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Clinical Study and Visual Outcomes Following Toric Intraocular Lens Implantation in Phacoemulsification Cataract Surgery

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Abstract: ***Purpose: To assess visual and refractive outcomes following toric intraocular lens (IOL) implantation in patients with pre-existing corneal astigmatism undergoing phacoemulsification. Methods: A prospective interventional study included 44 eyes of patients aged 21-70 years with regular astigmatism >1D-5D. UCVA, BCVA and keratometry were recorded preoperatively and on postoperative days 1, 7, and 30. Results: Preoperatively, 77.3% of eyes had UCVA 6/60-6/18. By day 30, UCVA improved to 6/12-6/6 in 93.2% of eyes, with all achieving BCVA in this range. Mean astigmatism reduced from 2.16±1.01D to 0.48±0.61D (p<0.0001), and 77.3% achieved residual cylinder <1D. Early complications such as Descemet folds and corneal edema resolved by day 7. Conclusion: Toric IOL implantation offers safe, effective astigmatism correction with significant visual improvement and reduced spectacle dependence in cataract patients.***

Keywords: Toric intraocular Lens, Phacoemulsification, Astigmatism, Residual cylinder

1. Introduction

Cataract surgery is one of the most commonly performed ophthalmic procedures worldwide, offering rapid recovery and excellent visual outcomes. Corneal astigmatism >1D is present in 30-39% of cataract patients, and 3-4% exhibit high astigmatism >3D. (1) (2) Correction may be achieved postoperatively with spectacles or contact lenses, or intraoperatively using limbal relaxing incisions, arcuate keratotomy, or opposite clear corneal incisions, though these may be unpredictable. (3) (4) (5) Toric IOLs offer a more precise alternative for regular astigmatism. (6) This study evaluates their effectiveness in improving refractive outcomes and visual acuity.

2. Materials and methods

A prospective interventional case series of 44 eyes with cataract and corneal astigmatism (more than 1 D TO 5 D) in patients of 21-70 years of age were included in the study. Patients with pre-existing ocular disorders and irregular corneal astigmatism were excluded.

3. Study Procedure:

A detailed preoperative ocular examination was undertaken in all cases. Keratometry was done using auto refractometer. Biometry was done using IOL Master (Carl Zeiss Meditec, Germany) in all patients. In the present study surgical incision site was 135 degrees in all patients Acriol EC Toric intraocular lens model AS-6T1-T6 was implanted in all cases.

Post operative evaluation of vision, autorefraction, keratometry, slit lamp examination and Intraocular Pressure measurement were conducted on follow up on post operative day 1 and 30.

4. Results

The distribution of pre-operative uncorrected visual acuity (UCVA) among the study participants showed that the majority, 77.3% (34 out of 44), had a UCVA between 6/60 and 6/18. A smaller group, 22.7% (10 out of 44), had a UCVA of less than 6/60. Notably, no participants had a pre-operative UCVA within the 6/12 to 6/6 range. The distribution of astigmatism type among the study participants shows that 59.1% (26 out of 44) had against-the-rule astigmatism, while 40.9% (18 out of 44) had with-the-rule astigmatism. The distribution of post-operative day 30 uncorrected visual acuity (UCVA) among the study participants indicates that the majority of participants, 93.2% (41 out of 44), achieved a UCVA between 6/12 and 6/6. A small percentage, 4.5% (2 out of 44), had a UCVA between 6/60 and 6/18, while only 2.3% (1 out of 44) had a UCVA of less than 6/60.

Table 1: Distribution of pre operative and post operative cylinder

Cylinder Value		Pre-Operative	Post Operative	Total	P
<1	Number	0	34	34	<0.0001
	%	0.00%	77.27%	38.63%	
1 to 2	Number	15	7	22	
	%	34.10%	15.90%	25.00%	
2 to 3	Number	12	2	14	
	%	27.30%	4.50%	15.90%	
3 to 4	Number	10	1	11	
	%	22.70%	2.30%	12.50%	
4 to 5	Number	7	0	7	
	%	15.90%	0.00%	8.00%	

