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Visual function among multiple sclerosis patients in Malaysia

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Abstract

This is a study of the visual function among the clinically definite multiple sclerosis patients in Malaysia. The study subjects consisted of 15 patients from the Neurology Clinic of the University Malaya Medical Centre. The Female:Male sex ratio was 11:4. The average age of onset of symptom was 30 years. Tests for colour vision, contrast sensitivity, visual field and visual evoked potential were performed. The 30 eyes were classified into three groups: Group I - history of optic neuritis and visual acuity ≤ 6/12, n=9; Group II - history of optic neuritis but had recovered visual acuity to ≥ 6/9, n=9 and Group III - without clinical involvement of the optic nerve and had visual acuity ≥6/9, n=12. At least one of the four tests gave an abnormal result in 100%, 100% and 67% of the three groups respectively. The comparative rates of abnormal tests in Group II & III eyes were: contrast sensitivity (62%), visual evoked potentials (57%), colour vision (29%) and visual field (29%). The abnormal contrast sensitivity were seen mainly in the intermediate and low spatial frequencies. The visual field defects were varied, ranging from central scotoma, hemifield loss to constricted visual fields. *Conclusion:* Subclinical optic neuropathy were common among Malaysians with MS. The two most sensitive tests for detecting subclinical optic neuropathy were contrast sensitivity and visual evoked potential.

Key words: Multiple sclerosis, Malaysian, optic neuritis, visual function.

INTRODUCTION

Optic nerve involvement is an important aspect of multiple sclerosis (MS). Between 15-35% of patients with multiple sclerosis present with optic neuritis.[1-4] Clinical involvement of the optic nerve occurs in more than 50% of the patients at some stage of the disease.[3,6] On the other hand, up to 75% of females and 35% of males with optic neuritis will ultimately develop into multiple sclerosis when followed up for 15 years.[6] Between 50 – 70% of the patients with isolated optic neuritis have abnormal MRI changes in the brain similar to that seen in multiple sclerosis.[3]

Visual acuity as measured by the Snellen optotype may return to normal after an attack of optic neuritis. This spontaneous improvement usually occurs over several months. However, even if visual acuity returns to 6/6, other visual functions, such as contrast sensitivity, brightness sensitivity and colour vision may still be defective and symptomatic.[7-12] It has been shown that between a third to two thirds of the clinically unaffected contralateral eye to the symptomatic optic neuritis also show abnormality in contrast sensitivity function, colour vision testing and evoked potential recording.[9,13] This is consistent with the autopsy study, where the MS plaques showed a preponderance to lesions in the optic nerves, and the visual pathways were invariably affected.[9,14]

There is difference between the MS seen among the Caucasian populations and that seen among Asian populations. The MS seen among the Asians has the following characteristics: low prevalence, rare occurrence of similar family history, a more frequent occurrence of acute transverse myelopathy, with Devic's disease being more common; and a more severe involvement of the spinal cord with greater functional disability and less frequent involvement of the cerebellum.[15-18] A higher incidence of visual failure at the onset of illness and a more severe visual impairment during follow-up were the other features of Asian MS.[7,13,19-25] This is a cross-sectional descriptive study to evaluate the various visual function amongst Malaysian patients with clinically definite MS.

METHODS

A total of 15 patients (30 eyes), under the follow-up of the Neurology Clinic, University Malaya Medical Centre were recruited for the study. All were diagnosed with clinically definite MS based on the criteria by Poser et al.[6] They were included in the study irrespective of

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whether there was any previous history of optic neuritis, and were excluded if there were any other pathology that would otherwise affect visual function.

The subjects were tested for visual acuity, colour vision, contrast sensitivity function, visual field and visual evoked potential. A retroilluminated Snellen chart, placed 6 meters away was used to test for visual acuity and all subjects were required to wear their best-corrected glasses before proceeding to the other tests. Colour vision was tested using the Lanthony's Desaturated 15-hue test and no time limit was enforced. The subjects could arrange the chips till they were satisfied. A wall-mounted Vistech VCTS 6500 chart was used for contrast sensitivity and the Humphrey field analyzer central 30-2 programme was used for visual fields. The Visual evoked potential studies were done using standard procedure with black and white checkerboard stimulation. The pattern field subtended an angle of 14.6 degree and the standard check size used was 27.4 minutes.

Colour vision and contrast sensitivity were done among 20 healthy controls (40 eyes) with a mean age of 30 years, ranging from 20 years to 53 years. There were 8 males and 12 females. All were Malaysians with best-corrected visual acuity of 6/6. The normal values for the visual evoked potentials were previously determined based on 40 healthy subjects comprising of 19 males and 21 females, with age range from 19 to 52 years. A value of mean $\pm$ 2.5 SD was taken as abnormal.

