

## A COMPARATIVE STUDY OF SURGICALLY INDUCED ASTIGMATISM IN STRAIGHT, FROWN AND MODIFIED CHEVRON INCISIONS IN MANUAL SMALL INCISION CATARACT SURGERY

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### HOW TO CITE THIS ARTICLE:

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**ABSTRACT: PURPOSE:** To compare the surgically induced astigmatism following straight, frown and modified chevron incisions in MSICS. **METHOD:** This is a Prospective interventional study conducted in RIO Bhopal during academic session of April 2009 to October 2010 in which 145 eyes of 137 patients were evaluated. Patients with relatively soft nuclei and healthy cornea, adequate anterior chamber and those who could be called up for regular follow up were chosen for the study. Preoperative keratometry was done to determine K-reading in both horizontal and vertical meridians. Astigmatism was graded and classified according to Holmström's gradation<sup>1</sup> 37.9% cases were given straight incision, 18.6% cases were given Frown incision. While in the remaining 43.4% cases Modified chevron was made. In majority of cases 71%, 6.5 mm incision was made while larger incision 7mm and 7.5mm were made in 23.4% and 5.5% cases respectively. Post-operative keratometry readings were taken at first post-operative day and at the end of 6<sup>th</sup> week following surgery and surgically induced astigmatism was calculated. **RESULTS:** Post operatively frown incision group's average SIA was 0.68 D. Modified chevron incision group had 1.02 D SIA, Straight incision group had the maximum SIA of 1.15D. However the mean surgically induced astigmatism in all incision types in our study was found to have SIA=1.01 D. **CONCLUSION:** In our study we observed that Frown incision was the best of all incision types with regards to SIA.

**KEYWORDS:** SIA, Modified chevron incision, straight incision, frown incision.

**INTRODUCTION:** In the developing countries where cost<sup>1</sup> is a major issue, MSICS was developed after the advent of phacoemulsification, and hence it is a relatively younger technique than the latter. Innumerable variations in methodologies of MSICS as well as the utility of MSICS in the day to day practice invoke a great deal of discussion and debate. In MSICS which is based on the concept of scleral tunnel, everything about the wound has to be carefully planned depending on the type of technique, hardness of the nucleus, amount of preoperative astigmatism.<sup>2,3</sup> It has been unequivocally demonstrated that smaller the incision,<sup>4,5</sup> lesser the number of sutures<sup>6,7</sup> and valvular construction of wound would induce minimal corneal curvature change that is astigmatism. The parameters<sup>8</sup> important for the structural integrity of the tunnel are-

- The self-sealing property of the tunnel.
- The location of the wound on the sclera with respect to the limbus,<sup>7,9</sup> and
- The shape of the incision.<sup>7,10</sup>

Cataract surgery has gone beyond just being a means to get the lens out of the eye. Postoperative astigmatism plays an important role in evaluation of final outcome of surgery. Astigmatic consideration hence forms an integral part of incisional considerations prior to surgery.

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After evolution of SICS the importance of INCISION FUNNEL<sup>11</sup> was known. This study is done to compare surgically induced astigmatism between modified chevrons, straight and frown incisions.

### **MATERIALS AND METHODS:**

#### **AIMS & OBJECTIVES:**

1. To calculate the amount of surgically induced astigmatism in straight incision, frown incision and modified chevron incision in MSICS.
2. To assess the BCVA in the three groups.

**Inclusion Criteria:** Patients with relatively soft nuclei and healthy cornea, adequate anterior chamber and those who could be called up for regular follow up were chosen for the study.

#### **Exclusion Criteria:**

- Hyper mature cataracts.
- Raised IOP.
- High myopia with thin sclera.
- Previous intraocular surgery causing scarring at limbal area.
- Subluxated lens.
- Anterior and/or posterior segment pathology.

