

## A Comparative Study of Surgically Induced Astigmatism (SIA) Following Superior, Superotemporal and Temporal Incision in Manual Small Incision Cataract Surgery (MSICS)

Sonia Goel<sup>1</sup>, Mital Patel<sup>2</sup>, Manali Shah<sup>3</sup>, Rukshar Shahid Mujawar<sup>4</sup>, Akshay M Chaudhari<sup>5</sup>

<sup>1</sup>DNB Resident, Department of Ophthalmology, GMERS Medical College, Valsad

<sup>2</sup>Assistant Professor, Department of Ophthalmology, GMERS Medical College, Valsad

<sup>3</sup>Senior Resident, Department of Ophthalmology, GMERS Medical College, Valsad

<sup>4</sup>DNB Resident, Department of Ophthalmology, GMERS Medical College, Valsad

<sup>5</sup>Associate Professor, Department of Ophthalmology, GMERS Medical College, Valsad

Received: 25-12-2023 / Revised: 23-01-2024 / Accepted: 26-02-2024

Corresponding Author: Dr. Akshay M Chaudhari

Conflict of interest: Nil

### Abstract:

**Introduction:** Cataract is the most common cause of reversible blindness, and surgery is the only intervention available till now. In developing countries like India MSICS is the most favoured method. Astigmatism may be an error either of curvature, canting or due to refractive index. Site and size of scleral incisions are the factors which influence the SIA. We conducted this study with aim of comparing the Surgically Induced Astigmatism (SIA) in small incision cataract surgery by Superior, Supero-Temporal and Temporal incision.

**Material & Methods:** Total 150 cases were included. Pre-operative and post-operative findings were noted. Astigmatism found is examined after 1<sup>st</sup> day, 7<sup>th</sup> day, 30<sup>th</sup> day and 60<sup>th</sup> day.

**Results:** In our study on 150 eyes in MSICS (50 eyes in each group), we found that there is significantly less SIA in Supero-temporal and Temporal approaches as compared to Superior approach of incisions. Superotemporal and Temporal incision group patients get BCVA 6/9 or 6/6 with less amount of cylindrical number in comparison to Superior incision group.

**Conclusion:** In spite of the fact that the Superotemporal incision induces higher SIA than the Temporal approach but the difference between the both is not significant, the disadvantages associated with temporal incision are more. So, we recommend Superotemporal approach better for Manual SICS over the Superior and Temporal incisions.

**Keywords:** Cataract, Astigmatism, Temporal etc.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

### Introduction

Cataract is the most common cause of reversible blindness, and surgery is the only intervention available till now [1,2]. Cataract derived from Greek word 'katarraktes' which means waterfall [3]. In cataract surgeries, today's trend is Manual Small Incision Cataract Surgery (MSICS) and Phacoemulsification with PCIOL implantation, Phacoemulsification is the most favoured method in industrialised countries, while in developing countries like India MSICS is the most favoured method [4].

MSICS has the advantage of a self-sealing sutureless incision with least SIA at a low cost [5] MSICS is safe, simple, consistent, stable, and cost effective way of cataract removal [6] MSICS is an alternative surgical technique that developed after phacoemulsification. It is a safe, simple, consistent,

stable, and cost effective way of cataract removal. In this technique the whole nucleus, or the nucleus divided in parts, is removed through a self-sealing sutureless tunnel incision [7]. Phacoemulsification is difficult and prone to complications in eyes with mature and hypermature cataracts. Therefore, it is prudent to consider manual small incision cataract surgery that may be safer and as efficacious [8].

Astigmatism may be an error either of curvature, canting or due to refractive index. Corneal astigmatism is a type of curvature astigmatism which can be With the Rule (WTR) or Against the Rule (ATR) depending upon the eyelid pressure that decreases with age, So ATR is most common in elder patients [9]. Astigmatism following cataract surgery consists of two components: Preoperative Astigmatism, which is intrinsic to the

patient, and Surgically Induced Astigmatism (SIA), which is a result of the procedure [10]. Site and size of scleral incisions are the factors which influence the SIA. Larger the incision more is the Astigmatism and when the size is kept constant, the main determinant for the amount of SIA is the site of the scleral incisions [11].

There are three common sites where the scleral incisions are made namely: Superior, SuperoTemporal, and Temporal. Out of these, Superior Scleral Incision is commonly performed as it is easy and has the forehead support of the patient [12]. Temporal scleral incision is difficult to make due to lack of support and less area of exposure for the incision and instruments. That's why we are doing this study to compare SIA in all these 3 types of incision.

Astigmatism is found in 20–40% of the general population [13]. Among patients having cataract surgery ~15–20% have more than 1.5 D. Because as little as 0.75 D of astigmatism may cause ghosting and halos, correcting astigmatism in cataract surgery is desirable [14].

