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Rotational stability of the enVista® toric lens compared to other commonly implanted toric intraocular lenses – a literature review

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HIGHLIGHTS

Rotational stability is one of the most important parameters determining the benefits of using a toric lens in a patient with co-occurring cataract and astigmatism.

The enVista toric lens has comparable rotational stability to other toric lenses available on the market.

ABSTRACT

Preoperative corneal astigmatism higher than 1 D is present in up to 30–47% of eyes with cataracts. Proper correction of astigmatism, apart from the adequately determined spherical power of the artificial intraocular lens (IOL), is the main factor ensuring the desired result of the procedure manifested as postoperative spectacle's independence, visual function, and as a result – patient satisfaction. Toric IOL implantation allows simultaneous cataract removal and correction of corneal astigmatism during one surgical procedure. Since the introduction of toric IOLs, more rotationally stable lenses allowing for better refractive performance have been introduced to clinical practice. EnVista® is an acrylic toric IOL (enVista® MX60T; Bausch and Lomb Inc., Rochester, NY, USA), which was introduced in 2018, and currently is one of the most used toric IOLs in clinical practice worldwide. Rotational stability, apart from adequately selected spherical and toric IOL equivalents, is the most crucial parameter determining the benefits of using a toric lens because it is estimated that for every 1° of rotation of the toric IOL from the target axis, the correction of astigmatism is reduced by 3.5%; therefore a significant change of position in the postoperative period may require another surgical intervention. In this review, based on published research, we summarized the rotational stability of the enVista® lens compared to the other toric IOLs available on the market.

Key words: toric intraocular lens, astigmatism, refractive error, cataract surgery, phacoemulsification

INTRODUCTION

Total astigmatism consists of two components: corneal and lenticular astigmatism. Corneal astigmatism results from anterior and/or posterior corneal curvature asymmetry. It is typically defined by the altitude expressed in cylindrical diopters (D) and the axis presented in the range of 0–180° [1]. According to estimates, preoperative corneal astigmatism higher than 1 D is present in up to 30–47% of eyes with cataracts [1, 2], while corneal astigmatism above 2 D and 3.5 D occurs in 8% and 1.7–2.7% of patients, respectively [3, 4]. It is known that astigmatism above 1 D leads to a significant reduction in the quality of life resulting from difficulties in performing basic activities [1]. Due to the high percentage of astigmatism in the population of patients with cataracts, in recent years, substantial attention has been paid to its appropriate correction.

Cataract surgical techniques have been remarkably improved over the last decades, aiming at both reducing the invasiveness of the procedure with the current leading trend as manual small-incision cataract surgery (MSICS), as well as achieving the highest degree of spectacles independence, which is achieved by improving surgical techniques and instruments and designing more technologically advanced artificial intraocular lenses (IOLs) [4]. Besides correcting the spherical error, adequate correction of astigmatism during cataract surgery is one of the most critical factors determining the postoperative spectacle's independence, visual function, and as a result – patient satisfaction [4].

The Food and Drug Administration (FDA) approved the first IOL for correcting corneal astigmatism during cataract surgery in 1998 [5]. Toric IOLs, in addition to the ability to correct the spherical component of refractive error, also can reduce astigmatism through the built-in toric feature on the posterior surface of the artificial lens [4] and thus achieve better visual and refractive effects compared to spherical IOLs [2]. Therefore, toric IOL implantation is the most beneficial solution for patients with concomitant cataracts and astigmatism, as it allows simultaneous cataract removal and correction of corneal astigmatism in one surgical procedure, without the need for additional corneal incisions [6]. Since the introduction of toric IOLs, more rotationally stable lenses allowing for better refractive performance have been launched [5], one of which was introduced in 2018 enVista hydrophobic acrylic toric lens (enVista® MX60T; Bausch and Lomb Inc., Rochester, NY, USA) [7]. In this review, we summarized the rotational stability of the enVista® lens by comparing it to the commercially available toric IOLs based on published research.

