A QUASI-EXPERIMENTAL STUDY ON EFFECTS OF 3.2MM SUPRATEMPORAL CLEAR CORNEAL INCISION DURING PHACOEMULSIFICATION ON PREOPERATIVE ASTIGMATISM: BRIDGING THEORY AND SURGICAL PRACTICE

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ABSTRACT

OBJECTIVES

This study aimed to evaluate the effect of 3.2 clear corneal superotemporal incisions on postoperative astigmatism in patients surgically treated with phacoemulsification for cataract extraction, thereby bridging the gap between theory and surgical practice.

METHODOLOGY

This quasi-experimental study was conducted in the ophthalmology department of the Medical Teaching Institute, Lady Reading Hospital, Peshawar, from February 2024 to August 2024, following ethical approval and informed consent from the patients. Seventy-three patients presenting with non-complicated and non-traumatic cataracts between the ages of 20 and 85 years were enrolled. Phacoemulsification surgery was performed on these patients of both genders. A 3.2 super temporal clear corneal incision is used during phacoemulsification surgery. Using the Keratometer and comparing the corneal dioptric power along the horizontal and vertical meridians, the pre-and post-operative astigmatism at 3- and 6-month follow-ups was assessed. The data was entered and analyzed using SPSS version 25.

RESULTS

A total of 73 patients with cataracts were enrolled in this study. The patients' mean age was 61.6 ± 11.9 years. The ratio of male to female was in the ratio of 2:1. The mean pre-operative astigmatism was 0.88±0.4947D. The mean astigmatism after surgery was 1.15±0.748 D, and after 6 months, it decreased to 0.67 D. Following the study, the young surgeons in years 3 and 4 learned about the negating effect of this incision.

CONCLUSION

There was no significant difference in astigmatism when followed postoperatively over an extended period of 6 months with a 3.2 mm supratemporal clear corneal incision during phacoemulsification. The practical aspect of the study yielded more satisfactory results during the training of Postgraduate residents (PGRs).

KEYWORDS: *PGRS, Clear cornea, Cataract, Phacoemulsification, and With and Against the Rule of Astigmatism*

INTRODUCTION

As evidenced by multiple studies, the prevalence of cataracts in Pakistan is the same as in the rest of the world, and the best surgical techniques are the need of the day. Phacoemulsification is a surgical method used to treat cataracts, the primary cause of reversible blindness.[1] It has emerged as one of the most well-liked and safest methods for cataract removal worldwide, and in Pakistan, it is considered superior to alternative surgical techniques. Even in low-income countries, the advantages of early visual recovery compelled the use of this particular surgical technique. At one end of the spectrum, cataract is the primary cause of vision dimness; on the other end, astigmatism -a type of corneal asymmetry that causes poor image quality in patients with cataracts -exacerbates the visual handicap of these patients, increasing their discomfort.[2] Numerous studies also conclude that 53.7% and 68.2% of patients who develop cataracts in their eyes have preexisting astigmatism.[2] Modern cataract surgery aims to achieve early visual rehabilitation, best-corrected visual acuity, and minimal postoperative astigmatism.[3] The type, dioptric power, and correction, as well as the type of cylinder used for preoperative astigmatism, affect the type and amount of postoperative astigmatism. After surgery, astigmatism may be lessened with a small incision. That small incision can now be used for removing cataractous lenses due to phacoemulsification and the use of foldable intraocular lenses (IOLs). Significant changes in corneal curvatures are avoided by various techniques, which can hasten visual recovery. A small incision technique pioneered

