10th Evolving Practice Of Ophthalmology Middle East Conference
EPOMEC
EXPANDING VISION

Selective Measuring And Treating Isolated High Order Aberrations Of The Cornea

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- ***RABIAH MEDICAL CENTER , KUWAIT***

- ***NO FINANCIAL INTERST***

HIGH ORDER WAVEFRONT ABERRATIONS

Most of high order wave front aberration are either

1- PRIMARY
Keratoconus, PMD

2- SECONDARY
Trauma, post Laser treatment

3- IATROGENIC
To induce high order aberration on normal cornea

INDICATIONS FOR SELECTIVE HIGH ORDER ABERRATION CORRECTION

1- Cases with corneal distortion e.g.

Advanced Keratoconus , post PKP, Corneal scarring, etc…

Poor Vision even With Full Correction, due to high order aberrations, So such HOA has to be corrected before then Can Proceed For Phakic Or Aphakic Lenses

2- <u>Post Lasik Complication</u>

A- Coma (Decentered Ablation, Incomplete Flap Cut, Partial Ablation)

B- Spherical Aberration (Small Treatment Zone) With Night Vision Disturbance

3- ***<u>On Normal Cornea, To Induce Abnormal Cornea</u>***

 # ASTIGMATISM

 # COMA

 # Spherical Aberration

ASTIGMATISM

1. ***Convert Irregular To Regular***

2. ***Reduce Regular Astigmatism With Minimal Coupling Effect***

 # COMA

1. ***Decentered Ablation***
2. ***Ectasia***
3. ***PMD***

Spherical Aberration

1- Mostly Post Myopic Laser Correction

2- We May Intend To Increasing Spherical Aberration Fo Presbyopia Management By Increasing Depth of Focus

(inducing irregularity on regular cornea)

Ocular Wave Front Aberration

- *Low Order Wave Front Aberration*

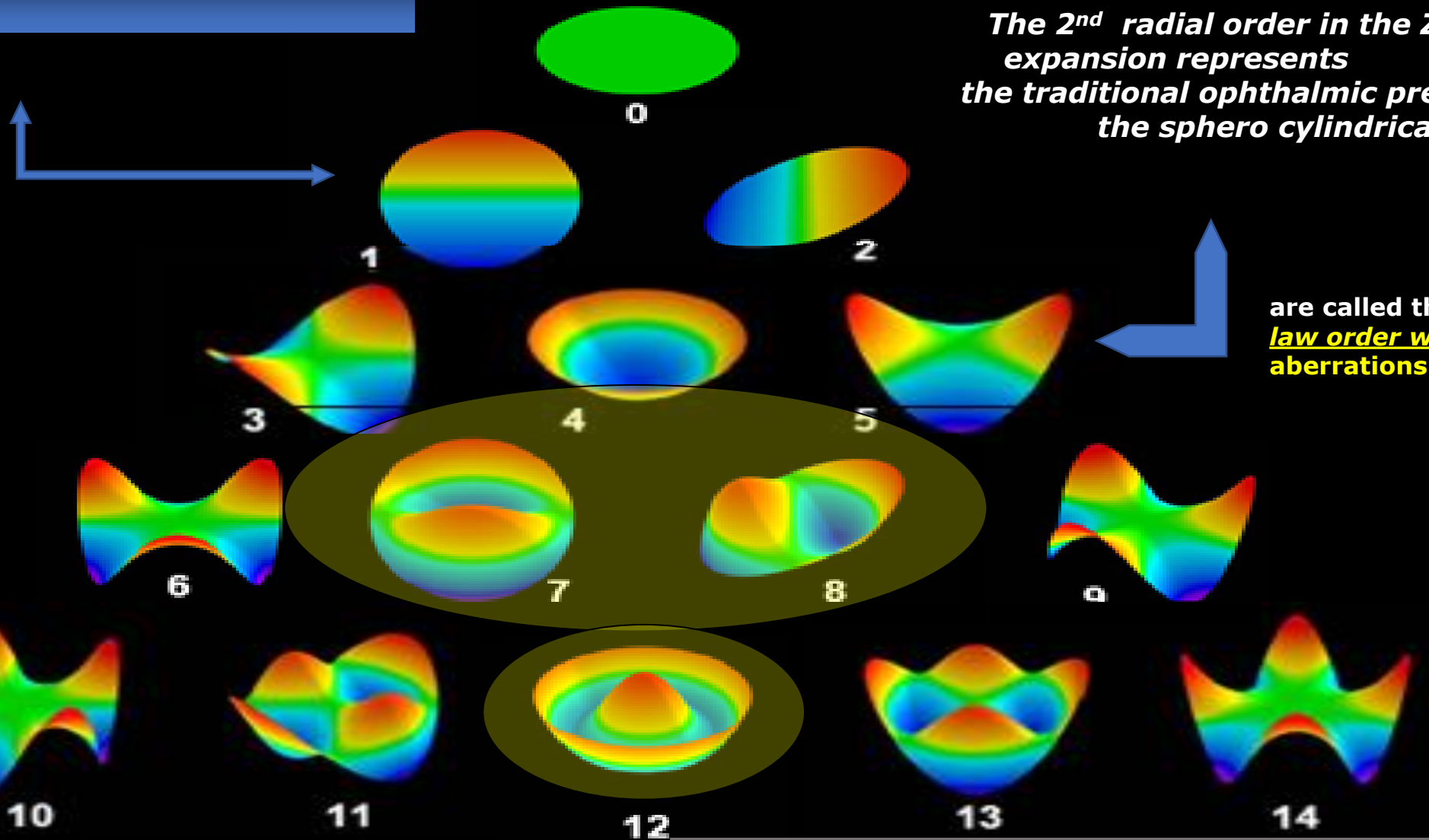
  Correctable with glasses i.e. Sphere and cylinder

- *High Order Wave Front Aberration*

  Uncorrectable with glasses

The 0 and 1st radial orders of the Zernike expansion are generally ignored.

The 2nd radial order in the Zernike expansion represents the traditional ophthalmic prescription. the sphero cylindrical.

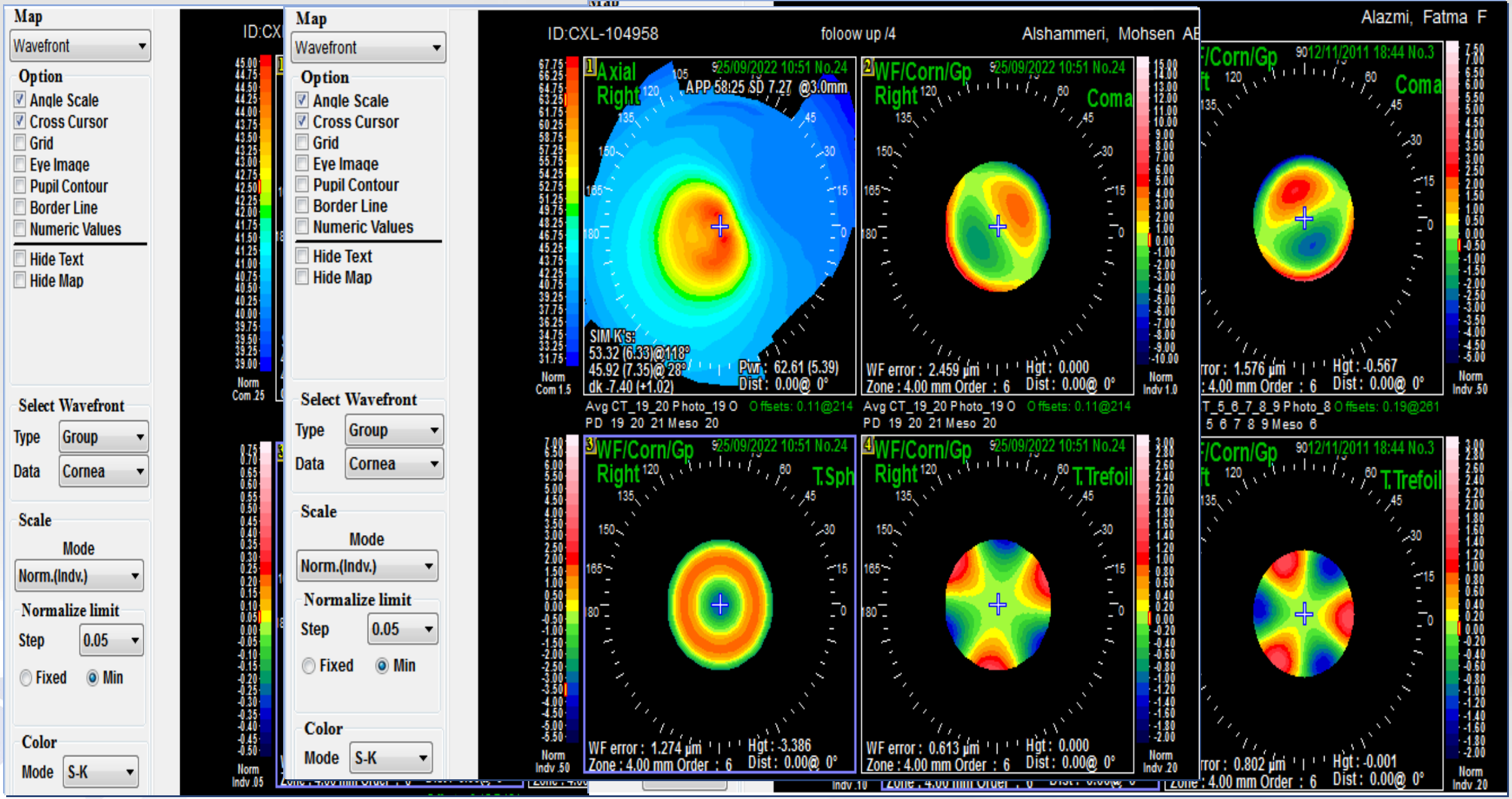


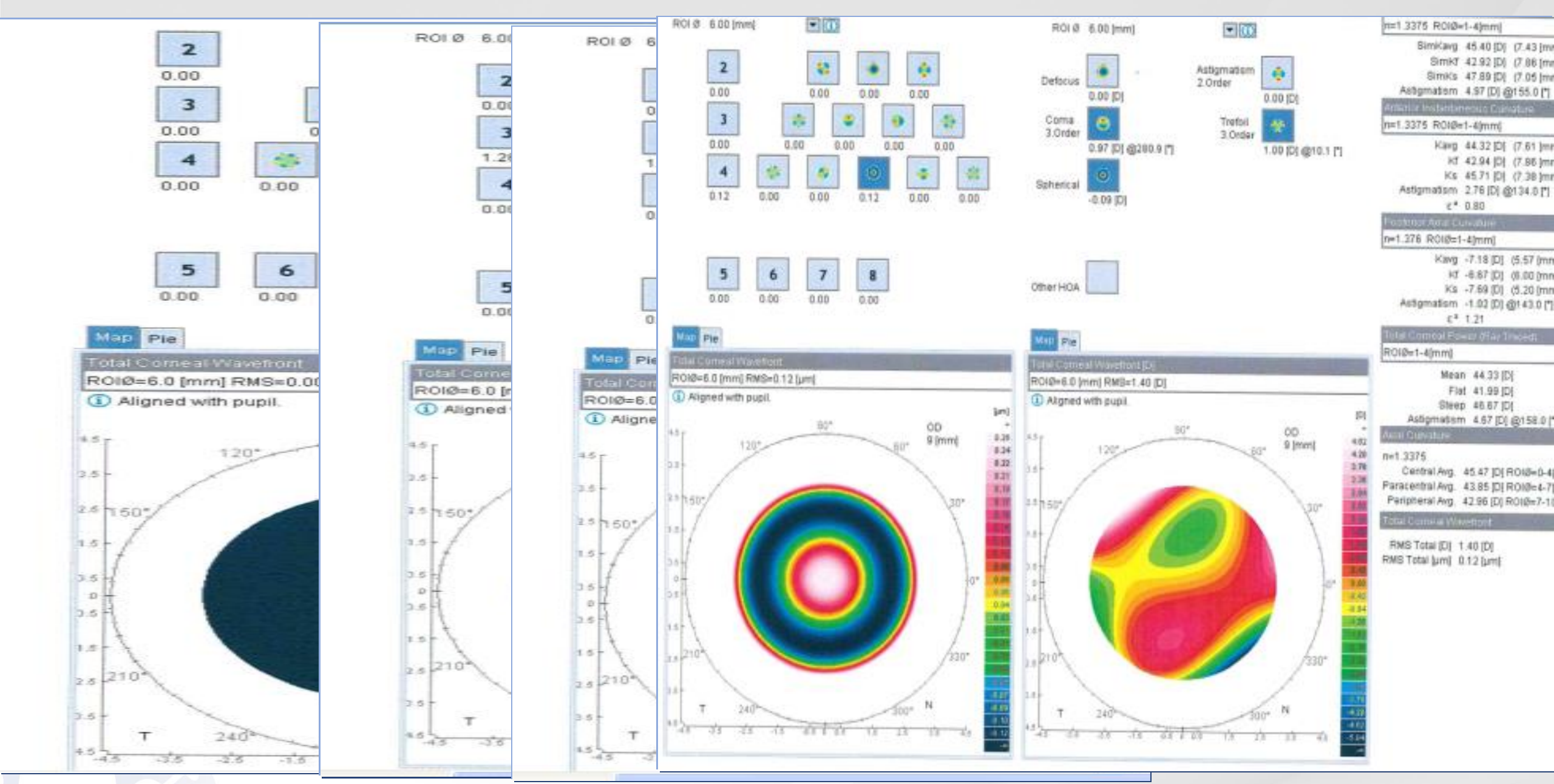
are called the *law order wave front* aberrations.

The 3rd radial order and higher are collectively called the higher order wave front aberrations.

