Mixed and Compound Hyperopic High Power Astigmatism: Still a Problem ?

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Correction of High Power Astigmatism

Goals

- Good visual acuity
- Reducing cylinder power
- Obtaining the widest possible optical zone
- No increase in aberrations

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High Power Mixed and Compound Hyperopic Astigmatism

- Still the most complex refractive errors to treat
- Several ablation patterns proposed:
  - Steep meridian: myopic cyl ablation + hyperopic sph ablation
    (Dausch D, J Cataract Refract Surg 1994, 20 S)
  - Flat meridian: hyperopic cyl ablation + myopic sph ablation
    (Argento CJ, J Cataract Refract Surg 1997, 23)
  - Cross - Cylinder
    (Vinciguerra P, J Refract Surg 1999, 15)
  - Bitoric ablation (asymmetrical split on two meridians)
    (Chayet AS, Ophthalmology 2001, 108)

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High Power Mixed and Compound Hyperopic Astigmatism

- Azar, in a thorough analysis of different available methods, recommended correction on the hyperopic meridian only, with the advantage of removing less cornea than with any other technique.

(Azar DT, J Cataract Refract Surg 2000, 26)

- However, good visual acuity remains the most important goal
- Astigmatic ablation on one meridian only induces tetrafoil

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Astigmatism

The presently available techniques for the correction of astigmatism are adequate on the steepest meridian, but create <u>overcorrection</u>

on the oblique meridians, that feature a lower preoperative dioptrical power.

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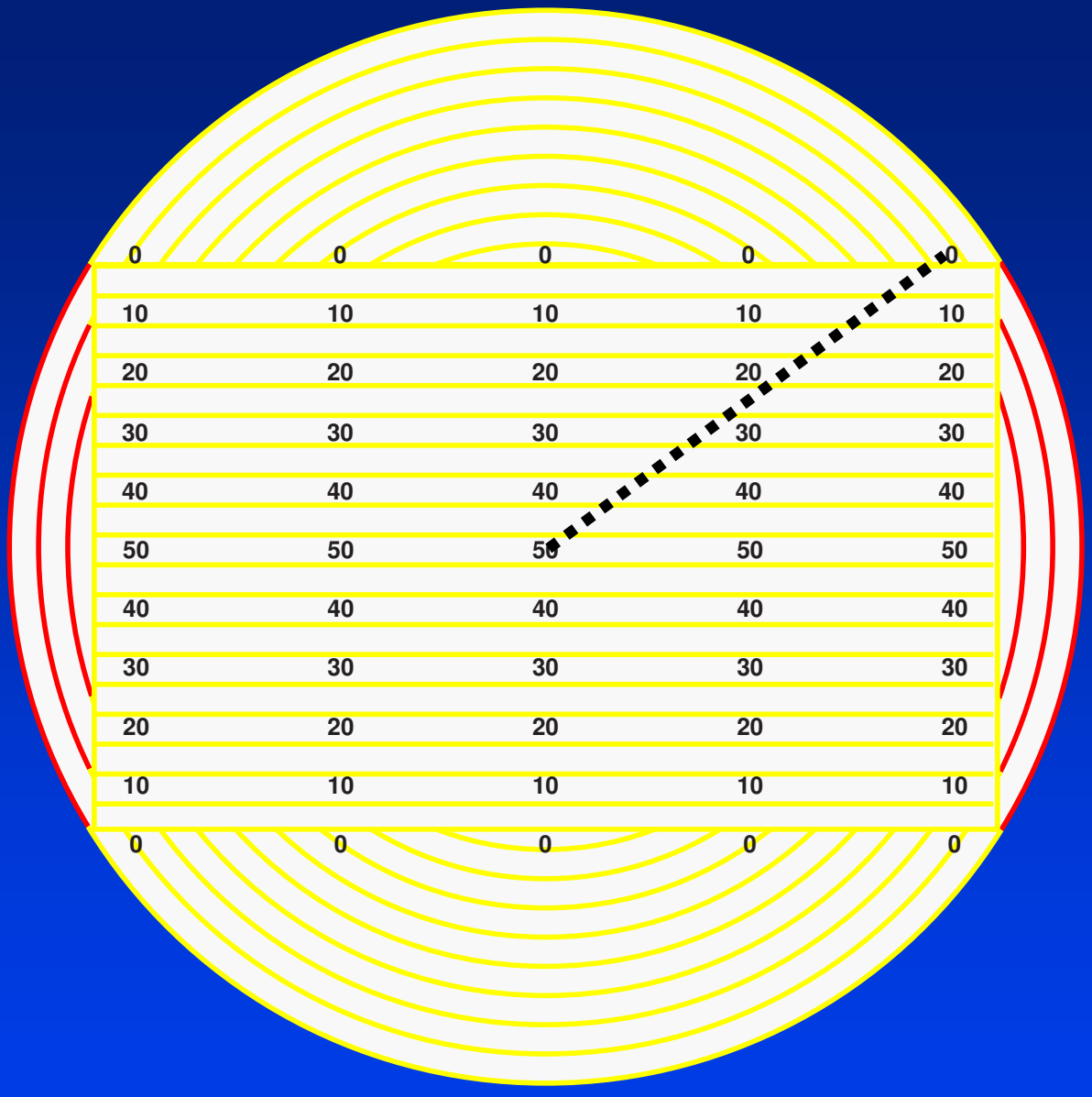

