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ORIGINAL RESEARCH

Rotational Stability and Subjective Results of Tecnis Eyhance Toric II Intraocular Lens

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Purpose: This study aims to evaluate rotational stability and patient-reported outcomes associated with Tecnis Eyhance toric II "monofocal plus" intraocular lens (IOL), particularly in light of a modified haptic design.

Methods: A prospective, interventional study was conducted with patients undergoing routine cataract surgery and Tecnis Eyhance toric II IOL implantation. The inclusion criteria were topographic corneal astigmatism of 0.5–4.0D. Exclusion criteria included previous corneal or ocular surgeries, mesopic pupils >5.5mm, wear of rigid gas-permeable contact lenses, and ophthalmic pathologies that might limit vision outcomes. Toric stability was assessed on day 1, week 1, and month 3 using slit-lamp exams and toriCAM app. Quality of Vision (QoV) and Near Activity Visual Questionnaires (NAVQ) before the surgery and 3 months post-operatively.

Results: The study analyzed 98 eyes from 65 patients. Mean absolute IOL rotation was 1.73±1.64° (range: 0–7°) from day 1 to week 1, with 95% rotating ≤5°. From week 1 to month 3, mean rotation was 1.13±1.53° (range: 0–8°), with 98% rotating ≤5°.

Conclusion: The data from this study suggest that the Tecnis Eyhance toric II IOL exhibits good postoperative rotational stability and positive patient-reported visual outcomes.

Keywords: rotational stability, visual acuity, subjective results, toric IOL

Introduction

Cataracts and corneal astigmatism are prevalent conditions that significantly affect visual acuity and quality of life. Approximately 30% of individuals presenting for cataract surgery have corneal astigmatism of 0.75 diopters (D) or more, which can compound the visual impairment caused by cataracts.[1] In the past, traditional cataract surgery with standard intraocular lenses (IOLs) would not address corneal astigmatism, often necessitating additional refractive procedures or the use of corrective eyewear postoperatively.[2]

Toric IOLs have solidified their place as the primary method of addressing corneal astigmatism at the time of cataract surgery.[3] However, optimal correction is dependent on the rotational stability within the eye as rotational misalignment can diminish or alter the intended astigmatic correction, potentially resulting in suboptimal visual results for patients.[4] Depending on the implanted toric power, every degree of rotation may reduce cylindrical correction by as much as 3.3%, leading to residual astigmatism and reduced visual acuity. Ten or more degrees of misalignment may necessitate surgical repositioning.[5–7] Rotation is presumed to occur as a result of the instability of the IOL within the pre-fibrotic capsular bag.[4] Other contributing factors may include cyclotorsion of the eye and its effect on planning or alignment, imprecise positioning of the IOL, IOL haptic design, IOL material, capsulorhexis size, and capsular bag shrinkage.[6] In addition to reduced uncorrected acuity, patients with rotated toric IOLs may experience visual disturbances such as distorted vision, ghosting or monocular diplopia.[8] Misalignment can also cause higher-order aberrations.[5] Ultimately, these problems can result in decreased patient satisfaction and a possible need for re-operation. The goal of the modern toric IOL design is to minimize these risks and enhance the stability and predictability of the refractive outcomes.

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The Tecnis Eyhance Toric II "monofocal plus" IOL aims to combine the benefits of toric correction with an extended range of intermediate vision via a graduated power increase in the central optical zone of the lens. The design aims to provide improved intermediate vision while maintaining high-quality distance vision. A recent design modification was introduced with haptic edges left frosted rather than polished to increase capsular bag friction and improve rotational stability. Post-market analysis is required to validate the effect of this change.[4,9]

This study assesses the rotational stability and visual outcomes of the Tecnis Eyhance Toric II IOL in a real-world clinical environment.

