Glaucoma in the Trenches
Current Thoughts in Clinical Care

James L. Fanelli, OD, FAAO
jamesfanelli@CEinItaly.com

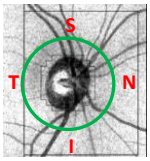
Disclosures

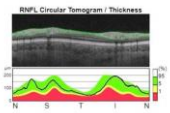
- Dr. Fanelli has received support and/or honoraria from:
  - Heidelberg Engineering Advisory Board
  - Glaukos Advisory Board
  - Topcon Advisory Board
  - Maculogix Advisory Board
  - Olleyes Advisory Board
  - AAO FDR research support SENSA study
  - Review of Optometry editor
  - CE in Italy/Europe
- There are no conflicts of interest involved with this presentation. All relevant relationships have been mitigated.

Knowing your Technology

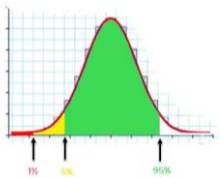
- Why is this important?
  - Knowing what your technology DOES.
  - Knowing what your technology DOES NOT do.

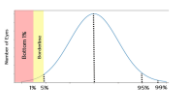
Comparison with a Reference Database





Thickness measurements and comparison with a reference database

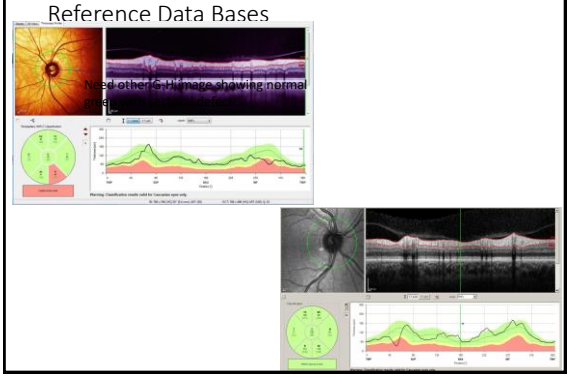




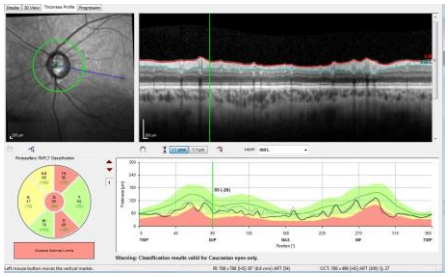
Reference Data Bases

- Are statistical measures only
- Are comparative measures
- How does your patient stack up against other 'like' individuals
  - Reference data base debates
  - Good?
    - Where does your patient fit in
  - Bad?
    - They are a pretty picture

Reference Data Bases



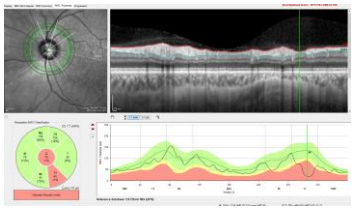
Significant Change???



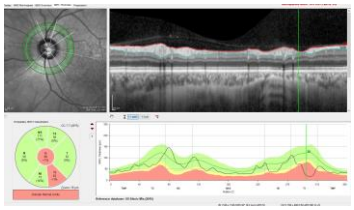
OCT and Glaucoma Analysis

- RNFL
- Posterior pole analysis
  - Reliable and accurate as resolution of system is 2-3 microns
- Cross (radial) section Optic Nerve
  - Identification of BMO as new norm in quantifying NRR tissue and monitoring progression over time*

