A SIMPLE TEST OF SPATIAL FREQUENCY DISCRIMINATION IN PATIENTS WITH MULTIPLE SCLEROSIS

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Abstract

A simple spatial frequency discrimination test was designed with gratings ranging from 0.28 to 35.0 seconds per degree of visual angle, and presented to two groups of subjects.

The first group consisted of 16 normals. The second, a group of 18 subjects from the Multiple Sclerosis Society, consisted of three with other neurological disorders and 15 with definite multiple sclerosis (MS).

Results show that the MS group was significantly less able to perform the test correctly (although the visual acuity was usually 6/9 or better) and showed a marked response of confusion, even though instructions were clearly understood.

Key words: *Spatial frequency discrimination, multiple sclerosis.*

Multiple Sclerosis (MS) is a diffuse nerve disease in which demyelination of the visual pathway is an almost universal consequence, although visual abnormalities are not always evident in clinical testing.[1]

However, testing spatial frequency discrimination at different levels of contrast sensitivity has shown that patients with MS may have an abnormal modulation transfer function with a selective visual loss to medium spatial frequencies in the presence of normal Snellen's acuity.[1,2]

These gratings are usually generated electronically on an oscilloscope screen or are available as a set of printed gratings of varying contrast and spatial frequencies. However, neither is easily available for routine testing.

It has recently been suggested[3] that subjects with MS may also have difficulties with discrimination between varying spatial frequencies when sensitivity is normal, and the level of contrast is constant. With this in mind, a simple clinical test was designed and tested on a group with known MS to determine whether there was any significant difference in the response of this group compared with that of a normal group.

METHOD

Twenty four discs, each with a diameter of 5 cm, were constructed. Each disc consisted of a black and white grating (i.e. 100% contrast) of a particular spatial frequency ranging from 0.28 to 35 cycles per degree at 40 cm (i.e. from fine stripes approximately 0.1 mm wide to broad stripes approximately 1.3 cm wide). These were numbered 1 to 24 on the back and mounted onto a white card (8 cm square), and covered with a protective coating. For ease of use they were divided into three subsets, set A contained the

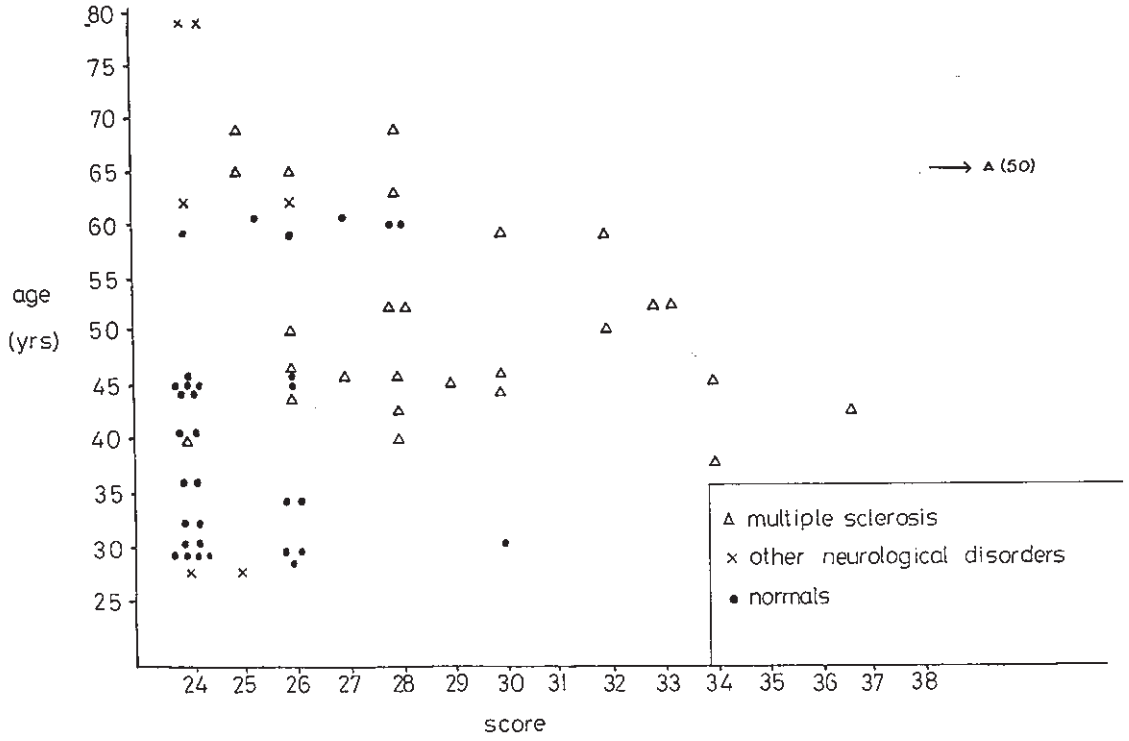

Figure 1: Graph showing scores of normals, MS group and those with other neurological disorders.

finest gratings (1 to 8), set B the medium gratings (9 to 16) and set C the widest gratings (17 to 24).

