Bringing the Love Back to the Visual Field

Greg Caldwell OD, FAAO
South Dakota Optometric Society
September 18, 20/20

Disclosure Statement (next slide)

1

Disclosures- Greg Caldwell, OD, FAAO

- Will mention many products, instruments and companies during our discussion
  - I don't have any financial interest in any of these products, instruments or companies
- Pennsylvania Optometric Association –President 2010
  - POA Board of Directors 2006-2011
- American Optometric Association, Trustee 2013-2016
- I never used or will use my volunteer positions to further my lecturing career
- Lectured for: Shire, BioTissue, Optovue, Alcon, Allergan, Aerie
- Advisory Board: Allergan, Sun
- Envolve: PA Medical Director, Credential Committee
- TelaSight: Consultant
- TelaHealth: Ambassador
- Optometric Education Consultants - Scottsdale, WDW, St. Paul, Quebec City, and Nashville, Owner

2

Question

- With advanced imagining and modern electrophysiology
  - OCT imagining
    - Nerve Fiber Layer
    - Ganglion Cell Complex
  - OCT-Angiograpghy
    - ONH – Radial Peripapillary Capillaries
    - Retina – Capillary density around the macula
  - Diopsys – electrophysiology
    - Electroretinography (ERG)
      - Pattern, flicker, and multifocal ERG
    - Visual evoked potential (VEP)
- Do we really need to be doing Visual Fields
  - Especially in glaucoma?

3

Perimetry versus Imaging
The Other False Positive

- Perimetry in healthy eyes can yield scotomas ($p < 0.5\%$)
  - However, the pattern will not be repeatable
- Retesting with perimetry will only be reproductible in damaged eyes
- Perimetry can identify false positives by repeating the test several times

- Imagining is typically very repeatable
  - False positives cannot be detected or eliminated with repeated testing

4

Visual Fields - Perimetry

- The future is exciting
- Should be done on every glaucoma patient
- Be careful relying on structure and function agreement with current technology
  - Agreement is low
  - Discordance is high
- Let's now bring some love back to the visual field

5

Humphrey Field
Humphrey Field Analyzer 3 Continuous Innovation

6

Latest HFA3 Innovation

New Features, HFA3 v. 1.5	Description
SITA Faster 24-2	• 24-2 tests in about 2 minutes or less
SITA Faster 24-2C	• More information in the central visual field than 24-2
Mixed SITA GPA	• Use complete patient test history for GPA reports
Data Synchronization	• Synchronize patient tests in a network of multiple HFA3 units
Review Software	• View and analyze HFA reports in exam lanes
Automated Patient Alignment	• Automated pupil and lens finding centers patient's eye to the lens

7

Normal Visual Field Parameters

- 60° superior
- 60° nasal
- 75° inferior
- 100° temporal

- Macula the central 13°
- Fovea the central 3°

- Visual field is limited by the size of the retina and margins of the orbit

8

Pearls on Static Visual Fields

- Most visual fields test 0-51 decibels
  - 41-51 decibels is outside human vision
- 1 diopter of refractive blur in undilated patient
  - A little more than 1 decibel of depression of the hill of vision
    - With Goldmann III stimulus
- Leave cylindrical errors of less than 2 diopters uncorrected
  - Adjusted with spherical equivalent
  - Above 2 diopters correct the astigmatism with trial lens
- Background of a visual field illuminated (31.5 apostilbs)
  - Minimum brightness for photopic or daylight
  - Cones are isolated, test photopic system
    - More on contrast, less on absolute brightness
  - Changes in pupil size, crystalline lens color and transparency have less effect on result

9

Static Perimetry in Eye Care

- Neurological disease
- Retinal disease
- Glaucoma
  - Perimetry is essential in diagnosis and management
  - Why test the central 24-30 degrees?
    - Only a small percentage of glaucomatous defects occur in the peripheral visual field alone
    - Testing the central 24-30-degree field is preferred in glaucoma management
    - Most of the retinal ganglion cells are within the 30 degrees of fixation

10

24-2 versus 30-2 Static Visual Field

- 30-2 tests 76 locations
- 24-2 tests 54 locations
  - Tests 30 degrees nasal
  - Little diagnostic information lost in 24-2
  - Time is saved
  - Fewer trial lens and lid artifacts
- 24-2 has become the VF for glaucoma
  - Only downside, 30-2 can sometimes find progression earlier due to more test points

