INTRODUCTION

Traumatic Brain Injury

• Traumatic brain injury (TBI) is one of the major health care concerns in the United States [1].
• Since ~70-80% of TBI is of the “mild” variety, most research has been conducted in that population [2].
• To diagnose objectively visual dysfunctions in the mTBI population, researchers have used the VEP to assess brain damage occurring in the early afferent visual pathway [3, 4, 5].

Visual Evoked Potential (VEP)

• The visual-evoked potential (VEP) refers to an electrical signal generated over the primary visual cortex (V1) in response to a time-kicked visual stimulus.
• The VEP is an objective, rapid, repeatable, and non-invasive method to assess functionality and integrity of the retina and early-afferent, visuo-cortical pathways [6].
• Due to its objective nature, this technique has proven to be beneficial for special populations (e.g., infants and young children, non-verbal patients, and cognitively-challenged patients) [6].
• Critical VEP parameters include check size, contrast, luminance, and temporal frequency [6].
• Two parameters with particular physiological and clinical importance are check size and contrast, which are the main focus of the present study.

Check Size and Contrast

• These parameters are both important in assessing visual-pathway dysfunction in many retinal and neurological disease conditions [7].
• Optimization of these parameters is important to provide rapid and repeatable responses containing high information content.
• However, the literature results are equivocal regarding the effect of check size and contrast on the amplitude and latency of the visually-evoked potential (VEP) in the visually-normal adult population [8, 9, 10].
• Furthermore, VEP optimization has not been assessed in those with mTBI.

METHODS

• The purpose of the present investigation was to assess the effect of different check sizes and contrast levels on the VEP amplitude and latency in visually-normal individuals, as well as in those with mTBI.
• A primary goal was to optimize the above VEP test parameters in the mTBI population to improve their diagnostic capability and assessment of therapeutic efficacy in the future.

19 visually-normal adults (mean age 26±5.6 years) and 16 individuals with mTBI (mean age 27±5.1 years; 6 months to 10 years post-insult) participated in the study.

• Conventional full-field VEP testing was employed using the DIOPSYS™ NOVA-TR system (Dioptys, Inc., Pine Brook, New Jersey, USA) (17º H x 15º V stimulus size, 64 cd/m², 1 Hz temporal frequency, 1 meter distance, binocular viewing with spectacle correction) with three different check sizes (10, 20, and 40 min arc) and at two contrast levels (20% and 85%).
• Test duration was 20 seconds for each trial. The average of four trials for each of the 6 test conditions (i.e., 3 check sizes X 2 contrast levels) was used in the analysis. All 6 test conditions were counterbalanced.

RESULTS

Group VEP amplitude: Visually-normal and mTBI

• There was an significant effect of check size and contrast on amplitude in both groups (Figure 1a and 1b).
• In visually-normal, at both contrasts, the 20 min arc amplitude was significantly larger than for 40 min arc.
• In mTBI, at high contrast, the 20 min arc amplitude was significantly larger than for 40 min arc, but not at low contrast.

Group VEP latency (P100): Visually-normal and mTBI

• There was a significant effect of check size and contrast on latency in both groups (Figure 2a and 2b).
• In both the visually-normal and mTBI groups, at both contrast levels, the response latency for the 10 min arc check size was significantly longer than that found for the 40 min arc check size. The VEP latency decreased exponentially with increase in check sizes in both the visually-normal (low, r = 0.89 and high, r = 0.86 contrast) and the mTBI (low, r = 0.83 and high, r = 0.83 contrast) populations.

CONCLUSIONS

• Use of the 20 min arc check size at both contrast levels represents an optimal clinical VEP test protocol in both the visually-normal and mTBI groups: thus, a common stimulus combination produced the largest VEP amplitude, in conjunction with normal latency values, at the 20 min arc check size at both contrast levels.
• Correlation using the 20 min arc check size at low contrast may be helpful to estimate the natural, cortically-based recovery time in those with mTBI having memory, cognitive, and/or verbal limitations.
• This protocol is rapid, high yield, and specially targeted for the visually-normal and mTBI populations.
• It only takes 10-15 minutes to complete testing in a patient.

REFERENCES


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