Measuring
High Order Aberration

- OPD Scan III
- Gallali Schimpflung


Map
Wavefront
Option
Angle Scale
Cross Cursor
Grid
Eye Image
Pupil Contour
Border Line
Numeric Values
Hide Text
Hide Map
Select Wavefront
Type
Group
Data
Cornea
Scale
Mode
Norm.(Indv.)
Normalize limit
Step
0.05
Fixed
Min
Color
Mode
S-K
ID:CXL-104958
foloow up /4
Alshammeri, Mohsen AE
Alazmi, Fatma F
1 Axial Right
25/09/2022 10:51 No.24
APP 58:25 SD 7.27 @3.0mm
SIM K's:
53.32 (6.33)@118°
45.92 (7.35)@ 28°
dk -7.40 (+1.02)
Pwr: 62.61 (5.39)
Dist: 0.00@ 0°
2 WF/Corn/Gp Right
Coma
WF error: 2.459 µm
Zone: 4.00 mm Order: 6
Hgt: 0.000
Dist: 0.00@ 0°
3 WF/Corn/Gp Right
T.Sph
WF error: 1.274 µm
Zone: 4.00 mm Order: 6
Hgt: -3.386
Dist: 0.00@ 0°
4 WF/Corn/Gp Right
T.Trefoil
WF error: 0.613 µm
Zone: 4.00 mm Order: 6
Hgt: 0.000
Dist: 0.00@ 0°
12/11/2011 18:44 No.3
Coma
Hgt: -0.567
Dist: 0.00@ 0°
T.Trefoil
Hgt: -0.001
Dist: 0.00@ 0°
Avg CT_19_20 Photo_19 O
PD 19 20 21 Meso 20
Offsets: 0.11@214
Offsets: 0.19@261


ROI Ø 6.00 [mm]
Defocus
0.00 [D]
Astigmatism 2.Order
0.00 [D]
Coma 3.Order
0.97 [D] @280.9 [°]
Trefoil 3.Order
1.00 [D] @10.1 [°]
Spherical
-0.09 [D]
Other HOA
Map
Pie
Total Corneal Wavefront
ROIØ=6.0 [mm] RMS=0.12 [µm]
ROIØ=6.0 [mm] RMS=1.40 [D]
Aligned with pupil
OD
9 [mm]
Mean 44.33 [D]
Flat 41.99 [D]
Steep 46.67 [D]
Astigmatism 4.67 [D] @158.0 [°]
RMS Total [D] 1.40 [D]
RMS Total [µm] 0.12 [µm]

WAVEFRONT ABERRATIONS

Spherical Aberration (PURE wave front guided)

1- Epithelial Shape& Thickness are Regular
2-No Rule Of Epithelium On Technique
3-Can Be Done On Surface Or Under The Flap

Astigmatism (PURE wave front guided)

Irregular Astigmatism

????? Regular Astigmatism

Coma Aberration (MIXED)

Keratoconus &Ectasia & Decentered treatment

Treatment

Customized PTK

A- Wave Front Guided Ablation,

Normal Topography, on Pupillary Center, Better Correction Of Wave front Aberration

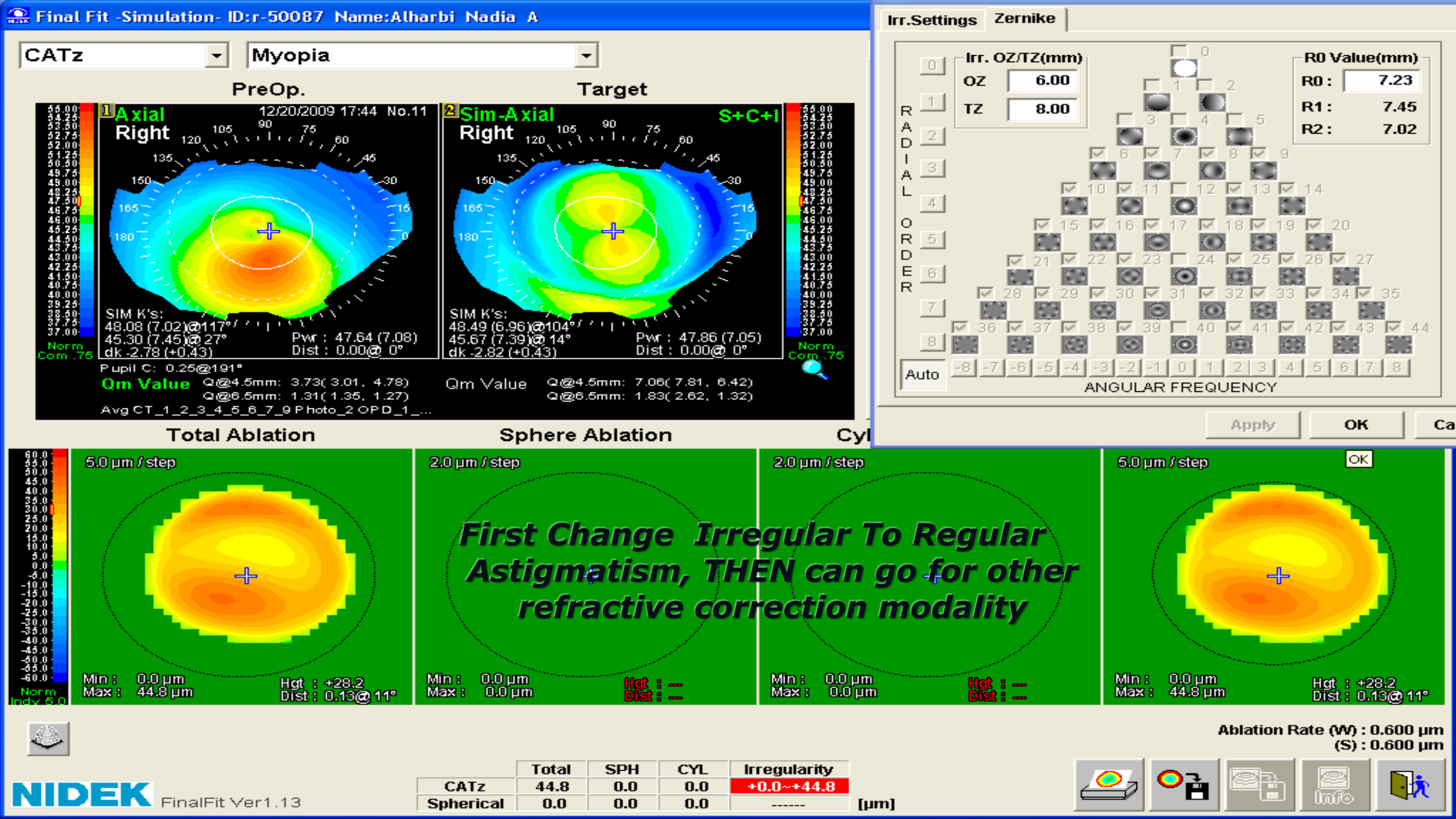
B- Topography Guided Ablation

Abnormal Topography , on Visual Axis, Corrects Only Topographic Pathology

ASTIGMATISM

1. ***Convert Irregular To Regular***

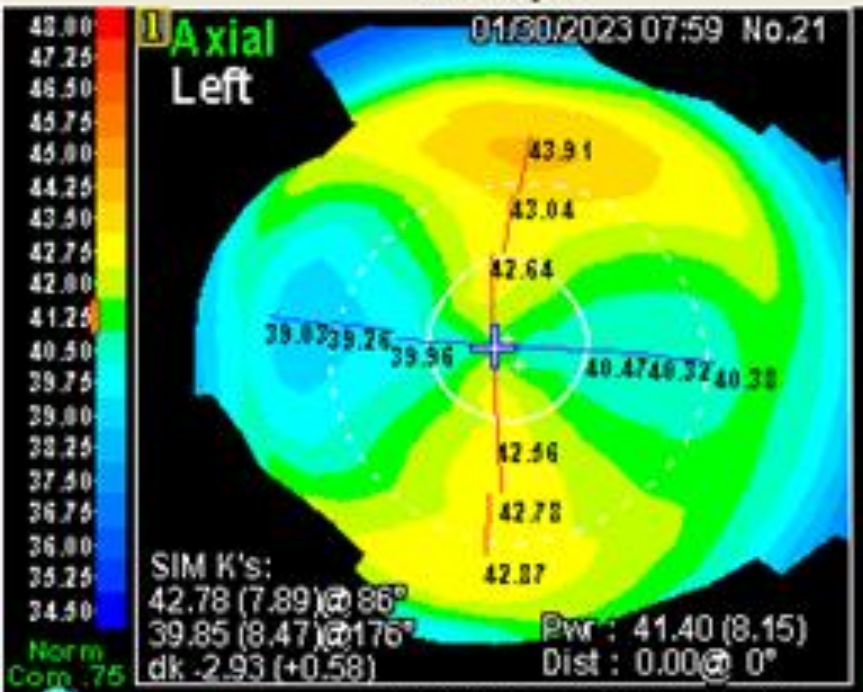
2. ***Reduce Regular Astigmatism With Minimal Coupling Effect***

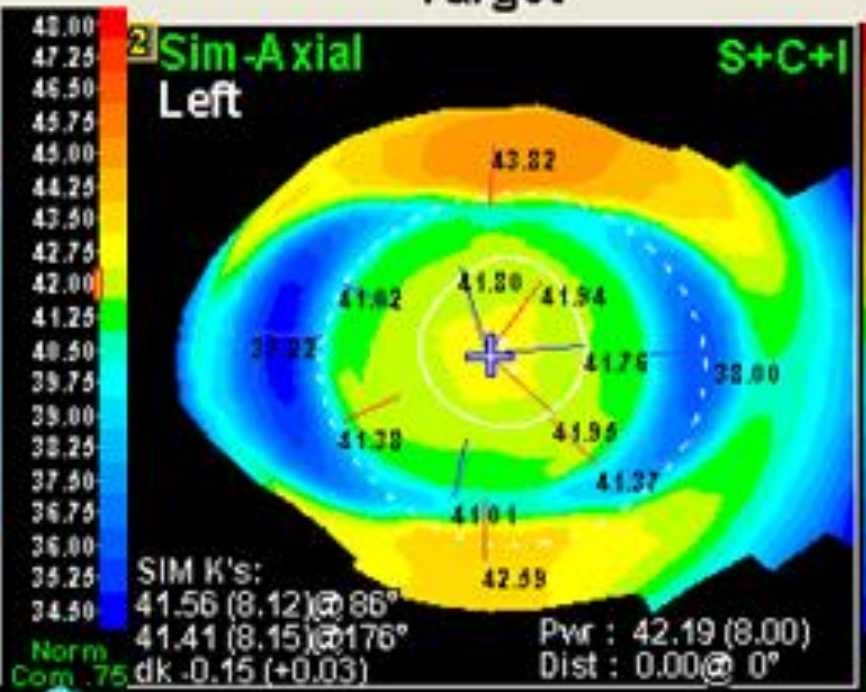

Final Fit -Simulation- ID:r-50087 Name:Alharbi Nadia A
CATz
Myopia
PreOp.
Target
1 Axial
Right
12/20/2009 17:44 No.11
SIM K's:
48.08 (7.02)@117°
45.30 (7.45)@ 27°
dk -2.78 (+0.43)
Pwr : 47.64 (7.08)
Dist : 0.00@ 0°
2 Sim-Axial
Right
S+C+I
SIM K's:
48.49 (6.96)@104°
45.67 (7.39)@ 14°
dk -2.82 (+0.43)
Pwr : 47.86 (7.05)
Dist : 0.00@ 0°
Norm
Com .75
Pupil C: 0.25@191°
Qm Value Q@4.5mm: 3.73(3.01, 4.78)
Q@6.5mm: 1.31(1.35, 1.27)
Avg CT_1_2_3_4_5_6_7_9 Photo_2 OPD_1_...
Qm Value Q@4.5mm: 7.06(7.81, 6.42)
Q@6.5mm: 1.83(2.62, 1.32)
Irr.Settings
Zernike
Irr. OZ/TZ(mm)
OZ 6.00
TZ 8.00
R0 Value(mm)
R0 : 7.23
R1 : 7.45
R2 : 7.02
RADIAL ORDER
ANGULAR FREQUENCY
Auto
Apply
OK
Total Ablation
Sphere Ablation
5.0 µm / step
2.0 µm / step
2.0 µm / step
5.0 µm / step
OK
Min : 0.0 µm
Max : 44.8 µm
Hgt : +28.2
Dist : 0.13@ 11°
Min : 0.0 µm
Max : 0.0 µm
Hgt : ---
Dist : ---
Min : 0.0 µm
Max : 0.0 µm
Hgt : ---
Dist : ---
Min : 0.0 µm
Max : 44.8 µm
Hgt : +28.2
Dist : 0.13@ 11°
First Change Irregular To Regular Astigmatism, THEN can go for other refractive correction modality
Ablation Rate (W) : 0.600 µm
(S) : 0.600 µm
NIDEK
FinalFit Ver1.13
Total SPH CYL Irregularity
CATz 44.8 0.0 0.0 +0.0~+44.8
Spherical 0.0 0.0 0.0 ------
[µm]
Info

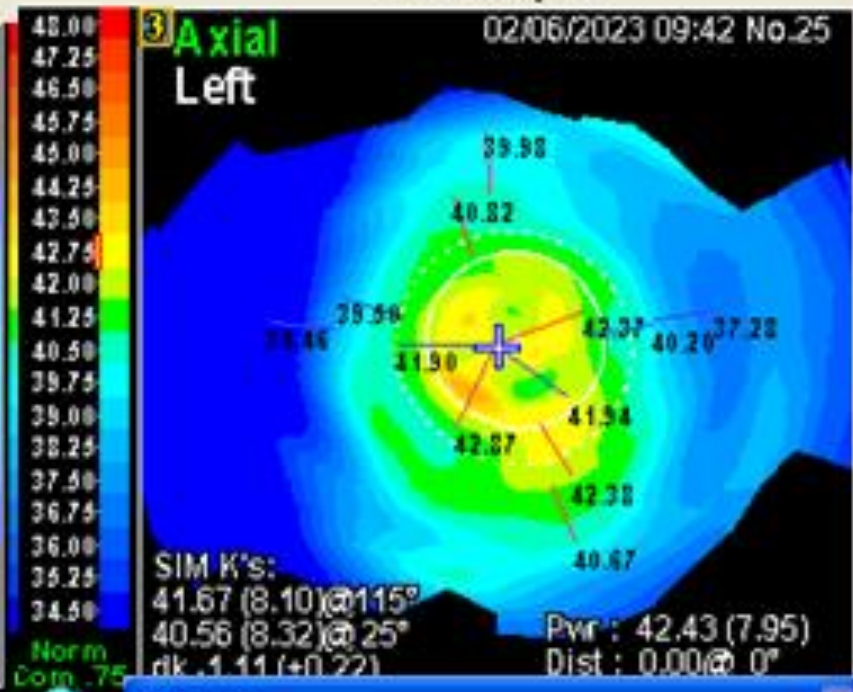
PreOp.

