ORIGINAL ARTICLE

ASTIGMATISM IN PATIENTS UNDERGOING MANUAL SMALL INCISION CATARACT SURGERY (SICS) IN GENERAL HOSPITAL, CALABAR

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Objectives: To determine and compare the pattern of preoperative and postoperative astigmatism in SICS patients at General hospital, Calabar.

Materials and methods: The study was a descriptive, longitudinal hospital-based study among adult participants who underwent SICS in General Hospital, Calabar. Ethical approval was obtained from the Cross River State Health Research Ethics Committee. Informed consent was obtained from two hundred and seventy-two participants who underwent SICS with Posterior chamber Intraocular lens implantation. Autokeratometry was carried out on all participants preoperatively, Days 1, 14, and 28 postoperatively. Determination of astigmatism was done using the keratometry readings. With-the-rule (WTR) astigmatism was considered when vertical reading (K1) was found to be greater than horizontal (K2). Against- the-rule (ATR) astigmatism was considered when K2 was greater than K1. Astigmatism values ≥ 0.5D were considered clinically significant. The statistical test was deemed significant if the p-value was < 0.05.

Results: Among the 272 study participants, 159 were males (58.5%) and 113(41.5%) females. Preoperatively, 233(85.7%) participants had astigmatism, of which 230(84.6%) had ATR astigmatism. Postoperatively, 261(96.0%) had a stigmatism on days 1 and 14, while 258(94.9%) had astigmatism on day 28. The difference between those who had it on final follow-up postoperatively compared to preoperative was

25(9.2%). The predominant pattern postoperatively was also ATR astigmatism occurring in 249 (91.6%) patients at postoperative day 28.

Conclusion

ATR astigmatism was observed to occur more frequently than WTR astigmatism both pre- and post-operatively. There was a significant increase in proportion of those with astigmatism post-operatively following SICS which did not alter the pattern. However, there was a reduction in the severity of astigmatism.

Keywords: Astigmatism, Manual Small Incision, Cataract Surgery.

INTRODUCTION

Astigmatism is a type of refractive error wherein the refraction varies in the different meridia. Thus, parallel rays of light entering the eyes do not converge to a point focus but form focal lines with the eyes at rest, resulting in blurring of vision. [1] It is a commonly encountered problem in ophthalmic practice, with clinically significant ones presenting with symptoms of visual blurring,

glare, monocular diplopia, asthenopia, and distortions.[2]

Astigmatism can occur naturally and could also occur following cataract surgery.[3] Surgically-induced astigmatism (SIA) occurs due to degradation of the optical performance of the cornea from a disruption in its structural and mechanical properties following surgery which results in alterations in its curvature. SIA is related to the length, location, architecture, and closure technique of the incision. Smaller incisions and peripheral incisions at the sclera and limbus result in less surgically induced astigmatism than those that involve the cornea. Similarly suturing the incision may result in either steepening or flattening of the cornea.[4] Corneal astigmatism is often classified according to the axis of astigmatism as being either with-the rule (WTR), oblique, or against-the-rule (ATR).[4]

Globally, cataract is the most common cause of blindness with a global prevalence of 51.0%.[5] Of the 39 million people estimated to be blind worldwide, cataract is responsible for about 20 million and is more prevalent in sub-Saharan Africa which constitutes about a third of the global cataract burden.[6] The most effective treatment for visually significant cataract is surgical extraction of the opaque lens which restores or maintain vision.

The visual acuity and postoperative complications of cataract surgery are important outcome measures following cataract surgery.[7] The incorporation of intraocular lenses (IOLs) implantation such as toric IOLs has further improved the visual outcome of cataract surgery.[8] The skill of the surgeon as well as the surgical technique are other important determinants of outcome following cataract surgery.

Several procedures have been developed to minimize and stabilize SIA. Manual small incision cataract surgery (SICS) is one of the most innovative and popular techniques. The use of small cataract incisions is thought to reduce SIA resulting in more stable refraction. This study, sought to determine the frequency and pattern of preoperative versus postoperative astigmatism in SICS patients at General hospital, Calabar.

MATERIALS AND METHODS

Study design

The study was a descriptive, longitudinal hospital-based study.

