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Comparative study of astigmatic outcomes and incisional integrity in temporal clear corneal incision and superior scleral incision phacoemulsification surgery

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ABSTRACT

Introduction: Cataract surgery now, is not just rehabilitative surgery but therapeutic also, as patient wants to be ridden off glasses. Surgically induced astigmatism (SIA) is the cause of poor post-operative vision even af ter uneventful cataract surgery.

Aims and Methodology: The aim of study was to compare the astigmatic outcomes and incision integrity in 5.5mm temporal clear corneal incision (TCCI) and superior scleral incision (SSI) in phacoemulsification surgery. A total of 200 eyes were included. Cases were randomly divided in two groups. Group A underwent phacoemulsification with TCCI and Group B with SSI, of 5.5mm length. Patients were followed up on post operative day (POD)1,8,40,90,180 Postoperative astigmatism was recorded by keratometry, SIA was analyzed by SIA Software and incision integrity observed by slit lamp examination.

Results: Mean Post-operative astigmatism in TCCI group was 0.90, 0.87, 0.79, 0.75, 0.73D on POD 1, 8, 40, 90, 180 respectively, and that in SSI group was 1.43, 1.37, 1.28, 1.24, 1.24D. It was low in TCCI group and statistically significant. Mean SIA in group A was 1.13(±0.59), 1.15(±0.5), 0.99(±0.42), 0.92(±0.44), 0.90(±0.46) on POD1, 8, 40, 90 and180. The change from POD1 to 40 was significant and there was no further significant change in SIA upto 6months. In group B, SIA was 0.9 2(±0.48), 0.92(±0.39), 0.80(±0.34), 0.75(±0.30) and 0.76(±0.36) on POD1, 8, 40, 90 and 180. The change from 1^{st} to 40^{th} day was significant and there was mild decrease in SIA on POD 90 and POD 180 but not significant compared to POD 40.

Conclusion: Though SIA was high and statistically significant in TCCI group but postoperative astigmatism was less and statistically significant. There was significant WTR shift in postoperative astigmatism in TCCI group and ATR in SSI group. Large incision size of upto 5.5mm clear corneal incision can have self-sealing properties hence dismissing the use of suture.

1. Introduction

Modern cataract surgeries with intraocular lens have become one of the safest, most successful, and most frequently performed surgeries. Cataract surgery has become refractive surgery offering better results in both 'best corrected' and 'uncorrected' visual acuity. One aspect which has confounded the cataract surgeons is the post-operative induced astigmatism.[1] Along with the availability of the foldable intraocular lens, the incision in the phacoemulsification cataract extraction has developed from scleral incision to the clear corneal incision because of its bloodless and fast approach. The approach through a clear corneal incision, as introduced by Fine, has demonstrated increased safety, decreased inflammation and pain, as well as reduced surgically induced astigmatism.[2]

Post-operative astigmatism is affected by various factors, such as preoperative astigmatism, location, type, size, closure and healing of the surgical incision, amount of scleral cauterization performed, type of suturing material used and its placement, position of intraocular lens and postoperative use of steroids all have effects on corneal curvature.[3] Aim of our study was to document the changes in corneal curvature occurring after cataract

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extraction over a period of 6 months post-operatively. We planned to compare surgically induced astigmatism (SIA) and post-op astigmatism produced by 5.5 mm temporal clear corneal phacoemulsification and scleral incision phacoemulsification surgery.

2. Materials and Methods

200 eyes of 200 patients were included in this prospective interventional study from July 2013 to September 2015. Institutional ethical committee approval and informed consent was taken from all the participants. All senile cataracts were included in the study and patients with any corneal pathology that might interfere with visual assessment and affect wound healing and astigmatism like corneal opacity or degeneration were excluded.

