Imaging in Glaucoma: GDxVCC and it's Interpretation

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*Intro

* Glaucoma -optic neuropathy characterized by a loss of retinal ganglion cells and their axons, the Retinal Nerve Fiber Layer (RNFL)
* Ganglion cell loss irreversible, hence early detection critical for prevention of progression of dx
* Prof. Weinreb -“If you diagnose glaucoma early, you can treat it early. If you treat glaucoma early, you can slow the rate of progression. If you slow the rate of progression, you prevent blindness.”

*Risk Factors

*IOP
*Age
*Race
*Family History
*Myopia
*Corneal Thickness

Glaucoma Diagnosis

- IOP Measurement/ Assessment
- ONH Assessment
- Visual Function
- Visual Fields Testing
- RNFL Assessment – less frequently

*Limitations of VFT

*Visual Field Assessment (SAP)

- Defect on VFT – Dx already moderate to advanced
  - as many as ½ of all GC lost
  - -OHTS OH → G only 50% had VF defects
- Variability on repeat testing- OHTS 86% of defects not replicated on repeat testing!
- Wang et al – Sensitivity and specificity – 70 and 67%

*RNFL Assessment

- >30 yrs ago – RNFL defect= earliest sign of glaucoma
- Sommer et al- 88% G[illegible] G had RNFL defects before VFT and 60% had RNFL defects 6 yrs prior to VF defects
- Airaksinen et al – early glaucoma -83% RNFL defects while only 42% C/D changes
- Several studies RNFL more sensitive for predicting future VF loss than ONH evaluation
- 2 methods – Red free RNFL photography and scanning laser polarimetry

*GDxVCC

* RNFL assessment through scanning laser perimetry
* Objective RNFL info compared to extensive normative database
* Deviations clearly presented interpretation simple
* Excellent reproducibility detection of small changes over time
* Reus and Lemij – sensi and specificity = 89 & 98%
* Fast, simple test practical , less operator influence
* Early detection, early Mx
* No replacement, but adjunct to traditional tools

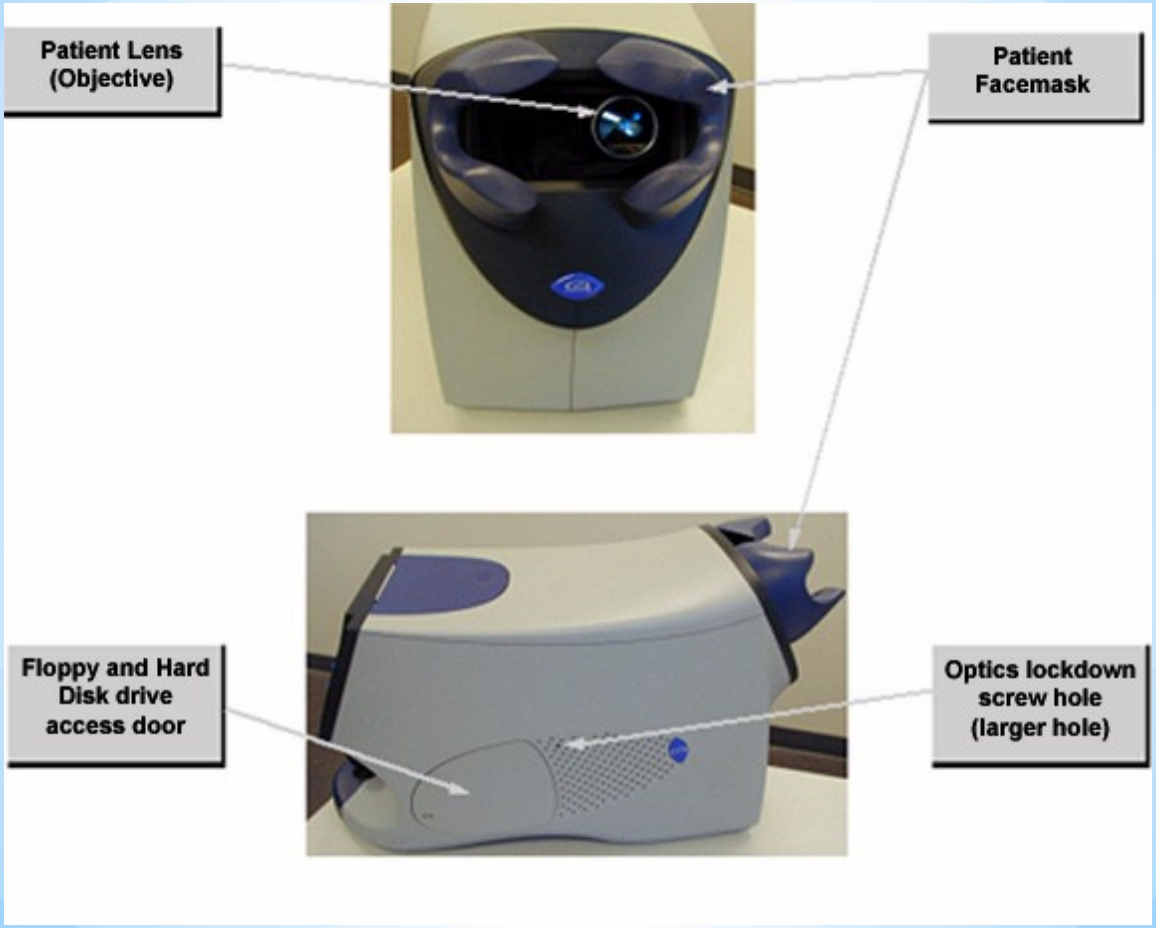
*Normative database

- 6 American institutions, examinations by experts
- Started sept.2006
- Def. of Normal –

