

# Study of corneal astigmatism in patients undergoing cataract surgery in a tertiary care hospital

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## Abstract

**Background:** A cataract is the opacity of the lens in the eye that is considered as one of the major causes of blindness worldwide and its only treatment is surgery. To achieve the best postoperative visual performance both spherical and cylindrical components should be corrected at the time of the surgery. The purpose of this study was to report prevalence of corneal astigmatism and evaluate clinical profile of patients with astigmatism posted for cataract surgery at our tertiary hospital. **Material and Methods:** Present study was cross-sectional study, conducted in patients posted for cataract surgery and corneal astigmatism was measured. **Results:** During study period, total 460 patients/ 460 eyes satisfying study criteria were posted for cataract surgery. Mean age was  $67.8 \pm 13.8$ , majority were male (55.22%), gender ratio (Male: Female) was 1.23:1. Majority of cataracts were mixed type (45.43%) and nuclear sclerosis (38.91%) other less common types were posterior sub capsular opacification (7.61%), mature cataract (5.22%), cortical cataract (2.39%) and developmental cataract (0.43%). Mean keratometry values were K1 - 42.19 D and K2 - 42.91 D and range was 32-51 D. Mean corneal astigmatism  $0.89 \pm 0.82$  D and range was 0- 5.61 D. Mean sphere was  $1.51 \pm 1.92$  D, mean cylinder  $0.39 \pm 0.59$  D and range of cylinder was 0-2.51 D. In present study, no astigmatism was noted in 8.04%, while oblique astigmatism was in 14.78% cases. Majority of cases had with the rule astigmatism (41.09%), followed by against the rule astigmatism (36.09%). **Conclusion:** Significant numbers of patients have preoperative corneal astigmatism of 1D or more which can affect the quality of vision after cataract surgery, astigmatism increases with age. Majority of these can be corrected by simple cost-effective keratorefractive procedures.

**Keywords:** Preoperative assessment, corneal astigmatism, cataract surgery, keratorefractive procedures.

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## INTRODUCTION

A cataract is the opacity of the lens in the eye that is considered as one of the major causes of blindness

worldwide and its only treatment is surgery. Cataract extraction with implantation of an artificial Intraocular Lens (IOL) implant is the currently accepted treatment for symptomatic cataracts.<sup>1</sup> The main aim of cataract surgery today is rapid visual rehabilitation, the best possible uncorrected visual acuity, and minimal postoperative astigmatism.<sup>2</sup> Ocular astigmatism is a refractive condition which occurs because of unequal curvatures of the cornea and the crystalline lens, decentration or tilting of the lens, or unequal refractive indices across the crystalline lens.<sup>3</sup> The prevalence of pre-existing anterior corneal astigmatism of >1.00 diopter (D), >1.5 D and >2.00 D has been reported to range from 32.5–45.5%, 21.0–26.20% and 8%, respectively, in patients with cataract.<sup>4,5,6</sup> To achieve the best postoperative visual performance both

spherical and cylindrical components should be corrected at the time of the surgery.<sup>7</sup> The purpose of this study was to report prevalence of corneal astigmatism and evaluate clinical profile of patients with astigmatism posted for cataract surgery at our tertiary hospital.

**MATERIAL AND METHODS**

Present study was cross-sectional study, conducted in Department of Ophthalmology, BKL Walawalkar Rural Medical College, Kasarwadi, Chiplun, India. Study was conducted during January 2020 to December 2020. Study approval was taken from institutional ethical committee.

**Inclusion criteria:** patients posted for cataract surgery

**Exclusion criteria:** Patients with corneal diseases, irregular astigmatism, History of ocular inflammation, corneal or intraocular surgery.

Study was explained and a written informed consent was taken for participation.

All cases underwent history taking (present, past medical/surgical), general/systemic examination followed by complete ophthalmological evaluation (visual assessment, slit lamp anterior segment examination and ophthalmoscopy through the dilated pupils). Corneal curvature was assessed by IOL. The keratometric values were collected by an experienced technician for the consecutive patients and an average of three measurements of the parameters was subjected to analysis. Corneal astigmatism (CA) was categorised as with the rule (WTR) when meridian of maximum curvature was within 308 of vertical 908 or against the rule (ATR) when meridian of maximum curvature was within 308 of horizontal 1808 and oblique (OBL) if it was neither WTR nor ATR. Data was collected and compiled using Microsoft Excel. Statistical analysis was done using descriptive statistics.

