Applicability of the King-Devick Test for Cognitive Impairment Detection in Patients with Multiple Sclerosis

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Introduction

Multiple Sclerosis (MS) is an autoimmune disease causing chronic inflammation and demyelination in the brain and spinal cord, facilitating deterioration of these nervous structures (Figures 1, 2). This results in not only motor-sensory deficits, but also specific qualities of cognitive impairment including decreased information processing speed, episodic memory, and executive function. The National MS Society recommends a combination of radiologic surveillance and serial evaluation with a validated cognitive screening test to identify and manage cognitive impairment in individuals with MS.

Currently used, common tests for cognitive impairment evaluation in MS include the Symbol Digit Modalities Test (5 minutes), Paced Auditory Serial Addition Test (5 minutes), Computerized Speed Cognitive Test (5 minutes), Multiple Sclerosis Neuropsychological Screening Questionnaire (5 minutes), and various Brief Assessment Batteries (15 – 90 minutes). We sought to determine the utility of the King-Devick Test, commonly used in sideline concussion protocol, in effectively identifying cognitive impairment in these patients (Figure 3). Usually taking less than 2 minutes to complete, the King-Devick Test may be an option to more conveniently and frequently screen people with MS while maintaining confidence in resultant indications of cognitive impairment status.

We used the Montreal Cognitive Assessment (MoCA) and the Symbol Digit Modalities Test (SDMT), both widely used measures of cognitive status, as a baseline evaluation for determining cognitive impairment in patients with MS as well as in a comparison group. We compared these results with the results of a subsequently administered King-Devick (KD) Test to determine if there was sufficient correlation between results to substitute this more rapid cognitive evaluation with currently accepted standards.

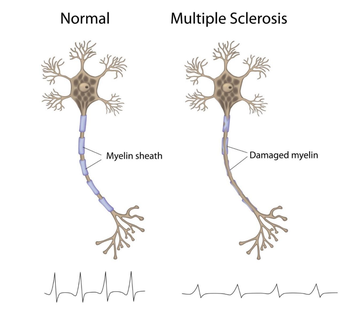

Figure 1

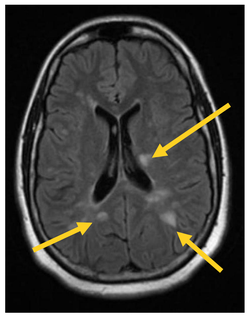

Figure 2

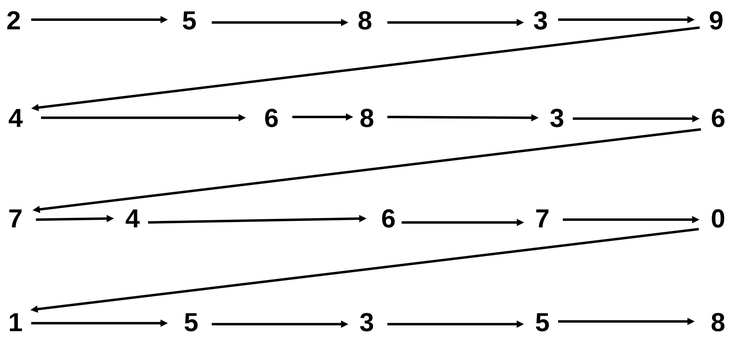

Figure 3

Participants

We recruited 77 individuals with MS and 34 control individuals without MS for our study. These were found to be a good representation of each other by one-way ANOVA (Table 1).

