

Effects of spiral taping applied to the neck and ankle on the body balance index

BYUNG HOON LEE, PhD, PT¹⁾, HYE RIM LEE, MED, OT²⁾, KYEONG MI KIM, PhD, OT³⁾,
JEONG HUN LEE, PhD, PT⁴⁾, KYUNG YOON KIM, PhD, PT⁵⁾*

¹⁾ Group of Industry Academy Cooperation, Chunnam Techno University, Republic of Korea

²⁾ Department of Occupational Therapy, Chunnam Techno University, Republic of Korea

³⁾ Department of Occupational Therapy, College of Biomedical Sciences and Engineering, Inje University, Republic of Korea

⁴⁾ Baeklim Clinic, Republic of Korea

⁵⁾ Department of Physical Therapy, College of Health and Welfare, Dongshin University: 252 Daeho-dong, Naju-si, Chonnam 520-714, Republic of Korea

Abstract. [Purpose] This study was performed to investigate the changes in the body balance index when spiral taping is applied to the neck and ankle. The findings are expected to serve as evidence of the usefulness of taping the neck instead of the ankle when ankle taping is not feasible in clinical practice. [Subjects and Methods] Twenty healthy male students at A university were enrolled in this study. Balance measurements were made under three conditions: no intervention, ankle intervention and neck intervention. Static balance was measured with subjects' eyes open and closed, and dynamic balance was measured with subjects' eyes closed. [Results] There were significant differences in dynamic balance assessed by the Overall Balance Index (OBI), and the Anteroposterior Balance Index (ABI) with subjects' eyes open when ankle or neck taping was applied compared to no intervention. The static balance (OBI) of subjects with eyes open showed significant differences from the no intervention condition in both the ankle and neck intervention. The static balance (OBI) with subjects' eyes closed also showed significant differences in both the ankle and neck interventions compared to the no intervention condition. [Conclusion] Our results indicate that neck taping stimulates the somatic senses around the neck and increase proprioception, resulting in balance improvement similar to that elicited by ankle taping. Further studies with larger sample sizes various experimental conditions should be performed to more systematically and objectively elucidate the effects of neck taping.

Key words: Spiral taping, Balance, Balance index

(This article was submitted May 19, 2014, and was accepted Jul. 18, 2014)

INTRODUCTION

Balance is the process which maintains postural stability and underlies the performance daily activities and functions¹⁾. Balance responds to the environment to maintain the center of gravity (COG) within the weight bearing base of support (BOS), and keeps the body from swinging or wobbling when it is moving²⁾. There are two types of balance: static balance, and dynamic balance. Static balance is the ability to maintain a certain posture within a fixed BOS, while dynamic balance is the ability to change to other postures by keeping COG within the BOS while moving^{3, 4)}. To maintain balance, somatic senses, including proprioception, visual sense and position sense, and input from the vestibular system need to work together⁵⁾. In particular,

the vestibular system controls the tension of the extensor muscles to maintain balance⁶⁾. Visual sense provides information on surroundings that may affect balance⁷⁾. Balance may decrease due to pallesthesia, injured proprioceptors, or impairment of perception, or the visual or somatic senses. The balance of individuals may differ depending on characteristics, including the length of legs, age, height, location of feet, or breathing^{8–10)}.

In recent clinical practice, tapes have been used to treat decreased muscle strength, muscle tensions and convulsions by applying them over the skin. They are also often used to relieve muscular pain by improving the circulation of blood, tissue fluid and lymph¹¹⁾. Taping elicits homeostasis of the muscles, which improves symptoms by balancing out with the surrounding tissues. Taping is applied to injured areas to protect joints, decrease edema and prevent secondary damage after acute injury. From this simple fixing application, taping has extended its clinical applications to reduction of pain, improvement of movement and blood circulation after injury, as well as the prevention of injury during exercise¹²⁾.

Various studies of taping have been conducted. They

*Corresponding author. Kyung Yoon Kim (E-mail: redbead7@daum.net)

have investigated the mechanisms behind the physical stimulation of the skin, such as contact, pressure or vibration, which decreases muscle tension and increases muscle contraction by inducing continuous contraction and relaxation of the muscle through the gamma motor reflex. Leanderson et al.¹³⁾ reported that taping decreased postural motion and increased the postural stability of soccer players with sprained ankles (one side) and that of average healthy subjects. Simoneau et al.¹⁴⁾ reported that taping the ankle increased proprioception without bearing weight: the body recognized the location of the joint during plantar-flexion more accurately, increasing subject' balance ability.

Most studies of balance improvement have only investigated ankle taping, and there are very few studies of alternatives when ankle taping is not feasible. Therefore, this study investigated the changes in the balance index with taping location by comparing the effects of spiral taping of the ankle and neck, to provide evidence of the effect of cervical taping on balance improvement.

