Journal of Society of Indian Physiotherapists 2020;4(2):97–100

Content available at: https://www.ipinnovative.com/open-access-journals

Journal of Society of Indian Physiotherapists

Journal homepage: www.ipinnovative.com

Case Report

# Effectiveness of repetitive magnetic stimulation in improving upper extremity function in post-stroke hemiparesis – A case report

**Tittu Thomas James[1,*], Ragupathy Sendhilkumar[1], Naveen Venkatesh[1], Dhargave Pradnya[1]**

[1] *Dept. of Physiotherapy, National Institute of Mental Health and Neuro Sciences, Bangalore, Karnataka, India*

ARTICLE INFO

*Article history:*
Received 20-06-2020
Accepted 25-08-2020
Available online 31-08-2020

*Keywords:*
Repetitive magnetic stimulation
Upper limb rehabilitation
Stroke hemiparesis
Super inductive system
Spasticity

ABSTRACT

Upper extremity (UE) motor deficits lead to significant disability and dependence in individuals, post-stroke. Intense physiotherapy has found to be beneficial in restoring the UE function. Repetitive Magnetic Stimulation (rPMS) is a novel therapeutic modality which aids in the rehabilitation of stroke patients. It utilizes high-intensity electromagnetic field to stimulate neuromuscular tissue which is found to be beneficial in pain management and other effects such as fracture healing, myostimulation, joint mobilization and spasticity reduction. The rPMS have found to decrease spasticity and bring about muscle balance by relaxing spastic muscles and stimulating antagonistic muscles respectively. Although rPMSis widely used all over the world, literature on the Indian population is lacking. This case report is the first from India which describes the beneficial effects of rPMS in UE rehabilitation of a post-stroke individual using BTL-6000 Super Inductive System.



## 1. Introduction

Stroke is defined as "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin".[1] It is the second leading cause of death and the third leading cause of disability around the world. Stroke is also a leading cause of dementia and depression. The motor deficits occuring post-stroke lead to a significant amount of disability and dependence in these individuals. Forty-five per cent of stroke survivors demonstrate permanent loss of affected upper limb (UL) motor function contributing to a severe stroke-related disability.[2] This, in turn, affects their quality of life and social participation.

Physiotherapy is found to be an essential component of post-stroke rehabilitation.[3] Restoration of the sensori-motor function using strength training, task-specific functional therapy, functional electrical stimulation, biofeedback, electrical stimulation, mirror therapy, modified constraint-induced movement therapy, robotics and virtual reality are administered with a view to improve UL function. Among these therapies task-oriented training and mCIMT have been recommended to be used for routine therapy.[4] The ultimate aim of UL rehabilitation focuses on the reduction in disability and increase in social participation.[2] Studies have identified an enhanced rate of recovery and a reduction in death or deterioration with intense physiotherapy protocol.[3]

Repetitive Magnetic Stimulation (rPMS) is a new technique which uses a magnetic field produced via an external device to create action potential to depolarize neurons and in turn to make the muscles contract and induce sensory afferents.[5,6] It is applied over spinal roots, nerves or muscles and is a painless, non-invasive approach to activate proprioceptive afferents with little activation of cutaneous receptors. The rPMS may affect biomechanical factors such as spasticity.[7] One of the recent studies showed that rPMS can promote neural plasticity and sensory-motor improvements.[8] But a recent meta-analysis showed inconclusive results for rPMS on improving upper limb

* *Corresponding author.*
*E-mail address*: tittutalks@gmail.com (T. T. James).

https://doi.org/10.18231/j.jsip.2020.015

function and muscle strength of dorsiflexors of ankle among stroke patients.[6] In this case report, we have shared our experience and findings when rPMS was used to treat a stroke patient in addition to regular therapy.

## 2. Case History

A sixty-five year old, right hand dominant female, with right hemiparesis, was referred to the Physiotherapy OPD with the chief complaint of difficulty in using the right upper limb for her daily activities. She had a previous and first history of stroke 2 years prior to the current assessment. A second stroke occurred 2 weeks prior to the current assessment, which resulted in the weakness of the right upper limb. She was independent in walking (Functional Ambulation Category = 4) with fair dynamic balance for activities in standing.

### *2.1. Assessment of right upper limb functions*

On observation, the right upper limb had a flexor dominant synergy,, with shoulder adduction, moderate flexion of elbow and wrist and fingers in resting position. Modified Ashworth Scale (MAS) demonstrated grade 2 for biceps and 1+ for triceps, pronators and wrist flexors. The Upper Extremity Functional Index (UEFI) and Fugl-Meyer Assessment for Upper Extremity (FMA-UE) were scored before the treatment sessions. The subject scored 16/80 in UEFI and 36/66 for FMA-UE motor functions. She also scored 11/12 for sensation, 23/24 for passive joint motion, and 22/24 for joint pain in FMA-UE sub-scores. Difficulty in picking up rice from the plate while eating, and difficulty in drinking using a glass were two functional activities she found difficult. We planned to train her to pick up small beads from the bowl and reaching and drinking using a stainless steel glass. Hence the number of beads picked up in a minute, and reaching for a glass of water and drinking was thus assessed. Before the treatment sessions, she could not pick up any beads in a minute. The subject could complete reaching and drinking task, with evident compensation with neck flexion during taking the glass towards the mouth and using the unaffected hand to release the glass after the task was completed.