Preoperative evaluation was done including visual acuity, intraocular pressure, sac syringing, thorough examination of anterior segment by slit lamp examination, posterior segment examination by 90D. Keratometry was done preoperatively and post operatively using automated keratometry, Axial length measured with a contact 'A' scan unit and the IOL power was calculated using SRK II formula.

Cases were randomly divided into two groups. One group (Group A) underwent phacoemulsification with temporal clear corneal incision of 5.5mm and other group (Group B) underwent phacoemulsification with superior scleral incision of 5.5mm incision size. All cases were operated under peribulbar block or topical anaesthesia. All patients received 6 hourly topical ciprofloxacin 0.3% eye drop one day prior to surgery and betadine drops were instilled thrice for asepsis 1 hour preoperatively. Preoperative adequate mydriasis was achieved by instillation of Tropicamide 0.5% and phenylephrine 5% eyedrop, homoatropine 2% eyedrop, flurbiprofen 0.03% eyedrop every 15 minutes, starting one hour prior to surgery.

Group A patients underwent phacoemulsification with temporal clear corneal incision of 5.5mm length with 15 No blade, following which a self sealing tri-planar corneal tunnel of 1.75mm length was made using crescent knife. Anterior chamber entry was done using 2.8mm keratome. Single side port entry was made. Nucleus was emulsified using stop and chop technique. Tunnel was extended with 5.5mm keratome and rigid PMMA lens of 5.25mm optic size of appropriate power was implanted in the bag in all cases. Stromal hydration of main incision and side port was done.

Group B patients underwent phacoemulsification with superior scleral tunnel made 1.5 mm posterior to the corneal vascular arcade. A straight incision of 5.5mm length was made with a 15 no. blade through partial thickness of the sclera. The tunnel was extended 0.75-1 mm into clear cornea. Length of tunnel being 2.25-2.5 mm. Two side port entries were made at 9:30 and 2:30 ' 0 clock. Anterior chamber was entered fr om the anterior limit of sclera-corneal tunnel using a 2.8 mm keratome. Nucleus was emulsified using stop and chop technique. The inner opening of tunnel was extended using blunt-tip keratome. 5.25mm optic, PMMA IOL of appropriate power was implanted in the bag in all cases. Side port opening was sealed by stromal hydration.

Post operative assessment was done on post op day 1, week 1, week 4, month 3 and month 6. Post op patients were assessed for visual acuity, corneal clarity, anterior chamber depth, PCIOL placement in bag and keratometry was done. Incisional integrity was checked on slit lamp, and SIA was calculated using SIA software.

3. Results

Mean age of patients in group A was 65.54±6.92 years and that in group B was 66.07±7.32 years. There was no statistical significant difference between two groups regarding age. Hence, the study was age matched Group A had 59 males and 41 females and in group B were 58 males and 42 females. Both the groups were comparable.

Table 1 shows comparison of preoperative and postoperative astigmatism on all post-op followups between two groups which is statistically significant and also comparison between two groups is significant. Also, comparison of preoperative astigmatism with post-op day1, day8, day40, day90, day180 in group A and B and it showed statistically significant difference on all post-op days.

Table 2 shows comparison of surgically induced astigmatism (SIA) among two groups and it shows statistically significant difference in both the groups on all postoperative days.

Table 3 shows significant change in type of astigmatism on all postoperative days and between the two groups. It shows significant With The Rule (WTR) shift in astigmatism in group A (Wilcoxon: Z value = 4.09, $P<0.001$) and significant Against The Rule (ATR) shift in astigmatism in group B (Wilcoxon: Z value = 3.42, $P<0.001$)

In our study, SIA in temporal clear corneal on 1^{st}, 8^{th}, 40^{th}, 90^{th}, 180th post-operative day were as follows 1.13(± 0.59), 1.15(± 0.50), 0.99(±0.426), 0.92((±0.446) and 0.90(± 0.465). There was a mild increase in the SIA from 1^{st} to 8^{th} post-operative day that decreased significantly by 40^{th} post-operative day. There was mild further decrease in SIA by 3^{rd} month which was not statistically significant and remained same by 6^{th} month.