This is a Prospective interventional study conducted in RIO Bhopal during academic session of April 2009 to October 2010 in which the cases were divided into 3 groups:

- Group I consisted of 55 cases of Straight incision
- Group II Consisted of 27 cases of Frown incision
- Group III Consisted of 63 cases of Modified chevron incision

**Ocular examination:** It Included recording of visual acuity by Snellen's chart, finger counting or perception and projection of light. Syringing of lacrimal passage was done and measurement of IOP was done.

All cases were subjected to slit lamp examination to exclude anterior chamber pathology. Grading of cataracts on the basis of color (Jaffe) was done, to determine nuclear hardness.

**Astigmatism:** Preoperative keratometry was done to determine K-reading in both horizontal and vertical meridians.

Astigmatism was graded and classified according to Holmström's gradation as,

- No astigmatism, when it was <0.25 D.
- Non-significant, when it was ≥0.25 D but <1.00 D.
- Significant, when it was ≥1.00 D but <2.00 D.
- High, when it was ≥2.00 D.

The axes of astigmatism were divided into three classes, "With the rule" (Minus cylinder at 180°±15°), "Against the rule" (Minus cylinder at 90°±15°) and "Oblique" (Minus cylinder at 16-74° & 106-164°).

A-scan was done to determine IOL power.

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Detailed fundus examination was done.

B-scan was done in all cases of mature cataract/where fundus was not visible.

Complete medical checkup was done to exclude septic foci or systemic illness. Patients were posted for surgery on the next day and experienced surgeons performed all the surgeries.

**Scleral Tunnel:** Different types of incision with varying degrees of length were made 2-2.5 mm behind the limbus and including about half thickness of sclera. With the crescent knife incision was then tunneled towards the limbus into clear corneal zone for about 1-2 mm. anterior chamber was punctured through an angled keratome.

All three types of incisions were having varying length between 6.5 mm to 7.5 mm depending on size of nucleus.

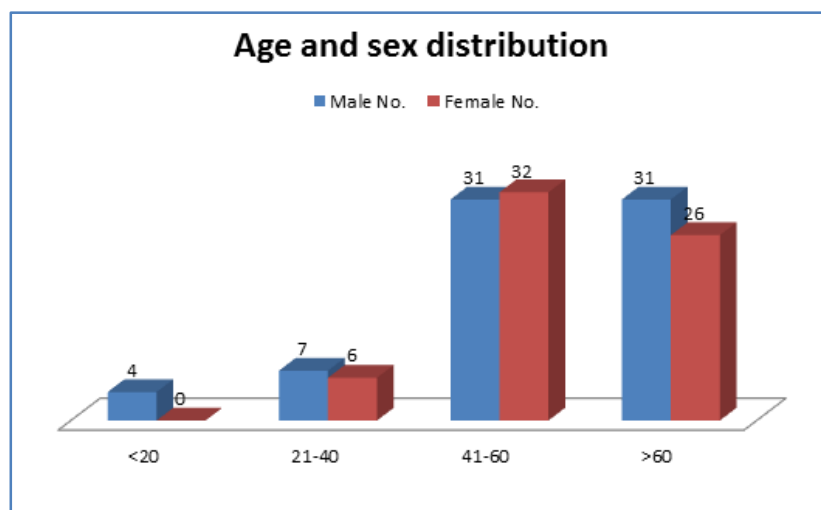
Width of the tunnel varied from <4 mm to 5 mm with majority of 4 mm. Continuous curvilinear capsulorrhexis was done in all cases. Viscoelastics were used generously. Minimal iris handling was ensured. In-the-bag placement of IOL was done. Patients were examined on the first post-operative day, at first week and at the end of 6 wks. Post-operative vision and refraction was performed at the end of 6 wks.

SIA calculator (warren Hill) / SIA calculator version 2.1 (Dr. Saurabh Sawhney and Dr. Aashima Agrawal) was used to calculate the SIA in our study.

