cassini
by i-Optics

TOTAL CORNEAL ASTIGMATISM

Premium treatment starts with premium diagnosis

i-Optics / AMO meeting
ESCRS Monday 15 September 2014

Company confidential – disclosed under NDA

Cassini: Repeatability measurements in 350 patients

Against-the-Rule Astigmatism Shift with Aging

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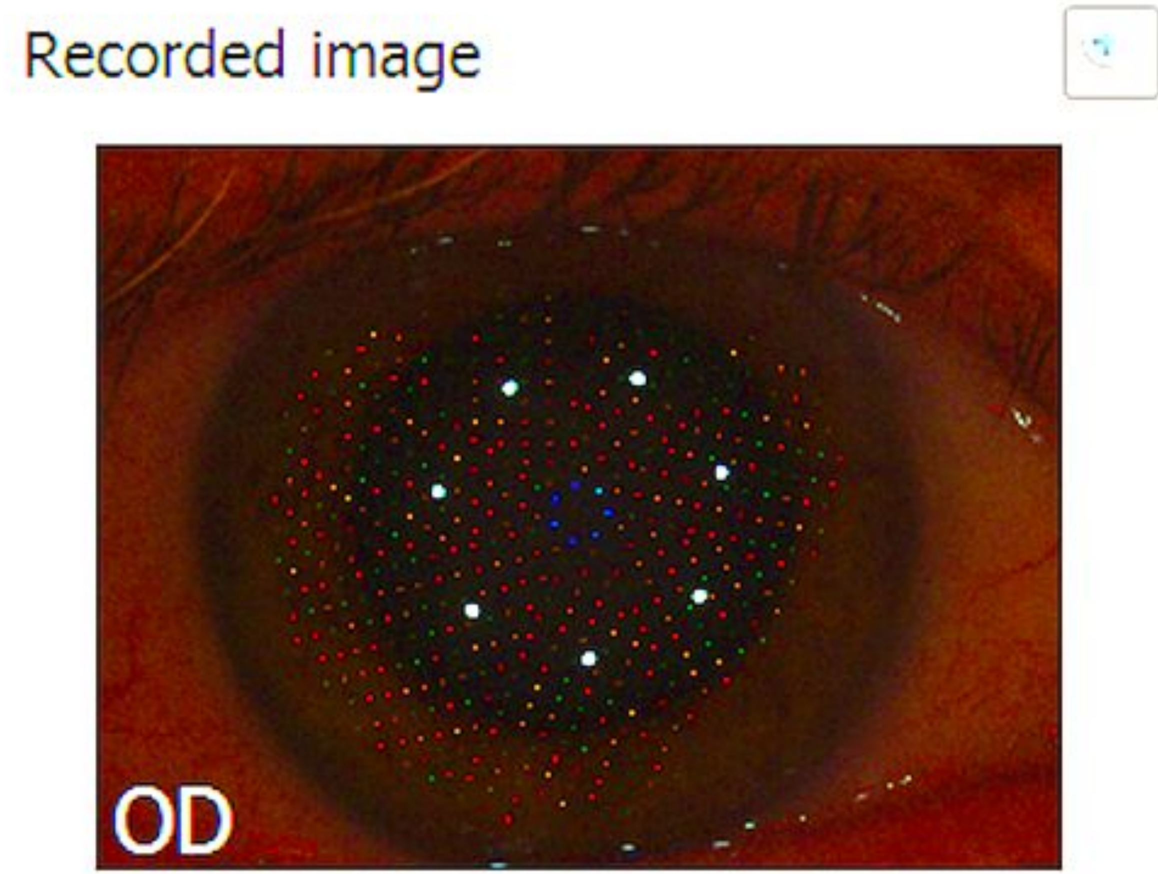
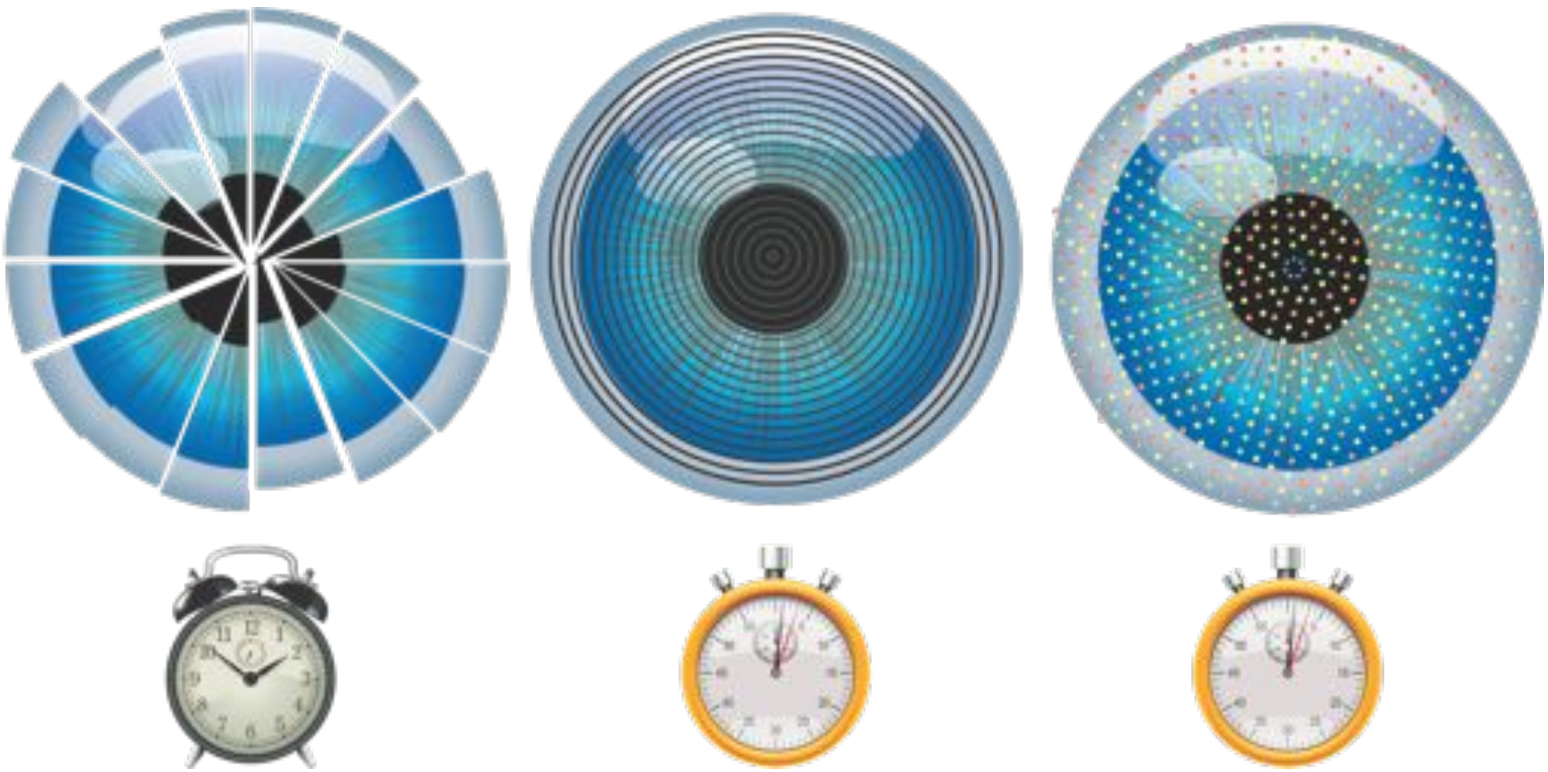
Acknowledgements

