


Double C-Loop Haptic Lenses Are Rotationally Stable – A Systematic Review

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Abstract: The purpose of this review is to summarize the clinical rotational stability outcomes reported in patients following implantation of the POD platform with double C-loop haptics. A literature search in PubMed (US National Library of Medicine) was carried out to find publications, both prospective and retrospective, which report rotational stability outcomes in patients who were implanted with this platform after cataract or refractive lens exchange surgeries. This platform is used in different commercially available intraocular lenses (IOLs), both monofocal and trifocal, made of hydrophilic or hydrophobic material. 19 clinical peer-reviewed studies published between 2013 and 2024 were included in this review. The data reported in the clinical publications was analyzed in detail, focusing on rotational stability (mean rotation values and ranges, and percentage of eyes with some degrees of rotation), measurement methods and rotation follow-up period. Our review encompassed a total of 1428 eyes implanted with the POD platform analyzed at different follow-up periods, up to a maximum of 26 months. The mean rotation across all the studies was 2.61°. The analysis carried out in this review leads us to conclude that the POD platform provides good rotational stability when used with different IOL models based on monofocal or trifocal designs and made using hydrophilic or hydrophobic material.

Keywords: rotational stability, haptic, double C-loop, intraocular lens, platform

Introduction

Stability of an intraocular lens (IOL) when implanted after cataract or refractive lens exchange (RLE) surgery is crucial for providing optimal refractive and visual outcomes. Minimizing postoperative rotation of the IOL is essential for reducing postoperative residual astigmatism. The degree of postoperative IOL rotation can be affected by an array of factors including capsulorhexis size, axial length, and the IOL design which in turn influences rotational stability.^{1,2} Given the wide range of factors that can contribute to a possible misalignment, maximizing the intrinsic rotational stability of the IOL is an important component in optimizing visual outcomes.³ Rotational stability of a toric IOL is dependent on a number of aspects, including lens material and design.⁴ A recent systematic review and single-arm meta-analysis of 51 published studies including 4863 eyes revealed that postoperative rotation is dependent on many aspects of lens material and design.³ The haptic design and material of an IOL may play an important role in its stability, since these may induce changes in the capsule.

One of the most widely used haptic designs worldwide is the POD platform (BVI Inc., Waltham, USA). This structure with a double C-loop, has a symmetrical quadripod design with two-by-two oppositely oriented haptics. This design provides four contact points for fixing the IOL in the capsular bag when implanted along with a large area. It has been used in monofocal and trifocal IOLs, both in toric and non-toric versions. In a biomechanical laboratory study, Bozukova et al⁵ found that hydrophobic acrylic C-loop, double C-loop, and closed quadripod haptics applied optimum compression forces to the capsular bag with negligible optic axial displacement and tilt compared with plate haptics and poly (methyl methacrylate) haptics. The axial displacement and tilt tests carried out in this experiment showed that whatever the test-well diameter, the optical part of the C-loop and double C-loop IOLs remained in a stable position. These authors argued that the moderate haptic compression force of the double C-loop IOLs contributes to their positional and refractive stability.

In a later study, Bozukova et al⁶ undertook a detailed analysis of the behavior of the double C-loop platform using a computer simulation, in vitro, and in vivo (animal) conditions, demonstrating the benefit of the haptic design in ensuring axial and centration stability. Recent studies^{7,8} using finite element modeling have looked at the biomechanical stability of IOLs prior to their implantation. The computer simulation⁷ analyzed the POD F and POD FT IOLs showing that the axial displacement was the maximal with the FT model, and the tilt, rotation, and lateral decentration were substantially lower than the acceptable tolerance limits established by ISO.11979–2.⁹ This study revealed that, in terms of rotation, all the IOL models were rotationally stable. Although the POD F IOL showed maximum magnitude of rotation at all compression diameters (varying from 0.375 ° to 0.256 °), this amount is not clinically relevant confirming excellent stability of this platform.

In addition to laboratory evaluation, clinical studies are necessary to fully understand the performance of this platform when implanted. While several publications have confirmed rotational stability of several types of POD based IOLs, to our knowledge there has been no meta-analysis performed. This paper reviews the metanalysis of internationally peer-reviewed publications evaluating the rotational stability outcomes of the different POD-platform-based IOL.