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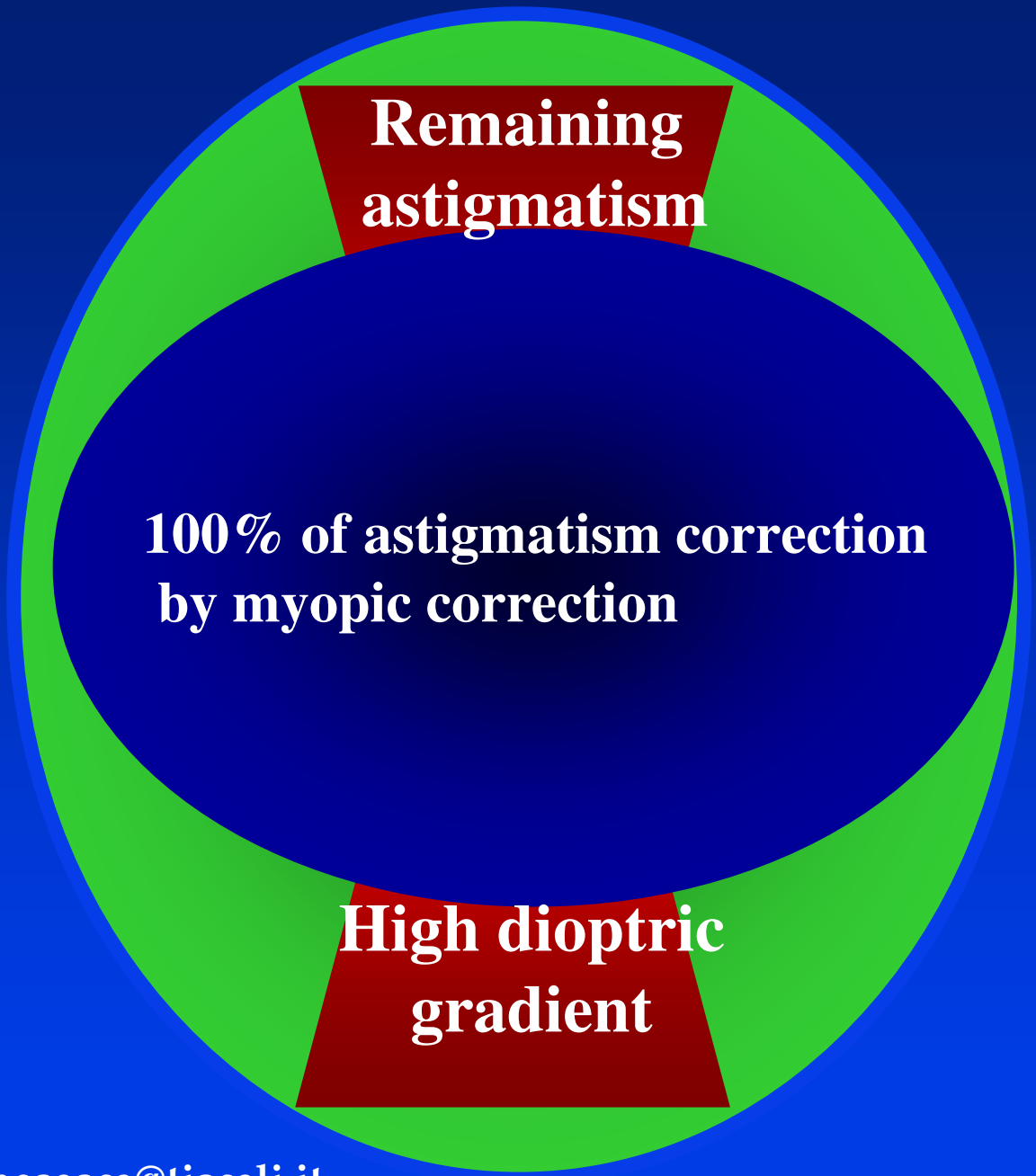

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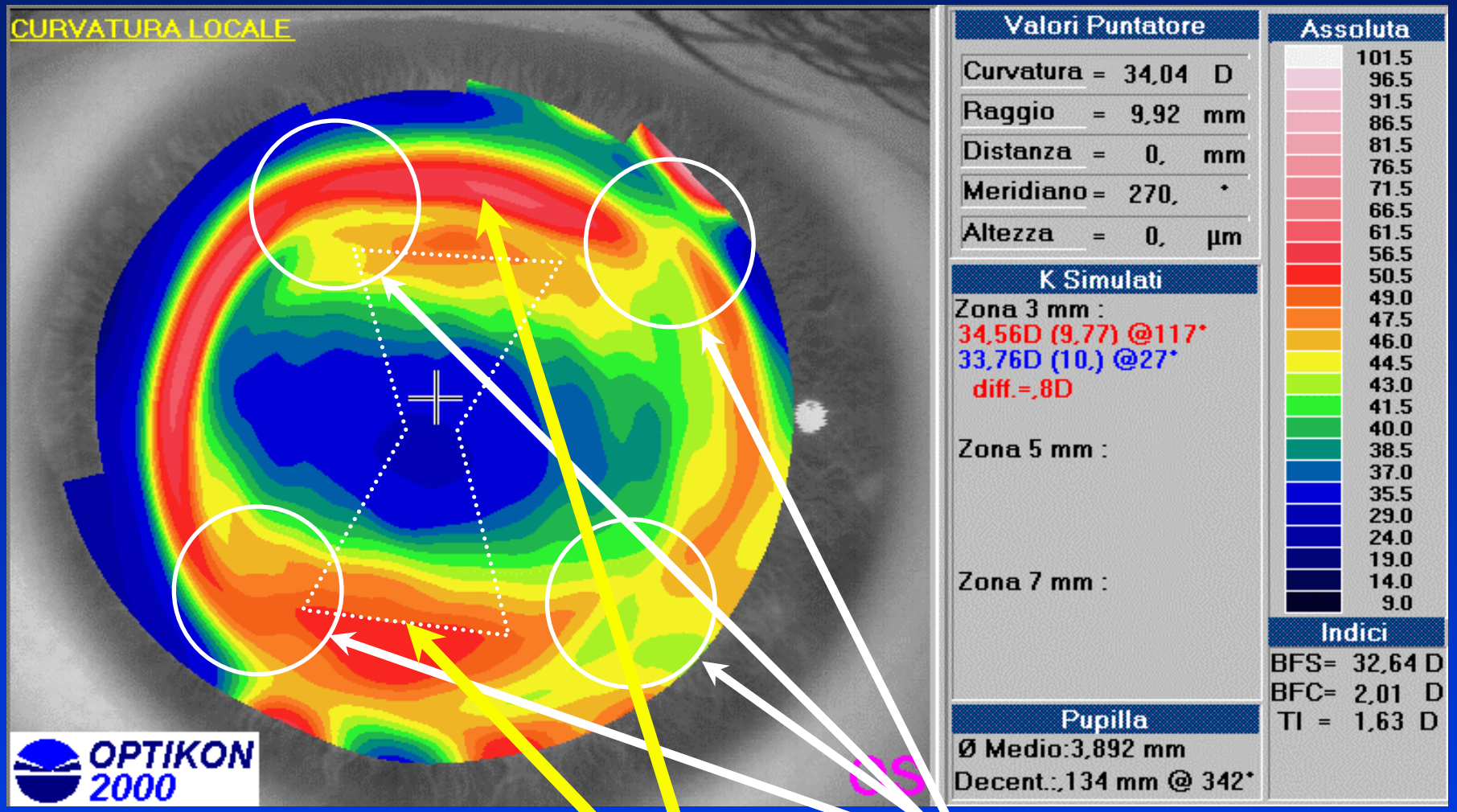

