ABSTRACT: AIM: To determine corneal astigmatism in patients with cataract posted for surgery. To achieve good visual outcome, significant corneal astigmatism has to be taken care of at the time of surgery either by corneal or limbal relaxing incisions or by implantation of toric intraocular lens. MATERIALS AND METHODS: This is a prospective observational case series conducted on 200 patients with cataract who attended the out-patient department of ophthalmology and consented for investigations and surgery. Keratometry readings were recorded along two principal corneal meridians using Bosch and Lomb Keratometer. RESULTS: Against the rule astigmatism is found to be more common than with the rule astigmatism, more so as age advances. Most of the patients had less than 1D of astigmatism. CONCLUSIONS: The younger the patient is, the lesser the chances of developing astigmatism. Amblyogenic astigmatism is very rare. KEYWORDS: Corneal astigmatism, Bosch and Lomb Keratometry, Cataract.

INTRODUCTION: Astigmatism is an optical defect in which vision is blurred due to the inability of the optics of eye to focus a point object into a sharp focused image on the retina. This may be due to an irregular curvature of cornea or lens. The prevalence and nature of corneal astigmatism among patients with cataract has not been well-documented. This study was undertaken to investigate pre-existing corneal astigmatism in adult patients with cataract. Correcting pre-existing 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. Peripheral corneal relaxing incisions were effective in reducing pre-existing corneal astigmatism during cataract surgery. The need to know the pattern of corneal astigmatism for population groups in order for surgeons and IOL manufacturers to predict patient requirement consequently becomes necessary. The cornea and lens are the main contributors to ocular astigmatism. For patients undergoing uncomplicated cataract surgery, significant preoperative corneal astigmatism remains the major obstacle to obtain satisfactory postoperative visual outcome. Moreover corneal astigmatism changes with age. This study shows the prevalence of corneal astigmatism in patients posted for cataract surgery in different age groups.

MATERIALS AND METHODS: It is a prospective observational case series conducted on 200 patients with cataracts who attended the department of ophthalmology at Maharajah’s institute of medical sciences during November 2014 to January 2015.
An analysis of the Keratometry record of all patients, who underwent routine elective cataract surgery, was done. All the patients had manual Keratometry using single Bosch and Lomb Keratometry by a single investigator as part of the preoperative biometric assessment for IOL implantation. Data collected included the age and sex of the patient, Keratometry readings in dioptres along the two principal corneal meridians, and the anterior corneal astigmatism in dioptres.

**INCLUSION CRITERIA:**
1. All patients with cataract posted for surgery.

**EXCLUSION CRITERIA:**
1. Patients with corneal opacities, corneal disease and cornel degenerations.
2. Patients with nasal and temporal Pterygium encroaching on to cornea.
3. Patients with history of eye surgery.
4. Patients with ptosis or other lid abnormalities.

**RESULTS:** Total no of eyes examined=200.
Patients were divided into four age groups 40 to49, 50 to 59, 60 to 69 and 70 and above. Majority of patients were in 7th decade (40%), followed by 6th decade (31.5%), and then by the 8th decade (21%).

Table 1 (age and sex incidence)

| Age       | 40-49 | 50-59 | 60-69 | 70 & Above |
|-----------|-------|-------|-------|------------|
| Male      | 9     | 22    | 31    | 27         |
| Female    | 6     | 41    | 49    | 15         |
| Total     | 15    | 63    | 80    | 42         |

Table 1: Age and sex incidence

Usually corneal surface is toric. With the rule astigmatism is due to the pressure exerted by the eye lids on the cornea in the vertical meridian. Though it is supposed to be the most common type, we found that against the rule astigmatism (48%) was more frequent than with the rule astigmatism (33.5%). In both the groups astigmatism <1.00D was found to be most common. Astigmatism > than 1.00 D was seen in 23 eyes (11.5%) in with the rule group and in 45 eyes (22.5%) in against the rule astigmatism group.% (Tables 2, 3 and 4).

