

Controlling Cyclodeviation

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Treatment of Astigmatism

- Treatment of astigmatism can be frustrating , mostly if **elevated**
- Residual error may be present despite all efforts
- Residual axis may be disturbingly **different** from preoperative axis
- Custom ablation... has solved the problem only **partially**

Pre-Custom

Up to 2001

Materials & Methods

- **NIDEK EC 5000**
- **PRK - LASEK**
- **Amoil's brush-Asico LASEK set**
- **Cross-Cylinder Technique**

Materials & Methods

High Power M and CH Astigmatism - Preoperative

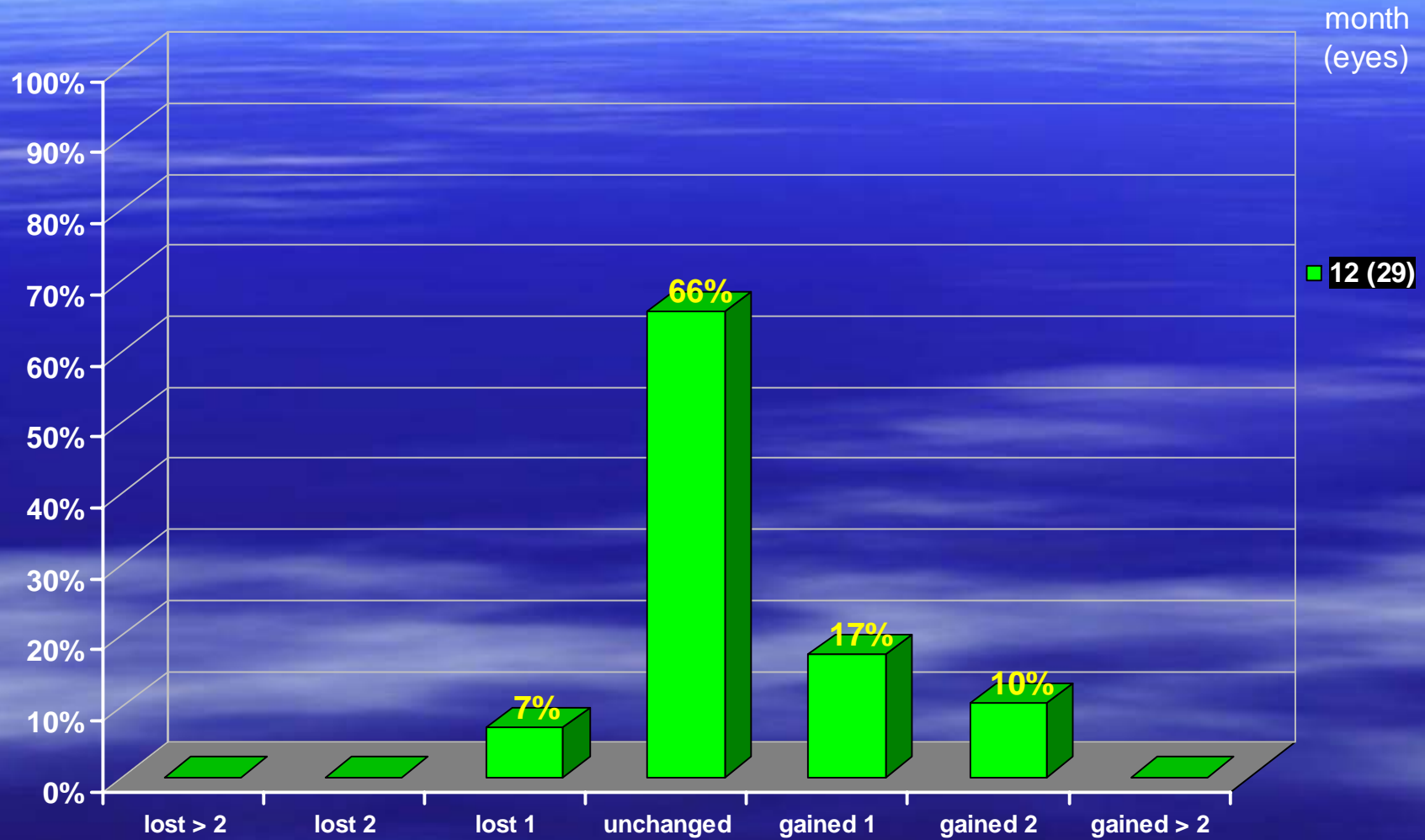
- 29 eyes of 20 patients
- VA 0.84 ± 0.15
- Sph 1.73 ± 1.25 D
- Cyl -3.20 ± 0.90 D
- Axis $37.9^\circ \pm 60.0^\circ$
- SE 0.06 ± 1.25 D

Results

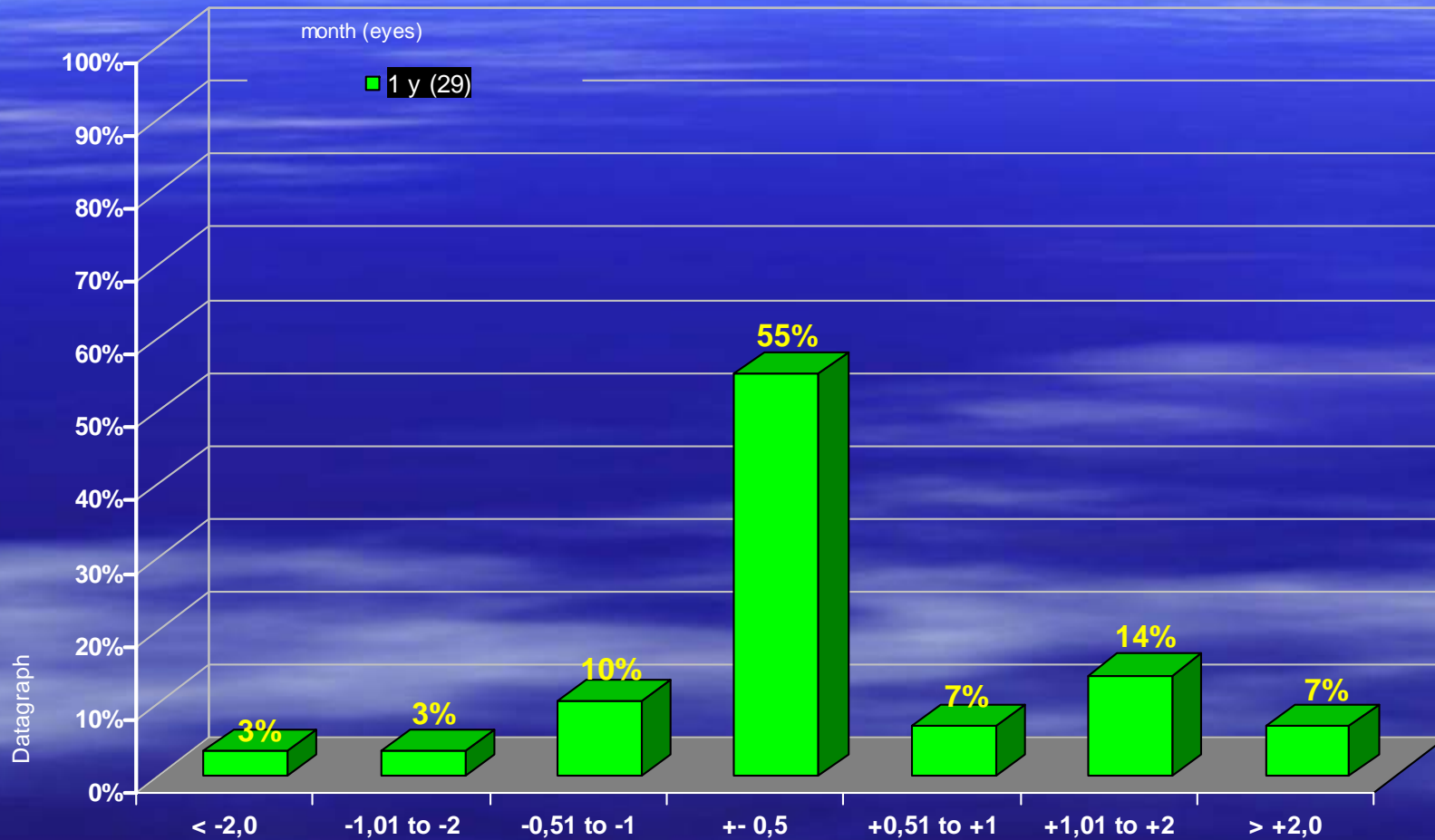
High Power M and CH Astigmatism - Postoperative

- Follow up: 327 ± 196 days
- VA 0.88 ± 0.11
- Sph 1.11 ± 1.52 D
- Cyl -1.55 ± 1.42 D
- Axis $41.3^\circ \pm 63.3^\circ$
- SE 0.34 ± 1.11 D