SUBJECTS AND METHODS

Subjects

The subjects of this study were 20 male university students. Subjects were excluded from the study if they exhibited a painful gait or painful range of motion, a history of ankle surgery, or ankle sprain within the past four weeks. The purpose, objective and procedures of this study were explained to the subjects who voluntarily agreed to participate in this study. Data collection was started after approval had been received from the University Institutional Review Board of Dongshin University (BM-002-010). The general characteristics of the subjects are summarized in Table 1.

Methods

The balance of the subjects was measured at one week intervals for each of the taping conditions: no intervention, ankle intervention and neck intervention. Static balance was measured with the subjects' eyes open and closed, dynamic balance was measured with the subjects' eyes were closed. Spiral taping (ExcelSpiral tape A type: Spiraltape of Tanaka, Japan) was used for the taping. The balance taping points of Danaka¹⁵⁾ were followed, and a left-oriented application was used for spiral taping because of the finding that 95~99% of the entire population have left-oriented directivity, while only 1~5% have right-oriented directivity. For ankle intervention, the tape was applied over the anterior and inferior lateral recesses of the medial malleolus, 4th and 5th metatarsals posterior junction and the anterior lateral malleolus of the right foot, and the anterior and inferior lateral recesses of the lateral malleolus, 1st and 2nd distal metatarsals and the medial border of the Achilles tendon three finger-widths above the medial malleolus of the left foot, as shown in Fig. 1. For the neck intervention, taping was applied bilaterally from the mastoid to 1/3 of the sternocleidomastoid muscle as shown in Fig. 1¹⁵⁾. The Biodex Balance System SD (Biodex Inc., USA) was used to measure balance. Force plate measurements are processed by computer software (Biodex, 950-302, Biodex Inc., USA) to derive the

Table 1. Characteristics of subjects

Parameters	Age (years)	Weight (kg)	Height (cm)
Subjects (n=20)	23.2±3.0	67.9±5.1	175.4± 6.00

All data are expressed as means with standard deviation.

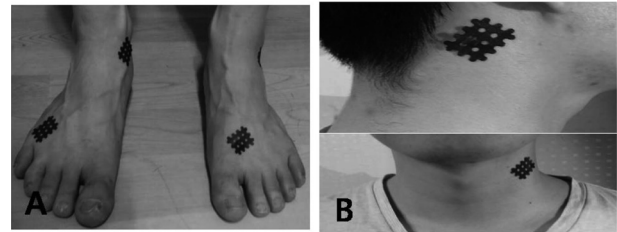


Fig. 1. The spiral taping method: A) ankle region, B) neck region

objective balance index, and the results of the balance measurement are presented as the Overall Balance Index (OBI), Anteroposterior Balance Index (ABI), and Mediolateral Balance Index (MBI)¹⁶⁾. A result of "0" indicates a stable status while "9" indicates an unstable status. The subject stands on the force plate in bare feet. The age and height of the subjects are entered into the machine, and the subject is asked to move his feet to follow the central point displayed on the monitor. The central point is recorded automatically and the coordinates of the feet are manually measured and entered. Static balance is measured with the subject's eyes open and closed on a fixed force plate. Dynamic balance is measured on the automatically moving plate which is pre-programmed with 1–12 levels. The subjects were asked not to move their feet on the force plate for 1 minute and 30 seconds for each measurement. They had a one minute break between the measurements. The measurements were performed three times and the mean of those results was used in the analysis. If a subject lost his/her balance during the measurement, the result was discarded and the measurement was repeated. Statistical analysis was performed using SPSS 12.0 for Windows. The mean and standard deviation were calculated for the general characteristics of the subjects. The Kruskal-Wallis test non-parametric method was used to evaluate the changes in the balance index among the taping conditions. Tukey's multiple range test was used as the post-hoc test. For the significance level of all statistics, $\alpha=0.05$ was used.

RESULTS

The change in the balance with taping location is presented in Table 2. For static balance with eyes open, OBI and ABI showed significant differences after ankle intervention compared to no intervention ($p<0.05$), but MBI did not ($p>0.05$). The OBI showed a significant difference after neck intervention compared to no intervention ($p<0.05$) but ABI and MBI did not ($p>0.05$). For static balance with the eyes closed, OBI, ABI and MBI showed significant differences ankle intervention compared to no intervention ($p<0.05$); and OBI showed a significant difference after

Table 2. The balance index values (unit: score)