Treated -7.25 -5/173

Oblique meridian overcorrection (tetrafoil)

Remaining astigmatism

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Astigmatism

Cross-Cylinder Technique

- Cyl power
  - 50% positive cyl
  - 50% negative cyl
  - Spherical equivalent added to sphere
- i.e. : +4.00 –3.00 (180)
  - +2.50 +1.50 (90)
  - -1.50 (180)

(Vinciguerra P, J Refract Surg 1999, 15)

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Materials & Methods

High Power Mixed and Compound Hyperopic Astigmatism

- Retrospective study, 2000 – 2003
- Selection criteria:
  - Cyl power: from -2.00 to -6.00
  - SE from -2.00 to +4.00

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Materials & Methods

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

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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° ± 60.0°
- SE 0.06 ± 1.25 D

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Results

Cross-Cylinder, Multizone Ablation

- Hyperopic ablation
  - OZ width: mean 5.8 ± 0.6 mm (range: 5.5 – 7.0 mm)
  - TZ width: mean 9.9 ± 0.4 mm (range: 8.0 - 10 mm)
  - Mean + sph: 0.71 ± 0.94 D
  - Mean + cyl: 1.71 ± 0.55 D
- Myopic Ablation
  - 1 – 6 OZs (mean: 2.4 OZ/eye)
  - OZ width: mean 4.9 ± 0.4 mm (range 4.7 – 7.5 mm)
  - TZ width: mean 7.5 ± 0.4 mm (range 10 – 8.6 mm)
  - Mean - sph : -0.20 ± 0.18 D
  - Mean – cyl : -0.51 ± 0.14 D

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Results

Surgical Data

- Smoothing with masking fluid:
  - 10 Hz
  - Diameter: 10 mm
  - Laser scans: 80 ± 25
  - Effective ablation: 30 μ

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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° ± 63.3°
- SE 0.34 ± 1.11 D

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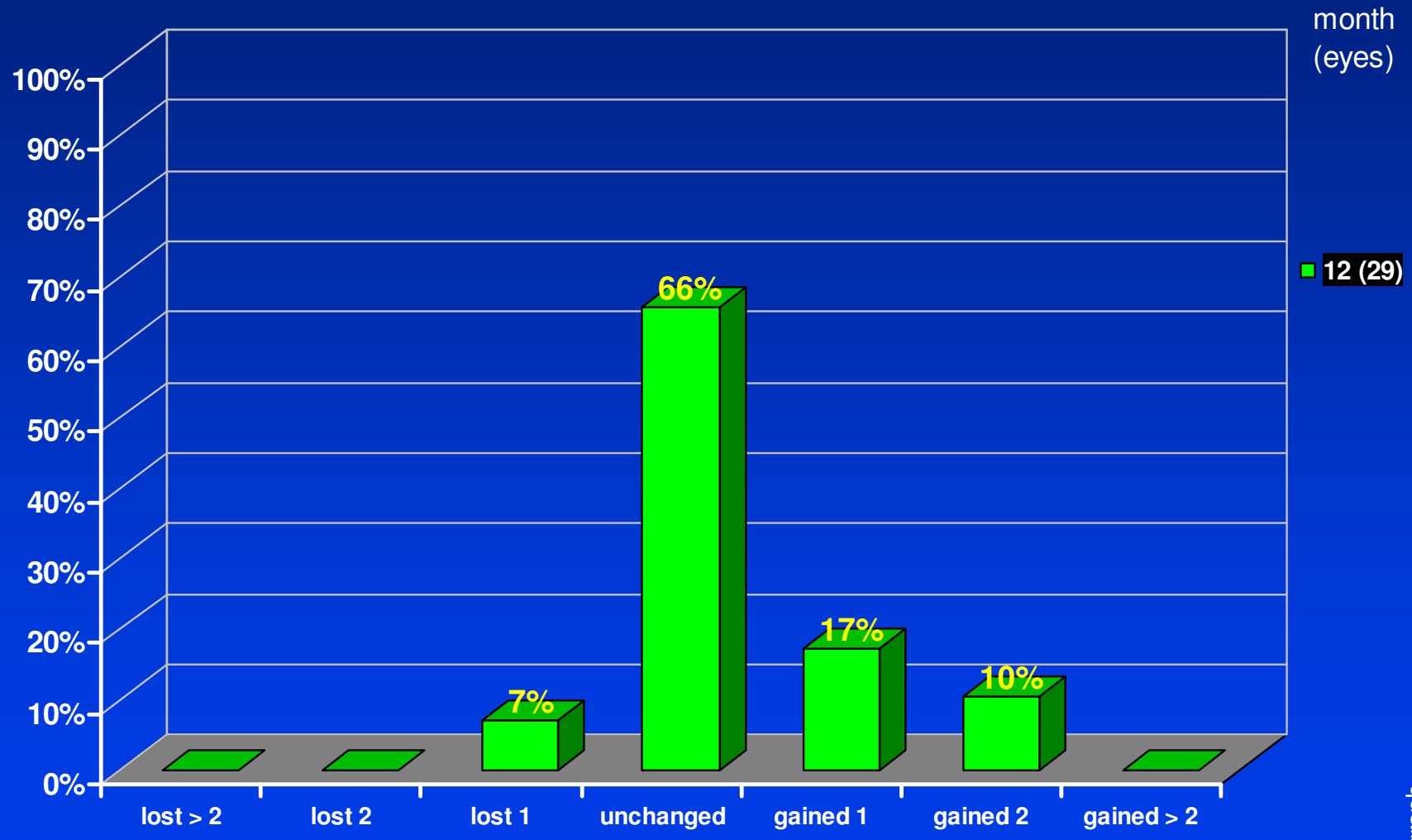
SAFETY: Change in BSCVA - Percent