ROTATIONAL STABILITY

Rotational stability, apart from adequately selected spherical and toric IOL equivalents, is the most crucial parameter determining the benefits of using a toric lens [8] and is defined as the lack of misalignment understood as the clockwise or counterclockwise rotation of the toric lens concerning the designated position at the end of surgery. Precise determination of the axis of corneal astigmatism in the preoperative examination and its attitude, considering astigmatism originating from the posterior surface of the cornea, proper placement of the toric lens during the procedure by the designated landmark, and rotational stability of the lens are the most critical factors in obtaining the desired effect in terms of uncorrected distance visual acuity (UDVA) [8, 9].

It is estimated that for every 1° of rotation of the toric lens from the target axis, the correction of astigmatism is reduced by 3.5% [4]. Previous studies have shown that the toric lens undergoes the highest rotation between 1 hour and 10 days after surgery [4]. The principal factors leading to rotational instability of toric lenses have been identified as intraoperative hypotonia, the presence of residual viscoelastic material posterior and/or anterior to the IOL, and lens bag-related factors such as capsular bag contraction, phimosis, shrinkage, as well as capsular bag diameter and capsulorhexis size [3, 4]. However, other factors such as axial length (AL) and IOL-related factors such as its design/material, axis IOL alignment, and IOL's haptic diameter have also been proposed [9].

Substantial rotation of the toric lens can be resolved by repositioning the previously implanted lens before complete fusion between the artificial lens and the lens bag. If repositioning is impossible, residual astigmatism can be corrected non-invasively with spectacles or surgically by implanting a second toric lens into the ciliary sulcus or performing refractive corneal surgery [3].

SUMMARY OF CURRENT RESEARCH

Since the enVista® toric IOL was introduced to clinical use, several studies evaluating its rotational stability have been published [7, 10–12]. In a survey of 122 eyes with preoperative astigmatism less than 1.5 D, 92% of eyes showed enVista® lens rotation below 5° after 6 months of follow-up [7], while in a study of a smaller group of 20 patients with higher corneal astigmatism of -2.5 D, the mean rotation after 3 months of follow-up was 2.05°, and it did not exceed 5° in the examined group [11]. Buckhurst et al. showed an enVista® lens rotation of less than 5° in 112 concerned eyes after 4–6 months after phacoemulsification [12], while Vokrojová investigated the rotational stability of the enVista® lens with intraoperative use of capsular bag tension ring (CTR) and without the use of CTR [10]. In both groups, after 5 months of follow-up, the rotation was 3.70° and 3.85°, respectively ($p > 0.05$).

Several studies have compared the rotational stability of the enVista® lens to other IOLs using the same protocol, which is crucial given the subtle differences in surgical approach between centers, particularly in terms of target-axis methods marking, as well as methodology and timing of control measurements performed in the postoperative period.

The rotational stability of enVista® was compared to other toric IOLs for the first time by Torio et al. EnVista®, AcrySof IQ Toric® (SN6AT3-9, Alcon Laboratories, Inc., Fort Worth, TX, USA), and FineVision® (PhysIOL BVI, Liege, Belgium) toric lenses were evaluated in this study. There were no marked differences between the compared toric IOLs. The average rotation for the enVista® lens was 2.47°, for AcrySof 2.66°, and for FineVision 2.75°. There were 0%, 2%, and 8% of rotation above 10° from the target axis for the lenses listed above, respectively [6].

