Automated Perimetry: Interpretation Of A Single Field Threshold Test Printout For Glaucoma On Humphrey's Perimeter.

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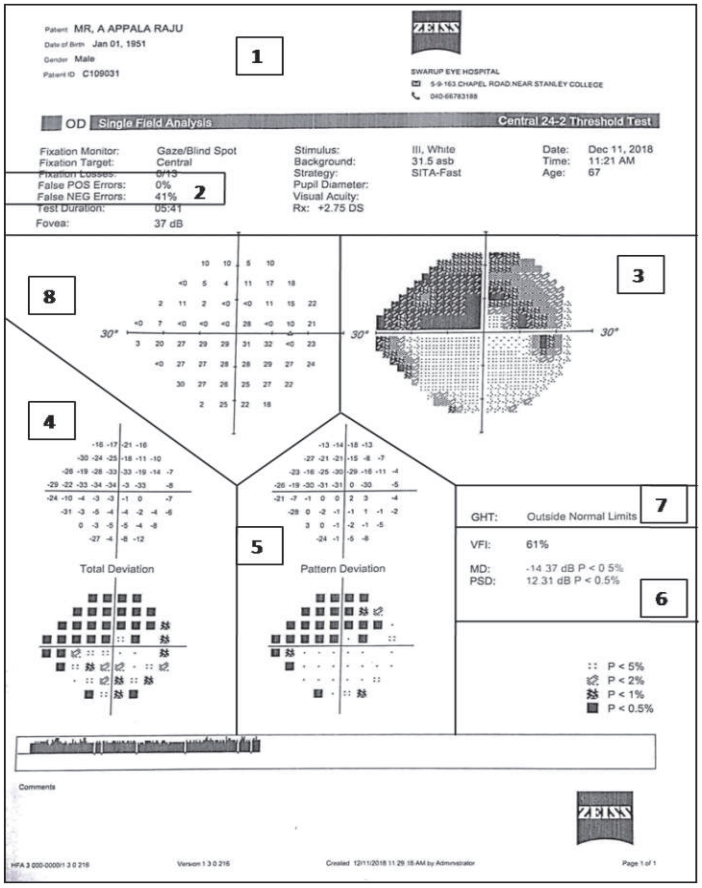
Figure 1 : COMPONENTS OF A SINGLE FIELD THRESHOLD TEST PRINTOUT – C24-2 with SITA STRATEGY



1. **Type of Test, Patient Demographics & Clinical Characteristics**
2. **Reliability Parameters**
3. **Greytone Chart**
4. **Total Deviation & Probability Plot**
5. **Pattern Deviation & Probability Plot**
6. **Global Indices**
7. **Glaucoma Hemifield Test**
8. **Raw Data**

Zone I. Type of Test, Patient Demographics & Clinical Characteristics.

Type of test-

Here we are looking at the Central 24-2 test. C signifies central. 24 signifies the central 24-degree field, but nasally 30-degree field is tested to include the nasal step. –2 is only a notation[1].

Patient Demographics-

1. Name
2. DOB should be correctly entered to enable retrieval of data & overview Analysis.
3. ID No. 4. Date of Test 5. Start Time 6. Test Duration

Clinical Characteristics-

1. Eye Treated Right/Left.
2. Stimulus III.
3. Background Illumination 31.5asb.
4. Fixation Monitor Blind spot.
5. Fixation Target Central. In central scotoma Fixation Diamond is used.
6. Strategy Full Threshold/SITA-Standard
7. Age-Interferes with sensitivity.1 decade –1.5dB drop. Hence correct age should be entered.
8. Pupil-Ideal size for perimetry is 3.5 mm. The suppression of field is more if the pupil size is between 1-3 mm than if it is 3-7 mm.
9. Visual Activity
10. Rx. More than NV correction. It can be calculated by the machine. This is a little more than the presbyopic correction, to give rest to the eye during test taking.
11. Foveal Threshold-Sensitivity in db. Abnormal values are flagged statistically.

Zone II. Reliability Parameters.

Determined by:[2]

1. Fixation Loss Rate.

2. False Positive Rate.
3. False Negative Rate.

1. **Fixation Loss Rate:** Rough measure of the number of times the patient fails to concentrate at the fixed target.

10% of stimuli in early stages (5% overall) are projected in the region of Blind Spot. If the patient responds to this stimulus, it is recorded as a fixation loss. Loss >20% is flagged XX. Upto33% is Considered OK.

Incorrectly determined OD (Eccentric OD)

Trigger Happy Patient.

2. False Positive Rate: Determined by the Analyzer setting up to project a stimulus with accompanying Click but not projecting one. Patient response is recognized.

FP >33% is flagged XX.