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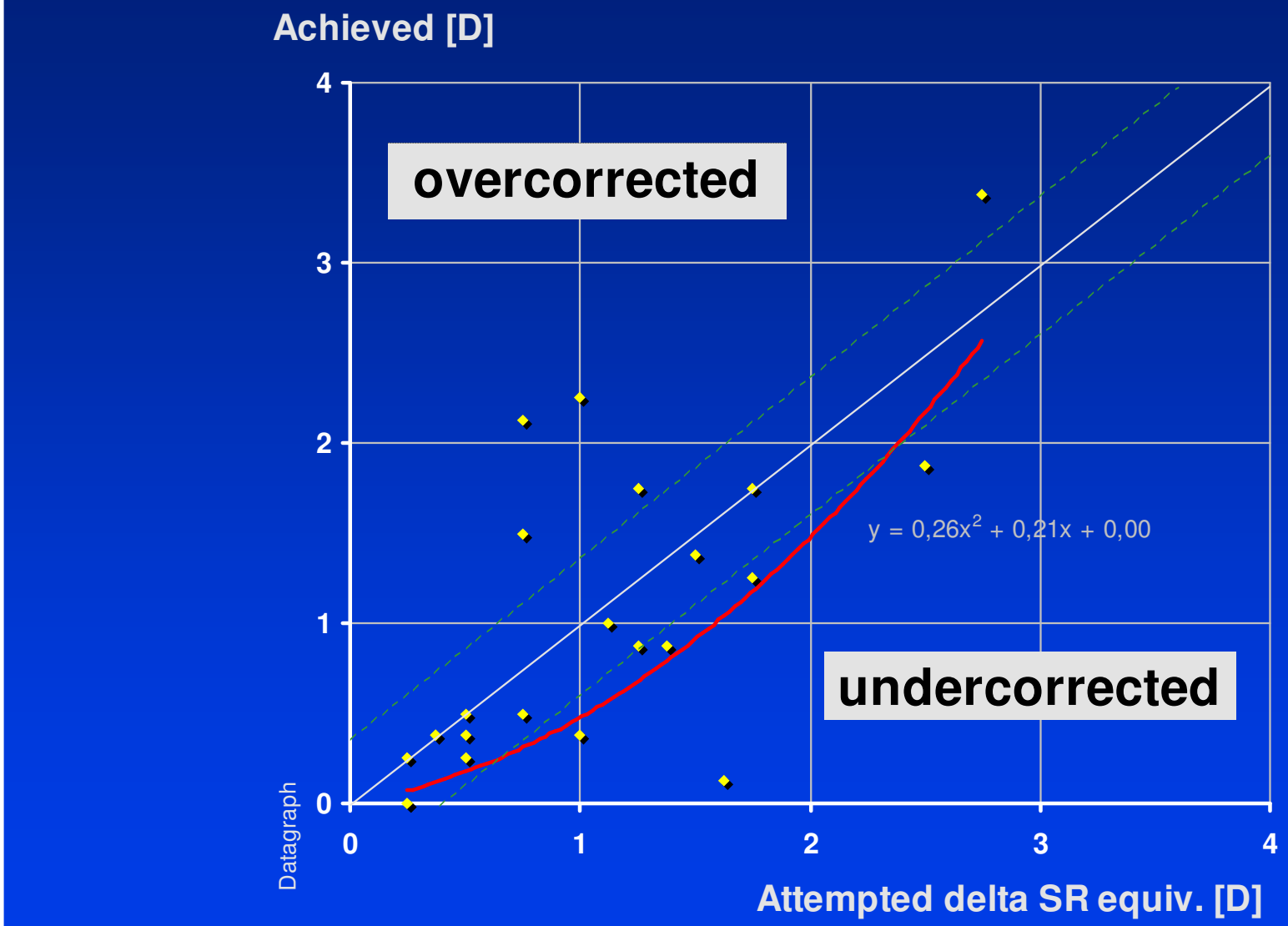
Datagraph

