Effect of Gross Motor Group Exercise on Functional Status in Chronic Stroke: A Randomized Controlled Trial

KWANGHYUN KIM, PT, Msc1), BYUNGOOJIN LEE, PT, Msc1), WANHEE LEE, PT, PhD1)*

1) Department of Physical Therapy, Sahmyook University: 26-21 Gongneung 2-dong, Nowon-gu, Seoul 139-742, Republic of Korea

Abstract. [Purpose] The aim of this study was to understand the effects of task-oriented gross motor group exercise based on motor development on chronic stroke patients’ joint, bone, muscle, and motor functions and activities of daily living. [Subjects] Twenty-eight stroke patients hospitalized at P municipal nursing facility for the severely handicapped were randomly assigned to the gross motor group exercise group (experimental group, n=14) or the control group (n=14). [Methods] The two groups performed morning exercise led by a trainer for 30 minutes a day, 5 times a week for 6 weeks in total. The experimental group performed a gross motor group exercise in addition to this exercise for 30 minutes a day, 3 times a week for 6 weeks in total. Before the experiment, all subjects were measured with the Modified Barthel Index (MBI) and for their neuromuscular skeletal and motor-related functions according to the International Classification of Functioning, Disability and Health. [Results] Significant improvements were found in the experimental group’s neuromusculoskeletal and motor-related functions and MBI test, except for the stability of joint functions. The control group showed no significant difference from the initial evaluation. [Conclusion] The gross motor group exercise based on motor development is recommended for chronic stroke patients with severe handicaps.

Key words: Chronic stroke, Group exercise, ICF

INTRODUCTION

Functional damage in stroke patients varies with regard to kind and level of seriousness, requiring a more systematic and consistent functional evaluation. The World Health Organization presented the International Classification of Functioning, Disability and Health (ICF) as a systematic tool and unified standard classification to express the status of health and related matters1). The ICF is closely correlated with other existing evaluation tools but is capable of further explaining the kind and seriousness of a stroke patient’s damage. Thus, it can be utilized as an evaluation tool for functionality status2,3).

Many studies for improving joint and bone function, muscle function, and motor function in stroke patients have been carried out. Previous studies on gross motor exercise using object grasping4) and task-oriented training focused on specific functional task performance by associating the musculoskeletal system with the nervous system5) and Bobath’s techniques, which are well known as neurodevelopmental treatments, have proved the effectiveness of these treatment methods. However, the effects of combined therapy composed of gross motor exercise, task-oriented training, and neurodevelopmental treatment have not been studied. Our hypothesis is that task-oriented gross motor group exercise that matches the neurodevelopment stage is more effective.

Given the above, the present study sought to suggest an effective exercise method to improve the joint, bone, muscle, and motor functions and performance of activities of daily living (ADL) in stroke by assessment with the ICF tool.

SUBJECTS AND METHODS

This study examined 28 stroke patients hospitalized in P municipal nursing center for the severely handicapped located in Seoul, Republic of Korea. The subjects were randomly grouped into a gross motor group exercise group (n=14) and a control group (n=14). Randomization was performed with a computer using a basic random number generator. A summary of the general characteristics of the subjects is shown in Table 1.

The subjects were selected based on the following criteria: 1) chronic stroke patients who were at least 5 years after their stroke diagnosis, 2) those whose brain lesions degree was 1 or 2, 3) those whose Mini-Mental State Examination-Korean (MMSE-K) score was 20 or more, and 4) those who understood the research experiment and were capable of...
Table 1. General characteristics of the subjects

| Parameters            | GMGEG (n=14) | CG (n=14) |
|-----------------------|--------------|-----------|
| Gender (male/female)  | 14/0 (100/0) | 14/0 (100/0) |
| Affected side (Rt/Lt) | 10/4 (71.4/28.6) | 8/6 (57.1/42.9) |
| Age (years)           | 58.2±10.3    | 55.9±10.1 |
| Height (cm)           | 163.1±7.1    | 168.3±6.3 |
| Duration (years)      | 11.4±2.7     | 9.4±3.1   |
| MMSE-K (score)        | 22.0±0.7     | 21.6±0.5  |

Values are numbers (%) or means±SD
GMGEG, gross motor group exercise group. CG, control group

Table 2. Change in MBI within groups and between groups

| Group                  | Pre-training | Post-training | Change value (post-pre) |
|------------------------|--------------|---------------|-------------------------|
| GMGEG (n=14)           | 62.1±18.3    | 64.2±17.2*    | 2.1±1.1*                |
| CG (n=14)              | 52.1±19.4    | 52.1±19.4     | 0±0                     |

Values are means±SD. *p<0.05
GMGEG, gross motor group exercise group. CG, control group

and movement-related functions were used. Their subitems included joint, bone, muscle, and motor function. This assessment tool has a high correlation with other tools along with higher validity and has proved to be a useful evaluation device for a stroke patient’s functional status.

RESULTS

The gross motor group exercise group was found to have significantly increased MBI results, increasing from 62.07 before training to 64.21 after training for a total of 2.14 points (p<0.05). The changes between the pre-/post-training measurements of the two groups were proven to be significant (p<0.05) (Table 2).

