

Immediate Effect of Kinesiology Taping on Gait Function in Stroke Patients with Foot Drop

Background: Recently, the kinesiology taping (KT) method was reported to be effective in improving walking ability in foot drop patients after stroke, but the clinical basis is still unclear.

Objectives: The KT method was compared with ankle-foot orthotics (AFO) to investigate gait ability in foot drop patients after stroke.

Design: Crossover study design.

Methods: In this study, 11 stroke patients with foot drop participated. Walking ability of all subjects for both conditions (KT and AFO) was measured using the GAITRite system. The order of application of the two conditions was determined randomly by drawing lots. Wilcoxon signed-rank test was used to compare walking ability between the two conditions. The level of statistical significance was set at $P<.05$.

Results: There were no significant differences between the KT and AFO methods in terms of velocity, cadence, step length, and stride length ($P>.05$, all).

Conclusion: This study recommends KT as an alternative to the AFO, since KT provides evidence of preventing of foot drops and improving gait ability in stroke patient.

Keywords: Foot drop; Gait; Kinesiology taping; Stroke

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INTRODUCTION

Stroke is a disease that causes various neurological symptoms, such as motor, sensory, cognitive, and speech dysfunction due to impaired brain function caused by problems of the cerebral blood vessels.¹ Stroke patients develop upper and lower extremity motor dysfunction due to hemiparesis, which causes many limitations in daily life.² Specifically, motor dysfunction in the lower extremities causes difficulties in transfers and movements, which negatively affects daily life.

Foot drop is a frequent symptom in hemiplegic patients after stroke. It is known to occur due to difficulty in proper contraction of the tibialis anterior muscle during the swing phase in walking owing to the paralysis of the common peroneal nerve.^{3,4} This occurrence results in abnormal gait patterns, such as convolution or excessive hip flexion. In addition, this abnormal pattern increases the risk of inefficient energy consumption and falls during walking.⁵

Therefore, it is clinically important to treat foot drop symptoms in hemiplegic patients after stroke for safe and efficient walking.

Methods for resolving foot drop symptoms in hemiplegic patients after stroke are largely divided into therapeutic or compensatory strategies. The therapeutic method aims to improve the actual walking function by supplementing the actual foot drop symptoms through methods, such as strengthening exercise, electrical stimulation, and therapeutic exercise.⁶⁻⁸ However, such a therapeutic method has a disadvantage in that it is costly, time-consuming, and cannot guarantee successful recovery, especially in chronic patients.

On the other hand, the compensatory method makes it possible to temporarily walk normally immediately, unlike the therapeutic method where it is uncommon to encounter immediate improvement of the actual gait function during recover. In addition, it has a relatively lower cost and has the advantage of being able to immediately relieve foot drop

symptoms during walking even in acute and chronic patients. Ankle-foot orthosis (AFO) is a representative compensatory method to relieve foot drop symptoms during walking.⁹ AFO generally uses the principle of three-point pressure to reduce or control the movement of the ankle joint during walking, relieving the symptoms of foot drop.¹⁰ Many previous studies have demonstrated that AFO is effective for immediate improvement of gait function in hemiplegic patients with foot drop after stroke, although the mechanism and clinical usefulness of the effect are unclear.^{10,11} Traditional AFO is generally made of hard material, causing discomfort during walking, and the thickness of the material causes an imbalance in the size of the feet on both sides. Additionally, because the sole of the foot is covered, sensory input from the ground may be completely or partially limited during walking.¹¹ Therefore, it is necessary to supplement the limitations of the AFO.

Recently, several researchers reported a method using kinesiology taping (KT) to prevent foot drop in stroke patients.^{12,13} KT can not only be easily applied to the skin, but also has the characteristic of fixing and restraining the movement of the joints or structures of the body due to its elasticity and adhesion.¹⁴ Previous studies have reported the use of KT to maintain the ankle joint in a neutral position in stroke patients with foot drop for compensation and demonstrated immediate improvement in gait function.^{12,13} KT has the advantage of being relatively inexpensive, maintaining the balance of the foot size on both sides, and providing full sensory input from the ground because the sole is completely open during walking. However, since previous studies only performed clinical and not quantitative evaluations, the results were still inconclusive; and they did not have comparison results with AFO. Therefore, this study aimed to quantitatively compare the effect of AFO and KT on foot drop patients after stroke.

