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A COMPARATIVE ANALYSIS OF SURGICALLY INDUCED ASTIGMATISM AND VISUAL OUTCOMES IN SUPERIOR VERSUS SUPEROTEMPORAL INCISION IN PATIENTS UNDERGOING MANUAL SICS.

Ophthalmology

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ABSTRACT

Background & objectives: A prospective randomised study of surgically induced astigmatism and visual outcomes in superior versus superotemporal incision in patients undergoing manual SICS.

Methods: 80 patients were prospectively randomised into two groups of forty each. Group 1 patients underwent superior sclerocorneal incision and group 2 underwent superotemporal sclerocorneal incision. The surgically induced astigmatism was calculated by vector analysis method by assessing the postoperative astigmatism on day 1, 2nd week, 4th week and 6th week. Visual outcomes was also noted on all postoperative followup days.

Results: SIA achieved by the superior scleral incision group was 1.22±0.45D and in the superotemporal scleral incision group was 0.70±0.40D. Final SIA analysis of patients showed 35 patients had an SIA of ≤1D in the superotemporal group whereas only 17 patients had an SIA of ≤1D in the superior scleral incision group which was statistically significant at $p<0.05$. Visual acuity assessment on the 4th and 6th week in both the groups showed a statistically significant outcome in the superotemporal scleral incision group as compared to that of the superior scleral incision group with a p value of 0.03 and 0.04 in both groups respectively.

Conclusion: Considering all the advantageous findings in our study, a simple changing of the incision site from superior to superotemporal scleral incision lessens the surgically induced astigmatism to a significant level, and also provides early wound stabilization and better visual outcomes.

KEYWORDS

SIA, ATR, WTR, astigmatism, superotemporal.

INTRODUCTION

Present day cataract surgery is perceived as an analogue of refractive surgery, which has led to increased expectations of patients and good post-operative unaided vision is the expected norm nowadays. [1] A major obstacle to achieving an excellent uncorrected visual acuity is postoperative surgically induced astigmatism (SIA). Astigmatism occurring due to surgery affects both the quality of vision and quality of life. Magnitude of astigmatism varies depending on the type of the incision, size of the incision, length, location, suture closure & other determinants. [2]With improved techniques and increased expectations, surgeons have been paying closer attention to the astigmatic effects of their surgeries.[3]

Manual sutureless SICS (small incision cataract surgery) can be performed with many incisions like superior, superotemporal and temporal incisions. The basis of these incisions was that it has been reported in earlier studies that superotemporal and temporal incisions induces less astigmatism than superior incision. The location of the incision is placed on the steeper corneal meridian based on the preoperative keratometric (K) assessment, leading to a flattening of the corneal curvature in the meridian on which the incision is placed, with a corresponding steepening of the same degree of the orthogonal meridian (right angled axis). This reduction in the corneal power between the flattened steeper axis and steepened flatter axis leads to lesser postoperative corneal astigmatism.[4]The present study at our institution is aimed at assessing the changes in postoperative surgically induced astigmatism in patients undergoing superior verses superotemporal sutureless manual SICS.

Surgically induced astigmatism is the change in both the power and to a lesser degree the orientation of the principal meridians following an incision for cataract extraction.WTR(with the rule) astigmatism is produced when the corneal curvature is steepest in the vertical meridian; conversely ATR(against the rule) astigmatism is produced when the steepest corneal meridian is horizontal.[5]

Following cataract surgery when the change in astigmatism occurs over time, the patient's actual spherical equivalent will remain constant. This effect described by Cravy was similar to that of a “hula hoop” wherein compression in one axis results in an equal expansion in the other axis.[6] This description was in effect the Gauss's law of elastic domes “for every change in curvature in one meridian there is an equal and opposite change 90° away.” This corneal change is known as the coupling effect. [7] The optical zone and the incision depth were the most important explanatory factors, along with age, gender, preoperative astigmatism and IOP also contributed to the surgically induced change in refraction.

MATERIALS AND METHODS

This was a prospective cohert, randomised clinical study conducted at a tertiary care hospital in South India, from January 2017 to December 2017 after taking due clearance from our institutional ethical committee. 80 patients attending the out patient department selected for cataract surgery divided into two equal groups of 40 each, were informed about the procedure being performed and informed consent was taken from all patients. All surgeries were performed by one surgeon and a 6mm frown incision for constructing a sclero corneal tunnel was used.