Attempted vs. Achieved SE



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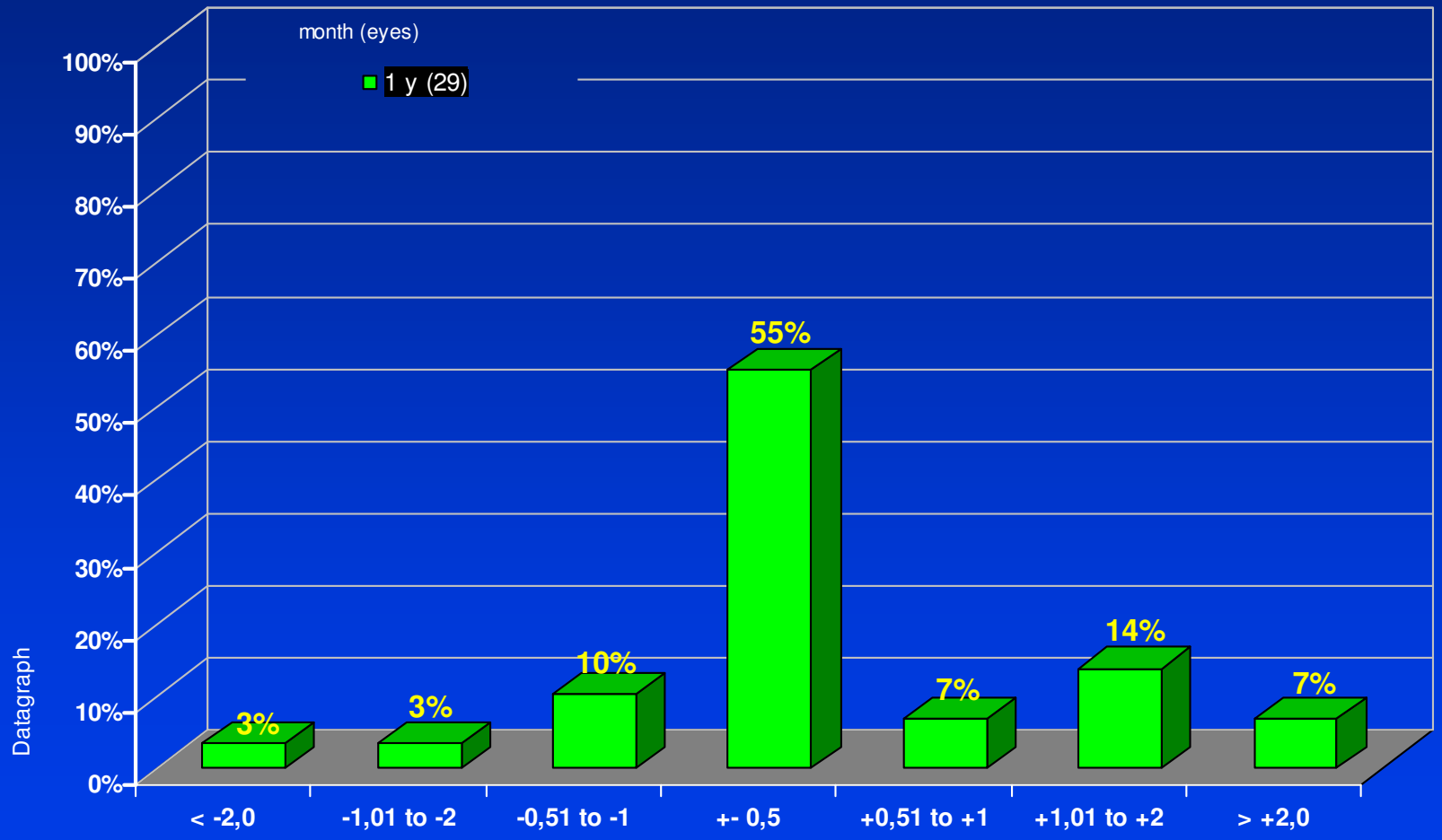
Refractive Outcome: % within Attempted Correction



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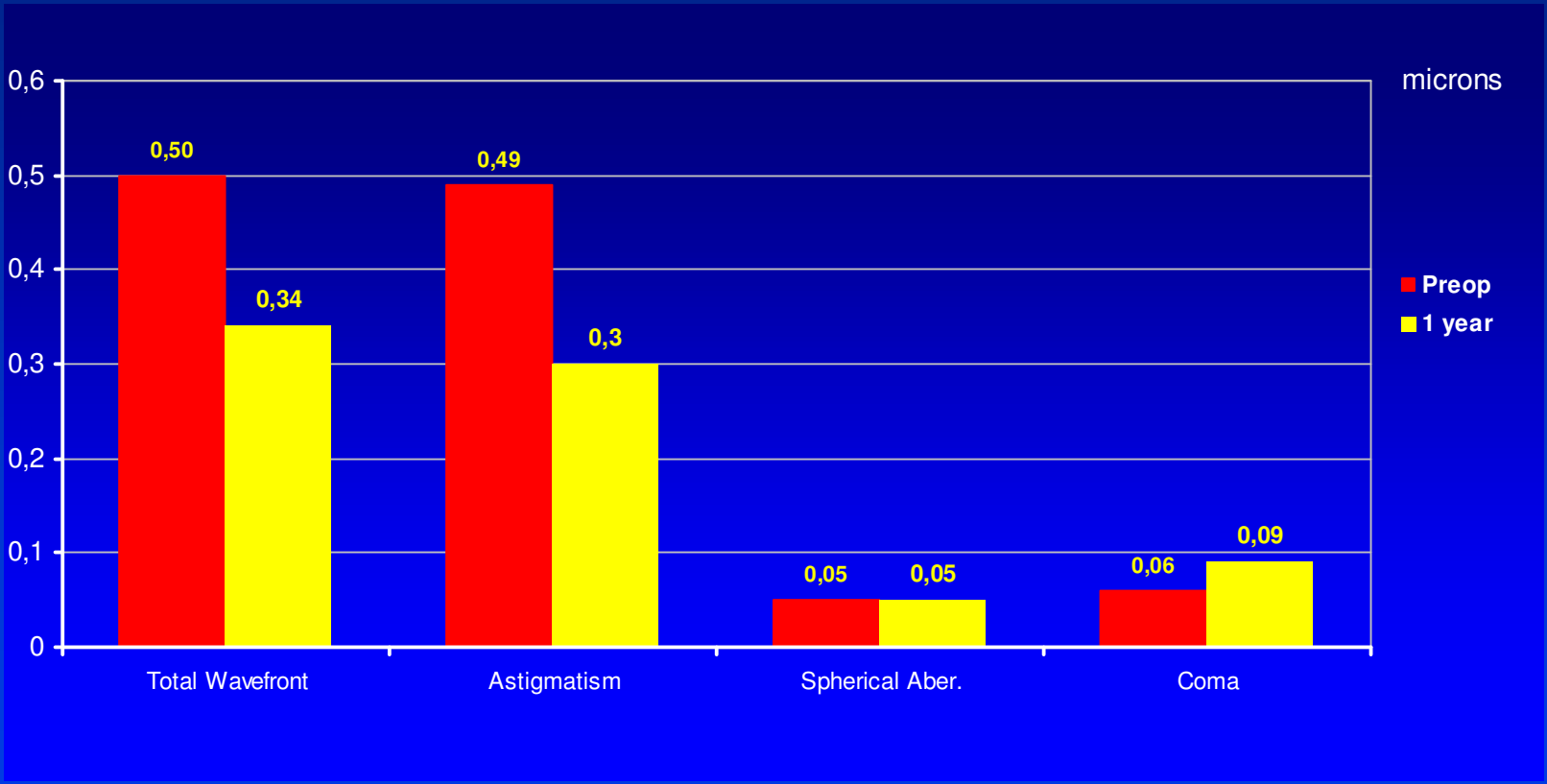
Wavefront Aberrations



