

Small Tips For Toric IOL Implantation

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No financial and proprietary interest in any
material or method mentioned.

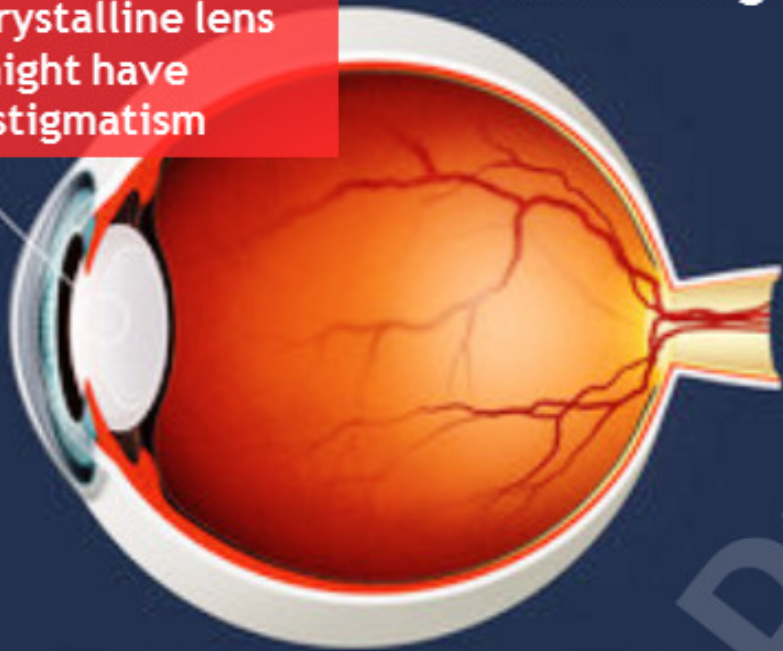
Reasons for Unsuccessful Toric IOL

- **Preoperative**
 - Wrong indication
 - Measurement error
 - Corneal radii
 - Axis
 - Posterior corneal surface
 - Unprecise pre-operative marking
- **Intraoperative**
 - Misalignment
 - Mislabelling of IOL
- **Postoperative**
 - IOL Rotation

Error Sources / Wrong Indications and Decisions

Before Surgery

Crystalline lens might have astigmatism



After Surgery

Traditional (Spherical) IOL will have no astigmatism



$$\text{Total Astigmatism} = \text{Corneal Astigmatism (external)} + \text{Lenticular Astigmatism (internal)}$$

$$\text{Total Astigmatism} = \text{Corneal Astigmatism (external)}$$

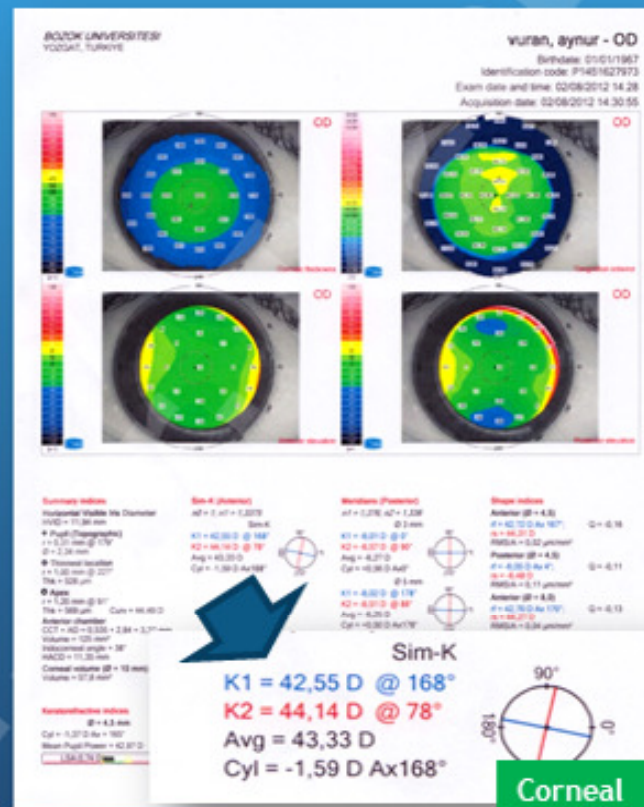
Error Sources / Wrong Indications and Decisions