Inclusion criteria:

All patients 40 years & above of either sex with senile uncomplicated cataract

Exclusion criteria:

Age below 40 years previous intra ocular surgery, inflammation or trauma, patients with complicated cataract, posterior segment complication, pre-existing corneal ectasia, systemic diseases which affects the corneal hysteresis, patients with pterygium, corneal opacity, degeneration uveitis, glaucoma, macular degeneration and dystrophies which independently cause limitation of vision.

Clinical assessment:

Detailed history and ocular examination, visual acuity testing, slit lamp biomicroscopy, fundus examination by 90D and indirect ophthalmoscopy, goldmann's applanation tonometry, keratometry, refraction, sac syringing, routine laboratory tests. The patients were recalled for follow up on 1st day, 2nd week, 4th week and 6weeks after surgery for keratometric analysis, visual acuity, slit lamp biomicroscopy, fundus evaluation with +90D and tonometry assessment. The resultant surgically induced astigmatism was calculated by vector analysis method.

Statistical analysis: Descriptive statistics like percentage, mean, standard deviation will be applied and other relevant inferential statistics like chi-square test was used. Level of significance was kept at $p<0.05$

OBSERVATION & RESULTS:

The age distribution of the two groups were comparable with mean age of 60.27±5.63 and 61±5.61. The number of male and female patients were comparable in both the groups and exhibited no statistical significance at $p<0.05$. A pre-operative astigmatism comparison between the two groups showed 30% of patients with WTR, 62.5% with ATR and 7.5% with no astigmatism in the superior scleral incision

group, whereas in the superotemporal scleral incision group 32.5% patients were WTR, 62.5% with ATR and 5% with no astigmatism showing comparability of groups. (p=0.88)

Table 1: Follow up of astigmatism pattern in superior group

PERIOD	ATR	%	WTR	%	No astigmatism
PRE OP	25	62.5	12	30	3
1ST DAY	31	77.5	9	22.5	0
2ND WK	32	80	8	20	0
4TH WK	33	82.5	7	17.5	0
6TH WK	35	87.5	5	12.5	0

In the superior scleral incision group of the current study, out of the initial 12 patients who had WTR, 9 patients had WTR on the first post-operative day. There after there was a consistent decrease in the WTR patients from 8 on the 2nd week, 7 on the 4th week and by the end of 6th week the total number of patients with WTR in the group was only 5. In 25 patients with ATR, the number kept increasing from 31 on the first post-operative day, 32 on the 2nd week of assessment, 33 by the end of 4th week and towards the end of 6th week it was 35. Statistical analysis of this data showed significance on the 6th post operative week.

Table 2: Follow up of astigmatism pattern in superotemporal scleral incision

PERIOD	ATR	%	WTR	%
PRE OP	25	62.5	13	32.5
1ST DAY	25	62.5	15	37.5
2ND WK	23	57.5	17	42.5
4TH WK	25	62.5	15	37.5
6TH WK	25	62.5	15	37.5

In the superotemporal scleral incision group, out of the 13 patients who were WTR, (2 patients with no astigmatism), there was a slight increase to 15 WTR on the first post-operative day and from then on it remained the same over the course of assessment on the 4th week and 6th week post operatively. The overall number of cases of ATR remained constant at 25 over the complete duration of assessment of the patients on the 1st day, 2nd week, 4th week and 6th week post operatively.

Table 3: Decay of mean astigmatism in superior versus superotemporal group

	SUPERIOR SCLERAL INCISION				SUPEROTEMPORAL SCLERAL INCISION			
POST OP	ATR	%	WTR	%	ATR	%	WTR	%
1ST DAY	31	77.5	9	22.5	25	62.5	15	32.5
2ND WK	32	80	8	20	23	57.5	17	42.5
4TH WK	33	82.5	7	17.5	25	62.5	15	37.5
6TH WK	35	87.5	5	12.5	25	62.5	15	37.5

In the present study, the decay of astigmatism in the superior scleral incision group showed a consistent increase in the "against the rule" astigmatism from 62.5% to 87.5% at 6 weeks post operatively which was statistically significant. Pre-operative "with the rule" astigmatism decreased from 30% to 12.5% postoperatively, which showed statistical significance. In the superotemporal scleral incision group there was a slight increase in the "with the rule" astigmatism from 32.5% to 37.5% on the 1st post-operative day and the number remained constant over a period of 6 weeks. Patients with "against the rule" astigmatism did not show any statistical significance and remained constant over the course of assessment over 6 weeks.(p>0.05).

