Toric IOLs: Literature and Personal Results

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I have no financial interests or relationships to disclose

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Summary

- Types of available toric IOLs
- Review of the literature
  - Decrease in cyl
  - Visual acuity
  - Alignement
  - Rotation
  - Induction of refractive defect
- Personal results

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Toric IOLs

- Game-changer in management of astigmatism
- Stability and predictability
- Accurate for high amount of astigmatism
- Some remaining astigmatism is commonly present:
  - Nonzero astigmatic targets
  - Variability of axis
  - Power effects of surgical incisions
  - Underestimation of the corneal plane cylinder power of the IOLs by the manufacturer

Goggin M, Arch Ophthalmol 2011

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Types of Available Toric IOLs

- SN60TT AcrySof IQ Toric
  1. Biconvex toric aspheric optic
  2. Posterior toric lens surface
  3. Anterior aspheric surface
  4. Range: 1.50 – 3.00 cyl

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Types of Available Toric IOLs

- AcrySof IQ ReSTOR Toric
  1. Same design as AcrySof IQ ReSTOR +3.00
  2. Biconvex, apodized diffractive aspheric toric
  3. Posterior toric lens surface
  4. Anterior aspheric surface
  5. Range: 1.00 – 3.00 cyl

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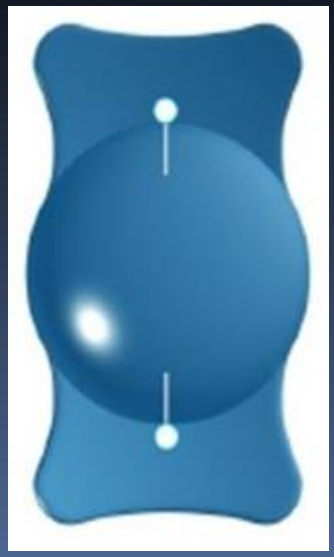
Types of Available Toric IOLs

- Zeiss AT TorBi 709 M toric IOL
  1. Bitoric aspheric (prolate)
  2. Equally convex optic
  3. Hydrophilic acrylic, hydrophobic surface
  1. UV filter
  2. Square edge
  3. 11 mm diameter
  4. Range: +1.00 - +12.00 cyl



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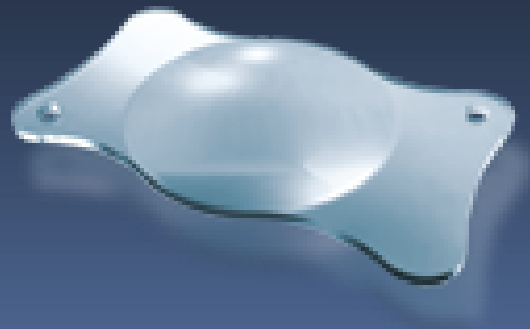
Types of Available Toric IOLs

- Zeiss AT Lisa 909 M toric IOL
- Diffractive multifocal
  1. Hydrophilic acrylic, hydrophobic surface
  1. Bitoric aspheric (prolate)
  2. UV filter
  3. Square edge
  4. 11 mm diameter
  5. Range: +1.00 - +4.00 cyl



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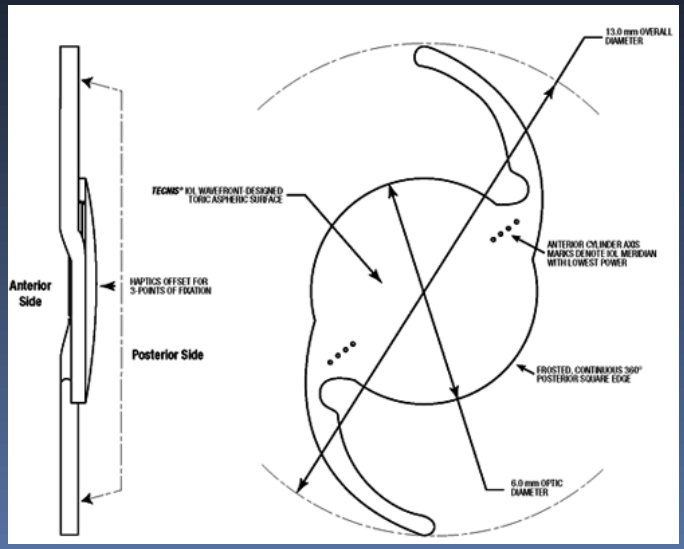
Types of Available Toric IOLs