George Asimellis, PhD and the LaserVision.gr Institute team

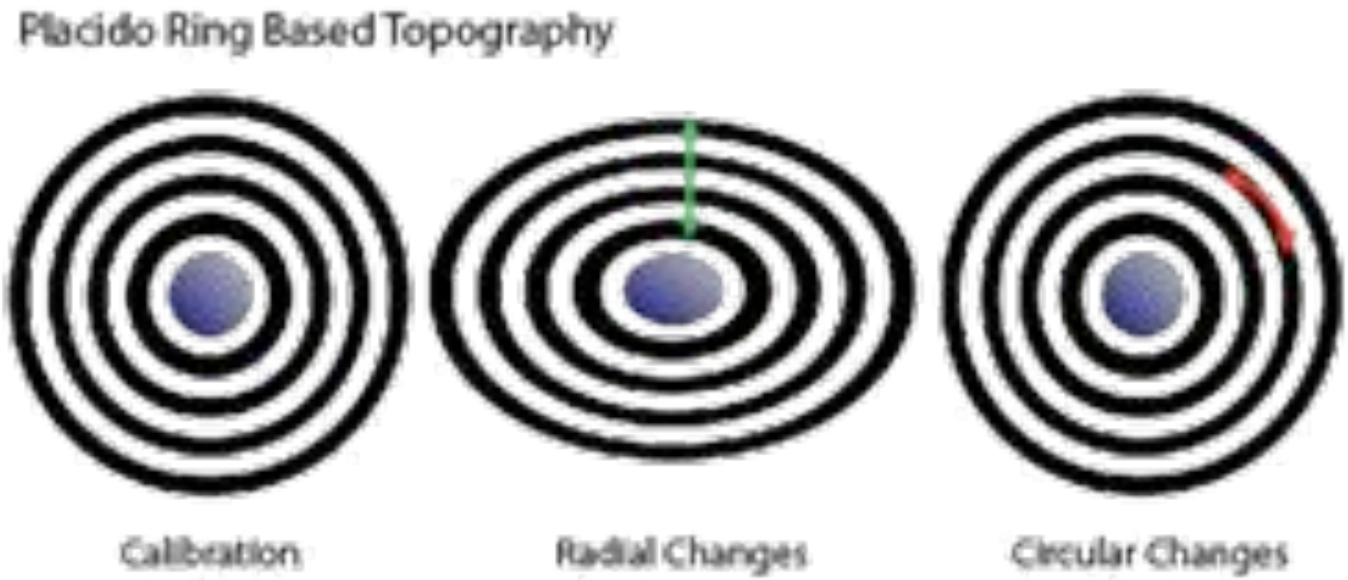
Cassini



Single-shot Acquisition

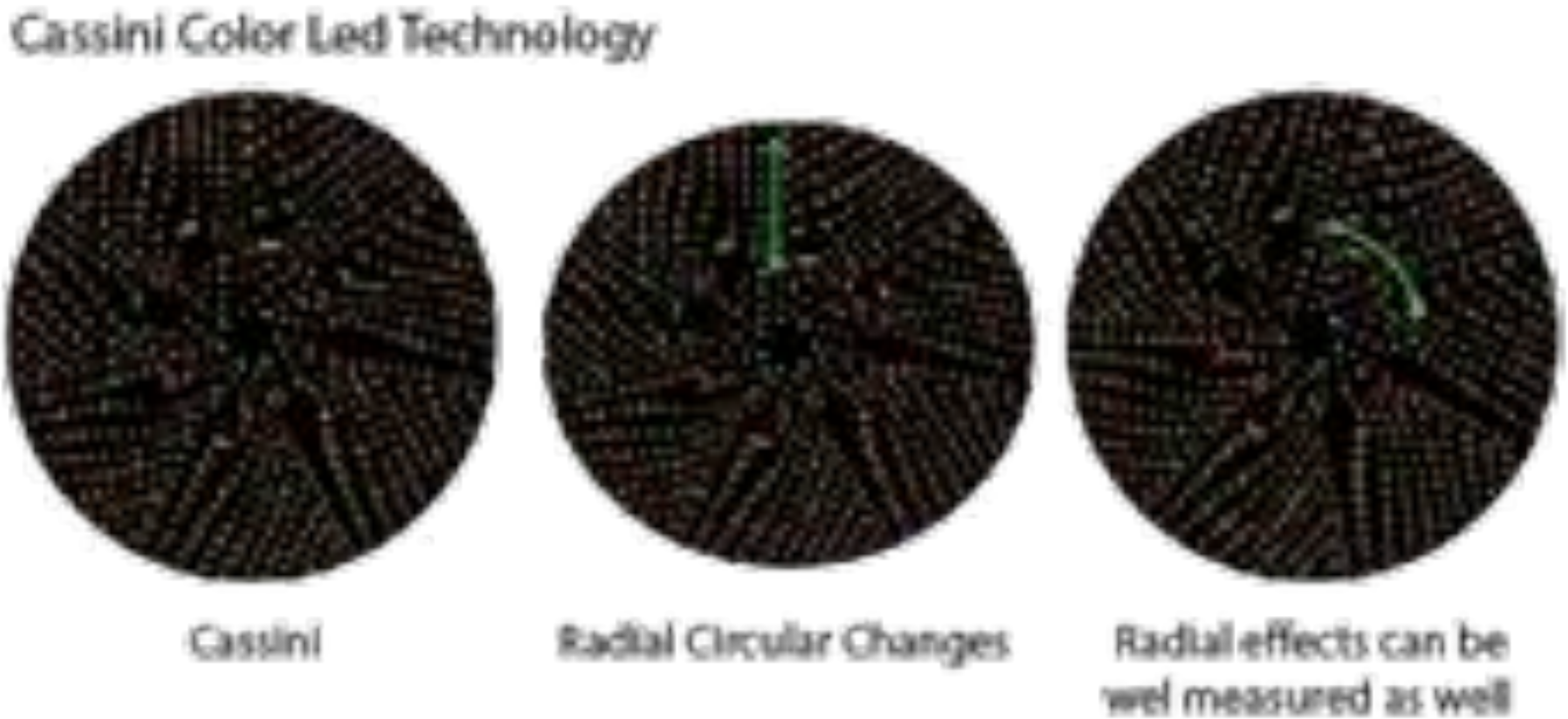


Cassini vs Placido

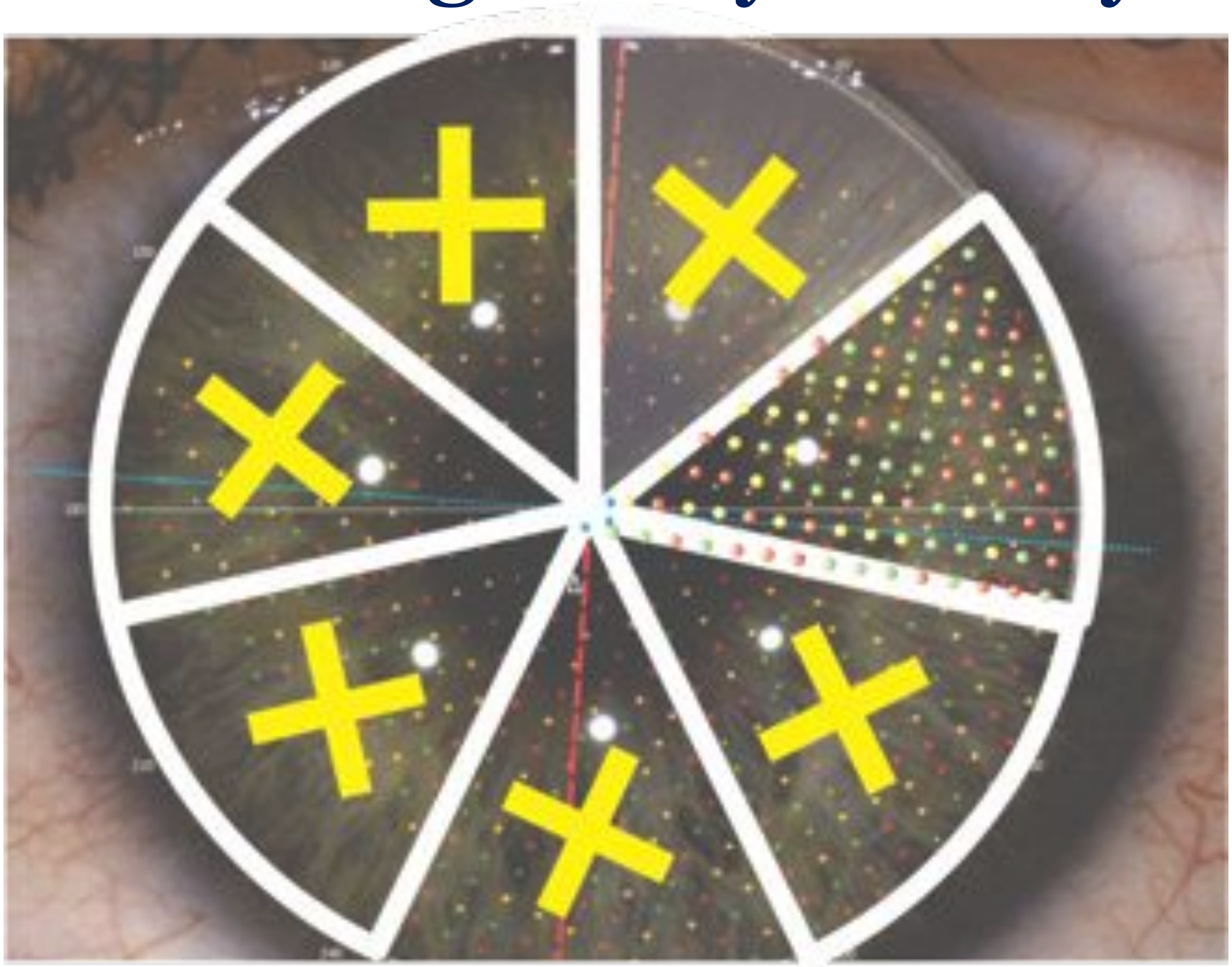


Ring pattern may not discern feature changes along the tangential direction.

