ORIGINAL ARTICLE

COMPARISON OF SURGICALLY INDUCED ASTIGMATISM L-SHAPED VS STRAIGHT INCISIONS IN MANUAL SMALL INCISION CATARACT SURGERY

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ABSTRACT

Aims and objective: To compare surgically induced astigmatism(SIA) in L-shaped vs straight incision in manual small incision cataract surgery(SICS).

Material method: 60 patients aged 35yrs and above with uncomplicated cataract with nuclear sclerosis of any grade were included in the study who were divided into 2 groups randomly. 30 patients underwent SICS with straight scleral incision and 30 with L-shaped incision. Data was analyzed using SPSS version 15.0 statistical analysis and calculations were performed using SIA calculator version 2.1.

Results: The SIA (surgically induced astigmatism) was 1.14 ± 0.44D, 0.81 ± 0.40D, 0.61 ± 0.33 D on 1st post-operative day, 4 weeks and 6 weeks respectively in straight incision group and the SIA was 0.79 ± 0.36D, 0.33 ± 0.31D, 0.15 ± 0.18D on 1st post-operative day, 4 weeks and 6 weeks respectively in L-shaped incision group.

Conclusion: L-shaped incision technique induces less amount of SIA as compared to straight incision and the difference is statistically significant. Also, L-shaped incision maintains better anterior chamber stability and leads to early visual rehabilitation. In poor and developing countries where still majority of cases are being operated by manual SICS, achieving emmetropia or minimal refractive errors should be the goal.

Key words: Astigmatism, Emmetropia, Straight incision, L-shaped incision, Cataract.

INTRODUCTION

There have been lots of developments and breakthroughs in the field of small incision cataract surgeries worldwide. But in developing countries like India, manual SICS is still the preferred lifeline due to reasons like poor economic background of patients, machine independency and very high patient load in hospitals.[1] Giant strides have been made to reduce post-operative surgically induced astigmatism by modifying wound architecture to achieve near emmetropia. SIA (surgically induced astigmatism) depends upon the length of the incision, type & location of incision and suture placement technique.[2]

There are various types of incisions like straight, frown and inverted V (chevron). The corneal astigmatism is directly proportional to the cube of the length of the incision and is inversely proportional to the distance the incision is placed from the limbus [3.] Singer proposed

that straight incision induce less amount of against the rule (ATR) astigmatism but accommodate up to 7mm PMMA(Poly methyl meth acrylate) optics[4].Inverted V incision induces least amount of ATR astigmatism[3].

In this study we are comparing L-shaped incision with straight incision in manual SICS. L-shaped incisions have been used for explantation and implantation of intraocular lens and it is found to be astigmatically neutral incision because the scar tissue tends to contract equally on both horizontal and its perpendicular axis leading to astigmatically neutral wound. Henekes and colleagues reported an L-shaped corneal tunnel incision for performing Phacoemulsification[5]. They extended the corneal tunnel wound perpendicularly for IOL (intra-ocular lens) implantation and found better results in terms of astigmatism. A comparative study of L-shaped incision verses linear incision group revealed less induced astigmatism. So in our study we tried to observe the outcomes in terms of SIA in patients undergoing manual SICS using 2 different types of incisions.

AIM AND OBJECTIVE

To compare the outcomes of L-shaped incision with straight incision in manual Small incision cataract surgery in terms of surgically induced astigmatism and best corrected visual acuity.

MATERIAL AND METHOD

The Present study was conducted on 60 patients who attended the out-patient department of Ophthalmology aged 35yrs and above with uncomplicated cataract with nuclear sclerosis of any grade. Informed written consent was obtained from all the patients undergoing surgery. The preoperative clinical examination included visual acuity testing with Snellen's chart, IOP measurement, lacrimal sac syringing, slit lamp examination and fundus examination. Manual keratometry (Bausch & Lomb) was done before surgery and at day 1, 4weeks and 6weeks of surgery. SRK-2 formula was applied for intraocular lens (IOL) power calculation. Axial length was calculated with A-scan. Patients were randomly divided into two groups L and S, each having 30 patients each and were given L-shaped and Straight incision respectively.