Methods

Study Design and Objectives

This prospective observational study assessed the rotational stability and subjective visual quality outcomes of the Tecnis Eyhance Toric II Extended Depth-of-Focus IOL in patients undergoing cataract surgery by 4 surgeons (GM, HO, SW, KV). The study received ethics approval from an independent review board, Veritas. Consent was obtained from all participants after providing them with detailed information about the study. This study adheres to the Declaration of Helsinki. This research was supported through an investigator-initiated study grant from Johnson & Johnson Vision. The primary outcome was rotational stability of the IOL during the first three postoperative months. Secondary outcomes included subjective visual quality outcomes before surgery and 3 months postoperatively.

Participants

Individuals who were 21 years of age or older, scheduled for routine cataract surgery, and had preoperative corneal astigmatism of 0.5 to 4.0 diopters were included. The exclusion criteria included prior corneal or intraocular surgery, mesopic pupil sizes exceeding 5.5 mm, recent use of rigid gas-permeable contact lenses, pre-existing macular pathology, intraocular hypertension and poorly controlled diabetes were excluded from the study.

The IOL

The Tecnis Toric EDof IOL is a foldable, UV light-absorbing, hydrophobic acrylic one-piece IOL with a C-loop haptic. It is available in spherical powers of +5.00D to +34.00D in 0.5D increments, with cylinder power from 1.00D to 8.00D. The lens is preloaded in the Tecnis Simplicity Delivery System injector with frosted haptics, as discussed, intended to increase rotational stability.[10] The power of the IOL was calculated using the toric IOL calculator provided by Johnson & Johnson Vision online. The target refraction aimed for emmetropia, set between 0 and −0.5 D. The selection was based on the smallest predicted residual cylinder along the correct axis to minimize the risk of overcorrection and subsequent axis inversion.

Surgical Procedure

All participants underwent standard phacoemulsification cataract surgery through a 2.4 mm wound without the use of a femtosecond laser. The Verion Image Guided System (Alcon) was used to capture preoperative anatomic landmarks, and images were transferred to the Verion Digital Marker. Under local anesthesia, a temporal clear cornea incision was used in each case, with surgeons adjusting for their own surgically induced astigmatism (SIA). An anterior capsulorhexis of 5 mm was created, and the IOL was placed in the capsular bag according to the manufacturer's guidelines and rotated to the predetermined axis using the Verion system's intraoperative digital toric marking system.

Outcome Measures

The rotational stability of the IOL after surgery was measured by comparing the alignment of the IOL's at one day, one week, and three months post-operatively, using the toriCAM smartphone application. Patients were examined at the slit lamp with the head adjusted to be in vertical alignment and fixated on a distance target with the fellow eye. With the pupil dilated to expose paired IOL toric markings, a narrow-slit beam was created and rotated to intersect both markings. The orientation of this beam in degrees was then recorded by overlaying it onto the ToriCAM application alignment

Table 1 Patient Characteristics

Demographics	
Eyes	98
Patients	65
Age (Mean ± SD)	68.47 ± 9.28
Gender (Male/Female)	36/29
Laterality (Right/Left)	53/45

screen. The patient-reported visual quality was assessed using the Quality of Vision (QoV) questionnaire and the Near Activity Visual Questionnaire (NAVQ) three months postoperatively. The QoV questionnaire was used to evaluate the frequency, severity, and degree of bother associated with visual disturbances such as glare, halos, starbursts, hazy vision, blurred vision, distortion, double/multiple images, fluctuation in vision, focusing difficulties, and difficulties in judging distance or depth perception. Each symptom was evaluated based on frequency, severity, and bothersomeness, with raw data scaled from 0 to 100, where 0 indicates no symptoms and better visual quality.

The NAVQ assessed functional outcomes related to near activities, including reading, using electronic devices, and other close-up tasks, by asking patients to rate their difficulty with each activity. With 11 questions rated from 0–3, 0 indicating no difficulty and 3 representing extreme difficulty. The questionnaire is scored from 0–33, with a lower score indicating better visual quality.

Statistical Analysis

Participant demographics and baseline characteristics were summarized using descriptive statistics. To evaluate the statistical significance of the change of absolute rotation over time, we employed the Kruskal–Wallis Test. Mean, interquartile range, the range between the first and third quartile (IQR), and outliers were calculated.