VD=12

<R>	SPH	CYL	AX
	+ 0.50	-1.25	160
	+ 0.50	-1.25	159
	+ 0.50	-1.25	159
	0.00	-1.00	154
	0.00	-0.50	143
	+ 0.25	-1.25	141
<hr/>			
	+ 0.50	-1.00	154
<R>	mm	D	AX
R1	7.96	42.50	163
R2	7.65	44.00	73
Ave	7.80	43.25	
CYL		-1.50	163
<hr/>			
<L>	SPH	CYL	AX
	+ 1.50	+1.25	105
	+ 1.50	+1.25	103
	+ 1.50	+1.00	106
	+ 1.50	+1.00	98
	+ 1.50	+1.00	98
	+ 1.50	+1.00	98
<hr/>			
	+ 1.50	+1.00	106
<L>	mm	D	AX
R1	7.92	42.50	2
R2	7.83	43.00	92
Ave	7.87	42.75	
CYL		-0.50	2
PD =	63		
Reichert		RK600	

Total astigmatism

Corneal astigmatism



Corneal astigmatism

Scheimpflug - Placido topographer (Sirius) printout

VURAN AYNUR, 01.01.1967

Examination 1 of 02/08/2012
Analysis 4, standardized
Bometry

Time: 14:29
Duration: 5:58

		OD	OS
		Right eye	Left eye
Measuring mode	Mode	Phakic	---
Axial length	AL	21,77 mm	±0,008 mm
Cornea thickness	CCT	534 µm	±3,3 µm
Aqueous depth	AD	2,76 mm	±0,022 mm
Anterior chamber depth inc.	ACD	3,30 mm	±0,020 mm
Lens thickness	LT	2,96 mm	±0,005 mm
Retina thickness	RT	200** µm	±5,0 µm
<hr/>			
Flat meridian	K1	42,51 D @ 168°	±0,046 D
Steep meridian	K2	44,09 D @ 75°	±0,050 D
Astigmatism	AST	1,58 D @ 75°	---
Keratometric index	n	---	---
<hr/>			
White to White	WTW	11,95 mm	---
Iris barycenter	ICX	-0,32 mm	---
	ICY	0,00 mm	±0,048 mm
<hr/>			
Pupil diameter	PD	3,12 mm	±0,237 mm
Pupil barycenter	PCX	-0,17 mm	±0,018 mm
	PCY	-0,01 mm	±0,030 mm

Corneal astigmatism

Optical Low - Coherence Reflectometry (Lenstar) printout

Autorefractokeratometry printout

Error Sources / Measurement of Corneal Radii and Axis

Measuring Corneal Astigmatism

- ❖ Manual Keratometry
- ❖ Automatic Keratometry
- ❖ Non-contact Biometry
 - ❖ Partial coherence interferometry (IOLMaster)
 - ❖ Low coherence interferometry (Lenstar)
- ❖ Corneal Mapping
 - ❖ Topography (Reflection based/ Placido disks)
 - ❖ EyeSys
 - ❖ Tomey
 - ❖ Nidek
 - ❖ Atlas
 - ❖ Tomography and Hybrid Systems (Scheimpflug camera, Scanning-slit imaging)
 - ❖ Pentacam
 - ❖ Galilei
 - ❖ Visanti Omni
 - ❖ Orbscan
 - ❖ Sirius

Precedence	For Power	For Axis
1	Manual Keratometry	Autokeratometry
2	Autokeratometry	Non-contact optical biometry
3	Non-contact optical biometry	Topography
4	Topography	Manual Keratometry

•Hill W, Osher R, Cooke D, Solomon K, Sandoval H, Cervantes RS, Potvin R. *J Cataract Refract Surg* 2011; 37:2181-7.

•Lee H, Chung JL, Kim EK, Sgrignoli B, Kim T. *J Cataract Refract Surg* 2012; 38:1608-15.

Error Sources / Measurement of Corneal Radii and Axis

What if the measurements do not correlate?

