ANALYSIS OF VISUAL OUTCOME IN CATARACT PATIENTS WITH CORNEAL ASTIGMATISM UNDERGOING CATARACT SURGERY TORIC IOL IMPLANTATION

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ABSTRACT

BACKGROUND

Correction of pre-existing corneal astigmatism is a challenge in managing cataract patients as the residual pre-existing astigmatism in the post-operative period compromises the uncorrected visual activity. The toric intraocular lens (IOL) neutralizes the pre-existing anterior corneal astigmatism, with predictable visual outcome of close to hundred percent if there is no associated fundus pathology.

MATERIALS AND METHODS

This is a cross sectional study and a retrospective analysis of 468 eyes of 434 patients with pre-operative astigmatism of 1.5 D to 6.5 D cylinder. All patients underwent phacoemulsification with acrylic toric IOL implantation (AcrySof Toric IOL). The patients were assessed on 6th day and one-month post-op. The visual outcome was measured using Snellen Visual Acuity Chart (UCVA), refraction done and rotation of the IOL noted if existed.

RESULTS

Mean UCVA improved to 6/6 nil glasses for distance in 468 number of patients. The mean refractive active medicine reduced from the pre-operative value of 0.6 D to 0.20±0.60 D.

CONCLUSION

AcrySof toric IOL is an effective tool to correct pre-operative astigmatism in cataract patients expecting spectacle independence for distance.

KEY WORDS

AcrySof Toric IOL, Visual Outcome, Corneal Astigmatism, Cataract Patients, Spectacle Independence.

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BACKGROUND

During cataract surgery the refractive status of the cataract patient is modified. Some IOLs correct spherical refractive errors, whereas other IOLs correct both spherical and astigmatic errors. Preoperative astigmatism 1.5 D or greater is present in 20% of the cataract patients undergoing surgery for age related cataract.[1] Approximately 20% to 30% of the patients with cataract have anterior D are known.[2 & 3] Patients are many times more likely to use spectacles per D of astigmatic error in the better eye and the remaining post-operative astigmatism is the main reason for spectacle use in patients with spherical equivalent refraction ±0.5 D. Correcting residual astigmatism gives significant improved visual activity at all contrast levels at both distance and near.[4]

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Astigmatism can be corrected by implanting a toric IOL or by changing the corneal curvature by LASIK or similar procedure by placing relaxing incisions at the steepest meridian to flatten the corneal curvature.[5] The recently introduce multifocal toric IOLs offers the opportunity to achieve spectacle independence not only for distance vision but also for near and intermediate vision.[6] Toric IOLs can rotate. Small rotations do not the astigmatic power, but larger rotations will reduce the power of IOL. Thus, larger rotations generally 10^0 is used as a limit, require surgical interventions to reposition the IOL.[7] Hence, the present study was aimed to analyse the visual outcome of cataract patients who underwent toric IOL implantations related to those who could read 6/6 nil glasses, and those who had residual astigmatism and their magnitude as compared to the preoperative anterior corneal astigmatism.

MATERIALS AND METHODS

This is a retrospective descriptive study. This study involved the age group from 25 to 80 years of age of both sexes. All patients with corneal astigmatism of more than 1.25 D cylinder were considered for toric IOL implantation. Patients with regular astigmatism are ideal. Irregular astigmatism in patients with mild to moderate keratoconus which is stable and non-progressive,[8] pellucid marginal degeneration,[9] small non-progressive pterygium, peripheral corneal scar induced

