

NIDEK Offset System: A New Approach to Alignment Control

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Evolution of Alignment Systems

- **Manual adjustment** of patient's head
- **Suction ring**
- First eye-tracker system: **surgeon identification** of the pupil center (Chiron)
- **Automatic identification** of pupil center (Nidek)
- **Tracking of pupil center** with high speed movements (Autonomus)
- **Tracking of cyclotorsion movements** (Torsion Error Detector - TED): **iris pattern identification** (Nidek, Visex)

Parameters

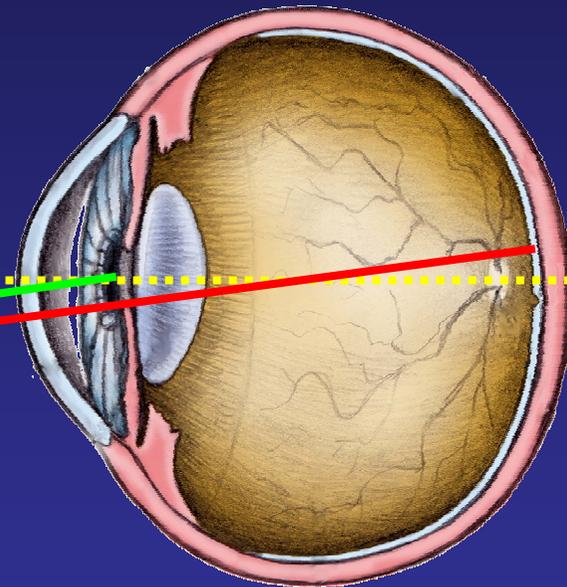
- **Geometrical corneal center**
- **Optical axis (theoretical)** line between anterior vertex (pole) of the cornea to posterior pole of the eye – defined by geometric centers of the two lenses of the eye
- **Visual axis:** line between the fovea and the fixation object (it goes through lens and corneal nodal points)
- **Line of sight (LOS):** line between the center of the entrance pupil and the fixation object
- **Pupillary axis:** line perpendicular to the cornea, it goes through pupil center

Axes of the eye

**Optical Axis
(theoretical)**

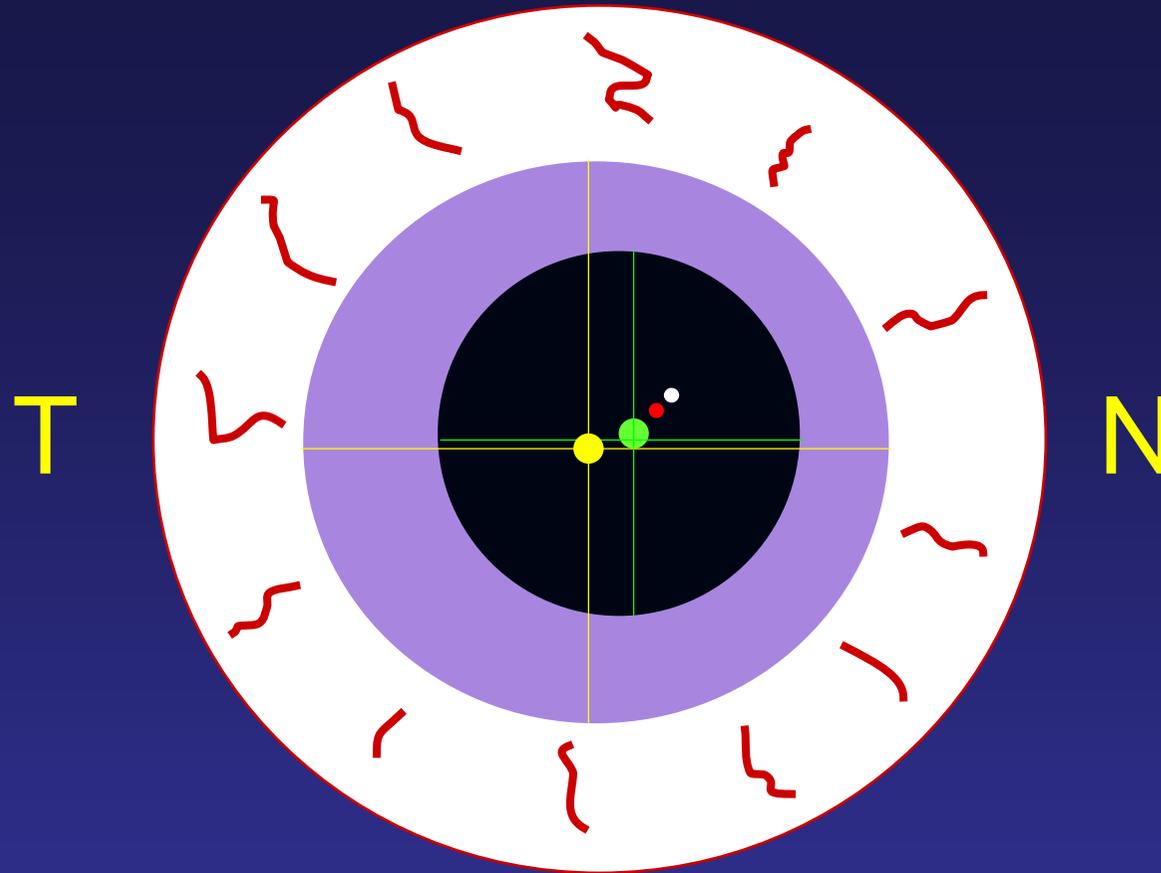


Line of Sight (LOS)



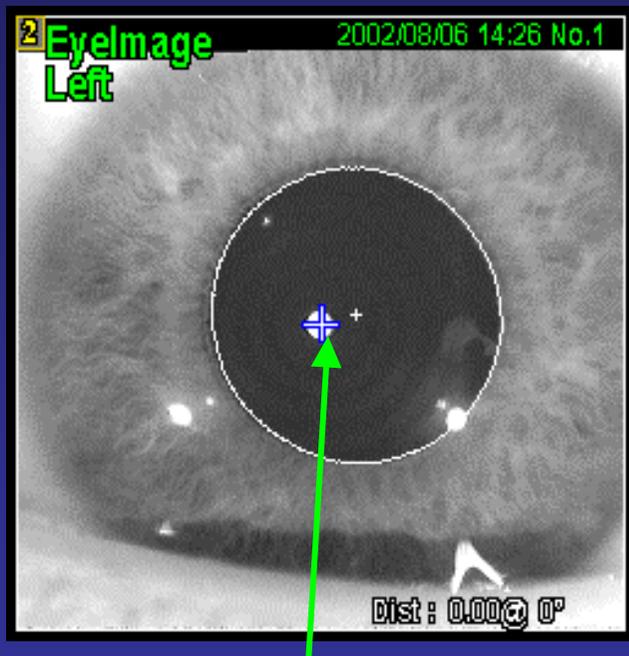
FOVEA

Visual Axis



- Geometrical corneal center (Optical Axis)
- Entrance pupil center (LOS)
- Visual axis
- Coaxially sighted corneal reflex (depends on the position of the light source!)

