



RESEARCH REPORT

# The effects of repetitive transcranial magnetic stimulation on unilateral neglect of acute stroke patients: A randomised controlled trial



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## KEYWORDS

repetitive  
transcranial  
magnetic  
stimulation;  
stroke;  
unilateral neglect

**Abstract** *Background:* Rehabilitation of the unilateral neglect of acute stroke patients represents a major challenge.

*Objectives:* This study aimed to evaluate the effects of repetitive transcranial magnetic stimulation on the functional recovery of stroke patients with unilateral neglect.

*Methods:* Twenty patients with stroke were randomly assigned to two groups: a repetitive transcranial magnetic stimulation group (experimental) and a control group. The stroke patients in the experimental group underwent repetitive transcranial magnetic stimulation therapy and comprehensive rehabilitation therapy. The stroke patients in the control group underwent sham magnetic stimulation therapy and comprehensive rehabilitation therapy. The patients in both groups received therapy 5 days per week for 4 weeks. The Motor Free Visual Perception Test (MVPT), Line Bisection Test (LBT), Albert Test (AT), and Star Cancellation Test (SCT) were assessed before and after the 4-week therapy period.

*Results:* The experimental group showed a significant increase in the MVPT, LBT, AT, and SCT values compared with the preintervention values ( $p < 0.05$ ). Furthermore, the control group showed a significant increase in the MVPT, LBT, and AT results compared with the preintervention results ( $p < 0.05$ ). A significant difference in the post-training gains for the MVPT ( $8.9 \pm 2.5$  vs.  $4.8 \pm 3.0$ ), LBT ( $-19.3 \pm 7.5$  vs.  $-6.5 \pm 9.5$ ), AT ( $13.1 \pm 8.0$  vs.  $4.0 \pm 1.9$ ), and SCT ( $-13.6 \pm 6.9$  vs.  $-4.5 \pm 6.9$ ) were observed between the experimental group and the control group ( $p < 0.05$ ). In addition, the effect size for gains in the experimental and control groups was very large in MVPT and AT (effect size = 3.25 and 2.90), respectively, and the effect size for gains in the experimental and control groups was small in LBT and SCT (effect size = 0.22 and 0.23, respectively).

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*Conclusion:* The current study findings indicated that repetitive transcranial magnetic stimulation may be beneficial in decreasing the unilateral neglect of stroke patients.

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## Introduction

Unilateral neglect refers to the inability to sense meaningful stimulation that is applied to the opposite side of a brain lesion [1]. Unilateral neglect can occur when either the left or right hemisphere is damaged, but generally occurs more frequently when the right hemisphere is damaged [2]. The continuance of this symptom in stroke patients leads to impaired ability to recognise objects placed in the space on the paralyzed side and difficulties carrying out daily activities independently [3]. In addition, it increases the incidence of other diseases and requires assistance or supervision during daily activities due to safety concerns [4]. Unilateral neglect can occur following lesions in various brain regions including the parietal lobe, frontal lobe, temporal lobe, basal ganglia, and thalamus, and patients with unilateral neglect are slower in functional recovery than patients without unilateral neglect [5]. Treatments for unilateral neglect determine the rehabilitation treatment period for acute stroke patients, and influence the level of their functional recovery [6]. Treatments that have been used to tackle unilateral neglect include constraint-induced therapy, mental imagery training, optokinetic stimulation and trunk rotation therapy [7,8]. However, most of the treatment protocols used are labour intensive, which makes the provision of intensive treatment for all affected patients difficult.

Transcranial magnetic stimulation is a noninvasive technique, which delivers magnetic pulses reaching the cerebral cortex through the scalp. It is generally accepted that high frequency (>1 Hz) repetitive transcranial magnetic stimulation induces an increase in cortical excitability, whereas low frequency (<1 Hz) repetitive transcranial magnetic stimulation reduces it [9], although these assumptions have been challenged by recent neuroimaging studies in nonmotor areas investigating functional connectivity [10]. Previous studies have demonstrated that repetitive transcranial magnetic stimulation is able to modulate the activity of a particular cortical region, resulting in transynaptic effects on other distant areas [11]. Repetitive transcranial magnetic stimulation has been used to treat motor skills disorders such as stroke and Parkinson's disease [12]. Le et al [13] reported that repetitive transcranial magnetic stimulation has positive effects on the recovery of hand functions in stroke patients. They also reported that the application of transcranial magnetic stimulation to the right parietal lobe of normal individuals led to increased temporal and spatial attention to the left side [14]. However, studies have not yet been conducted on the effects of repetitive transcranial magnetic stimulation on the functional enhancement of poststroke patients experiencing unilateral neglect. In this regard, this study aimed to examine the effects of repetitive transcranial

magnetic stimulation on the functional recovery of stroke patients with unilateral neglect.

## Methods

### Participants

Patients ( $n = 50$ ) with stroke were screened for this study from March 2014 to September 2014. The inclusion criteria were: (1) no significant cognitive deficit (a score of >25 points in the Mini-Mental Status exam) [15]; (2) significant unilateral neglect (a score of <16 points in the Motor-Free Visual Perception Test (MVPT) [16]; (3) no eyesight or hearing problems; and (4) no psychological or emotional problems. Twenty-two patients with stroke met the criteria. They all showed left unilateral neglect symptoms. The Research Ethics Committee of Eulji University Hospital approved the study, and all participants provided informed, written consent prior to involvement in the study. All experiments were conducted in accordance with the Declaration of Helsinki. After the completion of the initial assessment, participants were randomly assigned to an experimental group ( $n = 11$ ) or a control group ( $n = 11$ ). For randomisation, sealed envelopes were prepared in advance and marked inside with A or B, indicating the experimental group and the control group respectively.

The randomisation was done by a third party that was totally unaware of the study content. The participant characteristics and all outcome measures before and after the treatment were assessed by Physician 1 who was blinded to the treatment allocation. The repetitive transcranial magnetic stimulation and sham treatments were conducted in a closed room by Physician 2 who was not involved in the assessment of patients. Both physicians were instructed not to communicate with the study participants about the possible goals or the rationale of either treatment.

### Intervention

The patients in the experimental group received repetitive transcranial magnetic stimulation and conventional rehabilitation therapy for a total of 40 minutes (repetitive transcranial magnetic stimulation: 10 minutes; conventional rehabilitation therapy: 30 minutes) per day, with a 10-minute rest period halfway through the session. The patients in the experimental group received training 5 days per week for 4 weeks. Conventional rehabilitation therapy consisted of neurodevelopmental facilitation techniques. The patients in the control group received sham transcranial magnetic stimulation therapy and conventional rehabilitation therapy for a total of 40 minutes per day on the same day.

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