Nidek OPD-Scan III

Pre and Postoperative Diagnostic Tool

Richard S. Hoffman, MD

Clinical Associate Professor of Ophthalmology
Oregon Health & Science University

No Financial Interests

OPD Scan III

OPD Scan III

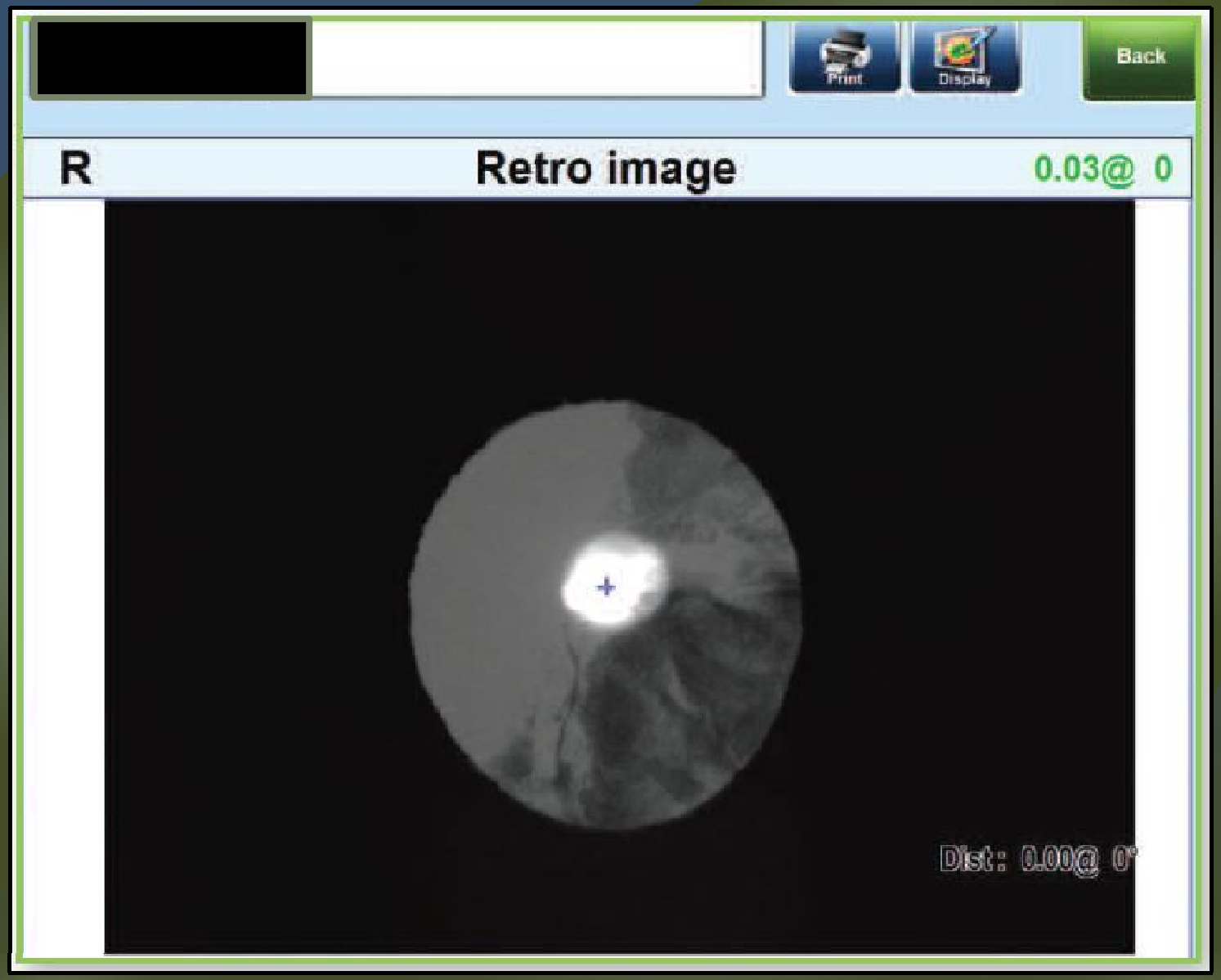
- Autorefractor
- Keratometer
- Pupillometer
- Corneal Topographer
- Wavefront Aberrometer

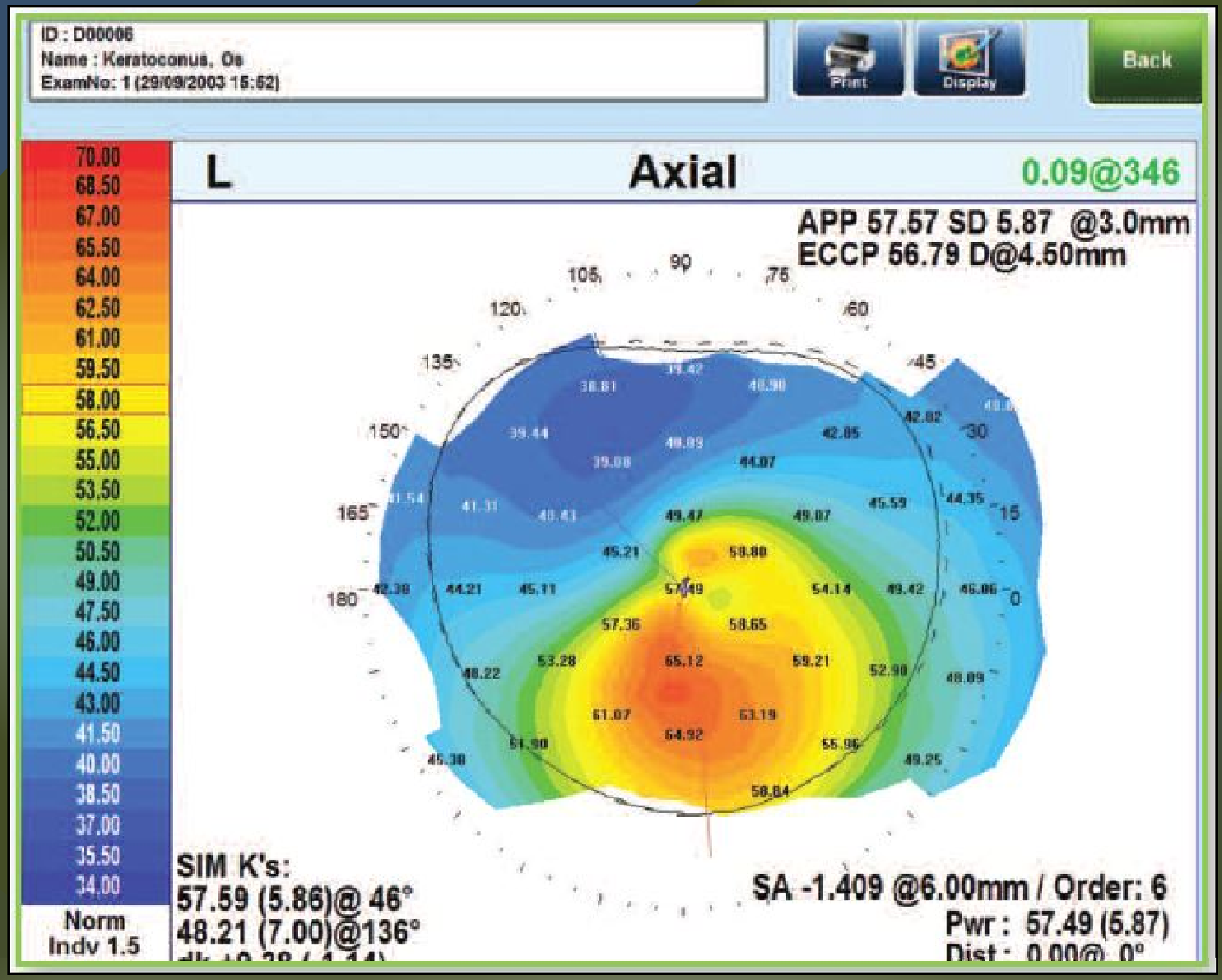
10 seconds / eye

- Retro illumination images
- Toric IOL Summary for axis marking
- APP – Average Pupil Power
- ECCP – Effective Central Corneal Power
- Wavefront Summary

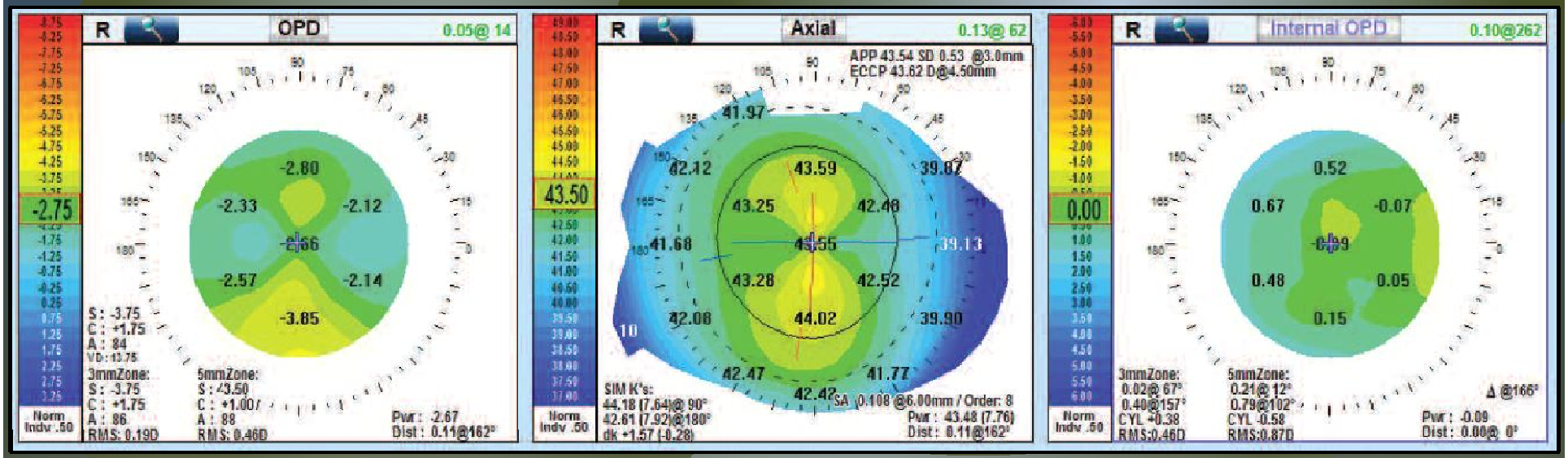
10 seconds / eye

- MTF Graph
- Cataract Summary
- Visual Acuity Simulation of $\overline{sc}$ and $\overline{cc}$ vision
- Zernike Graph of OPD, Cornea or Internal OPD

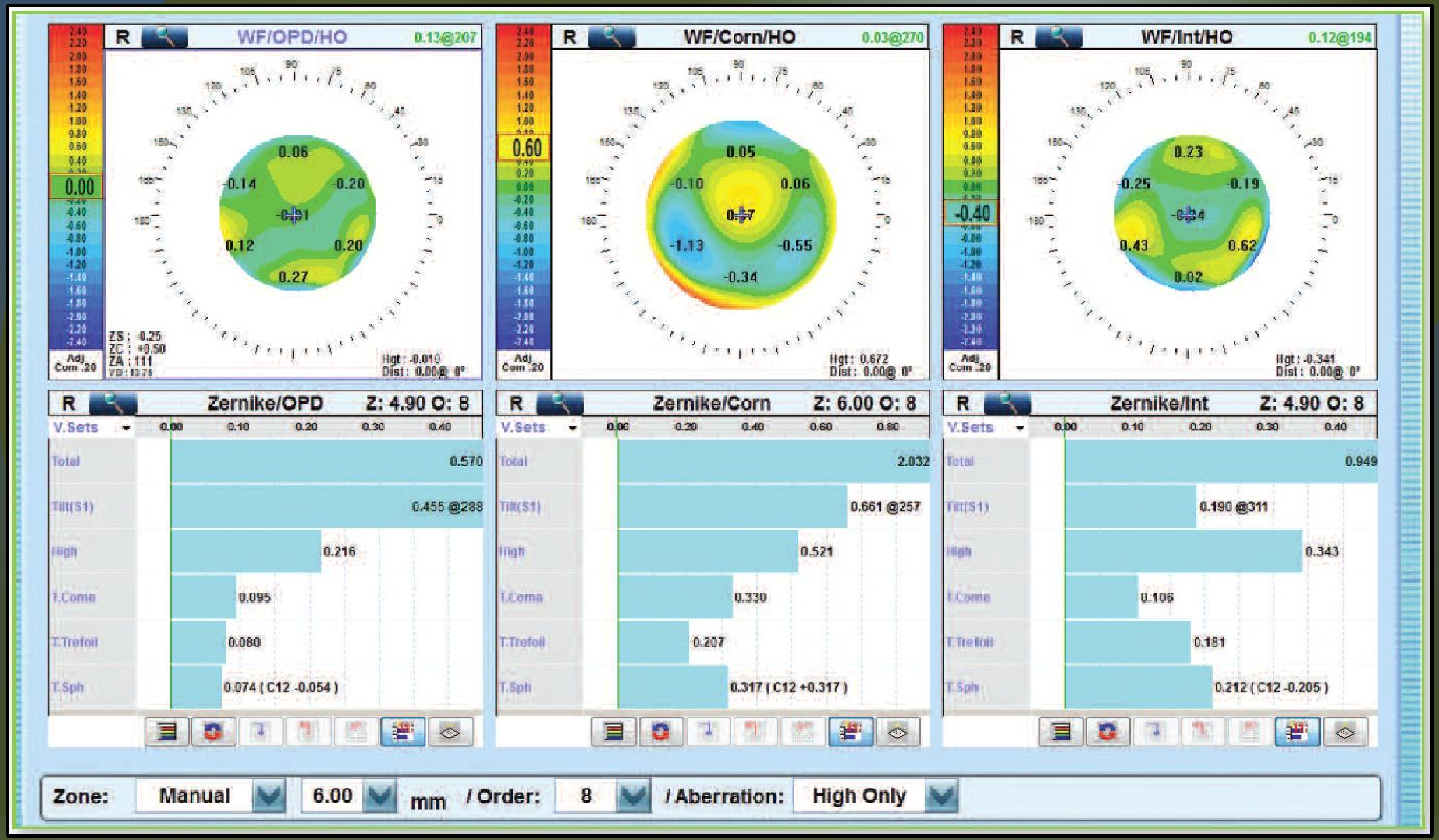

Print
Display
Back
R
Retro image
0.03@ 0
Dist: 0.00@ 0°


ID : D00006
Name : Keratoconus, Os
ExamNo: 1 (29/09/2003 15:52)
Print
Display
Back
70.00
68.50
67.00
65.50
64.00
62.50
61.00
59.50
58.00
56.50
55.00
53.50
52.00
50.50
49.00
47.50
46.00
44.50
43.00
41.50
40.00
38.50
37.00
35.50
34.00
Norm
Indv 1.5
L
Axial
0.09@346
APP 57.57 SD 5.87 @3.0mm
ECCP 56.79 D@4.50mm
90
105
75
120
60
135
45
150
30
165
15
180
0
SIM K's:
57.59 (5.86)@ 46°
48.21 (7.00)@136°
SA -1.409 @6.00mm / Order: 6
Pwr : 57.49 (5.87)
Dist : 0.00@ 0°

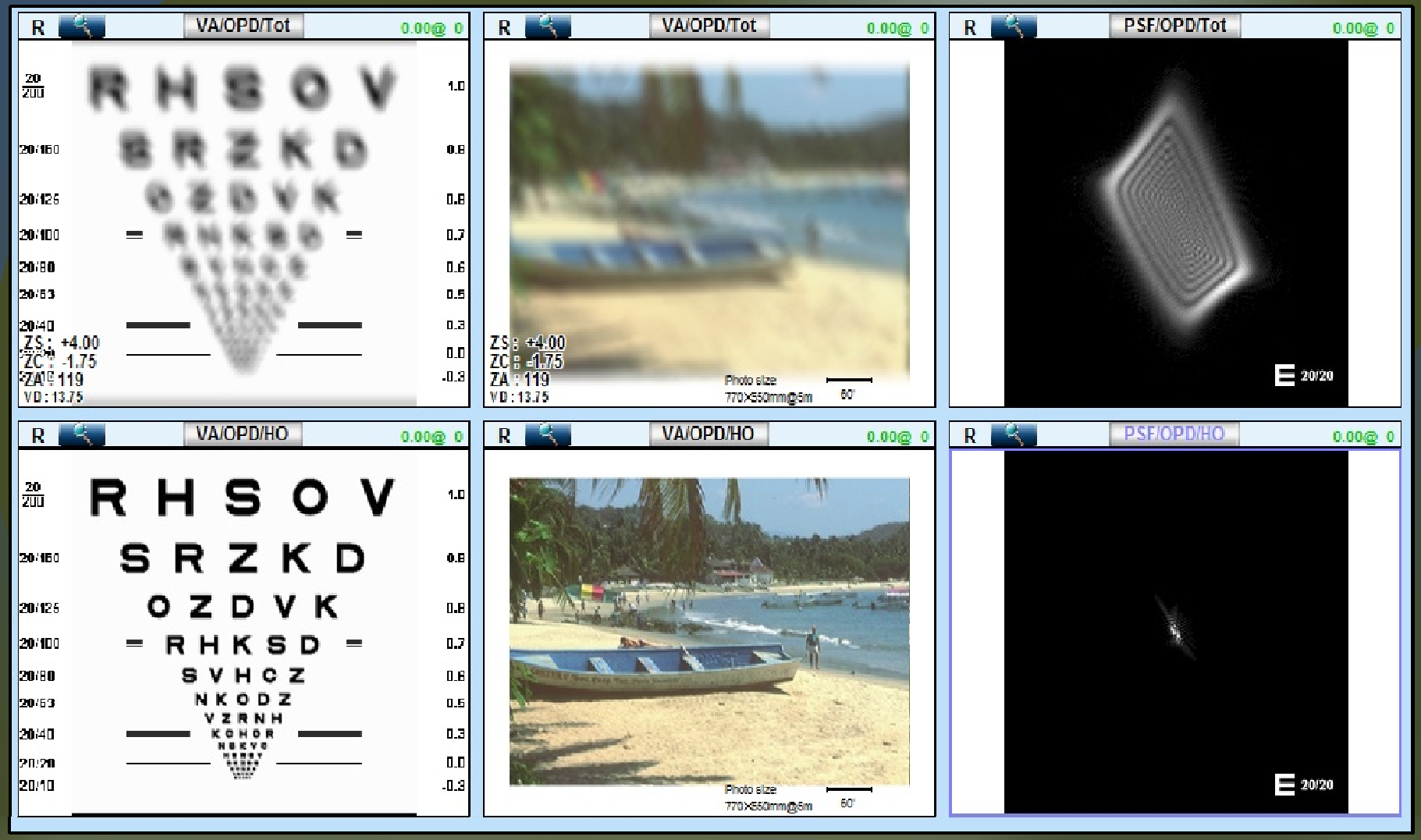
Total and Internal (lens) Wavefront Maps



