CAMPIMETRY

AUTHOR

Luigi Bilotto: Brien Holden Vision Institute

PEER REVIEWERS

Timothy Wingert, University of the Incarnate Word Rosenberg School of Optometry

Maureen Hanley, The New England College of Optometry

INTRODUCTION

This chapter includes a review of:

- Confrontation fields (CF)
- Amsler grids
- Tangent screen
- Other campimetric devices

CAMPIMETRY

Campimetry involves testing the VF by presenting stimuli on a **flat surface**. The actual VF is somewhat deformed from the transposition of the sensitivities of a spherical retinal surface onto a flat surface. With more eccentric presentation (further from fixation) the test distance of a given stimulus increases while its angular size decreases. For central VF testing, this effect is clinically acceptable. For more peripheral testing, however, circular surfaces are necessary.

A number of methods are available to perform campimetry. Some methods are quite useful clinically especially in circumstances where expensive modern equipment is not available. However, with the advent of the more precise bowl perimetry, campimetry generally assumes a more secondary role in VF testing.

Methods of Campimetry
Confrontation Fields
Amsler Grids
Tangent Screen
Others
Autoplot
Harrington-Flock screener
Friedman
Automated Devices
Henson
Tubinger

CONFRONTATION FIELDS (CF)

CF testing is the simplest form of campimetry, the flat surface being an imaginary area midway between the examiner and the patient. CF fields, with which you should already be familiar, are used routinely on every patient as a screening VF test. CF testing is a relatively crude purely qualitative method that is suitable only to identify gross VF defects. CF can also be useful to confirm other VF results that do not seem to correlate with clinical observations or to test patients that are unable to perform sophisticated VF testing.

The CF test is simple, inexpensive and sufficiently reliable when performed thoroughly and adequately. A full CF includes facial Amsler, central & peripheral finger counting, simultaneous finger counting, hand comparison as well as colour comparison across meridians if necessary.

AMSLER GRIDS

The Amsler grids kit is a set of 7 charts (10 X 10 cm) used to detect small abnormalities (~1°) in the central VF that could remain undetected by the usual methods of VF testing. At the appropriate testing distance, the charts are specifically designed to assess a central 20° field. Anatomically, this correlates with the area just inside the temporal vascular arcades but excluding the optic nerve.

Each chart has a different pattern and is recommended for different purposes. In general, however, the charts serve to detect small central scotoma or metamorphopsia. Metamorphopsia is an anomaly of visual perception in which objects appear distorted, larger (macropsia) or smaller (micropsia). This is generally due to pathological changes in the fundus that result in a displacement of photoreceptors. Metamorphopsia may, however, also have a central origin (e.g. migraine).

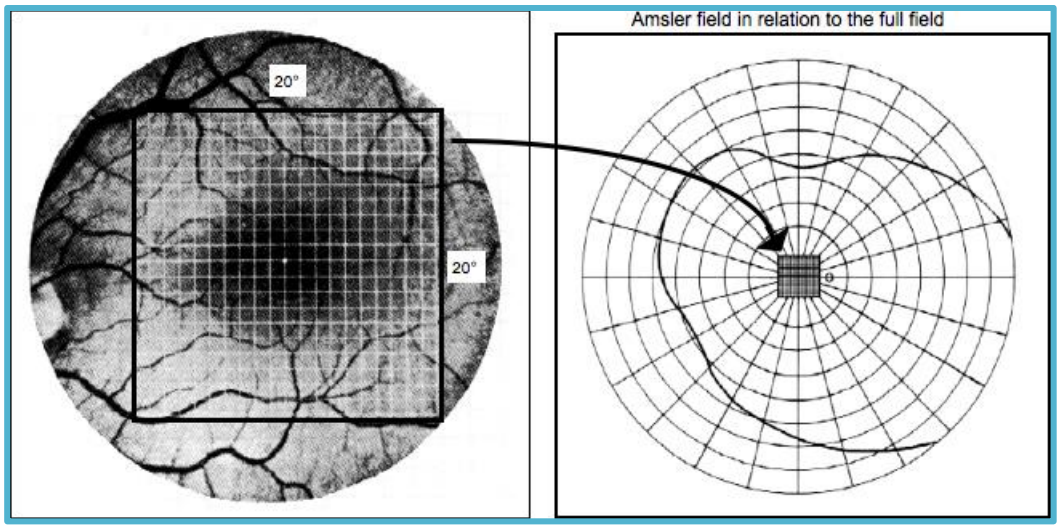
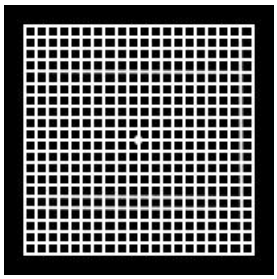


Figure 5.22: *Amsler grid in relation to the visual field and represented over the retina*

Instrumentation

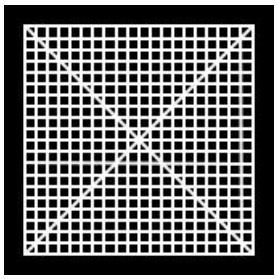
Note: The following section is a review of the *Amsler Grid* section of the Clinical Optometric Procedures 1 chapter *Visual Fields.*

Chart #1



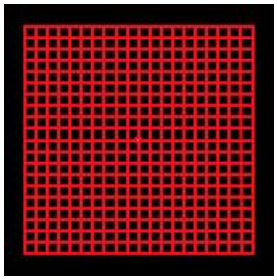
The first Amsler chart is the standard grid which is the most familiar and widely used. It is a 20X20 white square grid on a black background with a white central fixation dot. Each square (5mm) corresponds to 1° of VF at the standard testing distance of 30cm. The chart is used to reveal distortion, relative and absolute scotomas.