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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 ?

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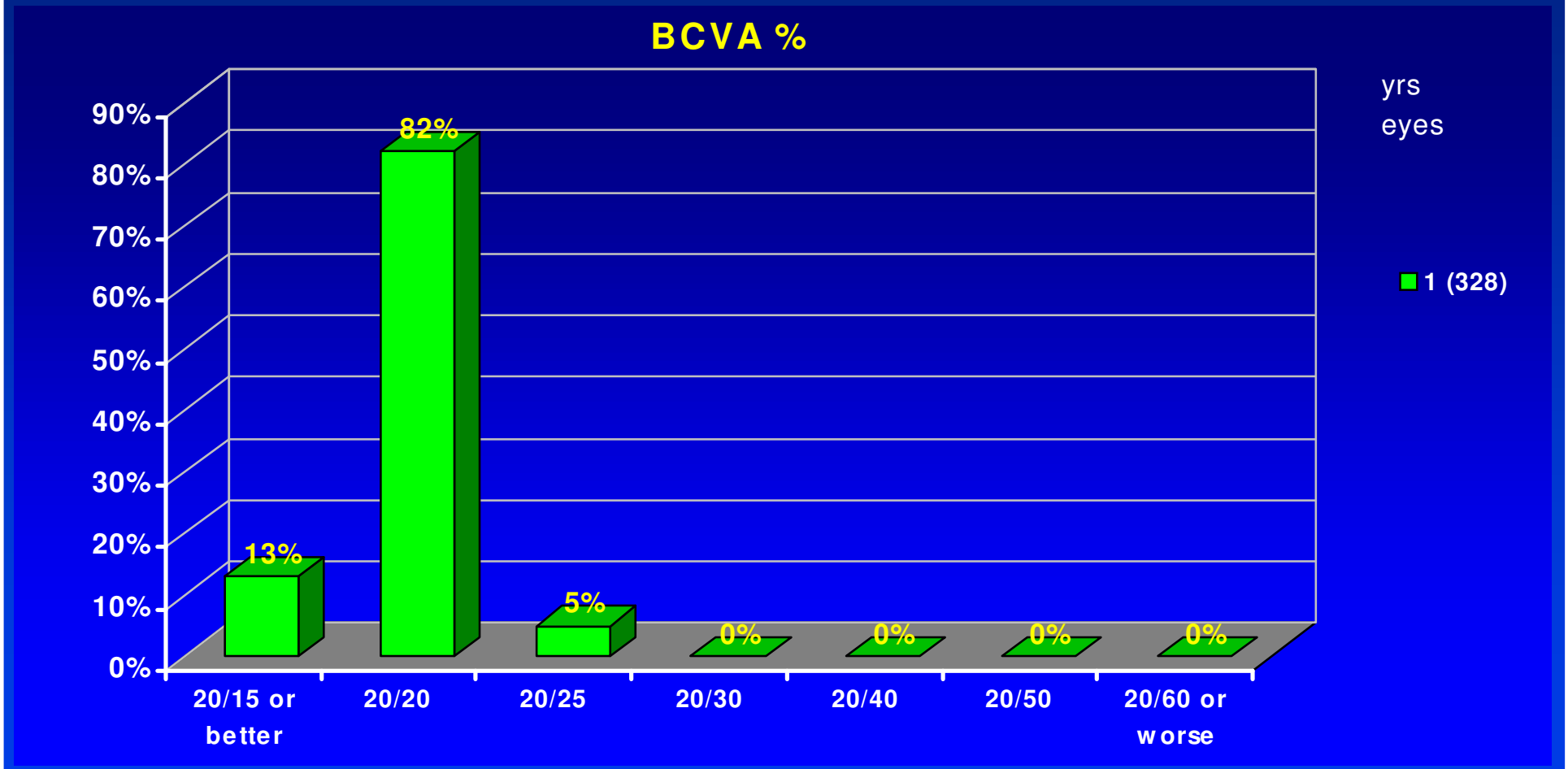
Results

Myopic Astigmatism



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Total Induced Change in Astigmatism (Vectoral Change)

- The cylindrical component of the spherocylindrical lens that mimics the change in power of the cornea, as calculated by vectoral analysis; that is, the combined change of power and axis of the astigmatism.