Characteristic	ANOVA F	Group	Minimum	Maximum	Mean (SD)
Highest Education (yrs)	0.061 (p = 0.072)	MS	9	20	14.68 (0.324)
		Control	9	20	14.53 (0.496)
Age (yrs)	3.306 (p = 0.072)	MS	19	71	47.32 (1.413)
		Control	26	71	51.97 (2.132)
			Value	**Frequency**	**Percent**
Gender	3.917 (p = 0.050)	MS	Male	14	18.2
			Female	63	81.8
		Control	Male	12	35.3
			Female	22	64.7
Race	0.296 (p = 0.588)	MS	Asian	1	1.3
			African American	21	27.6
			Caucasian	54	71.1
		Control	Asian	0	0
			African American	9	26.5
			Caucasian	25	73.5
Ethnicity	1.844 (p = 0.805)	MS	Hispanic	1	1.3
			Non-Hispanic	75	98.7
		Control	Hispanic	2	5.9
			Non-Hispanic	32	94.1

Table 1

Results – Cognitive Deficits

We were able to establish the ability of these tests to determine cognitive decline by comparing between the clinical and control groups, and measured the correlation between Expanded Disability Status Scale (EDSS) score and cognitive test scores.

The clinical group did not differ from the control groups on the MoCA. We did, however, find that the clinical group scored significantly worse on both the SDMT and KD tests.

Furthermore, we found that there was a significant correlation between EDSS scores and both SDMT and KD test scores (Table 2).

Test	F	*P*-score	EDSS
MoCA	1.5000	0.223	r = -0.171
SDMT	4.596	0.034	r = -0.409**
KD	3.188	0.077	r = 0.229*

*** Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level*

Table 2

Results – Test Correlations

We found significant correlations between the KD Test and both the MoCA (r=-0.378, p<0.01) and SDMT (r=-0.488, p<0.001) in the clinical group and in the control group (MoCA: r=-0.500, p<0.01; SDMT: r=-0.732, p<0.01) (Figure 4).

We further found the SDMT and KD Test to be significantly correlated with the Extended Disability Status Scale (EDSS) scores in our test group (SDMT: r=-0.409, p<0.01; KD: r=0.229; p<0.05). The SDMT was found to be correlated with education level (r=0.283, p<0.05), age (r=-0.289, p<0.05), and disease duration (r=-0.382, p<0.01).

The KD Test was not found to be significantly related to education level, age, or disease duration. The MoCA was only found to be significantly correlated with education level (r=0.277, p<0.05) of the variables measured.

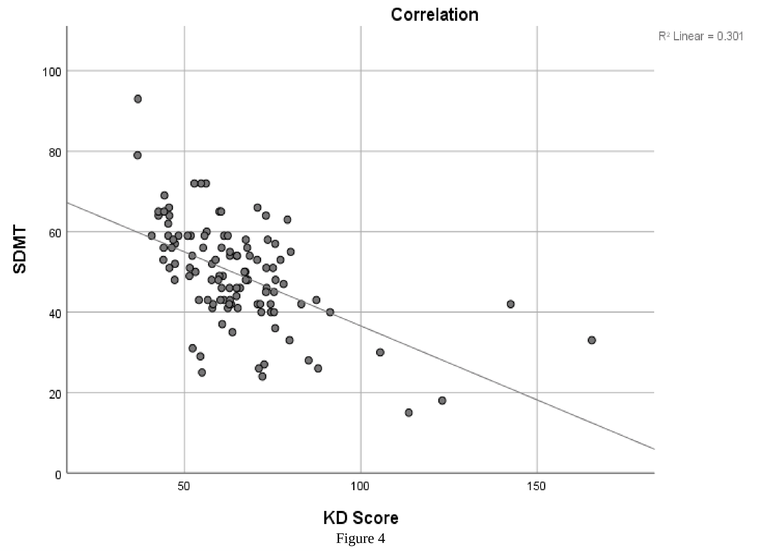

Figure 4

Conclusions

These results indicate that the SDMT continues to demonstrate utility in identifying cognitive impairment in individuals with MS, and suggest that the KD Test may also be an effective tool for determining impairment, while the MoCA may not be as useful to these individuals.

More extensive use of the KD test in a clinical setting could allow for more frequent testing and therefore more sensitive detection of cognitive decline in patient with MS.

These results could be further expanded through improved diversification in the individuals recruited in both the clinical and control groups. Although Caucasians of European decent have the highest MS prevalence, timely detection of cognitive decline is especially important in those individuals with limited access to healthcare.