Chart #2



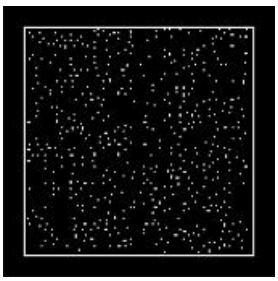
The second chart is similar to the first except that 2 diagonal lines intersect at the center of the grid. These are used for patient with a central scotoma that cannot fixate the central dot. The lines will orient the patient's fixation by allowing fixation approximately where the lines would cross.

Chart #3



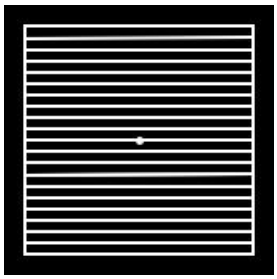
The third chart is similar to the first but the squares are red instead of white. The chart is particularly useful for patients with suspected central or cecocentral scotomas that are commonly due to **toxic** (e.g. alcohol, chloroquine, etc.) or **nutritional amblyopia**. It may also used as a deceptive test to detect malingering (faking, false vision loss) when used with red-green lenses. In normal condition, the red grid will disappear when viewed through a green lens but will remain when viewed through a red lens. Malingerers will claim that the lines are invisible in both the red and green filters.

Chart #4



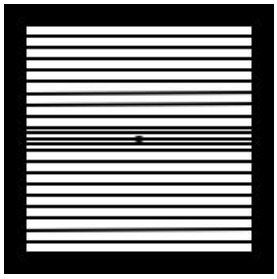
The fourth chart is composed of small white dots (no lines) on a black background. The chart is indicated for patients with one or more paracentral scotoma making it easier to delineate the affected areas.

Chart #5



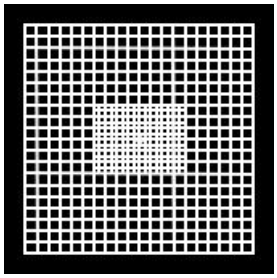
The fifth chart consists of 20 white horizontal lines evenly spaced by 5mm on a black background. The chart may be rotated for evaluation in any meridian to facilitate the identification of **"oriented"** metamorphopsia which primarily affects lines going in one direction.

Chart #6



The sixth chart is similar to the 5th except that it is made of black lines on a white background. It also contains 2 additional lines in the 1° region above and below the fixation dot. This chart is meant to facilitate the observation of metamorphopsia along the reading level.

Chart #7



The last chart is similar to chart # 1 but the inner 6° X 8° which corresponds anatomically to the macular area includes smaller 0.5° white squares instead of 1°. The smaller grid is intended to facilitate the detection of subtle visual disturbances in the macular area.

Clinical Procedure

The Amsler grids are performed under uniform bright illumination **(F+)** at a testing distance of **30 cm**. The patient must be undilated with the **best near Rx** in place. The test is performed preferably before any contact or fundus observation procedure to insure that the result is unaffected by previous tests. Amsler grids are always tested monocularly with the better eye tested first to facilitate the patient's understanding and observations. **Fixation must constantly be monitored**. The test is performed asking the following 5 questions of the patient:

1. Can you see the central white dot?

This question rules out relative or absolute central scotomas. If no central dot is visible then an absolute scotoma is present and chart #2 should be used. If the central dot appears faint or blurry, a relative scotoma may be present.

2. Continue looking at the central white dot. Can you see all 4 sides & corners of the large square?

This rules out arcuate, altitudinal, quadrantic, hemianopic or field constriction defects. If the answer is “no”, the patient is asked to document the defect. Chart #3 may be used to facilitate the observation of a suspected cecocentral scotoma.

3. Continue looking at the central white dot. Are any of the small squares blurry or missing on any part of the grid?

This step rules out relative or absolute paracentral, cecocentral, or altitudinal scotomas. If the answer is “yes” first rule out bad refractive correction or media opacities. If squares are definitely missing or blurry then an absolute or relative scotoma may exist and the patient is asked to document the defect. To make defect clearer chart #4 may be presented.

4. Continue looking at the central white dot. Do any of the horizontal or vertical lines that make up the square appear wavy or bent?

Metamorphopsia is addressed here. If the answer is “yes”, first rule out artifacts resulting from multifocal lenses. Then ask the patient to document the defect. Waviness can range from minimum to severe with some of the lines being discontinuous or broken.

Macropsia, which results from increased photoreceptors density, will make a square appear rounded like a barrel.

Micropsia, the opposite, will make the square appear like a pincushion.

5. Continue looking at the central white dot. Is any part of the grid shimmering, flickering, or coloured?

This helps rule out scintillating scotomas which are commonly associated to migraines but which can also result from retinal causes (e.g. serous detachment) or visual pathway lesions (e.g. AV malformation).

Modified Procedures

Threshold Amsler grids: A modified testing procedure can help increase the sensitivity of Amsler grids to detect very shallow (subtle) VF defects. Two cross-polarized filters are placed in front of the eyes and rotated with respect to each other to reduce the contrast of the grid against the black background until it is barely discernible. This sets up a threshold situation that facilitates the recognition of VF alterations. Relative scotomas are easier to detect and absolute scotomas easier to observe. The procedure is the same as described above.

Modified Amsler grids: Several modified Amsler charts are available on the market. Despite some additional features that may present some advantages, their principle remains similar to the conventional Amsler grids.

The **Yanuzzi card** (Fig. 5.23) is a minified version of Amsler chart # 7 the size of a credit card (16° X 10°). The advantage of the Yanuzzi card lies in its ease of portability.