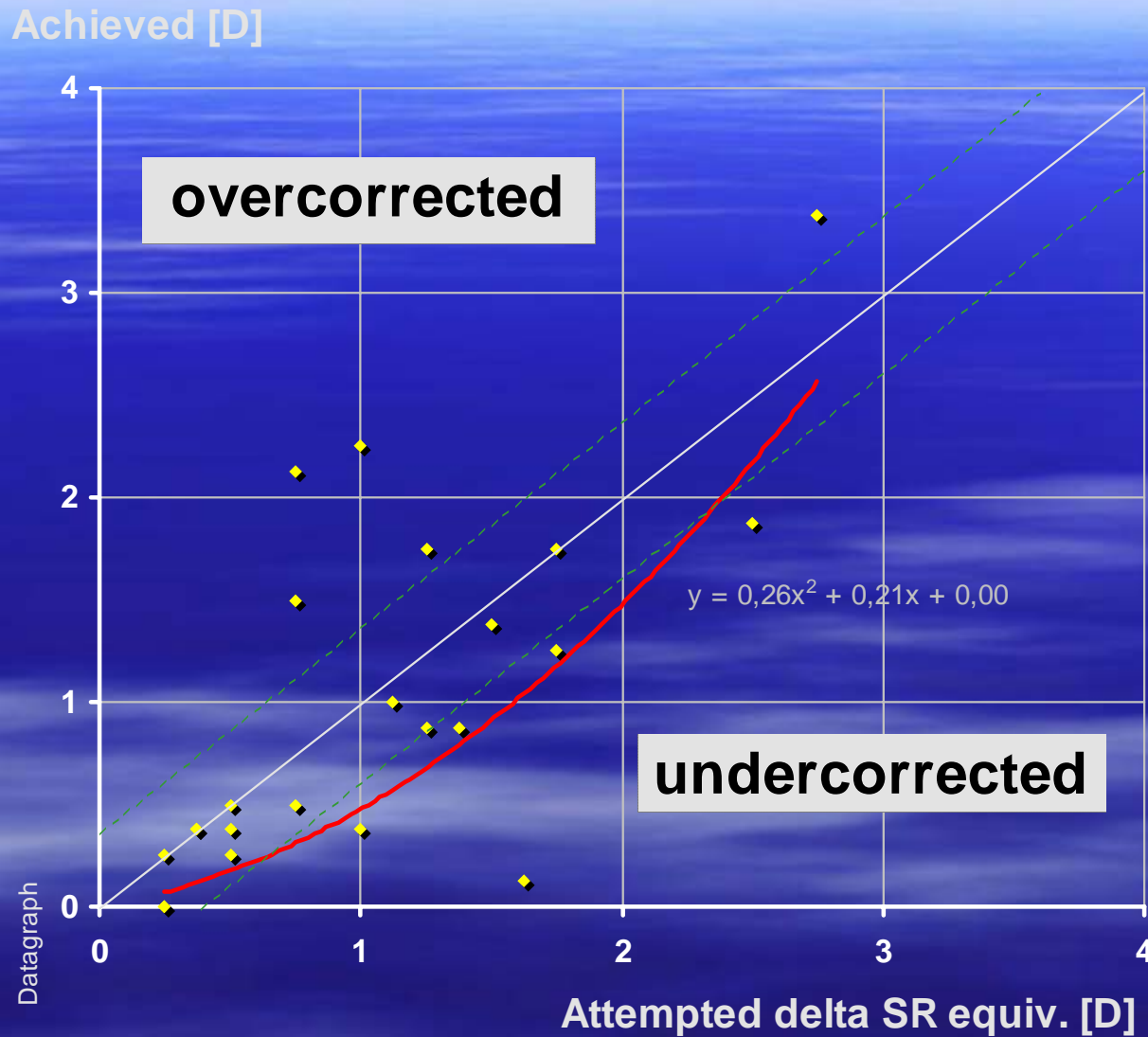
SAFETY: Change in BSCVA - Percent



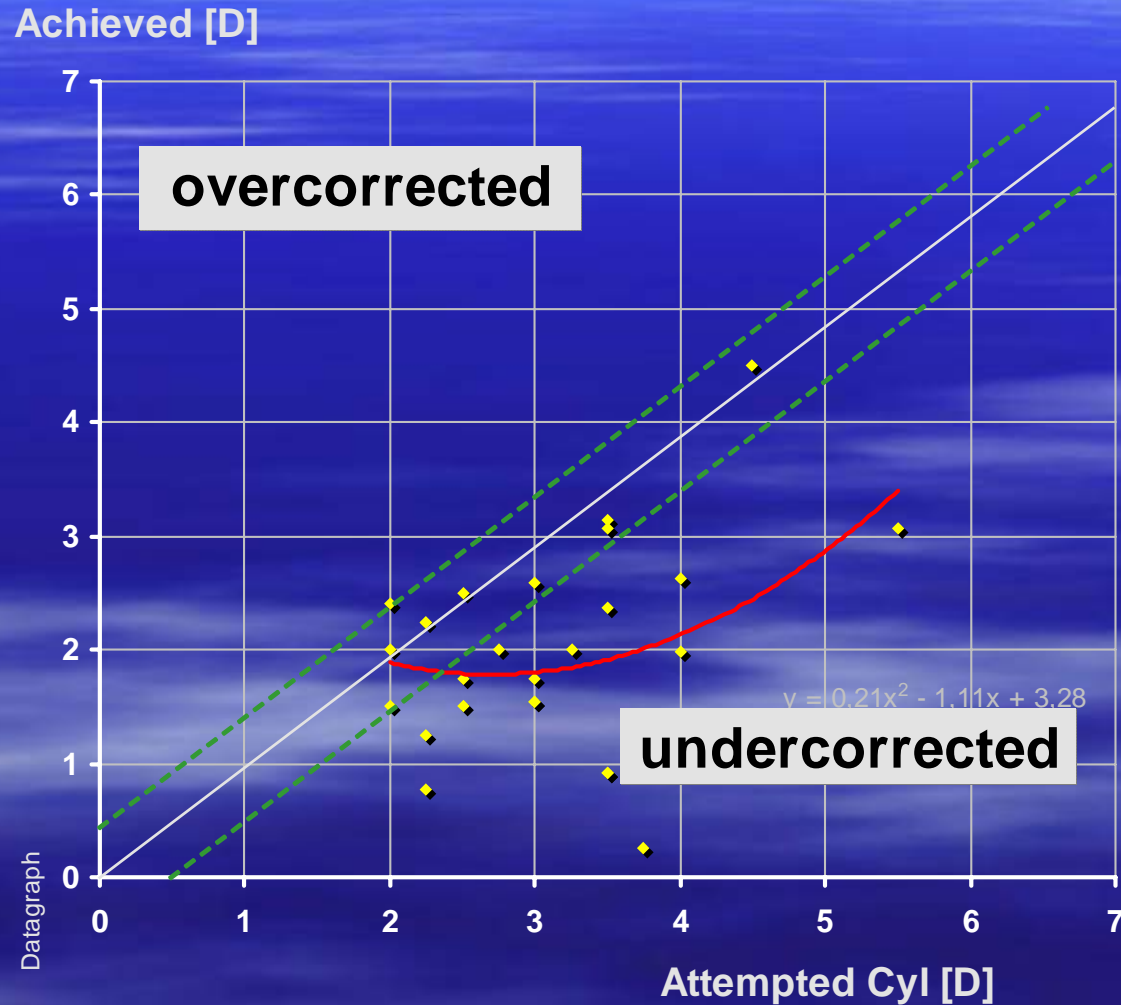
Refractive Outcome: % within Attempted Correction



Attempted vs. Achieved SE



Preop Cyl vs. Achieved Change in Cyl. (based on Vector Analysis)



Conclusions

High Power M and CH Astigmatism

- Multizone Cross-Cylinder is a safe technique
- Reduction: **56%** Sphere and **49%** Cylinder
- Total wavefront error: decreased (astigmatism is the main component)
- Spherical aberration and coma: unchanged

