

## Effects of Ankle Kinesio Taping on Balance Control Ability of Adults, Stroke Patients, and Musculoskeletal Patient: A Systematic Review

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### | Abstract |

**PURPOSE:** This study examined the effects of ankle kinesio taping on the balanced control capabilities of normal adults, stroke patients, and musculoskeletal patients.

**METHODS:** One thousand articles were searched, and 100 of them were selected as taping papers. Subsequently, 33 papers classified according to balance, muscle strength and pain were analyzed according to the effect size and age group.

**RESULTS:** The effect of ankle kinesio taping on balance control was examined by dividing the effect size into three groups according to the type of disease. Studies with normal adults had a large effect size of 1.213, whereas the effect size of stroke studies was .377, which was small. Studies on musculoskeletal disorders had a large effect size of 1.429. All three groups did not include 0 in the 95% confidence interval, indicating a significant effect.

**CONCLUSION:** The effect of kinesio taping on balance

control was positive in all subjects, including normal adults, stroke patients, and musculoskeletal patients. On the other hand, in terms of the effect size of kinesio taping on balance control, musculoskeletal patients and normal adults had larger effect sizes than stroke patients.

**Key Words:** Ankle, Kinesio taping, Muscle strength, Pain, Postural balance

### I. Introduction

Among the various intervention methods in physical therapy, taping therapy has recently emerged. Taping refers to the application of tape to a joint, muscle, or ligament to prevent or treat an injury. This taping helps relieve pain and balance the body to assist in physical activity [1].

Generally, taping methods have been developed and used to improve the muscle function in preventing injury, protecting injury, and treating injury, supplementing smooth movement of joints and applying them to various symptoms and movements. In Korea, kinesio taping therapy corrects the imbalance of muscle tension and relaxation and is a treatment for pain relief, muscle recovery, and functional recovery of the human body [2-5].

In sports, taping is used as a muscle and joint system

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therapy to reduce acute or chronic pain, owing to its ease of application without any special side effects. It is an efficient way of improving performance by relaxing the tense muscle strength of an area at risk of injury and helping contract the weakened muscles. In terms of injury prevention, there has been a sharp increase in taping by ordinary people and athletes because of the effect on balancing metabolic functions and blood flow activation to recover from muscle fatigue [5-7].

Taping has been developed and applied in various ways to reduce pain by attaching tape directly to the skin and muscles in the event of damage to the musculoskeletal system to improve functions, such as muscle strength, muscular endurance, and net repulsion [3]. Stroke is a neurological condition that results from an interrupted blood supply to the brain tissue, resulting in various exercise, sensory, and cognitive problems [8,9].

In particular, in the ankle of stroke patients, deformation of the foot due to excessive muscle tone appears, and the backward or prostrate foot makes postural control more difficult and increases sway compared to the neutral foot [8,10]. This is caused by ankle joint movement and reduced contact with the supporting surface of the foot [8,11].

A previous study examined the balance and walking ability of stroke patients who applied kinesio taping to the paralyzed ankle and reported improvement [8,9]. This result was explained by kinesio taping providing sensory information to skin receptors and promoting proprioceptive sensation through joint realignment [10]. Kinesio taping is a treatment that uses adhesive tape or bandages to help improve the anatomical characteristics, kinetic functional characteristics, and the size and shape of each part.

Ankle Kinesio taping is used to improve the sense of balance and prevent injuries and the recurrence of injured areas by fixing them during rehabilitation or training and first aid. In addition, the purpose is to prevent injuries by taping the areas expected to be injured in advance and support the muscles in the injured area prone to recurrence

due to reduced flexibility and stability. Therefore, kinesio tape prevents recurrence. Few physiologically accurate studies have been reported, and there are no studies of the muscular activity, particularly at the onset of walking from posture to motion to ankle response.

Therefore, studies on the effect of kinesio taping on the balance control ability of general adults, musculoskeletal patients, and stroke patients are needed. There are also no reports distinguishing between stroke patients, musculoskeletal patients, and normal people's ability to balance the ankles. Accordingly, it is necessary to identify and analyze the effects of kinesio taping on the ankles of stroke patients. This study examined the effects of ankle kinesio taping on the balanced control capabilities of normal adults, stroke patients, and musculoskeletal patients in normal adults and stroke patients.