**RESULTS**

During study period, total 460 patients/ 460 eyes satisfying study criteria were posted for cataract surgery. Mean age was 67.8 ± 13.8, majority were male (55.22%), gender ratio (Male: Female) was 1.23:1. Majority of cataracts were mixed type (45.43%) and nuclear sclerosis (38.91%) other less common types were posterior sub capsular opacification (7.61%), mature cataract (5.22%), cortical cataract (2.39%) and developmental cataract (0.43%).

**Table 1: General characteristics**

Characteristic	Numbers (n) / Mean ± SD	Percentage (%)
Number of patients/ Number of eyes	460	
Age range (years)	14-82	
Mean age (years)	67.8 ± 13.8	
Gender		
Male	254	55.22%
Female	206	44.78%
Gender ratio (Male: Female)	1.23:1	
Types of cataract		
Mixed type	209	45.43%
Nuclear sclerosis	179	38.91%
Posterior sub capsular opacification	35	7.61%
Mature cataract	24	5.22%
Cortical cataract	11	2.39%
Developmental cataract	2	0.43%

Mean keratometry values were K1 - 42.19 D and K2 - 42.91 D and range was 32-51 D. Mean corneal astigmatism 0.89 ± 0.82 D and range was 0- 5.61 D. Mean sphere was 1.51 ± 1.92 D, mean cylinder 0.39± 0.59 D and range of cylinder was 0-2.51 D.

**Table 2: Keratometry values**

Keratometry values	Value / Mean ± SD
Mean keratometry (D)	
K1	42.19
K2	42.91
Mean corneal astigmatism (D)	0.89 ± 0.82
Range of corneal astigmatism (D)	0- 5.61
Range of Keratometry	32-51
Mean sphere (D)	1.51 ± 1.92
Mean cylinder (D)	0.39± 0.59
Range of cylinder (D)	0-2.51

In present study, no astigmatism was noted in 8.04%, while oblique astigmatism was in 14.78% cases. Majority of cases had with the rule astigmatism (41.09%), followed by against the rule astigmatism (36.09%).

**Table 3: Distribution of different types of corneal astigmatism**

Types of astigmatism	Numbers (n)	Percentage (%)
With the rule	189	41.09%
Against the rule	166	36.09%
Oblique astigmatism	68	14.78%
No astigmatism	37	8.04%

## DISCUSSION

Advances in the calculation of IOL power have significantly reduced the incidence of spherical refractive errors, while residual astigmatism after surgery is a concern for both ophthalmologists and patients and can leave patients with symptomatic decreased visual function.<sup>8</sup> Various factors such as physiological changes in the corneal curvature as age advances, pressure from eyelids, pressure by intraocular pressure, and of the extraocular muscles have been anticipated to be responsible factors for changes in ATR and WTR with age. Correcting preexisting corneal astigmatism is commonly carried out at the time of cataract surgery by making limbal or corneal relaxing incisions or by the implantation of toric IOLs.<sup>9</sup> There exist several techniques to reduce preexisting corneal astigmatism including axis phacoemulsification, opposite clear corneal incisions (OCCI), limbal relaxing incisions (LRI's), excimer laser refractive procedures, femtosecond laser-assisted astigmatic keratotomy and toric intraocular lens (IOL) implantation.<sup>10,11</sup> Chaudhary M<sup>12</sup> studied 225 eyes of 185 subjects, out of which 61.3% were female eyes. The mean age of the subjects was 64.45±12.89 years. Mean amount of corneal astigmatism was 0.84±0.80 D. 16.9% had no significant corneal astigmatism while 65.3% had corneal astigmatism between 0.25 and 1.50 diopter and 17.8% had corneal astigmatism of 1.50D or higher. With-the-rule astigmatism (axis of correcting cylinder 180±30 degrees) was present in 44.4% eyes, 40.04% of the eyes had against-the-rule (ATR) astigmatism (correcting minus cylinder 90±30 degrees), and 12.9% of the eyes had oblique astigmatism. Approximately two thirds of pre-operative cataract patients had 1D or less astigmatism. Sharma A *et al.*,<sup>13</sup> studied 3597 eyes, 50.3% females, mean age was 59.121±15.19. The mean corneal astigmatism among all patients was 1.17±1.15 D (range 0–12.5 D). There was no astigmatism in 99 eyes (2.78%), with-the-rule (WTR) in 1062 eyes (29.83%), against-the-rule (ATR) in 1843 eyes (51.72%) and oblique astigmatism (OA) in 555 eyes (15.59%). The tendency of a gradual change from with the rule (WTR) to against the rule (ATR) astigmatism was noted as the age advanced. Around 56.69% of eyes had