Conflict: Centration on **LINE OF SIGHT** or **VISUAL AXIS** ?



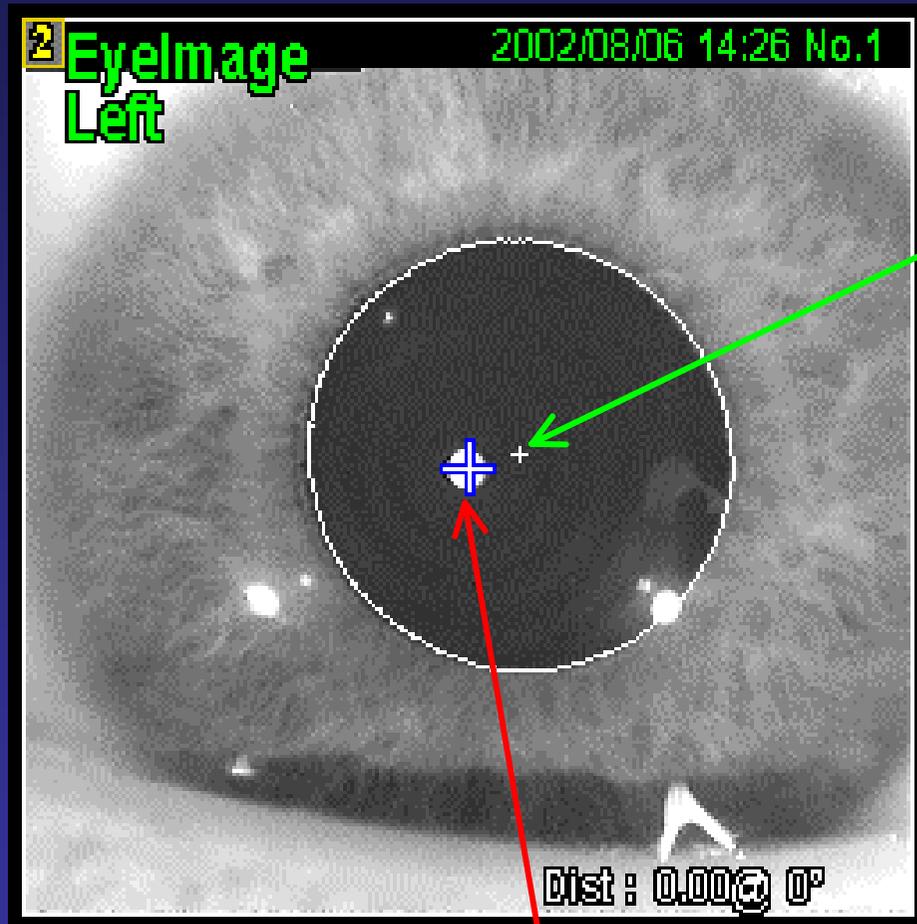
**OPD measures on
VISUAL AXIS !**



**Eye Tracking Syetem
follows L O S !**

80% pts Kappa @ < 0.3 mm

20% pts Kappa @ > 0.3 mm

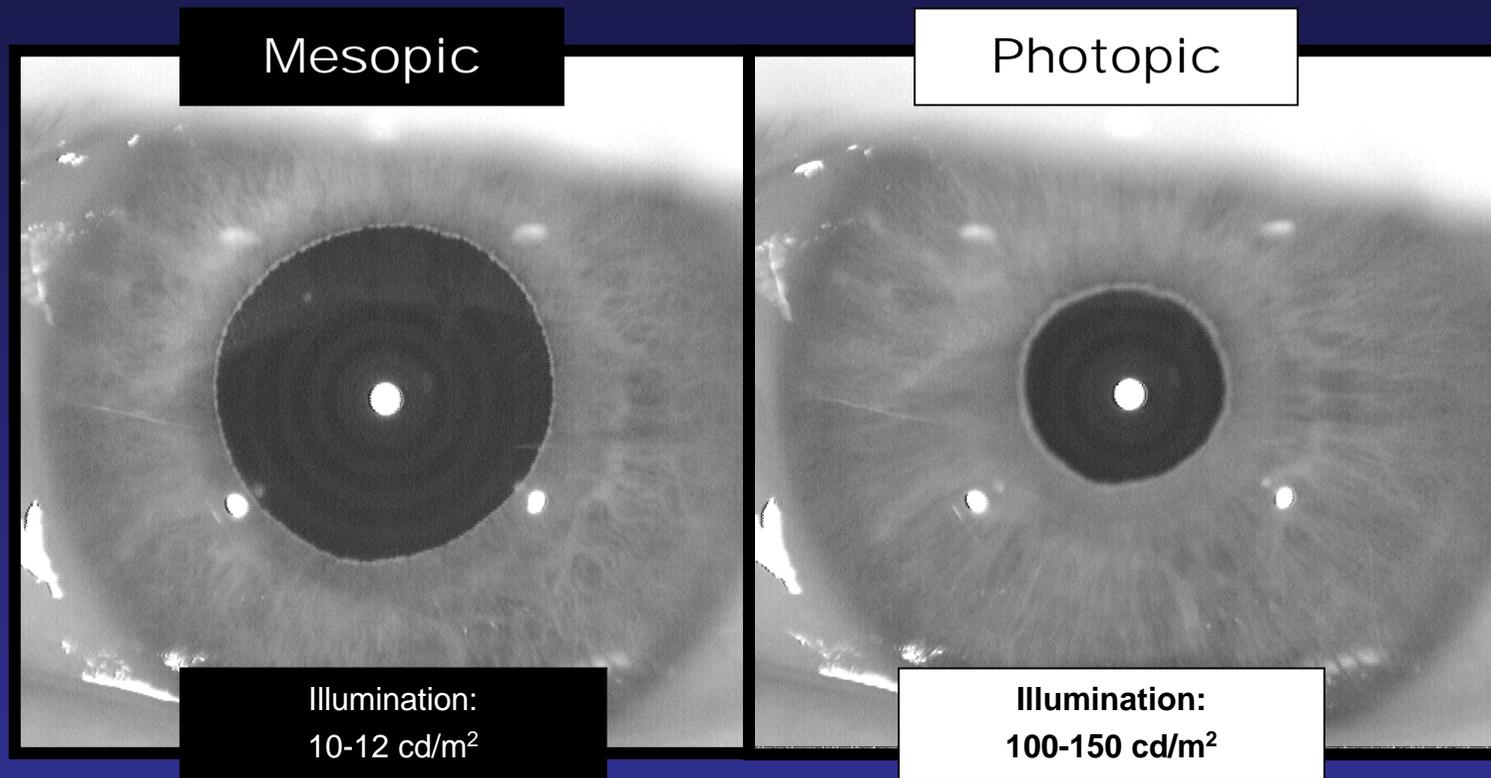


Line of Sight
(Pupil Center)