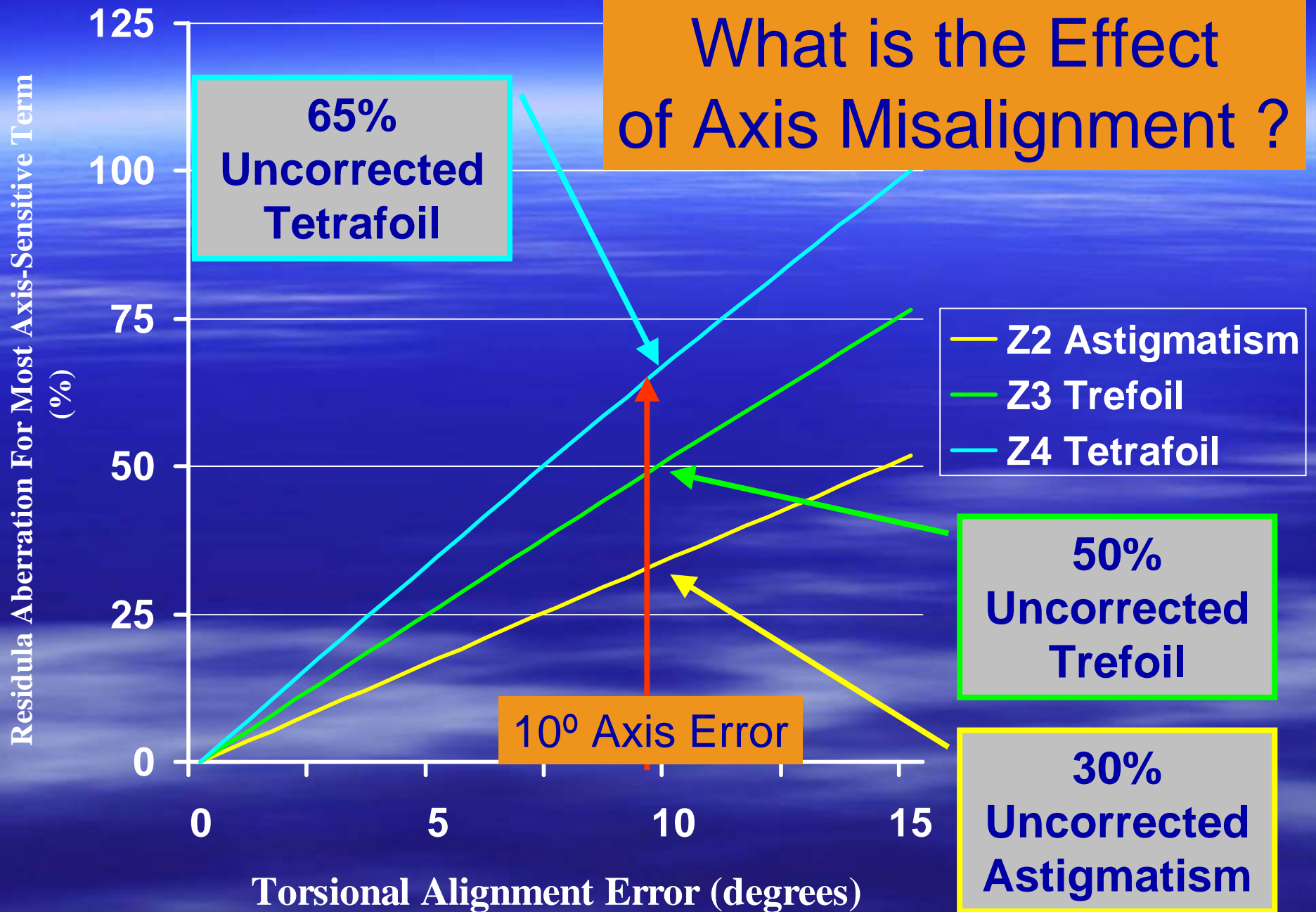
...is that all ?

Axis Alignment

High Power M and CH Astigmatism

- Mean preoperative axis: 37.9 ± 60.0 degrees
- Mean postoperative axis: 41.3 ± 63.3 degrees
- Mean resultant axis of correction: 63.3 ± 64.5 degrees
- Mean axis error: 9.6 ± 14.6 degrees

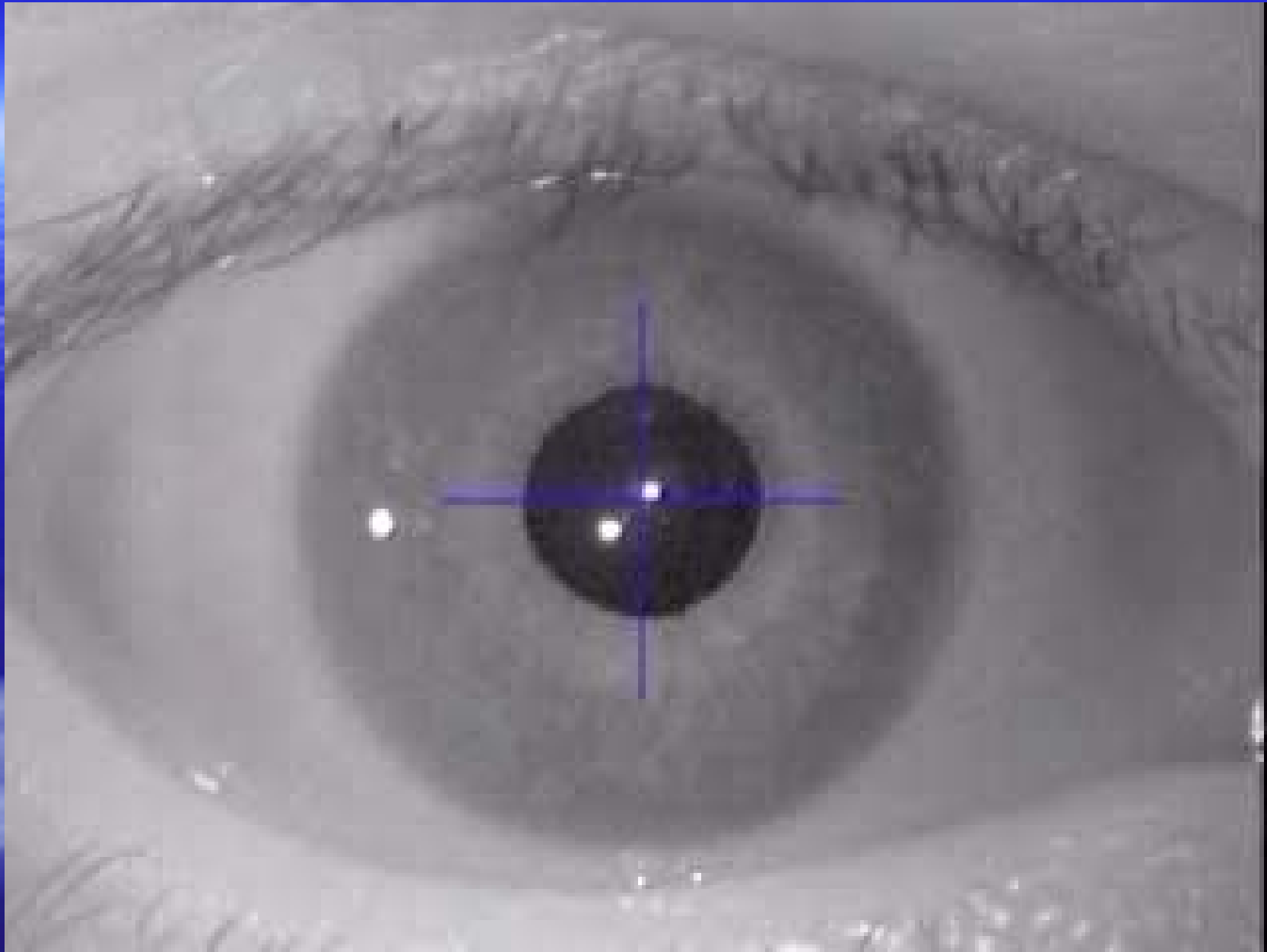
What is the Effect of Axis Misalignment ?



Power - Vectorial Change

Astigmatism

- Mean preoperative cyl: -3.20 ± 0.90 D
- Mean postoperative cyl: -1.55 ± 1.42 D
- Mean cyl power vectorial change :
 -1.98 ± 0.84 D
- Mean **Refractive Error** induced by axis misalignment:
 - 0.92 ± 1.38 D sphere
 - -1.22 ± 1.06 D cylinder



Dott. Fabrizio Camesasca

Topics in Ophthalmology

Cyclotorsion

- Extensive cyclotorsional movement is a clinical reality
- Cyclotorsional can result in significant optical errors
- Compensation with **automated cyclotorsional tracking** is necessary to optimize the benefits of wavefront-driven ablations

(McDonald MB, AAO

Refractive Surgery Subspecialty Day, 2003)

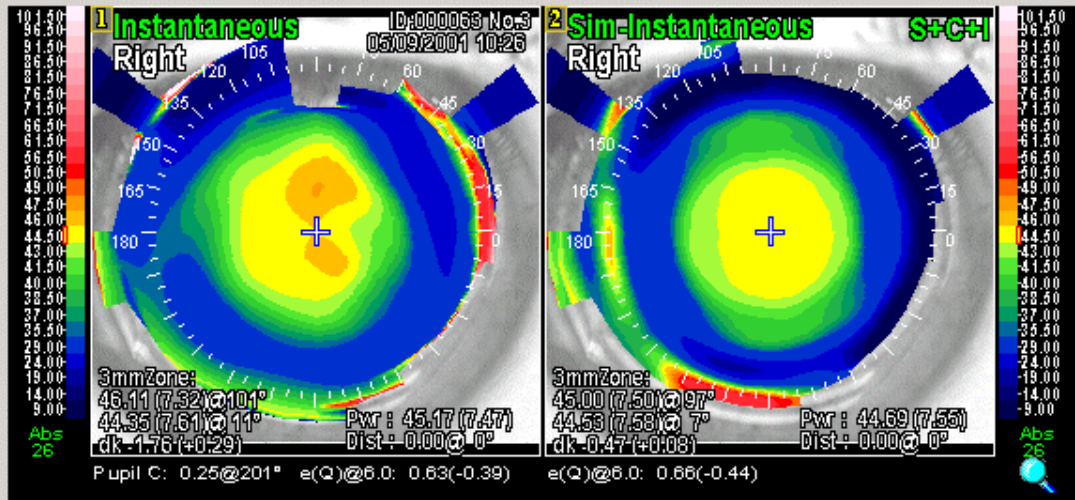
Effects of Ocular Cyclotorsion during Ablation

- Cyl
 - Undercorrection
 - Different postop. axis
- Sphere
 - Negative Cyl: induces + sphere
 - Positive Cyl: induces - sphere
- HO Aberrations
 - Undercorrection
 - Increases HO aberrations (mostly coma)

No Axis Error

PreOp.

