TRANSCRANIAL DIRECT CURRENT STIMULATION AND AUGMENTATIVE AND ALTERNATIVE COMMUNICATION FOR CHILDREN WITH CEREBRAL PALSY: A RANDOMIZED, DOUBLE-BLIND, CONTROLLED CLINICAL TRIAL

Amanda Macedo de Freitas Souza Ramos[1]
Paula Soares da Silva[2]
Sara Viana de Abreu Silva[3]
Caroline Priscila de Oliveira[4]
Rafael dos Anjos Silva[5]
Giselle Araujo Ferreira[6]
Marcele Paganoto Garcia Rodrigues da Silva[7]
Marcela de Oliveira Araújo[8]
Luanda André Collange [9]
Evangelical University of Goiás – UniEVANGÉLICA[1-9]

ABSTRACT

The objective of this research project is to compare the effects of ten speech therapy sessions using Augmentative and Alternative Communication (AAC) during transcranial direct current stimulation (tDCS) on the active dorsolateral prefrontal cortex and placebo in the Activity and Participation domain of the ICF of children with CP. This is a randomized, placebo-controlled, double-blind clinical trial involving 24 children diagnosed with CP, aged between 6 and 12 years. Participants will be assessed one week before, one week after, and one month after the end of the intervention, using the Communication Matrix, Pediatric Evaluation of Dysfunction Inventory, and the Participation and Environment Measure – Children and Youth. The experimental group will undergo speech therapy with AAC associated with the application of active anodal tDCS on the left dorsolateral prefrontal cortex. The control group will undergo speech therapy with AAC associated with placebo tDCS. The intervention will consist of ten sessions, conducted over two consecutive weeks, each lasting 20 minutes. Considering the potential effect of anodal tDCS on the left dorsolateral prefrontal cortex, it is expected that the intervention will increase the effect size of speech therapy with AAC in children with CP.

Keywords: cerebral palsy, child, communication, language, speech therapy, transcranial direct current stimulation.

Introduction

Cerebral palsy (CP) is a motor development disorder primarily resulting from brain damage in children up to two years of age. This health condition is chronic and changeable, with secondary musculoskeletal alterations. It can have intellectual, sensory, vestibular, visual, and auditory impacts (ROSENBAUM et al., 2007). This results in a condition that restricts the child's ability to perform activities and participate, impacting their functional performance in various ways (JACKMAN et al., 2022).

In addition to impaired motor functions, the rate of speech, language, and hearing impairment is quite high, resulting in lifelong communication deficits (AVAGYAN et al., 2021; ROSENBAUM et al., 2007). Previous studies have estimated that 30% to 80% of children with CP have communication impairments (AVAGYAN et al., 2021). Communication difficulties associated with CP can be multifactorial, resulting from motor, intellectual, and/or sensory impairments, and children with this diagnosis may have mild to severe difficulties expressing themselves. They are often referred to speech-language pathology services to maximize their communication skills and help them take on as independent a role as possible in interaction. This may include introducing Augmentative and Alternative Communication (AAC) systems, such as symbol charts or speech synthesizers, in addition to addressing children's natural forms of communication.

AAC is a means of communication, assisted or unassisted, that supports an individual's existing communication abilities or replaces natural speech due to any speech and language disorder (MILLAGER et al., 2024). According to the *American Speech-Language-Hearing Association* (ASHA), AAC is intended to compensate for and facilitate, either permanently or temporarily, impairments and disabilities in individuals with severe disorders of comprehension and expressive communication (gestural, speech, and/or written).

Advances in neuroscience show that the impairments observed in children with CP involve a set of neurophysiological impairments caused by a global reduction in subcortical activity that compromises the activity of corticospinal and somatosensory circuits, affecting the execution of movements and functional skills, such as communication (SHIN et al., 2012).

In this sense, non-invasive brain stimulation techniques are gaining increasing prominence in science and clinical practice in Brazilian rehabilitation services. Transcranial direct current stimulation (tDCS) is a noninvasive transcranial stimulation technique that has shown promising and encouraging results for the treatment of neurodevelopmental disorders (DORUK CAMSARI; KIRKOVSKI; CROARKIN, 2018).

In the rehabilitation process, tDCS aims to promote an increase in local synaptic efficacy by altering the maladaptive plasticity pattern that arises after cortical injury or dysfunction. It has been shown to promote subtle changes in

excitability, considered more physiological, as it alters the cell's membrane potential, facilitating or hindering depolarization without actually generating it. Therefore, a major benefit of using tDCS is the possibility of using it in conjunction with neurofunctional rehabilitation. Stimulation appears to be a way of modulating cortical activity, opening a pathway for increasing and prolonging the functional gains promoted by neurofunctional activity training (FREGNI et al., 2021).

