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Case Study

Influence of mental practice on upper limb muscle activity and activities of daily living in chronic stroke patients

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Abstract. [Purpose] The aim of this study was to determine the effects of mental practice on muscle activity of the upper extremity and performance of daily activities in chronic stroke patients. [Subjects and Methods] In this research, mental practice was conducted by 2 chronic hemiplegic stroke patients. Mental practice was conducted 30 minutes a day, 5 times a week, for 2 weeks. Evaluation was conducted 4 times before and after intervention. Muscle activity was measured using a surface electromyogram test, and the Modified Barthel Index was used to measure changes in the ability to carry out daily activities. [Results] Both the muscle activity of the upper extremity and capability to perform daily activities showed improved outcomes after mental practice was conducted. [Conclusion] Through this research, mental practice was proven to be effective in improving the muscle activity of upper extremity and capability to perform daily activities in chronic hemiplegic stroke patients.

Key words: Mental practice, Muscle activity, Stroke

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INTRODUCTION

Mental practice is a therapeutic method of training by thinking only about the given assignment without direct movement or stimulation from the outside[1)]. In a study that applied mental practice to stroke patients, Korn (1983) applied motor mental practice to increase the motor execution ability of stroke patients[2)] and found out that a group that performed mental practice while sitting showed a significant increase in balance ability compared with a group that had rehabilitation. According to a study by Deutsch and Newell, mental practice brings about changes in the exercise-related area of the brain[3)] and improves physical functions. Especially, it was reported that the improvement of the upper limb function are possible in the exercise of stroke patients. However, most of the previous studies of the measurement methods showed that most of them used evaluation tools such as the Fugle-Meyer Motor Assessment (FMA), Action Research Arm Test (ARAT), and Jebsen hand function test[4)]. These evaluation tools have limitations in that they could not exclude the supervision of a therapist even when assessment is performed by a trained evaluator for qualitative evaluation of upper limb movement. Thus, this research attempted to secure more objective evidence on improvement of upper limb function in stroke patients as a result of mental practice through measurement of muscle activity using a surface electromyogram test. It also examined the influence of mental practice on improvement of activities of daily living.

SUBJECTS AND METHODS

This research was conducted on 2 patients who were diagnosed with hemiplegia due to stroke and were hospitalized to receive treatment at I Hospital in South Korea. The subjects recruited for this study were volunteers who understood the

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Table 1. General characteristics of the subjects

	Age	Gender	Diagnosis	Affected side	Dominant hand	Months from stroke onset	MMSE-k
Participant 1	64	Female	Ischemic	Rt.	Rt.	42	29
Participant 2	65	Male	Ischemic	Rt.	Rt.	37	30

objectives and content of the study and showed an intent to actively participate in it. All subjects and their guardians signed an informed consent form after receiving information about the purpose and method of the study. The present study was approved by the Inje University Faculty of Health Science Human Ethics Committee. The selection criteria for subjects were as follows: unilateral hemiplegia for over 6 months; a score of over 24 on the Korean Mini-Mental State Examination (K-MMSE); a score below an average of 2.26 on the mental practice test; no problems in communication; no hemineglect or visual or hearing defects; and ability to stretch a wrist by at least 20 degrees while turning it upside down or bending it, stretch the metacarpophalangeal joint by at least 10 degrees, and grab and put down an object with the affected side. The general characteristics of the subjects are noted in Table 1. Subject 1 was a 64-year-old female who had right hemiplegia due to a middle cerebral artery infarction and had the disease for 42 months. Subject 2 was a 65-year-old man who had had hemiplegia on the right hand due to the middle cerebral artery infarction and had had the disease for 37 months. Both subjects were right-handed before the disease occurred and were receiving conservative physical therapy and occupational therapy for 30 minutes 5 times a week. This study used an interrupted time series (ITS) design to determine whether task-oriented activity had an effect greater than that of natural recovery on impairment of the hemiplegic upper extremity function and ADL in people after a stroke. Subject assessment was carried out 4 times for 3 weeks before and after mental practice intervention. A surface electromyogram measurement tool (BTS FreeEMG 300, BTS S.p.A., Milan, Italy) was used to measure the upper limb muscle activity of subjects. To reduce measurement error, the hair on the parts of the limbs where the electrodes would be attached was removed, the areas were wiped clean with medical alcohol, and the electrodes were then attached to the areas. The muscles of the subject that greatly influenced the upper limb reaching activity included the anterior deltoid, posterior deltoid, biceps brachii, and triceps brachii. Muscle activity was measured and data were collected by having the seated subjects reach to grab a plastic cup from a desk in front of them with the affected arm, and the average value for this action performed 3 times was used. The measured electromyogram signal was analyzed by the root mean square (RMS) method. The Modified Barthel Index (MBI) was used to measure the ADL. The MBI is designed to measure the degree of independence in ADL and consists of 15 specific ADL motions. Mental practice was carried out for 30 minutes once a day, five times week, for two weeks in an occupational therapy room with a quiet environment under the subjects' physical, psychological stability. All training programs were recorded for 10 minutes, and the programs used in the previous studies were applied, which included a total of 3 types as follows: passing the bookshelf, picking up and putting in peas, and stacking up plastic cups[5]. Data analysis included descriptive analysis of mean differences to test whether the mental practice had a larger positive effect on impairment than natural recovery. For each participant, the individual pre-intervention data points were used to determine a mean pre-intervention score for each measure; the same procedure was followed to obtain mean post-intervention scores.

RESULTS

Table 2 shows the muscle activity of the upper extremity and ADL scores before and after mental practice. Only the posterior deltoid of subject no. 2 showed a decrease in muscle activity when stretching the upper limb after the mental practice, and most subjects showed increases in their muscle activities. Most subjects showed improvement in performing the activities of daily living.

DISCUSSION

This research attempted to examine the possibility of therapeutic effects on upper limb muscle activity and activities of daily living ability as a result of applying mental practice in chronic stroke patients. The results demonstrated that mental practice had a positive effect on both upper limb muscle activity and activities of daily living in the patients. Almost all of patients' muscles that were measured showed improvement after training, indicating that mental practice had a positive effect on improving upper limb function and that such result was helpful for enhancing the activities of daily living. Also, these results are in agreement with the results of a previous study that discussed the possibility of improving upper limb function and the ability to perform activities of daily living in stroke patients through mental practice[6]. The clinical significance of this research is that it confirmed the positive effects of mental practice on stroke patients, who were mentioned in many of existing studies, through a more objective measurement tool. However, the limitation of this research is that it is difficult to generalize the results due to the small number of subjects and to objectify the interpretation of results due to the spasticity of stroke patients' areas measured by RMS for electromyogram signals through the measurement of upper limb muscle activity.

Table 2. Mean pre- and post-intervention scores and mean differences

Measure		Pre-test	Post-test	Mean difference
RMS				
Participant 1	Deltoid Anterior	44.5	61.1	16.5
	Deltoid Posterior	30.5	33.4	2.9
	Biceps Brachii	31.2	34.8	3.5
	Triceps Brachii	24.5	27.8	3.3
Participant 2	Deltoid Anterior	60.6	63.4	2.8
	Deltoid Posterior	28.5	15.2	−13.3
	Biceps Brachii	31.7	43.2	11.5
	Triceps Brachii	10.3	23.5	13.2
MBI				
Participant 1		81.0	86.0	5.0
Participant 2		79.0	85.0	6.0

RMS: root mean square; MBI: Modified Barthel Index

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