Comparison of accuracy in predicting postoperative residual astigmatism: theoretical adjustment vs. measured posterior corneal astigmatism

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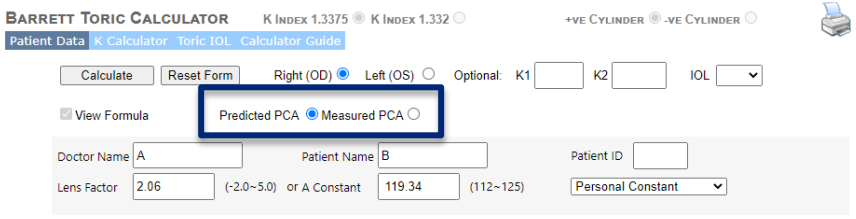
Toric IOL calculation: how do we incorporate posterior corneal astigmatism (PCA)?

- Use regression/theoretical models
  - Baylor nomogram
  - Abulafia-Koch: Vector version of Baylor nomogram + clinical data
  - J&J (AMO): J&J clinical trial data + Baylor nomogram
  - Barrett toric calculator (standard, predicted PCA)
- Measure the posterior cornea
  - Barrett toric calculator (new, measured PCA)

Purpose

- To compare the accuracy of predicting residual astigmatism after cataract surgery using Barrett toric calculator with:
  - Predicted PCA
  - Measured PCA from IOLMaster 700



Methods

- Dataset from VERACITY surgical database
  - Included eyes with monofocal non-toric IOLs:
    - Eliminate postop toric IOL alignment issue
- Exclusion criteria
  - Ocular surgery: LASIK/PRK/RK, corneal incisions for astigmatism correction
  - Postop follow up < 3 weeks
  - Postop manifest refraction with DCVA < 20/40

Methods

- Residual astigmatism prediction calculated using Barrett toric calculator with
  - Predicted PCA
  - Measured PCA
- Astigmatism prediction error (PE): difference between
  - Actual postop refractive astigmatism
  - Predicted residual astigmatism

Methods: astigmatism PE

- Scalar PE: difference between
  - Absolute value of postop cylinder
  - Absolute value of predicted residual astigmatism independent of angle
- Vector PE: vector analysis
  - Difference in magnitudes as ***best*** measure of accuracy
  - Double angle plots to look at centroid and spread of data as a secondary way to interpret the data

Example

Preop: 2D@90
Predicted: 0.5D@90
Outcome: 0.5D@180

Scalar PE = 0.5D - 0.5D = 0

Vector PE = 1.0 D
Due to change in meridian

Methods

- % of eyes with PE magnitude
  - ≤0.25 D, ≤0.50 D, ≤0.75 D, and ≤1.00 D
- Analysis performed in
  - Whole group (n=602)
  - Subgroup of eyes with anterior corneal astigmatism ≥0.5 D (n=432)
    - Potential eyes for toric IOL implantation

Results: summary of characteristic data

Parameters	Mean ± SD	Range
Mean anterior keratometry (D)	44.16 ± 1.67	39.60 to 58.74
Anterior astigmatism magnitude (D)	0.90 ± 0.70	0.00 to 7.14
Mean posterior keratometry (D)	-5.86 ± 0.27	-8.23 to -5.10
Posterior astigmatism magnitude (D)	0.27 ± 0.13	0.00 to 1.01

Results: mean scalar and vector PE magnitude

	Scalar PE magnitude (D)		Vector PE magnitude (D)	
	Predicted PCA	Measured PCA	Predicted PCA	Measured PCA
Whole group	0.39 ± 0.32	0.37 ± 0.31	0.57 ± 0.40	0.54 ± 0.40
Subgroup (astig ≥0.5D)	0.43 ± 0.35	0.41 ± 0.34	0.62 ± 0.43	0.60 ± 0.43

Measured PCA produced smaller mean absolute scalar and vector PEs (all $P<0.05$)

Results: % PEs in whole group (n=602)

	Scalar PE magnitude		Vector PE magnitude	
	Predicted PCA	Measured PCA	Predicted PCA	Measured PCA
≤0.25 D	41.2%	43.9%	16.8%	19.8%
≤0.50 D	72.6%*	76.1%*	52.5%**	57.6%**
≤0.75 D	88.2%	89.05%	77.1%	78.6%
≤1.00 D	94.9%	95.5%	88.0%	89.2%

* **: significant differences between predicted and measured PCA

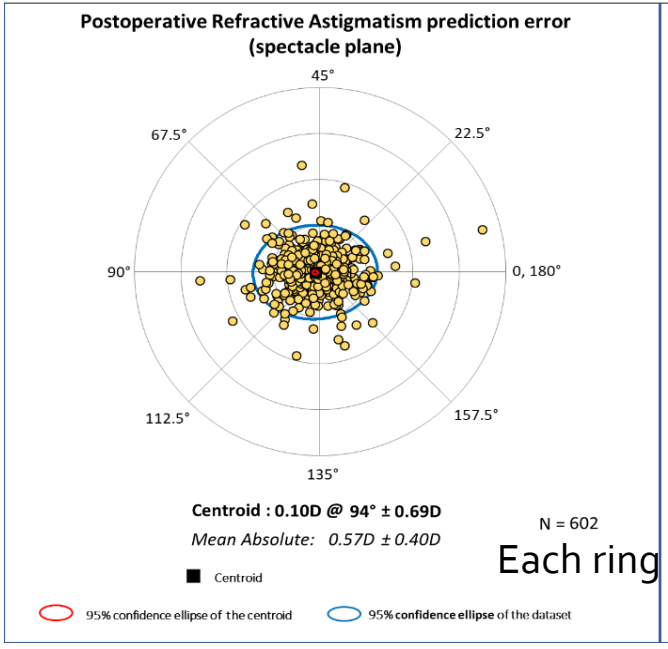
Results: % PEs in subgroup with astigmatism ≥0.5 D (n=432)

