

**ORIGINAL ARTICLE****Surgically Induced Astigmatism after Manual Small Incision Cataract Surgery**

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**Abstract:**

**Background:** Cataract surgery is of extraordinary importance because it is the commonest cause of avoidable blindness worldwide. Over the years patient's expectations from cataract surgery have increased significantly. Appropriate calculation of intraocular lens power, innovations in intraocular lens (IOL) designs and material has allowed complete spherical correction. Advances in incision construction have improved the refractive results of cataract surgery by minimizing surgically induced astigmatism (SIA). Astigmatism prevention and control is one of the biggest challenges for a surgeon after cataract surgery. The major determinants of astigmatism are the site and size of incision, the type of suture used and suturing technique. **Aim and Objective:** To know the type and extent of induced astigmatism after manual small incision cataract surgery. **Material and Methods:** This prospective study was conducted at a tertiary eye care centre in rural Maharashtra. Patients fulfilling selection criteria were included in the study after thorough clinical examination. Preoperative keratometric values were recorded in addition to visual acuity in 108 selected patients. Manual small incision cataract surgery was performed in all patients with incisions at superior, supero-temporal and temporal sites. The size of incision varied according to the size of nucleus. The surgically induced astigmatism was calculated after 40 days of surgery in all patients. **Results:** Out of the 108 patients, majority of patients were in age group of 60-69 and 70-79 years. Only 3 patients were above 90 years of age. Male: Female ratio in this study was 1: 0.64. Against-the-rule astigmatism was present in 77% of patients; 21% of the patients had with-the-rule astigmatism, and 4% were astigmatically neutral and no patients had oblique astigmatism. The magnitude of postoperative astigmatism at end of 40 days with superior-temporal incision was 0.56 D, 0.63D, 0.75D with 5.5mm, 6mm and 6.5mm size of incisions respectively. With temporal incision it was 0.9D, 1.08D and 1.34 D with 5.5mm, 6mm and 6.5mm size of incisions respectively. With superior incision SIA was 1.36

D, 1.38D and 1.95D with 5.5mm, 6mm and 6.5mm size of incisions respectively. **Conclusion:** The SIA was least with supero-temporal incision. The superior incision showed more astigmatism than the supero-temporal and temporal incision.

**Keywords:** PolymethylMethacrylate (PMMA), Surgically induced astigmatism (SIA), Small incision cataract surgery (SICS).

**Introduction:**

Cataract surgery is the commonest procedure performed in ophthalmology [1]. It is an extremely important procedure as cataract is the commonest cause of preventable blindness worldwide. Cataract surgery has become a refractive surgery today as patients demand better and earlier visual rehabilitation [1]. Over the years patient's expectations from cataract surgery have increased significantly. Surgeons have transitioned from ICCE to conventional ECCE to SICS to phacoemulsification.

Now a day, patients demand clear vision without spectacles. Appropriate calculation of intraocular lens power, innovations in intraocular lens (IOL) designs and material has allowed complete spherical correction. Advances in incision construction has improved the refractive results of cataract surgery by minimizing surgically induced astigmatism (SIA). In order to minimize astigmatism, length, site and architecture of the incision are to be considered [2]. The better pre-operative and intra-operative measurement of astigmatism and uses of improved instrumentation (phacoemulsification, improved blades and needles) have led to a series of improvements, which promise to solve or greatly reduce the problem of induced astigmatism following cataract surgery in majority of the patients.

Femto-laser is now in vogue for various steps in cataract surgery to have a better out come [3].

Astigmatism prevention and control is one of the biggest challenges for a surgeon after cataract surgery. The major determinants of astigmatism are the site and size of incision, the type of suture used and suturing technique [4]. As the induced astigmatism has to be kept at minimum in MSICS, location and configuration of incision is modified to compensate for the larger size [5].

This study was done from September 2013 to March 2014 at a tertiary eye care centre in rural Maharashtra to know the induced astigmatism after manual small incision cataract surgery (MSICS). Patients fulfilling selection criteria were included in the study after thorough clinical examination. Preoperative keratometric values were recorded in addition to visual acuity in 108 selected patients. MSICS was performed in all patients with incisions at superior, supero-temporal and temporal sites. The size of incision varied according to the size of nucleus. The surgically induced astigmatism was calculated after 40 days of surgery in all patients [5]. The present study was done to know the type and extent of induced astigmatism after manual small incision cataract surgery.