Target

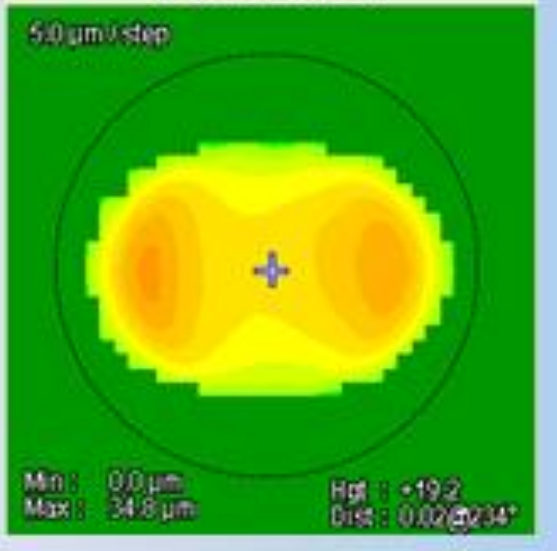
PostOp.1

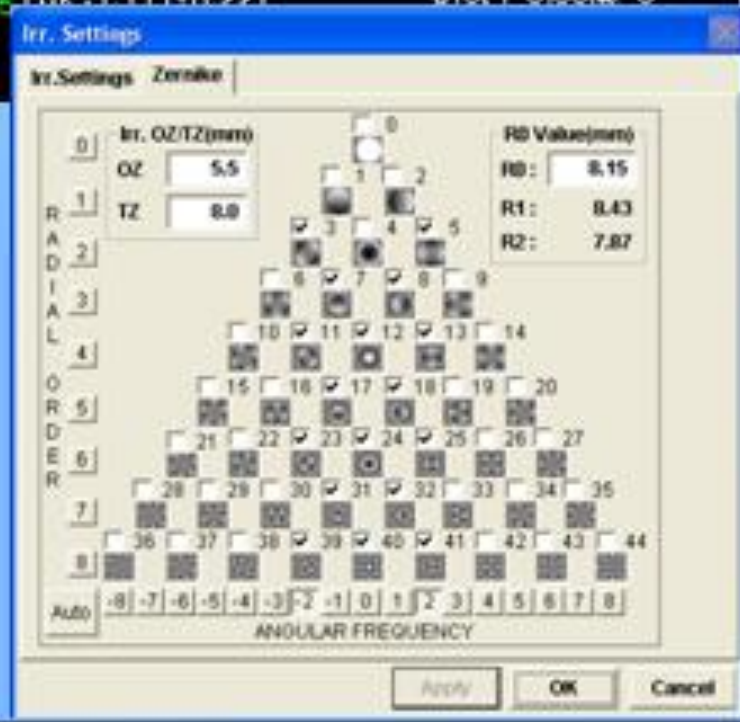






Total Ablation





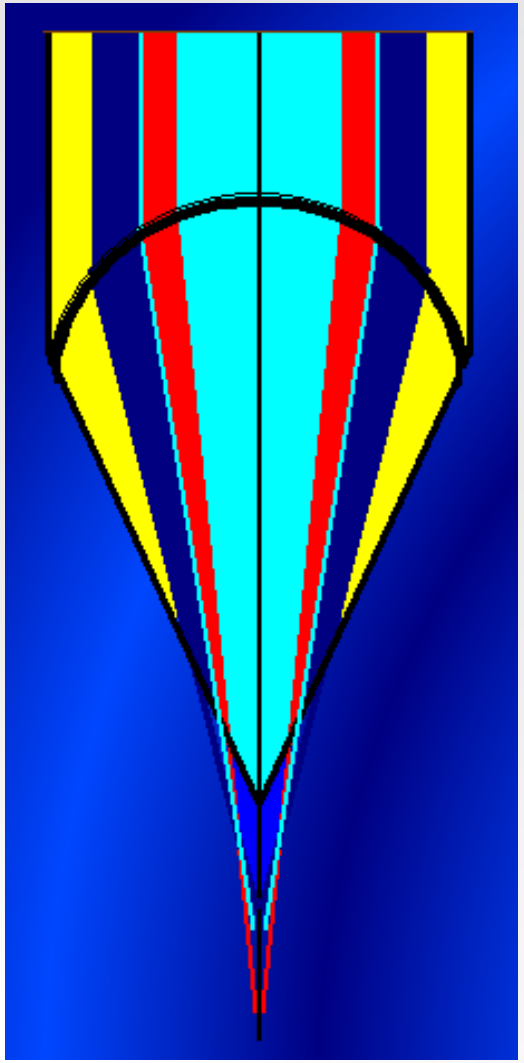
Spherical Aberration

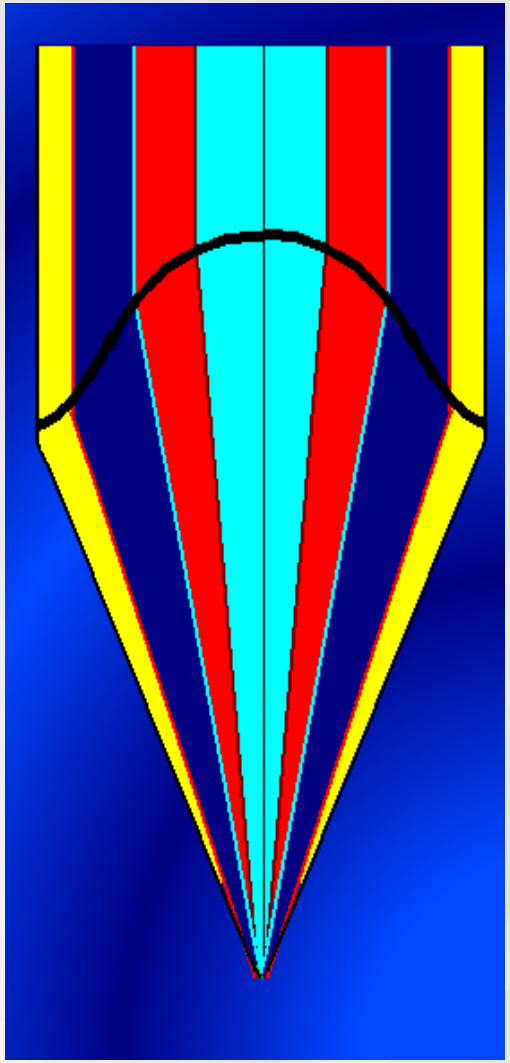
1- Mostly Post Myopic Laser Correction

2- We May Intend To Increase Spherical Aberration For Presbyopia Management By Increasing Depth of Focus

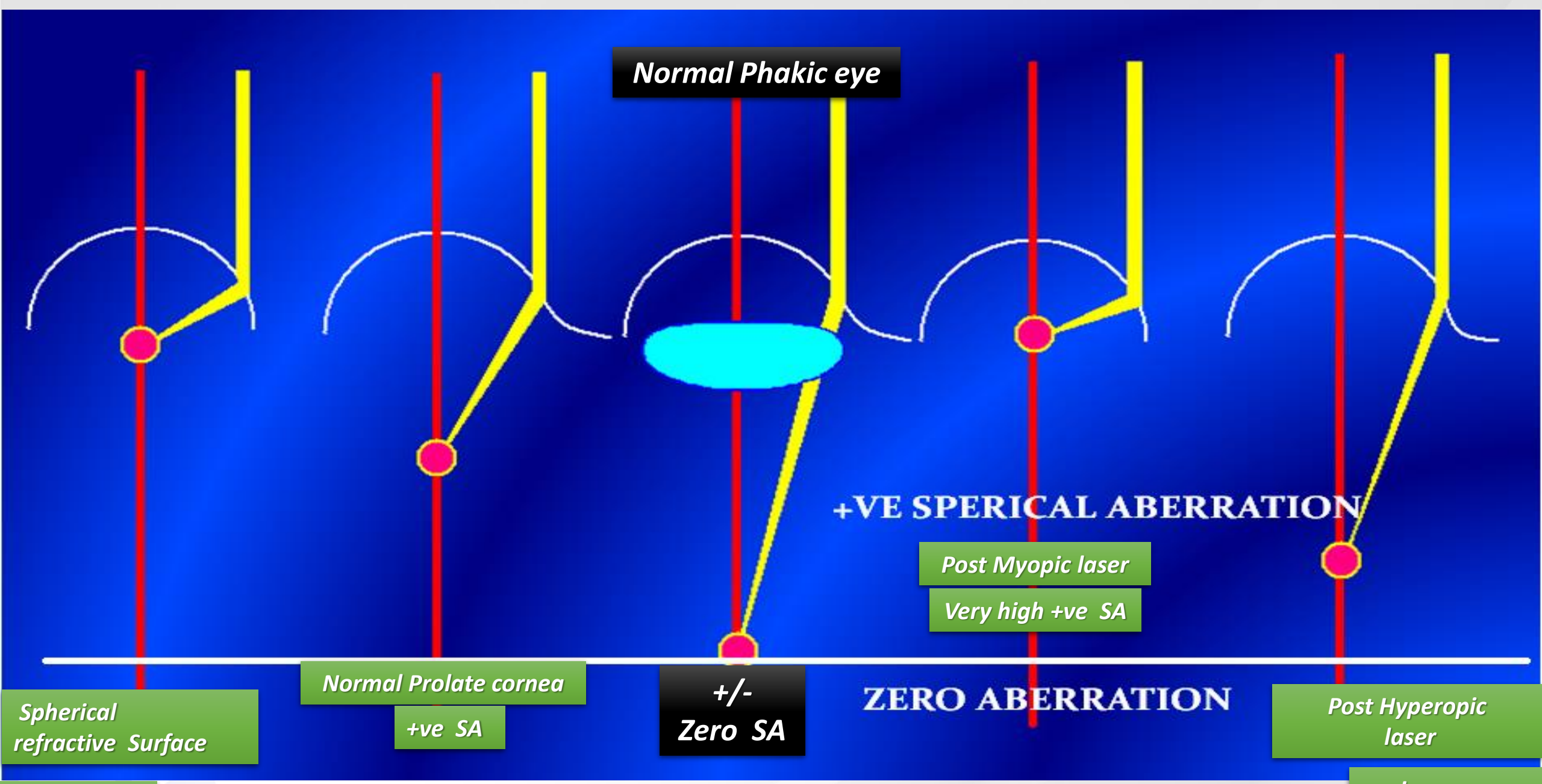
(inducing irregularity on regular cornea)

