·Clinical Research·

Comparison of surgically induced astigmatism in various incisions in manual small incision cataract surgery

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Abstract

• AIM: To determine the surgically induced astigmatism (SIA) in Straight, Frown and Inverted V shape (Chevron) incisions in manual small incision cataract surgery (SICS).

• METHODS: A prospective cross sectional study was done on a total of 75 patients aged 40y and above with senile cataract. The patients were randomly divided into three groups (25 each). Each group received a particular type of incision (Straight, Frown or Inverted V shape incisions). Manual SICS with intraocular lens (IOL) implantation was performed. The patients were compared 4wk post operatively for uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA) and SIA. All calculations were performed using the SIA calculator version 2.1, a free software program. The study was analyzed using SPSS version 15.0 statistical analysis software.

• RESULTS: The study found that 89.5% of patients in Straight incision group, 94.2% in Frown incision group and 95.7% in Inverted V group attained BCVA post-operatively in the range of 6/6 to 6/18. Mean SIA was minimum (-0.88 ±0.61D ×90 degrees) with Inverted V incision which was statistically significant.

• CONCLUSION: Inverted V (Chevron) incision gives minimal SIA.

• KEYWORDS: manual small incision cataract surgery; incisions; surgically induced astigmatism
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INTRODUCTION

With the advent of phacoemulsification, cataract surgery has been reduced to a day care surgery. But due to economic reasons, phacoemulsification is limited to big cities & institutions only. Non-phaco or manual small incision cataract surgery (SICS) by virtue of its self sealing suture-less incision appears as a ray of hope for tackling the cataract burden in developing countries [1-4]. Lower cost of instrumentation and disposables in manual SICS is an added advantage [5,6]. It is also better suited for advanced and mature cataracts seen in developing countries[7]. However, one African study has recommended inclusion of phacoemulsification for their vision 2020 program[8].

A variety of scleral incisions are being used in manual SICS, with the aim of keeping the post operative astigmatism to a minimum[9]. All scleral pocket incisions share the advantages of intra & post-operative stability which include early healing, faster visual restoration & superior astigmatism control. Some previous studies have analyzed the best site for incision and the surgically induced astigmatism (SIA)[10-14].

Few studies in Manual SICS have compared SIA between two types of scleral incision [15,16]. Our study offers a comparative analysis of SIA induced by 3 different incisions in manual SICS. The current study was done with an aim to compare the induced astigmatism with 3 different incisions (Straight, Frown and Inverted V 'Chevron' Incisions) in Manual SICS at 4wk postoperatively.

SUBJECTS AND METHODS

It was a prospective cross sectional study, enrolling 75 patients aged 40y and above with uncomplicated senile cataract till grade 4 nuclear sclerosis. The study was done in accordance to the tenets of the Declaration of Helsinki. The study was approved by the Scientific Research Committee and Institutional Ethics Committee of Vivekananda Polyclinic and Institute of Medical Sciences Lucknow. Informed consent was obtained from all the study participants. Patients with any other concurrent eye disease and keratometric astigmatism >1.5 D were not included in the study. The standard clinical examination was carried out including visual acuity testing with Snellen chart, lacrimal sac syringing, applanation tonometry, slit lamp examination and fundoscopy. Manual Keratometry (Bausch & Lomb) was performed before surgery and at 4wk after surgery. Intraocular lens (IOL) power was calculated using SRK II

formula with the Sonomed A scan. Patients were randomly divided into groups S, F and V and were given Straight, Frown and Inverted V 'Chevron' incision respectively.

Surgical Procedure On the day of surgery, pupil was dilated with 0.8% tropicamide and 5% phenylephrine drops. Ketorolac 0.4% eye drops were instilled twice to maintain intra-operative mydriasis. The surgery was performed under peribulbar anesthesia. All the surgeries were performed by one surgeon. After making fornix based conjunctival flap, in group S a 6 mm Straight incision was made 2 mm away from superior limbus, in group F a 6 mm Frown incision was made, the centre of the frown being 1.5 mm and periphery 4 mm from the superior limbus. In group V an Inverted V incision was made with apex of incision being 1.5 mm from superior limbus and ends of 2 limbs being 4 mm from superior limbus. The distance between two ends of the limbs was 5 mm. A sterile disposable, 2.8 mm crescent blade was used to create a self sealing scleral corneal tunnel, extending into the clear cornea for 1 mm. A 3.2 mm keratome was used to enter the anterior chamber through the tunnel incision. Continuous curvilinear capsulorrhexis was done using a 26 G cystitome through the main tunnel under viscoelastic cover. The internal wound was now enlarged to 8-10 mm length approximately which is sufficient to accommodate larger nucleus as well. None of the incisions were enlarged per-operatively. Hydro dissection and delineation was performed. The prolapsed nucleus was engaged in the scleral tunnel and was delivered out using irrigating vectis. A single piece PMMA IOL was implanted in the capsular bag and dialed. Self sealing wound was left suture less after checking for any wound leakage.