All the surgeries were performed by a single surgeon. In group L, a L-shaped incision was made with horizontal length of incision around 4 mm and perpendicular incision length was around 3mm and it was 1.5mm away from the superior limbus. In group S, a straight incision was made of around 6.0-6.5mm in length, 1.5 mm away from limbus. A single piece PMMA (polymethylmethacrylate) IOL was implanted in all the cases. Antibiotic steroid eye

ointment applied and pad and bandage was done in the end. Figure 1 shows L-shaped incision after MSICS on first post-operative day and figure 2 shows showing straight incision after MSICS on first post-operative day.

Patients were examined on day 1, 4 weeks and 6weeks postoperatively. Drugs were continued till 6 weeks. Slit-lamp examination, uncorrected visual acuity (UCVA) and best corrected visual acuity (BCVA) were recorded and findings were noted at each visit. Keratometry and autorefractometry was done on day 1,4th and 6th postoperative week.

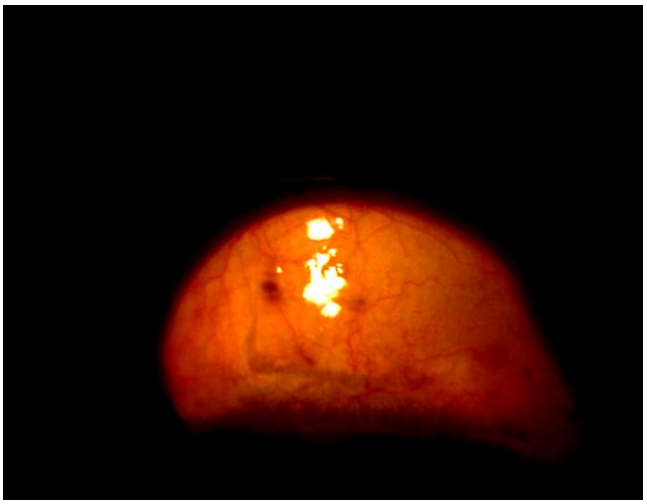

Figure 1. Showing L-shaped incision after MSICS on first post-operative day

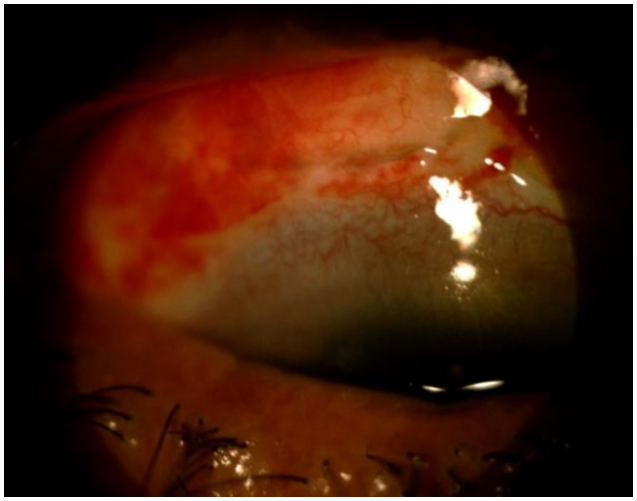

Figure 2. Showing straight incision after MSICS on first post-operative day

Statistical Analysis

Data was analysed statistically using SPSS version 15.0 statistical analysis software. The study was analyzed using the SIA Calculator version 2.1, software program. Data was

interpreted in form of mean, percentages and standard deviation(SD). Chi square test was applied and *p* value of <0.05 was considered statistically significant.

RESULTS

The characteristics of patients in terms of age, gender and laterality of eye with cataract in two Groups (Group S and Group L) are shown in the Table-1. There was no statistically significant difference regarding sex (p=0.09), age and laterality among the two groups. Patients were regularly followed at 1st post operative day, 4th and 6th week and follow-up time was same in both the groups.

