6 Step Approach to Evaluate the Visual Field

Murray Fingeret, OD, FAAO
Chief, Optometry Section
VA New York Harbor
Brooklyn/St. Albans Campus
Clinical Professor, SUNY College of Optometry
murrayf@optonline.net

6 Steps in Analyzing Visual Field

• Why perform perimetry
  – Measure of glaucomatous damage
  – Method to discover progression
  – Standard of care is to perform perimetry annually for glaucoma or ocular hypertension
  – Retrospective chart review suggests perimetry underused
    • Fremont 2003 AJO
      – 43% > 1 yr interval between fields
    • Coleman 2005 Ophthalmology
      – Medicare review 30% did not have field in prior year

• Fremont 2003 AJO
• Coleman 2005 Ophthalmology

6 Steps in Analyzing Visual Field

• SITA Standard
  – Standard test used with Standard Automated Perimetry (SAP)
  • SITA Fast used only in select situations
    – Greater variability
  • Will detect loss when considerable damage has occurred to optic nerve
    – May underestimate damage in early disease
  • Requires patient attention and focus
  • Significant inter-test variability
    – Multiple tests needed to confirm damage or progression

6 Steps in Analyzing Visual Field

• Right Test
  • Strategy
    – SITA STD vs. SITA Fast vs. Full Threshold
  • Test Stimulus Size
    – Size III vs. Size V
  • Test Pattern
    – 24-2 vs. 30-2 vs. 10-2
  • Eye
  • Age
    – Date of birth correct as used with normative databases

6 Steps in Analyzing Visual Field

• Right Test
  • Pupil Size
    – Be consistent test to test
      – Improved when using serial field analysis
    – Often done dilated
    – > 3 mm
  • Refractive Error
    – Input data correctly
      – Input new data if refraction changes
    – Allow instrument to calculate trial lens
  • If field full and patient at risk, perform FDT or SWAP
6 Steps in Analyzing Visual Field

- Reliability
  - Indices
    - Fixation loss
      - Increase may be due to testing artifact
      - Blind spot not located correctly
    - False positives
      - Best indice
      - As little as 5% could reflect unreliable field
    - False negatives
      - Worst indice
      - Could be due to fatigue or commonly seen when field loss present

Unreliable - False Positives

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- Reliability
  - Blind spot plotted as absolute scotoma
    - Is there a 0 in blind spot?
    - Indicative as steady fixation
    - Blind spot not averaged over an area
  - Gaze Tracker
    - Excellent Method to monitor fixation and patient performance
    - Crisp gaze tracker indicative of excellent test taker

Excellent Gaze Tracker

6 Steps in Analyzing Visual Field

- Reliability
  - Old standard from Humphrey Full Threshold perimetry
    - Indices flagged at
      - Fixation loss 25%
      - False positive and False negative 33%
    - These cut-offs were based on statistical significance, not clinical significance
      - For false positives, as little as 5-10% may destroy the credibility of the field

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- Patient Performance
  - Take time to set patient up properly
    - Patient comfortable
    - Patient understands test
    - Tape lid if ptosis suspected
  - Pause test at 6 minutes and sometimes sooner
    - Many patients need break during test
  - Patient needs to be observed during test
    - Many patients back away slightly leading to trial lens defect
  - Be careful using 1st test performed
    - Diffuse loss common
6 Steps in Analyzing Visual Field

• Probability Plots
  – Compare total to pattern deviation plots
  – Comparison using age related normative database
  – Examine pattern of depressed plots
    • Widespread vs. Localized
    • One hemifield or both hemifields
    • Number of points
    • Location of depressed points
    • Severity of depressed points

• Widespread vs. Localized
• One hemifield or both hemifields
• Number of points
• Location of depressed points
• Severity of depressed points

• Greater number of points on Total side usually indicates cataract though other conditions can also cause this
• Not usually glaucomatous
• Greater number of points on Pattern side usually indicate unreliable field
  – Rule does not apply to SWAP or FDT tests
  – Beware that probability points can be flagged even when gray scale appears clean
    • Factor of SITA Algorithm

