Motor effects of intervention with transcranial direct current stimulation (tDCS) for physiotherapy treatment in children with cerebral palsy: randomized clinical trial

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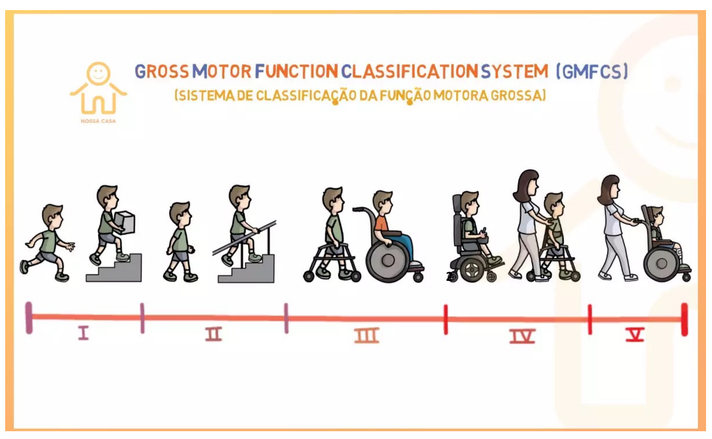
Introduction

Children with Cerebral Palsy (CP) may exhibit dysfunctions, including difficulty with gross motor function and impairment in activities of daily living (ADLs) (RETHLEFSEN, Susan A.; RYAN, Deirdre D.; KAY, Robert M 2010).

This study is a randomized clinical trial aiming to quantify whether the tDCS improves gross motor function in domain E of the Gross Motor Function Measure (GMFM) compared with sham in children with CP in the Gross Motor Function Classification System (GMFCS) I or II both using physiotherapy.

The GMFM is a tool to quantify movement skills of children with CP and Down Syndrome. The assessment is divided in five dimensions: Dimension A assesses lying down and rolling over; Dimension B, sit; Dimension C, crawling and kneeling; Dimension D, standing posture; Dimension E, walk, run and jump. Applied to children with CP, it is scored from 0 to 3 (0 = unable to start an activity; 1 = activity started; 2 = activity partially performed; 3 = complete activity).

The GMFCS allows a functional classification of walking, sitting and standing (RETHLEFSEN, Susan A.; RYAN, Deirdre D.; KAY, Robert M. 2010).



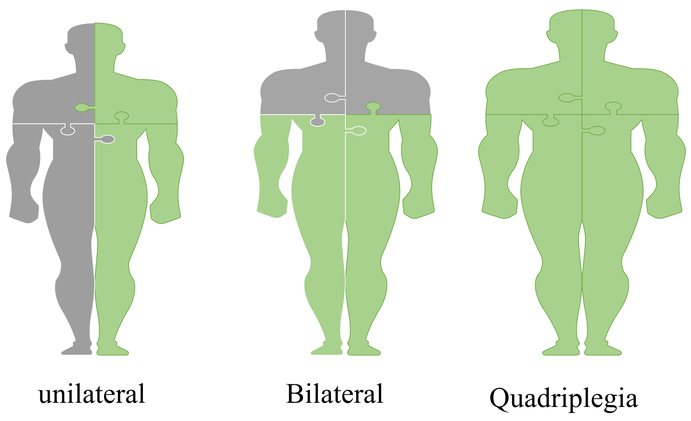
Gross Motor Function Classification System (GMFCS), https://nossacasa.org.br/gmfcs/

Population

CP has a wide range of clinical presentations. It is traditionally classified by motor type, by topography of motor impairment or by the degree of functional impairment. The four main types of CP are: spastic, dystonic, ataxic and hypotoni (NOVAK, Iona *et al* 2017).

Although spastic is the most common, many children have spastic and dystonic types at the same time. When it occurs, it is recommended to classify the child according to the most predominant type (RETHLEFSEN, Susan A.; RYAN, Deirdre D.; KAY, Robert M 2010).

As for topography, presentation varies between unilateral PC and bilateral PC. Treatment strategies differ between topography classification. It is worth emphasizing the difference between the neuromotor involvement of hemiplegia, diplegia and quadriplegia. Hemiplegia refers to the involvement of only one side of the body, diplegia is marked by the involvement of the lower limbs more intensely than the upper limbs. Quadriplegia, in turn, is the involvement of four limbs, although there is a difference in the severity of this impairment (BAX, Martin *et al* 2019).



unilateral Bilateral Quadriplegia

Inclusion Criteria - Population:

- Thirty children
- between 8 and 12 years old
- Diagnostic of a CP
- Both sexes
- GMFCS I/II
- walking independent
- compression of the commands

Intervetion

This project was ethically evaluated by the local ethical board on July 12, 2021. Each participant were included after a signed informed consent.

