UNDERSTANDING VISUAL FIELD TESTING

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Definitions

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- **Visual Field**:
  - The portion of space which is visible when gaze is fixed in one direction
- **Perimetry**:
  - The measurement of the extent and sensitivity of the visual field

Indications for Perimetry

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- History
  - General medical problems
  - Neurological problems
  - Ophthalmic problems
  - Potentially toxic medications

Indications for Perimetry

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- Examination
  - Unexplained reduction in best corrected visual acuity
  - Defect noted on confrontation fields
  - Abnormal pupils or EOM's
  - Proptosis
  - Elevated intraocular pressure

Indications for Perimetry

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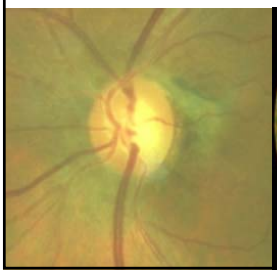
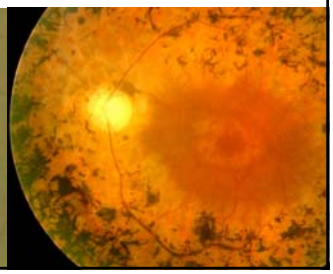
- "Funny looking optic disc"
- Retinal or Choroidal Disease





Purposes of Perimetry

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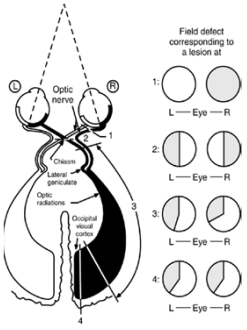
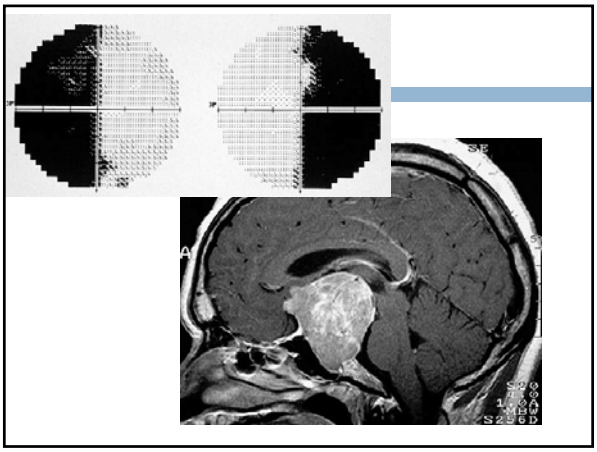
- Detection of defects (screening function)
- Definition of defects (e.g., location, shape, and depth)
- Clinical correlation (what caused the defect?)
  - The visual field defect tells you where the lesion is in the visual pathway
  - Knowing where the lesion is suggests what caused it





Monocular limits of the visual field

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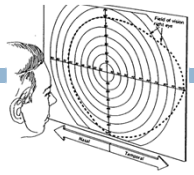

Direction	Limit	Anatomy
Superior	60°	Frontal orbit (brow)
Nasal	60°	Nose
Inferior	70°	Maxilla (cheek)
Temporal	110°	Nasal retina

Binocular Overlap of Fields

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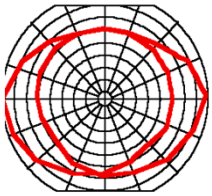
- The visual fields for the two eyes overlap allowing relatively large field defects to go unnoticed by the patient
- Because of this phenomenon, perimetry is ALWAYS performed MONOCULARLY



Traquair's Island of Vision

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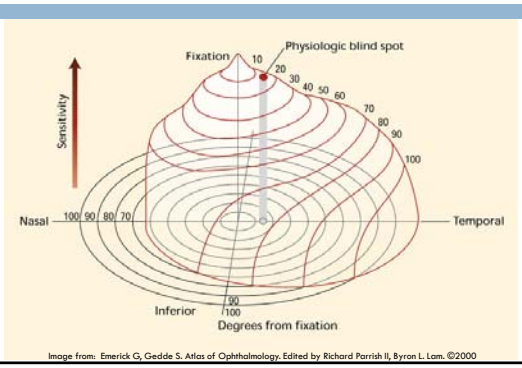

Image from: Emerick G, Gedde S. Atlas of Ophthalmology. Edited by Richard Parrish II, Byron L. Lam. ©2000

