IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 18, Issue 1 Ser. 16 (January. 2019), PP 13-18
www.iosrjournals.org

A Comparative Study of Surgically Induced Astigmatism after Phacoemulsification by Temporal Clear Corneal and Superior Clear Corneal Approach

Dr.Abdul Aziz Makayee[1*], Nilofar Nazir[2], Maroof Nabi[2], Saliya Ayoob[3]
[1] *Consultant, Department of Ophthalmology, Government district Hospital Baramulla, Directorate of health services, Kashmir, India.*
[2] *Theatre Technologist, Department of Ophthalmology, Government district Hospital Baramulla, Directorate of health services, Kashmir, India.*
[3] *Assistant (Student), Department of Ophthalmology, Government district Hospital Baramulla, Directorate of health services, Kashmir, India.*
Corresponding Author: Dr.Abdul Aziz Makayee

Abstract:
Introduction: *Cataract surgery has undergone various advances since it was evolved from ancient couching to the modern phacoemulsification cataract surgery. Surgically induced astigmatism (SIA) remains one of the most common complications. The introduction of sutureless clear corneal incision has gained increasing popularity worldwide because it offers several advantages over the traditional sutured limbal incision and scleral tunnel. A clear corneal incision has the benefit of being bloodless and having an easy approach, but SIA is still a concern.*
Materials and Methods: *It was a hospital-based prospective interventional comparative randomized control trial of 261 patients conducted in a rural-based secondary eye care center from September 2017 to August 2018. The visual acuity and detailed anterior segment and posterior segment examinations were done and the cataract was graded according to Lens Opacification Classification System II. Patients were divided for phacoemulsification into two groups, group A and group B, who underwent temporal and superior clear corneal approach, respectively. The patients were followed up on day 1, 7, 14, 30, and 90 postoperatively. The parameters recorded were uncorrected visual acuity, best-corrected visual acuity, slit lamp examination, and keratometry. The mean difference of SIA between 30th and 90th day was statistically evaluated using paired* t-*test, and all the analyses were performed using SPSS 18.0 (SPSS Inc.) software.*
Results: *The mean postoperative SIA in group A was 0.998 D on the 30th day, which reduced to 0.768 D after 90 days, and in group B the SIA after 30 days was 1.651 D, whereas it reduced to 1.293 D after 90 days.*
Conclusion: *Temporal clear corneal incision is evidently better than superior clear corneal incision as far as SIA is concerned.*

Key words: *phacoemulsification, temporal, clear corneal, SIA*

Date of Submission: 12-01-2019 Date of acceptance: 29-01-2019

I. Introduction

Cataract is the most important and significant cause of bilateral blindness in senile age group, both in India as well as on a global scale. Modern cataract surgeries with intraocular lens (IOL) have become one of the safest, most successful, simple, and consistent, and are the most frequently performed surgeries. Small incision cataract surgery (SICS) is gaining popularity in developing countries as an inexpensive alternative to phacoemulsification. [1] SICS and phacoemulsification have advantages like early visual rehabilitation, less induced astigmatism, and no suture-related complications as wound construction and closure is gaining attention and importance. With astonishing advances in technology and predictability of surgery, expectations of both surgeons and patients have increased. Surgeons aim to meet the individual patient's refractive goal and patients expect good vision without the spectacles immediately.

Surprises in refractive errors after cataract surgery have become unacceptable in recent few years. As a result, cataract surgery has become refractive surgery offering improvements both in "best corrected" and "uncorrected" visual acuity. One aspect which has confounded the cataract surgeons is the postoperative induced astigmatism. [2] Surgically induced astigmatism (SIA) calculates the magnitude and axis of postoperative induced astigmatism by various methods introduced by Alpins and Goggin, [3] Holladay *et al.*, [4] and many others. Postoperative 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 IOL, and postoperative use of steroids, and all these have effects on corneal curvature. [5] In 1975, Jaffe and Clayman were first to report surgically induced astigmatism after cataract surgery. In 1975, Jaffe and Clayman first reported the exact measure of change induced by surgery, the SIA. [6] Now MS Excel sheet-based programs are available that calculate SIA. One such program was used in our study to determine SIA. It used the vector analysis with trigonometry formulas to calculate the SIA. They are also used to predict and modify the surgical skills to reduce SIA according to individuals. [7]

In our study, we compared the SIA in clear corneal phacoemulsification by temporal approach, with superior approach. Comparisons between SIA of the two incisions were done using keratometric reading of preoperative and postoperative refractive changes.