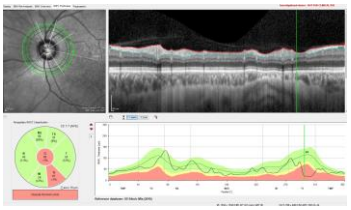
RNFL 3.5



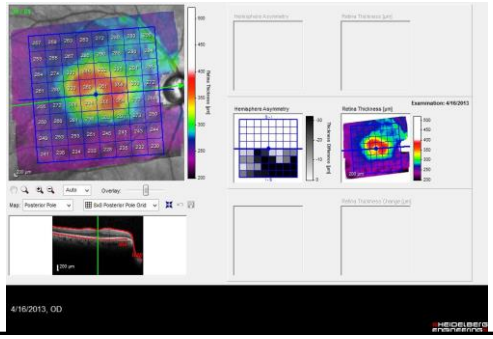
RNFL 4.1

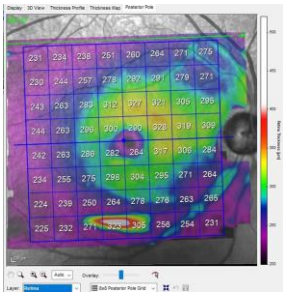


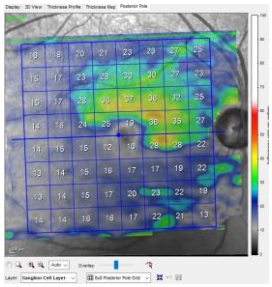
RNFL 4.7



Glaucoma posterior pole analysis



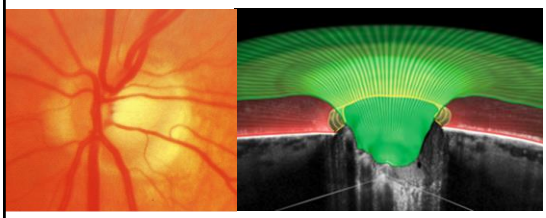




Macular Thickness in G

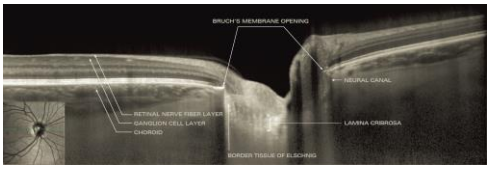
- Overall retinal thickness can be influenced by several diseases
  - AMD, macular dystrophies etc
    - THINNER READINGS
  - ERM, VMT etc
    - THICKER READINGS
- Macular Ganglion Cell Layer Thickness
  - Less influenced by coexistent macular disease

NeuroRetinal Rim
Bruchs Membrane Opening



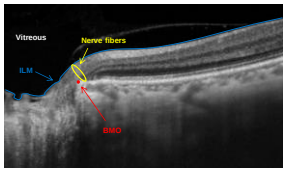
Identification of Bruch's Membrane Opening (BMO)

- All axons of ganglion cells pass medial to BMO



Objective Landmark of Inner Edge of Rim

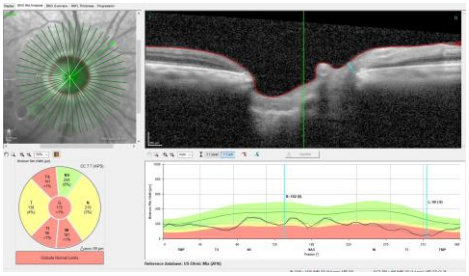
- The most anterior part of ONH contains the optic nerve fibers which make up the neuroretinal rim
- It is separated from the vitreous by the inner limiting membrane of Elschnig (ILM)
- ILM is an objective inner boundary of neuroretinal rim tissue that is consistently detected by SD-OCT



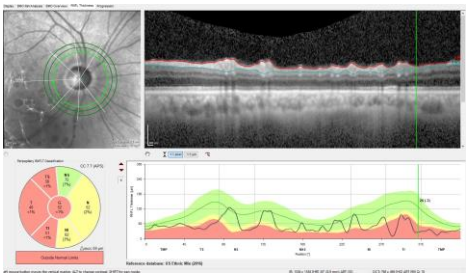
Alexandre S.C. Reis, Glen P. Sharpe, Hongli Yang, Marcelo T. Nicolela, Claude F. Burgoyne, Balwantray C. Chauhan. **Optic disc margin anatomy in patients with glaucoma and normal controls with spectral domain optical coherence tomography**. *Ophthalmology 2012. Apr;119(4):738-47*

