Evaluating the efficacy of a short duration rTMS protocol to improve motor performance in patients with multiple sclerosis: a pilot study

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BACKGROUND

Prior research on motor performance in patients with multiple sclerosis (MS) has demonstrated increased task-based cortical recruitment and modifications to cortical excitability that may represent attempts to compensate for disease progression. Since its introduction, repetitive Transcranial Magnetic Stimulation (rTMS) has proved capable of modifying both cortical physiology and functional performance in patients with neurological impairments.

Hypothesis: Motor performance will improve in a group of patients with MS following the application of a short duration, high frequency rTMS protocol over the motor cortex.

Objective: To evaluate the efficacy of short duration rTMS to improve motor performance in a group of participants with relapsing-remitting multiple sclerosis during remission.

METHODS

- Twenty six participants with relapsing-remitting MS
- Participants were recruited from a primary study evaluating cortical excitability in patients with MS
-Each participant had below average performance on the Nine-Hole Peg test (9-HPT) relative to standardized norms
- Patients were randomly assigned to receive either sham or real rTMS
- rTMS was applied to primary motor cortex of the dominant hemisphere

PROTOCOL

- Twenty one-second trains
- Interstimulus interval - 59 seconds
- Stimulus -10 Hz at 90% of resting motor threshold

	Sham rTMS		Real rTMS	
	μ	SD	μ	SD
Age (years)	45.81	13.11	47.22	9.04
EDSS	2.6	1.8	3.62	1.8
MSFC (z-score)	0.09	0.58	-0.24	0.40
Time of Dx (y)	16.1	30.17	8.80	5.21
9-HPT Dom(s)	26.42	12.40	25.58	7.28
9-HPT N-Dom(s)	23.70	5.29	25.68	5.71

Table 1: Patient recruitment characteristics between the sham and real rTMS groups. 9-HPT performance is from a primary study from which participants were recruited.

RESULTS

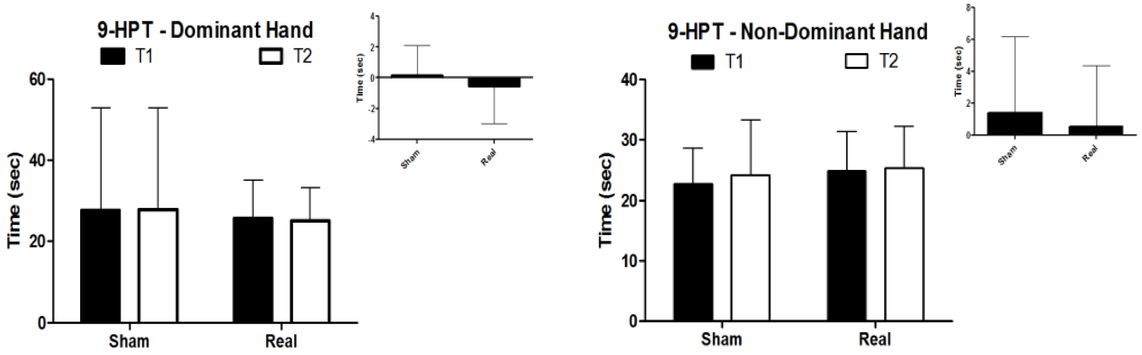

Figure 1. Mean performance from both the dominant (left panel) and non-dominant (right panel) hands for the sham and real rTMS groups pre (T1) and post (T2) rTMS. Inset panels denote changes in performance between pre- and post-administration. No significant difference was observed in either the dominant or non-dominant hand for the sham or real rTMS group. Error bars represent one between-participant standard deviation.

	Sham rTMS		Real rTMS	
	Dom. Hand (n=13)	Non-Dom. Hand (n=13)	Dom. Hand (n=13)	Non-Dom. Hand (n=12*)
Baseline Performance				
Mean (sec)	27.66 [-21.34,76.65]	22.68 [11.12,34.25]	25.70 [7.57,43.84]	24.90 [12.16,37.64]
Change in Performance				
Mean (sec)	0.16 [-3.77,2.12]	1.42 [-3.35,6.19]	-0.53 [-2.93,1.88]	0.53 [-3.32,4.39]
Improve (n)	0	1	0	1
Decline (n)	0	3	0	1
None (n)	13	9	13	10

Table 2: Baseline performance and resulting change in performance in the 9-HPT at the group and individual level for the sham and real rTMS groups. No changes were observed with the dominant hand. A small group of individuals in both groups showed either an increase or decrease in performance with the non-dominant hand. Individual change in performance was determined by a greater than or equal to 20% change in performance. Values in brackets indicate 95% confidence intervals. *One participant was not able to complete this task for the non-dominant hand.