RESULTS

Clinical features: The 15 patients consisted of 4 males and 11 females with a mean age of 30 years, ranging from 15 years to 60 years. Clinical optic neuritis was seen in 10 patients (67%), 6 at the onset while the remaining 4 patients were between 2 to 36 months of illness. Eight patients had bilateral involvement during the first attack of optic neuritis. Recurrent attacks of optic neuritis were seen in 50% of the cases.

Eighteen eyes (60%) had previous episode(s) of clinical optic neuritis. Of these, 9 (50%) sustained a visual outcome of 6/12 or worse. Table 1 lists the visual outcome in relation to the clinical optic neuritis. As shown, of the 12 eyes with one episode of clinical optic neuritis, 8 (67 %) had visual acuity of 6/9 or better and 3 eyes had visual acuity of 6/60 or worse. Six eyes had recurrent optic neuritis. One (17 %) retained visual acuity of 6/6, while 4 (67 %) had visual acuity of 6/60 or worse. Analysis with Fisher's exact test however did not confirm a significant relationship between recurrent optic neuritis and final visual acuity with p value of 0.066.

Sensitivity of the visual function studies: The 30 eyes were divided into 3 groups. Group I consisted of 9 eyes with history of optic neuritis and whose visual acuity was 6/12 or worse. Group II consisted of 9 eyes with history of optic neuritis but had visual acuity of 6/9 or better. Group III consisted of 12 eyes without history of optic neuritis and had normal visual acuity of 6/9 or better.

For the 9 eyes in group I where clinical evidences of optic nerve atrophy and relative afferent pupillary defect were evident, abnormalities were seen universally in all the three psychophysical tests and visual evoked potential. Of the 21 eyes in Group II and III, the comparative rates of abnormal tests were: contrast sensitivity (62%), visual evoked potential (57%), colour vision (29%) and visual field (29%). In 17 (81%) of these eyes, there was at least one abnormal test result. Only one eye showed abnormality in all 4 tests. In 4 eyes (19%), there was abnormality in only one of the tests which was either visual evoked potential or contrast sensitivity. Of the 7 eyes with normal visual evoked potential, 3 had abnormal contrast sensitivity, 2 each had abnormal colour vision and visual field. Of the 5 eyes with abnormal visual evoked potential, one had normal contrast

Table 1: Visual acuity in relation to the episode(s) of clinical optic neuritis

Visual acuity	No. of eyes	No. of episodes of optic neuritis			
		0	1	2	3
6/9 or better	21	12	8	0	1
6/12 to 6/36	2	0	1	1	0
6/60 or worse	7	0	3	3	1
Total	30	12	12	4	2

Table 2: Comparisons of visual evoked potential, contrast sensitivity, colour vision and visual field in Groups II and III.

		Optic Neuritis positive	Optic Neuritis negative	total	Prevalence	0.429	42.9%
Visual evoked potential	**abnormal**	7	5	12	**Sensitivity**	0.778	77.8%
	normal	2	7	9	**Specificity**	0.583	58.3%
total		9	12	21			
Contrast sensitivity	**abnormal**	6	7	13	**Sensitivity**	0.667	66.7%
	normal	3	5	8	**Specificity**	0.417	41.7%
total		9	12	21			
Colour vision	**abnormal**	2	4	6	**Sensitivity**	0.222	22.2%
	normal	7	8	15	**Specificity**	0.667	66.7%
total		9	12	21			
Visual field	**abnormal**	4	2	6	**Sensitivity**	0.444	44.4%
	normal	5	10	15	**Specificity**	0.833	83.3%
total		9	12	21			

sensitivity, 3 had normal colour vision and 5 had normal visual field. Contrast sensitivity and visual evoked potential together were able to detect abnormalities in 100% of eyes in Group II and 67% of Group III. At least one of the four tests gave an abnormal results in 100%, 100% and 67% of the three groups. The sensitivity and specificity of the tests are listed in Table 2.

Colour vision: All the nine eyes (100%) with visual acuity of 6/12 or worse (Group I) had some form of colour vision defects with 6 suffering from total loss of colour appreciation. The other 3 eyes had deutan, tetartan and a combination of duetan and tritan defects. Six out of 21 eyes (29%) with visual acuity of 6/9 or better (Group II & III) had colour vision defect. Of these, 2 had history of clinical optic neuritis.

Contrast sensitivity: Of the 9 eyes in Group I, 6 (67%) had a total loss of contrast appreciation. The other 3 eyes also had diminished contrast sensitivity, with one eye demonstrating low and intermediate frequencies abnormalities while in the other 2, all the frequencies were affected. Among the 21 eyes in Group II & III, 13 (62 %) demonstrated abnormal contrast sensitivity. The type of defect varied with diminished contrast sensitivity seen in low (2), low to intermediate (4), intermediate (3), intermediate to high (1) and all spatial frequencies (3). Figure 1 is the cumulative data of eyes with diminished contrast sensitivity in the various spatial frequencies. The intermediate and low spatial frequencies appear to be sensitive parameters for detecting possible optic nerve involvement in patients with good visual acuity, accounting for 95 % of total abnormalities detected in these eyes.