### RESULTS:

Sl. No.	Age in years	Male		Female		Total	
		No.	%	No.	%	No.	%
1.	<20	4	2.9	0	0	4	2.9
2.	21-40	7	5.1	6	4.4	13	9.5
3.	41-60	31	22.6	32	23.4	63	46
4.	>60	31	22.6	26	19	57	41.6
<b>Total</b>		<b>73</b>	<b>53.3</b>	<b>64</b>	<b>46.7</b>	<b>137</b>	<b>100</b>

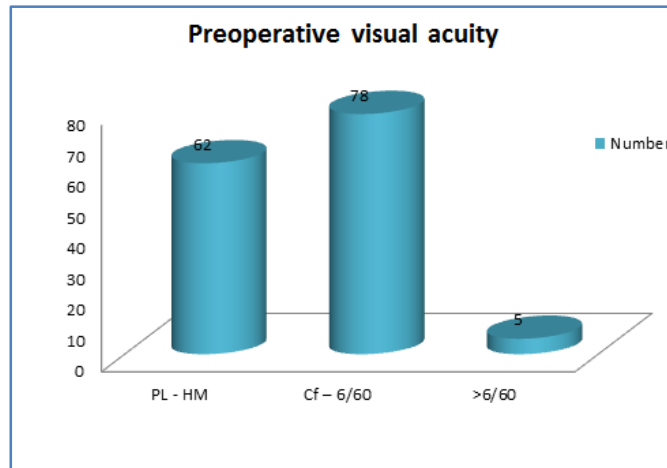
Table 1: Age and Sex Distribution (N=137)



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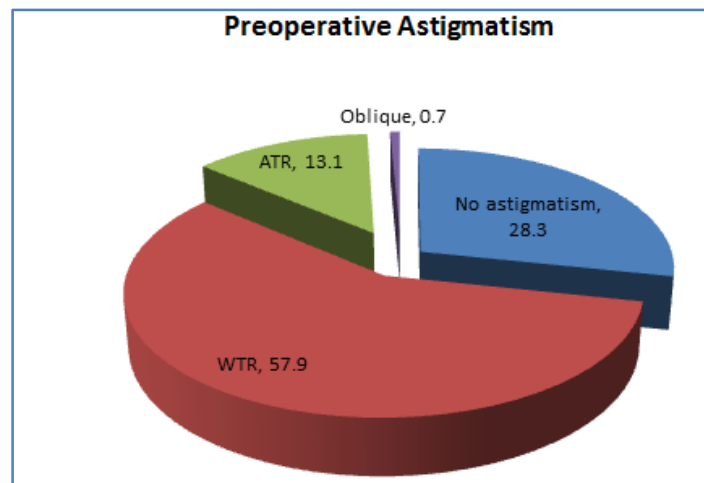
Sl. No.	Visual acuity	Number	%
1.	PL - HM	62	42.8
2.	Cf - 6/60	78	53.8
3.	>6/60	5	3.4
<b>Total</b>		<b>145</b>	<b>100</b>

**Table 2: Preoperative Visual Acuity (N=145)**



Sl. No.	Astigmatism	Number	%
1.	No astigmatism	41	28.3
2.	WTR	84	57.9
3.	ATR	19	13.1
4.	Oblique	1	0.7
<b>Total</b>		<b>145</b>	<b>100</b>

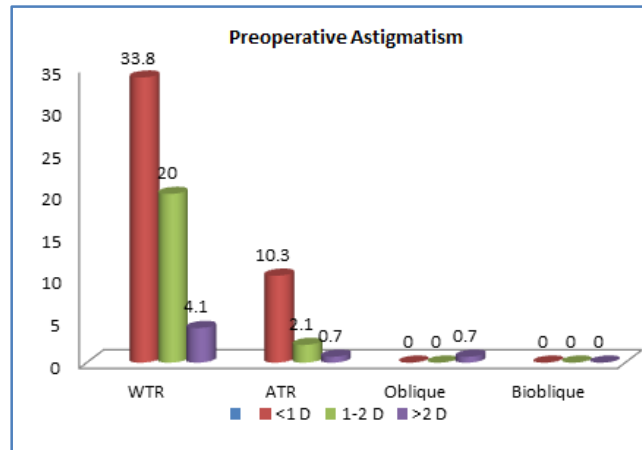
**Table 3: Preoperative Astigmatism (N=145)**