Angle Kappa : distance
between the Pupil
Center and the visual
axis

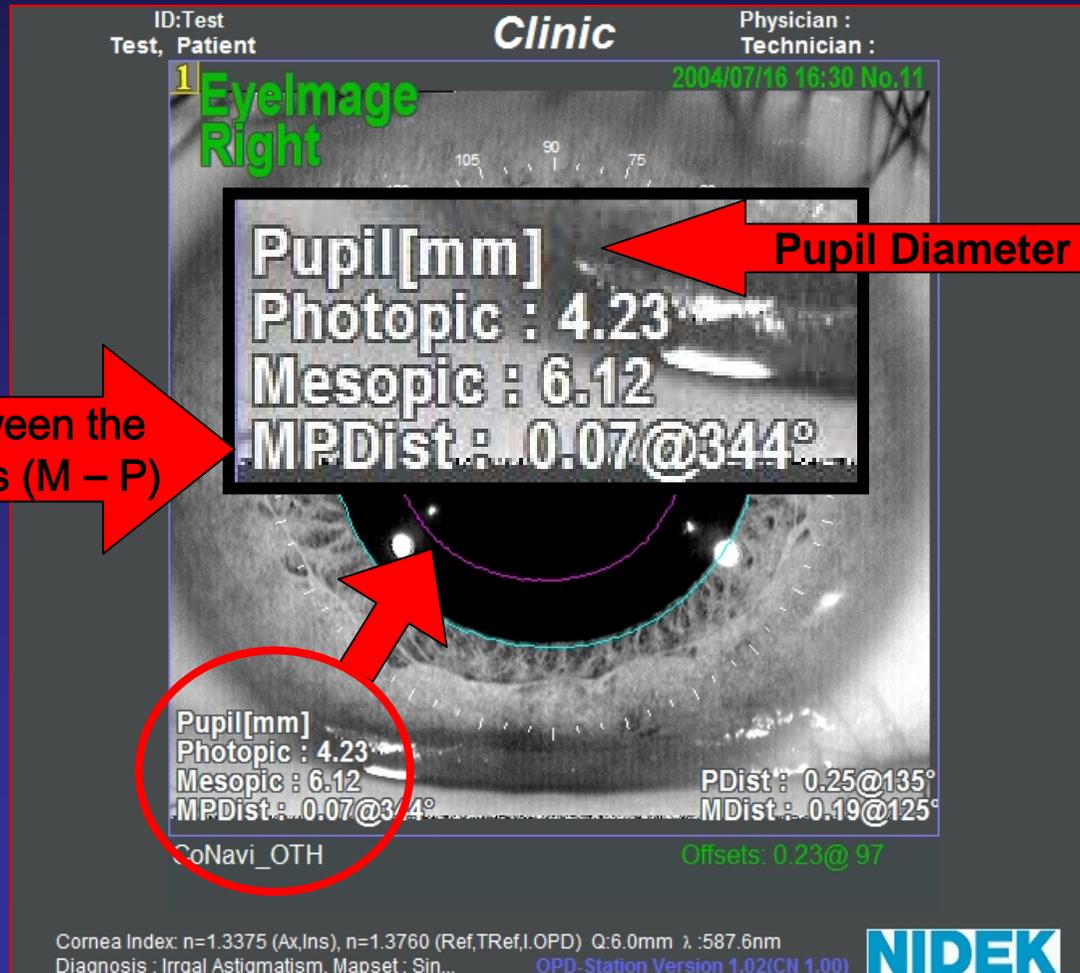
Visual Axis

PUPILLOMETRY



**Pupillometry measures pupil diameter variation
and its importance on refractive examination
Nasally and superiorly motion of pupil centroid eric
donnenfeld**