II. Materials And Methods

A hospital-based prospective interventional comparative randomized control trial of 261 eyes of patients was conducted in a secondary eye hospital from September 2017 to August 2018. All patients were selected from the outpatient department randomly and were divided into group A and group B. Group A included 138 cases who underwent phacoemulsification through temporal clear corneal approach, and group B had 123 cases who underwent the procedure through superior clear corneal approach.

All the patients provided written informed consent to participate in the study. Those above the age of 40 years who understood the study and were willing were enrolled. Patients with posterior subcapsular cataract, cortical cataract, or posterior polar cataract were included, and grading was done according to Lens Opacification Classification System II.

Patients with astigmatism of more than three diopters (D) in both meridians, complicated cataract, corneal diseases, pseudoexfoliation, primary or secondary glaucoma, macular or retinal diseases, and diabetic retinopathy were excluded from the study. Also, those not willing to participate in the study and lost to follow-up were excluded subsequently.

Work up

All patients underwent slit-lamp examination and posterior segment examination, and uncorrected and best-corrected visual acuity (UCVA and BCVA) were recorded. All UCVA, BCVA were converted to logarithm of the minimum angle of resolution (LogMAR). The keratometric readings in diopteric power were taken using a Shin Nippon autorefractokeratometer and the IOL power was calculated with Biomedix A scan machine using SRK II formula. After routine preoperative investigations and preanesthetic assessment, the patients were randomly allotted by a computer generated sheet to either group A or group B.

Surgical procedures

All phacoemulsification surgeries were done by a single right-handed surgeon (AN) under peribulbar anesthesia. The machine used for phacoemulsification was Opticokon pulsar, and acrylic hydrophilic foldable IOLs were implanted.

In temporal approach, the surgeon sits at the 9 o'clock position in the case of the right eye and at 3 o'clock position for the left eye. A side port was made at 90° to the planned main port ie, at 1 o'clock in the right eyes and 6 o'clock in the left eyes. Anterior capsular staining was done with Trypan blue, which was then washed out with balanced salt solution (BSS) after approximately 20 seconds, and anterior chamber (AC) formation was done with hydroxy propyl methyl cellulose (2%). A main port was made with a clear corneal triplanar self-sealing horizontal incision with 2.8 mm keratome about 0.5 mm inside the limbus. The keratome goes parallel to the corneal surface for one-third of the corneal thickness, then dips toward the anterior chamber. This change in direction of the keratome gives a triplanar incision. In the superior approach, the main port was made at the 12 o'clock position and the side port was made at the 3 o'clock position for both the eyes. The technique for nuclear fragmentation used was direct chop or stop and chop, and the rest of the surgical steps for both the approaches were done as for routine phacoemulsification.

Patients were started on topical antibiotic and steroid combination and were followed up on the 1st, 7th, 14 th, 30th and 90th postoperative day. The parameters which were recorded on all days were UCVA, BCVA, and slit-lamp and fundus examination, and autorefractometry and keratometry were done after 1 week follow-up.

Statistical analysis

SIA was calculated by subtracting the preoperative astigmatism and postoperative astigmatism by a simple subtraction method without taking the axis into consideration. The association of type of cataract and treatment groups was determined using χ^2 test. The statistical significance of difference in the proportion of each LogMAR score in the two treatment groups was studied using *z*-test. The difference in the mean K-vertical and K-horizontal parameters between the two groups was tested for significance using *t*-test for independent samples. The mean difference of SIA between the 30th and 90th day was statistically evaluated using paired *t*-test. The statistical significance was evaluated at 5% level, and all the analyses were performed using SPSS 18.0 (SPSS Inc., Chicago, IL, USA) software.

