

ESSENTIALS OF GLAUCOMA

2 - The Visual Fields (part 1)

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Introduction

The visual field is that portion of space in which objects are simultaneously visible to the steady fixating eye. It is somewhat more than one half of a hollow sphere, situated before and around each eye of the observer.

Traquair's comparison of the visual field to "an island hill of vision surrounded by a sea of blindness" has firmly established in clinical practice the quantitative method of perimetry.

Retinal sensitivity is greatest in the foveal area and decreases in direct proportion to the distance of the rods and cones from the fovea.

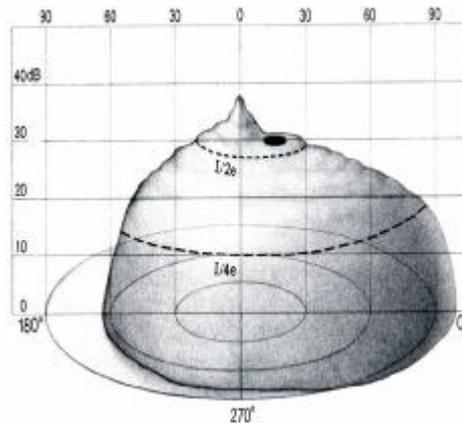
In the normal eye with 20/20 vision at fixation, acuity decreases rapidly in the peripheral field so that:

At 5 degrees, it is 20/70

At 10 degrees, vision measures 20/100

At 20 degrees, vision is 20/200

At 40 degrees, it is about 20/400.



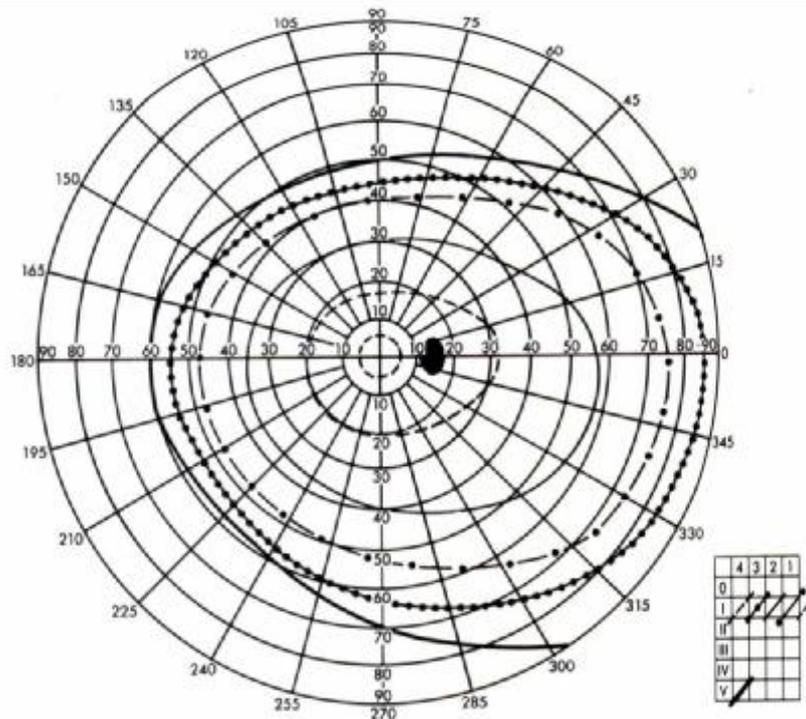
The limits within which a certain size object can be seen by the normal observer can be surveyed on the hill as a contour line and plotted on a map or chart. These are the isopters of the normal field.

Visual Field Theory and Methods

The Normal Visual Field

The normal visual field (island of vision) has a sharp central peak, corresponding to the fovea, with sloping sides. The island of vision extends:

- 60 superiorly and nasally
- 75 inferiorly
- And 100 temporally.



Visual Acuity versus Visual Field

Visual acuity measurements test the resolving power of the retina for objects of distinct form.

Visual field measurement tests a more primitive retinal function differential light sensitivity.