  IOP under 22mmHg, GHT within normal and PSD>5%, Normal disc with no assymetry>0.2, no rim thinning, notching, excavation or observable RNFL
- 540 normal eyes, 271 glaucoma, 18-71 yrs, caucasian 70%, African Americans 18%, Asians 12%
- Estimated that healthy eye loses 5,000 GC per yr as aging process

*GDxVCC Front view

*GDxVCC- patient and side view



*Positioning patient

*Introduction

- *GDxVCC employs patented GDx Scanning Laser Polarimetry (SLP) to provide three –dimensional quantitative in vivo info about the RNFL
- *Info used for 2 levels of analysis

1. Symmetry analysis to compare RE and LE to each other and normative database
2. Guided Progression Analysis for comparing the eye to itself over time

1. Pat. with corneal phase shift >140nm
2. Pat. with dense cataracts
3. Pat. with central vision loss and unable to fixate on a target
4. Pat. with refractive errors from +8D to -13D
5. Pat. less than 18yrs of age

*Unreliable results in…

Overview of the Symmetry Analysis Report

Quality Indicators
Q ≥ 7, recommended
Residual (ECC) ≤ 4
Residual (VCC) < 12
TSS (ECC) > 40
TSS (VCC) > 60

Fundus Image
Reflectance image showing the optic nerve head (ONH).

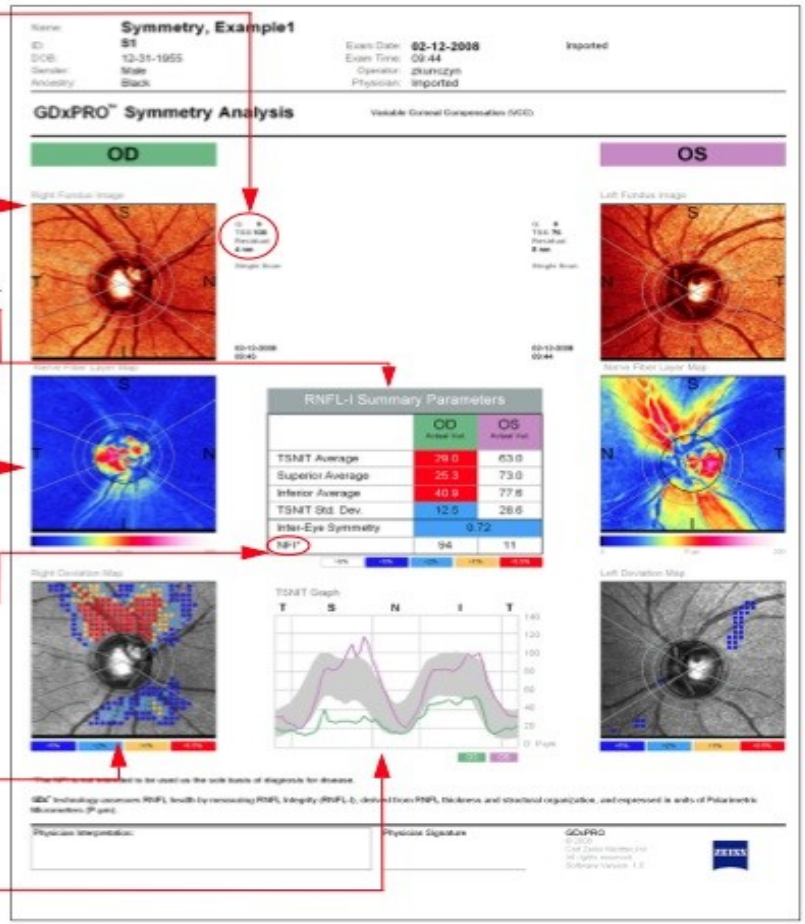
RNFL-I Summary Parameters Table
Color-coded parameters indicating comparison to normative limits. All except the NFI are calculated only from the Calculation Circle.

Nerve Fiber Layer Map
An hourglass shape of yellow and red colors around the ONH is typical of normal eyes.

NFI
Nerve Fiber Indicator is related to the likelihood that the nerve fiber layer map is abnormal.

Deviation Map
Color-coded indicating comparison to normative limits.

TSNIT Graph
Displays normal range (shaded area) and patient's RNFL-I values along the Calculation Circle.



Sample courtesy of:
Joseph Sowka, OD, FAAO, Professor and Director of Glaucoma Services, Nova Southeastern University College of Optometry, Ft. Lauderdale.