Factors influencing visual field measurements

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Stimulus Factors

Response Factors

Clinical Variables

Factors influencing visual field measurements

STIMULUS FACTORS

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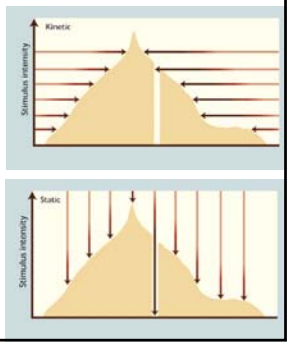
- Luminance
- Contrast
- Stimulus Size
- Duration
- Kinetic vs. Static Presentation



Factors influencing visual field measurements
RESPONSE FACTORS

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- **Patient instructions**
- **Patient's expectations**
- **Examiner's personality**
- **Response criterion**
  - The patient's willingness to say "yes" when a target is presented
    - Strict criterion – higher threshold
    - Relaxed criterion – lower threshold
- **Reaction time**
  - In general, the more peripheral the stimulus, the longer the reaction time

Factors influencing visual field measurements
CLINICAL VARIABLES

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- **Pupil size**
  - It is best to test the visual field with a pupil diameter of at least 3 mm (record pupil size when testing visual field)
- **Fixation**
  - Important to monitor during visual field testing
- **Target blur**
- **Media opacities** (e.g., cataracts)
- **Age**

} decreased sensitivity can result in an overall depression in the visual field

Factors influencing visual field measurements
CLINICAL VARIABLES

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- **Physical limitations**
  - Overhanging brow
  - Ptosis of upper lid
  - Trial lens frame
  - Large nose
- **Psychological factors**
  - Fatigue
  - Anxiety/stress
  - Practice
  - Attentiveness/Cooperation
  - Psychogenic/malingering

16 Methods of visual field testing

Confrontation Visual Fields

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- Estimates the patient's visual field limits as compared to the clinician's field
- Helpful in picking up gross defects such as hemianopsia, quadrantanopsia, or altitudinal loss
- Typically part of the basic patient workup

Amsler Grid

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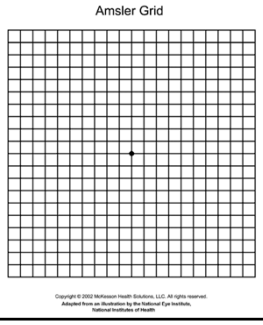

- Used by the patient to self-monitor changes in the central 10° of the visual field
- Used in monitoring macular disease

Manual Perimetry

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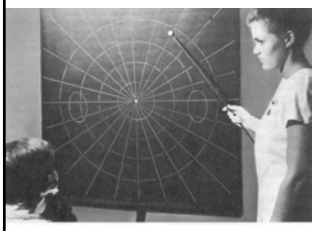
- Tangent Screen
- Goldmann Bowl



20 Automated Perimetry

Using an automated perimeter

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- **Screening tests**
  - Used for detection of a defect
  - Major advantage is speed of test
  - Disadvantages includes having limited data for quantification (not as accurate)
- **Threshold tests**
  - Allows for assessment of defects
  - Test takes longer than screening test
  - More accurate than screening test

Humphrey Field Analyzer II (II-i)

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Humphrey Field Analyzer III

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Humphrey Field Analyzer

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- Uses a bowl/perimeter with a radius of 33 cm
  - Because of working distance, presbyopia or cycloplegia will affect the clarity of the targets presented to the patient
  - Testing within the central 30° of the visual field should always be done with a nearpoint correction in place

Perimetry Compensation Lenses

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- The patient's habitual nearpoint correction is not suitable for perimetry because:
  - It is set for a different distance (ie., 40cm vs. 33cm)
  - It is usually in the form of a multifocal which would be useful only for the inferior fields
- Trial lenses used instead of glasses
- Contact lenses should be removed for testing, as tear film deficiencies and dryness can affect results of test

Perimetry Compensation Lenses

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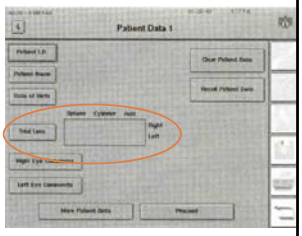
- The compensation lens can be manually determined and entered into the HFA II (II-i), or you can have the the machine determine the compensation lens for you (based on patient's distance Rx and date of birth)



Perimetry Compensation Lenses

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- The trial lens power you use depends on the accommodative status of the patient:
  1. Absolute presbyope (or cyclopleged patient)
  2. Intermediate presbyope
  3. Non presbyope