Terminology and Definitions

Fixation

That part of the visual field corresponding to the fovea centralis. Patients with poor fixation move their eyes repeatedly and produce an unreliable visual field test result.

Central field

That portion of the Visual field within 30 of fixation.

Bjerrum's area (arcuate area)

That portion of the central field extending from the blind spot and arching above or below fixation in a broadening path to end at the horizontal raphe nasal to fixation. Bjerrum's area usually is considered to be within the central 25 of visual field.

Static perimetry.

The position of the stimulus is held constant while the stimulus intensity is varied.

Kinetic perimetry.

The intensity and size of the stimulus are held constant while the stimulus location is moved.

Threshold

At a given retinal point, the intensity of a stimulus that is perceived 50% of the times it is presented.

Depression

A reduction in sensitivity greater than the expected normal reduction.

Scotoma

A localized defect or depression in the visual field.

Absolute defect

A field defect that persists when the maximum stimulus of the testing apparatus is used. The normal blind spot is an absolute scotoma.

Relative defect

A field defect that is present to weaker stimuli but disappears when tested with brighter stimuli.

Candela per square meter (cd/m²)

The international unit of luminance

Apostilb

0.1 milliambert = 3.183 cd/m²

Log unit

Logarithm base 10 of the luminance in apostilbs.

Decibel

One tenth of the log unit.

Symbol									
dB	51-36	35-31	30-26	25-21	20-16	15-11	10-6	5-1	0
asb	0.0008-0.25	0.31-0.8	1-2.5	3.1-8	10-25	31-80	100-250	315-800	1000

1 asb = 0.318 cd/m²

Kinetic perimetry

In kinetic perimetry the stimulus is usually presented in the periphery and moved at approximately 2 per second toward fixation until the patient first perceives it. The stimulus is moved to another to another meridian in the periphery out of view and advanced toward fixation again until the patient sees it.

By repeating these maneuvers at approximately 15 intervals around 360 of the visual field, the examiner defines a series of points that can be connected to describe an isopter corresponding to the stimulus used.

By decreasing or increasing the size or brightness of the stimulus, a smaller or larger isopter will be outlined.

After initial detection scotoma can be defined more precisely with kinetic perimetry by placing the stimulus in the scotoma and moving the stimulus outward until it is perceived. This process is repeated in varies directions until all edges of the scotoma have been defined.

Combined static and kinetic perimetry

Combined static and kinetic perimetry uses the speed of kinetic perimetry and the sensitivity of static testing. It is used routinely in manual perimetry, and rarely with automated perimeters.

Screening tests

Screening tests for visual field defects are available by manual perimetry and with most computerized perimeters.

They only detect rather large changes in the visual field (defects that are greater than 4 or 5 dB below an expected level).

Early glaucomatous defects may not be detected.

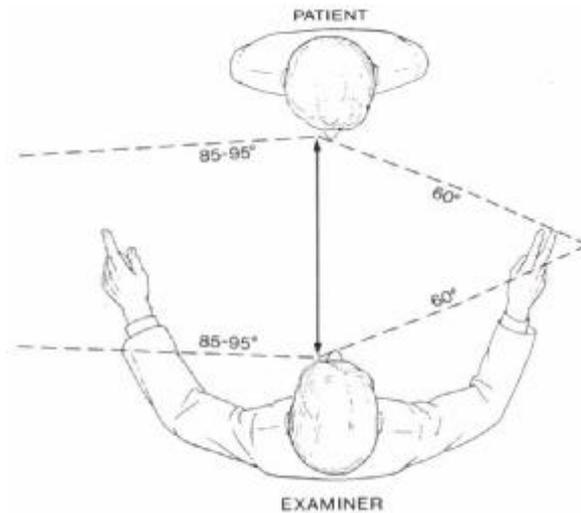
Techniques and variables in visual field testing

- Patient variables
- Age
- Fixation
- Reliability
- Ocular variables
- Pupil size
- Media clarity
- Refractive correction

Perimetry without special instruments

Confrontation testing

Rapid screening visual field test Suitable for identifying gross defects in the peripheral field. The examiner and patient facing each other about 0.5 meters apart.



