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Original Research Article

Preoperative prevalence of magnitude and type of anterior corneal astigmatism in cataract patients who underwent phacoemulsification in a teaching hospital in Kolkata, India: A retrospective observational study

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ABSTRACT

Aim: To determine the magnitude and type of preoperative astigmatism in cataract patients and to find any relationship with their demographic profiles.

Materials and Methods: It is a retrospective observational study. Records of patients who underwent phacoemulsification in KPC Medical College from July 2021 to June 2023 were screened for demographic profile, keratometryand astigmatism with its axis. Patients who had any major ocular surface disorder or corneal pathology or lid tumors or who underwent other ocular surgery prior was not included in this study. Name of the patients were not collected to maintain confidentiality and safeguard the interest of the patients.

Data was collected on Microsoft Excel and was analyzed by SPSS software.

Results: 536 eyes of 524 patients were studied after considering all the excluding criteria. Mean age of the patients was 65.14 with range of 37 to 92. There were 252 males and 282 females. The mean residual astigmatism was 0.83 Dioptre (D).31 patients had no astigmatism. 341 patients (63.62%) have astigmatism less than 1D whereas 164 patients (30.6%) had 1D or more astigmatism. ATR had the highest prevalence (44.95%) followed by OA (32.67%) and WTR (22.97%)

Conclusion: In this study we found 63.62% patients had corneal astigmatism less than 1.00 D which would need some keratorefractive correction (like on axis phaco or LRI) suited for a developing country like us and 30.6% patients had corneal astigmatism more than 1.00 D which would warrant use of toric lenses. Prevalence of ATR was highest in all age groups except 60-69 years.

1. Introduction

Cataract is the commonest surgically correctable cause of blindness in the world[1] where the normally transparent lens of the eye becomes opaque causing visual deterioration. So cataract surgery is the commonest ophthalmic surgical procedure in the world. The surgery consists of removing the cataractous lens and replacing it with a transparent artificial lens which enables the patient to see again. Apart from an uncomplicated surgery pre-operative corneal astigmatism is an important determinant of post-operative visual recovery.[2] Astigmatism is type of refractive error where the two principal meridians of cornea (Vertical & Horizontal) have different powers. This is called regular astigmatism. Where the two meridians are other than the principal meridians it is called Oblique astigmatism. The meridian with more power is called the steep axis and the one with lesser power is called the flat axis. The patients with astigmatism cannot focus the light rays coming from

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distance to a point focus. So every effort should be done to neutralise it during the surgery. A considerable amount of residual astigmatism after cataract surgery will leave the patient unhappy with blurred vision which warrants a spectacle correction in the post-operative period which will cause additional expenditure to the patient along with the discomfort of wearing it constantly. With the advent of newer highly efficacious phacoemulsification machines and standardised operative procedure more and more patients are asking for spectacle independence. On axis phaco (where the main incision is made on the steep axis to flatten it thereby reducing postoperative residual astigmatism)or use of a toric intraocular lens(which has cylinder power incorporated in the IOL itself) or Limbal relaxing incision (LRI) on cornea are the different modalities of correcting pre-operative astigmatism[3] during the surgery. All these need a thorough understanding of preoperative corneal astigmatism and its axis.

Optical Biometry and Keratometry using low coherence interferometry of eye gives a more accurate measurement of astigmatism and it's axis compared to the older methods like manual keratometry or automated refractometer.[4]

Most of the previous studies are either done by older methods[5] or they are based on patients who underwent cataract surgery in either a North or South Indian Hospital.[6–8] So we did a retrospective descriptive study to assess the Prevalence of different type of astigmatism in the patients who had undergone cataract surgery in a teaching hospital in eastern India to get a clear understanding of the problem.

2. Materials and Methods

Records of all the patients who underwent cataract surgery in Kpc Medical College between July 2021 to June 2023 were studied. Only those patients who underwent Optical biometry by low coherence interferometry (Topcon Aladdin, Topcon Corp. Japan) before surgery were included. Demographic data like age, sex and astigmatism related data like magnitude and axis of steep and flat keratometry along with residual astigmatism and its axis were collected. Patients with any pre-existing corneal disease like corneal opacity, Pannus, h/o corneal ulcer or chemical injury, corneal degeneration, keratoconus, corneal or limbal tumor or mass lesion like pterygium and patients with H/o any previous ocular surgery were excluded from the study.