Eligibility Criteria

Inclusion criteria for this study were consenting adult patients aged 18 years and above, booked for cataract surgery who had not had previous ocular surgery in the operated eye. Participants with previous ocular surgery in the same eye, grossly altered corneal surface, those less than 18 years, and those unwilling to give consent to participate were excluded.

Sample size estimation

The minimum sample size calculated was 272 participants.

Subject selection

Consecutively eligible patients that presented in the clinic on account of cataract were enrolled into the study and given a code. Ocular examination done included Visual acuity testing using illuminated Snellen's chart, autokeratometry using Auto refractokeratometre (Grand Seiko GR-3100k), slit-lamp biomicroscopic examination of the anterior segment with carl Zeiss slit lamp biomicroscope (SL 115 classic), and direct fundoscopy with Keeler's Ophthalmoscope. All operations were performed by a single surgeon under peribulbar anesthesia. All patients had manual SICS with posterior chamber intraocular lens implantation using a temporal or supero-temporal approach. All patients received steroid-antibiotics eyedrops which they used for a one-month postoperative follow-up period. Post-operatively, visual acuity, autokeratometry, slit-lamp examination, and fundoscopy were performed. This was repeated at days 14 and the final 28 days postoperatively.

Data collection

Data was collected from the participants using a proforma which was broadly divided into four parts viz; socio-demographic information, ocular symptoms, ocular examination, and physical examination findings.

Ethics

Ethical approval was obtained from the Cross River State Health Research Ethics Committee. The study adhered to the tenets of the Declaration of Helsinki. Written informed consent was obtained for all participants. Confidentiality was maintained by using identification numbers.

Data analysis

Data obtained was entered into Statistical Package for Social Sciences (IBM SPSS) version 20 for analysis. Patients' characteristics were shown using descriptive statistics (frequency, percentage, and mean). Categorical variables were reported as frequencies while continuous variables were reported as means. Astigmatism was defined based on the difference between K1 and K2 readings preoperatively and at each follow-up visit. All the astigmatic changes (preoperative and postoperative) were studied only in the vertical or horizontal axis (only at 90° and or at 180°) as the autokeratometry measurements for the machine used were limited to r these two meridians. Oblique astigmatisms could therefore not be studied. Categorical variables were compared using McNemar's chi-square test (χ^2) (and Fisher's exact test where necessary) while continuous variables were compared using Student's t-test. Determination of astigmatism was done using the keratometry readings. With-the-rule (WTR) astigmatism was considered when vertical reading (K1) was found to be greater than horizontal (K2) while Against-the-rule (ATR) astigmatism was considered when K2 was greater than K1. Astigmatism values ≥ 0.5D were considered clinically significant. Astigmatism was defined as mild if < 1 dioptre, moderate 1-1.99 dioptre, severe 2-3 dioptres and extreme > 3dioptres.The statistical test was deemed significant if the p-value was < 0.05.

RESULTS

A total of 272 participants were enrolled in the study with males constituting 159(58.5%) and females 113(41.5%) which gave a male: female ratio of 1.4: 1. The age range of participants was 18- 95 years. There was no loss to follow up of any of any of the participants by day 28 of the study.

Pattern of preoperative and postoperative astigmatism

The pattern of astigmatism observed in the patients was ATR and WTR. ATR astigmatism was more common among study participants compared to WTR astigmatism both pre-and postoperatively. The proportion of participants who had ATR astigmatism decreased postoperatively from 95.6% on Day1 to 93.8% on Day 14 then to 91.5% on Day 28 (p =0.001) Conversely, WTR astigmatism increased from 0.4% on day 1, to 2.2% on day 14, then to 3.3% on day 28 postoperatively as displayed in Table 1 below

Table 1: Pattern of preoperative versus postoperative astigmatism

Pattern of astigmatism	Pre-operative	Post-op Day 1 Frequency (%)	Post-op Day 14 Frequency (%)	Post-op Day 28 Frequency (%)
WTR	3(1.1)	1(0.4)	6(2.2)	9(3.3)
ATR	230(84.6)	260(95.6)	255(93.8)	249(91.6)

Comparison of preoperative and postoperative astigmatism

Preoperatively 233 (85.7%) of study participants had astigmatism. On day 1 and day 14 postoperatively, 261 (96%) had astigmatism. At 28 days post, operatively 258 (94.9%) had astigmatism. The difference between the cases of astigmatism on Day 28 compared to the pre-operative value (incidence) is 25 (9.2%). Table 2 below depicts the comparison between pre-operative and post-operative astigmatism.

