Prediction of Refractive Outcomes With Toric IOL Implantation at a Teaching Institution

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Background

Optimizing toric IOL refractive outcomes is dependent on several variables:
- Preoperative Corneal Measurement
- IOL alignment
- Calculation methods
- Surgically induced astigmatism

There are several corneal measurement devices and toric calculators available to surgeons. We compared the options available at our institution to determine the most accurate method.

Purpose

To compare the accuracy of different methods of measurement and calculation using predicted refractive outcomes.
- Two different automated keratometers
  - IOL Master (PCI)
  - Lenstar LS 900 (OLCR)
- Three different methods of calculation
  - Acrysof Toric Calculator
  - Acrysof Toric Calculator with the Baylor Nomogram
  - Barrett Toric Calculator

To compare the accuracy of two different surgeon groups with different levels of experience using predicted refractive outcomes.
- Attending surgeons
- Resident surgeons

Setting

- This study reviewed the case records of consecutive patients who had cataract extraction with implantation of a toric Acrysof IOL (models SN6AT3 to SN6AT9, Alcon Laboratories, Inc.) through a 2.75 mm clear corneal incision by multiple surgeons at the Central Texas Veterans Health Care System from November 2013 to October 2015.
- The study was approved by the Institutional Review Board, Central Texas Veterans Health Care System, Temple, Texas.
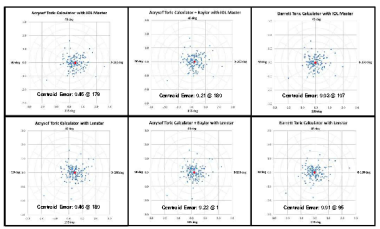
Design

- Retrospective Case Series

Methods

- Inclusion criteria were: patients with (1) post-operative manifest refraction four to six weeks after surgery with a corrected distance visual acuity of 20/30 or better, and (2) preoperative measurements with two devices (partial coherence interferometry based IOLMaster; optical low-coherence reflectometry based Lenstar LS 900).
- Exclusion criteria were: (1) previous ocular trauma or surgery, (2) intraoperative or postoperative complications, (3) contact lens wear, and (4) corneal disease.
- Predicted error was calculated for each combination of a keratometer with a toric calculator based on postoperative IOL alignment, according to a technique described by Hill et al[1].
- SIA was reported by each surgeon individually (postoperative keratometry was not performed for each patient), and IOL alignment was estimated based on intended alignment of the IOL in the operative note (postoperative IOL alignment was not measured).
- The Acrysof and Barrett toric calculator were accessed online on February 2016. This was before the Acrysof toric calculator update on August 15, 2016.

Results

- Our study evaluated 147 eyes from 125 patients (Table 1). Faculty surgeons placed 66 toric IOLs (Table 2) and resident surgeons placed 81 toric IOLs (Table 3).
- There was no significant difference between corneal measurement devices (Lenstar and IOLMaster) using all three calculation methods.
- The mean absolute error of the Barrett toric calculator was significantly lower than the Acrysof toric calculator (p-value: Lenstar 0.0038, IOLMaster 0.0024), but was not significantly lower than the Acrysof toric calculator with the Baylor nomogram (p-value: Lenstar 0.25, IOLMaster 0.29).
- The centroid error of the Barrett toric calculator was significantly lower than the Acrysof toric calculator with (p-value: Lenstar 0.00037, IOLMaster 0.0021) or without (p-value: Lenstar 0.00001, IOLMaster 0.00001) the Baylor nomogram.
- There was no significant difference between Faculty and Residents using each calculation method.

Conclusions

Corneal Measurement Devices
- There was no significant difference between IOLMaster and Lenstar LS 900 in our study.

Toric IOL Calculators
- The Barrett toric calculator was the most accurate based on centroid error.

Residents vs. Faculty
- Surgeon experience may not play a significant role in predicted outcomes of toric IOLs.

Table 2. RESIDENT. Absolute errors and controid errors in predicted residual astigmatism by measuring device and method of calculation.