III. Results

The mean age of the patients of group A was 61.63±8.35 SD years and in group B was 62.28±8.26 SD years. In group A, there were 71 (51.4%) males and 67 (48.6%) females, whereas in group B the males numbered 68 (55.3%) and females 55 (44.7%).

The mean preoperative LogMAR score was 0.9 in both group A and group B. However, the difference in the two means was statistically insignificant with *p*-value of 0.557 ($p>0.05$) as obtained using paired *t*-test (Figure 1).

Table 1 provides the distribution of patients according to SIA and study groups. In group A, the mean astigmatism on the 30th day was 0.988, and on the 90th day it reduced to 0.768, and the difference in the two means was statistically significant with a *p*-value <0.0001 as obtained using paired *t*-test. Similarly in group B, the mean astigmatism on the 30th day was 1.651, while on the 90th day it was 1.293, and here also the difference in the two means was statistically significant (Table 1).

Astigmatism	Preoperative number (%)		Postoperative number (%)			
			30th day		90th day	
	Group A (N:138)	**Group B (N:123)**	**Group A (N:134)**	**Group B (N:122)**	**Group A (N:134)**	**Group B (N:122)**
0	25 (18.12)	29(23.58)	11(8.21)	3(2.46)	21(15.67)	10(8.2)
0.25	2(1.45)	1(0.81)	19(14.18)	3(2.46)	26(19.4)	6(4.92)
0.5	8(5.8)	14(11.38)	13(9.7)	3(2.46)	18(13.43)	11(9.02)
0.75	8(5.8)	4(3.25)	11(8.21)	4(3.28)	12(8.96)	9(7.38)
1	21(15.22)	27(21.95)	33(24.63	13(10.66)	26(19.4)	14(11.48)
1.25	12(8.7)	6(4.88)	5(3.73)	7(5.74)	5(3.73)	7(5.74)
1.5	14(10.14)	12(9.76)	19(14.18)	24(19.67)	10(7.46)	21(17.21)
1.75	15(10.87)	4(3.25)	5(3.73)	9(7.38)	5(3.73)	8(6.56)
2	16(11.59)	12(9.76)	17(12.69)	36(29.51)	10(7.46)	31(25.41)
2.25	5(3.62)	2(1.63)	0(0)	2(1.64)	1(0.75)	2(1.64)
2.5	5(3.62)	6(4.88)	1(0.75)	13(10.66)	0(0)	2(1.64)
2.75	4(2.9)	2(1.63)	0(0)	4(3.28)	0(0)	0(0)
3	3(2.17)	4(3.25)	0(0)	1(0.82)	0(0)	1(0.82)
		Mean	0.988	0.651	0.768	1.293
		SD	0.629	0.642	0.622	0.695

Table 1: Distribution of patients according to astigmatism and study groups

After 7 days in group A, the mean LogMAR visual acuity score (UCVA) was 0.36; while in group B, the mean LogMAR score was 0.47. The difference in the two means was statistically significant with a *p*-value of 0.002 ($p<0.05$) as obtained using *t*-test. Similarly, after day 90 the mean LogMAR score (BCVA) was 0.03 in group A; while in group B, the mean LogMAR score was 0.08. The difference in the two means was statistically significant with a *p*-value of <0.0001 ($p<0.05$) as obtained using *t*-test (Figure 2).

