

Comparison of the Effects of Talus Stabilization Taping and Kinesio Taping on Balance and Walking Speed in Persons with Chronic Stroke

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Objective: The purpose of this study was to compare walking speed and balance abilities according to various taping methods in patients with stroke.

Design: Cross-sectional study

Methods: Twenty patients with stroke who were hospitalized at a rehabilitation hospital were allotted to either the talus stabilization, Kinesio or sham taping, or barefoot conditions by drawing lots. Assessment tools used were the Functional Reach Test (FRT), Timed Up and Go test (TUG), One-Legged Stance Test (OLST), and the 10-Meter Walk Test (10MWT). After each test was measured three times, the mean values of each test were used for analysis.

Results: Significant results were observed with the talus stabilization and Kinesio taping group compared to the barefoot and sham taping method for the FRT, TUG, the OLST, and the 10MWT ($p < 0.05$). Also, significant differences in the results were seen in the OLST, TUG, and the 10MWT with the talus taping compared to the Kinesio taping method ($p < 0.05$).

Conclusions: The use of talus stabilization taping applied to the ankle of patients with stroke was more effective for balance and walking ability improvement than Kinesio taping through the correction of an abnormal position of the talus. It is considered that these methods of taping can be applied effectively in the clinic.

Key Words: Athletic tape, Postural balance, Stroke, Walking speed

Introduction

Stroke is a disease that is accompanied by various major neurological symptoms of acquired disorders as a result of loss of cerebral function due to ischemic or hemorrhagic causes of cerebral blood vessels [1]. In the case of patients with chronic stroke, limited ankle range of motion due to gait asymmetry, weakness of the ankle muscles, and ankle stiffness are ankle injuries that are more prominent than other lower extremity injuries, and it is a factor that interferes with balance, gait, and activities of daily living over a long period of time [2]. Various methods are used to

improve walking ability through the use of interventions on the ankles of stroke survivors, and representative examples include plastic ankle orthosis and robotic rehabilitation. These interventions increase weight-bearing ability and improve walking speed and walking ability after gait training [3-4].

Walking with talus stabilization taping has been recently proposed as a new intervention to increase passive ankle dorsiflexion [5]. It has been reported that stretching and compression caused by non-stretch taping can interfere with nociceptive signaling and alter pain perception [6]. It has been stated that talus stabilization taping not only stimulates proprioception,

Received: Dec 1, 2022 Revised: Dec 21, 2022 Accepted: Dec 23, 2022

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but also increases joint position sense and postural control ability by identifying the exact position of the ankle joint [7]. The use of talus stabilization taping is an easy-to-apply, time-saving and cost-effective method for improving gait, stride length and ankle stabilization in patients with chronic stroke. Also, it has been stated to be effective in improving walking speed, stride length, and step length based on static balance ability and the Timed Up and Go (TUG) test results [8].

Previous studies on Kinesio taping applied to the ankle of patients with stroke have focused only on orthopedic methods, facilitation of dorsiflexion, as well as the application of taping on patients with stroke patients in order to evaluate gait with the 10-Meter Walk Test (10MWT) and the TUG, but there is no study yet that has quantitatively confirmed the spatiotemporal gait variables and balance as to how they affect gait [9]. In addition, there are studies on Kinesio taping compared to talus stabilization taping, but there are insufficient studies to confirm the effects of each individual method of taping, such as the non-elastic talus stabilization taping, sham taping, and Kinesio taping. Among the systematic reviews through meta-analysis, studies on the efficacy of sham and Kinesio taping alone are also insufficient [10].

In this study, the effect of talus stabilization taping, the effect of Kinesio taping, the difference between various taping interventions, and the difference between Kinesio taping and talus stabilization taping methods used in clinical practice were investigated in order to search for a more effective taping method for the ankle joint of patients with stroke. This study was conducted to evaluate how these interventions affect balance and walking speed, respectively, by evaluating them with gait speed and balance measuring tools used in clinical practice.