Figure 6-2 Sample Symmetry Analysis Report – Abnormal OD and Normal OS

OSG 2014

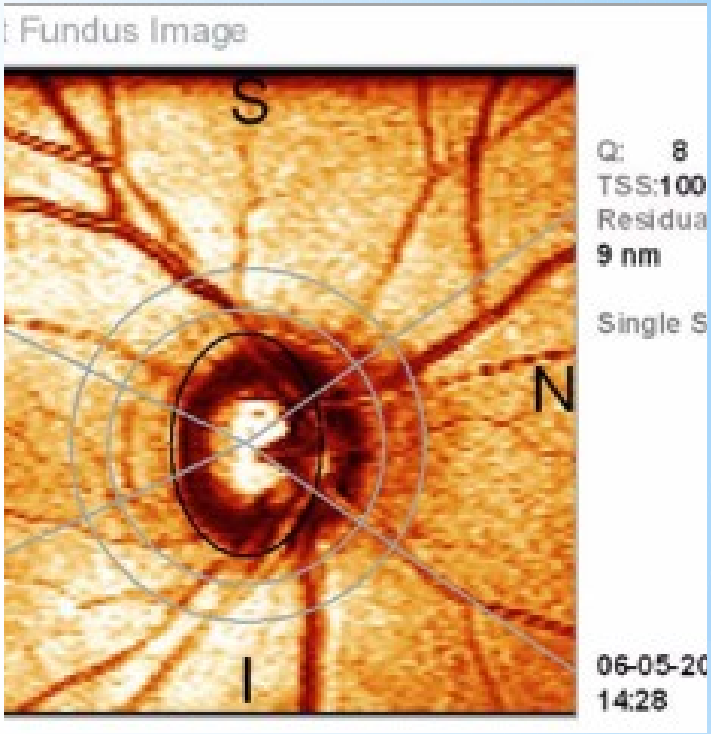
*Typical Print out

1. Demographic data
2. Quality indicators
3. Fundus image
4. Nerve Fiber layer Map
5. Deviation Map
6. TSNIT Graph
7. RNFL-I Summary Parameters Table

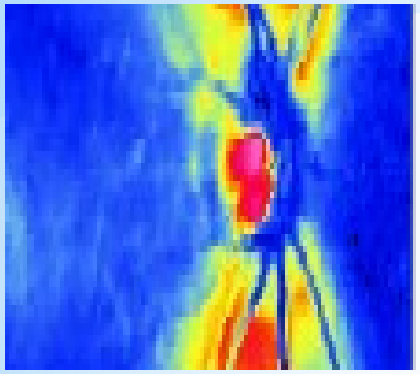
*Features of a normal printout

* Q – Quality Score, >7
* TSS – Typical Scan Score
  - measures ‘typicality’ of RNFL image, > 60
* Residual – Rep. error of corneal compensation, < 12nm
* SD – Standard Deviation

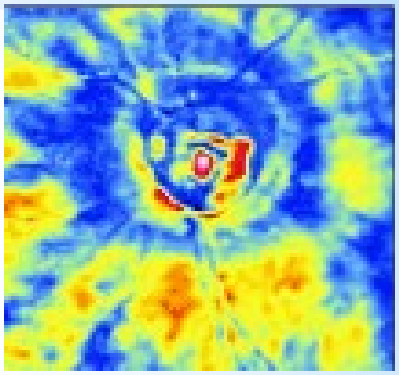
-mean of 2 or 3 measurements, < 8.6



* 1. Quality Data



Typical

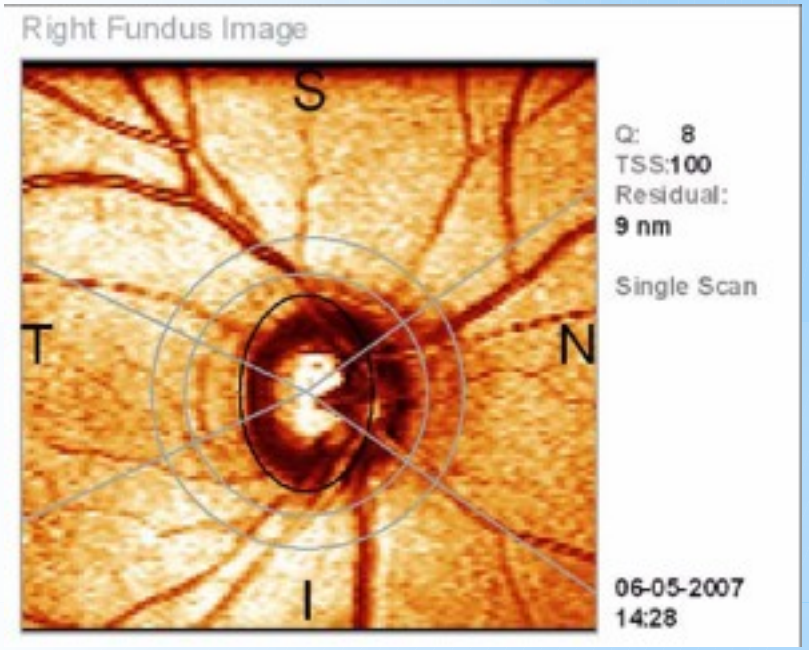


Atypical

Atypical scans more common in pale fundi, high myopes and elderly eyes

*Typical Scan Score

* Calculation circle
  -defines area of data acquisition -20 x 20 deg. of posterior pole
* -16,000 data pts
* - Fundus image – Initial quality evaluation, centered?

