Research & Reviews

ISSN: 2319-9865

Research and Reviews: Journal of Medical and Health Sciences

Astigmatism: A Cataract Surgeon's Nightmare.

Sudhir Hegde K, Rajani Kadri, Vikram MJ*, Ajay Kudva, Asha Achar, Devika P, and Vandana Serrao

Department of Ophthalmology, AJ Institute of Medical Sciences, Kuntikana, Mangalore 575004, Karnataka, India.

Research Article

Received: 18/06/2013
Revised: 25/06/2013
Accepted: 29/06/2013

***For Correspondence**

Department of Ophthalmology, AJ Institute of Medical Sciences, Kuntikana, Mangalore 575004, Karnataka, India.
Mobile: +91 8277313636

Keywords: Astigmatism, cataract surgery, keratometry, incision.

ABSTRACT

To analyse the surgically induced astigmatism and its decay with respect to the length of the scleral tunnel incision, the type of astigmatism induced. 200 patients who underwent sutureless small incision cataract surgery at our institute between November 2012 and April 2013 were included in this prospective study. They were randomised into 3 groups. Keratometric values were recorded pre- operatively and post- operatively on day1, 1 week and 6 weeks. All changes of keratometry were recorded, tabulated for each corresponding period and the astigmatism decay for the three types of incisions were calculated using statistically acceptable method. A statistically significant reduction in the number of patients showing with- the- rule astigmatism was noticed at the end of 6 weeks post- operatively. An increase in the number of patients showing against the rule astigmatism was seen. In all the 3 groups, maximum number of patients showed less than 1.0D of surgically induced astigmatism which was calculated using subtraction method. Manual small incision cataract surgery induced an against the rule astigmatic change. A low mean astigmatism was seen in all the three groups, which stabilised by the sixth post-operative week.

INTRODUCTION

Astigmatism, the so called final frontier of cataract surgery, is an area of research where few venture. Cataract surgery incisions have been known for more than a century to influence astigmatism. Significant astigmatism may be visually disabling causing diminution in visual acuity, glare, monocular diplopia, asthenopia and distortion. A number of procedures have been developed to minimize and stabilize surgically induced astigmatism. Manual small incision cataract surgery is one of the most innovative and popular technique [1]. The use of small cataract incision is thought to reduce surgically induced astigmatism resulting in more stable refraction [2]. There are many factors responsible for surgically induced astigmatism such as the location and type of cataract incision, size, configuration of wound, suture material used, technique of wound closure etc [3,4,5,6,7,8]. This knowledge has led to the advent of small incision cataract surgery which returns to the patient, the greatest amount of functional vision in the least amount of time. A small incision about 3 mm long is ideal to perform cataract removal and intraocular lens insertion. However, because of practical considerations a slightly larger wound is used [9].

MATERIALS AND METHODS

The present prospective study was done on 200 patients (109 males and 91 females) who underwent sutureless small incision cataract surgery between November 2012 to April 2013 at our institute The study was approved by the hospital ethical committee. All patients with senile cataract were included in the present study after obtaining a written informed consent. Patients with corneal degenerations, dystrophies, ocular trauma, infection, inflammations, pterygium, congenital anomalies of eye, retinal pathologies, glaucoma, disease of posterior segment of eye were excluded from the study. A thorough preoperative evaluation of the cases including preoperative keratometry, slit lamp examination and A- scan were done. They were randomised into 3 groups . The group assignment was determined after surgery, based on chord length of external incision used into 6.0mm (Group A), 6.5 mm (Group B) and 7.0 (Group C). Surgery was performed under peribulbar anesthesia. A 3-step incision was made starting 1.5-2.0 mm behind the limbus. A scleral tunnel was fashioned with a crescent blade. The incision extended approximately 1 mm into the cornea. The dissection was carried out towards the limbus on both sides to create a funnel shaped "pocket". Anterior chamber was entered with the keratome and cataract extraction was done. Posterior chamber intraocular lens (PCIOL) was inserted in all cases.

ISSN: 2319-9865

On the immediate post- operative day, keratometry readings were taken in all patients. Periodic examinations (Keratometry and slit lamp examination) were performed at 1 week and 6th week post- operatively. For simplification of analysis, all astigmatic changes were studied only in the vertical or horizontal axes. Axes between 60^0 and 120^0 were considered as being against the rule and between 150^0 and 30^0 were considered as being with the rule. Analysis of astigmatism was restricted to keratometric cylinder only, as it is an objective measurement of corneal contour and is not influenced by subjective patient perception. The change in keratometric cylinder was calculated using simple subtraction method. The course of astigmatic changes were determined by keratometry performed with a standard calibrated Bausch and Lomb Keratometer. All changes of keratometry were recorded, tabulated for each corresponding period and the astigmatism decay for the three types of incisions were calculated using statistically acceptable method. The Chi- Square test was applied to find out the significant differences between the three groups.

