EFFECTS OF CEREBELLAR THETA-BURST STIMULATION ON ARM AND NECK MOVEMENT KINEMATICS IN PATIENTS WITH PRIMARY DYSTONIA

Giulia Paparella[1], Matteo Bologna[2], Andrea Fabbrini[1], Giorgio Leodori[1], Giovanni Fabbrini [1-2] & Alfredo Berardelli[1-2]

[1]Department of Neurology and Psychiatry, Sapienza University of Rome, Italy
[2]Neuromed Institute IRCCS, Pozzilli (IS), Italy

BACKGROUND

- The pathophysiological mechanisms of dystonia are still not entirely clear.
- Dystonia is classically considered a disorder of basal ganglia but clinical, neuroimaging and neurophysiological evidence suggest a possible involvement of the cerebellum in this condition (Sadnicka et al., 2012).

OBJECTIVE

- To investigate the cerebello-thalamo-cortical connectivity in different forms of primary focal dystonia using the cerebellar continuous theta burst stimulation-cTBS protocol (Koch et al., 2009)
- To evaluate the effects of cerebellar cTBS on arm and neck movement kinematics in patients.

METHODS

- *Participants & Procedure:* Thirteen patients with FHD, 13 patients with cervical dystonia (CD) and 13 healthy subjects (HS) underwent two experimental sessions: (i) cTBS over the right cerebellar hemisphere (real cerebellar cTBS) and (ii) cTBS over the neck muscles (sham cerebellar cTBS). The two sessions were performed at least one week apart. The effects of real and sham cerebellar cTBS were quantified as excitability changes on contralateral primary motor cortex (M1), as well as possible changes of arm movements, i.e. writing, reaching movements on the ipsilateral arm and neck movements in patients. Primary motor cortex excitability was assessed by recording the input/output curve of the motor evoked potentials (MEP) from the right first dorsal interosseous muscle. ***FIGURE1***
- *Transcranial magnetic stimulation (TMS):* Single-pulse and repetitive TMS was delivered using two Magstim stimulators (Magstim Company, Withland, UK).
- *Kinematic recordings and analysis:* We used a motion analysis system (SMART DX 100, BTS, Milan, Italy) to record arm and neck movements in the three-dimensional space. ***FIGURE 2***
- *Statistics:* Electrophysiological and kinematic data were analyzed by repeated measures analysis of variance (ANOVAs). Pearson's coefficient was calculated to evaluate possible correlations between neurophysiological and kinematic data. Statistical significance was determined when $P<0.05$.

