

Pre-existing Corneal Astigmatism in patients undergoing Cataract Surgery in Western Nepal; A hospital-based Unicentered, Comprehensive, Prospective Observational Study

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ABSTRACT

Introduction: Cataract surgery is one of the most commonly performed surgical procedures worldwide. The final postoperative visual acuity is dependent on the pre-existing corneal astigmatism, accurate biometry and surgically induced astigmatism. Because of the increase in the patient's demand for better postoperative visual acuity, it becomes important to evaluate the distribution of pre-existing corneal astigmatism in different populations. The objective of the study was to analyze the magnitude and pattern of pre-existing corneal astigmatism in cataract surgery patients in Western Nepal.

Methods: A hospital-based cross-sectional descriptive study was carried out in the Department of Ophthalmology, Manipal Teaching Hospital, Pokhara. Three hundred and two patients undergoing routine cataract surgery between February 2016 and January 2018 were recruited in the study. Keratometric data from these patients were collected and were analyzed using the statistical software SPSS version 21.

Results: The mean age of the subjects was 70.25 ± 10.97 years (range 35 to 94 years). There was a preponderance of females (62%) over males (38%). The mean corneal astigmatism was 0.78 ± 0.59 D (range 0.00 to 5.00 D). The pre-existing corneal cylinder ≥ 1.00 D was seen in 40.06% of patients. The corneal astigmatism was mainly against the rule (65.56%). The amount of corneal astigmatism and corneal steepness increased with age.

Conclusion: Corneal astigmatism of 1.00 D or more was seen in 40.06% of the patients undergoing cataract surgery which should be corrected to meet the patient's expectation for good, unaided visual acuity after cataract surgery.

Keywords: *Astigmatism; Cataract; Corneal; Surgery*

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INTRODUCTION

Cataract surgery is one of the most commonly performed surgical procedures worldwide.



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The main aim of cataract surgery is rapid visual rehabilitation, the best possible uncorrected visual acuity and minimal postoperative astigmatism.¹ The final postoperative visual acuity is dependent on the pre-existing corneal astigmatism, accurate biometry, intraocular lens (IOL) power calculation and surgically induced astigmatism. Astigmatism leads to a reduction in visual performance for both distance and near, reduction in stereoacuity and contrast sensitivity.²

The prevalence of regular corneal astigmatism in the cataract population has been reported from European nations, China and Thailand.^{3,4,5,6,7,8,9} Similarly, a study has been reported from Central Nepal but none has been conducted in Western Nepal.¹⁰

The purpose of this study was to analyze the magnitude and pattern of corneal astigmatism in the Nepalese population who underwent routine cataract surgery.

METHODS

A hospital-based cross-sectional descriptive study was conducted in the Department of Ophthalmology, Manipal Teaching Hospital, Pokhara from February 2016 to January 2018. Three hundred and two patients undergoing routine cataract surgery were recruited. The sample size was calculated using the formula:

$n = \frac{Z\alpha/2 \times \sigma}{E}^2$ ($Z\alpha/2=1.96$, where $Z\alpha/2$ is the standard variate at 95% confidence interval,

$E=0.1$, where E is the margin of error of 10%, $\sigma=0.8D$ of mean corneal astigmatism

$$E = \frac{[1.96 \times 0.8]^2}{[0.1]^2}, \text{ SD was taken from the study.}^{10}$$

= 246.

Preceding the study, ethical approval from the institutional research ethical committee was obtained with ID no. MEMG/IRC/GA 1296. Inclusion criteria included the presence of cataract and age between 35 and 95 years. Exclusion criteria included irregular

astigmatism, corneal disease, previous corneal or intraocular surgery, and history of ocular inflammation. Subjects who had participated gave written consent before enrollment in the study. All the patients had undergone complete ophthalmologic examination including visual acuity, refraction, slit-lamp examination, tonometry, keratometry, ultrasound A-scan and B-scan if required. Keratometric data were collected using Bausch and Lomb keratometer (Appa Samy).

Astigmatism was calculated from the dioptic difference of vertical reading from horizontal reading. With the rule (WTR) astigmatism was considered when steep meridian was at $90^\circ \pm 20^\circ$. Against the rule (ATR) astigmatism was considered when steep meridian was at $180^\circ \pm 20^\circ$. Astigmatism in another direction was defined as oblique astigmatism.

Data were collected and analyzed using statistical software SPSS version 21.

RESULTS

During the study period, 302 patients were recruited. The mean age of the subjects was 70.25 ± 10.97 years (range was between 35 to 94 years). There was a preponderance of females (62%) over males (38%). Table 1 lists the demographic characteristics of the patients. The mean corneal astigmatism was 0.78 ± 0.59 D (range 0.00 to 5.00 D).

Table 1: Demographic characteristics and clinical findings of the study population

Characteristics	Value
No. of eyes/patients (n)	302/302
Age (years)	
Mean \pm SD	70.25 \pm 10.97
Range	35 - 94
Gender (Male/Female)	115/187
Mean corneal astigmatism (D) \pm SD	0.78 \pm 0.59 0.00 - 5.00
Range of corneal astigmatism (D)	0.00 - 5.00
Mean Keratometry (D)	
Flat \pm SD	43.85 \pm 1.31
Steep \pm SD	44.63 \pm 1.44
Range of keratometry (D)	40.25-50.00

SD-Standard Deviation, D-Dioptre

Table 2 demonstrates the prevalence of corneal astigmatism stratified by the amount of astigmatism. The pre-existing corneal cylinder ≥ 1.00 D was seen in 40.06% of patients.