Pre-operatively, no patients had a cylinder value of less than 1 diopter, but post-operatively, 34 patients (77.27%) achieved this outcome, accounting for 38.63% of the total. In the 1 to 2 diopter range, 15 patients (34.10%) had this cylinder value pre-operatively, while only 7 patients (15.90%) remained in this range post-operatively, contributing to 25.00% of the total cases. For cylinder values between 2 and 3 diopters, 12 patients (27.30%) were observed pre-operatively, while 2 patients (4.50%) remained in this range post-operatively, representing 15.90% of the total. In the 3 to 4 diopter range, 10 patients (22.70%) had this cylinder value pre-operatively, but only 1 patient (2.30%) had it post-operatively, making up 12.50% of the total. Lastly, 7 patients (15.90%) had cylinder values between 4 and 5 diopters pre-operatively, with no patients remaining in this category post-operatively, contributing 8.00% to the total. The analysis showed a highly significant reduction in cylinder values post-operatively, with a p-value of less than 0.0001. The mean preoperative astigmatism in this study was 2.16±1.01D and the mean postoperative astigmatism in the present study was reduced to 0.48±0.611D.

On the first day following toric IOL implantation, a few complications were observed. Specifically, 5 cases of Descemet's membrane folds, 1 case of an air bubble in situ, and 5 cases of corneal edema were recorded. However, it is noteworthy that by the seventh day post-surgery, all these complications had fully resolved.

5. Discussion

The use of toric intraocular lenses (IOLs) has become a highly effective method for correcting pre-existing corneal astigmatism during cataract surgery, offering improved refractive outcomes, enhanced uncorrected visual acuity (UCVA), and greater postoperative patient satisfaction. Findings from the present study support this, demonstrating a significant reduction in postoperative astigmatism along with substantial visual improvement. These results are comparable to previously published work, where toric IOLs have shown superior refractive predictability and stability versus non-toric IOLs. Studies by Al-Mohtaseb Z et al. (2024) (7) reinforce the benefit of toric IOLs in reducing residual cylinder and improving refractive outcomes.

Pre-Operative Astigmatism

The mean preoperative astigmatism in this study was 2.16±1.01D, comparable to Shen J et al. (2023) (8), who reported 2.06±0.79D. Moulick PS et al. (2018) (9) reported a broader range of 1.5-4.5D, similar to the upper range observed here. In contrast, the values documented by Jeeva IK et al. (2024) (10) 1.52±0.84D were lower, suggesting that their study populations may have included milder corneal astigmatism. Hoffmann PC et al. (11) reported that approximately 60% of cataract patients exhibit corneal astigmatism >0.75D, emphasizing the need for toric correction where appropriate.

Post-Operative Astigmatism

The mean postoperative astigmatism in the present study was reduced to 0.48±0.611D, confirming successful cylinder neutralisation. Comparatively, Jeeva IK et al. (2024) (10) reported lower postoperative cylinder values (0.01±0.09D), while Shen J et al. (2023) (8) recorded 0.29±0.30D at three months—slightly lower than our findings, possibly due to longer postoperative stabilization. Overall, our results demonstrate favorable refractive reduction consistent with published outcomes.

Visual Acuity Outcomes

Postoperative improvement in visual acuity was notable. Preoperatively, 77.3% of patients had UCVA between 6/60-6/18, while by day-30, 93.2% achieved UCVA of 6/12-6/6 and 100% reached BCVA of 6/12-6/6. RA Ho et al. (12) also reported marked improvement in UCVA and BCVA post-toric IOL implantation. Lazar A et al. (13) observed postoperative UCVA and BCVA reaching 20/20 in most patients, slightly better than our outcomes. Moulick et al. (9) demonstrated similar improvement

6. Complications

Early postoperative complications included Descemet membrane folds and corneal edema, all resolving by day-7. Suboptimal outcomes in three patients resulted from IOL rotation and pre-existing amblyopia. Qiu X et al. (2021) (14) similarly identified IOL misalignment and amblyopia as common causes of reduced postoperative visual recovery. Visser N et al. (6) emphasised rotational instability as a major complication. Reduced outcomes were more common in eyes with high preoperative cylinder.

7. Conclusion

The study's findings emphasize the effectiveness of toric intraocular lenses in providing precise astigmatism correction for cataract patients, leading to improved visual outcomes with spectacle independence and patient satisfaction. These results support the consideration of toric intraocular lenses as a valuable option in cataract surgery, particularly for patients with significant pre-existing corneal astigmatism.

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