The Effects of Home Based Exercise Program on Balance Recovery in a Post-Stroke Population

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Abstract  The present study was designed to investigate the effect of home based exercise program on balance recovery of stroke patients. In total, 20 participants were assigned to a control group(n=10) or exercise group(n=10) between September 2013 and December 2013. In addition to existing physiotherapy, the exercise group received home based exercise program consisting of weight transfer, training endurance, mobility, sensory retraining, lower limb exercise for 30 minutes, 2 times a week, for 8 weeks, every time for 30 minutes. Balance ability was assessed by measuring foot pressure(FP), limit of stability(LOS) and velocity sway(VS) by using Biorecuse and by using the functional reaching test(FRT). To compare the improvement level of each group’s balance ability, examination of independent sample T was done. Significant differences between control group and exercise group in LOS, VS of affect side and FRT were observed. This study showed that home based exercise program application was effective strategy on balance recovery in a post stroke population.

Key Words: Stroke, Balance, Home based exercise program, Limit of stability, Velocity sway

요 약  본 연구는 가정운동프로그램이 뇌졸중 환자의 균형능력회복에 미치는 효과를 알아보기 위하여 실시하였다. 본 연구는 2013년 9월에서 2013년 12월까지 실시하였으며, 대상자는 총 20명으로 일반적인 통원 물리치료를 실시한 대조군 10명, 일반적인 통원 물리치료를 실시하고 추가적으로 가정운동프로그램을 실시한 운동군 10명으로 나누어 배정하였다. 가정운동프로그램은 신경계 물리치료사가 대상자 집을 방문하여 8주 동안 주 2회씩 매주 30분간 시행하였으며 체중이동훈련, 지구력훈련, 운동체제훈련, 감각재훈련, 하지운동으로 구성되었다. 균형능력을 평가하기 위하여 Biorecuse를 이용하여 촉각, 안정성한계, 동요속도를 측정하였고 임상적인 측정방법 중 하나인 기능적 팔뽑기 검사를 실시하였다. 연구결과 대조군과 운동군은 안정성한계, 동요속도, 기능적 팔뽑기 검사에서 유의한 차이가 나타났다. 본 연구는 가정운동프로그램이 뇌졸중 환자의 균형회복을 회복하는데 효과적인 치료전략 중 하나라는 것을 나타냈다.

주제어: 뇌졸중, 균형, 가정운동프로그램, 안정성한계, 동요속도

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1. Introduction

Due to the mortality decrease of stroke patients, the importance of rehabilitation treatment for the function recovery of stroke patients is increasing gradually[1]. Residual neurological deficits are major contributors to stroke-related disability. These deficits disrupt gait and balance, promote fall risk, and increase social isolation and sedentary behaviors. Reduced activity after stroke affects cardiovascular disorder, muscle weakness and gait disturbance, and associated decreases in physical ability and social function. Well-designed exercise programs can promote function after stroke[2].

The earlier study reports that the point when they started the remedial exercise after the outbreak of disease and the amount of the remedial exercise are 2 important elements for the recovery of stroke patients. Earlier the exercise is carried out, the more concentrated the treatment is, the better recovery of the functional abilities are shown[3].

Recently, the importance of exercise programs after leaving the hospital is being magnified[3]. Actually more than half of the stroke patients need help in their movement of everyday lives even after 6 months since the outbreak of the disease, and many patients and families want the home base treatment to leave the hospital and get treated easily living with their families[4]. Several study have suggested that home-based exercise program is more cost-effective than traditional hospital-based care[5,6]. Similarly, Young and Forster found that home-based exercise seemed to be slightly more effective and resource-efficient than day hospital-based rehabilitation[7]. These investigators reported that home physical therapy was as beneficial as hospital-based care. Therefore, the importance of long-term rehabilitation programs such as the well systematized home-based exercise program are gradually increasing, but studies and guidelines about the home base exercise program is still not enough done.

Balance is a little vague term used to describe the capability to maintain or move within a weight-bearing posture without falling[8]. Balance is necessary for optimal functioning of the locomotor system and the performance of various activities of daily living[9].

Balance can further be divided into three aspects: symmetry, steadiness, and dynamic stability. The term symmetry is used to represent equal weight distribution between the feet in a standing position. Steadiness refers to the ability to sustain a given posture with minimal unrelated movement, and dynamic stability is the capability to move within a given posture without falling[10]. All of these components of balance have been observed to be disturbed following stroke[11]. The impaired balance of the stroke patient becomes a factor to arouse a fall and makes independent performance of everyday lives movements difficult[12,13]. Mediating the impaired balance which can cause fall through effective rehabilitation programs can be said as one of the most important elements in the rehabilitation of strokes[12].