Target



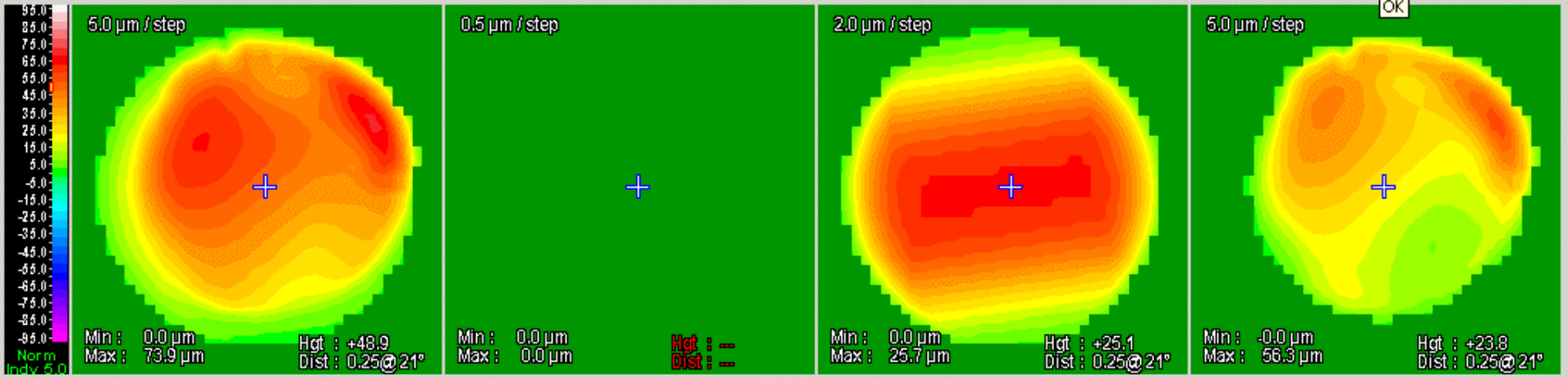
Sph. (None)
 Flat Nomogram ID (None)
 Cyl.
 Steep
 Irr.
 Manifest Ref. Sph. Cyl. Axis
 Object Ref. Sph. Cyl. Axis
 Attempt Correction Sph. Cyl. Axis
 Laser Settings Sph. Cyl. Axis
 VD mm
 CYL +/- Apply OK Cancel

Total Ablation

Sphere Ablation

Cylinder Ablation

Irregular Ablation



Ablation Rate (W) : 0.660 μm
 (S) : 0.660 μm

	Total	SPH	CYL	Irregularity
CATz	73.9	0.0	25.7	-0.0~+56.3
Spherical	21.1	0.0	21.1	-----

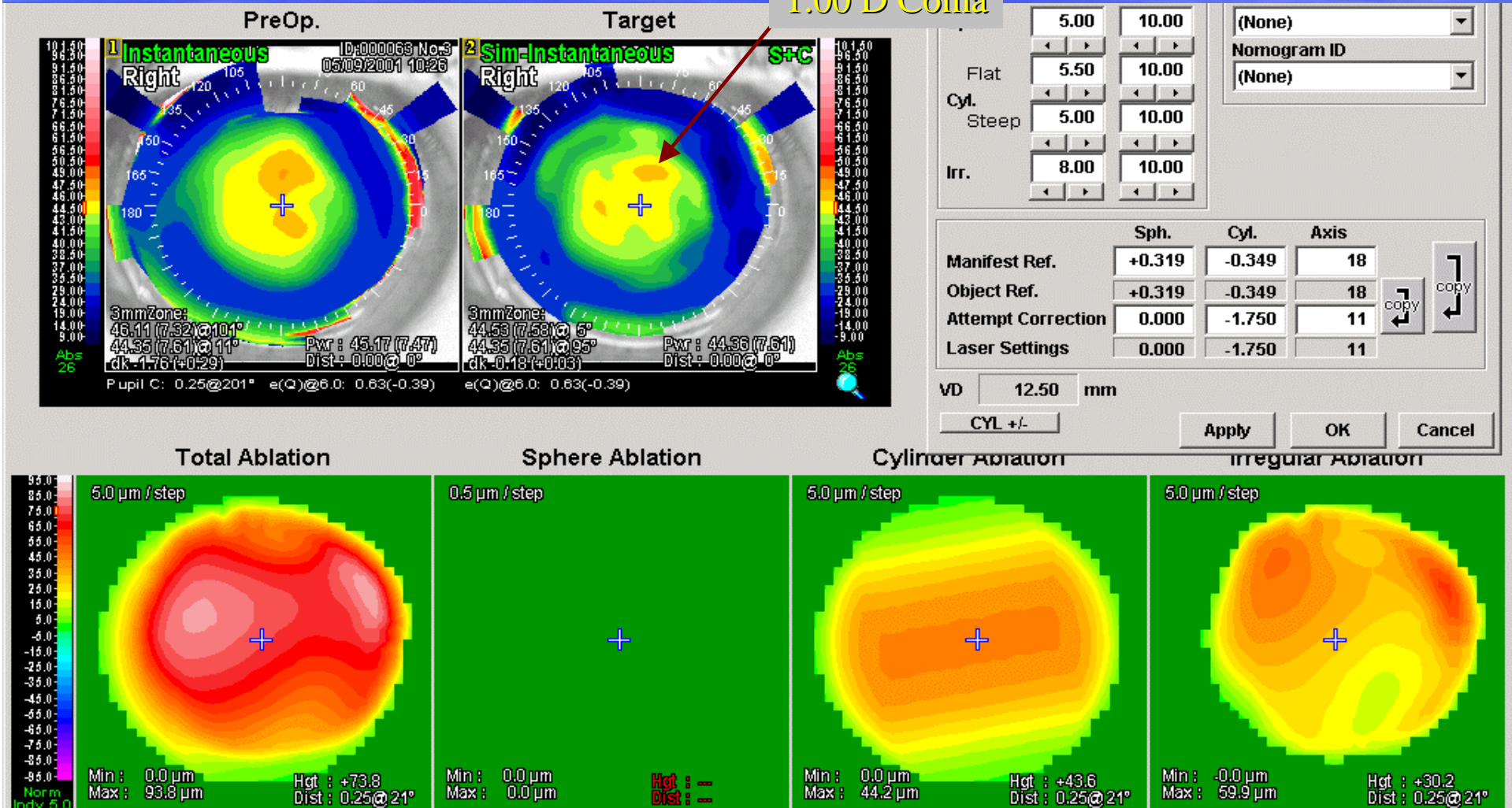
[μm]



3° Axis Error !