1. When the steep axis of Astigmatism is within 60 degrees to 120 degrees i.e within 30 degrees of either side of vertical meridian of cornea it is considered as "With the Rule Astigmatism" (WTR).
2. When the steep axis of Astigmatism is within 0 degrees to 30 degrees or between 150 degrees to 180 degrees i.e within 30 degrees of either side of horizontal meridian of cornea it is considered as "Against the rule Astigmatism(ATR). C) When the steep axis of Astigmatism is other than the above mentioned 2 groups it is considered as Oblique Astigmatism (OA).

The residual astigmatism was calculated by subtracting the flat value from the steep value. The patients were divided into 10 year age groups with 1 group of less than 40 years and 1 group of more than 90 years. Results in each group are calculated to find the trend across the age groups.

Names of the patient were not collected to safeguard patient's privacy. As all patients gave consent preoperatively to use information for medical research so no new consent was needed. All the data were collected according to Helsinki declaration. Data were collected in Microsoft Excel spread sheet and analysed using SPSS statistical software version 29. Descriptive analysis was done to find prevalence of magnitude and number of different type of astigmatism in different age groups.

3. Results

536 eyes of 524 patients were studied after considering all the excluding criteria. Mean age of the patients was 65.14 with range of 37 to 92. There were 252 males and 282 females. The mean residual astigmatism was 0.83 Dioptre (D) with range from 0 D to 3.57D. The results are depicted in Table 1.

Table 1: Demographics and astigmatism summary

Characteristics	Value
Age	
Mean±SD	65.14±7.8
Range	37-92
Sex	
Male	254(47.38%)
Female	282(52.61%)
Residual corneal astigmatism	
Mean±SD	0.83±0.59
Range	0-3.57
Steep K Astigmatic Value (Mean±SD)	44.68±1.7
Flat K Astigmatic Value (Mean±SD)	43.86±1.68

31 patients in our study had no astigmatism. 341 patients have astigmatism less than 1D whereas 164 patients had 1D or more astigmatism. The residual astigmatism and their types in different age groups are shown in Table 2.

The mean residual astigmatism in different age group is shown in Table 3.

In our study the percentage of different types of astigmatism in different age groups is shown in Table 4.

Prevalence of different types of astigmatism according to sex is given in Table 5.

It was found that the prevalence of ATR was more than the other types of astigmatism in all age groups except 60-69

Table 2: Residual astigmatism according to age strata

S.No	Age Group (Years)	0	0.01-0.49	0.5-0.99	1-1.49	1.5-1.99	2-2.49	2.5-2.99	>3
1	<40			2			1		
2	40-49		2	4	3	1			
3	50-59	4	40	45	21	6	4		
4	60-69	22	65	96	44	14	7	2	
5	70-79	5	31	45	30	16	3		4
6	80-89		1	10	5				
7	>90						1	1	1
	Total	31	139	202	103	37	16	3	5

Table 3: Mean residual astigmatism in different age group

Age Group	Mean Residual Astigmatism
<40	0.2633
40-49	0.8340
50-59	0.7974
60-69	0.8310
70-79	1.0012
80-89	0.8406
>90	2.8767

Table 4: Types of astigmatism as per age group

Age Group (years)	ATR	WTR	OBLIQUE
<40(3)	3(100%)		
40-49(11)	5(45%)	4(36%)	1(9%)
50-59(120)	55(46%)	27(22%)	38(32%)
60-69(249)	99(38%)	56(22%)	72(48%)
70-79(134)	53(39.5)	27(20%)	49(36%)
80-89(16)	9(56%)	2(12%)	5(31%)
>90(3)	3(100%)		
TOTAL	227	116	165

Table 5: Prevalence of astigmatism according to sex

Sex	ATR	WTR	OBLIQUE
Male-237	114	48	75
Female-268	111	67	90

in our study. The percentage prevalence of ATR in different age groups are depicted by a graph in Figure 1.

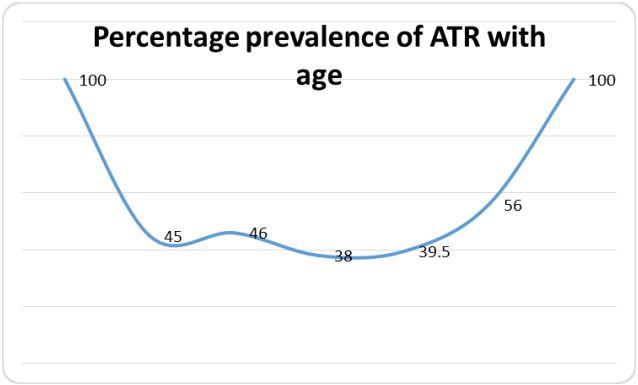

Figure 1: Percentage prevalence of ATR with age

4. Discussion

Preoperative corneal astigmatism and its management in intraoperative period is the key to a satisfying cataract surgery outcome. So we studied the magnitude and different types of corneal astigmatism in 536 patients in a descriptive clinic based retrospective study in a teaching hospital in Eastern India.

