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Effect of Paretic Side and Non-paretic Side Arm Training on Trunk Control and Upper Limb Functions in Stroke Patients

Background: Stroke patients usually have arm weakness, which affects trunks and arms.
Objective: To investigate the effects of paretic side and non-paretic side arm training on trunk control and upper limb functions.
Design: Randomized Controlled Trial (single blind).
Methods: Twenty patients with stroke in hospital were enrolled in the study. Twenty subjects were randomly assigned to paretic side arm training group (PATG, n = 10) or non-paretic side arm training group (NATG, n = 10). Trunk impairment scale (TIS) was used for trunk control, and box and block test (BBT) was used for upper limb function. Training was conducted for 4 weeks.
Results: PATG showed significant difference in TIS (static balance, dynamic balance, coordination, total score) and BBT. NATG showed significant differences in static balance, and dynamic balance and total score except for coordination and BBT. PATG also showed a more significant difference in BBT and coordination and total score than NATG.
Conclusions: The arm training performed on the paretic side are more effective than those performed on the non-paretic side in improving both upper limb function and trunk control in stroke patients.

Key words: *Arm training, Trunk control, Upper extremity function, Stroke*

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INTRODUCTION

Stroke is a brain attack that causes irreversible damage to the brain. The largest impairment after the stroke is weakness, which is more frequent in the upper limb than in the face and lower limb [1]. Arm weakness causes subluxation [2], which is associated with complications such as decreased motor function recovery, and these complications affect the upper limb function [3]. In addition, overall upper limb function is highly correlated with trunk impairment [4]. Conversely, upper limb exercises improve trunk control and balance ability in stroke patients [5]. However, all of the previous studies on trunk control and upper limb functions only performed on bilateral or unilateral (affected side) arm training [5, 6, 7]. Rather, non-paretic side upper limb training increases paretic side hand movement [8]. In addition, despite the fact that non-paretic side upper limb exercises increase abdominal activity [9], there have been no studies on non-paretic side upper limb training using trunk control and upper limb function. Although trunk training can improve trunk performance, there is still little evidence for upper limb recovery [10]. This study aimed to investigate the effect of paretic side upper limb training and non- paretic side upper limb training on trunk control and upper limb function.

METHODS

Subjects

This study was conducted with 20 stroke patients admitted to R hospital in Gyeonggi - do. The 20 stroke patients were divided into a paretic side arm

training group (n = 10) or a non-paretic side arm training group (n = 10). The selection criteria included the following: stage 3 or more in the Brunnstrom recovery stage, 24 or over in the Korean version of the Mini-Mental State Examination, more than 6 months since the stroke diagnosis, those with no orthopedic diseases in the arm and trunk, and 5 points or more for the TIS static score.

Material and outcome measures

Trunk control ability measurement

Trunk control was confirmed by the trunk impairment scale. This items were evaluated by static balance (7 points), dynamic balance (10 points), and coordination (6 points), and subsequently, the total score (0-23 points) was calculated. TIS has been proven to be reliable and valid for the evaluation of trunk control in stroke patients11).

Upper extremity function measurement

The BBT (Box and block test) evaluation measures the number of 3 cm cube blocks transferred into a 22 × 32 cm box. The measurement was carried out for 1 minute, and the height of the obstacle between the block and box was 7 cm [12]. In this study, the paretic side arm was used for BBT measurement.

Intervention Procedures

Arm training consists of three methods. The first method used a towel to wipe a table up, down, left, and right. The second method was a shoulder flexion exercise using a ladder. The third method was to fit a cone located at the front and the side using a ring. The paretic side arm training group used the paretic side and the non-paretic side arm training group used the non-paretic side to complete the exercises. To prevent improper trunk compensations, the participants leaded to return to the starting point after reaching the target point in a range not exceeding 45°.

Data and Statistical analysis

The Chi-squared test and Independent t-test were conducted to verify the homogeneity of general characteristics. The Paired t-test was performed to compare changes in trunk control and arm function before and after training in each group, and an independent t-test was performed to compare differences between groups. The alpha score of this study was .05 and SPSS 18.0 was used for statistical analysis.

RESULTS

1. General characteristics of subjects

Table 1 shows the general characteristics.

2. Comparison of TIS in two groups

Table 2 shows the TIS value. NATG showed significant difference in static balance and dynamic balance and total score except for coordination, and PATG showed significant difference in all TIS variables. In the coordination and total score, PATG showed more significant difference than NATG.