### *2.2. Treatment with rPMS*

The rPMS treatment was provided using BTL-6000 Super Inductive System, BTL Industries Ltd. Implanted medical devices such as pacemakers or deep brain simulators are contraindications for rPMS, were ruled out and informed consent was obtained before treatment. Treatment sessions were carried out in a sitting position with affected arm resting on a pillow. The total duration of the treatment was 16 minutes and used 2 protocols. The first protocol selected was ‘Spasticity Reduction’, with applicator placed over biceps and over wrist flexors for 4 minutes each. The intensity was did not elicit any any muscle contractions (20-23%). The second protocol selected was ‘Muscle Re-education’, with applicator placed over wrist extensors for 8 minutes. The intensity was set so that moderate muscle contractions were visible without causing pain (35-40%).

### *2.3. Conventional exercise therapy*

Therapy was focused on functional training of activities of daily living using manual assistance and resistance. Activation of finger ex tensors was trained using manual assistance as well as using techniques of co-activation and irradiation. Range of motion exercises of both passive and active-assisted was administered, with moist heat application over the shoulder for pain relief. The total duration of therapy was 20 minutes.

### *2.4. Daily treatment schedule*

The subject received institutional supervised therapy for 10 days, single session per day. The total duration of one session was 45 minutes including the rest periods. (16 minutes rPMS and 20 minutes of therapy). The assessment was done on the first day and the 10th day of treatment.

### *2.5. Post-treatment assessment*

Significant changes were demonstrated after 10 sessions of treatment using rPMS and exercise therapy. MAS scores were reduced to grade 1+ for biceps and grade 1 for triceps, pronators and wrist flexors. The subject scored 35/80 for UEFI and 52/66 for FMA-UE motor functions. Sensation, passive joint motion and joint pain sub-scores of FMA-UE remained the same. The changes in outcome measures after the intervention is depicted in table 1. While analysing the functional activities selected, she could pick up six beads in a minute after 10 treatment sessions. The subject could also complete reaching and drinking task without any compensations using neck flexion or the use of the unaffected hand.

## 3. Discussion

The rPMS treatment is a novel therapeutic modality in the field of rehabilitation utilizing the high-intensity electromagnetic field to stimulate neuromuscular tissue. It is found to be beneficial in pain management and other effects such as fracture healing, myostimulation, joint mobilization and spasticity reduction. The machine delivers frequency up to 150 Hz with intensity up to 2.5 Tesla. The field applicator has a six joint arm providing precise positioning over the treatment area, with coil cooling system ensuring maximum treatment time with minimal adverse effects.it has an advantage of stimulating nerve and muscle without much skin sensory stimulation. Patients need not remove t clothes and no are accessories required to apply rPMS

**Table 1:** The changes in outcome measures assessed before and after intervention

| Outcome Measures Assessed | | Before Intervention | After Intervention |
|---|---|---|---|
| Modified Ashworth Scale | Biceps | 2 | 1+ |
| | Triceps | 1+ | 1 |
| | Pronators | 1+ | 1 |
| | Wrist Flexors | 1+ | 1 |
| The Upper Extremity Functional Index | | 16/80 | 35/80 |
| Fugl-Meyer Assessment for Upper Extremity | Upper Extremity | 22/36 | 30/36 |
| | Wrist | 4/10 | 6/10 |
| | Hand | 7/14 | 12/14 |
| | Coordination/Speed | 3/6 | 4/6 |
| | Total Motor Function | 36/66 | 52/66 |
| | Sensation | 11/12 | 11/12 |
| | Passive Joint Motion | 23/24 | 23/24 |
| | Joint Pain | 22/24 | 22/24 |

**Fig. 1:** BTL – 6000 super inductive system

on the treatment areas. WHO recommendations consider a magnetic induction between 2-5T as acceptable.[9]

Studies by various authors have identified the beneficial effects of rPMS in treating joint contractures, reducing pain, healing fractures, myorelaxation, myostimulation, and an increased ability to perform activities of daily living (ADL). The effects were considered by the activation of spinal or supraspinal inhibitory neurons, increased circulation, promoting the formation of callus, nervous depolarization, etc.[10,11] There were no adverse effects or abnormalities documented by these authors. There is no previous literature available from studies of the Indian population.