In group S, the mean age of patients was 57.96±7.82 yrs with the range of 40-79 years. The age and sex distribution is shown in table 2. Pre-op visual acuity (VA) was similar in both the groups and is shown in table-3. The pre-operative corneal astigmatism is given in table-6 which was similar in both the groups. The SIA (surgically induced astigmatism) was calculated by comparing keratometer and autorefractor readings as mean ± SD on 1st post operative day, 4 weeks and 6 weeks respectively using SIA calculator version 2.1, by Dr aashima and Dr saurabh Sawhney.[6]

In group L, the mean age of patients was 56.26 ±7.89 with range of 41-78 years. Post operative uncorrected VA is given in table-4 and best corrected VA is given in table-5 at 6 weeks. About 90% patients had VA of 6\12-6\6 in L-shaped incision cases whereas 73.3% had VA of 6/12-6/6 in straight incision group. In terms of visual outcome, patients in group L had better visual outcomes as compared to group S as more patients had UCVA and BCVA in the range of 6/12-6/6. The post-operative corneal astigmatism in both groups is given in Table-7. The corneal astigmatism recorded pre-operatively was around 0.5D in majority of the patients in both the groups which increased post operatively to 1.0 to 1.5 D. The SIA was recorded on 1st post operative day, 4 weeks and 6 weeks respectively. There were 11 patients in Group S presenting with astigmatism of >0.75D at 6 weeks postoperatively whereas there was no patient presenting with astigmatism of >0.5 D in Group L at the end of 6 weeks indicating that L-shaped incision induced significantly less astigmatism when compared to straight incision. At first post-operative day, astigmatism measured was significantly more in Group S which gradually reduced on follow ups but still remained more as compared to Group L at the end of 6 weeks which suggest that L shaped incision induces less SIA.

Observations

Table 1. Pre-operative characteristics of patients of both groups

Characteristics	Group-S (straight incision)	Group-L (L-shape incision)	Statistical Inference (P-value)
1. No. of eyes	30	30	
2. Age in years (Mean ± S.D)	57.96± 7.82	56.26±7.89	
Gender			
1. Male	14(46.6%)	19(63%)	0.09
2. Female	16(53.33%)	11(36.66%)	
Eye involved			
1. Right	16(53.33%)	18(60%)	0.301
2. Left	14(46.66%)	12(40%)	

Table 2. Pre-operative visual acuity of patients (both groups)

Grade	Visual acuity	Group-S	Group-L
V1	PL (perception of light) + PR (projection of rays) +	14(46.6%)	9(30%)
V2	FCCF(finger count close to face) to 5/60	10(33%)	13(43%)
V3	6/60 to 6/18	6(20%)	8(26%)

Table 3. Post-op uncorrected visual acuity(UCVA) of both groups at 6 weeks

Visual Acuity	Group-S	Group-L
6\60 to Less	3(10%)	2(6.7%)
6\36 to 6\18	8(26.7%)	5(16.7%)
6\12 to 6\6	19(63.3%)	23(76.6%)

Table 4. Post-op best corrected visual acuity(BCVA) in both groups at 6 weeks

Visual Acuity	Group-S	Group-L
≤ 6\60	0	0
6\36 -6\18	8(26.7%)	3(10%)
6\12 -6\6	22(73.3%)	27(90%)

Table 5. Pre-operative corneal astigmatism in both the groups

Astigmatism in dioptre(D)	Group-S (no. of patients)	Group-L (no. of patients)
0.00	6	5
0.25	9	10
0.50	10	11
0.75	3	2
1.00	1	2
1.25	1	0
1.50	0	0
1.75	0	0
2.00	0	0
Total	30	30
Mean and SD	0.391±0.305	0.383±0.268

Table 6. Post-op surgically induced corneal astigmatism in patients on follow-up visits

Astigmatism in dioptre(D)	DAY-1		4WEEK		6WEEK	
	Group-S	Group-L	Group-S	Group-L	Group-S	Group-L
0.00	0	0	0	9	4	16
0.25	0	5	5	10	7	10
0.50	4	5	5	5	8	4
0.75	6	6	7	4	6	0
1.00	5	10	7	2	3	0
1.25	5	2	3	0	1	0
1.50	6	2	2	0	1	0
1.75	2	0	1	0	0	0
2.00	2	0	0	0	0	0
Mean and SD	1.14±0.44	0.79±0.36	0.81±0.40	0.33±0.31	0.61±0.33	0.15±0.18