Results

Patient Demographics and Baseline Characteristics

This study included 98 eyes from 65 patients, 53 OD (54%), 45 OS (46%). The mean age was 68.47 ± 9.28 years. There were 36 male and 29 female patients (Table 1). No capsular tension rings were used.

Rotational Stability

In Figure 1A, the Target IOL Axis to Day 1 shows a mean change of 2.99±3.49 degrees, with a median of 2.0 degrees. Several outliers were observed, with values of 14, 11, four occurrences of 9, and three occurrences of 15 degrees. In Figure 1B, there was a mean change of 1.73±1.64 degrees and a median change of 1.0 degrees from Day 1 to Week 1. The 1st quartile (Q1) was 0.75 degrees, the 3rd quartile (Q3) was 3.0 degrees, and the IQR was 2.25 degrees with one outlier at 7 degrees. 95% of eyes had an IOL rotation of ≤5 degrees. From Week 1 to Month 3, the mean change was 1.13±1.52 degrees and a median change of 1.0 degrees was found. Q1 was 0.0 degrees, Q3 was 2.0 degrees, and the IQR was 2.0 degrees with two outliers at 6 and 8 degrees. 98% of eyes had an IOL rotation of ≤5 degrees. From Day 1 to Month 3, the total lens rotation was 1.90 ± 2.03 degrees. All time intervals indicated no statistical significance (p-value >0.05).

The IOL rotated clockwise in 30 eyes (31%, 2 ± 1.51°), counterclockwise in 42 eyes (43%, −2 ± 1.57°) and did not rotate in 26 eyes (26%) between Week 1 and Day 1. Between Month 3 and Week 1, the IOL rotated clockwise in 30 eyes (31%, 1.6 ± 0.86°), counterclockwise in 23 eyes (23%, −3 ± 1.96°) and did not rotate in 45 eyes (46%) (Table 2).

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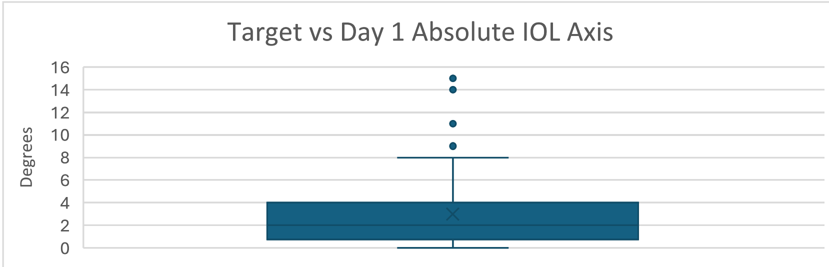
A.



B.

