Main topic: Functional Assessment in Glaucoma

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Special Focus:
Optimal testing, technologies to detect glaucoma damage and progression

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Core Concepts
- There are 2 global indices of visual field sensitivity: mean deviation (MD) and pattern standard deviation (PSD). Once glaucoma has been diagnosed MD and PSD provide data on disease severity.
- To be useful, tests must be reliable with few fixation losses and few false positive/false negative responses.
- Data on disease severity with measured visual field deterioration, along with patient age and health status should be used to estimate likelihood of visual impairment.
- Progression detection algorithms available are GPA I and II.
- Frequency of follow-up testing should be dictated by the relative risk of progression. The higher the risk, the more frequently testing should take place.
- The World Glaucoma Association Consensus Group on Glaucomatous Progression suggests at least 2 reliable fields in the first 6 months after diagnosis and at least 2 more fields within the next 18 months.
- Increased testing from baseline up to 2 years identifies more rapidly progressing patients with a lower false positive rate.
- When central vision is compromised it may be useful to obtain 10-2 visual fields that use a2-degree spacing.

Technologies to Detect Glaucomatous Visual Field Damage

There are several ways to identify glaucomatous defects from standard automated perimetry (SAP) print outs (Figure 1). Firstly, inspect sensitivity thresholds at each test point. It is not particularly useful to identify defects, because these values are not age-corrected. In older patients low thresholds could be attributable entirely to age. More meaningful information is available in the total deviation (TD) and pattern deviation (PD) probability plots (Figure 2). The TD probability plot shows the point-by-point probability of abnormality (in grey scale) compared with an age corrected normative database. The PD probability plot provides similar information adjusted for both age and generalized depression that could be caused by other pathologies (e.g. cataract). So in the PD plot, localized defects most likely from glaucoma are highlighted. Localized patterns of abnormality, identified on the PD probability plot, can be assessed to determine if they are what is considered characteristic for glaucoma (e.g. nasal step, superior or inferior arcuate patterns of defect). Odd-looking patterns

Figure 1 shows all of the information available on a standard automated perimetry print out.
might result from a test-taking artifact or patient inattention.

Two global indices of visual field sensitivity are available. Mean deviation (MD) is the weighted average of the point-by-point decibel deviations from normal that are shown in the TD plot. Pattern standard deviation (PSD) represents the relative point-by-point decibel deviations from normal across the visual field. PSD increases as the point-by-point deviations from normal across the visual field become more variable. PSD increases in the presence of localized defects. Although these global indices are not used for diagnosis, a PSD outside normal limits is likely to be more informative than an MD outside of normal limits because it is more likely to detect local defects earlier. Once glaucoma has been diagnosed, MD and PSD provide a general idea of the severity of the disease.

The Glaucoma Hemifield Test is a summary parameter that describes the relative difference in sensitivity in five zones of the superior hemifield compared with five corresponding zones in the inferior hemifield. Results are either “outside normal limits”, “borderline” or “within normal limits”. This parameter is particularly useful to detect early to moderate disease because glaucomatous visual field defects usually manifest asymmetrically across the visual field horizontal midline. The Visual Field Index (VFI) is another summary parameter; it is based on geographically weighted PD probability map values with emphasis on the central test points; it has been reported to represent the percentage of remaining useful vision. Theoretically the VFI ranges from 100 in a healthy eye to zero in a seriously damaged eye. There is no suggested abnormality cut-off for this parameter.

Consider other important items to identify glaucomatous defects. Firstly, tests must be reliable, with few fixation losses and few false positive and false negative responses. The latter reliability criterion is less important in individuals with advanced disease because a reported false negative may be a truly unseen test point that is the result of a severe defect. Secondly, observed abnormalities should be repeatable and consecutive abnormal tests should have the same general patterns of defect. In the Ocular Hypertension Treatment Study, 86% of 702 initial abnormal SAP tests did not show a subsequent abnormal test. In fact, 66% of these eyes had all indices within normal limits on follow-up testing, thus the importance of repeatable abnormal results to identify true glaucomatous defects. Finally, visual field results are quite variable and learning effects, artifact caused by drooping eyelids, small
pupils and by inattention can result in different patterns of defects that are not disease related: hence the need to check for similar and recognizable patterns of defect in consecutive tests (Figure 3).

