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Effect of Paretic and Non-paretic Side Spine Taping on Balance Ability in Patients with Stroke

Background: A number of researchers have attempted to improve the balance of stroke patients, however there is still a question as to whether taping is effective in increasing balance.

Objective: To determine the effect of paretic and non-paretic side taping on the balance ability in patients with stroke.

Design: A single-blind randomized controlled trial

Methods: This randomized single-blind controlled clinical trial with a repeated measures study included 45 subjects who were randomly assigned to paretic side taping groups (n=15), non-paretic side taping groups (n=15), and trunk exercise groups (n=15). Trunk exercise and paretic side taping groups had taping on the paralyzed erector spinae, while the non-paretic side taping group had taping on the non-paralyzed erector spinae. Trunk exercises were performed for 30 minutes to promote core muscles. The balance ability measured the center of pressure movement (paretic side, non-paretic side,forward, backward, limit of stability) in the sitting position. All measurements were evaluated using BioRescue.

Results: All three groups showed significant increase in all variables after 4 weeks. The paretic and non-paretic side taping groups had a significant increase in all variables after 30 min of attachment. However, there was no significant difference among the three groups.

Conclusions: Paralysis and non-paralysis taping improved the balance ability of patients with stroke in an immediate effect of 30 min. However, after 4 weeks of intervention, taping with trunk exercise did not differ from single trunk exercise. In future studies, various analyses need to be conducted through more diverse evaluations.

Key words: *Stroke, Trunk Exercise, Taping, Balance Ability*

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INTRODUCTION

Neurological impairment after stroke leads to weakening of the opposite side. Contralateral weakness also appears in the trunk muscles, but it may occur in the non-paretic and paretic sides owing to neurological dominance [1]. Since the Neural domination of trunks is dominated by both sides, even if one of the cerebral hemispheres is damaged, there will be weakening of the entire body [1]. This weakness of the muscle muscles makes walking and balance difficult, and it is involved in impairment of anticipatory postural adjustments [2, 3]. Stabilization exercises applied to patients with stroke improve walking and balance ability with proper postural control [3].

Taping on the vertebrae promotes anticipatory postural control [4], and taping on the trunk of patients with stroke improves trunk muscle activities and control abilities [5]. A previous study that applied taping on the trunk only considered trunk [6], and studies related to taping on the vertebrae attached the tape on the non-paretic side only [7]. The study on the proper method for correctly setting up a trunk in patients with stroke is currently conducted [5]. Therefore, in this

study, we investigated the effect of taping of the paretic and non-paretic sides on the balance ability and determined the more effective method.

SUBJECTS AND METHODS

Subjects

This study was conducted in 45 subjects who were hospitalized in a rehabilitation hospital in Gyeonggi-do Province. Written consent was obtained from all study subjects prior to participation in the study. First, 60 individuals were recruited, of which 15 were excluded and 45 were included in the final study. The selection criteria for the study subjects were as follows: (1) first stroke, (2) six months' duration after stroke, (3) static balance score ≥ 5 on the trunk impairment scale, (4) no impairment in cognitive function (Korean version of the Mini Mental State Examination, 24 points or more), (5) at least Brunnstrom stage 3, (6) no recent or previous orthopedic surgery, and (7) no skin disease. The exclusion criteria are as follows: (1) neurological and orthopedic problems that may affect balance and (2) redness with taping. In this study, G*Power was used in selecting the subjects. When the input effect size was .40 (Cohen's f effect size, large), α-error probability was .05, power was .8, number of groups was 3, number of measurements was 3, and correlation among repeated measures was 0.50, the total sample size was 45. This was a randomized single-blind controlled clinical trial with repeated measures design. The random selection method was performed by an unrelated officer, and the subjects were divided into three groups: paretic taping group (n=15), non-paretic taping group (n=15), and trunk exercise group (n=15). The participants did not know the purpose of the study or the group they belonged to. The evaluation was conducted by the researcher, and the study intervention was performed by eight physiotherapists in the fifth year of the clinical experience.

Table 1. shows the general characteristics of the study subjects.

Measurement methods

Dynamic balance measurement

To measure the dynamic balance ability of the study subjects, BioRescue (RM Ingénierie, 12000 Rodez, France), which consists of a force platform and Sycomore software, was used. Dynamic balance ability is the ability of the body to voluntarily move and maintain stability. The weight was shifted to eight directions, including the front, rear, left, right, and diagonal directions indicated by the monitor. The left and right sides were classified into paretic side and non-paretic side and measured. The distance to which the weight was shifted was used as data, and the mean value was used as the result [8].