Symbols used in Goldman perimeter

Symbols used to designate targets of varying size and brightness.

The target size and intensity are indicated by:

1. A Roman numeral (from O to V)
2. An Arabic numeral (from 1 to 4)
3. A lowercase letter (a through e).

The Roman numeral size of target I=0.25 mm²,

Roman numeral II indicates 1 mm²,

Roman numeral III indicates 4 mm²

Roman numeral IV indicates 16 mm²

Roman numeral V indicates 64 mm².

The Arabic numeral following the Roman numeral indicates the relative intensity of the light projected. Beginning with Arabic numeral 1, each additional numeral indicates a light that is 3.15 times brighter than its predecessor. A Goldmann 2 target is 3.15 times brighter than a Goldmann 1 target.

The small letter following the roman and Arabic numerals indicates a minor filter. Each minor filter adjusts the luminance by 0.1 log unit.

The “a” filter is the darkest, and therefore the stimulus intensity increases by 0.1 log unit for each letter up to “e”.

To summarize, the Roman numeral indicates size, the Arabic numeral indicates the major light intensity filter, and the lowercase letter indicates the minor filter.

Procedure

The light in the room must be dimmed so that it is less than that of the background luminance of the perimeter bowl.

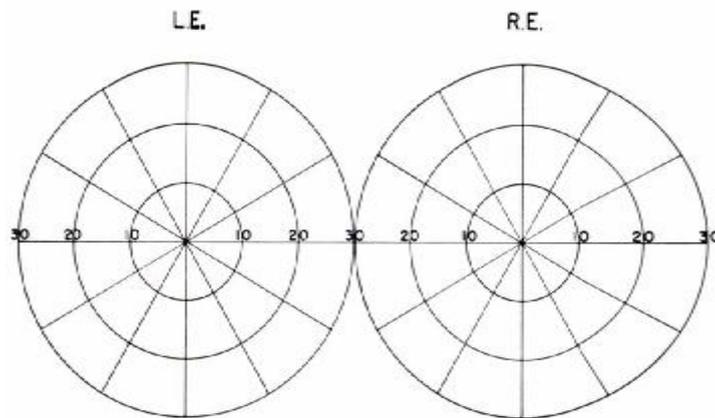
For a relatively normal patient, we tend to start with an I2e or I4e target. This isopter is in the region which generally includes most of the area within 30 degrees of fixation. We like to begin by mapping out the blind spot, because this is a good test of patient reliability, and it also shows the patient what it looks like. when the target disappears entirely, as it does in the absolute scotoma, of the blind spot itself.

The examiner increases the target luminance and/or size until the blind spot can be mapped effectively. Using this 25-to 30-degree isopter as a reference point, the stimulus value of the target is increased to examine the peripheral field and decreased to examine the central field.

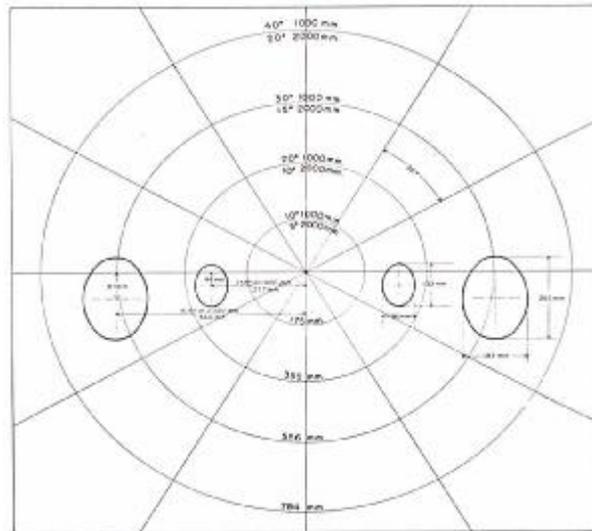
We have found it helpful to use different colors of ink to indicate different isopters. We usually start in the far periphery and move the target toward fixation until it is seen. This marks the peripheral edge of the isopter in question.

