

Original Article

Immediate effects of kinesio taping on fixed postural alignment and foot balance in stroke patients

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Abstract. [Purpose] The main aim of this study was to identify the short-term effects of Kinesio taping (KT) on the static body alignment and overall balance function presented by the coordinate and foot balance in stroke patients. [Subjects and Methods] Thirty-eight stroke subjects were randomly allocated into the study groups. The kinematic analysis measured deviation or changes from standard body alignment and foot pressure by the human anatomy-based coordinates were examined using the Shisei Innovation System PA200 ver.9.0. [Results] The glabella on the front view, larynx on the front view, rt. greater tubercle of the humerus (vertical changes), lt. greater tubercle of the humerus (vertical changes), posterior superior iliac spine, and greater trochanter (horizontal changes) showed statistically significant decreases, indicating dislocation from the axis center, after taping. [Conclusion] The clinical use of KT for stroke patients who have asymmetrical and imbalanced body posture could be an optimal therapeutic approach. Since more evidence based practices are needed, future studies should include large numbers of subjects and examine diverse KT application patterns.

Key words: Kinesio taping, Stroke, Postural balance

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INTRODUCTION

Stroke eventually induces various clinical symptoms and other severe complications, causing many casualties^{1, 3)}. Among many types of medical conditions introduced by stroke, lack of body balance, as well as abnormal muscle tone and reflexes may lead to gait disturbances²⁾. Body alignment and foot balance are crucial factors of the intervention of stroke patients because patients have trouble sustaining their body structure as a result of weakened muscle tone that leads to a gradual disuse of the affected side and even the whole body⁴⁾.

Diverse therapeutic approaches have been attempted to treat the balancing ability of stroke patients that focused on re-arranging the center of gravity and other aspects of body balance or foot pressure or even compare findings with healthy adults' performance^{5, 6)}.

The Kinesio taping (KT) technique is one of the most renowned clinical intervention methods that has been widely applied for many years to help to correct body balance and gait training^{7, 8)}. In accordance with the findings of Kase et al.⁹⁾, KT helps maintain lymph absorption, blood circulation,

and even joint fixation. One recent study reported that the KT application with intended tension could reduce pain as well as improve range of motion (ROM) and proprioception¹⁰⁾. Despite these advantages of KT and in the same sense, healthy adults or athletes received the same effect⁷⁾. Few clinical trials have used direct and strict measures for stroke patients who struggled with weak body balance and gait function. It is important that we precisely assess the effect of therapeutic applications after the intervention. The Shisei Innovation System recently been acclaimed for its ability to assess body postural alignment and foot pressure (static and dynamic) and is more accurate measurement system than other methods.

Accordingly, the main focus of this study was to conduct a kinematic analysis of body alignment and foot pressure using KT as an intervention for patients after stroke.

SUBJECTS AND METHODS

A total of 38 subjects diagnosed with stroke by medical doctors specializing in rehabilitative medicine participated in this study. The patients, all of whom were from across Korea, even Jeju Island, were hospitalized in the rehabilitation center in Ulsan city. Patients who were diagnosed with stroke, did not have any skin problems, and completed the informed consent form by themselves were included in the study. The exclusion criteria were: previous experience with KT; use of foot orthoses; and inability to walk 10 m. We ultimately included 18 males (mean age, 55.0 years; range, 49–68 years) and 20 females (mean age, 57.0 years; range,

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Table 1. Comparison of test results upon body postural alignment during pre-post taping in the experimental group (mean±SD)

