A simple method for determining regional visual acuity in humans

D.F. Davey[1] and W. Burke[1,2], [1]Department of Physiology and [2]Department of Anatomy & Histology, Institute for Biomedical Research, University of Sydney, NSW 2006, Australia.

Diseases affecting the retina do not create a uniform lesion throughout the retina. It is therefore useful to be able to assess the functioning of small regions of the retina, both for diagnostic reasons and also to monitor the progress of the disease and treatment. The following method was devised specifically to monitor the development, progress and treatment of a condition known as 'macular hole' in which there is detachment of the retina at the fovea. For this reason the regions of retina studied were in the foveal region, but the method could be adapted to any other part of the retina.

Acuity in the vicinity of the fovea was determined at nine positions. Position 0 was centred on the fovea, positions 1-4 were in the outer fovea, positions 5-8 were in the parafovea. They were chosen in order to determine the spread of the macular hole, if it developed, and whether it developed symmetrically. The method of testing was as follows: the subject sat so that the eye being tested was at 57 cm from the screen of a cathode ray tube monitor (280 cm × 210 cm; 1 cm on the screen ≡ 1°), the other eye being covered. If the subject would normally wear corrective spectacles for that working distance, they were worn for the test. Except during a trial, the screen displayed only cross-bars. The subject focussed on the position on the screen corresponding to the point where the cross-bars would intersect. This procedure avoided having a fixation mark in the same place as a letter at position 0. When ready the subject pressed the space bar and a letter flashed on the screen in one of the nine positions. The identification of the letter by the subject was entered into the computer. The duration of the flash (100 ms), being less than the reaction time, prevented identification of the letter subsequent to an eye movement.

The letters used were the following: A, B, C, D, E, F, H, L, O, P, S, T, X, and Z, a set used in many Snellen charts. The font used was Helvetica Bold. The luminance of the letters was 3.1 cd/m^2 against a background luminance of 23.5 cd/m^2, the ambient luminance in the room being about 18 cd/m^2. The choices of letter and of position in which it was flashed were determined randomly. The GNU (Free Software Foundation) C-library *rand()* function was used to generate a pseudo-random selection from the 14 letters of the Snellen character set for each test flash. The same function was used to select the flash position from the nine test positions. The initial size of a letter was 60 point, occupying 1 cm on the screen, i.e. subtending 1^o.

When a letter was identified correctly, the next time a letter was flashed in that position its size was reduced by a factor of $\sqrt{2}$. When a letter was identified incorrectly, the program kept the size unchanged in that position for a further nine trials. After ten trials at one position, if the percentage correct was 70% or less, the size was increased by a factor of $\sqrt{2}$ and ten trials applied with the new size. If the percentage correct was 80% or more, the size of letter was decreased by a factor of $\sqrt{2}$ and ten trials applied with the new size. The aim of this procedure was to determine a letter size that could be identified on 75% of trials. This size was obtained by linear interpolation between the sizes straddling the 75% correct value. This value was taken as a reasonable measure of the acuity at that position. Comparison of the values within the outer foveal and parafoveal permitted assessment of the symmetry of acuity, while comparisons over time using repeated tests allowed changes in acuity to be detected.