Dilation: Pupil Center Shift



Much more o

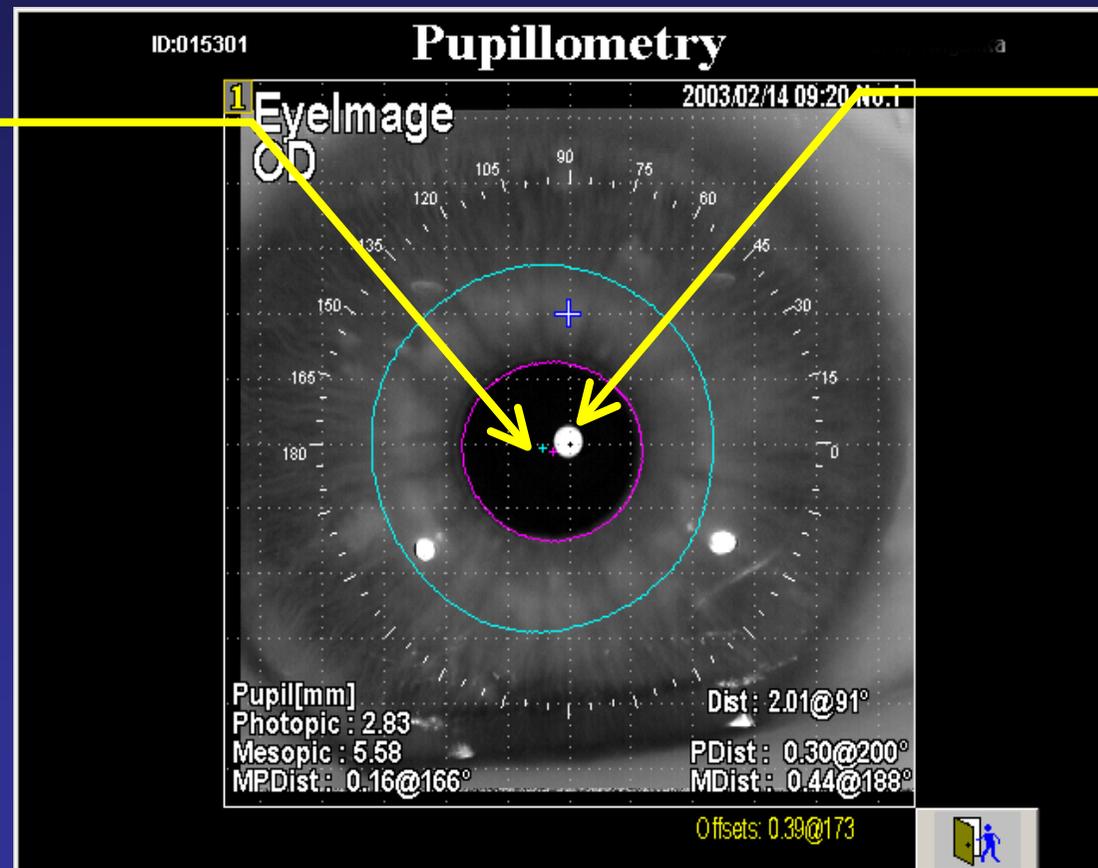
Indexes

PUPILLOMETRY

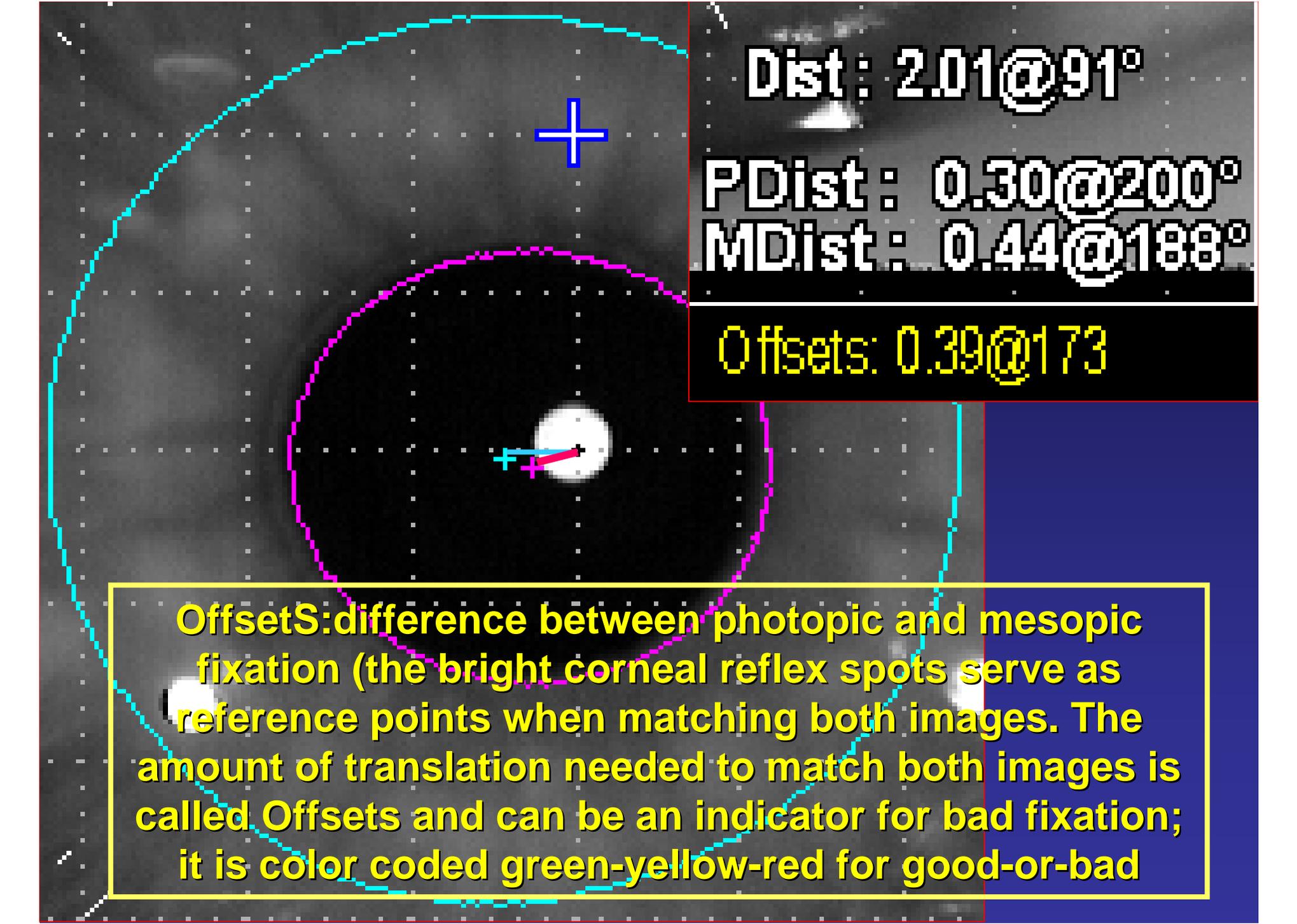
Pupil dynamics

Pupil
center/LOS

(Photopic or
Mesopic)



Visual
axis
(fovea-
fixation
object)



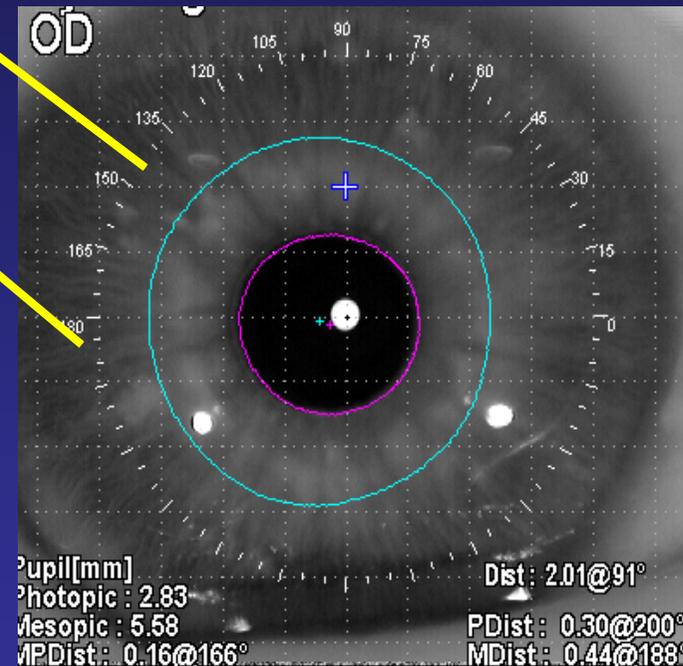
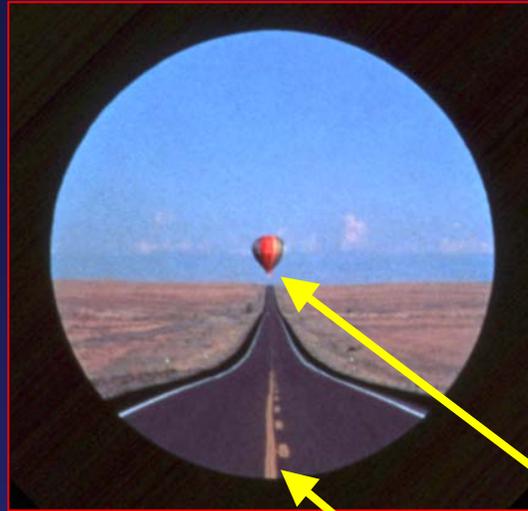
Dist: 2.01@91°

PDist: 0.30@200°

MDist: 0.44@188°

Offsets: 0.39@173

OffsetS: difference between photopic and mesopic fixation (the bright corneal reflex spots serve as reference points when matching both images. The amount of translation needed to match both images is called Offsets and can be an indicator for bad fixation; it is color coded green-yellow-red for good-or-bad



Pupil diameter and LOS vary when the pt looks to an object located near or at distance

Laser Fixation Target corresponds to infinity

Conflict: **LINE OF SIGHT OR VISUAL AXIS ?**

Measurement syst



Visual axis

Laser alignment syst



Pupil

- **Is it a conflict or a measurement difficulty**
- **Which of the two gives us the best result?**
- **Possible induction of Coma**
- **Need to analyze the distance between center of Mesopic and Photopic pupil**

PROs of Visual Axis Centration

- Physiologic formation of the retinal image (fovea – fixation object)
- Reduction of decentered treatment currently avoided through wide optical zones
- Prolate or aspheric surfaces on corneas that are not decentered
- Reduction of optical aberrations: coma
- Better contrast sensitivity
- Best Visual Acuity → “Supervision”