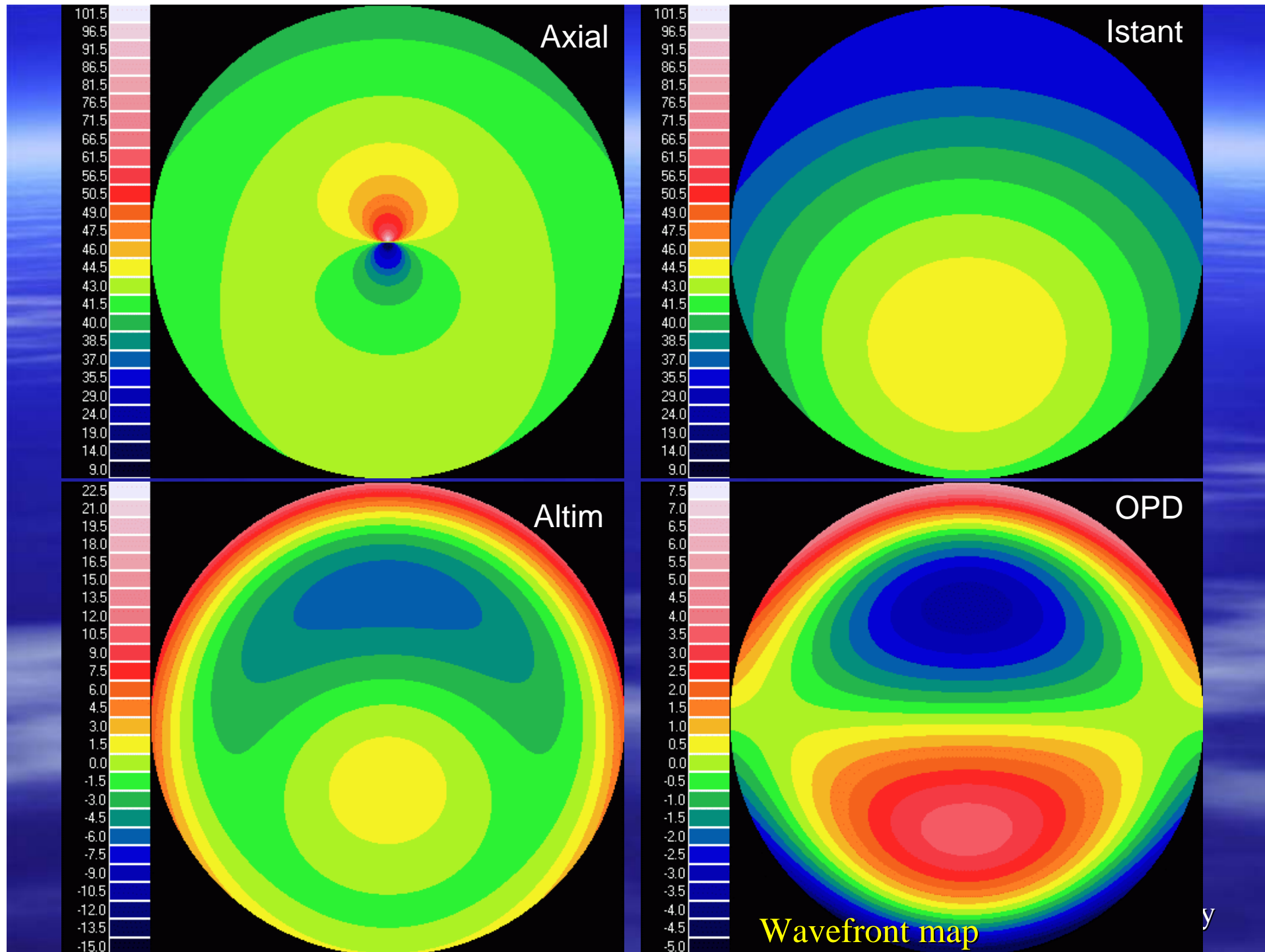
Inducing High Order Aberrations

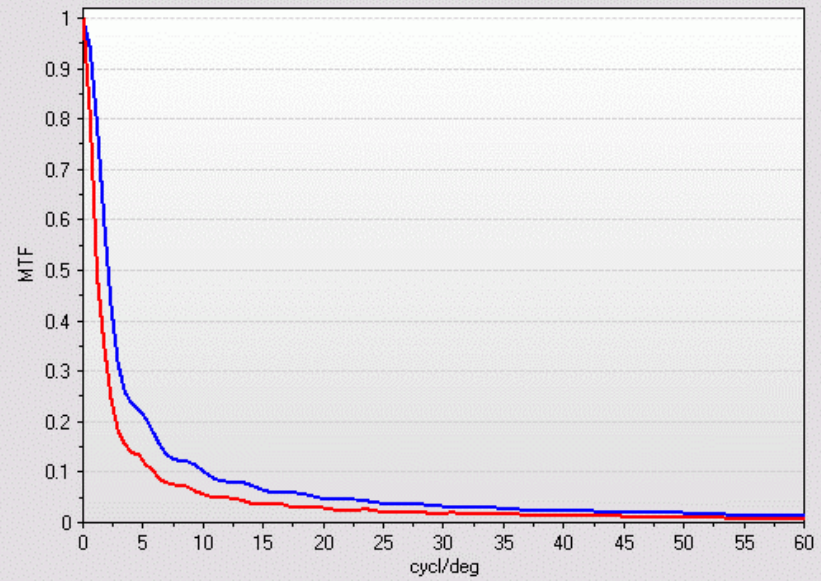
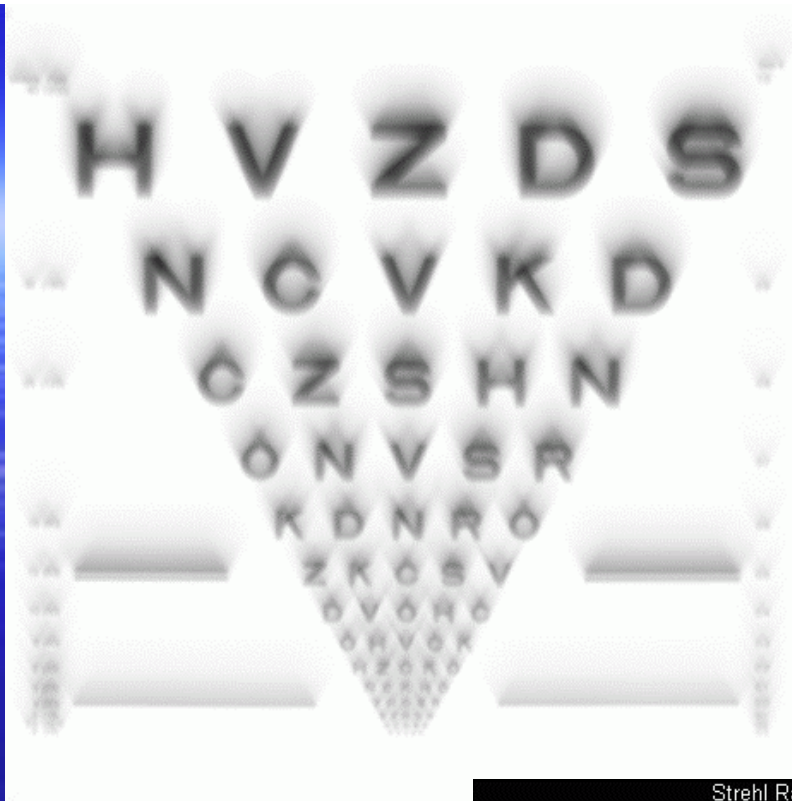
1.00 D Coma



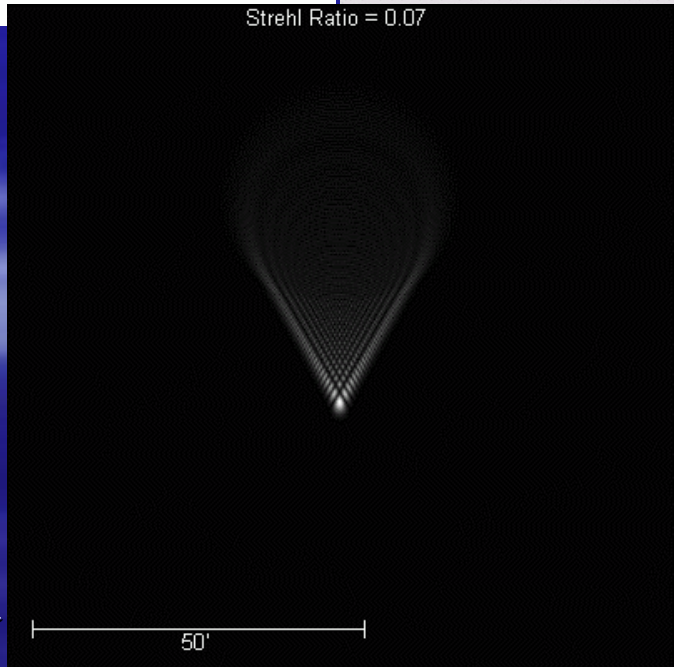
Compromising Custom Ablation Goal

- HO aberrations less tolerated than residual refractive error
- HO aberrations can not be corrected with spectacles