Methods

The POD double C-loop platform has a symmetrical quadripod design with two-by-two oppositely oriented haptics. This design provides four contact points for fixing the IOL in the capsular bag when implanted. The double C-loop design allows the IOL to be rotated both clockwise and counterclockwise during surgery. This haptic orientation also helps fix the IOL in the capsular bag, providing four contact points; a higher degree of haptic contact between the IOL and the capsular bag is associated with greater material-tissue friction, reducing the IOL rotation within the bag.⁶ This platform has been used with different IOL models, from monofocal to trifocal lenses, both with and without a toric design and using either hydrophilic or hydrophobic material. The main characteristics of the lenses (currently available) are illustrated in Table 1 and Figure 1 shows their respective images. All the lenses have an overall diameter of

Table 1 Characteristics of Different Intraocular Lenses That Use the POD Platform

Intraocular LensModel	Technical Name	Material	Optic Design	Haptic Design	Spherical Power (D)	Cylindrical Power (D)
ANKORIS	PODTAY26P	26% Hydrophilic Acrylic	Biconvex Aspheric Toric Monofocal	Double C-loop and Posterior Angulated Haptic	+6 to +30 (0.5D steps)	1.50, 2.25, 3.00, 3.75, 4.50, 5.25, 6.00
PODEYE	PADAGF	GFY Hydrophobic Acrylic	Biconvex Aspheric Monofocal	Double C-loop with Ridgetech® and Posterior Angulated Haptic	+10 to +30 (0.5D steps) 0 to +9 and +31 to +35 (1D steps)	—
PODEYE TORIC	PODT49P	GFY Hydrophobic Acrylic	Biconvex Aspheric Toric Monofocal	Double C-loop with Ridgetech® and Posterior Angulated Haptic	+6 to +30 (0.5D steps)	1.00, 1.50, 2.25, 3.00, 3.75, 4.50, 5.25, 6.00
FINEVISION (POD F)	PODFY26P	26% Hydrophilic Acrylic	Biconvex Aspheric Trifocal	Double C-loop and Posterior Angulated Haptic	+6 to +35 (0.5D steps)	—
FINEVISION TORIC (POD FT)	PODFTY26P	26% Hydrophilic Acrylic	Biconvex Aspheric Toric Trifocal	Double C-loop and Posterior Angulated Haptic	+6 to +35 (0.5D steps)	1.00, 1.50, 2.25, 3.00, 3.75, 4.50, 5.25, 6.00
FINEVISION HP	PODFGF	GFY Hydrophobic Acrylic	Biconvex Aspheric Trifocal	Double C-loop with Ridgetech® and Posterior Angulated Haptic	+10 to +35 (0.5D steps)	—
FINEVISION HP TORIC	PODFT49P	GFY Hydrophobic Acrylic	Biconvex Aspheric Toric Trifocal	Double C-loop with Ridgetech® and Posterior Angulated Haptic	+10 to +35 (0.5D steps)	1.00, 1.50, 2.25, 3.00, 3.75, 4.50, 5.25, 6.00