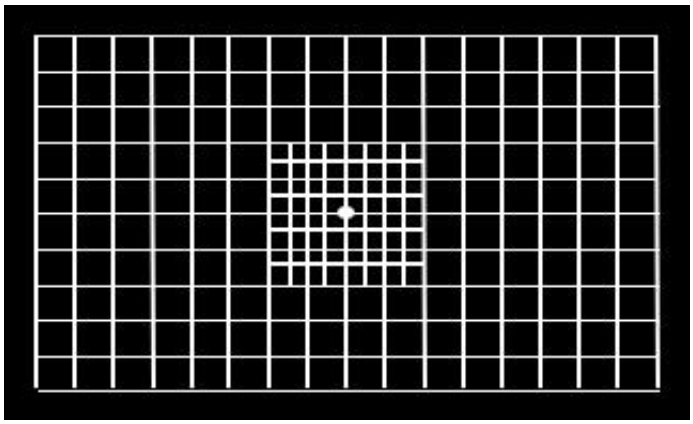


Figure 5.23: *Yanuzzi card*

The **Transilluminated grid** is similar to the standard Amsler grid except that it is constructed by punching 1mm holes (5mm apart) in a steel card to form the grid pattern. The transilluminated chart is advantageous in patients with media opacities that cannot view the standard chart.

The **Diamond chart** (Fig. 5.24) is similar to Amsler chart #5 except that it has black lines on a white background. The advantage of the Diamond chart lies in that it contains a 5mm central red fixation dot and a red diamond 10cm to one side of the dot that allows for proper distance control. When held at the proper working distance (40cm for Diamond grid), the diamond falls into the blind spot and disappears. The diamond also ensures monocular viewing: should the test accidentally be performed binocularly, the diamond will not disappear.

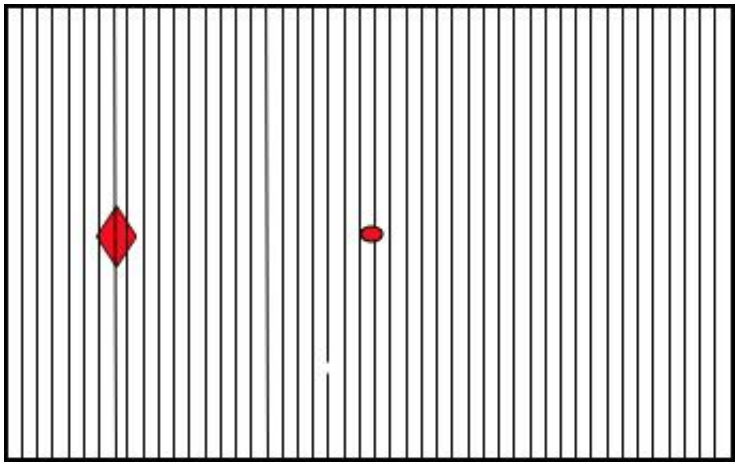


Figure 5.24: *Diamond card*

Additional information

Amsler grids are frequently dispensed for patients to perform self-monitoring at home. These are useful to **monitor progressive, recurrent, active or inactive diseases** that affect the central area and threaten vision. Amsler grids are particularly useful for age-related macular degeneration which affects a significant segment of the older population.

The self-assessment Amsler grids are prescribed for the interval between eye examination. Depending on the severity of the condition, the frequency of self-testing can range from once a day to once a week. The self-monitoring Amsler grid should be placed in an area where patients will be reminded to perform the procedure (e.g. on the refrigerator, toilet mirror etc.) The instructions described above are given both verbally and in writing and the patient is advised to call the office and return for consultation immediately should any visual change be noticed.

Recording

If scotomas are noted, the patient is asked to describe, show and **draw** the location & delimitation on the chart (Fig. 5.25 a to e). Patient's remarks about the appearance and depth of the scotoma are added. Comments about the result's reliability based on the patient's characteristics and expressions are noted as well. The grid is identified, dated and appended to the patient's record.