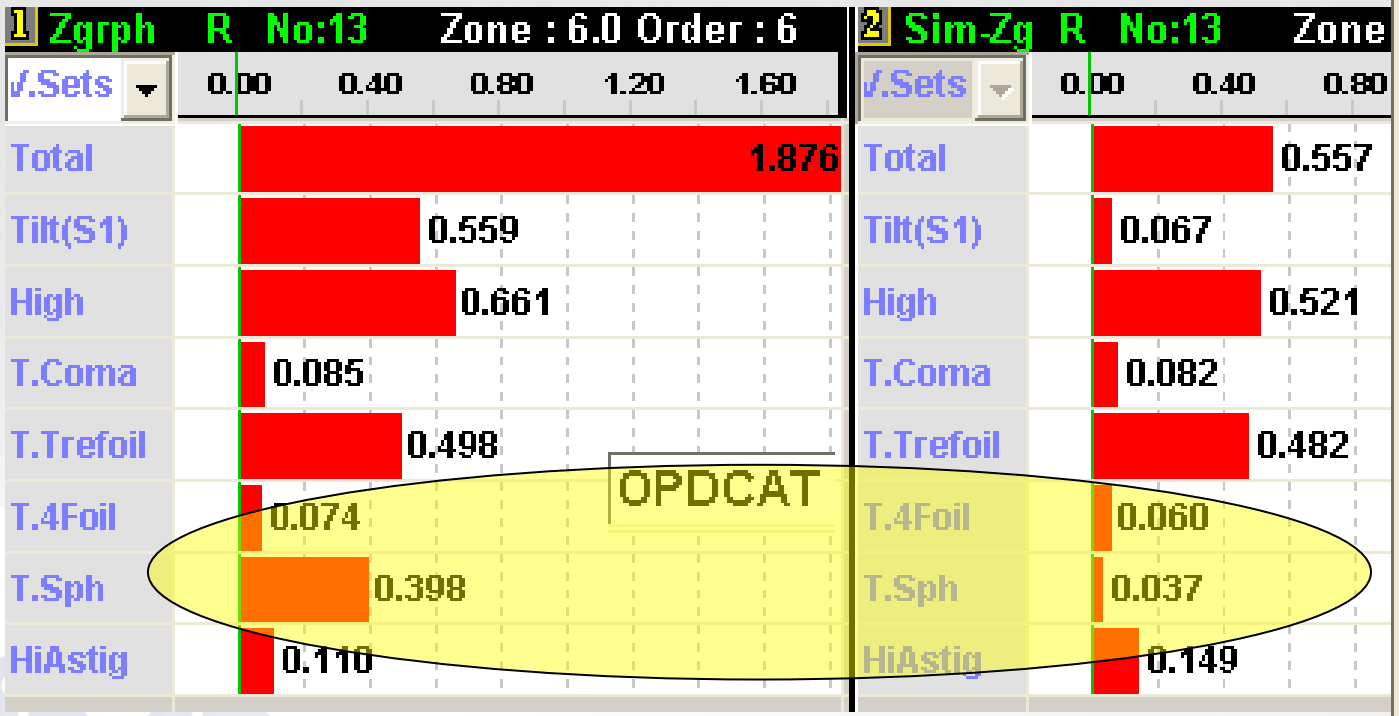
Spherical Refractive Surface

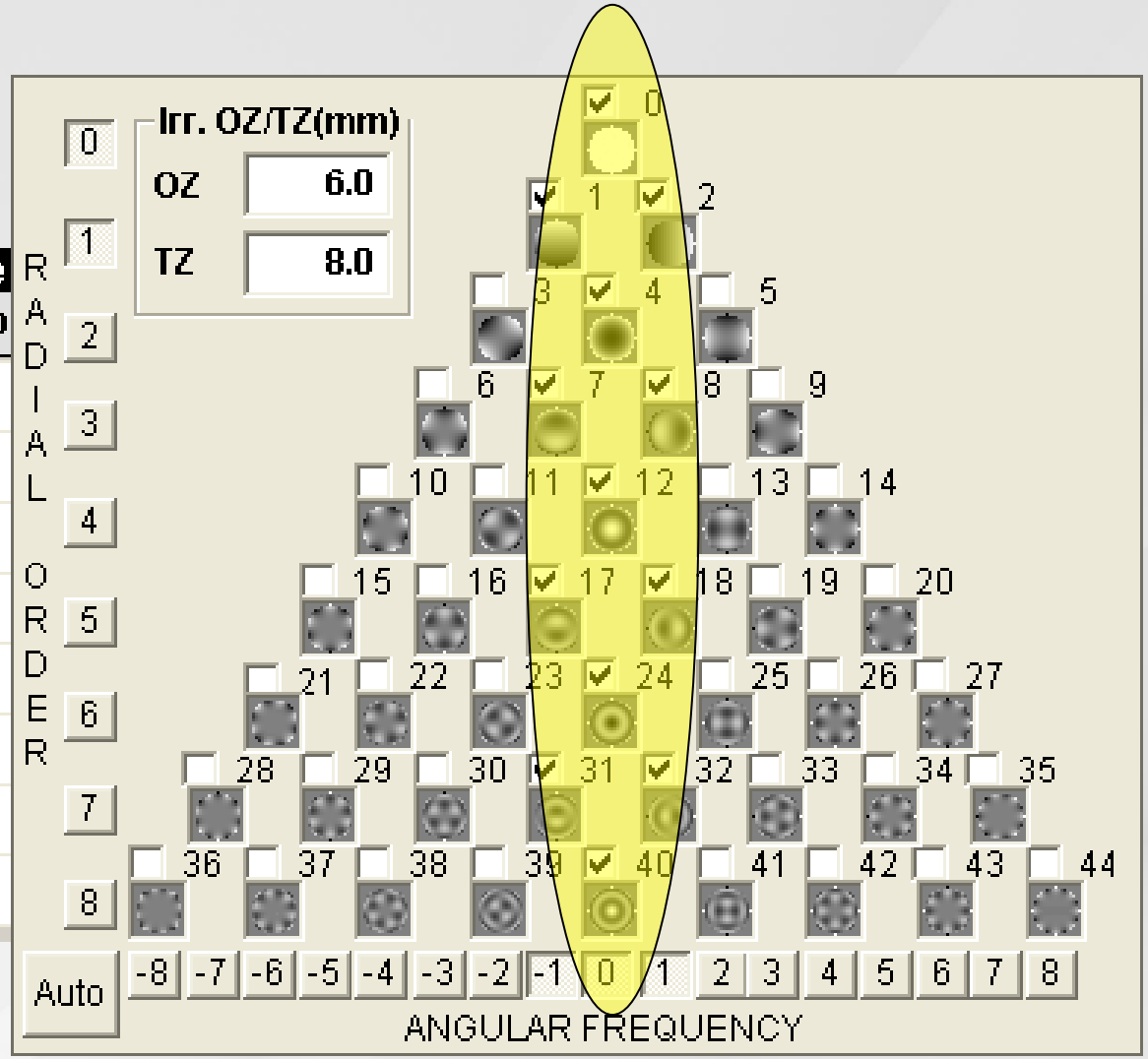


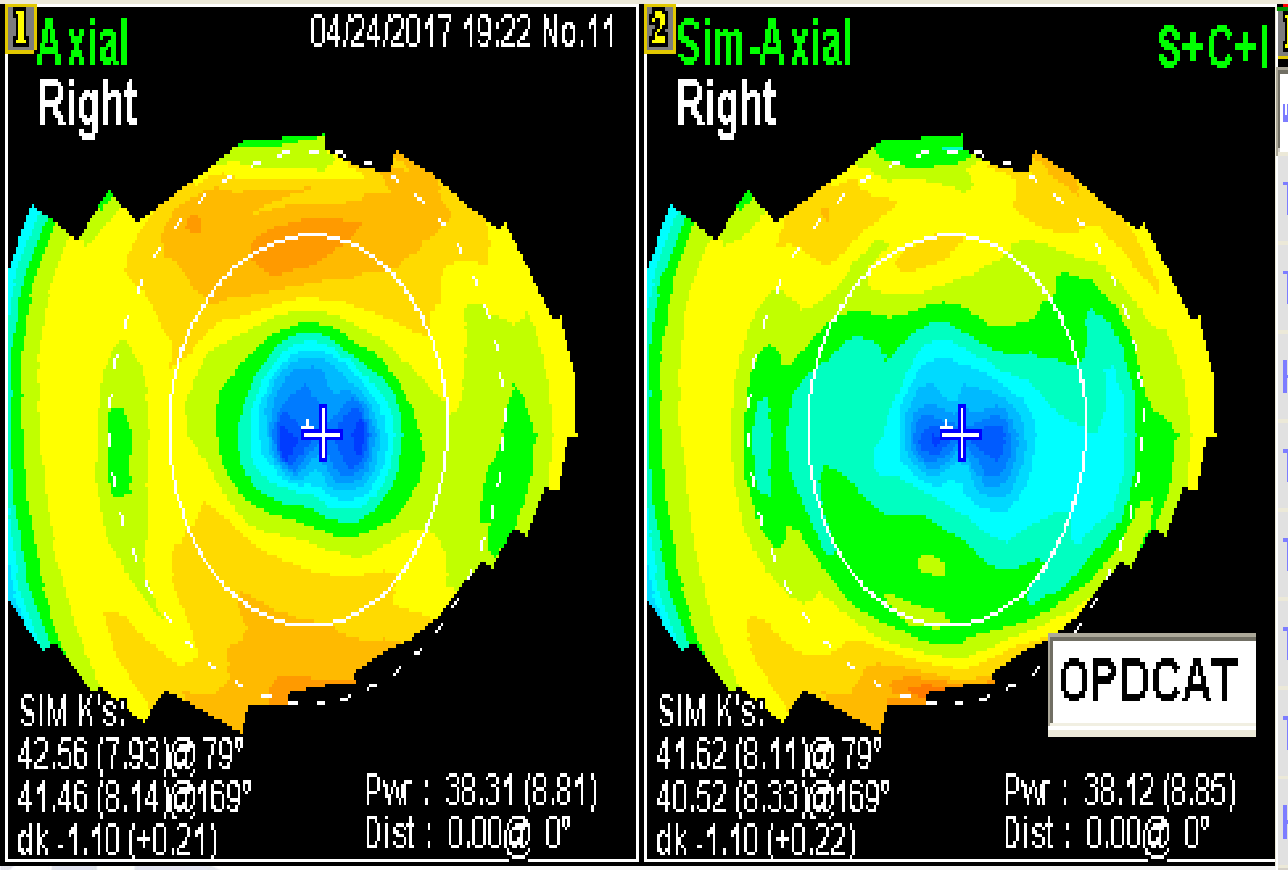


Aspherical Surface Normal Cornea

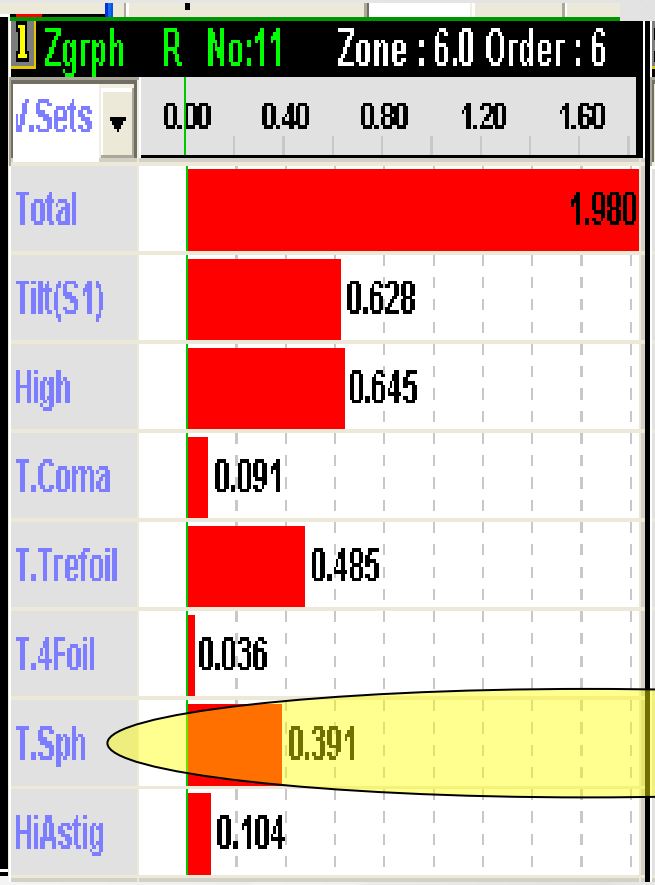

Normal Phakic eye
+VE SPERICAL ABERRATION
Post Myopic laser
Very high +ve SA
Normal Prolate cornea
+ve SA
+/-
Zero SA
ZERO ABERRATION
Post Hyperopic laser
Low +ve SA
Spherical refractive Surface
High +ve SA

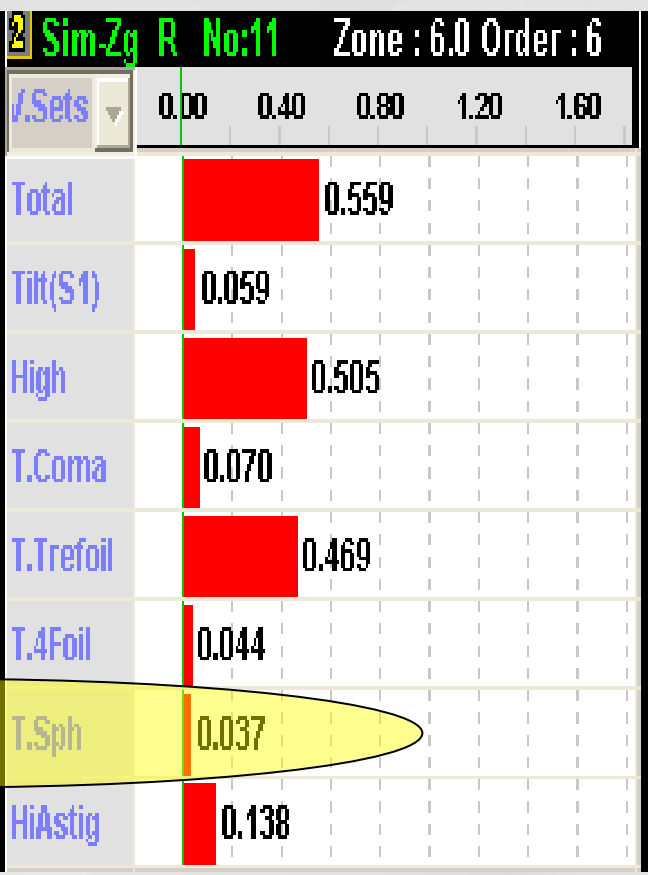

1 Zgrph R No:13 Zone : 6.0 Order : 6
√.Sets
0.00 0.40 0.80 1.20 1.60
Total 1.876
Tilt(S1) 0.559
High 0.661
T.Coma 0.085
T.Trefoil 0.498
T.4Foil 0.074
T.Sph 0.398
HiAstig 0.110
2 Sim-Zg R No:13 Zone
√.Sets
0.00 0.40 0.80
Total 0.557
Tilt(S1) 0.067
High 0.521
T.Coma 0.082
T.Trefoil 0.482
T.4Foil 0.060
T.Sph 0.037
HiAstig 0.149
OPDCAT


Irr. OZ/TZ(mm)
OZ 6.0
TZ 8.0
RADIAL ORDER
0 1 2 3 4 5 6 7 8
Auto
-8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8
ANGULAR FREQUENCY

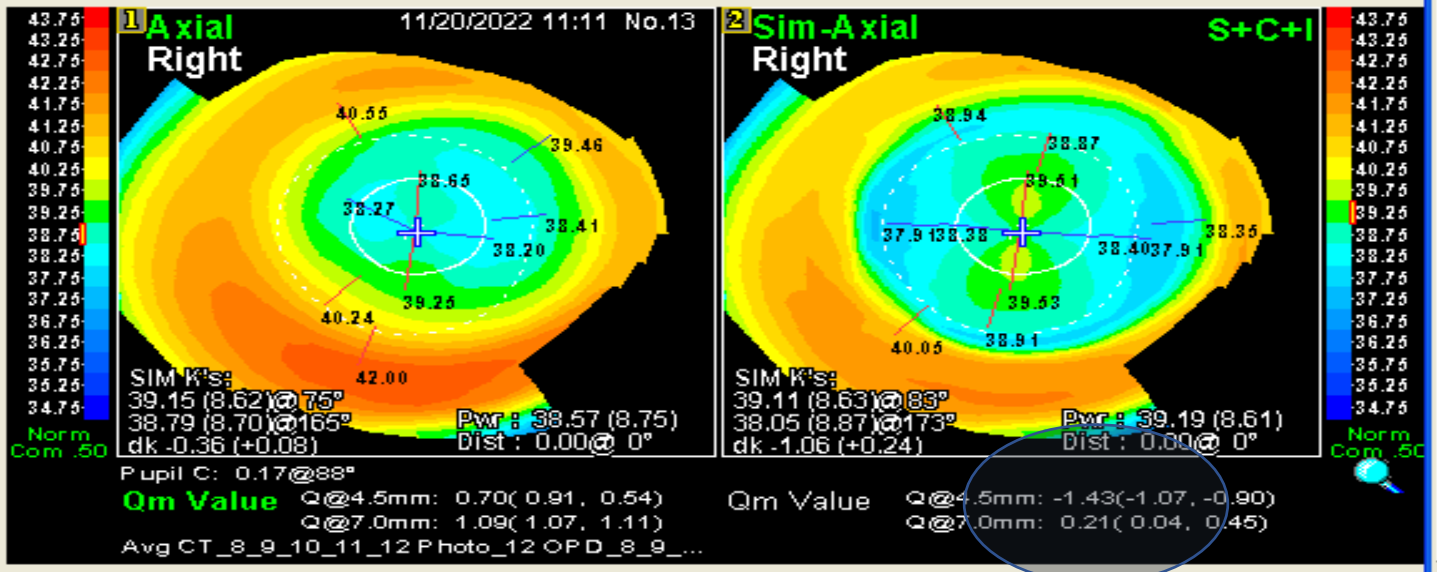

1 Axial
04/24/2017 19:22 No.11
Right
SIM K's:
42.56 (7.93)@ 79°
41.46 (8.14)@169°
dk -1.10 (+0.21)
Pwr : 38.31 (8.81)
Dist : 0.00@ 0°

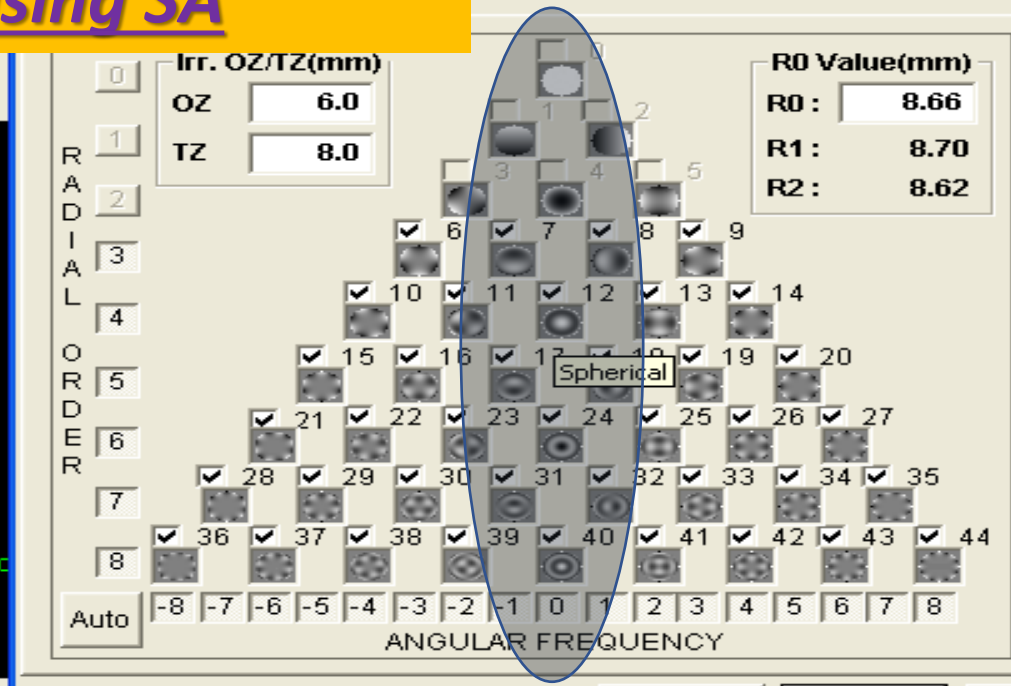
2 Sim-Axial
S+C+
Right
OPDCAT
SIM K's:
41.62 (8.11)@ 79°
40.52 (8.33)@169°
dk -1.10 (+0.22)
Pwr : 38.12 (8.85)
Dist : 0.00@ 0°