**Technologies to Detect Glaucomatous Progression**

Glaucoma management aims to preserve visual function for an individual’s lifetime. To this end, clinicians need to monitor closely the magnitude and rate of visual fields changes so that appropriate treatment can be initiated to preserve visual function. Information on the rate of visual field deterioration along with the severity of the disease at diagnosis and the patient’s age and general health status (i.e. likely longevity) should be used to estimate the likelihood of visual impairment.

Similar to detection of disease using SAP, disease progression also can be assessed subjectively based on information available in TD and PD probability plots. To do this, a longitudinal series of TD or PD plots can be compared for increases in scotoma size and/or depth or the development of new scotomas. Because of the large variability in SAP results, this information is not always meaningful. Two useful progression detection algorithms currently are available in the Humphrey Statpac software: Guided Progression Analysis (GPA) and linear regression of Visual Field Index (VFI).

GPA is a PD plot-based event analysis calculation that relies on the comparison of change at each test location to the variability observed between two baseline tests at the same location (Figure 4). According to the Early Manifest Glaucoma Trial criteria, “Likely Progression” is assigned to a visual field if at least three test points are flagged as significantly progressing at the same location over three consecutive tests (“Possible Progression” is assigned if the same three points have progressed over two consecutive tests). GPA is attractive because it is objective, but it relies on the variability between baseline tests. Because of this, its sensitivity to change can be variable. Also, it does not require the progressing points to be contiguous, so the observed change may not represent the predicted increase in scotoma size that is associated with disease progression. Once a GPA result of “Likely Progression” has been assigned, new baseline examinations should be obtained to allow identification of a subsequent progression event. As suggested by the 2011 World Glaucoma Association Consensus Group, new baseline examinations should be obtained after any significant therapeutic intervention.

Unlike the GPA, linear regression of the VFI can provide the rate of change over time (i.e. change in VFI value per year) and, because it is derived from PD and not MD, it likely is fairly resistant to the effects of developing/worsening cataracts. Knowing the rate of progression is more important for long-term disease management than simply knowing if a patient has progressed or not (Figure 5). This is in part because faster progression is a predictor for future progression and increases the likelihood of visual impairment in one’s lifetime. Like GPA, VFI is not perfect. For instance, using linear regression to suggest a predicted rate of change over time assumes that change over time is linear; this may not be true. It also assumes a stable treatment regimen and it does not consider intervening surgical procedures. Finally, assuming change over time is linear estimates of change of VFI over time (i.e. estimates of the negative slope of VFI) will be more accurate when more tests are included in the regression equation. This is because adding more test points will result in a better (“tighter”) linear fit.

Another available progression detection technique uses ordinary least squares linear regression and is implemented using Progressor® software. Based on five or more consecutive tests, Progressor software performs linear regression (like regression of VFI) of threshold sensitivity on a point-by-point basis using all test points in the 24-2 test pattern. Individual points are defined as progressed if the negative slope of the point-wise change in sensitivity meets or exceeds a user-selected cut-off. A global progression event can be assigned (similar to GPA) based on a user-defined global progression criterion (e.g. ≥ 0.5 dB/year for inner points and ≥2.0 dB for edge points, confirmed in three consecutive exams). No matter the technique used for progression detection, as suggested by the 2011 World Glaucoma Association Consensus Group statements, frequency of follow-up testing should be dictated by the relative risk of significant progression (based on extent of damage, life expectancy and any other relevant clinical observations, such as structural change and IOP control), with frequency increasing with increasing risk.