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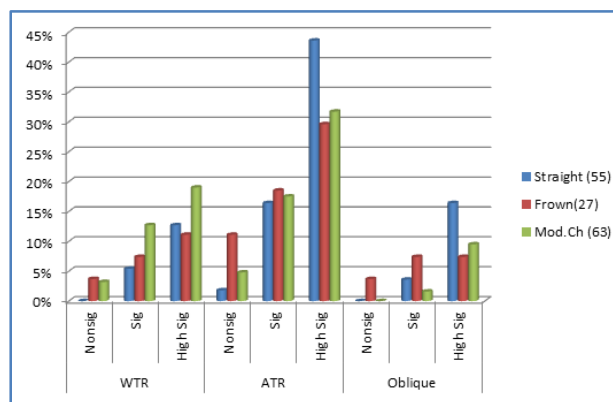
Sl. No.	Amount of astigmatism	WTR		ATR		Oblique		Bioblique	Total	
		No.	%	No.	%	No.	%	No.	No.	%
1.	<1 D	49	33.8	15	10.3	0	0	0	64	44.1
2.	1-2 D	29	20	3	2.1	0	0	0	32	29
3.	>2 D	6	4.1	1	0.7	1	0.7	0	8	5.5
<b>Total</b>		<b>84</b>	<b>57.9</b>	<b>19</b>	<b>13.1</b>	<b>1</b>	<b>0.7</b>	<b>0</b>	<b>104</b>	<b>71.7</b>

Table 4: Amount of Preoperative Astigmatism (N=104)



Sl. No.	Incision	WTR			ATR			Oblique		
		Nonsig	Sig	High Sig	Nonsig	Sig	High Sig	Nonsig	Sig	High Sig
1.	Straight (55)	0	3 (5.4%)	7 (12.7%)	1 (1.8%)	9 (16.4%)	24 (43.6%)	0	2 (3.6%)	9 (16.4%)
2.	Frown (27)	1 (3.7%)	2 (7.4%)	3 (11.1%)	3 (11.1%)	5 (18.5%)	8 (29.6%)	1 (3.7%)	2 (7.4%)	2 (7.4%)
3.	Mod.Ch (63)	2 (3.2%)	8 (12.7%)	12 (19.0%)	3 (4.8%)	11 (17.5%)	20 (31.7%)	0	1 (1.6%)	6 (9.5%)
<b>Total</b>		<b>3 (2.1%)</b>	<b>13 (9.0%)</b>	<b>22 (15.2%)</b>	<b>7 (4.8%)</b>	<b>25 (17.2%)</b>	<b>52 (35.9%)</b>	<b>1 (0.7%)</b>	<b>5 (3.4%)</b>	<b>17 (11.7%)</b>

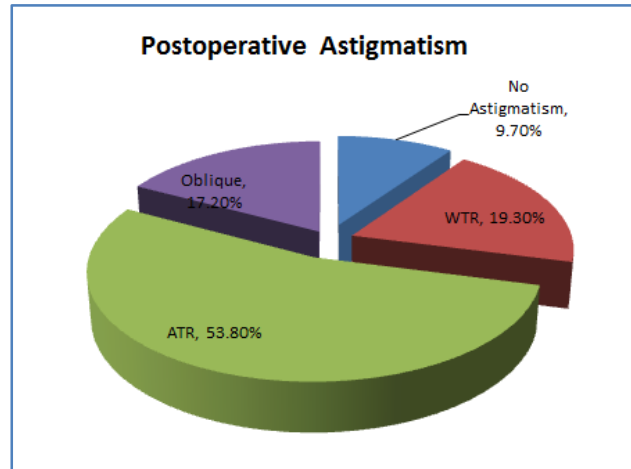
Table 5: Postoperative Astigmatism at 1<sup>st</sup> Pod