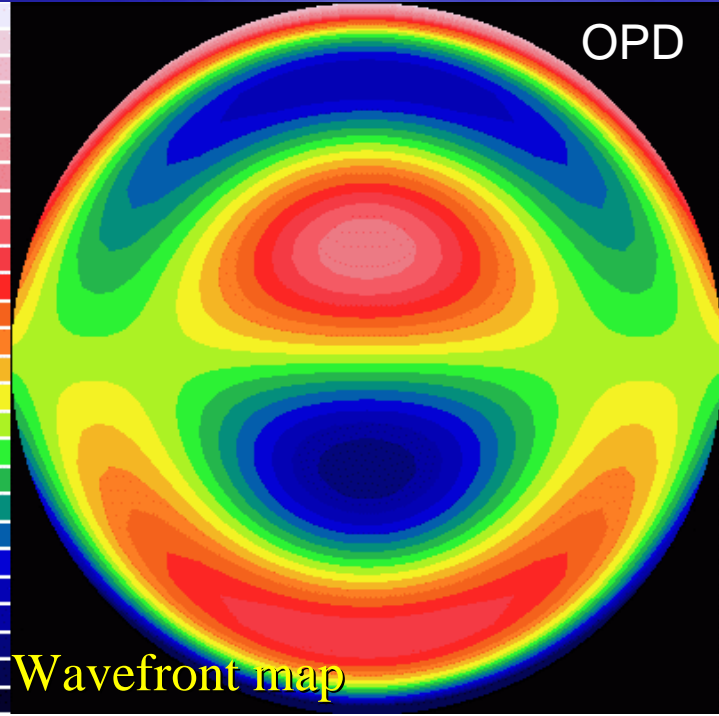
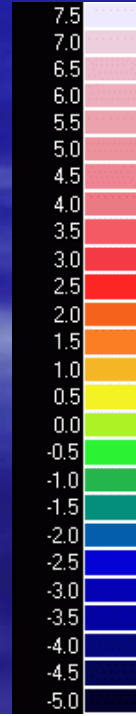
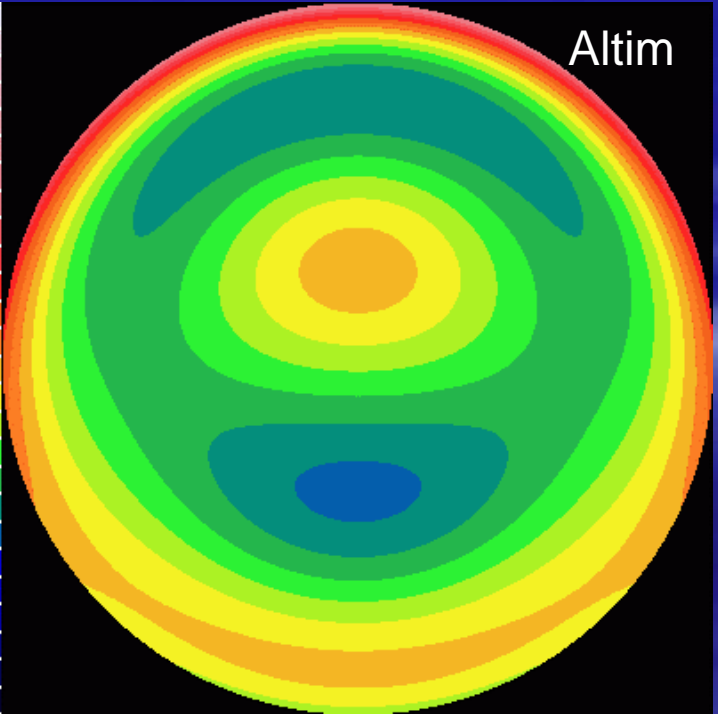
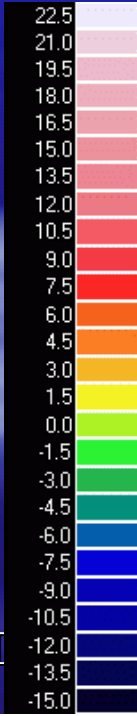
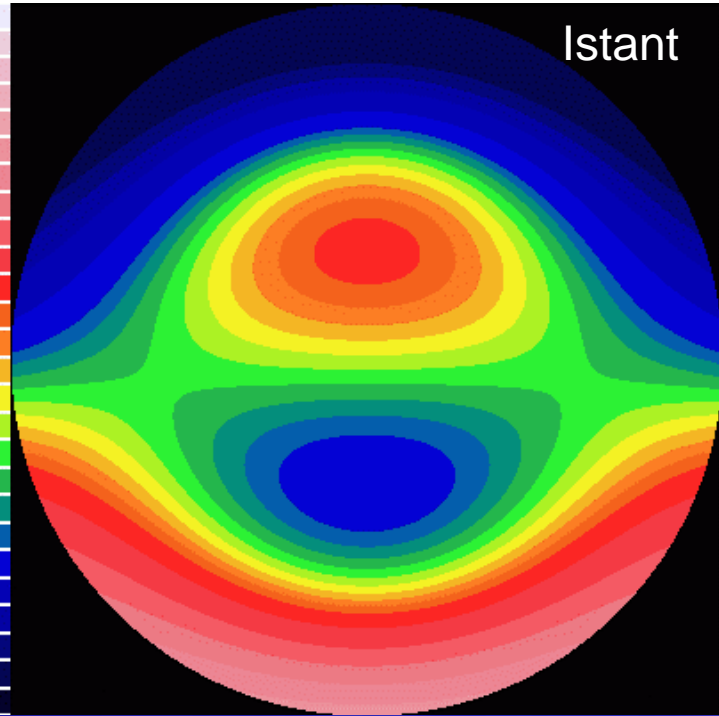
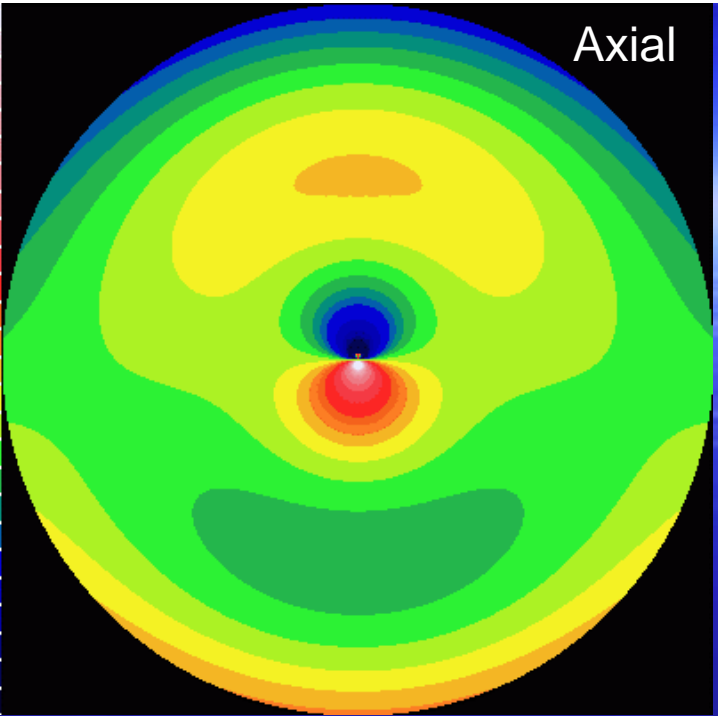
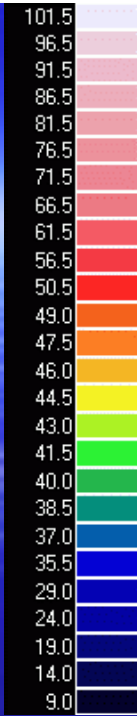


Strehl Ratio = 0.07



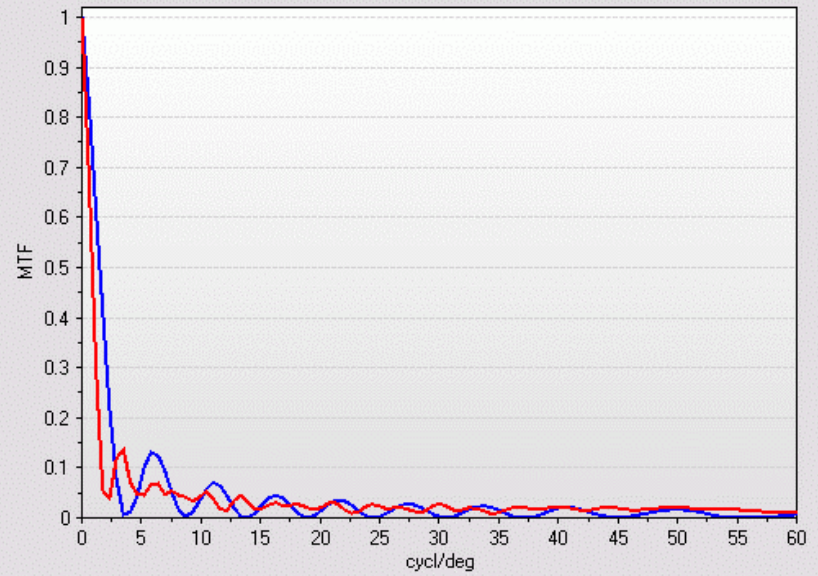
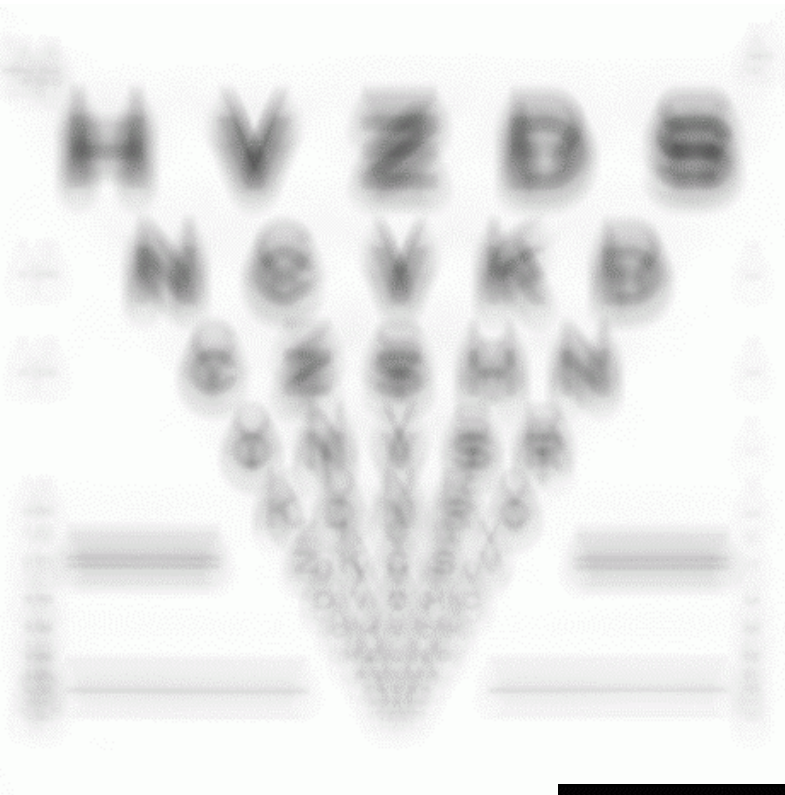
Coma