Type of Astigmatism	Preoperative		Postoperative	
	Number (%)		**Number (%)**	
	Group A (N:138)	**Group B (N:123)**	**Group A (N:134)**	**Group B (N:122)**
ATR	61(44.2)	50(40.7)	43(32.1)	113(92.6)
WTR	52(37.7)	44(35.7)	62(61.2)	4(3.3)
No Astigmatism	25(18.1)	29(23.6)	9(6.7)	5(4.1)

Table 2: Distribution of astigmatism in patients according to type and study groups

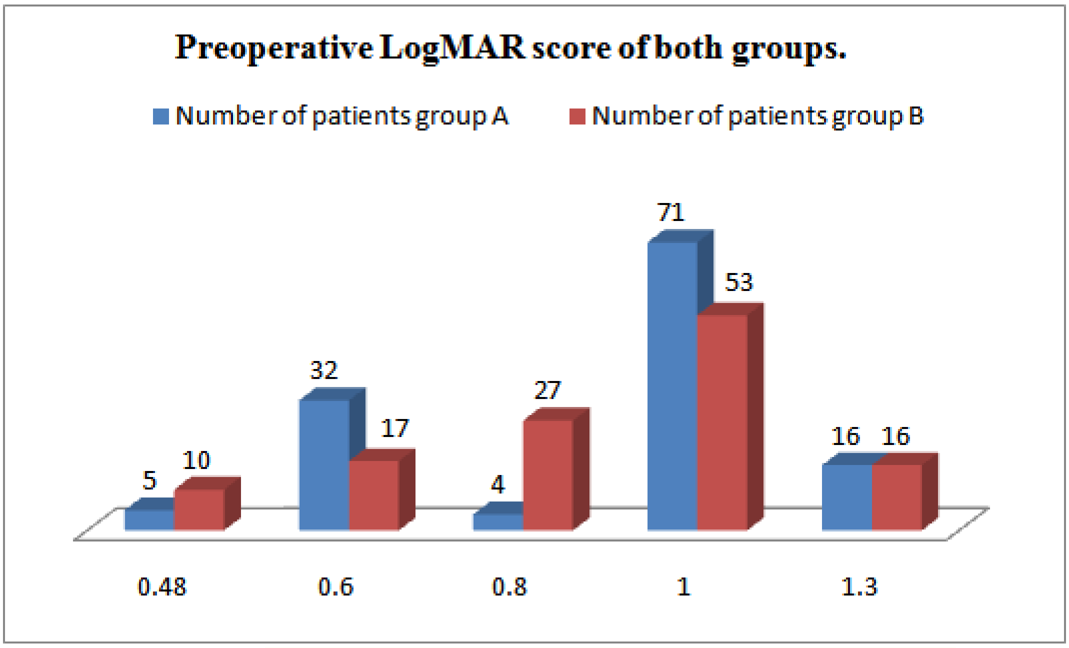

Figure 1: Preoperative Log MAR score of both groups.