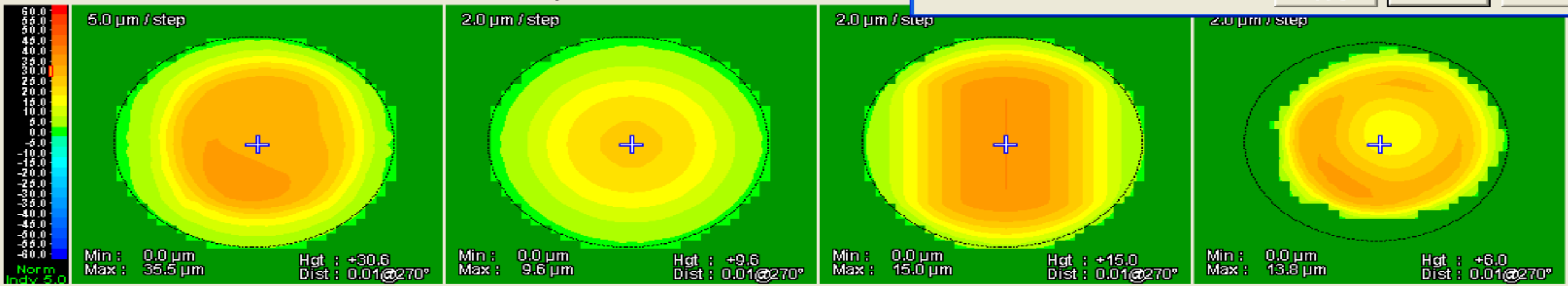

1 Zgrph R No:11 Zone : 6.0 Order : 6
√.Sets
0.00 0.40 0.80 1.20 1.60
Total 1.980
Tilt(S1) 0.628
High 0.645
T.Coma 0.091
T.Trefoil 0.485
T.4Foil 0.036
T.Sph 0.391
HiAstig 0.104


2 Sim-Zg R No:11 Zone : 6.0 Order : 6
√.Sets
0.00 0.40 0.80 1.20 1.60
Total 0.559
Tilt(S1) 0.059
High 0.505
T.Coma 0.070
T.Trefoil 0.469
T.4Foil 0.044
T.Sph 0.037
HiAstig 0.138

Myopic LVC, Residual error & decreasing SA







Ablation Rate (W) : 0.600 µm
(S) : 0.600 µm

	Total	SPH	CYL	Irregularity
CATz	35.5	9.6	15.0	+0.0~+13.8
Spherical	18.3	7.1	11.2	------

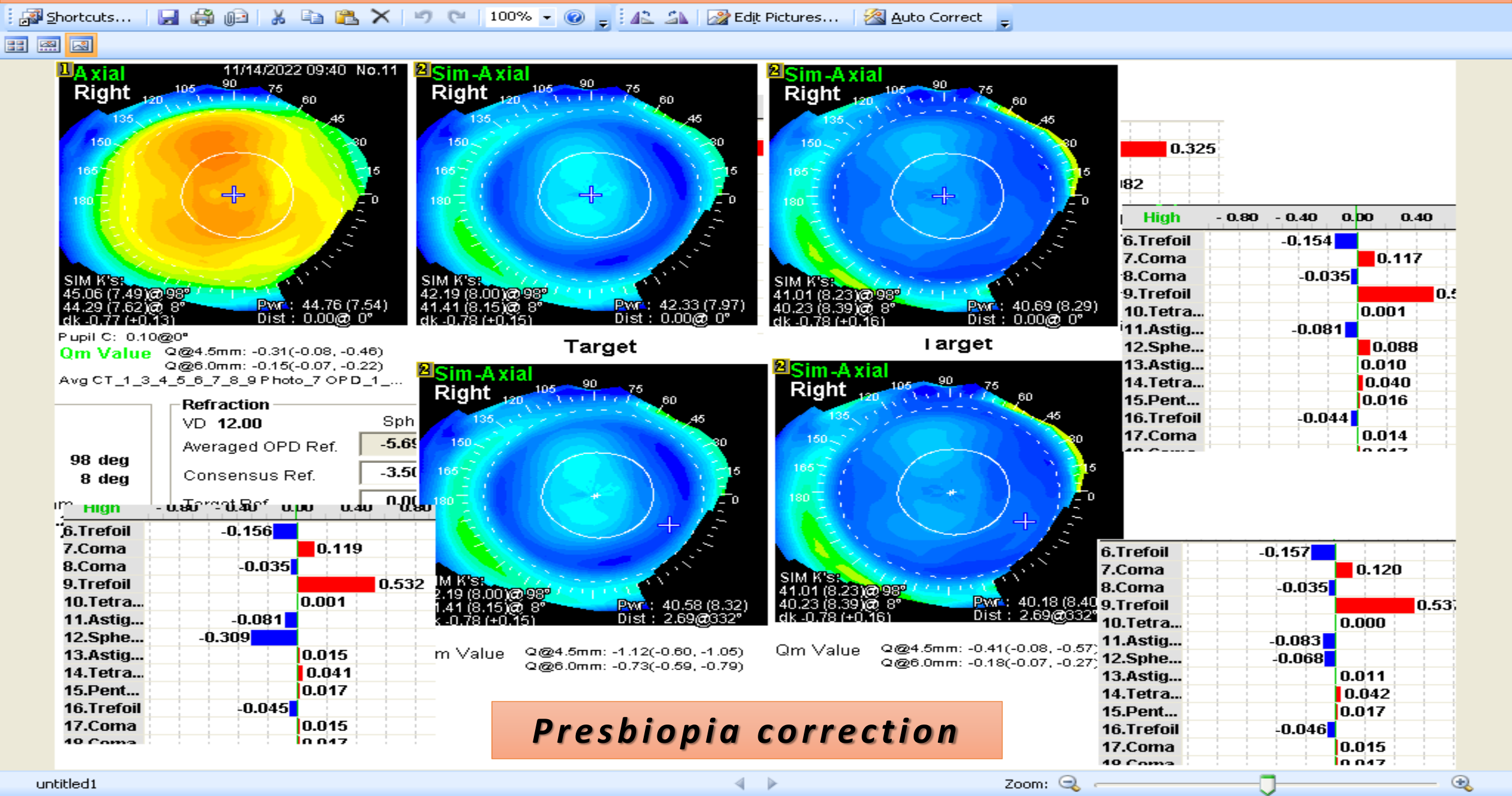
[µm]

NIDEK FinalFit Ver1.17

Inducing Irregularity On Regular Cornea

We may intend to increase spherical aberration (increasing Q value) in the non-dominant eye to increase the depth of focus for Presbiopia management

EXAMPLE & STEPS OF SELECTIVE ABERRATION CORRECTION



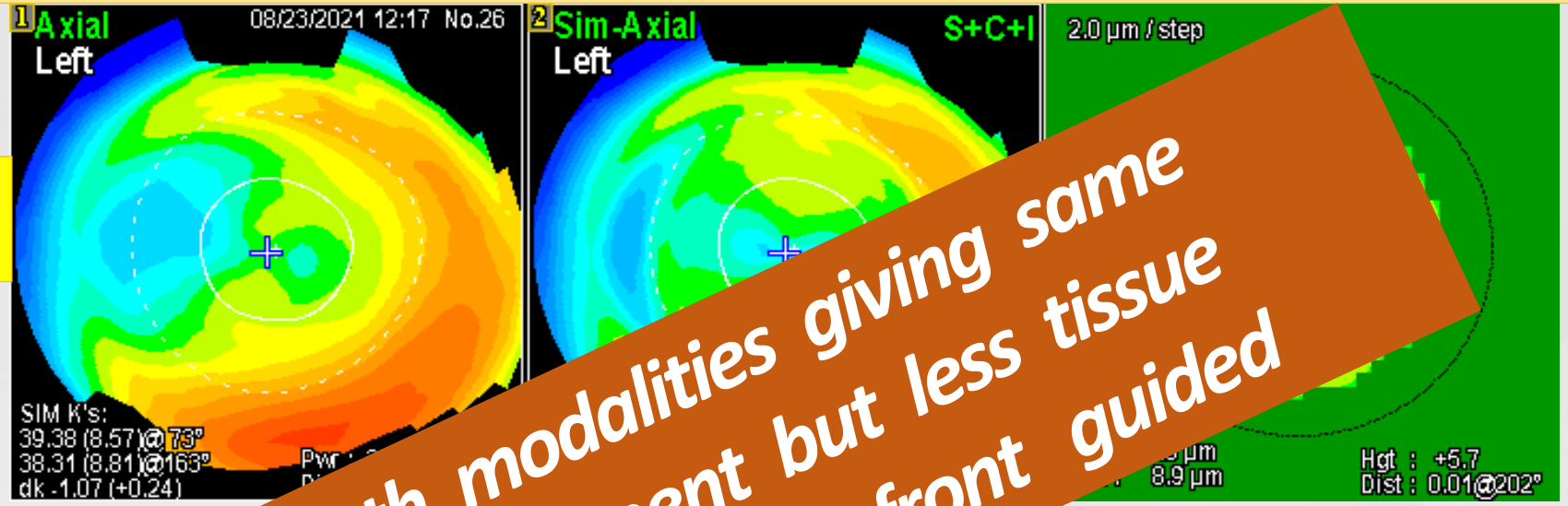
COMA

- ***Keratoconus***
- ***Pellucid Marginal Degeneration***
- ***Post LASIK***
  - ***Decentered Ablation***
  - ***Ectasia***

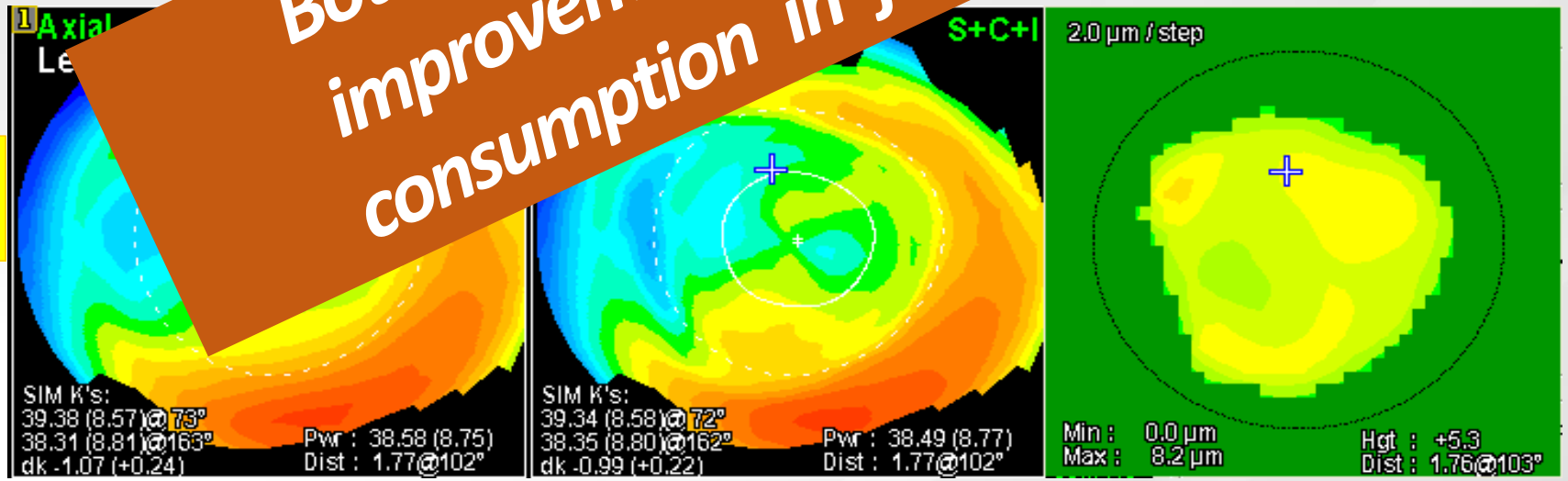
Decentered Ablation

Mixed Functional & Topographic

Topography Guided Ablation



Wavefront Guided Ablation

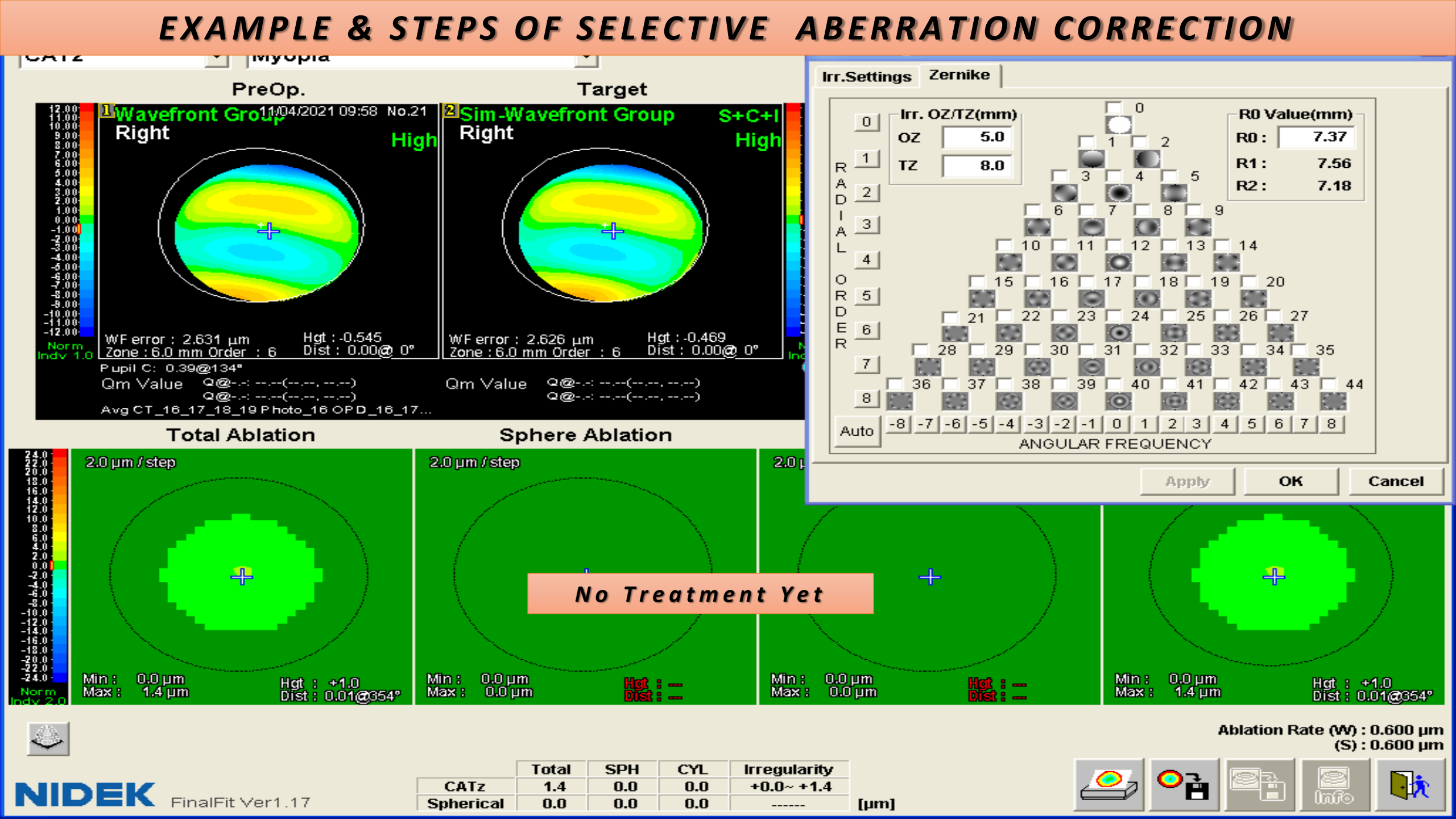


Both modalities giving same improvement but less tissue consumption in front guided