Perimetry Compensation Lenses

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- Absolute Presbyope (or cyclopleged patient)
  - Add +3.00 sphere to the distance correction

Example:

Distance Rx: -1.75 -1.25 x 086

Trial Lens: +1.25 -1.25 x 086

Perimetry Compensation Lenses

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- Intermediate Presbyope
  - The rule-of-thumb is to add +0.50 sphere to their habitual add

Example:

Distance Rx: +2.75 -2.25 x 107

Add: +1.25

Trial Lens: +4.50 -2.25 x 107

Perimetry Compensation Lenses

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- Non-Presbyope
  - Usually, you can use their customary distance Rx in the trial lens

Example:

Distance Rx: -3.75 -1.50 x 172

Trial Lens: -3.75 -1.50 x 172

Perimetry Compensation Lenses

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- Cylinder power
  - If the cylinder power is greater than 1.00D, correct all of the cylinder
  - If the cylinder power is 1.00D or less, use the equivalent sphere
  - If cylinder is used, place it in the lens well closest to the patient's eye

Perimetry Compensation Lenses

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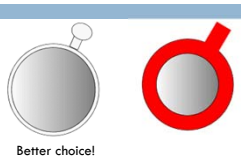
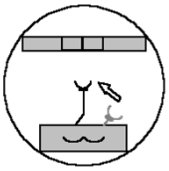
- Select a trial lens that is the least likely to block patient's side vision
- Trial lenses are only used when testing within the central 30° of vision
- If not using a trial lens, holder can be stored behind chin rest





Perimetry Compensation Lenses

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- An improperly positioned trial lens will produce a ring scotoma
- Using the wrong prescription can result in a central scotoma or depression of the visual field
- The bottom line is:
  - Always ask the patient if their fixation target is clear before proceeding with the test!

Example of trial lens artifact that disappears after retesting

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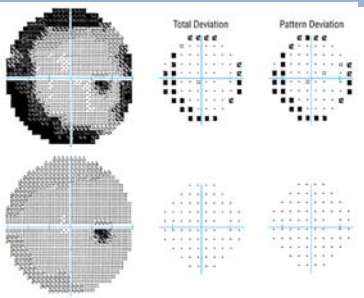

Keltner, J. L. et al. Arch Ophthalmol 2000;118:1187-1194.

ARCHIVES OF OPHTHALMOLOGY

HFA III

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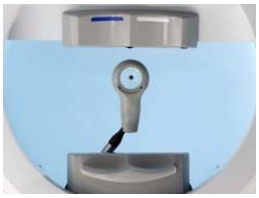

Zeiss.com

- No trial lenses needed!
- "Liquid Lens" technology
- Automatically loads patients correction based on data entered
  - Faster
  - Less error

Preparing the Patient

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- 1. Clean chin rest, forehead rest, response clicker, and eye patch with alcohol prep
- 2. Dim room illumination
- 3. Explain the purpose of the test and give patient instructions
  - Explain what the test measures
  - Assure the patient that the test is painless
  - Explain proper forehead and chin position
  - Explain where and how to fixate and how to respond
  - Reinforce that attention to fixation and responses will speed the testing and improve accuracy
  - Tell them to inform you if they need to pause the test at any time

Preparing the Patient

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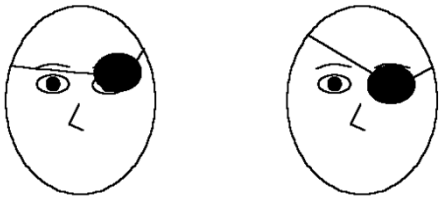
Incorrect Patch Position | Correct Patch Position



- 4. Have the patient remove their eyewear and patch the untested eye

Preparing the Patient

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- 5. Hand the patient the response "clicker" and demonstrate its use
  - If the "clicker" is depressed for several seconds, it will pause the testing
- 6. Use the forehead and chin rest to position the tested eye as near as possible to the center of curvature of the bowl (and to the trial lens)
- 7. Direct the patient's gaze to the fixation target
  - Foveal threshold will be checked first
- 8. Use the eye monitor and chinrest controls to center the eye
- 9. Start the test

Main Menu

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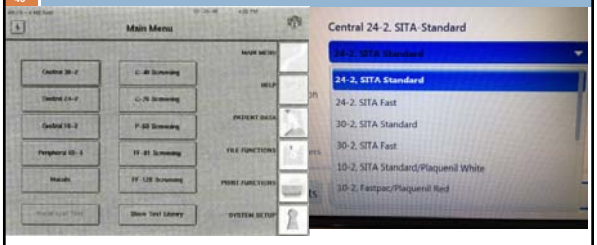

