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SIMPLE CHARTS FOR THE DIAGNOSIS AND QUANTIFICATION OF MACULAR DISORDERS

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ABSTRACT

This paper addresses the problem of helping patients with macular disorders to monitor their clinical condition in a simple way by means of three charts. Chart A determines if there is a foveal defect. Chart B determines the size of a foveal scotoma. Chart C enables the patient to calculate the magnitude and nature of a visual distortion (a metamorphopsia). A patient can easily learn to use the charts and can take them away and use them independently of the clinic.

KEYWORDS: Macular Degeneration Scotoma Metamorphopsia Amsler

INTRODUCTION

Macular disorders, especially macular degeneration and macular holes, account for a high proportion of visual disabilities. They are particularly troublesome because they lead to a serious loss of acuity, impaired reading ability, loss of driving license and difficulty in the performance of fine tasks such as threading a needle or artistry. Proper treatment of these disorders requires appropriate monitoring. At present, apart from visual inspection of the retina, the main tests are measurement of acuity with the Snellen chart and estimation of distortion (metamorphopsia) and scotomas with the Amsler chart, and, whenever finance permits, microscopical detection of retinal defects with Optical Coherence Tomography. Although the Snellen and Amsler tests can be easily and quickly applied, they both lack precision. We have previously described an improved method for measuring acuity, especially regional acuity in the vicinity of the fovea (Davey et al, 2004). Here I describe three charts relevant to the detection and quantification of scotomas and metamorphopsia. These charts are designed so that they are easily understood by patients and can be taken home in order to monitor the progress of their condition and the effectiveness of treatment.

Attention is often focussed on loss of acuity but for many patients it is the distortion of image that causes most problems. Therefore any method or treatment that reduces distortion is important but must be monitored precisely and carefully. Unfortunately, the Amsler chart (Amsler, 1953) is largely qualitative and has two serious deficiencies. First, it is dependent on the patient's ability to either describe or draw the perceived distortions. The patient's ability to do this accurately is obviously compromised by the same distortions. Secondly, although the Amsler chart may detect the position of a scotoma, it cannot give an accurate measure of its size because of 'filling-in' by the horizontal and vertical lines (the 'completion phenomenon'). This may prevent the detection of a small scotoma. There have been many attempts to improve the Amsler charts and many other different technologies are in use. Many of these methods are excellent but most can only be applied in the clinic. The aim of the charts described here is specifically that they can be used reliably by the patient away from the clinic. This will enable the progress of a visual disorder and its treatment to be monitored at short regular

intervals with minimal inconvenience to patient or clinician. The three charts described here should assist the patient to determine if there is a foveal defect, to measure the size of a scotoma and to quantify the extent of a distortion,

Chart A

Chart A (Figure 1) is intended to help in determining whether there is a defect in the foveal region. Figure 1 should be printed at a magnification to approximately fii a size A4 sheet of paper. The chart may be viewed at any convenient distance but in good illumination. The eye not being tested is covered. The patient is asked to run the test eye down the chart until it reaches a line where the letters are near the limit of resolution. The patient is then asked to focus on one letter and then determine whether the letter is easier to see or harder if the gaze is moved slightly away from the letter in any direction. If the letter is easier to see by such movement that means there is probably a foveal defect. Further information may be gained by noting if the letter is easier to read by moving the gaze in one direction rather than another. This test may be difficult to apply if the patient has a nystagmus or is otherwise unable to control their gaze.