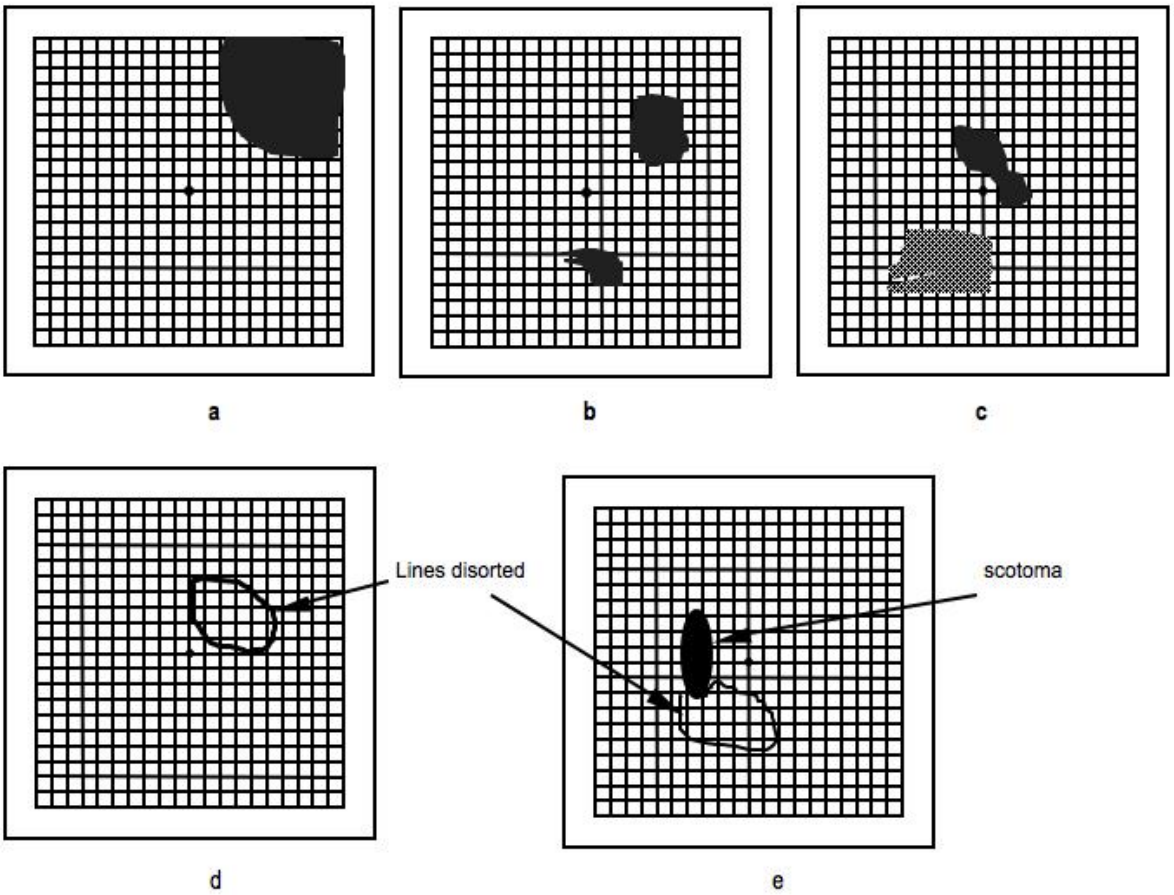


Figure 5.25a-e: *Documentation of various scotomas detected by the Amsler grid test*

TANGENT SCREEN

The tangent screen (TS) VF requires very simple and inexpensive instrumentation. It basically consists of a black cloth hanging on the wall and a rod with variable targets on one of its extremity (Fig. 5.26). The TS is used to test the central 30° area at a 1m distance. When performed properly & carefully, the TS is useful to detect & map some VF defects but it is far from being precise & sensitive. With the current and more advanced methods, the TS is rarely used.

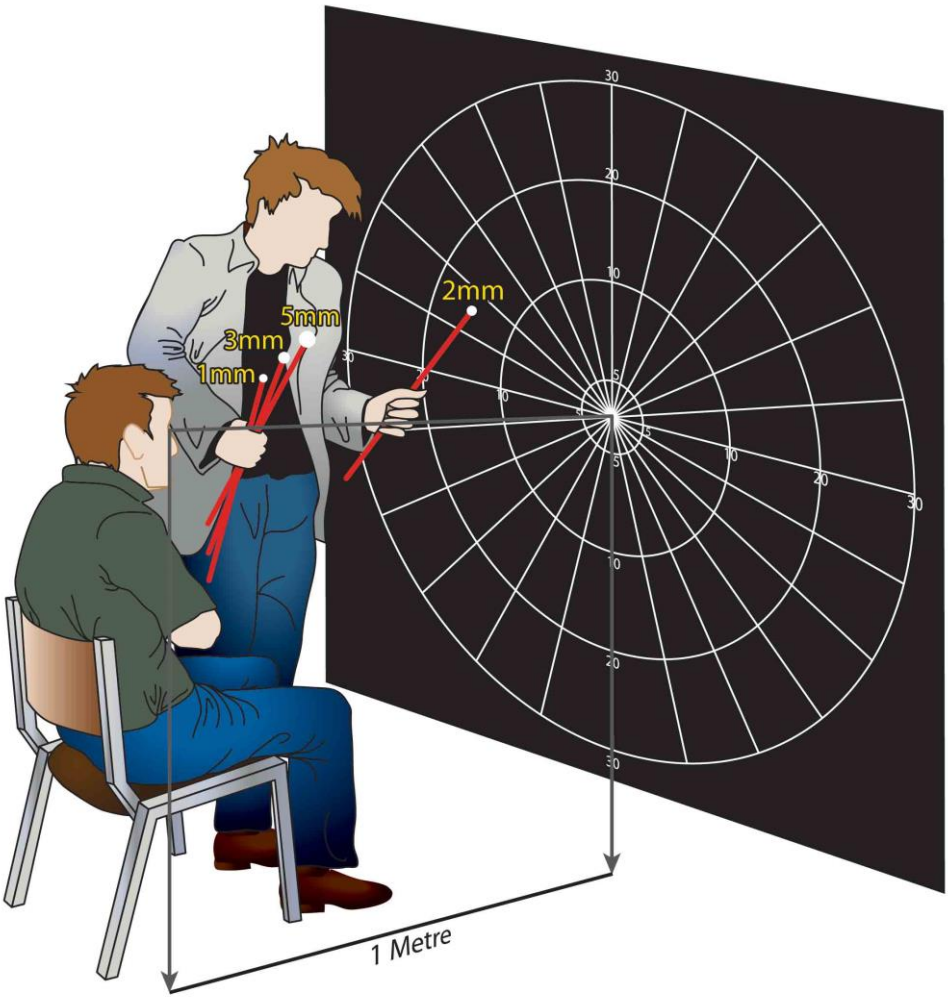


Figure 5.26: *Testing the visual field using the Tangent Screen*

Inspired by Anderson, Testing the Field of Vision, C.V. Mosby Company, 1982.

The TS remains useful, with feeble, neurologically impaired or low vision patients that are incapable of taking more sophisticated VF tests. The TS is the method of choice to help detect **tubular fields** that are **pathognomonic of malingering** (hysterical patients). Unlike true VF loss, tubular VF are constricted and circular and will remain the same size at <u>any test distance</u>.

Instrumentation

The TS can be obtained commercially or simply fabricated. It consists of a single black cloth (2 X 2m) usually made of felt material to absorb light. A white fixation target (button) is sown in the center. Concentric circles subtending 5° or 10°, meridians at 15° or 30° intervals and the expected blind spot are also delineated using black thread. Additional diagonal white lines may be added to orient fixation in patients with central scotoma. The test targets are white spherical beads or flat discs (1, 2, 3, 5, 10mm) mounted on a ½ to 1 meter black non-reflecting rod. Black pins are used to temporarily record the findings on the screen during the procedure before transferring them to a paper chart.

