ISSN No:-2456-2165

Astigmatic Change in Manual Small Incision Cataract Surgery (MSICS) with Chevron Type of Incision

Dr.Sujit Kumar Biswas, Dr. Quamrul Islam, Dr. Rajib Husain, Dr. Suborna Sultana, Dr. Nahid Anjum.

Dr. Sujit Kumar Biswas
MBBS, DCO, FCPS, FICO, MRCS (Glasgow), MRCS (Edinburgh).
Consultant
Chittagong Eye Infirmary and Training Complex,
Zakir Hossain Road, Chittagong, Bangladesh

Abstract:-
Aim: To evaluate the astigmatic change after Manual Small Incision Cataract Surgery with chevron type of incision.

Design: A prospective interventional study.

Materials & Methods: A total 100 cases were selected who underwent manual small incision cataract surgery with chevron incision for that one year period irrespective of gender. This study was done in cataract clinic at Chittagong Eye Infirmary and Training Complex. Related all pre- and postoperative data were recorded according to the protocol of the hospital. All surgeries were done under peribulbar anesthesia. A "V" shaped chevron partial thickness sclera incision was done on the superior quadrant of every patient by a keratome. Pocket tunnel is dissected with a crescent knife. All other steps of were done like standard small incision cataract surgery. All intraocular lenses (IOLs) were implanted in capsular bag. Post operatively patients were treated with topical corticosteroid six times daily approximately four weeks then tapered, topical antibiotic four times daily for one week and topical cycloplegic once daily for two weeks. All patients were followed up on 1st postoperative day, 7th postoperative day and after one month.

Results: Mean ages of these patients were 59.66 ± 10.81 years (ranged 30-70 years). Here we found that Chevron Incision is relatively more stable in ATR astigmatism group than WTR astigmatism (63.04% and 72.71% respectively). But in NO astigmatism group it gives opposite results, that that was changed to WTR astigmatism more than ATR astigmatism (60% and 40% respectively). A significant change occurred between pre- and post-operative astigmatism in different groups (p-0.001). Sixty nine percent (69%) gain Complete success i.e, incision induced astigmatism was up to 0.50 D, 27% were in Qualified success and only 4% were failed. Post operative final visual outcome of this study group is excellent, 98% achieved BCVS equal or better than 6/18. No patient showed significant post operative complication. Tunnel construction was the most difficult step in this type of incision through the sclera.

Conclusion: This prospective study showed chevron incision causes a significant change in astigmatism postoperatively. Although magnitude of surgically induced astigmatism was significant, outcome of chevron incision in term of final postoperative vision is excellent. Tunnel construction was somewhat difficult. We have to compare with other type of incision to assess the efficacy of Chevron incision.

Keywords:- *Chevron incision, manual small incision cataract surgery (MSICS), with the rule astigmatism (WTR), against the rue astigmatism (ATR).*

I. INTRODUCTION

Modern cataract surgery aims to achieve a better unaided visual acuity with rapid post surgical recovery, minimal surgery related complications and less surgically induced astigmatism. Postoperative astigmatism plays an important role in the evaluation of final outcome of surgery.[1] The basis of manual small incision cataract surgery are the tunnel construction, the location of the wound on the sclera with respect to the limbus and the shape of the wound.[2,3,4] Geometric shape of the external incision affects surgically induced astigmatism significantly.[5] There are different types of incision for tunnel construction such as smile, straight, frown, Blumenthal side cuts and chevron incision[3]. Chevron incision involves giving a "inverted V" shaped incision with an angle of approximately 120 degree (100-120 degree) between the two arms and the apex about 1.5 mm from the limbus [2-5] [Fig1-7]. In literature review, [5] it has been found that a chevron incision is best amongst all the incisions for Manual Small Incision Cataract Surgery (MICS). The main advantage of chevron incision is that it is very stable and gives excellent reduction in surgically induced astigmatism over other incision even in hard brown cataract.[5] In the present study, we were trying to find out the astigmatic change, outcome and complication of Manual Small Incision Cataract Surgery (MSICS) with Chevron type of incision.

II. MATERIAL AND METHODS

This prospective study was done at Chittagong Eye Infirmary and Training Complex (CEITC), from 01.11.2013 to 31.10.2014 (1 year). A total 100 cases were selected for surgery. All surgeries were done by the one qualified ophthalmologists of the cataract clinic of CEITC. Inclusion criteria were senile age related cataract with 'with the rule astigmatism', 'against the rule astigmatism', and 'no astigmatism'. Complicated cataract, traumatic cataract, secondary cataract, hypermature cataract with phacodonesis,

ISSN No:-2456-2165

subluxated lens, cataract with corneal opacities, cataract with abnormal pupil, posterior segment disease like vitreous opacity, macular diseases, optic nerve diseases, glaucoma or any other retinopathy causing functional impairment of vision were excluded from this study. Related all pre- and postoperative data were recorded according to the protocol of the hospital.

