

A Comparative study of surgically induced astigmatism in superior and temporal scleral incision in manual small incision cataract surgery

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Abstract

Background: Surgically induced astigmatism is one of the obstacle to the achievement of good uncorrected visual acuity after cataract surgery. Pre-operative astigmatism, Incision length, shape, location, closure, healing, scleral cauterization, type of suture material used and its placement, position of IOL, and post operative steroids used all these factors affect corneal curvature. **Aim & Objective:** The aim to study the post operative astigmatism in superior small incision versus temporal small incision cataract surgery. **Methodology:** 100 consecutive cataract patients treated with small incision extra capsular cataract extraction were prospectively studied and followed up for at least 6 weeks. The present study was undertake from April 2018 to Feb 2021. Cases from Mamata general hospital, Khammam (Mamata Medical College, Khammam). **Results:** The patients were randomly divided into two group of 50 cases each. Group-I cases who underwent MSICS with PCIOL implantation through superior scleral incision ECCE. Group-II cases who underwent MSICS with PCIOL implantation through temporal small incision ECCE. During immediate post operative period i.e., 7 days after surgery. The average astigmatism in Group-I cases was 6.0D \pm 1.82 and in Group-II was 2.75D \pm 1.3. After 6 weeks of surgery average post-operative astigmatism was 4.20 D \pm 1.17 in Group-I cases and 1.36 D \pm 0.70 in Group-II cases.

Conclusion: To conclude, temporal scleral incision in MSICS produces lesser surgically induced astigmatism as compared to superior scleral incision.

Keywords: astigmatism, Temporal Scleral Incision, Post operative, Surgical.

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Introduction

Cataract is an eye disease in which clear lens of eye becomes opaque leading to decrease of vision. Opaque lens can be replaced with clear artificial lens. Worldwide it is affecting millions of people not only medically but also socially. Over 51% of people in the world are suffering from blindness due to cataract. India is now home to world's largest number of blind people. Out of 15 million blind people in India, 62 to 65% (national blindness survey) of those surveyed randomly had cataract, which is the commonest cause of curable blindness[1].

Rapid recovery and good vision can be achieved by manual ECCE at low cost where there is need for high volume cataract surgery. Recent advances in surgical techniques in addition to the improvement of postoperative visual outcomes have progressively changed the primary concern of cataract surgery from the safe removal of the opaque crystalline lens to a procedure refined to yield the best possible refractive result[2].

Most of the above objectives are fulfilled by phacoemulsification. But due to the infrastructural facilities and economic structure of general population phacoemulsification cannot be undertaken routinely, more over it has difficult and long learning curve. The present study is worked up in our institution to compare the post-operative astigmatism in superior versus temporal scleral incision in manual small incision cataract surgery.

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Aims and Objectives

Modern cataract surgery is a refractive procedure. In addition to improving visual acuity one of the goals of modern cataract surgery is to reduce induced astigmatism that may affect the quality of vision. Surgically induced astigmatism is one of the obstacle to the achievement of good uncorrected visual acuity after cataract surgery. Pre-operative astigmatism, Incision length, shape, location, closure, healing, scleral cauterization, type of suture material used and its placement, position of IOL, and post operative steroids used all these factors affect corneal curvature. The spherical component of the refraction after cataract surgery can be controlled by a careful biometry and IOL power calculation. But cylinder component of refraction (astigmatism) can be controlled only by modification of site, length, closure and shape of the incision.

Aim

The AIM of present study is to evaluate and compare the surgically induced astigmatism in superior scleral incision and temporal scleral incision in manual small incision cataract surgery.

Materials and Methods

- 1) The present study was undertake from April 2018 to Feb. 2021. Cases from Mamata general hospital, Khammam (Mamata Medical College, Khammam).
- 2) Cases were divided into 2 groups irrespective of age and sex were admitted for cataract extraction.

Group – I: 50 patients undergoing small incision cataract surgery with superior incision with PCIOL.

Group-II: 50 patients undergoing small incision cataract surgery with temporal incision with PCIOL.

Pre-operative Examination: A thorough pre-operative examination of each case of using.