Two groups were studied. The first group consisted of sixteen randomly selected normal subjects whose ages ranged from 28 to 61 years.

The second group of 18 subjects was tested at the Multiple Sclerosis Society of N.S.W. at Chatswood. Their ages ranged from 27 to 80 years. Of this group only 15 actually had MS, whilst three had other neurological disorders, i.e. two with spinocerebellar degeneration and one with muscular dystrophy. These three were included in the study as their physical limitations were very similar to those of the MS subjects i.e. mobility disorders requiring wheelchairs or sticks, because of some muscular weakness.

For most subjects, visual acuity for near (Snellen's equivalent) was 6/9 or better. Three eyes had acuity of 6/60 or less and were not tested. Four eyes had acuity of 6/18, and for these cases the test proceeded from the threshold grating, and the final score was adjusted accordingly. This ensured that all subjects could see the stripes so that any anomalies could not be attributed simply to poor visual acuity.

The eyes were tested monocularly with reading glasses worn. The discs were presented, one group (A, B then C) at a time, in a scattered pattern on a flat table 40 cm from the eyes. The subject was requested to rearrange them in the correct order, from the finest to the broadest in the set. The test was repeated for each set. Good lighting was necessary, and the subjects were allowed a short rest between eyes.

It was found to be very important not to ask or answer leading questions and to ensure that all subjects maintained the correct test distance. In particular, the plates could not be picked up to be compared.

When the subject had ordered the plates within a reasonable time (allowing for the motor problems of the affected group) the numbers on the

back of the plates were recorded. The difference between each plate and its preceding number was used as a score, so that for each set of eight plates eight would be a perfect score, making a perfect score of 24 for the whole test. Obviously, with any errors, the score would be larger.

RESULTS (see Figure 1)

Of the normal group (32 eyes), 19 had a perfect score of 24, 12 scored at 28 or below and one scored 30. All approached the test with ease and organised the plates quickly. The mean score for this group was 25.6

Of the second group, three of the 30 MS eyes were not tested due to poor visual acuity. Of the remaining 27, only one had a perfect score, four scored below 28, 21 scored from 28 to 34 and one subject scored 50. The mean score for this group was 29.68. There was no apparent difference in the performances for sets A, B or C.

The means for each group were found to be significantly different, $t = 4.566$ ($p < 0.001$).

Apart from the larger scores, the reaction of the MS subjects was notable. Most showed a marked degree of confusion although they understood the instructions clearly. They were much slower than the normal group and became frustrated as they knew something was wrong but could not say where. To ensure that this confusion related to the spatial frequency ordering, rather than general confusion, several of the MS group were shown the plates upside down, and asked to order them in correct numerical order. All did this with ease.

All three of the subjects with other neurological disorders scored 26 or below. Despite the similarity in motility problems, they approached the test with confidence and finished it quickly.

DISCUSSION

This simple test did show a significant difference between the two groups, indicating that the MS subjects had problems with spatial frequency discrimination, quite apart from contrast sensitivity defects.

The problems of the MS group seemed to relate to the organisation of the gratings rather than poor resolution. For example, if they were asked to pick out the finest grating, then the next, and so on, most would have completed the task fairly accurately. It was the problems which arose from arranging the eight together which was most evident.

Because of the nature of the group studied (i.e. from the MS Society) all of those affected were at a moderately to severely advanced level of the disease. One obvious indication is to repeat the test on subjects with suspected or recently diagnosed MS and it is planned to do this in the future. However, it is emphasised that the test is quite simple to construct and perform and it is hoped that others may also assess its use with similar subjects.

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References

1. Regan D *et al.* Visual acuity and contrast sensitivity in multiple sclerosis—hidden visual loss. Brain 1977; 100: 563-79.
2. Arden GB. Visual loss in patients with normal visual acuity. Doyne Memorial Lecture. Trans Ophthalmol Soc UK 1978; 98: 219.
3. Regan D *et al.* Spatial frequency discrimination in normal vision and in patients with multiple sclerosis. Brain 1982; 105: 735-54.