## II. Methods

### 1. Data collection

#### 1) Data Retrieval Database

This study included Riss, Google Academic Search, Dbpia, Foreign Academic Support Center (Fric), and the National Assembly Library, among the journals in the field of physical therapy. The original text of the published paper was collected from the homepage of each journal.

<http://www.riss.kr/index.do>, <https://scholar.google.co.kr/>, <https://www.dbpia.co.kr/>, <http://www.fric.kr>, <https://www.nanet.go.kr>

#### 2) Search word selection

Korean words were used for the search terms, and according to PICO, P selected "elderly" and "normal adults", and I selected "Kinesio Taping", "Kinesio Taping Ankle", and "Taping".

C selected "exercise" or "non-elastic taping", and O selected "balance control" and "balance control ability".

Table 1. General Subject Characteristics

Author(year)	Participants			Comparison	Main Outcome (scale)
	Experiment	Other group			
Jun (2015)	N = 17	None		None	Balance system GAITRite system
Lee (2009)	N = 10	N = 10		Spiral taping	Biodex Balance System
Park (2005)	N = 14	None		None	EMG(ME100B,Biopac System) Cybex test
Lee et al.(2010)	N = 20	None		None	Biodex Balance System
Lee et al.(2008)	N = 23	None		None	Visual Analog Scale (VAS)
Lee (2008)	N = 15	None		None	Biodex pro system3
Lee (2017)	N = 31	N = 32		None	Visual Analog Scale (VAS)
Kwon et al.(2020)	N = 15	N = 15		Dynamic taping	Wii Balance Board, Functional reach test, Star excursion balance test
Joo et al.(2019)	N = 15	N = 15		Ankle muscle	Timed up and go test
Park (2005)	N = 15	None		None	Biodex system III
Kim et al. (2009)	N = 10	N = 10	N = 10	Strength exercise	Dynamic Balance System
Oh & Lee (2019)	N = 20	None		None	Visual Analog Scale (VAS) Myosystem™ DTS
Park et al. (2010)	N = 15	N = 15	N = 15	None	Visual Analog Scale (VAS)
Kim (2015)	N = 32	None		None	Algometer, Visual Analog Scale (VAS)
Kang (2011)	N = 20	None		Compression stocking	Visual Analog Scale (VAS)
Kim (2017)	N = 15	None		None	TKK-5402
Seo et al. (2012)	N = 10	N = 10		None	Visual Analog Scale (VAS)
Cho et al. (2012)	N = 10	N = 10	N = 10	Non-elastic Taping	MatScan
Lee (2016)	N = 25	None		None	Wii Balance Board
Yu & Lee (2018)	N = 13	N = 13	N = 13	Static stretching, Ultrasound	Space Balance 3D
Kim (2013)	N = 7	None		None	CSMI medical solution
Yeo et al.(2008)	N = 33	None		Wrist supporter	dynamometer
Yang & Lee (2006)	N = 25	None		None	Visual Analog Scale (VAS)
Suk et al. (2013)	N = 10	N = 10	N = 9	Pilates	TAKEI PHYSICAL FITNESS TEST
Lee et al. (2006)	N = 20	None		Elbow band, Sports taping, McConnel taping	Hand Dynamometer
Lee et al. (2010)	N = 16	N = 12		None	Baseline Pneumatic Squeeze Dynamometer
Lee & Jung (2005)	N = 10	N = 10		None	Pressure Algometer
Kim & Yoon (2019)	N = 15	N = 17	N = 15	Himo training,	Visual Analog Scale (VAS)
Lee (2005)	N = 7	N = 7	N = 7	Training group/control group	Biodex system3 (dynamometer)
Jung (2011)	N = 10	N = 10	N = 10	None	Visual Analog Scale (VAS)
Lee & Kwon (2011)	N = 40	None		None	Back-D(Japan)
Jeon (2015)	N = 20	None		None	Cybex
Lee et al. (2000)	N = 20	N = 20		None	Visual Analog Scale (VAS)
Choi (2018)	N = 12	N = 12		None	O'Connor formula (1RM)

When searching for papers, I and O were combined, and papers that did not fall outside the range of P and C were selected.