In superior scleral group, SIA was 0.92(±0.48), 0.92(±0.39), 0.80(±0.34), 0.75(±0.30) and 0.76(±0.36) on post op day 1, 8, 40, 90 and 180. The change from 1^{st} to 40^{th} day was significant and there was mild decrease in SIA on postoperative day 90 and 180 but was not significant as compared to postoperative day 40.

Table 1: Comparison of Astigmatism at pre op, post op day

Astigmatism	Group A (n=30)		Group B (n=30)		Z Value	P Value
	Mean	SD	Mean	SD		
Pre-operative	0.59	0.47	0.81	0.55	3.02	<0.005
Post op day 1	0.90	0.590	1.43	0.775	5.41	<0.0001
Post op day 8	0.87	0.539	1.37	0.741	5.39	<0.0001
Post op day 40	0.79	0.572	1.28	0.760	5.15	<0.0001
Post op day 90	0.75	0.548	1.24	0.689	5.57	<0.0001
Post op day 180	0.73	0.561	1.24	0.698	5.70	<0.0001

1, day 8, day 40, day 90 and day 180 in study groups
op:operative

In both groups, incision integrity was good and non-leaking on all postoperative days. Stromal hydration and self-sealing nature of incision maintained incision integrity postoperatively and there was no incidence of wound leak or endophthalmitis noticed.

4. Discussion

Astigmatism is one of the most common refractive errors encountered in clinical practice and surgically induced astigmatism is major unavoidable byproduct of cataract surgery. The need is to preplan the type of surgery to be offered to the patient as to have minimal postoperative astigmatism. Uncorrected astigmatism can cause blurred images and glare. These effects can create patient discomfort and dissatisfaction with otherwise uneventful cataract surgery.[4]

There are many studies that document temporal clear corneal incisions of 2.8, 3.2 and 4mm which induce low astigmatism.[3,5–8] But there is very less literature available that comments on the incision integrity and wound stability of suture less 5.5mm clear corneal incision. This study shows that results of self-sealing 5.5mm clear corneal incision are comparable to smaller incision phacoemulsification surgeries in terms of incision integrity and SIA. Incision site and its length are the two major factors affecting the SIA. The study compares two groups for same incision size (5.5mm) at two different sites, one for temporal clear corneal incision and other for superior scleral incision.

Surgically induced astigmatism and type of astigmatism was compared in both the groups for age, sex and laterality of the eyes operated, neither of them were statistically significant. On comparing the type of astigmatism post-operatively, it was found that there was change to WTR astigmatism after temporal clear corneal incision and to ATR astigmatism in the superior scleral incision which was significant. The difference was attributed to the distractive force of eyelid blinking on superior wound. The change in the corneal curvature is responsible for surgically induced astigmatism and the astigmatic refractive error.

Kohnen et al reported SIA by vector method in 20 eyes with a temporal 5.0mm clear corneal incision which was 0.91D (±0.77) and 0.70D (±0.50) SIA after postop week 1 and post-op 6 month. There was a steady decrease of SIA till six months post-operatively. Computerized video kerato graphic analysis pre-operatively and post-operatively was used.[8] Mahumad Asif et al performed a study on 50 eyes. Corneal astigmatism in 5.5mm temporal clear corneal incision was calculated on 4^{th} post-operative week was 1.737 (±0.344), on 8^{th} post-operative week was 1.739 (±0.344) and on 12^{th} post-operative week was 1.732 (±0.344). In comparison to the pre-operative astigmatism 2.028(+/-0.342) it was statistically significant.[9] Reddy et al concluded that there is significant ATR shift in superior incision by phacoemulsification and manual SICS surgery and temporal incision had WTR shift.[10] Karad et al compared SIA following non phaco SICS at different site and concluded that 5.5mm superior incision induces 1.02±0.52 while at temporal site had 0.7±0.49.[11]