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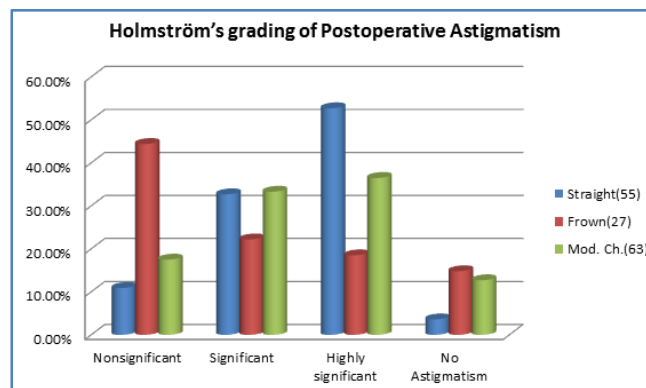
Sl. No.	Post op. Astigmatism	Number	%
1.	No Astigmatism	14	9.7
2.	WTR	28	19.3
3.	ATR	78	53.8
4.	Oblique	25	17.2
<b>Total</b>		<b>145</b>	<b>100</b>

**Table 6: Types of Postoperative Astigmatism at 6<sup>th</sup> Week**



Sl. No.	Astigmatism	Non-significant (0.25<1.0 D)		Significant (1-2 D)		Highly significant (>2.0 D)		No. Astigmatism (<0.25)	
		No.	%	No.	%	No.	%	No.	%
1	Straight (55)	6	10.9	18	32.7	29	52.7	2	3.6
2	Frown (27)	12	44.4	6	22.2	5	18.5	4	14.8
3	Mod.Ch.(63)	11	17.5	21	33.3	23	36.5	8	12.7
Total		29	20.0	45	31.0	57	39.3	14	9.7

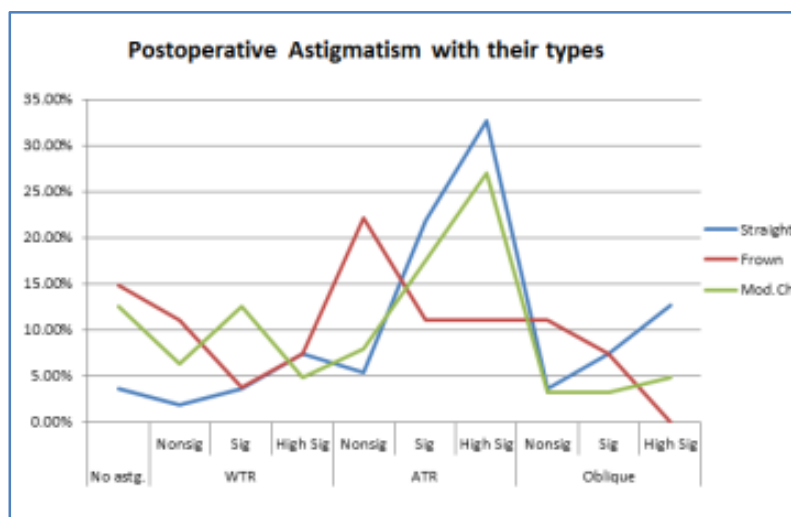
**Table 7: Holmström's Grading of Postoperative Astigmatism at 6<sup>th</sup> Week**