Tangent screens

The most flexible greatest usefulness within 30 degrees of fixation.



Two blind spots should be indicated on each side of fixation, one for the 2-meter distance and one for the 1-meter distance.



Tangent screen examination

Begin by outlining the blind spot with a test object large enough to be seen easily at 30 or 40 degrees of eccentricity.

A 20-mm test object will appear immediately in the patient's peripheral field and will disappear completely in the blind spot.

It should be outlined carefully with a small test object (between 1 and 3 mm).

Test object carriers should be:

Rigid enough so that there is a minimum of vibration when the test object is being moved.

Approximately 1 meter long
 1. Painted dull matte black.

Computerized perimeters

A machine constructed along the basic lines of a Goldman or Tübinger perimeter and sophisticated software programs that direct the machine to perform the visual test.

Targets of variable size or intensity are presented at any designated point or series of points within the hemispheric perimeter bowl.

Threshold test

The machine begins the bracketing sequence by projecting a light of such intensity that a normal patient should see it easily at the chosen test site. If the patient sees the light and responds by pushing the button, indicating "yes", seen, the machine tests other areas of the visual field and then returns to the original site and projects a dimmer light. This process continues until the light is so dim that the patient can not see it. The threshold has

been crossed. As the test continues, the machine increases the stimulus intensity level at the point in the question.

The results of the static threshold test are generally expressed in a decibel scale. Because we are using a reciprocal system dimmer lights detected in more sensitive areas are indicated by high numbers.

Symbol									
dB	51-36	35-31	30-26	25-21	20-16	15-11	10-6	5-1	0
asb	0.0008- 0.25	0.31- 0.8	1- 2.5	3.1- 8	10- 25	31- 80	100- 250	315- 800	1000

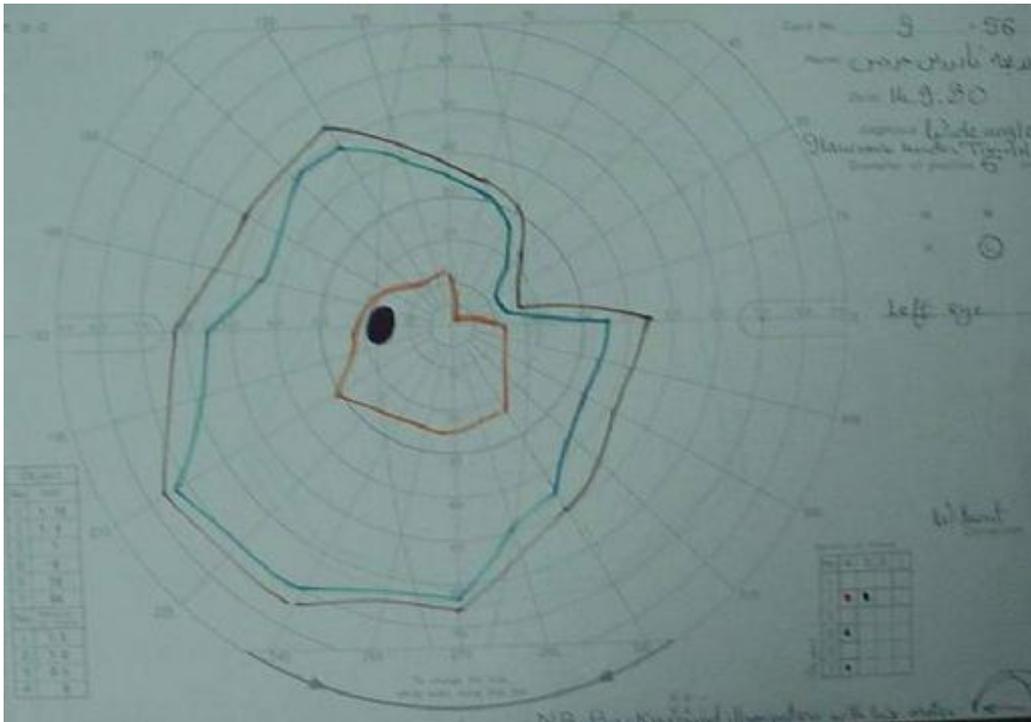
$$1 \text{ asb} = 0.318 \text{ cd/m}^2$$

In suprathreshold test the machine projects stimuli of the same intensity to each of the chosen test points throughout the field.

