Understanding Visual Fields

Steven Ferrucci, OD, FAAO
Chief, Optometry; Sepulveda VA
Professor; SCCO/MBKU

• WHAT
  The Visual Fields are a measure of the area you are able to perceive visual signals, when your eyes are in a stationary position and looking straight ahead

• WHY
  Measures the visual integrity between the retina and the visual cortex

• HELPS US
  Understanding of functional abilities.
  Help diagnose a vision/brain condition.
  Monitor treatment/progression of condition.

• USES:
  Glaucoma
    • Glaucoma affects peripheral vision before central vision
    • Assists in Diagnosis and Following of glaucoma
  Neurologic
    • Strokes cause characteristic visual field loss
    • Diagnose and help localize lesions
  Other
    • RP, blepharoplasty

• Historical perspective
  • Hippocrates described hemianopsia in late 5th century BC
  • Measurement of VF extent by Thomas Young in early 1800’s
  • VonGrafe provided first quantitative assessment in 1856
  • Hans Goldmann and his perimeter in the 1940’s

• Quick review
  • Normal adult dimensions
    | Dimension   | Degree |
    |------------|--------|
    | Superiorly | 50-60  |
    | Inferiorly | 70-75  |
    | Nasally    | 60     |
    | Temporally | 90-100 |
  • Threshold measurement is the intensity of stimulus that can be detected by the patient 50% of the time.
  • Db- the dimmer the stimulus the higher the threshold number (Db), patient is more sensitive.
  • By testing multiple locations at the threshold an isopter is formed

• Types of VF Defects:
  • Scotoma:
    • A defect surrounded by normal visual field
    • Relative: an area where dim objects cannot be seen but larger or brighter ones can
    • Absolute: nothing at all can be seen in that area
  • Generalized depression:
    • Overall VF is reduced vs. what it is expected
Types of VF Defects:
- Hemianopia: binocular field defect in each eye
- Bitemporal: the two halves lost on the outside, or the temporal side
- Homonymous hemianopia: the two halves are on the same side of the visual field, to the right or left

Getting set up:
- Consider your patient
  - Choose the appropriate test
    - Screener vs threshold test
    - Peripheral vs central
- Ensure good testing/reliability
  - Correct Rx
  - Patient limitations
- Analyze data
  - Make appropriate treatment recommendation

OPTIONS:
- Confrontation fields
  - Quick and easy screener
  - Doesn’t require equipment
  - Catches large defects

Advantages of Manual Perimetry
- Greater interaction between examiner and patient
- Not confined to VF testing algorithms
- Adaptable to patient
  - Ex: Goldman, Tangent Screen

Advantages of Automated Perimetry
- More sensitive/reproducible
- Quantitative information
- Results in a more timely manner
- Experienced perimetrist is not required
- With newer perimetric tests, early detection of glaucomatous damage is possible
  - EX: Humphrey, Octopus
- **Tangent Screen**
  - Simple and more sensitive than confrontation fields
  - Black felt screen with stitched circles 5 degrees apart
  - Tests to 30 degrees at 1 meter (3.2 feet)
  - Different color targets
  - Smaller target makes for a more sensitive test
  - Distance correction, including +1.00 for presbyopes at 1 m
  - No multifocals
  - Plot from non seeing to seeing, BS first
  - Monitor patients fixation

- **Goldman manual perimeter**
  - Easier to test large defects
  - Hemianopsias, low vision patients (ex: RP) or patients who cannot sit through a Humphrey field.
  - Calibrated bowl instrument
  - Background set at 31.5 apostilbs (in photopic range)
  - Can change size and intensity of target to plot different isopters
  - Roman numeral = size of stimulus
  - Number and letter = intensity of stimulus

- Plot the blind spot
  - Test each meridian from non seeing to seeing
  - Vertical and horizontal meridian
  - Place a dot at each meridian as soon as the patient clicks the button
  - Monitor fixation throughout
  - Form isopter
  - Evaluate
• **Humphrey Automated**
  - Light stimulus is flashed a number of static locations, if not seen intensity is increased.
  - Calculates field according to age matched norms (STATPAC)
  - Option of kinetic perimetry, social security disability or custom as well

• **FDT**
  - Tests supra threshold in 45 seconds and threshold in about 4-6 minutes.
  - Normal room lighting
  - Automatically occludes eye
  - 17 regions tested within central 20 degrees
  - High sensitivity and specificity for identifying glaucomatous defects.
  - Excellent for SCREENING

• **Octopus**
  - Standard automated, SWAP, flicker, goldmann automated or manual kinetic
  - Automated eye tracking
  - Faster threshold testing (2:30): TOP test strategy
  - Tells you when lens is too far; eliminates rim artifact
  - Also has progression analysis software
Before starting!