Patients were examined on 1, 7d; 4, 6 and 12wk postoperatively. Prednisolone acetate 1% eye drops were instilled 8 times a day & Gatifloxacin eye drops 0.3% were instilled four times daily postoperatively. Mydriatic and anti-glaucoma medications were also given as and when required. Prednisolone was tapered over 6wk. Drugs were continued till 6wk. Uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA) and slit lamp findings were recorded at each visit. Keratometry was repeated at 4th wk postoperatively. Data was analyzed statistically using SPSS version 15.0 statistical analysis software. The study was analyzed using the SIA Calculator version 2.1, a free software program.

RESULTS

This study was done on 75 patients divided equally in 3 groups, each group receiving a different incision in manual SICS. There were almost equal percentage of males 49.33% (37) and females 50.67% (38). Mean age of patients was 56.57 ±7.99y (42-75y). Maximum patients (59.3%) had against the rule astigmatism preoperatively. For the purpose of statistical analysis visual acuity has been quantified using the following gradation scale (Table 1).

Table 1 Quantification of visual acuity

Grade	Visual acuity
0	Visual acuity <1/60 to PL+
1	Less than 3/60 to 1/60
2	Less than 6/60 to 3/60
3	Less than 6/18 to 6/60
4	6/6 to 6/18

From visit I to visit III, there is an increase in UCVA in all groups but maximum increase is observed in group V which is probably due to lesser amount of induced astigmatism but the difference among groups at both the time intervals is not statistically significant (P>0.05; Table 2).

There is an increase in BCVA in all the incision groups but no significant intergroup difference was observed for any of the follow-up visits (P>0.05; Table 3).

In the present study, 89.50% of patients in straight incision group, 94.7% in frown incision group and 95.20% in inverted V group respectively have BCVA of at least 6/18 or better at 4wk postoperatively. Only 6.86% (4) patients had BCVA less than 6/18 which was attributed to macular edema in one patient, drusens at macula in 1 patient, vitreous in anterior chamber in one patient and thick fibrinous membrane over the IOL in one patient.

A significant intergroup difference was observed in mean SIA. 33.3% of patients in group V did not have any induced astigmatism and none had induced astigmatism >2 D. The mean SIA value was greatest in group S and minimum in group V (Table 4).

Multiple comparisons revealed that both groups S and F had significantly higher mean SIA as compared to group V which was also statistically significant (P <0.05). However, no significant difference was observed between group S and group F (P=0.620; Table 5).

DISCUSSION

It is reported from previous studies that patients undergoing Manual SICS have an early visual rehabilitation [2,3,17]. The quick visual restoration is attributed to little inflammation and less SIA. Patients also have fewer complaints regarding ocular discomfort in terms of pain, foreign body sensation and redness. Zawar and Gogate [1] in their study on 2000 eyes undergoing manual SICS found that 93.4% of eyes achieved a final BCVA better than 6/12 at 6wk postoperatively. Rohatgi *et al*[15], found 93.3% of patients had BCVA of 6/18 or better at 8wk after SICS with central frown incision.

In our study 33.3% of the eyes in group V did not have any postoperative astigmatic error. Induced astigmatism up to 1 D was seen in major proportion of eyes (47.6%) in group V. This finding is well supported by the study of Randeri *et al*[16] in 2008 concluding that 57.14% of patients showed

Table 2 Comparison of UCVA among different incision groups at various post-operative follow-up visits

SN	Postop. visit	Group S (straight incision)			Group F (frown incision)			Group V (inverted V incision)			Significance of difference (Kruskall-Wallis test)	
		n	Mean	SD	*n*	Mean	SD	*n*	Mean	SD	Chi-square	*P*
1	I	25	2.40	1.15	25	2.64	1.04	25	2.72	1.02	1.346	0.510
2	II	19	2.79	1.32	20	3.35	0.49	23	3.43	0.51	2.991	0.224
3	III	19	3.26	1.24	19	3.58	0.51	21	3.76	0.44	2.236	0.327
4	IV	6	3.33	0.52	12	3.67	0.49	11	3.73	0.47	2.648	0.266
5	V	1	4.00	-	1	4.00	-	4	3.75	0.50	-	-

SN: Serial number.

