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Original Article

Prevalence of corneal astigmatism before cataract surgery in Western Indian Population

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ABSTRACT

Background: The prevalence and nature of corneal astigmatism among cataract surgery candidates has not been well-documented in Indian population. The purpose of the study is to analyse prevalence and presentation patterns of corneal astigmatism (CA) in cataract surgery candidates.

Methods: Keratometric values were measured in patients before cataract extraction. Descriptive statistics of CA were analysed including the assessment with age ranges.

Results: 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 dioptre (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.

Conclusions: Considering CA < 1.25 D in majority of cataract surgery candidates, it is preferable to perform inexpensive keratorefractive procedures rather expensive toric IOLs, especially in developing world.

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Introduction

With the advancement in the calculation of intraocular lens (IOL) power, a significant reduction in spherical error has been achieved. However, residual astigmatism remains concern

for both the treating surgeon and the patient due to reduced visual acuity after phacoemulsification. There exist several techniques to reduce pre existing corneal astigmatism including axis phacoemulsification,¹ opposite clear corneal incisions (OCCI),² limbal relaxing incisions (LRI's),³ excimer laser refractive procedures,⁴ femtosecond laser-assisted

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astigmatic keratotomy,⁵ and toric intraocular lens (IOL) implantation.⁶ The procedure chosen primarily depend on the type and the strength of astigmatism. The current study is primarily aimed to study the parameters pertaining to corneal astigmatism in patients selected to undergo cataract surgery so that an estimate could be done by the hospitals and the manufacturing companies of the percentage of patients who would be requiring toric IOL implantation and the percentage of patients who would benefit from low cost keratorefractive surgery. In effect it would help in assessment of the need of astigmatically neutral surgery vis-a-vis implantation of toric intraocular lenses.

Material and methods

This study adheres strictly to the tenets of the Declaration of Helsinki, and a prior approval of the institutional ethical committee has been taken. In this cross-sectional study, keratometric values of cataract surgery candidates were collected from January 2015 to December 2015. A total of 223 eyes of 223 patients have been included and the study was carried out in a tertiary care hospital in Western India. The above sample size was calculated based on true prevalence value of corneal astigmatism (CA) as 87% (based on previous study),⁷ confidence interval as 95% and an absolute error of margin as 5%. Written informed consent was taken from all the patients.

Patients with corneal diseases, irregular astigmatism, history of ocular inflammation, corneal or intraocular surgery have been excluded from the study. All eyes underwent complete ophthalmological assessment before the cataract surgery procedure, including visual assessment, slit lamp anterior segment examination and ophthalmoscopy through the dilated pupils. Corneal curvature was assessed by IOL Master 500 (Carl Zeiss Meditec AG). 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. CA was categorised as with the rule (WTR) when meridian of maximum curvature was within 30° of vertical 90° or against the rule (ATR) when meridian of maximum curvature was within 30° of horizontal 180° and oblique (OBL) if it was neither WTR nor ATR.

Statistical analysis

Data analysis was done by using SPSS (Statistical package for social sciences) version 19.0. Descriptive statistics was applied to estimate the mean astigmatism, the percentage of individuals in different types and ranges of astigmatism in addition to the percentage of different types of astigmatism in different age brackets. One-way analysis of variance (ANOVA) was applied for the comparison of variance for normally distributed data among different age groups. ANOVA was carried out after testing for homogeneity assumption. Post hoc analysis was done using bonferoni test. p -Value < 0.05 is considered as significant.

Results

This study comprises of 223 eyes of 223 patients. Of these, 121 (54.30%) were male, while 102 (45.70%) were female. The mean age of the patients was 60.70 ± 10.46 years (range: 35–90 years). Right eye was operated in 124 patients and left eye in 99. The mean preoperative keratometric (K) astigmatism was 0.87 ± 0.61 (95% CI, 0.80–0.96) with mean anterior corneal power at one axis (K1) as 44.12 ± 1.612 dioptre (D) (range, 39–48 D) and mean anterior corneal power at 90° to K1 (K2) as 44.95 ± 1.62 D (range, 39–50 D). The most common cylindrical value lies in between 0.25 and 1.25 D and seen in 63.7% of eyes followed by >1.25 D of astigmatism in 18.8% of eyes. The least amount of astigmatism i.e. 0–0.25D is seen in 17.5% of eyes.

Using analysis of variation, Table 1 and Fig. 1 depict that the mean CA does not show a statistically significant difference ($p = 0.253$) in different age groups. However, a trend is being seen of decrease in mean astigmatism up to 60 years of age and thereafter, an increase in mean astigmatism up to 90 years of age.

Out of 223 eyes, WTR astigmatism was found in 62 eyes (27.8%; 95% CI, 44.56–51.64), ATR astigmatism in 114 eyes (51.1%; CI, 44.56–51.64) and OBL astigmatism in 47 eyes (21.1%; CI, 16.10–26.75). Table 2 shows that WTR predominates up to 40 years of age. Thereafter, ATR predominates and its predominance continues with advancing age and beyond 80 years, ATR is seen in 100% of eyes.

Table 1 – Mean corneal astigmatism (CA) in different age groups. Using ANOVA, insignificant difference ($p = 0.253$) was observed in CA among different age groups.