Therefore, the purpose of this study is to carry out the home-based physical therapy program for stroke patients and through various balance beam exercises find out about the influence it has on the recovery of balance disorder which is the complication of stroke patients.

2. Method

2.1 Participants

From patients that were diagnosed as stroke through CT and MRI tests at the D Hospital located in Daegu, Korea and getting physiotherapy as an outpatient between September 2013 and December 2013, this study was carried out on those who understood the purpose of this study and have completed the consent form, and they were divided to a control group of 10 patients that had general
physiotherapy as an outpatient and an exercise group of 10 patients that had general physiotherapy as an outpatient and home based physical therapy program additionally. Recipients were selected with those who have passed 6 months after getting diagnosed as stroke and understand and follow the contents that the researcher instructs, with the score of MMSE-K over 24 point, and the stroke patients that have severe residual disability with the Barthel index score of 5-14 were left out from this experiment.

2.2 Intervention
The control group got the existing physiotherapy as an outpatient equally as before, and the existing physiotherapy as an outpatient is made up of functional electrical stimulation treatment for 15 minutes and rehabilitation ergometer exercise for 15 minutes and the treatment as an outpatient went on twice a week, for 8 weeks. The exercise group got the existing physiotherapy as an outpatient equally as before, and got the home based exercise program by referring to the Hale et al study in addition[14]. 4 physical therapists that have 2 years of work experiences on the nerve system physiotherapy participated in this program. The exercise is carried on by visiting the recipients’ houses 2 times a week for 8 weeks, every time for 30 minutes. The home based exercise program consisting of weight transfer, training endurance, mobility, sensory retraining, lower limb exercise is as below(Table 1).

2.3 Outcome measure
In this study, the balance ability was assessed by measuring foot pressure(FP), limit of stability(LOS) and velocity sway(VS) by using Biorecuse(RM Ingenierie, France) and by using the functional reaching test(FRT) which is clinically one of the most reliable measurement methods in the balance ability assessment of stroke patients[15].

2.4 Data analysis
To compare the improvement level of each group’s balance ability, examination of independent t–test was done, and in order to examine the statistical significance the significance level was set to 0.05. The results acquired from the experiment were suggested as averages and standard deviations, and the experiment results were statistically processed using the PASW 18.0 for windows.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Home based exercise program described by participating physiotherapists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight transfer</td>
<td>Rocking up on the toes and back on the heels, standing on 1 foot, high stepping</td>
</tr>
<tr>
<td>Training endurance</td>
<td>Exercycle</td>
</tr>
<tr>
<td>Mobility</td>
<td>Get up and walk to the toilet, go out to the kitchen and make a cup of tea, carry things safely</td>
</tr>
<tr>
<td>Sensory retraining</td>
<td>Brushing</td>
</tr>
<tr>
<td>Lower limb exercise</td>
<td>Give weights to push using different hands and different surfaces, sizes, and objects</td>
</tr>
<tr>
<td>Sit to stand</td>
<td>Side stepping</td>
</tr>
<tr>
<td>Bridging exercise in bed</td>
<td></td>
</tr>
</tbody>
</table>

3. Result

3.1 General features of the participants of study
The participants of this study were total of 20 stroke patients, 10 people in the control group and 10 in the exercise group, and the gender in the control group were 6 males and 4 females, and 8 males and 2 females in the exercise group, and the average age was 49.90±5.04 for the control group and 52.20±7.96 for the exercise group(Table 2).
<Table 2> General characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control group (n=10)</th>
<th>Exercise group (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (male/female)</td>
<td>6/4</td>
<td>8/2</td>
</tr>
<tr>
<td>Paretic side (left/right)</td>
<td>6/4</td>
<td>7/3</td>
</tr>
<tr>
<td>Type of stroke (hemorrhage/infarction)</td>
<td>8/2</td>
<td>6/4</td>
</tr>
<tr>
<td>Age (years)</td>
<td>Mean±SD=49.90±5.04</td>
<td>Mean±SD=52.20±7.96</td>
</tr>
<tr>
<td>Time since stroke (month)</td>
<td>Mean±SD=19.60±7.63</td>
<td>Mean±SD=21.3±10</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>Mean±SD=165.10±8.50</td>
<td>Mean±SD=167.20±5.24</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>Mean±SD=59.70±10.49</td>
<td>Mean±SD=63.10±10.12</td>
</tr>
</tbody>
</table>