## 2. Classification Method

### 1) Selection criteria

In this study, studies that meet the following conditions were selected.

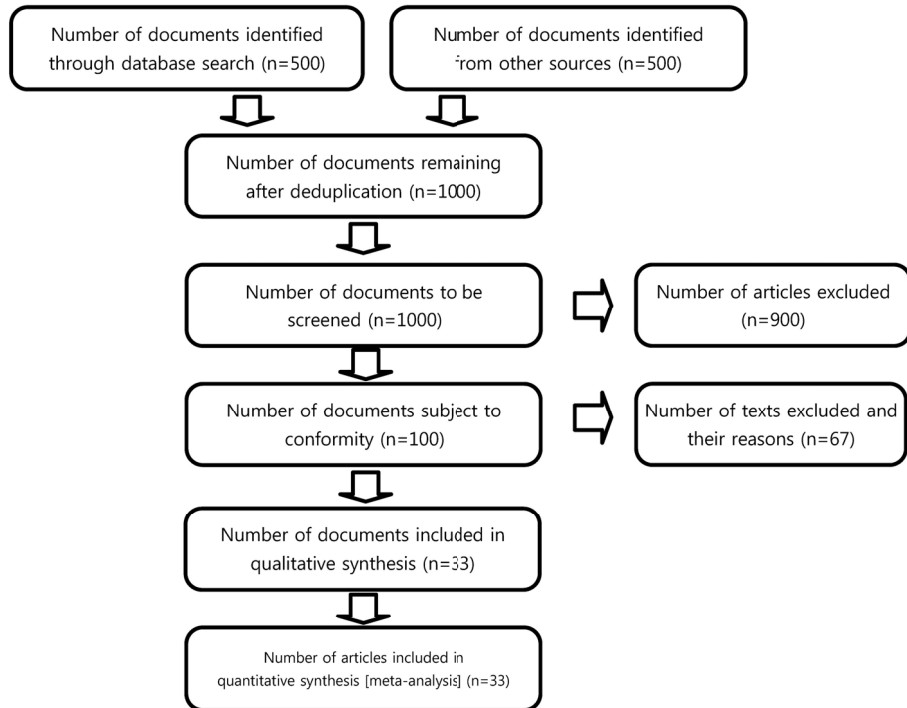


Fig. 1. Summary of the study selection process.

- (1) Duplicate papers in the journal.
- (2) Papers Using Kinesio Taping and Ankle.
- (3) Studies that showed objective results and numerical values.
- (4) Studies related to the ability to control the balance of the ankle.
- (5) Studies involving normal adult, stroke, and musculoskeletal patients.

## 2) Exclusion Criteria

Duplicated studies, studies that could not verify the original text, and studies that did not present the appropriate findings were excluded.

## 3) Research Selection Process

One thousand papers published in Korea from 2009 to 2021 were searched using the search terms and search strategies set out in this study. One hundred domestic papers

that met the purpose of this study were selected. Thirty-three papers were finally selected after re-analyzing and classifying the effects of taping as papers that studied balance, muscle strength, and pain.

## 4) Evaluation of Study Bias

The quality of the study was evaluated independently by one researcher using the Cochrane risk of bias (ROB) tool. Items that did not match were reviewed and discussed in the original text of the study, and conclusions were drawn.

## 3. Analysis Method

### 1) Quantitative Analysis of Research Results

A study comparing the taping effects of the experimental group and the control group showed the results as Cohen's D. The effect size of taping was then found through

statistical analysis. The effects of taping were analyzed by classifying them into three groups [general, stroke patients, and musculoskeletal patients] according to the characteristics of the subjects in each study.

2) Statistical processing

In this study, the effect size was calculated using the Effect Size Calculators (University of Colorado, USA) program, and the average effect size (d) and 95% confidence interval (95% confidence intervals, 95% CI) of each outcome variable were presented. The effect size was then interpreted.