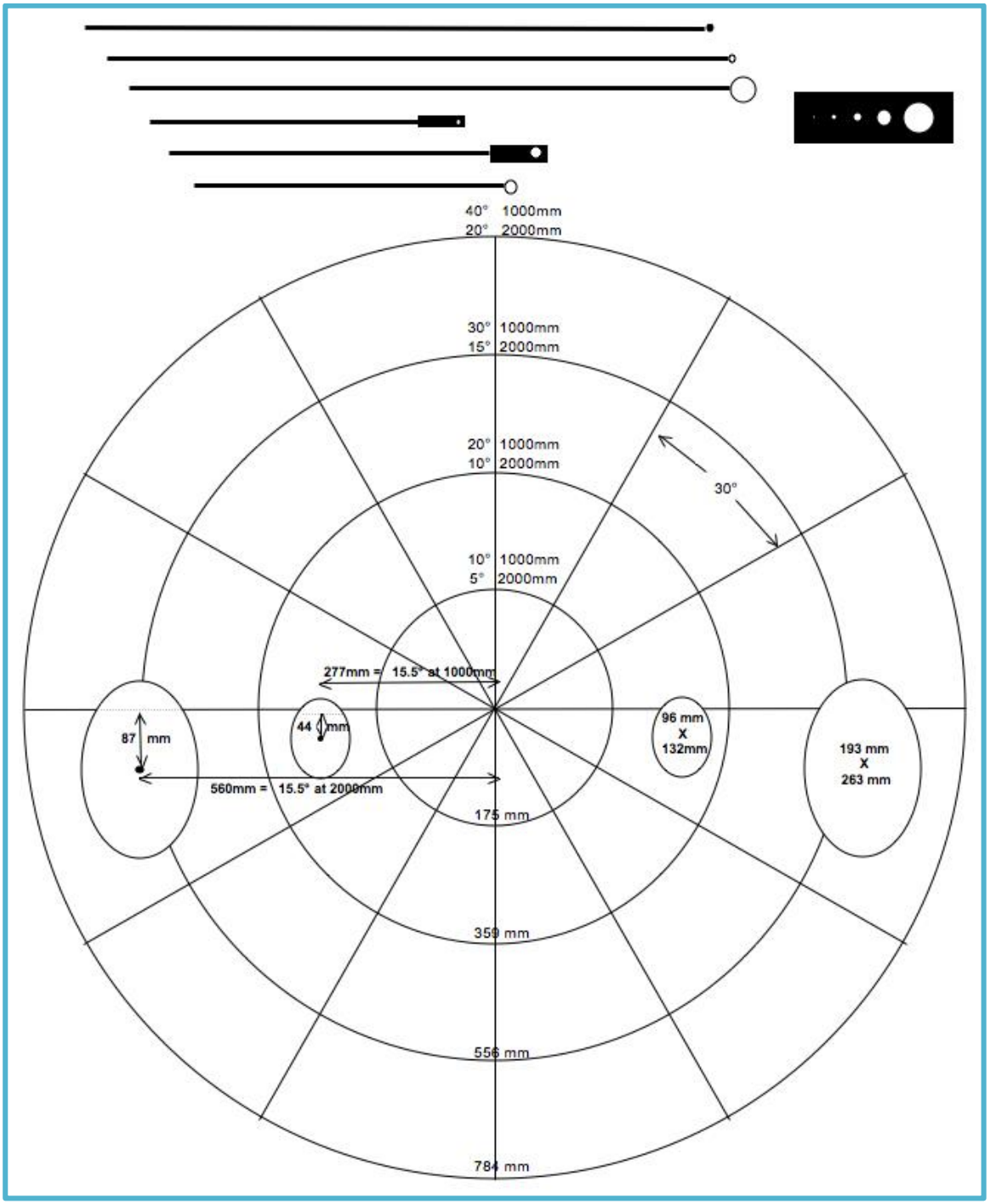


Figure 5.27: *Dimensions of the tangent screen plot*

Clinical Procedures

Examination Set-up

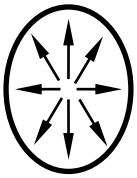
The TS can be done at any distance using a variety of stimulus sizes (0.25mm-75mm). The test is usually performed at 1m to test the central 30° using stimuli of 1, 2, 3, 5, & 10mm. A 2m test distance is also used regularly to test the central 15° or to magnify defects in order to study them more accurately. The TS is performed at both distances to detect tubular fields. Good even illumination of the screen is very important: 1 spot light (150W bulb) above and slightly behind the patient's head is recommended. The examiner should be positioned side-ways so as to constantly face the patient to monitor fixation and still be able to see the screen. Long enough rods should be used to allow the examiner to stand clear from the screen. A black glove may be used so that the hand motion does not influence the patient's response.

Patient preparation

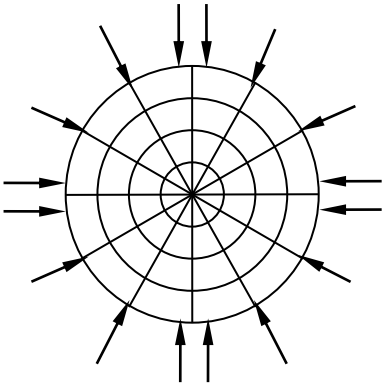
- Occlude non-tested eye with a patch
- OD or better eye is tested first
- Always use best Rx
- For astigmatic corrections < 1.00DC the equivalent sphere is sufficient
- Include the proper add for the test distance
- Seat patient comfortably with the tested eye at the same level as the fixation dot
- Instruct patient clearly to always maintain fixation on the white central dot of the screen
- Show & explain that targets will purposefully appear and disappear during test
- Instruct the patient to signal when the target appears (or disappears).

Testing Protocol

- **Plot blind spot first**
- This demonstrates the test & confirms the patient's ability to take the test
- Use a 5mm target first to insure good fixation & understanding
- Adjust size if necessary according to patient's VA, mental status & cooperation
- Start where the target disappears in the blind spot (~ 15° temporal & 1.5° below fixation)
- Move out (non-seeing to seeing) in the 8 cardinal directions to map the blindspot borders
- Retest the blind spot with smaller target (1mm)
- Place a pin at each point where the target becomes visible.