Factors of proper alignment with NAVEX Platform –NIDEK

- Lateral alignment: X/Y axis
- Z-plane focusing
- Tilt control
- Torsion Error Detector (TED)
- 200Hz Eye Tracking movement during ablation

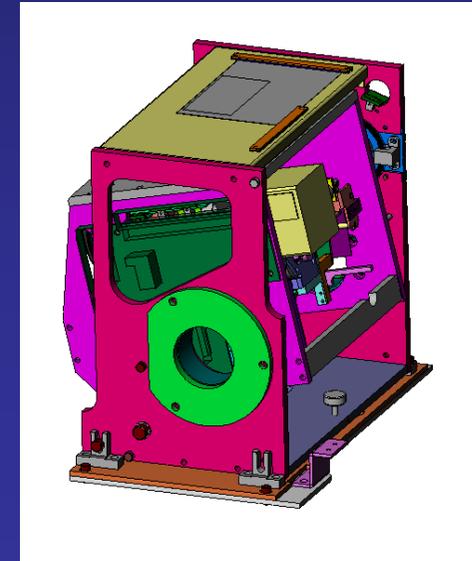
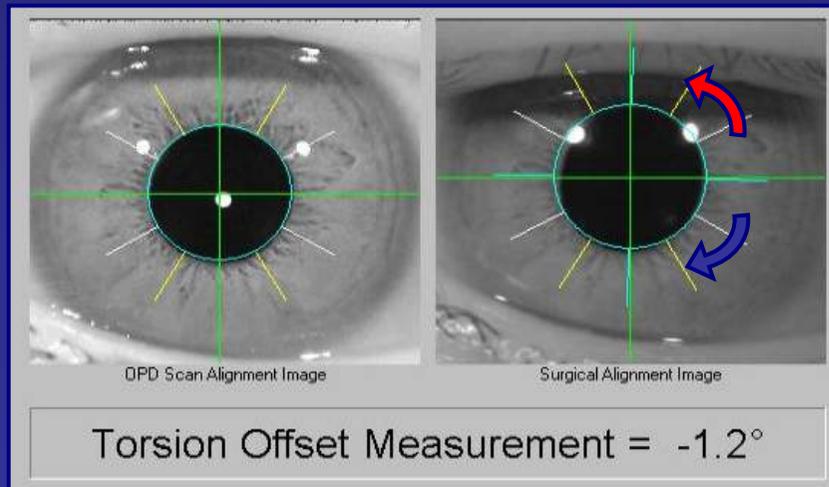
TE Detection → TE Correction

On-line Torsion (Jul.2006) : CX/CXII also available

Detection of Cyclo-Torsion Error during laser ablation

Torsion Error Correction (Dec.2006) : CXIII only

Detection of Cyclo-Torsion Error & Adjust the position of laser beam automatically

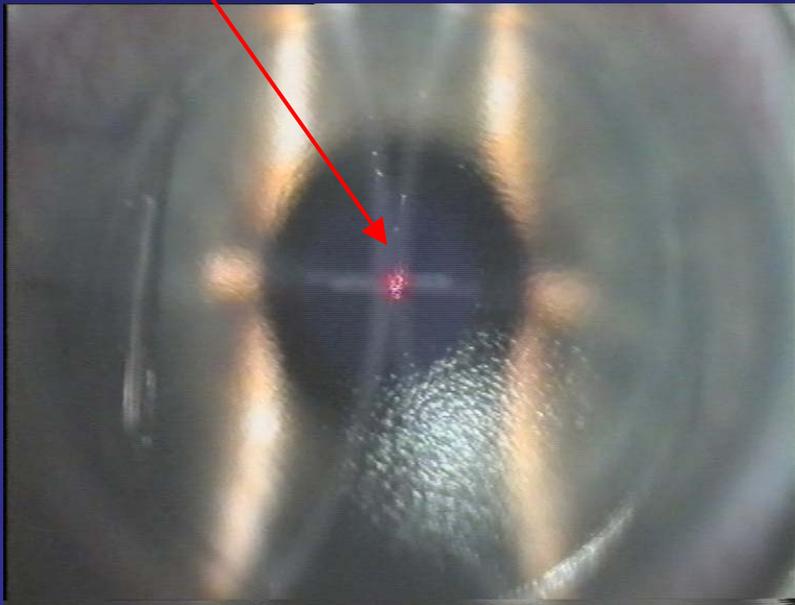


NAVEX Platform

- Improves cylinder correction accuracy while ensuring that the excimer laser ablates with unparalleled precision during conventional and customized refractive surgery procedures.
- Accurate and precise laser alignment and delivery during the procedure.

Manual TE Offset (Current Method)

Center of Ablation



EC-5000

OPTIONS

Parameters

Laser Repetition Rate Myopia : 40 Hz Vertex Distance : 12.50 mm
Desired Ablation Rate on PMMA : 0.300 μ m Limit of Total Ablation Depth : 190 μ m
Default Flap Thickness : 160 μ m

Control condition

Printer control : No print Manual print Auto print
Save Operation Data : Auto Manual
Sph./Cyl.order : Sph. first Cyl. first
Enable Delivery Position Movement : Yes No
OZ/TZ Cyl.independent of OZ/TZ Sph. : Yes No
Offset Control in Eye Tracking : Yes No
Enable TEST ABLATION on plate : Yes No
Enable Multi Stage Operation : Yes No

Enable OZ/TZ size Recommendation : Yes No
Axis setting independent of PreOP axis : Yes No

Back (B) Nomogram (N) Print (P) OK (O)

SYSTEM POWER OFF 5/12/2004 12:26 PM

EC-5000 Myopia Stage 1

Patient Name & ID : Lucardi Marica 493041 Eye : L

Physician's ID : []

NIDEK Standard

Nomogram ID : MYO_SUR_UNDER40

1 Eyelimage 2003.02.14 09:20 No.1

OD

Pupil[mm]
 Photopic : 2.83
 Mesopic : 5.58
 MPDist: 0.16@166°

Dist: 2.01@91°
 PDist: 0.30@200°
 MDist: 0.44@188°

X, Y Radius, Angle

X : 0.00 mm
 Y : 0.00 mm

P.Dist
 X : 0.00 mm
 Y : 0.00 mm

M.Dist
 X : 0.00 mm
 Y : 0.00 mm

Set (S)