Every patient surgery was done under peribulbar anesthesia. An inverted "V" shaped Chevron partial thickness sclera incision was done on the superior quadrant of every patient by a keratome, the apex which lies one millimeter from the limbus. . The pocket tunnel was dissected with a metal crescent disposable knife. All other steps of were done like standard small incision cataract surgery. All intraocular lens (IOL) were implanted in capsular bag. Post operatively patients were treated with topical corticosteroid six times daily approximately four weeks then tapered, topical antibiotic four times daily for one week and topical cycloplegic once daily for two weeks. Doses and duration of topical corticosteroid was increased according to postoperative inflammation. All patients were followed up on 1st postoperative day, 7th postoperative day and after one month.

Visual acuity was assessed using Snellen's charts in each follow up and the need for further surgical procedures assessed. Refraction and keratometry was done at final follow-up to detect post operative astigmatism. Any complication or any intervention during operation was also noted.

Post-operative astigmatism was expressed as the power of the cylinder lens needed for best correction. All cylindrical lens power pre-and postoperatively was converted into minus and categorized as "acceptable astigmatism" (0 to ≤ 0.50 DCyl), "moderate astigmatism" (> 0.50 to ≤ 1.50 DCyl) and "large astigmatism" (>1.50 DCyl). Although there are no clear definitions for acceptable, moderate and large astigmatism in the literature, but in this study, acceptable astigmatism will be defined as 0 to 0.50 DCyl, assuming that this range would not hamper the patient's vision.[5]

Internationally accepted post-operative corneal astigmatism is 0.50D [5,11]. So, complete success was defined as post operatively astigmatic change 0 diopter to - 0.50 diopters cylinder; qualified success as an astigmatic changes - 0.50 to - 1.50 diopters cylinder and failure as an astigmatic changes more than - 1.50 diopters cylinder

Statistical analysis relevant data were done by using SPSS16 software. A statistically significant difference was being assumed for *'p'*- values lower than 0.05.

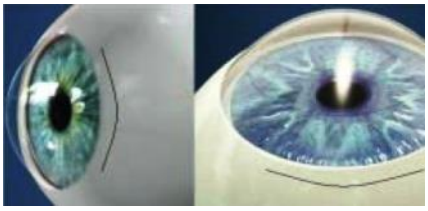

Fig. 1: Smile incision[3]

Fig. 2: Straight incision[3]

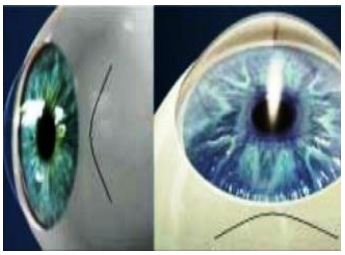

Fig. 3: Frown incision[3]

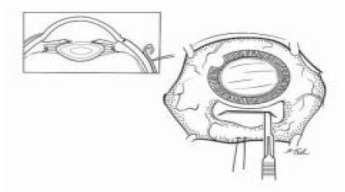

Fig. 4: Blumenthal side cuts[3]

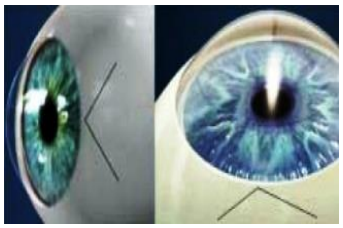

Fig. 5: Chevron 'V' incision[3]

Fig. 6: Postoperative view of operated eye before conjunctival apposition with Chevron incision.

Fig. 7: Postoperative view of operated eye after conjunctival apposition with Chevron incision.

ISSN No:-2456-2165

III. RESULTS

Mean ages of these patients were 59.66 ± 10.81 years (ranged 30-70 years). The most of the patients belonged to older age groups, particularly in 50-59 and 60-69 years.

Fifty percent (n-50) patients were presented with different systemic diseases. Hypertension was the most common, found in 26% (n-26) of patients as only hypertension and rest 42% (n-42) patients have hypertension associated with other systemic diseases.

