Feasibility of remote transcranial direct current stimulation for pediatric cerebral palsy during the COVID-19 pandemic

Emma Simpson, Daniel Lench, PhD, Ellen Sutter, PT, DPT, Sunday M Francis, PhD, Bernadette Gillick PhD, MSPT, PT
Gillick Pediatric Neuromodulation Lab- University of Minnesota Department of Rehabilitation Medicine

BACKGROUND

- CP is caused by a congenital brain lesion with associated motor deficits which may result in lifelong disability[1]
- 3.6 per 1,000 children in US are affected by Cerebral Palsy (CP)[1]
- Physical and occupational therapy interventions can be costly and time intensive, with varying rates of success
- Transcranial direct current stimulation (tDCS) is a form of non-invasive brain stimulation (NIBS) that enhances therapy and pediatric rehabilitation interventions through neuroplasticity[3]
- COVID-19 stresses the importance for at home, remote neuromodulation interventions to optimize outcomes
- tDCS is ideal for remote neuromodulation: low cost, tolerable, portable, compatible with rehabilitation[4-6]
- Remote tDCS has been studied in adults with neurological disorders

OBJECTIVE

Can remote tDCS be successfully performed by a "parent-child" team without compromising the efficiency, quality and comfort of administration?

PARTICIPANT DEMOGRAPHICS

- 7 children (3 males, 4 females) with diagnosis of CP and motor disability. Ages 11-16 (13.86 years ± 1.8)
- Gross Motor Function Classification System
  - I (6/7) and II (1/7)
- All parents had high school/GED education level or higher

METHODS

Recruitment from Gillick Lab Database
(Inclusion criteria: children with history of CP/brain bleed)

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Virtual Meeting via Zoom
- Discussed study procedures
- Reviewed and obtained consent/assent via REDCap

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Sent supplies to family via USPS
- Soterix Medical SNAPstrap, mini-CT stimulator, sponge pads, alcohol wipes, measuring tape, pen

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Participants performed tDCS setup according to video instructions embedded in REDCap survey
- 3 consecutive days
- See expanded details in data collection panel
- Mean, standard deviation and ANOVA analyses were performed

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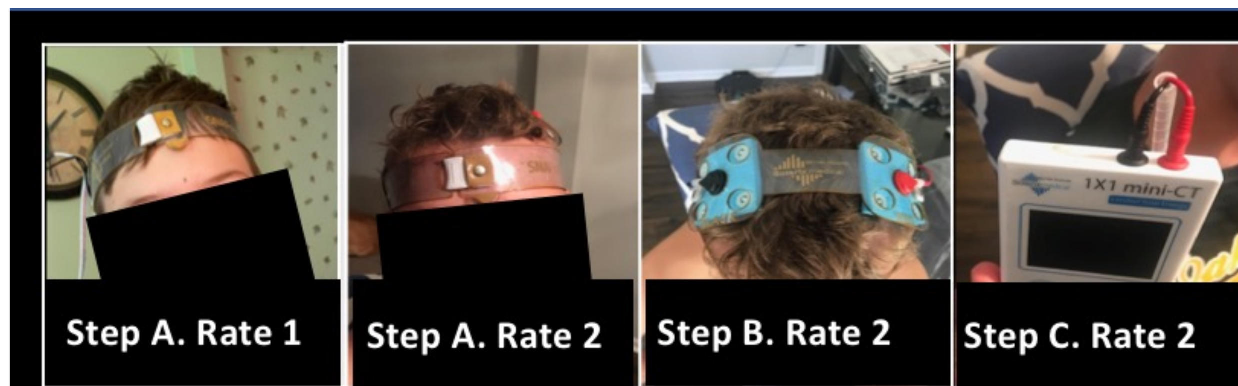
Virtual zoom meeting to receive feedback

RESULTS

QUALITY



Rating score	Step A.			Step B.			Step C.		
	Day			Day			Day		
	1	2	3	1	2	3	1	2	3
2 = complete	5/7	7/7	6/7	7/7	6/7	7/7	7/7	7/7	7/7
1 = incorrect	1/7	0/7	1/7	0/7	0/7	0/7	0/7	0/7	0/7
0 = incomplete	1/7	0/7	0/7	0/7	1/7	0/7	0/7	0/7	0/7

Figure 1. *Quality of tDCS setup tasks*. All images were rated on a scale of 0-2 to evaluate the quality of task completion (2:performed successfully; 1:performed incorrectly; 0:incomplete). Step A required alignment of Soterix tDCS head-strap with nasion of child. Step B required attachment of two electrode sponge pads to tDCS montage. Step C involved connection of the red and black electrodes to the mini-CT device. After the 10 minute sessions, the headgear moved on 1/7 participants on day one and three, and 4/7 participants on day 2. The average displacement for the sessions with movement was 0.73 cm $\pm$ 0.46.