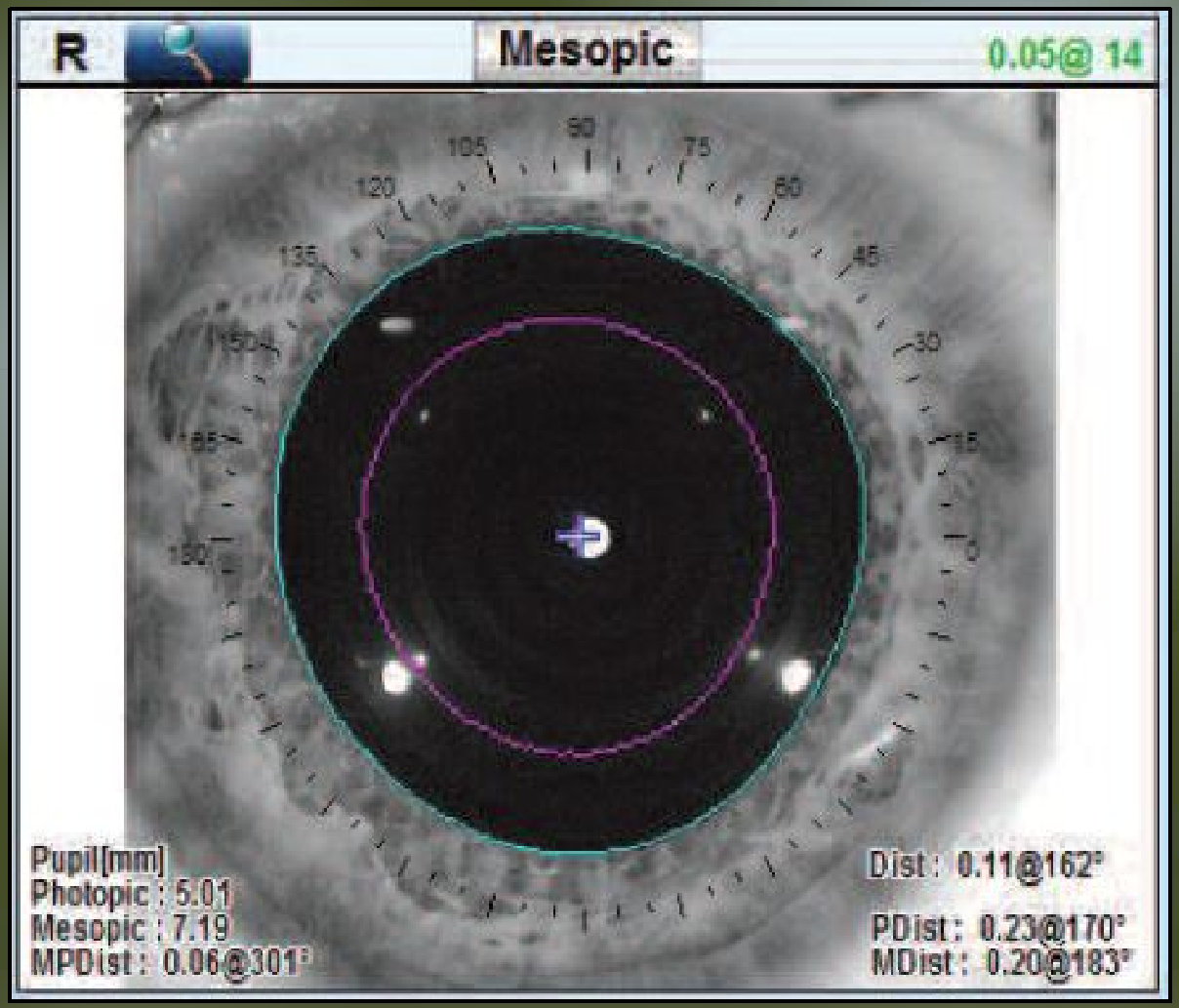
Zernikes


R
WF/OPD/HO
0.13@207
0.06
-0.14
-0.20
0.12
0.20
0.27
ZS : -0.25
ZC : +0.50
ZA : 111
Hgt : -0.010
Dist : 0.00@ 0°
R
WF/Corn/HO
0.03@270
0.05
-0.10
0.06
-1.13
-0.55
-0.34
Hgt : 0.672
Dist : 0.00@ 0°
R
WF/Int/HO
0.12@194
0.23
-0.25
-0.19
0.43
0.62
0.02
Hgt : -0.341
Dist : 0.00@ 0°
R
Zernike/OPD
Z: 4.90 O: 8
V.Sets
Total 0.570
Tilt(S1) 0.455 @288
High 0.216
T.Coma 0.095
T.Trefoil 0.080
T.Sph 0.074 (C12 -0.054)
R
Zernike/Corn
Z: 6.00 O: 8
V.Sets
Total 2.032
Tilt(S1) 0.661 @257
High 0.521
T.Coma 0.330
T.Trefoil 0.207
T.Sph 0.317 (C12 +0.317)
R
Zernike/Int
Z: 4.90 O: 8
V.Sets
Total 0.949
Tilt(S1) 0.190 @311
High 0.343
T.Coma 0.106
T.Trefoil 0.181
T.Sph 0.212 (C12 -0.205)
Zone: Manual 6.00 mm / Order: 8 / Aberration: High Only

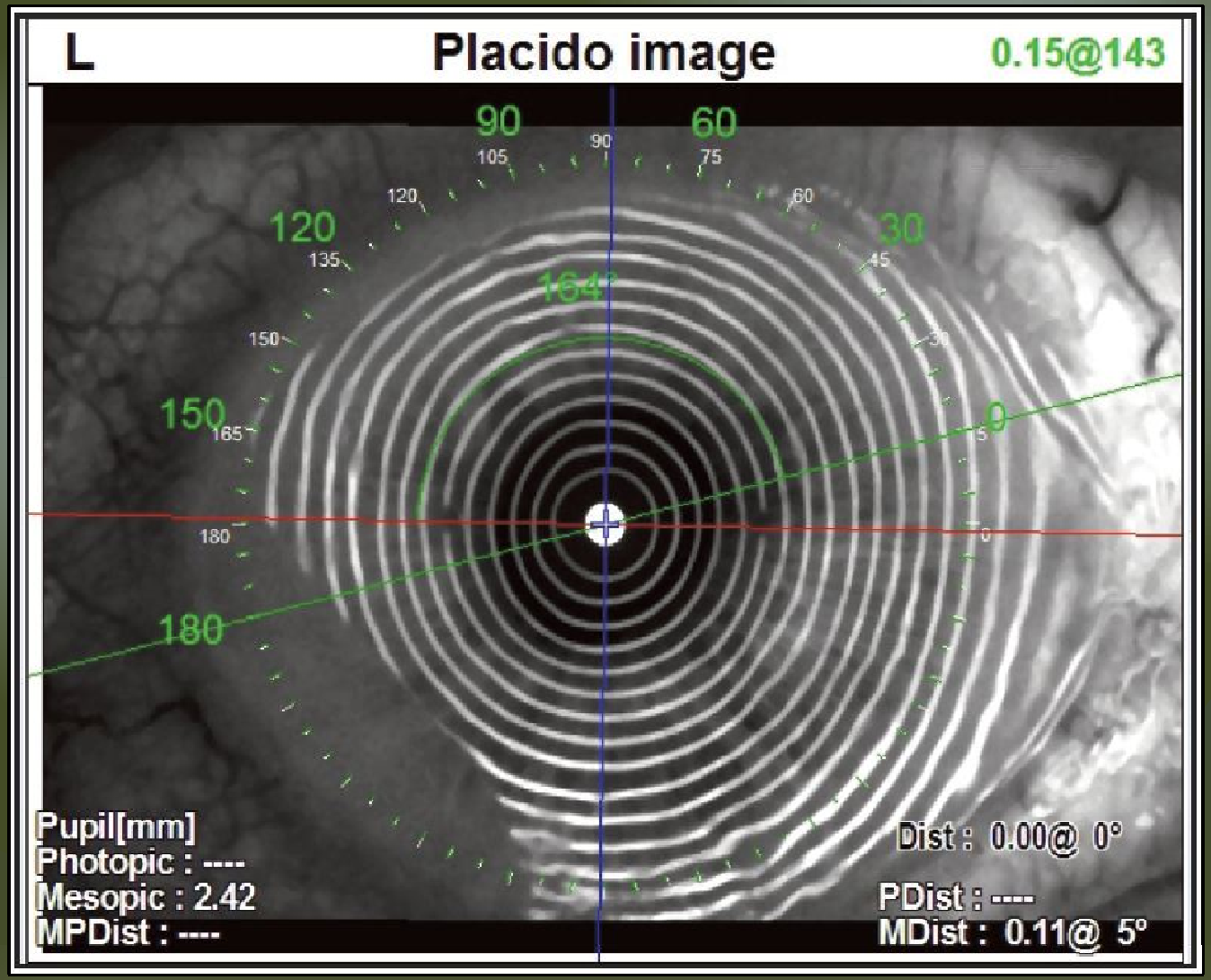
Visual Acuity Simulation



Mesopic and Photopic Pupil



Placido Disc Image



Nine Types of Text Maps

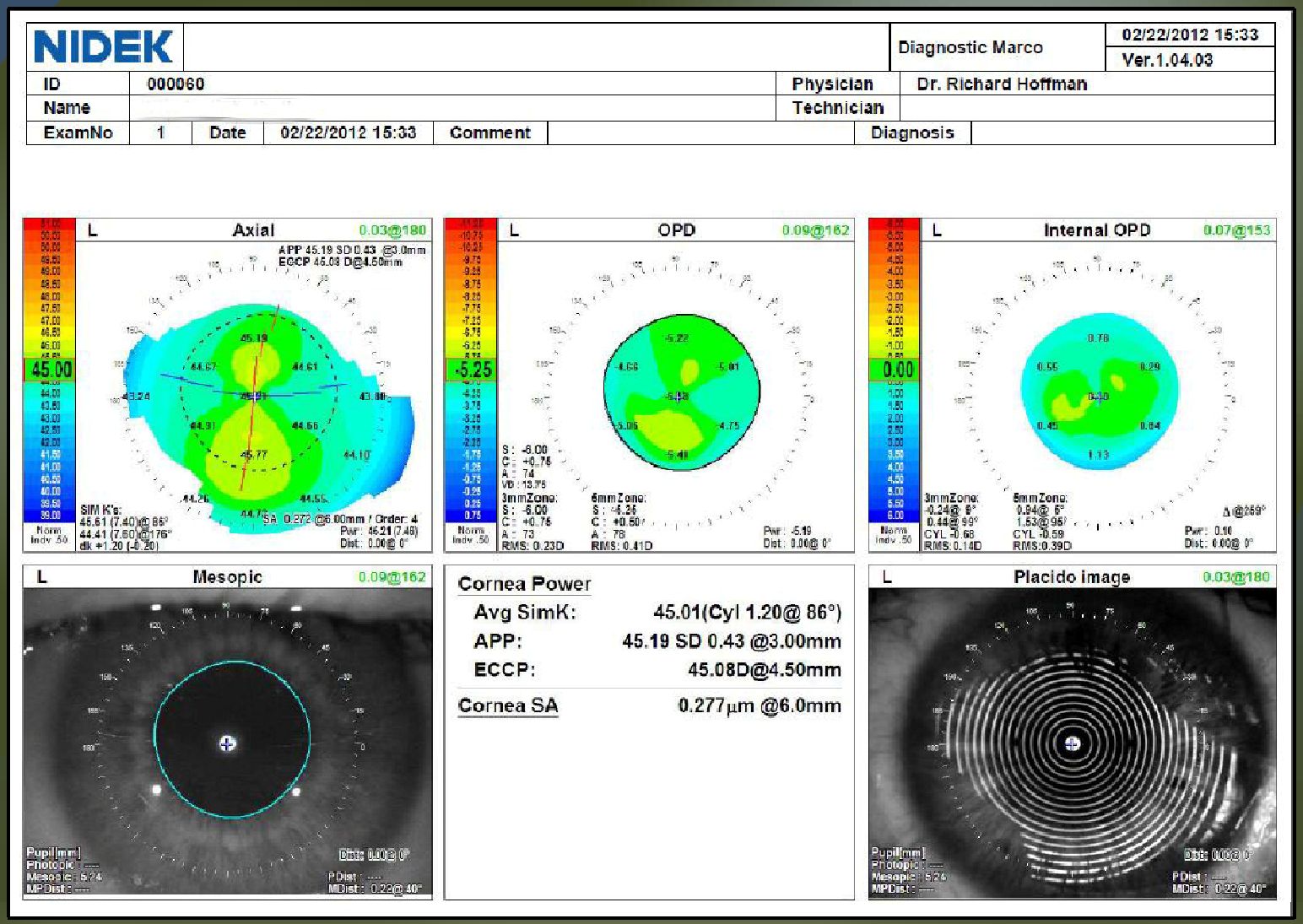
HOA [μm]: @6.00mm / Order = 8

	T.Sph	T.Coma	T.Tre	HO
Total:	0.297	0.083	0.313	0.460
Cornea:	0.398	0.146	0.480	0.804
Internal:	0.123	0.156	0.496	0.721

Refraction: VD = 13.75mm

	Sph	Cyl	Axis	RMS
WF@4.00	-7.75	+1.00	94	0.19D
WF@6.00	-8.50	+1.25	98	0.46D
Diff	-0.75	+0.25	4	

Customized Displays



Summary Displays

- Overview
- Cataract
- Diagnostic
- Toric IOL
- Wavefront
- Optical Quality
- White to White
- Pupil Image
- Contact Lens
- Cornea

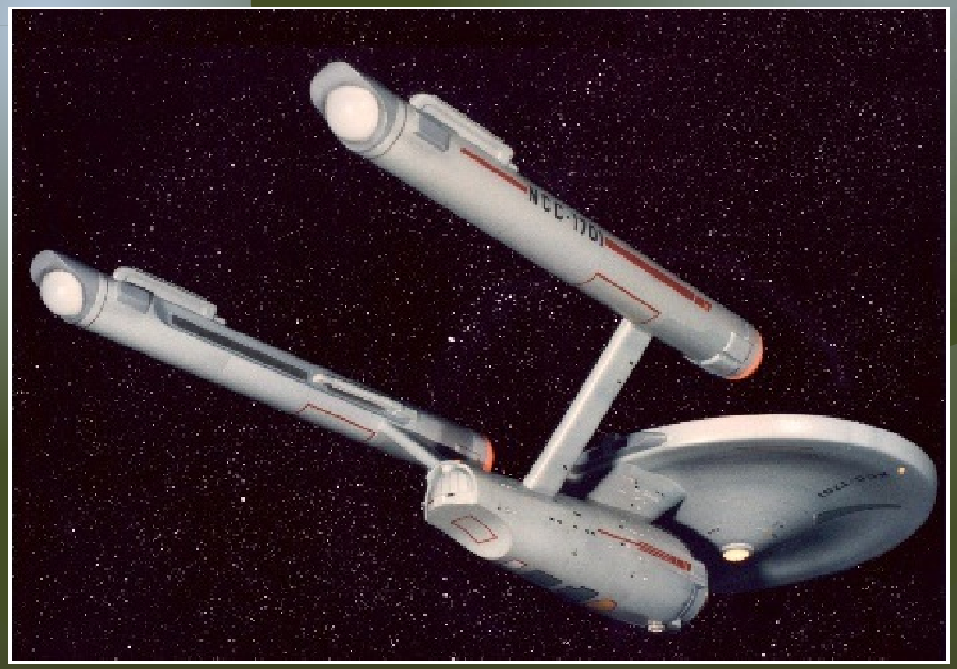
Retroillumination Images

Case 1

- Patient has had monofocal IOL implant
- Patient recently had YAG
- Patient says he can not drive at night

One more thing….

Patient says…he sees the *Starship Enterprise* !



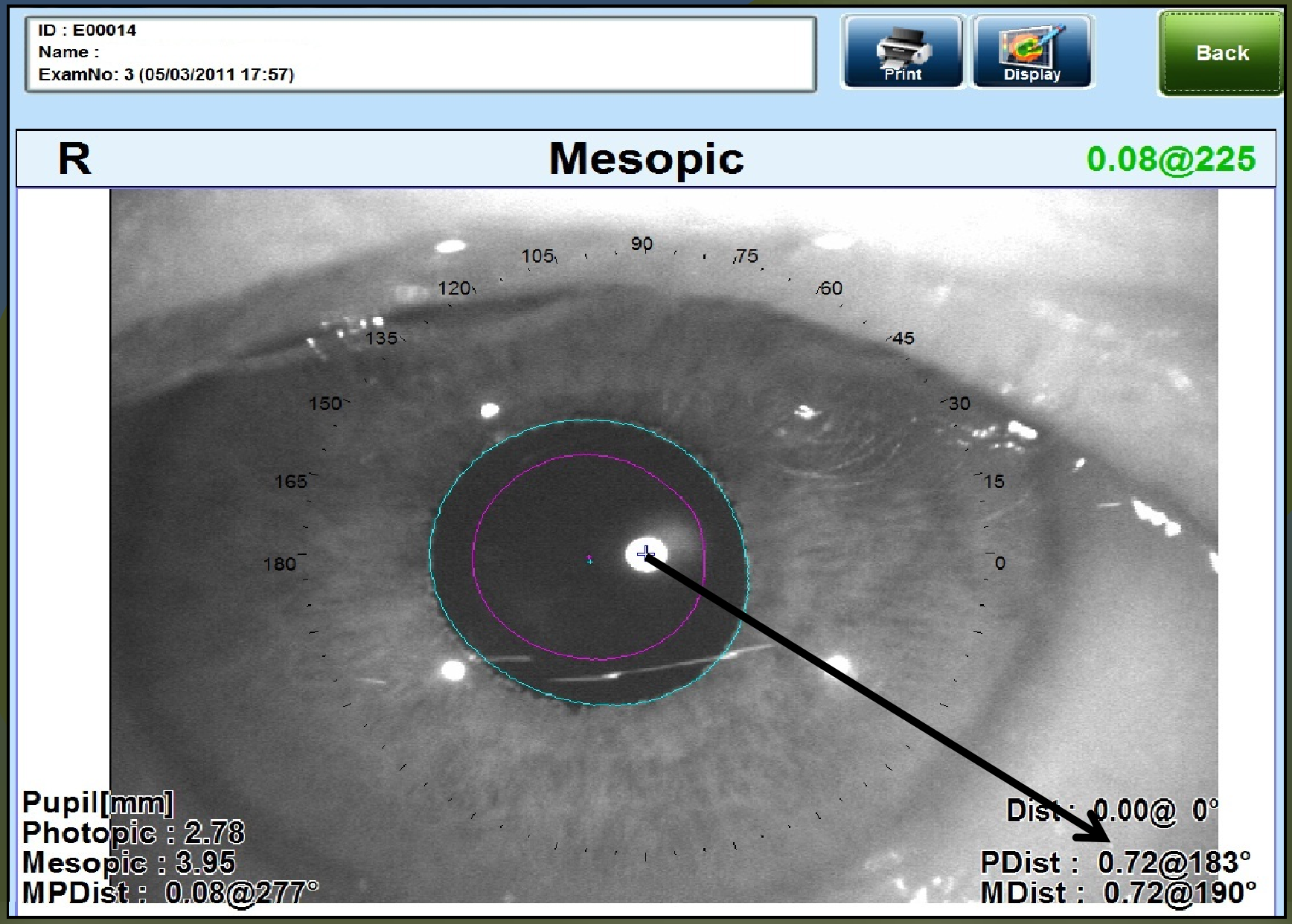
ID : E00006
Name : Starship, Enterprise
ExamNo: 2 (20/03/2011 05:03)