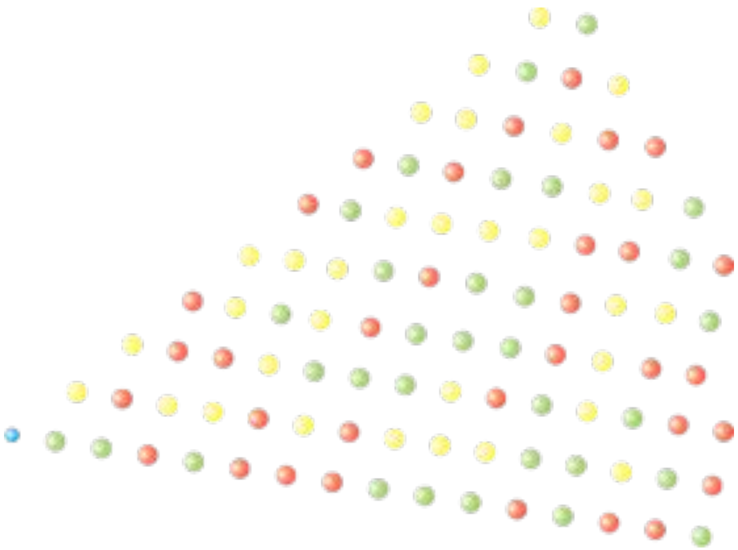
Cassini vs Placido

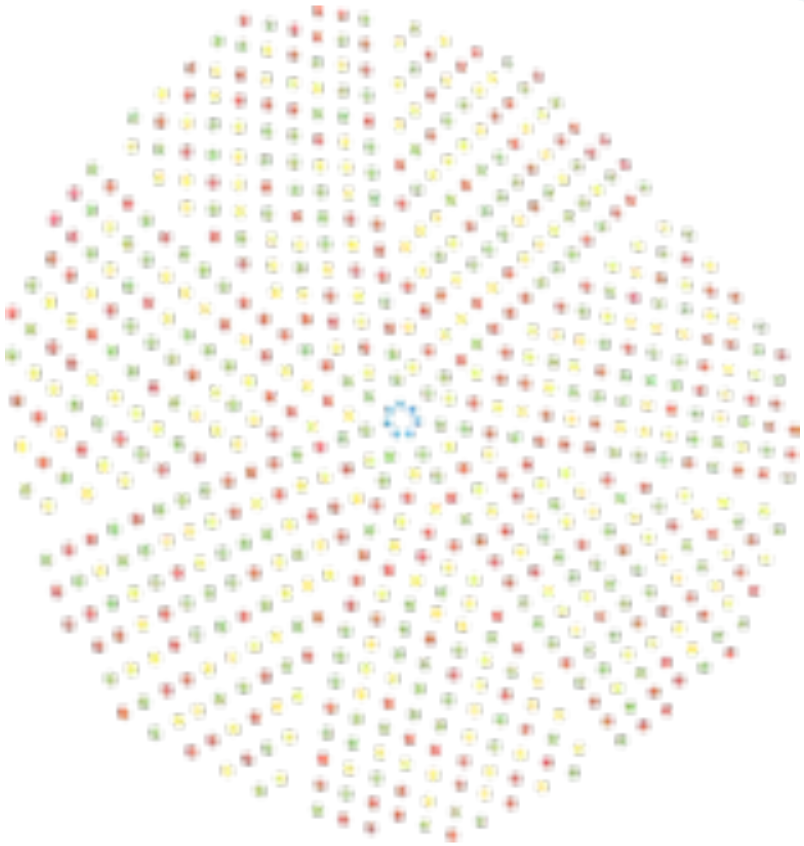


Breaking the Symmetry



Color – coded Point-Source Analysis



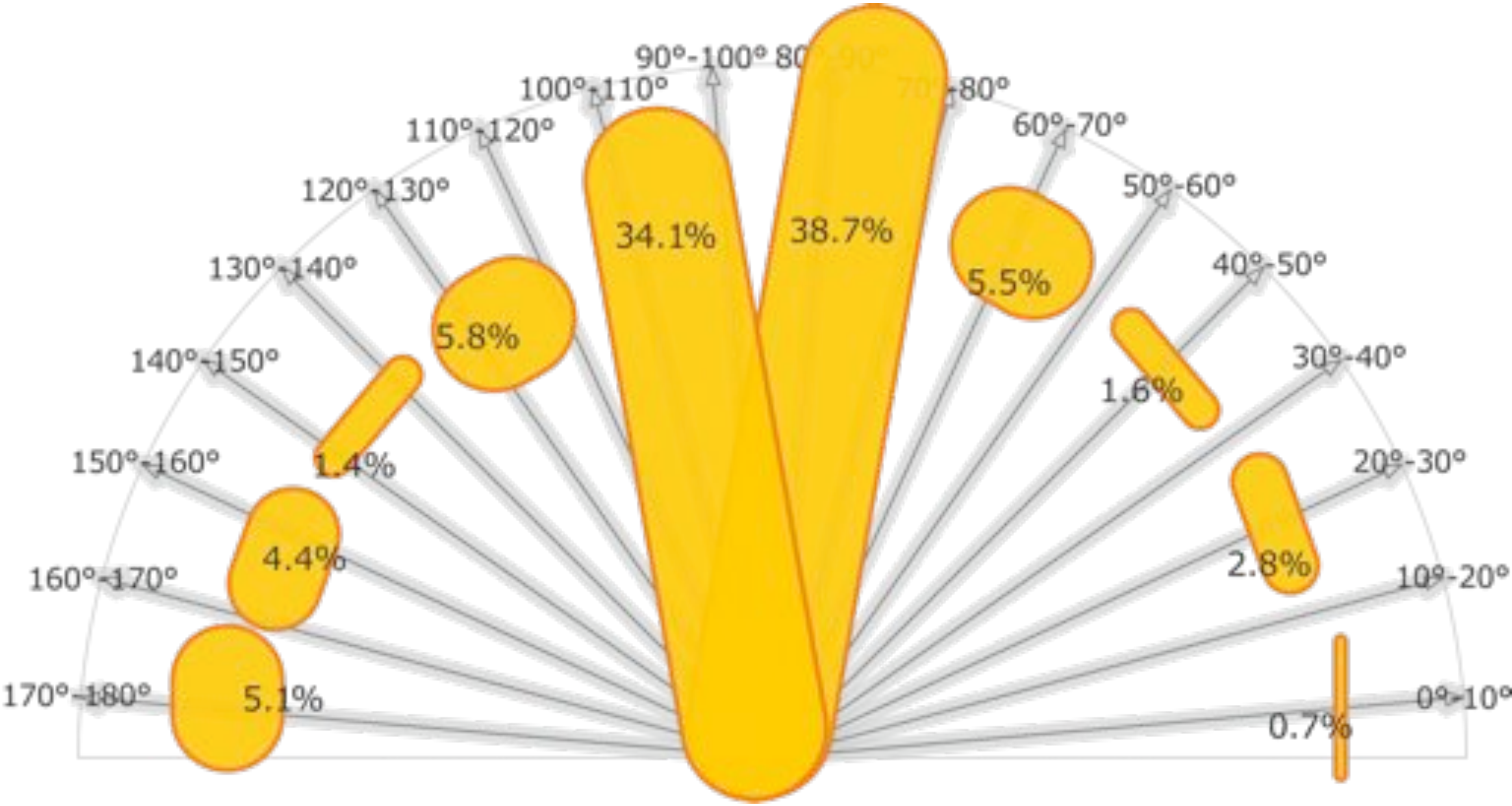


Intro/Methods

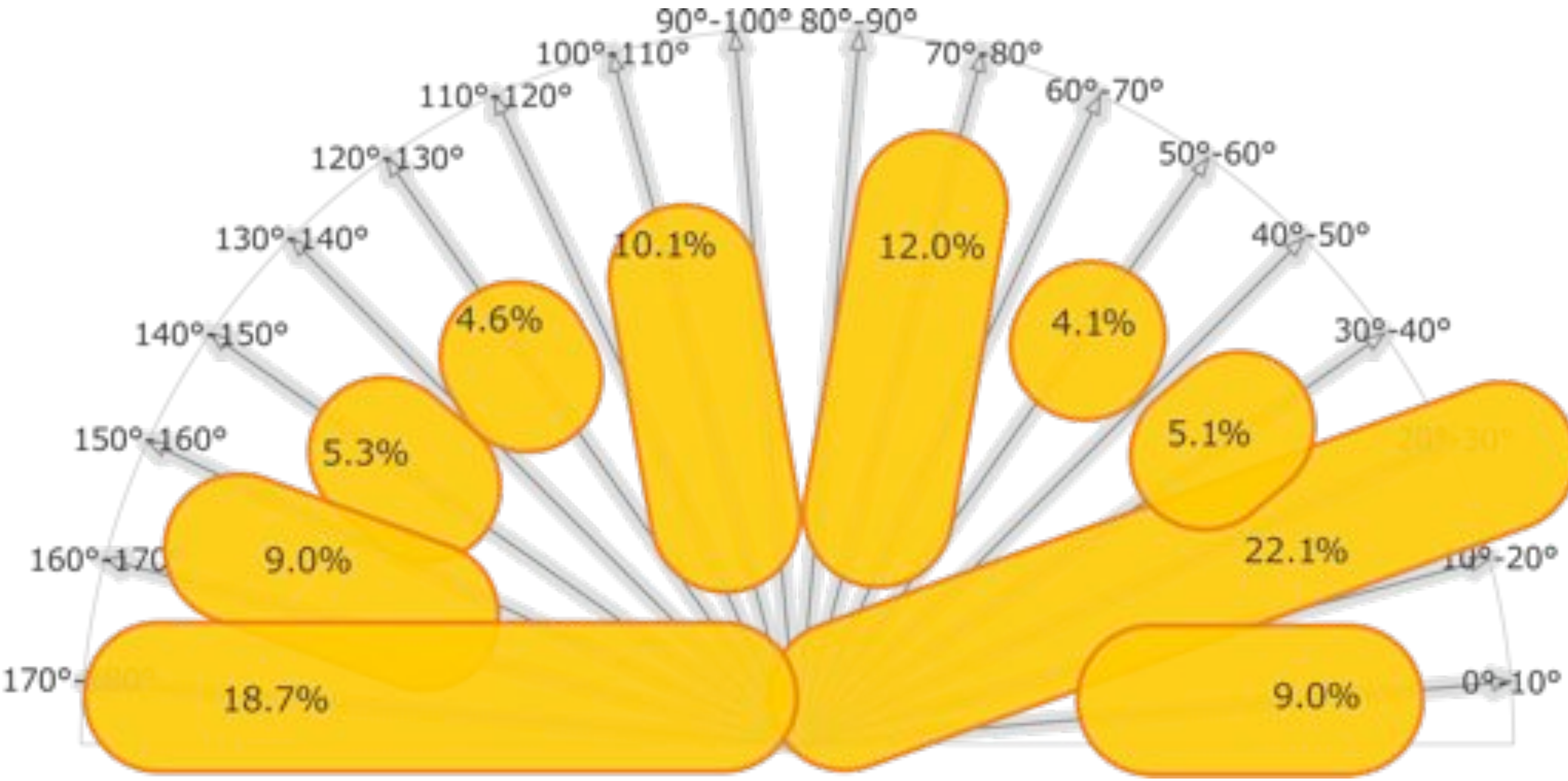
- To evaluate the clinical efficacy of a novel corneal topography device and investigate repeatability of axis and astigmatism measurements in healthy and pre-cataract eyes (**350 cases)**.
- Anterior corneal surface imaging with the Cassini a novel multicolored-spot reflection topographer was investigated in a group of healthy patients (**control group A**) and a group of pre- cataract patients **(group B)**.


Results

- The control group-A (mean age **35.74 years**) had on average ‘with-the-rule’ astigmatism, while the older-age pre-cataract group-B (mean age **73.59 years**) had on average ‘against- the-rule’ astigmatism. In group-A average axis repeatability measurement was **from 2.49°** (within astigmatism 0-0.99 D subgroup) to 1.14° (within astigmatism ≥3.00 D subgroup) and magnitude repeatability measurement from 0.25 D to 0.59 D. In group-B average axis repeatability measurement was from **3.03°** (within astigmatism 0-0.99 subgroup) to 0.62° (within astigmatism ≥3.00 D subgroup) and magnitude repeatability measurement from 0.35 D to 0.61 D.



Control (younger) pts steep meridian axis



Group B Cataract pts steep meridian axis

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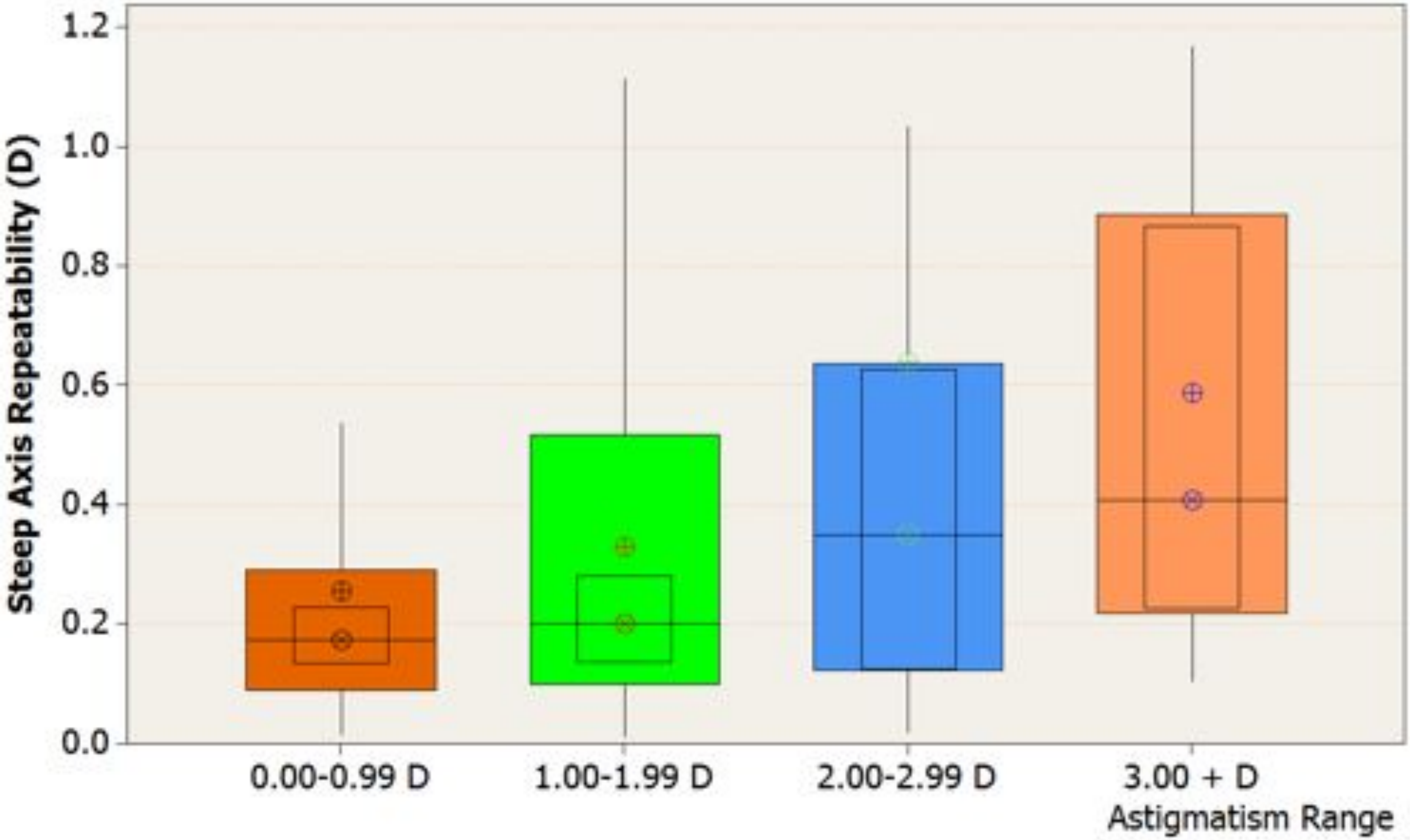
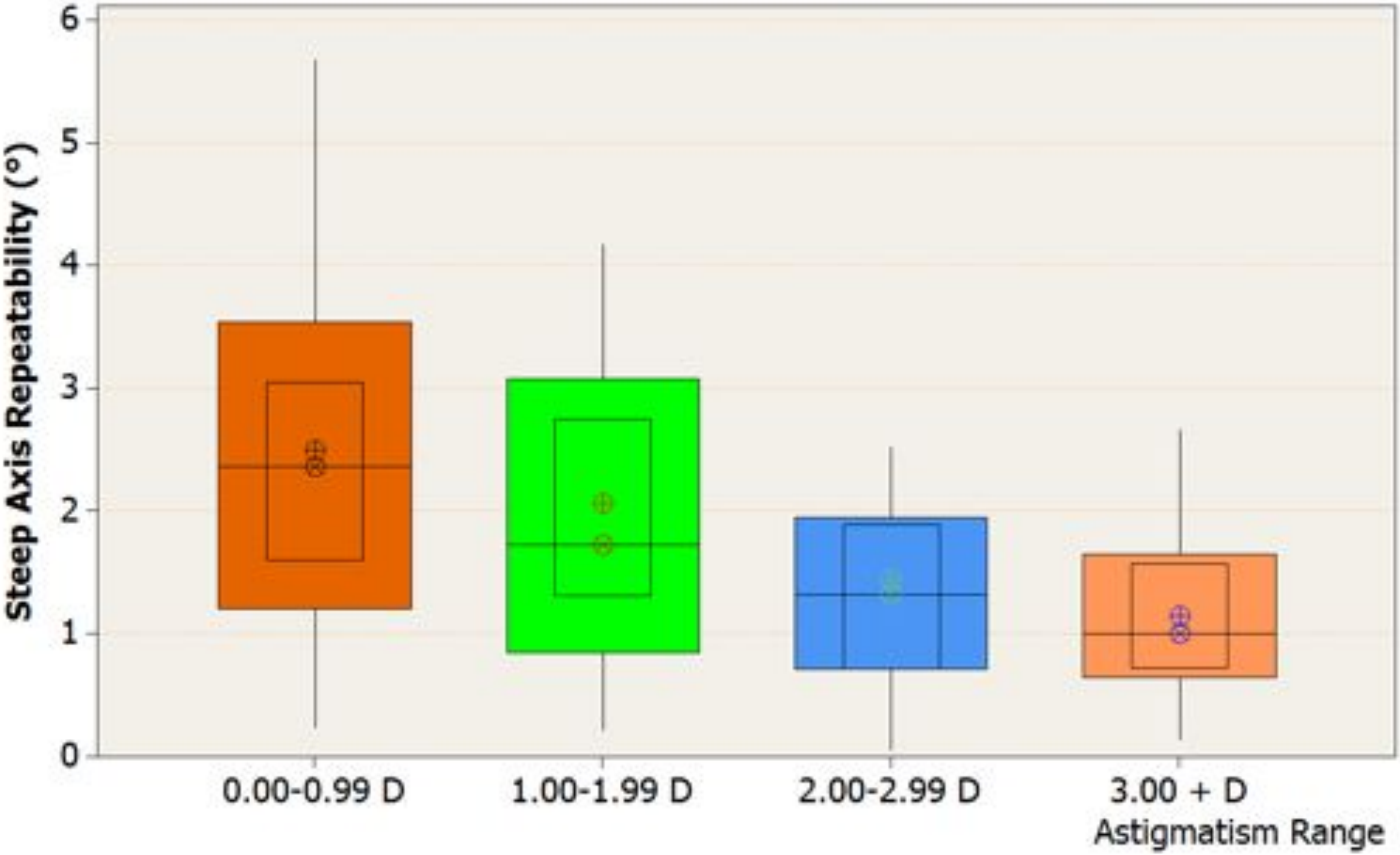
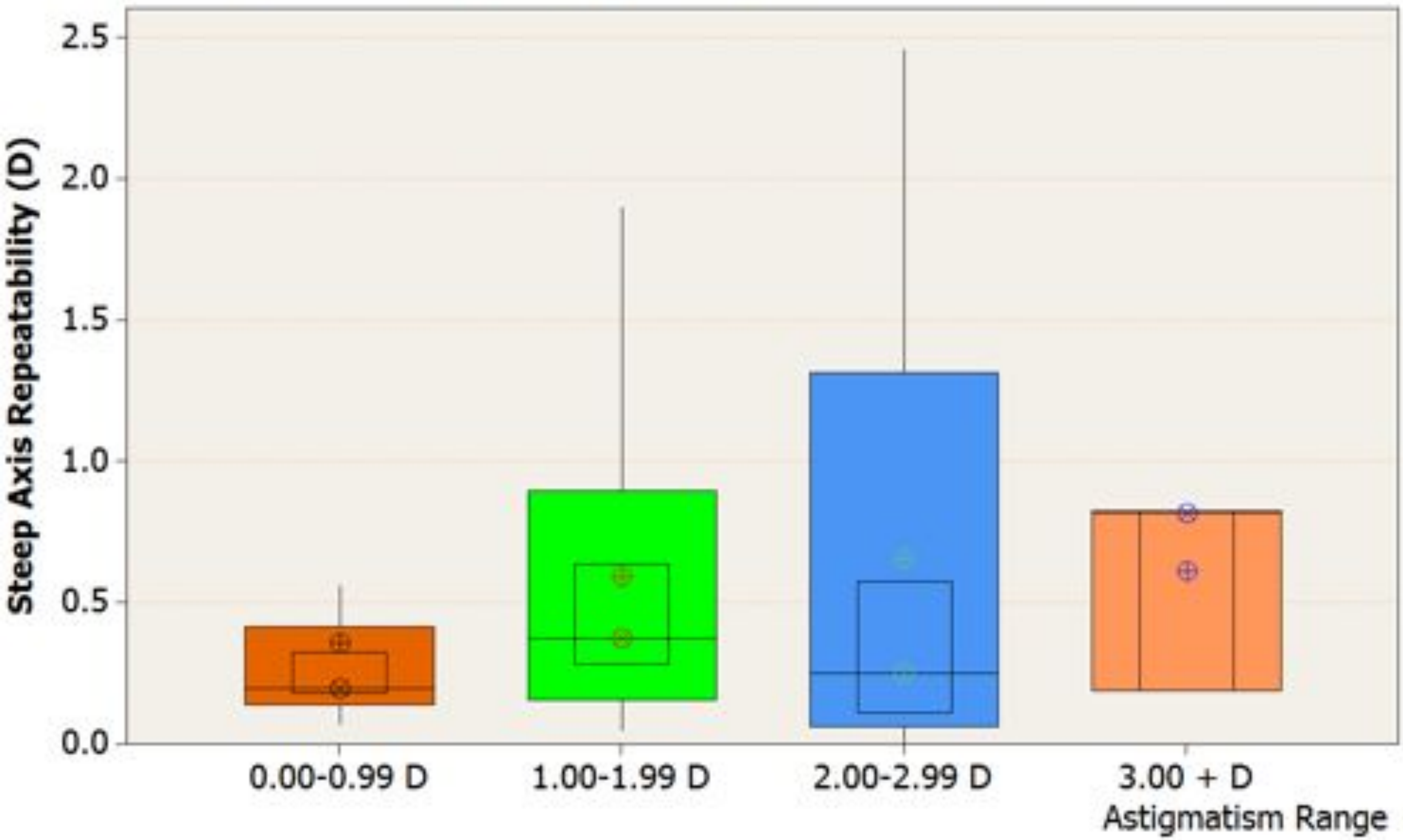
Magnitude Measurement Repeatability vs Astigmatism Range Group A