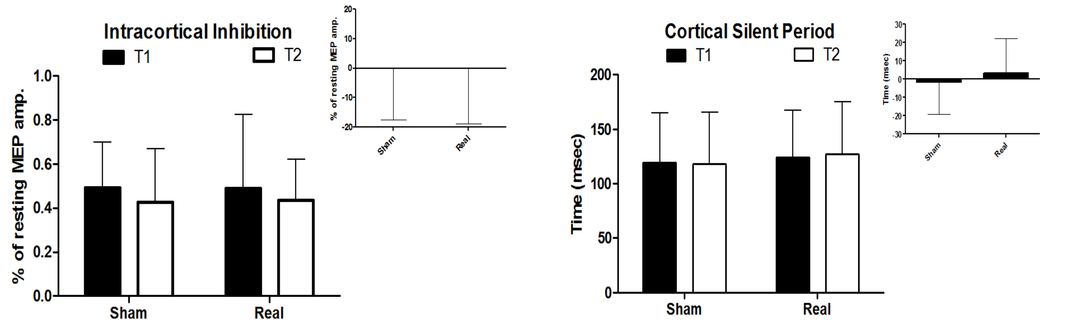

Figure 2. Intracortical inhibition and cortical silent period for the sham and real rTMS groups. Inset panels denote changes in performance between pre- and post-administration. No significant differences were found in either the sham or real rTMS groups. Error bars represent one between-participant standard deviation.

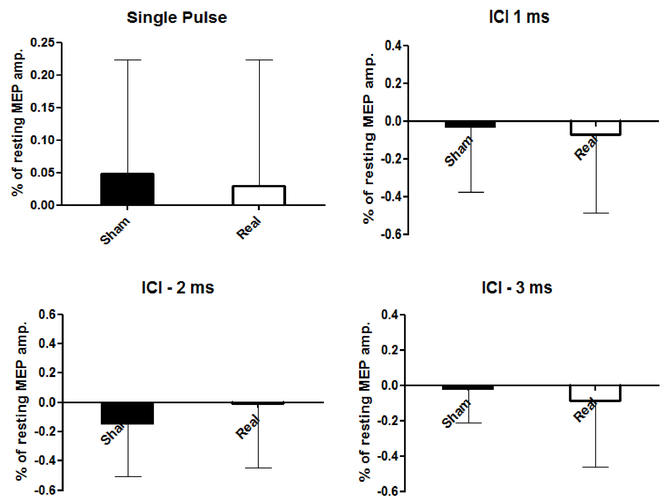

Figure 3: Results from single pulse (SP) and intracortical inhibition (ICI) recordings taken at intervals of 1, 2, and 3 ms. Panels represent change in relative MEP sizes between pre- and post-rTMS administration. No change was found in either the sham or real rTMS group. Error bars represent one between-participant standard deviation.

	Sham rTMS		Real rTMS	
	Dom (n=13)	N-Dom (n=13)	Dom (n=13)	N-Dom (n=12)
Correlation (ρ) with change in performance				
Age	-0.11	0.28	0.12	-0.09
MSFC	-0.03	0.22	0.37	0.07
EDSS	-0.38	0.46	-0.44	-0.55
T - Dx	0.09	0.06	-0.46	-0.57
9-HPT Dom	-0.35	0.48	-0.47	0.01
9-HPT N-Dom	-0.20	-0.12	-0.65*	-0.27

Table 3: Correlation analysis of mean change in performance (see Table 2) with patient characteristics. Only one significant correlation was observed with change in motor performance for the real rTMS group. 9-HPT is from baseline testing in the current study. T-Dx = time since diagnosis. *Significant at $p < 0.05$.

DISCUSSION

Findings from the current study do not provide support for the administration of this particular protocol in improving motor performance in patients with MS. Future research should evaluate the efficacy of longer duration protocols to improve MS related motor impairments.

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