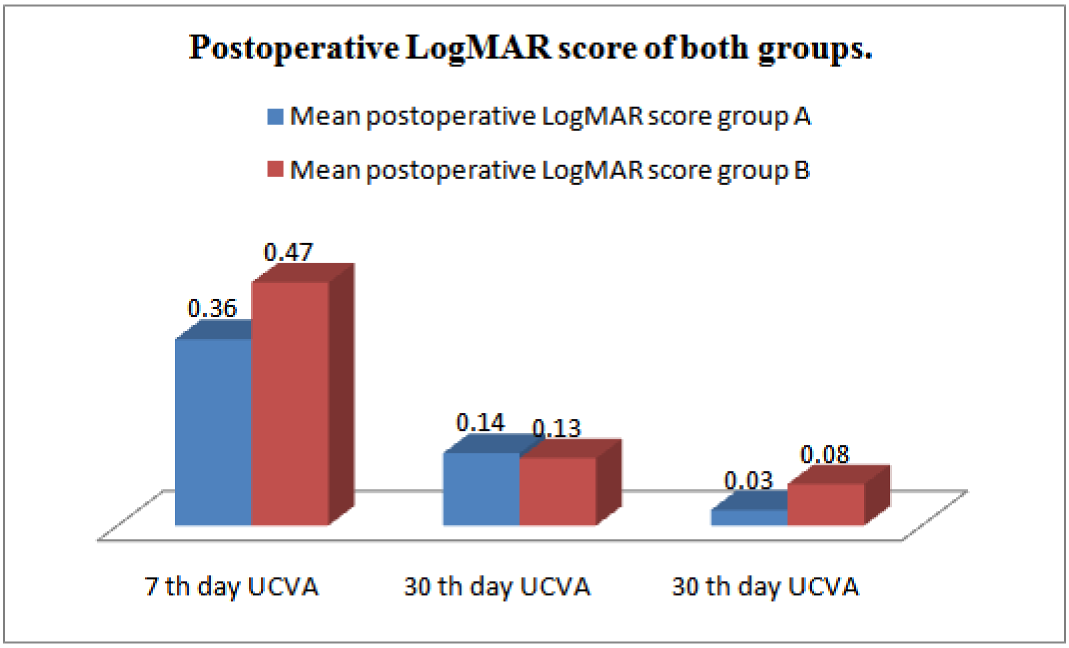

Figure 2: Postoperative Log MAR score of both groups

IV. Discussion

The mean preoperative LogMAR score did not differ significantly in the two groups (p=0.557). Individual Log-MAR scores were 0.48 (p=0.589), 0.60 (p=0.075), 1.00 (p=0.220), and 1.30 (p=0.874) in both groups. Thus, essentially there was equitable distribution of patients with regards to LogMAR scores. Higher values of LogMAR score usually relate to poor visual acuity.6

Je et al7 did a prospective study of 60 eyes and divided patients into two groups: temporal clear corneal and nasal clear corneal. They recorded UCVA and BCVA in both groups at 1 and 3 months after surgery. The mean UCVA at 3 months found in group A was 0.25±0.30 and in group B was 0.17±0.15, which is comparable to our study (p-value 0.338). Similarly in our study, after 3 months UCVA was 0.14±0.12 for group A and 0.13±0.12 for group B (p=0.527). The BCVA at day 90 was significantly better in group A than group B (0.03±0.06 versus 0.08±0.09, p<0.0001).

Preoperative astigmatism was absent in 18.12% (25/138) of patients in group A and 23.58% (29/123) of patients in group B. A maximum number of patients in both groups had astigmatism in the range of 1–2 D. The type of astigmatism also did not differ in the two groups significantly (*p*=0.550). In group A, with the rule (WTR) was 37.7% and against the rule (ATR) was 44.2% and nil was 18.1%, whereas in Group B WTR was 35.7%, ATR was 40.7%, and no astigmatism was noted in 23.6% of subjects (Table 2). Similar observations were made by Pakravan et al3 who compared the astigmatic outcomes of temporal versus nasal clear corneal incisions in phacoemulsification cataract surgery. They found preoperative WTR in 30.00%, ATR in 50%, and no astigmatism in 20% in the temporal group, whereas WTR was 40%, ATR was 25%, and no astigmatism was 35% in the nasal group.

In our study, the average postoperative astigmatism in group A was around 1 D, whereas in group B average astigmatism was around 1.5 D. The mean SIA in group A was 0.98 D on the 30th day, which reduced to 0.768 D after 90 days. In group B, the mean SIA was 1.651 D after 30 days, whereas it reduced to 1.293 D after 90 days. These observations proved that the SIA reduces after 90 days and that there is a significant difference between 30th and 90th day SIA (Figure 3).

In a similar prospective randomized study, Borasio et al9 assessed SIA after phacoemulsification in eyes with mild to moderate corneal astigmatism by temporal versus on-axis clear corneal incisions. The SIA after 2 months was 0.34 D in the temporal group, whereas it was 0.63 D in the on-axis group. Finally they concluded that the clear corneal temporal incision induced less SIA than clear corneal on the axis incision.

Marek et al10 compared SIA of temporal versus superior 2.8 mm clear corneal incisions. The mean SIA in the temporal group was 0.63±0.28 D and it was 1.00±0.54 D in the superior group, and the differences were statistically significant ($p<0.05$). They also concluded that clear corneal temporal approach of 2.8 mm was better than the superior clear corneal incision of the same size.