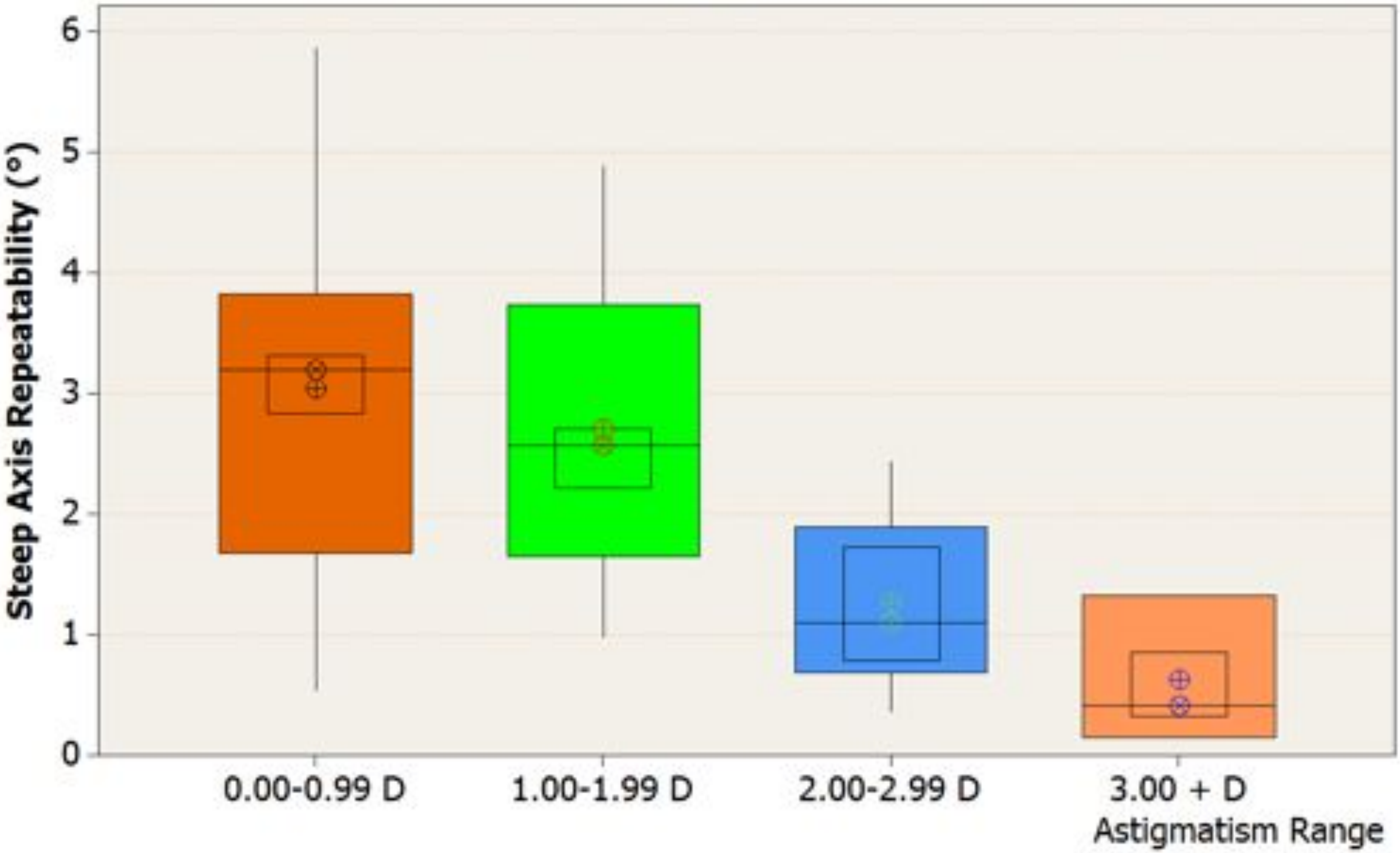
Axis Measurement Repeatability vs Astigmatism Range Group A



Magnitude Measurement Repeatability vs Astigmatism Range Group B



Axis Measurement Repeatability vs Astigmatism Range Group B



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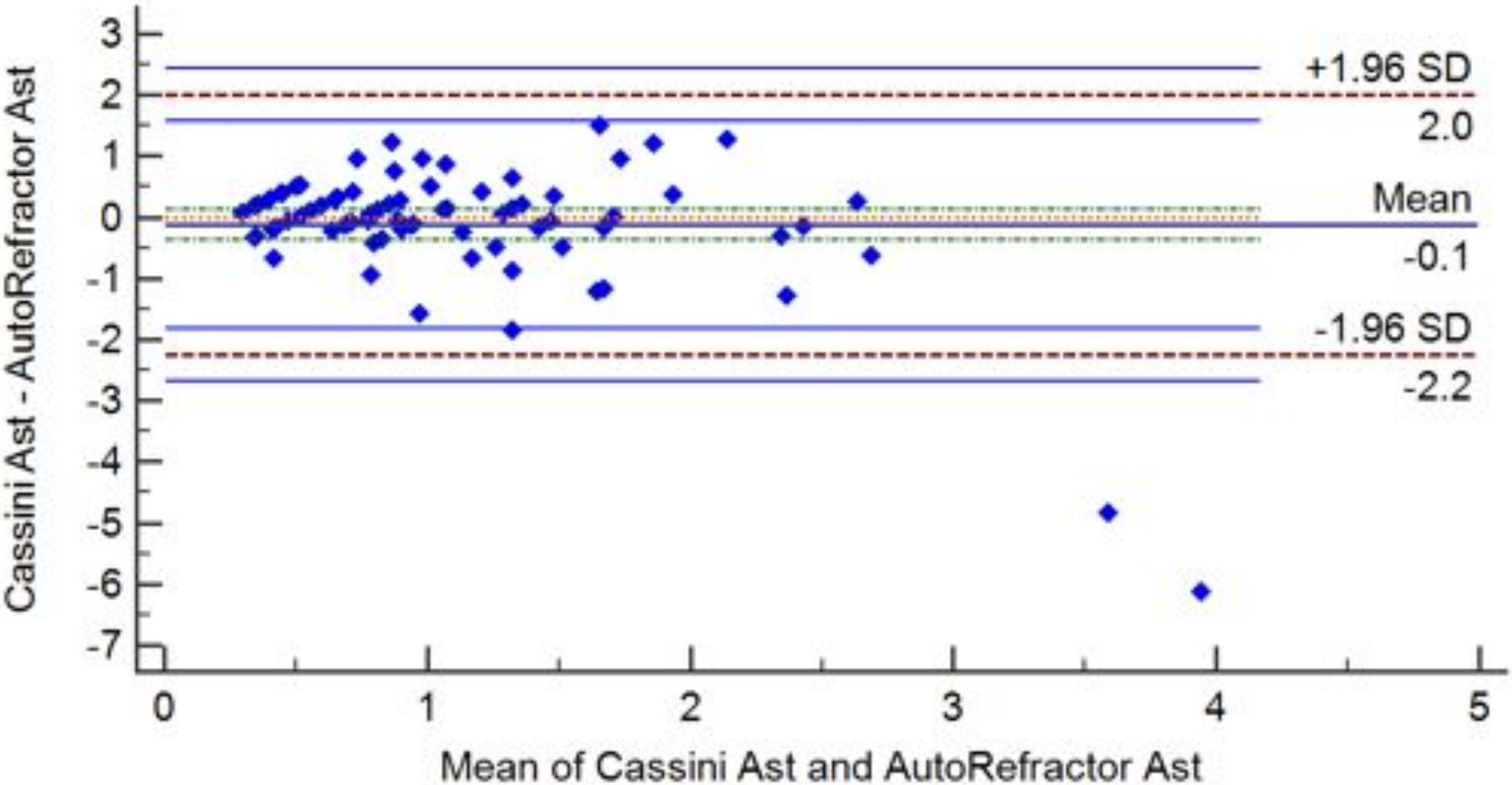
Conclusions

- Astigmatism appears to shift from on average 'with-the-rule' to 'against-the-rule' with aging. Employment of the Cassini topography results in astigmatism magnitude repeatability under 0.6D and axis repeatability **under 3°**, an impressive sensitivity benchmark.
- Even better repeatability on axis measurement was noted, as expected, in cases with higher astigmatism.