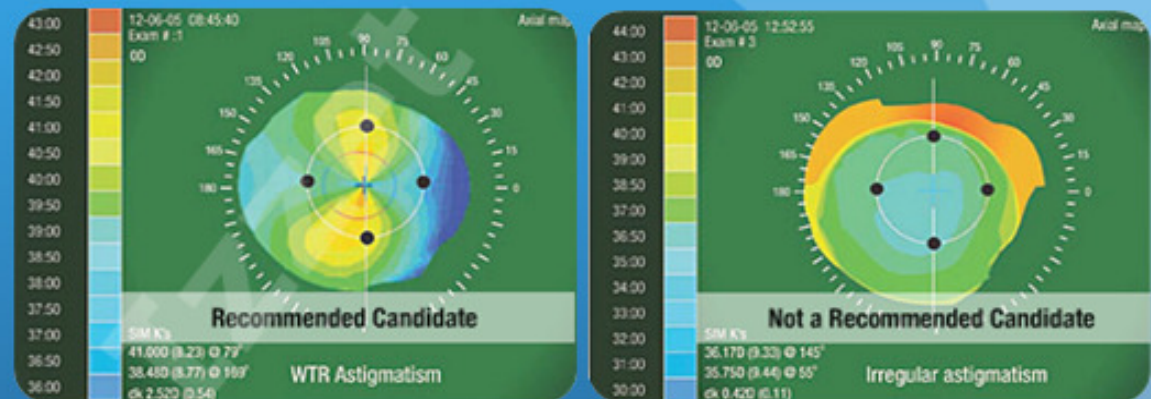
- ❖ Before drops
 - ❖ Exception: artificial tears
- ❖ Remove CLs 2-3 weeks prior to measurements
- ❖ Repeat all of them
- ❖ Ensure that tear film/lids are optimized

Error Sources / Wrong Indications and Decisions

Indications

Preoperatively

- Corneal astigmatism > 0.75 D.
- Manual keratometry:
Regular astigmatism
- Corneal topography:
bowtie or wedge type
regular astigmatism



Contraindications

- Young patient with forme fruste keratoconus
 - (exception: older patient with stable KC)
- Severe zonular abnormalities
- Previous hyperopic LASIK

Error Sources / Ignoring Posterior Corneal Astigmatism

Study	Imaging Modality Used	Posterior Astigmatism (D)	
		Mean \pm SD	Range
Royston, 1990	Purkinje images (Polaroid camera)	0.38	0.17-0.78
Dunne, 1991	Purkinje images (Polaroid camera)	0.26	
Prisant, 2002	Scanning-slit topography (B&L Orbscan)	0.66 \pm 0.23	0.32-1.38
Modis, 2004	Scanning-slit topography (B&L Orbscan)	0.78 \pm 0.61	0.16-3.30
Dubbelman, 2006	Scheimpflug photography (Topcon SL-45 camera)	0.31	
Ho, 2009	Rotating Scheimpflug imaging (Oculus pentacam)	0.33	0.00-0.94
Koch, 2012	Rotating Scheimpflug imaging (Ziemer Galilei DSA)	0.30	0.01-1.10

 **9% of the eyes have posterior corneal astigmatism more than 0.50 D. And 86.8% of them is aligned vertically.**

Koch DD et al. JCRS 2012; 38: 2080-7.