Table 2: Comparison of preoperative versus postoperative astigmatism

	Astigmatism present Number (%)	Astigmatism absent Number (%)	Total Number (%)	Chi-square test	p-value
Pre-operative	233(85.7)	39(14.3)	272(100.0)	2.355	*0.001
Post-operative Day 1	261(96.0)	11(4.0)	272(100.0)		
Post-operative Day 2	261(96.0)	11(4.0)	272(100.0)		
Post-operative Day 28	258(94.9)	14(5.1)	272(100.0)		

Relationship between pattern of preoperative and postoperative astigmatism

Table 3 shows the relationship between the pattern of preoperative and postoperative astigmatism. Of the three participants who had WTR astigmatism preoperatively, two had ATR astigmatism postoperatively while the remaining one did not have astigmatism postoperatively. Among those with ATR astigmatism preoperatively, 9(3.9%) had WTR astigmatism postoperatively, 214(93.1%) remained as ATR astigmatism while 7(3.0%) no longer had astigmatism. Among the 39 without astigmatism preoperatively, 33(84.6%) had astigmatism postoperatively, while 6 (15.4%) still did not have astigmatism postoperatively. The difference between those who had WTR and ATR astigmatism pre-operatively in comparison with post-operative measurement was statistically significant. (p=0.001)

Table 3: Relationship between the pattern of preoperative and postoperative astigmatism

The pattern of preoperative astigmatism	Pattern of postoperative astigmatism					
	WTR	ATR	No astigmatism	Total	Chi-square test	p-value
WTR	0	2	1	3	13.029	0.011*
ATR	9	214	7	230		
No astigmatism	0	33	6	39		

*=*Statistically significant*

Comparison of severity of preoperative versus postoperative astigmatism

Of the 272 patients, 233 (85.7%) had preoperative astigmatism while 39 (14.3%) had no astigmatism. Among those who had astigmatism, it was mild in 105 (38.7%), moderate in 76(27.9%), severe in 29(10.5%), and extreme in 23(8.6%) of study participants. On postoperative day 28, 258 (94.9%) of the participants had astigmatism. Of this number, 157 (57.8%) were mild, 79 (29%) were moderate, 15 (5.5%) were severe and 7(2.6%) were extreme as shown in Table 4.

Table 4: Severity of astigmatism pre-and postoperatively

Variable	Preoperative		Postoperative day 28	
Severity of astigmatism	**Number**	**Percentage**	**Number**	**Percentage**
Mild < 1D	105	38.5	157	57.8
Moderate 1-1.99D	76	27.9	79	29.0
Severe 2-3D	29	10.5	15	5.5
Extreme >3D	23	8.6	7	2.6
	233	85.7	258	94.9

DISCUSSION

Regarding the pattern of postoperative astigmatism, against-the-rule (ATR) astigmatism was more common in the study participants (91.5%) at the final postoperative period than with-the-rule (WTR) astigmatism. This finding is similar to the report by Adio et al [10] also in Nigeria where a greater proportion of participants (73.7%) had ATR astigmatism postoperatively. Another study by Arthur et al [11] also showed that ATR astigmatism was higher than WTR astigmatism postoperatively. The observation of a high proportion of ATR astigmatism in the postoperative period is not limited to this locality. Studies conducted in other parts of Africa and Asia have consistently reported a higher proportion of ATR astigmatism.[12,13,14,15] Ayena et al [16] in Togo reported 56% of ATR astigmatism postoperatively while Magdum et al[17] had a similar result in India. This finding may likely be because a greater percentage of the participants were above 60 years of age where ATR astigmatism is more prevalent. It could also be due to the finding that ATR was the more common pattern pre-operatively. The site of surgical incision could also be a factor here, however, this was not evaluated in this study. The Studies on astigmatism following SICS for Europe and America is limited because the gold standard for cataract surgery in these regions is phacoemulsification.[18]