In the study group preoperative WTR astigmatism was 46% (n-46), ATR was 44% (n-44) and NO was 10% (n-10), where as postoperative WTR astigmatism was 46% (n-46), ATR became 52% (n-52) that was increased and NO reduced to 2% (n-2) [Fig 08].

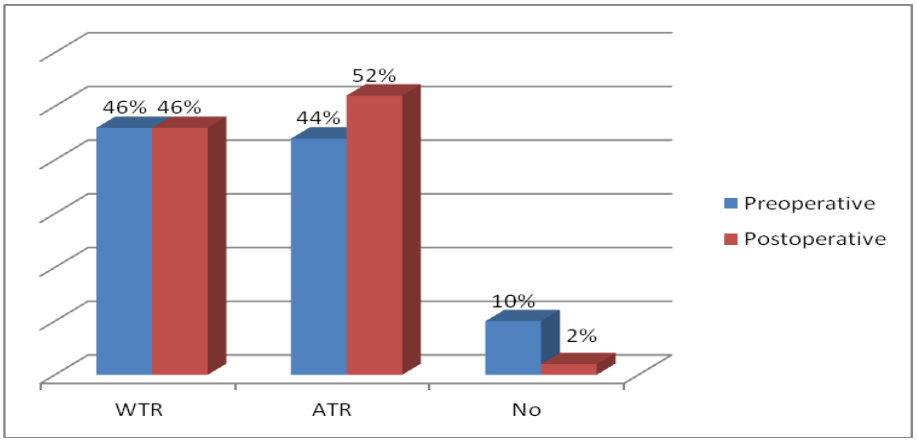

Fig. 8: Comparison between pre- and postoperative astigmatism

Preoperative Astigmatism	Post-operative Astigmatism			
	WTR n (%)	ATR n (%)	NO n (%)	Total n (%)
WTR	29.0 (63.04%)	16.0 (34.28%)	1.00 (2.17%)	46
ATR	11.0 (25.0%)	32.0 (72.71%)	1.00 (2.27%)	44
NO	6.0 (60.0%)	4.0 (40.0%)	0.00 (0.0%)	10
Total	46.0 (%)	52.0 (%)	2.0 (%)	100
(x^2=14.31; Cramers's V= 0.267; df= 4; sig; p=0.006 (p< 0.05)				

Table 01 Distribution of Pre- and Post Operative Rule Astigmatism

Note: WTR- With the rule astigmatism, ATR- Against the rule astigmatism, NO- No astigmatism.

The differences among the pre- and post-operative astigmatic changes are statistically significant at < 0.05 level (x^2=14.31; Cramers's V= 0.267; df= 4; sig; *p*=0.006 (*p*< 0.05). Among the WTR astigmatism, 63% (n=29) of this group remains at the same group and about 34% (n=16) turn to ATR astigmatism and only 2% (n= 1) had diminished astigmatism after surgery. About 44 cases of pre-operative ATR astigmatism, post-operatively more than 72% (n=32) was remain at the same group while only 25% (n=11) turned over to the group of WTR astigmatism and only 2% (n=1) move in the group of no astigmatism. About 10% cases was present preoperatively at the group of "no astigmatism" and dramatically all of them distributed between WTR astigmatism (60%, n=6) and ATR astigmatism (40%, n=4) group in post-operative cases. [Table 01]. In this study it is observed that Chevron Incision is relatively more stable in ATR astigmatism group than WTR astigmatism (72.71% vs 63.04%), that means Chevron incision causes flattening of vertical meridian more in ATR astigmatism group. Conversely No astigmatism group changed into WTR astigmatism relatively more than ATR astigmatism (60% vs 40%), that means this incision causes steepening of vertical meridian more in NO astigmatism group. So it is concluded that in each group postoperatively astigmatic change occurred significantly (*p*=0.006).

The post-operative changes of astigmatism shows difference about the distribution of the pre-operative cases. Among the 100 cases, 61 cases had acceptable astigmatism (0 to ≤ 0.50 D), and postoperatively 42 cases (69%) remained at same categorized group whereas 18 cases (29%) moved to the group of moderate (>0.50 to ≤1.50 D) astigmatism group and only 01 case (2%) moved to the group of large (>1.50D) astigmatism group. About 35 cases were in the group of moderate (>0.50 to ≤1.50 D) astigmatism and in the post operative cases 60% (n=21) remained at the same group while the other 29% (n=10) of cases jumped over to the group of acceptable (0 to ≤ 0.50 D) astigmatism group and 11% (n=11) of cases moved to the group of large (>1.50 D) astigmatism. Moreover only 4 pre-operative cases of large (>1.50D) astigmatism, 25% (n=1) remained at the same group whereas 50% (n=2) moved to the group of moderate (>0.50 to ≤1.50 D) astigmatism and 25% (n=1) moved to the group of acceptable (0 to ≤ 0.50 D) astigmatism [Table 02]. In this study, majority of the patients of acceptable and moderate astigmatism group

remained in the same group post-operatively (68% and 60% respectively), whereas in large astigmatism group it was 25%. 50% of large astigmatism group changed into moderate astigmatism group and remaining 25% into acceptable group.