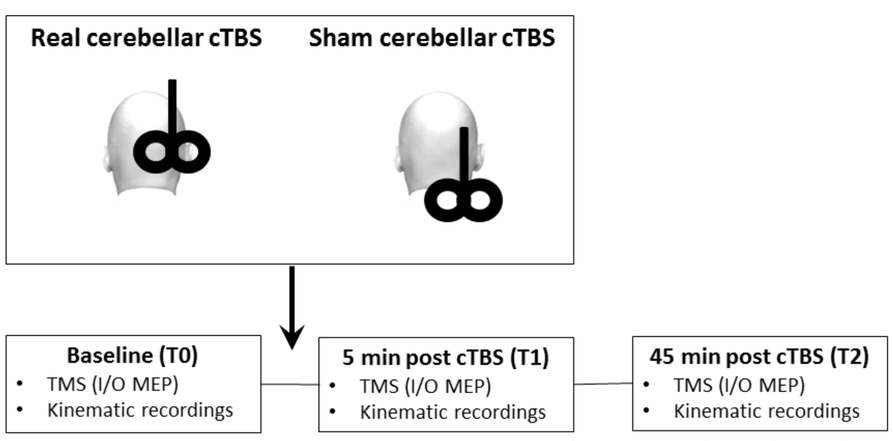

Figure 1. Experimental procedure

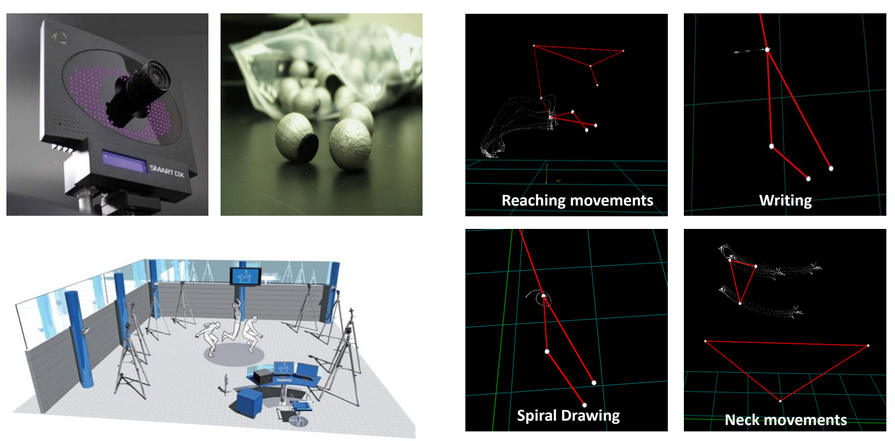

Figure 2. Motion analysis system

RESULTS

- Real cerebellar cTBS reduced the excitability in the controlateral primary motor cortex in healthy subjects and in patients with cervical dystonia, though not in patients with focal hand dystonia($F_{20, 350}$=1.59, P=0.03 by repeated-measures ANOVA). ***FIGURE 3***
- There was no significant change in arm and neck movements, as assessed by kinematic techniques, after real or sham cerebellar cTBS in patients and in healthy controls (all P >0.05). ***FIGURE 4 & 5***
- There was no correlation between individual changes of M1 excitability and movements abnormalities in patients with dystonia. (all P>0.05)

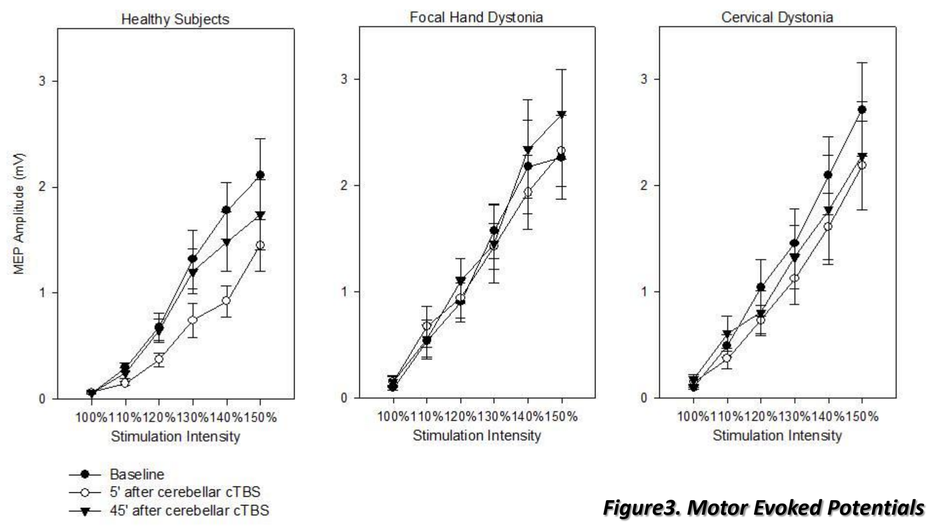

Figure3. Motor Evoked Potentials

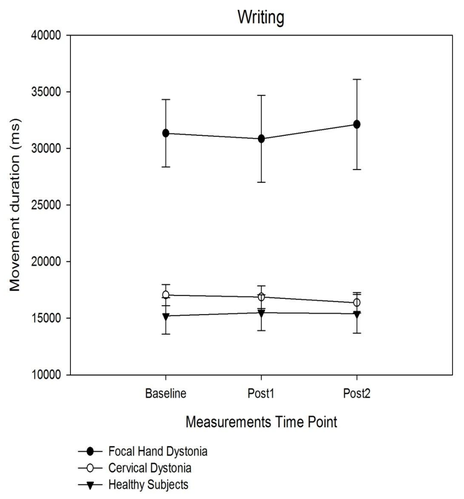

Figure4. Writing movements

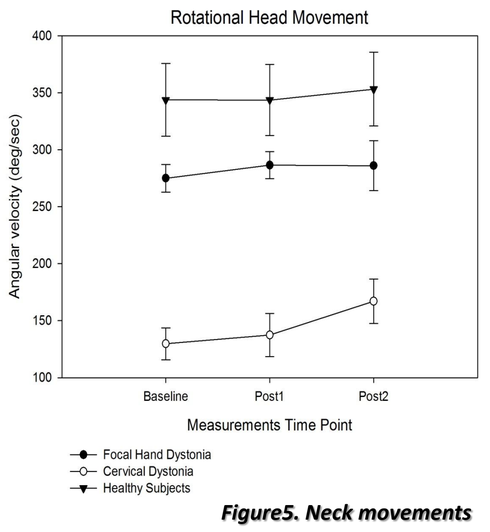

Figure5. Neck movements

CONCLUSIONS

- The functional cerebello-thalamo-cortical connectivity tested by cTBS is differently involved in the pathophysiology of different types of dystonia and possible relationship with motor abnormalities remains unclear.
- A single session of cerebellar cTBS does not ameliorate motor abnormalities in dystonia.

Major References

Sadnicka A, Hoffland BS, Bhatia KP, van de Warrenburg BP, Edwards MJ. The cerebellum in dystonia - help or hindrance? Clin Neurophysiol. 2012 Jan;123(1):65-70.

Koch G, Mori F, Marconi B, Codecà C, Pecchioli C, Salerno S, Torriero S, Lo Gerfo E, Mir P, Oliveri M, Caltagirone C. Changes in intracortical circuits of the human motor cortex following theta burst stimulation of the lateral cerebellum. Clin Neurophysiol. 2008 Nov;119(11):2559-69.