**Optimal Testing**

Several critical clinical questions must be answered to determine how best to “monitor closely” visual function in glaucoma patients, using any or all of the techniques described above. How many visual fields are really needed? How often should visual field tests be obtained? Given the variability of visual field results, a sufficient number of visual field tests must be obtained in order confidently to identify changes that are greater than the variability of the measurement. More visual fields, offer a better estimate of the rate of visual field progression. But how many visual field tests are needed over what period of time? According to Chauhan et al,13 to detect relatively slow progression (~0.50 dB/yr) in 2 years, 7 visual fields are needed each year; clearly more than is practical. On
the other hand, to detect fast progressing glaucoma (≥0.20 dB/yr), Chauhan et al 13 recommend that newly diagnosed patients complete visual field testing three times per year during the first two years after glaucoma diagnosis.13 These recommendations were adopted by The European Glaucoma Society in 2008.14 The 2011 World Glaucoma Association Consensus Group6 on Glaucomatous Progression recently developed similar guidelines on the optimal number of visual field tests required with newly diagnosed glaucoma patients. Specifically, during the first two years after a diagnosis of glaucoma “at least two reliable visual fields is optimal in the first six months... and at least two further visual fields should be performed within the next 18 months. Where the lifetime risk of visual disability is high, such as those who already have advanced damage, three baseline visual fields may be necessary.”

After the initial two years following a diagnosis of glaucoma, the frequency of visual field testing should be based on the risk of visual impairment during the patient’s lifetime. The 2011 World Glaucoma Association Consensus Group6 recommends that, “In low and moderate risk patients, subsequent visual field frequency should be one visual field per year ... and, as a rule, repeated sooner ... if other clinical observations are suggestive of possible progression or increased risk of progression.” However, “In high risk patients, subsequent visual field frequency should be two visual fields per year and repeated sooner if possible progression is identified on the basis of an ‘event’ analysis, or if other clinical observations are suggestive of progression or increased risk of progression.”

Recently, computer simulation has been used to determine the optimal spacing for the intervals between testing for detection of rapidly progressing glaucoma (rate of loss: ≤2dB/yr). Crabb and Garway-Heath15 suggest that compared with evenly-spaced follow-up every six months, visual field testing 2 or 3 times at baseline and at the end of a 2 year period identifies more patients with rapidly progressing visual fields (58% and 62%, respectively) with a lower false positive rate (5.9% and 0.4%, respectively). By aggregating the visual field testing earlier and later in the follow-up period, there is increased efficiency to reduce the false positive rate, and to estimate the rate of visual field loss. This “wait and see” approach, developed using “moderate” variability of the visual fields in the computer simulation to detect fast progression, is being tested in longitudinal studies.

The number of fields and intervals between them can also influence the methods used to measure the rate of change. For example, Medeiros et al. 12 recently reported that a Bayesian-based slope estimate technique was more predictive of future impairment than ordinary least square regression, particularly in eyes with moderate to fast rates of change.

Most patients can be monitored using the 6-degree by 6-degree grid spacing of 24-2 visual field test pattern. However, when central vision is compromised or threatened, it may be useful to obtain 10-2 visual fields that use 2-degree by 2-degree spacing to better document how glaucoma is affecting central vision.16, 17 Using a relatively small number of eyes, Hood et al.17 reported evidence of visual field damage in the central visual field using 10-2 test pattern that is not detected in the peripheral field using 24-2 testing. Zhang et al.16 documented that the 10-2 test pattern results are useful to make clinical management decisions; in about one third of visual fields considered to threaten fixation based on 30-2 or 24-2 test patterns, the threat, based on 10-2 testing was not imminent. In some patients, 10-2 testing can be important to determine the level of visual impairment expected from glaucomatous visual field loss in the central and peripheral visual field.

References
What’s New:
Where are we going with approaches such as PERG, VEP, SWAP and FDT?