3) Establishing a search strategy.

This study formed a part of the Cochrane Collaboration. Systematic Literature Review Handbook and Preferred Reporting Item for Systematic Reviews and Meta-Analysis Systematic literature review and meta-analysis presented by the (PRISMA) group It was carried out in accordance with the reporting guidelines [9]. The literature search was conducted primarily by the author and related experts according to the search strategy. A study included in the final evaluation was selected through an agreement between the two researchers.

- (1) The significance was confirmed by suggesting a 95% confidence interval of the mean effect size, suggesting that it is significant if 0 is not included.
- (2) According to the effect size interpretation criteria, in the standardized mean difference, if the effect size was less than or equal to 2, it was interpreted as a small effect size. If it was 5, it was interpreted as a medium effect size, and if it was greater than

or equal to 8, it was interpreted as a large effect size [12]. For example, the normal adult had a relatively large effect if a score of 1.213 was obtained.

**III. Results**

1. General characteristics of selected studies

All the studies included in this study were kinesio taping intervention studies, and 33 studies included in the literature review were analyzed. One researcher evaluated the quality of the study independently using the Cochrane risk of bias (ROB) tool. Items that did not match were reviewed and discussed in the original text of the study, and conclusions were drawn. The publication years were 14 publications (42.42%) from 2005 to 2016 and 19 publications (57.57%) from 2017 to 2020.

Among them, 27 papers (81.81%) were from academic journals, and six papers (18.18%) were degree theses. The subjects were classified according to the type of disease. There were 10 studies of normal adults, 13 studies of stroke patients, and 10 studies of musculoskeletal diseases (Table 2).

2. Effect of Ankle Kinetic Taping on Balancing Capability

The effects of ankle kinesio taping on balance control were examined. The effect size was confirmed by dividing into three groups according to the type of disease. Studies with normal adults had a large effect size of 1.213. The effect size of stroke studies was .377, which was small. On the other hand, studies on musculoskeletal disorders had a large effect size of 1.429. None of the three groups

Table 2. Classification According to Disease Type

Variable	Disease Type	Percent	N
Balance control ability	Normal	30.3	10
	Stroke	39.4	13
	Musculoskeletal disorders	30.3	10
Total		100	33

Table 3. Analysis of Effect Size on the Balance Control Ability of Kinesio Taping

Variable	Disease Type	ES	95% CI	
		Cohen's d	Lower	Upper
Balance control ability	Normal	1.213	.572	1.924
	Stroke	.377	.179	.617
	Musculoskeletal disorders	1.429	.614	2.337

ES: effect size, CI: confidence interval

included 0 in the 95% confidence interval, indicating a significant effect (Table 3).

#### IV. Discussion

All the studies included were kinesio taping intervention studies, and 33 studies were included in the literature review were analyzed. The effect size was then analyzed using Cohen's D. Ten studies were related to the normal adults. In 10 musculoskeletal patients, the effect size was 1.429, which had a large effect size. In 13 stroke patients, the effect size was .377, which had a small effect size.

Thirteen studies that applied kinesio taping to stroke patients reported that Hwang-applied kinesio taping to the ankle joint of stroke patients helped reduce stiffness and improve balance [13]. In particular, a change in the longitudinal plantar arch and a decrease in the center of gravity movement cause disturbances in the proprioceptive input and affect balance ability. Therefore, the treatment of the ankle joint is very important for dynamic and static posture control. Carda et al. applied kinesio taping to the ankle joint of a patient with subacute stroke. They reported that taping reduced the muscle tone and improved the range of motion compared to passive stretching techniques [14]. The research papers searched also showed significant differences when comparing before and after applying kinesio taping to stroke patients. Therefore, there is a significant effect compared to other studies.