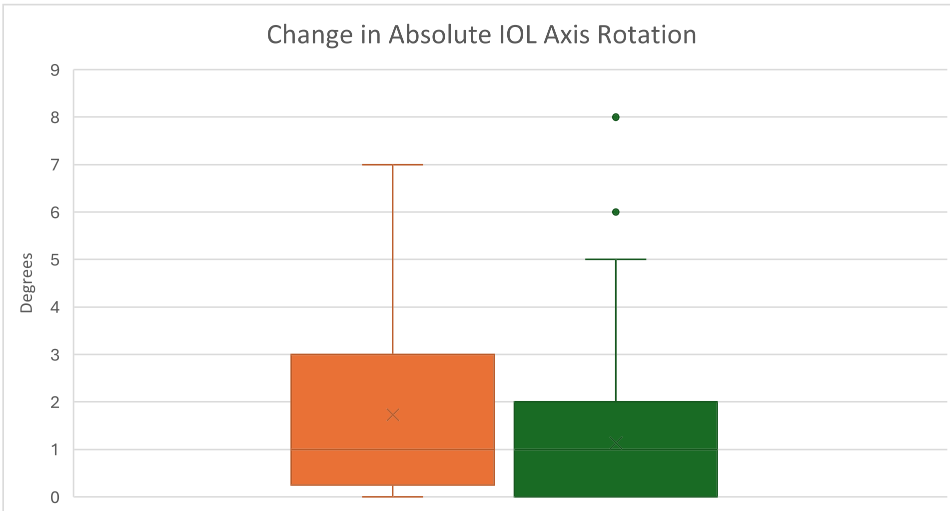


Figure 1 Boxplot analysis- (**A**) Difference in IOL Axis between Target and Day 1, (**B**) Change in absolute IOL axis rotation for two intervals: Day 1 to Week 1 and Week 1 to Month 3. The box plot illustrates the mean, median, IQR, and outliers (1.5xIQR+Q3). The whiskers extend to the remainder of the distribution, with outliers depicted separately.

Patient Reported Outcomes

Patients completed the QoV questionnaire and the NAVQ at the three-month follow-up (Tables 3 and 4, respectively). The QoV questionnaire results showed positive results for all categories.

Table 2 Absolute Rotation Values and Distribution of Rotation Direction

Observation Period	Absolute IOL Rotation in Degree		≤5° (%)	P value	Absolute Number of IOLs Rotating Clockwise: Counter-Clockwise: No Change
	Median (Range)	Mean±SD			Distribution
Target IOL Axis to Day 1	2.0 (0–15)	2.99±3.49	84	>0.05	48:26:24
Day 1–Week 1	1.0 (0–7)	1.2±0.9	95	>0.05	30:42:26
1 week–Month 3	1.0 (0–8)	1.1±0.8	98	>0.05	30:23:45

Table 3 Quality of Vision Questionnaire Responses

Subscale	Postoperative Mean ± SD
Frequency	40.2 ± 10.1*
Severity	38.6 ± 11.5*
Bothersome	39.5 ± 12.6*

Note: (*) indicates a significant value p<0.05.

Table 4 Near Activity Visual Questionnaire Responses

Question	Postoperative Mean ± SD
1. Reading small print (eg, newspaper)	0.8 ± 0.4
2. Reading large print (eg, books)	0.7 ± 0.3
3. Reading very large print (eg, signs)	0.6 ± 0.2
4. Seeing objects close up (eg, needlework)	0.9 ± 0.5
5. Seeing objects in the distance (eg, driving)	0.5 ± 0.3
6. Recognizing faces	0.4 ± 0.2
7. Using a computer or digital screen	0.6 ± 0.3
8. Seeing at night	1.0 ± 0.4
9. Seeing in dim light	0.9 ± 0.3
10. Performing near tasks (eg, cooking)	0.7 ± 0.3
11. General satisfaction with near vision	0.8 ± 0.4
Overall Score	6.95 ± 1.5

Discussion

This study evaluated the rotational stability and patient-reported outcomes following cataract extraction and insertion of the Tecnis Eyhance Toric II IOL in 65 patients (98 eyes). The mean absolute rotation of the IOL was 1.73 ± 1.64° from day 1 to week 1 and 1.13 ± 1.53° from week 1 to month 3, with 95% and 98% of eyes demonstrating rotations of ≤5° in these intervals, respectively. Additionally, patient-reported outcomes showed significant improvements in visual quality and near-activity performance.

Rotational Stability

A determining factor in the success of toric IOLs is rotational stability, as misalignment from the intended axis reduces the effectiveness of the lens in correcting astigmatism. This study showed consistent rotational stability, with an observed rotation of 1.90 ± 2.03 degrees from Day 1 to Month 3, comparable to the results reported by Zeilinger et al for the Tecnis Toric II IOL who reported rotational stability as 1.34 ± 1.46 degrees.[11]

Various factors influence the rotational stability of a toric IOL, including IOL interaction with the capsular bag, IOL material, and haptic design. Studies suggest that the capsular bag fibrosis typically stabilizes within 3 months.[12] Studies have found that achieving a strong adhesion between the IOL and the capsular bag helps to minimize rotation.[13,14] In a paper comparing the rotational stability of toric IOLs, unpolished surfaces demonstrated more rotational stability compared to polished surfaces of IOLs with made with identical design and material, likely due to the higher coefficient of friction between the surface of the lens and the capsule.[15] Our findings revealed no significant changes in IOL rotation from day 1 to month 3, which is in line with the typical stabilization period observed with capsular bag fibrosis. Adhesion to the capsular bag is heavily determined by the material of the IOL. The lens and haptics are made of soft, foldable, UV-light absorbing, hydrophobic acrylic material, which has been found to have the highest levels of adhesion when compared to other materials, such as PMMA and silicone.[15–17]

