



Monitoring Advanced Glaucoma

By

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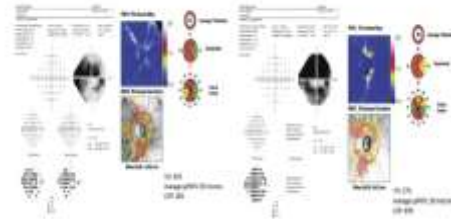
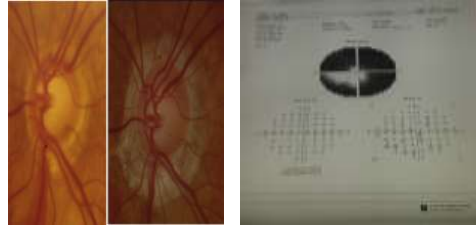
Monitoring of advanced glaucoma

1. *Visual field testing*

2. *Optic disc photography*

3. *Optical coherence tomography*

4. *Alternative methods*



1. Visual field testing

A. Areas of low sensitivity

B. Stimulus size

C. 10-2 strategy

A. Areas of low sensitivity

- One factor that limits the useful dynamic range of perimetry is *that* the responses of retinal ganglion cells (RGCs) increase approximately *linearly* with stimulus contrast at *low* contrasts (areas more than 20 dB).
- At *high* contrasts (areas less than 15 dB), they show *response saturation*, and their spike rate no longer increases

Areas of low sensitivity

- This means that, for a given visual field test location, once it reaches sensitivities equal or less than 15 dB, it becomes impossible to determine confidently whether progression to 10 dB (or even 5 dB) is indeed real without *extensive repeat testing*.

B. Stimulus size

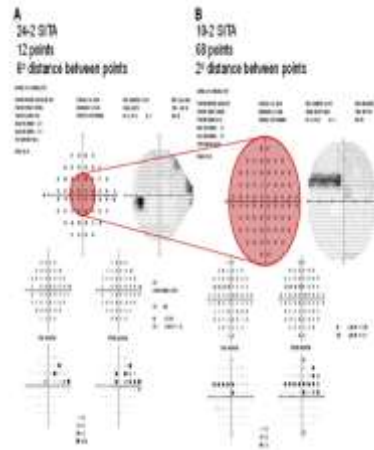
- *The Goldmann **size III** is the most widely used stimulus size in automated perimetry and is also used for legal definitions of blindness. .*
- *It has been proposed that use of a **size V** reduces variability, allowing reliable visual field testing to be performed **later** into the disease process.*

B. Stimulus size

- *Using a **size V** stimulus also results in a **higher sensitivity at the same location**. For instance, a test location that reached a sensitivity value of 15 dB with size III may reveal a sensitivity of 20 dB when tested with a size V stimulus .*
- *This higher sensitivity means that a location will not reach the lower limit of reliable testing until later in the disease process, resulting in **more reliable and less variable** estimates of sensitivity at damaged visual field locations.*

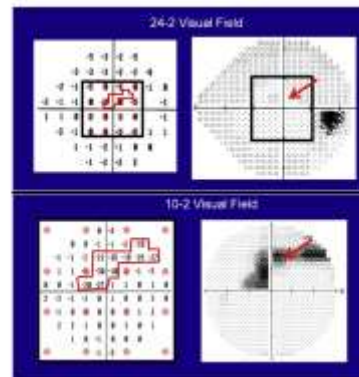
C. 10-2 strategy

- *With 10-2 grid, one can now test 68 test points in the central 10, each separated by 2 and 1 degrees from the horizontal and vertical meridians instead of 12 points with 6 degrees degrees from each other and thus better assess the presence and progression of paracentral damage*



C. 10-2 strategy

In 10-2 strategy the defect that falls between the points tested with the conventional grid (6 apart) can be detected.



