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The Effects of Task-Centered Programs on Gait in Stroke Patients

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Abstract

Background/Objectives: we evaluated the effects of a real life task-based program on gait of stroke patients with hemiplegia.

Methods/Statistical analysis: Thirty stroke patients participated in this study. Subjects were randomly divided into a task-centered program group(N=15) and a general balance training group (n=15), both of which were applied for 30 minute / a day, thrice a week / 4 weeks. The MTD balance system was used to evaluate weight bearing capacity on the paralyzed side of the patient prior to walking ability, and the Timed Up and Go test (TUG) was used to assess walking ability.

Findings: The task-centered program group showed significant improvement in weight-bearing and walking abilities on the paralyzed side compared to the general balance training group after treatment.

Improvements/Applications: It was found that task-centered programs were helpful in improving weight-bearing and walking ability on the hemiplegic side.

Keywords: Stroke, Hemiplegia, Task-centered programs, Weight bearing, Gait

1. Introduction

Stroke is a disease that interrupts the blood supply to blood vessels in the brain [1]. A major physical impairments from stroke is a decreased in walking and balance abilities [2]. When maintaining a walking or standing position, patients with hemiplegia shift 61-80% of their body weight on the non-affected side, resulting in weight-bearing imbalance [3]. To complement these, hemiplegia patients excessively move their lower extremity joint on the paralyzed side. Therefore, walking may require more energy than normal walking [4, 5]. These balance disorders may cause problems such as delayed mobility recovery, gait disturbance, and an increased incidence of falls [6]. In addition, the fear of experiencing a fall affects daily living activities and mobility [7], it reduces social participation and mobility and consequently reduces quality of life [8]. Additionally, patients cannot independently perform many routine activities after a stroke so they cannot live independently [9].

Several rehabilitation treatment methods are currently being applied to restore balance and walking ability in stroke patients. Among them, recent research has shown that a task-centered approach is effective for improving the functional activity required for balance, walking, and daily living activities in hemiplegia. The task-centered programs method proposed by Carr and Shepherd (2003) is a form of treatment that is designed for hemiplegia patients based on the motor learning theory. Through this method, patients learn the strategies they need to adapt to a changing environments. This programs develops problem-solving and effective reward strategies by practicing the skills necessary to achieve task goals and improve adaptability in various situations [10]. Task-centered training is a method of solving problems efficiently and effectively by using related body parts for problems assigned as functional tasks, unlike existing treatment methods that repeatedly train single movements [11]. A study using a task-based approach reported that task-based training showed statistically significant differences in balance, gait ability, and trunk control in hemiplegia [12].

Therefore, the purpose of this study was to find an effective rehabilitation treatment method to improve limbic function in hemiplegis by examining the effect on the weight-bearing and walking abilities of the paralyzed side when task-centered activities related to real life were provided to hemiplegia patients.

2. Materials and Methods

2.1. Subject

This study was conducted at Hospital B, Gyeonggi-do, South Korea. 30 patients diagnosed with hemiplegia were randomly assigned to two groups. The study period was from March to May 2019. The detailed selection conditions for the subjects are as follows:

1) Cerebral hemorrhage or cerebral infarction diagnosis (onset period of more than 6 months)

2) Individual who can communicate and understand instructions with a score of 24 or higher on the Korean Mini-Mental State Test (MMSE-K)

3) Individuals who can walk more than 5m without a support device

4) No joint deformity, musculoskeletal pain, fracture, or hemianopia

5) A Patient (or guardian) is a person who understands the contents of this study and agrees to participate

2.2. Evaluation tools

2.2.1. MTD balance system

The Messen Trairuieren Dokumentieren (MTD, Germany) system was used to evaluate the left and right balance abilities of the paraplegic and non-paraplegic sides of stroke patients [Figure 1]. A total of 8 postures were evaluated, and the weight-bearing rate (%) of the right and left sides of the body was measured by maintaining a standing posture for 10 s before and after treatment. The MTD system records the center of gravity 10,000 times per second for 10 seconds and calculates it as a percentage of the subject's body weight (% BW) [13].

Figure 1. Messen Trairuieren Dokumentieren (Germany)'s MTD balance system (http://www.mtd-systems.com/News/news.html [14])

2.2.2. Timed up and Go(TUG) test

The TUG test is a method developed by Podsiadlo and Richardson (1991) that has been used to predict the risk of falling by evaluating balance ability and functional mobility in the elderly. It has also been used in patients with illnesses. The time it takes to get up from sitting on a armrest-chair, walk 3m, and return to sitting again was recorded. This test was performed 3 times and the average value was obtained [Figure 2]. The intra-examiner reliability was 0.99 and the inter-examiner reliability was 0.98, indicating high reliability [15].