- Tecnis multifocal toric 1-piece ZMT
- Biconvex, anterior toric aspheric surface
- Soft foldable acrylic, UV absorber
- Range: 1.00 – 4.00 D cyl



Types of Available Toric IOLs

- Finevision toric
- Aspheric, diffractive trifocal
- 25% hydrophilic acrylic
- Square edge
- Incision size: 1.8 mm

- ANKORIS
- Biconvex aspher
- -0.11 mu SA
- 26% hydrophilic acrylic
- Range: 1.50 – 6.00 cyl

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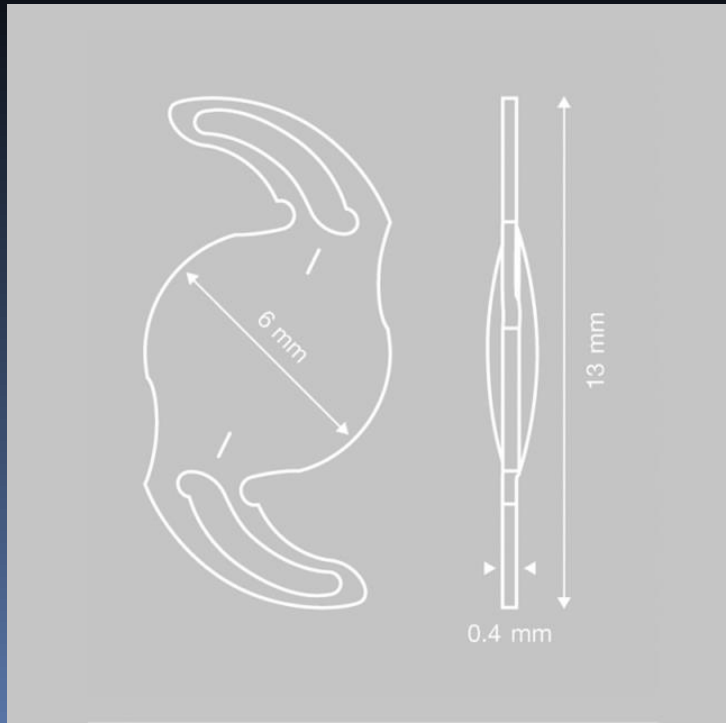
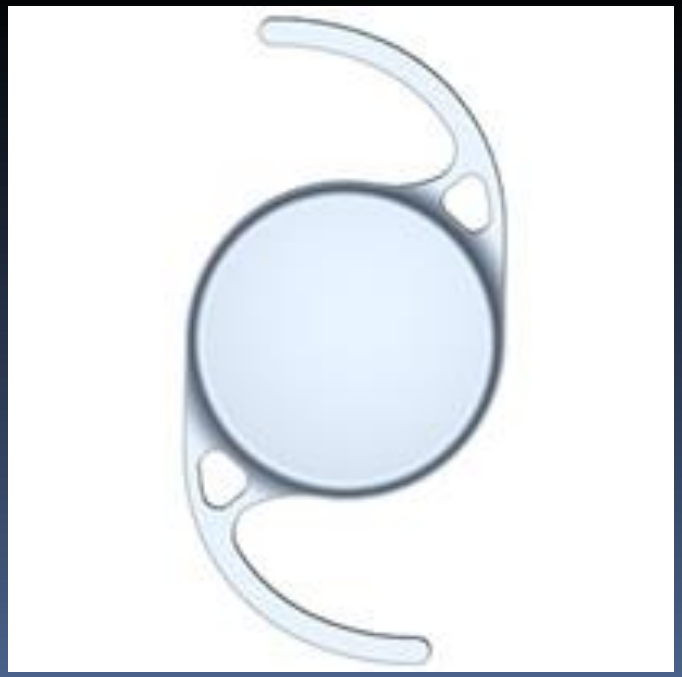
Types of Available Toric IOLs

- Aspheric Bi-Flex T (677 TA)
- Aspheric hydrophilic acrylic
- Mono- or bitoric
- 25% water content



Types of Available Toric IOLs

- Bausch & Lomb enVista
- Hydrophobic acrylic IOL
- Aberration free
- Glistening-free