#### Material and Methods:

This prospective study was conducted at a tertiary eye care centre in rural Maharashtra from September 2013 to March 2014. Sample size was determined by statistician using the formula [6,7]  $n = \frac{Z^2 S^2}{d^2}$ . The minimum sample size calculated was 82; However, we included all cases during the study period (108 cases).

The study was commenced after approval of institutional ethics committee. 108 eyes of 108 patients that underwent small incision cataract surgery with implantation of a single piece Polymethyl Methacrylate (PMMA) intraocular lens were included in this study. Patients were selected for this study after thorough ophthalmic check-up and necessary investigations for fitness. Pre-operative astigmatism was determined with the help of keratometer. Manual SICS was performed under peribulbar anaesthesia. The

patients having cataract with pterygium, traumatic cataracts and cataracts with pre-existing corneal problems were excluded from the study. SICS was performed by same ophthalmic surgeon in all patients. Cases with difficult nucleus delivery leading to extension and suturing of incision were not included in the study.

The surgical technique was uniform in all the cases. Patient's eye to be operated was dilated with tropicamide (0.8%) and phenylephrine (5%) eye drops at every 10 minutes 1 hour prior to the surgery. Flurbiprofen (0.3%) eye drops were instilled every 10 minutes 1 hour prior to the surgery along with tropicamide and phenylephrine eye drops.

The lids and periocular area were painted with povidone iodine 5% solution and the patients were draped. A superior rectus (Bridle suture) was taken in cases of Superior and Superior temporal incisions. A fornix based flap was mobilized and the underlying tenon was dissected. Light cautery was applied to the bleeders and 5.5, 6mm and 6.5 mm external scleral incision taken 2mm behind the limbus, according to the surgeon's assessment of nucleus size. All cases underwent frown incision. A metal crescent disposable knife was used to dissect the sclera-corneal pocket tunnel. The internal aspect of the tunnel was about 25% larger than the external incision. The pocket tunnel dissection was carried forward 1 mm into the clear cornea in front of the vascular arcade. After the construction of the tunnel, the crescent was withdrawn, and side port was created 3 clock hours apart position. The anterior chamber was entered with 2.8mm keratome. A continuous curvilinear capsulorhexis of 5 to 5.5 mm was performed under viscoelastic. Hydroprocedures were carried out. Viscoelastic was injected and nucleus was dialed and prolapsed out of capsular bag after making sure that the capsulorhexis was large enough with respect to nucleus size into anterior chamber. In case of immature cataract, the nucleus was prolapsed in anterior chamber with the help of hydro procedure. The nucleus was delivered out of the eye by visco expression. Remaining cortex was removed with Simcoe's irrigation-aspiration cannula. Bag and anterior chamber was filled with viscoelastic.

A PMMA posterior chamber intraocular lens was implanted using McPherson IOL holding forceps and was dialed in position.

Implantation of a single piece PMMA intraocular lens was done in patients undergoing this study. The specifications of PMMA lens used are: 6mm optic diameter, Curvature Step vault equiconvex, Overall length 12.5mm, Model Eye-O- Care single piece.

Anterior chamber was washed and reformed with the irrigation solution. Side port entry was sealed with hydro procedure to maintain anterior chamber. A subconjunctival injection of gentamycin and dexamethasone was given; the conjunctiva was opposed by cautery. Postoperatively eye was patched with chloromycetin eye applicap. From the first postoperative day, the patients received a combination of antibiotics and steroid eye drops every hour for one day then four to six times a day till six weeks. Keratometry was done 1 week after surgery. Refraction was done and keratometry repeated 40 days after surgery. Jaffe and Claymans vector analysis method was used to calculate the magnitude of surgically induced astigmatism responsible for producing the resultant postoperative astigmatism. Surgically induced astigmatism is going to be considered with-the-rule if vertical meridian was steeper than horizontal postoperatively and against-the-rule if vertical meridian was flatter than horizontal postoperatively.