• Pattern plots associated with glaucomatous loss
  • Effect of cataract or other field depression subtracted
  – Beware that grayscale and probability with SITA do not always agree
    • SITA uses same shadings as Full Threshold
6 Steps in Analyzing Visual Field

• Global Indices
  – Mean Deviation (MD)
    • Average loss for entire field with weighting of
      points closest to fixation
    • Can not recognize pattern of loss from number
      – When negative, could be due to anything from cataract to
        scar to glaucoma
    • If significant, a p value if provided telling how often
      value will occur in a normal population

• Pattern Standard Deviation (PSD)
  • Measure of local loss
    – Higher PSD indicated greater localized loss up until
      approximately -12 dB
    – As glaucoma gets worse effecting both fields, PSD
      declines

• Glaucoma Hemifield Test (GHT)
  • Evaluates asymmetry between superior of inferior fields
  • Clusters of points are evaluated against a normative
    database
  • Clusters based upon RNFL anatomy
  • Printout reads Outside Normal Limits, Borderline or Within
    Normal Limits
  • Also may read as General Reduction in Sensitivity,
    Abnormally High Sensitivity

• RNFL Pattern of Field Loss
  – What is the earliest indicator of glaucoma
  – GHT Outside Normal Limits along with Cluster of 3 points
    flagged with one of the points at
    the P < 1% level
  – Should be repeatable

• RNFL Pattern of Loss
  – Not all RNFL pattern due to glaucoma
    • Altitudinal defect
    • Watch for artifacts such as trial lens or lid defects
    • Choriotretinal scar
    • Neurologic
    • Others
6 Steps in Analyzing Visual Field

- Pattern of Loss
  - Normal
  - Non Diagnostic
  - Glaucoma
  - Other

Visual Field Defects

- Partial arcuate
- Arcuate
- Nasal step
- Vertical Step
- Paracentral
- Central

- Widespread
- Temporal wedge
- Superior depression
- Altitudinal
- Partial peripheral rim
- Peripheral rim

Visual Field Defects

Widespread

- Diffuse visual field loss in all four quadrants
- Glaucoma Hemifield Test (GHT) shows general reduction in sensitivity or
  - Mean Defect (MD) < 5%
- Pattern standard (PSD) or Corrected Pattern Standard Deviation (CPSD) not flagged
- Majority of abnormal points on total deviation plot not abnormal on pattern deviation plot

Visual Field Defects

Arcuate

- Visual field loss in nerve fiber bundle area
- Extends across contiguous points
- Goes from blind spot to at least one point outside 15° adjacent to nasal meridian
**Visual Field Defects**

- **Partial Arcuate**
  - VF loss in nerve fiber bundle
  - Extends incompletely from blind spot to nasal meridian
  - Defect generally contiguous with either blind spot or nasal meridian
  - Must include one location in temporal field

- **Nasal Step**
  - Visual field loss limited to nasal horizontal meridian
  - At least one abnormal point at or outside 15° on meridian
  - Can not include more than one significant point in nerve fiber bundle on temporal side
Visual Field Defects
Vertical Step
• Limited visual field loss that respects vertical meridian
• Includes at least two abnormal points at or outside 15° along vertical meridian

Visual Field Defects
Altitudinal
• Severe visual field loss in entire superior or inferior hemifield
• Respects horizontal midline
• Majority of points involved within the hemifield
• Entire horizontal line adjacent to meridian involved

Visual Field Defects
Superior Depression
• Two or more points reduced in superior region
**Visual Field Defects**

**Temporal Wedge**
- Visual field defect temporal to blind spot

**Central**
- Visual field loss in macula region
- Foveal threshold reduced to $P < 5\%$

**Paracentral**
- Relatively small visual field abnormality in nerve fiber bundle
- Not contiguous with blind spot or nasal meridian
- Does not involve points outside $15^\circ$
6 Steps in Analyzing Visual Field

• Learning effect is real
  – May take 3 fields to eliminate learning
• Confirm abnormal field in experienced field takers
• Field loss may be the first sign of glaucoma
  – OHTS data showed field loss was first sign in 35%

The Development of Glaucomatous Field Defects

• Learning Effect
  – May take up to 3 fields before learning effect disappears
• Anyone can have a bad day leading to a changing field
• Defect develops in one of 3 ways
  – Scotomas become denser
  – New scotomas develop
  – Scotomas expand

6 Steps in Analyzing Visual Field

• Reaffirm Disease
  – Stage disease
  – Compare optic nerve, RNFL and visual field determining if they correlate
    • Repeat test if needed
  – If field defect already present, did it progress or change?

