Pathological Events Affecting Visual Fields

Marcus Gonzales, OD, FAAO
UHCO Cedar Springs Eye Clinic
Dallas, TX

Outline
- What is a visual field anyway?
- Visual field instrument basics
- What is the technician’s role?
- How do you interpret the print out?
- How is vision transmitted via the brain?
- How do different diseased visual fields look?

What is a Visual Field?
- A measure of the sensitivity/extent of one’s vision

What is a Visual Field?
- “Hill of Vision”
- Greatest sensitivity at the center (Fovea)
- Physiologic blind spot

Why perform perimetry??
- Dermatochalasis or ptosis
- Retinal disease
- Unexplained vision loss
- Glaucoma
- APD
- Stroke
- Suspected neurologic disease

Basic Visual Field Testing
- Kinetic
  - Moving stimulus of known size & brightness from non-seeing to seeing
  - Examples
- Static
  - Presentation of non-moving stimuli of varying intensities
    - Screening
    - Threshold
    - Examples
Kinetic Perimetry Instruments

- Humphrey
- Octopus
- Dicon
- Oculus
- FDT
- Matrix

Static Perimetry Instruments

Available Tests

- Foveal Threshold Testing
  - Conducted before peripheral field testing
  - Peak threshold is about 36-38 dB
  - No direct threshold equivalent to VA
  - Use for asymmetry and comparison over time

Visual Field Instrument

- A small spot of light flashed against uniform background
  - SAP – white light on dim white background
  - SWAP – blue light on yellow background
  - FDT – black/white grating on white background
- A threshold is the number representing one’s ability to see a certain brightness of light
  - Higher threshold = dimmer light is visible
  - Lower threshold = brighter light is necessary to see

Visual Field Instrument

- Thresholds are measured in units of decibels
- Decibels are based on a logarithmic scale

<table>
<thead>
<tr>
<th>28dB</th>
<th>60w</th>
</tr>
</thead>
<tbody>
<tr>
<td>29dB</td>
<td>600w</td>
</tr>
</tbody>
</table>
Pearls for Interpreting VFs
- VF affected by anything in the visual pathway
  - Cornea, Lens, Vitreous, Retina, ONH, Visual Cortex
- Abnormal doesn't always equal pathology
- Look for patterns of vision loss which may indicate a particular disease

Visual Fields aren't diagnostic for anything
- Comparison to Age-Matched Database
- Compare over time
- Correlate what you're expecting to see from the patient's history, direct evaluation of the macula, ONH/RNFL and OCTs

Obtaining VFs in Real World
- Obtaining reliable, repeatable visual fields is MUCH more challenging than managing disease
- Subjective and variable…but it's all we got
- Better patient/test setup = better results = better decision-making!

Tips For Obtaining Better Fields
- Prep the patient
  - Bright/dim lights
  - Fixation
- Patient positioning
  - Back/Neck comfort
  - Head/chin
  - Lid
- Pupil Size
  - Dilated?
- Trial Lens
  - Determining power
  - Positioning
- Watch the patient
  - Outside
  - Viewing window

Monitor head and eye position relative to the center of the trial lens.
Tips For Obtaining Better Fields

- Encourage the patient
  - Doing well
  - Remember to keep looking straight ahead
  - Almost done
  - Hand on shoulder

- Pause/Stop if necessary
  - Pause button on instrument
  - Patient can hold button on clicker

Interpreting a VF Report

- Patient info
- Test info
- Reliability
- Defect

Reliability

- Fixation Losses: (<20%)*
- False Positives: (<15%)
- False Negatives: (<20%)
- Gaze Tracker: Flat as can be

Fixation Losses

- Stimuli presented where the instrument believes the physiologic blind spot is

  Why?
  - Patient is searching for the lights during test
  - False positive
  - *ONH is not where instrument believes it should be

False Positives

- Stimuli isn't truly presented, but patient supposedly saw it

  Why?
  - Patient trying too hard (over anxious)
  - In a hurry
  - Doesn't understand test