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Review of the Literature

- Cyl reduction: 2.05 D

Preop D	Postop D	Eyes	Toric IOL	Author	Year	Journal	
1.60 ±1.20	0.40 ±0.60	230	AcrySof	Gayton JL	2011	JRS	Simple and complex
1.70 ±0.4	0.4 ±0.4	234	AcrySof	Ahmed II	2010	JCRS	bilateral
4.6 ±2.3	1.12 ±0.9	68	MicroSil	Dick HB	2006	Klin Monbl	
4.00 ±1.10	0.55 ±0.60	19	AcrySof SN60T	Cervantes-Coste G	2012	JRS	
2.39 ±1.48	-0.49 ±0.53	284	AT Lisa 909M	Bellucci R	2013	JCRS	
1.93 ±0.90	0.30 ±0.54	30	Bi-Flex T	Bachernegg A	2013	JCRS	
2.17 ±0.41	0.73 ±0.45	30	AcrySof TT	Toto L	2013	JCRS	

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Review of the Literature

- Visual Acuity (2010 -2013): 0.19 logMAR

UCVA logMAR	MOS	Eyes	Toric IOL	Author	Year	Journal
0.33 ± 0.18	13.3	30	AcrySof Toric	Kim MH	2010	KJO
0.2	6	30	AcrySof Toric SN60TT	Koshy JJ	2010	JCRS
0.13 ± 0.10	3	40	AcrySof SN60T	Mingo-Botin D	2010	JCRS
0.23 ± 0.23	4	33	Rayner T-Flex 623T	Entabi M	2011	JCRS
0.16 ±0.22	6	284	AT Lisa 909M	Bellucci R	2013	JCRS
0.11 ±0.09	3	19	AcrySof SN60T	Cervantes-Coste G	2012	JRS
0.05 ±0.12	3	30	Bi-Flex T	Bachernegg A	2013	JCRS
0.20	6	30	AcrySof T	Toto L	2013	JCRS
0.3	3	72	AcrySof SN6At, AT Torbi 709M	Scialdone A	2013	JCRS

Review of the Literature

- IOL Alignement

% > ±5°	% > ±10°	Eyes	Mos	Toric IOL	Author	Year	Journal	
91.1	100	161	6	AcrySof	Ahmed II	2010	JCRS	bilat
90	99	100	1	AcrySof SN60T	Chang DF	2008	JCRS	
70	90	90	1	AA4203	Chang DF	2008	JCRS	
85	99	68	3	MicroSil	Dick HB	2006	Klin M.	
	100	40	2	Tecnis T, AcrySof IQ T	Ferreira TB	2012	JRS	
37.0		26	3	Staar silicone	Chua WH	2012	JCRS	
95.8		284	6	AT Lisa 909M	Bellucci R	2013	JCRS	
61.1		36	3	AcrySof SN6AT	Scialdone A	2013	JCRS	
66.6		36	3	AT Torbi 709 M	Scialdone A	2013	JCRS	

Review of the Literature

- IOL rotation: 4.45°

Mean rotation °	Eyes	Mos	IOL	Author	Year	Journal	
3.35 ±3.41	100	1	SN60T,	Chang DF	2008	JCRS	
5.56 ±8.49	90	1	AA4203	Chang DF	2008	JCRS	
3.15 ±2.62	20	2	Tecnis	Ferreira TB	2012	JRS	
3.25 ±2.04	20	2	AcrySof IQ T	Ferreira TB	2012	JRS	
4.23 ±4.28	24	3	AcrySof	Chua WH	2012	JCRS	
9.42 ±7.80	26	3	Staar silicone	Chua WH	2012	JCRS	
2.12 ±3.45	30	3	Bi-Flex T	Bachernegg A	2013	JCRS	

Review of the Literature

- Induction of refractive defect
- Misalignement of toric IOL:
  - Reduction in astigmatic correction
  - Hyperopic spherical change
  - Astigmatic rotation

  Jin H, J Cataract Refract Surg 2010

- Toric IOL rotation of less than 10° changed eye refraction of less than 0.50 D

  Felipe A, J Cataract Refract Surg 2011

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Review of the Literature

- Commonly used three-step ink-marker procedure: mean error in IOL placement: 5°

Visser N, J Cataract Refract Surg 2011

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Personal Results

- Precise intraoperative toric IOL axis orientation:
  - May be haphazardous
  - Complicated
  - Time-consuming
  - Every degree of misalignement leads to residual astigmatism and sphere
- Limbal vessels pattern may be a precise referral structure for proper axis alignement.

