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Editorials

Perimetry – back to the future?

What does the future hold for the patient with glaucoma? Years and years of repetitive strain injury caused by perimetric testing, or relief following its replacement by other simpler and less demanding tests? A recent editorial in this journal has drawn attention to these problems,¹ and applauded the attempt to lessen patient discomfort by shortening the duration of the test.² It raises the question of whether further simplification should occur and bring computer assisted perimetry in line with the Friedman analyser or whether this form of test should be replaced by alternative methods of assessment.

Bjerrum introduced the campimeter and first described the comet shaped visual field defect or scotoma which bears his name.³ Traquair and others described the appearance of progressive 'stages' of the disease.⁴ Goldmann quantified the defect and with his bowl perimeter introduced reproducible measurement methods.^{5,6} Initial attention was directed towards kinetic perimetry, but the need for more accurate testing in the central visual field fuelled the drive towards static and preferably threshold perimetry.^{7,8} Initially, these tests were performed manually; the 'perimetrist' became the skilled individual who coaxed the exact nature of the visual defect out of the patient. 'Perimetry is an art', a statement which realistically identified one problem with this burgeoning support service for glaucoma – not all perimetrists reached the same, required standard,⁹ thus giving an incentive to automation. The development of computer driven perimeters allowed perimetric testing which created increasingly accurate pictures of the visual field. For the first time visual field defects could be quantified three dimensionally and measurement of change (for better or worse) arrived at (see Heijl for review¹⁰). This placed perimetry at the same level as tonometry as a measurable feature of the patient's disease. Arguably it is more important to the patient for it represented the ophthalmologist's success or lack of it in treatment. For the first time a method of monitoring the patient with glaucoma other than by checking the intraocular pressure became available, while the numerical data were available for sophisticated mathematical analysis to improve identification of disease.¹¹ However, with this increase in accuracy came a number of problems largely related to the psychophysical nature and the duration of the test.

The first generation of software programs only provided this information from the (large) number of 'questions asked'. This has resulted in tests lasting longer than many earlier 'field tests' often with patient alienation and underperformance. Secondly, a longer test duration without extra space or staffing resources has reduced the number of available tests per session. Thirdly, initial underperformance

gave rise to false positive results, and miraculous 'improvements' in visual field defects occurred with practice. Fourthly, as a result of better analysis programs it is now recognised that for unequivocal detection of change at least three, probably four, and often five visual fields are required. We have become more demanding of our patients.

Perimetry has to answer two calls, does glaucomatous field loss exist and, also, is an existing defect getting worse? There are problems with relying on threshold perimetry for identifying early glaucoma. Considerable loss of retinal neurons may have occurred before a defect is detectable.¹² Short term fluctuation (variability of response) improves on repeat testing.¹³ A massive loss of function (0.5 log unit) is required to exceed short term fluctuation. These problems have restricted the perimeter in early detection of functional loss. As changes are visible both at the optic disc and the retinal nerve fibre layer before they can be registered on the visual field,^{14,15} and as both have been evaluated for the purpose of early glaucoma detection,^{16,17} it would seem appropriate to rely more on recognising these objective signs when making the diagnosis. The introduction of planimetric measurements has greatly facilitated the separation of 'glaucomatous' from 'normal' discs,^{18,19} and the extension of this two dimensional method to three dimensions with scanning laser ophthalmoscopy promises to take this process even further.

This can only enhance the role of optic disc and retinal nerve fibre analysis in the detection of early ('preperimetric') glaucoma. Alternative tests of the visual system, such as a massed ganglion cell response like the pattern electroretinogram,²⁰ or the selective assessment of defects in the parvocellular pathway, like colour contrast testing,²¹ or the magnocellular pathway like motion or contrast detection^{22–24} may also be of use in identifying early defects in visual function because of their easy applicability to the primary care setting.

For the ophthalmologist to be able to discontinue perimetry in the glaucoma suspect in favour of other examination methods will free up much needed visual field time for the management of the established disease. This should only be done when he has confidence in the use of the alternative methods outlined.

