

# Immediate Effect of Elastic Taping on Postural Sway in Patients with Stroke

Stroke can cause leg weakness, sensory abnormalities, and balance disorders. The purpose of this study was to investigate the effect of elastic taping on postural sway in patients with stroke. This study randomly applied elastic taping to 20 patients with stroke in two ways. The center of pressure (COP) distribution was measured before and after the elastic taping. The measurement variables were COP area and length, and measurements were performed immediately after taping. The elastic taping on tibialis anterior muscle showed a significant decrease in COP area and length compared to that without elastic taping. The elastic taping on gastrocnemius muscles showed a significant decrease in COP area and length compared to that without elastic taping. There was no significant difference in COP area and length between the elastic taping on tibialis anterior muscle and gastrocnemius muscles. Our results suggested that applying elastic taping on the ankle joints is effective in decreasing postural sway after in patients with stroke.

Key words: *Elastic Taping, Ankle Joint, Postural Sway, Stroke*

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## INTRODUCTION

Patients with stroke have muscle weakness in the hemi side extremities due to central nervous system damage<sup>1, 2</sup>. These patients have poor balance because of a reduced base of support and an ankle strategy that can not be used due to weaknesses in the tibialis anterior (TA) and gastrocnemius (GCM) muscles<sup>3, 4</sup>. Transcutaneous electrical stimulation (TENS), ankle orthosis, and elastic taping have been applied to the ankle to improve the balance ability of patients with stroke<sup>5-9</sup>.

Among these, elastic taping methods can be applied to various body parts and can reduce pain, correct joint alignment, and improve proprioception, inhibition, and facilitation of muscle function<sup>10</sup>. Ankle joint Kinesio taping in children with functional ankle instability is effective in improving eversion-to-inversion concentric strength ratios and dynamic position sense of the

ankle<sup>11</sup>. Position sense also improved when Kinesio taping was applied to the shoulder complex in patients with stroke<sup>12</sup>.

Center of pressure (COP) distribution measures COP changes within the base of support. COP changes are defined as postural sway, and COP parameters measure the mechanism of postural control<sup>13</sup>. Stroke patients were greater COP changes than healthy subjects and have visual dependence on COP measurement<sup>14</sup>. Ankle eversion taping did not reduce anteroposterior occlusion in patients with stroke but reduced the mediolateral displacement of the center of pressure (COP)<sup>15</sup>. Because the ankle strategy is an anteroposterior movement<sup>3</sup>, other taping methods are needed to reduce the anteroposterior displacement of the COP in patients with stroke. The purpose of this study was to evaluate the COP area and length after elastic taping of the TA and GCM muscles.

## SUBJECTS AND METHODS

### Subjects

This study has a repeated measures design that confirmed the application of TA and GCM taping to only one group of subjects. Twenty patients were hospitalized due to stroke in A Hospital. The inclusion criteria of the study subjects were as follows: absence of ankle joint contracture and orthopedic surgery, absence of skin disease, independent maintenance of posture for more than 1 min, modified Ashworth scale (MAS) score  $\leq 2$ , and stroke for at least 6 months, as well as a score  $\geq 24$  in the Korean version of mini-mental state examination

### Measurement methods

#### Postural sway measurement

In this study, BioRescue (AP1153 BioRescue, France) was used to measure the postural sway in standing posture of patients with stroke. The device has 1600 pressure sensors embedded in a 400 mm  $\times$  400 mm measurement area and can measure foot pressure distribution. The subjects stood on the foot plate with their eyes closed. The COP area and length were then measured in standing posture for 30 s. The COP length is defined as the total distance traveled by the COP during trial test. The data were collected three times, and the mean value was used. The researchers placed safety personnel to prevent the patient from falling.

### Intervention Methods

#### Elastic taping methods

An adhesive elastic tape (Kinesiology 3NS Tape, TS, Korea) was used in this study. Before taping, the tape was cut to fit the subject's body length. The tape was then folded into four parts, and the first parts were cut further. In this study, the remaining three quarters were used. The tape ends were not stretched to relieve skin pressure<sup>16)</sup>. Without taping is shown in figure 1. TA and GCM tapes were attached to the origin and insertion of the muscles, respectively (Figures 2 and 3).