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Patient Evaluation

- Diagnostic exams: hunting for the axis
  - Subjective refraction
  - Corneal topography
  - Aberrometry
  - Scheimpflug tomography
  - Accurate IOL calculation

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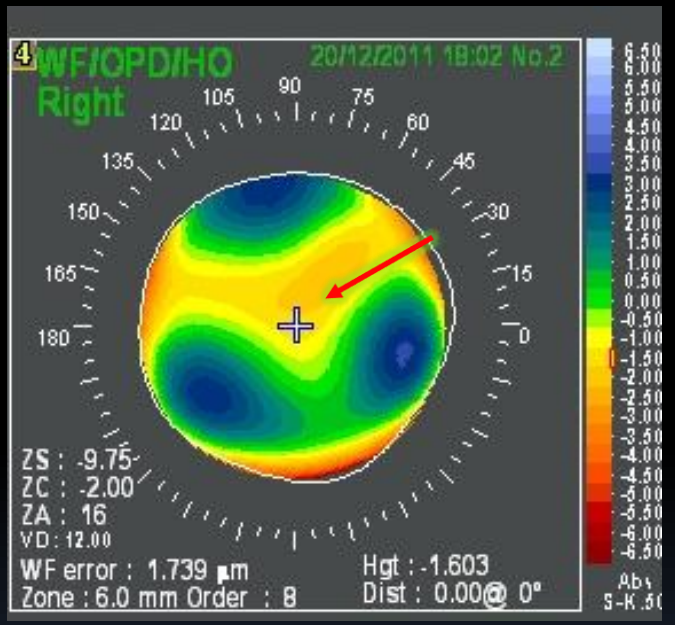
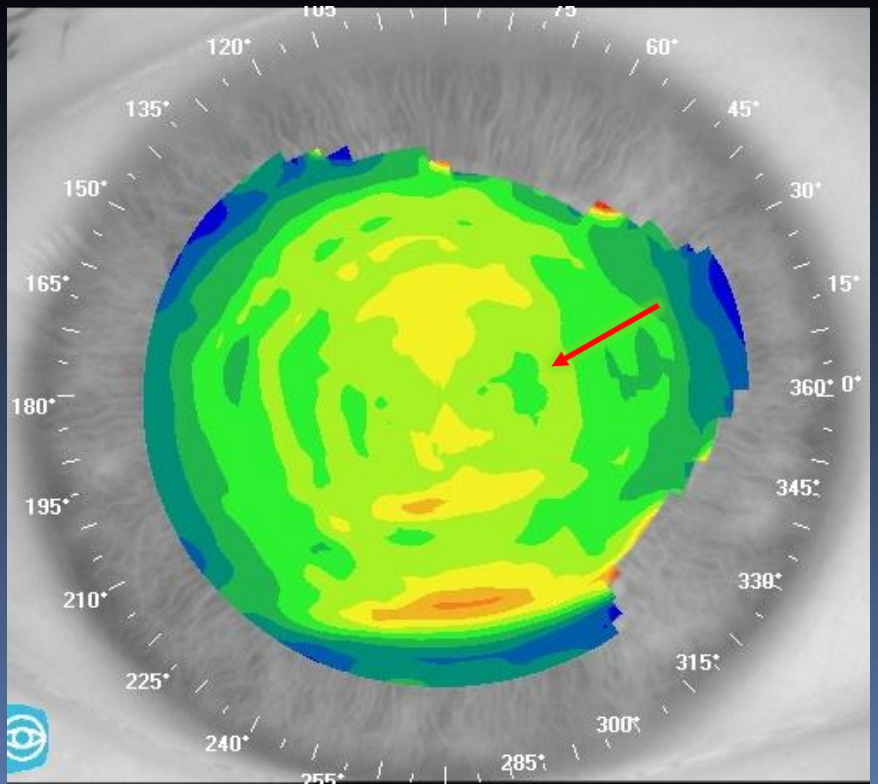
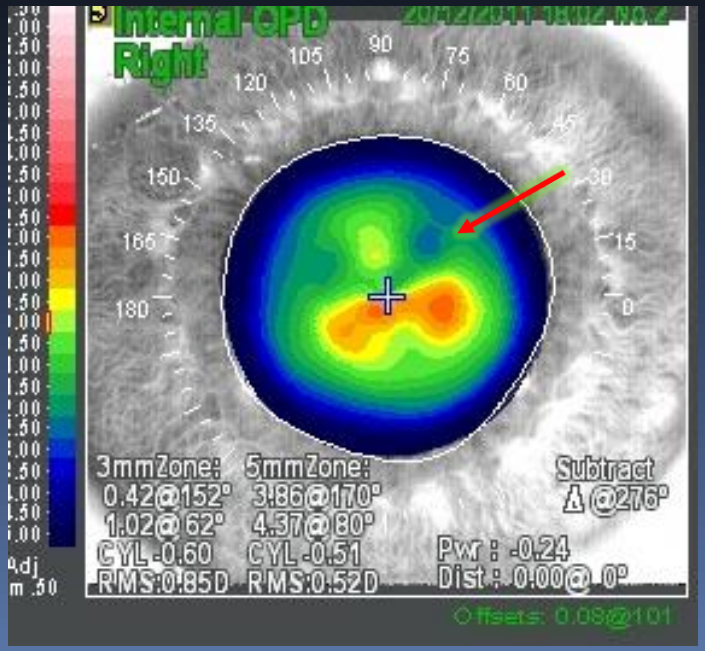
Corneal Topography + Aberrometry