Advanced OAG

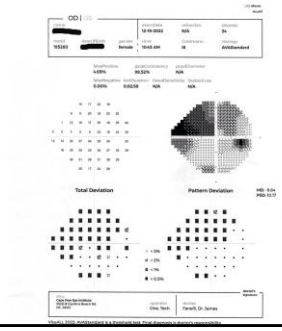
69 y/o elevated IOP+cupping OD



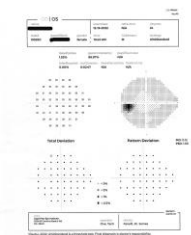
69 y/o elevated IOP+cupping OD



69 y/o elevated IOP+cupping OD



69 y/o normal IOP(-)cupping OS



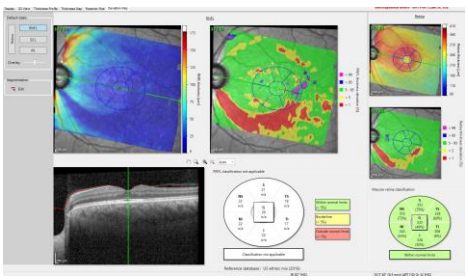
Deviation Maps

- Deviation from expected outcomes of:
- Full Retinal Thickness
- RNFL
- Ganglion Cell Layer

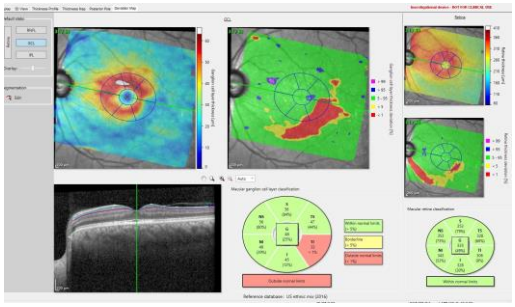
Case

- 66 year old Caucasian female
- Referred by primary care because of 'cataracts'
- IOP 20mmHg OD, 22mmHg OS
- Clinical C/D 0.6x0.65 0.65x0.8
- Pachymetry: 507 501

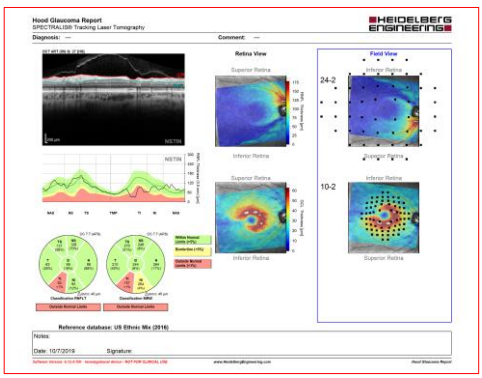
Deviation Maps RNFL Loss

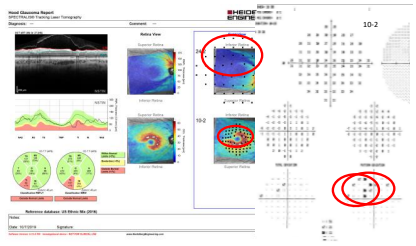


Deviation Map Ganglion Cell Bodies



Hood Glaucoma Report

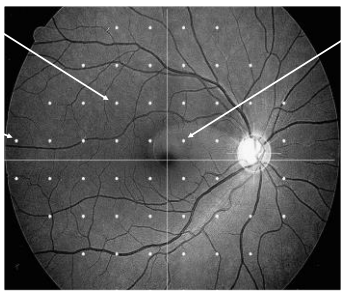




Visual Fields

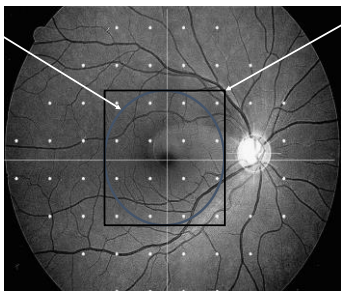
- The visual field relatively under-samples the macula
- The visual field is relatively less sensitive to ganglion cell loss in the macula

The Macula in Relation to the Visual Field



43

The Macula in Relation to the Visual Field



44

What About 24-2 vs 10-2

Journal List › Transl Vis Sci Technol › PMC4849532

tvst translational vision science & technology — Bridging basic and clinical research — ARVO