Pre-operative Astigmatism	Post-operative Astigmatism			
	(0- ≤ 0.50) D n (%)	(>0.50 - ≤1.50)D n (%)	>1.50 D n (%)	Total n
(0 to ≤ 0.50) D Acceptable astigmatism	42 (68.82%)	18 (29.50%)	01 (1.64%)	61
(>0.50 to ≤1.50)D Moderate astigmatism	10 (28.57%)	21 (60.0%)	04 (11.43%)	35
>1.50D Large astigmatism	01 (25.0%)	02 (50.0%)	01 (25.0%)	04
TOTAL	53 (%)	41 (%)	6 (%)	100 (%)

Table 02 Distribution of Pre and Post Operative magnitude of Astigmatism.

In comparison between the acceptable, moderate and large groups of astigmatism there are statistically significant change observed between the pre-operative and post-operative status of the cases (p= 0.001). In the group of "Acceptable" astigmatism the pre-operative cases were 61% where as in the post-operative cases percentage was decreased and became 53%. Moreover, at the group of "Moderate" group, the number increased from 35% to 41% and the increasing tendency was same for the "Large" where post-operative cases were increased from 4% to 6%. [Table 03]. In this study it is clear that Chevron incision induce a significance change in post-operative astigmatism.

Astigmatism Diopter	Preoperative		Postoperative		*'p'- value*
	N	%	N	%	
0 to ≤ 0.50 Acceptable astigmatism	61	61%	53	53%	*0.001 (<0.05)*
> 0.50 to ≤ 1.50 Moderate astigmatism	35	35%	41	41%	
> 150 Large astigmatism	4	4%	6	6%	
TOTAL	100	100%	100	100%	

Table 03 Comparison of pre- and post-operative astigmatic change

Pre-operative mean astigmatism was 0.478 ± 0.4647 and post-operative astigmatism was 0.587 ± 0.4788. After statistical analysis of 2-tailed t- test, the change of astigmatism was significantly different between pre- and post-operative astigmatism. The change of astigmatism was also significantly correlated (p= 0.000, Pearson correlation-0.466) between the pre and post operative astigmatism of the patients. [Table 04]

Astigmatism	Mean ± SD	*'p' - value*
Pre-operative	0.478 ± 0.4647	*0.028*
Post-operative	0.587 ± 0.4788	

Table 4: Pre- and postoperative mean astigmatism

In this study, majority of the patients (69%) gain Complete success i,e. incision induced astigmatism was up to 0.50 D, 27% were in Qualified success and only 4% were failed. (Table 05)

Operational definition	Induced Astigmatism	Frequency	Percentage
Complete success	0 to ≤ 0.50 D	69	69%
Qualified success	> 0.50 to ≤ 1.50 D	27	27%
Failed	> 150 D	04	04%
TOTAL		100	100%

Table 5: Incision induced post-operative astigmatism.

Final post operative visual outcome of this study group was excellent. Dramatic improvement of BCVS of Good category and rapid reduction of Borderline category were observed from first post –operative day to one month follow-up (67% to 98% and 32% to 1% respectively) where as Poor category was same. At final follow up (after 1 month post-operatively) 98% patients achieved BCVS equal or better than 6/18, 1% (n=1) achieved borderline BCVS due to post operative large astigmatism (-2.00 Dcyl ATR) and another 1% (n=1) felt in poor outcome due to macular scar. [Table 06].

ISSN No:-2456-2165

VA (BCVS)	1st POD	7th POD	1month POD	WHO standard
6/6 to 6/18 (Good)	67%	73%	98%	>80%
6/24 to 6/60 (Borderline)	32%	26%	1%	<15%
< 6/60 (Poor)	1%	1%	1%	<5%
TOTAL	100%	100%	100%	100%

Table 6: Post operative visual acuity

Note: VA- Visual acuity, BCVS-Best corrected visual acuity.