- Subjective astigmatism:
  - Corneal astigmatism (A/P)
  - Lens astigmatism
- VOD 0.65 -5.00 -1.50 (175)







Purpose of the study

- Evaluate:
  - subjective and objective refraction
  - topographic astigmatism (TA)
  - before and after implantation of toric aspheric monofocal IOL
  - aligned with an empirical method based on the limbal vessels pattern.

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Materials and Methods

1. IOL Aligment
    1. Preoperative identification of topographic axis of astigmatism
    2. Slit-lamp identification and photograph of limbal vessels in correspondence of the most curve axis of astigmatism
    3. Preoperative mark of 0° - 180° axis
    4. Intraoperative detection of involved limbal vessel and IOL alignement

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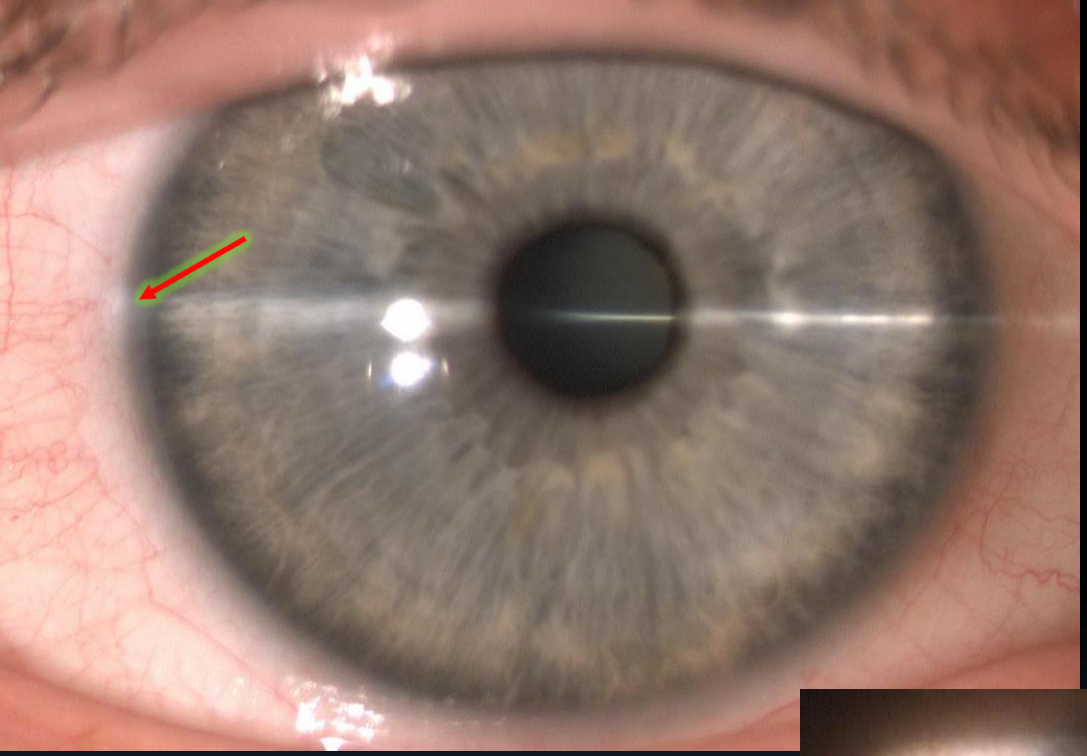
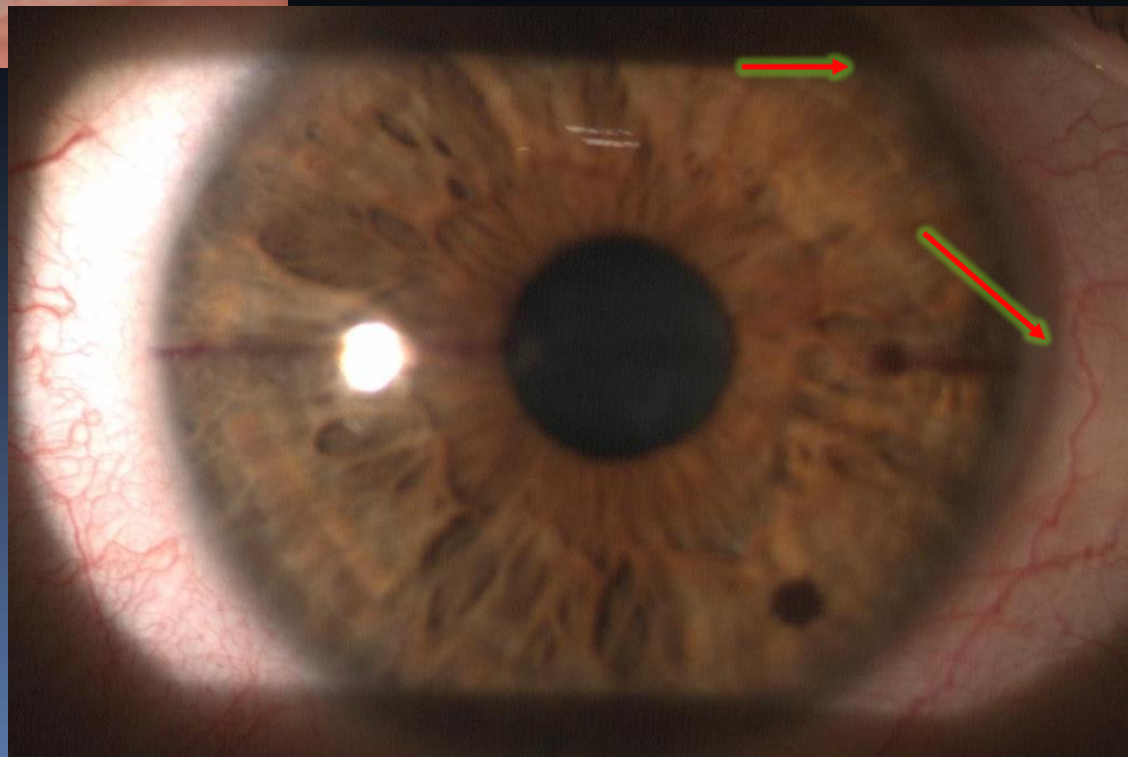

Materials and Methods

1. Thirty-six eyes (20 patients, mean age 64.35 ± 16.59)
2. 2.2 mm incision surgery