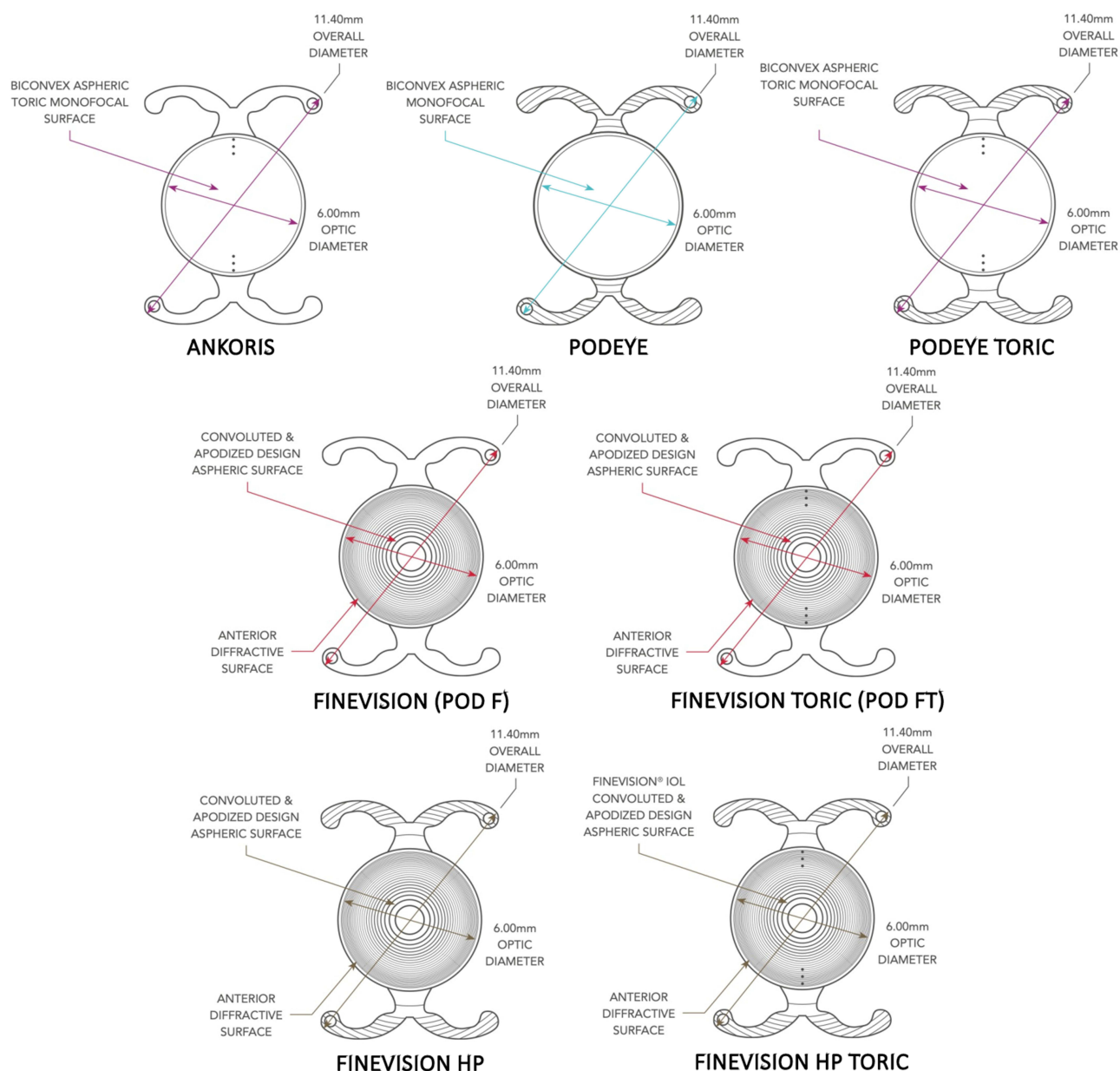


Figure 1 Images of the different intraocular lenses evaluated (courtesy of BVI Inc., Waltham, USA).

11.40 mm and an optical diameter of 6.00 mm. In all models, monofocal, monofocal toric, trifocal or trifocal toric the optic design is biconvex aspheric. Trifocal models are diffractive lenses with two additional powers at the IOL plane of +1.75 D and +3.50 D. Toric models have cylinder values ranging from 1.00 D up to 6.00 D. The spherical power ranges from 0 D up to +35.00 D, with different steps, depending on the model. The materials used are 26% hydrophilic acrylic (refractive index of 1.46 and Abbe number of 58) or GFY hydrophobic acrylic (refractive index of 1.53 and Abbe number of 42). The POD AY 26P, is no longer available on the market, and was the first lens to use this platform. This model has a monofocal aspherical design and is made of 26% hydrophilic acrylic with an overall diameter of 11.4 mm.

To find published clinical studies that include IOLs with the POD platform we used the PubMed database (US National Library of Medicine). Both retrospective and prospective clinical studies based on cataract or RLE surgeries published in peer-reviewed journals written in English were considered for this analysis. The date of the latest electronic search was January 15th, 2025. To be included, the publications had to provide data on the rotational stability of the platform. Note that any studies evaluating IOL models with this platform but which did not report rotational stability

were excluded from the analysis. The search included a combination of any of the following keywords: “IOL”, “ANKORIS”, “PODEYE”, “TORIC”, “FINEVISION”, “POD F”, “POD FT”, “HP”, “PODTAY26P”, “PADAGF”, “PODT49P”, “PODFY26P”, “PODFTY26P”, “PODFGF”, and “PODFT49P”. Moreover, for each article selected from this search, all of its references were also checked to ensure that any clinical publications including the POD platform would not be missed.

Results

The search identified 19 articles with publication dates from 2013 to 2024.^{7,10–27} These were reviewed and analyzed in detail. The first publication that reported on rotational stability outcomes of the POD platform was published in 2013¹⁰ (the reported lens POD AY 26P lens is no longer available commercially). The principle features of each publication were extracted, including the name of the authors, publication year, number of eyes and patients recruited, type of study (prospective or retrospective), type of surgery (cataract or RLE), follow-up time, patient age, axial length, and IOL power (sphere, and cylinder for the toric models. These are tabulated (Table 2). Where available, the mean, standard deviation, and ranges were included. Where data was reported for multiple follow-up periods, outcomes used for analysis were from

Table 2 Peer-Reviewed Clinical Publications Using the POD Platform Reporting Rotational Stability Outcomes