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Core Concepts
- Standard automated perimetry (SAP) with white on white stimulus remains the gold standard for functional testing.
- Pattern electroretinogram (PERG) can be used where perimetry is not possible; it is valuable to investigate unexplained visual loss.
- Scotopic threshold response (STR) has not been found useful for clinical detection of glaucoma.
- Photopic negative response (PhNR) has not been shown to be a good discriminator to detect disease.
- Multifocal visually evoked potential (mfVEP) has been found useful to investigate patients with visual field loss that does not match the clinical picture.
- Short wavelength automated perimetry (SWAP) has been shown useful in younger patients who are good observers, without nuclear sclerosis, where there is high suspicion of early damage.
- Frequency doubling technology (FDT) matrix is at least as sensitive as SAP for detection of damage.
- Flicker defined form (FDF) may detect glaucomatous defects similarly to SAP. More data is needed to determine sensitivity/specificity and ability to detect early disease.
- Alternative strategy subjective tests SWAP, FDT matrix and perhaps HEP can be used in “pre-perimetric glaucoma” patients, as they may detect changes earlier.

Is anything new in functional testing?
There have been many attempts to refine psychophysical and electrophysiologic techniques over the last 20 years to enable earlier detection and/or possibly provide an objective means for monitoring function. While a few techniques survive in clinical practice, there has generally not been any major breakthroughs in recent times in the functional testing area. Standard automated perimetry (SAP) with white on white stimulus still remains the gold standard despite all its well known limitations.

PERG/ STR/ PhNR
The pattern electroretinogram (PERG) consists of an averaged response to a uniformly reversing checkerboard pattern, and is derived from the central visual field. It has been described as abnormal in glaucoma in many studies dating back as far as the 1980’s. Reduction of the two main components P50 (positive wave at 50 ms) and N95 (negative wave at 95 ms) has been reported, but in glaucoma there may be more significant effects on the N95. The Freiburg group use a PERG ratio comparing responses at 0.8 degree check size (which are more affected in early glaucoma) to 16 degree checks. Latency changes are also reported, although not as substantial as that seen in demyelinating diseases (optic neuritis).

The PERGLA (Lace Elettronica, Pisa, Italy) is a system designed to provide more rapid investigation using a short protocol steady state PERG. While many animal and human studies agree that the PERG is reduced by ganglion cell loss, and source analysis confirms it to be generated in the inner retina, clinical correlations have not been accurate enough for it to become widely used for diagnostic or monitoring purposes. There is a wide range of variability in normal and disease with considerable overlap. Also it is subject to reductions from any other pathology.

Figure 1. Binocular simultaneous mfVEP (dichoptic). Shows reduction of signal in scotoma areas in both eyes compared to corresponding SITA field.
The scotopic threshold response (STR) is a signal recorded to a dim stimulus at the depths of dark adaptation. It appears to be generated in inner retina and is sensitive to optic nerve damage in animal models, and regularly used in lab based research. In humans it has not been found to be useful for clinical detection of glaucoma.

The photopic negative response (PhNR) is a slow negative response following the b wave peak. It is easier to record than the STR, and seems to be dependent on retinal ganglion cell function. However while there are reports of its reduction in human glaucoma, it also has not been shown to be a good discriminator for detecting disease.

mfVEP

The conventional pattern VEP (visually evoked potential) represents a single summed response that is mainly derived from the macular region, and due to cortical anatomy, it is dominated by the inferior hemifield. In fact, a dense superior field defect can go undetected on conventional VEP testing.

To evaluate local VEP responses from the visual cortex and to map them topographically the multifocal VEP (mfVEP) has been developed. Using a multichannel mfVEP technique it is possible to objectively detect visual field defects. Multifocal stimulation is now available commercially in several different electrophysiological systems. The visual stimulus is usually generated on a CRT screen (eg, 22-inch high-resolution display), but with faster refresh rates, LCD flat screens can now be used. We have also used virtual reality goggles and twin LCD screens to present the stimulus dichoptically (see Figure 1). A blue-on-yellow mfVEP has also been described using a sparse blue pattern-onset stimulus (instead of pattern reversal) on a yellow-adapting background. The goal was to target the koniocellular pathway. This approach showed good sensitivity and displayed more extensive scotomata than the conventional black-white mfVEP (92.2% sensitivity), and it correlated well with SAP. The advantage of the blue on yellow stimulus over standard mfVEP, however, was probably more likely related to the fact that the pattern onset stimulus was spatially sparse (likely due to less lateral inhibition) and was of low luminance, both of which we have demonstrated may increase sensitivity.