New York City preliminary pre-cataract surgery data



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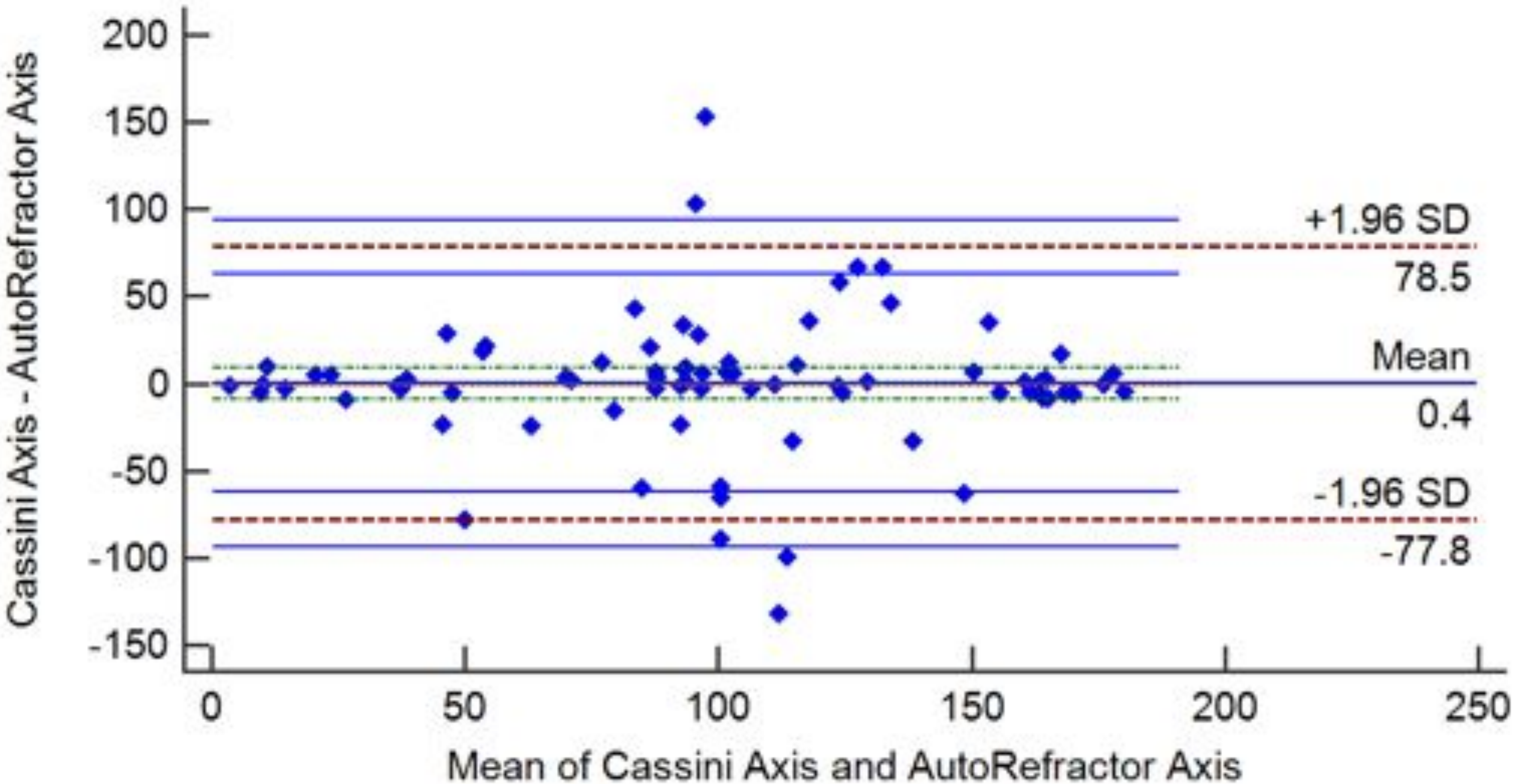
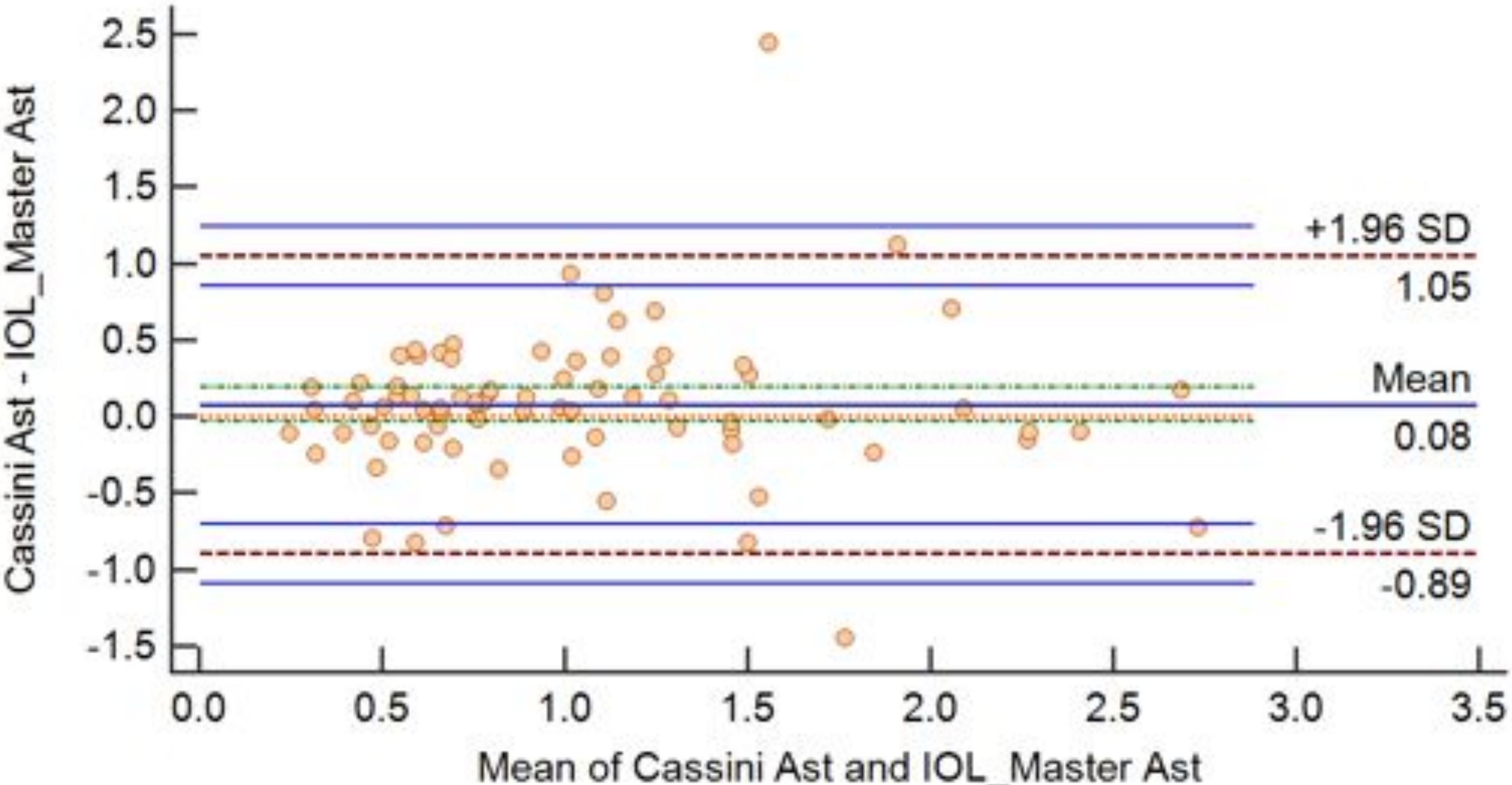
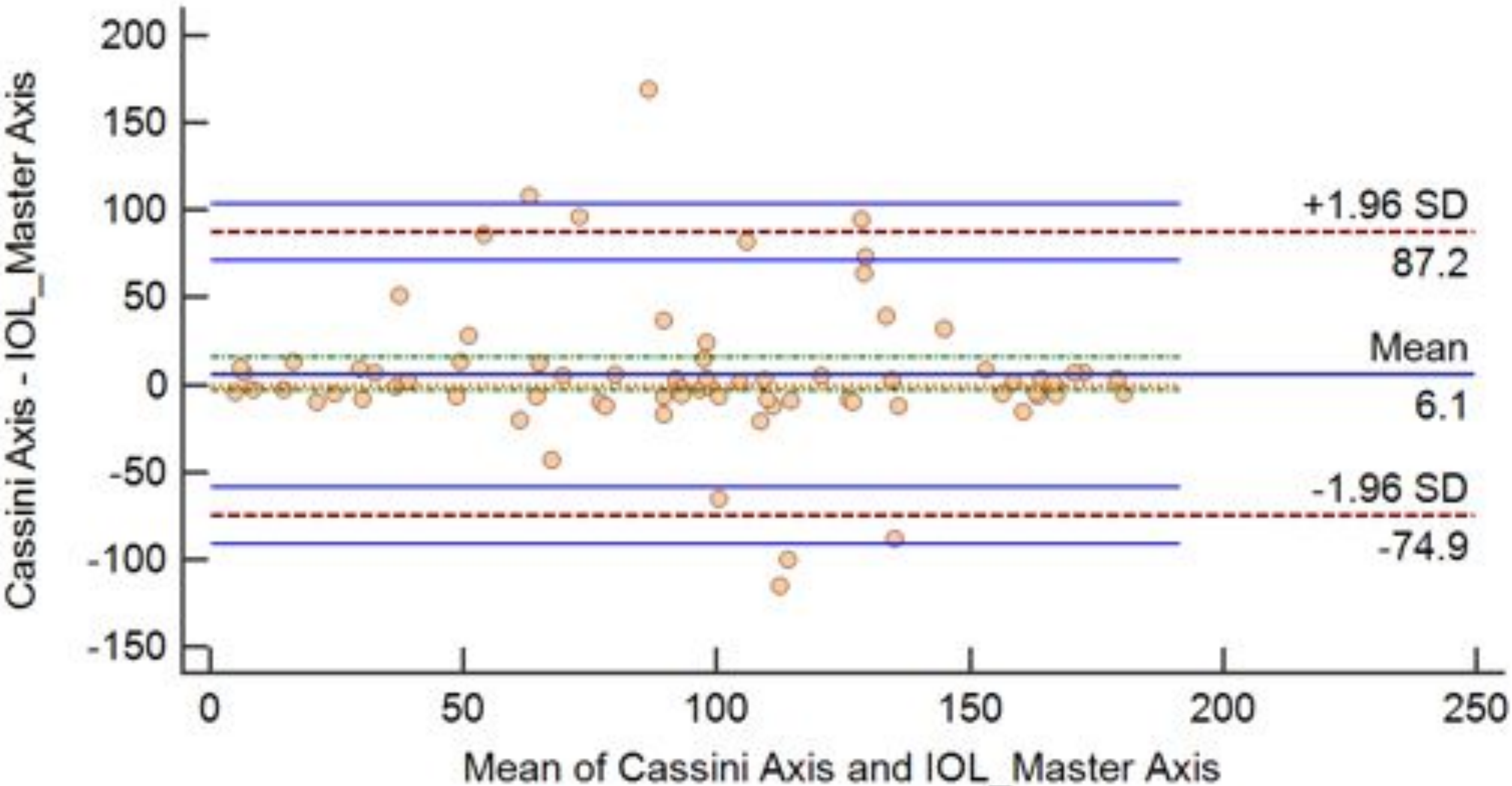
Cassini Vs AR



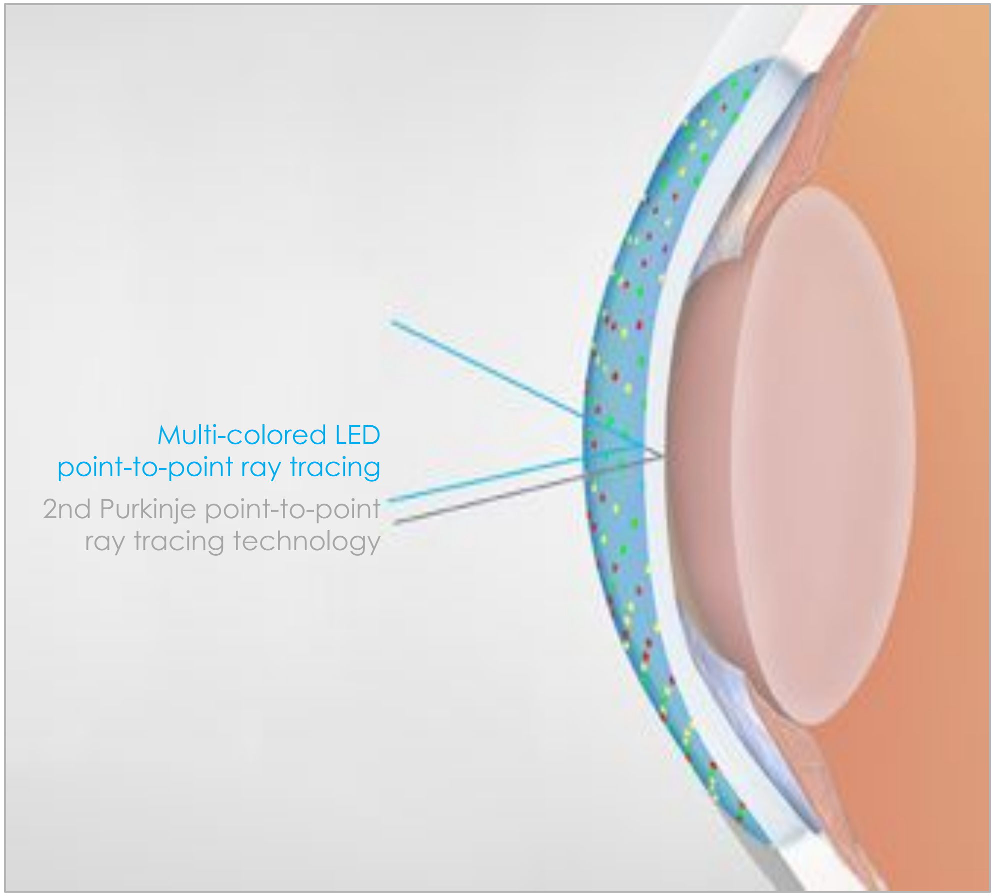
Cassini Vs IOL master astigmatism



Cassini Vs IOL master axis



Total Corneal Astigmatism



Cassini uses patented multi-colored LED point-to-point ray tracing to provide a GPS-like analysis of the cornea along with high-resolution images utilized for surgical guidance.

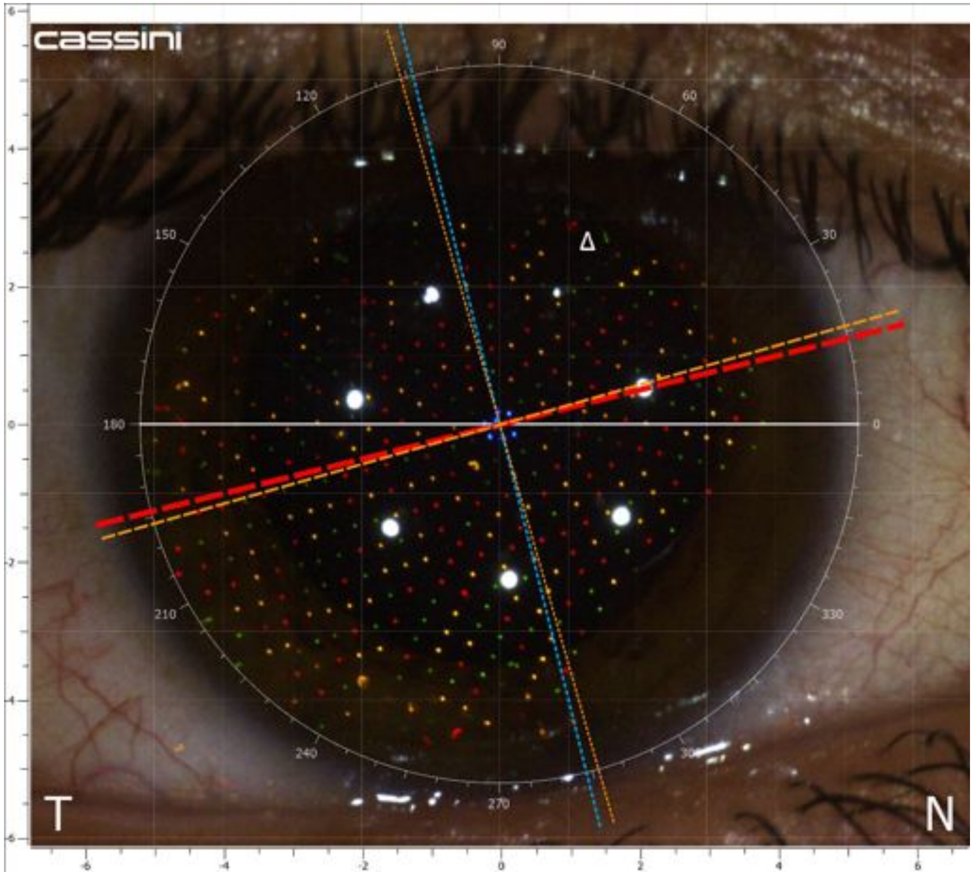
The unique measuring principle enables highly accurate and repeatable measurements of the Total Corneal Astigmatism.