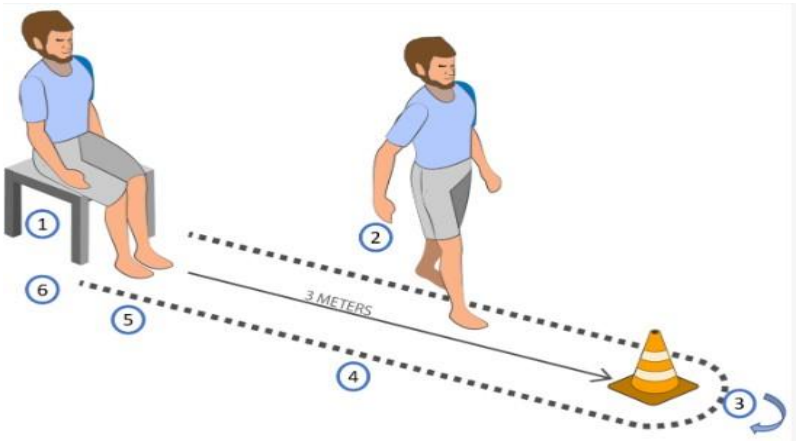

Figure 2. Timed up and Go test [16]

2.3. Intervention

For this study, subjects were divided into a general balance training group and an task-centered program group with 15 subjects each, using a blinding method. The experiment was conducted thrice a week, with 30 minutes per session, for a total of 4 weeks. The intervention program included a task-centered program in the experimental group and general balance training in the general balance training group.

The task-centered program group was performed through interviews with the subject among the standardized tasks presented by the Exercise Processing Skills Assessment (AMPS) so that they can be easily accessed and applied in daily life. Five tasks that could be performed at home or in society were selected, which were: 1) pouring drinks from the refrigerator into cups, 2) cleaning windows, 3) hanging laundry that has been washed and dried, 4) walking while moving things, and 5) going up and down the stairs.

Each activity was performed for 5 min, with a 1 min break between items and movement time for doing other items. Each task began with the patient being comfortable, gradually increasing in speed, intensity, and difficulty with the patient's consent over the course of 4 weeks. The control group performed general balance training using treatment tools such as a balance board and a trampoline. The therapeutic intervention was the same as in the experimental group.

2.4. Statistical analysis

Analysis of the collected data was statistically processed using the SPSS 24.0 software. It was found that all variables of the data collected from the study were normally distributed. A paired t-test was conducted to investigate the intra- and post-group changes in weight-bearing and gait ability after 4 weeks in the task-centered program group and balance training group. An independent t-test was performed to compare the changes.

3. Results and Discussion

3.1. General characteristics of subjects

The general characteristics of the participants included in this study are listed in Table 1. There were 10 males (66.7%) and 5 females (33.3%) in the task-centered program group, and 7 males and 8 females in the general balance training group. In the control group, the types of brain injury were cerebral infarction (n = 6; 40%) and cerebral hemorrhage (n = 9; 60%) in the experimental group, and cerebral infarction (n = 8; 53.3%), and cerebral hemorrhage (n = 7; 46.7%) in the control group. In the experimental group, 8 patients (53.3%) had right hemiplegia and 7 patients (46.7%) had left hemiplegia. While in the control group, 10 patients (66.7%) had right hemiplegia and five patients (33.3%) had left hemiplegia. The mean age was 45.29 ± 12.10 years in the task-centered program group and 48.45 ± 15.15 years in the general balance training group. The duration of disease was 28.35 ± 20.18 months in the task-centered program group and 26.74 ± 12.68 months in the general balance training group.

Table 1: General characteristics of subjects

Variables	Division	Task-centered training group(n=15)	General balance training group(n=15)
Gender (person)	Male	10(66.7%)	7(46.7%)
	Female	5(33.3%)	8(53.3%)
Brain injury type	Infarction	6(40.0%)	8(53.3%)
	Hemorrhage	9(60.0%)	7(46.7%)
Paratic side	Right	8(53.3%)	10(66.7%)
	Left	7(46.7%)	5(33.3%)
Average age(year)		45.29±12.10	48.45±15.15
Average disease period(month)		28.35±20.18	26.74±12.68

3.2. Comparison of results pre- and post-intervention in the task-centered program group

There was a significant difference in the weight-bearing rate of the paralyzed side before (38.23 ± 5.87%) and after (47.16 ± 5.84%) the test in standing posture ($p < 0.001$). Additionally, there was a significant difference in gait ability before (26.47 ± 13.28 seconds) and after (22.19 ± 19.19 seconds) the test ($p < 0.001$) [Table 2].

Table 2: Comparison of results before and after the intervention in the task centered group

	Pre-intervention test(M±SD)	Post-intervention test(M±SD)	t
MTD(%)	38.23±5.87	47.16.±12.88	-8.758***
TUG(sec)	26.47±13.28	22.19±19.19	7.608***

The values are mean (standard deviation), MTD(%), *p<0.05, **p<0.01, ***p<0.001 by paired t-test

3.3. Comparison of results pre- and post-intervention in general balance training group

There was a significant difference in the weight-bearing rate of the paralyzed side before (38.34 ± 5.79%) and after (41.44 ± 10.73%) the test in standing posture ($p < 0.001$). Additionally, there was a significant difference before (36.63 ± 18.71 seconds) and after (34.21 ± 18.36 seconds) the test in terms of gait ability ($p < 0.05$) [Table 3].