SUBJECTS AND METHODS

Participants

This study recruited 11 patients with hemiparesis after stroke. This study was conducted at an local rehabilitation center in Korea. The inclusion criteria were as follows: incidence of stroke > 12 months prior, presence of foot drop symptoms, ability to walk under supervision, ankle joint stiffness of < 2 on modified Ashworth scale,¹⁵ ankle dorsiflexor muscle strength > fair grade, and intact lower limb sensory status. The

exclusion criteria were as follows: implanted cardiac pacemaker, history of seizure or epilepsy, unstable vital signs. Ethical approval was obtained from the Seoul medical center Institutional Review Board prior to study commencement (2019-03-004).

Study procedure

Walking ability of all subjects for both conditions (KT and AFO) was measured using the GAITRite system. The order of application of the two conditions was determined randomly by drawing lots (Figure 1).

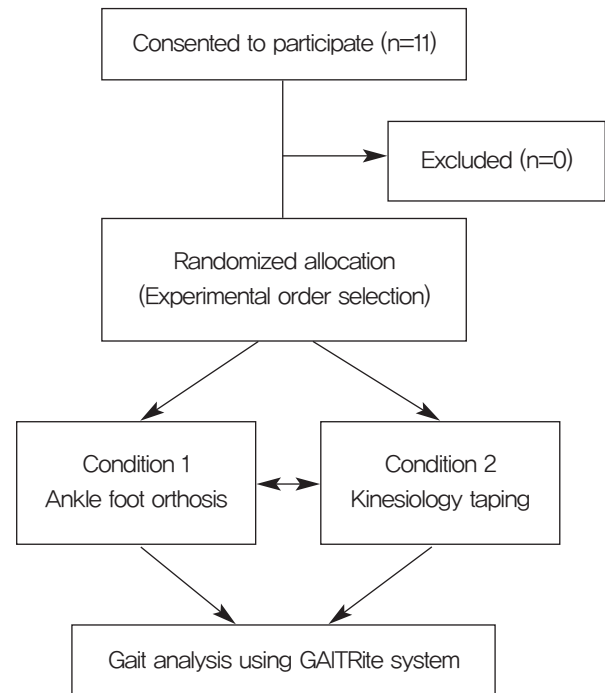


Figure 1. Study flowchart

This study used commercial kinesiology tape (BB Tape, WETAPE Inc., Seoul, Korea). The taping method for foot drop prevention was performed with reference to previously published literature,^{12,13} and the specific method is as follows. The subject maintained a supine position on a bed. The therapist kept the subject's ankle joint in dorsiflexion, in a neutral position (approximately 10 to 20 degrees). The tape was cut into an I shape (approximately 5 cm × 20 cm). The ends of the tape were attached to the skin of the middle part of the lower leg and the top of the foot, with dorsiflexion of the foot. The middle section of the tape was then attached firmly. The pulling force was 50% of the maximum tensile strength of the tape.

Outcome measurements

In this study, gait ability was assessed using the GAITRite system (CIR System, Easton, PA, USA) comprising an electronic gait mat with 13,824 1-cm-diameter sensors, attached at 1.27-cm intervals, for data acquisition. 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 were performed automatically. The assessment was performed three times in succession, and the mean values measured were recorded.

Data analysis

All statistical analyses were performed using SPSS version 15.0 (IBM Corporation, Armonk, NY, USA).

Descriptive statistics are presented as means with standard deviations. Wilcoxon signed-rank test was used to compare walking ability between the two conditions. The level of statistical significance was set at $P < .05$.

RESULTS

General characteristics of the participants

Eleven patients with hemiparesis after stroke were enrolled in this study. The general characteristics of the subjects are shown in Table 1.

Effect of gait function

Comparison of the walking ability using KT and AFO revealed no statistical difference in velocity, cadence, step length, and stride length ($P > .05$) (Table 2).