Table 1. General characteristics

Variable	PATG (n=10)	NATG (n=10)
Sex (male/female)	6/4	5/5
Paretic side (left/right)	3/7	5/5
Age (years)	61.20±4.96	58.80±5.90
Height (cm)	166.08±7.14	162.59±9.48
Weight (kg)	68.30±8.59	63.55±16.12
Duration (month)	15.20±3.61	15.00±2.35
K-MMSE (score)	25.20±1.39	25.80±2.34
Brunnstrom (score)	3.80±1.13	3.70±0.82

PATG: Paretic side arm training group
NATG: Non-paretic side arm training group
K-MMSE: Korean-mini mental state examination

Table 2. Comparison of TIS in two groups (Mean ± SD)

Variable		PATG	NATG	t	p
Static balance(score)	Pre	6.20±0.78	6.20±0.63	1.116	.279
	Post	6.90±0.32	6.60±0.51		
	Post–Pre	0.70±0.67	0.40±0.51		
	t	−3.280	−2.449		
	p	.010*	.037*		
Dynamic balance(score)	Pre	3.10±0.57	3.40±0.52	1.897	.074
	Post	3.90±0.74	3.80±0.36		
	Post–Pre	1.40±0.51	1.20±0.78		
	t	−6.000	−2.449		
	p	.000**	.037*		
Coordination(score)	Pre	1.40±0.52	1.60±0.52	2.121	.048*
	Post	2.20±0.92	1.80±0.63		
	Post–Pre	1.10±0.56	0.00±1.41		
	t	−3.207	−1.500		
	p	.011*	.168		
Total(score)	Pre	10.70±1.57	11.20±1.23	3.545	.002**
	Post	13.00±1.56	12.20±0.92		
	Post–Pre	3.20±1.22	1.20±1.93		
	t	−7.667	−4.743		
	p	.000**	.001**		

*p<.05, **p<.01
PATG: Paretic side arm training group
NATG: Non–paretic side arm training group
TIS: Trunk impairment scale

3. Comparison of BBT in two groups

Table 3 shows the BBT value. There was no significant difference in NATG but there was significant difference in PATG. PATG also had a more significant difference in BBT score than NATG.

Table 2. Comparison of TIS in two groups (Mean ± SD)

Variable		PATG	NATG	t	p
BBT (score)	Pre	25.70±6.83	24.80±5.49	4.789	.000**
	Post	32.30±5.03	25.60±4.59		
	Post–Pre	6.60±3.53	0.80±1.47		
	t	5.906	1.714		
	p	.000**	.121		

*p<.05, **p<.01
PATG: Paretic side arm training group
NATG: Non–paretic side arm training group
BBT: Box and block test

DISCUSSION

In this study, we compared the effects of paretic side arm training and non-paretic side arm training on trunk control and arm function in patients with stroke. PATG showed significant differences in TIS total score, static, dynamic balance, coordination and BBT; showed a more significant difference in TIS total score, coordination, and BBT than NATG. Non-paretic side exercises in previous studies were effective in identifying the static strength of the contralateral arm [8] or when abdominal muscle activity included horizontal abduction and extension [9]. The arm training performed in this study was designed to be flexion oriented, so it was not effective in NATG. In previous studies, non-paretic side flexion exercises also supported the present study because there was no difference in abdominal muscle activity [9]. On the other hand, task orientation exercises on the paretic side significantly increased after the trunk performance and paralyzed arm function [13]. In this study, paretic side arm training was effective for TIS due to paretic side trunk movement and direct paretic use. The strong correlation of the overall upper limb function with that of trunk impairment supports the result [4]. PATG had greater effects on BBT score than NATG. However, there is an opposing opinion that it is possible to be no correlation between upper extremity muscle strength and trunk muscle strength [14]. Previous researchers have stated that body recognition changes posture [14]. The arm training performed in this study was not a simple arm function but included trunk participation. Therefore, clinical significance in that trauma control and arm function is confirmed through direct paretic side training and its participation in trunk movement. The study period of this study was short and there is a limitation because only measurement tools were used. Hopefully, future research will be a more reliable exercise method if objective measurement equipment and long-term studies are performed.

CONCLUSION

This study compared the effects of paretic side arm training versus non-paretic side arm training on trunk control and arm function in stroke patients. As a result, we confirmed that paretic side arm training is a more effective method for trunk control and arm function than non-paretic side arm training. Hopefully, future research will use paretic side intervention for trunk and arm rehabilitation of stroke patients. It is also necessary to compare the results with the results of bilateral task orientation exercises.

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