Authors	Year	IOL	Eyes (patients)	Type (Surgery)	Follow-up (months)	Age (years)	Axial length (mm)	Spherical IOL power (D)	Cylindrical IOL Power (D)
Chassain et al ¹⁰	2013	POD AY 26P	117 (91)	Retrospective (Cataract)	12	72.5±8.9	23.8±1.63 (20.35 to 29.08)	NR	—
Chassain ¹¹	2014	ANKORIS	52 (64)	Retrospective (Cataract)	3	NR	23.22±1.34 (20.84 to 26.85)	21.68±3.13* (10 to 28)	2.85±1.08 (1.5 to 6)
Gundersen and Potvin ¹²	2015	FINEVISION TORIC (POD FT)	22 (11)	Prospective (Cataract)	3	61.1±7.5 (51 to 72)	24.43±1.49 (22.66 to 27.11)	NR	NR
Poyales et al ¹³	2016	FINEVISION (POD F)	21 (21)	Prospective (Cataract)	3	64±9 (44 to 78)	23.36±0.94 (21.32 to 25.31)	21.86±2.86 (16.50 to 26.50)	—
Draschl et al ¹⁴	2017	PODEYE POD AY 26P	80 (40)	Prospective (Cataract)	3	71±6 (NR)	NR	NR	—
Vandekerckhove ¹⁵	2018	FINEVISION TORIC (POD FT) ANKORIS	37 (26) 34 (27)	Prospective (Cataract)	12	63.3±9.5 (43 to 80) 70.2±10.2 (34 to 87)	23.95±1.43 (22.05 to 27.59) 23.84±1.31 (21.93 to 28.08)	19.01±4.20 (9 to 26) 20.18±3.73 (11 to 27.5)	1.90±0.88 (1 to 3.75) 2.51±1.19 (1.50 to 6)
Chassain and Chamard ¹⁶	2018	PODEYE	66 (50)	Retrospective (Cataract)	12	75±9 (NR)	23.66±0.70 (NR)	NR	—
Poyales et al ¹⁷	2019	FINEVISION (POD F) FINEVISION TORIC (POD FT)	26 (26) 26 (26)	Prospective (Cataract)	3	64.5±6.9 (53 to 78) 57.3±3.9 (49 to 64)	23.22±0.84 (21.37 to 24.75) 23.58±1.32 (21.11 to 25.38)	22.70±3.19 (20.50 to 25.50) 20.79±3.32 (20.50 to 25)	— 2.40±0.49 (1 to 6)
Ribeiro et al ¹⁸	2019	FINEVISION TORIC (POD FT)	51 (43)	Prospective (Cataract)	3-18	68±8 (50 to 82)	23.40±1.54 (20.11 to 28.36)	22.07±3.91 (11.50 to 33)	2.40±1.11 (1 to 6)
Dubinsky-Pertsov et al ¹⁹	2020	ANKORIS	56 (56)	Retrospective (Cataract)	1	70±8 (50 to 86)	23.95±1.56 (21.77 to 28.97)	20.1±4.53 (NR)	3.06±1.07 (1.50 to 6)
Remón et al ⁷	2020	FINEVISION (POD F) FINEVISION TORIC (POD FT)	15 (15) 15 (15)	Prospective (Cataract)	3	NR	23.36±0.90 (21.32 to 25.31) 24.07±0.72 (22.11 to 27.54)	21.46±3.19 (15 to 25.50) 20.91±3.07 (12.50 to 27)	NR

(Continued)

Table 2 (Continued).

Authors	Year	IOL	Eyes (patients)	Type (Surgery)	Follow-up (months)	Age (years)	Axial length (mm)	Spherical IOL power (D)	Cylindrical IOL Power (D)
Ribeiro and Ferreira ²⁰	2020	FINEVISION TORIC (POD FT)	60 (30)	Prospective (Cataract)	3	68±9 (47 to 77)	23.92±1.79 (20.11 to 27.14)	20.28±4.78 (8 to 33)	2.23±1.41 (1 to 3)
Sheen-Ophir et al ²¹	2022	FINEVISION TORIC (POD FT)	50	Retrospective (Cataract)	1	67±9 (NR)	24.17±1.41 (NR)	18.98±4.21 (NR)	2.46±1.09 (NR)
Yoo et al ²²	2022	FINEVISION TORIC (POD FT)	32 (32)	Retrospective (Cataract)	12	57.63±7.57 (42 to 73)	24.56±1.75 (22.34 to 26.41)	NR	NR
Ang ²³	2023	FINEVISION TORIC (POD FT)	187 (100)	Prospective (Cataract)	21-26	67.3±8.4 (48 to 88)	23.90±1.38 (22.99 to 29.20)	19.3±3.9 (8 to 29.50)	1.7±0.8 (1 to 6))
Chassain et al ²⁴	2023	PODEYE TORIC	136 (102)	Retrospective (Cataract)	4-6	74.0±7.9 (38 to 91)	23.81±1.34 (21.13 to 28.71)	21.57±3.97 (6 to 29.50)	1.91±0.81 (1 to 6)
Ang et al ²⁵	2023	PODEYE TORIC	47 (94)	Prospective (Cataract)	4-6	68.9±8.2 (51 to 86)	23.90±1.32 (21.69 to 27.55)	19.8±4.1 (6.5 to 30)	2.0±0.8 (1 to 4.50)
Daya and Espinosa Lagana ²⁶	2024	FINEVISION HP TORIC	62 (34)	Retrospective (Cataract +RLE)	6 weeks	62.39±6.96 (51 to 80)	23.86±1.75 (19.93 to 27.43)	20.04±5.74 (10 to 33.50)	1.94±0.87 (1 to 4.50)
Ang et al ²⁷	2024	PODEYE TORIC	236 (118)	Prospective (Cataract)	11-13	69.4±4.4 (51 to 86)	24.03±1.40 (21.69 to 28.22)	19.7±4.3 (6.5 to 30)	2.0±1.0 (1 to 6)

Note: Values reported as the mean ± standard deviation (range). *spherical equivalent.