Print | Display | Back

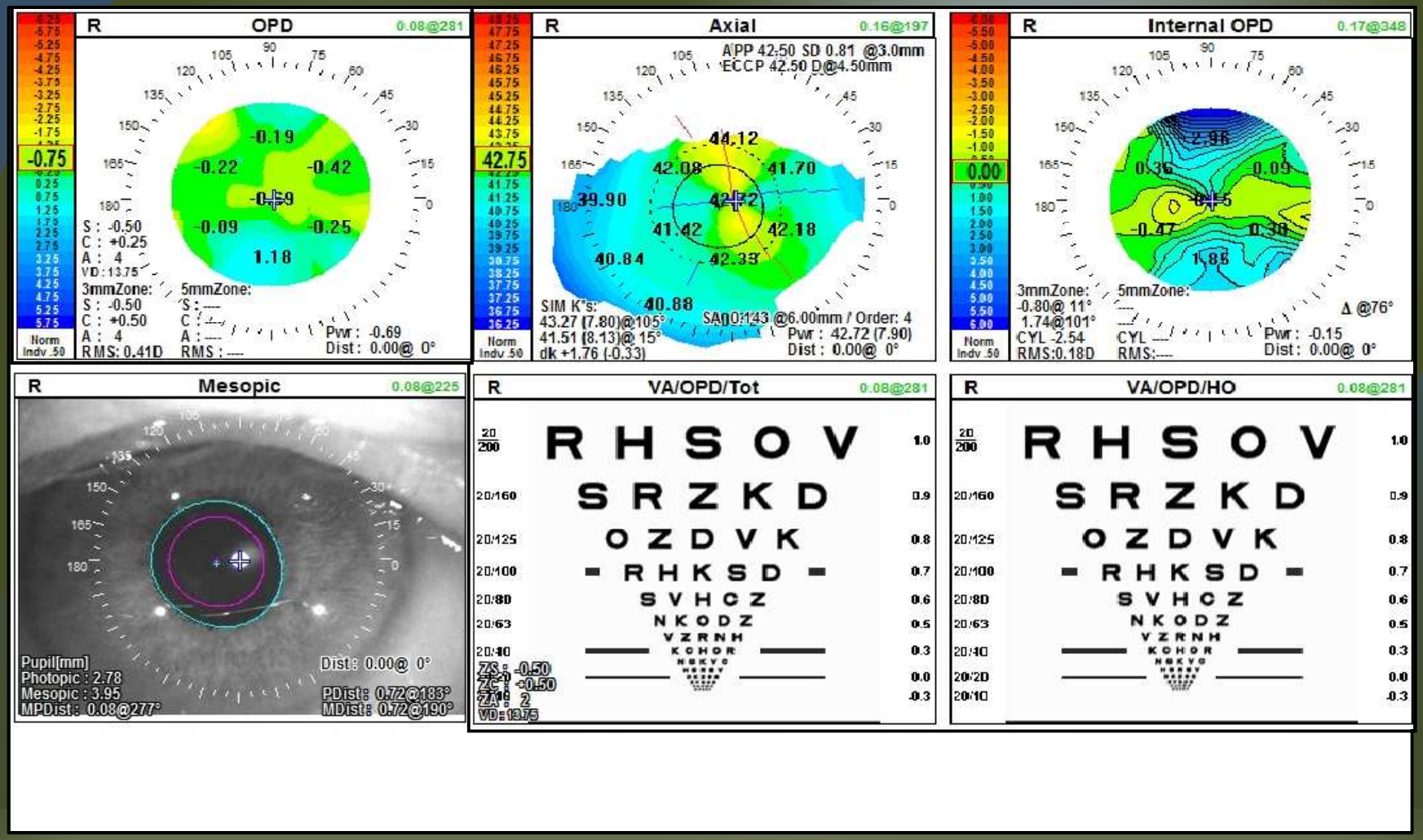
L Retro image 0.07@333

Case

- Patient wanting multifocal IOLs
- Patient has seen commercials and is convinced he will not need glasses
- Patient has a lot of astigmatism
- Patient may not be good candidate…why?


ID : E00014
Name :
ExamNo: 3 (05/03/2011 17:57)
Print
Display
Back
R
Mesopic
0.08@225
90
105
75
120
60
135
45
150
30
165
15
180
0
Pupil[mm]
Photopic : 2.78
Mesopic : 3.95
MPDist : 0.08@277°
Dist : 0.00@ 0°
PDist : 0.72@183°
MDist : 0.72@190°

Patient opted for Toric and is happy with the result

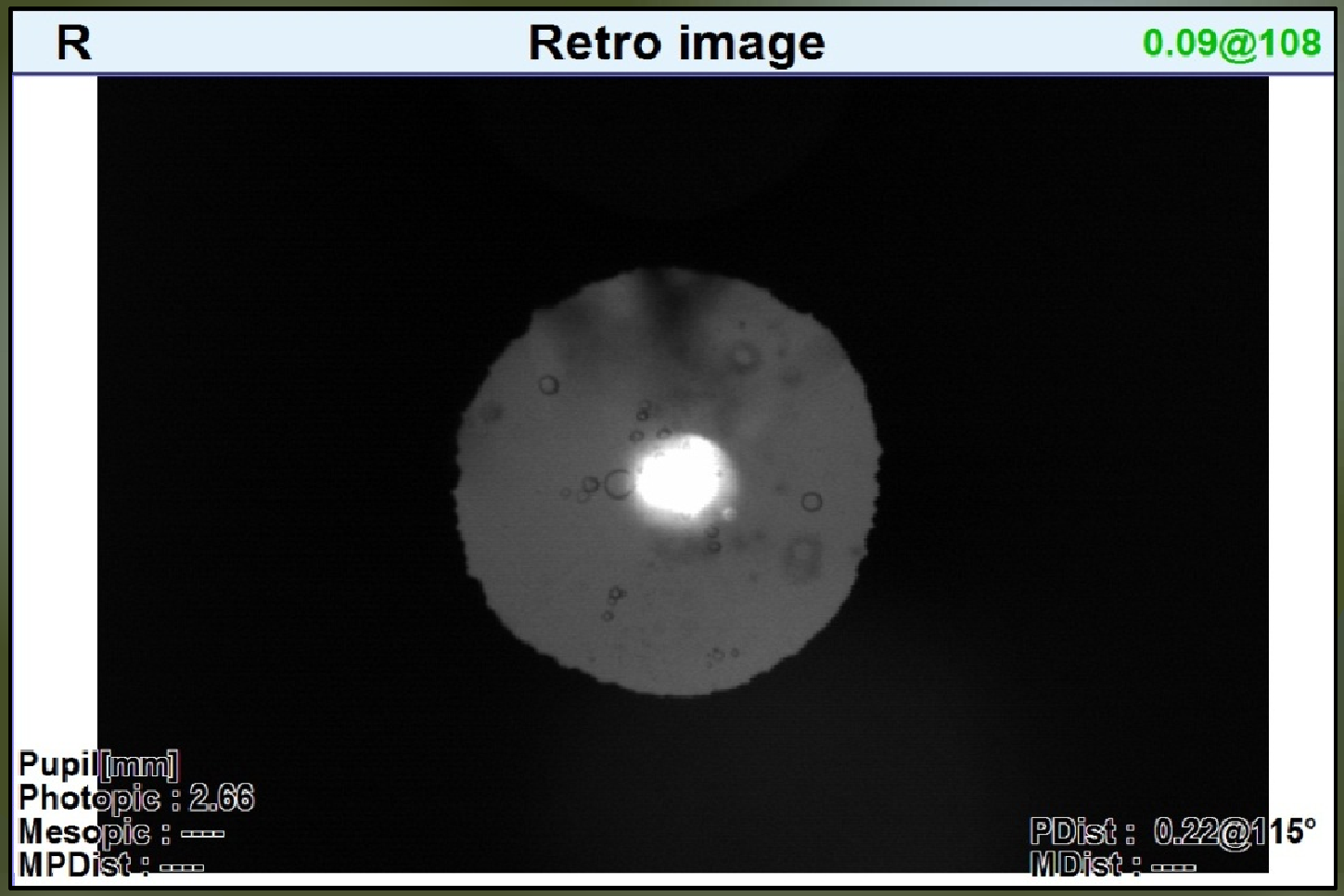


Patient Education Opportunities

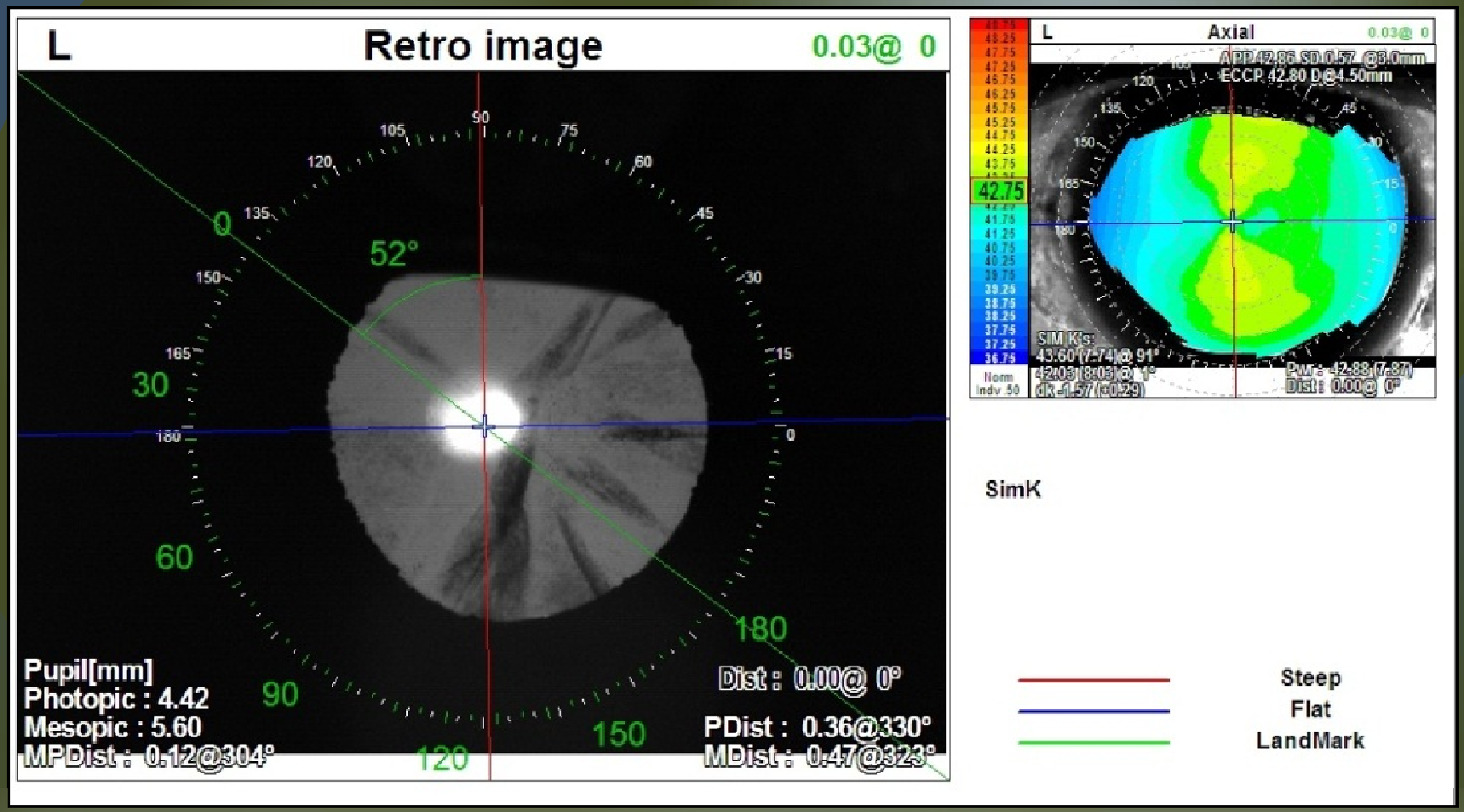
Patient Education

- Corneal aberrations
- Astigmatism
- Retro-illumination photos
  - Cataract progression
  - PCO
- Visual acuity maps
  - Photos
  - Snellen charts

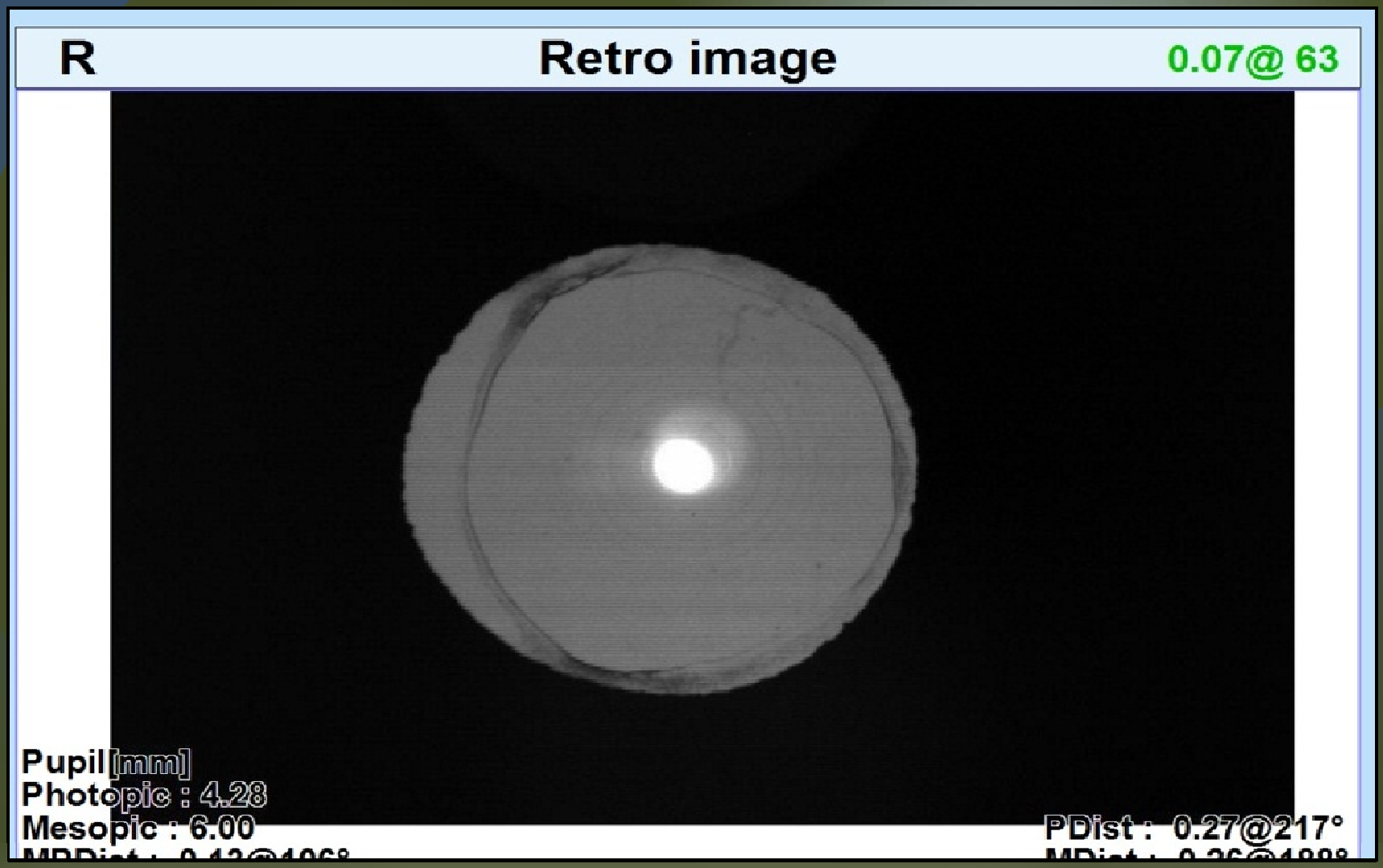
Vacuoles


R
Retro image
0.09@108
Pupil[mm]
Photopic : 2.66
Mesopic : ----
MPDist : ----
PDist : 0.22@115°
MDist : ----

Cortical Cataract



Centered ReStor Implant



Case 2

- Patient works for MD
- Patient not convinced cataracts are bad enough
- Being able to demonstrate her cataracts and visual function was enough to convince her

ID : E00011
Name : Cataracts, R and I
ExamNo: 1 (29/03/2011 04:55)

Print | Display | Back

R — Retro image — 0.04@ 45

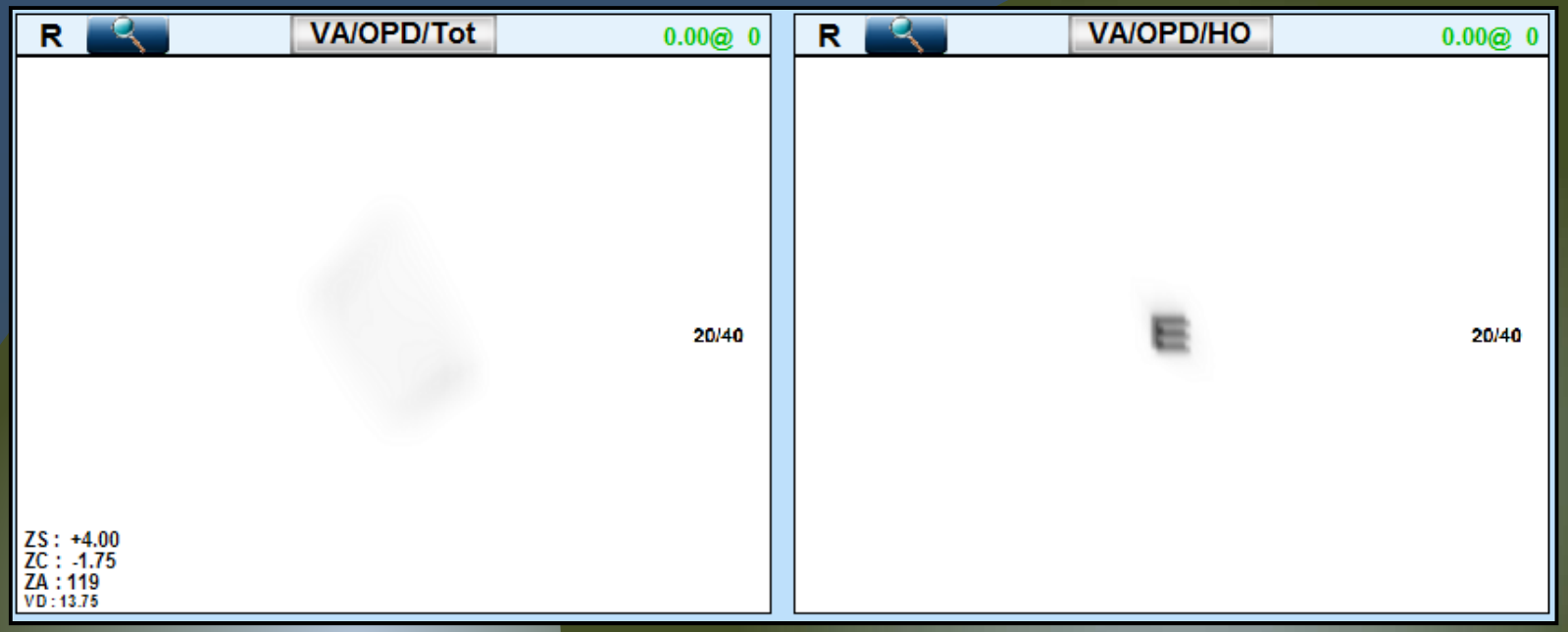
ID : E00011
Name : Cataracts, R and I
ExamNo: 1 (29/03/2011 04:55)