Patterns of threshold testing

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- Central 30-2
  - '30' stands for central 30°
  - '2' stands for 2nd type (test points straddle the midline vs. 30-1 where points are on the midline)
  - 76 points total are tested with each point separated by 6° of visual space

Humphrey 30-2 test pattern

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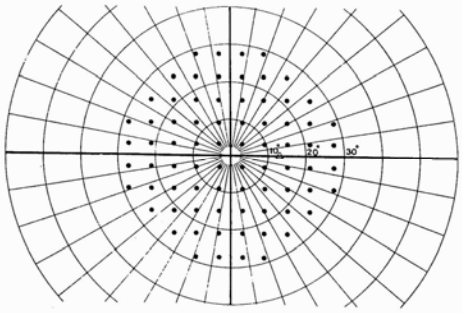

Humphrey 30-1 test pattern

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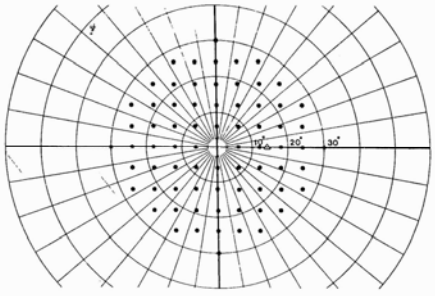

Patterns of threshold testing, cont.

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- Central 24-2
  - Covers central 24˚ (except nasally where it extends out to 30˚) ; 54 points with 6˚ between points
  - Takes less time than Central 30-2
- Central 10-2
  - 10˚ ; 68 points with 2˚ between points
  - Most often used on patients with conditions that affect central vision (ie., macular degeneration, diabetic retinopathy) or when only a small amount of central vision remains (ie, end-stage glaucoma)
  - Also useful as a screener for potentially toxic medications (ie, Plaquenil)

Patterns of screening testing

45

- C-76 Screener
  - Screens the central 30˚
  - Uses exact test point pattern as the 30-2
- Full field 81/120
- Custom

Patient Data

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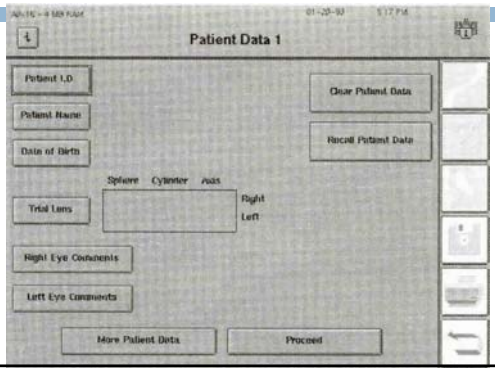

Start Screen

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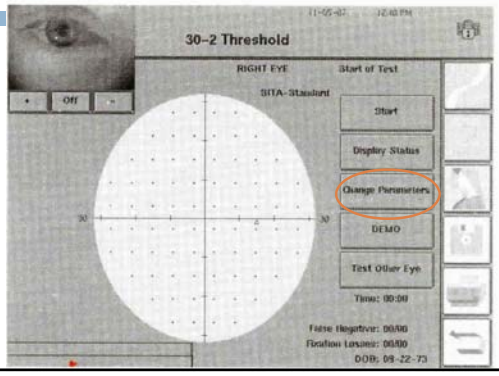

Parameter Setup

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Parameter Setup-Test Strategy

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- **SITA**=**S**wedish **I**nteractive **T**hresholding **A**lgorithm
  - The operating system for the HFA II
  - Questions and pace of test are determined by patient's responses which helps reduce testing time
- SITA Standard
  - Offers high accuracy in a relatively short test time
- SITA Fast
  - Twice as fast (e.g., 3 min for 30-2 vs. 7 min for 30-2 on SITA Std)
  - Best used for "screening" or practice threshold tests

Start Screen

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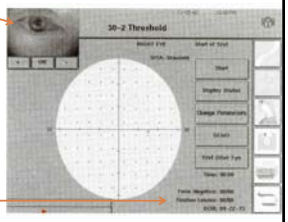
- Eye monitor used for initial setup and to confirm proper position and fixation throughout the test
- Reliability indicators
  - False negative
  - Fixation losses
  - False positives