Age groups	n	Mean CA	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
≤40	14	-.93	.605	.162	-1.28	-.58	-2	0
41–50	20	-.89	.598	.134	-1.17	-.61	-3	0
51–60	57	-.70	.619	.082	-.87	-.54	-3	0
61–70	99	-.95	.581	.058	-1.06	-.83	-3	0
71–80	30	-.91	.671	.122	-1.16	-.66	-3	0
81–90	3	-1.13	.749	.432	-2.99	.73	-2	0
Total	223	-.88	.610	.041	-.96	-.79	-3	0

CA: corneal astigmatism.

Fig. 1 – A box and whisker plot depicting mean corneal astigmatism (y axis) at different age groups (x axis).

Discussion

The prevalence and nature of CA in cataract surgery candidates is less well documented in Indian population. The current study is a step ahead to address this issue as it will direct the surgeon to adopt a suitable corrective procedure for CA in order to enhance the post cataract surgery satisfaction rate. First described by Thomas Young in 1801, CA is currently present in more than 90% of adult eyes. Careful assessment of CA is therefore an essential component of any preoperative examination. Refinement of the refractive outcome may arguably be the single most pressing and important challenge faced by today's cataract surgeons. Even after performing an accurate biometry before implanting a spherical IOL during cataract surgery, CA if not addressed to, thus leading to patients having some amount of unaided blurring/distortion of vision which requires to be corrected with sphero-cylindrical glasses.

The mean CA as reported in our cohort is slightly less than the reported literature.^{8–14} This difference shows that western Indians have slightly less mean astigmatism as compared to Africans, Caucasians, Orientals and North Indians.

In our study, a large proportion of eyes have CA between 0.25 and 1.25 D. This observation is in line with the study by

Chen et al.¹¹ and Prasher et al.¹⁴ However, Collier Wakefield et al.,¹⁵ have observed a lower result unlike Khan et al.,¹⁶ which have observed a higher result in the similar group. Moreover, the proportion of eyes with <0.25 D of CA is 4.8% as observed by Khan et al.,¹⁶ unlike our study with CA as 17.5%. This variation in results among the studies could be attributed to the difference in sample size in addition to the recruitment of cases from different races.

There exist various corrective techniques for astigmatism in a cataract surgery candidate and has been mentioned above. It is well known that astigmatism <0.25 D does not require correction as patients have good visual acuity without any distortion/blurring of vision. Astigmatism between 0.50 and 1.25 D can be managed either by steep axis incisions, OCCI or LRI's. Patients with astigmatism ≥1.25 D are invariably corrected by toric IOLs. To correct unusually high levels of astigmatism, LRI's may be used in conjunction with a toric IOL or excimer laser surgery. The proportion of eyes in different ranges of astigmatism in a population enable insurance agencies to decide about the budget related to cataract surgeries including the estimation by manufacturing agencies about the requirement of toric IOLs.

ATR was greater in higher age group as compared to lower age group and this is an accepted fact which is aptly outlined in various studies.^{8,11,12,14,17–20} On the contrary, extensive literature search revealed only one study highlighting the predominance of WTR over ATR.²¹ The predominance of ATR in cataract surgery candidates clearly directs cataract surgeons to opt for temporal incision over superior incision when none of the above mentioned astigmatism neutralising procedures is being performed. A majority of studies^{8,12,15} have used regression analysis to correlate the CA with age and has found positivity in it. Unlike these studies, we compared the mean CA in different age groups and in line with the study by Ferrer-Blasco et al.,⁷ found the changed astigmatic trend i.e. decreased negativity in CA with advancement of age except in the older age groups.

The current study is unique in many aspects. Firstly, after an extensive PUBMED search, we could not find a similar study in relation to Western Indian population. Secondly, it provides data related to the pattern of CA in Western Indian population. Thirdly, this study states that in majority of cataract candidates, the CA lies in between 0.25 and 1.25D, hence low cost keratorefractive procedures like steep axis phacoemulsification, OCCI and LRI's will provide a better visual rehabilitation especially in developing world like India. Fourthly, this study highlights that a less percentage of

Table 2 – Percentage variation in types of corneal astigmatism at different age groups using descriptive statistics.

Age group (years)	Type n (%)			
	ATR	OBL	WTR	Total
≤40	3 (21.4)	3 (21.4)	8 (57.1)	14 (100)
41–50	09 (45)	03 (15)	08 (40)	20 (100)
51–60	35 (61.4)	11 (19.3)	11 (19.3)	57 (100)
61–70	43 (43.4)	24 (24.2)	32 (32.3)	99 (100)
71–80	21 (70)	06 (20)	03 (10)	30 (100)
81–90	03 (100)	00 (0)	00 (0)	03 (100)

n: number of eyes; ATR: against the rule astigmatism; OBL: oblique astigmatism; WTR: with the rule astigmatism.

cataract candidates require expensive Toric IOLs, which is well suited to our country.

Conclusion

To conclude, the preoperative CA can well be managed by a cost effective keratorefractive procedure in a developing world like India. However, similar natured studies in Indian context are required to supplement this study.

Conflicts of interest

The authors have none to declare.

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