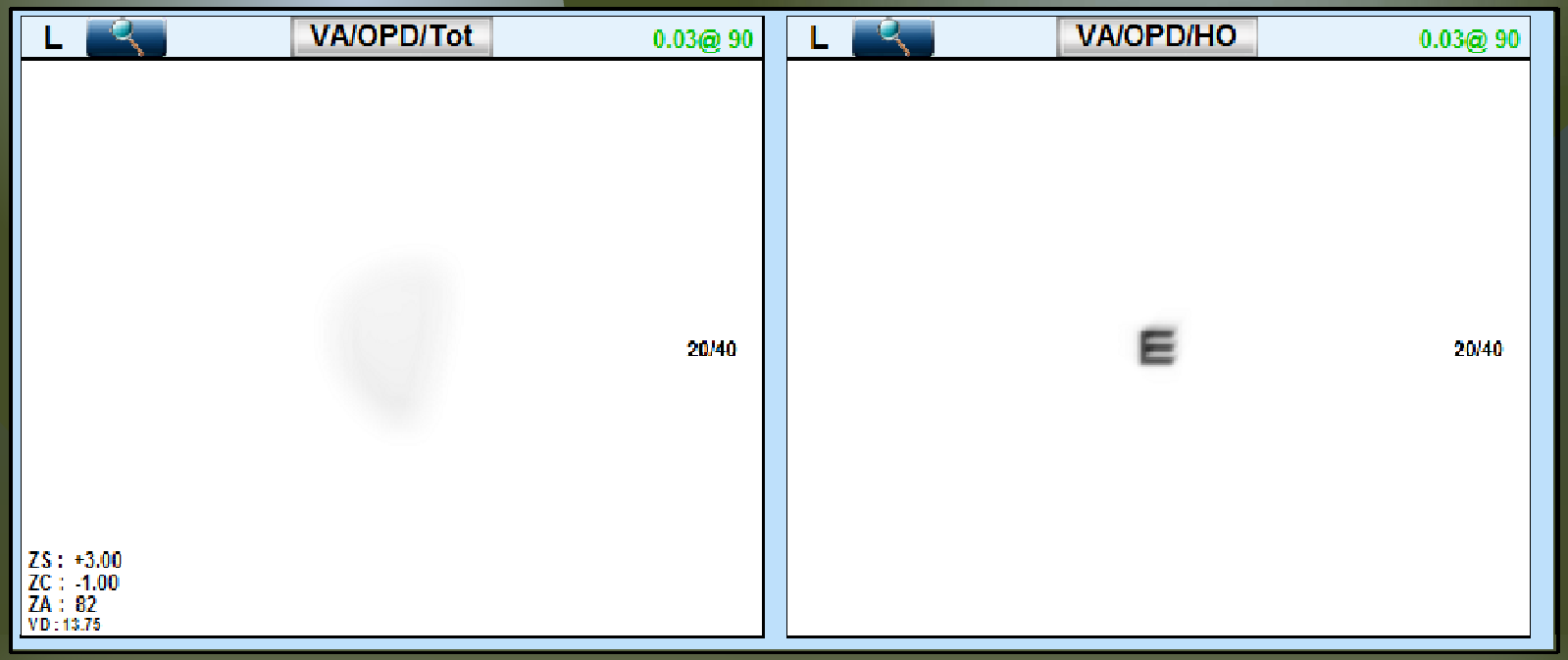
Print | Display | Back

L

Retro image

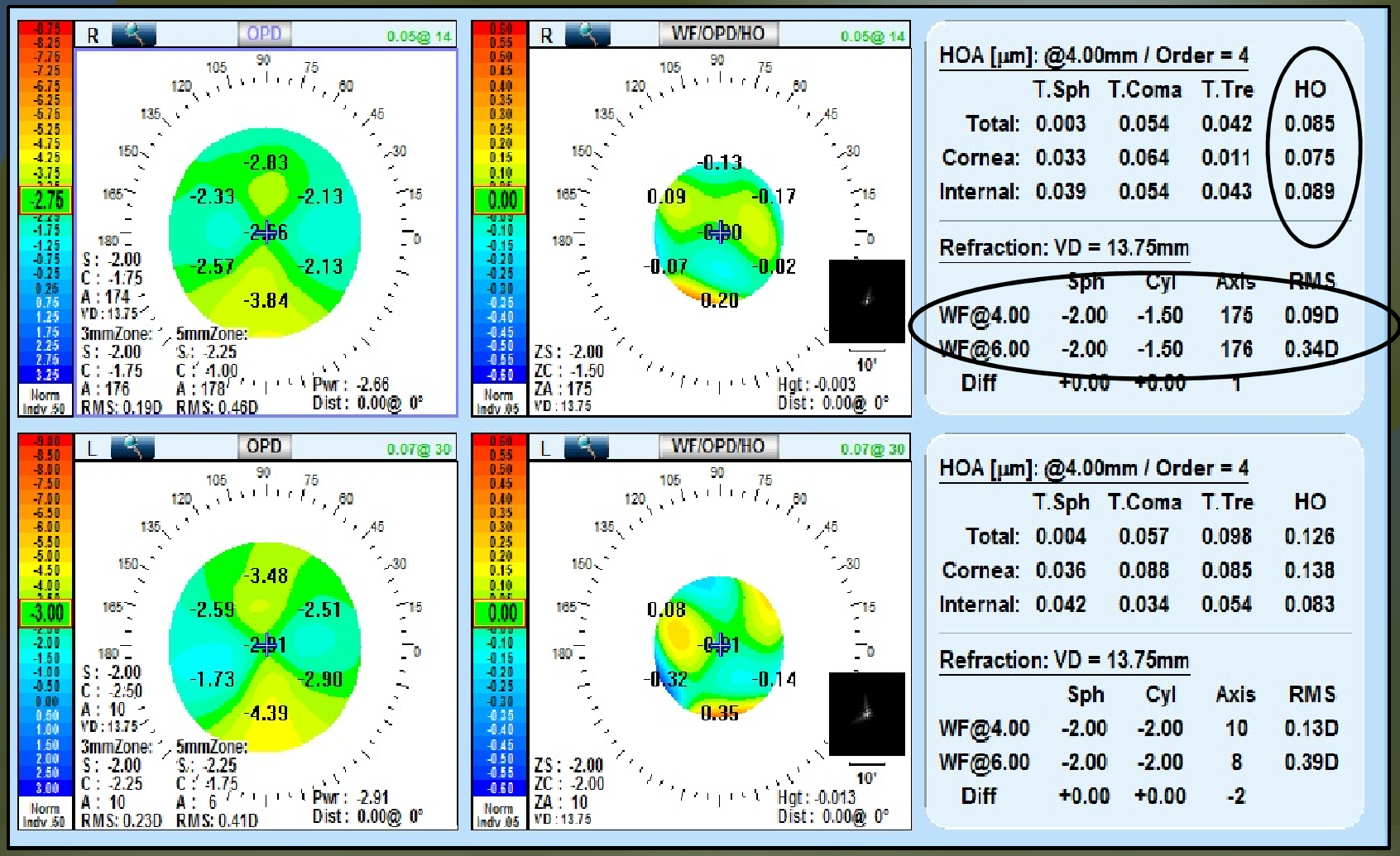
0.00@ 0


R
VA/OPD/Tot
0.00@ 0
20/40
ZS : +4.00
ZC : -1.75
ZA : 119
VD : 13.75
R
VA/OPD/HO
0.00@ 0
20/40


L
VA/OPD/Tot
0.03@ 90
20/40
ZS : +3.00
ZC : -1.00
ZA : 82
VD : 13.75
L
VA/OPD/HO
0.03@ 90
20/40

Night and Day Refractions

Correctible



HOA [μm]: @4.00mm / Order = 4

	T.Sph	T.Coma	T.Tre	HO
Total:	0.003	0.054	0.042	0.085
Cornea:	0.033	0.064	0.011	0.075
Internal:	0.039	0.054	0.043	0.089

Refraction: VD = 13.75mm

	Sph	Cyl	Axis	RMS
WF@4.00	-2.00	-1.50	175	0.09D
WF@6.00	-2.00	-1.50	176	0.34D
Diff	+0.00	+0.00	1	

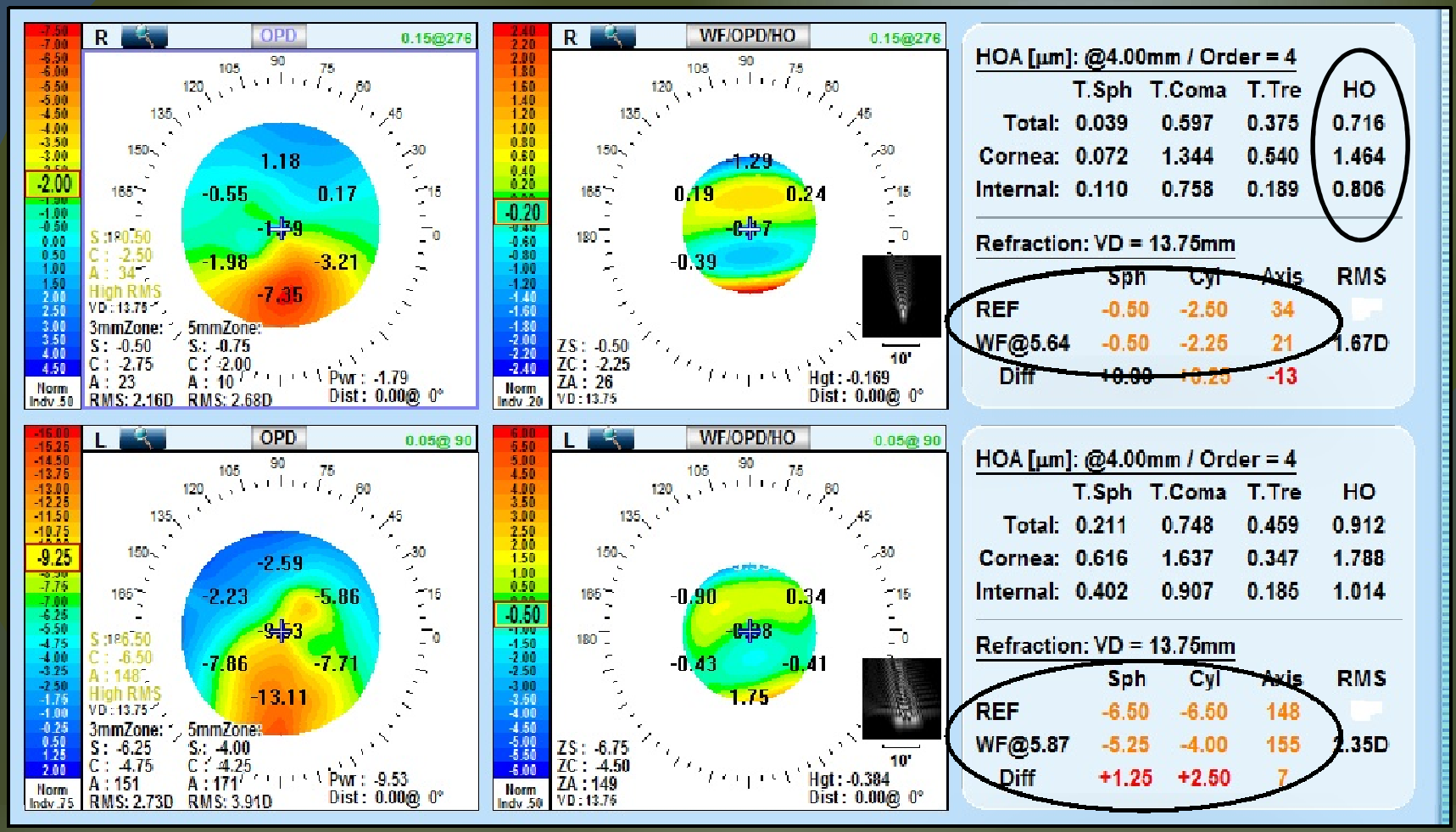
HOA [μm]: @4.00mm / Order = 4

	T.Sph	T.Coma	T.Tre	HO
Total:	0.004	0.057	0.098	0.126
Cornea:	0.036	0.088	0.085	0.138
Internal:	0.042	0.034	0.054	0.083

Refraction: VD = 13.75mm

	Sph	Cyl	Axis	RMS
WF@4.00	-2.00	-2.00	10	0.13D
WF@6.00	-2.00	-2.00	8	0.39D
Diff	+0.00	+0.00	-2	

HOAs (High RMS) = Less Correctable



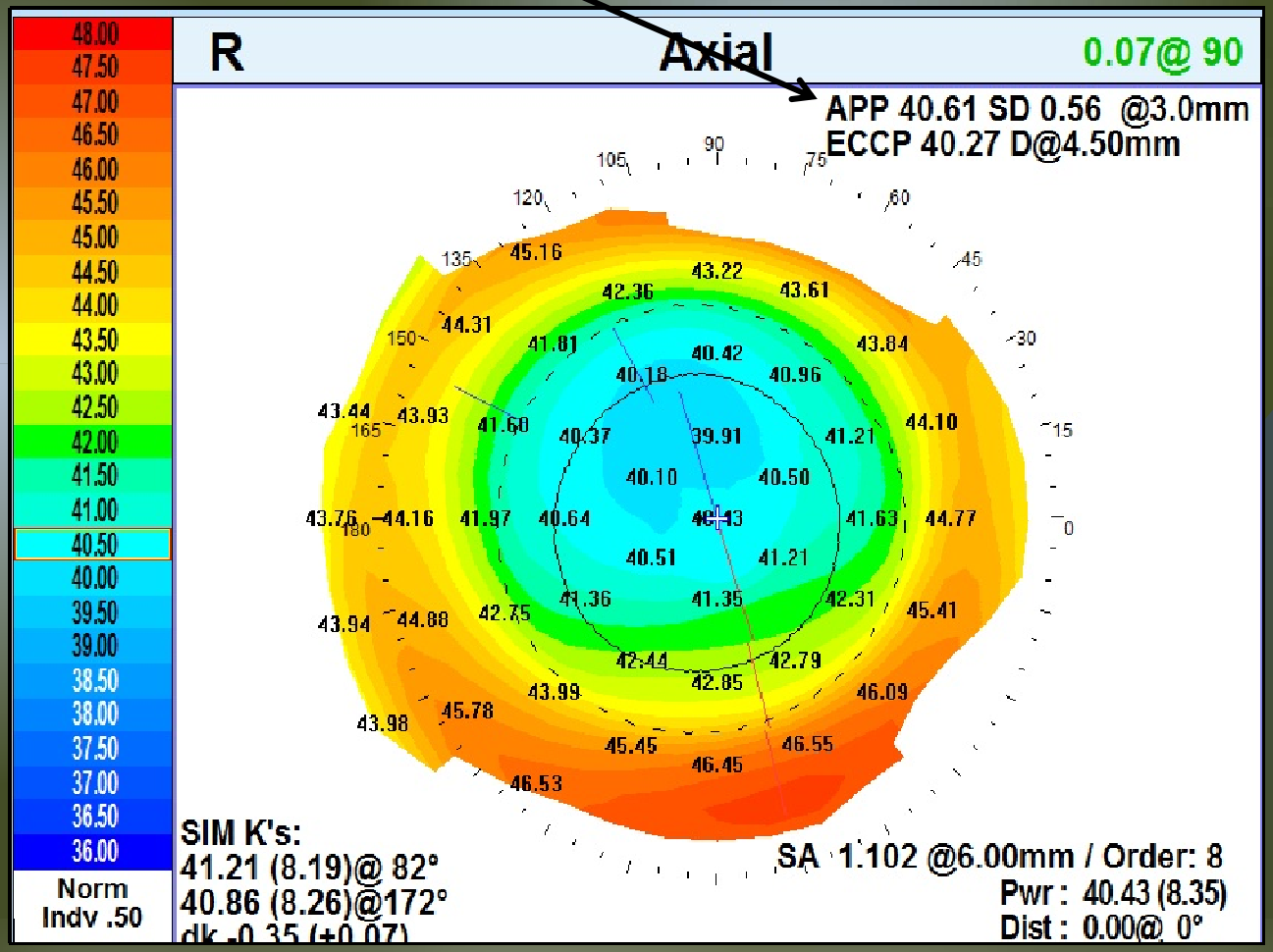
IOL Selection

There are many factors we need to assist us in selecting the best IOL for a patient

- Corneal power (post-refractive surgery)
- Spherical aberration (Aspheric)
- Corneal Astigmatism (Toric or LRIs)
- Angle Kappa (Multifocals)

APP – Average Pupil Power

The average K refractive power within the pupil



ECCP (Effective Central Corneal Power)

Obtained by correcting
keratometry values using
the mean K refractive power
within 4.5 mm – diameter area
after myopic refractive surgery and the
estimated amount of correction

ECCP
Effective Central Corneal Power

"The software looks at the Topography and then determines the 3 and 4.5 mm corneal power centered over the pupil. It then looks at periphery , around 9 mm, and determines if there is an inflection (knee), introduced by myopic ablation. It then determines what the central curvature would have been before the ablation. Knowing these values the central corneal power over the pupil can be modified to compensate for the posterior radius of the cornea, yielding the ECCP (Effective Central Corneal Power) used for IOL Calculations.

In short, the ECCP provides a K-reading to be used for IOL Calculations in post myopic Refractive surgery patients."

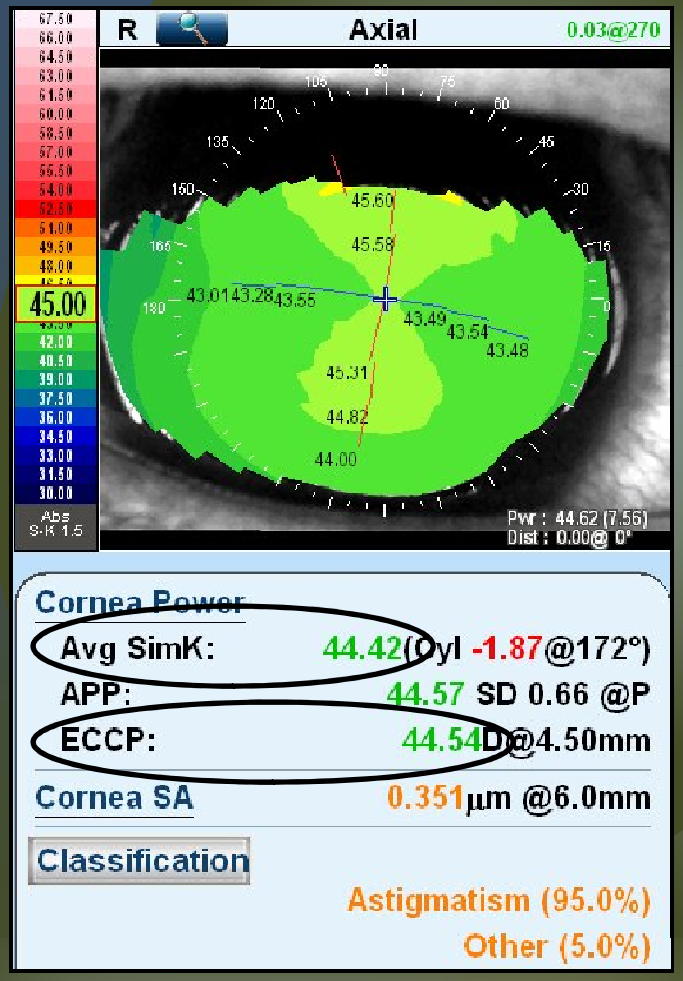
Jack Holladay, MD

ECCP (Effective Central Corneal Power)

- A better K-Value for cases where we do not have the pre-refractive surgery data
- Based on an estimation of the correction done by refractive surgery using data from the unchanged corneal periphery
- Traditional K values underestimate the true change of corneal radius by ~10%

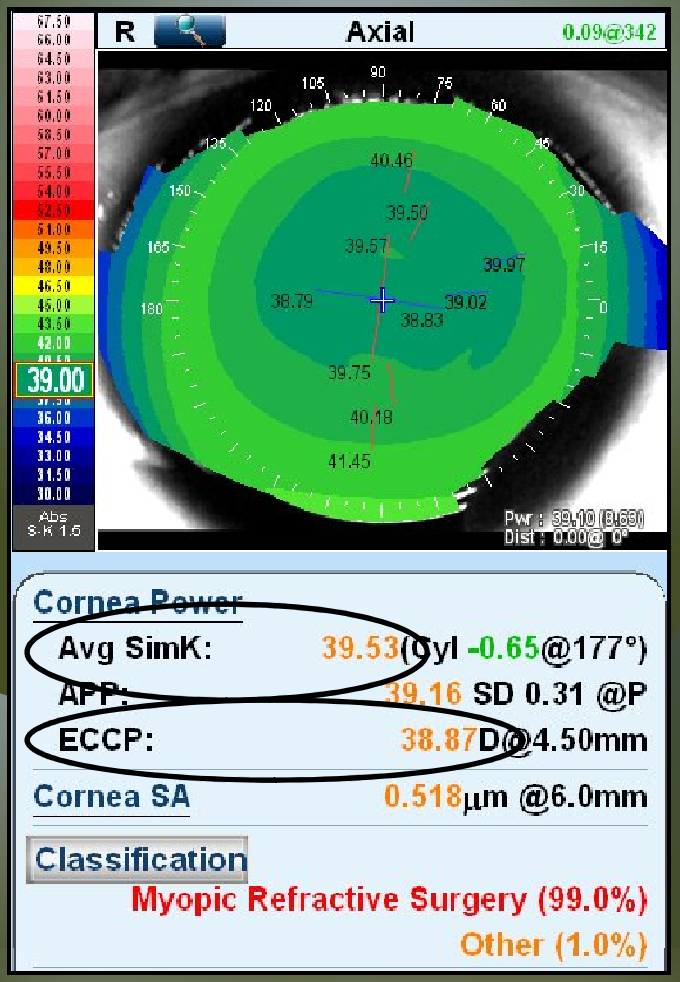
  (ratio $r_{\text{back surface}}/r_{\text{front surface}}$ changed by treatment)
- ECCP is the average corneal net. power over 4.5 zone centered on the pupil – 10% of the estimated refractive change induced by previous refractive surgery.
- IOL Calculation using standard formulas.

