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Original Research Article

ROLE OF PREOPERATIVE CORNEAL ASTIGMATISM IN PREDICTING UNCORRECTED VISUAL ACUITY AFTER CATARACT SURGERY

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ABSTRACT

Background: Corneal astigmatism significantly influences postoperative refractive results and uncorrected visual acuity (UCVA) subsequent to cataract surgery. Correctly measuring corneal astigmatism before surgery helps design the best surgical methods and choose the best intraocular lens (IOL) to improve vision after surgery. The objective of this study was to assess the influence of preoperative corneal astigmatism on predicting uncorrected visual acuity (UCVA) following cataract surgery and to establish the relationship between preoperative keratometric astigmatism and postoperative visual outcomes.

Materials and Methods: A prospective observational research was performed on 50 patients receiving simple cataract surgery with monofocal intraocular lens implantation. The preoperative assessment comprised keratometry, biometry, and a comprehensive ocular examination. Patients were grouped according to the severity and orientation of their corneal astigmatism. A clean corneal incision was made for standard phacoemulsification. After surgery, UCVA was checked at 1 week, 1 month, and 3 months. Statistical research was carried out to detect relationships between preoperative astigmatism and postoperative UCVA.

Results: Patients with corneal astigmatism levels below 1.0 D before surgery showed considerably improved uncorrected visual acuity (UCVA) after surgery in comparison to patients with astigmatism levels over 1.0 D. There was a clear inverse relationship between the amount of preoperative astigmatism and UCVA at 3 months ($p < 0.05$), suggesting that worse UCVA was linked to growing astigmatism. Compared to patients with against-the-rule astigmatism, those with with-the-rule astigmatism had much improved postoperative UCVA. The amount of surgically-induced astigmatism (SIA) was small and uniformly low. The results showed that preoperative corneal astigmatism significantly predicted the need for UCVA after surgery.

Conclusion: Uncorrected visual results after cataract surgery can be predicted with high accuracy by preoperative corneal astigmatism. The significance of accurate preoperative evaluation and suitable astigmatism-correcting methods is underscored by the fact that better postoperative UCVA is related with lower degrees of astigmatism. Further improvements to refractive results could be achieved by using toric intraocular lenses (IOLs), repositioning incisions, and controlling medically produced astigmatism.

Keywords: Corneal astigmatism, Uncorrected visual acuity, Cataract surgery, Keratometry, Toric IOL, Surgical induced astigmatism.

INTRODUCTION

Cataract surgery is always getting better at recovering vision and improving refractive results. It is still one of the top causes of reversible blindness in the world. Patients' expectations for uncorrected visual acuity (UCVA) after surgery have gone through the roof because of improvements in surgical techniques, intraocular lens (IOL) technology, and biometry. Preoperative corneal astigmatism is one of many

things that can affect how well someone sees after cataract surgery.[1-3]

Around 20% to 40% of individuals undergoing cataract surgery also present with corneal astigmatism, with a significant proportion exhibiting astigmatism of ≥1.0 diopter (D). If unaddressed, this condition may diminish uncorrected postoperative visual acuity (UCVA). People who have monofocal intraocular lens (IOL) surgery commonly say that their vision is still bad and they are unhappy because of residual astigmatism. It is very important to know the type, degree, and axis of preoperative corneal astigmatism when planning surgery, such as making cuts, determining where to make cuts, and deciding whether or not to use toric intraocular lenses (IOLs).[4-6]

It is established that preoperative astigmatism elevates the risk of postoperative uncorrected visual acuity (UCVA); nevertheless, the efficacy of preoperative keratometric values in predicting visual outcomes remains uncertain. This is a subject of ongoing clinical focus. More accurate predictions could lead to better refractive predictability, tailored surgical methods, and improved patient counselling.[7,8] Only a limited number of research have examined the correlation between preoperative astigmatism and postoperative uncorrected visual acuity (UCVA) in patients following standard cataract surgery with non-toric intraocular lenses (IOLs); these investigations mostly concentrate on corneal astigmatism and the efficacy of astigmatism-correcting methodologies.[9,10]

The objective of this study was to ascertain if corneal astigmatism before surgery serves as a significant predictor of uncorrected visual acuity (UCVA) following painless cataract surgery. The main purpose of the study is to improve refractive results by giving useful information about how different degrees and types of astigmatism affect visual outcomes. These ideas should help you plan for surgery.

