



ORIGINAL ARTICLE

Assessment of neuro-optometric rehabilitation using the Developmental Eye Movement (DEM) test in adults with acquired brain injury

Neera Kapoor^{a,*,c}, Kenneth Joseph Ciuffreda^b

^a New York University's School of Medicine's Department of Rehabilitation Medicine, New York University's Langone Medical Center's RUSK Rehabilitation, 240 East 38th Street, Room 15-32, New York, NY 10016, United States

^b State University of New York, State College of Optometry, 33 West 42nd Street, New York, NY 10036, United States

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KEYWORDS

Traumatic brain injury (TBI);
Cerebral vascular accident (CVA)/stroke;
Developmental Eye Movement (DEM) test;
Eye movements;
Neuro-optometric rehabilitation

Abstract

Purpose: This pilot study sought to determine the efficacy of using the Developmental Eye Movement (DEM) test in the adult, acquired brain injury (ABI) population to quantify clinically the effects of controlled, laboratory-performed, oculomotor-based vision therapy/vision rehabilitation.

Methods: Nine adult subjects with mild traumatic brain injury (mTBI) and five with stroke were assessed before and after an eight-week, computer-based, versional oculomotor (fixation, saccades, pursuit, and simulated reading) training program (9.6 h total). The protocol incorporated a cross-over, interventional design with and without the addition of auditory feedback regarding two-dimensional eye position. The clinical outcome measure was the Developmental Eye Movement (DEM) test score (ratio, errors) taken before, midway, and immediately following training.

Results: For the DEM ratio parameter, improvements were found in 80–89% of the subjects. For the DEM error parameter, improvements were found in 100% of the subjects. Incorporation of the auditory feedback component revealed a trend toward enhanced performance. The findings were similar for both DEM parameters, as well as for incorporation of the auditory feedback, in both diagnostic groups.

Discussion: The results of the present study demonstrated considerable improvements in the DEM test scores following the oculomotor-based training, thus reflecting more time-optimal and

* Corresponding author.

E-mail address: Neera.Kapoor@nyumc.org (N. Kapoor).

^c At the time of the study, Dr. Kapoor was an associate clinical professor at SUNY-State College of Optometry with Dr. Kenneth J. Ciuffreda.

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PALABRAS CLAVE

Daño cerebral traumático (DCT); Accidente cerebro-vascular (ACV)/ictus; Prueba DEM (Developmental Eye Movement); Movimientos oculares; Rehabilitación neuro-optométrica

accurate saccadic tracking after the training. The DEM test should be considered as another clinical test of global saccadic tracking performance in the ABI population.

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Valoración de la rehabilitación neuro-optométrica mediante la prueba DEM (Developmental Eye Movement) en adultos con daño cerebral adquirido

Resumen

Objetivo: Este estudio piloto trató de determinar la eficacia del uso de la prueba DEM (Developmental Eye Movement) en la población adulta con daño cerebral adquirido (DCA) para cuantificar clínicamente los efectos de la rehabilitación/terapia visual controlada, realizada en laboratorio, y de carácter oculomotor.

Métodos: Se valoraron nueve sujetos adultos con daño cerebral traumático leve (mTBI) y cinco con ictus, con anterioridad y posterioridad a un programa de entrenamiento de ocho semanas, informático oculomotor y versional (movimientos de fijación, sacádicos, de persecución y lectura simulada, de 9,6 horas en total). El protocolo incorporó un diseño cruzado e intervencional, con y sin adición de retroalimentación auditiva en relación a la posición bi-dimensional de los ojos. La medida del resultado clínico se llevó a cabo mediante la puntuación de la prueba DEM (Developmental Eye Movement) (ratio, errores) realizada con anterioridad, en el punto medio, e inmediatamente tras el entrenamiento.

Resultados: Para el parámetro de ratio DEM, se encontraron mejoras en el 80-89% de los sujetos. Para el parámetro de error DEM, se encontraron mejoras en el 100% de los sujetos. La incorporación del componente de retroalimentación auditiva reveló una tendencia hacia la mejora del rendimiento. Los hallazgos fueron similares para ambos parámetros DEM, así como para la incorporación de la retroalimentación auditiva, en ambos grupos diagnósticos.

Discusión: Los resultados del presente estudio demostraron mejoras considerables de las puntuaciones de la prueba DEM tras la terapia oculomotora, lo que refleja una mayor optimización y precisión del seguimiento sacádico en el tiempo tras la terapia. Deberá considerarse la prueba DEM como una prueba clínica para valorar el rendimiento del seguimiento sacádico global en la población de DCA.

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Introduction

The topic of "concussion" has been prominent over the past decade in both the medical literature and popular press, in part due to publicity in the sports arena, especially regarding football.^{1,2} It is estimated that there are 300,000 sports-related concussions annually in the United States.³ Moreover, there is evidence that after having incurred even a single concussion, the visual system can be adversely affected in 15% of these individuals.⁴ Further, a concussion can lead to visual system signs and symptoms of both a short- and long-term nature.⁵ Lastly, having a first concussion increases the probability of subsequent ones,⁶ perhaps due to reduced attentional capacity and impaired vigilance, as well as possible concurrent dizziness and vestibular problems.

The diagnosis of a concussion is critical in contact sports, such as football and hockey, where such decisions frequently are made rapidly on the sidelines based on simple verbal query and/or gross visual observation of the player.

If not diagnosed properly, it could lead to a subsequent concussion in the same game, with potentially longer-term consequences, as mentioned earlier. Several ideas have been put forth regarding making a tentative sideline concussion diagnosis, including the use of objective pupillometry,^{7,8} cognitive testing,⁹⁻¹¹ near point of convergence,^{12,13} distance vergence facility,¹⁴ and global saccadic eye movement assessment,^{10,15,16} with the last typically employing the King-Devick (K-D) test.^{11,17} The K-D test provides a simple, rapid, and quantitative manner for such assessment and analysis that was developed in 1976.¹⁸ However, it does not differentiate between a pure oculomotor deficit and a problem of random automated naming (RAN). Thus, a subsequent test was developed in 1990¹⁹ and used in the assessment of general oculomotor problems, especially as related to reading, namely the Developmental Eye Movement (DEM) test. It is similar to the K-D test, but it circumvents this potential RAN problem.

The present *pilot* investigation sought to determine if the DEM test could be used in both the adult concussion/

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