Abbreviations: D, diopters; IOL, intraocular lens; NR, not reported; RLE, refractive lens exchange.

the longest postoperative from surgery. Two articles assessed the POD AY 26P IOL,^{10,14} 3 articles looked at the ANKORIS IOL,^{11,15,19} 2 articles evaluated the PODEYE IOL,^{14,16} 3 articles reported on the PODEYE TORIC IOL,^{24,25,27} 3 articles studied the FINEVISION IOL,^{7,13,17} 8 articles were on the FINEVISION TORIC IOL,^{7,12,15,17,18,20–23} and 1 analyzed the FINEVISION HP TORIC IOL.²⁶ 8 articles were retrospective and 11 prospective in cataract patients, except for one including both cataract and RLE patients.²⁶ The follow-up period varied from 1 to 26 months.

Ang et al²⁷ included the largest sample of eyes of all the 19 studies, with 236 eyes implanted with the PODEYE TORIC IOL. The study with the longest follow-up period, up to 21 to 26 months was also published by Ang,²³ and reported on the FINEVISION TORIC IOL. It should be noted that four studies evaluated two models in the same publication: Draschl et al¹⁴ implanted the PODEYE IOL in one eye and the POD AY 26P IOL in the contralateral eye; Vandekerckhove¹⁵ evaluated the FINEVISION TORIC and the ANKORIS IOLs in different groups; and both Poyales et al¹⁷ and Remón et al⁷ assessed the FINEVISION and FINEVISION TORIC IOLs, also in different groups.

Collating data from all publications, a total of 1428 eyes were implanted with the POD platform (POD AY 26P IOL: 157 eyes; ANKORIS IOL: 142 eyes; PODEYE IOL: 106 eyes; PODEYE TORIC IOL: 419 eyes; FINEVISION IOL: 62 eyes; FINEVISION TORIC IOL: 480 eyes; and FINEVISION HP TORIC IOL: 62 eyes). The mean axial length across all the studies was 23.80±0.36 mm (range 23.22 mm^{11,17} to 24.56 mm).²² The average spherical IOL power across all the studies was 20.61±1.12 D, ranging from 18.98 D²¹ to 22.70 D.¹⁷ For toric lenses the mean astigmatic diopter power was 2.25±0.40 D, (ranging from 1.7 D²³ to 3.06 D).¹⁹

The rotational stability outcomes for all the studies are tabulated (Table 3). In addition to the mean and ranges of rotation values, for each study, where available, the IOL used is indicated as well as the measurement method used to estimate the rotation of the IOL, and the period of time for which the rotation was calculated. There was a wide variety of measurement methods and examination periods. The mean rotation across all the studies was 2.61 °, but the individual rotation values ranged from 1.18 °¹⁷ to 5.84 °.²⁶ Note that when two periods in the same study were evaluated the