- **Plot central isopter**
- The standard target is usually 1mm; check its visibility in 4 quadrants
- If 1 mm spot is subthreshold, choose the smallest target visible at 30°
- Slide the target inward (**non-seeing to seeing)** on the cardinal meridians.
- Maintain the constant recommended speed of 2-4°/sec
- The 1mm isopter should almost reach the extreme limits of the screen.
- Place a pin at each point where the target becomes visible
- Avoid scanning exactly on the vertical & horizontal meridians
- Scan 5° to either side to help detect defects that respect the meridians



- **Perform the Bjerrum plot**
- Static spot check the central area
- Areas of interest are the central 20° + the nasal 20-30°
- Without moving the target, flip the spot from its black side to its white side
- Usually 76 central points are tested: 4 points within the 5° radius + 72 points where the 5°-10°-15° circles cross the 24 meridians at each 15° (Fig. 5.28a)
- Additional points (~10-20) may be tested at the 20°-30° nasal area to look for the nasal step
- Alternatively (less desirable but more efficient), test the central 20° radius in a kinetic zigzag presentation (Fig. 5.28b)
- Mark any VF defects with black-headed head pin
- Like mapping the blind spot, assess defect from non-seeing to seeing (Fig. 5.28c)
- Use various targets to map the extent, slope & depth of any VF defect
- Consider increasing the distance to 2m to evaluate the scotoma with greater precision.

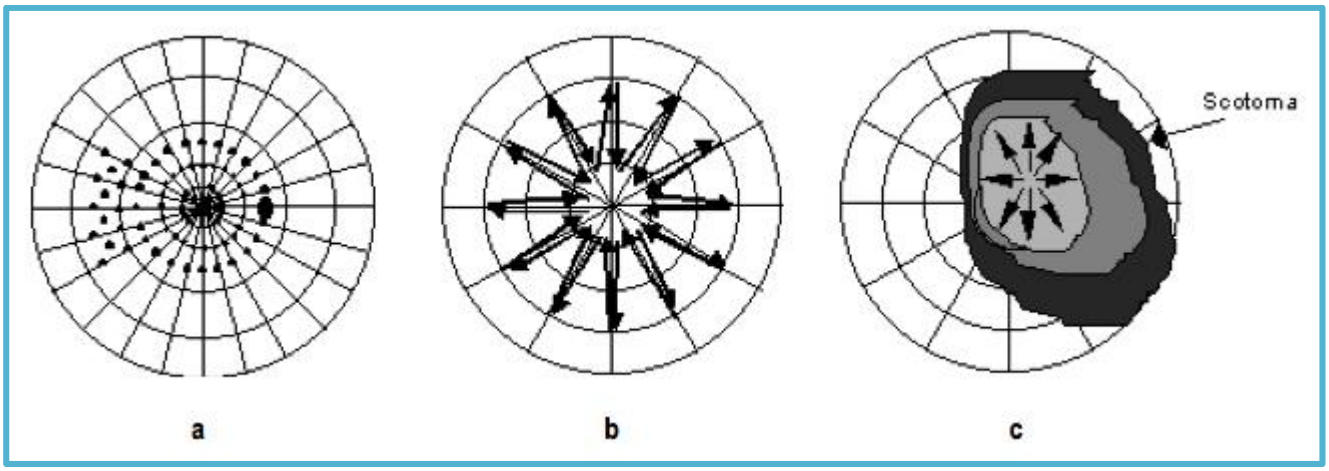


Figure 5.28: *Tangent screen a)76 central points of the Bjerrum plot, b) testing the central 20° radius in a kinetic fashion, c) documenting scotomas and testing from non-seeing to seeing*

Tips

- During the procedure, constantly check the patient for fatigue & attention. Randomly present the spot inside the blind spot or flip it on its black side in areas of visibility
- If physical restrictions are present, adjust the head to compensate for it. For example, if a bifocal line interferes with the test, lower the head to allow viewing above the line.

Recording

Transfer your findings to the paper recording chart. Note **test performed**, **stimulus size/test distance in mm and target colour (e.g. 1/1000 W)**. Add any comments on fixation, patient cooperation & reliability of the test. Different labels or colour pens may be used to identify the different isopters more easily (Fig. 5.29).

E.g.: Note how isopters traced on the tangent screen appear smaller with the use of smaller less visible targets. The right eye shows a general constriction.