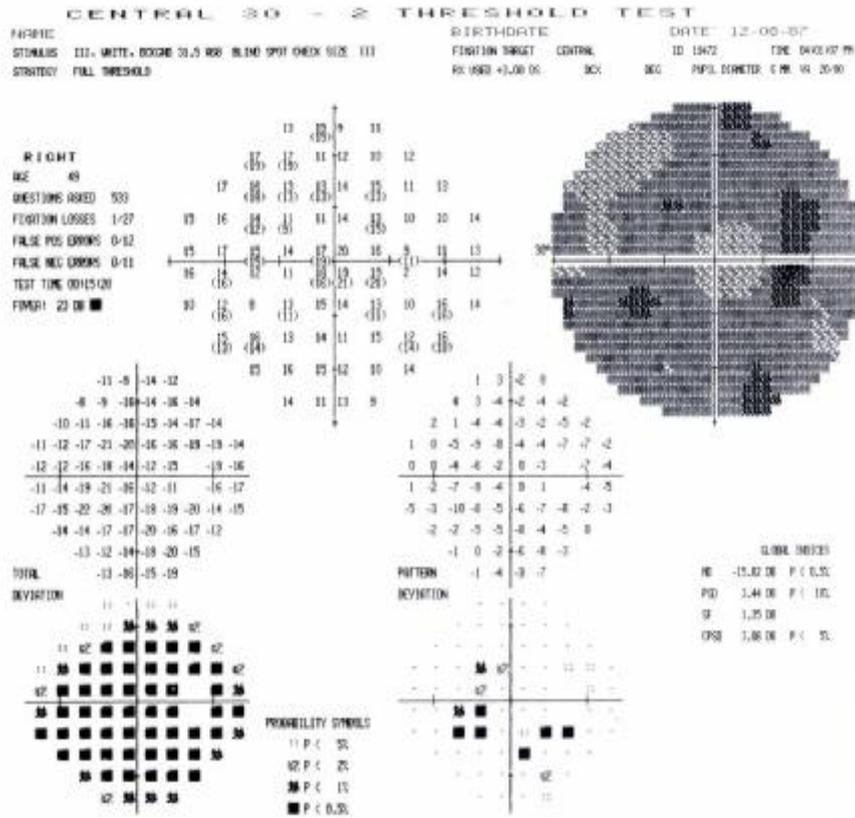
The light is bright enough to be seen by a normal patient at all the point in question. The test is much faster than the full threshold test but gives less information.

Short wavelength automated perimetry

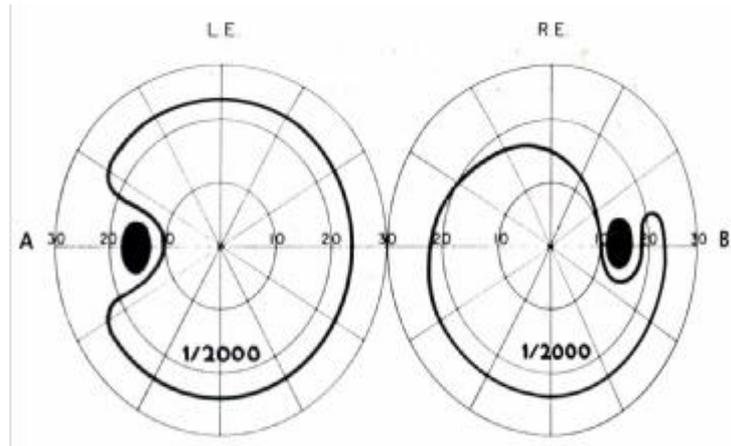
Visual field test in which short wavelength-sensitive (blue) cones are isolated by using blue light stimuli projected on a yellow background. Also called blue on yellow perimetry.



