

Original Research Article**Surgically induced astigmatism following cataract surgery: A comparative study**

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Abstract

Surgically induced astigmatism is a universal phenomenon following cataract surgery. The objective of this comparative study was to compare the incidence and the amount of astigmatism following extracapsular cataract surgery, small incision cataract surgery and temporal clear corneal phacoemulsification surgery. The present study included 75 patients divided into three groups of 25 patients in each. Group A underwent extracapsular cataract surgery; Group B small incision cataract surgery and Group C temporal clear corneal phacoemulsification surgery. The patients were followed up at 1week, 3week and 6week duration. At each visit keratometry reading was done. The amount of surgically induced against the rule astigmatism was calculated using trigonometric cosine and sine rule. The incidence of surgically induced astigmatism in Group A was 13 (52%), Group B 16 (64%), Group C 18 (72%). The amount of mean surgically induced against the rule astigmatism in Group A was 1.38D, in Group B 1.31D and in Group C 1.27D. The amount of mean surgically induced astigmatism was least in temporal clear corneal phacoemulsification surgery.

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1. Introduction

Astigmatism is one of the commonest refractive error encountered during our clinical practice. Surgically induced astigmatism is the main obstacle to achieve good uncorrected visual acuity following cataract surgery. In addition to the preexisting astigmatism various parameters contribute to the post operative astigmatism such as size, width, length, depth and configuration of the incision. Donders first observed that alteration in corneal curvature is an unwelcome consequence of cataract surgery.¹ Extensive work

has been done in this context over several years to improve the surgical techniques.²⁻⁵ There is an evidence that the more peripheral the incision lesser is the least induced astigmatism.⁶ The suture material and suturing technique of full thickness limbal wound has got appreciable effect on induced astigmatism.⁷⁻¹¹ The newer instruments which are used during cataract surgery are aimed at reducing induced corneal astigmatism.¹²⁻¹⁵ Although the ophthalmic surgeons are concerned with post-operative corneal astigmatism, because it is an integral part of the post-operative refractive error, there has

been confusion in explaining the pathophysiology of post operative corneal astigmatism. Most of the individuals are having with the rule astigmatism that is, vertical meridian being more curved than horizontal because of the constant eyelid pressure on the cornea. This preoperative astigmatism will change following cataract surgery because of wound remodelling which is an important deciding factor of surgical outcome.¹⁶⁻¹⁹ Modification and control of astigmatism has been a long term goal of the ophthalmologists. Keeping all these facts in view the present study was carried out to compare the incidence and the amount of astigmatism following extracapsular cataract surgery, small incision cataract surgery and temporal clear corneal phacoemulsification surgery.

2. Materials and methods

This study was conducted in 75 patients undergoing cataract surgery in the Department of Ophthalmology, A. J. Institute of Medical Sciences, Mangalore, Karnataka, India. These patients were divided into three groups. Group A, included 25 patients undergoing extracapsular cataract surgery, Group B had 25 patients undergoing small incision cataract surgery and Group C had 25 patients undergoing temporal clear corneal phacoemulsification surgery. Children less than 12 years, patients with corneal

pathology, and post operative complications were excluded from the study.

Preoperatively all patients were subjected to detailed history taking, general physical examination and complete ophthalmic examination. Keratometry was done by using Baush and Lomb type keratometer. An axial length and intra ocular lens (IOL) power were calculated using A-scan. All surgeries of three groups were conducted by a single surgeon. Post operative follow up was done at 1 week, 3 week and 6 week duration. At each visit complete ophthalmic examination and keratometry, slit lamp examination and fundus examinations were done. At the end of 6 weeks best corrected visual acuity was done.

All the keratometric values were recorded and surgically induced astigmatism was calculated using trigonometric cosine and sine rule application.²⁰⁻²² The law of cosines is $K_2^2 = K_1^2 + K_3^2 - 2K_1K_3 \cos k_2$ and law of sines is $K_1 / \sin k_1 = K_2 / \sin k_2 = K_3 / \sin k_3$ where K_1 is preoperative astigmatism, K_2 is surgically induced astigmatism, K_3 is postoperative astigmatism and axis was given by k_1, k_2, k_3 . The trigonometric functions were calculated by using a scientific calculator. The numerical data were compared between three groups using Kruskal- Wallis test.