(Harris DJ, Ophthalmology 1989;96:1597-607)

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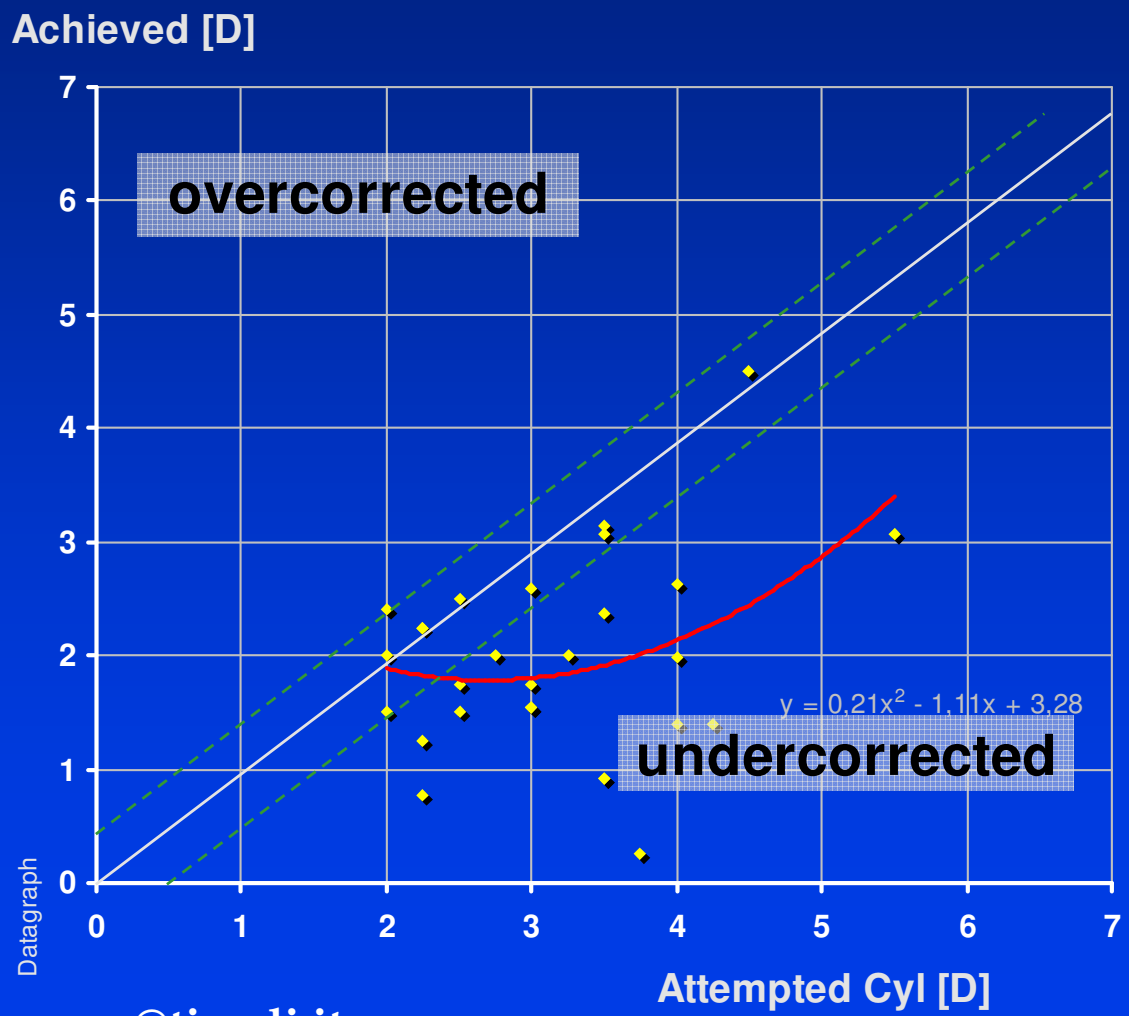
Preop Cyl vs. Achieved Change in Cyl. (based on Vector Analysis)



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Axis Alignement

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

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Vectoral Change

Cyl Power

- Mean preoperative cyl: -3.20 ± 0.90 D
- Mean postoperative cyl: -1.55 ± 1.42 D
- Mean cyl vectoral change :

  -1.98 ± 0.84 D

- Mean refractive error induced by axis misalignment:
  - 0.92 ± 1.38 D sphere (53% of preop.)
  - -1.22 ± 1.06 D cylinder (38% of preop.)

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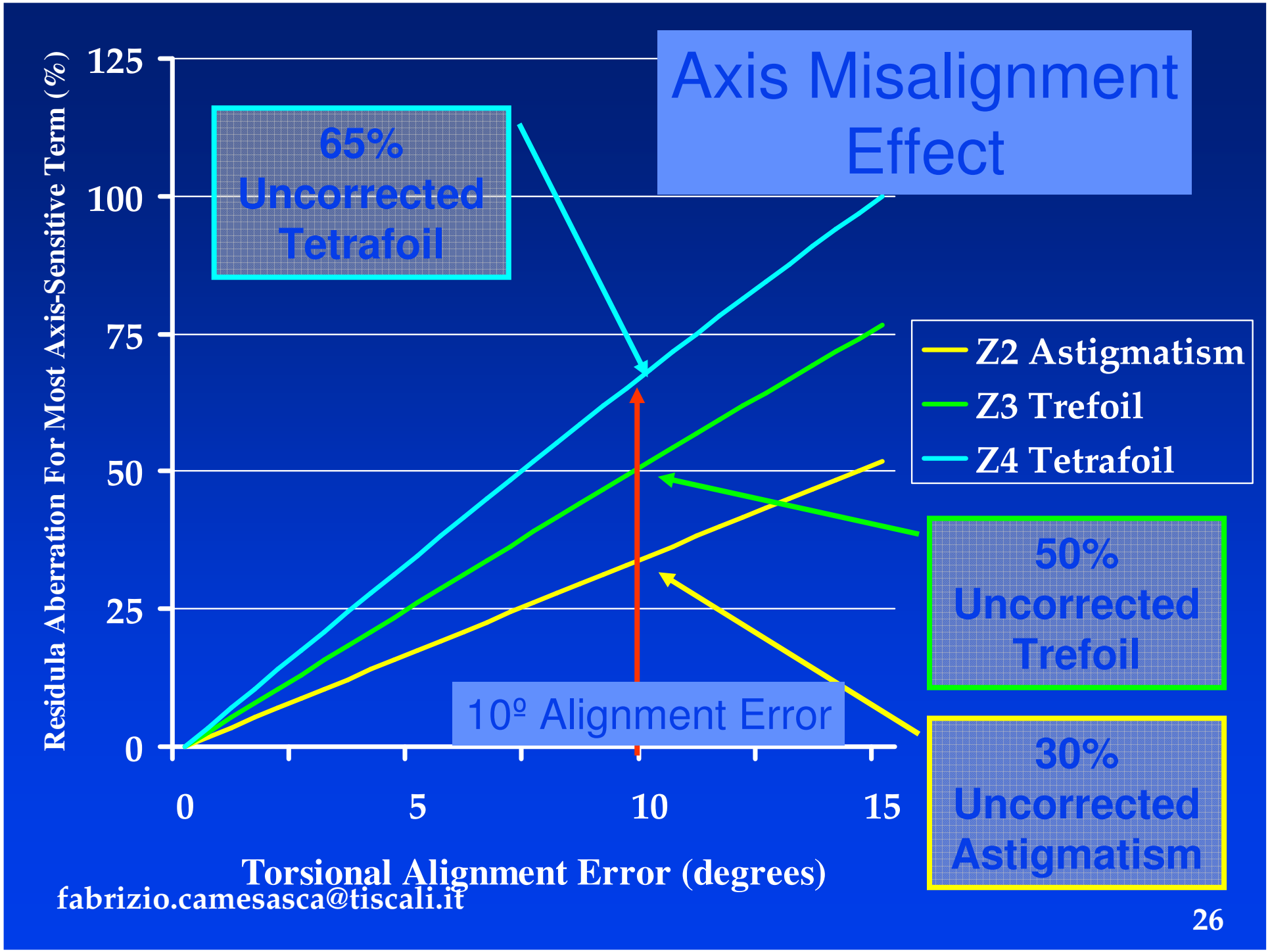