by pterygium surgery, one eyed patients with regular astigmatism, corneal astigmats with fundus pathology, complicated cataracts, irregular pupils were all included in the study. The patients with corneal astigmatism of less than 1.25 D cylinder, the situations where the astigmatism was attributed to posterior corneal surface, irregular astigmatism, lenticular astigmatism, patients with progressive keratoconus, pellucid marginal degeneration, corneal opacity inducing astigmatism, were all excluded from the study. A large fleshy pterygium encroaching into cornea inducing against the rule astigmatism, the patient with traumatic subluxated cataract, patient with pre-existing zonular dialysis, were not offered toric IOL implantation. Patients with central corneal scar, eccentric pupil, traumatic cataract due to penetrating trauma inducing irregular astigmatism, astigmats with less than 1 D cylinder or less, corneal dystrophies which might require corneal transplantation at a later state were all excluded from the study. Patients were informed about the necessity to wear near vision glasses for presbyopia correction in the post-operative period. Only one type of lens made of acrylic, hydrophobic material namely AcrySof toric IOL was used. The series consisting of model T2 to T9 were used.

Pre-operatively, the zonular dialysis more than one clock hour was not offered toric IOL implantation. A small zonular dialysis managed with CTR was offered toric IOL. The visual acuity outcome was analysed and documented one week, and one-month post op. refraction was also done by manual retinoscopic method one week and one-month post op to document for residual astigmatism. During both the visits, the marking on the IOL was examined for alignment with cornea using a slit lamp.

All the patients were examined very carefully pre-operatively for pre-existing corneal astigmatism. All their old prescriptions and the current prescribed glasses were studied for the presence of pre-existing astigmatism, the consistency and whether the corneal astigmatism is with the rule/against the rule/regular astigmatism/irregular astigmatism. The amount of astigmatism, the site of steep meridian and flat meridian, the regularity and irregularity are documented.

A Topographer was used to study the anterior corneal surface, the presence of regular bow-tie was considered as most ideal for Toric implantation. Scheimpflug imaging is preferred as this allows anterior and corneal surfaces to be studied. Understanding the posterior corneal astigmatism helped us to eliminate the patients from toric IOL implantation. The patients with posterior corneal astigmatism were denied Toric IOL implantation. The pupillary status was analysed after full dilation. Pupillometry was used to quantify the pupillary dilatation. This would help the surgeon to plan the Toric IOL marking alignment with the corneal marking. If the patient was using rigid gas permeable contact lens for correction of higher amount of astigmatism, the patient was advised to discontinue the RGP lens prior to evaluation. The high levels of irregular astigmatism which was neutralized by RGP contact lens is less suitable for patients to opt for Toric IOL.

The patients with amblyopia and macular pathologies like age related macular degeneration, diabetic maculopathy, glaucoma patients should be identified pre-operatively and counselled cautiously so as not to raise their expectations. OCT was performed in all the patients so that subtle macular pathologies like IS/OS junction disruption can be identified, documented and the patient counselled accordingly. Accurate biometric measurements is important as this is an advance technology IOL offered to the patient. All the patients were pre-operatively subjected to Automated Keratometry/Manual Keratometry/corneal topography and Scheimpflug Imaging. Though many devices are used to understand astigmatism, in our study and experience, we consider the manual keratometry which is well calibrated and used by a single technician is practised.

Scheimpflug imaging measures both anterior and posterior corneal surfaces. The posterior cornea acts as a minus lens and affects with the rule and against the rule corneal astigmatism differently. This was accounted for IOL power calculation by decreasing minus 0.5 D corneal astigmatism in patients with WTR astigmatism and increasing by 0.5 D in patients with ATR astigmatism. While calculating the Toric IOL power, one important aspect to be considered is the Surgeon Induced Astigmatism (SIA). The two surgeons performing Toric IOL implantation, their SIA was calculated individually in the Hill.com software. SIA calculated for minimum of 100 cases each. All the incision sizes used for SIA calculations was 2.2 mm. The size of the incision influences the SIA outcome. Smaller incisions produce less SIA. All the incisions in our study for SIA was located at 180 degrees. The IOL used was AcrySof Toric IOL with a A constant of 119.0 Barrett universal formula is used. Appropriate IOL power is arrived.

RESULTS

The visual outcome analysis of the 468 patients with pre-existing corneal astigmatism were analysed age wise and gender wise. An analysis was also done based on the axial length of eye ball and hence the number of myopic eyes with toric IOL implants were documented. The model of the lens used was analysed. Finally, the visual acuity outcome was documented.