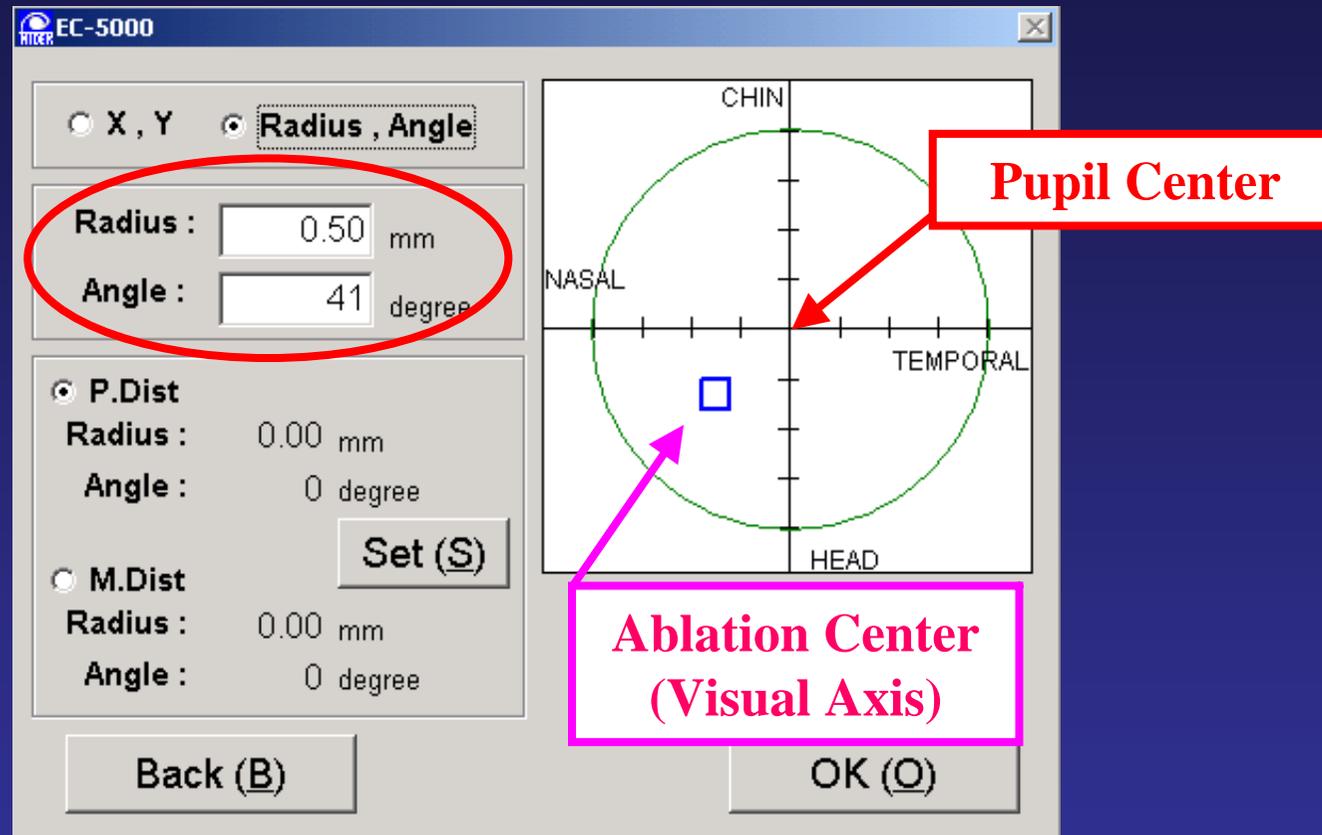
Back (B) OK (O)

Back (B) System Data (D) Start OP (O)

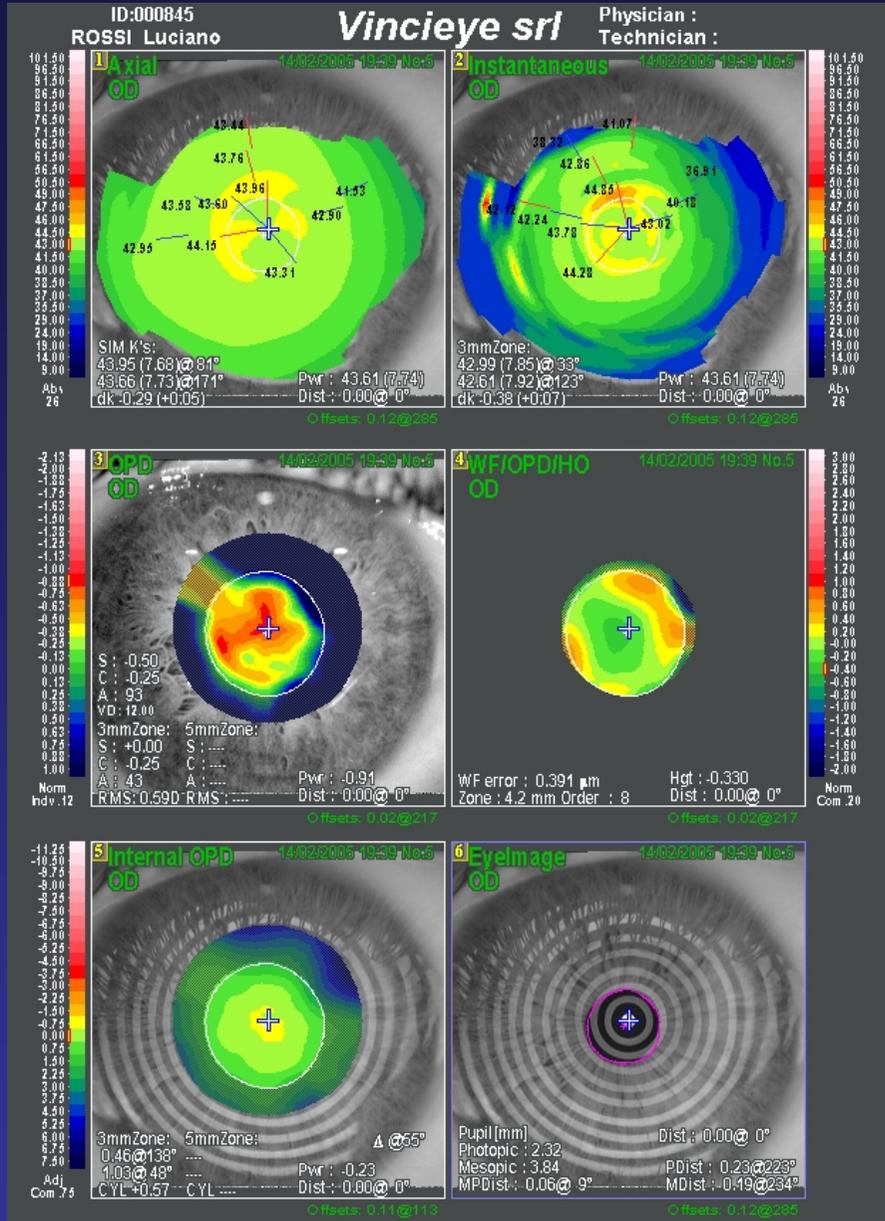
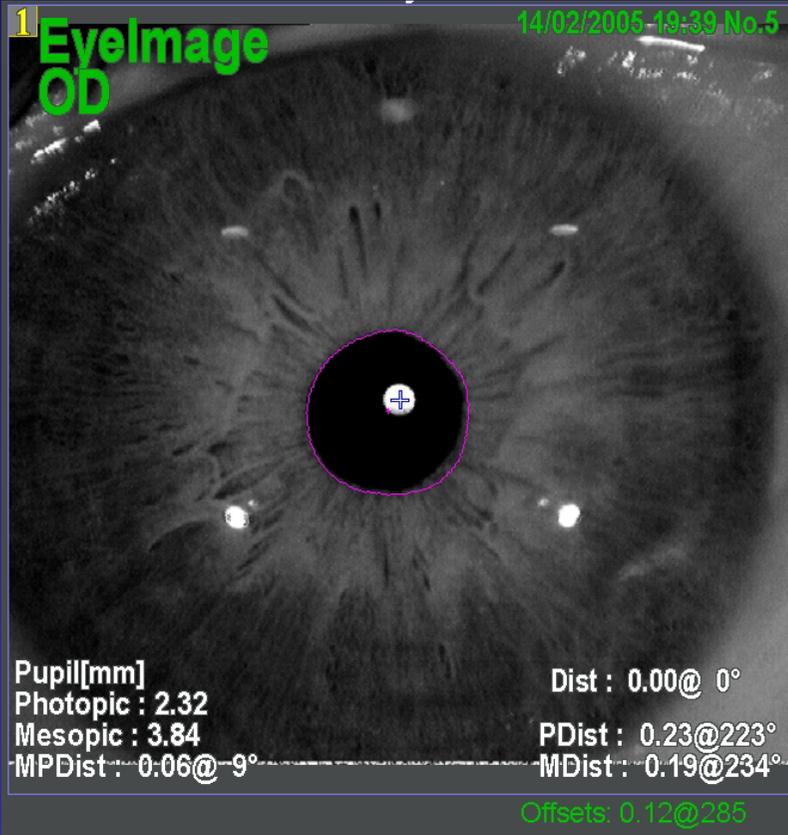
Mode = EGY NGR
 DATA RECEIVE ENABLE 07/27/06 2:26 PM

