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Comparison of Surgically Induced Astigmatism between Superior and Supero-Temporal Incisions in Manual Small Incision Cataract Surgery

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ABSTRACT

Objective: To compare visual outcomes and differences in surgically induced astigmatism between superior and supero-temporal incisions in manual small incision cataract surgery (MSICS).

Study Design: Quasi-experimental study.

Place and Duration of Study: Combined Military Hospital, Rawalakot Pakistan, from Jan to Jun 2017.

Methodology: Sixty patients were selected and divided into two groups of 30 patients each. One Group was given a superior incision, the other was made the supero-temporal incision, and Manual small incision cataract surgery was performed. Preoperative and postoperative visual acuity, keratometry and refractive data were collected for all patients. In addition, surgically induced astigmatism (SIA) was analysed using a line SIA calculator.

Results: The mean age of our patients was 59.57±10.13 years. Post-operatively, the visual acuity significantly improved in both groups. Mean induced astigmatism due to surgery came out to be 0.75±0.44 D for the superior incision and 0.45±0.18 D for the supero- temporal incision. The study found that in the Superior Incision-Group, induced astigmatism was slightly higher than in the Supero-Temporal-Group. Moreover, the Supero-Temporal-Group had a better uncorrected visual outcome than the Superior Incision-Group.

***Conclusion*:** Overall, manual small incision cataract surgery has good visual outcomes. Manual small incision cataract surgery through supero-temporal incision was found to have a better visual outcome with less surgically induced astigmatism than the superior incision.

Keywords: Astigmatism, Cataract, Incision, Manual small incision, Surgically induced astigmatism.

How to Cite This Article: *Rauf A, Ahmad F, Malik MB, Khan AM, Abbas H, Suri AK. Comparison of Surgically Induced Astigmatism between Superior and Supero-Temporal Incisions in Manual Small Incision Cataract Surgery Pak Armed Forces Med J 2022; 72(6): 2002-2005.*
DOI: https://doi.org/10.51253/pafmj.v72i6.3613

INTRODUCTION

A cataract is a common ophthalmic condition that poses a significant socioeconomic burden.[1] With the emergence of phacoemulsification, cataract surgery is now only an outpatient surgery.[2] Although because of high costs, phacoemulsification is still not available and accessible to many underprivileged areas. Other surgical methods include Extracapsular Cataract Excision (ECCE) and the somewhat obsolete Intracapsular Cataract Excision (ICCE).[3,4] Each method has its risks and benefits. Manual small incision cataract surgery (MSICS), a sub-type of ECCE, due to its suture-less and self-sealing incision, is a more advantageous option for treating cataracts in underdeveloped countries.[5,6]

Surgically induced astigmatism (SIA) can be described as the change in orientation and power of the principal visual axis after a corneal incision. High refractive astigmatism is one of the common causes of poor, uncorrected visual acuity following cataract surgery.[7,8] SIA is multi-factorial, with the major contributors being incision location, size, and architecture, all influencing the post-operative SIA.[9] Other factors include corneal radius, thickness, rigidity and the individual biologic response of a patient's cornea.[10]

Various studies have been done in our population to compare incision size because it causes the most significant effect on SIA. However, as mentioned, SIA is multifactorial, so this study is being done to compare the effect of site on SIA in our population, keeping all other variables constant.

METHODOLOGY

This quasi-experimental study was carried out at the Ophthalmology Department, Combined Military Hospital, Rawalakot Pakistan, from January to June 2017. The study commenced after approval was obtained from the Ethical Review Committee (ERC) of the institute (Dated: 09-01-2017). Informed consent (verbal and written) was taken from all patients.

A total of 60 subjects were selected for the study from the Outpatient Department using a non-probability consecutive sampling technique. The sam-

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Received: 12 Dec 2019; revision received: 25 Feb 2020; accepted: 03 Mar 2020

ple size was calculated using the WHO sample size calculator, and reference parameters were set at a confidence level of 95%.[11]

Inclusion Criteria: Adults of either gender, having a lenticular cataract, keratometric astigmatism of 2.00 D and less were included in the study.

Exclusion Criteria: Patients with glaucoma, corneal scarring, previously operated eyes and any keratometric astigmatism greater than 2.00 D were excluded from the study.

Complete ophthalmic examination was done, including keratometry and A-scan biometry were performed. All surgeries were done by one surgeon (AMK) under retrobulbar anaesthesia.

Selected patients were then divided equally into two equal groups. The first 30 were assigned Group-A, in whom superior incision was given. The next 30 were assigned to Group-B, in whom a supero-temporal incision was given.