Age Wise Analysis

This study revealed the implantation to be widely accepted between the age group of 50 and 80 years of age. This age group involves both active/productive age group as well as retired age group. This implies that the desire and expectation of spectacle independence for distance is present both in active and retired age group. The results indicate that 40.4% of the patients belong to the age group of 61-70 yrs., followed by 71-80 yrs. of age group in which 25% of patients had corneal astigmatism. 21.6% of patients belongs to 51-60 yrs., while 1.1% of them belongs to 31-40 yrs. old age group (Table – 1). From these results it was concluded that, the maximum number of patients opting for spectacle independence for distance fall within the age group of 61 – 71.

Gender Wise Analysis

Gender wise analysis shows that there was no sex predilection for opting for toric IOL implantation. Both sexes were equally involved. Out of 468 eyes of patients with corneal astigmatism, 50% were male and 50% were female (Table – 2). This shows that both male and female patients had equal desire for spectacle independence for distance.

Quantifying the Pre-Existing Astigmatism

The pre-existing corneal astigmatism was quantified with the intention of identifying maximum number of astigmats who underwent toric IOL implantation. The magnitude of pre-existing corneal astigmatism in the eyes of the patients, undergoing treatment for cataract with toric IOL were analysed. Out of 468 eyes, 67.5% had corneal astigmatism at the range of 1.0 – 2.0 D. In 2.25 – 3.0 range, 25.4 % of the eyes had corneal astigmatism. The percentage of corneal astigmatism was very low (0.6 %) in the diopter of above 5. The results were predicted in table - 3.

Eyes of Astigmats and their Axial Length

The frequency distribution of eyes of astigmats were studied for their axial lengths. The results revealed that, 88.9% had axial length of 20-24 mm (normal eyes), 9.4% of them had 24-26 mm (large myopic eyes). 1.7% of eyes were very large with high myopia with axial length more than 26 mm (Table – 4). The high myopes with large bags also had rotational stability with AcrySof toric IOL. Frequency distribution of respondents based on the IOL power used at the time cataract surgery were recorded. The maximum of 70.3 % of IOLs used was within 20 to 25 D (70.3%). The least percentage (1.1) of eyes being within 5 to 10 D (Table – 5).

Visual Outcome Analysis in One Month Post op.

Uncorrected visual acuity of the patients was studied. Out of 468 eyes with corneal astigmatism, a maximum frequency of 317 eyes (67.7%) had normal vision. 132 eyes (28.2%) of patients with corneal astigmatism had an outcome of 6/9 visual acuity. The visual acuity of 19 eyes was 6/12 and below. Out of which 3 eyes suffered from fundus pathology (Table - 6).

Post-Operative Residual Astigmatism

The frequency distribution of the eyes of respondents with residual post-operative astigmatism based on their post-operative cylindrical power was observed. After cataract surgery, 67.7% eyes of the patients did not have any residual astigmatism. 27.83% of eyes had residual astigmatism of ±0.5 – 0.75 cylinder. 4.1% of the eyes had residual astigmatism of ±1.0 – 1.5 D cylinder, out of which three eyes had fundus pathology. The results were tabulated in Table – 7.

From this study, it is concluded that, the visual acuity outcome indicates that hydrophobic, acrylic (AcrySof), toric IOL implants in pre-existing corneal astigmatism is very safe and consistent.