- Make sure date of birth entered
- Results are compared to normative data base
- Make sure correct RX is used
- Calculate trial lens
- Use set procedure
- Explain test to patient
- Get patient positioned in instrument
- Cover eye NOT being tested

Choose your test

- Ex: 24-2, 30-2, 10-2, 60-4
- SITA Standard/Fast: collects twice as much info, faster, starts testing near threshold. Time interval customized to patients responses.
- SITA SWAP: faster blue yellow threshold test for early detection of glaucoma
- Full Threshold

Visual field interpretation

- Visual fields are inherently variable
  - Consider learning effect/fatigue on psychophysical testing
  - Makes our job more difficult
  - We must look for overall trends to identify progression
  - New statistical analyses intend to help with this
• Reliable?
• Does the VF defect respect the horizontal or vertical meridian?
• Is the VF defect in one or both eyes?
• Is the VF defect in the papillomacular, arcuate or nasal nerve fiber bundle?
• If binocular, is the VF defect on the same side or the opposite side?
• If on the same side, are the VF defects carbon copies?

• Crunching numbers

• Reliability indices
  • Fixation loss- should be less than 20 %, watch patient through test, make note of good fixation on print out
  • False positive- “trigger happy” Patient pressed the button when no light was presented.
  • False negative- patient could not see a bright stimulus in a place they previously saw a dim stimulus
    • Studies: Both should be less than 33% to be reliable
    • Actually, less than 10-15%

• Sources of Error

• Poor performance
• Uncorrected Rx
• Lens rim defect
• Media opacity
• Ptosis/dermatochalasis
• Inadequate retinal adaptation

• Visual field should match clinical findings

• Color vision
• Visual Acuity
• Optic Disc Appearance

• Grey scale
  • Graphical representation of the raw data

• Total deviation
  • Raw data and graphical representation of how the patient did compared to age matched normals.
  • Zero = exact match.
  • (+) patient did better than his peers
  • (-) patient did worse than his peers.

• Pattern deviation
  • Graphical and numerical representation of field without generalized depression
  • Accentuates focal areas of damage.
  • A high number may indicate loss in discrete areas
• Glaucoma hemifield test (GHT):  
  - Compares points in the upper hemifield to corresponding points on the lower hemifield with the assumption that sensitivity should be similar in both fields.

• Visual field index (VFI):  
  - Global index gives you percentage of useful vision remaining.
  - Central parts of the visual field are weighted more.
  - Trend based analysis: pts age plus “velocity” of progression.

• Enhanced Guided Progression Analysis (GPA):  
  - Flags statistically significant progression automatically and tracks current rate of progression through a combination of threshold and SITA strategies.
  - Prints a one page “summary” of progression.
  - Projects current rate of projection up to 5 years.

• VF Defects in Glaucoma:  
  - Arcuate defects, bjerrum scotoma.
  - Nasal Step.
  - Paracentral scotoma.
  - Temporal wedge.
  - Blind spot enlargement.

• Media opacities:  
  - corneal scars, cataracts, vitreous hemorrhage

• Retina/ONH level:  
  - RD, AMD, glaucoma

• Brain:  
  - Early visual pathway: Optic nerve, chiasm, optic tracts.
  - Late in the visual pathway: LGN, Optic radiations, visual cortex.
Look for patterns!
- Cluster of 3 points
- Abnormal Glaucoma Hemifield Test
- Pattern Standard Deviation <5%
- Repeatable!!
- Correlate with clinical findings!

• VF Defects in Glaucoma:
  - Progression is indication that treatment is not sufficient
  - Correlate with clinical findings!
  - Performed at least once a year or more depending upon severity of disease

• Neurologic Field Loss:
  - Tends to be bilateral
  - Tends to be fairly symmetric
  - Symmetry of field loss increases through the visual pathway
  - VF loss can predict location based on anatomy
  - Lesion on contralateral side
• Others:
  • Retinitis Pigmentosa
  • Loss of peripheral vision
  • “tunnel vision”
  • Dermatochalasis
    • Superior defect which improves after surgical intervention
  • AMD
    • Central scotoma

• SUMMARY:
  • VF is useful clinical tool
  • Glaucoma, Neuro, Others
  • Very variable
  • Patient preparation is key!!
Thank You!!!