Methods

Participants

Procedure

Before proceeding with the assessment, the measurement process and conditions were fully explained to the study subjects, and only those who

had signed the consent form had undergone assessment. In addition, this study was approved by the Bioresearch Ethics Committee of Sahmyook University (2-1040781-A-N-012021037HR). The order of the application of the taping methods for each subject was determined by having the subjects draw lots and then clinical balance and gait assessment was performed for each method. For clinical balance evaluation, the Functional Reach Test (FRT), One-Legged Stance Test (OLST), Timed Up and Go (TUG) test, and the 10-Meter Walk Test (10MWT) were performed. The FRT, OLST, and the 10MWT were assessed three times each, and the average value was used for analysis. A rest period of 5 minutes was provided between measurements for each taping method.

Intervention

Talus Stabilization Taping

The subject placed their foot on a chair with their ankle placed in dorsiflexion in order to apply a rigid strapping tape (width of 37mm, Mueller M tape) that does not stretch. Beginning at the lateral malleolus, the tape was wrapped in a lateral and posterior direction, was rolled up diagonally, went passed the medial malleolus, wrapped around the Achilles tendon and then wrapped around the lateral malleolus which was the starting point, resulting in the ankle being wrapped for a total of two times (Figure 1) [8].



Figure 1. Talus Stabilizing Taping

Kinesio Taping

A total of 4 strips of Kinesio tape was required for the Kinesio taping method. One strip was attached from the origin to the insertion sites of the gastrocnemius muscle, the second strip was attached to the dorsal surface of the foot with the ankle in dorsiflexion and was stretched and attached 1/2 way up to the anterior tibialis muscle, the third strip was attached from the medial malleolus going past the plantar surface of the foot and to the lateral malleolus, and the final strip was wrapped around the ankle in a dorsiflexion state (Figure 2) [11].

Sham Taping

The sham taping method was applied in the same direction as the talus stabilization taping method to the lateral malleolus. However, unlike the talus stabilization taping method, no glide was applied to the lateral malleolus, and rather than being stretched the tape was simply applied to the skin (Figure 3) [12].

Outcome measures

Functional Reach Test (FRT)

The FRT is a balance assessment tool that is simple and can be used easily in clinical practice. In a standing position, the subject's feet were shoulder-width apart, the body did not touch the wall during the test, the shoulder joint was flexed at 90°, and the hand that was positioned at the reference line was extended as far as possible by bending forward as far as possible horizontally without falling forward. To improve accuracy, this position was held for 3 seconds and the distance between the beginning and ending position of the third metatarsal was assessed [13]. Measurement was carried out after one practice session, and the average value was recorded after performing a total of three times. The FRT has a high test-retest and inter-rater reliability with $r=0.92$ and $r=0.98$ respectively [14].

One-Legged Stance Test (OLST)

The OLST began with the subject's eyes open and standing in a comfortable position with the arms next



Figure 2. Kinesio Taping

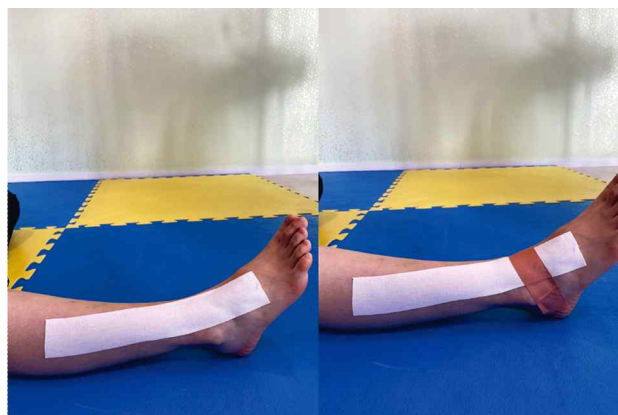


Figure 3. Sham Taping

to the torso. The subject lifted one leg without assistance and was timed immediately after the foot was off the floor, and was timed until the raised foot touched the floor [15]. For patients with stroke, the OLST has a high test-retest reliability with an ICC = 0.88 to 0.92 [16].