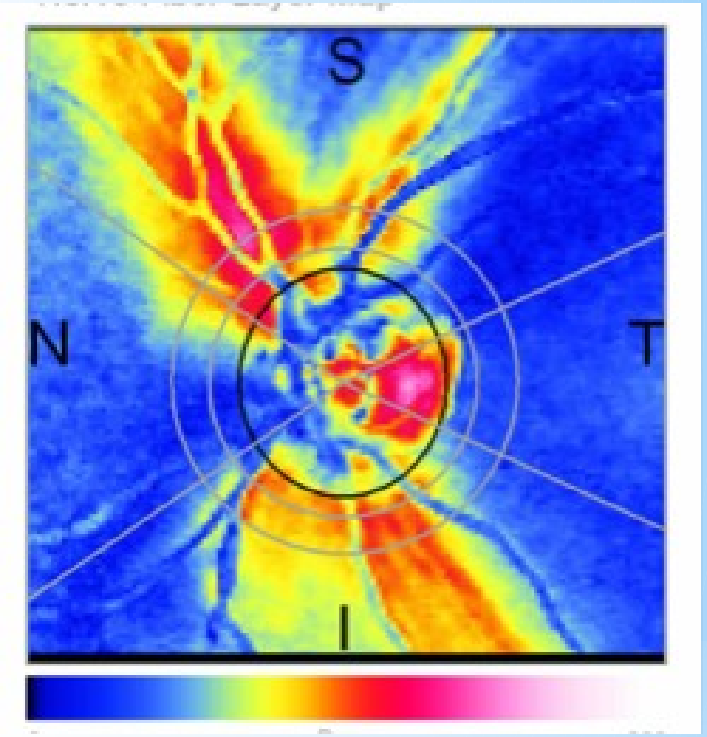


* 2. Fundus Image and calculation circle

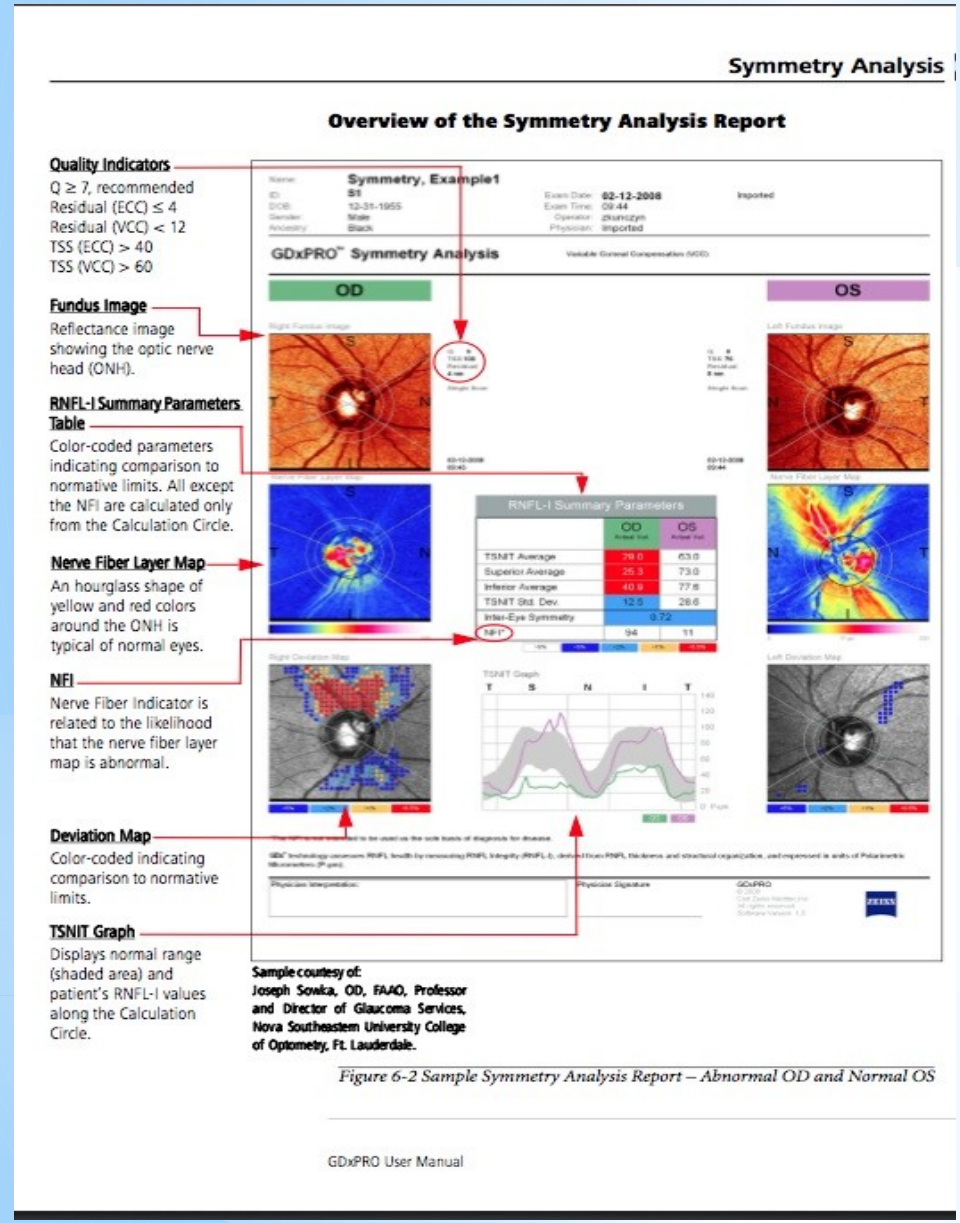
* Color map of RNFL –I of 20x20 area of ONH
* Color scale-

dark blue – thin,

bright red/yellow – thicker NF

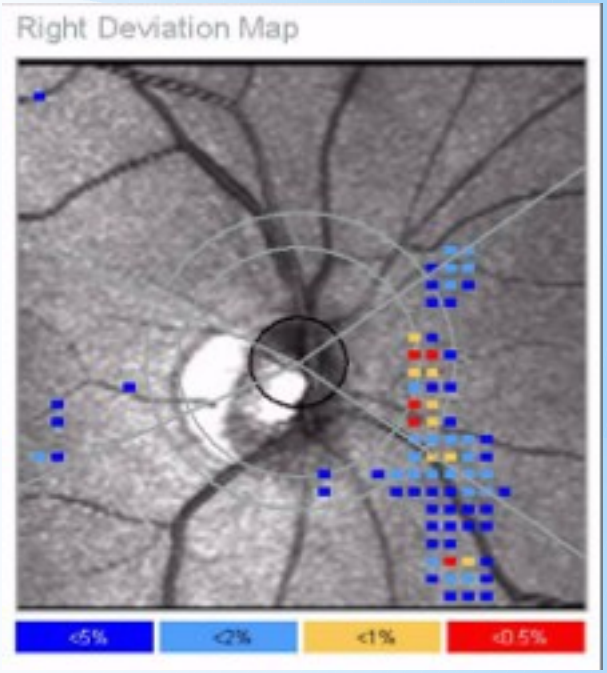


* 3. Assess NFL Maps and Symmetry



*4. Evaluate and Compare Deviation Maps

* Comparison with normative database
* Deviation rep. by color-coded squares at each location on a b/w fundus image