- Visual acuity and pin hole recording.
- Slit lamp biomicroscopy
- Keratometry, A-scan.
- Iop recording and lacrimal sac syringing.
- Blood pressure, Routine Blood investigation were done.
- fundoscopy

Any focus of infection was noted and treated prior to surgery; chronic straining factors like constipation, bronchitis, were ruled out. If there is any use of antiplatelets they are stopped 5 days prior to surgery and started 2 days after surgery.

Exclusion Criteria

1. Cases with irregular astigmatism.
2. Cases with any corneal ectasia. (Keratoconus)
3. Cases with traumatic cataract.
4. Cases with corneal dystrophies and degeneration.
5. Cases with previous intraocular surgeries, inflammation or trauma.
6. Cases with pterygium, corneal opacity.
7. Inability to give informed consent.

Preoperative Preparation

Topical broadspectrum antibiotic ciprofloxacin eye drops were instilled every two hourly one day prior to surgery. Short acting anticholinergic agent tropicamide is used as mydriatic 3-4 times at 10 minute interval prior to surgery. Flurbiprofeneyedrops were also used.

Anaesthesia

All the patients were operated under local anaesthesia.peribulbar block with 2% lignocaine with adrenaline 1:2,00,000 with hyaluroinidase (1500IU) and Bupivacaine (0.5%) was given using 1.5", 24 gauge needle. Gentle massage was applied over the eye and movement was observed in any direction. Hypotony was achieved by applying intermittent digital pressure and external ocular pressure with pinky ball for 10 minutes after peribulbar injection.

Steps of Operation

The eye to be operated upon and the skin around it was painted with 10% solution of betadine and draped with surgical sheet.

Superior rectus bridle Suture:

The suture was passed through the superior rectus just near its insertion. The suture was clamped with towel clip or artery forceps.

All the cases were operated under operating microscope.

Peritomy

A fornix based conjunctivalperitomy was done to reflect the conjunctiva and tenon's capsule, sclera is exposed and the bleeding points were cauterized using a heat cautery.

Group-I Cases

Incision – Superior Incision

A 6mm scleral incision, 1.5 mm away from limbus was made with no.15 Bard parker blade. Length the groove was measured by Vernier calipers.

A funnel shaped sclerocorneal pocket incision was created with a crescent knife. 1 sideport made 90° apart of scleral tunnel with 15°angulation knife with a 2.8mm keratome. Anterior chamber was entered 1.5mm into clear cornea. Methyl cellulose was injected into the anterior chamber. Internal incision is enlarged to 8mm sideways.

Anterior Capsulotomy

Anterior capsulotomy was done with cystotome.

Hydrodissection

Hydro-dissection was performed by irrigating Ringer lactate between lens capsule and the lens cortex to weaken capsular-cortical connections.

Expression of the Nucleus

The nucleus was expressed out by any of the following techniques.

1. Viscoexpression technique
2. Hydro-extraction by irrigating vectis.

Irrigation / Aspiration of Cortical Matter:

Irrigation/aspiration was done by simcoe cannula.

Intraocular Lens Implantation (IOL)

IOL implantation was done .

Closure of Incision Line

Fornix based conjunctival flap was replaced in each group. A subconjunctival injection of 20 mg of gentamycin and 2 mg of dexamethasone was given to each patient with 26 gauge needle. Superior bridle sutures were removed. Conjunctiva is closed by heat cautery Pad and bandage applied and patient was shifted to ward.

Post-Operative Treatment

1. Tablet Ciprofloxacin – 500 mg twice a day for 5 days.
2. Tablet Ibuprofen – 400 mg twice a day for 5 days.
3. Steroid and antibiotic mixture eye drops were given for 1 month.
4. Cyclopentolate eye drops twice a day for a week

Post-Operative Care

- The bandage was opened on the next day.
- Eye was cleaned with antibiotic eyedrops using cotton swab.
- Dark glasses were worn by all patients.
- Eye shields were used at night for few days to avoid injury during sleep.
- Patient was advised to avoid hair bath for few days and any kind of exertional activity, and avoid rubbing of the eye.

Discharge: Patients were discharged on 1st day. At the time of discharge, thorough slit lamp examination was done to see the state of cornea, iris, anterior chamber, pupil and IOL, reaction etc.

Follow-up

The patients were recalled for post-operative follow-up. Detailed examination, including slit lamp biomicroscopic and ophthalmoscopy, was performed at 1, 2, 4 and 6 weeks.