Table 3: Comparison of results pre- and post-intervention in the general balance group

	Pre-intervention test(M±SD)	Post-intervention test(M±SD)	t
MTD(%)	38.34±5.79	41.44.±10.73	-6.654***
TUG(sec)	36.63±18.71	34.21±18.86	2.190*

The values are mean (standard deviation), MTD(%)

3.4. Comparison of results between the two group

The task-centered program group showed a weight-bearing rate of 8.93 ± 5.79% in standing posture during MTD evaluation, which was significantly higher than the weight-bearing rate of 3.10 ± 4.94% in the general

balance training group ($p < 0.05$). In the gait ability test, the task-centered program group was significantly different to the control group, with -4.28 ± 5.91 seconds for the experimental group and -2.42 ± 0.15 seconds for the control group before and after the TUG test ($p < 0.05$) [Table 4].

Table 4: Comparison of results between the two group

	Task-centered training group(n=15) Post-Pre test(M±SD)	Balance training group(n=15) Post-Pre test(M±SD)	t
MTD(%)	8.93±5.79	3.10.±4.94	2.657*
TUG(sec)	-4.28±5.91	-2.42±0.15	-2.178*

The values are mean (standard deviation), MTD(%)

3.5. Discussion

This study was conducted to investigate the effects of task-centered program on weight-bearing and gait ability of the paralyzed side of stroke patients, and to suggest a therapeutic approach to improve the functional ability of hemiplegia to move their limbs.

The subjects of this study were hemiplegic patients diagnosed with stroke, with an onset period of 6 months or longer. As a study method, two groups of pre-treatment and post-treatment post-treatment designs were used. The subjects were subjected to training 3 times a week, with 30 min per session for 4 weeks. The intervention was limited to thrice a week because after-hours treatment may increase patient fatigue. In addition, the 4-week intervention period limit was employed since it was difficult to proceed with the study since subjects tend to drop out when an intervention period of 4 weeks or more is performed owing to the rapid rate of hospitalization and discharge. The task-centered activity applied in this study is not as simple as tasks used in previous studies. The tasks were especially chosen since they related to daily life and the actual home environment to which the patient will be coming back. Thirty research subjects who met the selection criteria were selected and randomly assigned to an task-centered program group or a general balance training group, and each group was classified according to therapeutic intervention.

The results of the study showed that both the task-centered program group and general balance training group shortened execution time before and after the experiment in the TUG test that evaluated dynamic balance ability. Additionally, there was a significantly higher amount of change in the task-centered program group compared to in the general balance training group. This means that the task-centered activity used in this study was helpful in enhancing the subjects' dynamic balance ability. In the study by Kim et al. (2012), the task-centered program showed great improvement in TUG [17]. Therefore, it is consistent with the results of this study and previous studies and supports the effectiveness of the study.

There was a significant difference both before and after the experiment in the task-centered program group and the general balance training group while standing upright in the MTD, which measured the body weight-bearing rate in relation to balance. Additionally, the amount of change in the task-centered program group was significantly different from the amount of change in the balance training group. Based on these results, task-centered activities indicate a positive effect in increasing the weight-bearing rate from the standing position to the paralyzed side in hemiplegic patients.

This study is limited due to the small number of subjects and short task-centered training duration; therefore, the results of this study must be cautiously interpreted. Future studies should increase the sample size and intervention duration. Additionally, it is necessary to study whether the treatment effect differs according to the type and characteristics of the patient, such as the type of brain damage and the area on the paralyzed side. Lastly, since task-centered training is an activity that is often used in real life, it is necessary to study whether it is really effective in real life through follow-up surveys after the intervention.

4. Conclusion

From February 2014 to April of the same year, 30 subjects were divided into 2 groups at Hospital B in

Gyeonggi-do, South Korea, and the experiment was conducted. Task-centered activities consisting of a total of five tasks were conducted three times a week for four weeks. Weight-bearing ability on the paralyzed side was evaluated using an MTD system where the patients have to stand upright, and balance ability was evaluated using the TUG test. The differences between the task-centered program group and general balance training group before and after treatment were compared, and the results are as follows: the balance ability of the task-centered program group showed a significant difference in both the TUG and MTD tests, the balance ability of the general balance training group showed a significant difference in TUG and MTD, and there was a significant difference in the amount of change in TUG and MTD between the task-centered program group and general balance training group in terms of balance ability.

Through this study, it was found that task-centered program was more effective in improving some balance abilities of stroke patients than general balance instruction. In particular, the fact that the improvement of balance ability was induced by training the actual task makes this study significant in that it helps people participate in daily life when returning to society and home, and that the continuity of treatment can be maintained. However, it is difficult to generalize and interpret the results owing to the small number of subjects in the study, and the short intervention period. Therefore, future research should increase the number of subjects and establish the basis for task-centered activities through a sufficient research period such that an effective treatment approach for improving limbic function in hemiplegic patients can be developed.

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