Intervention Methods

Erector spinae taping methods

In this study, the tape was applied to the erector spinae using a 2-inchs wide elastic tape (Benefact, Nippon Sigmax Co. Ltd., Japan) [9]. The tape was measured and cut to fit the erector spinae of the subject. When the tape was applied, the subject kept the spine straight as much as possible. We removed 25% of the tape and stretched it to the length of the first cut tape using 75% of the tape and applied it to the subject. The paretic side taping group had the tape attached to the paretic side erector spinae (direction, to insertion from origin), and the non-paretic side taping group had the tape attached to the

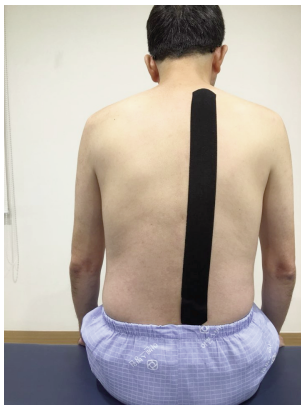

Fig. 1. Paretic side erector spinae taping.

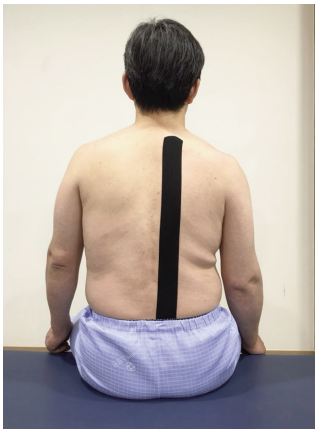

Fig. 2. Non-paretic side erector spinae taping.

Table 1. Trunk exercise programs

The subjects bend the knee joint and lift the pelvis in the lying position. At this time, possible subjects perform bridging exercises by straightening the paralyzed legs.	5 min
The subjects bend the knee joint and lift the head in the lying position. At this time, possible subjects perform sit-up, turning their trunk to the right or left. During the sit-up, subjects are asked not to bend the head excessively, and body bending is performed until the lower angle of the shoulder bone touches the ground.	5 min
The subjects perform trunk flexion and extension in sitting position. Upper trunk flexion and extension are repeated, bending and expanding the upper trunk without moving the lower trunk. Lower trunk flexion and extension are performed in the front and back of the trunk.	5 min
The subjects repeatedly perform the exercise in the left and right directions in which the elbows reach the bed and return to the starting sitting position.	5 min
The subjects perform a rotation exercise, moving the right and left shoulders forward and backward in a sitting position. The right and left knees are also moved forward and backward.	5 min
The subjects bend the body from their hips in a sitting position and stretch to a fixed point at shoulder height. At this time, possible subjects perform a stretching exercise in a diagonal direction to a fixed point at shoulder height in a sitting position.	5 min

non-paretic side erector spinae (Figure 1, 2) [7]. The tape was attached for 24 h, and tape removal was performed using a lotion to reduce skin pulling.

Trunk exercise methods

In this study, a trunk stabilization exercise was performed [11].

The exercise is shown in Table 2, and one session was performed for 5 min, in a total of 30 min.

Statistical analysis

In this study, we analyzed the data using SPSS 20.0 software (SPSS, Inc., Chicago, IL, USA).

The general characteristics of the subjects were evaluated using frequency analysis and descriptive statistics. Two-way repeated measures ANOVA was used for the 30-min and 4-week changes in the balance ability of the three groups. We analyzed the tests of within-subject effects and Wilks' lambda items according to the test of sphericity. Paired t-test (30-min and 4-week) was used to find the significant differences in the taping method based on the timing. In this study, there was no difference in the tests of between-subjects effects, and a post hoc analysis was not conducted. The α-level of statistical significance in this study is .05.

RESULTS

Table 1 shows the general characteristics of the subjects.

All three groups showed a significant increase in all variables after 4 weeks. The paretic and non-paretic side taping groups had a significant increase in all variables after 30 min of attachment. However, there was no significant difference in main effects and interaction among the three groups. main effects and interaction

DISCUSSION

All three groups showed a significant increase in all variables after 4 weeks. The paretic and non-paretic taping groups had a significant increase in all variables after 30 min of attachment. However, there was no significant difference among the three groups. The taping method in this study was applied to maintain correct standing posture through spinal extension. In the same method as that in this study, taping on the non-paretic side was introduced as a method for trunk correction [9], and it significantly increased the

Table 2. General characteristics of the subjects

	PTTG (n=15)	NTTG (n=15)	TG (n=15)	p-value
Sex (male/female)	11/4	11/4	9/6	.661
Affected side (left/right)	7/8	9/6	8/7	.765
Onset (month)	10.40±2.03	10.73±2.19	11.33±2.87	.560
K-MMSE (point)	26.67±0.72	26.93±0.80	26.80±0.94	.679
Age (years)	62.20±5.07	61.53±6.21	61.07±5.07	.890
Height (cm)	164.40±10.54	164.13±9.26	163.40±11.08	.963
Weight (kg)	68.47±10.36	69.27±10.71	66.40±12.00	.766