Keratometry

Keratometric evaluation was done one week and six weeks post-operatively. At 6 weeks retinoscopy was done and prescriptions for spectacles were given to the patients.

Group II Cases

In Group II Cases temporal incision is given and rest is same as Group I cases.

Results and Observations

100 cases of cataract were selected for the study of post-operative astigmatism in superior scleral incision versus temporal scleral incision in small incision cataract surgery.

A General Physical examination and thorough examination of anterior segment was performed in all cases. One Eye was taken as one case.

These were divided into 2 groups of 50 cases each group.

Group-I: 50patients undergoing small incision cataract surgery with superior scleral incision.

Group-II: 50patients undergoing small incision cataract surgery with temporal scleral incision.

Pre-Operative Observations

The age and sex distribution of cases in the study is given in Table-1.

Table 1: Age and Sex Distribution

Age (Years)	Group-I				Group-II			
	Male	Female	Total	Percentage (%)	Male	Female	Total	percentage(%)
<40	--	--	--	0.0	--	--	0	0.0
41-50	1	16	17	34.0	5	8	13	26.0
51-60	4	7	11	22.0	10	7	17	34.0

61-70	13	8	21	42.0	11	5	16	32.0
>70	--	1	2	8.0	1	3	4	8.0
Total	18	32	50	100.0	32	18	50	100.0

The youngest patient studied in series in Group-I was 42 years old Female and the eldest patient was 80 years old Female.
In Group-I, 34% patients were males and 66% patients were females.

In Group-II, 54% patients were males and 46% patients were females.

Pre-Operative Visual Acuity

Table 2: Pre-Operative Visual Acuity

Visual Acuity	Group-I		Group-II	
	No. of Cases	percen-tage (%)	No. of Cases	Percentage (%)
6/60	8	16.0	12	24.0
CF at 1m	12	24.0	16	32.0
HM close to face	12	24.0	12	24.0
Accurate light projection	18	36.0	10	20.0
Total	50	100.0	50	100.0

Operated Eye

Table 3: Eye Operated

Eye Operated	Group-I				Total	Percentage
	Male	Percentage	Female	Percentage		
Right	8	16.0	19	38.0	27	54.0
Left	9	18.0	14	28.0	23	46.0
Total	17	34.0	32	66.0	50	100.0

Eye Operated	Group-II				Total	Percentage
	Male	Percentage	Female	Percentage		
Right	12	24.0	16	32.0	28	56.0
Left	15	30.0	7	14.0	22	44.0
Total	27	54.0	23	36.0	50	100.0

Pre-Operative Astigmatism Keratometry was performed in all the cases pre-operatively. The relationship between number of cases and type of astigmatism observed pre-operatively is shown in Table-4.

Table 4: Relationship of No. of cases with type of Astigmatism

Type of Astigmatism	Group-I		Group-II	
	No. of Cases	Percentage	No. of Cases	Percentage
No astigmatism	6	12.0	6	12.0
Astigmatism with the rule	18	36.0	24	48.0
Astigmatism against the rule	26	52.0	20	40.0
Oblique astigmatism	--	--	--	--
Total	50	100.0	50	100.0

Table 5: Relationship of No. of cases its distribution among cases

Type of Astigmatism	Group-I		Group-II	
	No. of Cases	Percentage	No. of Cases	Percentage
0.00 – 0.50	28	56.0	26	52.0
0.75 – 1.00	6	12.0	8	16.0
1.25 – 1.50	10	20.0	10	20.0
1.75 – 2.00	6	12.0	6	12.0
Total	50	100.0	50	100.0

Number of cases with pre-operative astigmatism of 1D or less than 1D was 34 in Group-I and 34 in Group-II.
Mean value of pre-operative astigmatism in Group-I was 0.74D.
Minimum value of pre-operative astigmatism in Group-I was 0.00.
Maximum value of pre-operative astigmatism in Group-I was 1.5 D.
Mean value of pre-operative astigmatism in Group-II was 0.90 D.
Minimum value of pre-operative astigmatism in Group-II was 0.00.
Maximum value of pre-operative astigmatism in Group-II was 2.5 D.