However, scientific evidence analyzing the effects of tDCS application on this noble brain area during speech therapy interventions with AAC is limited. To date, no studies have been identified that analyze the effects of anodal tDCS on the left dorsolateral prefrontal cortex during speech therapy intervention with AAC in children with CP with moderate to severe communication impairment (CFCS level III–V). Thus, the objective of this study is to compare the effects of ten sessions of speech therapy with AAC during 20 minutes of active tDCS on the left dorsolateral prefrontal cortex versus placebo in the Activity (communication) and Participation domains of the ICF in children with CP.

Methodology

This is a randomized, placebo-controlled, double-blind clinical trial involving 24 children diagnosed with CP, aged between 6 and 12 years, who meet the eligibility criteria. Participants will be assessed one week before, one week after, and one month after the end of the intervention, using the Communication Matrix, Pediatric Evaluation of Dysfunction Inventory, and the Participation and Environment Measure – Children and Youth.

Participants will be randomly assigned to the experimental group and the control group. The experimental group will undergo speech therapy with AAC associated with the application of active anodal tDCS. The control group will undergo speech therapy with AAC associated with the application of placebo tDCS. Speech therapy with AAC will be performed using TD Snap software, with the modeling of five essential words (yes, no, stop, more, and I want). tDCS will be applied with the anode electrode positioned over the left dorsolateral prefrontal cortex and the cathode electrode over the right deltoid muscle. The intervention will consist of ten sessions, with a frequency of five sessions per week, conducted

over two consecutive weeks, each lasting 20 minutes. The results will be analyzed statistically.

Expected results

Considering the potential effect of active anodal tDCS, the intervention is expected to enhance the effect size of AAC use in children with CP, as well as optimize the effects of neurofunctional training on the ICF Activity and Participation domains, with only ten intervention sessions. The therapeutic approach studied may represent a paradigm shift in the neurofunctional rehabilitation of children with CP through an effective, low-cost, and short-term intervention.

Conclusion

The research project schedule involves the start of recruitment and assessment procedures in October 2024. The results obtained will be analyzed and presented in scientific articles.

References

AVAGYAN, A.; MKRTCHYAN, H.; SHAFA, F. A.; MATHEW, J. A.; PETROSYAN, T. Effectiveness and Determinant Variables of Augmentative and Alternative Communication Interventions in Cerebral Palsy Patients with Communication Deficit: a Systematic Review. **CoDAS**, v. 33, n. 5, 2021.

DORUK CAMSARI, D.; KIRKOVSKI, M.; CROARKIN, P. E. **Therapeutic Applications of Noninvasive Neuromodulation in Children and AdolescentsPsychiatric Clinics of North** America2018.

FREGNI, F.; EL-HAGRASSY, M. M.; PACHECO-BARRIOS, K.; CARVALHO, S.; LEITE, J.; SIMIS, M.; BRUNELIN, J.; NAKAMURA-PALACIOS, E. M.; MARANGOLO, P.; VENKATASUBRAMANIAN, G.; SAN-JUAN, D.; CAUMO, W.; BIKSON, M.; BRUNONI, A. R. **Evidence-Based Guidelines and Secondary Meta-Analysis for the Use of Transcranial Direct Current Stimulation in**

Neurological and Psychiatric Disorders International Journal of Neuropsychopharmacology 2021.

JACKMAN, M.; SAKZEWSKI, L.; MORGAN, C.; BOYD, R. N.; BRENNAN, S. E.; LANGDON, K.; TOOVEY, R. A. M.; GREAVES, S.; THORLEY, M.; NOVAK, I. Interventions to improve physical function for children and young people with cerebral palsy: international clinical practice guideline. **Developmental Medicine and Child Neurology,** v. 64, n. 5, 2022.

MILLAGER, R. A.; FELDMAN, J. I.; WILLIAMS, Z. J.; SHIBATA, K.; MARTINEZ-TORRES, K. A.; BRYAN, K. M.; PRUETT, D. G.; MITCHELL, J. T.; MARKFELD, J. E.; MERRITT, B.; DANIELS, D. E.; JONES, R. M.; WOYNAROSKI, T. Diversity of Research Participant Gender, Race, and Ethnicity in Communication Sciences and Disorders: A Systematic Review and Quantitative Synthesis of American Speech-Language-Hearing Association Publications in 2020. **Perspectives of the ASHA Special Interest Groups,** v. 9, n. 3, p. 836–852, June 3, 2024.

ROSENBAUM, P.; PANETH, N.; LEVITON, A.; GOLDSTEIN, M.; BAX, M. **A report: The definition and classification of cerebral palsy April 2006Developmental Medicine and Child** Neurology2007.

SHIN, Y. K.; LEE, D. R.; HWANG, H. J.; YOU, S. (Joshua) H.; IM, C. H. A novel EEG-based brain mapping to determine cortical activation patterns in normal children and children with cerebral palsy during motor imagery tasks. **NeuroRehabilitation,** v. 31, n. 4, p. 349–355, Nov. 12, 2012.