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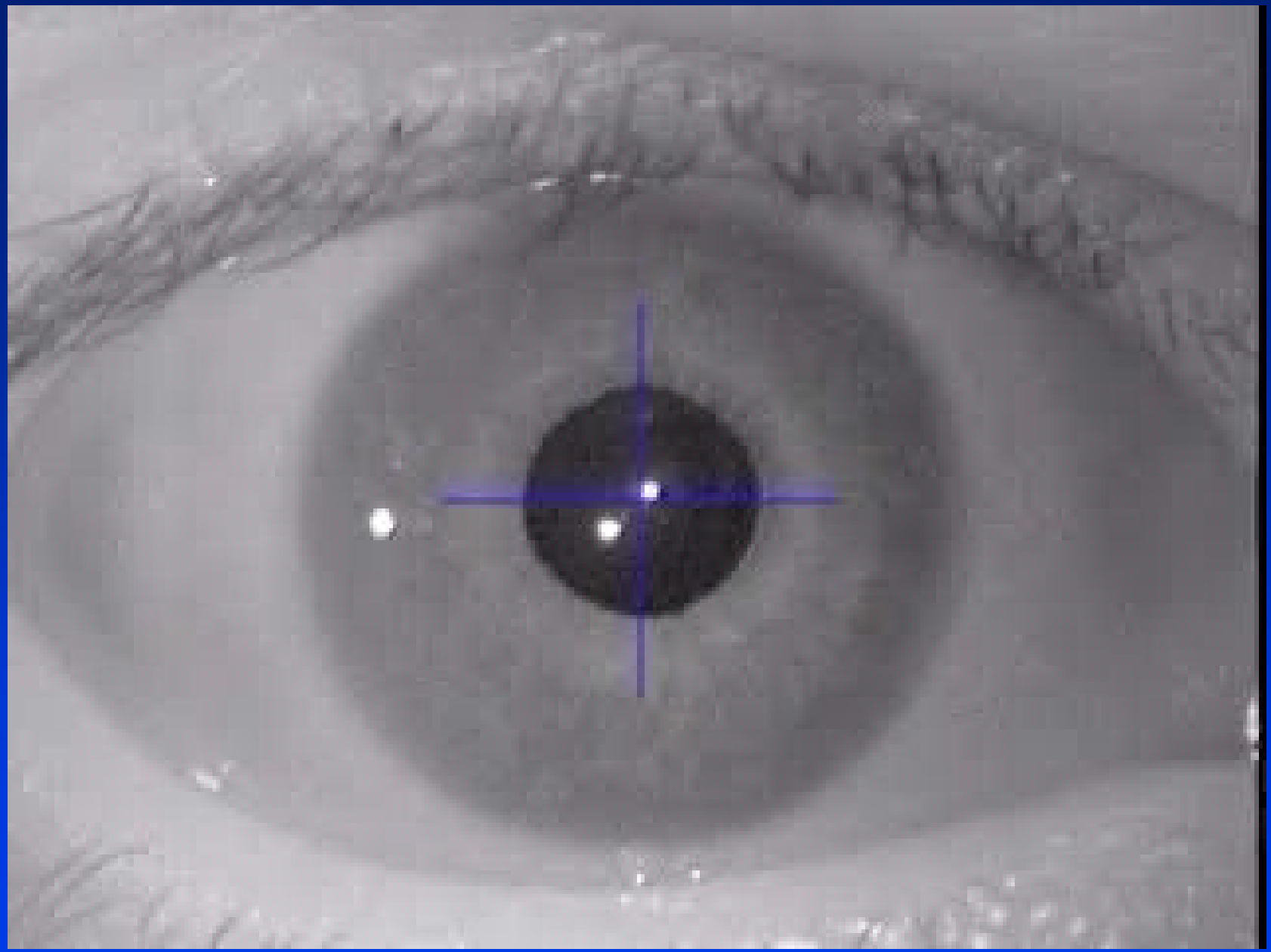

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Overcorrection (≤20%) of the oblique meridians

Axis	Theoretical	Real	Overcorrection D
90	50	50	0
108	40	47.5	0.75
126	30	40	1
144	20	29	0.9
162	10	15.5	0.55
180	0	0	0

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