No patient showed significant post operative complication. Intra operatively premature entry occurred in 3 patients and intra operatively suturing was done with 10-0 nylon suture and among them one patient developed hyphema and evacuation of blood clot done on the first POD. These 3 patients were achieved good visual outcome (6/9) finally. One patient had posterior capsular rent and fortunately there was no vitreous loss and finally achieved good visual outcome (6/9). Ninety six percent (96%) showed uneventful surgery.

IV. DISCUSSION

Cataract surgery has changed tremendously in recent years mainly to fulfill the expectation of the patients that is early visual rehabilitation and minimal induced astigmatism. Small incision manual cataract surgery is an effective alternative to phacoemulsification in countries where very high volume surgery with inexpensive instrumentation is required. Wound construction plays a major role in MSICS. Reduction in the amount of surgery induced astigmatism are now obtainable with newer techniques in the wound construction.

Different types of incision for tunnel construction in Manual Small Incision Cataract Surgery (MSICS) are Smile, Straight, Frown, Blumenthal side cuts and Chevron incision.[6] Smile incision is easy to make, but results in increased astigmatism Smile incision is a curvilinear incision which runs parallel to the limbus. With this incision, there is an increased chance of corneal flattening after surgery in the vertical meridian with increased induced astigmatism [Fig.01]. Straight incision as the name suggests, is a straight line incision about 2 mm away from the limbus. This incision induces moderate flattening and consequently moderate astigmatism after surgery [Fig.02]. Frown incision is difficult to make for a beginner. The base of the curve is about 2 mm from the limbus. This induces minimal astigmatism [Fig.03]. Blumenthal side cuts involve straight incision with oblique cuts placed at its either ends. This increases the space in the tunnel for an easy delivery of the nucleus [Fig.04]. Chevron 'V' incision involves giving an "inverted V" shaped incision with an angle of approximately 120 degree between the two arms and the apex about 1.5 mm from the limbus. [Fig. 05] This incision is quite difficult to make. The tunnel size in this incision is relatively smaller. This incision has least/nil induced astigmatism. [6]

All these incisions induce less astigmatism if placed more posteriorly on the sclera.[3] Burgansky et al. have shown an increase in astigmatism with an increase in the incision size.[7] More the distance from the limbus (on sclera), less is the induced astigmatism although tunnel making and maneuverability are difficult. The ideal distance is around 1–2 mm.[3] Kimura et al. have shown that surgically induced astigmatism is less with an oblique incision (Frown and Chevron) than with a straight incision.[8]

The aim of the study was to assess the surgery induced post-operative astigmatism in patients undergoing MSICS with Chevron incision with rigid IOL implantation. Our study included 100 patients adhering to the inclusion and exclusion criteria who underwent MSICS with Chevron incision with rigid IOL implantation by a same surgeon over a span of one year. Study patients were divided into 3 groups WTR astigmatism, ATR astigmatism and NO astigmatism.

The most of the patients belonged to older age groups, particularly in 50-69 years age groups (68%). Mean age of these patients were 59.66 ± 10.81 years. There is no correlation between the pre-operative age or sex of cases in study groups which will influence the final outcome of the surgery with the type of incision used.

In our study we try to find out the relationship between the preoperative astigmatism and postoperative astigmatism with Chevron type of incision and we also tried to analyze magnitude of induced astigmatism with this type of incision.

In this study we found that in WTR and ATR astigmatism groups, a significant percentage of patients (63.04% and 72.71% respectively) remain in the same group where as a least percentage (2.17% and 2.27% respectively) fall in the NO astigmatism group postoperatively. In this study it is observed that Chevron Incision is relatively more stable in ATR astigmatism group than WTR astigmatism (72.71% vs 63.04%), that means Chevron incision in patients with ATR astigmatism causes flattening of vertical meridian in majority of cases (72.71%) and patients with WTR astigmatism causes steepening of vertical meridian in majority of cases (63.04%). In NO astigmatism group 60% patients convert to WTR astigmatism group and remaining 40% patients convert to ATR astigmatism group. This means Chevron incision causes steepening of vertical meridian more than horizontal meridian of NO astigmatism group. This gives a mixed result in different groups [Table 01].

