Combined Transcranial Direct Current Stimulation and Robotic Upper Limb Therapy Improves Upper Limb Function in Adults with Cerebral Palsy

K. M. Friel1,3, P. Lee1, H.-C. Kuo2, D. Gupta1, A. Barachant1, A. R.P. Smorenburg1, M. Marneweck2, D. J. Edwards1,3

1Burke Medical Research Institute, White Plains, NY; 2Teachers College, Columbia University, New York, NY; 3Weill Cornell Medical College, New York, NY

OBJECTIVE
To determine feasibility and efficacy of upper limb therapy plus excitatory tDCS for adults with cerebral palsy.

BACKGROUND
Cerebral Palsy is caused by a nonprogressive brain injury or stroke during the first two years of life. Unilateral spastic cerebral palsy (USCP) causes weakness and motor deficits on one side of the body. Few therapies exist for upper extremity rehabilitation in adults with USCP.

Robotic therapy has demonstrated significant reductions in impairment of the affected limb of stroke patients. Transcranial direct current stimulation (tDCS) is a safe, non-invasive technique for modulating neural excitability that is transient. TDCS can augment the efficacy of robotic therapy when delivered immediately before training.

PARTICIPANTS
- 37 y/o male; acquired left side USCP at age 18 months
- 25 y/o female; congenital right side USCP

STUDY DESIGN AND METHODS

Motor Outcomes:
- Wolf Motor Function Test
- Fugl-Meyer
- Grip Strength
- Robotic kinematics

Neurophysiology Outcomes:
- Motor mapping (transcranial magnetic stimulation) of the paretic hand representation
- Electroencephalography during motor task

Combined tDCS + Robotic Training: 3x/wk, 12 weeks (36 sessions)

SESSION PROCEDURES

tDCS: 2mA anodal, 20 min, targeted to motor map of paretic hand

Side Effects: Mild transient scalp tingling, headache. Dissipated <10 min.

Robotic Therapy: training of shoulder/elbow or wrist (alternating sessions), 1 hr, 1000 movements/session

FOLLOW-UP MOTOR AND NEUROPHYSIOLOGY OUTCOMES

Upper Extremity Motor Outcome Measures

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Participant #1 Before</th>
<th>Participant #1 After</th>
<th>Participant #2 Before</th>
<th>Participant #2 After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wolf Motor Function Test</td>
<td>45</td>
<td>52</td>
<td>51</td>
<td>55</td>
</tr>
<tr>
<td>Fugl-Meyer</td>
<td>10</td>
<td>13</td>
<td>40</td>
<td>46</td>
</tr>
<tr>
<td>Grip Strength Affected Hand</td>
<td>21 lbs</td>
<td>23 lbs</td>
<td>27 lbs</td>
<td>31 lbs</td>
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</tbody>
</table>

BASELINE MEASURES

Neurophysiology:
- 9 blocks - 10x right + 10x left per block

CONCLUSIONS
Robotic therapy combined with tDCS shows promise as a therapy to safely improve upper extremity deficits in adults with cerebral palsy.

Shoulder/Elbow Robot Reaching Accuracy

Accuracy in Drawing Circles

Suppression of Sensorimotor Rhythm (EEG)

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