*a Mean±SD

<Table 3> Improvement level comparison of balance function between the group

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Exercise group</th>
<th>Comparison of improvement between the groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP(%)</td>
<td>pretest 44.42±5.27</td>
<td>posttest 42.45±3.79</td>
<td>t=-0.691, p=0.498</td>
</tr>
<tr>
<td>Affect</td>
<td>pretest 45.87±3.18</td>
<td>posttest 45.64±3.64</td>
<td></td>
</tr>
<tr>
<td>LOS (mm²)</td>
<td>pretest 415.60±147.94</td>
<td>posttest 505.80±144.88</td>
<td>t=-3.806, p=0.001*</td>
</tr>
<tr>
<td>VS (cm/s)</td>
<td>pretest 0.63±0.24</td>
<td>posttest 0.61±0.15</td>
<td>t=2.177, p=0.043*</td>
</tr>
<tr>
<td>FRT (cm)</td>
<td>pretest 22.40±5.17</td>
<td>posttest 23.80±5.14</td>
<td>t=-2.297, p=0.034*</td>
</tr>
</tbody>
</table>

FP: foot pressure
LOS: limit of stability
VS: velocity sway
FRT: functional reaching test
*a Mean±SD
*p<.05

3.2 Improvement level comparison of balance function of the two groups

The improvement of affect side foot pressure did not show any significant differences between control group and exercise group (p>.05) (Table 3)(Figure 1). The affect side LOS of the exercise group was from 441.60±147.94 to 505.80±144.88, being significantly higher than the improvement level of the control group (p<.05) (Table 3)(Figure 2). The VS of the exercise group was from 0.61±0.15 to 0.46±0.13, being significantly lower than the improvement level of the control group (p<.05) (Table 3)(Figure 3). The FRT of the exercise group was from 23.80±5.14 to 25.90±4.65, being significantly higher that the improvement level of the control group (p<.05) (Table 3)(Figure 4).
The Effects of Home Based Exercise Program on Balance Recovery in a Post–Stroke Population

In this study, compared to control group, exercise group more significant improvements in the LOS, VS and FRT. These results indicate that home based exercise programs can effectively improve balance ability of stroke patients.

LOS can be described as the maximum distance a person can purposely displace his/her center of gravity, and lean his/her body in a given direction without falling, stepping or grasping. Therefore, one’s LOS ability is likely to be an essential prerequisite for execution of movements such as using a chair to reach into a high cabinet as well as bending over from standing position to pick up an object from the floor[18]. The improvement in maximum excursion, as shown the limits–of stability test of this study, suggests that home based exercise programs improved balance function by increasing the ability of the participants. Clinically, these changes indicate increased potential for effectively performing daily life function.

Previous studies found to strong relationships between lower–limb muscle strength and limit of stability[18, 19]. Lin et al reported home based physical therapy in a program supervised by a physical therapist resulted in some improvement in motor function in the lower limbs[20]. These findings indicate that home based exercise programs can effectively improve balance function with lower limb muscle strengthening.

Sway velocity as measured with a force platform has been widely used in balance research. Small center of pressure displacement and fast center of pressure velocity characterized decreased adaptive postural actions[21]. Postural sway velocity has been found to increase during aging[22] and to correlate with difficulties in activities of daily living[23] and musculoskeletal disability in elderly subjects[24] and balance disorder in stroke patients[25]. Fernie et al reported that sway velocity is correlated with risk of falling[26]. Whereas the control group did not show large changes velocity sway values, the exercise group showed significantly increased values after the...
exercise. This indicates that home base exercise programs can effectively improve the adaptive postural control.

Loss of cutaneous sensation is correlated with impaired balance and an increased risk of falling[27] and instability[28]. In particular, forefoot anaesthesia appears to be important in balance mainly when eyes are closed[27]. Thus, plantar insensitivity may affect balance and gait in stroke patients with sensory deficits[29, 30]. In this study, the balance ability of exercise group significantly increased after exercise. Results of the present study show that home based exercise program is effective for improving the balance function of stroke patients. The reason for this was that sensory retraining of home based exercise programs improves plantar sensitivity.

Based on this finding, it is believed that home based exercise program is effective for improving the balance in stroke patients. Previous studies have reported that multidisciplinary home based rehabilitation applications provide more positive outcome for stroke patients[6,31]. We also believe that our stroke patients would have had better influences if they had been provided with professional rehabilitation team services. Moreover, Redzuan et al reported home based physical therapy by digital videodisk is safe and effective treatment in stroke patients[32]. From now studies on various home based exercise programs using videos or robots should be consistently carried on.

5. Conclusion

A 8 week tailored home based exercise program targeting balance dysfunction and monitored by a physiotherapist, was feasible and demonstrated trends for improved balance function in adults with stroke.

REFERENCES

The Effects of Home Based Exercise Program on Balance Recovery in a Post–Stroke Population


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