Reliability Indicators

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- **False Negative**
  - A catch trial that indicates the patient is not responding to stimuli that were previously seen
  - Likely indicates that the patient is becoming fatigued or is inattentive and should be re-instructed and encouraged
    - The pause control can be used to give the patient a rest
  - May also be high in a reliable patient with significant field loss

Reliability Indicators

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- **Fixation Losses**
  - When the test begins, the machine "locates" the blind spot by an initialization process
  - During testing, presentations of stimuli are presented in the position of the blind spot, and a fixation loss is assumed if the patient responds
  - Fixation losses are presented as a fraction with the numerator representing the number of losses and the denominator representing the number of presentations
    - If a patient appears to have >33% fixation losses, it is probably worth it to pause the test and reinstruct the patient towards the fixation target

Reliability Indicators

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- **False Positives**
  - False positives are not shown on the SITA screen (you will need to monitor the decibel graph to catch high false positives)
  - False positives are determined by using periods during the test when no positive answers are expected (ie, "trigger happy")
    - Instruct the patient to respond only when a stimulus is seen and that he/she may not be able to see all of the stimuli that are presented

Decibel Graph

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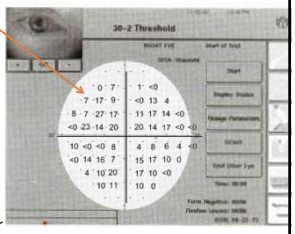
- The dB (decibel) numbers are a measure of the patient's ability to see dim stimuli
  - Range from 0 to 50
  - 30 is fairly normal
  - 0-20 indicates low sensitivity and significant field loss
  - >40 indicates "hypersensitivity" and that the patient may be "trigger happy"—usually indicating an unreliable test



Fixation Monitoring

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The following are used on the Humphrey Field unit to assist in monitoring fixation and in gauging patient reliability:

- direct video observation of the patient's eye
- blind spot stimulus presentations
- gaze tracking

Fixation Monitoring-Gaze Tracking

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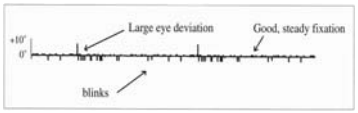
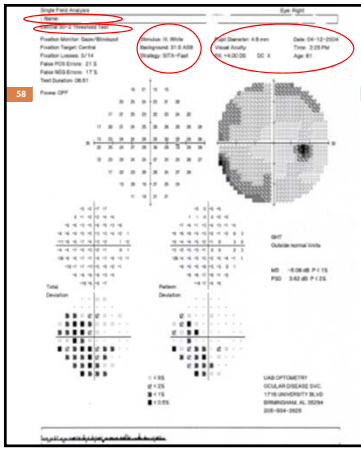
Good fixation with a large number of blinks



Poor fixation with a large number of eye movements

57 Interpreting the Printout



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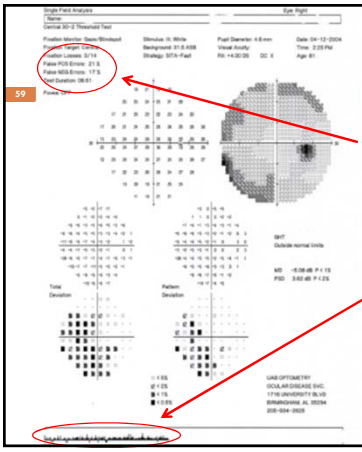
- Patient information
  - Name
  - DOB
  - Age
  - Exam date/time
  - Trial lens used
  - Pupil size
  - Best VA
- Test Parameters
  - Test pattern and strategy
  - Stimulus size and color



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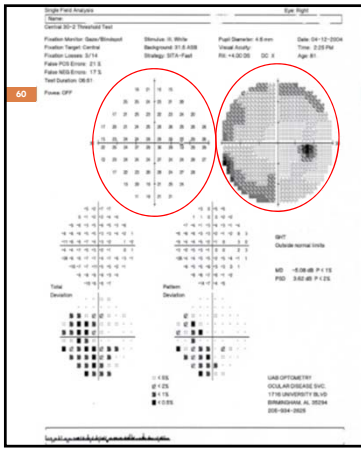
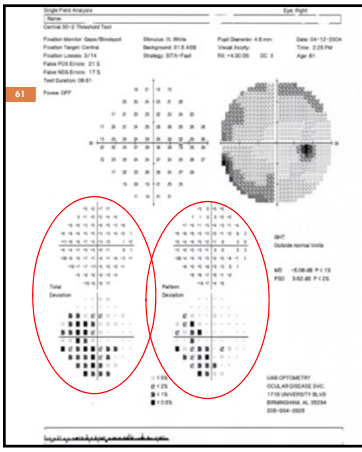
- **Reliability Indices**
  - **Fixation Losses**
  - **False Positives**
  - **False Negatives**
- **Fixation Monitoring**
  - **Gaze tracking**



