EFFECT OF TRANSCRANIAL DIRECT CURRENT STIMULATION ASSOCIATED WITH PROPRIOCEPTIVE EXERCISES IN CHILDREN AND PRE-ADOLESCENTS WITH ACQUIRED AND CONGENITAL VISUAL IMPAIRMENT: RANDOMIZED CLINICAL TRIAL

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SUMMARY

In the absence of information from the visual system, balance is guided by only two of the three afferent systems. If there is no early stimulation of these systems, blind children tend to become passive, which can have a negative impact on muscle tone, coordination, and balance. The objective of the present study was to analyze whether transcranial direct current stimulation (tDCS) is capable of enhancing the effects of static and dynamic proprioceptive exercises on gait and balance control in children and pre-adolescents with acquired or congenital visual impairment. The study will be conducted after approval by the Research Ethics Committee of the Evangelical University of Anápolis, Anápolis, GO, Brazil (certificate number: 4610052.6.0000.5076). The study will be divided into three phases. Phase 1 will be a cross-sectional study for the characterization of gait, postural control, and balance (static and dynamic) in the sample. Phase 2 will be a pilot study that will serve to determine the sample size for Phase 3. Both phases 2 and 3 will employ the same methods and will constitute a randomized, controlled, double-blind clinical trial. The participants will be randomly divided into four groups: G1) Active TENS + static proprioceptive exercises; G2) simulated TENS + static proprioceptive exercises; G3) active TENS + dynamic proprioceptive exercises; G4-sham TENS + dynamic proprioceptive exercises. The results will be based on evaluations conducted at three time points (pre-intervention, post-intervention [after ten treatment sessions], and one-month follow-up) and will involve three-dimensional gait analysis, as well as

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assessments of functional mobility and balance (static and dynamic).
KEYWORDS: Children; Blindness; Transcranial stimulation; Gait.

Introduction

Body balance is derived from the interaction between various systems, such as visual, somatosensory, and vestibular, which are responsible for providing the central nervous system with feedback about position and adjustments to be made. In the absence of visual information, body balance is guided by only two of the three afferent systems (Matos et al., 2010). Blind individuals become more dependent on information derived from the vestibular and somatosensory systems to maintain balance control, while individuals with normal vision primarily rely on visual inputs (Häkkinen et al. 2019). In an attempt to maintain postural control to avoid falls, postural deviations are observed from childhood to old age, and even the adoption of compensatory postures for maintaining an upright posture, as well as influencing the gait pattern (Bortolaia et al., 2003 Hallemans et al., 2010).

Proprioceptive exercises are capable of improving balance, as well as promoting body stability through smaller displacements of the center of pressure and a faster recovery (Latash et al. 2003; Baldaço et al. 2010). In this way, proprioception and sensory information from the plantar skin surface are important sources of sensory systems for maintaining postural control under normal conditions for blind individuals (Bonfim and Barela, 2007). If there is no early stimulation for the blind child, they tend to become passive, which can lead to changes in tone, coordination, static and dynamic balance. Therefore, early intervention in these individuals is of utmost importance in order to reduce possible neuromotor delays (Farias, 2003).

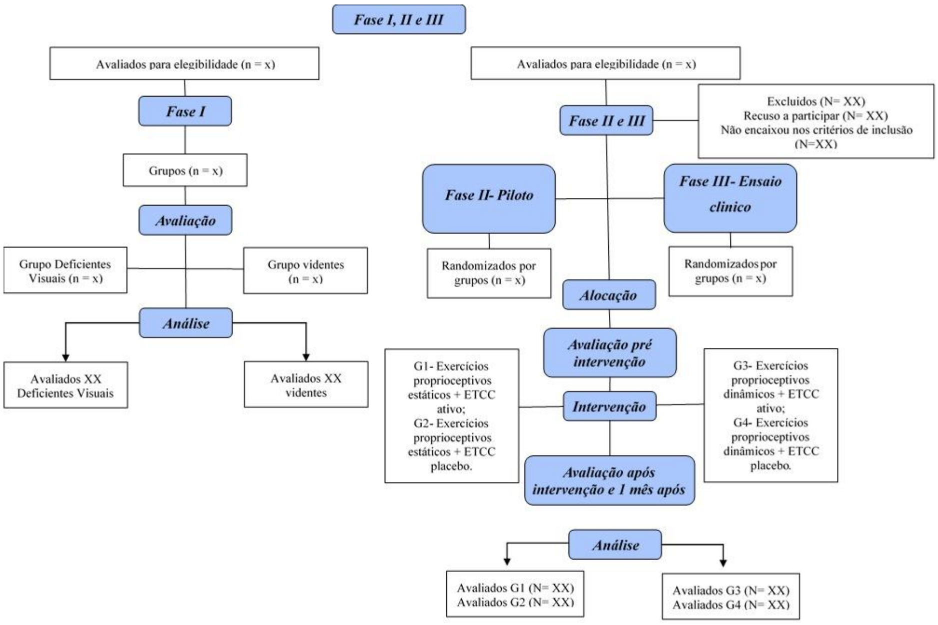
The combination of motor therapies with therapies that stimulate cortical motor areas can bring even more effective results. Transcranial direct current stimulation (tDCS), according to Zhou et al. 2014, is capable of acting on cortical networks during the execution of postural control and gait tasks through the modulation of cortical excitability, affecting motor function during a cognitive task. However, the effects of tDCS on children and pre-adolescents with visual impairment are still not fully known. Therefore, the objective of the present study is to analyze the effects of TCC associated with static and dynamic proprioceptive exercises on gait and balance control in children and pre-adolescents with acquired and congenital visual impairment.