Garzón et al. compared the rotational stability of three toric monofocal lenses: Lentis LT® (LU-313T; Oculentis, Berlin, Germany), AcrySof IQ Toric IOL® and enVista®, as well as a multifocal lens - AcrySof IQ ReSTOR® (SND1 T1-T5, Alcon Laboratories, Inc., Fort Worth, TX, USA). In this study, the postoperative UDVA was the best in the enVista® group with an average of 0.09 ±0.14, compared to 0.14 ±0.16, 0.12 ±0.11, and 0.09 ±11.82 for AcrySof IQ®, AcrySof IQ ReSTOR® and Lentis LT® (Oculentis GmbH, Berlin, Germany), respectively ($p > 0.05$). Rotational stability was measured 1 hour, 1 day, 7 days, and 1 month after surgery. In the first hour after surgery, the highest degree of rotation was observed for the Lentis LT®. It was 3.78° ±5.87°, while for the AcrySof IQ®, enVista®, and AcrySof IQ ReSTOR® lenses, 0.96° ±4.51°, -0.67° ±6.09° and 2.82° ±5.11°, respectively. The final measurement showed that the enVista® was the only toric IOL with an anti-clockwise rotation of -0.42° ±5.87°. In contrast, the clockwise rotation for the other lenses was 0.32° ±5.85°, 3.71° ±5.94° and 2.78° ±5.83° for AcrySof IQ®, Lentis LT®, and AcrySof IQ ReSTOR®, respectively ($p > 0.05$). Rotation below 5° was observed in 69.6% of monofocal lenses and 67.9% of multifocal lens cohorts. A slightly lower percentage of rotational instability above 10° (17.8%) was found in the multifocal group compared to the monofocal group (18.9%) [13]. The enVista® lens had both the highest percentage of rotation below 5° and the lowest percentage of rotation above 10° at the end of the observation period (90.5% and 9.5%) compared to Lentis LT® (64.6% and 14.28%) and AcrySof IQ® (64.3% and 21.4%) [13].

In another study, the rotational stability of the enVista®, AcrySof60WF® (Alcon Laboratories, Inc., Fort Worth, TX, USA), and Tecnis ZCB00® (Johnson & Johnson Vision, Santa Ana, CA, USA) lenses between the state at the end of surgery and follow-up examinations performed 1 hour after surgery, and then at 1 week, 1 month, and 6 months after surgery. The highest rotation was observed within the first hour after surgery: 1.6° ±2.6°, 1.9° ±3.8°, and 2.5° ±5.2° for AcrySof®, Tecnis®, and enVista®, respectively ($p > 0.05$). Within the first postoperative hour, the percentage of eyes with a rotation above 5° was the lowest for AcrySof® – 3.5%, while 4.1% for Tecnis® and 12.5% for enVista®. Further observation revealed that from the first hour after surgery to the follow-up visit after 1 week, there were 0.9% of eyes with a rotation above 5° in the AcrySof® group and 2% and 3.3% in the enVista® and Tecnis® cohort, respectively. In the total 6-month observational period, the altitude of rotation was the lowest in eyes with AcrySof® (4.8%), at the medium level in the Tecnis® group (7.5%), and the highest in eyes with enVista® [8]. The paired comparison showed a statistically significant difference between the AcrySof® and enVista® groups ($p = 0.014$). However, there were no significant differences between the other pairs: AcrySof® and Tecnis® and enVista® and Tecnis® [8]. In the abovementioned study, lens decentration and tilt have also been evaluated. The lowest horizontal dislocation was found in the enVista® group (0.02 ±0.21 mm) compared to the highest (0.11 ±0.21 mm) in the AcrySof® group. In contrast, the lowest vertical dislocation was found in the AcrySof® group (-0.03 ±0.33 mm) compared to the highest (-0.15 ±0.24 mm) for the Tecnis® platform. The most downward average tilt in both horizontal and vertical planes was observed in the enVista® group (-4.58° ±2.62° and -1.97° ±1.58°, respectively). Whereas in the AcrySof® group, the highest altitude of horizontal and vertical tilt was found (-4.87° ±2.0° and -2.89° ±2.31°) [8]. Kramer et al. also compared the rotational stability of enVista®, AcrySof®, and Tecnis® in a population of patients with current residual astigmatism equal to or greater than 0.5 D. The results showed that AcrySof® showed significantly less rotation above 5° in the postoperative period compared to enVista® and Tecnis® ($p = 0.0011$ and $p < 0.001$, respectively); however, the analysis rotation magnitude did not reveal marked differences between the compared groups ($p > 0.05$ for all paired comparisons) [5].

CONCLUSIONS

The available publications show varied results regarding the rotational stability of individual toric platforms. However, it can be concluded that the enVista® toric lens has comparable rotational stability to other toric IOLs on the market. Therefore, the surgeon's preference based on the experience with results regarding rotational stability may be a significant factor in choosing a preferred toric lens platform.

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