

# Comparison of astigmatism after superotemporal incision in right eye and superonasal incision in left eye with superior incision in clear corneal phacoemulsification

Trupti Mahesh Solu<sup>1</sup>, Umeshaben Ishvarbhai Padvi<sup>1</sup>, Bhavesh K Golakiya<sup>2</sup>

<sup>1</sup>Department of Ophthalmology, Government Medical College, Surat, Gujarat, India, <sup>2</sup>Consultant Ophthalmologist, Sardar Patel Multispecialty Hospital, Ankleshwar, Gujarat, India

**Correspondence to:** Umeshaben Ishvarbhai Padvi, E-mail: umesha.padvi@gmail.com

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## ABSTRACT


**Background:** Today, cataract surgeries are aiming pseudophakic emmetropia, which makes eliminating post-operative astigmatism must. Phacoemulsification can be done with superior, oblique, or temporal clear corneal incision (CCI), which affects post-operative astigmatism. **Objectives:** The aim of this study is to compare astigmatism after superotemporal incision (STI) in the right eye and superonasal incision (SNI) in the left eye with superior incision (SI) in clear corneal phacoemulsification. **Materials and Methods:** This prospective study includes 90 patients, having CCI phacoemulsification with foldable intraocular lens between October 2014 and December 2015, divided into three groups, each having 30 patients, on the basis of the type of incision in SI, STI in the right eye, and SNI in the left eye. Astigmatism was measured by Bausch and Lomb manual keratometer before surgery, on 1<sup>st</sup>, 4<sup>th</sup>, and 6-8<sup>th</sup> weeks post-operatively. All patients were astigmatically neutral pre-operatively. **Results:** SI, STI, and SNI-induced post-operative astigmatism was against-the-rule (ATR) and was 66.7%, 53%, and 50% in SI, STI, and SNI groups, respectively. This showed no statistical significant ( $P < 0.05$ ) indicating that horizontal component of surgically induced astigmatism (SIA) becomes steeper due to corneal healing. Mean total astigmatism was lower in STI group than SI and SNI. 93%, 73.4%, and 63.3% patients in STI, SI, and SNI groups had uncorrected visual acuity (UCVA) of  $\geq 20/60$ , respectively ( $P > 0.05$ ), suggesting statistical significant difference indicating better UCVA in STI group due to less SIA. Best-corrected visual acuity (BCVA) of all patients was 20/20. **Conclusion:** There is no statistically significant difference in SIA among SI, STI, and SNI. However, better UCVA obtained in STI.

**KEY WORDS:** Phacoemulsification; Clear Corneal Incision; Surgically Induced Astigmatism

## INTRODUCTION

Today, cataract surgery is regarded as a refractive surgery, promises rapid visual rehabilitation and pseudophakic emmetropia, which makes eliminating corneal astigmatism critical. Thus, control of post-operative astigmatism is a key

in meeting these expectations. The concept of surgically induced astigmatism has added an entirely unique dimension to cataract surgery with emphasis more focused on the refractive aspect of the surgery in the present era. Surgically induced astigmatism (SIA) is still a common obstacle for achieving excellent uncorrected visual acuity (UCVA). SIA is related to the length, location, architecture, and suture closer technique of incision. Smaller incision is associated with less surgically induced change in corneal curvature. Peripheral incisions at limbus and sclera result in a less surgically induced change in corneal curvature than those involve cornea.<sup>[1]</sup> Multiplanar incisions give the wound greater stability enabling self-sealing of the wound, and thereby

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avoiding the need of sutures.<sup>[2]</sup> Suturing the incisions may result more changes in post-operative corneal astigmatism than without suturing.

In this study, we analyzed post-operative corneal astigmatism after phacoemulsification with foldable intraocular lens implantation through a clear corneal incision (CCI) and evaluated the effect of small superior, superotemporal, and superonasal CCIs on post-operative corneal astigmatism.

1. To compare the surgically induced astigmatism after phacoemulsification with intraocular lens implantation through a CCI superiorly, superotemporally in the right eye, and superonasally in the left eye.
2. To study the influence of site of the incision on post-operative astigmatism in phacoemulsification with intraocular lens implantation through a CCI.

**MATERIALS AND METHODS**

This prospective comparative study included 90 eyes (46 right and 44 left eyes) of 90 patients with cataract. This study was conducted in a tertiary government hospital in South Gujarat during a period of 15 months from October 2014 to December 2015. The patients included in the study had no history of previous ocular trauma, surgery, or disease that could have affected corneal refraction. Written consent was obtained from each patient. All operations were performed by the same surgeon under peribulbar anesthesia. We had divided 90 patients into 3 groups, superior incision (SI) group, superotemporal incision (STI) group, and superonasal incision (SNI) group. STI was put in only right eyes and SNI was put only in left eyes. Three-step clear corneal tunnel incision was made with a 3.0 mm blade. The tunnel length was 1.75-2.0 mm. Phacoemulsification was performed. The incision was enlarged to 3.2 mm, and foldable intraocular lens was implanted in the capsular bag. All incisions were left sutureless. Patients were given moxifloxacin-dexamethasone eye drops four times per day, and the regimen was tapered over 1½-month post-operatively. Corneal astigmatism was measured by Bausch and Lomb manual keratometer pre-operatively and at the 1<sup>st</sup>, 4<sup>th</sup> and 6-8<sup>th</sup> weeks post-operatively.