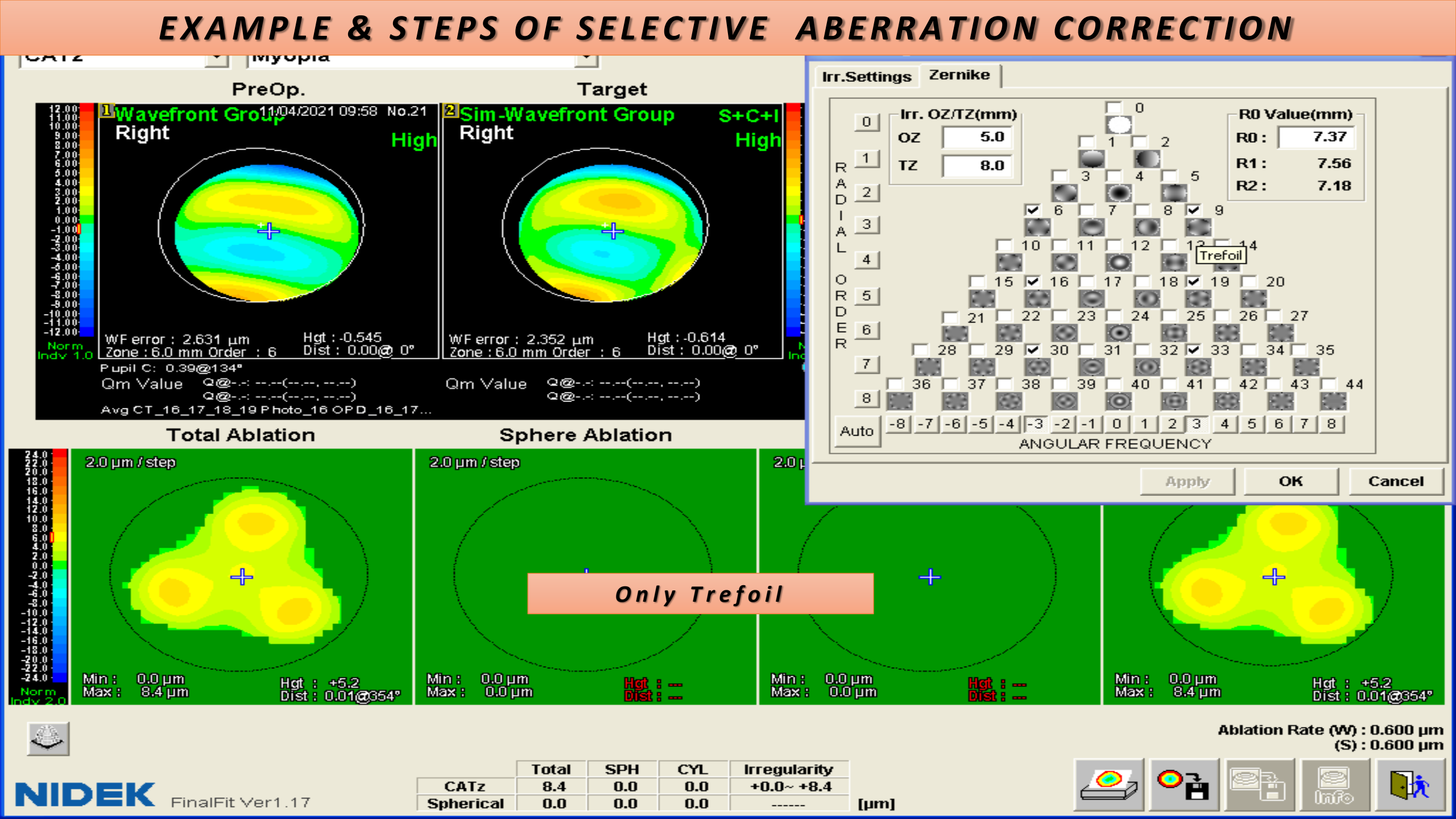

Final Fit -Simulation- ID:54342 Name:Athab Maha AB.
CATz
Myopia
PreOp.
Target
1 Axial
Left
11/20/2022 11:12 No.14
2 Sim-Axial
Left
S+C+I
SIM K's:
40.18 (8.40)@87°
40.04 (8.43)@177°
dk -0.14 (+0.03)
Pwr : 40.02 (8.43)
Dist : 0.34@326°
SIM K's:
39.71 (8.50)@88°
39.47 (8.55)@178°
dk -0.24 (+0.05)
Pwr : 40.06 (8.43)
Dist : 0.34@326°
Pupil C: 0.20@327°
Qm Value
Q@4.5mm: 0.77(0.73, 0.82)
Q@7.0mm: 0.78(0.96, 0.62)
Qm Value
Q@4.5mm: 0.84(1.57, 0.44)
Q@7.0mm: 0.54(0.91, 0.29)
Avg CT_8_9_10_11 Photo_8 OPD_8_9_10_1...
Total Ablation
Sphere Ablation
2.0 µm / step
Min : 0.0 µm
Max : 19.9 µm
Hgt : +17.9
Dist : 0.33@326°
Min : 0.0 µm
Max : 0.0 µm
Hgt : ---
Dist : ---
Min : 0.0 µm
Max : 0.0 µm
Hgt : ---
Dist : ---
Min : 0.0 µm
Max : 19.9 µm
Hgt : +17.9
Dist : 0.33@326°
Irr. Settings
Irr.Settings
Zernike
Irr. OZ/TZ(mm)
OZ 6.0
TZ 8.0
R0 Value(mm)
R0 : 8.41
R1 : 8.43
R2 : 8.40
RADIAL ORDER
ANGULAR FREQUENCY
Auto
Apply
OK
Cancel
Coma & SA
Ablation Rate (W) : 0.600 µm
(S) : 0.600 µm
NIDEK
FinalFit Ver1.17
Total SPH CYL Irregularity
CATz 19.9 0.0 0.0 +0.0~+19.9
Spherical 0.0 0.0 0.0 ------
[µm]

Technique

EXAMPLE & STEPS OF SELECTIVE ABERRATION CORRECTION



EXAMPLE & STEPS OF SELECTIVE ABERRATION CORRECTION

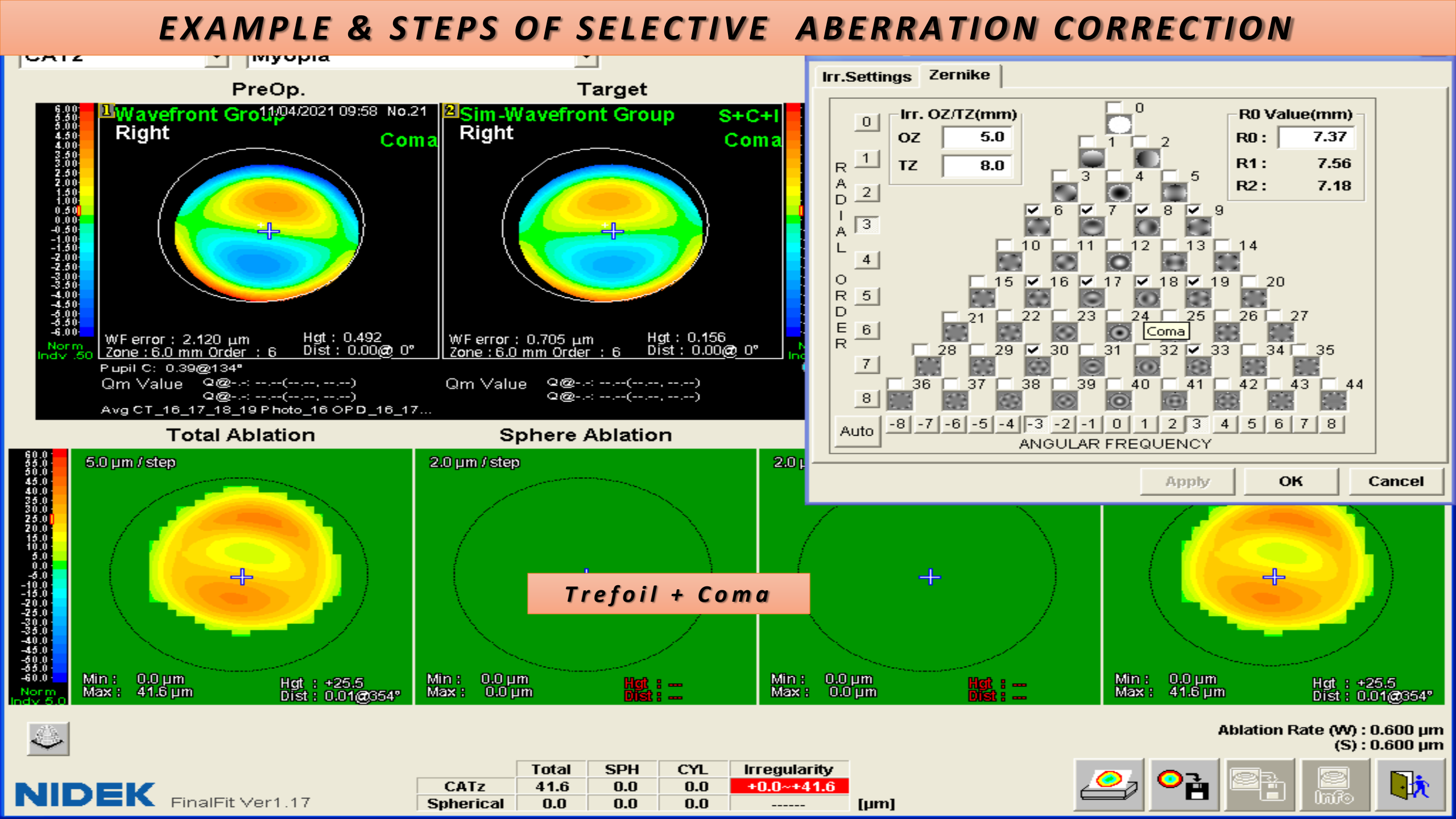


	Total	SPH	CYL	Irregularity
CATz	8.4	0.0	0.0	+0.0~ +8.4
Spherical	0.0	0.0	0.0	------

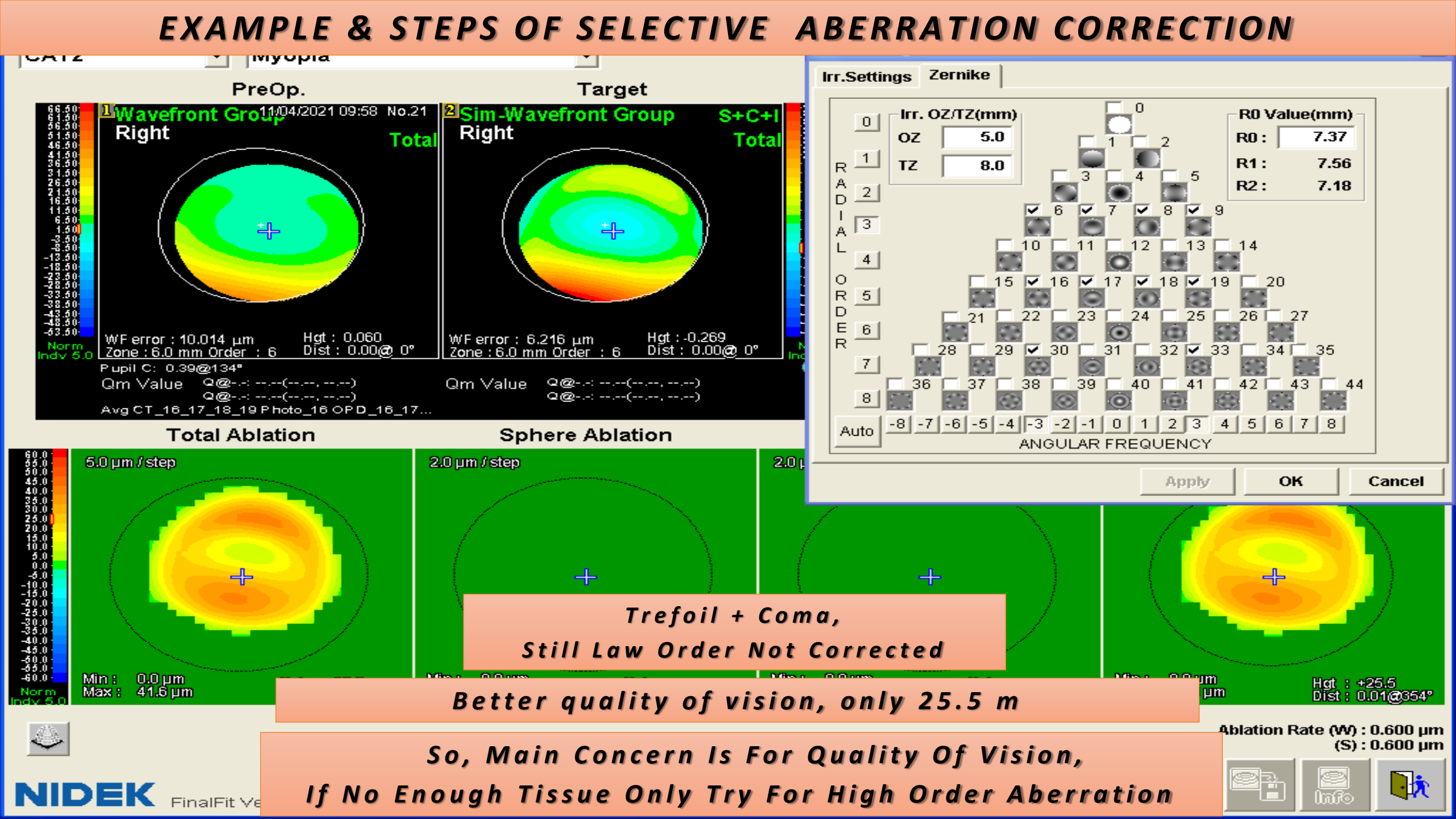
[µm]