11

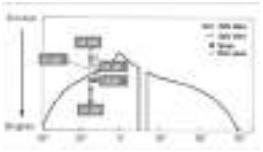
SAP and SITA

- SAP- Standard Automated Perimetry
  - Determines the threshold (how dim of light) can be seen at various points
  - Various algorithms have been developed to determine this threshold using few to numerous individual points in a single visual field test
- SITA-Swedish Interactive Thresholding Algorithm
  - Optimizes the determination of perimetry thresholds
  - Continuously estimating what the expected threshold is based on the patient's age and neighboring thresholds
  - Reduce the time necessary to acquire a visual field by up to 50%.
  - Decreases patient fatigue and increases reliability
  - SITA mode is now widely used in many computerized automated perimeters
- SITA- can be applied to:
  - SAP- Standard Automated Perimetry
  - SWAP-Short Wavelength Automated Perimetry (SWAP)

12

Sita Standard versus Sita Fast

- Sita strategies are twice as fast as order strategies
- Sita fast takes 67% the time of Sita standard
  - Sita fast has larger retest variability
- Primary difference is between the two strategies is the amount of certainty that is required before testing is stopped
- Sita standard
  - More precise
  - More tolerate of mistakes
  - Easier test as stimuli are brighter



- Stay tuned: "Sita-Faster" ~~Coming Soon~~ is here

13

Sita Faster

- Turns off False Negatives
- Turns off Blind Spot monitor
- Leaves on False Positives
- Leaves on Gaze Tracking

- Faster test with same reliability

14

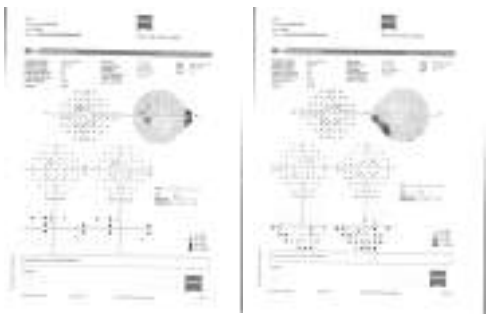
Sita Faster

15

Sita Faster

16

SITA Faster
24-2C

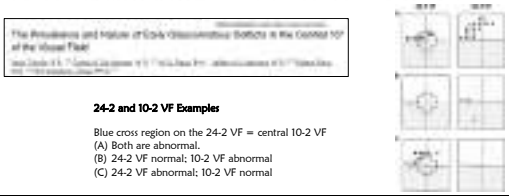


17

Opportunities for Improvement in Central 10 Degrees

Glaucomatous damage of the macula

- Glaucomatous damage of the macula is common and can occur early in the disease
- Can be missed or underestimated or both, with standard 24-2 VF tests that use a 6 grid



24-2 and 10-2 VF Examples

Blue cross region on the 24-2 VF = central 10-2 VF
(A) Both are abnormal.
(B) 24-2 VF normal; 10-2 VF abnormal
(C) 24-2 VF abnormal; 10-2 VF normal

18

Highest Importance Locations Chosen from 10-2 Pattern

Selecting additional test locations to enhance the 24-2 pattern using a scoring system

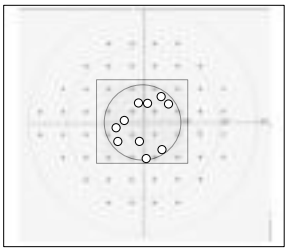
- The expert group selected specific 10-2 test point locations
- Prevalence and depth of glaucomatous macular defects were systematically evaluated to select optimum test points
- Pattern covers areas known to be susceptible to glaucomatous defects both from structural and functional studies

Selected test locations are shown in red boxes

The expert group: Donald C. Hood, Stuart K. Gardiner, Allison M. McKendrick and William H. Swanson.