Implications: A Trigger-happy Patient.

Improper understanding of the Test

3. False Negative Rate: Determined when the computer projects a Suprathreshold stimulus in an already tested location. Patient's no response to the stimulus is recognized.

FN >33% is flagged XX.

Implications: An inattentative patient,

Fatigue or Malingering to produce a poor field.

Zone III. Greytone Chart.

Greytone chart is a display (a map) of all test points & locations with assigned interpolated values. Points are measured at 6 deg., but values are assigned at 1 deg. interval.

Threshold values are combined in groups of 5dB, so that the range from 1-40 is assigned 8 different shades of Grey. The higher numbers in dB correspond to lighter areas in Grey scale.

This chart gives an overall impression & is useful to explain to patient.

Zone IV. Total Deviation & Probability Plot.

Total deviation plot has two kinds of displays - Numeric & Probability Displays.

This represents the difference between the measured threshold for each test location & the age corrected normal for that location. The perimeter has stored normal data of the population and the measured threshold at each point is compared with this stored data.

Abnormal if difference is >5dB. for that age. Near the edge especially in superior hemifield, a difference >5dB. is OK.

Probability plot is linked to probability value symbols. A value P < 1% means that the measured threshold for that age and point is such that is usually seen in less than 1% of the normal population.

Zone V. Pattern Deviation & Probability Plot.

Represents difference between the adjusted threshold for each test location & the age corrected normal for that location. The perimeter adjusts the diffuse component of the suppression of retinal sensitivity. By this adjustment, the focal defects get unmasked. [1,3,4]

This adjustment is equivalent to the general change in least damaged portion. This value generally corresponds to the 7th highest value in Raw data. The probability plot is again linked to the probability symbols.

Correlation between Total Deviation & Pattern Deviation

To understand the correlation between the total and pattern deviation plots, lets use an analogy. Suppose a man while crossing the road trips and sustains an injury on his hand. Subsequently he develops fever. As a result of this injury and fever he looks quite sick (total deviation). But when we adjust his total illness by removing the general component of fever, the real hand injury gets unmasked (pattern deviation).

When we analyse this printout, the greytone chart suggests diffuse suppression of retinal sensitivity as corroborated in total deviation probability plot. But when the perimeter adjusts the sensitivity by removing the generalized change as per the least damaged portion, (eg. Cataract figure 2) the real biarcuate defect (glaucoma figure 3) gets unmasked.

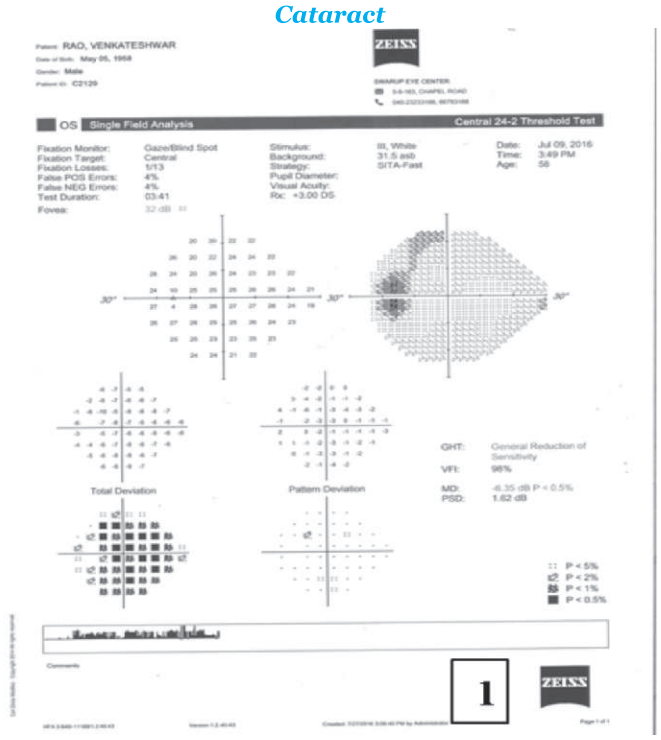


Figure 2 : Greytone chart shows diffuse suppression as corroborated in total deviation with all points normal in pattern deviation. (Likely Cataract).