All 40 eyes in the control group had best-corrected visual acuity of 6/6 or better and none had any colour vision or contrast sensitivity abnormality.

Visual field: All nine eyes in Group I had some form of visual field defects. The defects were varied, ranging from central scotomata, hemifield loss to constricted visual fields. Six out of 21 eyes (27 %) in Group II & III had visual field defects. Of these, 4 had previous history of optic neuritis. The field changes were also varied as in the eyes with poorer visual acuity. Distribution of the various field defects is shown in Table 3.

Visual evoked potential: All nine eyes in Group I had abnormal visual evoked potentials with

Figure 1: Graph showing cumulative data of eyes demonstrating diminished contrast sensitivity function.

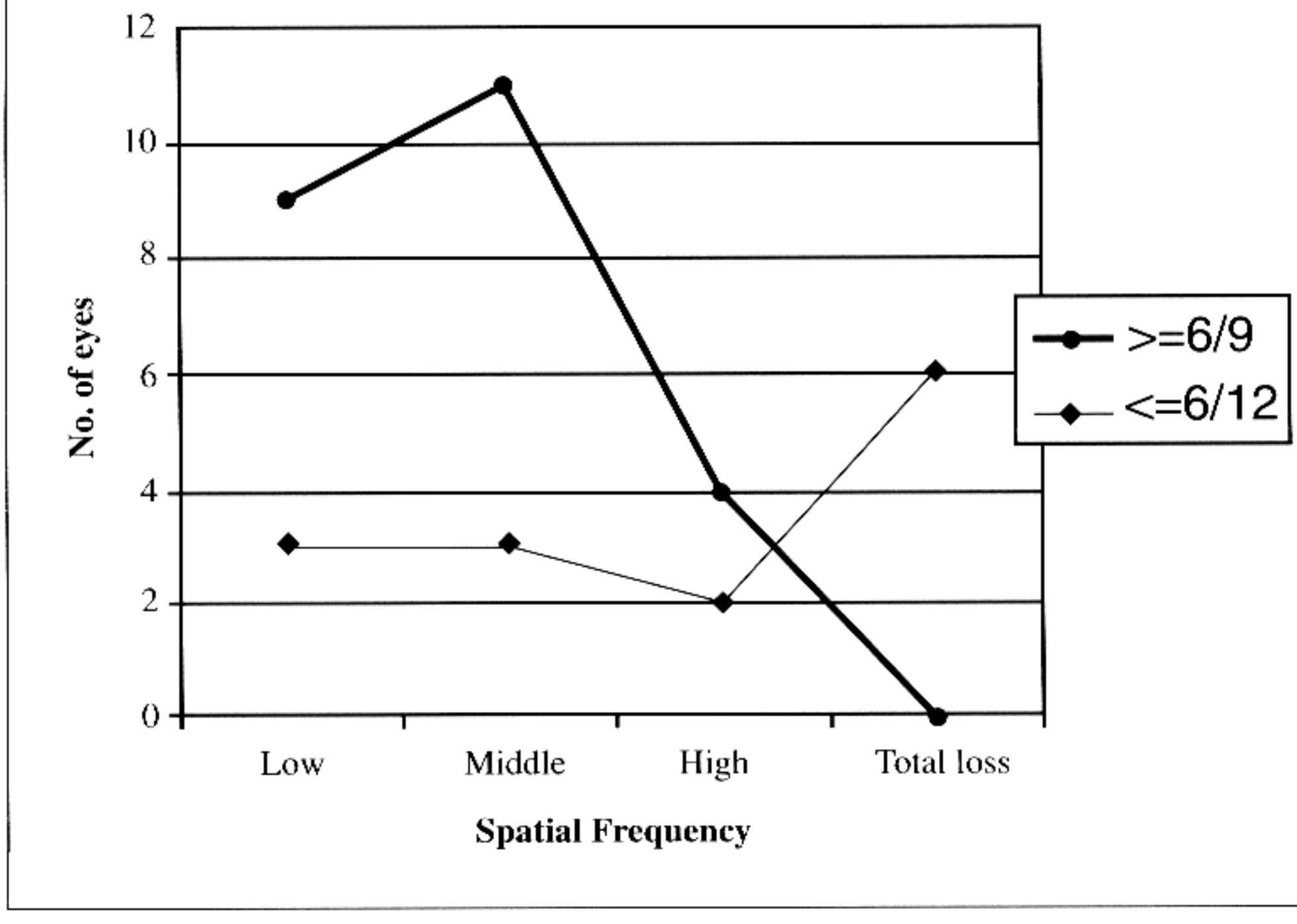

Table 3: Distribution of visual field defects with respect to visual acuity.