Table 1: Mean surgically induced astigmatism in Group A

Types of astigmatism	Group A		
	1 wk	3 wk	6wk
With the rule	1.5 D	0.96 D	0.9 D
Against the rule	1.19 D	1.46 D	1.38 D
Oblique	4.73 D	4.26 D	4.43 D
No astigmatism	0	0	0

Table 2: Mean surgically induced astigmatism in Group B

Types of astigmatism	Group B		
	1 wk	3 wk	6 wk
With the rule	0.59 D	0.7 D	0.5 D
Against the rule	1.26 D	1.26 D	1.31 D
Oblique	4.00 D	4.00 D	5.00 D
No astigmatism	0	0	0

3. Results

In this study, Group A and Group B had 52% males and 48% females and Group C had 44% males and 56% females. The prevalence of the preoperative astigmatism was 88% and majority of it was against the rule type (0.66D). The incidence of surgically induced astigmatism in most of the Group A patients was 13 (52%) against the rule type and average amount of astigmatism was 1.38D. Table 1 shows the mean surgically induced astigmatism in Group A. In group B also against the rule astigmatism was found in 16 (64%) patients and the amount of astigmatism was 1.31D. Table 2 shows the mean surgically induced astigmatism in Group B. In group C the incidence of against the rule astigmatism was highest 18 (72%) and the amount of astigmatism was least (1.27D) when compared to other two groups. Table 3 gives the mean surgically induced astigmatism in Group C. Table 4 shows the incidence of surgically induced astigmatism in all the three groups.

4. Discussion

Astigmatism following cataract surgery is a most common complication which affects the visual acuity of the patient. The factors which are responsible for this astigmatism are incision site, size, suture materials used and technique of wound closure.²³⁻²⁵ The surgical procedures involving the cornea may induce or correct astigmatism by altering the radius of curvature of the cornea in a meridian, in turn inducing a change in the shape of the cornea.²⁶

When an incision is placed superiorly there is flattening of the vertical meridian. When this wound is closed with suture it may induce steepening of the vertical meridian, if sutures are tight and causes flattening when it is too loose. With time as the wound healing progresses there is a flattening of the vertical meridian due to stretching of the incision scar.²⁷ So as a rule, in early post operative period with the rule astigmatism was seen and in the late post

Table 3: Mean surgically induced astigmatism in Group C

Types of astigmatism	Group C		
	1 wk	3 wk	6 wk
With the rule	1.33 D	1.35 D	1.30 D
Against the rule	1.25 D	.30 D	1.27 D
Oblique	0	0	0
No Astigmatism	0	0	0

p=0.066

Table 4: Incidence of surgically induced astigmatism

Type of astigmatism	Group A	Group B	Group C
With the rule	5 (20%)	6 (24%)	5 (20%)
Against the rule	13 (52%)	16 (64%)	18 (72%)
Oblique astigmatism	3 (12%)	1 (4%)	0
No astigmatism	4 (16%)	2 (8%)	2 (8%)

operative period against the rule astigmatism was seen.

In this study the incidence of preoperative astigmatism in all the three groups was 88%. It is comparable to 95% of Duke Elder's study.²⁸ The pattern of preoperative astigmatism in group A included 44% with the rule and 44% against the rule while 12% had no astigmatism. In group B with the rule astigmatism was seen in 40% and against the rule astigmatism in 48% and 12% had no astigmatism. In group C 28% had with the rule astigmatism, 60% were against the rule type and 12% had no astigmatism. In all the three groups incidence of against the rule astigmatism was highest. It is comparable to a study by Archana et al.²⁹

The amount of pre operative astigmatism in group A with the rule astigmatism was 0.77D and against the rule astigmatism 0.36D. In group B with the rule astigmatism was 0.72D and against the rule astigmatism was 0.43D. In group C with the rule and against the rule astigmatism was 0.5D. This is comparable to a study done by Gokhale and Sawhney.³⁰

In our study most common type of surgically induced astigmatism was against the rule. The amount of surgically induced astigmatism was least in clear corneal incision surgery (against the rule 1.27D) when compared to other groups. According to this study whenever there is high degree of with the rule preoperative astigmatism one could consider small incision cataract surgery or clear corneal incision and if patient is having high degree of against the rule astigmatism any of the three types are suitable but most preferred would be temporal clear corneal incision surgery.

In small incision cataract surgery because the incision was placed more peripherally it exerts less traction on the cornea there by controlling surgically induced astigmatism and it also increases appositional surface to enhance wound healing.

The limbal based extra capsular cataract extraction (ECCE) incision creates a wound that has deficient closure and with clinically apparent problems at the time of surgery that might affect the long term wound healing. This had been demonstrated by Talamo et al. who had observed astigmatic instability of the post operative extra capsular cataract surgery patients.³¹

Most anteriorly placed temporal clear corneal incision has a self sealing property. Temporally placed clear corneal incision has added advantage of controlling astigmatism because the distance from the visual axis to the incision is longer in that meridian.²⁰ Therefore flattening at the incision is less likely to be transmitted to the visual axis, so it has very good astigmatic control.

In conclusion, the surgically induced astigmatism is comparatively less in temporal clear corneal incision surgery and with the availability of down sized phacoemulsification tips and foldable IOL this surgery has become the technique of choice for early visual rehabilitation.

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