DISCUSSION

Surgically induced astigmatism is the main hurdle in obtaining emmetropia post cataract surgery. Less studies have been done on L-shaped incision in SICS and more work needs to be done in this field. So, in the present study we have compared L-shaped incision with straight shaped incision in terms of inducing SIA in small incision cataract surgery. Corneal astigmatism measured by keratometry readings and autorefractor readings for recording astigmatism was done both pre and post operatively in both the groups. The data obtained was tabulated and interpreted using SIA calculator and results were interpreted. Various studies have been done for calculation of SIA after cataract surgery. L-shaped scleral incision may be ideal for IOL explantation and insertion.[7] The length and width of the incision, the relationship between the length and width of the incision, and the distance of the scleral incision from the limbus significantly affect postoperative astigmatism.[7] This principle probably helps to settles the issue of irregular scarring in a scleral incision, leading to an astigmatically neutral wound.

Biaxial microincision cataract surgery with an incision size of 1.6 mm resulted in the least SIA. Enlargement of the corneal incision beyond 2.0 mm during IOL implantation led to significant increases in SIA.[8] A statistical and significantly greater postoperative corneal astigmatism than preoperative corneal astigmatism was observed for a group of cataract patients who underwent superior approach MSICS.[9] Temporal or superior steep astigmatic axis with selected shape can reduce SIA. The high postoperative corneal astigmatism may create blurred images through a bigger circle of the least confusion on the retina.[10]

Many studies have been done to compare different incisions such as straight, chevron, frown etc and their effect on SIA.[11,16] The wound construction in manual small incision cataract surgery (MSICS) in relation to anatomy, physiologic functioning and challenges of sclerocorneal tunnel has been widely studied.[12] Valvularly competent sclerocorneal tunnel largely contributes to the outcome of sutureless MSICS and core to a successful MSICS is the construction of a leak-proof sclerocorneal tunnel.[12]

The parameters 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, and the shape of the wound. Postoperative astigmatism plays an important role in the evaluation of final outcome of surgery.[13,14]

Many studies have compared the astigmatism induced by a superior, supero-temporal and temporal incision in manual small incision cataract surgery. They found that induced astigmatism was lower in the temporal and superotemporal groups compared to that in the superior group.[15] Hennekes *et al*. used L-shaped corneal tunnel incision for performing phacoemulsification. It has been thought that if the corneal tunnel is extended for IOL implantation, it is better to extend the wound perpendicularly in an L-shape rather than its linear extension. A comparative study of an L-shaped incision vs. a linear incision group revealed less induced astigmatism.[5] L-shaped incisions have consistently shown better results than straight incisions in terms of postoperative astigmatism shift, induced astigmatism, pressure resistance and other complications.[5] Different types of incisions varying in length, shape and location are tried by many surgeons to obtain optimal visual rehabilitation of patients which are both beneficial and cost effective to the patients. There is need of more studies using L shaped incision in MSICS, as it has better wound stability and induces less post-operative astigmatism[5], so that better vision outcomes can be obtained in regions where tertiary care is still not easily accessible to many patients and most of the cataracts are still being managed using SICS.

In our study we enrolled 60 patients. In 30 patients, straight incision was given and in other 30 patients L-shaped incision was given. The patients were followed for 6 weeks. In the

first post-operative week there was astigmatism ranging 0.50-2D in 90% patients in both the groups which gradually reduced in the following weeks to 0.50 D SIA in 13% patients in Group-S and 0.25D SIA in 35% patients in Group-L. There were 11 patients in Group S presenting with astigmatism of >0.75D at 6 weeks postoperatively whereas there was no patient presenting with astigmatism of >0.5 D in Group L at the end of 6 weeks The results were found to be statistically significant and we concluded that L-shaped incision induces less SIA.