The mfVEP is particularly useful for investigating patients with field loss that does not match the clinical picture, either because they are poor performers on subjective tests or there is a suspicion of other pathology. It supplements but does not replace the findings of subjective SAP and does not have the suitable follow up capability to compare with SITA or Octopus progression analysis software.

Pupil perimetry has also been reported, as a form of objective perimetry and uses a multifocal type stimulus with sophisticated pupil tracking to capture responses. It has the issues associated with pupil variability to deal with and requires an intact efferent pathway (in at least one eye) to give meaningful results, but does seem to work well as a screening tool and is completely non-invasive.

SWAP (short wavelength automated perimetry), and FDT (frequency doubling technology)

The SWAP technique for perimetry presents a 440nm blue size V target on a bright yellow background to attempt to selectively test the koniocellular pathway. Initial studies had reported favourable early detection of glaucoma, despite some of the limitations including greater fluctuation of responses, lens absorption of the blue light stimulus, and generally lower patient acceptance of the test. Some more recent reports suggest no clinical advantage in detection over SITA white-on-white. It may still be useful in younger patients who are good observers where there is a high index of suspicion of early damage, but despite the introduction of SITA SWAP it has generally not been as widely adopted as once anticipated.

The FDT technique was also introduced as a means of attempting to target a subpopulation of ganglion cells, in this case the magnocellular pathway, to
achieve early detection of ganglion cell loss. The initial FDT perimeter which had 19 test zones, has been expanded in the Matrix Perimeter (Zeiss) to include a test grid similar to the standard 24-2 and 30-2 Humphrey fields. The test strategy is relatively fast, being around 5-6 minutes. Studies suggest FDT Matrix is at least as sensitive as standard automated perimetry (SAP)11.

Flicker defined form (FDF)

Flicker defined form is a recently adapted technique in the Heidelberg Edge Perimeter (HEP, Heidelberg Engineering) which presents as a stimulus counter-phase dots to discrete areas within the field. In my early experience it seems to be well received by patients and detects glaucomatous defects with similar distribution to SAP.

Further studies are needed to test its sensitivity/specificity and ability to detect early disease. The addition of a combined structure-function map by combining the test results of the HEP with the HRT (Heidelberg Retina Tomograph) scan structural data has been a nice addition for clinicians. However, like all structure-function correlations, there appears to be many cases where the two simply do not match. Figure 2 shows an example of HEP where there is quite reasonable correlation with SAP findings. Figure 3 shows an example of a structure-function correlation map.

Clinical applications

Electrophysiology testing using either PERG or mfVEP can be helpful in patients who are poor perimetrists, in cases where there is disproportionate field loss compared to the clinical picture, and in other cases of unexplained vision loss including functional overlay.

The alternative strategy subjective tests SWAP, FDT Matrix and perhaps now HEP also, can be used in investigating patients with suspect early disease, as they may be able to detect changes earlier in some cases. However SWAP is quite variable and better reserved for younger patients who are good observers. I have found the Matrix FDT sometimes works well for patients who fatigue on SAP, and it can be easier for those with back problems due to easier positioning, however none of the alternate strategies have the same follow up software capabilities for progression analysis.

References


Figure 3. Structure function correlation map produced by Heidelberg Retinal Tomograph and HEP. Inner coloured ring represents Moorfield's classification, while outer ring represents HEP visual field result for corresponding sector of disc.
Clinical Issues:
What tests and strategies to use for whom and when?

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Core Concepts
- For each patient, choose thoughtfully the best visual field test or combination of tests as well as intervals between tests. This may change with time.
- Frequency doubling technology (FDT) and short-wavelength automated perimetry (SWAP) should not be used routinely instead of standard automated perimetry (SAP).
- To diagnose and monitor glaucoma, several testing strategies may be useful such as Full Threshold, SITA standard, FAST PAC and SITA FAST.
- Full threshold testing does not offer additional benefit to SITA and requires more time; SITA FAST takes less time again, but with greater variability.
- SITA 24-2 saves time compared with the 30-2 pattern without compromising ability to diagnose or monitor glaucoma.
- In patients with advanced glaucoma and/or visual field loss approaching fixation 10-2 testing is useful to monitor for progression in critical central vision.
- In patients with severe damage (especially with decreased VA) a size V is preferred to a size III stimulus.
- More frequent initial visual field tests are more accurate to assess the rate of any progression.
- The SITA 24-2 test most frequently offers the best combination of speed, reliability and availability of analysis software.