RESULTS

In the present prospective study, there was an increasing trend of with the rule astigmatism in Group C. However, against the rule astigmatism that was seen in majority of the patients in three groups was comparable to each other. Table 1 show preoperative and post operative (at 6 weeks) astigmatism in three groups.

Table1: Astigmatism in the three groups pre-operatively and after 6 weeks

	Group A			Group B			Group C		
	WTR	ATR	0	WTR	ATR	0	WTR	ATR	0
Pre-operative	22	29	14	23	31	11	15	42	13
Percentage (%)	33.2	43.8	23.0	33.8	45.5	20.7	21.5	59.6	18.9
6 weeks	5	46	11	15	48	2	19	49	2
Percentage (%)	7.8	71.3	17.1	23.5	73.2	2.7	27.6	69.4	3.2

The Chi- Square test was used to calculate p value. Overall we observed a reduction in the number of patients showing with the rule astigmatism over a period of 6 weeks. This decline was statistically significant. (p= 0.006). The number of patients who were astigmatically neutral also showed a statistically significant decrease. (p= 0.04). An increase in the number of patients showing against the rule astigmatism was seen but this was not statistically significant (P=0.3). All the 3 groups had a larger number of patients showing against the rule astigmatism after 6 weeks. This number did not significantly differ between the 3 groups. This suggests that manual small incision cataract surgery by a 3- step scleral tunnel induced an against the rule astigmatism. The number of patients did not significantly differ in the 3 groups although an insignificant increase in the number of patients showing with the rule astigmatism was seen in Group C.

The astigmatic profile over the 6 week period of follow up has been summarised in Table-2. A progressive increase in the number of patients showing against the rule astigmatism was seen at all follow up visits. The number of patients showing the respective type of astigmatism stabilised by the sixth post-operative week. Thus, after sutureless, small incision cataract surgery, at all post-operative follow ups a larger number of patients showed against the rule astigmatism.

Table 2: Astigmatic profile over 6 week period

	WTR No.(%)	ATR No.(%)	NONE No.(%)
Pre-operative	60 (30)	102 (51)	38 (19)
Post-operative Day-1	66 (33)	117 (58.7)	17 (8.5)
1 week	59 (29.3)	136 (68)	5 (2.7)
6 weeks	43 (21.5)	142 (71)	15 (7.4)

Table – 3 shows the amount of surgically induced astigmatism seen in the 3 groups after 6 weeks. This has been calculated using subtraction method. Maximum number of patients showed a less than 1.0 D of induced astigmatism. Most of these patients fell in the range of 0.1-0.5D. The amount of surgically induced astigmatism did not differ significantly between the 3 groups.

Table 3: Amount of surgically induced astigmatism in the 3 groups (Subtraction Method).

SIA(D)	Group A		Group B		Group C	
	(No.)	%	(No.)	%	(No.)	%
0.0	5	7.2	7	10.4	1	1.6
0.1-0.5	40	60.8	30	45.9	36	51.3
0.6-1.0	15	23.0	18	27.2	20	28.5
1.1-1.5	3	4.5	5	8.1	6	9.2
1.6	2	3.1	4	6.9	6	9.1

ISSN: 2319-9865

The amount of mean astigmatism seen immediate post-operatively reduced progressively over the 6 week period as shown in Table-4.

Table 4: Mean astigmatism (D) in the 3 groups over the period of study

	Group A	Group B	Group C
Pre-operative	0.62	0.61	0.76
Day 1	0.82	1.02	0.95
1 week	0.78	1.07	0.97
6 weeks	0.76	0.96	0.90

The proportion of patients showing $\leq$ 1.0D of astigmatism is shown in Table-5. A shift towards against the rule astigmatism is seen post- operatively which continues to remain even at the end of 6 weeks. The amount of astigmatism induced did not have any bearing on the type of astigmatism being induced. The stabilisation of cylinder was seen by the end of the first post-operative week in some and in most by the 6 weeks. In patients with > 2.5 D of astigmatism, a stable cylinder was achieved late with 46.1% showing against the rule on the first post- operative day, 57.5% on day 7, and 72.1% after 6 weeks. After applying the Chi-square test, a statistically significant decrease in with the rule astigmatism was seen in patients over the 6 weeks of study ($p< 0.0001$). An increase in against the rule astigmatism was seen but this was not statistically significant ($p=0.06$). Overall a significant decrease in with the rule astigmatism was seen in patients showing <1.0 D of cylinder ($p< 0.0001$) and an increase in against the rule astigmatism was seen ($p= 0.04$).