Glaucoma

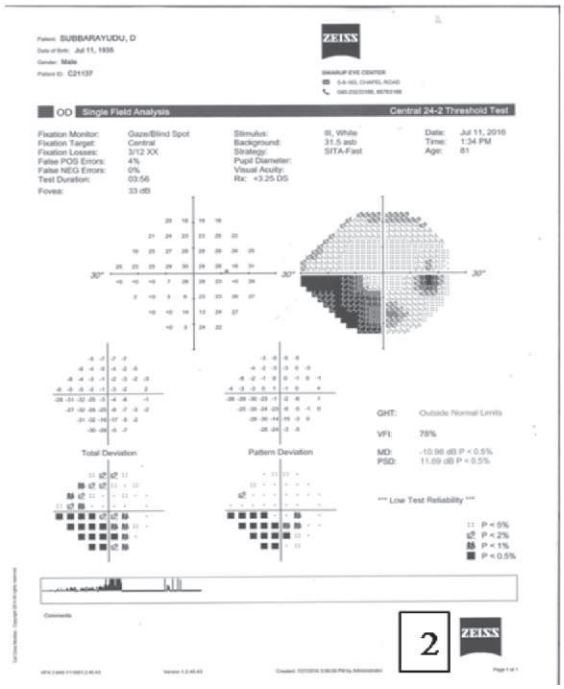


Figure 3 : Greytone chart shows inferior arcuate suppression as corroborated in total deviation with significant and exact persistence in pattern deviation. (Likely Glaucoma).

Cataract + Glaucoma

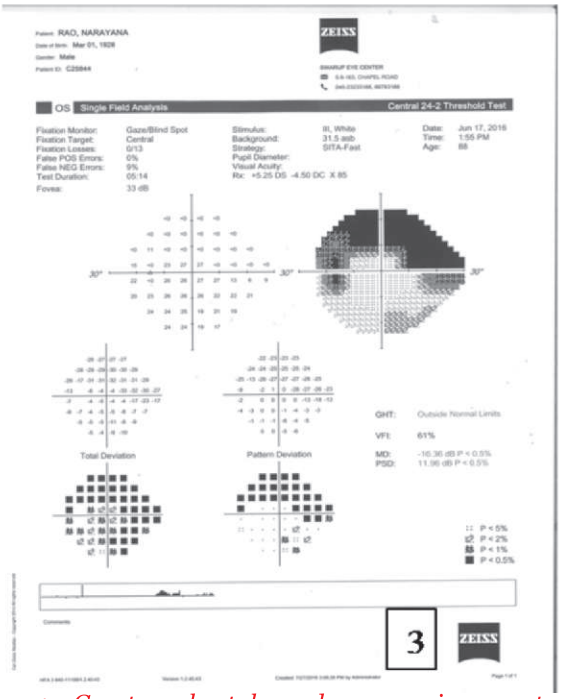


Figure 4 : Greytone chart shows dense superior arcuate defect and diffuse suppression as corroborated in total deviation with significant persistence in form of superior arcuate defect in pattern deviation (Likely Cataract and Glaucoma).

Zone VI. Global Indices.

Mean Deviation: It is the average of numbers displaced in the total deviation plot.

MD index indicates the overall severity of Field loss. It is an arithmetic mean of all the values in total deviation plot.

Pattern Standard Deviation: PSD is a measure of amount of localised depression as compared with aged matched controls.

Low PSD is consistent with smooth hill of vision. High PSD suggests local irregularities.

Mean deviation gives an indication as to how much the field / sensitivity is suppressed overall, where as PSD indicates whether this change is smooth (diffuse) or irregular (focal defects).

Visual Field Index: Whenever we tell the patient that he/she has Glaucoma, the immediate question that prop up is:[5] what is the percentage of Vision Loss? This index expresses the visual field status as a percent of a normal age-adjusted visual field.

Greater weight is given to points closer to fixation to adjust for ganglion cell density and visual function. The index may also be less sensitive to cataract and media changes.

All the global indices are marked in terms of Probability Symbols (P value).

Probability Symbols: P<5% means it is that kind of defect which may normally be seen in about 5% of the population. P<0.5% means it is that kind of a defect which may be seen in about only 0.5% of the population hence more serious.

Zone VII. Glaucoma Hemifield Test.

Calculated by comparing 5 Zones in the upper hemifield with identical locations in inferior field after adjusting for general height of vision.[6]

It gives information about threshold value between the two halves of the field.

Results –Glaucoma Hemifield Test. We get 5 different types of results.

1. Within Normal Limits: No significant difference & sensitivity is within 99.5% of range.
2. Outside Normal Limits: Difference between two halves greater than would occur in 99% of normal population. ie., the defect is such that is seen in 1% of the population.
3. Borderline: Difference between the two halves greater than would occur in 97% of normal population. ie., the defect is such that is seen in 3% of the population.
4. General Reduction of Sensitivity: Overall sensitivity of the least damaged portion is below99.5% range, but there is no difference between the two halves.

5. Abnormal High Sensitivity: Overall Sensitivity is higher than in 99.5% of population.

Zone 8. Raw Data.

This is a display of all threshold values measured at every point.