* 4. Evaluate and Compare Deviation Maps

* 5. Evaluate RNFL-I Summary Parameters

* Parameters computed from calculation circle

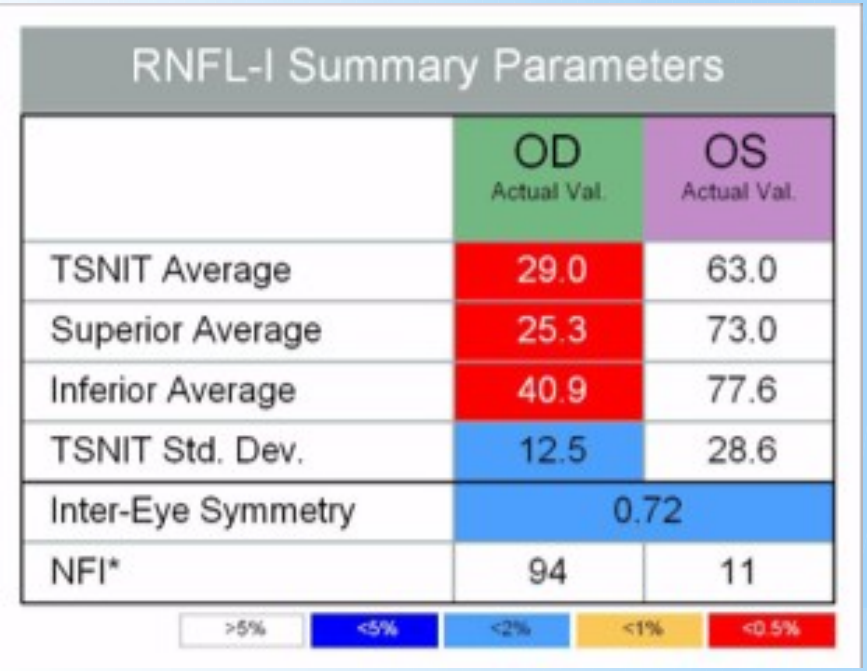
(NFI data outside ca.ci)

* Color-coded to indicate deviation from normal

TSNIT Std. Dev. – The higher the no, the greater the modulation in d-hump pattern

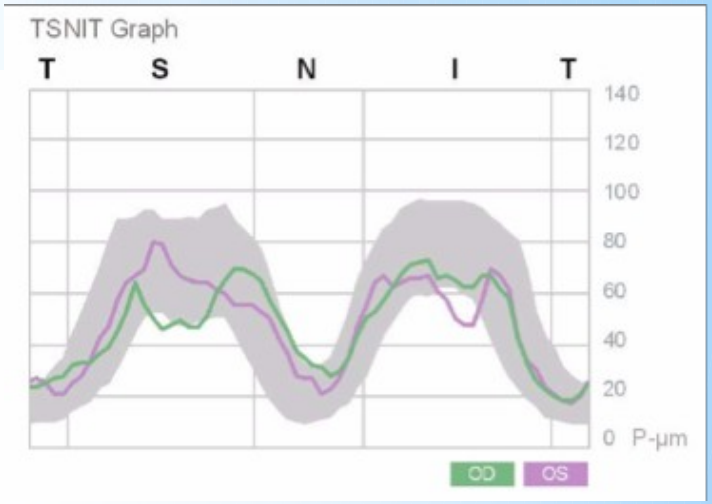
NFI- Nerve Fiber Indicator- Single GDx parameter in differentiating b/n normal and glaucomatous eyes

Normal- <37. High values indicative of abnormality but not definite



6. Evaluate TSNIT Graph

- Normal and pat. Values from calc. circle
- Double hump



* GDxVCC alone not enough to diagnose glaucoma.
* To confirm glaucoma, GDxVCC parameters should correlate with other data measurements such as IOP measurements, VFT and dilated exams of the ON

* Caution!

Example 1

Name: **Symmetry, Example1**
ID: **S1**
DOB: 12-31-1955
Gender: Male
Ancestry: Black

Exam Date: **02-12-2008**
Exam Time: 09:44
Operator: zkunczyn
Physician: Imported

Imported

GDxPRO™ Symmetry Analysis

Variable Corneal Compensation (VCC)

OD	OS
Right Fundus Image	Left Fundus Image
Q: 9 TSS:100 Residual: 4 nm Single Scan 02-12-2008 09:43	Q: 9 TSS:76 Residual: 8 nm Single Scan 02-12-2008 09:44
Nerve Fiber Layer Map	Nerve Fiber Layer Map

RNFL-I Summary Parameters

	OD Actual Val.	OS Actual Val.
TSNIT Average	29.0	63.0
Superior Average	25.3	73.0
Inferior Average	40.9	77.6
TSNIT Std. Dev.	12.5	28.6
Inter-Eye Symmetry	0.72	
NFI*	94	11

>5% <5% <2% <1% <0.5%

Right Deviation Map

TSNIT Graph

T S N I T

140 120 100 80 60 40 20 0 P-um

OD OS

Left Deviation Map

<5% <2% <1% <0.5%

*The NFI is not intended to be used as the sole basis of diagnosis for disease.