60

- **Threshold Sensitivity**
  - numeric values of the sensitivity of each point tested (in dB)
  - some points may be retested and will show a value in parenthesis below the original value
- **Grayscale**
  - Symbolic representation of the numeric scale
  - Used mainly for patient education—not for doctor's interpretation



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- **Total Deviation**
  - The upper plot represents the difference, in dB, between the numeric scale values and the age-corrected normal values
  - The symbols beneath the plot indicate the relative probability that the corresponding deviations occurred by chance alone
- **Pattern Deviation**
  - The single most useful analysis on a HVF printout
  - Similar to the Total Deviation plot except it is adjusted for any changes in the height of the measured hill of vision. This makes the analysis sensitive to any localized scotomas 'hidden' under an overall field depression

Comparing Total and Pattern Deviation

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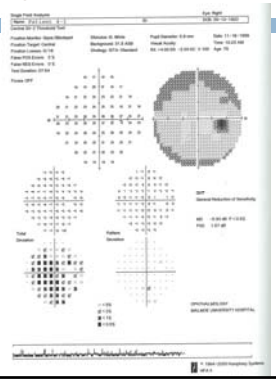

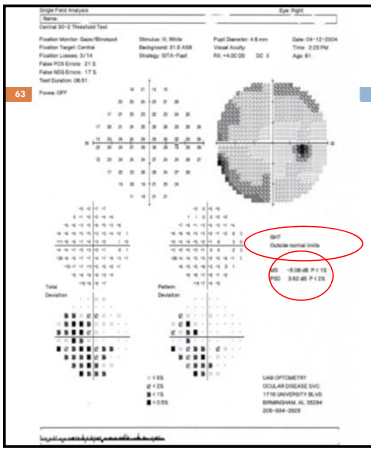

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- **Glaucoma Hemifield Test**
  - Corresponding points above and below the horizontal midline are compared to determine if any deviation is outside normal limits
- **Global Indices**
  - Mean Deviation (MD)
    - the mean elevation or depression of the patient's overall field compared to the normal reference field
  - Pattern Standard Deviation (PSD)
    - measures the degree to which the patient's field departs from the expected shape (smoothness of the hill of vision)

Global Indices

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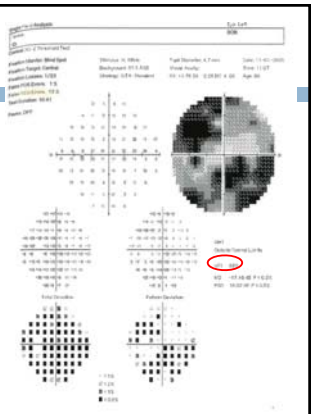

- **VFI – Visual Field Index**
  - Included in HFA II-i and later software
  - Approximately 100% in normal fields and approaches 0% in perimetrically blind fields
  - With successive fields, can calculate rate of progression

Billing & Coding for Visual Fields

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- 92081
  - **Limited examination**
- 92082
  - **Intermediate examination**
- 92083
  - **Extended examination**
    - E.g., Humphrey visual field analyzer full threshold programs 30-2, 24-2

- Clear documentation of the reason for testing including corresponding ICD-10 code and interpretation of the visual field in the patient's record are required
- VF codes are bilateral

OOPS!!

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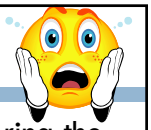

- Common mistakes in administering the visual field test…..
  - **No patch** – no blindspot and the periphery is unusually large
  - **Wrong trial lens Rx** – generalized depression in central 30 degrees of visual field
  - **Incorrect placement of trial lens** – ring scotoma
  - **Patient fatigue** – inconsistent responses, high false negatives and fixation losses, superior visual field loss
  - **Ptosis, dermatochalasis** – superior visual field loss

Your responsibilities as a technician…

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- To be comfortable and knowledgeable with the instrument used
- To perform accurate and reliable visual fields
- To perform repeatable visual fields
- To accurately gather diagnostic data
- To keep the patient as comfortable and relaxed as possible
- To monitor the patient during testing
  - Do not leave the patient unattended!
  - Monitor fixation, attentiveness, positioning
- Keep in mind, this is not a speed test!!