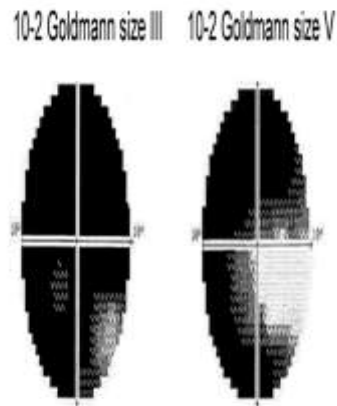
24-2 Versus 10-2 Spot size V

- Patient with advanced glaucoma showing *absolute* field defect with 24-2 testing.
- Changing to *10-2 stimulus size V* shows the remaining island of vision with of more reliable visual field tests to monitor progression.



Spot size III versus V in 10-2

- Changing from stimulus size III to V on 10-2 tests can increase the time span of more reliable visual field tests to monitor progression.



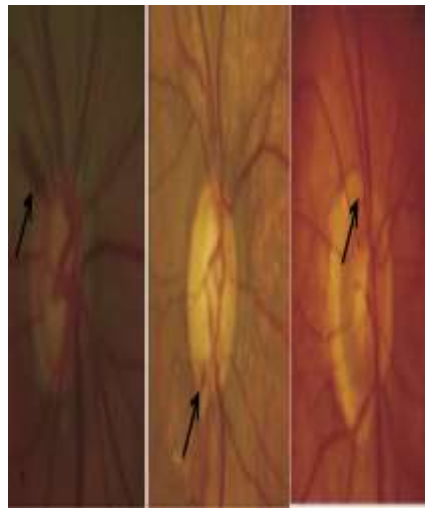
2. Optic disc photography

- *Although With little or no tissue left, detection of change becomes compromised, there are 2 signs of optic disc progression even in severe cases:*

- A. Disc hemorrhages*
- B. Beta-zone parapapillary atrophy*

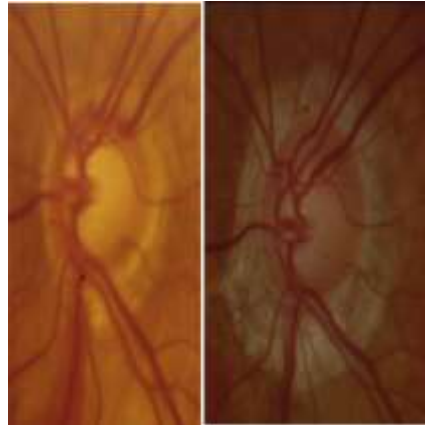
A. Disc hemorrhages

- *Eyes with advanced glaucoma, significant loss of neuroretinal rim tissue and nerve fibers, but in which disc hemorrhage detection was still possible and could be an **indicator of future progression** and active neurodegeneration.*
- *Disc hemorrhages are **transient**; therefore, frequent assessment of the optic nerve head increases their likelihood of detection.*



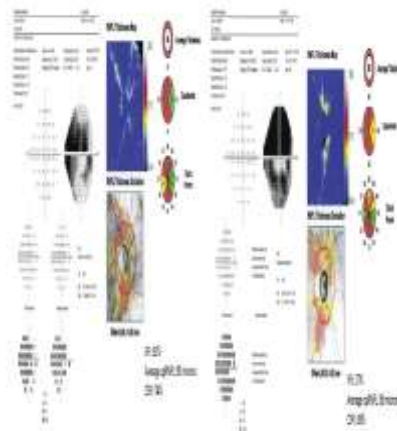
B. Beta-zone parapapillary atrophy

- Similarly to disc hemorrhages, the region of largest β PPA area predicts the location of future most rapid visual field progression
- Follow-up photograph of the same patient from 2004 to 2013. Note the beta-zone PPA enlargement despite severe baseline structural damage.



3. OCT in Advanced Glaucoma

- Beyond a certain point in advanced glaucoma, there is no further decrease in the thickness of the RNFL, rarely falling below 50 μm and almost never below 40 μm , despite the presence of optic atrophy, because support structures account for the residual thickness of the RNFL.
- Example of 2 eyes with advanced glaucoma. Both eyes had identical measurements of RNFL thickness of 56 μm , despite widely different degrees of visual field loss.



4. *Alternative methods*

A. Electrophysiological test

B. Kinetic perimetry

C. Amsler grids

A. Electrophysiological test

- The *pattern electroretinogram* for glaucoma may be useful in detect early glaucoma, sometimes even before significant abnormalities are detected with SAP (1) but little is known regarding its applicability in advanced glaucoma and detection of progression (2).