The identification of change is considerably more difficult. Objective methods, such as the measurement of change in the appearance of the optic disc or retinal nerve fibre, become less useful with more advanced disease. Change detection is comparatively easy with the relatively normal disc, difficult with the damaged one. There can be quite marked progression in the visual field with little to show on objective testing. The laser scanning ophthalmoscope is not yet ready for this

role. Similarly, change can be difficult to quantify in non-perimetric psychophysical tests such as motion detection. Visual field testing, by contrast, has the edge with its ability to achieve reproducible quantifiable change. With practice the patient can be trained to 'perform' accurately even though practice based improvement may occur in up to 10 successive fields.

Which patients should be subjected to repeat perimetry for their glaucoma follow up, and how often? The concept of 'normal' intraocular pressure (IOP) (with the inference of stable disease) is seductive and wrong. The demonstration that visual field loss continues in patients, despite 'good' IOP control after glaucoma surgery, means that long term visual field follow up is required, with further adjustments to IOP as necessary.²⁵ The lower the IOP in the series reviewed, the lower the risk of progression.²⁵ Patients 'controlled' on medical treatment have an even greater need for accurate perimetric assessment. Here greater diurnal variation as well as a higher mean IOP may be responsible for a greater rate of visual field loss.²⁶ Finally, patients with normal tension glaucoma need the closest of monitoring, for they too will progress and IOP measurements will always be 'normal'.

Which patients do *not* need visual field monitoring? Those with cataract likely to influence the visual field – in practice nuclear sclerosis sufficient to reduce central acuity to $\leq 6/18$ will cause visual field progression at a rate exceeding that of the glaucoma; those whose rate of loss is so slow that actuarial analysis would suggest that they will not be visually embarrassed in their lifetime; and, of course, those whose visual performance is so poor that the chances of a reproducible progression being detected must be extremely low. In practice these exclusions remove a considerable body of the typical glaucoma clinic population from the perimetric net, freeing much needed services for those patients who do.

What perimeter should be used and what program? Threshold perimetry offers the best possibility of detecting change and should be available to all patients who can be 'trained'. The 24-2 program on the Humphrey perimeter and its equivalent the Octopus perimeter is shorter in duration and encompasses the most important part of the visual field. The outer two rows of the 30-2 program are tested towards the end of the program and would be affected most by fatigue and droopy eyelids and could be ignored. Those patients unable to cope with these should undergo suprathreshold perimetry or kinetic perimetry for they are less demanding, but at the cost of greater change in the visual field being required for detection. Recent shorter programs such as FASTPAC have yet to be shown to be superior for eyes having visual field defects.²

How should change be identified using the 24-2 program? This can be by event analysis or trend analysis. Event analysis can be simple raw data comparison of corresponding retinal test locations on subsequent fields; however it is time consuming, cumbersome, inconvenient, and inconsistent.²⁷ It fails to allow for long term fluctuations and is of little value. The STATPAC 2 program is of limited value, for it only allows comparison of a 'new' field with a baseline field and plots change likelihood at the 0.05 level without giving an idea of depth of change. Any change so identified needs ratification by a further field performed 1 month later.

Trend analysis makes the reasonable assumption that field loss occurs in a linear fashion,²⁸ and analyses quadrants, areas or individual retinal points by linear regression. This has the advantage of ironing out long term fluctuation and provides statistical verification of long term changes. It assumes that the linear pattern is constantly present (so far only shown in patients with untreated normal tension glaucoma (McNaught

E, unpublished observations)) and relies on specialist software.^{29 30}

In conclusion, perimetry has a reducing role in the identification and follow up of the glaucoma suspect, but a major role in the management of patients with established disease. For these patients the most accurate and demanding is threshold perimetry. For best results it should be available for testing two to three times a year for some but not all patients with glaucoma. The remainder may only require less demanding perimetric tests or none at all. In this way appropriate perimetry can be used in glaucoma, and the repetitive strain injury of repeat testing given only to those who need and stand to gain by it.

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