Age	Frequency of Eyes	Percent
Below 30 yrs.	14	3.0
31-40 yrs.	5	1.1
41-50 yrs.	22	4.7
51-60 yrs.	101	21.6
61-70 yrs.	189	40.4
71-80 yrs.	117	25.0
Above >80 yrs.	20	4.3
Total	**468**	**100.0**

Table 1. Frequency Distribution of the Eyes of the Respondents with Pre-Existing Corneal Astigmatism based on Age

Gender	Frequency of Eyes	Percent of Eyes
Female	234	50.0
Male	234	50.0
Total	468	100.0

Table 2. Gender Wise Frequency Distribution of the Respondents

Magnitude of Cylindrical Power in Diopters	Frequency of Number of Eyes with Astigmatism	Percentage of Eyes with Toric IOL Implants
1.0 - 2.0	316	67.5
2.25 - 3.0	119	25.4
3.25 - 4.0	23	4.9
4.25 - 5.0	7	1.5
>5	3	0.6
Total	**468**	**100.0**

Table 3. Frequency Distribution for the Pre-Existing Corneal Astigmatism in the Eyes of the Respondents

Axial Length of Eyes	Frequency of Eyes Based on Axial Length	Percentage of Eyes Based on Axial Length
20-24 mm	416	88.9
24-26 mm	44	9.4
>26 mm	8	1.7
Total	**468**	**100.0**

Table 4. Frequency Distribution of Eyes of Astigmats based on their Axial Length

IOL Power	Frequency of Eyes	Percentage of Eyes
5-10 D	5	1.1
10-15 D	11	2.4
15-20 D	97	20.7
20-25 D	329	70.3
25-30 D	26	5.6
Total	**468**	**100.0**

Table 5. Frequency Distribution of Respondents based on the IOL Power

UCVA	Frequency of Eyes	Percentage of Eyes
6/6	317	67.7
6/9	132	28.2
6/12 & below	19	4.1
Total	**468**	**100.0**

Table 6. Frequency Distribution of Respondents based on their Uncorrected Visual Acuity

Post-Operative Cylindrical Power	Frequency	Percent
-.75	21	4.5
-.50	74	15.8
.00	317	67.7
.50	26	5.5
.75	11	2.4
±1.0 - 1.50	19	4.1
Total	468	100.0

Table 7. Frequency Distribution of the Respondents based on the Post-Operative Residual Astigmatism

DISCUSSION

In the present study, 67.5% had corneal astigmatism at the range of 1.0 – 2.0 D. In 2.25 – 3.0 range, 25.4 % of the eyes had corneal astigmatism. The percentage of corneal astigmatism was very low (0.6 %) in the diopter of above 5. Our results find support from Hoffer (1980) on a study conducted on 7500 eyes of patients with cataract. In which, the mean corneal

astigmatism was identified to be 1.0 D. 4.2 % of them had no corneal astigmatism. 76.8 % had astigmatism between 0.25 to 1.50 D. Those with more than 1.5 was 19.1%. Ferrer-Blasco et al. (2009) studied the corneal astigmatism on 4540 cataractous eyes. They inferred that, 13.2% had no astigmatism, 64.4% of them had astigmatism upto 0.25 to 1.25 D and 22.2% of them had more than 1.5 D cylinder. This study also closely resembles the present study.

In our study 95.9% of patients who underwent toric IOL implantation for pre-existing corneal astigmatism were independent of glasses of spectacles for distance. The keratotomies are relaxing incisions, did not provide precision or consistency in visual acuity outcome due to varied healing response of the corneal tissue.[10,11] There is ultimately overcorrection, under-correction etc. and hence loss of best corrected visual acuity.

The silica toric IOLs lacked rotational stability. But the AcrySof toric IOL with acrylic hydrophobic material offered great rotational stability.

CONCLUSION

Our study indicates that AcrySof toric IOL is an effective, safe and predictable method, used to correct moderate to high amounts of astigmatism and offers spectacle independence for distance, after cataract surgery. No undesirable visual discomfort as glare, halos or visual blur is noted in this study. Minimal residual error of 0.5 to 1.0 D was well tolerated and did not raise any complaints. Opting for Toric IOL implantation as a replacement to limbal relaxing incision, or opposite clear corneal incision is a good choice, as this technology of toric IOL is superior in reducing the amount of post-operative astigmatism.

However, patient's visual acuity outcome depends on precision in arriving at accurate corneal astigmatism, precise pre-marking, good peroperative alignment and right choice of toric IOL with good rotational stability.

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