19

Resulting SITA Faster 24-2C Pattern on HFA3



The 24-2C test pattern combines all 24-2 points + ten selected 10-2 points (shown in OD orientation)

Large Gray	24-2 pattern
Large Orange	Ten additional 24-2C points
Small Gray	10-2 pattern

20

Minimize Time and Maximize Information with HFA3

SITA Faster 24-2

- test in 2 minutes or less
- ~50% faster than SITA Standard; ~30% faster than SITA Fast

SITA Faster 24-2C

- More information in the central field
- ~20% faster than SITA Fast 24-2

Mixed SITA GPA

- Clinical equivalence of tests allows intermixing SITA Faster, Fast, Standard, 24-2, 30-2, and 24-2C in progression analysis
- Add new tests to patient progression
- Helps immediately adopt SITA Faster

22

24-2C SITA Faster

Flagged points detected centrally in OD

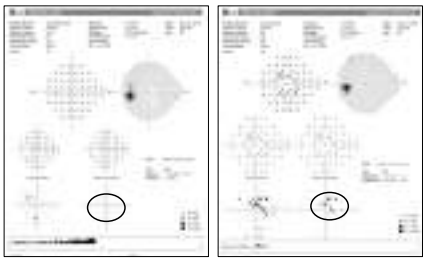
24-2 SITA Standard **24-2C SITA Faster**

23

24-2C SITA Faster

Flagged points detected centrally in OS

24-2 SITA Standard **24-2C SITA Faster**



24

Foveal Threshold

Fovea "On" versus "Off"

- Instrument can do 51 db
  - Perfect macula and perimetrically trained young person = 40 db
- Visual acuity and foveal threshold should correlate
  - Each validate each other
  - Visual acuity is good and threshold is low
    - Possible early damage to fovea
      - Glaucoma
      - Plaquenil toxicity
- 47% of patients with 20/20 had threshold better than 37db [1]
  - This method may be useful to predict visual acuity in eyes with possible nonorganic visual acuity loss.

1 Flaxel CJ, Samples JR, Dustin L. **Relationship between foveal threshold and visual acuity using the Humphrey visual field analyzer.** Am J Ophthalmol. 2007 May;143(5):875-7. Epub 2007 Jan 2

25

Short Wavelength Automated Perimetry (SWAP)

- Blue-yellow perimetry
- Goldmann V stimuli on yellow background
- Thought to detect glaucomatous defect earlier than white on white
- Due to Sita standard strategy can find defect as early

26

Glaucoma Visual Field

- Need a current refraction
  - Cataracts cause refractive shifts
- 24-2
- Sita-Standard (not fast)
- Fovea "on"

27

Interpreting Visual Fields

- No longer reliable or unreliable
  - A continuum from highly reliable to marginally informative
- False positives
  - More destructive to interpretation than formerly believed
- False negatives
  - Expected to be abnormal in a glaucomatous visual field
  - Even in attentive tester
- Gaze tracker
  - Typically a better indicator than blind spot
- Progression is not present or absent
  - Is the rate of change acceptable

28

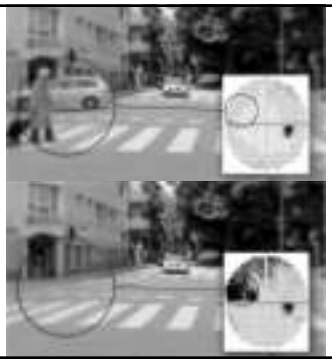
5 Decibel Loss

- Read slower
- Don't leave home as much
- Walk slower
- Increase in car accidents

29

30

31



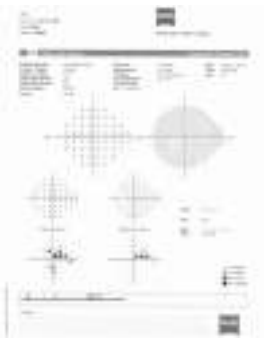
32

Interpreting Visual Fields

- Diagnosis
  - Probability Plots
  - Glaucoma Hemifield Test
- Staging and following over time
  - Mean Deviation
  - Visual Field Index

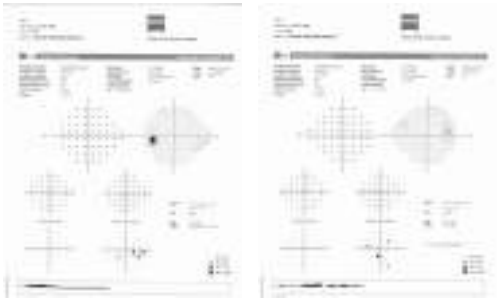
33

Probability Plots
Total Deviation to Pattern Deviation
What We Expect- Raises the Hill of Vision