GDx® technology assesses RNFL health by measuring RNFL Integrity (RNFL-I), derived from RNFL thickness and structural organization, and expressed in units of Polarimetric Micrometers (P-µm).

Physician Interpretation:

Physician Signature

GDxPRO

Software Version 1.0

ZEISS

Example 2

Name: **Symmetry, Example2**
ID: **S2**
DOB: 09-12-1973
Gender: Female
Ancestry: Black

Exam Date: **03-05-2008**
Exam Time: 14:27
Operator: zkunczyn
Physician: Imported

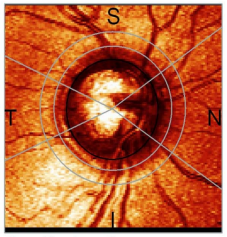
Imported

GDxPRO™ Symmetry Analysis

Variable Corneal Compensation (VCC)

OD | **OS**

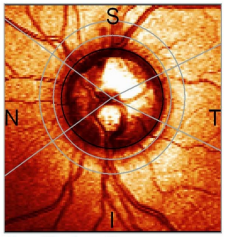
Right Fundus Image



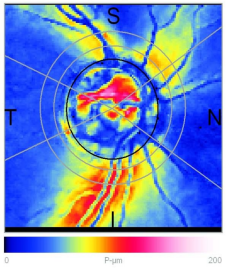
Q: 8
TSS: 40
Residual: 11 nm
Single Scan
03-05-2008 14:27

Q: 7
TSS: 70
Residual: 8 nm
Single Scan
03-05-2008 14:27

Left Fundus Image



Nerve Fiber Layer Map

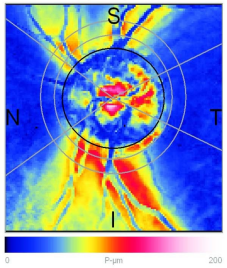


RNFL-I Summary Parameters

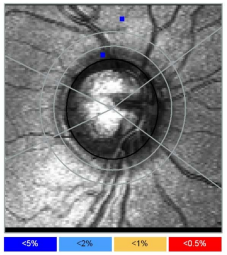
	OD Actual Val.	OS Actual Val.
TSNIT Average	58.3	54.4
Superior Average	60.4	63.6
Inferior Average	73.7	70.8
TSNIT Std. Dev.	22.0	27.3
Inter-Eye Symmetry	0.89	
NFI*	12	13

>5% | <5% | <2% | <1% | <0.5%

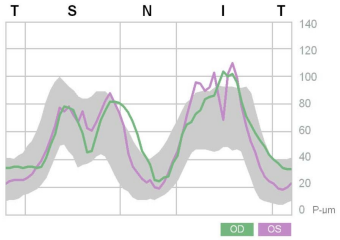
Nerve Fiber Layer Map



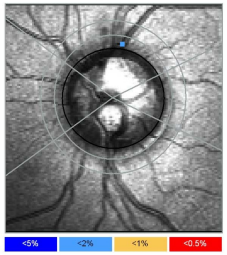
Right Deviation Map



TSNIT Graph



Left Deviation Map



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Physician Interpretation:

Physician Signature

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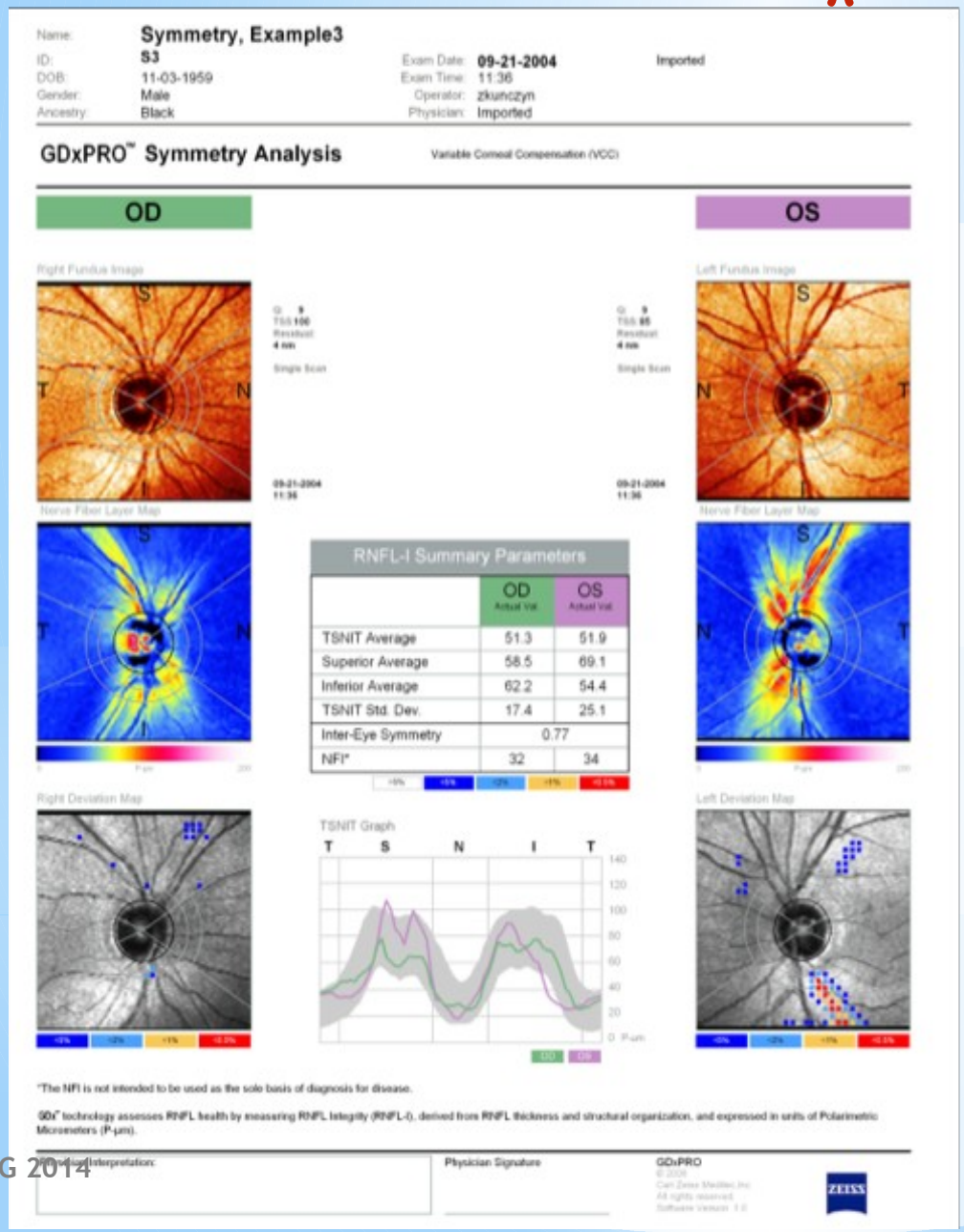
Example 3



