Brief Report

Preliminary study for Neurovisual Assessment Model using Eye Tracking (NAMET) related to cognitive functions for TBI patients

Abstract

Introduction: Traumatic brain injury can cause visual dysfunction (if not treated with visual therapy) and it can hinder a patient's rehabilitative progress. Screening for a Visual processing assessment to identify visual symptoms in TBI patients at the HCFMUSP Neurology Clinic. Previous literature presents common visual symptoms that were identified in these patients, such as:

- visual field loss;
- double vision;
- posture and balance difficulties;
- blurred vision;
- attention and concentration problems;
- difficulties in near visual tasks;
- headaches;
- reading difficulties;
- reading problems;
- motor coordination problems;
- difficulties locating objects accurately;
- accommodative dysfunction;
- convergence insufficiency

This study presents a Neuro Visual assessment model for visual and cognitive rehabilitation post - TBI and it can include Visual Acuity (VA) Visual Field, eye movements (Eye Tracking), Accommodation and Convergence.

Results: In the preliminary study, similarity was found between existing literature and visual dysfunctions from patients post - TBI.

Conclusion: The assessment protocol post - TBI can identify changes in saccadic eye movements, segments and their impacts on cognitive functions, sensory, motor and emotional systems. The treatment to improve visual dysfunctions can improve Reading problems; oculomotor, balance and binocular disorders using prisms, lenses and filters for both attention and concentration difficulties. Literature shows cases of improvement post-TBI visual symptoms using nonfunctional lenses, prisms, filters, binasal occlusions. Previous literature can found cases of improvement of depressive symptoms, aggressive behavior, self-confidence, self-esteem, posture and balance.

Keywords: visual disorders, visual impairment, severe TBI, neuro-optometry

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Introduction

Traumatic brain injury affects over 1 million people a year in Brazil and more than 1,700,000 people in the United States each year.[1] Neurovisual Assessment Model using Eye Tracking (NAMET) identifies how visual information is processed in the brain. The Neurovisual Assessment Model is an important tool to identify symptoms or visual signs such as visual field loss, double vision, difficulties in posture and balance, blurred vision, difficulty maintaining attention and concentration on near visual tasks, headaches, reading difficulties, motor coordination problems, difficulties in locating objects accurately.

These neurovisual signs and symptoms cause a negative impact for TBI patients' quality of life and also in patient's visual perception and their mood.[2–8]

Objective

To standardize NAMET for TBI patients and a secondary objective is to review the literature about visual symptoms for TBI patients at cognitive rehabilitation process to compare with actual evaluated patients.

Methods

Longitudinal study evaluated 10 TBI patients at cognitive rehabilitation stage to assessment some visual functions. Analysis of the data available from June 2017 to December 2019 was performed. All information used to analyze post TBI patients in Brazil are from ICHCSP (Central Institute from Hospital das Clinicas in São Paulo). All excluded patients were those who suffered "eye trauma or had any pathologic eye condition," considering these injuries to be less specific to TBI.

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Neuro Visual Assessment Model for visual and Neuro Cognitive Rehabilitation post - TBI can include:

- Visual Acuity (VA)[2,4,9]
- Visual Field,[4,5,8]
- Oculomotricity (Eye Movements with Eye Tracking),[5,10–13]
- Accommodation[14–20]
- Convergence,[14,21]
- Pupillary reflex,[4,22–26]

The Visual Acuity Test was performed at a distance of 1 meter and at a near distance of at least 30 cm using a low vision table called ETDRS and LEA TEST and Rosenbaum Near Vision Card (Near Chart). Damato's Test, Confrontation Test and Funcional Visual Campimetry were used to evaluate Visual Field Function.[11,28]

In the evaluation of Smooth Pursuit (or just Pursuit - class of rather slow eye movements that minimizes retinal target motion) it suggested to use eye tracking or NSUCO Test. Accommodation was measured using the Near Point of Accommodation (NPA) and Convergence test, evaluated by the Near Point of Convergence (PPC) test.[14,21]

Image 1 Eye tracking Device: Neurokinects

Results

NAMET evaluated alterations in eye movements (saccadic, smooth pursuits and fixation) not visible in subjective tests without the use of the Eye Tracking Device but it was not able to use eye tracking with severe TBI patients.

Post-TBI visual symptoms:

Binocular Visual Deficit (80%)

Photophobia (75%)

Accommodation and Convergence Problems (70%)

Diplopia (50%)

Reading Deficit (50%)

Oculomotor Deficits (80%)

Visual Field Loss (20%)

Conclusion

In some cases, visual rehabilitation improves cognitive rehabilitation (with a transdisciplinary team) improving visual acuity, using prisms, lenses and filters, improving the patient's reading time, oculomotricity, balance, posture performance and proprioception for visual dysfunctions after TBI. Patients can identify the changes in saccadic eye movements, smooth pursuits and their impacts on cognitive functions, sensory, motor and emotional systems.

Treatment for visual dysfunctions can improve Reading Problems; oculomotor dysfunctions, balance and binocular disorders using prisms, lenses and filters for both attention and concentration difficulties.[18,29–33] Literature shows cases of improvement post-TBI visual symptoms using nonfunctional lenses, prisms, filters, binasal occlusions, cases of improvement of depressive symptoms, aggressive behavior, self-confidence, self-esteem, posture and balance.[4,13,31,32,34–36]

Acknowledgments

None.

Conflicts of interest

The author declares no conflicts of interest.

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