Table 2: Prevalence of corneal astigmatism

Corneal astigmatism (D)	Frequency (n)	Percentage (%)
<0.5	68	22.52
0.5-<1.0	113	37.42
1.0-<2.0	113	37.42
2.0-<3.0	5	1.65
≥ 3.0	3	0.99
TOTAL	302	100

D-Diopter

The corneal astigmatism was mainly against-the-rule (ATR) that was seen in 65.56%, whereas 23.18% had with-the-rule astigmatism (WTR) as shown in table 3.

Table 3: Pattern of corneal astigmatism

Age (Years)	WTR	ATR	N/A
≤ 49	8/73%	2/18%	1/9%
50-59	15/43%	13/37%	7/20%
60-69	34/39%	38/43%	16/18%
70-79	12/12%	78/80%	8/8%
80-89	1/2%	62/95%	2/3%
≥ 90	0	5/100%	0

WTR- With-the rule-astigmatism, ATR- against-the-rule astigmatism, NA- No astigmatism

The descriptive statistics by age group are displayed in table 4.

Table 4: Descriptive statistics by age group

Age (years)	Frequency (n)	Astigmatism Mean \pm SD (D)	K1* Mean \pm SD (D)	K2* Mean \pm SD (D)
≤ 49	11	0.39 \pm 0.26	42.93 \pm 0.35	43.32 \pm 0.25
50-59	35	0.51 \pm 0.40	43.10 \pm 1.17	43.59 \pm 1.22
60-69	88	0.69 \pm 0.73	43.48 \pm 1.34	44.18 \pm 1.45
70-79	98	0.75 \pm 0.46	43.88 \pm 1.18	44.63 \pm 1.15
80-89	65	1.11 \pm 0.53	44.74 \pm 1.04	45.85 \pm 0.99
≥ 90	5	1.55 \pm 0.45	45.40 \pm 0.52	46.8 \pm 0.59

SD-Standard Deviation, D-Dioptre, *K1-flat keratometry, K2-steep keratometry

Overall, the maximum number of patients

with corneal astigmatism was seen in the age group between 70 to 79 years. There was a progressive increase in the magnitude of astigmatism and both the keratometric values with an increase in age. Figure 1 depicts a progressive increase in ATR astigmatism with age.

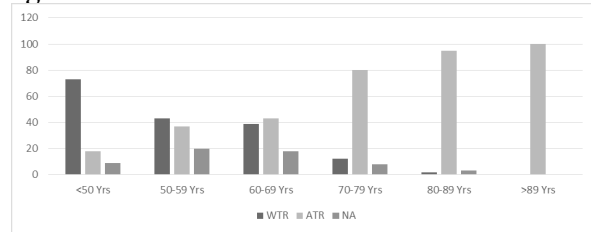


Figure 1: Distribution of astigmatism according to various age-groups

DISCUSSION

The significant visual and functional impact of uncorrected astigmatism emphasizes the need for its correction. The reduction in distance visual acuity with induced astigmatism is said to be least with induced with-the-rule astigmatism and greatest with either against-the-rule or oblique astigmatism.² Guo and Atchison concluded that a reduction in the visual acuity of 0.1logMAR line of letters required 0.28 ± 0.12 D of induced cylindrical power.¹¹ So, it is important to analyze the magnitude and pattern of preoperative astigmatism to meet the patient's expectation for good, unaided visual acuity after cataract surgery.

This study reports the burden of corneal astigmatism in patients before cataract surgery and describes the distribution in different age subsets. A significant number of patients undergoing cataract surgery had pre-existing corneal astigmatism of 1.00 D or more (40.06%). These results agree with those seen in Chinese (41%), and the British population (40.4%).^{5,6} The corneal astigmatism was reported to be even higher in another Chinese study (45.4%) whereas it was less in the Thai population (37.8%) and Spanish population (35%).^{7,9,4} In the present study, there was a preponderance of females (62%) over males (38%) which was also seen in other studies.^{4,5,6,7,9} This explains that cataract is more prevalent in the female population.

The mean corneal astigmatism (0.78 ± 0.59 D) was similar to the study by Chaudhary et al.¹⁰ (0.84 ± 0.80 D) which was lesser than other studies, which could be due to racial factors.^{4,5,6,7,9} The range of corneal astigmatism was similar to studies reported by Lekhanont et al.⁹ (4.5 D) and Guan et al.⁷ (5.2 D) and it ranged upto 6.75 D in the Spanish population.⁴ The tendency of corneal astigmatism to increase with age was congruent with several other studies.^{6,7,8,9} The corneal astigmatism was mainly ATR which was observed in 65.56% of the subjects. Studies in the Thai population (62.2%) and various studies in the Chinese population (58.2%, 53.2%, 50%) resembled our result.^{6,7,8,9} Rashid et al.¹² reported a much higher prevalence of ATR (79%). However, WTR astigmatism was more common among the Germans (46.8%).³ The incidence of ATR astigmatism increased with age. Identical results have been reported by other studies.^{6,7,9,12} The lower range of keratometry values was higher as compared to other studies 40.25 to 50.00 D vs 38.00 to 49.00 D reported by Lekhanont et al.⁹ and 38.00 to 48.00 D by Ferrer-Blasco et al.⁴ The highest range was seen in the study reported by Guan et al.⁷ This study was limited by a small number of subjects. So, it may not represent the data of the whole population of Western Nepal.

CONCLUSION

The level of corneal astigmatism ≥ 1.00 D was seen in more than one third of the total subjects and majority of them had against-the-rule astigmatism accounting for two-third of the cases. This amount of corneal astigmatism after the cataract surgery will significantly influence the postoperative visual acuity. Because of the increase in the patient's demand for better postoperative visual acuity, it becomes important to evaluate the distribution of pre-existing corneal astigmatism in different populations.

CONFLICT OF INTEREST

None

SOURCES OF FUNDING

None

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