Effects of Mental Practice with Action Observation Training on Occupational Performance after Stroke

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Background: Studies on whether mental practice (MP) in patients with stroke using action observation training (AOT) is effective in improving physical performance are still insufficient. To examine the effects of MP on both occupational performance and motor function to complement studies relevant to MP with AOT. *Methods:* Subjects of this study were 3 individuals who were diagnosed with stroke. We used an A-B-A study design with follow-up evaluation, which is a type of reversal single experimental research design. A total of 20 experimental sessions were conducted. To assess the long-term effect of MP with AOT, follow-up baseline measurements were made after 2 weeks without MP. Three-dimensional motion analysis and electromyography were conducted during each of the 20 sessions. The Motor Activity Log and Assessment of Motor and Process Skills were measured 3 times: in the pre-MP phase, the post-MP phase, and the 2-week follow-up phase. *Results:* Occupational performance improved after intervention in all 3 subjects when applying an MP task using AOT. All subjects showed improvement of motor functions, including smoothness of movement, agonistic muscle activation, and coordination. The treatment effect continued after 2 weeks. *Conclusions:* MP using AOT in patients with stroke is an effective treatment protocol to improve occupational performance and motor function. Thus, MP using AOT may be applicable for treating stroke patients with stroke not only while they are in the hospital but also at home or in the community. **Key Words:** Action observation training—mental practice—motor function—occupational performance—stroke.
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Introduction

Mental practice (MP) is a form of active mental exercise. Recently, studies have reported the effectiveness of MP with stroke patients for motor skill learning and performance improvement.[1,2] More than 85% of stroke patients experience hemiparesis, and more than 69% of these cases experience upper extremity dysfunctions, such as limited range of motion because of muscle weakness and spasticity.[3-5] Therefore, patients with stroke are limited in performing independent activities of daily living (ADLs) because of limited use of their upper extremities.[6] It is desirable for patients with stroke to repeatedly practice and become trained in ADL tasks to enhance their upper extremity function. The effects of repetitive exercises and task-oriented training have been demonstrated.[7,8]

MP is beneficial because motor skills can be developed with minimal energy consumption and expense. MP

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allows stroke patients to perform rehabilitation-related activities to improve motor ability safely and independently.[9] It promotes active participation, and practice can be continued independently once training is completed.[10-13] Thus, MP generates functional improvement in stroke rehabilitation.[11,14-18] Previous studies using the MP program have demonstrated its effects on stroke recovery (eg, use of affected arm, movement kinematics, and physical strength).[5,15,19,20] Theoretical evidence for MP has been reported by several researchers. MP has similar effects on particular skills and subserves the same muscular and neural structures as physical practice.[21,22] It also allows trainees to concentrate on the skills to be practiced,[6] to prepare in advance for physical reactions in various circumstances, and furthermore, to cope with particular circumstances with confidence.[23] MP stimulates visual imagination related to practice and subsequently activates memory processes or abilities.[24] Furthermore, it has been indicated that because action verbs are often used, MP is related to the promotion of motion practice and learning.[4]

Several researchers have discovered that imagining affected limbs takes more time than imagining normal limbs, even when no cognitive damage has been reported and relevant neural circuitry has been spared.[3,25,26] Action observation training (AOT) is recommended to address issues in stroke patients to aid in forming accurate motor images.[27,28] Action observation that replicates neural system activity can mediate motor learning of new skills or the relearning of motor skills lost because of stroke.[29] However, few studies have examined whether MP with AOT is effective in improving physical performance in stroke patients. MP using AOT is a treatment strategy that elicits powerful imaginative responses. These responses enhance the subject's concentration by providing multisensory cues (eg, visual, auditory, kinesthetic). The observation of motor behavior through a monitor is considered to be the optimal learning method for improving not only the perceptual realism of the visualization but also its own schema and project sequences.[30] Therefore, not only performance abilities related to treatment skills and methods but also changes in occupational performance and motor function should be studied to demonstrate the effects of MP with AOT. Although existing studies investigating MP have primarily focused on its effectiveness for occupational performance, such studies are insufficient. Furthermore, most studies on MP have mainly analyzed short-term effects; thus, little is known about its long-term effects.[21]

The purpose of this study was to investigate the effects of MP on both occupational performance and motor function. Further, this study aimed to complement studies relevant to MP with AOT and to demonstrate persistent effects through follow-up evaluation 2 weeks later. To determine the effects of MP with AOT, we hypothesized that (1) there will be effects on occupational performance and motor function of the affected arm in stroke patients, and (2) there will be long-term effects of MP with AOT.

Methods

Research Design

For this study, we used an A-B-A study design with follow-up evaluation, which is a type of reversal single experimental research design. A total of 20 experimental sessions took place; these sessions were divided into the baseline phase and the MP phase. The pre-MP phase consisted of 5 sessions, the MP phase consisted of 10 sessions, and the post-MP phase consisted of 3 sessions, without the application of MP. To assess the long-term effect of the MP, follow-up baseline measurements were made after 2 weeks without MP (Fig 1). In each of the 20 sessions, 3-dimensional (3-D) movement analysis and electromyography (EMG) were conducted (Fig 2). The Motor Activity Log (MAL) and the Assessment of Motor and Process Skills (AMPS) were conducted three times in total: pre-MP phase, post-MP phase, and the 2-week follow-up phase. All 3 participants received physical therapy during all sessions to improve muscle strength and limited range of motion through occupational therapy, exercise therapy, and walking practice at the rehabilitation hospitals.

Participants

The participants of this study were 3 individuals who were diagnosed with stroke and were presently undergoing rehabilitation at Y Rehabilitation Hospital. The specific participant selection criteria were as follows:

1) participants diagnosed with hemiplegia after a stroke, excluding patients with parietal damage injury or tremor diagnosis,
2) participants with disease duration of 3 months or more; the selection was made after the initial functional recovery period to minimize the effect of contaminating variables on the intervention,
3) participants without audiovisual impairments,
4) participants with Mini-Mental State Examination-Korean (MMSE-K) of 24 points or more, to select participants with no cognitive deficits, which is necessary to conduct MP and complete tasks,
5) participants with Vividness of Movement Imagery Questionnaire of 2.26 points or less, to select participants with above-average vividness of imagery,
6) participants in Brunnstrom hand function recovery stages 3-6, to select participants who could complete assigned tasks, and
7) participants with grade 3 or lower in Modified Ashworth Scale (MAS), in order to examine whether they had spasticity that was severe enough to interfere with the study.

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