Table 3 Rotational Stability Outcomes

Authors	Intraocular Lens	Measurement Method	Rotation Period	Pupil Dilated	Mean Rotation (°)
Chassain et al ¹⁰	POD AY 26P	Slit-lamp photography	3 weeks to 12 months	NR	2.35±1.86* (NR) 2.50±2.06‡ (NR)
Chassain ¹¹	ANKORIS	Slit-lamp photography	1 day to 3 months	NR	2.26±1.95 (NR)
Gundersen and Potvin ¹²	FINEVISION TORIC (POD FT)	NR	Intended axis of implantation to 3 months	NR	NR
Poyales et al ¹³	FINEVISION (POD F)	Retroilluminated slit-lamp photography	1 day to 3 months	Yes	1.85±1.01 (0.32 to 3.13)
Draschl et al ¹⁴	PODEYE POD AY 26P	Retroilluminated slit-lamp images	NR to 3 months	NR	1.6±1.61 (0.1 to 6.1) 2.4±1.85 (0.3 to 7.1)
Vandekerckhove ¹⁵	FINEVISION TORIC (POD FT) ANKORIS	Galilei 6	15 minutes to 12 months	NR	2.55±2.62 (0 to 10) 4.23±4.64 (0 to 18)
Chassain and Chamard ¹⁶	PODEYE	Slit-lamp	8 days to 12 months	NR	1.97±1.43† (NR) 1.46±1.08‡ (NR)
Poyales et al ¹⁷	FINEVISION (POD F) FINEVISION TORIC (POD FT)	Retroilluminated slit-lamp photography (PIOLET)	Surgical day to 3 months	Yes	2.72±1.82 (0.09 to 4.63) 1.18±1.18 (0.21 to 3.31)
Ribeiro et al ¹⁸	FINEVISION TORIC (POD FT)	Retroilluminated slit-lamp photography	NR to 3–18 months	Yes	1.33±0.90 (0 to 4)
Dubinsky-Pertsov et al ¹⁹	ANKORIS	Slit-lamp	Surgical day to 1 month	Yes	3.77±3.62 (0 to 13)
Remón et al ⁷	FINEVISION (POD F) FINEVISION TORIC (POD FT)	Retroilluminated slit-lamp photography (PIOLET)	Surgical day to 3 months	Yes	2.48±1.51 (0.76 to 6.5) 1.59±0.45 (0.84 to 2.24)
Ribeiro and Ferreira ²⁰	FINEVISION TORIC (POD FT)	Retroilluminated slit-lamp photography	NR to 3 months	Yes	1.89±3.31 (NR)
Sheen-Ophir et al ²¹	FINEVISION TORIC (POD FT)	Retroilluminated slit-lamp photography	Planned axis to 1 month	Yes	3.52±3.38 (0 to 16)
Yoo et al ²²	FINEVISION TORIC (POD FT)	Slit-lamp photography	NR to 12 months	Yes	2.14±1.72 (NR)
Ang ²³	FINEVISION TORIC (POD FT)	Slit-lamp	Surgical day to 21–26 months	Yes	2.00±2.42 (NR)
Chassain et al ²⁴	PODEYE TORIC	Retroilluminated slit-lamp photography	Surgical day to 4–6 months	NR	2.05±2.17 (0 to 15)
Ang et al ²⁵	PODEYE TORIC	Retroilluminated slit-lamp photography	Surgical day to 4–6 months	Yes	1.22±2.21 (0 to 10)
Daya and Espinosa Lagana ²⁶	FINEVISION HP TORIC	Internal aberrometry	Intended axis of implantation to 6 weeks	No	5.84±6.41 (NR)
Ang et al ²⁷	PODEYE TORIC	Retroilluminated slit-lamp photography	Surgical day to 11–13 months	Yes	2.52±2.59 (0 to 12)

Notes: Values reported as the mean ± standard deviation (range). *3 weeks to 3 months; ‡3 to 12 months; †8 days to 3 months.

Abbreviation: NR, not reported.

Table 4 Mean (\pm Standard Deviation) Rotational Stability Outcomes as a Function of the Intraocular Lens Model Computed From the Different Studies

Intraocular Lens	Mean Rotation ($^{\circ}$)
POD AY 26P ^{10,14}	3.63 \pm 1.73
ANKORIS ^{11,15,19}	3.42 \pm 1.03
PODEYE ^{14,16}	2.52 \pm 1.29
PODEYE TORIC ^{24,25,27}	1.93 \pm 0.66
FINEVISION (POD F) ^{7,13,17}	2.35 \pm 0.45
FINEVISION TORIC (POD FT) ^{7,15,17,18,20–23}	2.03 \pm 0.75
FINEVISION HP TORIC ²⁶	5.84

rotation of the lens was the summation of the two. Specifically, [Table 4](#) shows the mean rotation for each IOL model from each individual study along with reference is illustrated in [Table 4](#).

Discussion

As we have mentioned, the stability of an IOL once implanted is a key factor for the refractive success of the surgical procedure. This is especially relevant with toric lenses where minimal rotation if any is desired in order to ensure reliable astigmatic correction and in turn refractive and visual outcome. Increasing expectations of reliable astigmatic correction following use of toric lenses has influenced IOL design to ensure minimal if any rotation.

This review assesses the outcomes and rotational stability of the POD platform with four C loop haptics of a variety of lenses. This meta-analysis revealed a mean rotation value 2.61 $^{\circ}$. Individual mean rotation values ranged from 1.18 $^{\circ}$, reported by Poyales et al¹⁷ for the FINEVISION TORIC IOL from the day of surgery to 3 months post-surgery, to 5.84 $^{\circ}$, reported by Daya and Espinosa Lagana,²⁶ for the FINEVISION HP TORIC IOL from the intended axis of implantation 6 weeks after the surgery. Note that all the other studies reported mean rotation values of less than 5 $^{\circ}$ (see [Table 3](#)). The study by Daya and Espinosa Lagana²⁶ was the only one that used internal aberrometry to measure rotation, and, as indicated by these authors, this method is not as accurate as directly observing the lens positioning with a dilated pupil; and highly dependent on the quality of the test performed and prone to error from lens tilt.²⁶ A systematic review and single-arm meta-analysis on the rotational stability of toric IOLs, by Li et al³ found a pooled mean absolute rotation of 2.36 $^{\circ}$ (95% CI, 2.08–2.64) for all studies with different lens designs, haptics and materials. The mean rotation for the POD platform is similar. Rotation of 5 $^{\circ}$ is considered clinically relevant,²⁸ <10 $^{\circ}$ can lead to a minimal to moderate loss of cylindrical correction, with the largest cylindrical correction loss occurring between 10 $^{\circ}$ and 20 $^{\circ}$;²⁹ ≥ 45 $^{\circ}$ rotation leads to the total loss of cylindrical correction.³⁰ Li et al³ reported that certain haptic designs and lens models exhibit exceptional rotational stability in comparison with others. After analyzing by haptic type, they indicated that loop haptics are more stable than plate-haptics, and double-loop haptics (quad-haptics) and plate loop haptics (closed-loop haptics) have even greater rotational stability than traditional loop haptics. They suggest that the exceptional rotational stability of double-loop haptics may be due to the increased number of contact points between the haptics and the capsular bag, effectively increasing the total friction. The study indicated that the FINEVISION TORIC lens exhibited exceptional rotational stability despite using hydrophilic lens material with its double-loop haptics. The pooled mean absolute rotation for this IOL reported by these authors was 1.53 $^{\circ}$ (95% CI, 1.02–2.04). Specifically, in our review the mean value calculated was 2.03 $^{\circ}$ ([Table 4](#)).