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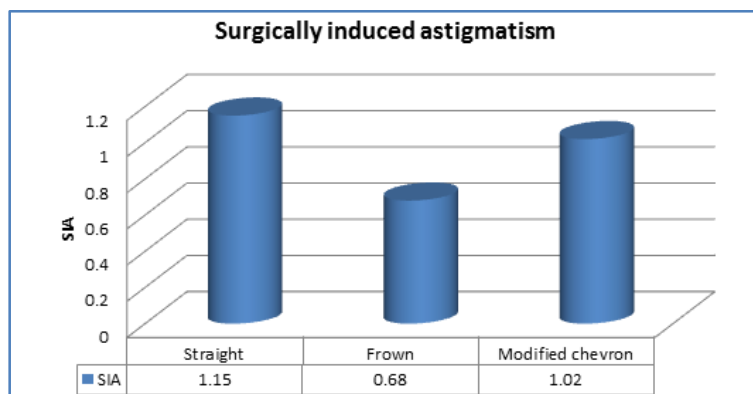
Sl. No	Incision	No astg.	WTR			ATR			Oblique		
			Non-sig	Sig	High Sig	Non-sig	Sig	High Sig	Non-sig	Sig	High Sig
1.	Straight (55)	2 (3.6%)	1 (1.8%)	2 (3.6%)	4 (7.4%)	3 (5.4%)	12 (21.8%)	18 (32.7%)	2 (3.6%)	4 (7.4%)	7 (12.7%)
2.	Frown (27)	4 (14.8%)	3 (11.1%)	1 (3.7%)	2 (7.4%)	6 (22.2%)	3 (11.1%)	3 (11.1%)	3 (11.1%)	2 (7.4%)	0 (0%)
3.	Mod.Ch (63)	8 (12.6%)	4 (6.3%)	8 (12.6%)	3 (4.8%)	5 (7.9%)	11 (17.5%)	17 (27.0%)	2 (3.2%)	2 (3.2%)	3 (4.8%)
<b>Total</b>		<b>14 (9.7%)</b>	<b>8 (5.5%)</b>	<b>11 (7.6%)</b>	<b>9 (6.2%)</b>	<b>14 (9.7%)</b>	<b>26 (17.9%)</b>	<b>38 (26.2%)</b>	<b>7 (4.8%)</b>	<b>8 (5.5%)</b>	<b>10 (6.9%)</b>

Table 8: Postoperative Astigmatism with Their Types at 6<sup>th</sup> Week



Sl. No.	Incision	SIA
1.	Straight	1.15 D
2.	Frown	0.68 D
3.	Modified chevron	1.02 D

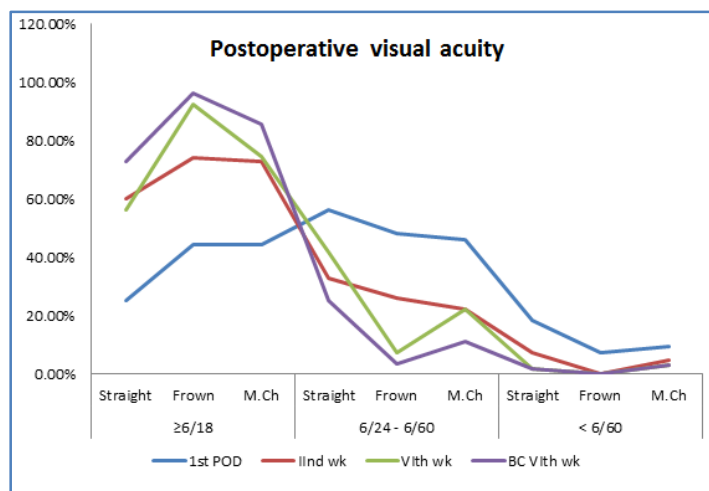
Table 9: Surgically Induced Astigmatism with Reference to Incision at 6<sup>th</sup> Week



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Sl. No.	VA	≥6/18				6/24 - 6/60				< 6/60			
		Straight	Frown	M.Ch	T	Straight	Frown	M.Ch	T	Straight	Frown	M.Ch	T
1.	Ist POD	14 (25.4%)	12 (44.4%)	28 (44.4%)	54 (37.2%)	31 (56.4%)	13 (48.1%)	29 (46%)	73 (50.4%)	10 (18.2%)	2 (7.4%)	6 (9.5%)	18 (12.4%)
2.	IIInd wk	33 (60%)	20 (74.1%)	46 (73%)	99 (68.3%)	18 (32.7%)	7 (25.9%)	14 (22.2%)	39 (26.9%)	4 (7.3%)	0	3 (4.8%)	7 (4.8%)
3.	VIth wk	31 (56.4%)	25 (92.6%)	47 (74.6%)	103 (71%)	23 (41.8%)	2 (7.4%)	14 (22.2%)	39 (26.9%)	1 (1.8%)	0	2 (3.2%)	3 (2.1%)
4.	BC VIth wk	40 (72.7%)	26 (96.3%)	54 (85.7%)	120 (82.7%)	14 (25.4%)	1 (3.7%)	7 (11.1%)	22 (15.2%)	1 (1.8%)	0	2 (3.2%)	3 (2.1%)