Presently one must use the eye tracking offset function to enter the difference between visual axis and pupil center, defined as Cartesian or polar coordinates.

New Eye Tracking Offset Function



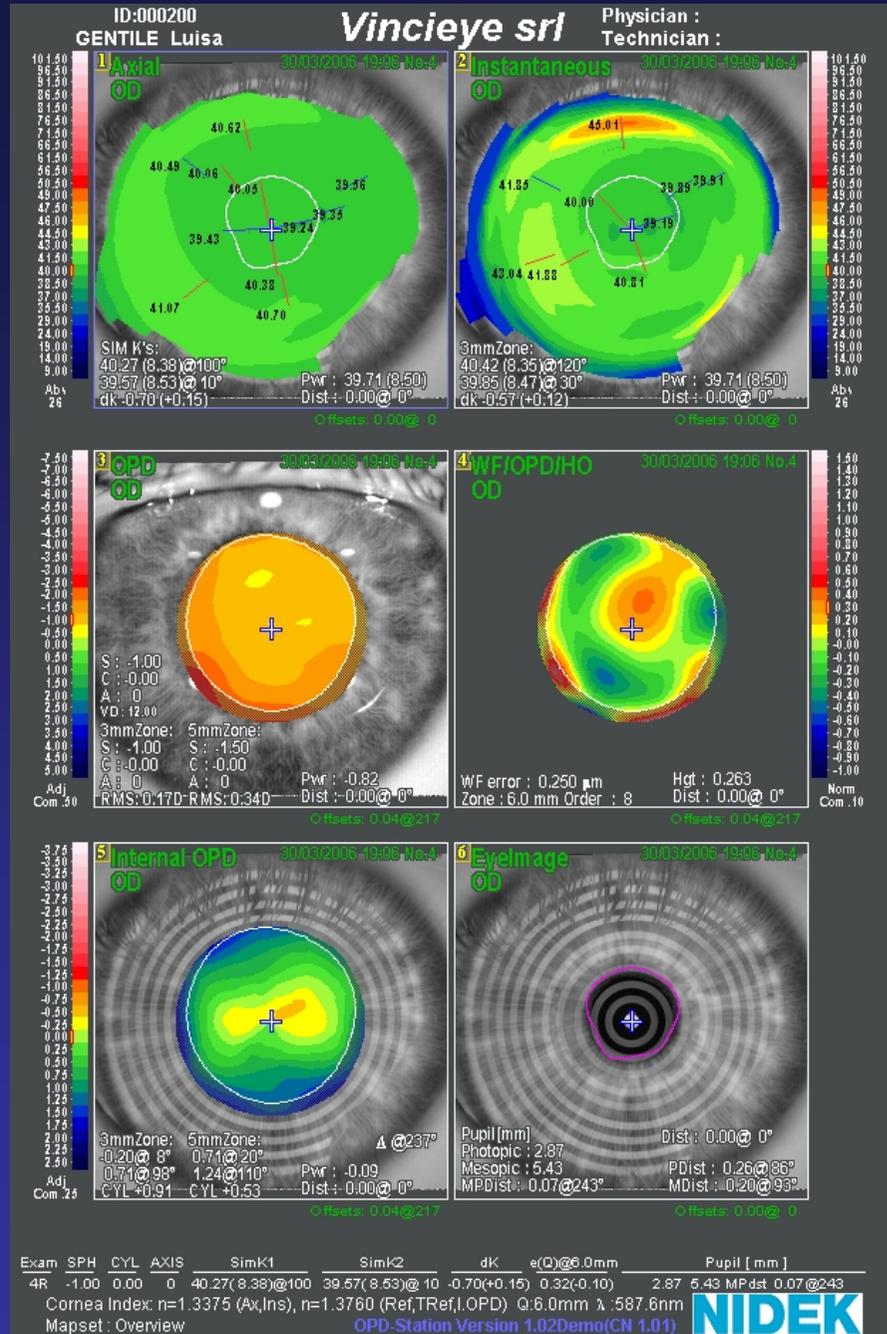
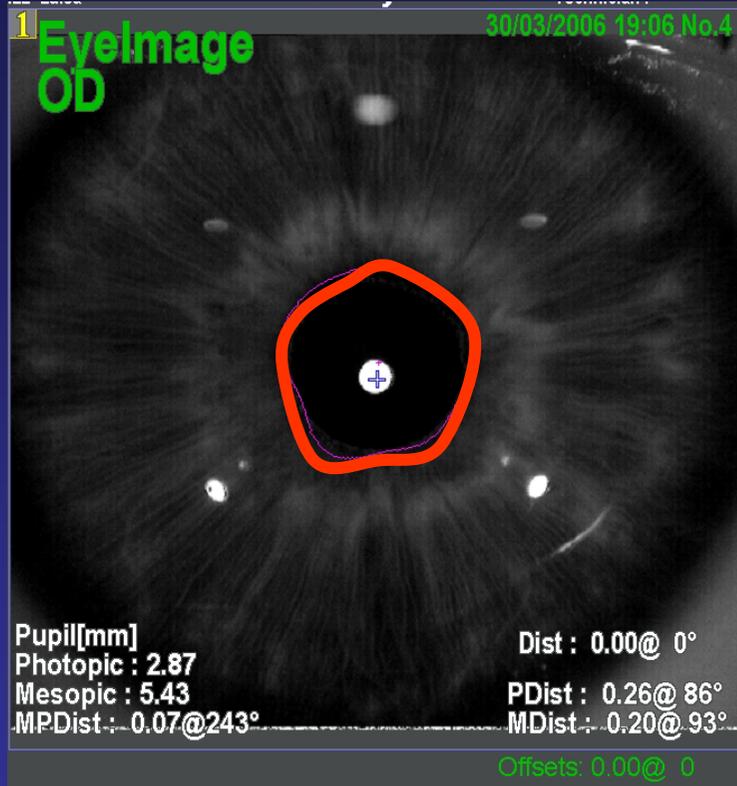
Future software version will automatically transfer this numbers via FinalFit as it is included of the OPD – Scan data.



