Transcranial Magnetic Stimulation Therapy in Spastic Cerebral Palsy Children Improves Motor Activity

Meena Gupta[1], **Bablu Lal Rajak**[1], **Dinesh Bhatia**[1*] **and Arun Mukherjee**[2]

[1]*Department of Biomedical Engineering, North Eastern Hill University, Meghalaya, India*

[2]*UDAAN-for the differently abled, Lajpat Nagar, New Delhi, India*

[*]**Corresponding author:** Dinesh Bhatia, Department of Biomedical Engineering, North Eastern Hill University, Shillong-793022, Meghalaya, India, Tel: +913642723853; E-mail: bhatiadinesh@rediwmail.com

Rec date: Oct 04, 2016; **Acc date:** Nov 03, 2016; **Pub date:** Nov 05, 2016

Abstract

Transcranial magnetic stimulation (TMS) is a new interventional tool used in the study of neuronal activity and treatment of psychiatric disorders. Repetitive TMS (rTMS) is a non-invasive technique of stimulating the brain employing magnetic pulses. Recent research has demonstrated the efficacy of rTMS in facilitating motor functions. Using these evidences, we studied the effectiveness of rTMS in improving motor activity in spastic cerebral palsy (CP) children. CP is a neuro-developmental disorder of movement and posture that is caused by injury to the developing brain that restrict activities of daily living. In the quest to treat CP, several interventions are used among which physical therapy is the mainstay therapy. In this study, we selected 45 spastic CP children and divided them randomly into three groups-the reference group (RG) that was provided only physical therapy (PT) for 30 minutes daily for 20 days; the interventional group (IG) that was administered rTMS frequency of 5Hz (IG-A) and 10Hz (IG-B) for 15 minutes (1500 pulses) daily followed by PT as in RG. Gross motor function measure (GMFM) was used as assessment tool to evaluate the motor performance. Prior to start of therapy, pre-assessment of GMFM was performed on all participants and post assessment after completion of 20 sessions. The result was statistically significant in all three groups ($p<0.001$) and the mean change demonstrated 0.64%, 1.75% and 2.59% improvement in motor activity among participants in RG, IG-A and IG-B respectively. The study demonstrated positive effect of rTMS in improving motor activity when combined with PT.

Keywords: Cerebral palsy; Gross motor function measure; Physical therapy; Transcranial magnetic stimulation

Introduction

Transcranial magnetic stimulation (TMS) is a unique investigational tool used to study various neural processes and treat a variety of neurological illnesses due to its ability to directly modulate corticospinal and intracortical motor cortex [1]. Repetitive TMS (rTMS) is a non-invasive brain stimulation technique through which a focused magnetic Ẑeld is delivered by a coil deep into the brain tissue. HXe repetitive pulses of the magnetic Ẑeld stimulate neuronal activity in the target brain area by changing the pre-stimulus dynamics of neuronal Ẑring in the stimulated region [2]. Recent studies have established that

to be the motor pathway. This study was conducted after approval from the institutional ethics committee for human samples or participants (IECHSP), of the host institution and written consent from the parents or guardians of spastic CP children that met our inclusion criteria. Inclusion criteria followed were-willingness to participate; age group between 2 to 15 years; muscle tightness mild to moderate and cognitive deficiency nil to moderate, no metallic implants, no uncontrolled seizures or congenital diseases. Total forty-five children were selected from the out-patient department of UDAAN-for the differently abled, Delhi, a non-profit organization that pioneered the rehabilitation of CP children using various interventions. The recruited children were randomly assigned into three groups in equal numbers– reference/ control group (RG), interventional group A (IG-A) and interventional group B (IG-B). RG consisted of 12 participants (mean age: 7.49 SD 4.95; male: 7, female: 5), IG-A consisted of 15 participants (mean age: 7.93 SD 4.86; male: 9, female: 6) and IG-B consisted of 14 participants (mean age: 8.06 SD 4.10; male: 10, female: 4). Three participants from RG and one from IG-B did not continue the study due to some unknown reasons; thus, their baseline data was not used for any statistical analysis.

The assessment of gross motor function of recruited children were performed using gross motor function measure (GMFM) which is an internationally approved scale used by trained physiotherapists to monitor motor development in spastic CP patients [14] and for assessing efficacy of any treatment [15]. GMFM is a performance based measure that reflects developmental milestones of a growing child (rolling, crawling, sitting, standing, walking/running) referred to as gross motor abilities of CP patients [16]. GMFM has total 88 assessment items which are grouped into five domains, namely A-lying and rolling (17 items), B-sitting (20 items), C-crawling and kneeling (14 items), D-standing (13 items), and E-walking, running and jumping (24 items). Additionally, GMFCS for CP is a level based scale that evaluates patient's self-initiated movements, with emphasis on sitting, moving and walking.

In this study, prior to starting the therapies, GMFM pre-assessment was performed on all participants of different groups namely, RG, IG-A and IG-B. Participants of RG were provided only PT for 30 minutes daily for 20 days (5 days per week for 4 weeks) whereas children in IG-A was administered rTMS of 5Hz frequency and those in IG-B with 10Hz comprising of 1500 pulses (50 pulses per train with total 30 trains having inter-train delay of 20 seconds) for 15 minutes daily for 20 days. The rTMS session of both the groups were followed by PT of 30 minutes daily as given to RG. After completion of 20 sessions of different therapies (only PT and rTMS+PT) administered to different groups, post-assessment of GMFM was performed. It is to be noted that PT and rTMS sessions were provided by trained professionals and the assessment was done by a trained physiotherapist who was kept blinded to the research protocols used in the study.

Statistical Analysis

The pre and post GMFM mean scores for each of he three groups were analyzed with a paired-sample t-test, to determine whether any significant differences existed. The variance and covariance analyses were also performed. Additionally, mean and median GMFM scores were used to evaluate the percentage of functional gain that was brought about in different groups. All statistical analysis was performed using SPSS 20.0 (Armonk, NY, IBM Corp., USA) and Microsoft Excel 2010. The p-value of less that 0.001 was considered statistically significant.

Results

The mean, standard deviation (SD), minimum and maximum GMFM scores of pre and post treatment measures for different groups are given in Table 1. The change between the two measurements for different groups is shown in Figure 1.

Group	Min		Max		Median		Mean ± SD	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
RG	5.28	6.27	91.94	92.46	66.54	67.11	52.87 ± 31.51	53.54 ± 31.61
IG-A	3.40	7.00	86.00	88.81	56.78	58.28	48.97 ± 29.74	50.72 ± 29.73
IG-B	3.53	6.27	96.94	98.46	61.45	63.59		

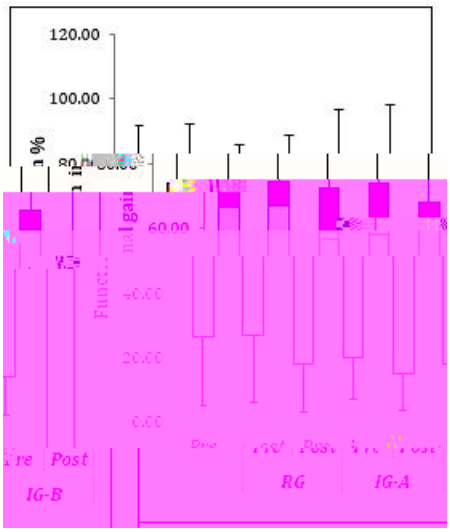

Figure 1: Functional improvement in motor performance of different groups. Shown are median (black center line) and range of functional gain (green and pink).