NIDEK FinalFit Ver1.17

EXAMPLE & STEPS OF SELECTIVE ABERRATION CORRECTION



EXAMPLE & STEPS OF SELECTIVE ABERRATION CORRECTION

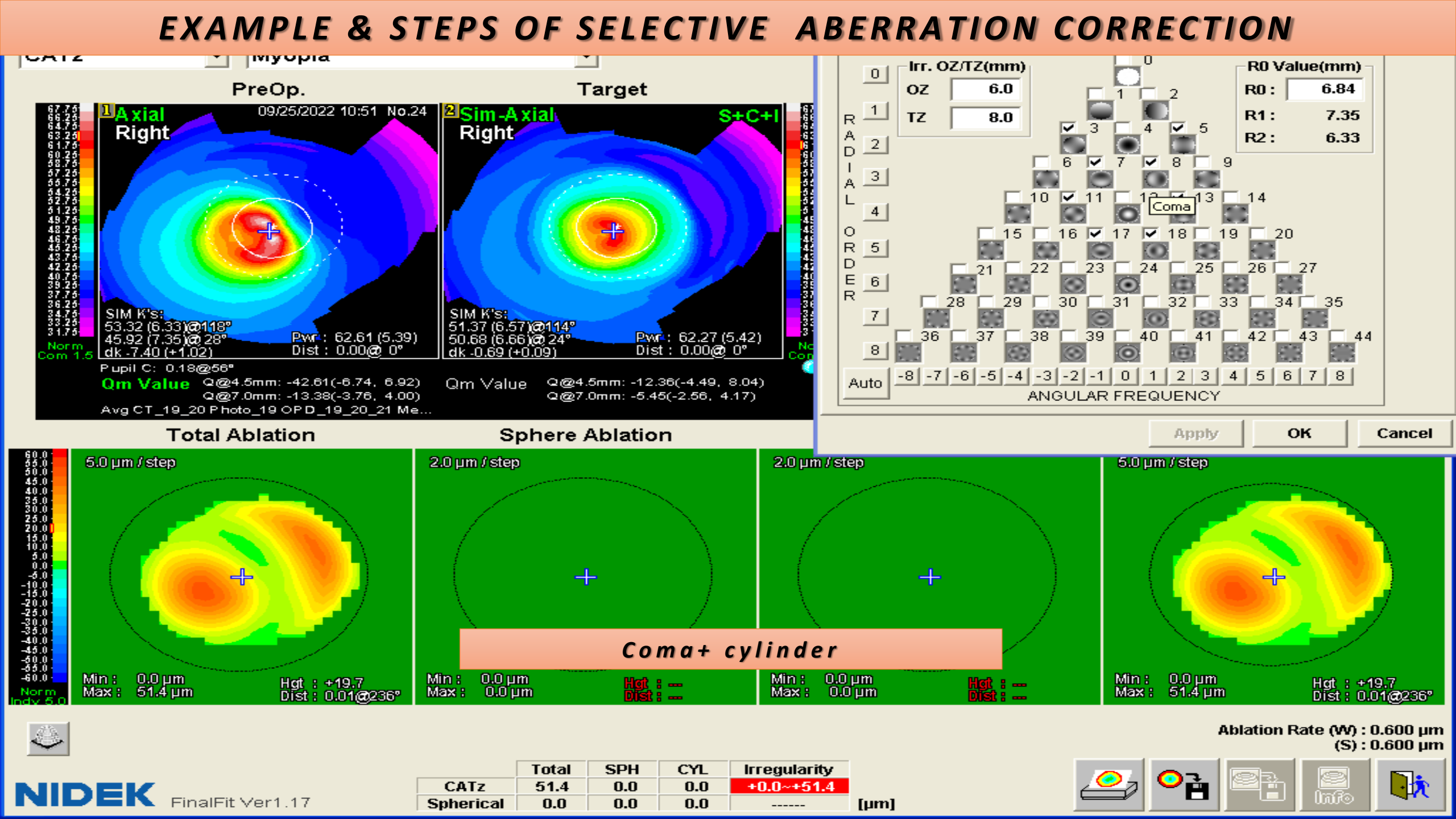


Trefoil + Coma,
Still Law Order Not Corrected

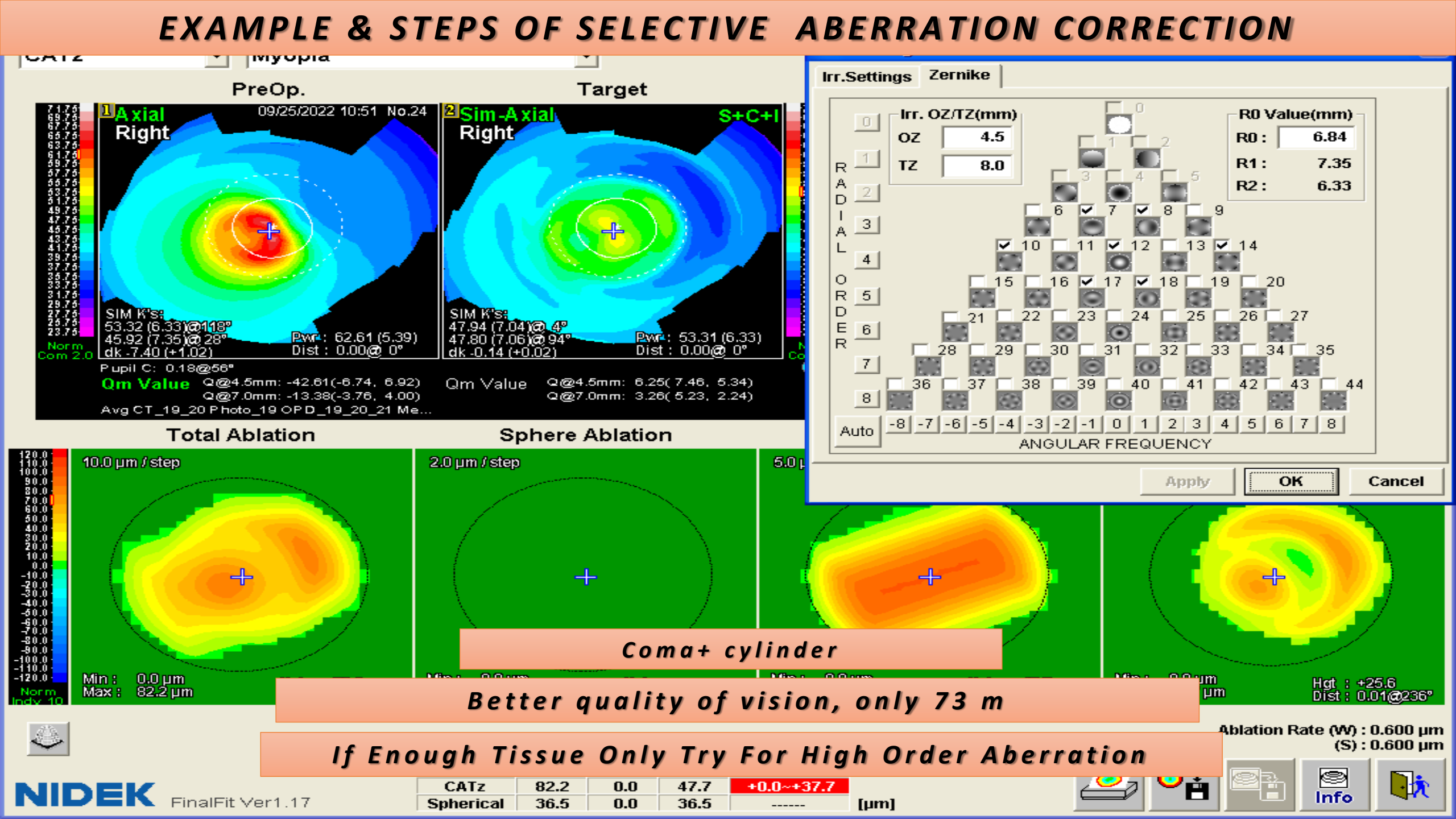
Better quality of vision, only 25.5 m

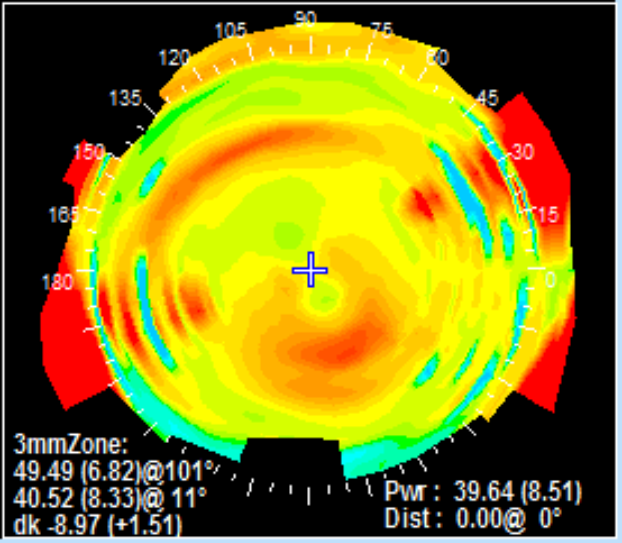
So, Main Concern Is For Quality Of Vision,
If No Enough Tissue Only Try For High Order Aberration

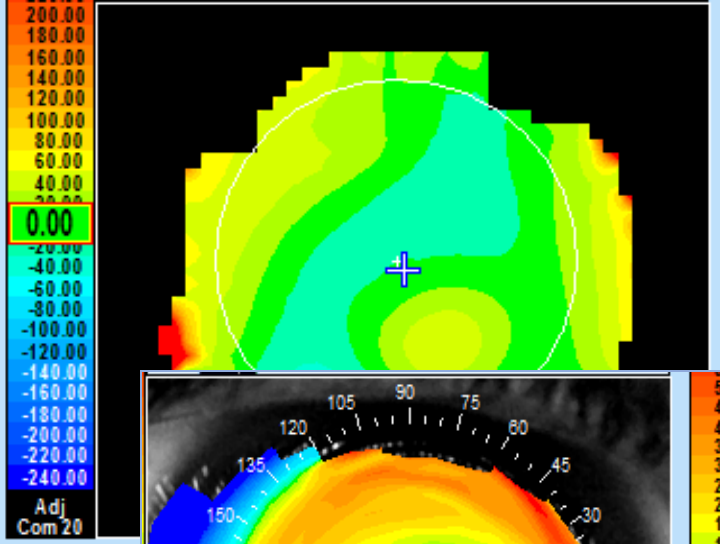
EXAMPLE & STEPS OF SELECTIVE ABERRATION CORRECTION

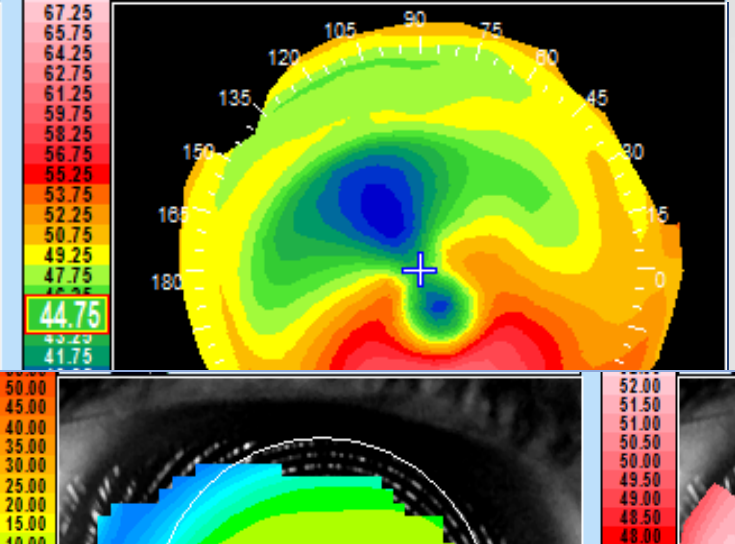


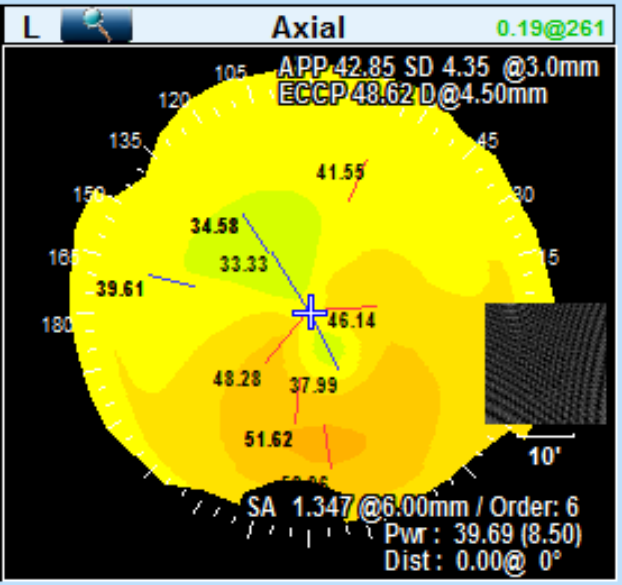
EXAMPLE & STEPS OF SELECTIVE ABERRATION CORRECTION