Minimizing incision length effectively decreases surgically induced astigmatism with both scleral and clear-corneal incisions (CCIs) [15]. It was found that two millimeter wounds were stable and Larger wounds (6.0–10.0 mm) showed an important ATR shift early after surgery, with continuous progression up to 5 years after surgery [16]. Incision over the superior meridian produces “against the rule” astigmatism and incision over the temporal meridian produces “with the rule astigmatism”. We conducted this study with aim of comparing the Surgically Induced Astigmatism (SIA) in small incision cataract surgery by Superior, Supero-Temporal and Temporal incision.

Our objectives are -To evaluate the Surgically Induced Astigmatism (SIA) in SICS patients after giving incision at different sites and to study the effect of three different incision sites on postoperative best corrected visual acuity.

### Materials and Methods

Study area: GMERS Medical College and Hospital, Valsad, Gujarat Study duration: 18 Months (November 2020 to April 2022) Study design: Prospective Observational study. Sample size: Total 150 eyes with consideration of 10% dropout. Study population: Patients posted for MSICS at GMERS Medical College and Hospital, Valsad, South Gujarat.

### Inclusion criteria:

1. Patients with all types of cataracts
2. Patients without any previous history of ocular surgery.

3. Patient willing to give written informed consent.
4. Patient must be accessible and willing for follow up.
5. Age group: 30-80 years whether male or female.

### Exclusion criteria:

1. Patients with irregular astigmatism.
2. Patients having pre-existing astigmatism of >1.5D.
3. Any Corneal Pathology like Corneal dystrophies, degenerations, etc.
4. Patients with Pterygium, Traumatic Cataract, Complicated Cataract, Lenticular Subluxation and other Ocular Diseases and any systemic illness affecting visual outcome.

### Pre -Operative Assessment:

Written consent, detailed history taking, the vision will be taken by Snellen chart or logMAR chart in literate and Landolt's C in illiterate and then will be documented in logMAR chart. Then ocular examination using slit lamp bio-microscopy and fundus examination by using a Direct or Indirect Ophthalmoscope. On slit lamp, cataract will be graded by Morphological Classification. Pre-operative IOP will be recorded by Non-Contact Tonometer. Sac syringing will be performed in all patients. Astigmatism will be measured with Bausch and Lomb Keratometer. The amount and type of astigmatism will be noted in all patients.

### Surgical Procedure:

Superior Sclero-Corneal Incision- Scleral frown incision is made with 15 no. Bard Parker knife at 11 to 1 o'clock, 2mm from limbus superiorly in Right/left eye. Frown incision given to all patients as it causes minimally induced astigmatism. Side port made at 3 o'clock.

Supero-Temporal Sclero-Corneal Incision- For Right Eye, incision has to be placed at 10 to 12 o'clock and for Left Eye at 12 to 2 o'clock hour position. Side port made at 2 o'clock in right and at 4 o'clock in left eye.

Temporal Sclero-Corneal Incision- For Right Eye, incision has to be placed at 8 to 10 o'clock and for Left Eye at 2 to 4 o'clock hour position. Side port made at 12 o'clock in right and at 6 o'clock in left eye.

**Post-Operative:** 1. In this, we will do follow up at 1st post-operative day, 1st week, 1 month and 2 months. 2. We will do UCVA, Refraction, Slit lamp examination, wound site assessment and Keratometry on each followup. BCVA will be taken at 2nd month follow up.

### Results

In this study, there are 3 groups, Group A (Superior scleral incision), Group B (Supero-temporal scleral incision) and Group C (Temporal scleral incision).

There are total 150 eyes of 150 patients (50 eyes in each group) and analysis was done using some

statistical tests like chi-square, one-way ANOVA, and the fisher's exact test.

Surgically induced astigmatism was calculated by vector analysis method. P-value <.05 is considered as significant.

**Table 1: Age wise distribution of patients in 3 groups**

Age	Group A	Group B	Group C	Total
30-45 years	05	05	04	14
46-60 years	24	19	20	63
61-70 years	16	16	18	50
>70 years	05	10	08	23
Total	50	50	50	150
Mean SD	57.86 ± 11.41	60.26 ± 11.56	61.56 ± 10.71	

**Table 2: Distribution of pre-operative unaided visual acuity in 3 groups**

	Group A	Group B	Group C	Total
PL + PR4+	06 (12%)	07 (14%)	07 (14%)	20 (13.3%)
HM FCCF	03 (06%)	03 (06%)	02 (04%)	08 (5.3%)
2.08 to 1.3	19 (38%)	19 (38%)	16 (32%)	54 (36%)
≤1.00	22 (44%)	21 (42%)	25 (50%)	68 (45.3%)
Total	50	50	50	150

In this study pre-operative visual acuity was <1.00 in 54.7% patients in all 3 groups, whereas 45.3% patients had pre-operative visual acuity ≥1.00. Chi square test shows that there was no any significant difference pre-operative visual acuity between 3 groups.  $X^2 (6, N=150) = 1.066, p = .98$ .