ECCP: a better K value in post LASIK Corneas



SimK-ECCP

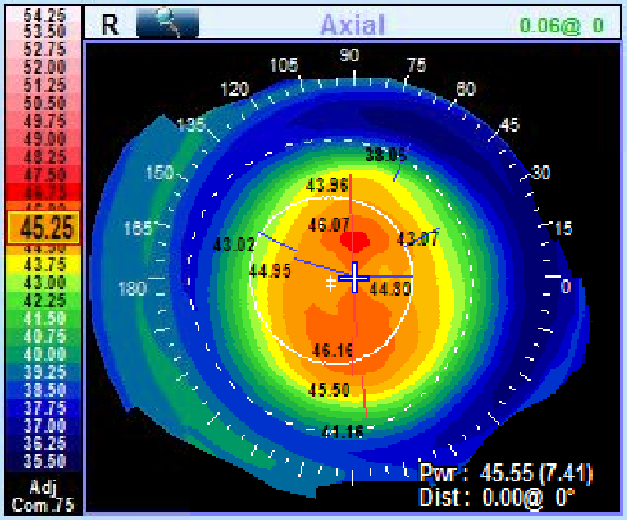
-0.08D



SimK-ECCP

0.66D

ECCP: post Hyperopic and post Myopic LASIK



Cornea Power

Avg SimK:	45.31(Cyl -1.10@174°)
APP:	44.64 SD 1.58 @6.00mm
ECCP:	45.70D@4.50mm

Cornea SA -0.872µm @6.00mm

Classification

Hyperopic Refractive Surgery (99.0%)

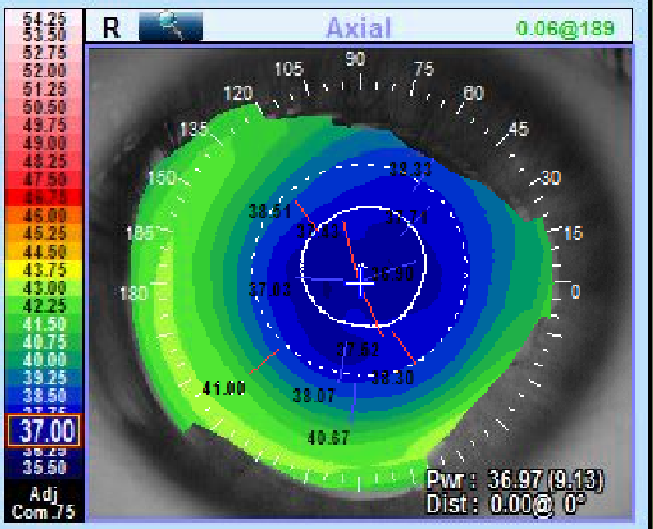
Other (1.0%)

Indices

SRI: 1.25 IAI: 0.65

PVA: 20/20 LogMAR: 0.04

SimK-ECCP -0.39D



Cornea Power

Avg SimK:	37.52(Cyl -0.38@ 36°)
APP:	37.86 SD 0.90 @6.00mm
ECCP:	36.65D@4.50mm

Cornea SA 0.883µm @6.00mm

Classification

Myopic Refractive Surgery (99.0%)

Other (1.0%)

Indices

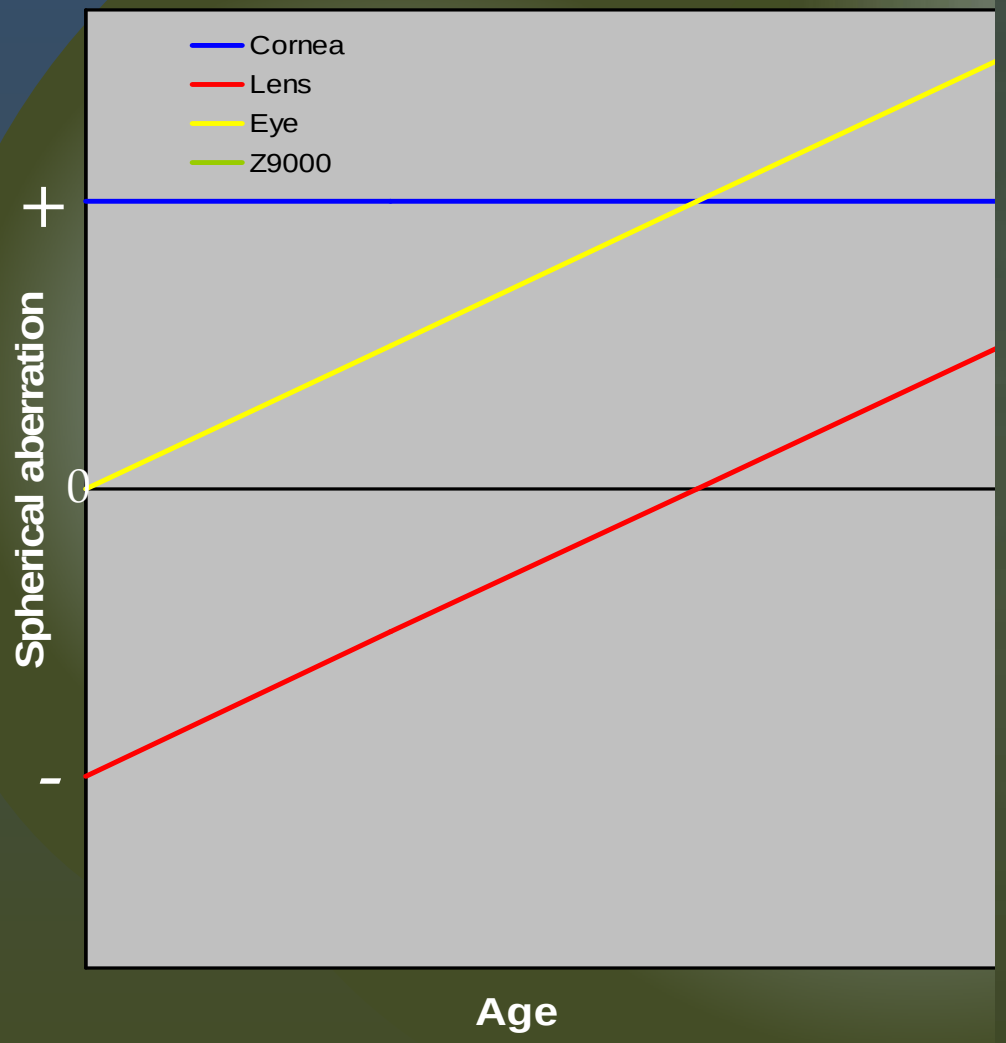
SRI: 0.81 IAI: 0.54

PVA: 20/20 LogMAR: -0.04

SimK-ECCP +0.87D

Spherical Aberration

SA of the Eye Increases with Age



Aspheric IOLs

- Theoretical goal : Final Spherical Aberration = 0

Aspheric IOLs

Mean residual SA of +0.10 μ

May yield the best contrast sensitivity

Beiko GH. Personalized correction of spherical aberration in cataract surgery. *J Cataract Refract Surg* 2007;33(8):1455-60

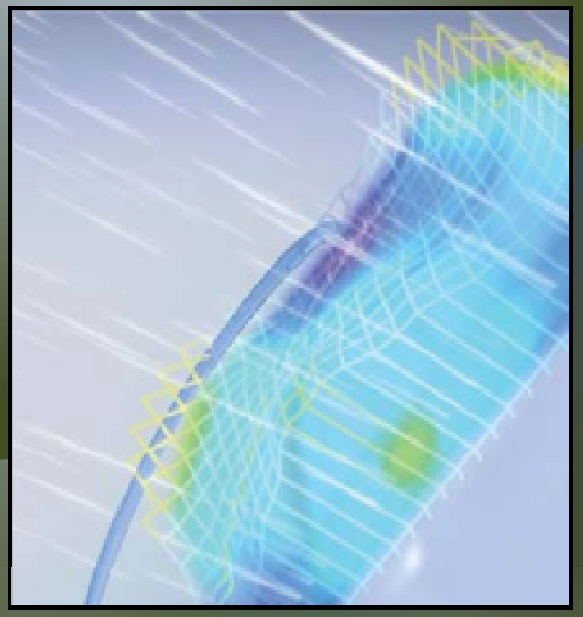
Aspheric IOLs

- Theoretical goal : Final Spherical Aberration = 0
- Measuring the SA of the cornea allows us to predict the SA that will remain when the cataract is removed

Aspheric IOLs

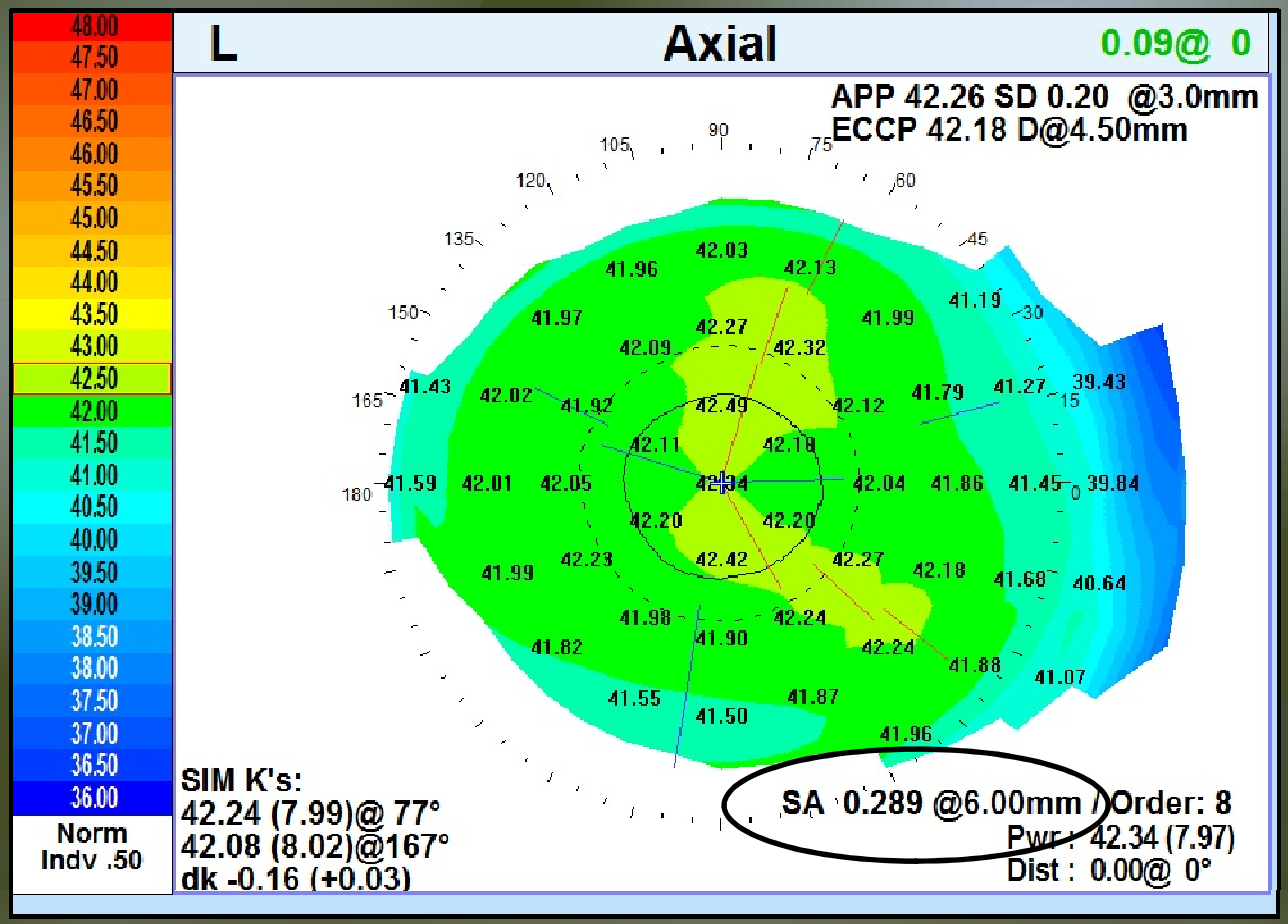
Average cornea +.27μ SA

- AMO Tecnis® Z9000 - .27 μ
- Alcon AcrySof® SN60WF - .20 μ
- Hoya AF-1 iSpheric IOL - .18 μ
- Staar® Surgical (AQ2015) - .08 μ
- B&L Sofport® (Akreos™ AO) 0 μ
- Spherical (monofocal) +.15 μ



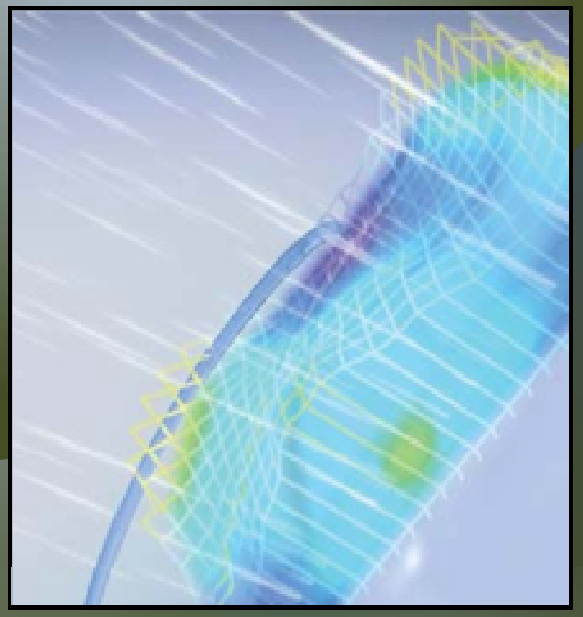
Average Cornea

No previous treatments



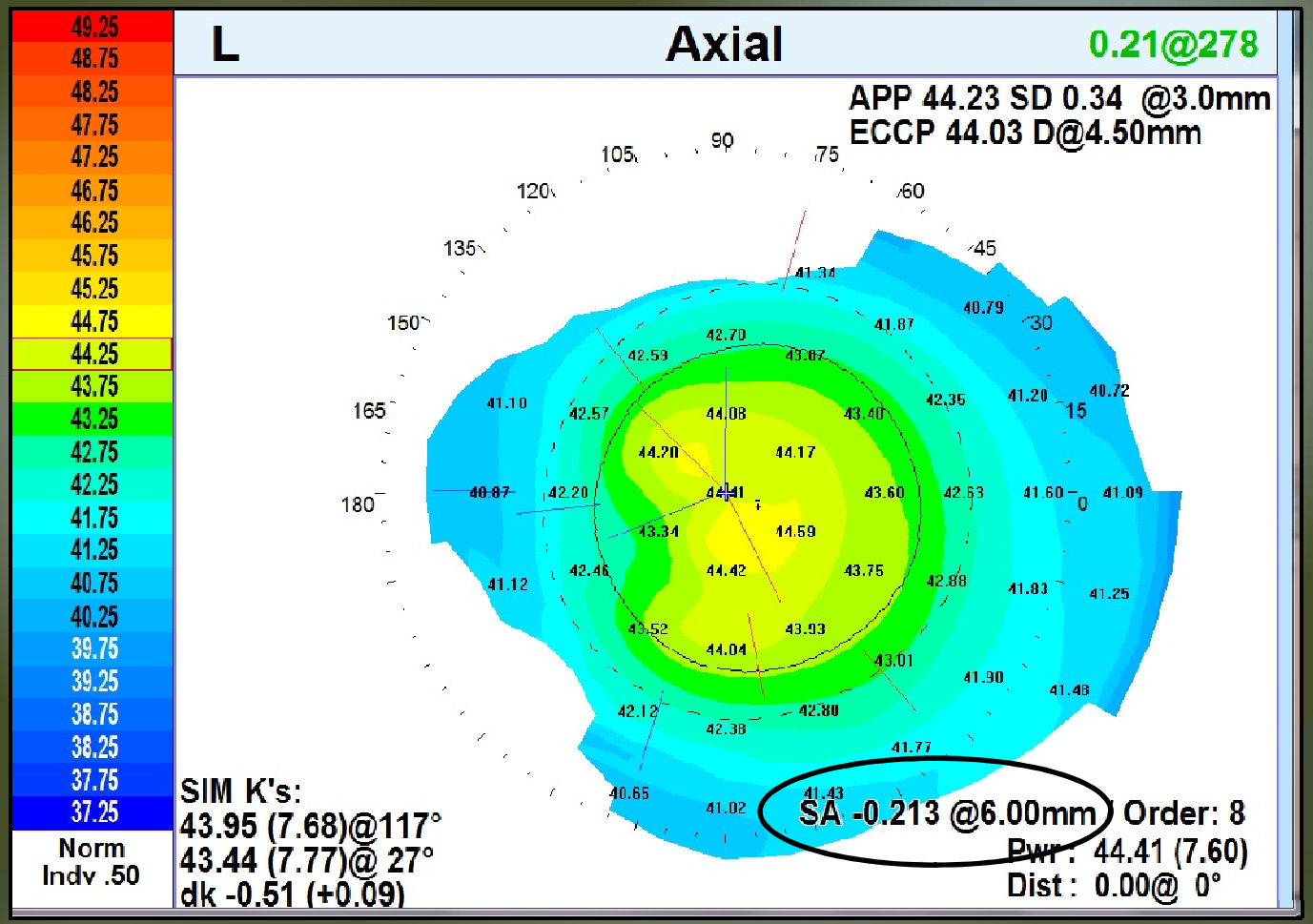
Aspheric IOLs

- AMO Tecnis® Z9000 - .27 µ
- Alcon AcrySof® SN60WF - .20 µ
- Hoya AF-1 iSpheric IOL - .18 µ
- Staar® Surgical (AQ2015) - .08 µ
- B&L Sofport® (Akreos™ AO) 0 µ
- Spherical (monofocal) +.15 µ