Functional Assessment in Glaucoma
All glaucoma patients and suspects should have periodic visual field examinations if they are able to perform this test. This functional assessment in glaucoma is crucial to provide the information necessary to make the best decisions in a patient’s management. The clinician must choose thoughtfully the best visual field test (or combination of tests) as well as the interval between examinations for each patient.

As testing technologies and software analysis for visual fields continue to evolve, standard automated perimetry (SAP) remains the gold standard for diagnosis and monitoring of progression in glaucoma. While other testing modalities are available, e.g. frequency doubling technology (FDT) and short-wavelength automated perimetry (SWAP), these should not be used at the expense of SAP.

As the most widely utilized hardware, the Humphrey field analyzer (HFA) is well be the example in this article, although the same principles apply to other SAP modalities such as Octopus perimetry.

To diagnose and monitor glaucoma, several testing strategies can be employed: Full Threshold, SITA (Swedish Interactive Thresholding Algorithm) standard, FAST PAC, screening strategies and SITA FAST. Full threshold requires a long period of concentration and does not appear to offer additional benefits to SITA standard. A SITA FAST test takes less time but has a greater degree of variability. It is less useful to monitor glaucoma, but can be used as a first screening test for diagnosis.

Using the same test pattern over time improves the chance to detect visual field changes. As the 24-2 test pattern saves time compared with the 30-2 pattern, without compromising the ability to diagnose or to monitor glaucoma progression, it is the preferred test pattern for most patients.

In patients with advanced glaucoma and/or visual field loss approaching fixation, a HFA 10-2 test is useful to monitor for progression in this critical central region of vision. 10-2 tests can be alternated or combined with 24-2 tests in patients with remaining peripheral vision, such as patients with one hemifield threatening fixation but with the other hemifield relatively normal. Although there is currently no statistical progression analysis available within the HFA for 10-2 fields, thresholds from these important points close to fixation can be compared subjectively.

In patients with severe visual field damage, particularly with decreased central visual acuity, where a traditional Size III stimulus does not provide a dynamic range to observe progression, a Size V stimulus can be useful to assess the remaining visual function.

The number and frequency of visual field tests need to be considered carefully in the context of the burden of repeated tests on patients, the number of visits required, the reliability of test results and financial implications. The optimal frequency for visual field tests depends on the course and severity of the disease and patient factors such as age, test tolerability and performance. As there is considerable variation between individuals for rate of progression, more frequent initial tests provide an earlier and more accurate analysis of this rate for the individual. Ideally, 6 visual field tests in the first two years following a glaucoma diagnosis should be done, and then the number can be adjusted.

In summary, a correct selection of visual fields, both for diagnosis and monitoring will depend on the individual patient’s characteristics. Most frequently a SITA 24-2 test will offer the best combination of test speed, reliability and...
Practical Tips: Minimizing artifacts and avoiding pitfalls in interpretation

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Core Concepts
• Successful communication between perimetrist and patient are of utmost importance.
• The patient needs to be comfortably and properly positioned. Activate the forehead rest alarm.
• Comments by the operator on patient performance and accompanying circumstances are useful for interpretation.
• Potential operator errors are listed in the field analyser manual and should be reviewed by the technician from time to time.
• The greyscale is of limited use but distinctive patterns such as the Clover leaf, the Maltese Cross or Swiss Cheese suggest that test data is not reliable.
• The foveal threshold measurement option should be switched on.
• Use of the diamond fixation targets can help obtain reliable fields in patients with central vision defects (e.g. from macular degeneration).
• “Baseline fields” should be established as soon as possible and updated as needed.
• Always consider the complete clinical picture including the role of coexisting conditions. Never interpret the visual fields in isolation.