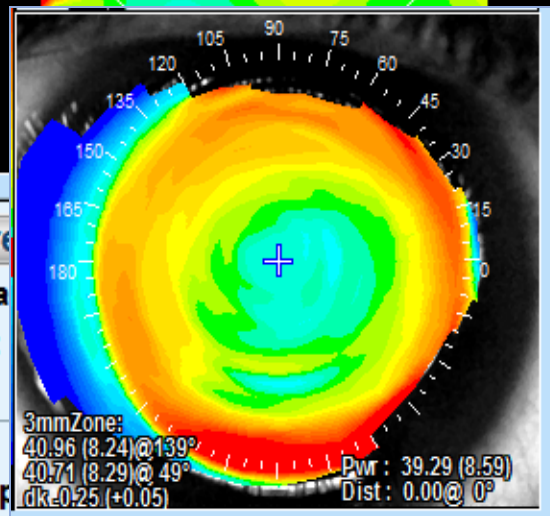


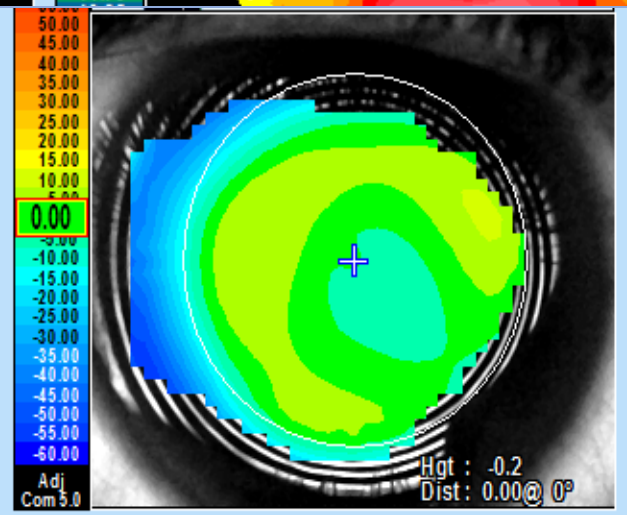


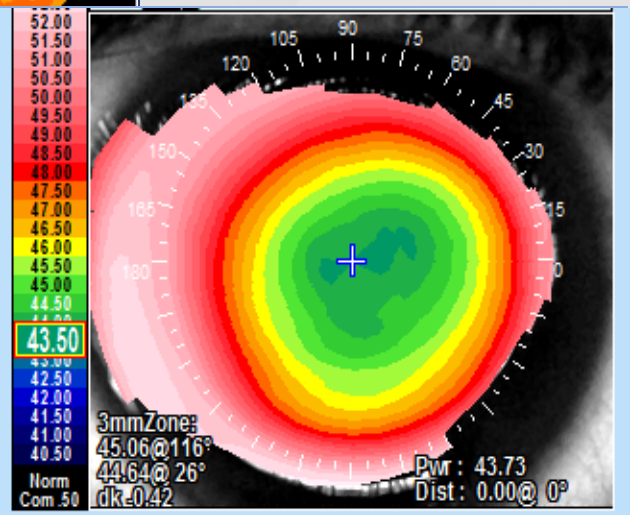


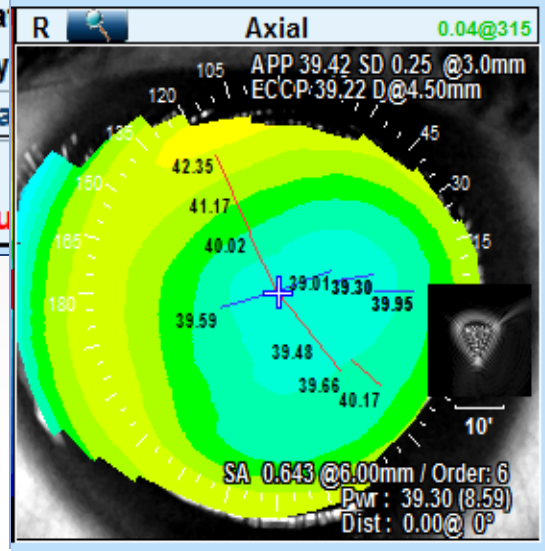












Refere
Surfa
BFS:
SimK
Steep
Fla
Cy
Cornea
Class
Pellu

Reference surface R

Surface: Sphere Zone: 8.4mm

BFS: 8.31mm

SimK

Steep: 40.18@116° / 8.40mm

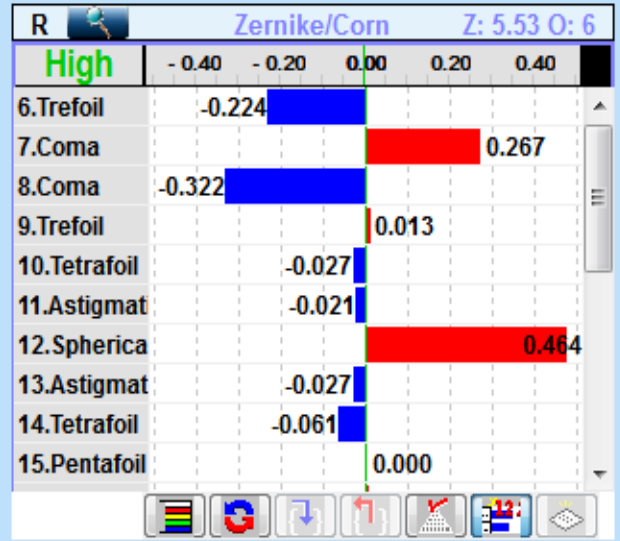
Flat: 39.75@ 26° / 8.49mm

Cyl: -0.43@ 26°

Corneal asphericity Q: 0.64 e: -0.80

Class

Myopic Refractive Surgery (99.0%)



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COMA

- Keratoconus
- Pellucid Marginal Degeneration
- Post LASIK
  - Decentered Ablation
  - Ectasia

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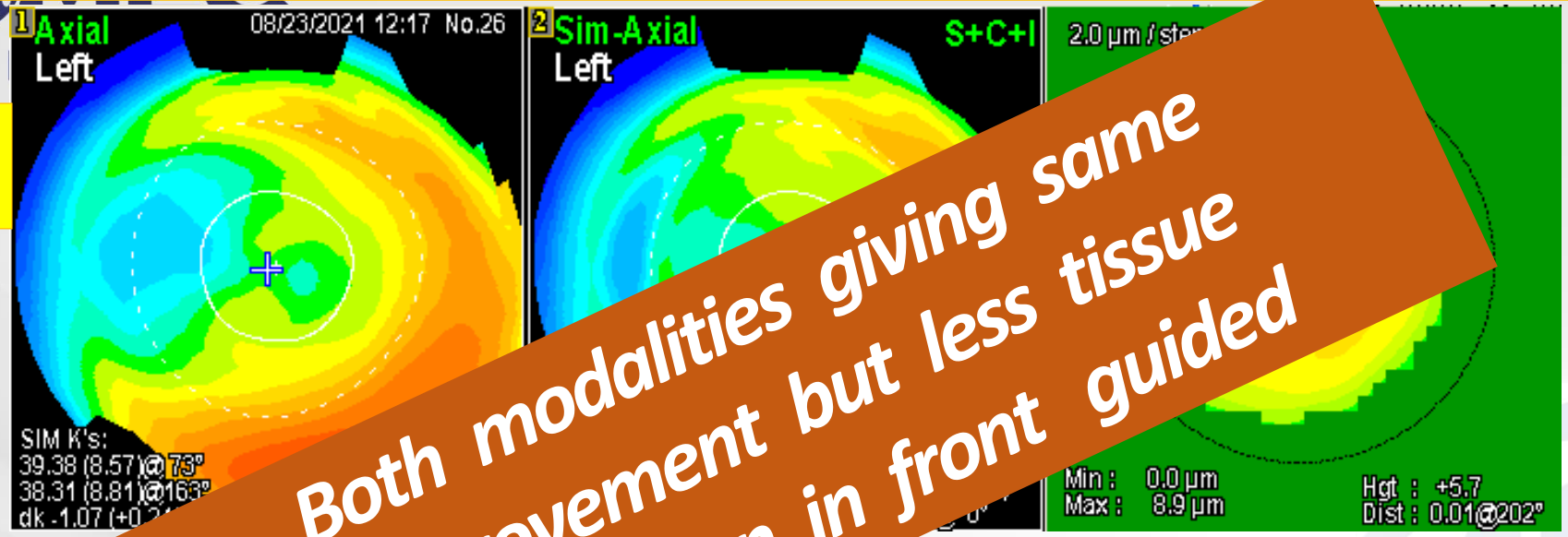
Technique

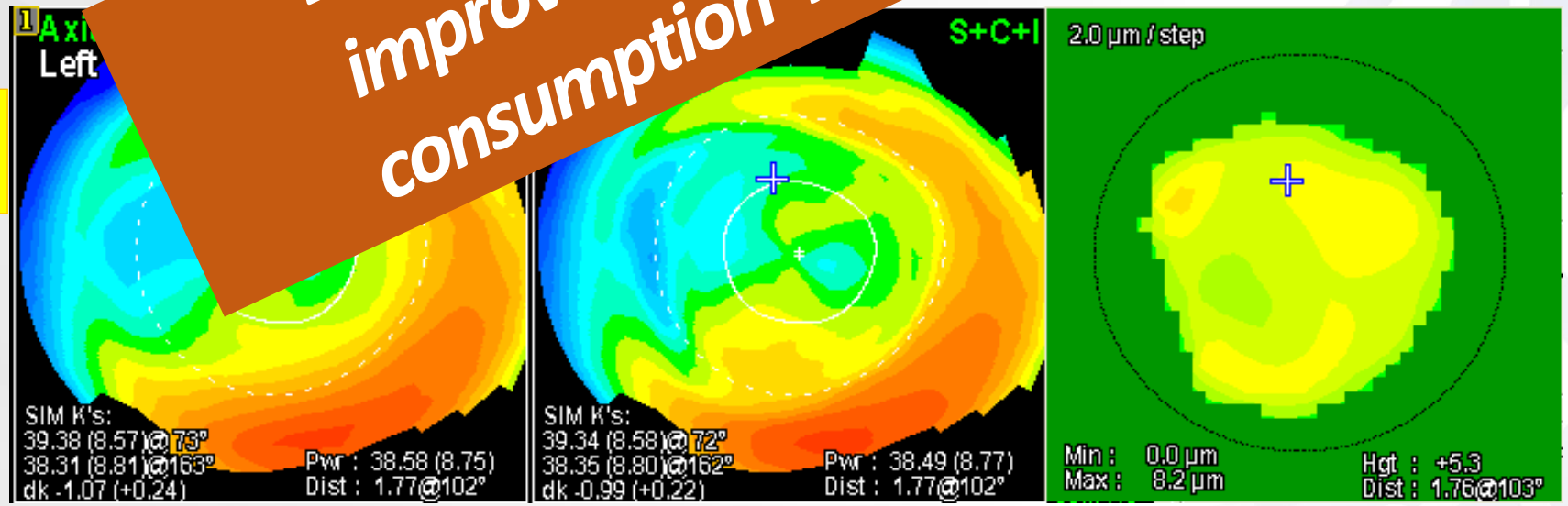
Decentered Ablation

Mixed Functional & Topographic

Topography Guided Ablation

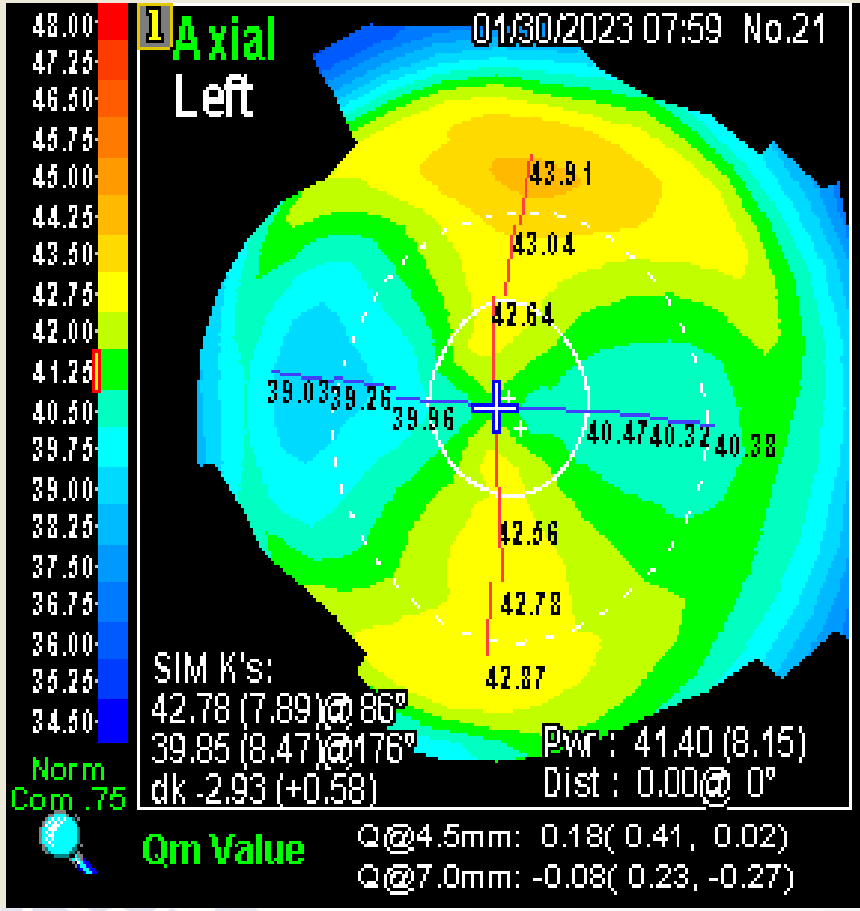


Wavefront Guided Ablation

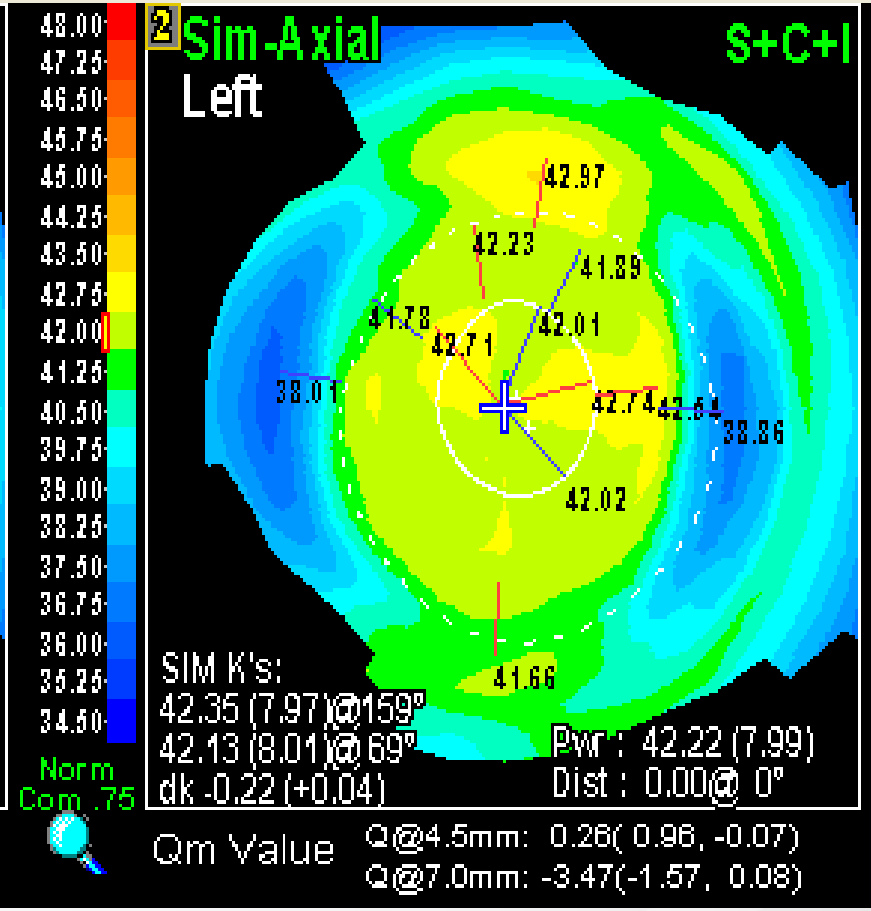


Both modalities giving same improvement but less tissue consumption in front guided

PreOp.



Target



PostOp.1