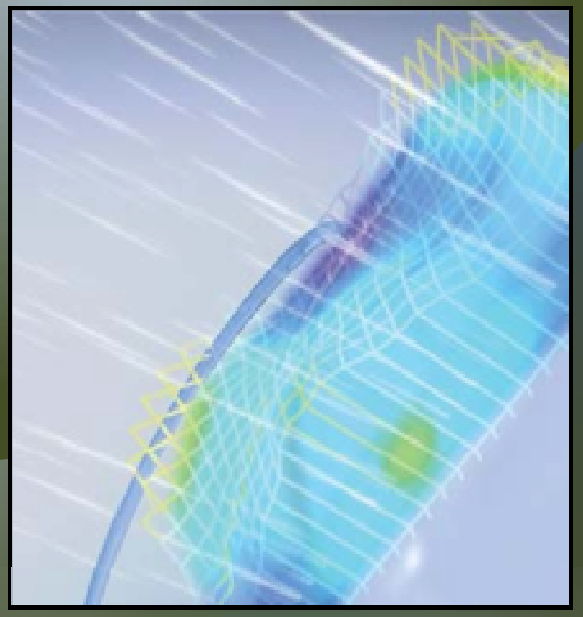
Post Hyperopic LASIK

Induces Negative SA



Aspheric IOLs

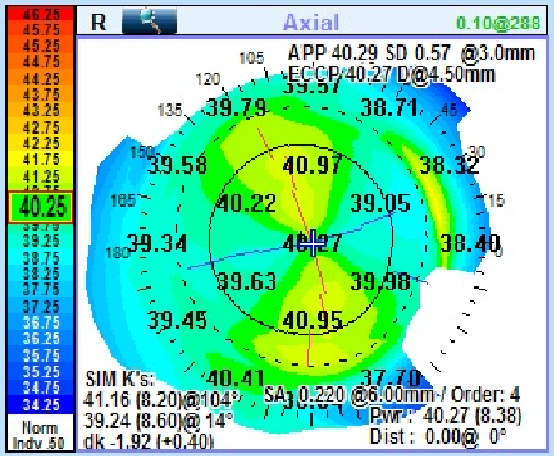
- AMO Tecnis® Z9000 - .27 µ
- Alcon AcrySof® SN60WF - .20 µ
- Hoya AF-1 iSpheric IOL - .18 µ
- Staar® Surgical (AQ2015) - .08 µ
- B&L Sofport® (Akreos™ AO) 0 µ
- Spherical (monofocal) +.15 µ

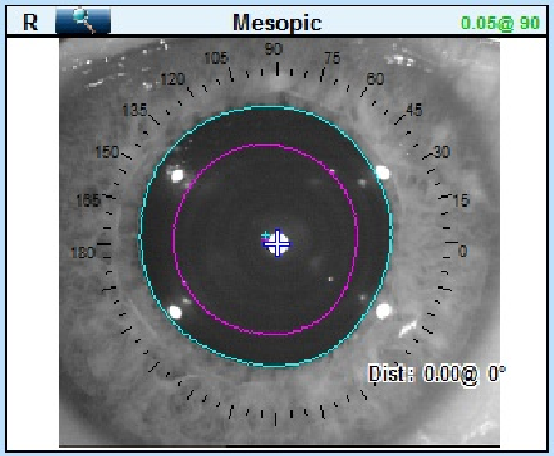


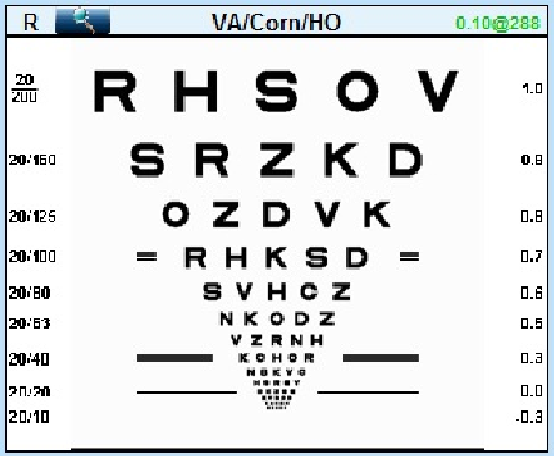
Toric IOLs

OPD III is a great device for pre and postoperative Toric IOL evaluations

Cataract Summary Check Pre Op







Cornea Power

Avg SimK:	40.20(Cyl -1.92@ 14°)
APP:	40.29 SD 0.57 @3.00mm
ECCP:	40.27D@4.50mm
Cornea SA	0.220µm @6.0mm

Cyl: VD = 0.0mm

Total	Cornea	Internal
-1.25@ 17°	-1.92@ 14°	-0.30@ 84°

Pupil Information

Photopic	4.79mm / dist 0.33@159°
Mesopic	6.52mm / dist 0.37@145°
Dist to P/M	0.09@ 84°
Retro	

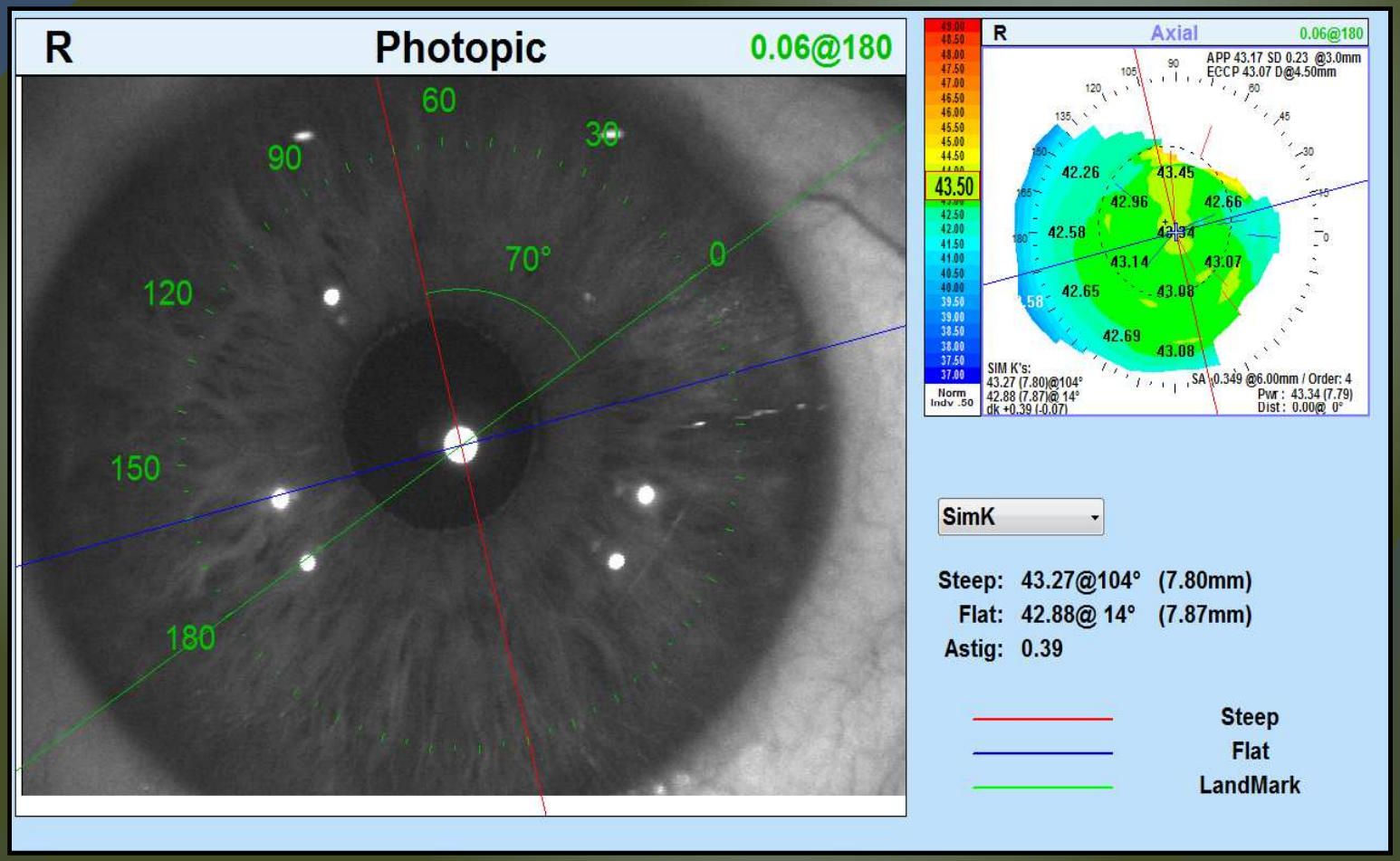
HOA [µm]: @4.00mm / Order = 4

	T.Sph	T.Coma	T.Tre	HO
Total:	0.104	0.034	0.178	0.225
Cornea:	0.037	0.044	0.024	0.080
Internal:	0.145	0.068	0.157	0.233

Refraction: VD = 13.75mm

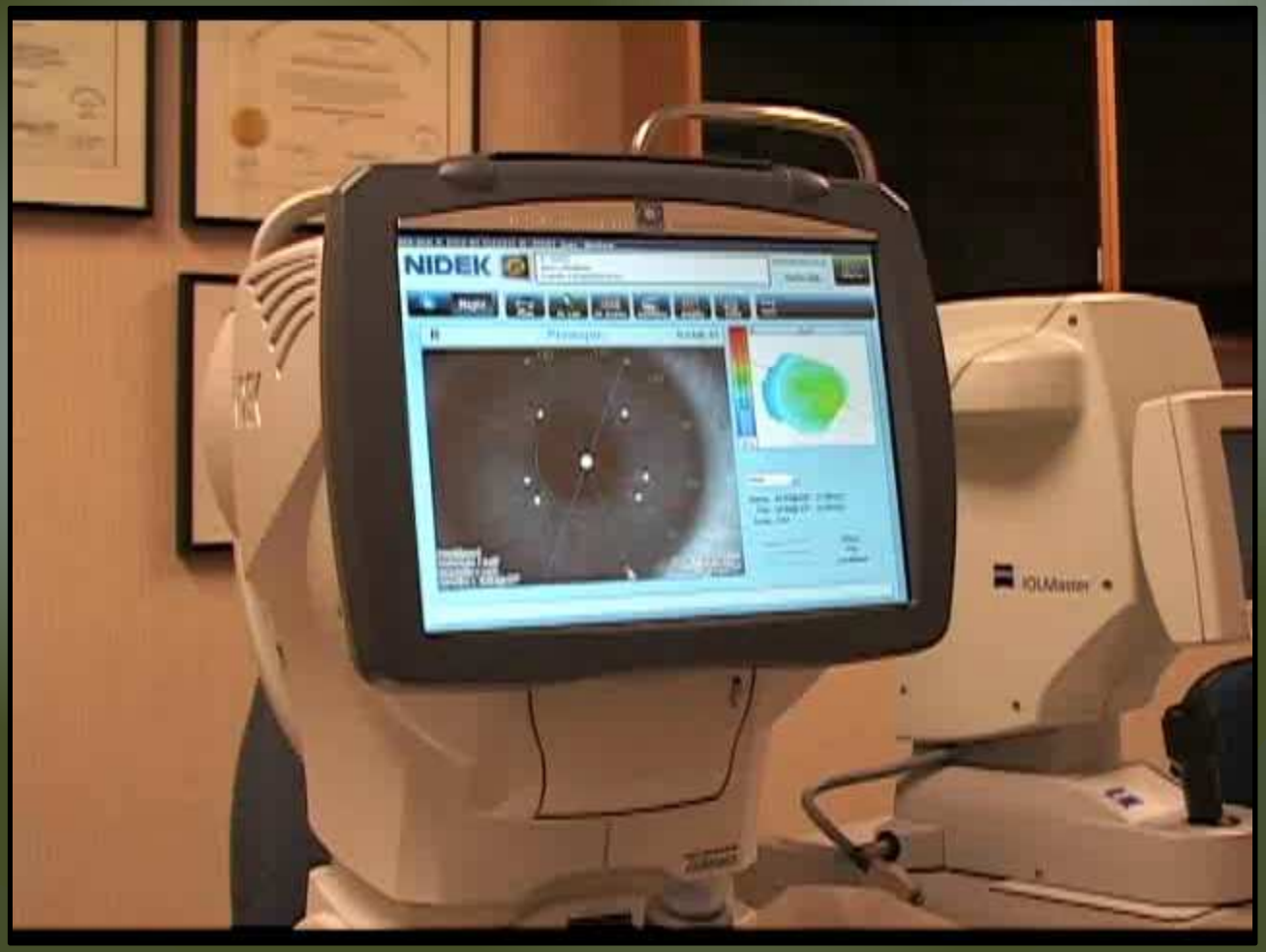
	Sph	Cyl	Axis	RMS
WF@4.00	-3.25	-1.75	17	0.23D
WF@6.00	-2.50	-2.00	18	0.53D
Diff	+0.75	-0.25	1	

TORIC IOL Summary



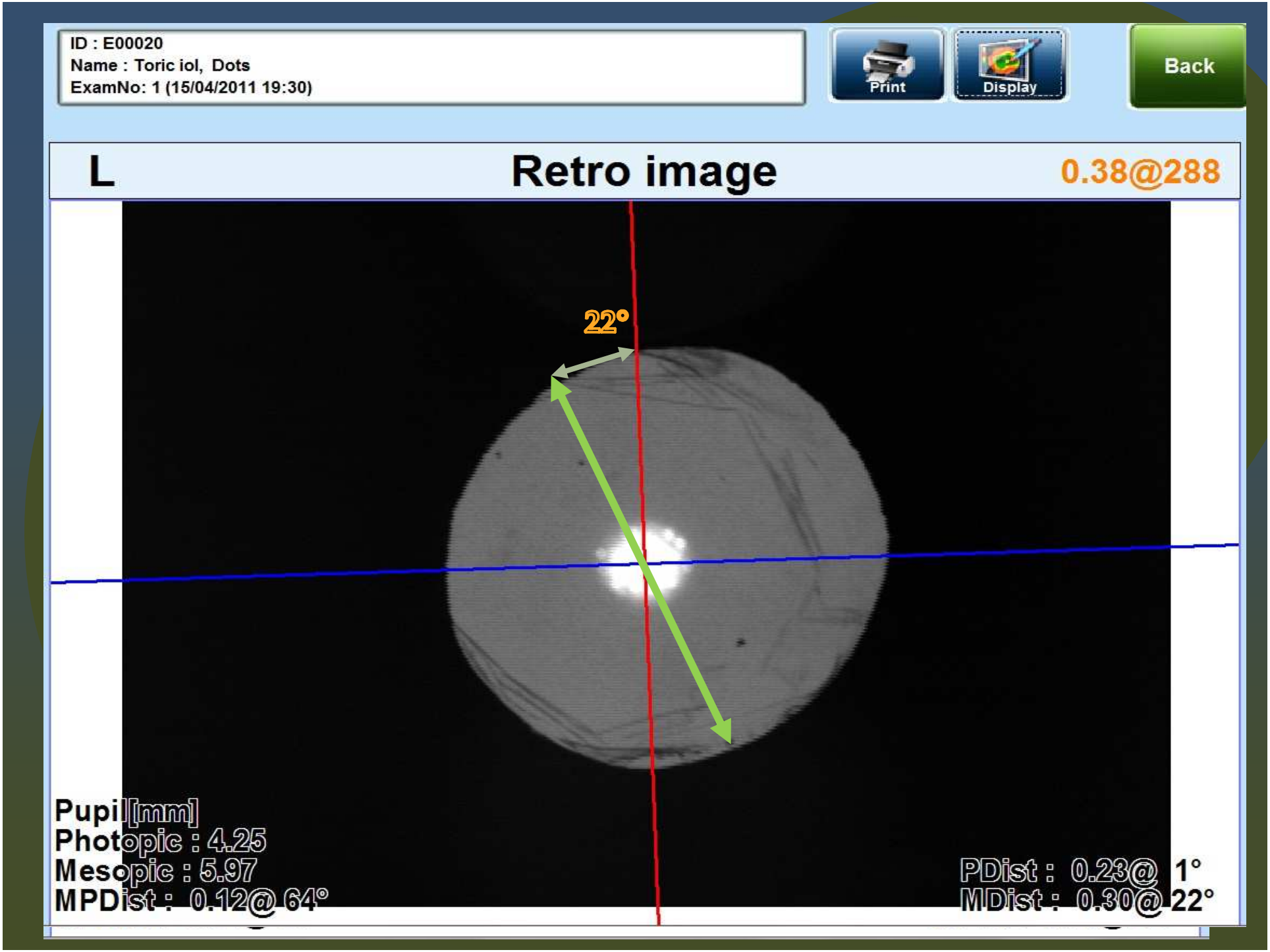
Printout allows you to accurately mark cornea based on landmarks on iris or blood vessel on sclera and gage axis

Toric IOL Summary

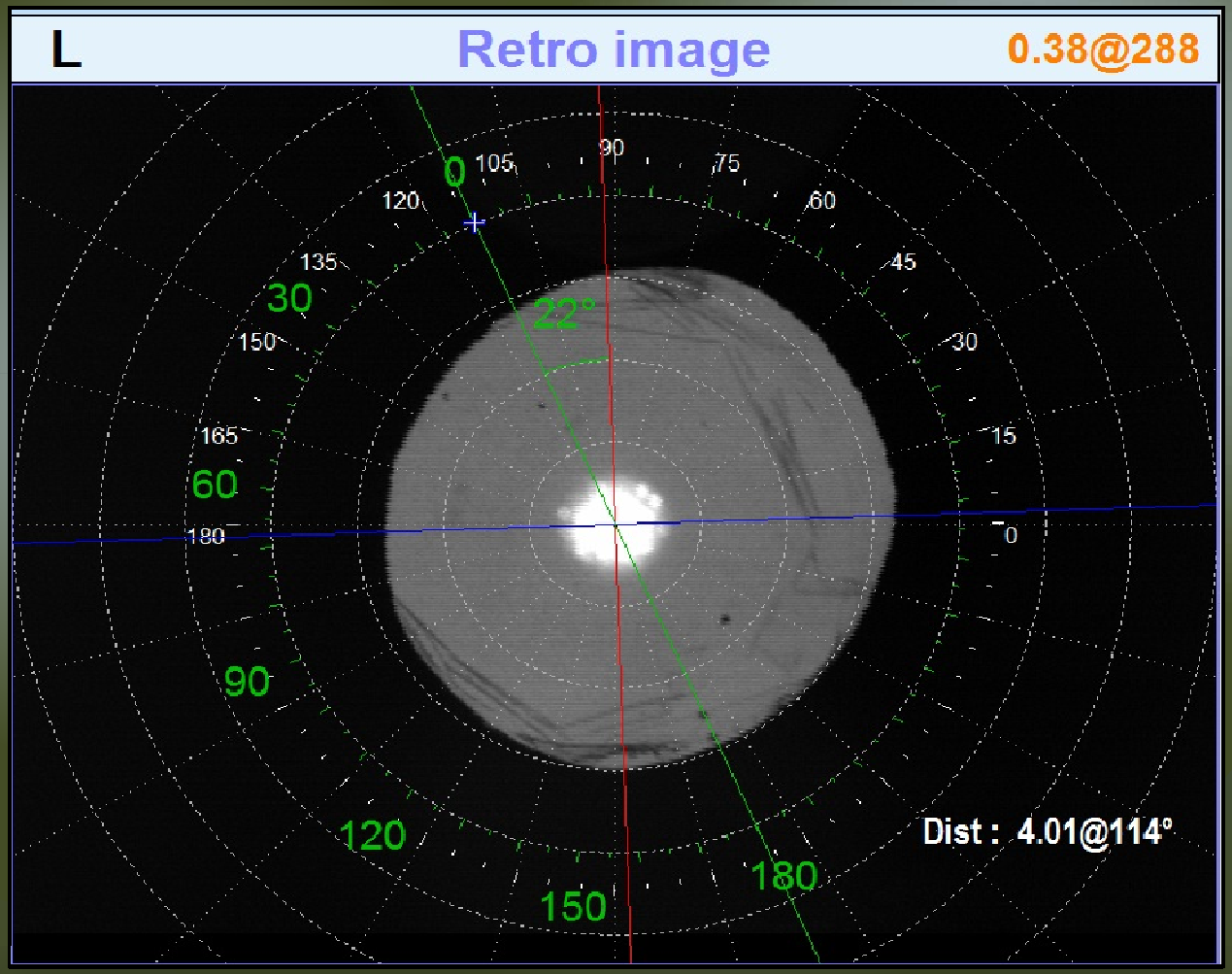


Case

- Patient has toric IOL implants OD/OS
- Patient has not been happy with vision OS
- Patient has had YAG
- Patient is doctor's wife
- Patient is not happy….doctor is not happy!