When we were comparing pre-and post-operative astigmatism in "Acceptable", "Moderate" and "Large" for how much change occurred we got a p-value of 0.001 which is statistically significant [Table 03]. This means there is significant changes occurred between pre- and post-operative astigmatism in different groups. After statistical analysis (2-tailed t-test) between pre- and post-operative

ISSN No:-2456-2165

mean astigmatism we got a p-value of 0.028 that is also statistically significant. We have to compare with other type of incision to assess the efficacy of Chevron incision. In one comparative study between straight, frown and chevron incision among 100 patient by Nidhi et al showed mean surgery induced astigmatism (SIA) was minimum (-0.88±0.61Dx900) with chevron incision.[9] Another study by Dhiraj et al on 100 patients in a comparison study between chevron incision and frown incision of same size showed chevron incision had more stable configuration in term of surgery induced astigmatism (SIA).[10]

Post operative visual outcome of this study group is excellent. Dramatic improvement of best corrected visual acuity (BCVA) of Good category and rapid reduction of Borderline category were observed from first post – operative day to one month follow-up (67% to 98% and 32% to 1% respectively) where as Poor category was same. At final follow up (after 1 month post-operatively) 98% patients achieved BCVS equal or better than 6/18, 1% (n=1) achieved borderline BCVS due to post operative large astigmatism (-2.00 Dcyl ATR) and another 1% (n=1) fell in poor outcome due to macular scar (Table 3.11). Nidhi et al also showed in her comparison study 95.70% patients of chevron incision group achieved post operative best corrected visual acuity (BCVA) 6/18 or better.[9]

No patient showed significant post operative complication. Tunnel construction was the most difficult step in this type of incision through the sclera. Three premature entries occurred in 100 patients even by an experienced surgeon. It is quite difficult in beginner surgeon.

V. CONCLUSION

This comprehensive prospective study on the astigmatic changes in 100 cataract patients who underwent MSICS with Chevron incision with rigid PMMA IOL implantation has helped us to arrive certain conclusions. This prospective study showed Chevron incision causes significant change in astigmatism postoperatively. Magnitude of surgically induced astigmatism (SIA) also significant. Outcome of Chevron incision in term of final postoperative vision is excellent in this study. Although tunnel construction is somewhat difficult, no devastating complications have occurred in this study. We have to compare with other type of incision to assess the efficacy of Chevron incision.

- **Conflict of interest:** None.
- **Financial support:** None
- **Acknowledgement:** Ms. Rahnoma Tarannom for statistical analysis.

REFERENCES

[1.] Raj swasthya. Small incision cataract surgery. Chapter: 6 http://www.rajswasthya.nic.in cataract surgery with IOL. Indian Journal of Ophthalmology. 2009 Jan-Feb; 57(1): 9–13.

[2.] Pallin SL. Chevron incision for cataract surgery. J Cataract Refract Surg. 1990;16: 779–81.

[3.] Haldipurkar SS, Gokhale VN. Astigmatic Considerations in SICS. J International Soc Manual Small Incision Cataract Surgeons. 2005 Nov 01; 46–8.

[4.] Ashok Garg. Jorge L. Alio. Surgical technique ophthalmology- cataract surgery. Jaypee- highlight, Medical Publishers, Inc.2010; 38; 205-6.

[5.] American Academy of Ophthalmology Basic and Clinical Science Course. Section 3: Clinical Optics, 2007-2008. San Francisco, CA. American Academy of Ophthalmology; 2007:117-118.

[6.] Basti S, Vasavada AR, Thomas R, Padhmanabhan P. Extra capsular cataract extraction: Surgical techniques. Indian J Ophthalmology. 1993;41:195–210

[7.] Burgansky Z, Isakov I, Avizemer H, Bartov E. Minimal astigmatism after sutureless planned extracapsular cataract extraction. J Cataract Refract Surg. 2002;28: 499–503.

[8.] Kimura H, Kuroda S, Mizoguchi N, Terauchi H, Matsumura M, Nagata M. Extracapsular cataract extraction with a suture less incision for dense cataracts. J Cataract Refract Surg. 1999; 25:1275–9.

[9.] Nidhi Jauhari, Deepak Chopra, Rajan Kumar Chaurasia, and Ashutosh Agarwal. Comparison of surgically induced astigmatism in various incisions in manual small incision cataract surgery. Int J Ophthalmol. 2014; 7(6): 1001–1004.

[10.] B.Dhiraj, Y. Sidhdharth. a randomized study to evaluate SIA in patient of SICS operated by chevron and frown incision. Journal of Forensic Medicine, Science and Law - A Journal of Medicolegal Association of Maharashtra. 2013; 22 (1).

[11.] Dieudonne Kaimbo, Wa Kaimbo. Astigmatism – Definition, Etiology, Classification, Diagnosis and Non-Surgical Treatment. Department of Ophthalmology, University of Kinshasa, DR Congo.