MSICS was performed with the incision completely identical in both patient groups. A 6.50(±0.5) mm scleral frown incision was made at a distance of 1.5 mm from the limbus with the tip of 3.2 mm keratome (Alcon, USA). Next, a sclero-corneal tunnel incision was created with the same knife. Using the same knife, two side ports were made 150-160 degrees apart on both sides of the scleral tunnel. With the keratome, the anterior chamber of the eye was entered 1.5 mm deep into the transparent cornea. Then the internal incision was carefully enlarged to 8 mm. Capsulorhexis (29 gauge insulin syringe) and hydro dissection procedures were carried out. The nucleus prolapsed into AC by hooking it and dialling with a lens dialer. Lens was delivered with the help of wire Vectis, and a Simcoe two-way cannula did the cortical cleanup. A single-piece foldable intraocular lens (Raner R-100, UK) of 5.25mm optic size was injected into the capsular bag. Throughout the procedure, Methyl-cellulose was used liberally. Side ports were hydrated, and an air bubble at the end formed AC.

Moxifloxacin eye drops and tobramycin-dexamethasone combination eye drops were administered six times every day for the first postoperative week and then gradually decreased weekly over six weeks. An ophthalmologist examined the patients on days 1st POD and 30th POD. All patients were followed up without any dropouts.

Preoperative and postoperative (day 30) keratometric readings and automated refraction (day 30) were used in our analysis. The calculations were performed through the SIA Calculator Version 1.0 (software from siacalculator.com). The magnitude of pre-operative and post-operative astigmatism was calculated from the difference in the keratometric value between the steeper and the flatter meridian using the plus (+) cylinder notation.

Statistical Package for Social Sciences (SPSS) version 21.0 was used for the data analysis. Frequency and percentages were calculated for qualitative variables, while the chi-square test was used to find the association. Mean with standard deviations was calculated for continuous variables such as age, and the t-test was used to find the mean difference. The magnitude of SIA was calculated for each eye in our data from the pre-operative and post-operative amplitudes given by the SIA calculating software. The *p*-value lower than or up to 0.05 was considered as significant.

RESULTS

A total of 60 operated eyes were analysed, of which 36 were females, and 24 were males. Of these, 28 were right eyes, and 32 were left eyes. The mean age of our study population was 59.57±10.13 years, and the age range was between 30–95 years old.

Our data showed that pre-operative visual acuity in the Superior Incision-Group had a greater number of patients with vision worse than 6/60 (n=20, 66.66%) as compared to Supero-Temporal-Group (n=16, 53.33%) (Table-I).

Table-I: Comparison of Pre-Operative and Post-Operative Visual Acuity between the Two Incision Groups (n=60)

	Superior Incision-Group n=30 n (%)	Supero-Temporal Incision-Group n=30 n (%)	*p*-value
Pre-Op Visual Acuity:			
6/60 or worse	20 (66.66)	16 (53.33)	
6/18 – 6/36	10 (33.33)	14 (46.67)	
6/12 or better	Nil	Nil	0.300
Post-Op Visual Acuity:			
6/60 or worse	Nil	Nil	
6/18 – 6/36	17 (56.66)	14 (46.67)	
6/12 or better	13 (43.33)	16 (53.33)	0.445
Post-Op Best Corrected Visual Acuity			
6/60 or worse	Nil	Nil	
6/18 – 6/36	6 (20.00)	4 (13.33)	
6/12 or better	24 (80.00)	26 (86.67)	0.694

However, this was statistically insignificant (*p*-value=0.300). Post-operatively the visual acuity significantly improved in both groups, with no patient having VA worse than 6/60. Moreover, the Supero-Temporal-Group had a better-uncorrected outcome, with 16 patients (53.33%) having VA better than 6/12 compared to 13 patients (43.33%) in the Superior Incision-Group. After refractive correction, the visual outcome improved to 26 patients (86.67%) having VA better than 6/12 for the Supero-Temporal-Group and 24 patients (80.00%) for the Superior Incision-Group (*p*-value= 0.694).

Table-II: Comparison of Mean Surgically induced Astigmatism (SIA) between the Two Incision Groups (n=60)

	Superior Incision-Group (n=30)	Supero-Temporal Incision-Group (n=30)	*p*-value
Mean±SD	0.75±0.44 D	0.45±0.18D	0.001
Range	0.28 - 1.66 D	0.21 - 0.85 D	

A statistically significant difference was noticed between the two incision groups in the mean values of SIA (Table-II). The Superior Incision-Group showed a mean SIA of 0.75±0.44 D. As compared to this. The Supero-Temporal-Group showed significantly less mean SIA of 0.45±0.18 D. Difference between the two means was analysed by independent sample t-test, and the results were statistically significant (*p*-value = 0.001). The breakdown of the range of SIA in both groups was compared in the Figure, which showed six patients in the Superior Incision-Group with SIA >1.00 D as compared to no patient with this SIA in the Supero-Temporal Group.