Concentric contraction



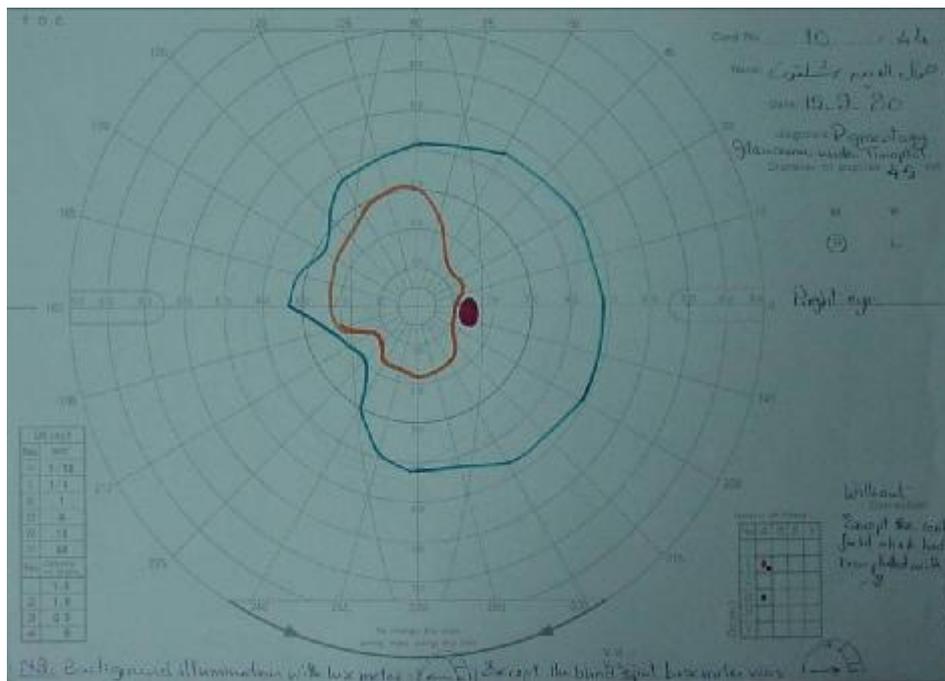
Marked difference between the defect in the total deviation and pattern deviation due to the effect of cataract



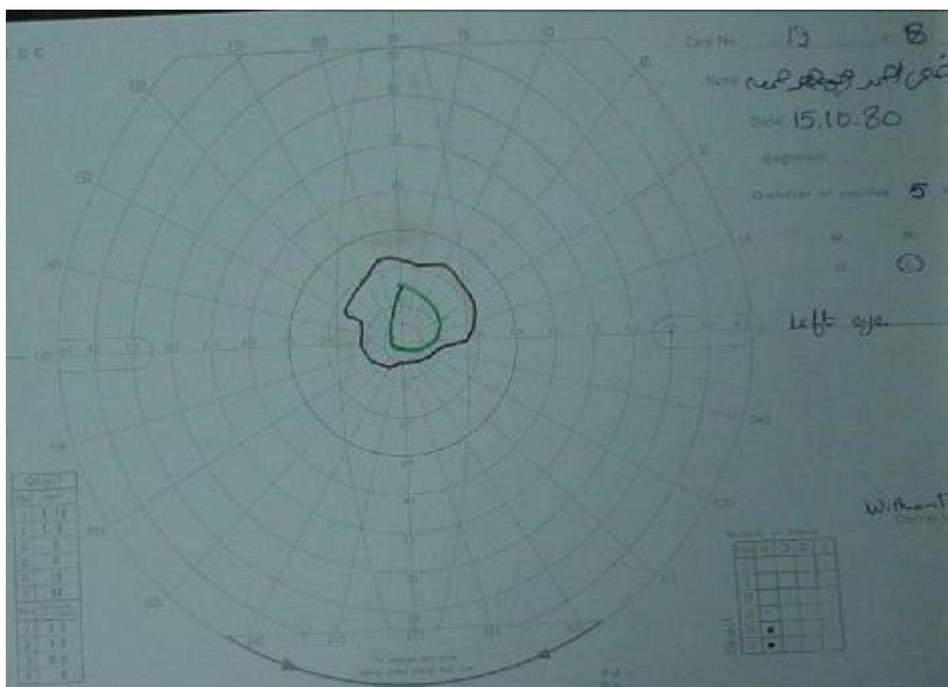
- A: False baring of the blind spot
- B: True baring of the blind spot



