

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

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뇌졸중 환자의 균형능력 회복을 위한 가정운동프로그램 효과

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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 Biorescue 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

요약 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 8주동안 주 2회씩 매회 30분간 시행하였으며 체중이동훈련, 지구력훈련, 운동재훈련, 감각재훈련, 하지운동으로 구성되었다. 균형능력을 평가하기 위하여 Biorescu를 이용하여 족저압, 안정성한계, 동요속도를 측정하였고 임상적인 측정방법 중 하나인 기능적 팔뚝기 검사를 실시하였다. 연구결과 대조군과 운동군은 안정성한계, 동요속도, 기능적 팔뚝기 검사에서 유의한 차이가 나타났다. 본 연구는 가정운동프로그램이 뇌졸중 환자의 균형회복을 회복하는데 효과적인 치료전략 중 하나라는 것을 나타낸다.

주제어 : 뇌졸중, 균형, 가정운동프로그램, 안정성한계, 동요속도

Received 9 May 2014, Revised 9 June 2014

Accepted 20 July 2014

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ISSN: 1738-1916

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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 are 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 to 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 Biorescue(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 1) Home based exercise program described by participating physiotherapists

Weight transfer
Rocking up on the toes and back on the heels, standing on 1 foot, high stepping
Training endurance
Exercycle
Mobility
Get up and walk to the toilet, go out to the kitchen and make a cup of tea, carry things safely
Sensory retraining
Brushing
Give weights to push using different hands and different surfaces, sizes, and objects
Lower limb exercise
Sit to stand
Side stepping
Bridging exercise in bed

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

Variable	Control group(n=10)	Exercise group(n=10)
Gender(male/female)	6/4	8/2
Paretic side(left/right)	6/4	7/3
Type of stroke(hemorrhage/infarction)	8/2	6/4
Age(hears)	49.90±5.04 ^a	52.20±7.96
Time since stroke(month)	19.60±7.63	21.3±10
Height(cm)	165.10±8.50	167.20±5.24
Weight(kg)	59.70±10.49	63.10±10.12

^aMean±SD

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

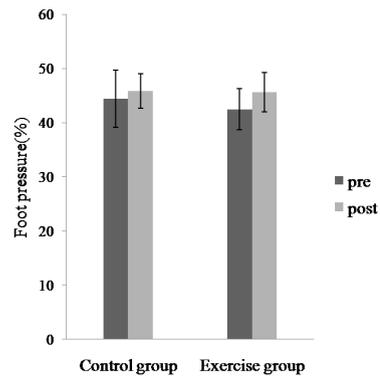
		Control group	Exercise group	Comparison of improvement between the groups	
				t	p
FP(%)	pretest	44.42±5.27 ^a	pretest 42.45±3.79	-0.691	0.498
	Affect posttest	45.87±3.18	posttest 45.64±3.64		
LOS(mm ²)	pretest	415.60±159.49	pretest 441.60±147.94	-3.806	0.001*
	Affect posttest	420.70±164.82	posttest 505.80±144.88		
VS(cm/s)	pretest	0.63±0.24	pretest 0.61±0.15	2.177	0.043*
	Affect posttest	0.61±0.21	posttest 0.46±0.13		
FRT(cm)	pretest	22.40±5.17	pretest 23.80±5.14	-2.297	0.034*
	posttest	22.80±5.07	posttest 25.90±4.65		

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

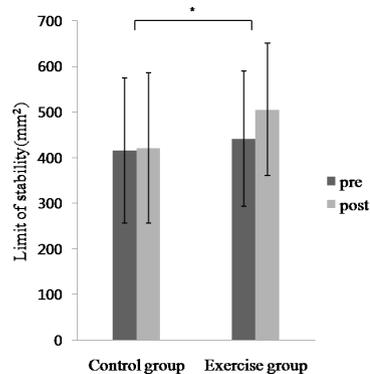
3.2 Improvement level comparison of balance function of the two groups

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

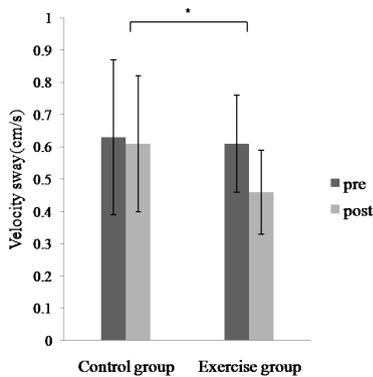
affect side LOS of the exercise group was from 441.60±147.94 to 505.80±144.88, being significantly higher than the improvement level of the control group(p<.05)(Table 3)(Figure 2). The VS of the exercise group was from 0.61±0.15 to 0.46±0.13, being significantly lower than the improvement level of the 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).



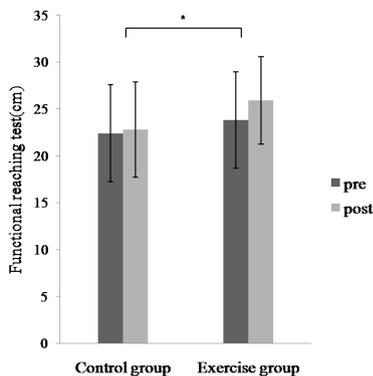
[Fig. 1] Improvement level comparison foot pressure between the groups



[Fig. 2] Improvement level comparison limit of stability between the groups



[Fig. 3] Improvement level comparison velocity sway between the groups



[Fig. 4] Improvement level comparison functional reach test between the groups

4. Discussion

This study aimed to evaluate the effectiveness of a 8 weeks home exercise programs targeting balance deficits in adults with stroke. The past 20 years have seen most long term care transferred from hospitals to care homes with an increased demand in chronic conditions of stroke[16,17]. However, rarely have home exercises programs been reported as part of a balance recovery for adults with stroke. The study established the feasibility of this exercise approach for stroke and there were positive trends indicating that this approach may achieve benefits of balance.

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.

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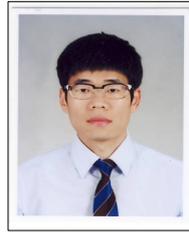
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