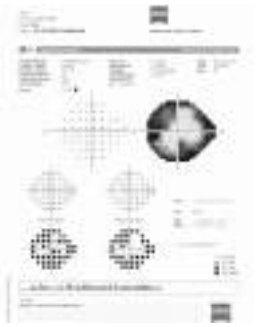


34

Probability Plots- Total Deviation to Pattern Deviation-Now What Happened?



35

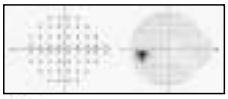


Probability Plot
Butterfly/Cloverleaf
The patient is zoning out

36

Polling Question #2

MD and PSD



MD

- 54 spots on 24-2
  - All 54 spots reduced by 1 DB (54DB)
  - MD 1DB
- 54 spots on 24-2
  - 27 spots reduced by 2 DB (54 DB)
  - MD 1 DB
- 54 spots on 24-2
  - 13.5 spots reduced by 4 DB (54DB)
  - MD 1 DB

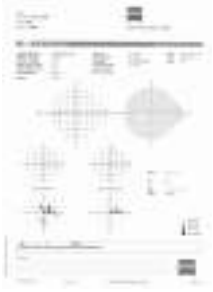
PSD

- Low PSD (Generalized loss)
  - 1.00 DB
- Moderate PSD (More localized loss)
  - 3.00 DB
- High PSD (Localized loss)
  - 5.00 DB

37

Visual Field Index-VFI

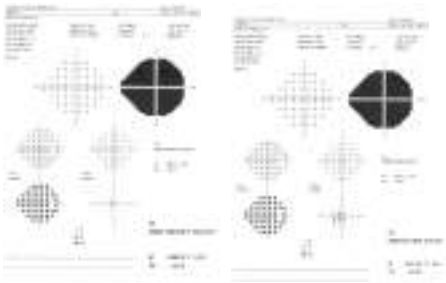
- Part of the visual field indices
  - MD, PSD, and VFI
- Mean Deviation- zero indicates, no deviation
  - "How deep" is the defect (or elevated)
- Pattern Standard Deviation
  - "How localized" is the defect
- Visual Field Index
  - Enhanced Mean Deviation
    - Designed to be less affected by cataracts
    - More sensitive to changes in the center of the visual field
      - Better correlates with ganglion cell loss
  - Normal 100%
  - Perimetric blindness 0%
- VFI and MD helpful in:
  - Staging
  - Following over time



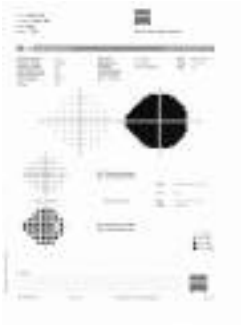
38

Thoughts on Mean Deviation (MD)

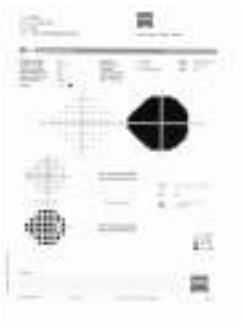
What is the Mean Deviation on a visual field of a blind eye?



39



HFA-3



40

Thoughts on Mean Deviation (MD)

- Turn on your VF let it run
  - 30 DB (decibel)
- 0-5 (1/6) 30% reduction
- 5-10 (1/3) 40% reduction
- >10 (1/2) 50% reduction

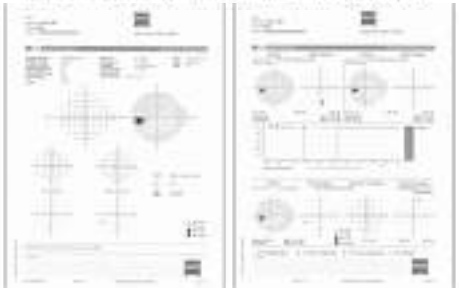
- How many DB difference to reliable VF should cause a RAPD?
  - 3 DB for a small APD, the larger the difference the greater the APD