1st order

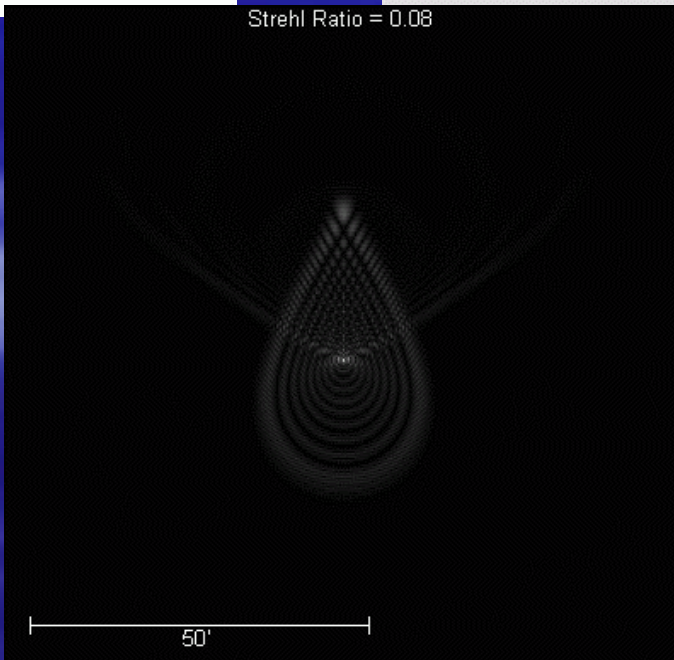


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Wavefront map



Strehl Ratio = 0.08



Coma

2nd order

Custom Ablation,
no Torsion Error
Detector
2001 - 2002

Materials & Methods

- OPD scan
- NIDEK EC 5000
- Final Fit + CATz
- Eye tracker
- LASEK
- Amoil's brush-Asico LASEK set

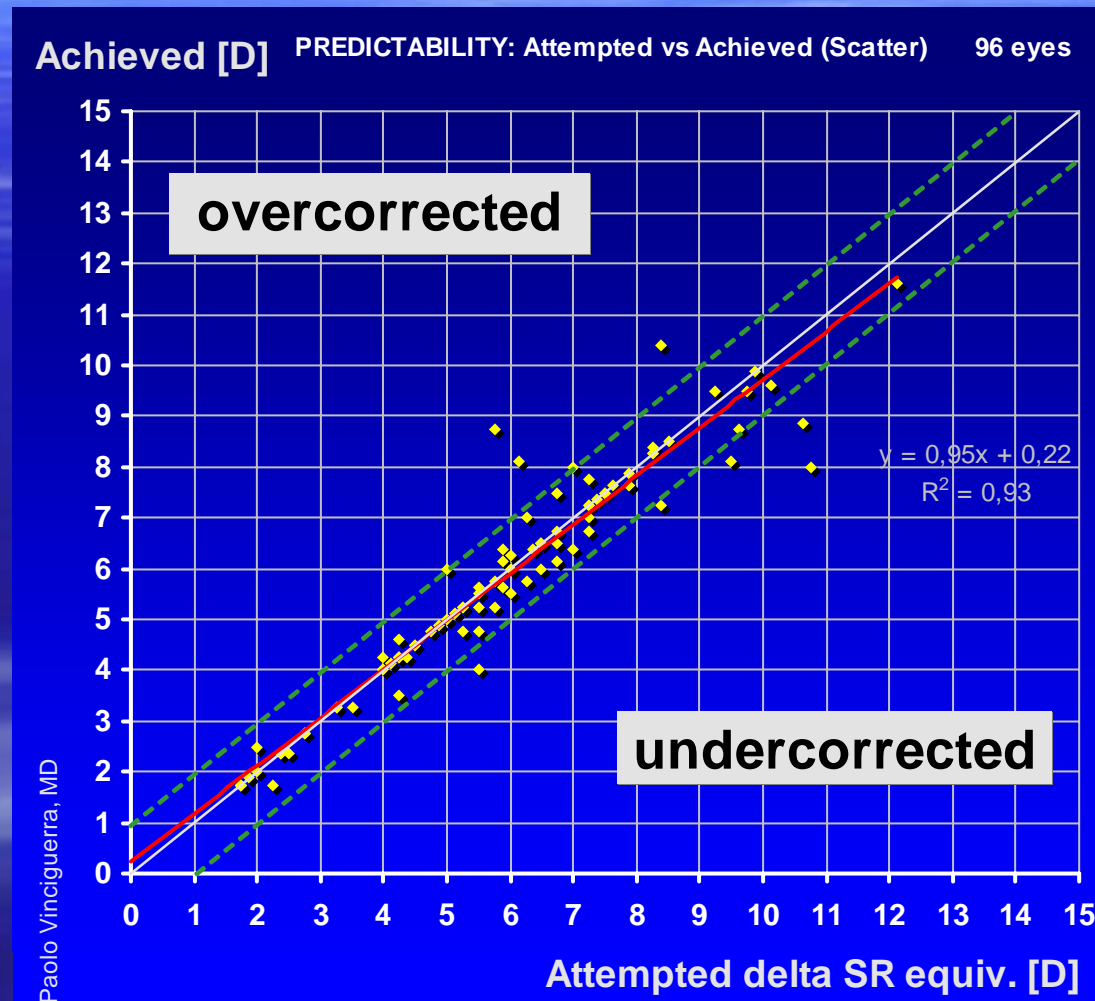
Materials & Methods

Custom Ablation, no Torsion Error Detector

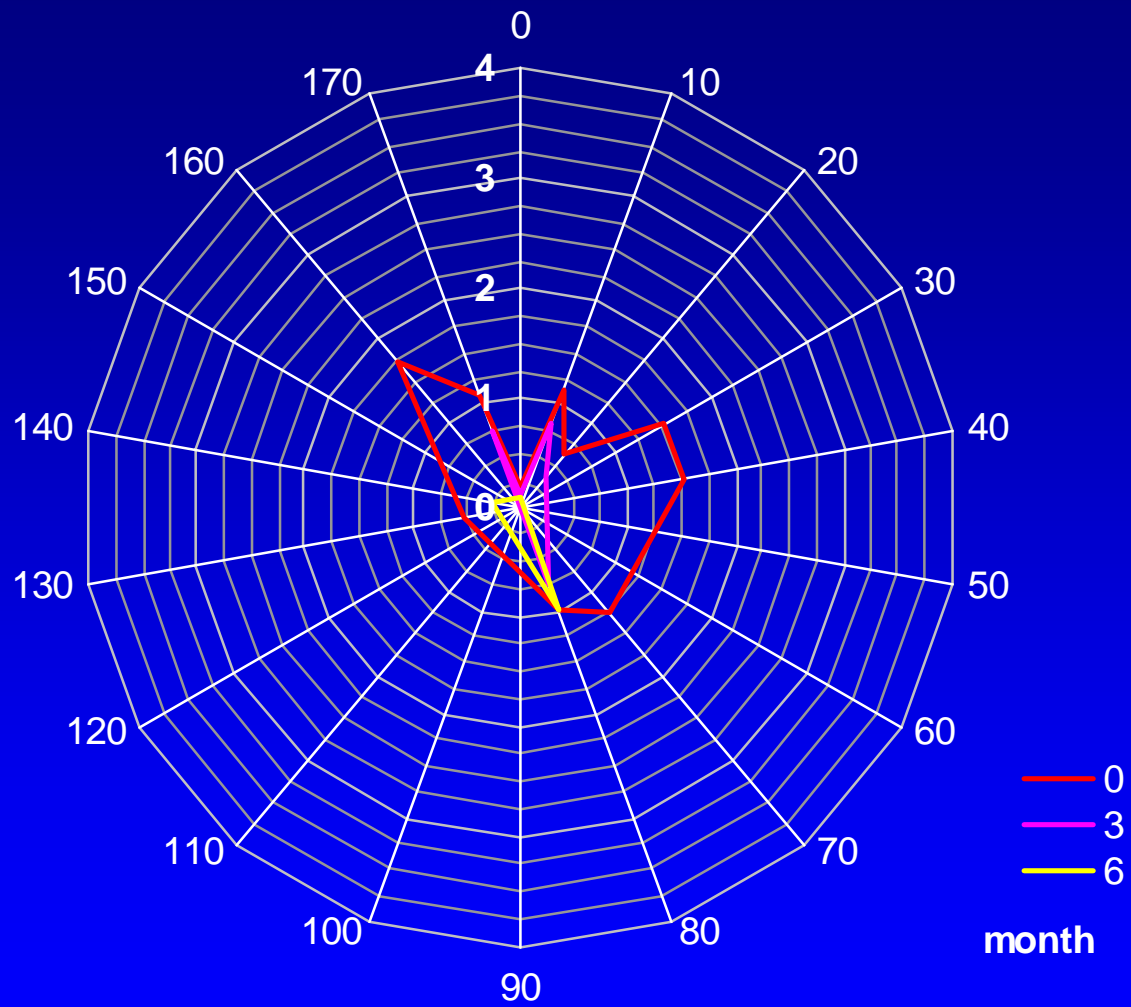
125 eyes

- Mean age: 34 years (range: 20 to 53 yrs)
- Mean \pm SD sph.: -5.12 D \pm 2.54 D (-12.75 to 2.00)
- Mean \pm SD cyl: -0.94 D \pm 0.81 D (-4.50 to 0.00)
- Mean \pm SD SE: -5.59 D \pm 2.54 D (-13.63 to 2.00)