Other Pre-Operative Observations

Intraocular pressure in all eyes pre-operatively ranged between 13.4mm of Hg and 18.9mm of Hg. Eyes with IOP exceeding 20.6 mm of Hg were excluded from the study.

Slit lamp examination

Eyes with intra-ocular pathology are not selected for the study.

Post-Operative Observations

Keratometry

Type and amount of astigmatism after one week of surgery was recorded and studied. The relationship between type of post-operative astigmatism after one week of surgery and number of cases in Group-I and Group-II as observed is shown in Table-6 and the relationship between amount of post-operative astigmatism after one week of surgery and the number of cases in Group-I and Group-II as observed are shown in Table-7.

Table 6: Early Post-operative type of Astigmatism

Type of astigmatism	Group-I		Group-II	
	No. of Cases	Percentage	No. of Cases	Percentage
No astigmatism	--	--	--	--
Astigmatism with the rule	20	40	30	60
Astigmatism against the rule	12	24	4	8
Oblique astigmatism	18	36	16	32
Total	50	100.0	50	100.0

Table 7: Amount of post-operative astigmatism after one week surgery

Amount of astigmatism (D)	Group-I		Group-II	
	No. of Cases	Percentage	No. of Cases	Percentage
No astigmatism	--	--	--	--
0.25 – 2.00	--	--	20	40
2.25 – 3.00	--	--	14	28
3.25 – 4.00	12	24	10	20
4.25 – 5.00	6	12	4	8
5.25 – 6.00	10	20	2	4
6.25 – 7.00	12	24	--	--
7.25 – 8.00	4	8	--	--
8.25 – 9.00	4	8	--	--
> 9.00	2	4	--	--
Total	50	100	50	100

The minimum amount of astigmatism after one-week of surgery in Group-I was 3.5D and the maximum amount was 9.5D. The average amount of astigmatism one-week after surgery in Group-I was 5.94 D.

The minimum amount of astigmatism one-week after surgery in Group-II was 0.5D and the maximum amount was 6.0D. The average amount of astigmatism after one-week of surgery in Group-II was 2.75 D.

Table 8: Showing relationship of type of astigmatism after 6 weeks of surgery to the number of cases in each group

Type of astigmatism	Group-I		Group-II	
	No. of Cases	Percentage	No. of Cases	Percentage
No astigmatism	--	--	2	4
Astigmatism with the rule	6	12	34	68
Astigmatism against the rule	40	80	8	16
Oblique astigmatism	4	8	6	12
Total	50	100.0	50	100.0

Table 9: Amount of post-operative astigmatism after 6 weeks surgery

Amount of astigmatism (D)	Group-I		Group-II	
	No. of Cases	Percentage	No. of Cases	Percentage
No astigmatism	--	--	2	4
0.25 – 1.00	--	--	22	44
1.25 – 2.00	4	8	22	44
2.25 – 3.00	2	4	2	4
3.25 – 4.00	16	32	2	4
4.25 – 5.00	22	44	--	--
5.25 – 6.00	4	8	--	--
6.25 – 7.00	2	4	--	--
7.25 – 8.00	--	--	--	--
8.25 – 9.00	--	--	--	--
> 9.00	--	--	--	--
Total	50	100	50	100

The minimum amount of astigmatism 6 weeks after surgery in Group I was 2.0 D and the maximum amount was 7.0 D. The average amount of astigmatism 6 weeks after surgery in Group-I was 4.20 D.

The minimum amount of astigmatism 6 weeks after surgery in Group II was 0.5 D and the maximum amount was 4.0 D in two cases

no astigmatism was seen. The average amount of astigmatism 6 weeks after surgery in Group-II was 1.36 D.

Retinoscopy: The retinoscopy was done 6 weeks after surgery to evaluate the final reaction. The frequency of value of sphere on final follow-up 6 weeks after surgery is recorded in Table-10.

Table 10: Spherical Value

Spherical Value (D)	Group-I		Group-II	
	No. of Cases	Percentage	No. of Cases	Percentage
> 3	--	--	--	--
-2.25 to – 3.0	2	4	4	8
-1.25 to – 2.0	15	30	18	36
0 to –1	17	34	22	44
0	2	4	--	--
0 to +1	10	20	4	8
+1.25 to +2	4	8	2	4

+2.25 to +3	--	--	--	--
> +3	--	--	--	--
Total	50	100	50	100

The average value of sphere required 6 weeks after surgery in Group-I was 0.75D. The minimum value of value of sphere required after 6 weeks of surgery in Group-I was 0 and the maximum value of sphere required after 6 weeks of surgery in Group-I was 2.5D.