Timed Up and Go test (TUG)

The TUG test evaluates the risk of falling, walking ability, balance and mobility in the elderly population. Starting with the subject's back against the back of the chair, the subject was timed from when the subject stood up from the chair after the signal "go", walked 3 meters at a comfortable pace, and then sat back into

the chair [17]. The TUG test has been stated to have a high test-retest reliability after a 7-day interval with ICC=0.95 for patients with chronic stroke [18].

10-Meter Walk Test (10MWT)

The 10MWT was developed to evaluate walking speed during short distance walking. It measures the time it takes to walk a set distance of 10m. A walking test is conducted by applying various distances, but 10m is commonly used. Subjects were informed to walk at a comfortable pace, and if an assistive device was used, it was recorded that an assistive device was used [19]. The test-retest reliability has been stated to have an ICC=0.95 to 0.99 when performed by patients with chronic stroke [20].

Data and Statistical Analysis

For all statistical analyses, the mean and standard deviation values were calculated using the Windows statistical program PASW version 18.0 (SPSS Inc, Chicago, U.S.A.), and descriptive statistics were used for the general characteristics of the subjects. Normality of the subject's general characteristics and variables was confirmed with the Shapiro-Wilk test. To compare the effects of bare feet, talus stabilization taping, Kinesio taping, and sham taping conditions when applied to the ankle of stroke survivors, balance was evaluated with the FRT and OLST and gait was evaluated with the TUG and the 10MWT. Thus, repeated measures ANOVA was performed on a total of 16 results as the four conditions were applied and evaluated. The Least Significant Difference was used for post-hoc analysis and the statistical significance

level of all data was set to $p < 0.05$. Since this was a cross-sectional study, there were no missing data.

Results

General and medical characteristics of study subjects

The age, height, and weight of the study subjects were homogeneous based on the Kolmogorov-Smirnov test, and the general and medical characteristics are shown in Table 1. FRT results were significantly increased with the talus stabilization taping and Kinesio taping methods compared to the sham taping and barefoot conditions ($p < 0.05$), and there was no significant difference between talus stabilization taping and Kinesio taping ($p > 0.05$). Talus stabilization taping and Kinesio taping resulted in significantly longer times in the OLST than the sham taping and barefoot conditions ($p < 0.05$), and talus stabilization taping recorded significantly longer times in the OLST than Kinesio taping ($p < 0.05$) (Table 2). The talus stabilization taping and Kinesio taping methods recorded

Table 1. General characteristics of subjects (N=20)

Characteristics	Subjects
Gender (male/female)	14/6
Age (years)	60.65 ± 7.37 ^a
Height (cm)	170.35 ± 8.00
Weight (kg)	66.25 ± 8.66
Etiology (infarction/hemorrhage)	11/9
Brunnstrom stage	3.7 ± 0.86
Affected side (right/left)	8/12

^amean ± standard deviation

Table 2. Comparison of the FRT and OLST between conditions

(N=20)

Conditions	FRT (cm)	OLST (sec)
Talus Stabilizing Taping	26.73±3.4 ^a	4.22±2.04
Kinesio Taping	26.44±3.47	3.35±1.86
Sham Taping	23.68±1.02	2.51±1.02
Barefoot	23.42±4.3	2.46±1.12
F	20.805	25.132
P	<0.001	<0.001

Note: FRT = Functional reach test; OLST = One-leg stance test

Table 3. TUG and 10MWT between conditions

(N=20)

	TUG(sec)	10MWT(sec)
Talus Stabilizing Taping	17.37±2.63 ^a	18.50±3.29
Kinesio Taping	18.08±2.48	19.42±3.50
Sham Taping	20.10±2.74	21.99±3.48
Non Taping	20.22±2.77	22.10±3.58
F	62.984	70.234
p	<0.001	<0.001

주. ^amean ± standard deviation.

Note: TUG = Timed up and go test; 10MWT = 10-meter walk test

significantly longer and faster times in the OLST and the 10MWT, respectively, than the sham taping and barefoot conditions ($p < 0.001$) (Tables 2 and 3).