Table 4: Mean astigmatism in superior scleral vs superotemporal incision

	SUPERIOR	SUPEROTEMPORAL	P VALUE
PRE OP	0.91±0.62D	1.02±0.49D	p=0.18
1ST DAY	1.74±0.80D	1.48±0.55D	p=0.047
2ND WEEK	1.47±0.72D	1.44±0.53D	p=0.3
4TH WEEK	1.39±0.73D	1.08±0.52D	p=0.02
6TH WEEK	1.32±0.71D	1.06±0.71D	p=0.046

The preoperative mean ± standard deviation in the superior and superotemporal scleral incision group was 0.91±0.62D and 1.02±0.49D respectively which was not statistically significant (p=0.18). On the 1st postoperative day in the superior group it was 1.74±0.8D and in the superotemporal group it was 1.48±0.55D which was statistically significant at p<0.05(p = 0.047). On analysis at the 2nd week the mean astigmatism did not show any statistical significance. The mean values on 2nd week were 1.47±0.72D and 1.44±0.53D respectively (p=0.3). Analysis at 4th week showed mean astigmatism at 1.39±0.73D in the superior scleral incision group and 1.08±0.52D in the superotemporal group, which showed statistical significance at p<0.05(p=0.02). At 6th week the mean astigmatism was 1.32±0.71D and 1.06±0.71D in the superior and superotemporal scleral incision group respectively. The values were statistically significant at p<0.05 (p=0.04).

The mean final surgically induced astigmatism in the superior scleral incision group calculated by vector analysis method was 1.22±0.45D and in the superotemporal scleral incision group was 0.70±0.40D. On statistical analysis the values were significant at p<0.05.

6th week post-operative astigmatism showed 16 patients with ≤1D in the superior scleral incision group and 28 patients in the superotemporal scleral incision group. 24 patients had >1D astigmatism in the superior sclera incision group and 12 patients had >1D astigmatism in the superotemporal scleral incision group. The values were found to be statistically significant at p<0.05.

Table 5: Post operative visual acuity between superior vs superotemporal scleral incision group

VISION	Superior Day 1	Supero Temporal Day 1	Superior 2nd Wk	Supero Temporal 2nd Wk	Superior 4th Wk	Supero Temporal 4th Wk	Superior 6th Wk	Supero Temporal 6th Wk
6/6-6/9	2	2	3	4	4	9	5	10
6/12-6/18	15	18	20	22	22	26	21	25
6/24-6/36	21	19	16	13	14	5	14	5
≤6/60	2	1	1	1	0	0	0	0
	p=0.87		p =0.83		p = 0.03		p = 0.04	

There was a gradual increase in the visual acuity in both the groups over the course of assessment of 6 weeks. On comparison with the superior and superotemporal scleral incision groups there was statistical difference observed at 4th week and 6th week of visual acuity assessment in the two groups with a p value of 0.03 and 0.04 respectively.

DISCUSSION

To achieve good post-operative visual acuity the effect of astigmatism should be minimised and this can be achieved by simply changing the site of incision.[8] A similar analysis was also seconded by Burgansky et al [9] which showed an increase in astigmatism on increasing the size and changing the site of the incision .

In our current study where the mean age of the population was around 60 years, the pre-operative profile of patients, ATR was more common than WTR. The results were similar to that of the study conducted by Kavitha KNS et al[10] and Prasad M et al,[8] probably due to the stiff upper tarsal plate in young age leading to WTR and with advancing age the stiffness of the tarsal plate is lost leading to ATR.

In our study it was noted that the superior scleral incision caused a shift towards ATR than WTR. Similar results were observed in studies conducted by Gokhale NS et al [11] and Sowbhagya HN. [12] This shift towards ATR occurs due to the flattening of the vertical meridian in a superior scleral incision, whereas in a superotemporal scleral incision there is a decrease in the magnitude of ATR and a more WTR shift due to the flattening of the horizontal meridian.