Looking at the previous studies that applied kinesio taping to normal adults, there were 10 studies. Joo et al.

reported that a kinesio taping application method provided stability to the ankle joint, thereby reducing the postural sway and had a positive effect on the bug balance scale [15]. Shelton reported that the ease of taping affects muscle balance [16]. A report on the functionality of adhesive tape showed that ankle tape had a positive effect on improving balance because it provided stability to the ankle joint by strengthening the neuromuscular reflex [17,18]. In the research papers searched for, significant differences were found when comparing the before-and-after differences when kinesio taping was applied to the general population. Therefore, there is a significant effect compared to other studies. Ten studies applied kinesio taping to patients with musculoskeletal disorders.

Changmo Cho et al. reported pain reduction due to applying one-time kinesio taping to a patient with degenerative knee arthritis [19]. Ha et al. applied taping to patients with hindfoot pain, and the immediate pain reduction effect was verified [20]. These results had a significant effect when comparing the difference before and after applying kinesio taping to patients with musculoskeletal disorders. Therefore, there was a significant difference compared to other studies.

The effects of kinesio taping on balance control in these previous studies were effective on normal adults, stroke patients, and musculoskeletal patients. In terms of effect size, musculoskeletal patients and normal adults had relatively larger effect sizes than stroke patients.

The effect was significant in patients with musculoskeletal injuries and when there was ankle instability. Kinesio taping

had a more significant effect on the joint range of motion and balance than when no treatment was done. Kim et al. examined the balance index changes in the left, right, and anterior. They reported that the change in the total fluctuation index decreased significantly after taping [21]. Taping and ankle joint strength exercises affect the ankle stability and ankle joint strategy, thereby reducing the balance index. These results are consistent with the study of Shelton that the application of taping affects muscle balance [16]. A significant effect was observed on the normal adults, and stroke patients saw some effects of kinesio taping on the ankle joint. When joint stabilization taping was applied, it was believed to affect the ankle joint range of motion and balance ability by reducing the muscle tension on the paralyzed side.

The effect of kinesio taping was significant in patients with the musculoskeletal system. For musculoskeletal patients, Kelly conducted a study on the minimum meaning of the sagittal pain scale [22]. A difference of 9–10 mm or more is clinically meaningful. Hence, it was also effective in the general population and as a general effect [23].

One study showed that the application of taping application improved the functional performance in people with chronic ankle instability [24]. The application of taping had a good effect on the postural control and gait ability of people with chronic instability.

In stroke patients, Juilo et al. reported that the application of kinesio taping to the calf muscle reduced the muscle tone [25]. On the other hand, stroke patients showed a relatively small effect compared to patients with the musculoskeletal system and the general population. Seo's study found no significant difference in foot pressure changes after applying kinesio taping from the ankle joint to the front shin, posterior shin, long calf and foot [26]. The effect size analysis of the foot pressure variables before and after kinesio taping had a small effect. Furthermore, kinematic taping significantly improved the sensory accuracy [27]. In nervous system patients, those with

impaired ankle joint intrinsic water solubility experience increased body tremor and lower balance scale scores compared to those without impaired ankle joint intrinsic water solubility [28]. Muscle weakness in stroke patients causes difficulties in performing motor functions in response to sensory stimuli in various environments. In particular, abnormal movements cause problems with the musculoskeletal system. Deformation of the inversion and posterior needle appears when the position of the talus bone is lower than normal, and the muscle tone is high. This type of foot deformity lowers the balance ability of dynamic and static standing posture and causes gait disturbance, so the effect appears to be lower than that of other studies.

In addition, most previous studies applying taping were made on normal adult and sports players. Therefore, the subjects could not represent the patients. Another limitation was that the age group of the study subjects was biased because previous studies that applied taping often selected young subjects. According to these results, kinesio taping had a less positive effect on the foot and ankle joints because of changes in the musculoskeletal system in stroke patients.

## V. Conclusion

The effect of kinesio taping on balance control was positive in the general public, stroke patients, and musculoskeletal patients. On the other hand, musculoskeletal patients and normal adults had relatively larger effect sizes than stroke patients. The limitation of this study was that the number of papers analyzed was small (33 papers). Nevertheless, the effect of kinesio taping was clearly shown, and the effect size for each sub-classification showed a difference according to the age group. In future studies, studies on various variables other than muscle strength, balance control ability, and pain control should be analyzed by applying kinesio taping.

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