Transl Vis Sci Technol. 2016 Apr; 5(2): 15. PMCID: PMC4849532
Published online 2016 Apr 14. doi: 10.1167/tvst.5.2.15 PMID: 27134774

The 24-2 Visual Field Test Misses Central Macular Damage Confirmed by the 10-2 Visual Field Test and Optical Coherence Tomography

Lola M. Grillo,[1] Diana L. Wang,[1] Rithambara Ramachandran,[1] Alyssa C. Ehrlich,[1] Carlos Gustavo De Moraes,[2] Robert Ritch,[3] and Donald C. Hood[1,2]

24-2 vs 10-2 and OCT Macular findings

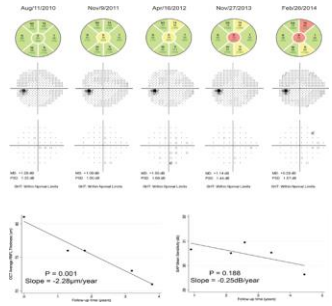
- Early glaucoma patients, OCT macular (GCL), 24-2 & 10-2 testing
- "Abnormal macular findings" were defined by structural AND 10-2 field abnormalities
- 52% of the individuals with 'abnormal macular findings' had clean 24-2 visual fields

That's why……

- Move toward 10-2 testing in early glaucoma
- SAP 24-2 (WOW) perimetry in early glaucoma often times does not identify field defects

ARVO JOURNALS

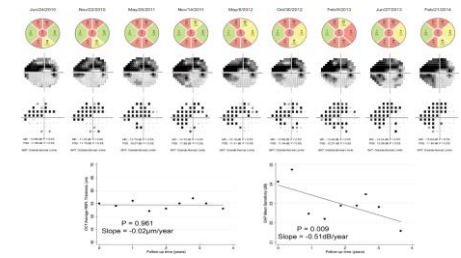
Example of an eye of a glaucoma patient with glaucomatous optic neuropathy but normal visual field at baseline (mild disease). Significant progression was seen on SD-OCT RNFL thickness measurements over time, with a rate of change of −2.28 µm/y (P = 0.001). Progression was not seen on SAP mean sensitivity measurements over time, with a slope of −0.25 dB/y (P = 0.188).



The Relative Odds of Progressing by Structural and Functional Tests in Glaucoma Invest. Ophthalmol. Vis. Sci.. 2016;57(9):OCT421-OCT428. doi:10.1167/iovs.15-18940

ARVO JOURNALS

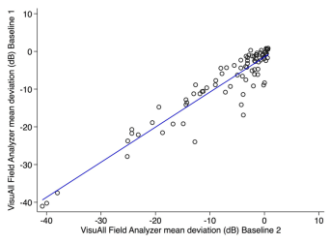
From: The Relative Odds of Progressing by Structural and Functional Tests in Glaucoma
Invest. Ophthalmol. Vis. Sci.. 2016;57(9):OCT421-OCT428. doi:10.1167/iovs.15-18940



Example of an eye of a glaucoma patient with moderate disease at baseline (baseline MD deviation of −10.96 dB). Significant progression was seen on SAP with a slope of change in mean sensitivity of −0.51 dB/y (P = 0.009). However, no significant change was seen on SD-OCT measurements, with a slope of change of −0.02 µm/y (P = 0.961).

VisuALL Virtual Reality Platform (VRP)

Correlation of Baseline 1 and Baseline 2 testing VisuALL



It's repeatable!

Reproducibility in Glaucoma Patients

Table 2. The inter-class correlation coefficient of mean deviation, pattern standard deviation, and mean sensitivity values.