After the 4th week, the difference in the mean astigmatism was not much in both the groups. In the superior scleral incision group the mean change between the 4th and 6th week values were only 0.07D whereas in the superotemporal group it was even more less at 0.02D. This shows that the astigmatic stabilization starts as early as the 4th week post operatively.

In the present study the final mean SIA achieved by the superior scleral incision group was 1.22±0.45D and in the superotemporal scleral incision group was 0.70±0.40D. On statistical analysis the values were found to be clinically significant at p<0.05.

The results of our study when compared with other similar studies conducted by Gokhale NS,[11] wherein the mean SIA in superior scleral incision group was 1.45±0.94D and superotemporal group was 0.51±0.49D was comparable to our study results. A similar study conducted by Satyajeet V [13] showed a mean SIA of 1.52±0.6D and

0.6±1.25D in the superior and the superotemporal groups respectively, which was suggestive that superior scleral incision induced greater astigmatic change than that of the superotemporal incision.

Post-operative decay as evidenced by a Vinay KV et al [14] found that the decay in post-operative astigmatism from 4th week to 6th week was 0.04D which was similar to our study (0.02D) implying an early wound stabilization in the superotemporal incision group. Superotemporal scleral incision induced lesser astigmatism as evidenced by the 6th week assessment wherein, 28(70%) patients had astigmatism of ≤1D in superotemporal incision group as compared to superior incision group which had 16 (40%) patients with astigmatism of ≤1D which was statistically significant at p<0.05(0.007).

The final SIA analysis of patients showed 35 patients had an SIA of ≤1D in the superotemporal group whereas only 17 patients had an SIA of ≤1D in the superior scleral incision group which was statistically significant at p<0.05. The results were comparable to the Gokhale et al [11] and Karad HT et al [15] study wherein the SIA in the superotemporal group was much less when compared to that of the superior scleral incision group.

Visual acuity on the first post-operative day and 2nd week in both the groups were comparable and no statistically significant difference was observed between the two groups probably due to post-operative corneal edema and anterior chamber reaction. However visual acuity assessment on the 4th and 6th week in both the groups showed a statistically significant outcome in the superotemporal scleral incision group as compared to that of the superior scleral incision group with a p value of 0.03 and 0.04 in both groups respectively. These results were comparable to the study conducted by Prasad M et al [8] and Vinay KV et al.[14]

The improvement in visual acuity in the superotemporal group is because it combines the advantageous aspects of both superior and temporal scleral incisions, although foreign body sensation and exposure to infection should always be kept in mind when considering superotemporal scleral incision.[13] A contributing factor to decreased visual acuity in the superior scleral incision group could also be due to a more against the rule type of astigmatism as evidenced by a Oshikha K et al.[16]

In our present study the superotemporal scleral incision has a statistically significant advantage in lowering the surgically induced astigmatism and the improved visual outcome. The results of our study were consistent with the similar kind of studies done my many authors as quoted above.

CONCLUSION

In our study since most of the population was above 60 years, against the rule type was the most common type of astigmatism observed. The superior scleral incision induced a higher magnitude of against the rule type of astigmatism, but is beneficial in cases of preoperative high magnitude with the rule type of astigmatism whereas superotemporal incision was more beneficial in cases of against the rule type of astigmatism.

The SIA in the superotemporal scleral incision (0.70D) is significantly less when compared to superior scleral incision (1.22D). The decay of astigmatism is almost negligible in the superotemporal scleral incision at 4thweek and 6th week at 0.02D, indicating early wound stabilization and hence early visual rehabilitation and correction if needed can be given. SIA of ≤1D was seen in majority of patients of the superotemporal scleral incision group (87.5%) whereas it was observed in only 42.5% in patients of the superior scleral incision group. The visual outcome at 4th week and 6th week on comparison with that of the superior scleral incision group was significantly better in the superotemporal scleral incision group indicating early visual rehabilitation and better visual outcomes. Although initially difficult to learn and master superotemporal scleral incision offers many advantages. It spares the 12 o'clock position which might be required on a later date. It is advantageous especially in deep set eyes and eyes with prominent brows. It also reduces the tendency of drag on the incision and alleviate the astigmatic effect of the eyelids.

Considering all the advantageous findings in our study, a simple changing of the incision site from superior to superotemporal scleral incision lessens the surgically induced astigmatism to a significant level, and also provides early wound stabilization and better visual outcomes.

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