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Short communication

Slowing of number naming speed by King–Devick Test in Parkinson's disease

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ABSTRACT

Background: The King–Devick (KD) test measures the speed of rapid number naming, and is postulated to require fast eye movements, attention, language, and possibly other aspects of cognitive functions. While used in multiple sports concussion studies, it has not been applied to the field of movement disorders.
Methods: Forty-five Parkinson's disease (PD), 23 essential tremor (ET), and 65 control subjects were studied. Subjects performed two trials of reading out loud single-digit numbers separated by varying spacing on three test cards that were of different formats. The sum time of the faster trial was designated the KD score and compared across the three groups.
Results: PD patients had higher (worse) KD scores, with longer reading times compared to ET and control subjects (66 s vs. 49 s vs. 52 s, $p < 0.001$, adjusting for age and gender). No significant difference was found between ET and control ($\Delta = -3$ s, 95% CI: −10 to 4).
Conclusions: This is the first study of the King–Devick Test in Parkinson's disease. PD patients were found to have a slower rapid number naming speed compared to controls. This test may be a simple and rapid bedside tool for quantifying correlates of visual and cognitive function in Parkinson's disease.

1. Introduction

Non-motor symptoms are well recognized in Parkinson's disease (PD) patients, even early in their disease process. Although clinicians routinely assess many non-motor symptoms such as those involving cognition, mood, and sleep, visual complaints are rarely evaluated quantitatively. PD patients frequently complain of blurred vision, double vision, and difficulty with reading. The underlying cause of these visual symptoms is not always well understood as many of these patients have normal or near normal visual acuity.

In addition to limb and axial motor symptoms, PD patients have ocular motor abnormalities. Studies have reported abnormal visual scanning [1], saccadic eye movement impairment [1,2], and deficiency in eye movement planning and target anticipation [2,3] in PD. Existing literature mainly focuses on laboratory recordings using electro-oculography or video-based eye tracking systems to examine saccades, antisaccades, ocular pursuit, and fixation tasks as quantitative parameters for ocular motor evaluation. The study of eye movements is important because it provides powerful insights into neural control of volitional and reflexive processes [2]. However, since specialized equipment is required, the current eye movement studies are often done in research setting instead of clinical practice, and patient access may be limited.

The objective of our study was to find an easy-to-use quantitative bedside tool to evaluate visual function of PD patients. The King–Devick (KD) test is a rapid number naming test that requires saccadic eye movements to perform, and is postulated to also capture attention, language, and possibly other aspects of cognitive function according to recent sports-related concussion research [4,5]. This test takes about 2 min to perform and can be done in a routine office visit. To our knowledge, this is the first study using the KD test to evaluate ocular motor function of Parkinson's disease patients.

2. Patients and methods

2.1. Subjects

Forty-five PD, 23 essential tremor (ET), and 65 control subjects were studied. Subjects were tested in the movement disorders