	Test 1	Test 2	Test 3	ICC	95% Confidence interval		*P*-value
					Lower bound	Upper bound	
MD (dB)	-2.58	-2.36	-2.47	0.92	0.83	0.95	< 0.001
PSD (dB	6.34	6.22	6.15	0.94	0.89	0.97	< 0.001
Global MS (dB)	28.14	28.27	28.35	0.91	0.81	0.95	< 0.001
Supero-nasal MS (dB)	26.92	26.73	26.68	0.90	0.82	0.95	< 0.001
Supero-temporal MS (dB)	27.67	27.92	28.05	0.85	0.70	0.91	< 0.001
Infero-temporal MS (dB)	29.66	29.78	29.85	0.83	0.68	0.90	< 0.001
Infero-nasal MS (dB)	28.47	28.82	29.01	0.94	0.79	0.94	< 0.001
Central MS (dB)	28.51	28.16	28.79	0.91	0.74	0.92	< 0.001
Peripheral MS (dB)	28.03	28.30	28.22	0.89	0.78	0.93	< 0.001

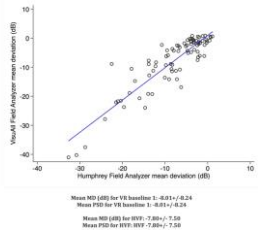
Excellent test-retest reliability of the mean deviation (MD), pattern standard deviation PSD), and mean sensitivity (MS) values in glaucoma patients.

Racette et al., University of Alabama

Correlation of the VisuALL Perimeter with the Humphrey Field Analyzer.

- Razeghinejad R, Gonzalez-Garcia A, Myers JS, Katz LJ. Preliminary Report on a Novel Virtual Reality Perimeter Compared With Standard Automated Perimetry. J Glaucoma 2021;30(1):17-23.
- Groth SL, Linton EF, Brown EN, Makadia F, Donahue SP. Comparison of a Virtual-Reality Perimeter to standard automated perimetry in normal children. AGS 2021.
- Slagle G, Reilly MA, Montelongo M, Welburn K, Nguyen A, De Ribot FM, Sponsel W. Locus-locus Comparison of VisuALL Virtual Reality Perimetry and Humphrey Perimetry in Eyes with Glaucoma. World Glaucoma Congress Abstract: 2021
- Chaudhry A, Berneshawi A, Liu J, Shue A, Chang D, Kim J, Robert Chang R. Repeatability and correlation of a virtual reality perimeter with standard automated perimetry in glaucoma patients. ARVO 2022, A0419.

Correlation between VisuALL and Standard Automated Perimetry in glaucoma patients.



Mean MD (dB) for VR baseline 1: -0.01+/-0.24
Mean PSD for VR baseline 1: -0.01+/-0.24

Mean MD (dB) for HVF: -7.80+/- 7.50
Mean PSD for HVF: HVF- 7.80+/- 7.50

Chang et al., Stanford University

VisuALL Test/Protocols

Perimetry

- 30-2 Adults & Pediatrics
- 24-2 Adults & Pediatrics
- 10-2 Adults & Pediatrics
- Supra-threshold Adults & Pediatrics
- Esterman
- Ptosis
- Other

Visual Acuity Test

- Landolt C Near
- Landolt C distance
- Low contrast VA

VisuALL Test/Protocols

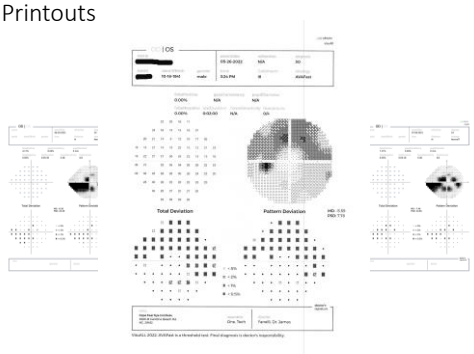
Color Vision

- Ishihara
- FMH D15
- Waggoner

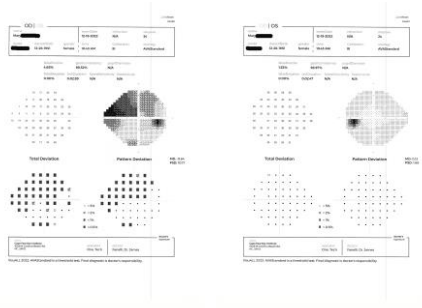
Pupillometry

EOM

Printouts



Eyes tested simultaneously



Key Points

- Know Your Technology
- Organized Patient Evaluation
- When Structure and When Function?

THANK YOU!