Effectiveness of Bilateral Arm Training for Improving Extremity Function and Activities of Daily Living Performance in Hemiplegic Patients

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Background: Bilateral movement therapy, which encourages simultaneous use of the limbs on both the affected and nonaffected sides, is known to help in motor function recovery in hemiplegic patients. However, studies on the effectiveness of bilateral arm training for improving upper limb function and activities of daily living (ADL) performance in hemiplegic stroke patients are lacking. The present study investigated the effectiveness of bilateral arm training for improving upper limb function and ADL performance in hemiplegic stroke patients. *Methods:* The study included 30 hemiplegic stroke patients. The patients were randomly divided into an experimental group (n = 15) and a control group (n = 15). All patients received a uniform general occupational therapy session lasting 30 minutes 5 times a week for 8 weeks. The experimental group received an additional session of bilateral arm training lasting 30 minutes, and the control group received an additional session of general occupational therapy lasting 30 minutes. The Fugl-Meyer assessment (FMA), Box and Block Test (BBT), and modified Barthel index (MBI) were used for evaluation. *Results:* In both the experimental and control groups, the FMA, BBT, and MBI scores were significantly higher after the intervention than before the intervention ($P < .05$). The changes in the FMA, BBT, and MBI scores were greater in the experimental group than in the control group ($P < .05$). *Conclusions:* Bilateral arm training along with general occupational therapy might be more effective than occupational therapy alone for improving upper limb function and ADL performance in hemiplegic stroke patients. **Key Words:** Stroke—bilateral arm training—upper extremity function—activities of daily living.

Introduction

Stroke is a cerebrovascular disorder that occurs when the brain cannot receive inputs from the motor and sensory nerves because of insufficient blood supply to the brain or cerebral hemorrhage in the brain.[1] Stroke generally accompanies hemiparesis, and over 50% of stroke patients lose control of the arm temporarily or permanently owing to upper limb paralysis and are unable to perform activities of daily living (ADL).[2] Among hemiplegic patients, 30%-60% cannot perform bilateral coordination tasks, which affects independent ADL[3] and causes severe physical and psychological pain.[4]

Bilateral movement therapy, which encourages the simultaneous use of the limbs on both the affected and nonaffected sides, has been reported to be helpful for motor

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function recovery in hemiplegic patients and has been used for treating these patients.[5,6] Bilateral upper limb training has been shown to activate the central nervous system and stimulate the cerebral hemisphere.[7] Parker et al[8] reported that 90% of the nerve fibers in the cerebral cortex and spinal cord control contralateral movement and the remaining 10% control ipsilateral movement, and that movement of the upper limb on the nonaffected side can influence movement of the upper limb on the affected side. Staines et al[9] found that the activation of the cortical region on the affected side is higher when the limbs on both sides are moved than when the limb on only the affected side is moved. Additionally, it has been shown that the performance of an ambidextrous task causes a complex interaction between both hemispheres, increasing the activity of the upper limb on the affected side.[10] Utley and Sugden[11] reported that, in hemiplegic patients, the movement of the hand on the affected side was faster when using both hands than when using only the hand on the affected side.

Most previous studies are concerned with the functional movement of the upper limb on the affected side. However, studies on the effectiveness of bilateral arm training for improving ADL performance in hemiplegic stroke patients are lacking. The present study investigated the effectiveness of bilateral arm training for improving upper limb function and ADL performance in hemiplegic stroke patients.

Methods

Participants

A total of 31 hemiplegic stroke patients were considered for inclusion in the present study. The inclusion criteria were as follows: (1) follow-up of at least 6 months after a diagnosis of hemiplegia due to stroke, (2) a score of over 24 points in the Mini-Mental State Examination—Korean version and ability to communicate, (3) a stage of over 3 in Brunnstrom recovery staging for the affected upper limb, and (4) ability to sit independently without assistance tools. The exclusion criteria were as follows: (1) visual perception and cognitive deficits, (2) joint contracture or limitations in the joint range of motion, and (3) inability to perform the motor program because of neurological or psychological problems. Among the 31 patients considered for inclusion, 1 patient was unable to participate regularly and was excluded. Therefore, 30 patients were finally included in the present study. Using a computer-generated random number table, the participants were randomly divided into an experimental group (bilateral arm training, n = 15) and a control group (general occupational therapy, n = 15). The flowchart of study inclusion in presented in Figure 1. All participants provided written informed consent, and the present study was approved by the institutional review board of Daegu University.

Procedure and Interventions

All participants in both the experimental and control groups received a uniform general occupational therapy session lasting 30 minutes 5 times a week for 8 weeks. The experimental group received an additional session of bilateral arm training lasting 30 minutes, and the control group received an additional session of general occupational therapy lasting 30 minutes.

General occupational therapy incorporated the Bobath approach, which involves neurodevelopmental treatment that boosts normal postural reactions and restrains abnormal reflective patterns, stretching exercises for enhancing flexibility of the paralyzed upper limbs, resistance movements for increasing the muscle strength of the upper limb on the affected side, and fine motor training for improving hand manipulation skills and dexterity. Bilateral arm training incorporated 5 tasks, including dishwashing, making coffee, typing, cutting fruit, and folding laundry, which are commonly performed in daily life.

Outcome Measurements

All assessments were performed by an experienced occupational therapist who was blinded to the group allocation. The Fugl-Meyer assessment (FMA) was used for the evaluation of upper extremity function. It is a quantitative assessment tool for motor function of the upper limbs in hemiplegic patients.[12] The assessment includes 18 items for the shoulder, elbow, or lower limb, 5 items for the wrist, 7 items for the hand and fingers, and 3 items for upper limb coordination.[13] Scores were given according to the completion of an item as follows: no completion, 0 points; partial completion, 1 point; and completion, 2 points. The maximum achievable score is 66 points. The test–retest credibility value (r = .99) and inter-rater reliability value (r = .99) indicated very high reliability and validity.[14]

Additionally, the Box and Block Test (BBT) was used. This test assesses hand manipulation and hand dexterity in physically handicapped patients.[15] The test involves moving 1-inch cube blocks (2.5 cm × 2.5 cm × 2.5 cm) from a rectangular box container (53.7 cm × 25.4 cm × 8.5 cm) to another container, and the number of blocks moved by each hand in 60 seconds is determined.[16] The test–retest credibility values (right hand, r = .94; left hand, r = .99) and inter-rater reliability values (right hand, r = 1.00; left hand, r = .99) indicated very high reliability and validity.[17]

Moreover, the modified Barthel index (MBI) was used. This index assesses the degree of ADL independence and includes the following 10 items: feeding, personal hygiene, bathing, dressing, toilet use, bladder control, bowel control, ambulation, transfer, and stair climbing, and the maximum achievable score is 100.[18] The score range of 1-24 indicates total dependence, 25-49 indicates severe dependence, 50-74 indicates moderate dependence, 75-90 indicates mild dependence, and 91-99 indicates minimal dependence, and