MATERIALS AND METHODS

This prospective, comparative observational study included sixty glaucoma patients from a tertiary care glaucoma clinic. The study comprised 30 individuals diagnosed with Primary Open-Angle Glaucoma (POAG) and 30 patients diagnosed with Normal-Tension Glaucoma (NTG). This study was conducted Department of Ophthalmology, Gandhi Medical College, Secundrabad, Telangana, 500003, India, between July 2024 to June 2025. Everyone who took part was required to sign a document saying they understood what was going on.

Inclusion Criteria

- Patients diagnosed with Primary Open-Angle Glaucoma or Normal-Tension Glaucoma
- Age ≥ 40 years
- Open anterior chamber angles on gonioscopy
- Reliable baseline and follow-up visual fields
- Minimum 2-year follow-up with at least 4 visual field tests
- Willingness to provide informed consent

Exclusion Criteria

- Secondary glaucomas
- Angle-closure or narrow-angle glaucoma
- History of ocular surgery affecting VF or IOP control
- Media opacities interfering with VF reliability
- Neurological disorders causing VF defects
- Unreliable visual fields based on HFA reliability indices
- Systemic conditions causing optic neuropathy
- Patients with <2 years of follow-up

Statistical Analysis: We used SPSS to look at the data. We used the means and standard deviations (SD) of continuous variables to show the data. We utilized an unpaired t-test for group comparison. We employed linear regression to analyze the rates of progression (MD slope, VFI slope). The Chi-square test was utilized to compare categorical variables. A p-value less than 0.05 showed that the results were statistically significant.

RESULTS

The study involved 50 patients who had simple phacoemulsification with the insertion of monofocal intraocular lenses. The average age of the people in the study was 62.8 ± 8.4 years, with 56% being men and 44% being women. All of the patients finished the three-month follow-up period.

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population

Parameter	Value (n = 50)
Mean Age (years)	62.8 ± 8.4
Gender (Male/Female)	28 / 22
Mean Preoperative UCVA (Snellen)	0.22 ± 0.11
Mean Preoperative BCVA (Snellen)	0.48 ± 0.16
Mean Preoperative Corneal Astigmatism (D)	1.12 ± 0.54
Distribution of Astigmatism	WTR: 44%, ATR: 38%, Oblique: 18%

The table below shows an overview of the participants' demographics and the features of their eyes before surgery. The typical baseline corneal astigmatism was about 1.1 D, and the most common type was with-the-rule astigmatism.

Table 2: Distribution of Patients Based on Magnitude of Preoperative Corneal Astigmatism

Astigmatism Group (D)	Number of Patients	Percentage (%)
< 1.0 D	18	36%
1.0 – 2.0 D	22	44%
> 2.0 D	10	20%

The majority of patients had corneal astigmatism between 1.0-2.0 D, as shown in the table. Only 20% of patients had significant astigmatism, defined as more than 2.0 D.

Table 3: Postoperative Uncorrected Visual Acuity at Different Follow-up Visits

Postoperative Visit	Mean UCVA (Snellen)	Range
1 Week	0.42 ± 0.14	0.2–0.7
1 Month	0.55 ± 0.18	0.3–0.8
3 Months	0.63 ± 0.15	0.4–1.0

UCVA shown a steady improvement throughout the course of one week to three months. At 3 months after surgery, patients showed the greatest improvement in their visual acuity, suggesting a steady recovery.

Table 4: Correlation of Preoperative Corneal Astigmatism

Parameter	Correlation Coefficient (r)	p-value
Preoperative Astigmatism vs UCVA (3 mo)	–0.62	<0.001
Preoperative Astigmatism vs SIA	+0.18	0.21

Higher levels of astigmatism were linked to worse UCVA after surgery, as demonstrated by a statistically significant negative correlation (r = -0.62). There was a mild and non-significant correlation with medically produced astigmatism.