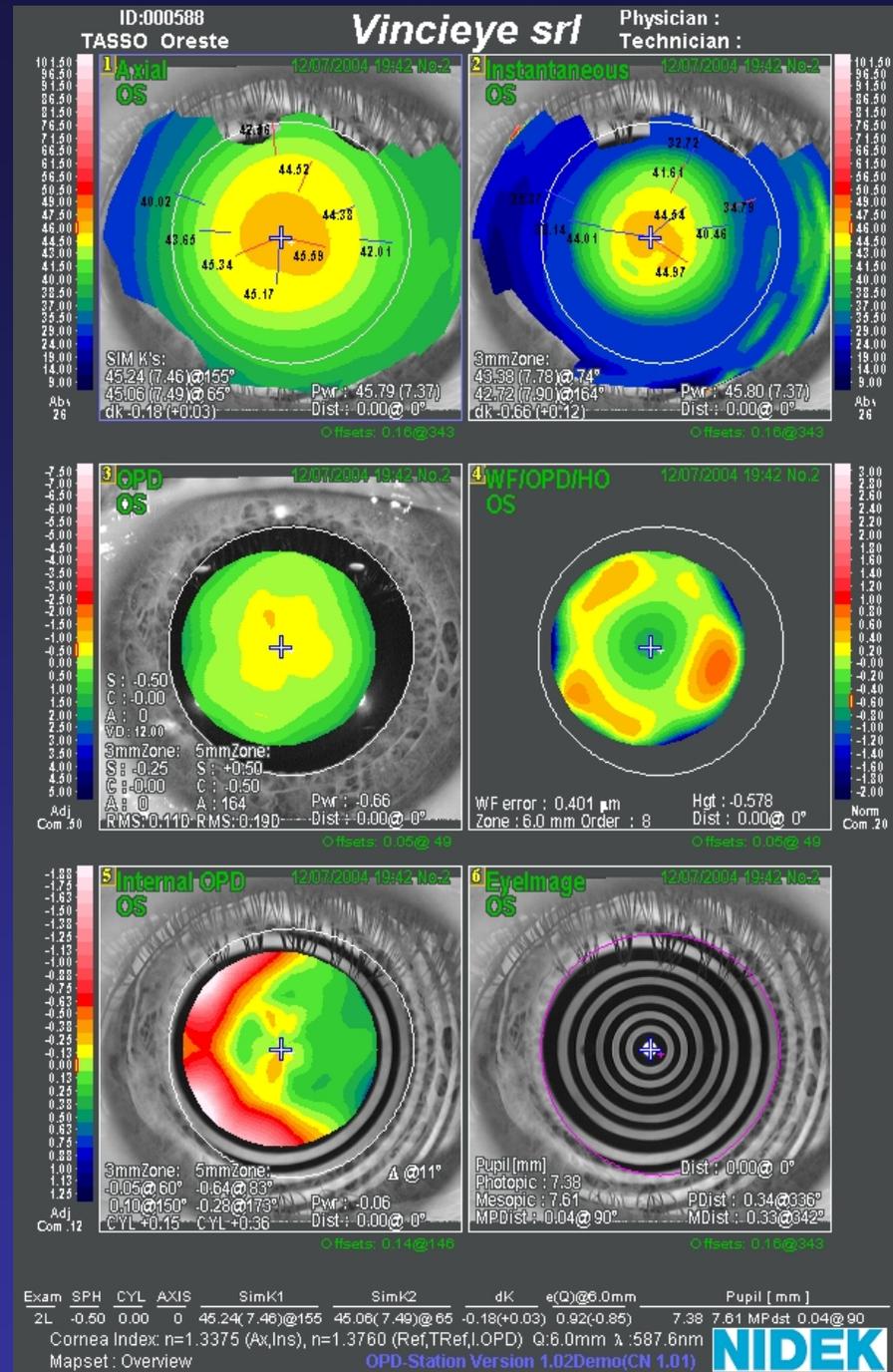
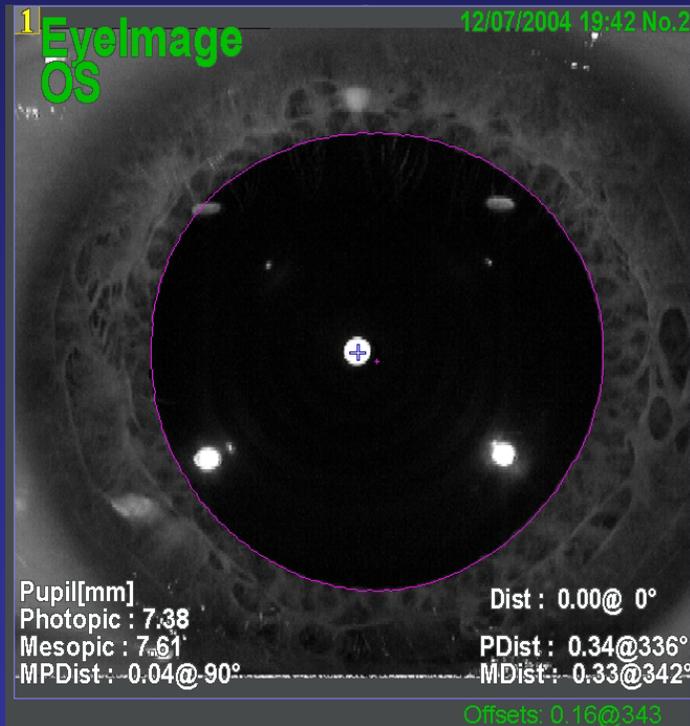
Exam	SPH	CYL	AXIS	SimK1	SimK2	dK	e(Q)@6.0mm	Pupil [mm]
5R	-0.50	-0.25	93	43.95(7.68)@81	43.66(7.73)@171	-0.29(+0.05)	0.36(-0.13)	2.32 3.84 MPdst 0.06@ 9

Cornea Index: n=1.3375 (Ax,Ins), n=1.3760 (Ref,TRef,I,OPD) Q:6.0mm λ:587.6nm
 Mapset : Overview **OPD-Station Version 1.02Demo(CN 1.01)** **NIDEK**

Asymmetric Pupil



Hyperopic treatment



Conclusions

Correct alignment is mandatory for successful customa blation

Correct alignement requires identification of:

- Ocular Axes:

Line of Sigth (LOS) and **Visual Axis**

- Cyclotorsion error :
astigmatism and HOA



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