Classification of Visual Fields in Glaucoma

• Mild Visual Field Loss
  – Mean Deviation Not Worse than -6dB
  – On pattern deviation plots
    • fewer than 25% of points depressed at 5% level and
    • fewer than 15% of points depressed at 1% level
  – No points in central 5° with sensitivity < 15dB
Visual Fields and Glaucoma

- Moderate Visual Field Loss
  - Mean deviation between -6dB and -12dB
  - On pattern deviation plots, fewer than 50% of points depressed below 5% level and fewer than 25% of points depressed below 1% level
  - No point within central 5° with sensitivity of < 0dB
  - Only 1 hemifield containing a point with sensitivity <15dB within 5° of fixation

- Severe Visual Field Loss
  - Mean deviation worse than -12dB
  - On pattern deviation plot, more than 50% of points depressed below the 5% level and more than 25% below 1% level
  - Any point within central 5° with sensitivity of 0 dB
  - Both hemifields containing a point with sensitivity <15dB within 5° of fixation
6 Steps in Analyzing Visual Field

• Reaffirm Defect
  – Compare to previous defect
  • Unchanged
  • Worse
  • Better

• Conventional perimetry is nonselective in stimulating retinal ganglion cells (RGCs)
  – Activates a variety of RGC pathways
  – Any of these pathways may lead to perception of stimulus

Types of pathways
- Magnocellular
  • Motion sensitive
  • Large cells
  • Achromatic
- Parvocellular
  • Most common
  • Color sensitive
  • Small cells
  • Fine detail
- Bistratified RGCs (Koniocellular)
  • Motion insensitive
  • Large cells

New Visual Field Tests

• SWAP and SITA SWAP
  – Bistratified or Koniocellular responses
  – Bleaching yellow background with size 5 blue stimulus
  – Emphasizing one pathway increases sensitivity
  – Detect early loss
  – Longitudinal studies show ability to recognize loss early
  – Correlates with optic disc
  – 8-30% abnormal in OHTN

• Short Wavelength Automated Perimetry (SWAP)
  – Limitations
    • More difficult to perform
    • Lens effects
    • Greater variability

Frequency Doubling Technology (FDT) Perimetry

• Magnocellular RGC responses
• Flicker stimulus imitates motion across retina
• Increased sensitivity to detect early loss
• Correlates with SAP and predicts loss
• Matrix 24-2
  • Sensitivity similar to SITA
  • Threshold variability unrelated to severity

Summary of Visual Field Tests

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<td>Variability Cataract effect Limited use</td>
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<td>Baseline VF Following for progression</td>
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6 Steps in Analyzing Visual Field

- VF test may confirm glaucoma diagnosis
- In some cases, field loss may drive the diagnosis when optic nerve appears normal and IOP elevated
  - Small optic nerve which masks cupping
- All patients should undergo SAP at baseline
- If SAP normal and suspect disease, run selective functional tests like FDT or SWAP

6 Steps in Analyzing Visual Field

- Follow-up Tests
  - In general, perform visual field tests annually
  - Timing of repeat tests may be varied depending upon severity of disease and level of risk

6 Steps in Analyzing Visual Field

- Reimbursement
  - Medicare documentation must include order for test as well as interpretation of the results
    - Describe reliability, changes since last test, assessment
  - Report must be signed
  - Visual field printout initialed and dated
  - ICD 92083 Extended examination

6 Steps in Analyzing Visual Field

- Right test
  - SITA SAP 24-2
  - SITA SAP 10-2
  - FDT Matrix
  - SWAP
- Reliability
  - GHT
    - WNL
    - Borderline
    - Outside Limits
- Pattern of Loss
  - Normal
  - Non Diagnostic
  - Glaucoma
  - Other
- Stage Glaucoma
  - Normal
  - Suspect
  - Mild
  - Moderate
  - Severe