Materials and Methods

The present study is a double-blind randomized clinical trial and complies with the Guidelines and Regulatory Norms for research involving human beings, formulated by the National Health Council, Ministry of Health, established in October 1996 and updated in resolution 466 in 2012, in Brazil. The study is approved by the Ethics Committee of the Evangelical University of Anápolis - UniEVANGÉLICA, Anápolis, GO (CAAE number: 4610052.6.0000.5076).

The sample will consist of children and pre-adolescents with acquired and congenital visual impairments who will be referred by professionals from the Municipal Center for Diversity Care (CEMAD) in the city of Anápolis, GO. Figure 1 shows the description of the study stages, according to Consort 2010.

Figura 1. Fluxograma do desenho do estudo com base no Consort.



Legend: G1 - active TENS + static propriocept exercises; G2 - placebo TENS + static propriocept exercises; G3 - active TENS + dynamic proprioceptive exercises; G4 - placebo TENS + dynamic proprioceptive exercises.
Source: Author's own.

Assessment instruments

The Timed Up and Go test is designed to assess functional mobility, measuring the in seconds that subjects need to stand up from a standard chair, walk in a straight lin a distance of 3 meters, turn around, return, and sit down again. The longer the time t to complete the test, the greater the impairment in the patient's functional mobility. A beginning of the test, the participant must remain with their back supported agains chair backrest, and must return to this position at the end of the test. You should only walking after the command "Time Up Go." The TUG will be conducted together with G-sensor inertial sensor, BTS Bioengineering. Through it, it is possible to accur quantify the time the individual took to complete the task (Podsiadlo & Richardson, 19 The Walk test is a walking test, in which the patient is asked to walk in a straight line meters. The test is conducted together with an inertial sensor, and from it, informatio be collected regarding space-time parameters; general kinematic parameters; symn index; propulsion index; kinematic pelvis.

To evaluate static balance with proprioceptive disturbance, the SMART-D 140® System (BTS Engineering) containing two Kistler Platform model 9286BA force platforms will be used. The participants will be instructed to stand in a static position, with their arms along their body and their heads in a vertical position. Measurements of 45 seconds of COP displacement on the X (antero-posterior) and Y (medio-lateral) axes and COP-GOG. The test will be conducted under four distinct conditions, namely: analysis of static balance with proprioceptive perturbation (which is configured with a soft surface) with eyes open; analysis of static balance with proprioceptive perturbation with eyes closed; analysis of static balance without proprioceptive perturbation with eyes open; analysis of static balance with eyes closed (Figure 2).

For the gait assessment, the SMART-D 140® system (BTS Engineering) will be used, consisting of eight infrared-sensitive cameras synchronized with a video system and a SMART-D INTEGRATED WORKSTATION® computer with 32 analog channels. Two force platforms (Kistler, model 9286BA) will be used for the collection of kinematic gait data, to capture the records of the center of pressure displacements and the foot contact time with the platform surface. At the time of gait analysis, participants should be dressed in swimwear (Kadaba et al., 1990). The electrical activity of the muscle will be collected simultaneously with the three-dimensional gait analysis system synchronized by a FREEEMG® electromyograph (BTS Engineering) containing eight channels of bioelectric signal amplifiers, through wireless data transmission (wireless system) and bipolar electrodes with a total gain of 2000 and within a frequency range of 20-450 Hz (Hermes et al., 1999).

Figure 2. Analysis of static balance with and without proprioceptive perturbation.

Caption: Patient performing static balance analysis on the Force Platform under two distinct conditions; a) without proprioceptive perturbation; b) with proprioceptive perturbation.
Source: Author's own.

Expected Results

The proposed study stands out for its originality, involving innovative techniques in the field of research and rehabilitation of the involved population. In this way, we believe that the results arising from this study will be disseminated with excellence in the scientific community, fostering growth and continuity in related research. One of the main expectations of the impact of the presented study refers to the potential of this innovative research in the context of the rehabilitation of this population, both as an intervention and as a method for evaluating therapeutic outcomes.

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