Given the objectives (and space constraints), I will mention a few well-known artifacts but concentrate more on selected issues that are easily overlooked in a busy clinic.

Instilling positive attitudes in patients and staff is a neglected but important component for effective perimetry. The person conducting the test does not require special qualifications but is as important as the machine. Their explanation, demonstration and interaction with the patient help obtain valid information. Though the grey scale is the least useful part of the printout, the occasional, typical patterns produced by some artifacts do make it worth just a passing glance. Distinctive appearances on the grey scale include the “Clover Leaf” pattern suggestive of patient fatigue, the “Maltese Cross” that occurs when the patient is a “slow starter” and the “white” scotomas (or “Swiss Cheese” appearance) produced by the false positives of “trigger happy” patients. The presence of more abnormal points on the pattern deviation as compared to the total deviation plot is a subtle indicator of false positives even when they have not been identified or labelled as excessive.

Such issues usually improve with proper instruction and as the patient gets over the learning curve. It usually takes two or three fields to get over the learning curve but a first field is not entirely useless. If an unreliable first field correlates with clinical findings, it still pro-

References:
vides valuable information required to initiate management. Conversely, it is difficult to produce a reliable normal field; so a reliable, normal field, even if it is the first the patient has done, is likely to be normal.

1. Elderly patients with “poor vision” from macular degeneration may not see the usual central fixation target. Use of the diamond fixation targets can help obtain reliable fields.

2. Patient positioning is not just about comfort. If the forehead drifts away from the forehead-rest, the rim of the correcting lens produces an artifact that can mimic a glaucomatous field defect. A patient I managed was advised urgent surgery for such a defect. A repeat field with adequate positioning was the safer intervention, and unlike surgery, even made the “defect” disappear. Switching on and heeding the alarm that sounds when the patient’s forehead drifts away from the forehead-rest helps avoid this artifact.

3. The operator should be encouraged to provide comments on patient performance. The defect depicted in Figure 1 was compatible with the advanced optic disc changes but no comments were added. The clinician noted the ptosis in this, the patients “good” eye. A repeat field with the eyelid taped up (as shown in Figure 2) changed the prognosis (and management). Think beyond glaucoma.

4. Some operator errors escape casual inspection. Careful inspection of Figure 3 shows that the baseline for the visual field index has merged the R and L eyes. The field analyser manual details, how this operator error can occur.

5. Detection of progression is the most important decision in glaucoma management and while there are logistical and reimbursement issues involved, it is important to establish a good baseline as soon as possible. The baseline should exclude fields obtained during the learning curve and should be changed as needed. Following surgery, the field in Figure 4 provides a “likely” progression message that disappeared with the new baseline (Figure 5). Remember that the fields “triggering” the event can be used for the new baseline.

6. The foveal threshold measurement option should be turned on. Foveal threshold serves as internal validity for vision and provides a feel for the “drop off” of the hill of vision. With the usual statistical comparisons to “normal”, it is easy to forget that a scotoma is actually a depression compared to the surround. The pattern deviation plot in Figure 6 suggests a central scotoma. As the foveal threshold is higher than the surround this is not a central scotoma but an artifact produced by (otherwise very helpful) sophisticated analyses. Measuring the foveal threshold helps identify a true scotoma: if the fovea has lost its physiological superiority, its sensitivity will be less than that of the surround. The su-
perior resolution of the 10-2 program is useful to detect such suspected scotomas (Figure 7).

7. A well defined posterior subcapsular cataract is a rare cause for a field defect that fulfills the criteria for a glaucomatous defect. Cataract surgery rather than glaucoma treatment is needed to address such a defect.

I’ll conclude with some common sense perimetrisms from Patel Bhai (personal communication)
• On their own, even the best automated perimeters are just dumb machines.
• The number of ways in which the perimetrist and/or patient can mess up the results is unlimited.
• The number of ways a clinician can mess up interpretation is also seemingly unlimited.
• Never, never ever interpret a visual field in isolation.

References

Figure 7

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