3. Toric aspheric monofocal IOL (Zeiss AT Torbi 409 MP)
4. Mean power: +16.33 D ± 7.57 D, -2.75 D ± 0.27 D cyl.
5. Preoperatively:
    1. Reference limbal vessels positioned in correspondance of the alignment axis recommended by the specific website software (Zeiss Z Calc) were photographed.
6. IOL axis orientation:
    1. Aligning the axis with reference limbal vessels
    2. Checking preoperative corneal topography astigmatism
7. Subjective refraction and TA were measured before and nine months after surgery.

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Results

1. Mean preoperative subjective refraction:-2.29 D ± 3.63 D sph with -2.19 D ± 0.55 D cyl at 64.44° ± 72.73°
2. Mean TA: -1.79 ± 0.39 at 118.88° ± 73.82° . Mean SIA was -0.20 D
3. Postop. (9 ± 4 months), mean subj. refraction was -0.41 D ± 0.79 D sph with -0.25 D ± 0.44 D cyl at 93.33° ± 45.09° .
4. Mean BSCVA and UCVA were -0.06 LogMar and -0.02 LogMar, respectively.
5. Mean TA was -1.87 D ± 0.40 D at 134.25° ± 63.90° .
6. Mean IOL axial orientation was at 90.83° ± 38.40° .