### Results:

The present study include 108 eyes of 108 patients from both genders (66 males and 42 females). The male: female ratio was 1: 0.64. In this study, out of the 108 patients, majority of patients were in age group of 60-69 years (33 Patients) and 70-79 years (39 patients). Only 3 patients were above 90 years and 27 patients were in the age group of 40 to 59 years.

Table 1 shows that 76.85% had against-the-rule astigmatism; 19.44% of patients had with-the-rule astigmatism and 3.70% were astigmatically neutral and no patients had oblique astigmatism.

Table 2 shows that 36 patients had incision size of 5.5mm out of which 13 had superior incision, 12 had

supero-temporal incision and 11 had temporal incision. Thirty-six patients had incision size of 6mm out of which 11, 11 and 14 patients had superior, superotemporal and temporal incision respectively. Remaining 36 patients had incision size of 6.5mm out of which 11 had superior incision, 12 had superotemporal incision and 13 had temporal incision.

Table 3 shows that 33 out of 35 (94.28 %) patients with superior incision had post operative against the rule astigmatism, whereas 28 out of 35 (80%) patients with supero temporal incision had against the rule astigmatism and 31 out of 38 (81.57%) patients with temporal incision had against the rule astigmatism.

Table 4 shows the postoperative UCVA at the end of 40 days in patients with groups of different sites and sizes of incision. Majority of patients had visual acuity of 6/ 18 (30.55%) and 19.44% patients had visual acuity of 6/12. Only 5 (4.6%) patients had visual acuity of 6/6, 8 patients had v/a of 6/12 and only 5 (4.6%) patients had visual acuity of 6/6, 8 patients had v/a of 6/60. The magnitude of postoperative astigmatism at end of 40 days with superior-temporal incision was 0.56 D, 0.63D, 0.75D with 5.5mm, 6mm and 6.5mm size of incisions respectively. With temporal incision 0.9D, 1.08D and 1.34 D with 5.5mm, 6mm and 6.5mm size of incisions respectively. With superior incision SIA was 1.36 D, 1.38D and 1.95D with 5.5mm, 6mm and 6.5mm size of incisions respectively.

Table No.1: Pre-operative astigmatic profile

| Astigmatism              | No. of Patients | Percentage |
|--------------------------|-----------------|------------|
| Against Rule Astigmatism | 83              | 76.85%     |
| With Rule Astigmatism    | 21              | 19.44%     |
| Neutral Astigmatism      | 4               | 3.70%      |

Table No. 2: Distribution of patients according to the size and site of incision

| Incision site   | Incision size |      |        |
|-----------------|---------------|------|--------|
|                 | 5.5 mm        | 6 mm | 6.5 mm |
| Superior        | 13            | 11   | 11     |
| Supero-temporal | 12            | 11   | 12     |
| Temporal        | 11            | 14   | 13     |
| Total Patients  | 36            | 36   | 36     |

Table No. 3: Post operative against the rule astigmatism

| Site of incision  | Number of Patients | Percentage |
|-------------------|--------------------|------------|
| Superior          | 33                 | 94.28%     |
| Superior-temporal | 28                 | 80%        |
| Temporal          | 31                 | 81.57%     |

Table No. 4: Post operative unaided V/A

| Incision | Superior |     |       | Sub-Temporal |     |       | Temporal |     |       | Total Cases |
|----------|----------|-----|-------|--------------|-----|-------|----------|-----|-------|-------------|
|          | 5.5mm    | 6mm | 6.5mm | 5.5mm        | 6mm | 6.5mm | 5.5mm    | 6mm | 6.5mm |             |
| 6/60     | 6        | 1   | 0     | 0            | 0   | 0     | 0        | 0   | 1     | 8           |
| 6/36     | 2        | 3   | 1     | 0            | 3   | 0     | 3        | 0   | 3     | 15          |
| 6/24     | 0        | 1   | 1     | 0            | 3   | 5     | 1        | 2   | 3     | 16          |
| 6/18     | 5        | 1   | 2     | 6            | 2   | 1     | 3        | 7   | 6     | 33          |
| 6/12     | 0        | 3   | 6     | 5            | 1   | 3     | 1        | 2   | 0     | 21          |
| 6/9      | 0        | 2   | 1     | 1            | 2   | 1     | 0        | 3   | 0     | 10          |
| 6/6      | 0        | 0   | 0     | 0            | 0   | 2     | 3        | 0   | 0     | 5           |
| Total    | 13       | 11  | 11    | 12           | 11  | 12    | 11       | 14  | 13    | 108         |

