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

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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

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.
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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 spectacle 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 lenses 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 hypotony, 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 ±0.12 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 lenses for all paired comparisons) [5].

The available publications show varied results regarding the rotational stability of the enVista® toric lens compared to other commonly implanted toric intraocular lenses – a literature review
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Authors’ contributions:
All authors have equal contribution to the paper.

Conflict of interest:
None.

Financial support:
None.

Ethics:
The content presented in the article complies with the principles of the Helsinki Declaration, EU directives and harmonized requirements for biomedical journals.