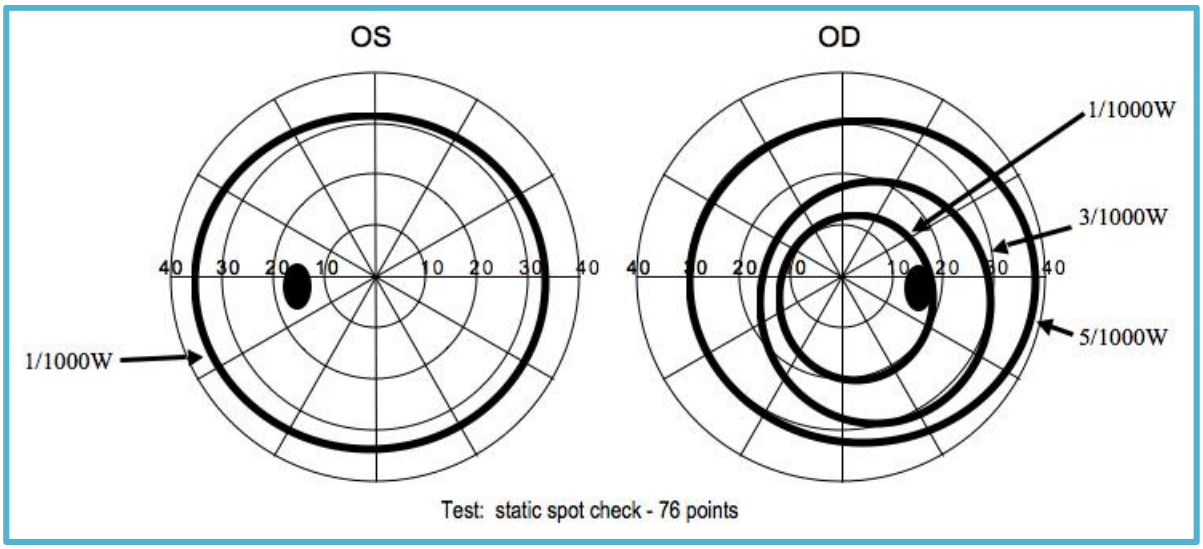


Figure 5.29: *Example of isopters documented on a tangent screen plot*

E.g.: Note how scotomas detected with the tangent screen VF appear larger with the use of smaller less visible targets.

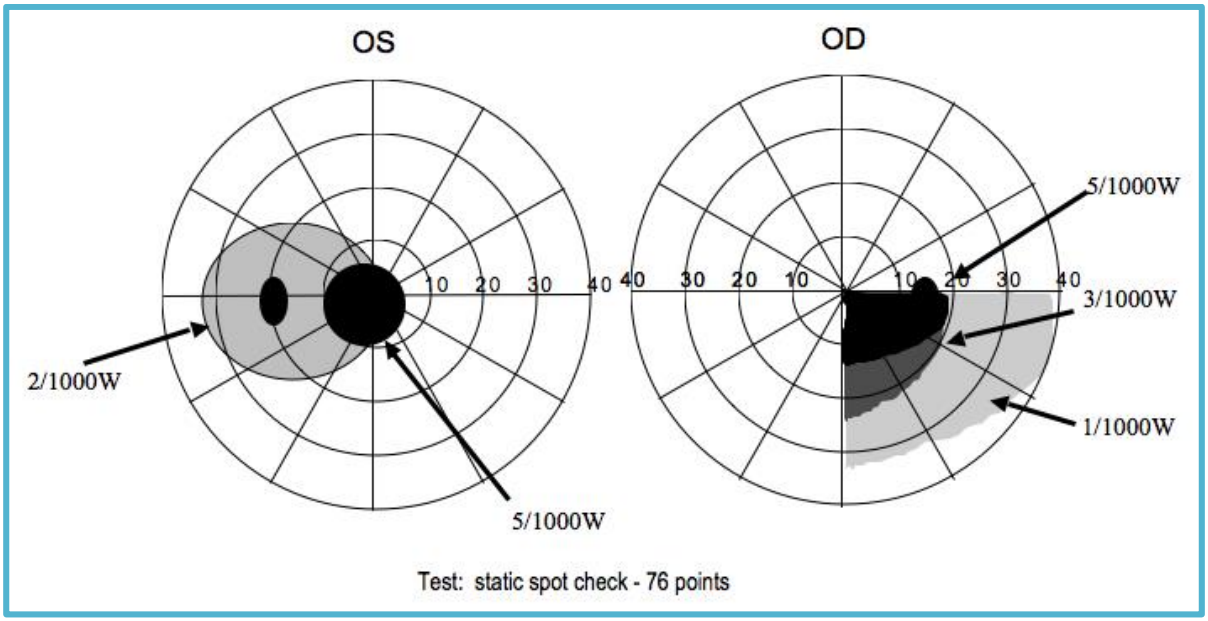


Figure 5.30: *Example of scotomas documented on a tangent screen plot*

OTHER CAMPIMETRIC DEVICES

Other types of campimeters are available. Like other forms of campimetry they are rarely used and may in fact not be commercially available anymore. These methods are briefly mentioned for sake of completion.

The **Autoplot (B&L)** is conceptually similar to the tangent screen. The target, however, is a variable light spot that is projected onto a flat screen 1 meter away. The examiner uses a sliding arm to control the projection. The arm contains a pencil holder that moves over a chart where a VF schema is drawn. The procedure is followed exactly as it would be using the tangent screen.

The **Harrington-Flock screener** (Fig. 5.31) consists of a “black light” (or UV lamp) that illuminates stimuli which are painted with fluorescent ink on 8 large cards (total of 33 stimuli). Under white light the stimuli are invisible, but when flashed with the UV lamp, they become momentarily visible. The test consists basically in spot checking statically the central area (25°) using different presentation cards. The patient is asked to identify the number of spots seen. Wrong answers would signal the presence of a VF defect which would require further investigation. The Harrington-Flock screener is exactly as the name suggests a screening test useful for gross VF evaluation. Since it uses stimuli that are all suprathreshold, the test is not sensitive to small shallow defects. The test is rarely used today, but it introduced the innovative method of simultaneous presentation to test multiple areas.