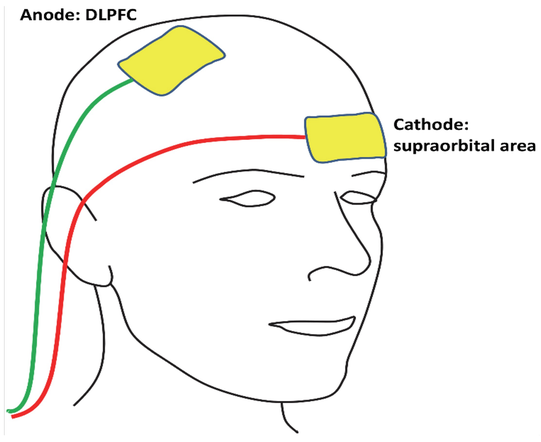
Initially, we will explain to the child how the intervention process will be carried out. The electrodes will be moistened in saline solution and will be placed on the participant's head, which may cause slight discomfort as it will wet the child's head and, to minimize this discomfort, we will frequently dry their face. Associated with this, the child will perform physical therapy exercises.

Control groups for tDCS (G1) experience sham mode stimulation for ten sessions to give the child an initial feeling of stimulation. Associated with the placebo, the child will perform neurorehabilitation activities, focusing on the demands of the GMFM dimension E. The tDCS intervention groups (G2), in turn, will expect a current of 1 mA for ten sessions also associated with neurorehabilitation, focusing on the demands of the GMFM dimension E.

The intervention lasts from 25 to 35 minutes with each participant followed by the research during all the sessions.

There will be five sessions with each participant per week over two consecutive weeks, using weekdays and saving the weekend. All participants prepared a session on the same day of intervention that completed up to ten sessions.

The anode will be set on the M1 of the participant's dominant hemisphere, according to the 10-20 System EEG Placement, while the cathode will be placed on the supraorbital region of the region contralateral to the anode. In the case of the experimental group, a current will be applied to M1 for 20 minutes associated with neurorehabilitation (BRUNONI, Andre Russowsky *et al* 2012).



After ten sessions, the GMFM test will be repeated. One researcher will carry out the intervention or the placebo with tDCS and the other researcher will evaluate the results blindly, without knowing which group is the intervention and which is the control. The use of the equipment and the evaluation will be carried out in different rooms in order to guarantee the researchers' blindness. Only the researcher in charge of using the tDCS will be aware of the allocation of children between experimental and control groups.

It is worth noting that the patients in the control groups learned, at the end of the study, the intervention that had the best effect on their motor function, respecting the study's ethical perspective that all children could receive the best treatment

Literature and conclusion

2000-2005 **65 vs. 1,500** 2011-2015

Popularity has grown greatly over the last decade

Number of publications in PubMed with the descriptor “tDCS”

- In the last 5 years 27954 items.
- Using the descriptor **tDCS** and **Cerebral Palsy** in the last 5 years has the 1.435 itens in the PubMed.

According to Lefebvre et al. (2015), the neuromodulation effects of tDCS on cortical excitability optimize motor learning and functional improvements in patients with neurological injuries, such as CP - being promising as a therapeutic technique to improve gait.

It has been proven that the use of tDCS has an effect on postural control, especially in reducing the displacement area. Studies in children with CP have shown positive effects compared to the control group in gait training with anodic tDCS on the primary motor cortex (M1) (DUARTE, Natália de Almeida Carvalho et al, 2014).

Recent studies show that tDCS seems to have good results in children with CP for balance, gross motor function and gait outcomes. The included population in many studies is always heterogeneous. Here, stimulation is being done on children without assistive support. Variability and heterogeneity of clinical presentation still demanding more studies to built consistent analysis/literature. Further studies still necessary to fully understand the improvement in the outcome of gross motor function with standardized measure in a targeted population.

References: RETHLEFSEN, Susan A.; RYAN, Deirdre D.; KAY, Robert M. Classification systems in cerebral palsy. **Orthopedic clinics**, v. 41, n. 4, p. 457-467, 2010. NOVAK, Iona et al. Early, accurate diagnosis and early intervention in cerebral palsy: advances in diagnosis and treatment. **JAMA pediatrics**, v. 171, n. 9, p. 897-907, 2017.BAX, Martin et al. Proposed definition and classification of cerebral palsy, April 2005. **Developmental medicine and child neurology**, v. 47, n. 8, p. 571-576, 2005.BRUNONI, Andre Russowsky et al. Clinical research with transcranial direct current stimulation (tDCS): challenges and future directions. **Brain stimulation**, v. 5, n. 3, p. 175-195, 2012.DUARTE, Natália de Almeida Carvalho et al. Effect of transcranial direct-current stimulation combined with treadmill training on balance and functional performance in children with cerebral palsy: a double-blind randomized controlled trial. **PloS one**, v. 9, n. 8, p. e105777, 2014.

Brainbox Initiative