Cassini provides critical information to properly select the power and position of Toric intraocular lenses

Cassini Posterior Surface Analysis

Example of Agreement Anterior – Total K

- 29 y.o. male LASIK candidate
- Anterior + Total keratometry



------ Keratometric SimK (flat)

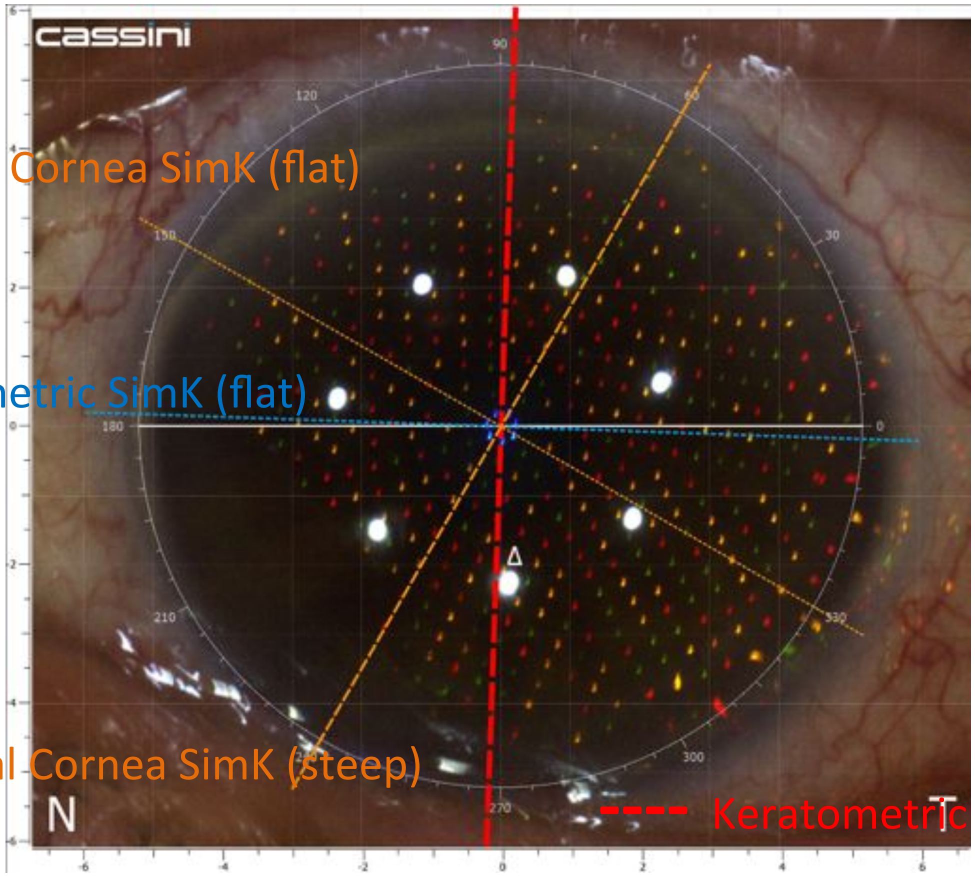
---- Keratometric SimK (steep)

---- Total Cornea SimK (steep)

····· Total Cornea SimK (flat)

Example of Disagreement Anterior – Total K

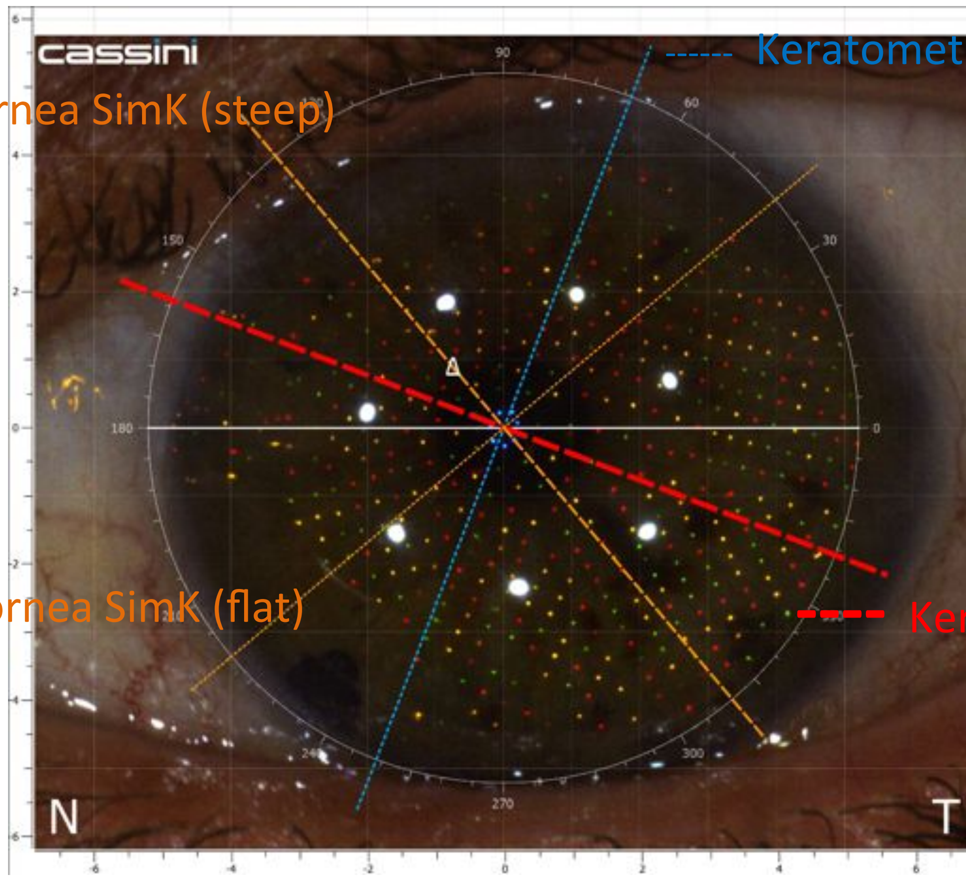
- 81 y.o. female cataract surgery candidate
- Anterior ≠ Total keratometry



Keratometric SimK			
Steep K	Flat K	Astigm	Axis (flat)
45.26	43.87	**1.39**	**178**
Total Cornea SimK			
Steep K	Flat K	Astigm	Axis (flat)
44.55	42.34	**2.25**	**150**

Example of Disagreement Anterior – Total K

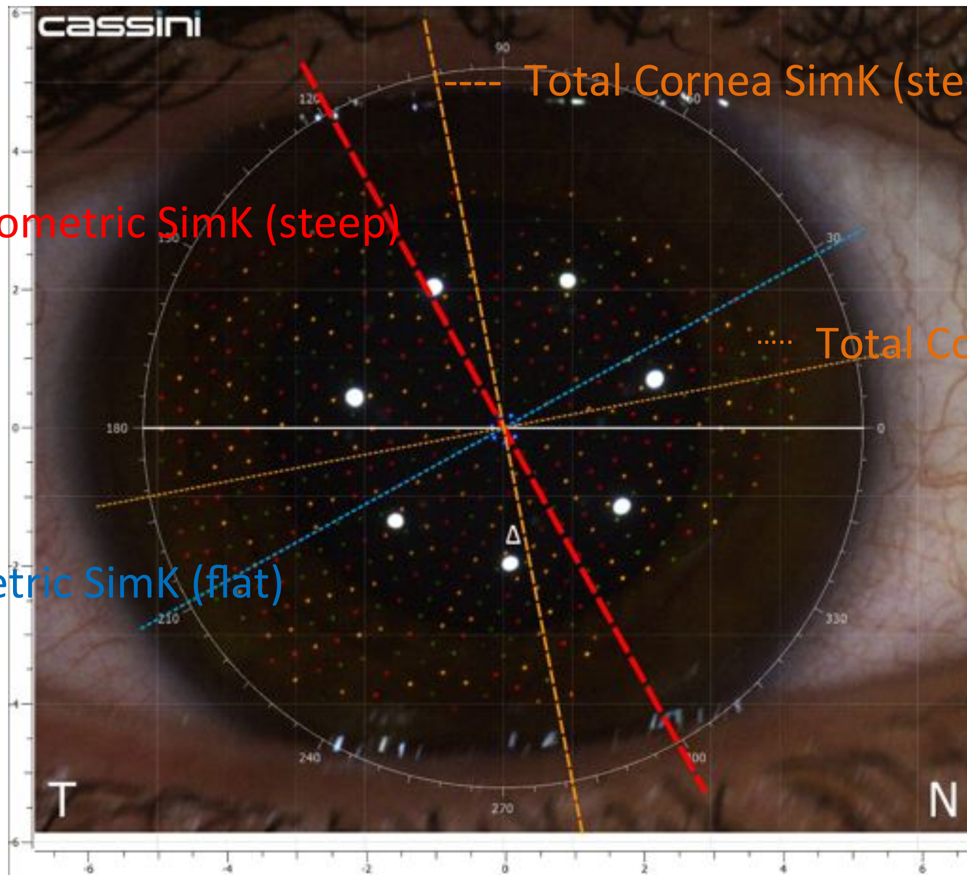
- 60 y.o. female cataract surgery candidate
- Anterior ≠ Total keratometry



Keratometric SimK			
Steep K	Flat K	Astigm	Axis (flat)
38.14	33.93	**4.21**	**69**
Total Cornea SimK			
Steep K	Flat K	Astigm	Axis (flat)
39.62	30.57	**9.75**	**40**

Example of Disagreement Anterior – Total K

- 30 y.o. female LASIK surgery candidate
- Anterior ≠ Total keratometry



---- Total Cornea SimK (steep)

---- Keratometric SimK (steep)

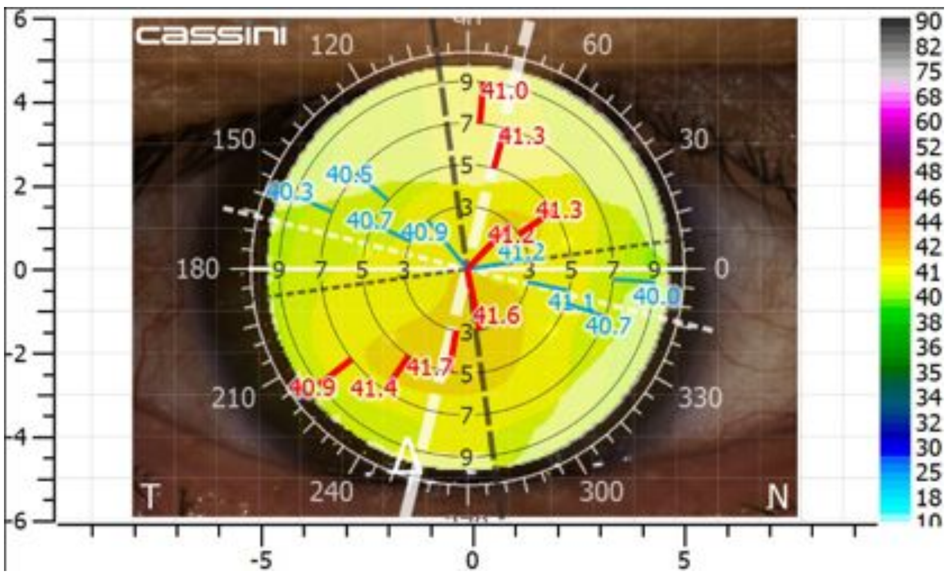
..... Total Cornea SimK (flat)

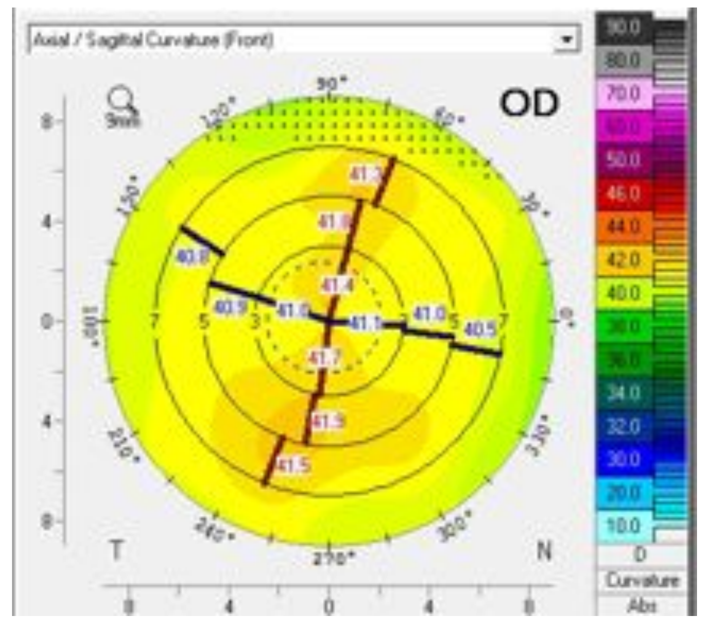
-- Keratometric SimK (flat)