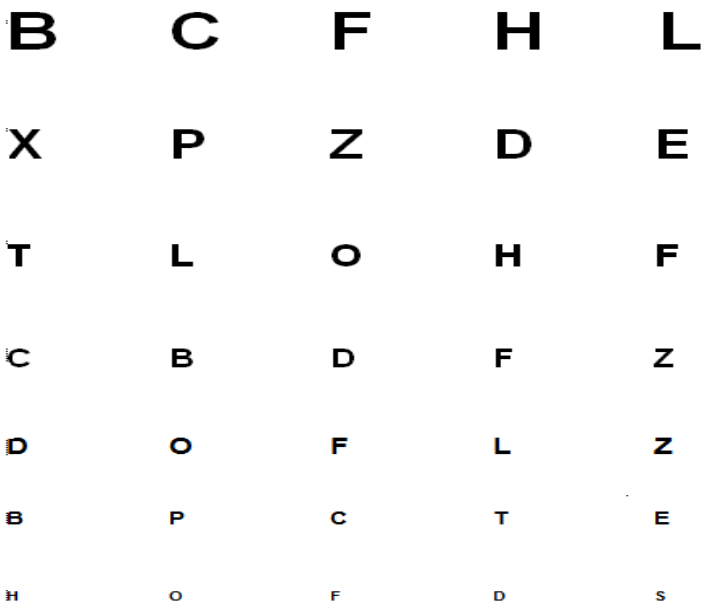

Chart A

Chart B

Chart B (Figure 2) is for the estimation of the size of a central scotoma. The chart should be printed at a magnification such that the largest disc has a diameter of 35 mm. If the chart is viewed at a distance of 57 cm, the largest disc will subtend an angle of 3.5 degrees and the diameters of all discs are indicated in degrees beside the discs. The chart should be viewed in good light. If necessary, the chart may be viewed at another distance but, if so, the size of any disc must be calculated appropriately.

The patient is asked to close or cover one eye and attempt to focus on the smallest black disc with the other. If this causes the disc to disappear from view the disc is smaller than the scotoma. The patient then repeats the procedure with the next larger disc. Depending on the variability of gaze, a disc may sometimes be visible. But if the disc becomes invisible, even transiently, it is smaller than the scotoma. The patient proceeds to larger discs in the same way until a disc is reached that remains always at least partly visible. This disc must then be slightly larger than the scotoma. The size of the scotoma lies between the sizes of that disc and the next smaller disc. We may specify the size of the scotoma as, e.g., 1.4-1.6^{o}. Since

the discs are circular, the method assumes that the scotomas are also circular, but this is not always the case. The method will therefore underestimate the size of the scotoma. In most cases this is probably unimportant. If an exact shape of the scotoma is required a more elaborate technique must be used such as microperimetry or optical coherence tomography and this would have to be done in the clinic, of course. Such methods would also have to be used if the scotoma is not central foveal. In Chart B, when viewing at 57 cm (arm's length), the sizes of all discs are expressed in degrees. If the chart is viewed at 28.5cm (arm flexed and chart placed at the tip of the elbow), the sizes of all discs are doubled.

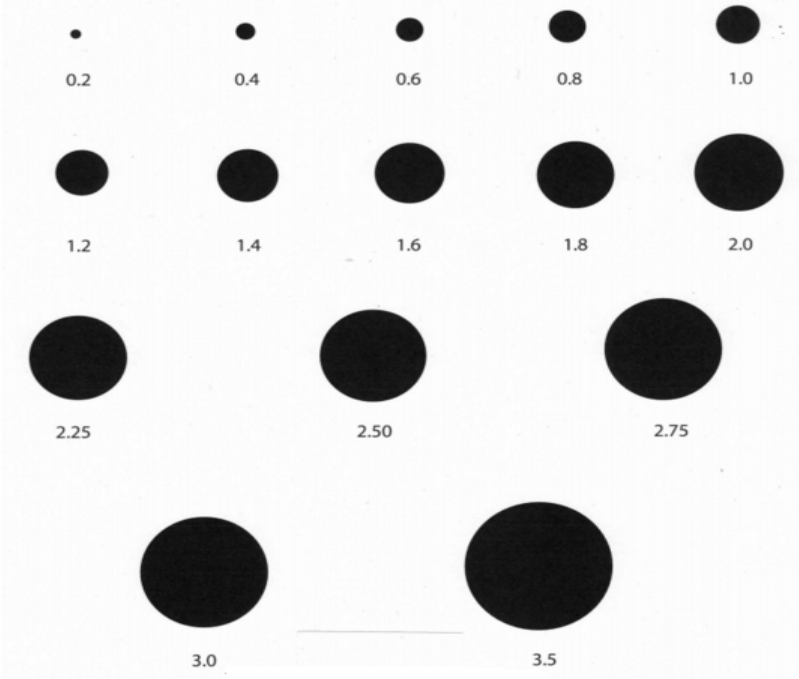

Chart B

Chart C

Chart C (Figure 3) is designed to assist in the diagnosis of metamorphopsia and in the quantification of the defect. Initially, to get some idea of the distortion of image experienced by the patient, they are asked to view the square at the base of Chart C and say if it is distorted, and, if so, how it is distorted. If possible they should draw the distorted shape; it may help if they close their eyes when doing this. The purpose of this exercise is to determine whether the sides of the square appear to bend outwards (barrel distortion) or inwards (pincushion distortion). To assist the judgement of this, very distorted diagrams are placed on either side of the test square, showing barrel distortion on the left and pincushion distortion on the right.