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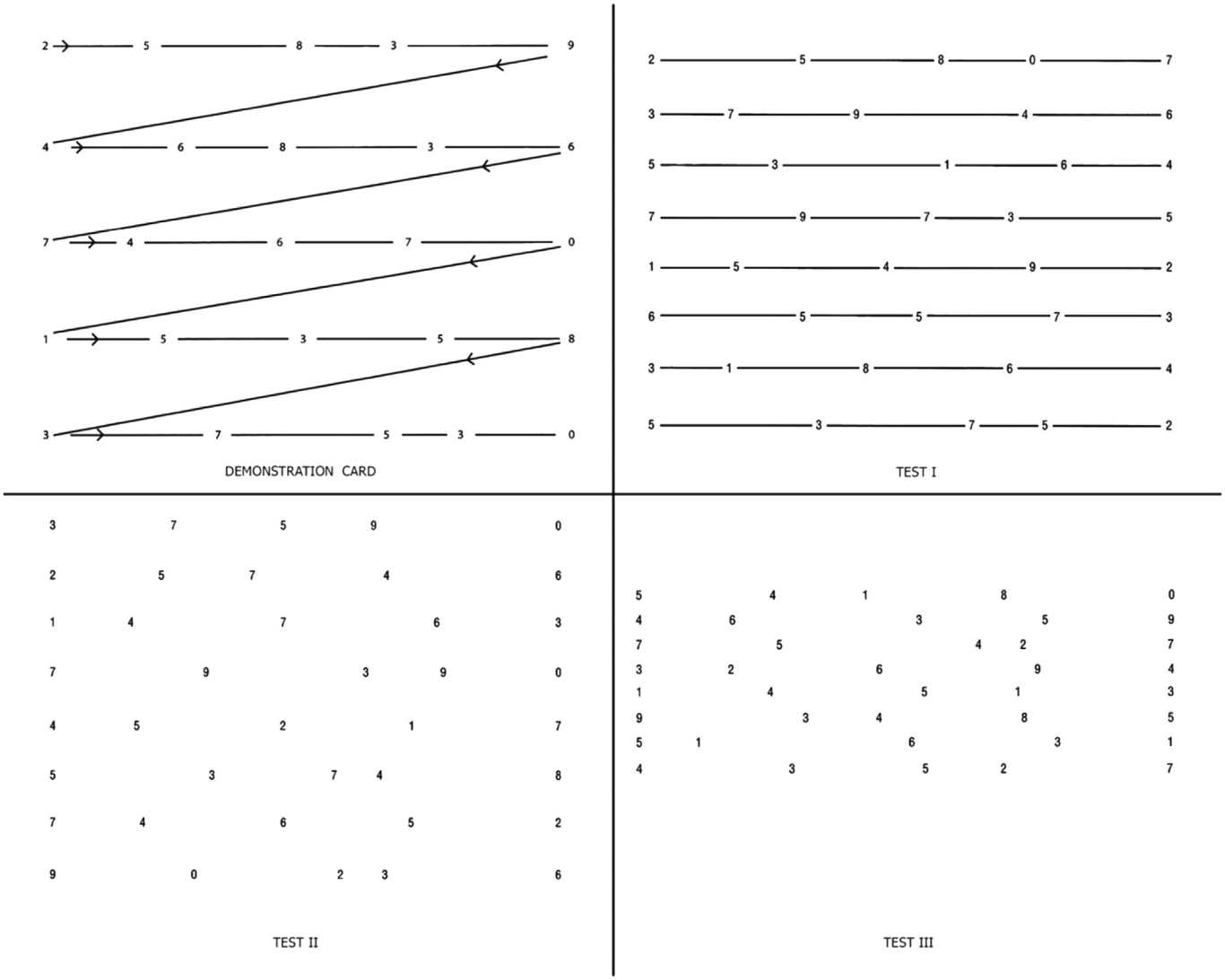

Fig. 1. Demonstration and test cards for the King–Devick (KD) Test for rapid number naming. To perform the KD test, participants were asked to read the numbers on each card from left to right as quickly as possible without making any errors. Following completion of the demonstration card (upper left), subjects are then asked to read each of the three test cards in the same manner. The times required to complete each card were recorded in seconds using a stopwatch. The sum of the three test card time scores constitutes the summary score for the entire test, the KD time score.

clinic at Mayo Clinic Arizona, or in the Arizona Study of Aging and Neurodegenerative Disorders (AZSAND) by the Arizona PD Consortium/Banner Sun Health Research Institute Brain and Body Donation Program. All participants signed written informed consents approved by the institutional IRBs. PD was clinically diagnosed according to the UK Brain Bank criteria, i.e., the presence of two of three cardinal features (resting tremor, bradykinesia, and rigidity) without atypical features (including early falls, early dementia, gaze palsy, early marked autonomic disturbance, fluctuating confusional states) or obvious secondary cause (such as stroke, drugs, toxins, arthritis). Subjects with dementia and those with a history of macular degeneration, glaucoma, untreated cataracts, or blindness were excluded from the study. Subjects were permitted to wear corrective lenses. The Unified Parkinson's Disease Rating Scale (UPDRS) was performed for all subjects.

2.2. King–Devick test

The King–Devick test consists of a demonstration card and three test cards with a series of single-digit numbers separated by varying spacing, either with or without a connecting line between numbers (Fig. 1). Participants started with a demonstration card and read the numbers out loud from left to right and top to bottom, as quickly as possible and without making errors. The three test cards were then read in order in two consecutive trials. The sum time of the three test cards from the faster trial was designated the final test score. Accuracy was important; if errors were not immediately corrected, the score was not valid. The mean KD scores from the three groups were compared by single factor analysis of variance. Adjusted means were compared by using a generalized linear model with terms for age and gender.

3. Results

PD subjects were younger (mean ± SD, 73.1 ± 8.4 years) compared to ET (80.8 ± 4.8 years) and control subjects (80.0 ± 6.3 years). There were more men in the PD group (67% PD vs. 43% ET vs. 32% Control). Disease duration for the PD group was 7.2 ± 5.9 years (range 1–25 years). The mean UPDRS part III score was 20.5 ± 11.8, and Hoehn and Yahr staging was 2.2 ± 0.7.

The mean KD score for PD (63 ± 18 s) was higher (worse) compared to scores for ET (51 ± 13 s) and control subjects