Discussion

The purpose of this study was to measure FRT, OLST, TUG, and the 10MWT as clinical gait evaluation tools commonly used in clinical practice through each type of taping method for patients with stroke. In the FRT, there was no significant difference between the barefoot and sham taping conditions before application of the four interventions (barefoot, talus stabilization taping, Kinesio taping, and sham taping) applied to the ankle joint ($p < 0.05$). For OLST, there was a significant increase in the talus stabilization taping and Kinesio taping conditions ($p < 0.05$), there was no difference between barefoot and sham taping, and it was found that the talus stabilization taping was more effective than Kinesio taping ($p < 0.05$). In patients with stroke, ankle dorsiflexion is limited and the alignment of the foot changes due to insufficient posterior glide of the talus, which increases the risk of abnormal ankle movement and ankle injury [21]. However, it has been reported that posterior talar glide in a weight-bearing position improved static balance by increasing afferent stimulation of the ankle joint in patients with stroke [22]. Application of taping in the posterior-downward direction produced a posterior talar glide and increased ankle dorsiflexion in patients with limited dorsiflexion [23] and thus improved static balance in patients with

chronic stroke [8]. In order to maintain balance in a standing position with postural fluctuations, the ankle or the hip strategy is used, or both strategies are used [24], and taping supports and protects the joint, enables functional movement, and improves joint stability by strengthening the ligaments and limiting movement [25]. In the case of talus stabilization taping, it is an intervention method that assists with balance by stabilizing the ankle. In the case of an ankle orthosis, it increases the contact area of the foot to improve proprioception and is effectively used for assisting balance and gait by stabilizing the ankle [26]. In the case of talus stabilization taping, it is thought that it was helpful in improving balance in the results of this study by attaching it to the ankle twice to improve stabilization.

To summarize, this study used talus stabilization taping as an intervention in the state of a posterior talus glide in order to increase ankle stabilization and assist with static balance. Therefore, it is considered that significant results were obtained in the FRT and the OLST.

Among the four methods applied to the ankle joint, the talus stabilization taping and Kinesio taping showed decreased TUG test scores, and the talus stabilization taping method was more effective ($p < 0.05$). The time for the 10MWT was reduced in talus stabilization taping and Kinesio taping among the four methods applied to the ankle joint ($p < 0.05$) but the talus stabilization taping method was more effective. Considering the results of previous studies, the application of talus stabilization taping of the ankle joint corrected abnormal gait patterns, and in regards

to ankle joint limitations, the application of the talus stabilization taping produced additional advancement of the talus and increased heel contact time [23]. For gait ability, the talus stabilization taping method was the most effective in improving TUG scores, gait distance, and stride length, and it was an effective method for restraining the ankle and improving gait in an efficient way compared to an orthosis [8].

Based on the results, talus stabilization taping may be effectively applied to patients with stroke in the treatment room because it is a quick and simple method. In addition, this taping method could lead in the direction of effective rehabilitation treatment by assisting with balance and gait ability. The effects of improved balance and gait ability include improved joint stability due to taping applied to the ankle joint, increased stance time in the gait phase, decreased swing time, and increased step length, step width, and stride length during walking. It is thought to be effective in assisting and supporting the affected ankle joint in patients with stroke. The limitations of this study include that the sample size and that it included subjects with stroke only. Also, since the purpose of this study was to examine the immediate effect of the taping intervention, experimental studies are needed to investigate the long-term effects. Therefore, further studies are warranted with larger sample sizes and follow-up investigations of the effects as well as a wider range of subjects in order to increase generalizability of the results.

The purpose of this study was to investigate the effect of talus stabilization and Kinesio taping on balance and gait speed when applied to the affected ankle of patients with stroke. After applying talus stabilization taping and Kinesio taping, there were significant improvements in balance and gait speed as shown in the FRT, OLST, TUG, and 10MWT results, and in particular, the talus stabilization taping showed significant results in the OLST, TUG and 10MWT compared to the Kinesio taping method. Therefore, the application of talus stabilization taping can be suggested as a method of improving balance and walking ability when applied to the affected ankle of patients with chronic stroke rather than Kinesio taping. However, since this study confirmed the immediate effect, the retention effect over time could

not be confirmed. In the future, a study that can examine various functions over time in patients with chronic stroke with limited chronic ankle function will be needed.

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