AN AUTOMATIC TARGET-ADDING SYSTEM FOR VISUAL FIELD SCREENING

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Abstract

The authors have developed a system which automatically adds test points to visual field screening. They applied this system to 102 clinical cases and compared the results with those of a 76-point quick screening test. They discuss three clinical cases whose diagnosis was improved with their system compared to the 76-point quick screening test. The number of added points ranged from one to 49 (average 10.8 ± 5.9 points) and the examination times from 133 to 634 seconds (average 265 ± 124 seconds). Nine ophthalmologists assessed the results. The outcomes for diagnosis improved in 34 cases and were unchanged in 68 cases, with no cases becoming worse. Comparing the results using the neural network assessment system, 24 cases had more reliable output values, 73 cases were unchanged, and five cases were less reliable. The added points in this program are useful for diagnosis and do not cause the patient to become fatigued.

Introduction

The purpose of visual field screening is to detect the shape and the depth of abnormal areas. Mapping the location of the test points on the fundus image, as shown in this example, we can easily see that the intervals between the test points are too wide in a 30-2 pattern to detect scotomas in a nerve fiber bundle defect (Fig. 1). As shown in Figure 2, suprathreshold perimetry was able to detect the Bjerrum scotoma1. Precise threshold tests of many points lower the reliability. We usually use suprathreshold static perimetry of 76 test points. If scotomas or other points in a question are found, the examiner can then add new points to be tested. Using this method, the shape and the depth of the abnormal area become clear. This procedure is useful in diagnosis of the visual field.

We have developed a new system for automatically adding test points.

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Fig. 1. Mapping the location of the test points on the fundus image, the test points are too wide in a 30-2 pattern to detect scotoma in a nerve fiber bundle defect.

Fig. 2. The same case as in Figure 1. Suprathreshold screening was able to detect the Bjerrum scotoma.
Method

An automated perimeter (Topcon SBP 2020) was used. The measuring strategy was a suprathreshold static perimetry that classified the threshold into five grades: normal, low 1, low 2, low 3, and missed. The normal level is tested at 5dB higher intensity than the threshold obtained from normal subjects. Low 1 is set 3dB higher than normal, low 2 3dB higher than low 1, and low 3 is set at maximum intensity and missed. A 76-point quick screening pattern was used. After this, the computer grouped the abnormal points and added additional points around the grouped areas, and then these new points were tested. Visual field charts of both the 76-point quick screening and our added point test were then printed out.

We applied this technique in 102 clinical cases with glaucoma, optic neuropathy, hemianopia, psychogenic visual disturbances, etc. Nine ophthalmologists with varying degrees of experience in ophthalmology were asked which visual field was more useful for making a diagnosis. The responses of these doctors was used in deciding...

Fig. 3. A case of normal-tension glaucoma. The results of the 76-point quick screening test show one ‘low 3’ point at the lower temporal area. Probability values by the neural network assessment system were 60% normal and 20% glaucoma.
Case 1

A 38-year-old female patient showed discs of glaucomatous cupping without elevation of intraocular pressure in both eyes. The results of the 76-point quick screening test showed one low 3 point at the lower temporal area (Fig. 3). The computer added five points around this point, and the Bjerrum area scotoma was clearly shown (Fig. 4). The results from the 76-point quick screening test showed that probability values from the neural network assessment system were 60% normal with a 20% chance of having glaucoma. After examination points were added, the probability value for glaucoma increased and the probability for normal decreased.

Fig. 4. After our program had added five points, the Bjerrum area scotoma could clearly be seen. The probability value for glaucoma increased.
Case 2

A 44-year-old male had an infarction in his left posterior lobe. A right lower quadrantanopia could be seen (Figs. 5 and 6), but the shape of the quadrantanopia became clearer after the points were added.

Case 3

A 67-year-old male with primary open-angle glaucoma had test results showing that only the central visual field remained. After the computer had added points to the border area, the shape of the scotoma became clearer, with low 2 and low 3 points appearing (Figs. 7 and 8).

The number of added points ranged from one to 49 (average 10.8 ± 5.9 points), the examination times from 133 to 634 seconds (average 265 ± 124 seconds).

Nine ophthalmologists judged the results. When comparing pre- and post-added points, the results were more useful than with the 76-point test in 34 cases and unchanged in 68 cases, while no cases showed worse results. Comparing pre- and post-added points using the neural network assessment system, the results were more reliable in 24 cases, unchanged in 73 cases, and became less reliable in five cases.

Discussion

A 30-2 pattern is convenient, easy to compare, easy for statistical analysis, etc. However, it is not suitable for use as a screening test as mentioned above. Moreover, threshold measurements take a lot of time, which lowers the reliability. Eye movement during measurement usually disturbs the results. We use the 76-point quick screening pattern, in which the test points are distributed where the visual field defects tend to occur. It is necessary to add some points around the defects or other points in question because the number of test points in this pattern is sometimes too small to make an accurate diagnosis.

If new points are added around each abnormal point, the number may become too large. We have developed a computer program to recognize abnormal points as groups and to add points around them. This program makes the number of added points useful for diagnosis and does not cause the patient to become fatigued.

We previously developed an assessment system using a neural network computer. This analyses the visual field pattern according to various groups, such as glaucoma, central scotoma, hemianopia, etc. In this assessment system, there are 76 input data which correspond to the 76-point quick screening pattern. The data from other test points are calculated, and these values influence the nearest point on the 76-point quick screening pattern. This may be because the probability value did not increase very much.
Fig. 5. A 44-year-old male had an infarction in his left posterior lobe. A right lower quadrantanopia can be seen.
Fig. 6. The results after the computer-added points test.
Fig. 7. A 67-year-old male with primary open-angle glaucoma. The visual field test shows that only the central field remains.
Fig. 8. The outcome after the computer-added points test. The shape of the scotoma is clearer, and low 2 and low 3 points have appeared in the border area.
References