**RESULTS**

On the 1<sup>st</sup> week post-operatively, SI group showed more mean SIA (0.71 ± 0.40 D) compared to mean SIA (0.68 ± 0.52 D) in STI group and (0.70 ± 0.51 D) in SNI group. This was statistically not significant (*P* > 0.05). On the 4<sup>th</sup> post-operative week, in SI group, mean SIA was 0.64 ± 0.48 D, in STI group, mean SIA was 0.59 ± 0.46 D, and in SNI group, mean SIA was 0.66 ± 0.51 D. The comparison between mean of the three groups was statistically not significant (*P* > 0.05). On 6-8<sup>th</sup> post-operative weeks, in SI group, mean SIA was 0.62 ± 0.47 D, in STI group, mean SIA was

0.57 ± 0.41 D, and in SNI group, mean SIA was 0.63 ± 0.50 D. The comparison between mean of the three groups was statistically not significant (*P* > 0.05). In this study, at the end of the 6-8<sup>th</sup> post-operative weeks, the mean total astigmatism was lower in the STI group than in SI and SNI group as shown in Table 1.

SI, STI, and SNI-induced post-operative against-the-rule (ATR) drift was 80%, 73.3%, and 43.3%, respectively, during the 1<sup>st</sup> post-operative week (*P* < 0.05), this showed statistical significant difference indicating that SNI induces less ATR drift in early post-operative period. However, at 6-8<sup>th</sup> weeks post-operatively, ATR drift was 66.7%, 53%, and 50% in SI, STI, and SNI group, respectively (*P* > 0.05). This showed no statistical significance indicating that a horizontal component of SIA becomes steeper due to corneal healing.

In our study, 93% of patients in STI group had visual acuity of ≥20/60 while 73.4% and 63.3% of patients had visual acuity of ≥20/60 in SI and SNI group, respectively (*P* < 0.05). This statistically significant difference indicates better UCVA in STI group due to less SIA as shown in Table 2. Best-corrected visual acuity (BCVA) of all patients was 20/20, so there was no statistical significant difference between three groups in BCVA.

**DISCUSSION**

CCI has been widely reported to produce minimal SIA.<sup>[3]</sup> To avoid an effect on corneal refraction, the appropriate size of corneal incision for self sealing is 3.0-3.5 mm in width and 1.7-2.0 mm in length. In our study, all operations were performed by the same surgeon who is right handed. The size of CCI in width after enlarging for intraocular lens implantation was 3.2 mm. CCI can be placed at superior, oblique (superotemporal and superonasal), or temporal locations.

The optical center of the cornea is not identical to the geometrical center; the optical center is located somewhat more nasally and inferiorly.<sup>[4]</sup> Therefore, a SNI will be closer to the center of the cornea than a STI and have a greater effect on the post-operative changes in corneal curvature. Second, the difference in surgically induced astigmatism might be

**Table 1:** Surgically induced astigmatism following SI, STI, and SNI on 1<sup>st</sup>, 4<sup>th</sup>, and 6-8<sup>th</sup> weeks

SIA (diopter) (week)	Mean±SD			P value
	SI	STI	SNI	
1 <sup>st</sup>	0.71±0.40	0.68±0.52	0.70±0.51	>0.05
4 <sup>th</sup>	0.64±0.48	0.59±0.46	0.66±0.51	>0.05
6-8 <sup>th</sup>	0.62±0.47	0.57±0.41	0.63±0.50	>0.05

SD: Standard deviation, SI: Superior incision, STI: Superotemporal incision, SNI: Superonasal incision, SIA: Surgically induced astigmatism

**Table 2:** UCVA following SI, SNI, and STI at 1<sup>st</sup>, 4<sup>th</sup>, and 6-8<sup>th</sup> weeks

Post-operative UCVA	1 <sup>st</sup> week			4 <sup>th</sup> week			6-8 <sup>th</sup> week		
	SI	STI	SNI	SI	STI	SNI	SI	STI	SNI
≥20/40	05	04	09	05	06	10	05	08	09
20/40-20/60	16	20	13	16	19	12	17	20	10
20/80-20/180	09	06	08	09	05	08	08	02	11
≤20/200	00	00	00	00	00	00	00	00	00
Total	30	30	30	30	30	30	30	30	30
	<i>P</i> >0.05, Not Significant			<i>P</i> >0.05, Not significant			<i>P</i> <0.05, Significant		

SI: Superior incision, STI: Superotemporal incision, SNI: Superonasal incision, UCVA: Uncorrected visual acuity

affected by surgical approach. The surgeon must operate in the left eye over the back of the patient's nose and eyebrow through SNI, which leads to a steeper angle of approach, particularly during the use of an incision making keratome and phacoemulsification handpiece. This might result in more wound stress and stretching of the corneal tissue.<sup>[5]</sup> Moreover, SNI phacoemulsification cataract surgery would be technically difficult in patients with deep-set globes.

In our study, all patients had neutral astigmatism pre-operatively. Hence, that it was easier to compare surgically induced astigmatism in different types of corneal incision in phacoemulsification.

Different studies confirmed that a small superior CCI-induced greater post-operative astigmatism than a small temporal or a small oblique CCI and that a small oblique CCI-induced greater post-operative astigmatism than a small temporal CCI.<sup>[6,7]</sup> In our study, superotemporal CCI was made in right eyes, superonasal CCI in the left eyes, and superior CCI was in either eye. We found no statistically significant differences in SIA between the superotemporal, superonasal, and SIs. It is consistent with the results reported by Ermi et al.,<sup>[8]</sup> and Yoon et al.<sup>[9]</sup>

The vertical component of astigmatism was statistically significantly lower in early post-operative period than pre-operatively in superior and STI group, which was probably the result of corneal relaxation due to the operative incision. Superonasal CCI, due to near location from optical point of the cornea, involves both components of astigmatism.

## CONCLUSION

In the era of modern cataract extraction surgery, post-operative best UCVA is must; it requires special attention to surgically induced corneal shape alterations. There is no statistically significant difference in SIA between superior, STI in the right eye, and SNI in the left eye. However, better UCVA can be obtained using STI.

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