Redetermined 10 cardinal points are shown in Parenthesis. These points are redetermined to give an index of SF variation. Apart from these points, the other points that are redetermined are points that are 5dB. less than expected normal. The points with a difference of >6dB. between the adjacent points are also redetermined.

SYSTAMATIC INTERPRETATION OF A SINGLE FIELD THRESHOLD TEST PRINTOUT- C24-2

For a proper interpretation of a printout, we have to answer the following questions.

1. What Type of Test is performed?
2. What are the Patient Demographics & Clinical Characteristics?
3. Is the field reliable?
4. Is the Visual Field abnormal?
5. What is the Pattern of Abnormality?
6. Is the Field worsening?
7. Is the abnormality due to disease or artifact?

1. What Type of Test is performed?

C24-2

2. Patient Demographics & Clinical Characteristics.

As discussed above.

3. Reliability Parameters.

As discussed above.

4. Is the Visual Field abnormal?

To know this, we have to consider:

1. Threshold Printout.
2. Foveal Threshold.
3. Greytone Chart.
4. Total Deviation & Probability Plot.
5. Mean Deviation.
6. Glaucoma Hemifield test.

5. What is the Pattern of Abnormality?

To know this we have to consider:

1. Greytone Printout.
2. Pattern Deviation numeric & probability Plot.
3. Glaucoma Hemifield Test.
4. PSD/CPSD.

6. Is the Field worsening?

By comparing the Baseline Field with subsequent Fields.

Important to differentiate Long-term fluctuation (LF) with real worsening.

Depression in some points & Improvement in others suggest LF.

Proportionate Change suggests Worsening.

Progression of Field Defect can be ascertained by:

1. Point wise Comparison.
   a) New Defect in an expected location, which is significant.
   b) Expansion of an existing defect
   c) Worsening of an existing defect.

The Defect is considered to have worsened if two or more non-edge points within or adjacent to an existing scotoma have worsened by at least 10db. or 3 times the average of the short-term fluctuations, whichever is greater.

2. Glaucoma Change Probability.
3. Regression analysis of Global Indices.

7. Is the abnormality due to disease or artifact?

The artifacts that should be ruled out include

1. Incorrect DOB. The result is compared to the normal data of a different age and wrong analysis is obtained.
2. Incorrect Refraction. This may result in diffuse suppression of the field.
3. Incorrect Fixation. This generally underestimates the defect.
4. Effect of Pupil Size. Miosed pupils show diffuse suppression
5. Dim Projector Bulb. Overall suppression of field may be seen. Here the brightest stimulus can be shown < 1 dB instead of <0 dB.
6. Long term Fluctuation. As already described.
7. Lens Rim Artifact. We generally get a circumferential suppression of sensitivity in the periphery.
8. Edge Artifact. The sensitivity decreases as we move to the periphery. Isolated defects outside 24 deg. are usually edge artifacts.
9. Lid / Brow Artifact. Manifests as a kind of superior arcuate defect.
10. Fatigue Effect: The cardinal points that are tested early are normal but the peripheral points are suppressed.
11. Learning Effect: Here the cardinal points that are tested early are suppressed as seen encircled in the figure. Subsequent field test shows normal sensitivity.

To know whether the defect that we are looking at is significant or otherwise, we have to see whether it is as per Anderson's criteria.

ANDERSON'S Minimal Abnormality Criteria for Glaucoma:

1. Three or more non-edge adjacent points in an expected location in cen.30 deg.field- that have P<5% on Pattern deviation, one of which must have P<1%.
2. Glaucoma Hemifield Test "Outside Normal Limits."
3. CPSD/PSD with P< 5%.

REPORTING OF A SINGLE FIELD THRESHOLD TEST PRINTOUT- C24-2

- Report Patient's name, age & Clinical Characteristics
- Report the Type of test done in each eye
- Comment on the Foveal Threshold.
- Comment on reliability Parameters.
- Comment on the Foveal Threshold.
- Give an overall view of the Greytone Chart & its corroboration with the Total deviation Chart & Probability plot
- Comment on "Significant" Persistence in Pattern deviation chart & Probability plot.
- Comment on Global Indices with special reference to CPSD/PSD.
- Comment on Glaucoma Hemifield Test.
- Comment on final review of Raw data if required.
- Final Impression: with suggested clinical correlation.

In Synopsis, to confirm a positive Glaucomatous defect

- Give a Preliminary look at the Greytone Chart. Note the foveal threshold.
- Corroborate it with Total deviation plot
- Look out for Significant Persistence in Pattern deviation plot
- Confirm this defect with PSD/CPSD & analysis of Raw Data.
- This defect should then be correlated clinically to OD Change & other parameters.

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