Table 5: Proportion of patients showing < 1.0 D and > 2.5 D astigmatism.

Astigmatism (D)	Pre-op		Day 1		1 week		6 weeks	
	WTR	ATR	WTR	ATR	WTR	ATR	WTR	ATR
0.1-0.5	35	31	9	29	5	28	8	31
(Percentage)	53.3	46.7	23.0	77.0	17.9	82.1	20.2	79.8
0.6-1.0	12	33	21	33	10	32	13	32
(Percentage)	26.4	73.6	40.0	60.0	25.1	74.9	27.6	72.4
>2.5	0	0	10	7	8	11	5	12
(Percentage)	0	0	53.9	46.1	42.5	57.5	27.9	72.1

Table 6: Comparison of Astigmatic Change after 6 Weeks

Astigmatic change (D)	Feil and co- authors		Present study	
	No.	%	No.	%
WTR				
>1.0	0	0	19	9.7
0.6- 1.0	1	4.5	20	10.2
0.1- 0.5	7	31.8	48	24.6
ATR				
0.1-0.5	9	40.9	58	29.7
0.6-1.0	4	18.2	38	19.5
>1.0	1	4.5	12	6.2

DISCUSSION

Manual small incision cataract surgery induced an against the rule astigmatic change as suggested by a decrease in the number of patients showing with the rule astigmatism and increase in those with against the rule astigmatism. Samuel Masket [10] compared sutured and unsutured scleral pocket incisions. He noted that the group without suture closure demonstrated only against the rule astigmatic changes at any time after surgery. He noted a 0.08D shift on post- operative day 1 and progressive degradation of against the rule astigmatism thereafter to result in 0.45D shift from pre- surgical astigmatism. These observations were similar to our results.

Feil and co- authors [11] , MM Lein and co- authors [12] have also concluded from their studies, that sutureless small incision cataract surgery induced an against the rule astigmatism. The results of the type and amount of induced astigmatism are comparable with a study by Feil and co- authors and are summarised in the Table 6.

Larger number of patients showed an induced astigmatism of $\leq$ 1.0D in both studies irrespective of an induced with or against the rule astigmatism. A statistical correlation cannot be established between the studies due to a large difference in number of cases in both studies. (22 in the study by Feil and co- authors and 200 in the present study).

ISSN: 2319-9865

Analysing the amount of induced astigmatism, the results of the present study reaffirm that small incision cataract surgery gives rise to a lower amount of astigmatism post- operatively. Maximum number of patients in the study showed a cylinder of $\leq$ 1.5D at any time post- operatively. This was true for all the 3 groups with no significant difference at any time after surgery. The number of patients with cylinder $\leq$ 1.5D progressively increased over the 6 week period, with a larger variability in group B. However this variability cannot be considered significant because of a relatively small sample size and requires further study and evaluation. Similar results were seen by Steinert et al [13] and M.M. Leen and co-authors. A progressive increase in the number of patients with cylinder $\leq$ 1.5D was seen in our study and were comparable with the figures in M. M. Leen's study.

Steinert et al[13] also found less astigmatism with small incision technique than the conventional incision technique at 1 and 6 weeks post-operatively. They studied incision lengths of 4 and 6.5mm. All patients showed low levels of mean induced astigmatism although variability in induced astigmatism was greater for the 6.5mm incision patients than for 4.0mm incisions.

Also, low mean astigmatism were seen on all follow up visits. A mean astigmatism of 0.97D in the 7.0mm group, 1.03D in the 6.5mm group and 0.80D was seen in the 6.0mm group on the first post-operative day. These are comparable with the study by Pham D.T and co-authors [14].

In our study we noted a relative stabilization of cylinder by the sixth post-operative week. This is especially true of the smaller cylinders of $\leq$ 1.0D.

