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Effect of Kinesiology Taping for Ankle Instability in Stroke Patients

Background: Ankle instability usually occurs after stroke, and contributes to unsafe walking and associated risk of falling in the affected patients.
Objective: To investigate the effects of kinesiology taping (KT) on gait and balance ability (center of pressure, CoP) in patients with ankle instability after stroke.
Design: One group, pre-post design.
Methods: A total of 11 patients with ankle instability after stroke were enrolled. In all subjects, the gait and balance ability were assessed under 2 conditions: KT and barefoot. Gait and balance ability was assessed using GAITRite system and FDM-S platform.
Results: Comparison between KT and barefoot condition, KT condition was significantly higher in velocity, cadence, step length, and stride length than barefoot condition ($P<.05$). KT condition was significantly lower in CoP path length and sway speed than barefoot condition ($P<.05$).
Conclusion: KT indicated potential as a helpful method for walking and balancing ability in patients with ankle instability after stroke. Therefore, this study recommends KT as an option applicable to the stroke with ankle instability.

Keywords: *Ankle instability; Gait; Kinesiology taping; Stroke*

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INTRODUCTION

Stroke with hemiplegia causes ankle instability that affects walking and balance; during walking, inversion or eversion of the ankle may lead to sprain,[1,2] which increases the risk of falling and negatively affects activities of daily living. Due to these facts, providing stability of the ankle joint enables safe walking.

Various methods have been reported over the past few years to improve the walking and balance ability of stroke patients with ankle instability. Among them, Ankle foot orthosis (AFO) is commonly used to provide ankle joint safety. AFO is commonly used to provide stability of the ankle joint. AFO achieves fixation of the ankle joint which prevents inversion or eversion of the ankle as well as foot drop during walking.[3,4] By this mechanism, it contributes to the patient's balance ability during walking, which is a positive influencing factor of the walking ability. However, AFO may result in nerve blockade at the soles of the feet, and consequently, sensory input from the ground may be reduced during walking.[5] Moreover, surgeons face difficulty in performing AFO at direction and strength suitable to the unique characteristics of the patient's ankle instability. A method that can compensate for these disadvantages is needed.

Kinesiology taping (KT) is commonly used in patients who undergo sports rehabilitation, or those with neurological or orthopedic diseases since it is a non-invasive and safe method that can be easily applied.[6] Due to its properties of elasticity and adhesiveness, KT is applicable to majority of the joints of the body, and the user can regulate application at the desired position, direction and strength, which is considered as an important advantage. KT contributes to improved stability during movement through support of the soft tissues such as the joints and ligaments.[7] Previous studies have reported that KT

applied at the ankle joints in various directions had an effect on the gait stability,[8-11] but clear supporting evidence is still needed. Because, most studies performed limited clinical evaluation, so KT cannot be used to quantify the effect of walking on gait. In this study, we aimed to objectively assess the effect of KT on walking ability and balance by using quantitative evaluation methods.

SUBJECTS AND METHODS

Participants

A total of 11 patients (age range 60-65 years; mean age, 60.2±5.7) with ankle instability after stroke were enrolled. Selection criteria were as follows: Stroke for duration of ≥3 months, ability to walk under guardian's supervision, ankle joint stiffness of ≤2 on modified ashworth scale, and ankle dorsiflexor muscle strength of fair grade or higher, or without cognitive problems. Exclusion criteria were as follows: Patients with skin problems due to tape attachment, those with abnormal structure of the ankle joints or swelling of the ankle joints, and inflammation.

Objectives and requirements of this study were explained to all participants who voluntarily signed an informed consent form. Ethical approval was obtained from the Institutional Review Board prior to study commencement (2019-03-004).

Study procedure

Gait and balance ability were evaluated for walking under both conditions of KT and barefoot. In all patients, walking was performed under 2 conditions, and evaluation was carried out by a rehabilitation therapist. Balance measurement was performed using a force-measuring platform for 60 s while the subject is standing upright and looking at the front. For the evaluation order of the 2 conditions, randomization was done with sealed envelopes.

KT application

Kinesiology tape (BB Tape, WETAPE Inc., Seoul, Korea) was applied with approximately 30-40% stretch. Taping application was performed according to the previous study.[12] First, for increase of dorsiflexion by posterior talar glide, the ankle was maintained at slightly dorsiflexed position, and taping was done starting from the talus in both directions up to the calcaneus. Second, for induction of ankle inversion, the ankle was inverted, and taping was done starting at 5 cm above the medial malleolus, and proceeding past the lateral calcaneus below the subtalar joint up to a point outward on the top of the foot. Third, for induction of ankle eversion, the ankle was everted, and taping was done starting at 5 cm above the medial malleolus, and proceeding past the lateral calcaneus below the subtalar joint to a point inward on the top of the foot.