41

65 YO woman, IOPs Tmax 24/24, Pachs 585/588

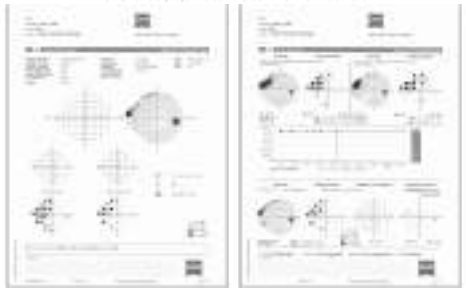
42

65 YO woman, IOPs Tmax 24/24, Pachs 585/588



43

54 YO Woman with POAG

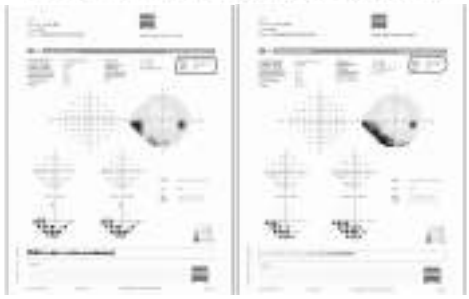


44

54 YO Woman with POAG

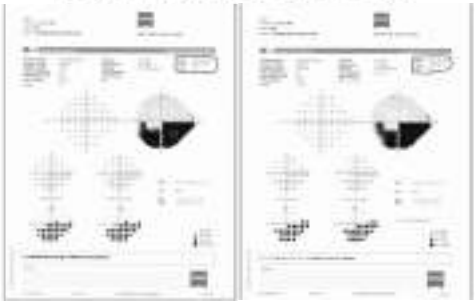
45

59 YO Man, Severe POAG (over 4.5 years)



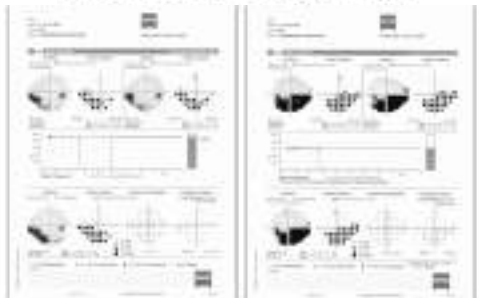
46

59 YO Man, Severe POAG (over 4.5 years)



47

59 YO Man, Severe POAG (over 4.5 years)



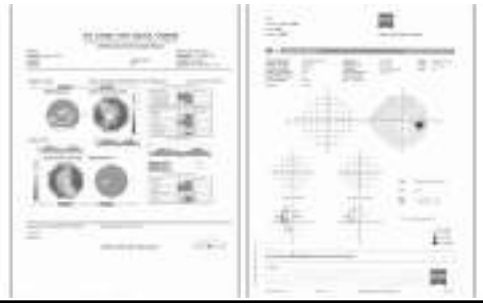
48

Structure versus Function Debate

48 YO man
Tmax 36/38
Strong family history of POAG

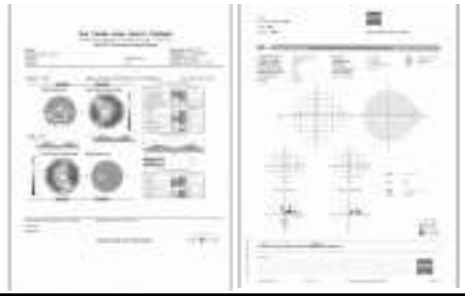
49

Structure and Function



50

Structure (okay) and Function



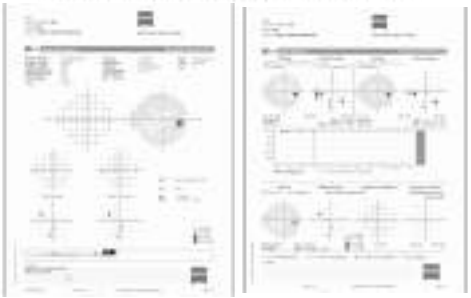
51