Furthermore, research has highlighted that extracellular matrix proteins such as fibronectin, type IV collagen and vitronectin play a role in adhesion and these proteins are seen in higher levels in acrylics compared to other materials. These factors likely contributed to the rotational stability of the Tecnis Toric II IOL. Takaku et al (2021) observed a significant decrease in axis misalignment and uncorrected astigmatism with the Tecnis Toric II featuring frosted haptics compared to the previous model, Tecnis Toric I, with smooth haptics.[17] They reported that the mean axis misalignment significantly decreased from 3.8 ± 2.7° with the Tecnis Toric I to 1.9 ± 1.3° with the Tecnis Toric II (p=0.04).[17] Osawa et al (2022) highlighted that modified haptics can significantly enhance surgical outcomes and rotational stability, reinforcing our findings.[15,18,19]

Connell et al (2025) compared the rotational stability of the Eyhance Tecnis Toric II with the Clareon Toric IOL. Stability between the two lenses was comparable. Additionally, as found in this study, Connell et al did not find any significant rotation in the Tecnis Toric II between day 1 and month 6.[20]

Similarly, Jung et al (2024) found minimal rotation at month 3, with a mean misalignment of $0.68 \pm 4.17°$, and average absolute misalignment was $3.41 \pm 2.44°$.[21]

Patient Reported Outcomes

This study, using the QoV and NAVQ questionnaires, demonstrated that the Tecnis Eyhance toric IOL provides significant improvements in both quality of vision and near vision function. To our knowledge, this is the first study to report patient-reported outcomes alongside rotational stability. These findings indicate a substantial reduction in visual disturbances such as glare, halos, and distortion, leading to higher patient satisfaction.[11]

Similarly, the NAVQ scores underscore the effectiveness of the Tecnis Eyhance toric IOL in enhancing near vision for daily tasks such as reading and using digital devices.[22] It was observed that patients with rotational instability exceeding 5 degrees experienced compromised patient-reported outcomes. Auffarth et al (2020) reported that the enhanced monofocal IOL improved intermediate vision performance while maintaining distance vision and managing photic phenomena, based on Catquest-SF9 results.[23] Similarly, Visser et al found in a randomized clinical trial that toric IOLs resulted in higher rates of spectacle independence for distance vision compared to aspherical IOLs in patients with cataracts and corneal astigmatism, benefiting daily life activities.[24] Moreover, Chang et al noted that 92.5% of surgeons were satisfied with the Tecnis Toric II IOL, reflecting its overall clinical success.[25]

Study Limitations and Conclusion

Possible limitations to our study include the unmeasured effects of tilt. The optical performance of toric IOLs can be marginally impacted by tilt, potentially leading to post-operative astigmatic error. Incorporating tilt measurements in future research would improve the assessment of IOL positioning, resulting in a more thorough analysis. Furthermore, expanding the study to encompass a larger and more diverse patient population and a singular surgeon with the same SIA could yield more comprehensive data on the performance of the Eyhance Toric II IOL across various demographics and ocular conditions.

Overall, our analysis indicates that the Eyhance Toric II IOL exhibits strong performance in terms of rotational stability and patient-reported outcomes. The design of this device appears to enhance its capability to maintain proper alignment post-surgery and improve patient-reported outcomes, making it a valuable addition to the existing IOL options for cataract surgery.

Disclosure

H. O'Donnell reports consulting agreement with Alcon and Bausch + Lomb, outside the submitted work. G. Moloney is a consultant for Kowa Ind. manufacturers of Glanatec (ripasudil) and has received a research grant from Johnson and Johnson. The remaining authors have no conflicts of interest to disclose for this work.

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