Table 3 Comparison of BCVA among different incision groups at various post-operative follow-up visits

SN	Postop. visit	Group S (straight)			Group F (frown)			Group V (inverted V)			Significance of difference (Kruskall-Wallis test)	
		n	Mean	SD	*n*	Mean	SD	*n*	Mean	SD	Chi-square	*P*
1	I	25	2.48	1.23	25	2.92	0.86	25	2.88	1.09	2.609	0.271
2	II	19	3.37	1.50	20	3.95	0.23	23	3.96	0.21	2.379	0.304
3	III	19	3.53	1.26	19	3.95	0.23	21	3.90	0.30	1.321	0.517
4	IV	6	4.00	0.00	12	4.00	0.00	11	3.91	0.30	1.545	0.462
5	V	1	4.00	-	1	4.00	-	4	4.00	-	-	-

SN: Serial number.

Table 4 Mean SIA in different incision groups at 4wk postoperatively

SN	Astigmatism (D)	[1]Group S (*n*=18)		Group F (*n*=19)		Group V (*n*=21)	
		No.	%	No.	%	No.	%
1	Nil	3	16.7	1	5.3	7	33.3
2	0-1	5	27.8	11	57.9	10	47.6
3	1.25-2	9	50.0	6	31.6	4	19.0
4	>2	1	5.6	1	5.3	0	0
[2]Mean±SD		-1.08±0.67×90 degrees		-0.96±0.71×89 degrees		-0.88±0.61×90 degrees	

SN: Serial number. [1]In one patient in group S assessment of astigmatism could not be made owing to presence of thick membrane on the IOL; [2]Mean value is calculated only for those cases in whom induced astigmatism was observed. z=6.465; *P*=0.039 (Kruskall Wallis test used; comparison of grades).

Table 5 Multiple comparisons of induced astigmatism in three incision groups (comparison of different grades, Mann-Whitney *U* test)

Comparison	Z	*P*
Straight incision group S *vs* Frown incision group F	0.543	0.620
Straight incision group S *vs* Inverted V incision group V	2.195	0.028
Frown incision group F *vs* Inverted V incision group V	2.108	0.035

astigmatism of less than 1 D in Chevron incision group. They have attributed this to the triangular configuration of Chevron incision which is geometrically more stable thereby causing minimal sliding of the tips of the incision.

In the present study, in frown incision group, maximum patients (57.9%) showed induced astigmatism of less than 1 D. Another study with central frown incision has reported induced astigmatism of less than 1 D in only 28.57% patients, with maximum patients (42.85%) had SIA between 1.25-2 D[16]. In manual SICS by 6 mm straight incision, Jha and Vats[18], report 85.5% of patients with astigmatism up to 1 D, with only 8.7% cases having astigmatism more than 2 D. However in our study the straight incision group shows only 27.8% patients with astigmatism up to 1 D with 50% patients having astigmatism between 1.25 to 2 D.

The mean SIA in Straight, Frown and Chevron incision was found to be -1.08±0.67 D, -0.96±0.71 D and -0.88±0.61 D respectively at four weeks postoperatively in our study. Another study in 2011 with 6 mm straight temporal sclero-corneal incision has reported mean SIA of 1.35±0.49 D four weeks post-operatively [19]. Gokhale and Sawhney [10] have found mean astigmatism in manual SICS with superior frown incision to be 1.28 D at 29 degrees. Minimum SIA with Chevron incision in our study is supported by previous studies of Rohatgi *et al* [15] and Randeri *et al* [16]. Also a comparative study between 5 mm and 7 mm Chevron incision did not find any statistical difference in mean SIA[20].

An inter group comparison in our study observed minimal SIA (-0.88±0.61 D) in the Chevron incision group while maximum SIA (-1.08±0.67 D) was seen in straight incision

group which was statistically significant (P<0.05).

To the best of our knowledge this is the first study which compares the SIA in 3 types of incision in manual SICS. The authors conclude that Chevron incision gives minimum SIA in manual SICS.

Limitations of this study include the small sample size and lack of long term follow up. The steep learning curve associated with Chevron incision has been the major factor for it not being universally accepted. At the moment, the ease of learning and performing frown incision with relatively low SIA has made it a popular choice among ophthalmic surgeons.

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