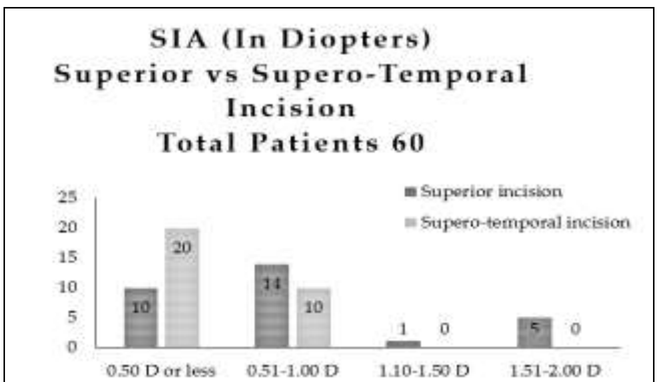

Figure: Comparison of the Range of SIA Observed in the Two Incision Groups (n=60)

DISCUSSION

Astigmatism can be visually disabling and cause a reduction in visual acuity, monocular diplopia, glare, distortion, and asthenopia. Unfortunately, very few ophthalmologists take into account factors related to astigmatism and perform corrective co-procedures during cataract surgery.[12,13] For example, in a large-scale study conducted in the UK, only 0.6% of cataract operations out of 201,667 performed over one decade took into account astigmatism and performed corrective co-procedures for astigmatisms like toric IOL implant, Opposite Clear Corneal Incisions, or Limbal Relaxing Incision.[11] Alterable factors for SIA during routine cataract surgery are; the location of the incision (superior, temporal, or supero-temporal), size of the incision and site of incision in relation to the limbus.

Phacoemulsification addresses most of the above factors for SIA and is the current gold standard. However, it is up to the surgeon to rectify any pre-operative astigmatism. Even in Phacoemulsification, SIA is lesser in Temporal incision as opposed to Superior incision.[14,15]

According to the corneal topographic analysis by Kim *et al*. the major factor for SIA is the location of the incision.[16] In addition, since the temporal location is far from the visual axis, any temporal incision is less likely to induce astigmatism by influencing the corneal curvature. Compared to this, if the incision is placed superiorly, gravity and eyelid blink cause further steepening of corneal curvature.[17] Moreover, we know there is an against-the-rule shift in astigmatism with age, and since most cataract patients are elderly, induced with-the-rule astigmatism from a temporal incision is beneficial.[18]

Our study found that SIA was much lower in the Supero-Temporal Incision Group than in the Superior Incision Group. The induced SIA from the superior incision was 0.75 D, whilst the supero-temporal incision only produced 0.45 D of SIA. This is in agreement with previously conducted studies. Gokhale *et al*. found that SIA in the superior incision was 1.28 D, in supero- temporal incision, it was 0.20 D, and in the temporal incision, it was 0.37 D.[19] Radwan *et al*. declared against-the-rule astigmatism in the superior incision of 2.10 D and with-the-rule astigmatism in the temporal incision of 0.70 D.[20]

There are different methods of calculating SIA. We used the online SIA calculator, but the studies described the above-used vector analysis calculators. Hence there are minor differences in SIA magnitude. In addition, since MSICS is a highly precise surgery, each surgeon can have a different SIA in the same incision type, size, and location, which is another reason accounting for differences across the mentioned studies.

LIMITATIONS OF STUDY

Short length of follow-up (even though astigmatism was stable after 1.5 months of surgery) and relatively inconsistent incision size and shape were the major limitations of our study. Improvements can be made by adding a Control Group with sutureless surgery like Phaco.

CONCLUSION

The overall outcome of MSICS with all incision types is very good for uncorrected and best-corrected visual acuity. To further improve visual outcome, we found that Superotemporal incision results in significantly less SIA; hence, it is recommended in all MSICS operations, especially in patients with against-the-rule astigmatism. Ophthalmologists should be trained and comfortable with this incision.

Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

AR & FA: Conception, drafting the manuscript, approval of the final version to be published.

MBM & AMK: Data acquisition, data analysis, critical review, approval of the final version to be published.

HA & AKS: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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