Measuring Device	Aleon Toric Calculator	Aleon Toric Calculator (Baylor Nomogram)	Barrett Toric IOL Calculator
IOLMaster (PCI)			
Mean +/- SD (D)	0.69 +/- 0.42	0.60 +/- 0.38	0.60 +/- 0.34
Range (D)	0.06, 2.63	0.08, 2.26	0.10, 1.98
Median (D)	0.64	0.52	0.57
Centroid +/- SD (D)	0.41 @ 180 +/- 0.49	0.19 @ 2 +/- 0.49	0.06 @ 94 +/- 0.48
Lenstar LS 900 (OLCR)			
Mean +/- SD (D)	0.69 +/- 0.47	0.61 +/- 0.43	0.59 +/- 0.39
Range (D)	0.05, 3.32	0.06, 2.86	0.09, 2.56
Median (D)	0.58	0.51	0.51
Centroid +/- SD (D)	0.43 @ 3 +/- 0.50	0.22 @ 7 +/- 0.49	0.06 @ 71 +/- 0.49

Table 3. FACULTY. Absolute errors and controid errors in predicted residual astigmatism by measuring device and method of calculation.

Measuring Device	Aleon Toric Calculator	Aleon Toric Calculator (Baylor Nomogram)	Barrett Toric IOL Calculator
IOLMaster (PCI)			
Mean +/- SD (D)	0.70 +/- 0.47	0.56 +/- 0.43	0.51 +/- 0.40
Range (D)	0.09, 2.23	0.06, 2.26	0.02, 2.28
Median (D)	0.62	0.45	0.42
Centroid +/- SD (D)	0.49 @ 178 +/- 0.48	0.23 @ 178 +/- 0.47	0.03 @ 146 +/- 0.45
Lenstar LS 900 (OLCR)			
Mean +/- SD (D)	0.72 +/- 0.48	0.56 +/- 0.47	0.53 +/- 0.44
Range (D)	0.08, 2.45	0.11, 2.59	0.07, 2.57
Median (D)	0.64	0.47	0.43
Centroid +/- SD (D)	0.50 @ 176 +/- 0.50	0.24 @ 175 +/- 0.50	0.06 @ 151 +/- 0.48

Table 1. Absolute errors and controid errors in predicted residual astigmatism by measuring device and method of calculation.

Measuring Device	Aleon Toric Calculator	Aleon Toric Calculator (Baylor Nomogram)	Barrett Toric IOL Calculator
IOLMaster (PCI)			
Mean +/- SD (D)	0.69 +/- 0.44	0.58 +/- 0.40	0.56 +/- 0.37
Range (D)	0.06, 2.63	0.06, 2.26	0.02, 2.28
Median (D)	0.63	0.47	0.48
Centroid +/- SD (D)	0.45 @ 179 +/- 0.49	0.21 @ 180 +/- 0.48	0.03 @ 107 +/- 0.47
Lenstar LS 900 (OLCR)			
Mean +/- SD (D)	0.70 +/- 0.48	0.60 +/- 0.45	0.56 +/- 0.41
Range (D)	0.05, 3.32	0.06, 2.86	0.07, 2.57
Median (D)	0.59	0.49	0.45
Centroid +/- SD (D)	0.46 @ 180 +/- 0.50	0.22 @ 1 +/- 0.50	0.01 @ 95 +/- 0.49

Table 4. Type of IOL and Frequency of Implantation

IOL Model	Eyes, n	%
SN6AT3	70	47.6%
SN6AT4	37	25.2%
SN6AT5	23	15.6%
SN6AT6	11	7.5%
SN6AT7	2	1.4%
SN6AT8	1	0.7%
SN6AT9	3	2.0%

1. Hill W, Osher R, Cooke D, Solomon K, Sandoval H, Salas-Cervantes R, Potvin R. Simulation of toric intraocular lens results: manual keratometry versus dual zone automatic keratometry from an integrated biometer. J Cataract Refract Surg 2011; 37:2181–2187.