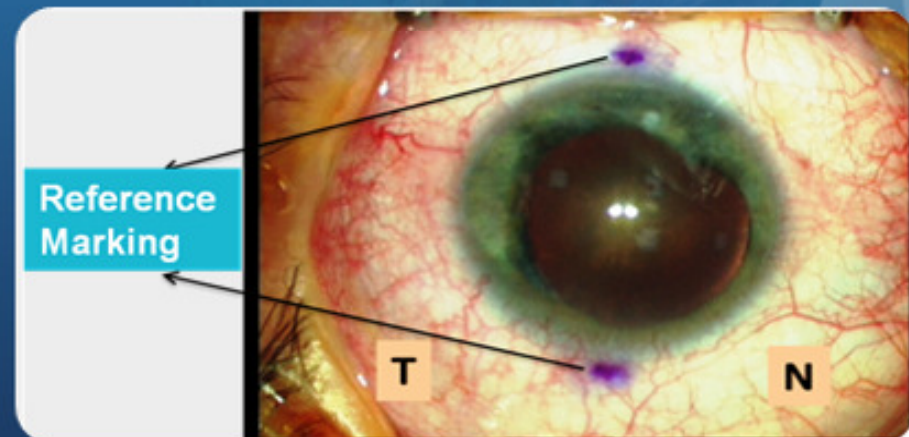
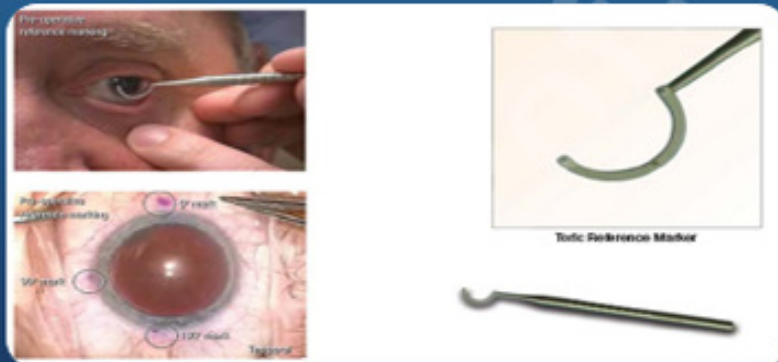
Error Sources /Surgery/ Corneal Marking

Small Pearls For Surgery

Make reference marks on the cornea preoperatively while patient is sitting up to avoid cyclorotation.

- Mean torsional rotation $4.1^{\circ} \pm 3.7$
 - (right eye 3.8 ± 3.7 degrees, left eye 4.2 ± 3.6 degrees).
- 8% had a deviation greater than 10 degrees.

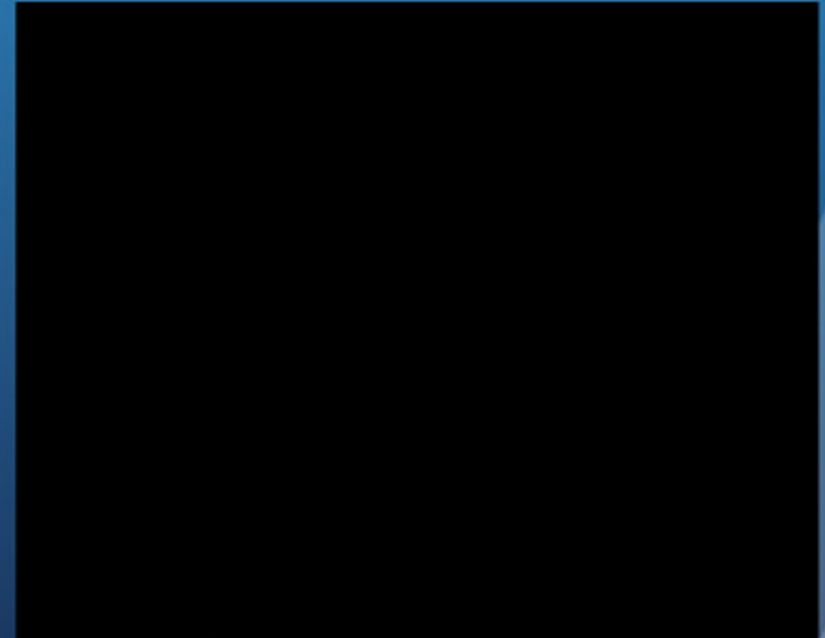
Swami AU et al. AJO 2002;133:561-2.