EFFICIENCY

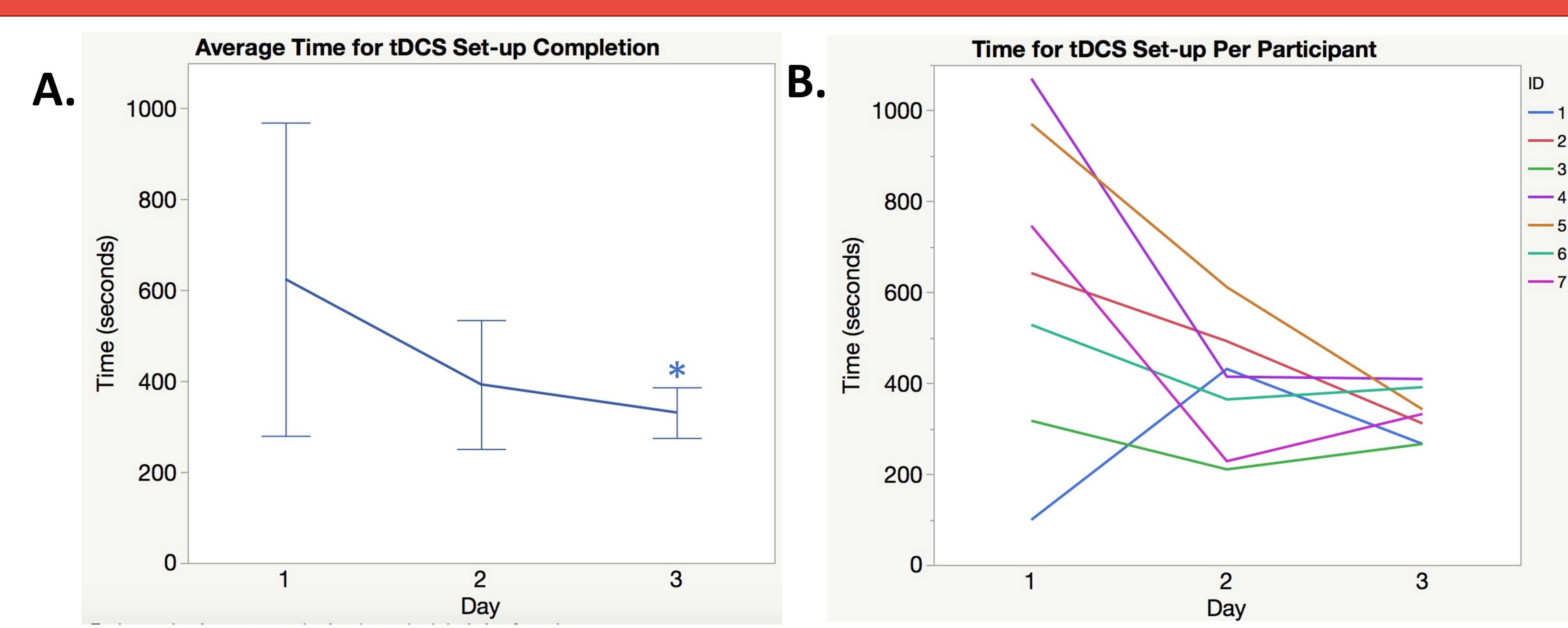


Figure 2. *Efficiency* **A.** *Average tDCS Setup Times.* The time (in seconds $\pm$ SD) to complete the tDCS set-up steps was 10 min 25 sec $\pm$ 344 (sec) on day 1, 6 min 33 sec $\pm$ 142 (sec) on day 2, and 5 min 31 sec $\pm$ 56 (sec) on day 3. A one-way ANOVA revealed a strong trend between day and time of completion (F (2,18)= 3.541, p=0.051). **B.** *tDCS Setup Times per participant*

COMFORT

Participant	Head circumference (cm)	Comfort of tDCS cap	Comments
1	52.6 cm	variable	"feels too tight", "pressure on forehead"
2	53 cm	comfortable	N/A
3	56 cm	slightly uncomfortable	N/A
4	54.6 cm	slightly uncomfortable	"head itches", "gives me a headache"
5	54 cm	slightly uncomfortable	N/A
6	53.3 cm	slightly uncomfortable	N/A
7	53.5 cm	slightly uncomfortable	"tightness on head"

Figure 3. *Comfort of tDCS headgear.* Participants are ordered by survey completion date.

Data Collection

Demographics
- age, child's gender, GMFCS mobility level, highest educational level of parent

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Instructional Video #1: Measurements
- Head circumference
- Distance from ear to ear
- Distance from nose to back of head

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Instructional Video #2: "mock" tDCS device setup
- Step A: Align arrow of tDCS headgear with nasion of nose 📷
- Mark locations of red/black electrodes on scalp
- Check scalp under electrodes for blemishes and clean area with alcohol swab
- Step B: Snap on two tDCS sponge pads to electrode markers 📷
- Step C: Plug in electrodes to mini-CT tDCS device 📷

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Leave tDCS setup in place for 10 minutes. Observe child's interaction with the device. Mark new arrow location after the 10 minutes.

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Debrief Questions
- Comfort
- Difficulty
- Area for improvement

📷 = Participants were instructed to upload an image of step performance

CONCLUSIONS

- Parent-child pairs have the ability to follow remote tDCS setup procedures with the guidance of instructional videos
- Efficiency increased by almost 50% after two days
- Parent-child pairs correctly positioned the device, although error of alignment occurred in one participant
- Future studies with tDCS remote stimulation delivery will lead to increased accessibility and participation in research
- Enables inclusion of families with limited access, mobility, and finances to access non-invasive brain stimulation (NIBS), particularly during COVID-19 pandemic

ACKNOWLEDGEMENTS

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