1. Bode SF, Jehle T, Bach M. Pattern electroretinogram in glaucoma suspects: new findings from a longitudinal study. *Invest Ophthalmol Vis Sci.* 2011;52(7):4300e6

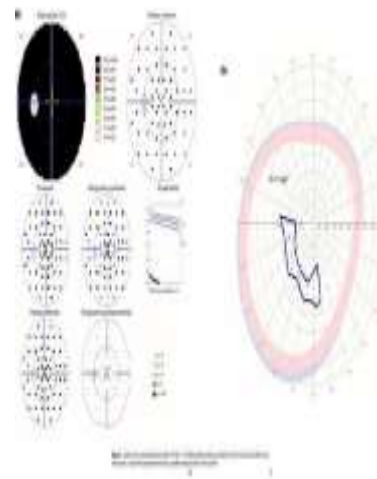
2. Fredette MJ, Anderson DR, Porciatti V, Feuer W. Reproducibility of pattern electroretinogram in glaucoma patients with a range of severity of disease with the new glaucoma paradigm. *Ophthalmology.* 2008;115(6): 957e63

B. Kinetic Vs Static Perimetry

	STATIC	KINETIC
LOCATIONS	Fixed number of pre-determined locations	Individually adjustable moving targets
AUTOMATION	Fully automated	Semiautomated, needs involvement of examiner
SPATIAL RESOLUTION	Low	High
ACCURACY OF VISUAL SENSITIVITY THRESHOLDS	Higher	Lower
WHAT IT IS BEST AT DETECTING	Small changes in sensitivity Changes in central 30°	Small changes in spatial extent (e.g. sharp-edged scotomas) Changes in periphery Remaining vision in advanced disease Defects in children
COMMON USES	Glaucoma Macular diseases Visual ability testing	Neuro-ophthalmological conditions Peripheral retinal diseases Low vision Children

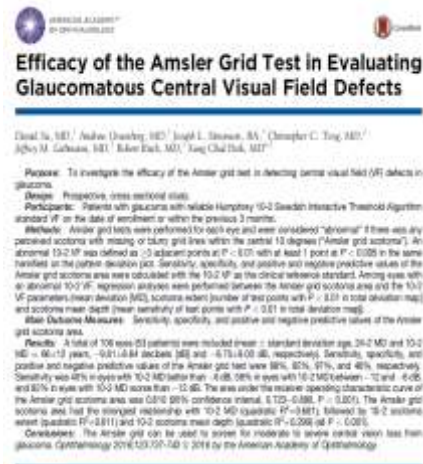
B. Kinetic perimetry

- For patients with end-stage glaucoma who can no longer undergo automated visual field testing, kinetic perimetry may be an option to monitor changes in the residual field outside (often in the temporal field).
- *Fixation* can be more easily controlled, and
- *Fatigue* is much less pronounced with this more interactive examination procedure.



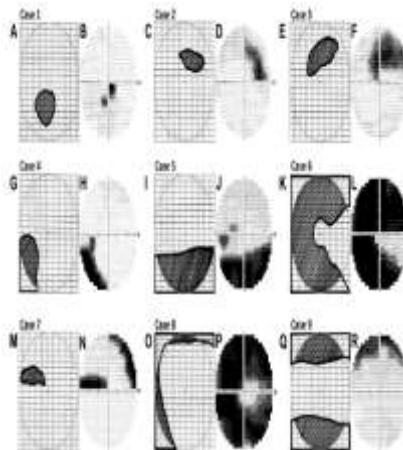
C. Amsler grids

- *Amsler grids have long been used to detect abnormalities in central visual function that SAP testing may overlook, namely metamorphopsia.*
- *Although not traditionally used in glaucoma, Amsler grids could potentially detect central functional damage from glaucoma.*



C. Amsler grids

- *Representative Amsler grid test results with corresponding 10-2 visual field*
- *A gray circle representing the central 10 degrees of VF is drawn on the Amsler grid, and the Amsler grid scotoma within the circle is shaded with diagonal lines.*



C. Amsler grids



C. Amsler grids