At 48 years old I will take my glaucoma serious

Tmax at diagnosis 26/32
Poor compliance from 44-48 YO

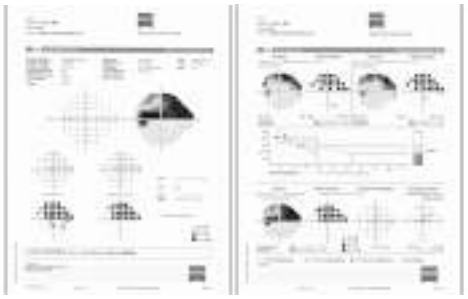
52

Now 51 Years Old Staying Compliant



53

Now 51 Years Old Staying Compliant



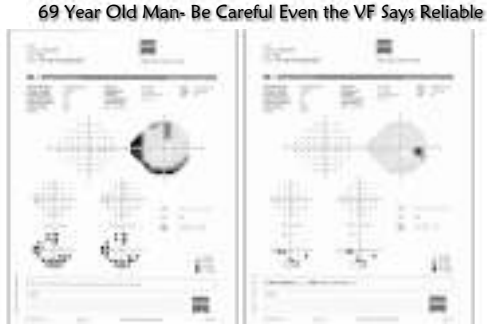
54

69 Year Old Man with POAG

Be careful OD VF looks reliable with
FL, FP,FN, and gaze monitor

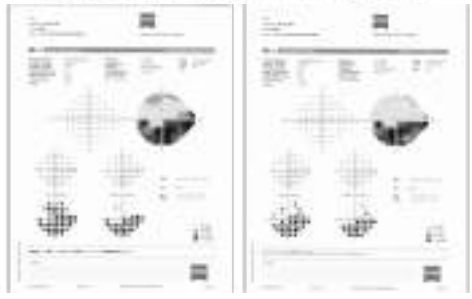
55

69 Year Old Man- Be Careful Even the VF Says Reliable



56

69 year old- Be Careful Even the VF Say Reliable



57

What Did We Learn?

58

24-2 and 24-2C OD

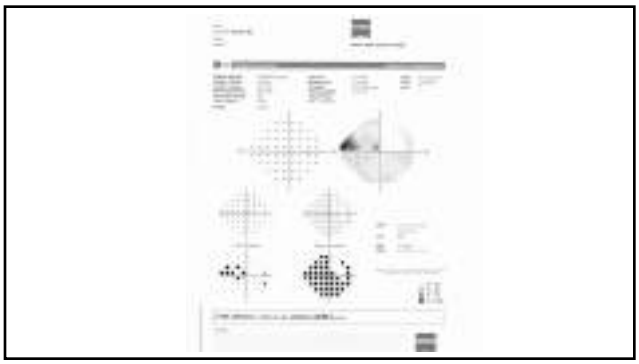
59

24-2 and 24-2C OS

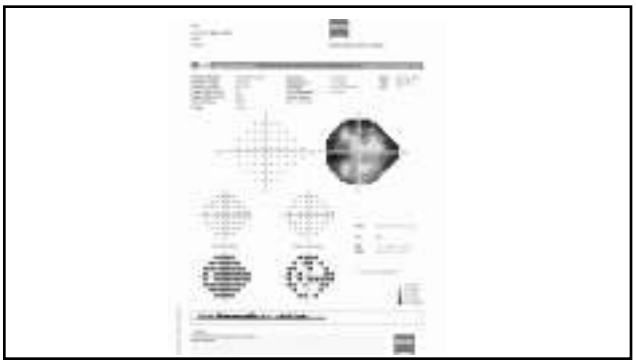
60

24-2C

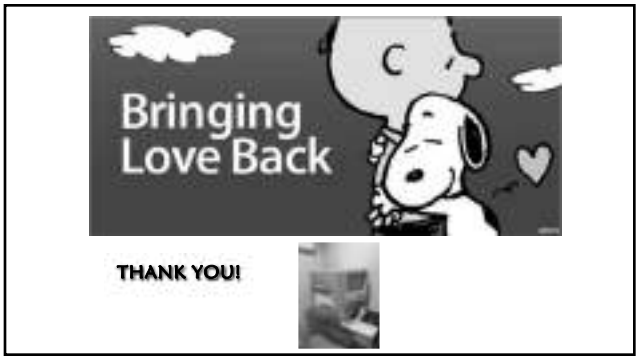
61



64



65



66