by D.I. Howard for the first time, not only eliminated surgically created astigmatism but also reduced postoperative inflammation. In most cases, the surgeons opt for a temporal or superior incision for different reasons.[4] However, for patients with significant preoperative astigmatism, the steeper corneal meridian is chosen for incision to decrease the likelihood of postoperative astigmatism. The risk of postoperative astigmatism is further nullified if the clear corneal incision is small, posterior, and within the limbus.[5] The site and the size of a 3.2mm transparent supratemporal corneal incision are advantageous (5), as injecting the foldable IOL via the 3.2 mm does not cause an increase in the size of the wound (5) and does not alter the curvature of the cornea. The position, dimensions, and arrangement of incisions also greatly influence surgical astigmatism. Astigmatism benefits from incision at the supratemporal location in the oblique meridian. Moreover, postoperative astigmatism is minimized by flattening the horizontal corneal axis with a clear corneal supratemporal incision.[6] Compared to anterior incisions, posterior incisions are less likely to cause astigmatism.[7] It is very effective to make the incision in the steep meridian of the astigmatism because nearly all wounds eventually relax post-operatively. However, the question arises as to why the temporal approach should be preferred, and it is justified because most elderly patients with age-related cataracts have against-the-rule astigmatism (ARA). A temporal approach can help reduce postoperative astigmatism more effectively than other approaches.[8] The alternative approach can be a temporal scleral tunnel, but additional bleeding from a temporal scleral incision may require cautery due to the anatomy of the scleral blood supply. On the other hand, excessive cautery to combat the bleeding steepens the cornea's meridian by causing the collagens to shrink excessively. This short steepening typically disappears in four to six weeks. When treating against-the-rule astigmatism (ARA), temporal clear corneal incisions are beneficial and are associated with less bleeding and, ultimately, less use of cautery.[8] The supratemporal clean corneal incision technique is considered a reliable method with minimal side effects in phacoemulsification. Unfortunately, local studies comparing the degree of astigmatism in these patients before and after surgery are scarce, particularly when assessing the degree of astigmatism to delayed best-corrected visual acuity. This study aims to bridge that gap by providing practical information that can inform clinical procedures. In addition to educating PGRs on the practical aspects of surgery, we also need to use evidence-based practice to illustrate these aspects. To improve interventions and update current treatment protocols, the results will be incorporated when designing practical guidelines in our teaching setup for young surgeons. To evaluate the effect of 3.2 clear corneal superotemporal incisions on short and long-term postoperative astigmatism in patients surgically treated by phacoemulsification for cataract extraction. To close the gap between theory and surgical practice by teaching the PGRs. After the study, we will be able to answer the following questions. How does the supratemporal clear corneal incision affect post-operative astigmatism after 6 months of follow-up? What particular changes in the current surgical guidelines for PGRs are we expecting as a result of our findings?

METHODOLOGY

A Quasi-experimental study was conducted at the Department of Ophthalmology, Lady Reading Hospital, Peshawar, over six months. February 2024 and August 2024. Using the OpenEpi calculator, the sample size was calculated based on a reference preoperative astigmatism of 0.78 ± 0.70 D and postoperative astigmatism of 1.20 ± 1.07 D (11), with a 95% confidence level and 10% absolute precision. Based on this, the sample size is 73 patients in the group. A non-probability consecutive sampling Technique was used. Both Male and female patients, aged 20 to 80 years, with non-complicated and non-traumatic cataracts undergoing phacoemulsification for cataract surgery, were included in the study. Other causes of Astigmatism, ocular abnormalities, and corneal degeneration. Following the Standard Research Protocol, approval was obtained from the Ethical Review Board of Lady Reading Hospital, Peshawar. This study was conducted at the Department of Ophthalmology at Lady Reading Hospital, Peshawar. All the patients were assessed according to defined inclusion and exclusion criteria, and informed consent was obtained from all participants after a detailed briefing regarding the procedure, potential risks, and expected outcomes. After taking a complete medical and ocular history, each patient underwent a thorough ocular examination. This included slit-lamp biomicroscopy, measurement of intraocular pressure using Goldmann applanation tonometry, and fundus examination using both direct and indirect ophthalmoscopy. In cases where fundus visualization was not possible due to media opacities, B-scan ultrasonography was employed to evaluate the posterior segment of the eye. Preoperative astigmatism was measured and recorded using the Huvitz Autorefractometer (model number: HRK-8000A). Keratometric readings were also obtained using the Huvitz Keratometer, ensuring proper alignment of mires and precise patient positioning with the forehead and chin resting in designated supports, as per standard protocol. The same trained technician took all refractive

measurements to ensure consistency. Routine preoperative laboratory investigations (complete blood count, random blood sugar, and serology) were performed as per hospital policy. On the day of surgery, after ensuring all aseptic precautions, local anesthesia was administered, and the operative field was draped using sterilized material. After administration of regional anesthesia and properly sterilized draping of the surgical field, a 3.2 mm clear corneal incision was made 0.50 mm from the superior limbus. The incision was placed in the supratemporal quadrant, with careful consideration of the laterality of the eye:

For the right eye (OD), the incision was made in the supratemporal quadrant, which lies between the superior and temporal meridians (approximately) at the 10-11 o'clock Position).

For the left eye (OS), the incision was similarly positioned in the supratemporal quadrant (approximately at 1-2 o'clock position).