Variables		Before taping	After taping	
Head	Glabe llas of front view (mm)	23.14 ± 2.90	19.70 ± 1.71*	
	Larynx of front view (mm)	21.08 ± 1.64	18.32 ± 1.79*	
	Ear hole of lateral view (mm)	21.51 ± 2.93	22.21 ± 3.11	
	7th cervical vertebras (mm)	37.15 ± 3.16	24.95 ± 0.32	
	Angles among hole of ear, 7th cervical vertebras and acromion (°)	109.01 ± 18.67	108.64 ± 24.13	
Upper extremities	Vertical changes	Rt. greater tubercle of the humerus (mm)	38.81 ± 31.50	25.83 ± 15.55*
		Lt. greater tubercle of the humerus (mm)	31.90 ± 5.12	26.62 ± 2.83*
	Horizontal changes	Rt. greater tubercle of the humerus (mm)	71.08 ± 50.50	68.88 ± 25.0
		Lt. greater tubercle of the humerus (mm)	89.14 ± 49.8	78.56 ± 26.49
Center	Navel	5.11 ± 3.01	3.33 ± 1.80	
Pelvis	ASIS (mm)	2.94 ± 0.64	2.74 ± 0.58	
	PSIS (mm)	3.06 ± 0.62	2.68 ± 0.63*	
	Angles between ASIS and PSIS (°)	65.80 ± 9.22	63.10 ± 10.68	
Lower extremities	Vertical changes	Greater trochanter (mm)	3.13 ± 1.24	3.02 ± 1.48
		Lateral condyle of the tibia (mm)	3.10 ± 1.25	3.22 ± 1.50
	Horizontal changes	Greater trochanter (mm)	65.8 ± 9.27	63.10 ± 10.68*
		Lateral condyle of the tibia (mm)	4.0 ± 2.43	3.32 ± 1.53

Values are presented as mean and (standard deviation) in dislocation from the center of the axis. *Significant difference at $p < 0.05$. Rt.: right; Lt.: left; ASIS: anterior superior iliac spine; PSIS: posterior superior iliac spine

50–69 years); stroke types included 13 hemorrhagic and 25 infarction; and duration of onset (month) was within 6 months for every subject. After the patients were measured by Shisei Innovation System PA200 ver. 9.0, they were randomized to treatment groups using drawing lots. In the first group, patients were first subjected to KT application and then underwent body alignment and foot pressure analysis by the Shisei Innovation System. Afterward, the subjects underwent the same procedure without KT. In the second groups, the patients were subjected to the same procedures in the opposite order. The KT tension was set at 55% (available tension is 100%) using 20 cm × 5 cm strips of Kinesio Tape KT 545 (Visiocare s.r.l., Vedano al Lambro, Monza-Brianza, Italy) applied to the extensor digitorum longus, surface of the cuneiform, 2–5 toes, tibial plateau, peroneus longus, and fibula head¹¹).

The kinematic analyses of postural alignment and foot pressure were performed using Shisei Innovation System PA200 ver. 9.0 software. The changes in displacement from the center standard line (also known as the center of the axis) on the coordinates and distribution degrees of foot pressure were calculated. Foot pressure was divided into right/left and front/backward portions. Smaller differences between each measurement point from the standard line indicate better therapeutic results, and a smaller disparity in pressure indicates that the subjects have good balance. Single markers were attached to the right ankle of the front view, left ankle of the front view, right apex patella of the front view, left apex patella of the front view, right anterior superior iliac spine (ASIS) of the front view, left ASIS of the front view, navel of the front view, right greater tubercle of the humerus of the front view, left greater tubercle of the humerus of the front view, larynx of the front view, glabe llas of the front view, left posterior superior iliac spine (PSIS) of

the back view, right PSIS of the back view, seventh cervical vertebra of the back view, lateral condyle of the tibia of the right side view, greater trochanter of the right side view, ASIS of the right side view, PSIS of the right side view, greater tubercle of the humerus of the right side view, seventh cervical vertebra of the right side view, ear hole of the right side view, lateral condyle of the tibia of the left side view, greater trochanter of the left side view, ASIS of the left side view, PSIS of the left side view, greater tubercle of the humerus of the left side view, seventh cervical vertebra of the left side view, and ear hole of the left side view of all the subjects.

All of the subjects agreed to participate in the study, provided written informed consent, and received a sufficient explanation prior to participating in accordance with the ethical principles of the Declaration of Helsinki. Every process was examined by the hospital director.

