(42%)	55(32.7%)	126 (42%)	0.000
Traumatic Hyphema	2(1.2%)	1(0.6%)	3(1%)	1.00*

Discussion:

The most preferred technique among most eye surgeons around the globe is phacoemulisfication, however, because to its similar surgical and postoperative results, manually performed small incision tunnel cataract surgery has become increasingly popular. Additionally, as cataract surgery is an elective procedure, the majority of patients from low-income rural communities frequently choose to receive their treatment in free medical camps because manually small incision tunnel cataract surgery offers the additional advantage of being an inexpensive and accessible.[13]However, the majority of patients from rural regions do not receive follow-up care, which is crucial for treating problems, post-operative precautions, and postoperative visual rehabilitation. [14]In our study, that wo surgery methods were compared on how they affect surgical induced astigmatism and in turn the postoperative visual acuity. After surgery, the UDVA was 6/18 or better in 60% who underwent manual small incision tunnel cataract surgery and in contrast the percentage was 75% in phacoemulisfication, the difference was not statistically significant (P=0.805).Compared to 90% of patients in the phacoemulisfication group, 85% of patients in the manually performed small incision tunnel cataract surgery group had better than or equal to 6/18, and this difference was adjusted within the first six months after the procedure. In their comparison of postoperative astigmatism between phacoemulisfication and manually performed small incision tunnel cataract surgery, Gogate et al. [14] found that the normal astigmatism was 1.2 D for the phacoemulisfication group and 1.2 D for the manual small incision cataract surgery group, respectively, while the mode of astigmatism was 0.5 D for the phacoemulisfication group and 1.5 D for the manual small incision cataract surgery group. In our study the average astigmatism for the manually performed small incision tunnel cataract surgery group was 1.21 D (0.2 SD) and phacoemulisfication group was 1.20 D (0.23 SD), astigmatism up to 0.75 D was present in 39.0% of participants in the manually performed small incision tunnel cataract surgery (MSICS) group and 49.2%of individuals in the phacoemulisfication group. This discrepancy in astigmatism between manually performed small incision tunnel cataract surgery (MSICS) and phacoemulisfication raises questions about the influence of incision types on astigmatism induction. While phacoemulisfication incisions are smaller and theoretically less likely to induce astigmatism, our study did not find substantial differences in post-operative astigmatism between two techniques. This suggests that factors beyond incision size may contribute to astigmatism induction, such as wound construction, corneal biomechanics, and surgical technique variations. The study findings show that both groups preoperative visual acuity was comparatively low, however following the surgeries, most patients had astigmatism of 1.20 D in group A and 1.21 D in group B, and visual acuity up to 6/12 (LogMar 0.3), thus representing a significant improvement in visual acuity. Both the surgical procedures usually give rise to several complications of which Anterior chamber reaction, posterior capsule rupture (PCR), and striate keratopathy are examples. There is an anterior chamber reaction in both groups, and the PCR results were in line with earlier research findings. Of 100 patients in the MSICS group, there was only one case was recorded, which is also in line with earlier research findings.[15]According to a similar study conducted in INDIA, Phacoemulisfication patients experienced higher complications than manual small incision cataract surgery patients (4.8% vs 1.46%) [17,] while according to a different local study phacoemulisfication patients experienced less complications than manual small incision cataract surgery patients (7.1% vs 15.1%). In our study surgery duration is lower in MSICS surgery as compared with PHACO. Additionally, according to Singh et al. [16] the MSICS group uses rigid IOL most of the time since they are less expensive than foldable IOL, which makes MSICS a cost effective surgical approach and a preferred choice, particularly in low income countries. Our study underscores the importance of considering surgical techniques beyond their primary goals of cataract extraction and intraocular lens implantation. Astigmatism management should be an integral component of cataract surgery planning, regardless of the chosen technique. While phacoemulisfication offers advantages in terms of precision

and tissue preservation, MSICS provides comparable outcomes in astigmatism correction, highlighting its efficacy as a cost-effective alternative, particularly in resource-limited settings. Mahayana *et al*.[18] found similar results, with an average astigmatism of 1.45D in the MSICS group and 0.98D in the PHACO group. Similarly, a study found that the MSICS group with rigid IOL implantation had significantly higher post-operative astigmatism than the PHACO group with foldable IOL implantation, even though there was no significant difference in post-operative visual acuity between patients who underwent PHACO or MSICS. Consistent with our research, Iqbal *et al.*[19] found that the MSICS group had somewhat more astigmatism than the PHACO group. The findings of our study have practical implications for ophthalmic surgeons and healthcare providers involved in cataract surgery decision-making. Astigmatism assessment and management should be tailored to individual patient characteristics and surgical preferences, rather than solely relying on the chosen surgical technique.

Future research endeavors should delve deeper into the mechanisms underlying astigmatism induction and correction in different cataract surgery approaches. To assess the stability of astigmatism correction and its effect on visual outcomes over time, long-term follow-up studies are necessary.

Conclusion:

Through the comparison of phacoemulisfication and manually performed small incision tunnel cataract surgery procedures, our work challenges preconceived ideas about how to correct astigmatism following cataract surgery. It is essential that specific astigmatism, intraoperative time and best corrected visual acuity (BCVA) management strategies be used in cataract surgery. In the group undergoing manually performed small incision tunnel cataract surgery, the UCVA was better than or equal to 6/18 in 85% of cases, whereas in the group undergoing phacoemulisfication, it was 90%.Our findings about astigmatism correction at six month was 1.18±0.32D in group B while 1.20±0.22D in group A. The mean intraoperative time for group A was significantly shorter than Group B i.e. 8.8±3.4 min and 12.2±4.6 min ($p<0.001$). In order to address astigmatism related to cataracts and improve patient satisfaction, more research is necessary to refine surgical outcomes.

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