**Table 3: Ranges of Surgically induced corneal astigmatism in 3 group on day 1**

	Group A	Group B	Group C	Total
0.0-0.5	18 (36%)	25 (50%)	28 (56%)	71 (47.3%)
0.51-1.0	17 (34%)	17 (34%)	19 (38%)	53 (35.3%)
1.01-1.5	10 (20%)	07(14%)	03 (6%)	20 (13.3%)
1.51-2.0	05 (10%)	01 (02%)	00 (00%)	06 (4%)
Total	50	50	50	150

The mean amount of surgically induced corneal astigmatism on 1st day after surgery was 0.78±0.50 in group A (Superior scleral incision), 0.52±0.39 in group B (Supero-temporal scleral incision), and 0.44±0.35 in group C (Temporal scleral incision). The difference between the three groups was statistically not significant with the fisher's exact test (p=.063).

**Table 4: Ranges of Surgically induced corneal astigmatism in 3 group on day 07**

	Group A	Group B	Group C	Total
0.0-0.5	07 (14%)	26 (52%)	18 (36%)	51 (34%)
0.51-1.0	22 (44%)	10 (20%)	24 (48%)	56 (37.3%)
1.01-1.5	11 (22%)	10(20%)	06 (12%)	27 (18%)
1.51-2.0	08 (16%)	02 (4%)	01 (2%)	11 (7.3%)
>2.0	02 (4%)	02 (4%)	01 (2%)	05 (3.3%)
Total	50	50	50	150

**Table 5: Ranges of Surgically induced corneal astigmatism in 3 groups after 01 month**

	Group A	Group B	Group C	Total
0.0-0.5	06 (12%)	25 (50%)	14 (34%)	45 (30%)
0.51-1.0	17 (34%)	12 (24%)	26 (52%)	55 (36.7%)
1.01-1.5	14 (28%)	10(20%)	07 (14%)	31 (20.7%)
1.51-2.0	10 (20%)	02 (4%)	03 (06%)	15 (10%)
>2.0	03 (6%)	01 (2%)	00 (00%)	04 (2.7%)
Total	50	50	50	150

In our study we found significantly less Surgically Induced Astigmatism in cataract surgery is with the Supero-temporal and Temporal approaches compared to that in the Superior approach. Even the unaided postoperative visual acuity is better in both groups Supero-temporal groups and Temporal than superior group. In Superior incision group, patients gets vision 6/9 or 6/6 with greater amount of cylindrical number in comparison to Superotemporal and Temporal incision

### Discussion

The MSICS is a good alternative to Phacoemulsification which gives visual results equivalent to Phacoemulsification, at lower expenses. Astigmatism following cataract surgery is a known complication from the time when cataract surgery was started. Various factors like incision size, its location, its techniques and suture material influence the post-operative astigmatism.

High astigmatism is the leading cause of poor uncorrected visual acuity following cataract surgery. Pre-existing astigmatism can be neutralized by changing the site of the incision. In view of these findings, this study was undertaken with the aim to evaluate the type and amount of SIA between Superior, Supero-temporal and Temporal scleral incision in a Tertiary care Hospital, South Gujarat

In this study, there are 48.67% are female and 51.33% male so nearly equal distribution with slight male preponderance among the patients getting admitted, like the same way seen in other studies explained by the fact that senile cataract does not show any gender predisposition. Silni Chandra, Smitha M et al [17] study found that the postoperative unaided distance visual acuity was best in temporal incision where 100% patients achieved a unaided visual acuity of 6/18 or better while in Superior section group only 56.4% patients achieved  $\geq 6/18$ .

Soumyadeep Hazra and Tapes Kanti Saha [9] in this study, it was seen that the Superotemporal incision group had more number of patients (78%) with visual acuity better than 6/9 at 4th postoperative week than Superior incision group (42%). Besides Supero-temporal incision provides better and early visual acuity postoperatively.

The present study and above-mentioned studies show that the patients in both Superotemporal and Temporal groups achieve better visual acuity than Superior group Madhumita Prasad, Sachin Daigavane et al. [18]. Study showed that the SIA in cataract surgery with Superior-temporal and the Temporal approaches provides a better quality of vision than the Superior approach The study found that postoperative astigmatism and SIA were maximum in Superior and least in Temporal while

Superotemporal had values between the both group similar to our study. Even study also shows Statistically significant difference between group A vs group B and group A vs group C whereas, group B vs group C didn't show any significance like in our study.

The present study and the above studies show that ATR is the commonest type of astigmatism in patients undergoing cataract surgery and in Superior group there is ATR shift while in Supero-temporal and Temporal Groups there is WTR shift.