Table 1. Demographic characteristics of the subjects

Subject	Gender	Age (years)	Stroke type	Lesion	Height (cm)	Weight (kg)
1	Man	58	Infarction	MCA	175	70
2	Man	55	Infarction	MCA	162	67
3	Man	64	Hemorrhage	Pontine	168	66
4	Man	61	Infarction	MCA	174	75
5	Man	59	Infarction	Pontine	171	71
6	Man	68	Hemorrhage	MCA	170	59
7	Man	70	Infarction	MCA	169	67
8	Woman	56	Hemorrhage	MCA	158	59
9	Woman	61	Hemorrhage	MCA	160	60
10	Woman	69	Infarction	MCA	161	55
11	Woman	62	Infarction	MCA	164	57

Table 2. Gait evaluation of two condition

Subject	KT condition	AFO condition	<i>P</i>
Velocity (cm/sec)	28.18 ± 4.31	27.61 ± 4.21	.821
Cadence (step/min)	55.21 ± 3.22	54.54 ± 3.42	.885
Affected step length (cm)	23.43 ± 2.31	24.52 ± 3.13	.871
Less-affected step length (cm)	24.14 ± 3.44	24.13 ± 2.45	.830
Affected stride length (cm)	43.55 ± 2.15	44.31 ± 2.87	.681
Less-affected stride length (cm)	46.28 ± 2.13	45.68 ± 2.18	.630

$P < .05$

Values are mean ± SD, KT: Kinesiology taping, AFO: Ankle foot orthosis

DISCUSSION

Although AFO is a traditional compensatory method to prevent foot drop,¹⁶ it has several disadvantages despite being effective for more normal walking. Therefore, there is a need for a new method that overcome the disadvantages of AFO while still being as effective. Recently, a new method using KT to prevent foot drop was reported, but the clinical basis is still insufficient. Therefore, this study investigated the effect of the KT method on gait ability in chronic stroke patients to prevent foot drop.

Comparison of KT and AFO using the GAITRite system revealed no statistically significant difference in velocity, cadence, step length, and stride length. The results of this study indicate that the KT method has similar beneficial effects as AFO in gait ability in patients with chronic stroke, which is consistent with the hypothesis of this study.

There are multiple explanations for the results of this study. First, the KT method produces its effect through external physical force. Both the AFO and KT methods use physical force to reduce foot drop symptoms, but their methods are slightly different. An AFO uses the three-point pressure principle to prevent foot drop symptoms while walking by applying a brace to the plantar surface of the foot. On the other hand, the KT method used in this study uses kinesiology tape's adhesive properties and elasticity to prevent foot drop symptoms while walking by applying the tape to the dorsal surface of the foot.^{12,13} We used external physical force to maintain slight dorsiflexion with the ankle joint in a neutral position, and then attached the tape from the surface of the shin across the ankle joint to the dorsal surface of the foot, maintaining 50% tension of the kinesiology tape. A previous study¹³ showed that applying kinesiology tape with approximately 75% tension to the dorsal surface of the foot improved walking ability in patients with foot drop following stroke, similar to the results of this study. The optimal tension of kinesiology tape required to prevent foot drop symptoms is not known. However, if the tension is too high, excessive dorsiflexion of the ankle joint may occur, which is thought to cause discomfort or unnatural gait. On the other hand, if the tension of the tape is too low, it may provide insufficient external physical force to prevent foot drop while walking. In this study, it was confirmed that kinesiology tape with 50% tension provided an effect similar to that of an AFO in patients with foot drop following stroke.

Second, KT affects the normalization of muscle tone and fascia function through sensory input, which contributes to improved joint mobility and stability.¹⁷ It is known that proprioception of the ankle joint during walking is closely related to walking ability and balance.¹⁸ By stimulating the sensory receptors of the peri-ankle ligaments, KT not only increases the flexion and extension of the ankle joint during walking but also reduces foot rotation, thus contributing to increased walking stability.¹³ Several previous studies have reported that KT improves ankle stability in patients with stroke and those with sports injuries, allowing the maintenance of balance in gait and improved gait ability.^{19,20} In addition, Bae et al.¹² recently reported a temporary improvement in static balance after applying KT in patients with foot drop after stroke, which is consistent with the results of this study. Other studies have previously reported the use of TheraBand to replace AFO.²¹⁻²³ It was designed to prevent foot drop during walking by connecting the ankle and leg by using the elasticity of the TheraBand. The results of the studies confirmed that TheraBand was effective for walking in patients with foot drop after stroke, which is similar to the results of this study. However, this study has some limitations. First, the research results cannot be generalized due to the small number of subjects. Second, this study attempted 50% tension of KT, but is not quantitative.

CONCLUSION

In this study, the KT method prevented foot drop in stroke patients and demonstrated improvement in gait ability similar to that seen with AFO. Therefore, this study recommends the use of KT as an alternative to AFO.

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