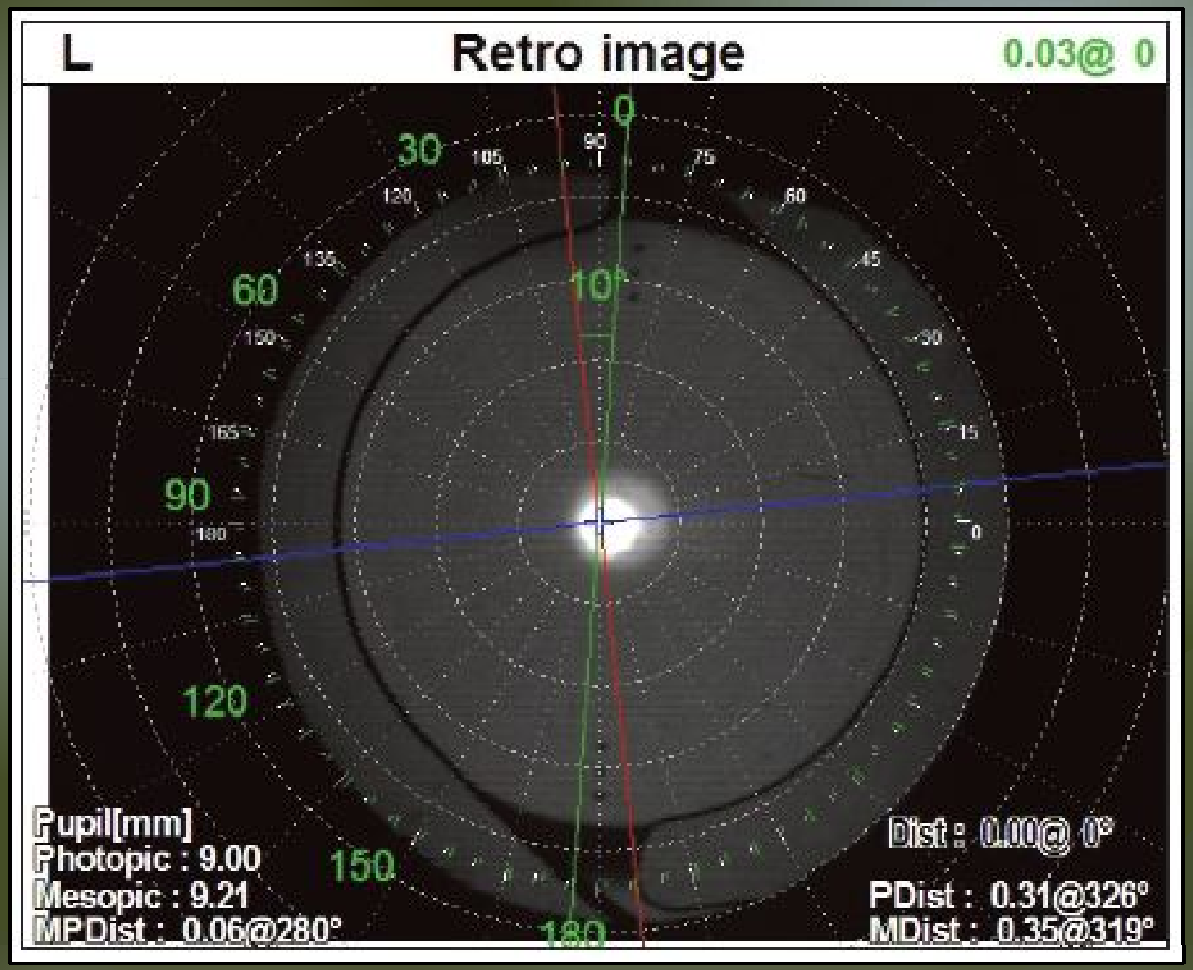

ID : E00020
Name : Toric iol, Dots
ExamNo: 1 (15/04/2011 19:30)
Print
Display
Back
L
Retro image
0.38@288
22°
Pupil[mm]
Photopic : 4.25
Mesopic : 5.97
MPDist : 0.12@ 64°
PDist : 0.23@ 1°
MDist : 0.30@ 22°

How do we know it is 22° ?

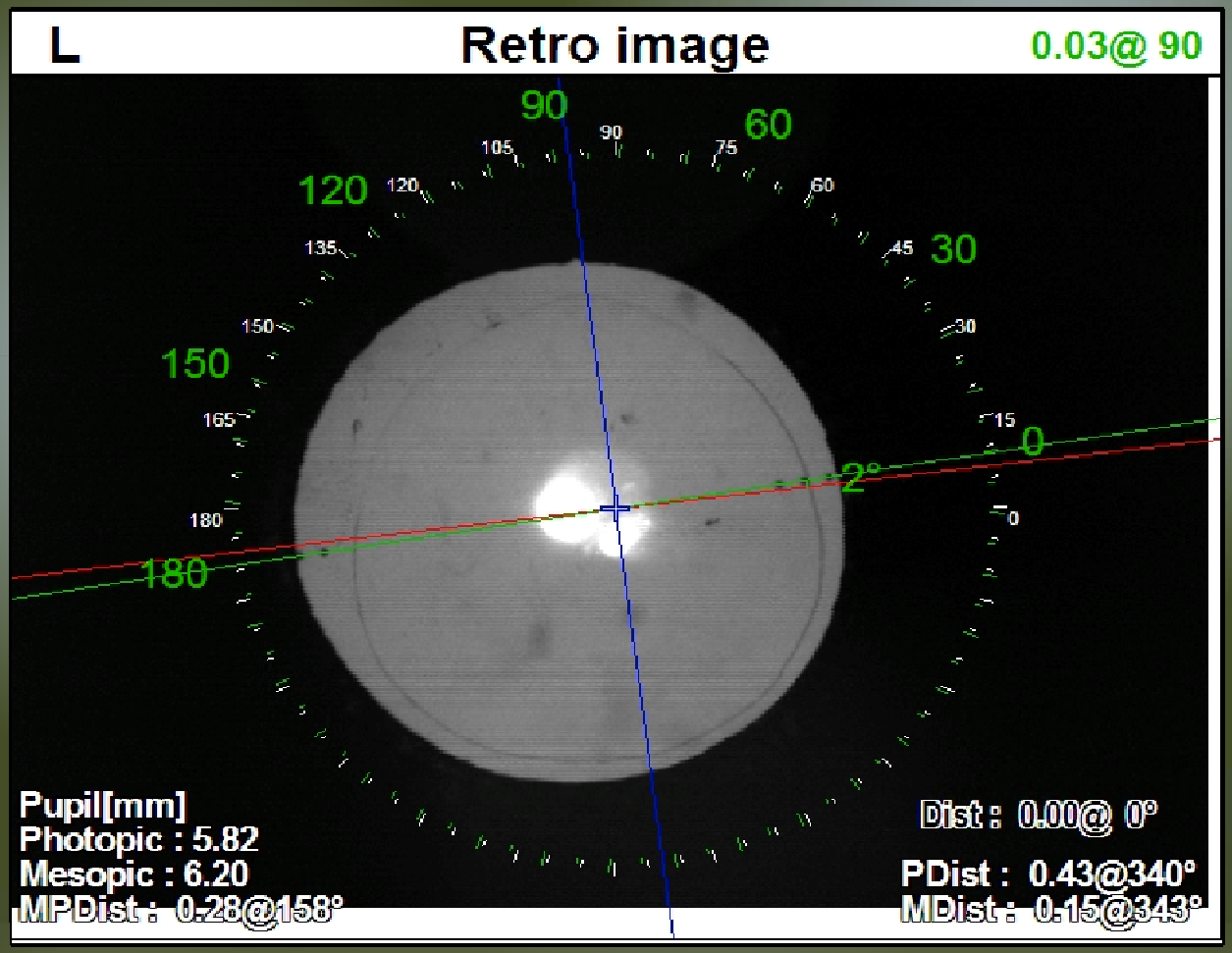


Toric IOL Summary

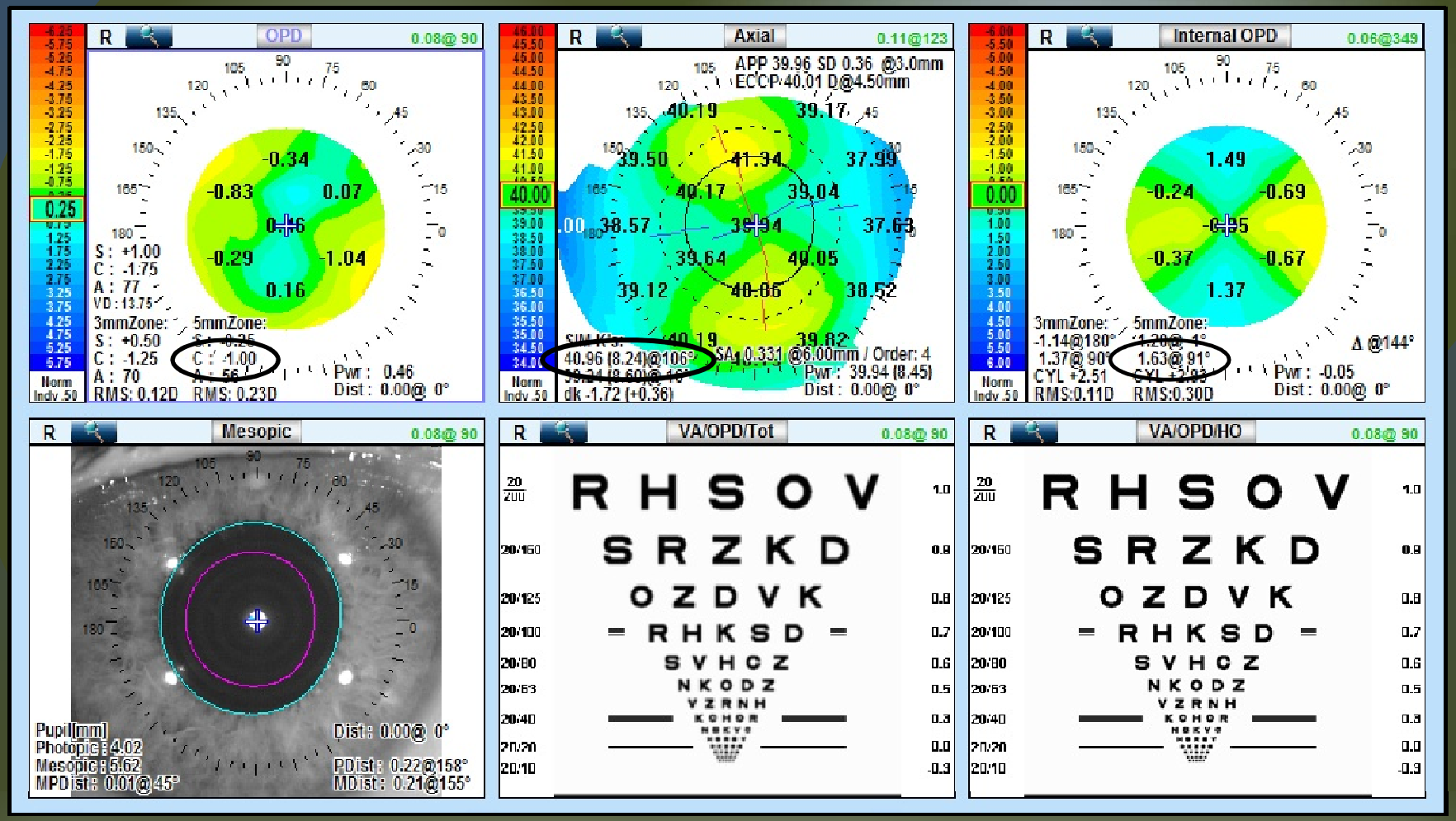
10 degree = 34% reduced effect



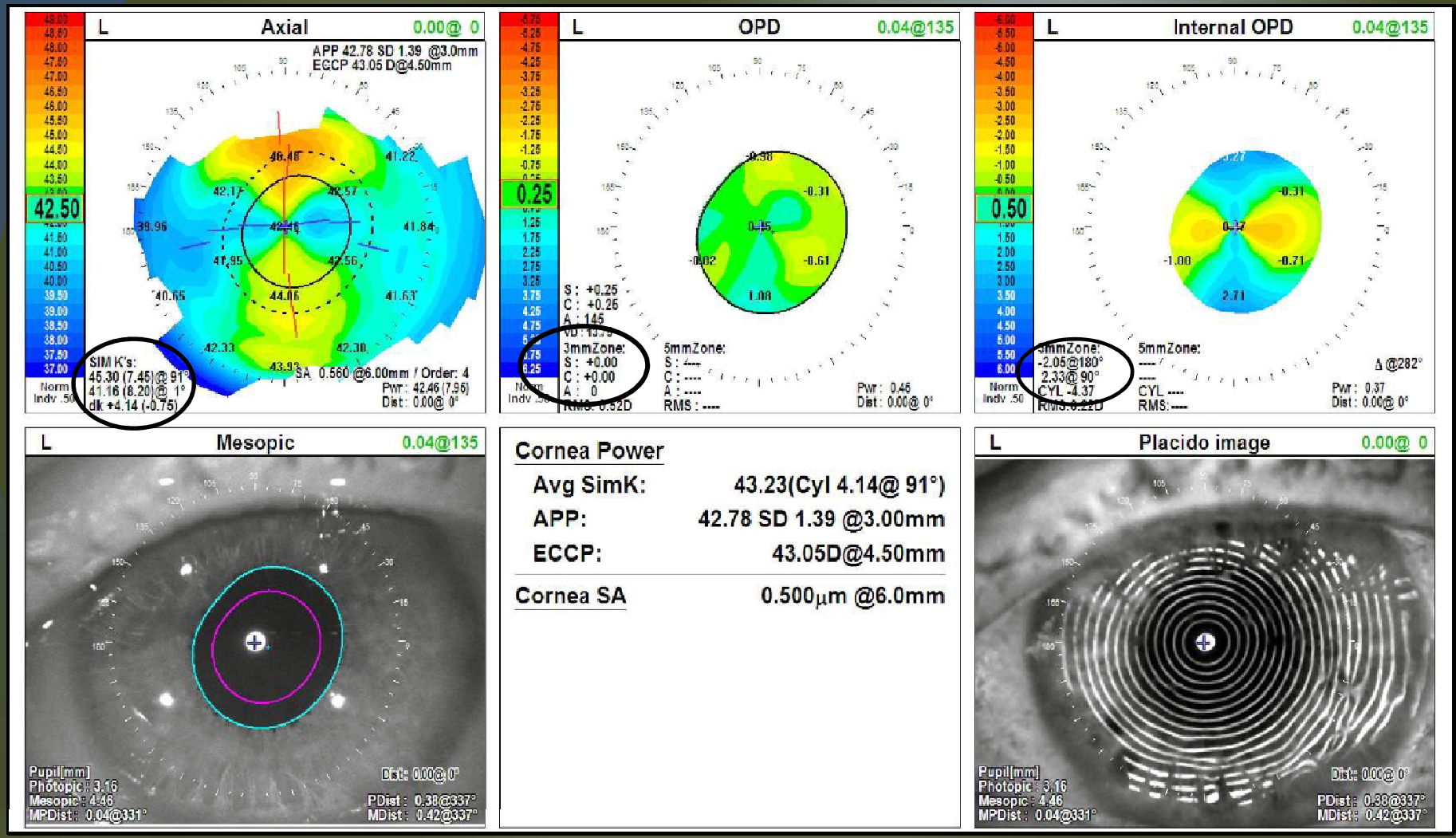
Toric IOL Summary



What if Toric IOL marks are not visible ?

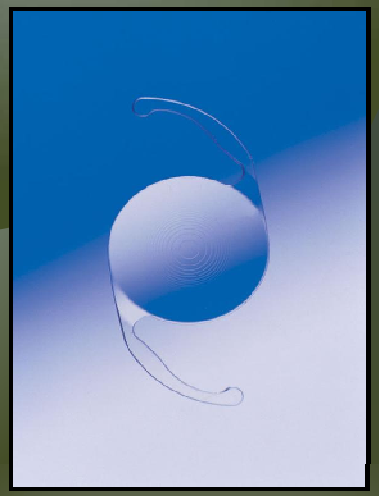


What if Toric IOL marks are not visible ?