Chart C contains twelve sets, each of two black bars. In different sets the bars are separated from each other by different distances. Chart C should be printed so that the largest gap, labelled '20' should measure20 mm. When this is done, the labels on the chart should indicate mm. If now the chart is viewed at 57 cm (arm's length), the labels on the chart will indicate the angle subtended by the gap in tenths of a degree. In the sets with the larger gaps there is a fine line at the centre of the gap: the patient is asked to focus on this line so as to be focussing halfway between the black bars. The chart can be viewed at any distance with appropriate correction of the angle. For example, at a distance of 28.5 cm the first set of bars labelled '2' will have a gap of 0.4 deg. A viewing distance closer than 28.5 cm will probably not be needed and a viewing distance more than 57 cm only if the distortion is very small.

The patient is asked to fixate the centre of the first set and say whether the edges of the bars bend inwards or outwards. If there is bending of one or both edges, the patient should move to set 3 and repeat the test. They should continue in this way, moving to higher and higher sets, until they reach a set in which neither edge bends. This gap size defines the extent of the distortion. Because it is difficult to keep the gaze steady in the centre of the gap, bending of only one edge may occur when the gaze strays towards that edge. However, absence of bending in both edges, even if only for a moment, is sufficient to define the limit of the distortion. The centre lines in the larger gaps will assist the patient to keep the gaze midway between the bars. There will probably be a break in the line at the point of gaze but the visible parts of the line should be straight and in line with each other. The fine lines are omitted in the sets with small gaps because of the possibility of confusion.

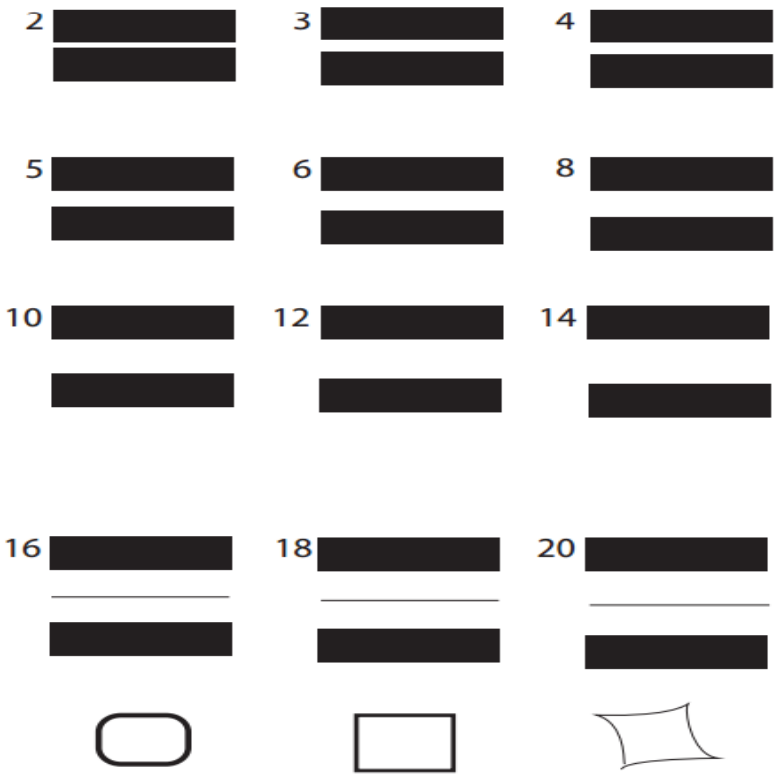

Chart C

Recording of Distortion by Means of Chart C

The vertical distortion is determined when the bars are horizontal. The chart is rotated 90^{o} to determine the horizontal distortion. The procedure is as for the vertical distortion. The bar sets with the smallest gaps showing no bending of bar edges are noted as a 'metamorphopsia index' (MI), e.g.

MI = L(R) V (H) P (B) D

Where L=left eye; R=right eye; V=vertical distortion; H=horizontal distortion;

P=pincushion distortion; B=barrel distortion; D=degree subtended by gap

To give an example of the kind of record, this is the MI for my left eye at the present time:

MI = L V B 0.8; L H P > 3.0

Thus, my left eye has a small vertical barrel distortion and a larger pincushion discussion, these defects resulting from a macular hole ((pincushion distortion) followed by a post-operative macular oedema (barrel distortion)."

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CONCLUSIONS

If it is desired that the patient perform repeated measurements away from the clinic, it may be easier if they make the measurements at arm's length (AL; this is approximately 57 cm) or at elbow length (EL; approximately 28.5 cm; achieved by bending the arm at right angles and placing the tip of the elbow on the chart). The exact distance will vary between individuals but if the patient always makes the measurements in the same way the succession of records will indicate a trend if there is one.

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