Keratometric SimK			
Steep K	Flat K	Astigm	Axis (flat)
45.99	45.34	**0.65**	**29**
Total Cornea SimK			
Steep K	Flat K	Astigm	Axis (flat)
45.88	43.18	**2.74**	**11**

Example of Agreement Cassini – Pentacam HR

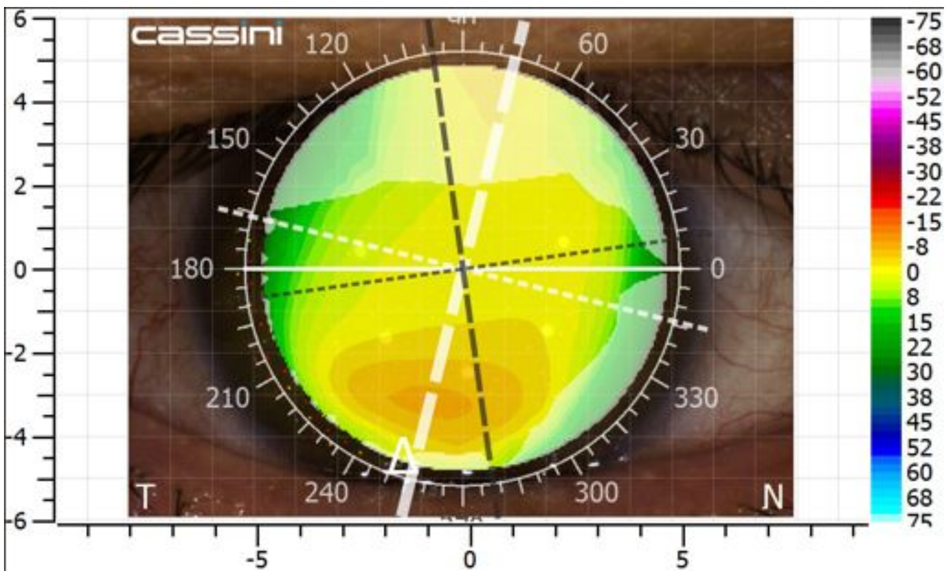
- 52 y.o. male pre-cataract patient
- Axial/ sagittal curvature, anterior cornea

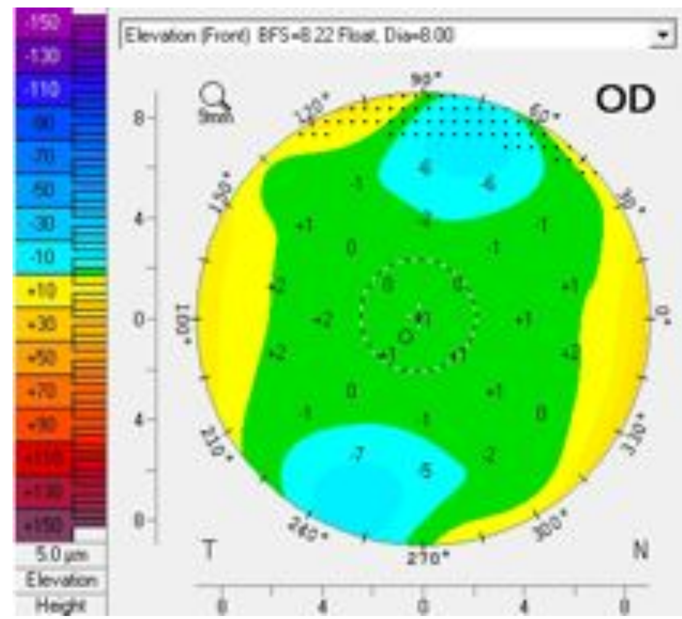




Example of Agreement Cassini – Pentacam HR

- 52 y.o. male pre-cataract patient
- Elevation, anterior cornea





Cassini: Keratometric Repeatability in Keratoconic, Collagen cross-linked and LASIK- treated Eyes

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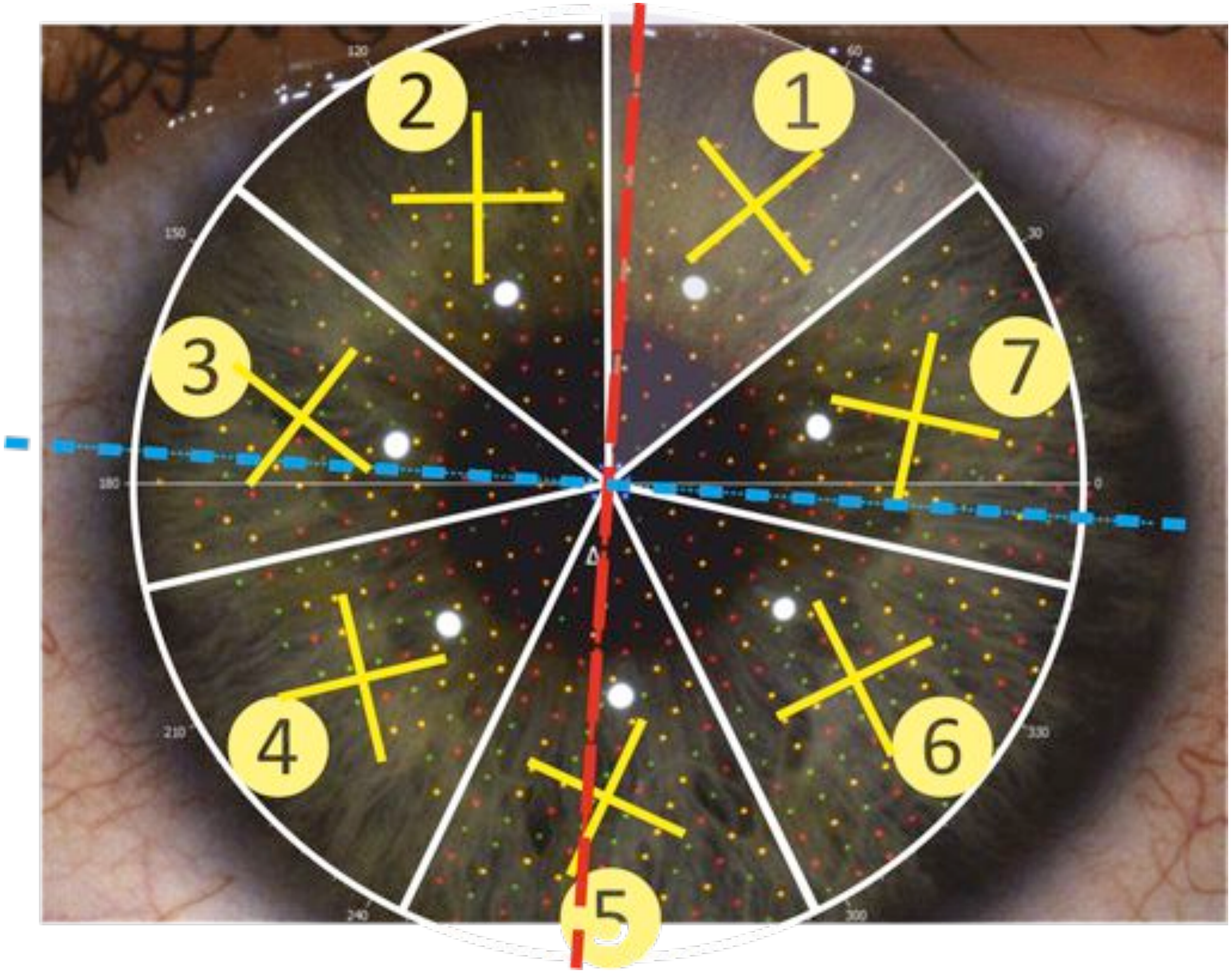


Raw data image as obtained by the Cassini Multicolored-Spot Reflection Topographer. The septima sections are numbered sequentially, along with a cross indicating the prime orientation of the 100 spots within the section. The red dashed line indicates the steep axis; the blue dotted line the flat axis.

Methods-2

The study group (n =374 different eyes)

- **Group-A (nA= 51 different eyes**) were myopic LASIK-treated eyes,
- **Group-B (nB= 95)** untreated keratoconic eyes,
- **Group-C (nC= 47)** eyes treated with partial anterior-surface topography-guided excimer ablation and same-session high-fluence collagen cross-linking, in a procedure known as the ‘Athens Protocol’.[15]
- **control (normal) Group-D** (nD= 280)

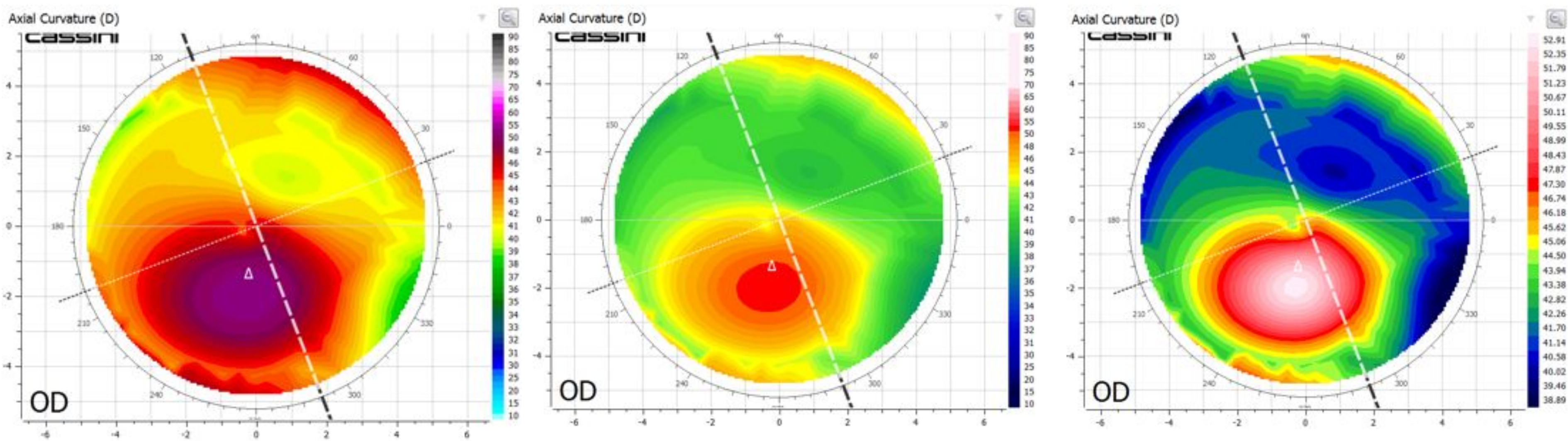
Results-1

- Flat keratometry repeatability was 0.74±0.89 (0.03 to 5.26) D in the LASIK group-A, 0.88±1.45 (0.00 to 7.84) D in the keratoconic group-B, and 0.71±0.94 (0.02 to 6.23) D in the Athens Protocol group-C. The control group-D had flat keratometry repeatability 0.36±0.46 (0.00 to 2.71) D. Steep keratometry repeatability was 0.64±0.82 (0.01 to 4.81) D in the LASIK group- A, 0.89±1.22 (0.02 to 7.85) D in the keratoconic group-B, and 0.93±1.12 (0.04 to 5.93) D in the Athens Protocol group-C.