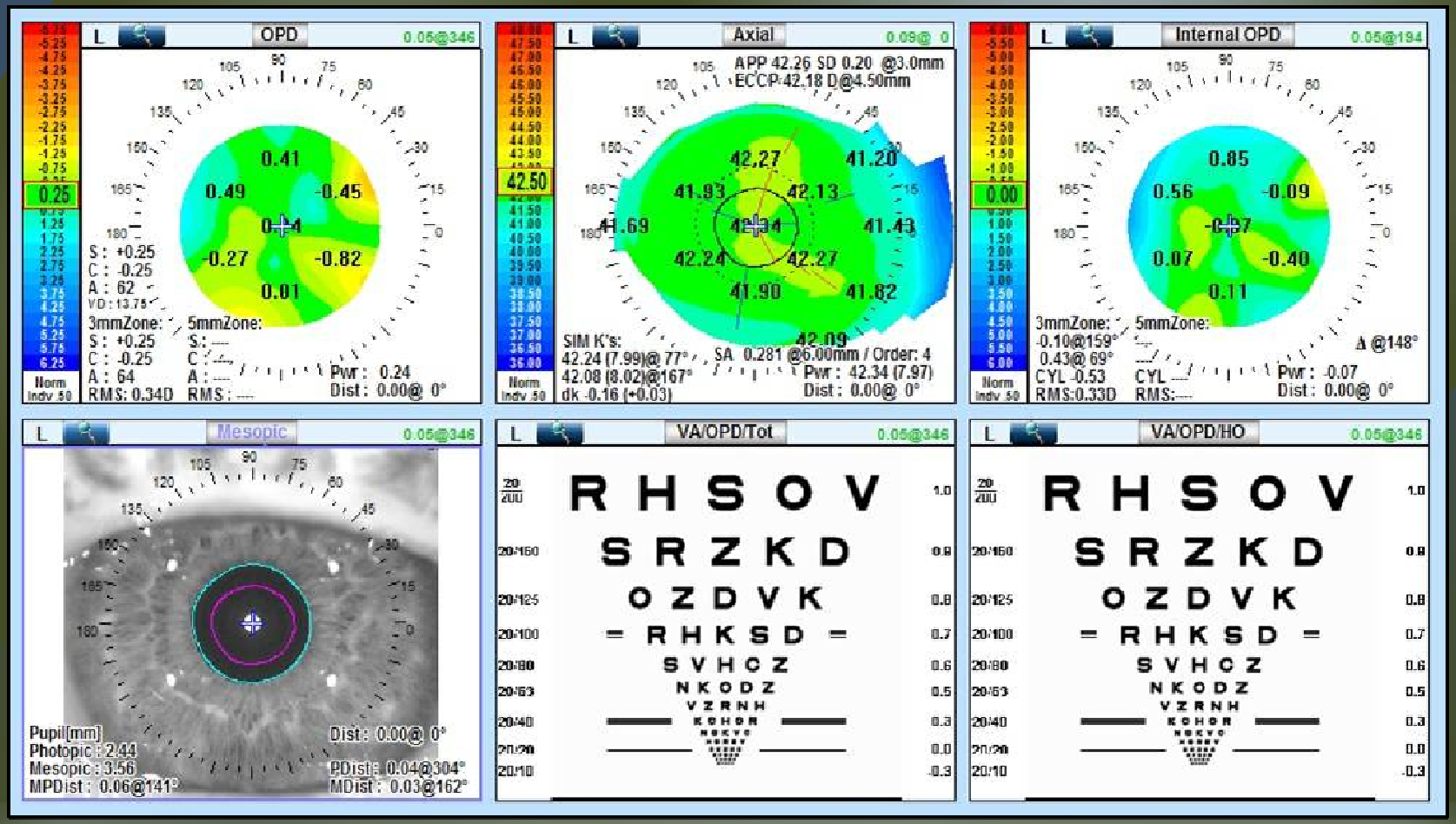
Multifocal IOLs

- Why do some patients have no problems and others do ?
  - Biggest contribution to glare and aberrations is residual refractive error
  - Angle kappa



Multifocal IOLs

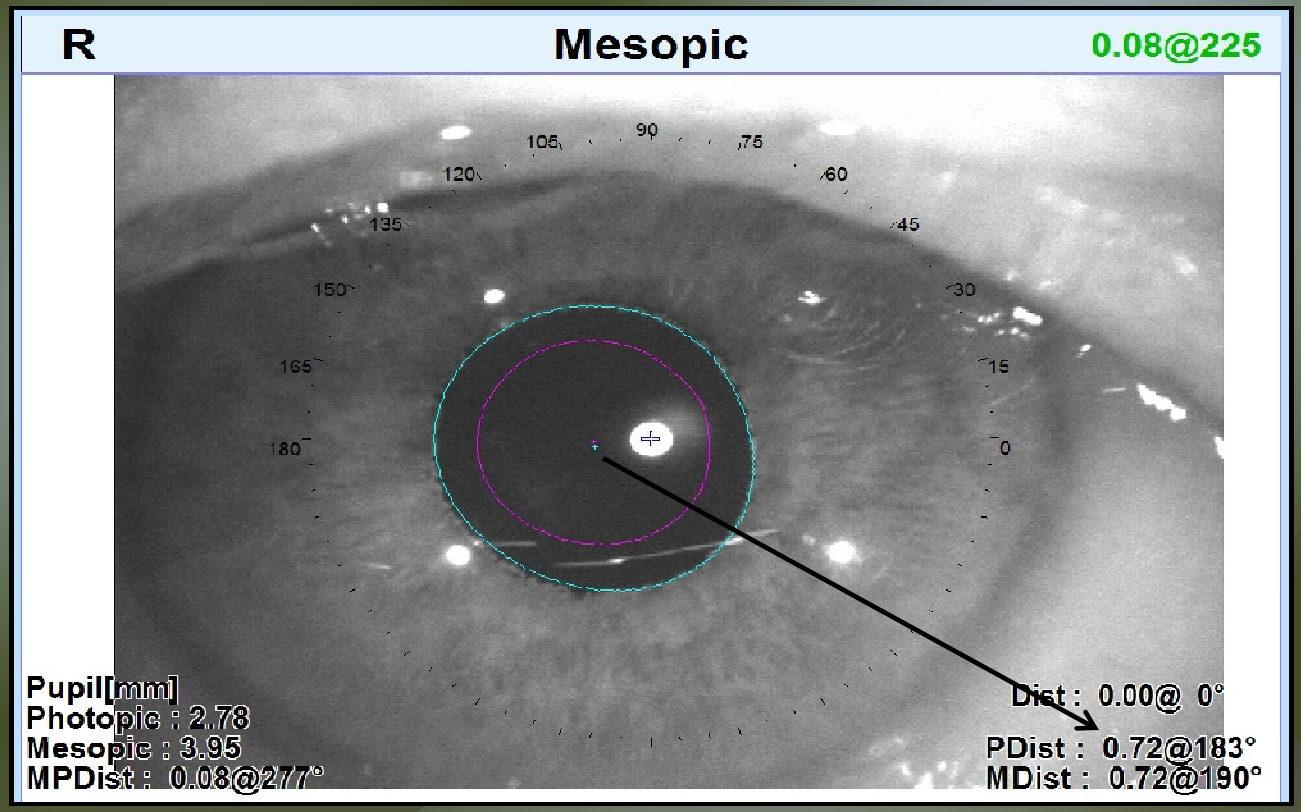
Good Candidate



Multifocal IOLs

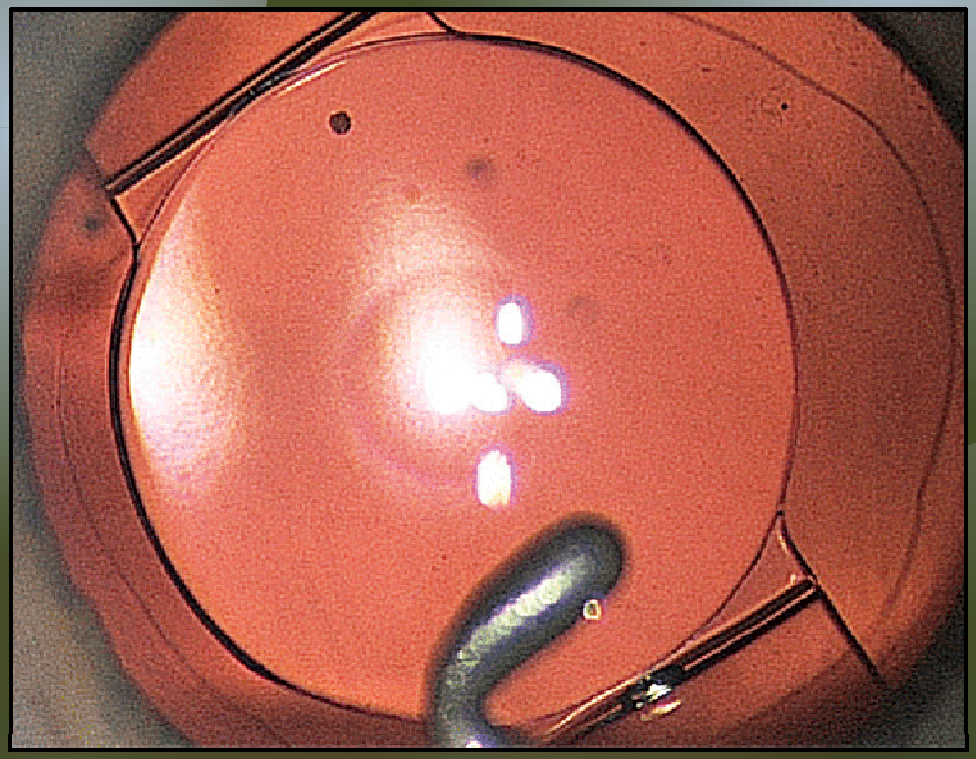
Not so good candidate

High Angle Kappa



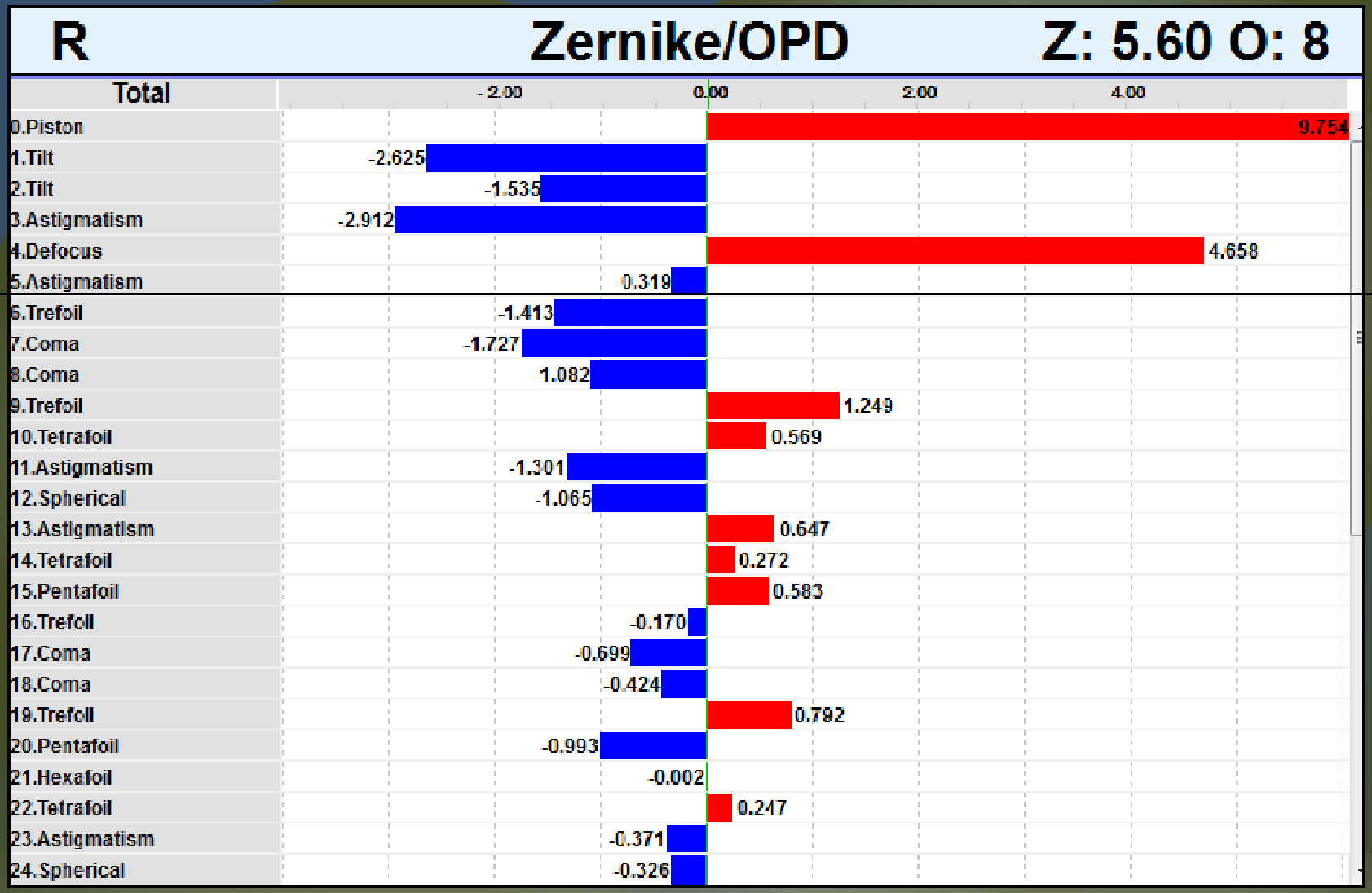
Greater than 0.4 mm = poor multifocal candidate

Crystalens HD



Removed from the market

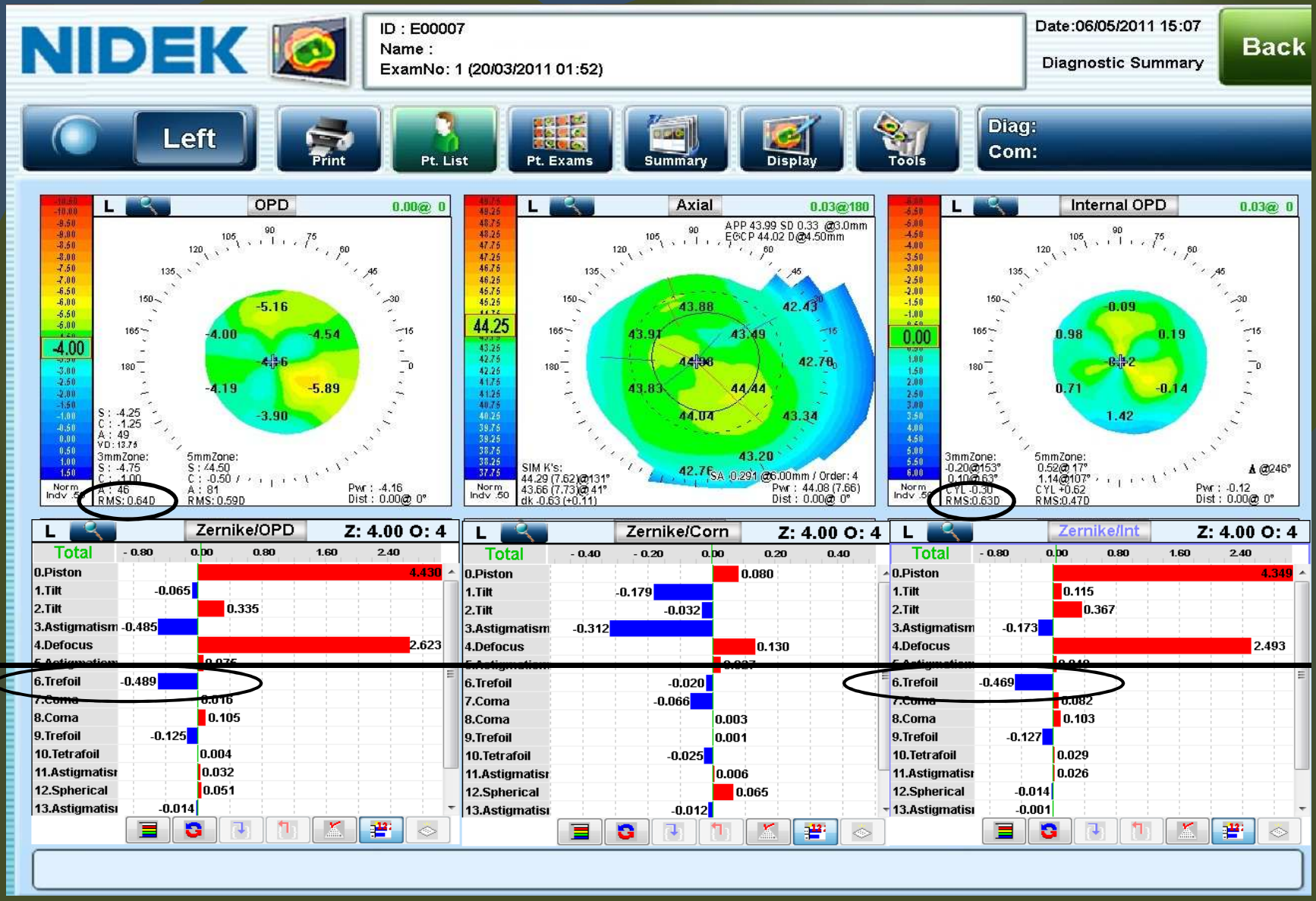
Wavefront Analysis


R
Zernike/OPD
Z: 5.60 O: 8
Total
- 2.00
0.00
2.00
4.00
0.Piston 9.754
1.Tilt -2.625
2.Tilt -1.535
3.Astigmatism -2.912
4.Defocus 4.658
5.Astigmatism -0.319
6.Trefoil -1.413
7.Coma -1.727
8.Coma -1.082
9.Trefoil 1.249
10.Tetrafoil 0.569
11.Astigmatism -1.301
12.Spherical -1.065
13.Astigmatism 0.647
14.Tetrafoil 0.272
15.Pentafoil 0.583
16.Trefoil -0.170
17.Coma -0.699
18.Coma -0.424
19.Trefoil 0.792
20.Pentafoil -0.993
21.Hexafoil -0.002
22.Tetrafoil 0.247
23.Astigmatism -0.371
24.Spherical -0.326

Halos and Glare

≤ 0.4μm RMS 0.4 to 1.0μm RMS ≥ 1.0μm RMS

Reduced Contrast Sensitivity


NIDEK
ID : E00007
Name :
ExamNo: 1 (20/03/2011 01:52)
Date:06/05/2011 15:07
Diagnostic Summary
Back
Left
Print
Pt. List
Pt. Exams
Summary
Display
Tools
Diag:
Com:
OPD
0.00@ 0
-5.16
-4.00
-4.54
-4.19
-5.89
-3.90
S : -4.25
C : -1.25
A : 49
VD : 13.75
3mmZone:
S : -4.75
C : -1.00
A : 46
RMS: 0.64D
5mmZone:
S : -4.50
C : -0.50
A : 81
RMS: 0.59D
Pwr : -4.16
Dist : 0.00@ 0°
Axial
0.03@180
APP 43.99 SD 0.33 @3.0mm
EGCP 44.02 D@4.50mm
43.88
42.43
43.91
43.49
42.78
43.83
44.44
44.04
43.34
43.20
42.76
SIM K's:
44.29 (7.62)@131°
43.66 (7.73)@41°
dk -0.63 (+0.11)
SA 0.291 @6.00mm / Order: 4
Pwr : 44.08 (7.66)
Dist : 0.00@ 0°
Internal OPD
0.03@ 0
-0.09
0.98
0.19
0.71
-0.14
1.42
3mmZone:
-0.20@153°
0.40@63°
CYL -0.30
RMS:0.63D
5mmZone:
0.52@17°
1.14@107°
CYL +0.62
RMS:0.47D
@246°
Pwr : -0.12
Dist : 0.00@ 0°
Zernike/OPD
Z: 4.00 O: 4
Zernike/Corn
Z: 4.00 O: 4
Zernike/Int
Z: 4.00 O: 4
Total
0.Piston 4.430
1.Tilt -0.065
2.Tilt 0.335
3.Astigmatism -0.485
4.Defocus 2.623
6.Trefoil -0.489
7.Coma 0.016
8.Coma 0.105
9.Trefoil -0.125
10.Tetrafoil 0.004
11.Astigmatisr 0.032
12.Spherical 0.051
13.Astigmatisr -0.014
0.Piston 0.080
1.Tilt -0.179
2.Tilt -0.032
3.Astigmatism -0.312
4.Defocus 0.130
6.Trefoil -0.020
7.Coma -0.066
8.Coma 0.003
9.Trefoil 0.001
10.Tetrafoil -0.025
11.Astigmatisr 0.006
12.Spherical 0.065
13.Astigmatisr -0.012
0.Piston 4.349
1.Tilt 0.115
2.Tilt 0.367
3.Astigmatism -0.173
4.Defocus 2.493
6.Trefoil -0.469
7.Coma 0.082
8.Coma 0.103
9.Trefoil -0.127
10.Tetrafoil 0.029
11.Astigmatisr 0.026
12.Spherical -0.014
13.Astigmatisr -0.001

Final Comments

OPD-Scan III

Powerful Pre and Postoperative Diagnostic Tool

- Autorefractor
- Keratometer
- Pupillometer
- Corneal Topographer
- Wavefront Aberrometer

OPD-Scan III

Powerful Pre and Postoperative Diagnostic Tool

- Patient Education
- Preoperative Cornea and Lens Evaluation
- IOL Selection
- Intraoperative Toric IOL Alignment
- Postoperative IOL Assessment

Obrigado