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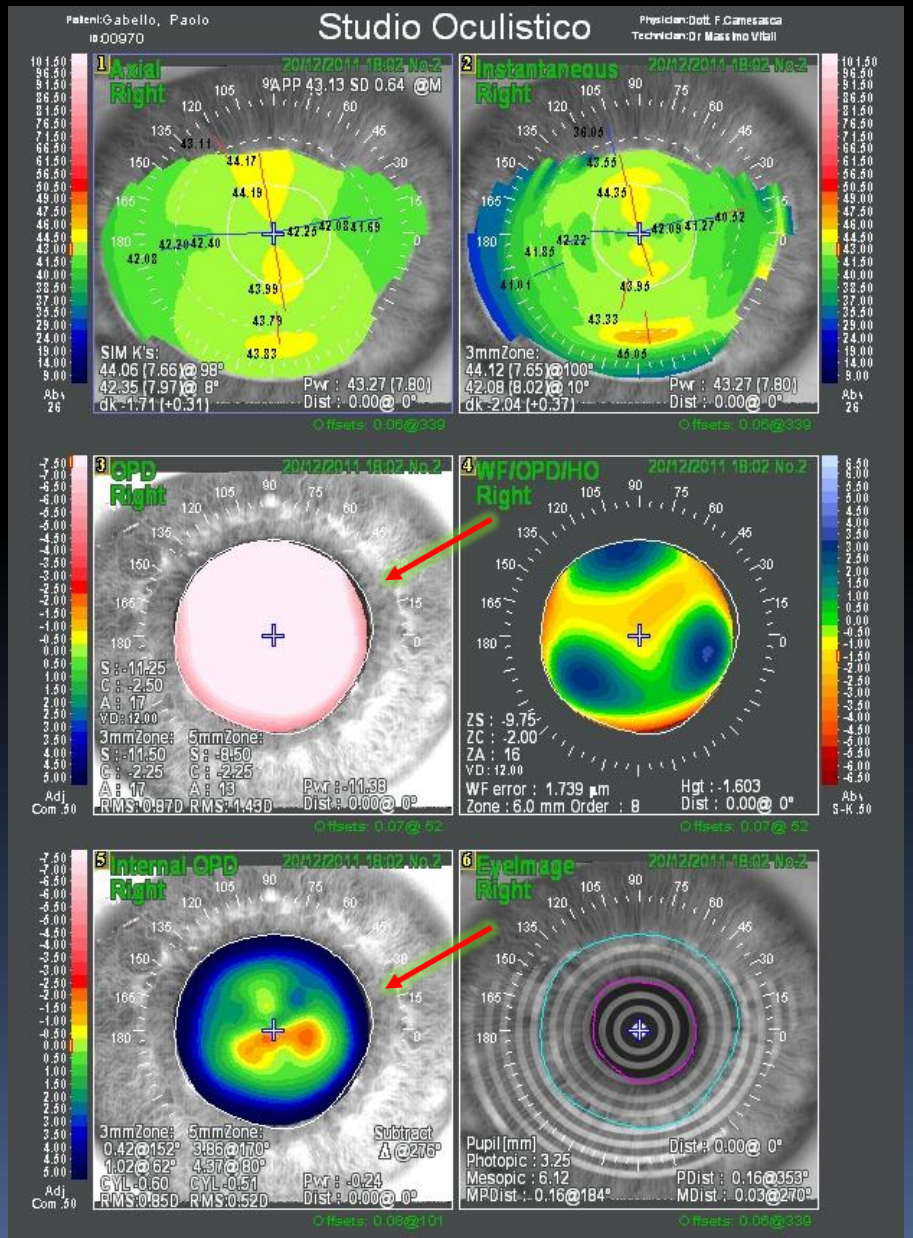