Table 2

| Age       | WTR  | ATR  | Without Astigmatism |
|-----------|------|------|----------------------|
| 40-49     | 6(3%)| 6(3%)| 3(1.5)               |
| 50-59     | 23(11.5%) | 29(14.5%) | 11(5.5%) |
| 60-69     | 24(12%) | 44(22%) | 12(6%)               |
| 70 & Above| 14(7%) | 17(8.5%)| 11(5.5%)             |
Among 200 eyes examined, there are 37 eyes (18.5%) that did not have astigmatism. The maximum percentage of people without corneal astigmatism was seen in the most elderly Patients (70 and above) followed by those in the younger age group (40 – 49). (Table no 5)

Table 3: With the rule astigmatism

| Age       | 0.25-1.00d | 1.00-1.50d | 1.50-2.00d | 2.00-2.50d | 2.50-3.00d | Total |
|-----------|------------|------------|------------|------------|------------|-------|
| 40-49     | 4          | 1          | 1          | 0          | 0          | 6     |
| 50-59     | 14         | 4          | 2          | 2          | 1          | 23    |
| 60-69     | 15         | 6          | 0          | 1          | 2          | 24    |
| 70 & Above| 11         | 2          | 1          | 0          | 0          | 14    |

Table 4: Against the rule astigmatism

| Age/diopters | 0.25-1.00d | 1.00-1.50d | 1.50-2.00d | 2.00-2.50d | 2.50-3.00d | Total |
|--------------|------------|------------|------------|------------|------------|-------|
| 40-49        | 4          | 1          | 1          | 0          | 0          | 6     |
| 50-59        | 17         | 8          | 2          | 2          | 0          | 29    |
| 60-69        | 22         | 13         | 5          | 3          | 1          | 44    |
| 70 & above   | 8          | 6          | 2          | 0          | 1          | 17    |

Table 5: Without astigmatism

| Age       | 40-49 | 50-59 | 60-69 | 70 & Above |
|-----------|-------|-------|-------|------------|
| No. of patients | 3(20%) | 11(17.46%) | 12(15%) | 11(26.19%) |

FIGURE 1
Out of 163 eyes with astigmatism, majority of them had less than 1D (58.28%). Among these 95 eyes which showed less than 1D, 44 eyes showed with the rule astigmatism and rest 51 eyes showed against the rule astigmatism.

The mean astigmatism in relation to age and sex was calculated (table 6). It was calculated by totaling the amount of astigmatism present among the patients of each sex in that age group irrespective of astigmatism with the rule or against the rule and dividing the sum with the number of patients. It was found that the average astigmatism was between 0.72 D to 0.87D among males between the ages from 40 to 69 years. However there is a sharp decline in the amount of mean astigmatism to 0.31D among males above the age of 70 years. Among females there was no such variation and the mean astigmatism varied from 0.61D.

| Age Group | 40-49 | 50-59 | 60-69 | 70 & Above |
|-----------|-------|-------|-------|------------|
| Male      | 0.75  | 0.72  | 0.87  | 0.31       |
| Female    | 0.61  | 0.73  | 0.62  | 0.71       |

Table 6: Mean astigmatism in relation to age and sex

The mean astigmatism with the rule and against the rule was calculated by totaling the amount of astigmatism in each group and dividing the sum by the number of patients with astigmatism (Table 7). A careful examination of the data from this table and that of tables 2 and 3 reveals that as the age advances there is a shift in the numbers from with the rule astigmatism to against the rule astigmatism.

| Age Group | 40-49 | 50-59 | 60-69 | 70 & Above |
|-----------|-------|-------|-------|------------|
| WTR       | 0.87  | 1.01  | 0.89  | 0.85       |
| ATR       | 0.79  | 0.79  | 0.92  | 0.92       |

Table 7: Mean Astigmatism
DISCUSSION: This study was aimed to determine the prevalence of corneal astigmatism in patients undergoing cataract surgery. With increasing age, a shift in the axis of astigmatism is found from a predominance of WTR astigmatism to a predominance of ATR astigmatism. This shift in astigmatic axis in older age appears to be due to changes in corneal curvature.(6-10) In a cross-sectional study of corneal and total astigmatism, Anstic found that internal astigmatism remained relatively stable over time and that changes in astigmatism throughout life were due primarily to changes in corneal curvature.(6) Baldwin and Mills investigated longitudinal changes in corneal and total astigmatism in patients over a 40-year period and found a steepening of the cornea and an increase in ATR astigmatism with aging.(7) The majority of this change in astigmatism was due to corneal change, that is, a steepening of the horizontal meridian of the cornea. This change in corneal curvature may be related to the reduction in tension of the eyelids that typically occurs with age.

CONCLUSION: In our study majority of the astigmatism is within 1 D and is well managed by existing inexpensive surgical means. Only the ones with more than 1.5 D astigmatism need toric intraocular lens or can be managed surgically using steep axis incision, opposite clear corneal incision, corneal relaxing incision or limbal relaxing incision. Residual amount of astigmatism can be corrected by glasses. Ambylogenic astigmatism is very rare.

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