Name: **Symmetry, Example3**
ID: **S3**
DOB: 11-03-1959
Gender: Male
Ancestry: Black
Exam Date: **09-21-2004**
Exam Time: 11:36
Operator: zkunczyn
Physician: Imported
Imported

GDxPRO™ Symmetry Analysis

Variable Corneal Compensation (VCC)

OD | **OS**

Right Fundus Image | Left Fundus Image

Nerve Fiber Layer Map | Nerve Fiber Layer Map

RNFL-I Summary Parameters

	OD Actual Val	OS Actual Val
TSNIT Average	51.3	51.9
Superior Average	58.5	69.1
Inferior Average	62.2	54.4
TSNIT Std. Dev.	17.4	25.1
Inter-Eye Symmetry	0.77	
NFI*	32	34

Right Deviation Map | Left Deviation Map

TSNIT Graph

T S N I T

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GDx® technology assesses RNFL health by measuring RNFL integrity (RNFL-I), derived from RNFL thickness and structural organization, and expressed in units of Polarimetric Micrometers (P-µm).

Physician Interpretation:

Physician Signature

GDxPRO

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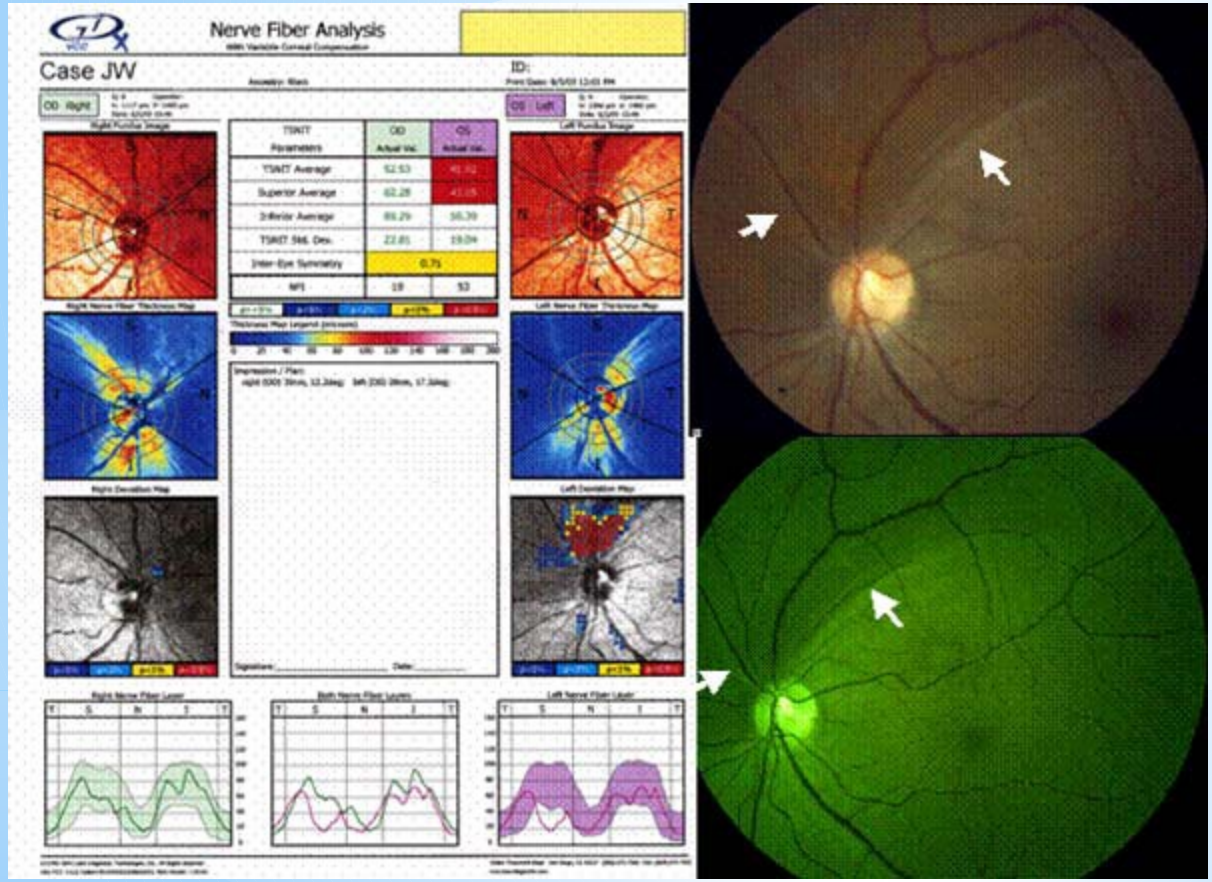
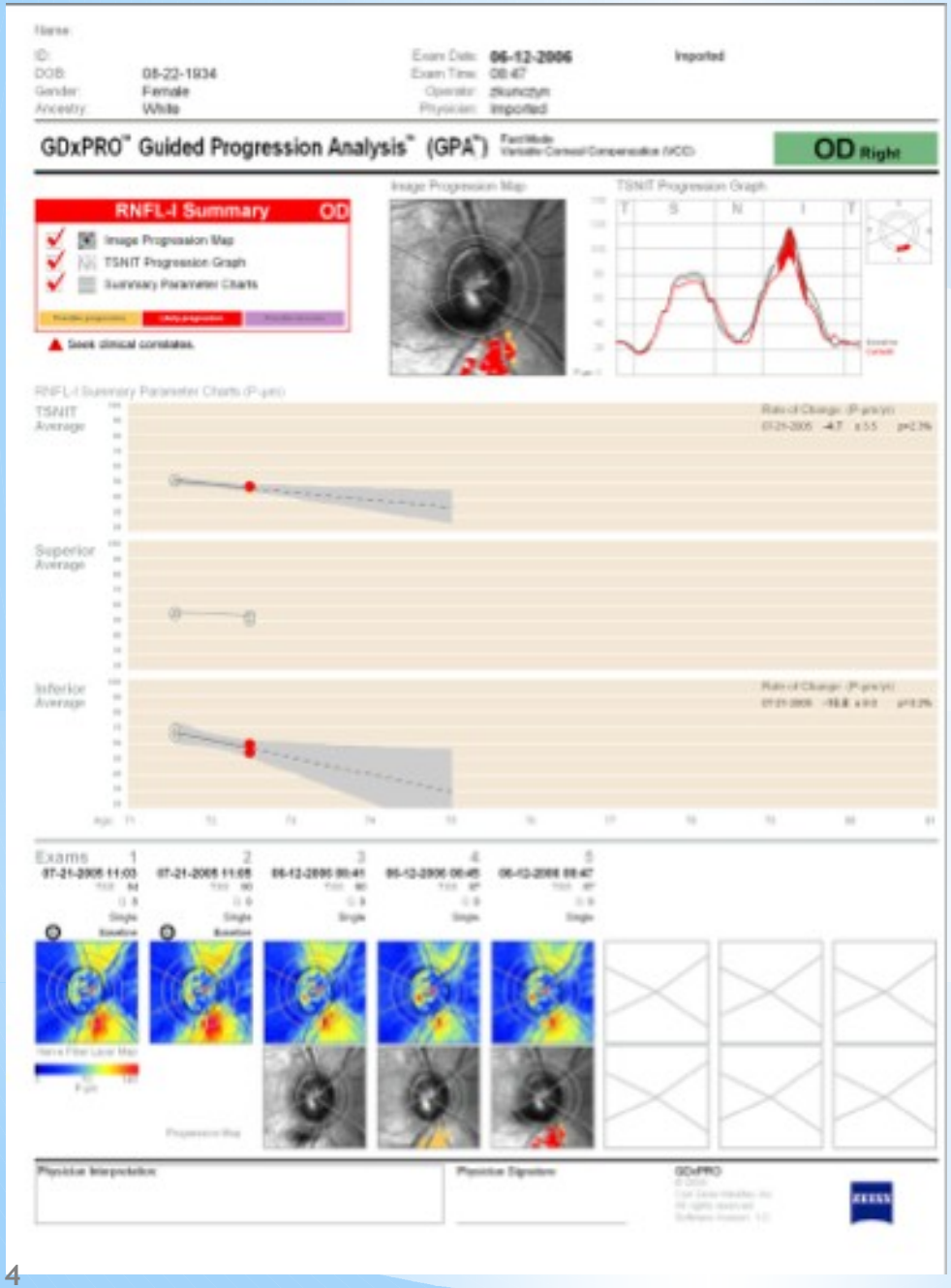
*Example 4



42 year old black male, IOPs =17mmHg OU, VFT normal, Borderline OS, C/D 0.2 OU



*Guided Progression Analysis (GPA)

*Conclusion

- *GDxVCC – powerful and accurate diagnostic tool for RNFL assessment in glaucoma
- *Excellent reproducibility, high diagnostic accuracy, simple interpretation, ease of use makes GDxVCC excellent tool for glaucoma diag. & Mx
- *Helps detect early glaucoma as RNFL changes occur before VF defects and OD changes
- *Should be used as adjunct, especially in indistinctive cases and follow-up of patients with OH
- *Provides the critical missing piece in glaucoma puzzle

*?s and comments

*Thank you