Error Sources /Surgery/ Corneal Marking



Reference marking



Error Sources /Surgery/ Corneal Marking



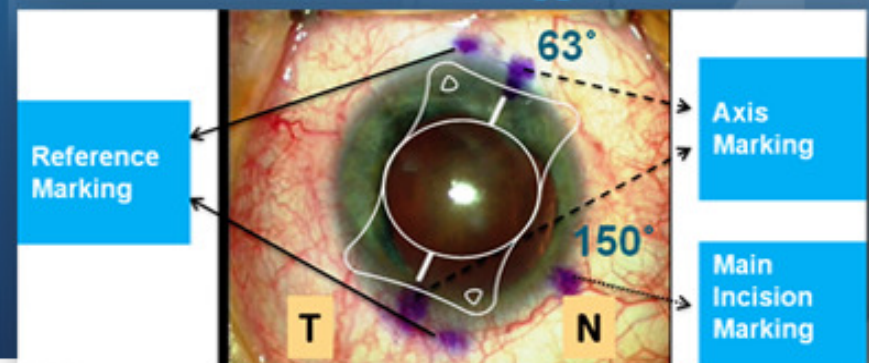


Surgeon		Patient	
Name-Surname	Izzet Can, MD, Prof.	Name-Surname	Reşat Kulu
Clinic	Bosok Univ. Med. Fac. Eye Dept.	Additional Information	
Phone	0532 4430401	IOL Type	Acryva® BB Toric T UDM 611
E-Mail	icizcan@yahoo.com		
Country	Turkey		

LEFT (OS)	
K1 (Flat K)	42.94 D
Flat Axis	153°
K2 (Steep K)	45.43 D
Steep Axis	63°
IOL Spherical Power	11.00 D
Surgically Induced Astigmatism	0.25 D
Incision Location	150°

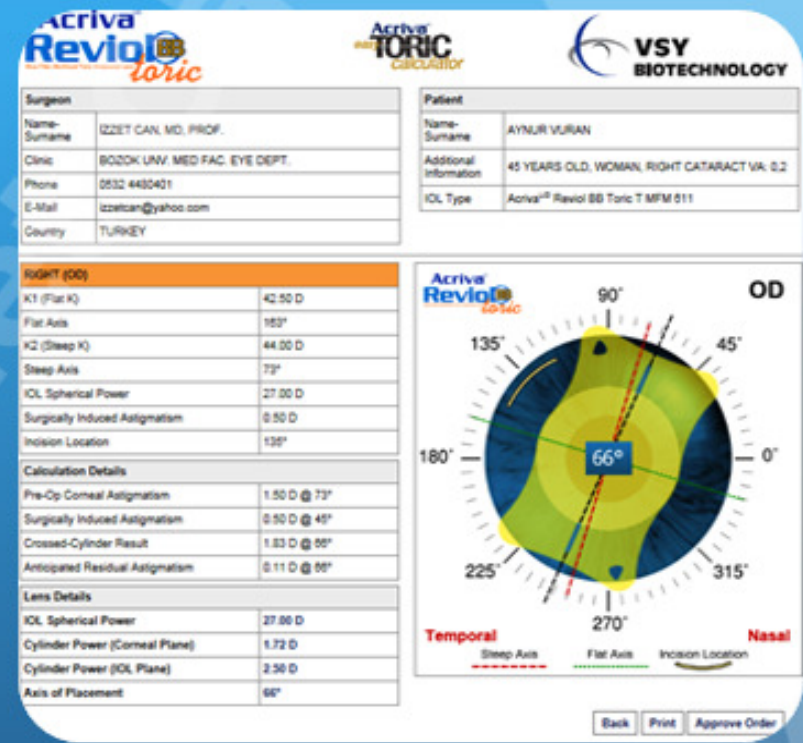
Calculation Details	
Pre-Op Corneal Astigmatism	2.51 D @ 63°
Surgically Induced Astigmatism	0.25 D @ 60°
Crossed-Cylinder Result	2.76 D @ 63°
Anticipated Residual Astigmatism	0.01 D @ 63°

Lens Details	
IOL Spherical Power	11.00 D
Cylinder Power (Corneal Plane)	2.75 D
Cylinder Power (IOL Plane)	4.00 D
Axis of Placement	63°



Prof. Dr. Izzet Can

Error Sources / Surgery



Error Sources During Surgery

- Changing your habitual technique and using large incisions
- Neglecting measures for small pupil
- Irregular and decentralized capsulorhexis

- Being harsh in IOL implantation step
- Remaining OVD behind IOL
- Finishing with high or low IOP
- Forgetting last check

Error Sources / Postoperative Rotation

Off-axis rotation	Loss of Cylinder Correction
1 °	3.3%
10 °	33%
15 °	50%
30 °	100%
90 °	Preoperative astigmatism doubles



Thank You Very Much For Your Attention