The sub-analysis performed as a function of the specific IOL model also reveals low mean values (see Table 4). Chassain et al¹⁰ were the first to assess the POD platform, with the POD AY 26P IOL. They found that the rotation was $>5^\circ$ in only one case (5%) and no rotation was $>10^\circ$ between 3 weeks and 3 months post-surgery. Furthermore, no rotation $>5^\circ$ was observed between 3 months and 1 year. Draschl et al¹⁴ analyzed the same lens up to 3 months post-surgery and found a rotation of $<3^\circ$ and $<6^\circ$ in 20 eyes (71.4%) and 27 eyes (96.4%), respectively. The direction of rotation was clockwise in 7 eyes (25.0%), counterclockwise in 9 eyes (32.1%), and essentially none ($\pm 1.5^\circ$) in 12 eyes (42.9%). The mean rotation value for this lens based on these two studies was 3.63° . Chassain¹¹ was also the first to evaluate the ANKORIS IOL reporting that 96% of eyes had a rotation of $<5^\circ$ and 80.6% had $\leq 3^\circ$; subsequently, in a 12-month follow-up period, Dubinsky-Pertsov et al¹⁹ found that the rotation was within 5° in 82% of eyes (46 eyes), between 6 and 10° in 10.8% of eyes (6 eyes), and between 11 and 13° in 7.2% of eyes (4 eyes). Vandekerckhove¹⁵ also examined this lens up to 12-months post-surgery, reporting 4° of rotation, using the Galilei 6 (Ziemer, Switzerland) to measure this rotation. Combining data from three studies, the mean rotation value for this lens was 3.42° . The PODEYE lens was analyzed first by Draschl et al¹⁴ who found a rotation of $<3^\circ$ in 23 eyes (82.1%) and $<6^\circ$ in 27 eyes (96.4%). The direction of rotation was clockwise in 2 eyes (32.1%), counterclockwise in 6 eyes (21.4%), and none ($\pm 1.5^\circ$) in 20 eyes (71.5%). Over a longer follow-up period, Chassain and Charmand¹⁶ found that no lenses case rotated $>5^\circ$. The mean rotation value for this lens was 2.52° . The PODEYE TORIC lens was also assessed by Chassain et al²⁴ who found that more than 85% of eyes rotated $\leq 3^\circ$, with 58.0% of eyes rotating clockwise rotation and 42.0% of eyes rotated counterclockwise. Two other studies on the same lens supported these good outcomes, with 97.87%²⁵ and 98.56%²⁷ of eyes having a rotation of $<10^\circ$. Taking into account the three studies, the mean rotation value for this lens was 1.93° .