The average value of sphere required 6 weeks after surgery in Group-II was 1.0D. The minimum value of sphere required after 6 weeks of surgery in Group-II was 0.25D and the maximum value of sphere required after 6 weeks of surgery in Group-II was 3.0D.

Table 11: Frequency of value of cylinder in series after 6 weeks surgery

Amount of astigmatism (D)	Group-I		Group-II	
	No. of Cases	Percentage	No. of Cases	Percentage
0.00 to 1.00	--	--	34	68
1.25 to 2.00	16	32	14	28
2.25 to 3.00	16	32	2	4
3.25 to 4.00	18	36	--	--
>4.00	--	--	--	--
Total	50	100	50	100

The total number of cases where a cylinder was required was 50 (100%) in Group-I and 48 (96%) in Group-II.

The average value of cylinder required in Group-I was 2.5D. The minimum value of cylinder in Group-I was 1.5 D and maximum value was 4.0D.

The average value of cylinder required in Group-II was 1.0D. The minimum value of cylinder in Group-II was 0.5D and maximum value was 2.5D. Against the rule astigmatism on retinoscopy was seen in 80% of cases in Group-I and 68% cases in Group-II. With the rule astigmatism was seen in 12% of cases in Group-I and 16% of cases in Group-II. Oblique astigmatism was in 8% of cases in Group-I and 12% of cases in Group-II.

In Group-II 4% cases had no astigmatism while astigmatism was seen in all cases of Group-I.

Discussion

Cataract surgery in modern days is said to be 'refractive cataract surgery'. In order to achieve good visual result effect of astigmatism on postoperative vision must be minimized. Today's cataract incisions provide better control over surgically induced astigmatism. Surgically induced astigmatism and post operative unaided visual acuity were the main aim of study. Astigmatism assessed using pre and post operative keratometry readings.

Either by using temporal approach to produce astigmatically neutral surgery or by using on-axis incision to induce astigmatism at the steep axis to counteract pre-existing astigmatism.

Surgically induced astigmatism is the main aim of the study.

Astigmatism assessed using pre-operative and post-operative keratometry readings.

Temporal incision is farthest from the visual axis and is less likely to affect corneal curvature and most of the elderly patients have preoperative against-the-rule astigmatism when the incision is located superiorly, both gravity and eye blink tend to create drag on the incision, these forces are neutralized better with temporally placed incisions because the incision is parallel to vector of forces.

With-the-rule astigmatism induced by temporal incision is advantageous because most elderly cataract patients have pre-operative against-the-rule astigmatism. On comparing the type of astigmatism post-operatively it was found that there is significant change to with-the-rule astigmatism or neutralization of pre-existing against-the-rule astigmatism after temporal scleral incision to against-the-rule astigmatism in superior scleral incision. Kannan *et al.* compared superior scleral incision to temporal incision, they reported mean surgically induced astigmatism of 1.45D in superior incision[3]. Coggin *et al.* and associates documented against-the-rule astigmatism of 0.41D between postoperative day 1 and 4 years with superior scleral incision[4].

Atchinson *et al.* found lesser postoperative astigmatism and better visual acuity in those with temporal incision as compared to those who underwent MSICS with superior scleral incision[5].

Study by Bhaskar Reddy *et al.* found that incisions placed temporally tends to decrease Against-the-rule astigmatism mostly prevalent in adult population due to absence of lid tone in both phacoemulsification and MSICS[6]. In the study of Gokhale *et al.* surgically induced astigmatism vector in superior group was 1.28D, 0.2D in superotemporal and 0.37D in temporal group[7].

In this study similar results were noticed with superior group having surgically induced astigmatism of about $4.20 \pm 1.17D$ and $1.36 \pm 0.70D$ in temporal group.

There was significant difference in surgically induced astigmatism among both the groups at postop first week and at 6 weeks.

The change in corneal curvature is responsible for surgically induced astigmatism and the astigmatic refractive error.

Uncorrected astigmatic error can cause blurred image and glare.