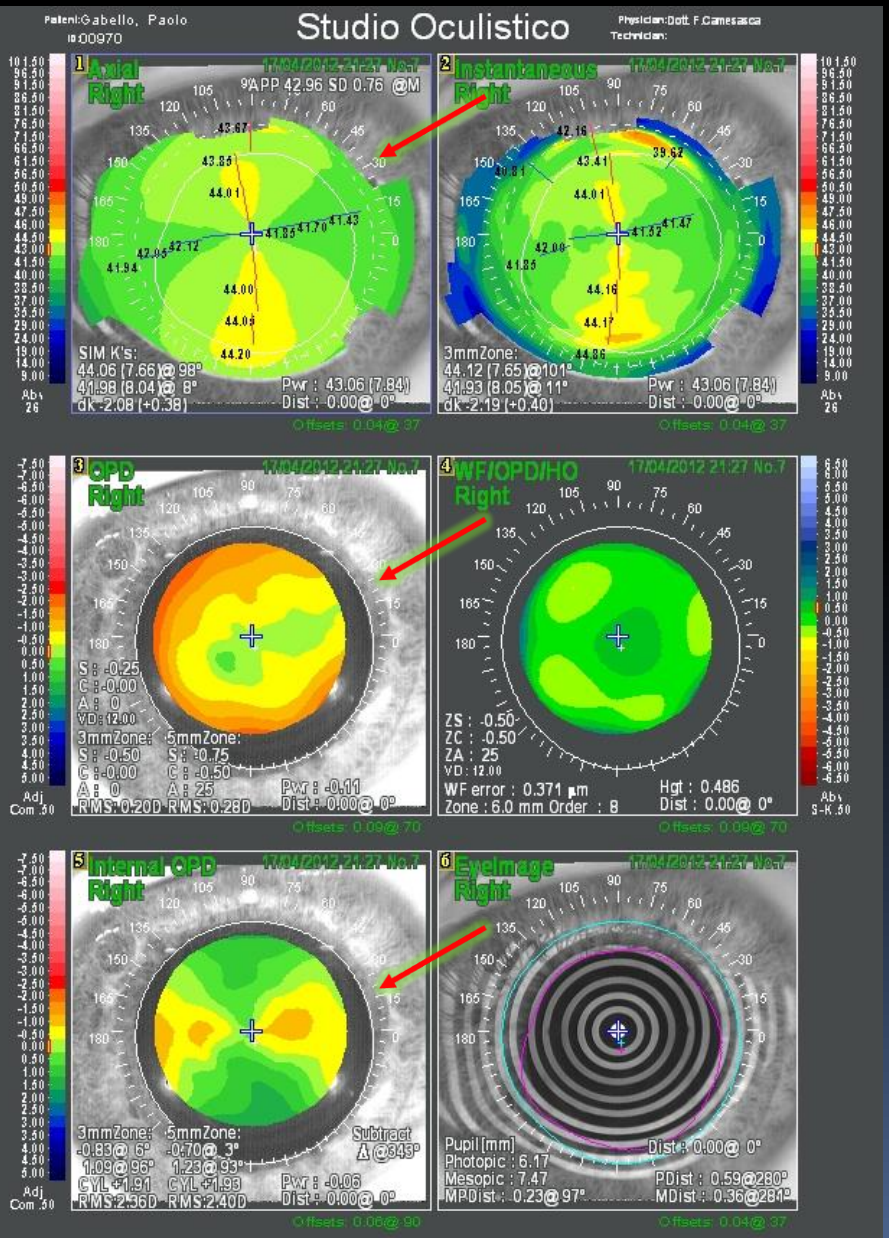

0.6 -11.25 -2.50 (17)

1.2 plano

Exam SPH CYL AXIS
7R -0.25 0.00 0 44.06(7
Cornea Index: n=1.3375 (A
Mapset : OvrviewKAM
SA@6.0
.24 C+0.32
Pupil
6.17 7.47
NIDEK

Study Conclusions

1. Patients receiving monofocal toric IOLs aligned through an empirical method reached optimal visual acuity.
2. Mean TA was not influenced by SIA
3. Final refraction showed highly satisfactory correction of spherical and astigmatic defect.

(van Gaalen KW, J Cataract Refract Surg 2010)

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But… is it all so easy ?

- Wrong belief no. 1: corneal astigmatism is stable throughout life
  - Corneal astigmatism in healthy subjects slowly changes from with-the-rule (WR) to against-the-rule (AR) with time.
  - -0.30 D in 10 years

(Hayashi K, Am J Ophthalmol 2011)

- Wrong belief no. 2: power of posterior corneal surface is not important
  - 0.50 D AR in with-the-rule corneas (WR)
  - 0.30 D AR in against-the-rule corneas (AR)

(Koch D, ASCRS pc)

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Conclusions

- Toric IOLs are an effective way to correct astigmatism
- Precise alignement mandatory
- IOL calculation will improve
- Posterior corneal surface to be considered
- Several IOLs available, with different ease of positioning
- Excellent visual acuity
- Possible residual astigmatism
- Limited postoperative rotation

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Thank you for your attention !