The present study affirms the suggestions of Steinert and co-authors that small scleral tunnel incisions afford a rapid and stable optical result, providing early visual recovery to the cataract patients. Multiple studies [15,16,17,18,19] show a low induced astigmatism, faster visual recovery and more stable refraction after small incision cataract surgery. Since, during the period of cylinder change, refractions is too unstable to permit prescription of glasses, an early stabilisation of cylinder with manual small incision cataract surgery enables early prescription of glasses with faster visual rehabilitat

CONCLUSIONS

A faster visual rehabilitation can be achieved by early prescription of spectacles due to a low mean astigmatism which was seen in all the 3 groups, and stabilised by the sixth post-operative week. However, long term evaluation of decay in astigmatism is required. The induced astigmatism immediately post-operative and at any follow up was against the rule in maximum number of patients. Thus, sutureless incisions induced a flattening of the surgical meridian but this did not significantly differ between incision lengths of 6.0-7.0 mm.

REFERENCES

1. Ernest PH, Mc Farmland MS and Siepser SB et al. 1990, Sutureless surgery to minimize astigmatism. In: Gills JP, Sanders, eds. Small incision cataract surgery. Thorofare, NJ Slack Inc., 1403.
2. Shepherd JR. Induced astigmatism in small incision cataract surgery. J Cataract Refr Surg. 1989; 15: 85- 88.
3. Vaazqiez LA, Panesso JL. Surgically induced astigmatism. A comparison of different cataract incisions. P R Health Sci J. 1993; 12(2) : 99-103.
4. Artaria LG. Kleinschnitt- Kataraktchirurgie: Anderungen des postoperative astigmatismus. Klin Monatsbl Augenheilkd. 1990; 196(5): 316-9.
5. Werblin TP. Astigmatism after cataract extraction : 6 year follow- up of 6.5 and 12 mm incisions. Refract Corneal Surg. 1992; 8(6): 448- 58.
6. Kullenberg C, Hermeking H, Willwerth A. E, Gerke E. Induced astigmatism in cataract surgery. Scleral tunneling incisions of 5.5 mm and 6.5 mm after 1 year follow-up. Ophthalmology. 1994; 91(4) : 421-24.
7. Cristobal RJ, Ruusuvaara P, Jarvinen E, Raivio I, Krootila K. Early rehabilitation after small incision cataract surgery. Refract Corneal Surg. 1993; 9(1): 67-70.
8. Levy JH, Pisacano AM, Chadwick K. Astigmatic changes after cataract surgery with 5.1 mm and 3.5 mm sutureless incisions. J Cataract Refract Surg. 1994; 20(6): 630-33.
9. Gregersen M. Lamelliform incision for opening the anterior chamber in cataract extraction. 1988; 193(4): 364- 9.
10. Masket S. 1 year post operative astigmatic comparison of sutured and unsutured 4 mm sclera pocket incisions. J Cataract Refr Surg. 1993; 19(4): 453-56.
11. Feil SH, Crandall AS, Randall JO. Astigmatic decay after small incision self sealing cataract surgery: 1 year follow up. J Cataract Refr Surg. 1995; 21: 433-36.
12. Leen MM, Ho CC, Yanoff M. Association between surgically induced astigmatism and cataract incision size in the early post operative period. Ophthalmic Surg. 1993; 24(9): 586-92.
13. Steinert RF, Brint S F, White SM, Fine IH. Astigmatism after small incision cataract surgery. A prospective randomized, multicenter comparison, 4 and 6.5mm incisions. Ophthalmol. 1991; 98 (4): 417-23.
14. Pham DT, Wollensak J, Drosch S. ECCE with self sealing cataract incision. Technique and results. Ophthalmol. 1995; 92(3): 256-60.
15. Van Horenbeck AG, Jan Van Rijwijcklaan. Bull Soc. Belge Ophthalmo. 1991; 242: 1-8;

ISSN: 2319-9865

16. Menapace R, Radax U, Amon M, Papanos P. No- stitch, small incision cataract surgery with flexible intraocular lens implantation. J Cataract Refrt Surg. 1994; 20(5): 534-42.
17. Baumgartner J. M, Bover J, Baumgartner A. Comparison of astigmatism due to ambulatory cataract surgery with 3 different techniques. Klin Monatsbl Augenheilkd. 1994; 204(50): 279-81.
18. Drosch S, Pham DT, Wollensak J. 1year follow-up of astigmatism after cataract operation. Wound closure with cross stitch suture vs no stitch suture technique. Ophthalmol. 1994; 91(4): 434-38.
19. Heinrich T. and co- authors. Astigmatism against the rule after small incision cataract surgery. A multifactorial multivariate study. Klin Monatsbl Augenheilkd. 1994; 204(5): 262-64.