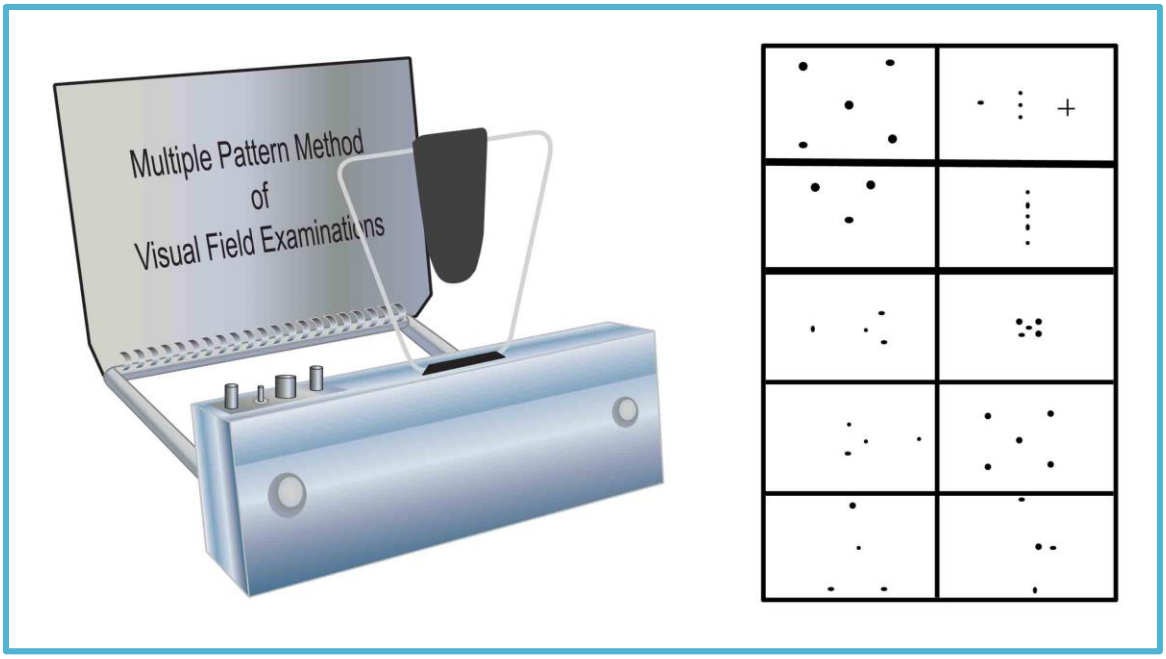


Figure 5.31: *Harrington-flock screener*

Inspired by Harrington DO, The Visual Field, C.V. Mosby Company 1990.

The **Freedman** VF analyzer (Fig. 5.32) also uses a multiple-stimulus presentation. The test consists basically of a flash-tube covered with a face-plate. The plate holds a total of 98 holes and allows 2,3 or 4 holes to open at a time for stimulus presentation. The Freedman offers a few advantages over the Harrington-Flock method. The stimuli are smaller and more numerous allowing for a more sensitive and extensive screening. The test also allows a rough foveal threshold estimate to allow the testing stimuli to be close to the actual threshold (0.2LU brighter). Finally, the instrument contains a self-contained source of background illumination which renders testing conditions a little more consistent. The Freedman VF is not used clinically anymore.

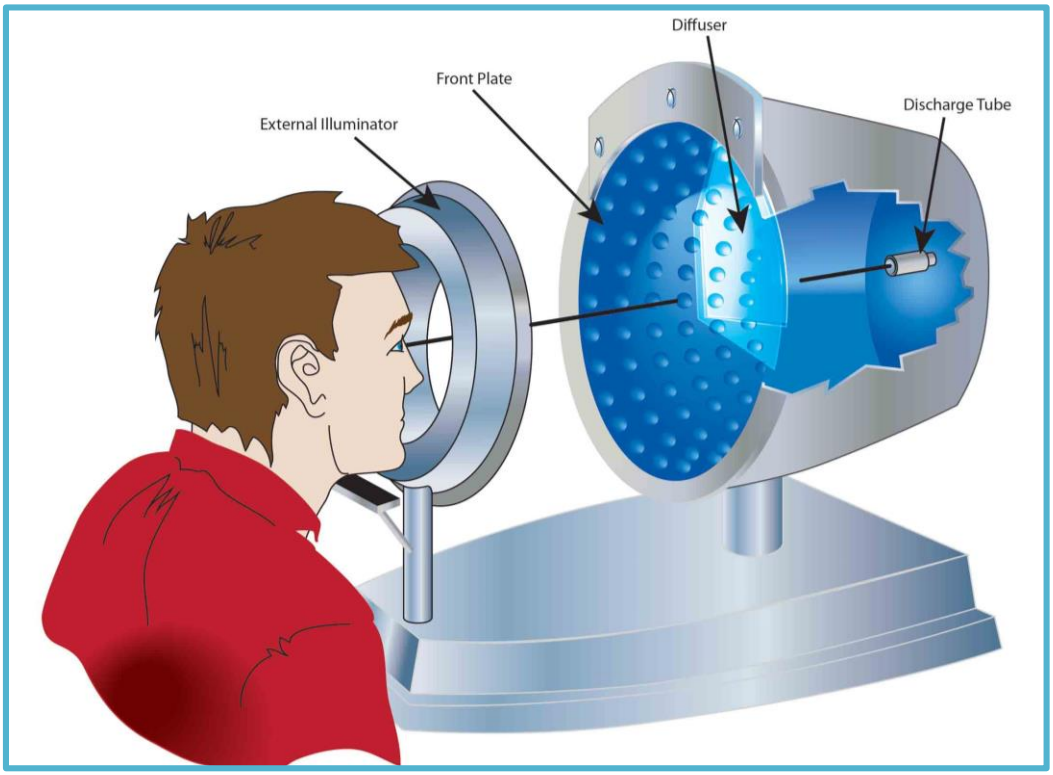


Figure 5.32: *The Freedman VF analyzer. Inspired by Anderson, Testing the Field of Vision, C.V. Mosby Company, 1982.*

AUTOMATED CAMPIMETRY

A number of automated campimeters are available commercially. Some are screening devices that present multiple static patterns to detect central VF anomalies. Although still used in situations where no other more sophisticated (& expensive!) apparatus is available, these instruments present significant disadvantages. Generally not recommended for clinical use anymore, they have for all practical purposes become obsolete.

Some recent devices however (e.g. Henson (Fig. 5.33), Tubinger), actually perform very usable screening and threshold testing of central points. The data interpretation of these devices is very similar to automated perimetry and will be covered under that section. Suffice it to say that some recent automated campimeter may prove useful in certain clinical situations. Automated campimetry is commendable, but with the more sophisticated automated bowl perimeters it remains a less than ideal choice in VF testing.

Figure 5.33: *Henson Automated Campimeter*