There are many studies conducted to test the after-effects of rPMS which aimed in spasticity reduction. The rPMS have found to decrease spasticity and bring about muscle balance by relaxing spastic muscles and stimulating antagonistic muscles respectively. The study by Prouza et al identified a 66% reduction in Modified Ashworth Scale and 81% improvement in Barthel Index in patients with post-stroke hemiparesis with rPMS.[12] Stuppler et al. studied the effect of rPMS applied on the extensor indices proprius muscle of stroke patients.[13] They suggested that rPMS reduced the spasticity in the finger flexor muscles and facilitated smooth contraction of index finger extensor muscles. They also found in another study that there was increased regional blood flow in the lesioned hemisphere and this was accompanied by increased movement amplitude and velocity during index finger extension task.[13,14] Further from their studies, it is evident that the rPMS induces proprioceptive inflow to the cerebral cortex and this can influence the motor planning to bring about agonist and antagonists reciprocal activation.[14,15] We identified that 10 sessions of rPMS over the spastic muscles using ‘Spasticity Reduction” protocol significantly reduced muscle tone that could have reflected in the improvement on UE function. Changes were significant in the FMA-UE motor functions with a difference of 17 points pre and

post-intervention. In this case report, there is a reduction of spasticity and improvement upper limb function in a stroke patient after additional application of rPMS along with regular physiotherapy. This case report can help the physiotherapists conduct further structured randomized studies.

## 4. Source of Funding

None.

## 5. Conflict of Interest

None.

## References


1. World Health Organization (1965) WHO: International Classification of Diseases. 1965 revision, 15. Geneva WHO.
2. Dromerick AW, Lang CE, Birkenmeier R, Hahn MG, Sahrmann SA, Edwards DF. Relationships between upper-limb functional limitation and self-reported disability 3 months after stroke. *J Rehabil Res Dev*. 2006;43(3):401–8.
3. Langhorne P, Wagenaar R, Partridge C. Physiotherapy after stroke: More is better? *Physiother Res Int*. 1996;1(2):75–87.
4. Wattchow KA, McDonnell MN, Hillier SL. Rehabilitation Interventions for Upper Limb Function in the First Four Weeks Following Stroke: A Systematic Review and Meta-Analysis of the Evidence. *Arch Phys Med Rehabil*. 2018;99(2):367–82.
5. Beaulieu LD, Schneider C. Repetitive peripheral magnetic stimulation to reduce pain or improve sensorimotor impairments: A literature review on parameters of application and afferents recruitment. *Neurophysiol Clin*. 2015;45(3):223–37.
6. Sakai K, Yasufuku Y, Kamo T, Ota E, Momosaki R. Repetitive peripheral magnetic stimulation for impairment and disability in people after stroke. *Cochrane Database Syst Rev*. 2019;11. doi:10.1002/14651858.CD011968.pub3.
7. Beaulieu LD, Schneider C. Effects of repetitive peripheral magnetic stimulation on normal or impaired motor control. A review. *Neurophysiol Clin*. 2013;43(4):251–60.
8. Beaulieu LD, Massé-Alarie H, Camiré-Bernier S, Édith Ribot-Ciscar, Schneider C. After-effects of peripheral neurostimulation on brain plasticity and ankle function in chronic stroke: The role of afferents recruited. *Neurophysiol Clin*. 2017;47(4):275–91.
9. Dragoi M, Elena V. The super inductive system - SIS therapy. *Techirghiol*. 2019;IV(17):39–40.
10. Kouloulas EJ. Peripheral Application of Repetitive Pulse Magnetic Stimulation on Joint Contracture for Mobility Restoration:Controlled Randomized Study. *Int J Physiother*. 2016;3(5):569–74.
11. Zarkovic D, Kazalakova K. Repetitive Peripheral Magnetic Stimulation as Pain Management Solution in Musculoskeletal and Neurological Disorders - A Pilot Study. *Int J Physiother*. 2016;3(6):671–5.
12. Prouza O, Kouloulas E, Zarkovic D. High-Intensity Electromagnetic Stimulation can Reduce Spasticity in Post-Stroke Patients. *Int J Physiother*. 2018;5(3):87–91.
13. Struppler A, Havel P, Müller-Barna P. Facilitation of skilled finger movements by repetitive peripheral magnetic stimulation (RPMS) – a new approach in central paresis. *Neuro Rehabil*. 2003;18(1):69–82.
14. Struppler A, Binkofski F, Angerer B, Bernhardt M, Spiegel S, Drzezga A, et al. A fronto-parietal network is mediating improvement of motor function related to repetitive peripheral magnetic stimulation: A PET-H2O15 study. *NeuroImage*. 2007;36:T174–T86.
15. Stuppler A, Angerer B, Havel P. Modulation of sensorimotor performances and cognition abilities induced by RPMS: clinical and experimental investigations. *Suppl Clin Neurophysiol* . 2003;56:358–67.


## Author biography


**Tittu Thomas James** Physiotherapist

**Ragupathy Sendhilkumar** Physiotherapist

**Naveen Venkatesh** Physiotherapist

**Dhargave Pradnya** Chief Physiotherapist


**Cite this article:** James TT, Sendhilkumar R, Venkatesh N, Pradnya D. Effectiveness of repetitive magnetic stimulation in improving upper extremity function in post-stroke hemiparesis – A case report. *J Soc Indian Physiother* 2020;4(2):97-100.