This standardized placement ensured consistent surgical access, minimized surgically induced astigmatism (SIA), and optimized wound architecture for self-sealing incisions. The same technique and orientation were followed in all patients to maintain uniformity in outcomes. A foldable acrylic intraocular lens (IOL), a single piece with an optical diameter of 6.0 mm, was implanted in the capsular bag. The same surgical technique, phaco machine (e.g., ZIES), and viscoelastic material were used in all procedures. To eliminate surgeon-related variability, all surgeries were performed by a single experienced surgeon with a consistent surgical protocol. Postoperative care included the administration of topical 0.3% moxifloxacin and 0.1% dexamethasone four times daily for the first 10 days. This was followed by a tapering combination regimen of both drugs over the next 30 days. Patients were advised to avoid eye rubbing, heavy lifting, and exposure to dusty environments during the recovery period. Follow-up was strictly maintained to ensure adherence to the protocol. Postoperative astigmatism was evaluated at 6 weeks, 3 months, and 6 months using the same Huvitz Autorefractometer to ensure measurement consistency. At each follow-up, the visual acuity (uncorrected and best-corrected), slit-lamp examination, intraocular pressure, and IOL position were assessed. Data regarding the axis and magnitude of astigmatism were recorded in diopters. The surgically induced astigmatism (SIA) was calculated using vector analysis methods such as the Alpins method or the SIA calculator software. All collected data were entered into a pre-designed structured proforma. Data were entered into SPSS version 25, and statistical analysis was performed using the same software. After assessing the normality of the data using Skewness and Kurtosis, frequencies and percentages were calculated for categorical variables, such as gender. The mean and standard deviation were calculated for numerical variables, including age, duration of cataract, preoperative astigmatism, and postoperative astigmatism. Paired t-tests were used for the comparison of pre-operative and postoperative astigmatism; p-value ≤0.05 was considered significant. The relationship between the pre-and post-operative dependent variables is analyzed through regression. Time series analysis is used to identify the mean difference between pre-and delayed postoperative astigmatism. Further statistical analysis of the data was conducted to investigate any correlations between variables, such as age groups, gender, and duration of cataract and post-operative astigmatism. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

In this study, the patients' ages ranged from 20 to 80 years. The mean age of the patients was 61.69 ± 11.93 years. The frequency of female to male in this study was 2:1, with a 65.8 % contribution from female patients. The duration of cataract presence varied among patients, and almost 24% of patients had cataracts for 1 year.

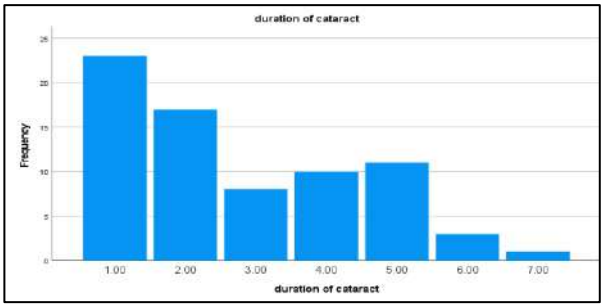

Figure 1: Frequency and Percentage of Patients According to Disease Duration

Table 1: Pre and Post, 3 & 6-month Astigmatism

	Pre-Op Astigmatism	Post-Op Astigmatism 3 Months	Post-Op Astigmatism 6 Months
Mean	0.8801	1.1541	0.6267
Std. Deviation	0.49496	0.74841	0.35630

Table 2: Comparison of Pre-Op and Post Op Astigmatism N = 73

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	p-value
					Lower	Upper			
Pair 1	Pre-opastigmatism - post-opastigmatism 3 months	0.31507	0.61524	0.07201	0.45861	0.17152	4.375	72	0.000

Table 3: Correlation of astigmatism with age (N = 73)

	Age	pre-op astigmatism	post op astigmatism 3 months	post op astigmatism 6 months
Mean	61.6986	0.8801	1.1541	0.6267
Std. Deviation	11.9031	0.49496	0.74841	0.35630

Table 4: Correlation of astigmatism with gender (N= 73)

Gender		Pre-op astigmatism	Post-op astigmatism 3-month	Post-op astigmatism 6 months	P Value
Male	Mean	0.9200	1.2400	0.7700	0.000
	Std. Deviation	0.47719	0.74120	0.30551	
Female	Mean	0.8594	1.1094	0.5521	0.000
	Std. Deviation	0.50767	0.75602	0.36084	
Total	Mean	0.8801	1.1541	0.6267	0.000
	Std. Deviation	0.49496	0.74841	0.35630	