Likewise, Wei et al11 studied the influence of corneal wound size on surgically induced corneal astigmatism after phacoemulsification with unsutured temporal clear corneal incisions. They compared 2.5 and 3.5 mm wound sizes. SIA was calculated by vector analysis using the Alpin’s method. They found that mean SIA in the 2.5 mm incision group was 0.84±0.53 D, whereas in the 3.5 mm group it was 1.19±0.81 D, and so they concluded that the mean SIA in the 3.5 mm group was larger than in the 2.5 mm group.

Barequet et al12 demonstrated a mean SIA of 1.17 D at 6 weeks and 1.04 D at 12 months by vector analysis. The side of the incision significantly affected SIA. At 6 weeks, temporal incisions induced a mean SIA of 0.74 D, and nasal incisions of 1.65 D, which reduced to 0.71 D for temporal incisions and 1.41 D for nasal incisions at 12 months. They finally concluded that temporal incisions induced significantly less astigmatism than nasal incisions, which is similar to our conclusion.

V. Conclusion

Our study demonstrated the effect on corneal astigmatism of two commonly used self-sealing incisions in phacoemulsification with foldable IOL. In spite of various modifications in the cataract surgery, phacoemulsification remains the fastest and best surgical procedure. A temporal approach is more accessible than superior approach as a prominent brow and deep-set sunken eyes obstruct the maneuvering of the probe in the superior approach, which is easier and more accessible in temporal approach. A self-sealing corneal incision gives a bloodless surgical field. A well-formed 2.8 mm biplanar clear corneal incision gives excellent wound stability and healing.

SIA in the temporal group is less than in the superior group and gives a better visual outcome, good optical quality and great patient satisfaction.

References

[1]. Jaffe NS, Jaffe MS, Jaffe GF. Intraocular lens implants. In: Jaffe’s cataract surgery and its complications; 6th edition. Harcourt, Mosby. 1997:147-199.
[2]. Khurana AK, Indu Khurana. Cornea, limbus and sclera.In: Anatomy and physiology of Eye. 2nd edition.Cbs. 2011:21-41.
[3]. Troutman RC, Buzard KA. Detection and measurement of astigmatism: Instruments and techniques. In Troutman’s Corneal Astigmatism. Mosby- Year book Inc. 1992:92-117.
[4]. Koch P. Structural analysis of cataract incision construction. J Cataract Refract Surg. 1991;17:661- 7.
[5]. Pallin S. Comparison of induced astigmatism with phacoemulsification and extracapsular cataract extraction. J Cataract Refract Surg. 1991;13:274-8.
[6]. Gills J, Sanders D. Use of small incisions to control induced astigmatism and inflammation following cataract surgery. J Cataract Refract Surg. 1991;17:740-4.
[7]. Hall G.W., Campion M., Sorenson C., Monthofer S. Reduction of corneal astigmatism at cataract surgery. J Cataract Refract Surg. 1991;17:407-14.
[8]. Freeman J. Scleral stretch incision for cataract surgery: a technique for no suture closure and control of astigmatism. J Cataract Refract Surg. 1991;17:696-701.
[9]. Pallin S. Chevron sutureless closure: a preliminary report. J Cataract Refract Surg. 1991;17:706
[10]. Burgansky Z, Isakov I, Avizemer H, Bartov E. Minimal astigmatism after sutureless planned ECCE. J Cataract Refract Surg. 2002;28:499-503.

[11]. Masket S. Astigmatic analysis of the scleral pocket incision and closure technique for cataract surgery. CLAO Journal. 1985;11:3:206-9.
[12]. Steinert RF, Brint SF, White SM, Fine IH. Astigmatism after small incision cataract surgery. A prospective, randomized, multicenter comparison of 4-and 6.5- mm incisions. Ophthalmology. 1991;98:417-23.
[13]. Oshika T., Tsuboi, Yaguchi S., et al. Comparative study of intraocular lens implantation through 3.2 - and 5.5-mm incisions. Ophthalmology. 1994;101:1183-90.

Dr.Abdul Aziz Makayee. “A Comparative Study of Surgically Induced Astigmatism after Phacoemulsification by Temporal Clear Corneal and Superior Clear Corneal Approach.” IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 1, 2019, pp 13-18.