ATR astigmatism progressively reduced from 95.6% on a postoperative day one, to 93.8% on day 14 and then 91.5% on day 28 postoperatively while WTR astigmatism progressively increased. The reduction of ATR astigmatism with time observed in this study has also been reported in Nepal by Malik et al.[12] The steady reduction in ATR astigmatism could be due to the healing process which occurs with time. This study was limited in determining this observation because the follow-up period was for 28 days only. A study by Khanday et al[19] in which patients were followed up for 12 weeks reported a steady decline in the levels and severity of astigmatism. At one week postoperatively, 84% had ATR while 4% had WTR astigmatism but at six weeks postoperatively, 66% had ATR, 4% had WTR while 30% of the participants no longer had astigmatism. There is a bit of discrepancy regarding decrease in surgically induced astigmatism with time. For example, while Eslami et al[20] opined that SIA in patients undergoing SICS was stable at 1.5 months after surgery, Zaman et al[21] on the other hand, found just a negligible change in astigmatism from 3rd to 6th week in superotemporal incision.

There seemed to be an inverse relationship between the change in the ATR astigmatism and WTR astigmatism. It has been observed that as the proportion of participants with ATR astigmatism decreases steadily with time, those that have WTR astigmatism increase steadily alongside. This corroborates the findings of Khanday et al[19] where ATR astigmatism was reported to decline steadily during the follow-up period. Magdum et al[17]however reported a gradual increase in the number of WTR astigmatism over time in patients who had a temporal incision. The importance of the surgical incision site in the occurrence of astigmatism has been documented.[12] In this study, temporal incision was used in the majority of patients which has been shown to decrease the incidence of SIA when compared to superior incision. Thus, to ensure an improved visual outcome in post-cataract surgery as well as their quality of life, surgical incision sites with the least potential of inducing astigmatism should be used.

Comparing the pattern of pre-and postoperative astigmatism, the prevalence of preoperative astigmatism was found to be 85.7%. This is similar to the 84% reported by Khanday[19]but lower than the 98.6% prevalence of preoperative corneal astigmatism reported by Isyaku et al[22]in northern Nigeria. In the study conducted by Isyaku, ATR constituted 56.7% while WTR astigmatism constituted 41.8%.[22] This may be attributable to the similarity in mean age in both studies as ATR astigmatism is commoner with increasing age due to the laxity of the eyelids on the globe thereby inducing less steeping in the vertical meridian. A study in Egypt to assess astigmatism following SICS with three months follow-up reported no statistically significant difference between pre-and postoperative astigmatism even though the mean preoperative astigmatism was lower than the postoperative value as noted in this study.[23]Likewise a report from a study in Togo that assessed astigmatism in SICS showed that about half of them had ATR astigmatism preoperatively with a slight increase in the proportion of those who had it

postoperatively.[16] This observation in the study done in Togo might be because the incision site was not chosen based on the type of preoperative astigmatism as all the patients had supero-temporal incisions. The pattern of preoperative astigmatism could be because the majority of the patients were above 60 years of age wherein ATR astigmatism is commoner.

The difference between preoperative and postoperative patterns of astigmatism was statistically significant (p= 0.011). This observation indicates that SICS is significantly associated with a change in the frequency of astigmatism.

Conclusion:

Astigmatism could be present pre-operatively or postoperatively. Surgically induced astigmatism is one of the determinants of the visual outcome following cataract surgery. ATR astigmatism was found to be more common than WTR astigmatism both pre-and postoperatively. Methods to minimize the occurrence and severity of astigmatism could be useful in improving the visual outcome following surgery.

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Conclusion:

ATR and WTR were the two forms of astigmatism noted in this study. The frequency of ATR astigmatism was much higher than WTR astigmatism pre- operatively and post-operatively. SICS was associated with a significant increase in post-operative astigmatism. There was also a slight increase in the proportion of WTR astigmatism post-operatively. The increase in the proportion of participants that had WTR astigmatism post-operatively was not statistically significant and did not alter the pattern of astigmatism among the participants.

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