A significant change was found in the mobility of joint function test in the gross motor group exercise group (p=0.016). No change was found in the control group. The change between the pre- and post-training measurements was significantly different between the two groups (p=0.003) (Table 3).

No significant change was found in the stability of joint function test between the pre- and post-training measurements within the experimental and control groups (p=0.066). The changes between the pre- and post-training measurements were significantly different between the two groups (p=0.034).

A significant change was found in the mobility of bone function test but only in the experiment group (p=0.016). The changes between the pre- and post-training measurements were significantly different between the two groups (p=0.016).

A significant decrease was found in the muscle power function test but only in the experiment group (p=0.017). The changes between the pre- and post-training measurements indicated a significant change between the two groups (p=0.003).

A significant difference was found in the muscle tone function test but only in the experiment group (p=0.026). The changes between the pre- and post-training measurements indicated a significant change between the two groups (p=0.007).

A significant difference was found in the muscle endurance function test but only in the experiment group (p=0.011). The changes between the pre- and post-training measurements indicated a significant change between the two groups (p=0.003).

The gross motor group exercise group displayed a significant difference in movement function (p=0.041). The changes between the pre- and post-training measurements
Table 3. Changes of ICF function within groups and between groups (N=28)

| Group | Test | MJF (median, range) | SJF (median, range) | MBF (median, range) | MPF (median, range) | MTF (median, range) | MEF (median, range) | MF (median, range) |
|-------|------|---------------------|---------------------|--------------------|---------------------|---------------------|---------------------|---------------------|
| GMGEG | Pretest | 1.2 (0.1–1.6) | 0.8 (0.1–1.4) | 1.0 (0.3–1.3) | 1.2 (0.8–1.9) | 1.1 (0.8–1.9) | 1.1 (0.6–1.6) | 1.3 (0.7–2.0) |
| (n=14) | Posttest | 0.9 (0.4–1.4)<sup>a,b</sup> | 0.7 (0.0–1.4)<sup>b</sup> | 0.8 (0.3–1.2)<sup>a,b</sup> | 1.1 (0.8–1.9)<sup>b</sup> | 1.1 (0.8–1.4)<sup>b</sup> | 1.0 (0.6–1.6)<sup>b</sup> | 1.2 (0.7–2.0)<sup>a,b</sup> |
| CG | Pretest | 1.2 (0.6–1.8) | 1.2 (0.6–1.4) | 1.1 (0.7–1.7) | 1.4 (0.9–1.9) | 1.2 (0.6–1.9) | 1.0 (0.6–1.6) | 1.3 (1.3–2.2) |
| (n=14) | Posttest | 1.2 (0.6–1.8) | 1.2 (0.6–1.4) | 1.1 (0.7–1.7) | 1.4 (0.9–1.9) | 1.2 (0.6–1.9) | 1.0 (0.6–1.6) | 1.3 (1.3–2.2) |

Values are expressed as medians (minimum value-maximum value)

<sup>a</sup>Significant differences between the pretest and posttest. p<0.05
<sup>b</sup>Significant differences between the GMGEG and CG. p<0.05

MJF, mobility of joint function; SJF, stability of joint function; MBF, mobility of bone function; MPF, muscle power function; MTF, muscle tone function; MEF, muscle endurance function; MF, movement function

indicated a significant change between the two groups (p=0.016).

**DISCUSSION**

As a result of the experiment in the present study, we found significant improvement in post-training mobility of joint function, mobility of bone function, muscle power function, muscle tone function, muscle endurance function, control of voluntary movement, and MBI test (p<0.05). But no significant change was observed in stability of joint function.

The cause of movement disorder in stroke patients was considered to be spasticity until recently, and thus spasticity treatment has been dominant. But more recently, the focus has been placed on improving muscle strength, joint mobility, etc., to reach a normal level. The effect of elevated muscle strength was larger on early-stage stroke patients and the group that received stretch training showed improvement in symmetric weight distribution. This indicates that diverse components such as stretching a hand out to an object, posture stabilization, and balance maintenance were coordinated for the same single movement goal.

In this study, we found significant changes in the control of simple voluntary movement (b7600), control of complex voluntary movement (b7601), coordination of voluntary movement (b7602), and supportive function of the arm or leg (b7603). Such results, as shown in previous studies, were possible because the present study’s tasks were constructed with coordination activities and because the efforts of the patients to pass the acceptance criteria of these tasks affected the coordination function.

The stability of joint function test in this study, means the function to support the structural frame of joints. This study found no significant change in joint stability function from before and after the training intervention. This was possibly because 9.42 years had passed on average since stroke occurrence. Suffering from power imbalance for a long time caused them to experience structural changes or soft tissue property changes.

When a stroke patient was trained with a task-oriented program, they showed significant improvements in ADL, independent activities, bowel control, and transfer. Also, a significant change was observed in MBI score, and this was due to the task structure in this study, which was comprised of sitting by placing an arm on the floor, standing up for a while alone, holding an object and moving it to the other hand, standing up by using a support, standing up on one leg, throwing away an object, and kicking a ball standing still, which is helpful for ADL performance.

As this study looked into patients with first- and second-grade brain lesions only, it would be difficult to generalize the study findings to all handicapped patients with brain lesions.

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