DISCUSSION

Over a 6-month follow-up period, our study demonstrated that a supratemporal 3.2 mm incision rarely causes astigmatism or substantially alters preoperative astigmatism, which is typically less than 0.45 to 0.5 diopters —a value that does not significantly impact vision quality. These results are comparable to those of Gautam N et al., which was a retrospective cross-sectional study.[5] The results of the study were similar to those of our research. The mean preoperative astigmatism in our study was 0.88 with a standard deviation (SD) of 0.49; 63.3% of patients had WRA preoperatively. Additionally, a UK-based study found that 78% of patients had more than 0.5 diopters of astigmatism preoperatively (12), which is less than our study. When we assessed the type of astigmatism in our study, whether WTR or ATR, we found that WTR astigmatism was more common. The same finding was observed in another study, where WRA was reported at a frequency of 35.3% (1). However, the type of astigmatism differed in another study, where the prevalence of ATR was higher than that of astigmatism preoperatively.[14] In our studies, the mean postoperative astigmatism was 1.14 D at 3 months of follow-up and decreased to 0.62 D at 6 months of follow-up. Regarding Table 5, the mean difference in astigmatism between the pre-and postoperative periods in our study was insignificant. Other studies have revealed that the same degree of postoperative astigmatism occurs, with 0.51±0.22 in temporal incisions, indicating that the clear corneal supratemporal incision either caused very little astigmatism or had no effect on preoperative astigmatism (15), leading to more early rehabilitation of vision in these patients. However, a recent study suggests that a temporal scleral incision yields less astigmatism than a temporal clear corneal incision during phacoemulsification.[16] Our patients' mean WTR astigmatism decreased with time. The flattening of the cornea along the incisional meridian with time is evident in multiple studies. A 2020 study aimed to demonstrate the effect of incision in the four different meridians concluded that the superotemporal clear corneal incision yields better and more accepted results than other incision locations.[17] This leads to WTR astigmatic changes over time with a temporal incision, which is comparable to the results of our investigation. In another related study, keratometry analysis of corneal astigmatism was conducted after surgery on two groups undergoing phacoemulsification via superior scleral incision and supratemporal corneal incision. The keratometry corneal astigmatism did not increase more with the superior scleral incision than with the former after three months of surgery.[18] Following cataract surgery, changes in the cornea's horizontal and vertical meridians depend on the length and location of the incision. These two factors also influenced this study. This finding is supported by other similar studies, which demonstrate that superior incisions resulted in greater changes than tiny temporal incisions.[19] The experience gained by the PGRs with the conclusion of this study was satisfactory, and it will help them in their clinical services to the patients. This suggests that it is better to plan preoperatively for temporal incision because the majority of elderly patients have preoperative ATR astigmatism. Despite the growing use of 3.2 mm supratemporal clear corneal incisions, limited literature specifically evaluates their impact on pre-existing corneal astigmatism. Most studies have traditionally focused on temporal or superior incisions, often overlooking quadrant-specific variations, such as supratemporal placement. Furthermore, available data vary widely in terms of incision size, measurement techniques, follow-up durations, and vector analysis methods, making it difficult to draw comparative conclusions. This quasi-experimental study addresses this critical gap by systematically analyzing the changes in preoperative astigmatism following standardized 3.2 mm supratemporal incisions in both right and left eyes, performed by the same surgeon using consistent techniques. By employing a single surgeon and standardized measurement tools (e.g., Huvitz Autorefractometer), this study reduces procedural variability and enhances the internal validity of findings.

LIMITATIONS

There is no comparison of superonasal and superotemporal incisions with the scleral tunnel.

Belonging to a low-income country, patients who could not afford foldable intraocular lenses (IOLs) were excluded from the study, making it difficult to generalize the results to the entire population.

CONCLUSIONS

Superotemporal, 3.2 mm clear corneal incision is quite stable and does not significantly increase post-operative astigmatism when followed over a long (several months) period. The supratemporal site and the clear corneal incision have also proved to be superior to larger and scleral incisions.

CONFLICT OF INTEREST: None

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AUTHORS CONTRIBUTION

Junaid Sethi *- Concept & Design; Data Acquisition Drafting Manuscript; Final Approval*

Fawad Ahmad *- Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Final Approval*

Nuzhat Rahil *- Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Supervision; Final Approval*

The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.