The mean age of our study was 65.14 which was similar to the studies by Joshi et al,[9] M Mohamadi et al[10] and E.H. Oh et al.[11] Most other studies had a higher mean age may be because of age of cataract population in their respective country due to the amount of UV exposure and other factors.

Females were marginally more (52.61%) like the studies of A Sharma et al[6] and Raul L E et al.[12]

Mean residual corneal astigmatism was 0.83 which was similar to Joshi et al,[9] and P.S. Moulick et al.[8] Most other studies reported a higher value.

Only 31 patients(5.8%) were found to have no astigmatism .So majority patients (94.2%) had some amount of astigmatism which was in accordance with Joshi et al and A Sharma et al.

30.6% of the total patient presented with corneal astigmatism 1.00 D or more which was similar to Joshi et al but less than most other studies. These are the patients who will benefit from Toric intraocular lens implantation as it was found to be more effective and predictable than LRI (Freitas G.O et al.[13] A study by Laurendeau C et al[14] showed that 66% Patients with Monofocal IOL implant needed post-operative spectacles compared to only 25% with Toric IOL implant. However another 63.62% of patients who have some corneal astigmatism but less than 1.00 D could be managed by some form of keratorefractive adjustment like phaco on steep axis or LRI (MX Nunez et al[15]).

In our study ATR had the highest prevalence (44.95%) followed by OA(32.67%), WTR(22.97) which was similar to Joshi et al. However in most studies WTR was second after ATR(P Sandhu et al,[16] M Moahamadi et al, A Sharma et al). Only Studies by Bernardo et al,[3] and Hoffman et al[2] have reported a higher prevalence of WTR than ATR (44% and 46.8%, respectively).

Age wise distribution of corneal astigmatism showed ATR having highest prevalence across all groups except 60-69. Most of the studies like M Isyaku et al,[17] E.H. Oh et al and others found ATR to gradually increasing with age. In our study ATR came down from <40 age group till 60-69 age group and then raised again as the age advanced.

The sex wise distribution of different type of corneal astigmatism did not show any difference in male and female group.

This study has the limitation of taking into consideration only patients attending a hospital for surgery. A population based study should have given a better distribution of astigmatism across different groups of people. However, as our objective is to study the astigmatism in Cataract patients and not the bigger chunk of population without cataract whose astigmatism can be corrected by spectacles only, studying the preoperative records remains the most logical and cost effective option. Most of the previous national and international had been done by this method only.[3–6,8,9,12]

In our study corneal astigmatism was measured with optical biometry using Low coherence interferometry (TOPCON ALADDIN) which is superior than the previous studies done with manual keratometry as done by Prasher P et al[16] or E.H.Oh et al. However newer optical biometry using S-OCT might throw some new insight into the topic.

In conclusion, we found 63.62% patients had corneal astigmatism less than 1.00 D which would need some keratorefractive correction (like on axis phaco or LRI) and 30.6% patients had corneal astigmatism more than 1.00 D which would warrant use of Toric lenses.[13] Understanding of this preoperative corneal astigmatism plays a very important role in planning who will need which form of astigmatism neutralising methods to give a satisfactory outcome of cataract surgery. With the increasing visual demand of using digital gadgets for longer time like computer, laptop & mobile phones more and more patients are demanding spectacle independence.

In our study, ATR had the maximum prevalence (44.95%) which means most patients had their steep axis at around 0 or 180 degrees (Horizontal meridian). To flatten it the main incision of phacoemulsification should be given at horizontal meridian of cornea (Temporal clear corneal incision) which can be done by sitting at the temporal side of the patient. So post graduate trainees of Ophthalmology should be trained to perform phacoemulsification from temporal side (3 or 9 ‘o clock position depending on the side of the eye). Normally they are taught to perform surgery sitting at the head end as older studies showed prevalence of WTR more than ATR.[2,3] Preferably they should also be introduced to the concept of astigmatism correcting IOLs (Toric IOL) as 30.6% of patients had astigmatism more than 1.00 D which can be corrected only with a Toric IOLs. This will make them future ready.

5. Source of Funding

None.

6. Conflict of Interest

None.

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