Attempted vs. Achieved SE



Double Angle Average Cyl



Custom Ablation, Torsion Error Detector

2002 - 2006

Materials & Methods

68 eyes

- Mean age: 36 yrs (range: 22 to 56 yrs)
- OPD scan
- NIDEK EC 5000
- Final Fit + CATz
- Eye tracker
- Torsion Error Detector
- LASEK
- Amoil's brush-Asico LASEK set

Preop. Refraction

(68 eyes)

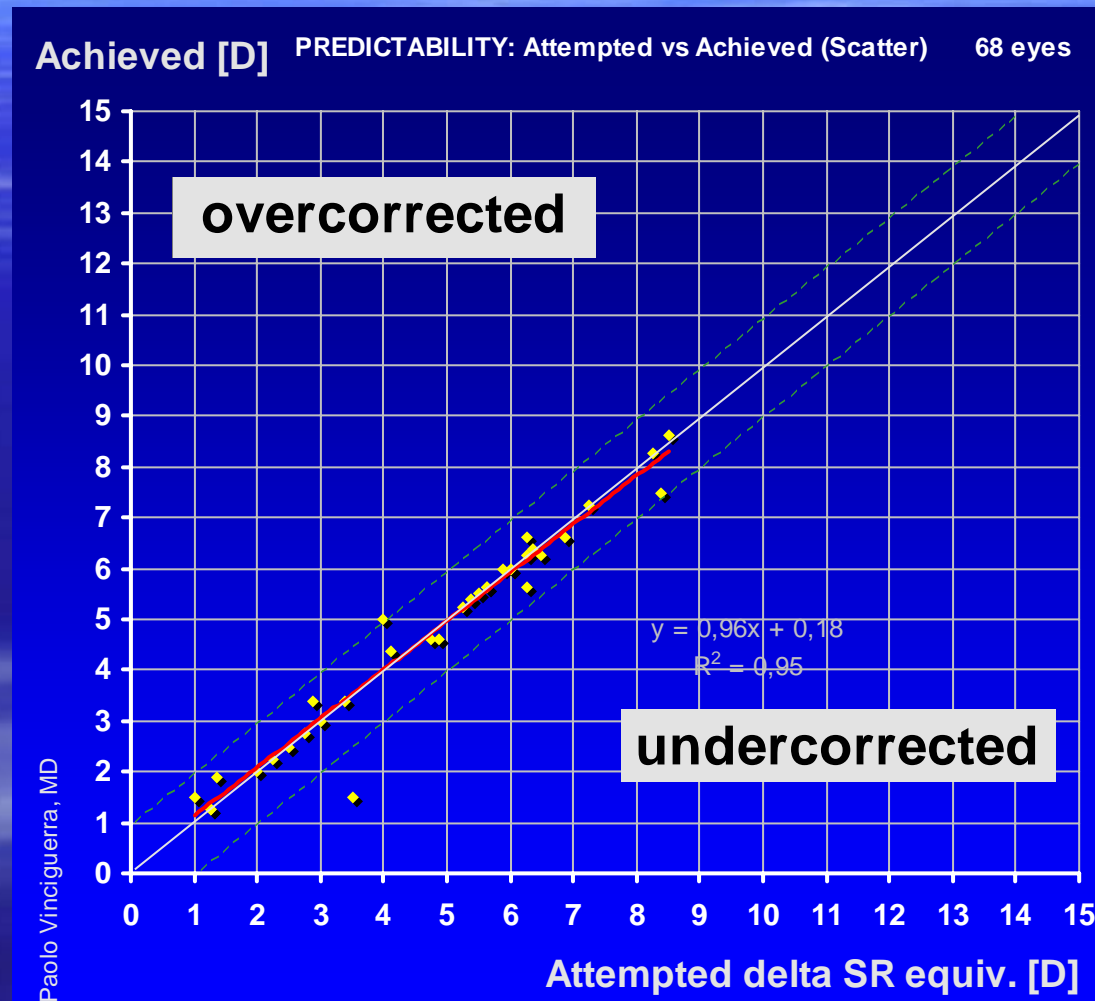
	Sphere	Cyl	SE
mean	-4.51	-0.80	-5.10
S.D.	2.89	0.76	3.11
mode	-6.00	-0.75	-6.25
median	-5.00	-0.75	-6.00
min	-9.00	-5.00	-10.00
max	+3.00	0.00	+4.00

Postoperative Refraction

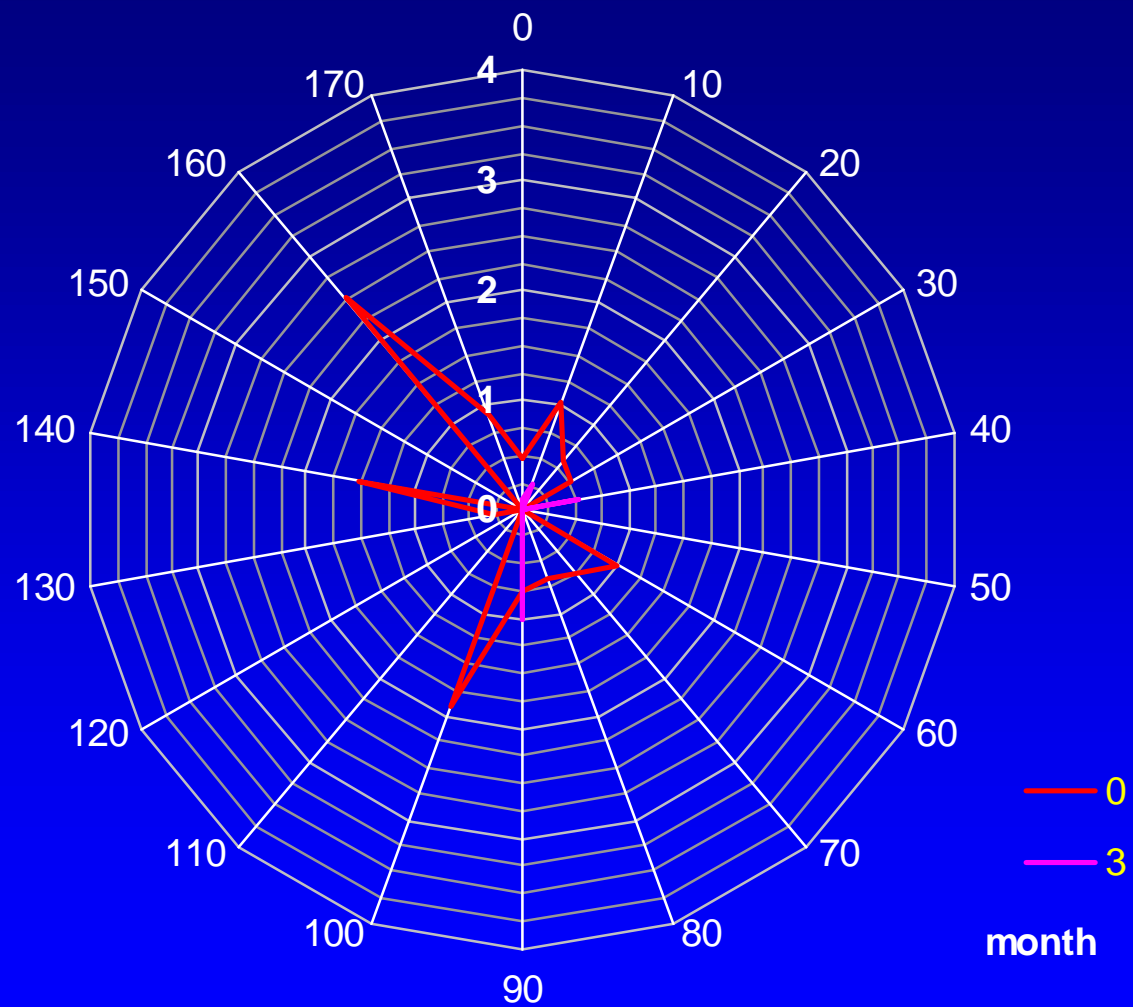
(3 mos)

	Sphere	Cyl	SE
mean	-0.09	-0.18	0.00
S.D.	-0.32	0.35	0.40
mode	0.00	0.00	0.00
median	0.00	0.00	0.00
Min	0.00	-1.00	-1.00
Max	+2.00	0.00	+2.00

Attempted vs. Achieved SE



Double Angle Average Cyl



Axis Rotation

- 24% negative axis rotation (i.e 10° to 5°)
- 76% positive axis rotation (i.e 10° to 15°)
- Mean: 3°
- S.D.: 2.64°
- Min.: 0°, Max.: 10°
- Mode: 3°, Median: 3°

Conclusions

- Custom Ablation applies eccentric focal ablations
- Cyclotorsion causes:
 - Unaccurate positioning of spots
 - Cylinder axis deviation
- Severe induction of aberrations

Conclusions

- Correct axis alignment is mandatory
- Torsion error detector improves safety and results of Custom Ablation

The Future

- NIDEK offset system
- LOS and visual axis difference....



Arrivederci
September, 2007

Refr@ctive.online