Table No. 5: Mean values of Surgically induced astigmatism at end of 40 days calculated by Jaffe and Clayman vector analysis method

| Incision site   | Incision size      |                  |                    |
|-----------------|--------------------|------------------|--------------------|
|                 | 5.5 mm<br>Mean± SD | 6 mm<br>Mean± SD | 6.5 mm<br>Mean± SD |
| Superior        | 1.36± 0.12D        | 1.38± 0.13D      | 1.95± 0.58D        |
| Supero-Temporal | 0.56± 0.4D         | 0.63± 0.42D      | 0.75± 0.47D        |
| Temporal        | 0.93±0.16D         | 1.08± 0.33D      | 1.34± 0.24D        |

**Discussion:**

Ideally cataract surgery should aim at clear vision without any spherical or cylindrical correction. Manual SICS is one of the alternatives for phacoemulsification but it is associated with higher degree of astigmatism because of the larger incision. Burgansky et al. have stated that SIA increases with size of incision [8]. Vinay KV et al. have studied astigmatism in superior and supero-temporal incision [9]. In our study, magnitude of surgically induced astigmatism was calculated by Jaffe and Clayman’s vector analysis method. From results the study, it was found that induced astigmatism was lower in superior- temporal and temporal groups compared to that in superior group. Our results agree with the study done by

Gokhale et al. in which preoperative and post-operative keratometric readings and refraction were used for analysis. It was found that induced astigmatism was lower in temporal and supero- temporal group [10]. Studies by Mallik VK et al. and Renu Magdum et al. also state that superior incision induces more astigmatism than temporal incision [11,12]. Vinay KV et al. have also stated that superior incision induces more ATR astigmatism [9]. This has been proven by our studies. The supero-temporal incision is also probably free from the effect of gravity and eyelid pressure and tends to induce less astigmatism [13]. In a study by Armenaides et al. on the effect of incision length, location and shape on the structural integrity and length had greatest effect on compromising the

structural integrity of the globe [14]. In our study also the SIA was proportional to the length of incision. Our results also matched with the following studies pertaining to the size and site of incision:-Robert Sinskey et al. used the superior frown incision for manual SICS.

The results suggest that the 6.0 mm no-stitch frown incision induces a low postoperative astigmatism and provides a stable incision [13]. Akura et al. carried out the comparative evaluation of a modified self-sealing incision and a frown-shaped, oblique incision-the BENT (between 9 and 12 o'clock) and reported that surgically induced astigmatism was less in frown-shaped, oblique incision.

Results of this study are quite similar to ones which were observed in our study [15].

Burgansky et al. have shown that enlarging the size of the chevron incision up to 7.0 mm resulted in a small increase in induced astigmatism [16]. According to Nielsen J and our study difference in an uncorrected visual acuity post-operatively at the end of 40 days was

statistically significant in the groups and was better in supero-temporal group with 5.5mm size of incision. Oshika et al. compared soft and conventional lenses. They reported a postoperative best corrected visual acuity of 20/25 in 65.6% of their patients on the first post-operative day, 85.9% of patients at the end of one week and 95.1% of patients at the end of one month [17]. The findings with regards to postoperative visual acuity in this study correlates closest to the study conducted by Oshika et al. [17] and also by Rajan AK [18]. Our results also corroborate with findings of Ghanta M M [19] who showed that a superior incision induces more ATR compared to temporal incision.

#### Conclusion:

The SIA was least with supero-temporal incision. The superior incision showed more astigmatism than the supero-temporal and temporal incision. More number of patient in the supero-temporal incision group had uncorrected visual acuity better than 6/18.

**Conflict of Interest** - Nil

**Sources of Support** - Nil

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