This might have contributed to the significant difference in postop unaided visual acuity in groups.

Age and Sex Incidence

Majority (73%) of patients of the present study who underwent cataract extraction belong to age group of above 50 years) reported that cataract occurred in 65% of people in sixth decade and over 95% in above 65 years. This age incidence was consistent with the findings reported by Gautham *et al.*[8]. Females outnumbered Males in Group-I and II i.e., 56 and 44 respectively. This difference in the incidence of male to female ratio would be a co-incident as either of the sex did not have any kind of bearing on the development of cataract. Most of the cases in this study fall in the age group of 61-70yrs. Many of these patients were pseudophakic in other eye, thus good vision in operated eye may be the reason for the delay.

Placement of Incisions

A superior scleral incision was made in Group-I cases and a temporal scleral incision in Group-II cases. Read *et al.* also started that astigmatism is inversely proportional to the distance the incision is placed from the limbus[9]. In this study it was observed that superior scleral incision had a mean surgically induced astigmatism of 4.20D while temporal scleral incision had mean surgically induced astigmatism of 1.36D. As per result the surgically induced astigmatism was less in temporal scleral incision group than superior scleral incision group. Temporal approach for SICS has yielded excellent results in some studies and has the advantage that it induces lesser astigmatism.

Astigmatism

Pre-operative astigmatism

The pre-operative value of astigmatism was recorded in each case. 12 cases (12%) had no astigmatism, 50 cases (50%) had astigmatism 'with the rule' and 38 cases (38%) had astigmatism 'against the rule'. Mean value of pre-operative astigmatism was 0.83 D.

After 7 days of Surgery

The mean induced astigmatism was 5.94D in Group-I and 2.74D in Group-II. The standard deviation was 1.78 and range is 6 (3.5-9.5) in

Group-I. The standard deviation was 1.28 and range is 5.5 (0.5-6.0) in Group-II.

After 6 weeks of Surgery

The mean induced astigmatism was 4.19D in Group-I and 1.34D in Group-II. The standard deviation was 1.15 and range is 5 (2.0-7.0) in Group-I. The standard deviation was 0.80 and range is 4 (0-4.0) in Group-II.

Changes in type of astigmatism after 6 weeks

In Group-I, 40 (80%) patients had astigmatism against the rule, 6 (12%) patients had astigmatism with the rule, and 4 (8%) had oblique astigmatism.

In Group-II, 34 (68%) patients had astigmatism with the rule, while 8(16%) had astigmatism against the rule and 6 (12%) had oblique astigmatism.

Read et al., noted against the rule astigmatism in 70% of cases after scleral flap incision for cataract surgery[9].

In this study, both the groups had significant improvement in post-operative visual acuity.

One of the factors that decide the uncorrected postoperative visual acuity is surgically induced astigmatism.

However, the surgically induced astigmatism does not have a direct bearing on the unaided post-operative visual acuity as this will depend on the pre-operative magnitude and vector of astigmatism.

Visual Acuity Results

Due 6th week of follow up post-operatively, the visual acuity of every patient was recorded after giving proper pseudophakic correction.

Eventhough surgically induced astigmatism was significantly less in temporal group incision both the groups showed significant improvement in final uncorrected visual acuity.

Table 12:Corrected Visual acuity results

Final corrected visual acuity	Group-I		Group-II	
	No. of Cases	Percentage	No. of Cases	Percentage
6/6 to 6/9	35	70	40	80
6/12 to 6/18	14	28	10	20
6/24 to 6/36	1	2	--	--
6/60	--	--	--	--
Total	50	100	50	100

The minimum amount of astigmatism one week after the surgery in Group-I was 3.5D and maximum amount was 9.5D. The average amount of astigmatism one week after the surgery in group-I was 5.94D. The minimum amount of astigmatism one week after the surgery in Group-II was 0.5D and maximum amount was 6.0D. The average amount of astigmatism after one week of surgery in group-II was 2.75D.

Conclusion

Cataract surgery in modern days is said to be 'refractive cataract surgery'. In order to achieve good visual result effect of astigmatism on postoperative vision must be minimized. Today's cataract incisions provide better control over surgically induced astigmatism. To conclude, temporal scleral incision in MSICS produces lesser surgically induced astigmatism as compared to superior scleral incision.

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