Eye (1991) **5**, 761–765

Letters to the Journal

Sir,

Monitoring Macular Degeneration

Some of your readers may be interested in an instrument that I designed in 1983 for monitoring the blind spot that had begun to shake my confidence when driving a car. Since then my maculas have continued to degenerate, and so, with the encouragement of my ophthalmologist, I have made improvements to the design and method of operation of my monitoring device. The latter is named 'Polar Plotter' because it enables one to plot the polar coordinates of the outline of the scotoma, and thereby to draw a diagram showing the degeneration of the macula magnified about a hundred times.

The instrument consists of a 30 cm diameter matt-black disc (a 12 inch record!) bolted through its centre to a 40 cm square of white hardboard on which are marked black radial lines at angular intervals of 15 degrees from 0 degrees at the top and progressing clockwise to 360 degrees in the manner of a compass rose. Nineteen holes, each $1\frac{1}{2}$ mm diameter, are drilled along a radius of the black disc at intervals of $7\frac{1}{2}$ mm so that the first is $7\frac{1}{2}$ mm from the centre and the nineteenth is $7\frac{1}{2}$ mm from the outside edge of the disc. These holes are identified by the letters 'A' to 'S' progressing outwards and they provide alternative locations for a drawing pin having a bright yellow head; the latter is named the 'roving spot'. The head of the central bolt is also covered by a bright yellow patch with a central black dot.

The Polar Plotter (PP) is propped up on a table in front of the seated patient so that it is 60 cm from the patient's eyes and normal to his line of sight. With one eye masked, the patient fixes the other eye on the central black dot. Whilst the disc is slowly rotated clockwise, the patient's peripheral vision follows the roving spot on its circular orbit. The patient calls out when the roving spot disappears and when it reappears whilst a fully sighted friend notes the angles. This procedure is repeated with the roving spot circulating at each of the nineteen radii in turn.

A squared chart is used for recording the arcs of blindness; the radii are marked along the top, and the angles 0 degrees to 360 degrees are marked down the left and right margins. The arcs of blindness are recorded by drawing red vertical lines. From this data it is quite simple to draw the outline of the blind

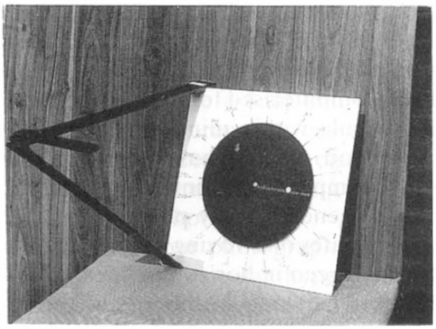

Fig. 1. *The Polar Plotter Mark 3 set up for a test. Note the jig for locating the patient's forehead so that his eyes are 60 cm from the centre of the Polar Plotter and his line of sight is normal to its surface.*

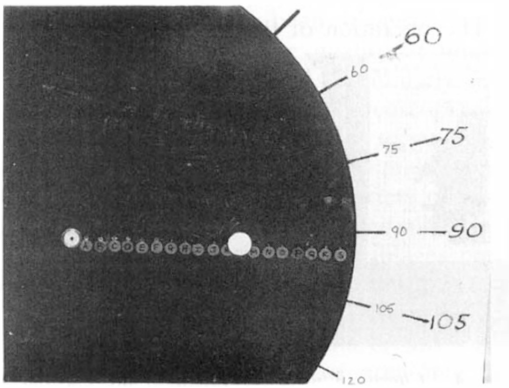

Fig. 2. *The 'roving spot' is shown at radius 'L', one of nineteen radii that may be selected.*

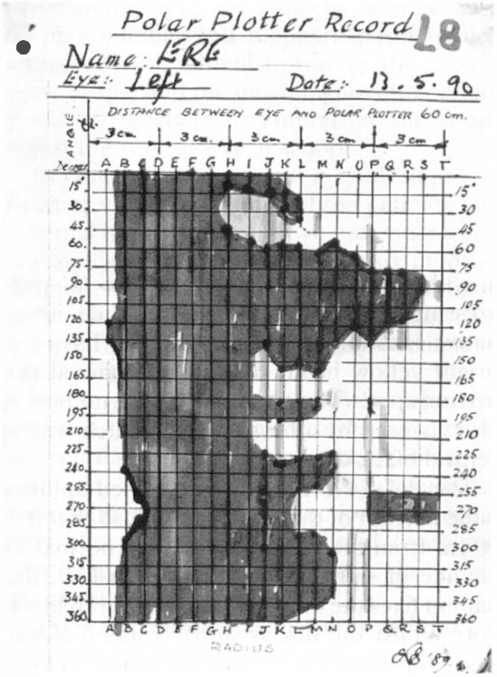

Fig. 3a (left). *The squared chart on which are recorded the arcs of blindness, ie the arcs over which the roving spot is not visible to the patient.*

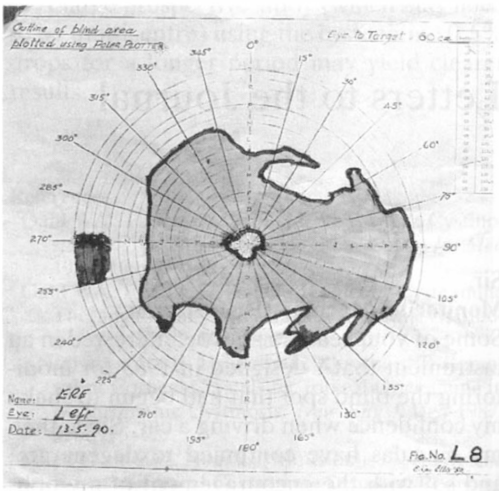

Fig. 3b (right). *The polar chart that was produced from the data of 3a showing the extent of the macular degeneration. Note the central 'hole' of vision.*

areas onto a polar chart marked out with radii and angles to the same scale as the PP. The blind areas may be coloured, say light red; this will be invisible to the patient when the chart is 60 cm in front of his eyes.