The FINEVISION IOL (non-toric) was evaluated by both Remón et al⁷ and Poyales et al,^{13,17} up to 3-months post-surgery. These authors found similar mean values (see Table 3), with the mean rotation value for the three studies being 2.35° . Specifically, Poyales et al¹⁷ observed that at the 24-h post-surgery evaluation, none of the lenses had rotated more than 5° , whereas at the 3-month follow-up visit, only one lens had exceeded a 5° rotation, specifically 6.5° . This is in line with the outcomes reported by different authors looking at the FINEVISION TORIC IOL (mean rotation value of 2.03°). The rotation of this lens was analyzed in a number of studies. The first¹² reported on only one lens, with a measured change in orientation of 5° between 1-day and 1-month post-surgery. In three of the cases, the 1-month postop orientation of the lens was noted to be about 10° from the intended axis. A chart review showed a similar but slightly lower alignment error 1-day after surgery, suggesting an alignment error rather than IOL rotation. With these exceptions, no change in lens orientation from 5° was measured between the 1- and 3-month visits. Vandekerckhove¹⁵ also examined this lens over a longer follow-up period (12-months), reporting about 2.5° of rotation measured using the Galilei 6 device. Poyales et al¹⁷ Ribeiro et al^{18,20} and Remón et al⁷ indicated lower values, 1.18° , 1.33° , 1.89° , and 1.59° respectively, using retroilluminated slit-lamp photography. These values are in line with the pooled mean absolute rotation for this IOL reported by Li et al³ (1.53°). Sheen-Ophir et al²¹ using the same method but for a short follow-up (1-month), reported a large value (3.52°) with the following percentage distribution of eyes as a function of rotation: 18% $<1^\circ$, 54% 1.5° , 22% 6– 10° , and 6% $>10^\circ$. Yoo et al²² and Ang,²³ with longer follow-up periods (12 and 21–26 months), found low values: 2.14° and 2.00° , respectively. Daya and Espinosa Lagana²⁶ are, to date, the only authors to have published outcomes for the FINEVISION HP TORIC lens. The value reported is the highest for this platform (5.84°) but, as indicated previously, they used internal aberrometry and the reported values were from the intended axis of implantation to 6 weeks after surgery. They found that in 61.3% of eyes the lens had rotated less than 5° , 29% showed a rotation of between 6 and 10° , and 9.7% presented a rotation of $>10^\circ$. The difference between this model and the FINEVISION TORIC lens is only the material: hydrophobic versus hydrophilic. This contrasts with the reported effect of the material on rotational stability, since greater rotational stability has been observed in hydrophobic acrylic lenses in comparison with hydrophilic acrylic lenses,¹ maybe due to increased adhesive strength between the IOL and the capsular bag. Hydrophobic acrylic IOLs exhibit stronger adhesion owing to the charge effect and higher fibronectin content.³¹ This leads us to suspect that perhaps the high value obtained by these authors is more related to the measurement method than to the lens itself.

Different methodology of measurements by different investigators are a potential source of discrepancy between studies. Rotation can be measured subjectively directly using a slit-lamp, aligning the slit beam with the axis of the lens

when the pupil is dilated. Some studies in this review used this method but certain errors are possible, including head tilt at the slit lamp and/or cyclotorsion effects. Notwithstanding, the majority of studies used digital image analysis, which is considered the best method for determining IOL orientation changes.³² Retroilluminated slit-lamp photography was the most common method used in these studies. Another factor that should be kept in mind when comparing studies is the rotation period. The timepoint from which the change in orientation is calculated is crucial. Some authors reported the change from the intended or planned axis,^{12,21,26} which may be significantly different to the actual implanted axis; some from the day of surgery;^{5,7,17,19,23–25,27} and others from days or weeks after the operation.^{10,11,13,16} It has been reported that lens rotation can occur within 1 hour of the surgery, with a large proportion of the rotation occurring within the first 10 days after implantation.³³ As the diameter of the capsular bag gradually decreases after cataract surgery, IOL stability increases as the capsular bag contracts.^{34,35} The dimension of the capsular bag is another influencing factor in IOL rotation.³⁴ However, the inability to readily measure the capsular bag makes it difficult to fully analyze this factor. Other parameters, such as white-to-white or lens thickness, have been used to indirectly estimate the dimension of the capsule to find a correlation with IOL rotation, but without a clear consensus.³⁴ The same is true of axial length, which has traditionally been considered to be an important factor contributing to the early postoperative rotation of lenses after cataract surgery,^{33,36,37} but no significant correlation has been found between axial length and rotation in other studies.^{38–40} Note that the anterior segment length, which can be considered the sum of anterior chamber depth and lens thickness, may play a direct role instead directly the whole axial length. The mean values for axial length in the studies analyzed in our review (see Table 2) were about 23–24 mm. It should be noted, for example, that Chassain et al²⁴ found good rotational stability for the PODEYE TORIC IOLs, even for the 25% of eyes with an axial length greater than 24.5 mm. Continuous curvilinear capsulorhexis (CCC) is also a factor, in this case related to the surgery, that has been analyzed.³⁴ It has previously been reported that the size of the capsulorhexis could influence rotational stability, and a maximum of 5.8 mm was suggested to improve IOL stability.⁴¹ A recent study evaluating rotational stability with and without primary posterior CCC over a 1-year period in 112 eyes concluded that primary posterior CCC slightly reduced IOL rotation in the early postoperative period; this can be attributed to accelerated capsular fusion.⁴²

Conclusions

This manuscript reviews the rotational stability outcomes of the POD platform. The clinical results reported in the peer-reviewed literature suggest that this platform model with double C-loop haptics provides good rotational stability when used with different IOL models based on monofocal and trifocal designs and made using hydrophilic or hydrophobic material. Future research on this platform should involve the hydrophobic toric trifocal lens as well as larger samples and longer follow-up periods and also to evaluate the role of different parameters such as axial length and anterior chamber depth (long and short eyes).

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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