Outcome measurements

In this study, the gait ability was assessed using GAITRite pressure sensor system (CIR System, Easton, PA, USA) comprising an electronic gait mat (length=about 4 m and width=0.89 m) with 1 cm-diameter sensors installed at 1.27 cm interval. The sensor pads were covered with a roll up carpet, which provided an active measurement area responsive to mechanical pressure from foot placement on the mat. Data from the activated sensors were collected by a computer at a sampling rate of 80 Hz, and footstep identification and calculation of parameters was done automatically.

In addition, the balance ability (center of pressure, CoP) was assessed using the FDM-S platform (Zebris Medical GmbH, Germany); the device is a force-measuring platform with built in capacitive force sensors for measurement and analyses of force distribution under the feet (dimensions: 69×40×2.1 cm; sensor surface: 54×33 cm; number of sensors: 2,560; sampling rate: 120 Hz).

Data analysis

This study compared the effects on walking under the two conditions using a Wilcoxon singled rank test. We used SPSS software (ver. 18.0 for Windows; SPSS, Chicago, IL). The level of statistical significance was set at $P<.05$.

RESULTS

General characteristics of the subjects

In this study, 11 patients were recruited, and of those, none were drop outs. Therefore, a total of 11 datasets were analyzed (male 6, female 5)

Table 1. Gait evaluation of two condition.

	KT	Barefoot	t	*P*
Velocity (cm/s)	64.83 ± 5.53	57.17 ± 4.26	−2.226	.026*
Cadence (steps/min)	91.67 ± 3.50	84.50 ± 3.02	−2.214	.027*
Step length (cm)	41.67 ± 1.63	37.00 ± 1.79	−2.207	.027*
Stride length (cm)	79.50 ± 1.87	72.50 ± 5.68	−2.214	.027*

*P<.05, KT: Kinesiology taping

Table 2. Balance evaluation of two condition.

	KT	Barefoot	t	*P*
CoP surface (mm^2)	1536.83 ± 165.59	1739.00 ± 115.29	−2.201	.028*
Sway speed (cm/s)	3.98 ± .18	5.05 ± .35	−2.201	.028*

*P<.05, KT: Kinesiology taping, CoP: Center of pressure

Assessment of gait function

In the comparison of the two conditions during walking, KT condition was significantly higher in velocity, cadence, step length, and stride length than barefoot condition (P<.05) (Table 1).

Assessment of static balance function

In the comparison of the two conditions during standing, KT condition was significantly lower in CoP path length and sway speed than barefoot condition (P<.05) (Table 2).

DISCUSSION

This study investigated the effects of KT on gait and balance in stroke patients with ankle instability. The results confirmed that KT has a positive effect on walking and balance ability in those patients.

This study used the GAITRite system to quantitatively evaluate each subject's walking ability. KT condition attained significantly different values of all the parameters as compared to those of barefoot condition. KT firmly supports the structure around the ankle joint, and can prevent inversion and eversion by maintaining neutral posture of the ankle during walking[10,13]; these attributes enable safe walking, and lessen the individual's fear of falling during walking.

We further evaluated walking ability with the FDM-S platform for quantitative approach. Our results revealed that KT achieved greater improvement of balance ability as compared to barefoot condition. This finding may be explained by the fact that KT provides positional stimulus through the skin to support the joint function, which can contribute to joint stability.[14] Moreover, Huang et al[15] reported that KT was effective in adjusting the fascia, normalizing the muscle function, and increasing the joint mobility and stability. In the current study, we applied KT at the ankle joint in two directions to stabilize the ankle joint. KT significant decreased the CoP path length and sway speed as compared to the barefoot condition, which suggests that the stability provided to the ankle joint could decrease the sway at standing position and maintain the sway speed without any momentary collapse in balance. Previous studies on ankle taping in patients with stroke reported an improvement of dynamic balance and postural control due to enhanced function of the proprioception and sensory motor system induced by stimulation of the cutaneous mechanoreceptors, and optimum positional sense of the ankle joint to maintain normal position.[16,17] This improvement of balance ability is thought to have a positive effect on the improvement of gait ability to support stability. Another mechanism of KT may involve the gamma motor reflexes of the skin[18]; adhesion of kinesiology tape on the skin allows continuous muscle contraction and induces reduction of the muscle tone according to the stimulus level of muscular contraction, and repetitive muscle contraction and release.

This study has some limitations. First, the number

of subjects was low, and therefore, the results cannot be generalized. Second, KT was applied at approximately 30-40% stretch
depending on the subjective judgement and experience of the therapist. Third, the investigator who performed the assessment was not blinded, and blinding could not be performed due to lack of manpower. Future studies to overcome these limitations, and focused on development of various designs of KT and the effectiveness of those are needed.

CONCLUSION

KT indicated potential as a useful method for walking and balancing ability in patients with ankle instability after stroke. Based on this result, clinicians should consider using KT to improve the patient's walking ability.

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