In our study out of the 150 patients undergoing MSICS, 85 patients had ATR, 43 patients had WTR and 22 patients had No Astigmatism (NA), gradually this ratio changed and at 2nd month follow up we found that in Group A 28 ATR, 14 WTR and 8 NA pre-operatively, gets converted to 46 ATR and 6 WTR at 2nd month follow up. Group B having 30 ATR, 14 WTR and 5NA pre-operatively, now been changed to 9ATR, 36 WTR and 5 NA. Group C having 27 ATR, 15 WTR and 8 NA pre-operatively gets converted to 4 ATR, 44 WTR and 2 NA at 2nd month follow up.

### Conclusion

In our study on 150 eyes in MSICS (50 eyes in each group), we found that there is significantly less SIA in Supero-temporal and Temporal approaches as compared to Superior approach of incisions. Superotemporal and Temporal incision group patients get BCVA 6/9 or 6/6 with less amount of cylindrical number in comparison to Superior incision group. As their unaided postoperative visual acuity on 2nd month was good in both Supero-temporal and Temporal groups than Superior group. In spite of the fact that the Superotemporal incision induces higher SIA than the temporal approach but the difference between the both is not significant, the disadvantages associated with temporal incision are more. So, we recommend Superotemporal approach better for Manual SICS over the Superior and Temporal incisions.

### Reference:

1. Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. *Br J Ophthalmol* 2012; 96:614-8.
2. Fong CS, Mitchell P, Rochtchina E, Teber ET, Hong T, Wang JJ. Correction of visual impairment by cataract surgery and improved survival in older persons: The Blue Mountains eye study cohort. *Ophthalmology* 2013; 120:1720-7.
3. A K Khurana, Bhawna khurana. Disease of the lens, *Comprehensive Ophthalmology book* fifth edition 2012. P. 180.
4. Vaishali Satyajeet Pawar, D.K.Sindal. A comparative study on the superior, superotemporal

- and the temporal incisions in small incision cataract surgeries for post-operative astigmatism. *Journal of clinical and diagnostic research* 2012 September (suppl). Vol-67:1229-32.
5. Khan M T, Jan S, Hussain Z, et al. Visual Outcome and Complication of Manual Sutureless Small Incision Cataract Surgery. *Pak J Ophthalmol* 2010; 26; 1:32-38.
  6. Haldipurkar S S, Shikari H T, and Gokhale V. Wound construction in manual small incision cataract surgery.
  7. Hennig A. Non-phaco Cataract Surgery: A Solution to reduce worldwide cataract Blindness? *Community Eye Health* 2003; 16; 48:49-5.
  8. Venkatesh R, Tan C S H, Sengupta S, et al. Phacoemulsification versus manual smallincision cataract surgery for white cataract. *J Cataract Refract Surg* 2010; 36:1849-54.
  9. Soumyadeep Hazra and Tapes Kanti Saha. A comparative study of post-operative astigmatism in superior versus superotemporal scleral incisions in manual small incision cataract surgery in a tertiary care hospital. *Int J Clin Exp Ophthalmol*. 2021; 5: 009-015.
  10. R Santhanalakshmi, S Srividya. Post-operative effect of temporal and superior approach in manual small incision cataract surgeries. DOI: <http://doi.org/10.26611/10091122>
  11. Machireddy R. Sekharreddy, Venkatesh Sugantharaj, Shruti Prabhat Hegde. Surgically induced astigmatism in manual small-incision cataract surgery: A comparative study between superotemporal and temporal scleral incisions. *TNOA J Ophthalmic Sci Res* 2019; 57:105-8.
  12. Pawar RK. Pearls and pitfalls in small incision cataract surgery. In: Garg A, Sahu A, editors. *Masters Guide to Manual Small Incision Cataract Surgery*. 2nd ed. New Delhi: Jaypee; 2010. p. 281-3.
  13. Anstice J: Astigmatism – its components and their changes with age. *Am J Optom Arch Am Acad Optom* 1971; 48:1001–1006
  14. Hoffer KJ: Biometry of 7,500 cataractous eyes. *Am J Ophthalmol* 1980; 90:360–368.
  15. Albert and Jakobiec's. *Principle and Practice of Ophthalmology*. Third edition; ch120: 1517-1524
  16. Drews RC: Five year study of astigmatic stability after cataract surgery with intraocular lens implantation: comparison of wound sizes. *J Cataract Refract Surg* 2000; 26:250– 253.
  17. Silni Chandra, Smitha M. How to minimize corneal astigmatism during cataract surgery. *JMSCR*. July 2018;6(7): 111-118.
  18. Madhumita Prasad, Sachin Daigavane. A comparative study of surgically induced astigmatism in superior, superotemporal and temporal incision in small incision cataract surgery. *International J of advanced research, ideas and innovations in technology*. 2017; 146-170.