A simple jig is attached to the PP to ensure that the patient's head is held in the correct position throughout the test. The power and position of the light source must be the same for each subsequent test.

The operation of the PP can be demonstrated to a new patient by using it to locate his natural 'blind spot' when the yellow roving spot, rotating at radius 'S', disappears in the region of 90 degrees with the right eye, and 270 degrees with the left.

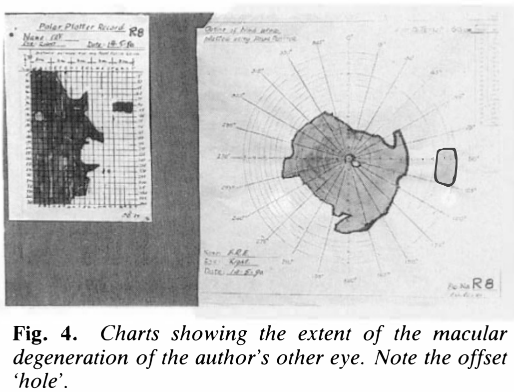

Fig. 4. *Charts showing the extent of the macular degeneration of the author's other eye. Note the offset 'hole'.*

In my experience I have found that the Polar Plotter enables me to produce a more convincingly accurate picture of my macular degeneration than is possible using an Amsler chart. Without going to the trouble of constructing a diagram, the PP can be used to quickly highlight the early onset of macular degeneration because it identifies dim areas as well as blind areas. An Amsler chart will warn the patient if his macular degeneration is of the 'Wet' form, but I have found a Georgian style window frame to be equally effective.

It has been suggested by Chopdar[1] and Gowler[2] that the principle of the Polar Plotter could be computerised to produce a print-out of the macula within minutes. I understand that Edmund Gowler has programmed his personal computer to print a diagram of his macular degeneration by plotting the Cartesian coordinates of a 'roving spot' whilst it traverses the screen in horizontal lines.

However I belong to the age of the slide rule, and so offer my macular monitor as the simple and cheap product of a pensioner's 'alternative technology'.

The Polar Plotter resulted from my curiosity about the progress of my own macular degeneration, but now, in my seventies, I should be happy to leave further development and clinical trials to others who may think it worthwhile.

Last year the local youth training workshop[3] kindly made three dozen PPs which were sold in aid of the Macular Disease Society's Research Fund.

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References

[1] A. Chopdar, FRCS, Department of Ophthalmology, East Surrey Hospital.
[2] E. Gowler, Chairman of the Macular Disease Society.
[3] Cheshire County Council, County Youth Workshop, Ellesmere Port.

Sir,

Optic disc pallor measurement

The major ophthalmoscopic features of optic nerve damage in glaucoma are pathological cupping and pallor of the disc.[1] Histological studies indicate that the appearance of optic disc pallor reflects loss of neural tissue and changes in light transmission of the atrophic optic nerve.[2,3] Thus disc pallor is a valuable clinical sign in the assessment and management of ocular hypertensive and glaucoma subjects. A number of different techniques have been used to measure disc pallor including colorimetry,[4] densitometry,[5] planimetry,[6] photometry[7] and computerised image analysis.[8–10] A review of the methods used shows that several of the studies used colour photographs,[4,8,9] while others used black and white or monochromatic images.[5,6,7,10] It is not known how well the colour and monochromatic pallor measurements correspond. To address this, the area of optic disc pallor was measured and correlated using colour and red-free fundus photographs.

Optic disc colour photographs (Zeiss fundus camera) of 25 ocular hypertensive and glaucoma patients were used to give a wide range of pallor values. The monochromatic images were obtained by taking red-free photographs (Wratten 58 filter) of the colour images. The 35 mm slides were projected (Omega 5500) onto a screen to give an $\times 10$ magnification, and the area of the optic disc and disc pallor measured using a compensating planimeter and expressed as relative units. The reproducibility of duplicate measurements (expressed as coefficient of variation, mean/standard deviation $\times 100\%$) was 4.2 + 2.5% for the colour measurements and 3.9 + 2.9% for the red free measurements.

The area of optic disc pallor (expressed as a percentage of optic disc area) was 36.6 + 16.5% for the colour photographs, and 38.1 + 16.2% for the red-free photographs. There was no significant difference between the mean values ($p = 0.95$). The Spearman rank correlation co-efficient between the colour and red-free pallor areas was $r = 0.89$ (p 0.0001). Subjectively there was little difference in the ease or difficulty with which the pallor boundary was outlined with either the colour or red-free images.

Comment

Optic disc pallor area has previously been shown to be significantly correlated with neuroretinal rim area[11] and visual field loss[12] in glaucoma. Measurement of pallor area can be made from monoscopic disc photographs and this represents an advantage over neuroretinal rim area measurement, which requires stereoscopic views (preferably simultaneous) to get a true representation of depth at the optic nerve head. Lens opacities, in particular nuclear sclerosis, can affect the colour of the optic disc affecting the quality of both colour and red-free fundus photographs. Circular light polarisers have been suggested as a means of improving the quality of fundus imaging in cataractous eyes.[13] Similarly, lens opacities affect the quality of stereoscopic disc photographs making it difficult to get topographic measurements, and also make visual field testing unreliable. The variety of techniques to measure pallor have used colour and monochromatic/black and white images interchangeably without knowing how well the colour and monochromatic pallor measurements correlated. The results of this study show that optic disc pallor area may be reliably and accurately measured from red-free fundus photographs.