Visual field defects	No. of eyes	Visual acuity ≥6/9	Visual acuity ≤6/12
Normal	15	15	0
Peripheral rim	3	0	3
Paracentral	1	1	0
Arcuate	1	1	0
Nasal Hemianopia	1	1	0
Temporal Hemianopia	1	0	1
Central Scotoma	2	0	2
Enlarged blind spot	1	0	1
Inferior altitudinal	1	1	0
Multiple foci	3	2	1
Total loss	1	0	1
Total	30	21	9

delay or diminished P_{100} or both. Twelve out of 21 eyes (57 %) in Group II & III had visual evoked potential abnormalities. Out of these, 5 (42 %) did not have any previous attack of clinical optic neuritis. Of the 21 eyes (70%) with abnormal visual evoked potential overall, 12 (40%) had delayed and diminished P_{100}, 8 (27%) had delayed P_{100}, and only one eye (3%) had diminished amplitude of P_{100} only.

DISCUSSION

This study demonstrated that for Malaysians with MS, when tested with a battery of visual function test, subclinical neuropathy could be demonstrated in 100% of the patients following an episode of optic neuritis, and in the 67% of the contralateral "normal" eye. Comparison between the various visual function tests revealed that visual evoked potential and contrast

sensitivity function were the most sensitive, with sensitivity of 78% and 67% respectively. The two tests together was able to detect all the eyes that were abnormal. These results were comparable to that of Sanders et al, who found 100%, 88% and 67% of the "non-recovered" eyes, "recovered" eyes and unaffected eyes demonstrating defect in at least one of the three visual function tests, namely contrast sensitivity, colour vision and visual field.[26]

Most neurologists are familiar with visual evoked potential in demonstrating subclinical optic neuropathy. This study showed that contrast sensitivity is also a sensitive test to detect optic neuropathy. However, abnormal contrast sensitivity is not peculiar to MS as conditions such as glaucoma, amblyopia and lesions in the visual cortex can also produce such abnormalities.[27]. In this study, the depression of contrast sensitivity was mostly restricted to low and intermediate spatial frequencies with high spatial frequency being spared. This finding accounted for 95.2% of the total abnormalities seen in eyes with good visual acuity. The contrast loss in optic neuritis can be thought of as neural blurring, explaining why some patients report their vision as "washed-out". Patients with depressed low and intermediate spatial contrast sensitivity but had normal Snellen acuity might experience difficulty in seeing large objects in foggy weather. Regan et al also found more intermediate frequency losses among their MS patients with unaffected Snellen acuity, what they termed as a "medium-frequency notch".[27] On the other hand, Hess suggested that optic neuritis might be the only condition in which there is a "true loss of contrast sensitivity in its more general sense".[28] Unlike conditions such as amblyopia where selective contrast channel may be affected, in demyelinating optic neuritis, Hess found all contrast channels to be equally affected. However, Wray accepted that any of the spatial frequencies may be affected, either selectively, in combination or in total.[4] The type of contrast sensitivity loss may be correlated to the area of visual field being tested.[4,29] For example, contrast sensitivity deficit affecting the high spatial frequency may correspond to a central foveal field defect, while a perifoveal field defect may predominantly affect the intermediate spatial frequencies region. However, in this series no such correlation could be demonstrated. On the contrary, one eye with low to intermediate spatial frequency loss had normal visual field and another eye with all spatial frequencies evenly affected demonstrated only an enlarged blind spot.

As a diagnostic test, the 15-Hue colour vision test in this series was found to be much less sensitive in detecting previous optic neuritis and subclinical optic neuropathy. Moreover, the types of defects detected were so varied that no trend could be seen. However, other studies using Farnsworth-Munsell (FM) 100 Hue test, found sufficient accuracy in detecting acquired colour vision defects secondary to optic neuritis.[4,9,30] Although FM 100 Hue test may be sensitive in detecting subtle colour vision defects, it is not suitable as a routine test for MS patients. Rearranging 85 tiny chips in a regular colour sequence is not an easy task even for a normal individual. For MS patients hampered by their visual and motor disabilities, it can be a rather frustrating exercise.

The sensitivity of the Humphrey visual field test was also low and did not seem effective in detecting previous optic neuritis and subclinical optic neuropathy. Moreover, visual field defects encountered in the present series were inconsistent, with some patterns of field loss not classically associated with optic neuritis such as hemianopia and altitudinal field defects seen. These findings suggested that any part of the optic nerve may be involved in demyelination and that selective fibers in the nerve representing different parts of the retina may be affected separately. Reports of chiasmal neuritis and retrochiasmal plaques confirmed by magnetic resonance imaging and demonstrated corresponding visual field defects were rather interesting.[31,32]

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