The data analysis was performed using IBM SPSS Statistics ver. 20. The subjects' general characteristics were analyzed using descriptive statistics, while the paired t-test was used to compare the pre- and post-KT intervention differences. The level of statistical significance was set at 0.05 for all of the analyses.

RESULTS

The differences in the digitalized kinematic analysis of the fixed postural alignment are shown in Table 1, while the changes in foot pressures are shown in Table 2. No patients discontinued participating. The glabe llas of the front view, larynx of the front view, rt. greater tubercle of the humerus (vertical changes), lt. greater tubercle of the humerus (vertical changes), PSIS, and greater trochanter (horizontal changes) showed statistically significant decreases indicative of dislocation from the center of the axis after KT ($p < 0.05$). In

Table 2. Comparison of test results upon foot pressure during pre-post taping in the experimental group (mean±SD)

Variables	Before taping (%)	After taping (%)
Weight distribution differences between Rt. and Lt. feet	5.50 ± 4.03	4.26 ± 3.47

Values are presented as mean and standard deviation in weight distribution differences between feet. *Significant difference at $p < 0.05$. Rt.: right; Lt.: left

contrast, the changes in ear hole of the lateral view, seventh cervical vertebra, angles among ear hole, seventh cervical vertebra and acromion, rt. greater tubercle of the humerus (horizontal changes), lt. greater tubercle of the humerus (horizontal changes), ASIS, greater trochanter (vertical changes), lateral condyle of the tibia (vertical changes), and lateral condyle of the tibia (horizontal changes) were not statistically significant ($p > 0.05$); however, among them, all variables except for vertical changes in the tibial lateral condyle tended to improve. The comparison of foot pressure revealed no significant differences ($p > 0.05$).

DISCUSSION

Balance problems and poor posture control are induced by dysfunction after stroke or from other etiologies, and KT techniques have been broadly used for their treatment^{12, 13}. There are various approaches to intervention for decreased balance and posture controls such as physical training, general gait, and balance trainings, but in the field of mechanisms of many interventions, therapeutic methods gradually shifted to novel methods like virtual reality¹⁴. Such methods are usually conducted with mostly computer game-based activities¹⁵. However, these kinds of clinical practices would still be controversial among professionals due to difficult brain encoding, which may not sufficiently substitute conventional therapies¹⁶.

In this study, KT results showed only glabellas of the front view, larynx of the front view, rt. greater tubercle of the humerus (vertical changes), lt. greater tubercle of the humerus (vertical changes), PSIS, and greater trochanter (horizontal changes). The numerical data were automatically extracted from the center of the axis, while measured deviations or changes in standard body alignment and foot pressure by the human anatomy-based coordinates were examined by Shisei Innovation System PA200 ver. 9.0. Therefore, the lower score means improved function. All of the other indicators presented clinically positive tendencies except for vertical changes of the tibial lateral condyle.

The KT approach has already been conducted through numerous studies and presented filed data. Related to this study, one published report showed that this therapeutic approach may support balance and neuromuscular functions¹⁷, and its instant effect is considered important in the clinical setting¹⁸. According to a recent study, enhancing active ROM is also a crucial coverage provision^{19, 20}. Another study presented ASIS-PSIS angles as 11.3 ± 4.3 ²¹, which indicated results that were quite different from those of our study (63.10 ± 10.68). We assumed that the stroke patients would showed unlike appearances or clinical aspects versus healthy or other invalid subjects. Thus, the main focus of

this study is that its results were derived from a digitalized kinematic analysis for treating stroke patients and determining effects of KT in the field of balance and body. We intend to determine KT feasibility using more precise assessments.

This study has several limitations. First, it was not a fully randomized controlled trial and its sample size was small. There remains a lack of evidence comparing conventional therapy and KT for correcting balance or posture, so further studies including greater numbers of subjects are strongly recommended to verify the final results of this report since KT is already broadly used.

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