	Scalar PE magnitude		Vector PE magnitude	
	Predicted PCA	Measured PCA	Predicted PCA	Measured PCA
≤0.25 D	37.7%	39.8%	15.3%	16.7%
≤0.50 D	67.1%*	70.6%*	46.3%**	50.5%**
≤0.75 D	84.3%	85.6%	71.8%	73.6%
≤1.00 D	93.1%	94.0%	85.2%	86.6%

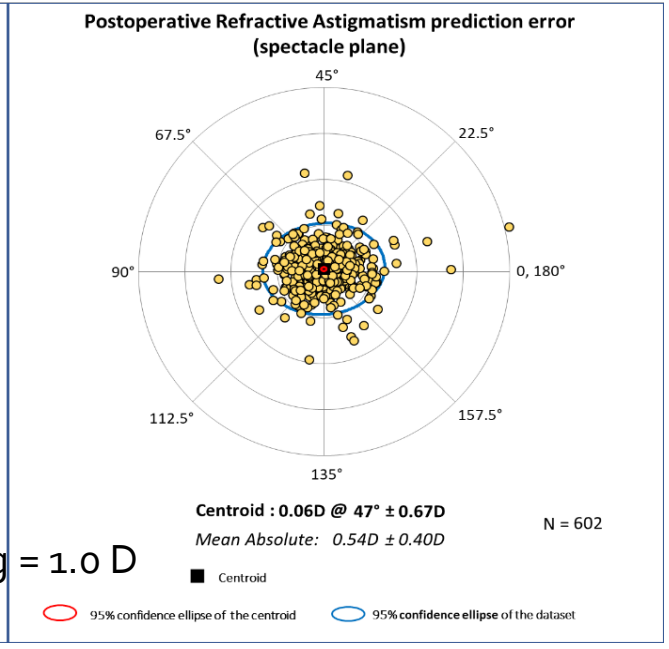
* **: significant differences between predicted and measured PCA

Results: vector PEs in whole group (n=602)

Predicted PCA



Measured PCA



Each ring = 1.0 D

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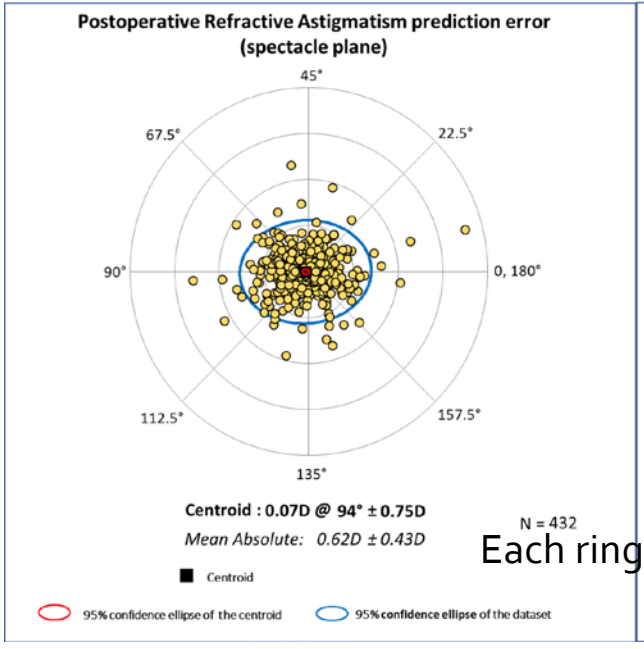
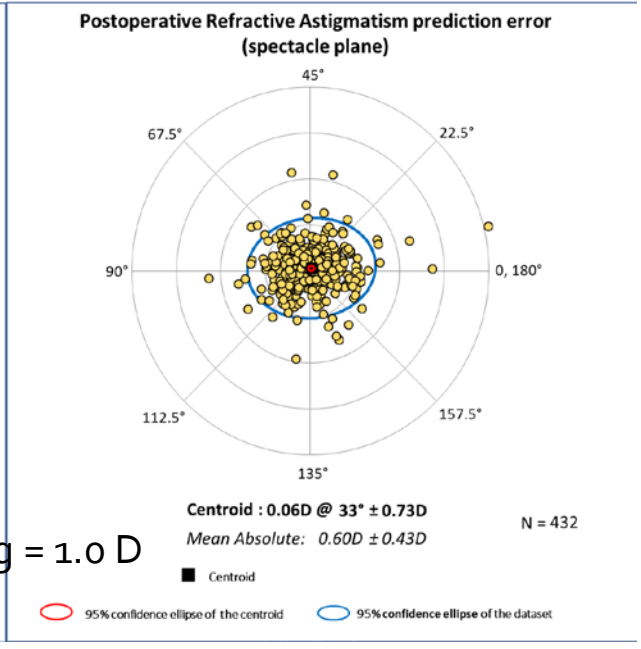
Results: vector PEs in subgroup with astigmatism ≥0.5 D (n=432)

Predicted PCA



Measured PCA



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Summary

- Barrett toric calculator with measured PCA produced:
  - Significantly smaller scalar/vector PE magnitude
    - But these differences are clinically small (<0.03 D)
  - Significantly higher % values with PE ≤0.5 D
    - But these differences are clinically small (~4%)

Summary

- Limitation
  - Non-toric monofocal IOLs included
- Further studies needed to assess the accuracy of incorporating measured PCA in toric calculator
  - Toric IOL eyes
  - Other toric calculators

Thank you for your attention!

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