### Statistical analysis

In this study, all statistical analyses were performed using SPSS 20.0. General characteristics were analyzed using frequency analysis and descriptive statistics, and normal distribution was confirmed through Shapiro–Wilk test. One-way repeated ANOVA was used to change the condition without taping, the condition with TA taping, and the condition with GCM taping. When a significant difference was observed, the paired *t*-test was used to confirm the change in taping application condition. The statistical significance level was set to .05.

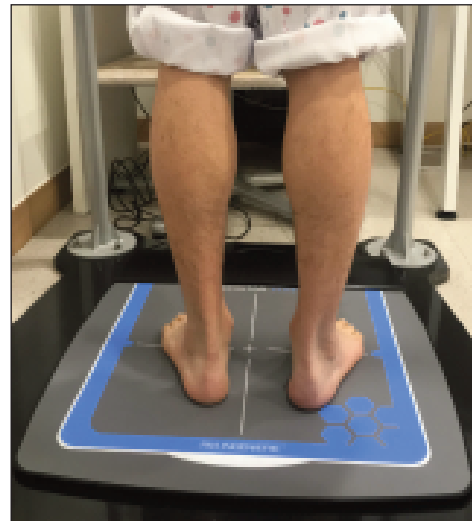


Fig. 1. Without taping condition

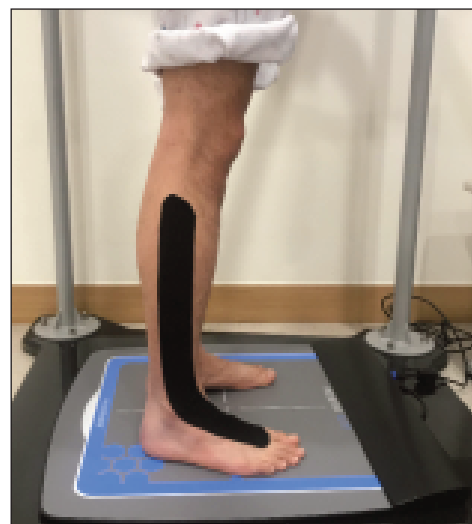


Fig. 2. TA taping condition

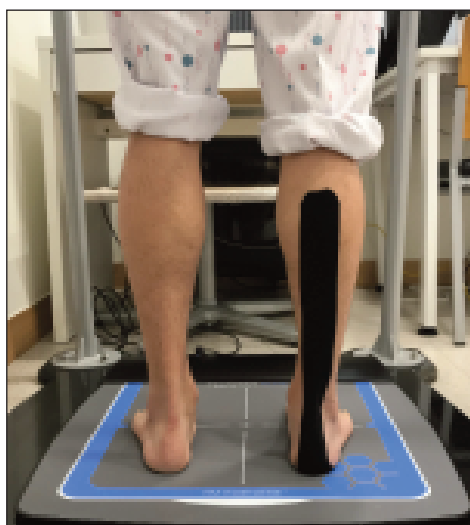


Fig. 3. GCM taping condition

## RESULTS

### 1. General characteristics of the subjects

The general characteristics of the subjects are shown in Table 1.

Table 1. General characteristics (mean ± SD)

Variable	Subjects (n=20)
Sex (male/female)	17/3
Paretic side (left/right)	6/14
Etiology (infarction/hemorrhage)	12/8
Age (years)	64.00±7.81
Height (cm)	168.70±6.26
Weight (kg)	70.20±6.36
Disease duration (month)	12.80±2.96
K-MMSE (point)	26.30±1.41

K-MMSE, Korean Mini-Mental State Examination

### 2. Comparison of COP distribution in three conditions

After the application of elastic taping, there were significant differences according to the conditions (without taping and TA taping, without taping and GCM taping, TA taping and GCM taping). The results of the paired t-test, according to taping conditions, are as follows.

The COP area and length were significantly decrease in TA taping condition and GCM taping condition than without taping condition

The TA taping condition group showed a significant decrease in the COP area and length compared to the without taping condition group. The GCM taping condition group showed a significant decrease in COP area and length compared to the without taping condition group. TA and GCM taping conditions were not significantly different with respect to COP area and length.

## DISCUSSION

The aim of the present study was postural sway change after TA and GCM taping conditions in comparison to without taping condition. The results of this study showed that COP area and COP length were significantly decreased when TA taping and GCM taping were applied, respectively, than without taping.