corneal astigmatism of <1.0 D that can be managed by simple cost-effective keratorefractive procedures especially in developing countries. While 40.49% patients had >1.0 D of corneal astigmatism, which may benefit by toric intraocular lenses. Similar findings were noted in present study. Gupta PS,<sup>14</sup> studied 370 eyes of 370 patients, mean age was 60.43 ± 9.9 years and 50.54% were males and the rest were females. The mean of K, K1, and K2 was 44.23 ± 1.65 D, 43.75 ± 1.68 D, and 44.71 ± 1.74 D, respectively. Almost 82.16% of the studied population had mean corneal astigmatism <1.5 D. The corneal astigmatism was against the rule (ATR) in 52.16%, with the rule (WTR) in 27.29%, and oblique in 17.83%. With increasing age, there is a gradual shift of astigmatism from WTR to ATR, in both males and females, which peaks in the sixth decade of life. Similar findings were noted in present study. Moulick PS *et al.*,<sup>15</sup> studied mean CA of 223 eyes of 223 patients [mean age 61 ± 10 years (range, 29–90 years)] was 0.88 ± 0.61 (95% CI, 0.80–0.96) with 27.8%, 51.1% and 21.1% having with the rule (WTR), against the rule (ATR) and oblique astigmatism (OBL) respectively. Between 40 and 50 years, ATR exceeds WTR and reaches 100% by 80 years. A trend of less negative CA was seen up to 60 years and then increases up to 90 years. CA was below 0.25 diopter (D) in 17.5% of eyes, between 0.25 and 1.25 D in 63.7% and ≥1.50 D in 18.8% of eyes. In study by Joshi RS<sup>4</sup> 1000 eyes of 880 patients were studied. Mean age was 65.1 ± 10.12 years. The mean astigmatism was 0.89 ± 0.63 D. A total of 179 eyes (17.9%) had astigmatism between 1.00 and 1.49 D; 34 eyes (3.4%) had astigmatism between 2.00 and 2.5 D; and 20 eyes (2%) had astigmatism >3 D. Overall, 325 eyes (32.5%) had astigmatism >1.00 D. Against the rule astigmatism was seen in 44.6% cases, oblique astigmatism was seen in 32% cases, and with the rule astigmatism was seen in 20.7% cases. Against the rule astigmatism increased with age and reached a maximum between 60 and 69 years. Male eyes had flatter corneal curvature than female eyes. The mean axial length was 25.59 mm, and the mean intraocular lens power was 21.05 ± 1.0D. With technological advancements in cataract removal, expectations for better quality of vision are rising. It not only addresses the dependency on the spectacle, but also improves quality of life. Postoperative astigmatism can be either surgery induced or residual of preoperative corneal astigmatism. Surgically induced astigmatism has greatly been reduced by the use of small phacotips and smaller incisions. However, the presence of preoperative corneal astigmatism continues to challenge the final visual outcome.<sup>16</sup>

## CONCLUSION

Preoperative assessment of corneal astigmatism is important for best visual results and patient satisfaction after cataract surgery. Significant numbers of patients have preoperative corneal astigmatism of 1D or more which can affect the quality of vision after cataract surgery, astigmatism increases with age. Majority of these can be corrected by simple cost-effective keratorefractive procedures.

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