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

Amanda Macedo de Freitas Souza Ramos[11]
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]

SUMMARY

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

Keywords: cerebral palsy; child; communicatio; language; speech therapy; transcranial direct current stimulation.

1,2,3,4,5,6,7,8,9 E-mail contato: amandamacedojc@yahoo.com.br - Evangelical University of Goiás – UniEVANGÉLICA

Introduction

Cerebral palsy (CP) is a motor development disorder primarily resulting from brain injuries in children up to two years old. This health condition has a chronic and mutable nature, with secondary musculoskeletal alterations. It can present with intellectual, culminates in a condition that restricts the child from performing activities and participating, impacting their functional performance in different ways (JACKMAN et sensory, vestibular, visual, and auditory impacts (ROSENBAUM et al., 2007). Which al., 2022).

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

AAC is a communication method, assisted or not, that supports an individual's existing communication skills 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 permanently or temporarily compensate for and facilitate the impairments and disabilities of individuals with severe comprehension and expressive communication disorders (gestural, speech, and/or written). Advances in neuroscience demonstrate that the impairments observed in children with CP involve a set of neurophysiological impairments caused by a global reduction in subcortical activity, which compromises the activity of cortico-spinal 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 the science and clinical practice of Brazilian rehabilitation services. Transcranial direct current stimulation (tDCS) is a non-invasive 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, altering the pattern of maladaptive plasticity that arises after a cortical injury or dysfunction. It is shown to be capable of promoting changes in excitability in a subtle manner, considered more physiological, as it alters the cell's membrane potential, facilitating or hindering depolarization without actually generating it. For this reason, a significant benefit of using the tDCS technique is the possibility of its association with neurofunctional rehabilitation. Stimulation appears as a way to modulate cortical activity, paving the way for the increase and prolongation of functional gains promoted by the training of neurofunctional activities. (FREGNI et al., 2021). However, the scientific evidence analyzing the effects of tDCS application on this noble brain area during speech therapy interventions with CAA is limited.

So far, no studies have been identified that analyze the effects of anodal tDCS on the left dorsolateral prefrontal cortex during speech therapy interventions with AAC in children with CP, with moderate and severe communication impairment (level III – V of the CFCS). Thus, the objective of the study is to compare the effects of ten sessions of speech therapy intervention with CAA during 20 of tDCS on the active and placebo dorsolateral prefrontal cortex in the domain of Activity (communication) and Participation 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. The participants will be evaluated one week before, one week, and one month after the intervention, through the Communication Matrix, Pediatric Evaluation of Disability Inventory, and Participation and Environment Measure for Children and Youth.

The participants will be randomly assigned to the experimental group and the control group. The experimental group will undergo speech therapy intervention with

AAC associated with the application of active anodal tDCS. The control group will undergo speech therapy intervention with AAC associated with the application of placebo tDCS.

The speech therapy intervention with AAC will be carried out using the 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 involve ten intervention sessions, with a frequency of five sessions per week, conducted over two consecutive weeks and lasting 20 minutes each. The results will be analyzed statistically.

Expected results

Considering the potential effect of the application of active anodal tDCS, it is expected that the intervention will increase the effect size of the use of CAA in children with CP, as well as optimize the effects of neurofunctional training on the Activity and Participation domain of the ICF, with just ten intervention sessions. The therapeutic approach studied could represent a paradigm shift in the neurofunctional rehabilitation of children with CP, through an effective, low-cost, and short-duration intervention.

Conclusion

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

Bibliographic 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 America**2018.

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 DisordersInternational 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, 3 jun. 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 Neurology**2007.

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, 12 nov. 2012.