CONCLUSION

This study concludes that L-shaped incision induces less amount of surgically induced astigmatism, less astigmatism shift and better vision as compared to straight incision in manual small incision cataract surgery. Also, L-shaped incision maintains better anterior chamber stability and leads to early visual rehabilitation but it has a longer learning curve. In developing countries where phacoemulsification cannot be performed in every patient, better incisions in MSICS for better post-operative visual outcome should be aimed at. Since most cataract patients in developing countries may have preoperative against the rule astigmatism, the ability of surgeons in these countries to adapt to a change in site of incision may be imperative.

References

1. Venkatesh R, Tan C.S.H, Sengupta S, Ravindran R.D, Krishnan K.T, Chang D.F. Phacoemulsification versus manual small-incision cataract surgery for white cataract. J Cataract Refract Surg 2010;36:1849-54.
2. Roman SJ, Auclin FX, Chong-Sit DA, Ullern MM. Surgically induced astigmatism with superior and temporal incisions in cases of with-the-rule preoperative astigmatism J Cataract Refract Surg. 1998;24:1636-44.
3. Gills JP, Sanders DR, editors. Small incision cataract surgery; Foldable lenses, One- stitch surgery, Sutureless surgery, Astigmatic keratotomy.Thorofare, NJ; Slack; 1990;147-50.
4. Singer JA.Straight incision for minimising induced astigmatism after small incision cataract surgery with rigid optic intraocular lens implantation. J Cataract Refract Surg 1991;17:677-688.
5. Hennekes RL, Van den Dooren KA.Asymmetric L-shaped corneal no-stitch tunnel incisions for cataract surgery. J Cataract Refract Surg. 1999;25(4):550-55.
6. Basak SK, Basaka S, Chowdhury AR. 'SIA-Soft': a new software to calculate surgically induced astigmatism in comparison with manual mathematics by vector method. Indian J ophthalmol. 2008;56(2):170.
7. Narang P, Agarwal A.L-shaped scleral incision may be ideal for IOL explantation, insertion. Ocular Surgery News U.S. Edition, January 10, 2016.
8. Tetikoğlu M, Yeter C, Helvacıoğlu F, Aktaş S, Sağdık HM, Özcura F.Effect of Corneal Incision Enlargement on Surgically Induced Astigmatism in Biaxial Microincision Cataract Surgery.Turk J Ophthalmol. 2016; 46(3):99-103.
9. Edmund A, Ahmed A, David B, Eugene A, Felix A, Frank Y et al.Postoperative Corneal and Surgically Induced Astigmatism following Superior Approach Manual Small Incision Cataract Surgery in Patients with Preoperative Against-the-Rule Astigmatism. J Ophthalmol. 2016;2016: 9489036.
10. Akura J, Kaneda S, Hatta S, Matsuura K. Controlling astigmatism in cataract surgery requiring relatively large self-sealing incisions. J Cataract Refract Surg.2000; 26:1650-9.
11. Jauhari N., Chopra D., Chaurasia R. K., Agarwal A. Comparison of surgically induced astigmatism in various incisions in manual small incision cataract surgery. Internat J Ophthalmol.2014;7(6):1001-1004.
12. Megbelayin E.Wound geometry as it relates to tunnel valvular competence in manual small incision cataract surgery. Niger J Ophthalmol 2014; 22(1):1-6.
13. SS Haldipurkar, Hasanain T, Vishwanath G. Wound construction in manual small incision cataract

surgery. Indian J Ophthalmol. 2009;57(1): 9-13.
14. Giansanti F, Rapizzi E, Virgili G, Mencucci R, Bini A, Vannozzi L et al.Clear corneal incision of 2.75 mm for cataract surgery induces little change of astigmatism in eyes with low preoperative corneal cylinder. Eur J Ophthalmol. 2006;16(3):385-93.
15. Gokhale NS, Sawhney S. Reduction in astigmatism in manual small incision cataract surgery through change of incision site. Indian J Ophthalmol. 2005;53(3):201-3.
16. Kohnen T, Lambert, R.J., Koch, D.D. Incision sizes for foldable intraocular lenses. Ophthalmology.1997;104:1277-86.