Vasavada et al also concluded that at the end of surgery, it is not the initial incision size alone but also the distortion of the incision during subsequent stages of surgery that determine the integrity of the CCI. Their study also demonstrated the impact of hydrating corneal incisions on the ingress of extraocular fluid into the anterior chamber, concluded that hydrating the incisions may help to prevent aqueous leakage and also, to some extent, the inflow of fluid from the ocular surface into the anterior chamber, because it restricts the ingress of small particles. Hence, Stromal hydration is done in conjunction with clear corneal incision in attempt to close the wound.

The temporally placed incision has an added advantage, since the distance from the visual axis to the periphery in the horizontal meridian is longer than for others in the cornea. Therefore, flattening at this incision is less likely to be transmitted to the visual axis resulting in significantly lower SIA. When the incision is located superiorly, both gravity and eye-blink tend to create a drag on the incision and hence ATR induced astigmatism. WTR astigmatism induced by a temporal incision is advantageous, since most elderly cataract patients have pre-operative ATR astigmatism.) According to this study, in patients with a high degree

Table 2: Comparison of SIA at post op day 1, day 8, day 40, day 90 and day 180 in study groups in diopter(D)

SI A	Group A (n=30)		Group B (n=30)		Z Value	P Value
	Mean	SD	Mean	SD		
Post op day 1	1.13	0.598	0.92	0.480	2.77	<0.01
Post op day 8	1.15	0.500	0.92	0.379	3.69	<0.0001
Post op day 40	0.99	0.426	0.80	0.340	3.49	<0.001
Post op day 90	0.92	0.446	0.75	0.304	3.15	<0.005
Post op day 180	0.90	0.465	0.76	0.306	2.61	<0.01

op:operative , SIA: surgically induced astigmatism

Table 3: Comparison of type of SIA in study groups

Type of SI A		Group A n=100	Group B n=100	Chi-square	P Value
Pre op	ATR WTR NA	70 21 9	72 28 0	10.03	<0.01
Post op day 1	ATR WTR NA	9 88 3	84 11 5	120.87	<0.0001
Post op day 8	ATR WTR NA	9 91 0	92 5 3	148.25	<0.0001
Post op day 40	ATR WTR NA	6 91 3	98 2 0	169.56	<0.0001
Post op day 90	ATR WTR NA	3 94 3	97 0 3	182.36	<0.0001
Post op day 180	ATR WTR NA	3 94 3	97 0 3	182.36	<0.0001

op:operative, SIA:surgically induced astigmatism, WTR:with the rule, ATR:against the rule, NA:no astigmatism

of WTR astigmatism, superiorly placed incision can be considered. But the temporal placed clear corneal tunnel is best preferred for cases of pre-operative ATR astigmatism. Hence type of preoperative astigmatism must be considered before planning the site of incision to reduce postoperative astigmatism. Large incision size of upto 5.5mm clear corneal incision can have self-sealing properties hence use of rigid PMMA lens in non affording patients and dismissing the use of suture.

5. Conclusion

The study concludes that there is statistically significant post operative shift to WTR astigmatism in temporal clear corneal incision as opposed to ATR astigmatism in superior scleral incision; hence it is better to plan temporal incision as mostly elderly patients have preoperative ATR astigmatism. Post-operative astigmatism was also significantly low in temporal clear corneal incision compared to superior scleral incision. Due to patient's non-affordability for foldable IOL, rigid PMMA lenses have been used. The study shows rigid PMMA gives comparable results as even 5.5mm clear corneal incision has proved to be self sealing without any need for suture and have good incisional integrity post operatively, thereby preventing wound leak and incidence of postoperative endophthalmitis.

6. Prior publication

None.

7. Source of Funding

None.

8. Conflict of Interest

None.

9. Permission

None.

10. Presentation at a Meeting

None.

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