When applying TA taping in a manner similar to that employed in this study, ankle spasticity and gait speeds significantly improved in patients with stroke<sup>5)</sup>. In addition, GCM taping, which is similar to that in this study, was combined with exercise therapy for 2 weeks to improve the balance ability and forward reach and spasticity of patients with stroke<sup>17)</sup>.

In the previous study, the effect of taping alone was not confirmed because it was combined with exercise

Table 2. Comparison of COP distribution in three conditions (mean ± SD)

Variable	Without taping	TA taping	GCM taping	F value	P-value
COP area (mm <sup>2</sup> )	208.70±194.50	167.10 ± 177.01 <sup>a</sup>	174.05 ± 181.11 <sup>b</sup>	6.221	0.009**
COP length (cm)	33.23 ± 24.39	27.52 ± 16.31 <sup>a</sup>	27.60 ± 18.00 <sup>b</sup>	3.838	0.041*

TA, tibialis anterior; GCM, gastrocnemius. All values are presented in mean ± SD, \*p<.05, \*\*p<.01

<sup>a</sup>: The values in the TA taping condition group were significantly higher than those in the without taping condition group.

<sup>b</sup>:The values in the GCM taping condition group were significantly higher than those in the without taping condition group.

therapy. However, in this study, the effect of elastic taping alone on the improvement of balance ability was confirmed. The ankle joint taping application in patients with stroke showed a significant increase in berg balance scale score (BBS) and limits of stability (LOS) and a significant decrease in COP area<sup>18</sup>. Previous studies have shown that elastic taping of the TA improves balance ability. However, in previous studies, several tapes were attached, and the change in balance ability was not confirmed in the eyes closed condition.

When GCM taping was applied to patients with multiple sclerosis in previous study, the anteroposterior COP shift distance in the eyes closed condition was significantly lower than that when taping was not interrupted, and the effect was further increased after one day of taping<sup>9</sup>. In addition, when applying TENS to the GCM in patients with stroke, the MAS score and the length in the eyes closed condition in the standing position significantly decreased compared to those in the placebo TENS group<sup>19</sup>.

These studies suggest that proprioception in the GCM muscle is improved through various interventions and balance ability is improved by ankle control<sup>18,19</sup>. However, in previous studies, subjects had multiple sclerosis. In other studies, the balance ability effect was confirmed by applying TENS to the GCM muscle. Therefore, we could not confirm the improvement in balance ability due to GCM taping in patients with stroke.

BBS score significantly increased when eversion taping was applied to the ankle joint of patients with stroke<sup>15</sup>. In the taping intervention group, the distance of COP movement between forward reach test (FRT) and mediolateral (ML) displacement was significantly lower than that in the without taping intervention group<sup>15</sup>. This result shows that taping improves the ankle alignment and increases the distance of ML displacement, and that the mechanoreceptor is influenced by taping for 24 h to enhance sensory stimulation and postural control<sup>15</sup>. However, since this taping method directly corrects the ankle joint, its effect cannot be confirmed when applying it to the ankle joint muscle.

It was possible to improve the balance ability by increasing the sensory input of the ankle joint by supporting ankle alignment, applying taping on the TA and GCM muscle of patients with stroke, and supporting the ankle in the correct posture<sup>20</sup>.

For this reason, persistent sensory input through taping can reduce spasticity in patients with stroke<sup>5,17</sup>. Sensory awareness of the TA and GCM muscles during balance changes leads to changes in paretic

side leg movement<sup>21</sup>, and taping affects muscle activity<sup>21</sup> and weakness of the GCM and TA muscles, leading to an improvement in COP distribution.

However, there was no difference between the two taping methods. For this reason, taping seems to be most effective 24 h after attachment and with immediate and quick evaluation on the same subject. In this study, it was attached to exclude interference and reevaluated immediately after 10 min and again after 10 min of rest.

The clinical significance of these findings lies in the fact that COP distribution decreased to a greater extent immediately after attachment compared to when it was not attached, even though the attachment time is short.

In future studies, it would be necessary to identify which taping method had a more long-term effect. It is expected that the effect of taping attachment method and the carryover effect according to time should be confirmed in the future.

## CONCLUSION

This study confirmed the effect of elastic taping of the TA and GCM muscles on standing postural sway in patients with stroke. As a result, it was confirmed that TA and GCM taping instantly decreased the postural sway. It is expected to be used as a method to improve balance ability in patients with stroke.

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