Defect in the Bjerrum's area

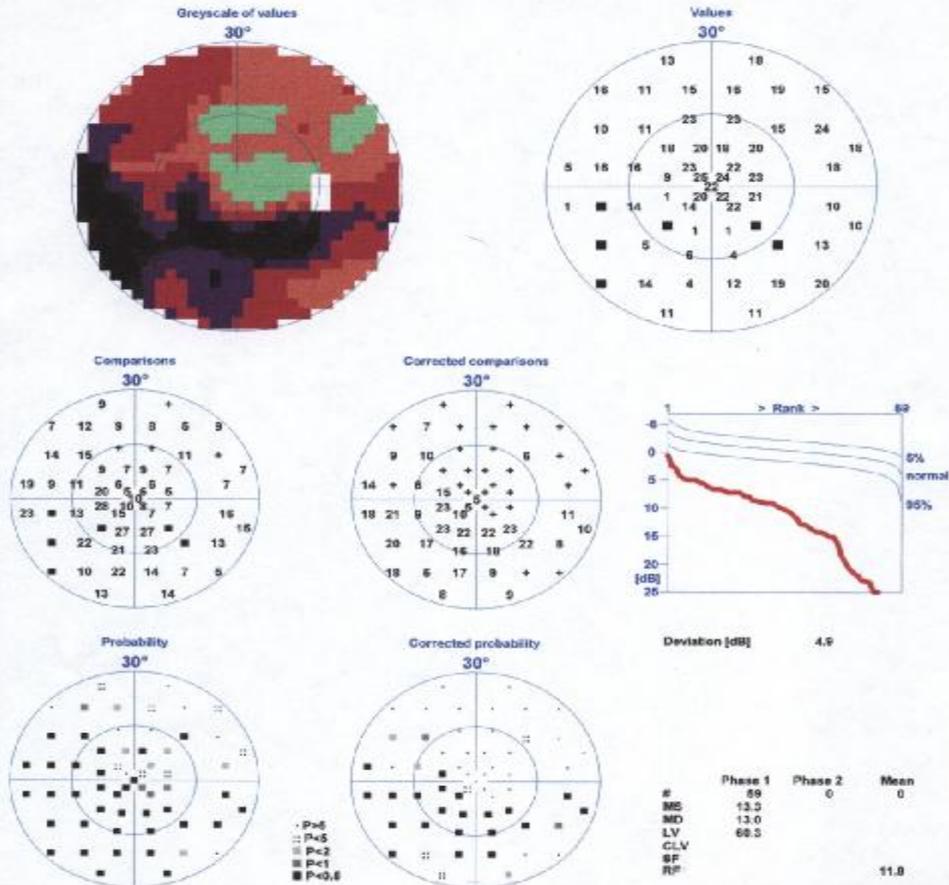


Baring of the blind spot

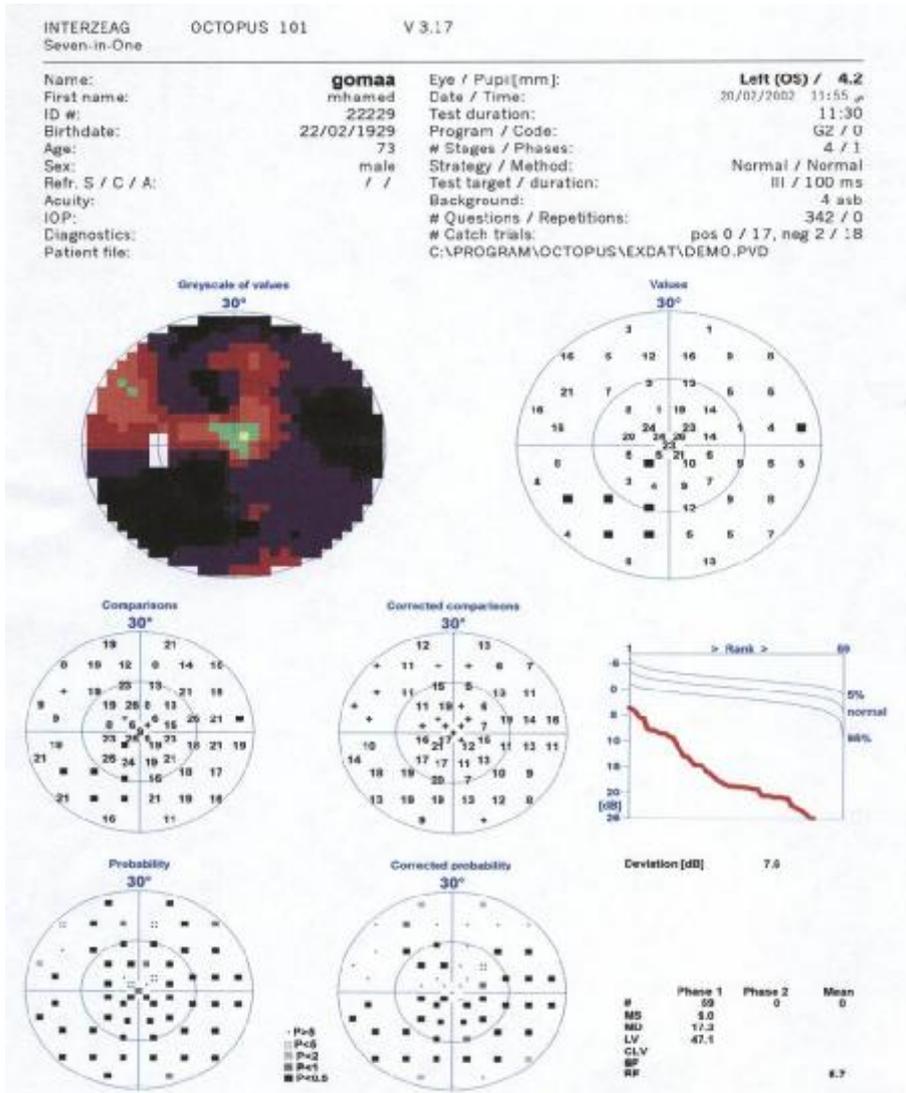


Marked contraction in advanced glaucoma

Name: **gomaa** Eye / Pupil[mm]: **Right(OD) / 4.5**
 First name: **mhamed** Date / Time: **20/02/2002 11:37**
 ID #: **22229** Test duration: **11:27**
 Birthdate: **22/02/1929** Program / Code: **G2 / 0**
 Age: **73** # Stages / Phases: **4 / 1**
 Sex: **male** Strategy / Method: **Normal / Normal**
 Refr. S / C / A: **/ /** Test target / duration: **III / 100 ms**
 Acuity: Background: **4 asb**
 IOP: # Questions / Repetitions: **339 / 0**
 Diagnostics: # Catch trials: **pos 1 / 17, neg 3 / 17**
 Patient file: C:\PROGRAM\OCTOPUS\EXDAT\DEMO.PVD



1. Generalized Depression
2. The difference Between the Probability and Corrected Probability Due to lens opacity



1. Generalized Depression
2. Advanced field defect encroaching On The central 50 denoting Marked nerve Fiber atrophy

References:

1. David O. Harrington, Michael V. Drake, The visual fields text and atlas of clinical perimetry, Sixth edition, Mosby, 1990.
2. Octopus visual field digest, Fourth edition, Interzeag (11/98) #4-0200-0010 revision2.
3. Robert L. Stamper, Mac F. Lieberman, Michael V. Drake, Becker-Shaffer's Diagnosis and the therapy of the glaucomas, Mosby, 1999.