All values are presented as mean and standard deviation
PTTG, Paretic side taping with trunk exercise group
NTTG, Non-paretic side taping with trunk exercise group
TG, Trunk exercise only group
K-MMSE, Korean version of the Mini Mental State Examination

Table 3 Changes of LOS in the groups before and after the intervention(30 min and 4 weeks) (mean±SD)

Classification		Pre-test	Post-test (30 min)	Post-test (4 weeks)	F	p-value
Paretic side COP movements	PTTG	353.87±275.08	371.40±286.09[a]	461.47±299.86[bc]	31.827	.001**
	NTTG	371.40±287.04	390.47±293.63[a]	494.73±374.26[bc]		
	TG	342.07±260.27	345.80±263.95	424.33±323.96[bc]		
Non-Paretic side COP movements	PTTG	422.80±357.41	444.67±375.95[a]	555.07±363.99[bc]	24.968	.001**
	NTTG	381.00±257.51	405.60±289.55[a]	523.27±365.31[bc]		
	TG	433.00±310.26	443.93±334.97	512.80±362.53[bc]		
Forward COP movements	PTTG	493.53±369.61	523.40±391.25[a]	658.47±415.26[bc]	21.847	.001**
	NTTG	504.93±640.39	534.47±357.52[a]	692.67±506.41[bc]		
	TG	534.27±376.76	550.40±395.19	643.00±460.74[bc]		
Backward COP movements	PTTG	232.29±163.14	241.93±168.81[a]	305.79±150.90[bc]	30.356	.001**
	NTTG	247.40±204.96	261.60±215.79[a]	325.33±231.23[bc]		
	TG	240.67±180.96	239.27±178.85	294.13±219.49[bc]		
Limit of stability	PTTG	776.47±607.13	1016.53±641.69[a]	1016.53±641.69[bc]	27.727	.001**
	NTTG	752.33±529.68	796.07±562.71[a]	1018.00±724.96[bc]		
	TG	774.93±534.49	789.73±559.65	937.13±657.87[bc]		

*p<.05, **p<.01. All values are presented as mean and standard deviation, LOS: limit of stability, COP: Center of pressure
PTTG, Paretic side taping with trunk exercise group
NTTG, Non-paretic side taping with trunk exercise group
TG, Trunk exercise only group
[a]Significant difference between the pretest and posttest at 30 min (p<.05)
[b]Significant difference between the pretest and posttest at 4 weeks (p<.05)
[c]Significant difference between the posttest at 30 min and posttest at 4 weeks (p<.05)

trunk control ability and manual function compared with non-taping [7]. Spine extension taping improved the Gross Motor Function Measure (GMFM) of children with cerebral palsy [12] and the body function, including daily activities, of patients with Parkinson's disease [13], supporting the results of this study. There was no significant difference in pressure movement after 30 min of intervention in the non-taping group, but a significant improvement was noted in the paretic and non-paretic side taping groups. Taping of the knee or ankle can increase immediate balance [14] and walking abilities [15] of a patient with stroke. In this study, there was a significant increase in pressure movement after 30 min of taping, and it was clinically significant in that it was confirmed after attachment to the trunk instead of the ankle. The study was evaluated the state of taping attachment; therefore, taping improved the pressure movement by activating the skin receptors. In addition, it seems that the elasticity of taping increased the COP movement by safely holding it when lean the trunk.

However, after 4 weeks, all three exercise methods showed improvement in pressure movement, but there was no difference among the three exercise methods. Although taping has the merit of assisting movement and the immediate effect is shown [14, 15], adjunctive effects were difficult to differentiate from long-term motor learning. Therefore, the improvement in trunk control ability seems to be the result of the trunk exercise rather than the continuous taping effect.

The abovementioned results can be interpreted as follows: We have identified that taping on the paretic side of the erector spinae or on the non-paretic side can activate the skin receptors to increase immediate pressure movement, but if the 4-week exercise intervention is applied, adjunctive taping effects cannot greatly improve pressure movement.

Therefore, it is considered that the intervention is performed by attaching the tape at the beginning and removing it when exercise is performed over time.

This study was conducted on patients with stroke hospitalized in a specific hospital, and all results could not be generalized. Moreover, the results of the 4-week intervention cannot confirm the long-term effect. In a further study, we expect that more patients and long-term effects will be needed to supplement these limitations.

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CONCLUSION

Trunk control exercises and paretic and non-paretic side taping can increase immediate pressure movements in patients with stroke, but the effect of taping was not evident after 4 weeks of intervention. In this study, we could confirm the timing effect of taping. In this study, since only the dynamic balance is analyzed as a dependent variable, more variables will need to be analyzed in future studies.

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