**Table 10: Postoperative Visual Acuity**



**DISCUSSION:** This study was done to evaluate the various aspects of manual small incision cataract surgery with reference to various types<sup>8</sup> of incision (Straight, Frown and Modified chevron)

Outcome of study was evaluated with reference to, surgically induced astigmatism and visual outcome.

- Straight incision group had highly significant ATR astig. in 32.7% cases. Frown incision group had 11.1% highly significant ATR astig. Modified chevron group developed 27.0% highly significant ATR astig. Highly significant oblique astigmatism was seen in 6.9% cases.
- In our study we observed that the mean SIA was 1.01 D.
- Mean SIA of Frown incision group was 0.68 D. mean SIA of Modified chevron incision group was 1.02 D and Straight incision group's mean SIA was 1.15 D.
- Best corrected V/A ≥6/18 was achieved in 96.3% cases of frown 85.7% Modified chevron incision group and 72.7%. In Straight incision group.

**CONCLUSION:** In our study we observed that Frown incision was the best<sup>12</sup> of all incision types because of -

- Lesser SIA.
- Better visual outcome.



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**Our findings are consistent with the following studies:** Gross and Miller et al (1981)<sup>13</sup> reported mean surgically induced astigmatism of 1.19 D with incision size 6.5 mm or less. Singer et al (1972) reported mean surgically induced astigmatism of 1.9 D with incision size 7 mm or more. Our observation coincides with the above studies.

Masket et al (1985) observed in 2 series operated with scleral pocket incisions of 5.5 mm and 7.0 mm length respectively that the average induced astigmatism during the first post op. week was approx. 1.5D in both groups. By 6 weeks it was reduced to about 0.5D only and at 4 months it was approx. 0.2 D.

Akura et al (2000)<sup>14</sup> concluded that bent frown incision effectively achieved astigmatic neutral post-operative condition. The incisions on the temporal or superior steep astigmatism axis reduced astigmatism in all cases.

Merriam et al (2001)<sup>15</sup> in a study on horizontal and vertical meridians of the cornea after manual SICS concluded that with 6 mm superior scleral tunnel incision the corneal meridians stabilized at average 1.2 months.

Nagpal et al (2000)<sup>16</sup> concluded that ATR astigmatism was more desirable than WTR astigmatism as it provided good near vision with acceptable distance vision.

We observed that, frown incision since placed in Astigmatic Neutral zone and prevents less sagging of wound and hence less postoperative ATR astig. Straight incision however has got the disadvantage of not being within the Astigmatic Neutral zone and also has got postoperative sagging of wound and thus results in more postoperative astigmatism. This can be improved upon with the help of Reverse side pockets in the form of Modified chevron incision; reverse side pockets prevent sagging of wound to considerable extent hence can be helpful in reducing postoperative Astigmatism.

A Watson<sup>17</sup> et al (1992) observed that uncorrected V/A was 6/9 or better in 25% of eyes on 1<sup>st</sup> day itself in SICS. Nikeghbali et al (1994) reported 49% of eyes with VA 6/12 or better after 1 week.

Javitt JC<sup>18</sup> et al (1993) reported that variability in the refractive state of the eye is a normal post op. finding as wound healing occurs. Refractive error usually stabilizes within 6 weeks after surgery and optical correction can be prescribed at that time. They also observed that refractive stability is achieved more rapidly after SICS.

Scipser et al (1991) reported 84% cases that achieved V. A. 6/12 or better at 4 weeks after surgery.

Outsalio<sup>18</sup> et al (1993) reported 70% cases of SICS V. A. of 6/12 or better on 1<sup>st</sup> post op. day which improved to 88% till 8<sup>th</sup> post op. week.

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