False Negatives

- More sensitive threshold was seen prior, but on re-test patient now can't see it

  Why?
  - Patient inattention
  - Fatigue
  - Less discerning
  - Disease process
Common Visual Field Artifacts
- Lens well artifact
- Eyelid artifact
- Clover leaf fields
- Trigger happy fields

Defect
- Grayscale
- Thresholds
- Total Deviation
- Pattern Deviation
- Probability Symbols
- GHT Statements
- VFI
- MD and PSD

Grayscale
Graphical plot of patient’s visual field

Thresholds
A numerical plot of patient’s thresholds

Total Deviation
Comparison to Thresholds
Probability Plot
Compared to someone of same age

Total Deviation Plot
Tells me how well the patient did taking the test
Total Deviation Defects
- Cataract, Small Pupil, Patient Strategy
- Probably real defect
- Unreliable (False Positives)

Pattern Deviation
- Adjusted Comparison to Thresholds
- Pattern of loss within patient's field
- Probability Plot

Pattern Deviation Plot
- Filters out an overall depression
- Tells me if there are any remaining areas of vision loss that have a pattern to it
- Correlation to the ONH/RNFL

Probability Symbols
- Less than 5% of the time, the given threshold was present in a normal patient
- Said in another way…over 95% of the time, the given threshold was NOT normal
- P < 5%
- P < 2%
- P < 1%
- P < 0.5%

Glaucoma Hemifield Test
- Instrument's interpretation of VF based on comparing groups of corresponding points on superior/inferior half

GHT Statements
- Outside normal limits – Differences between a matched pair of corresponding zones exceed the difference found in 99% of the normal population, or when both members of a pair of zones are more abnormal than 99.3% of the individuals with the normative population.
- Borderline – Matched pairs of zones are abnormal at the 97th percentile within the normative database
- General reduction of sensitivity – Both conditions for “outside normal limits” are not met, and the best region of the VF is depressed to a level at the 95.5th percentile within individuals of the normative database.
- Abnormally high sensitivity – The overall sensitivity in the affected region of the VF is better than 99.9% of individuals within the normative population.
- Within normal limits – None of the above conditions are met.
**Visual Field Index**

- VFI 99%

Percent of patient's vision relative to someone of same age.

**MD and PSD**

- Mean Deviation (MD) – avg threshold compared to someone of same age
- Pattern Standard Deviation (PSD) – how much variability there is within the patient's field

**The Visual Pathway**

- Optic nerve
- Optic chiasm
- Post-chiasmal
- Visual cortex

**Structure-Function Correlation**

**Glaucoma**

- Paracentral
- Nasal step
- Arcuate
- Overall constriction

**Glaucomatous Pattern Defects**

- Paracentral
- Nasal step
- Arcuate
- Overall constriction
Paracentral Defect

Nasal Step Defect

Arcuate Defect

Overall Constriction Defect

Ischemic Optic Neuropathy

Altitudinal Defect
Multiple Sclerosis (MS)

MS Field Defect

The Visual Pathway

Pituitary Tumor

Bitemporal hemianopia

In multiple sclerosis, the myelin sheath, which is a protective covering around the axon of a nerve cell, is destroyed with inflammation and scarring.

The visual pathway consists of the optic nerve, optic chiasm, post-chiasmal, and visual cortex.

A pituitary tumor can cause bitemporal hemianopia.
The Visual Pathway

- Optic nerve
- Optic chiasm
- Post-chiasmal
- Visual cortex

Brain Tumor

Primary brain tumor

Homonymous Hemianopia

Stroke

Homonymous Hemianopia

The Visual Pathway

- Optic nerve
- Optic chiasm
- Post-chiasmal
- Visual cortex
Visual Cortex Defects

Take Home Messages
- Subjective and variable…but it’s all we got
- Never trust one visual field…always repeat it
- More field loss equals more variability
- Make sure the visual field defect correlates
- Other things cause VF defects
- May look at both fields together
- Better patient/test setup = better results = better decision-making!

Thank you for your attention

Questions?