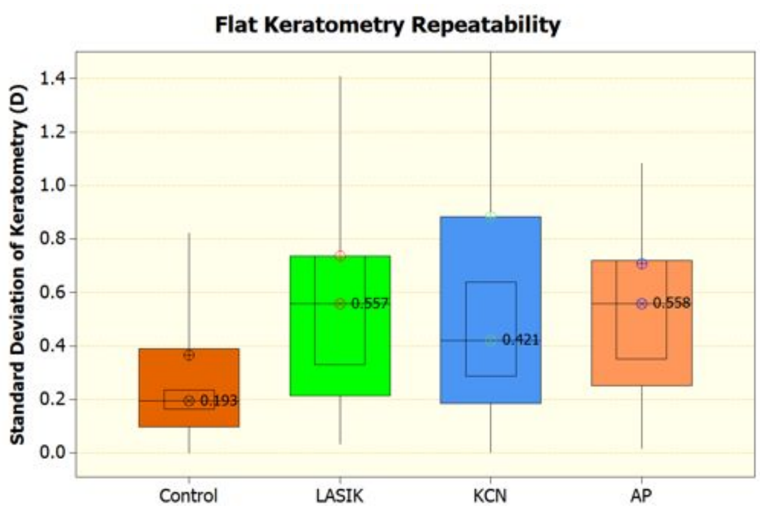
Results-2

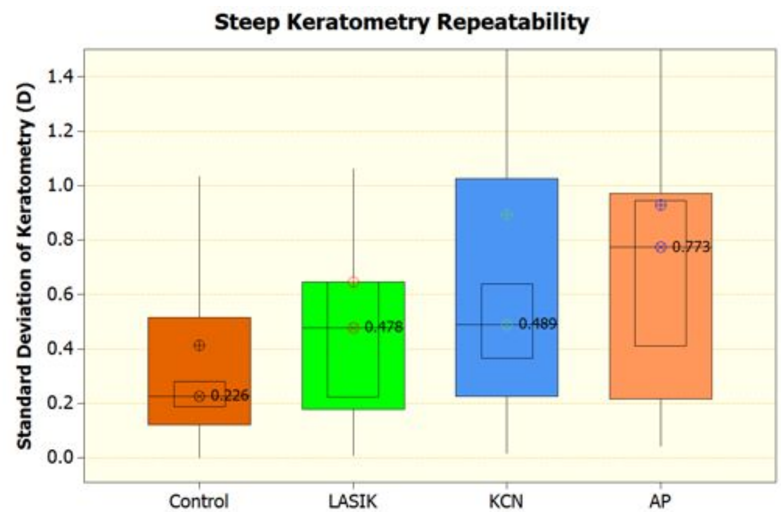
- The control group-D had steep keratometry repeatability 0.41±0.50 (0.00 to 3.51) D. Axis repeatability was 3.45±1.62 (0.38 to 7.78)° for the LASIK group-A, 4.12±3.17 (0.02 to 12.13)° for the keratoconic group-B, and 3.20±1.99 (0.17 to 8.61)° for the Athens Protocol group-C. The control group-D had axis repeatability 2.16±1.39 (0.05 to 5.86)°.

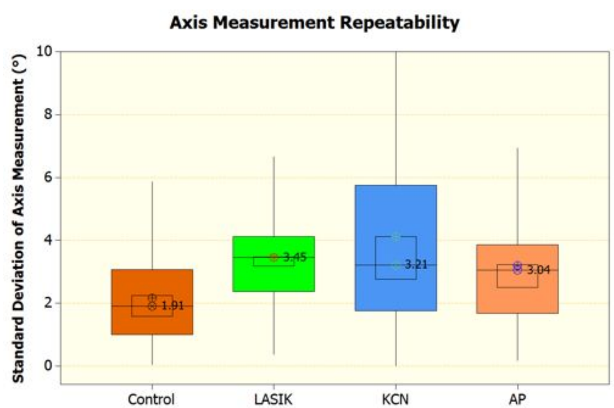
Axial curvature maps. In this example from the keratoconic group-C, the same axial map is illustrated in three different color scales, according to (a) the Oculus, (b) the KlyceUSS, and (C) the Normalized ISO19980 (Normalized) color scale.



Box plots illustrating steep and flat keratometry and axis measurement repeatability. Group-A, LASIK, group-B, Keratoconus (KCN), group-C Athens Protocol (AP), and control group-D. Numerical indicators correspond to median values.







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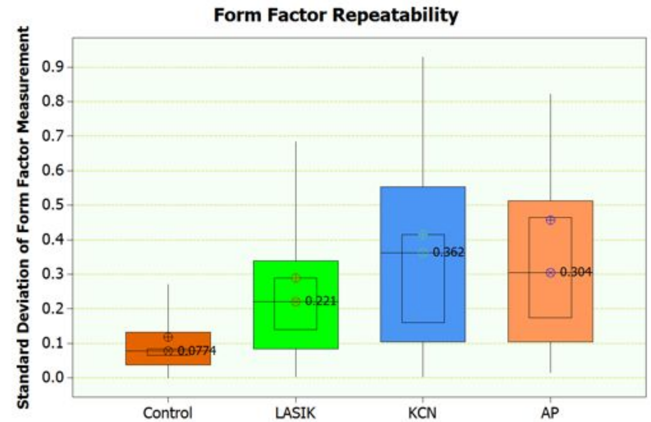
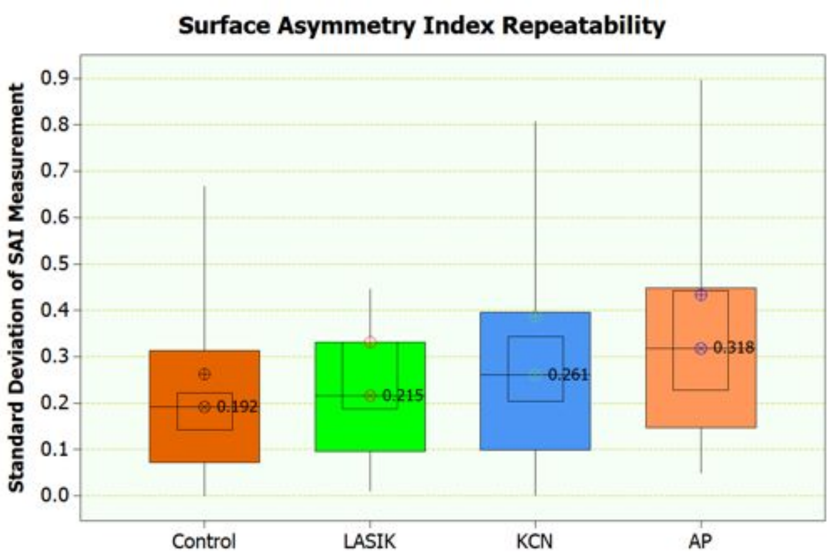
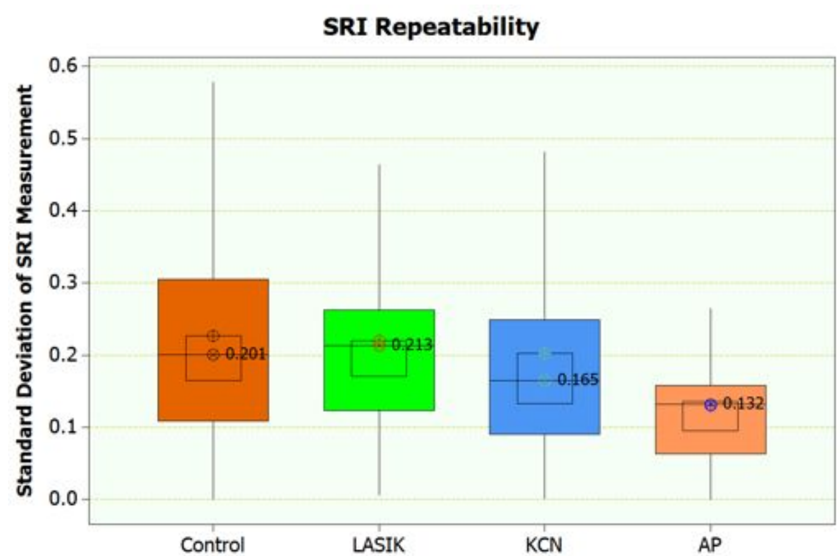
Box plots illustrating form factor, surface asymmetry index (SAI) and surface regularity index (SRI) measurement repeatability. Group-A, LASIK, group-B, Keratoconus (KCN), group-C Athens Protocol (AP), and control group-D. Numerical indicators correspond to median values.

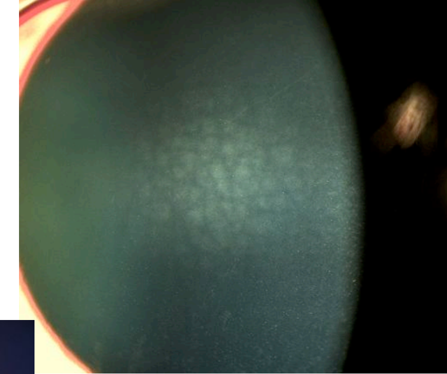


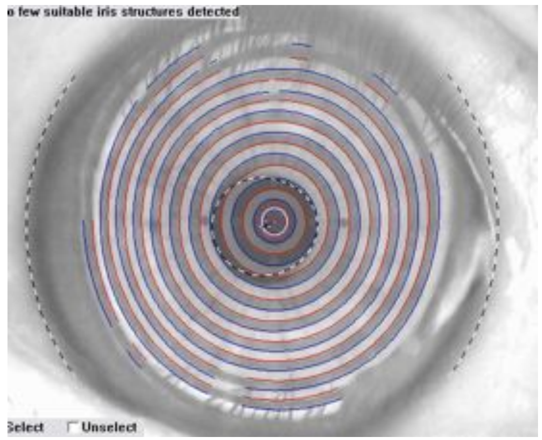


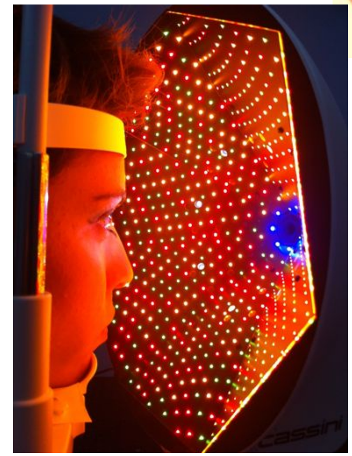


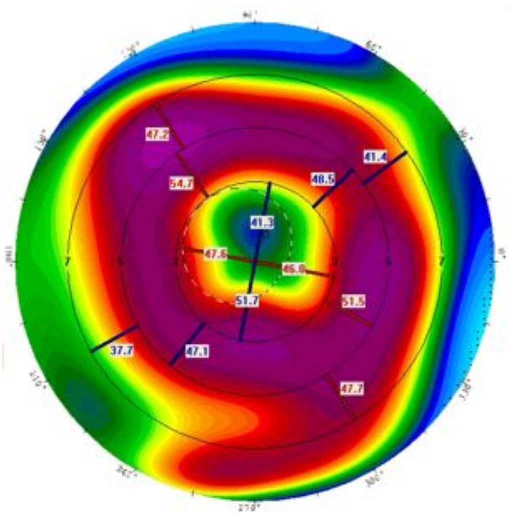
A simple case of Central Cloudy dystrophy (Francois) illustrates the possible discrepancy between different imaging modalities

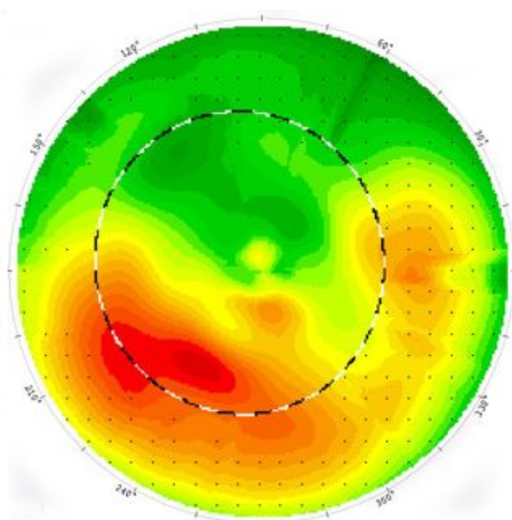
Kanellopoulos AJ, Asimellis G CRO 2013

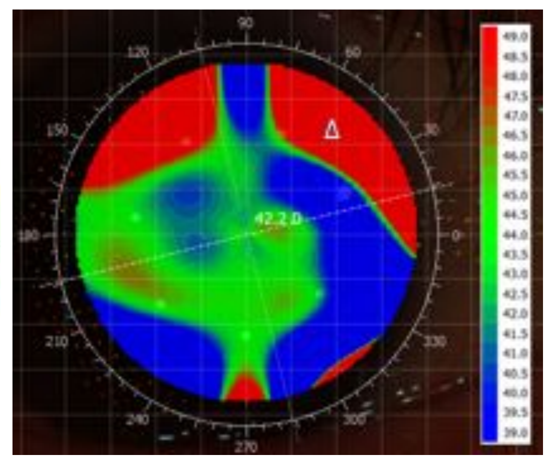












Conclusions

- The Cassini demonstrates very high specificity in estimating anterior and recently also total corneal keratometry and specific corneal irregularity indices even in highly irregular, challenging corneas such as LASIK-treated, keratoconic, and KCN post CXL.
- Keratometry repeatability was **under 0.6D** and **axis repeatability was under 3°** when employing the new topography device. High specificity and repeatability is an indicator of suitable application in clinical screening and postoperative evaluation.

cassini by i-Optics

Specifications

True Axis

- Axis repeatability within 3 degrees
- Multicolor LED Ray-Tracing combined with 2nd Purkinje Imaging Technology

True Magnitude

- Diopter range 4.00D – 171.00D
- Display K-values per zone 3 / 5 / 7 / 9 mm

True Capture

- Instantaneous Auto Capturing
- Measurement Quality Factor parameter
- Auto photophic detection
- Topographic indices: Shape factor), eccentricity, Asphericity), form factor
- Keratoconus indices: Surface Asymmetry Index,
- Surface Regularity Index

True Accuracy

- Submicron accuracy due to color LED triangulation technology <0,8 μ m

True Technology

- Pupillometry programs - mesopic & photopic
- HD External Ocular Photography
- Topographic maps: Axial, Refractive, Tangential, Elevation, Recorded Image and High Order Aberrations
- Multiple color scale options
- Incorporated Patient management program
- Connectivity: Femto secondlasers, Guidance systems, Toric IOL calculators, USB, Direct print, PDF, JPG, PNG, Excel

Thank you