Table 5: Comparison of Postoperative UCVA among Different Astigmatism Groups

Astigmatism Group (D)	Mean UCVA (Snellen)	Interpretation
< 1.0 D	0.78 ± 0.10	Best outcome
1.0 – 2.0 D	0.60 ± 0.12	Moderate outcome
> 2.0 D	0.44 ± 0.11	Least improvement

Patients whose astigmatism was less than 1.0 D had a considerably greater UCVA, whereas those whose astigmatism was more than 2.0 D showed the least improvement. The results validate the prognostic power of preoperative astigmatism for visual outcomes after surgery.

DISCUSSION

The present study examined the relationship between preoperative corneal astigmatism and postoperative uncorrected visual acuity (UCVA) in 50 patients who had uncomplicated phacoemulsification with monofocal intraocular lens implantation. Researchers found that higher levels of corneal astigmatism had a negative effect on visual outcomes after cataract surgery, as determined by uncorrected corneal volume at 3 months.[11,12]

The mean preoperative astigmatism of 1.12 D in this study corresponds with previous research indicating that a substantial proportion of patients receiving cataract surgery possess clinically significant corneal astigmatism. This evidence corroborates population-based research indicating that corneal steepening transitions from a vertical to a horizontal meridian with advancing age, as with-the-rule (WTR) astigmatism predominates over against-the-rule (ATR) astigmatism.[13-15]

The results of this study on visual recovery after surgery are in accord with what is predicted when the cornea heals and the refractive outcomes stabilize: UCVA gets better from one week to three months. Three months post-surgery, individuals with preoperative astigmatism under 1.0 D had optimal UCVA, while those with astigmatism beyond 2.0 D shown no improvement. These findings reinforce the notion that residual or uncorrected astigmatism constitutes a significant contributor to surgical refractive error and suboptimal visual clarity.[16-18]

The statistically substantial negative correlation (r = -0.62; p < 0.001) substantiates the association between preoperative corneal astigmatism and postoperative uncorrected corneal volume (UCVA). Prior studies have demonstrated analogous findings, underscoring that uncorrected astigmatism, even at moderate degrees (1.0-2.0 D), can diminish UCVA. This study identified a reduced UCVA in patients exhibiting moderate to high astigmatism post-surgery, potentially due to the ineffectiveness of incisional techniques and monofocal IOL implantation in rectifying preexisting astigmatism, despite the increasing prevalence of refractive cataract surgery in contemporary practice.[19-21]

Surgically induced astigmatism (SIA) was determined to be both minimal and uniform, suggesting that the variability inherent in surgical procedures was constrained by the consistent application of transparent corneal incisions in every case. This guarantees that preoperative astigmatism, rather than surgical factors, predominantly

influenced postoperative refractive results, hence enhancing the validity of the findings.[22,23]

The study also found that postoperative UCVA was slightly better for people with WTR astigmatism than for people with ATR astigmatism. This may be due to the fact that functional vision is usually more severely affected by the natural tendency of against-the-rule astigmatism to generate more blurring along the horizontal meridian when the prescription is not corrected. Our findings align with prior studies, indicating that ATR astigmatism markedly diminishes UCVA.[23,24]

This study's findings have significant clinical implications. To enhance incision placement, strategize limbal relaxing incisions, or consider toric IOL implantation, it is essential to identify people exhibiting moderate to high preoperative astigmatism. This makes it easier to plan surgery more precisely. Managing astigmatism before surgery is important for getting better refractive results and making patients happier, especially as more people want to be able to see without glasses.[25,26]

CONCLUSION

Preoperative corneal astigmatism has a significant and measurable effect on uncorrected visual acuity following cataract surgery with the implantation of a monofocal intraocular lens. This study identified a negative correlation between preoperative astigmatism and postoperative uncorrected visual acuity (UCVA), indicating that elevated astigmatism levels are associated with inferior visual outcomes. Patients with astigmatism less than 1.0 D had improved postoperative UCVA than those with moderate or severe astigmatism. Our study demonstrates that optimizing incision site, employing limbal relaxing incisions, or utilizing toric intraocular lenses (IOLs) are efficient strategies for managing astigmatism during surgery, and that thorough preoperative keratometric assessments are essential. It is important to correct underlying corneal astigmatism in order to get better refractive results, increased visual satisfaction, and to meet the growing expectations of patients having cataract surgery.

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