	Variable	PA	AA	NA
Static balance (eyes open)	OBI	0.43±0.20	0.18±0.08**	0.23±0.11**
	ABI	0.34±0.18	0.16±0.09*	0.21±0.12
	MBI	0.16±0.10	0.08±0.05	0.12±0.08
Static balance (eyes closed)	OBI	1.53±0.76	0.60±0.17**	0.81±0.43**
	ABI	1.21±0.65	0.55±0.18*	0.65±0.37
	MBI	0.74±0.55	0.16±0.10*	0.30±0.16
Dynamic balance	OBI	2.12±0.81	1.20±0.46**	1.23±0.52**
	ABI	1.59±0.64	0.81±0.30**	0.85±0.31**
	MBI	1.07±0.39	0.70±0.36*	0.71±0.33

Values are expressed as Mean±SD. The significance of differences was tested by the Kruskal-Wallis test, and a post-hoc test. Tukey's multiple range test was also performed. *: $p < 0.05$ compared to PA; **: $p < 0.01$ compared to PA. PA: no application; AA: ankle region application; NA: neck region application. OBI: overall balance index; ABI: anteroposterior balance index; MBI: mediolateral balance index

neck intervention compared to no intervention ($p < 0.05$), but ABI and MBI did not ($p > 0.05$). For dynamic balance, OBI, ABI and MBI showed significant differences after ankle intervention compared to no intervention ($p < 0.05$); and OBI and ABI showed significant differences after neck intervention compared to no intervention ($p < 0.05$), but MBI did not ($p > 0.05$).

DISCUSSION

Balance is a basic and necessary ability for the performance of daily activities or other human activities. It is the most important ability for physical activities such as moving or performing tasks¹⁷). Balance is affected by musculoskeletal and neurological factors: musculoskeletal factors include posture and flexibility of the musculoskeletal system, muscle strength and endurance, and neurological factors include sensory processing, integration of inputs from the central nervous system, and forming motor strategies¹⁸). Many studies have been conducted to develop various intervention programs for visual sense training, stimulation of proprioceptors or somatic sensors, posture control, and taping has recently received much attention.

This study measured the body balance index using the Biodex Balance System SD (Biodex Inc., USA) of 20 university male students after no intervention, ankle intervention and neck intervention to investigate areas suitable for taping if ankle taping is not feasible. The changes in the static balance index with subjects' eyes open of OBI and ABI were significant. The changes in the static balance index with subjects' eyes closed of OBI, ABI and MBI were significant. The changes in the dynamic index of OBI and MBI were significant after the ankle and neck interventions compared to no intervention. Nijokiktjen and DeRijke¹⁹) reported that anteroposterior body sway is greater than mediolateral body sway, and that greater balance ability is required during dynamic activity than static activity to maintain balance. In agreement with this finding, the anteroposterior balance index was greater than the mediolateral balance index, and the dynamic balance indices were

greater than the static balance indices in this study.

Shelton²⁰) reported that taping improves muscle coordination and muscle balance. Lultz et al.²¹) reported that taping of the ankle strengthens the extensor reflex to provide stability to the ankle, which improves balance, as was demonstrated in the present study. Delahunt et al.²²) reported that ankle taping significantly affects dynamic postural adjustment, which is in agreement with the results of the present study. We consider this finding is explained by the fixation effect of the joint or bone in the ankle area when spiral taping is applied over the ankle.

Maintaining balance and posture is influenced not only by the muscles around the ankle, but also by input from the visual senses, and vestibular system, and sensory information from the somatic senses in the neck²³). Burl et al.²⁴) reported that balance improves when stability was provided to the neck in a study that investigated the effect of taping the cervical spine on standing balance. Yoo²⁵) also reported that taping the neck positively affected posture, a result which is in agreement with our present study's findings. Cervical spiral taping improved the stability and balance of the head and neck muscles, which improved proprioception and balance. The balance indices improved after taping interventions for the two areas. Taping fixed the joints and stimulated the proprioceptors, eliciting the fusimotor reflex, which increased contractibility of the surrounding muscles, which improved postural balance.

This study had some limitations. First, the small sample size makes it difficult to generalize the results. Second, this study had a single-group pretest-posttest design, not a case control design. Third, the subjects were not patients.

In summary, taping had a positive effect on the static balance indices measured with subjects' eyes open and closed, and on the dynamic balance index of healthy adults who were in their 20s. Further studies using increased sample sizes and various intervention locations should be performed to more systematically and objectively confirm the effects of taping.

REFERENCES

- 1) Cohen H, Blatchly CA, Gombash LL: A study of the clinical test of sensory interaction and balance. *Phys Ther*, 1993, 73: 346–351, discussion 351–354. [[Medline](#)]
- 2) Nashner LM: Sensory, neuromuscular and biomechanical contribution to human balance. In: Duncan PM, ed. *Balance: Proceeding of the APTA Form*. Alexandria: APTA Publication, 1990.
- 3) Ragnarsdottir M: The concept of balance. *Phys Ther*, 1996, 82: 368–375.
- 4) Wade MG, Jones G: The role of vision and spatial orientation in the maintenance of posture. *Phys Ther*, 1997, 77: 619–628. [[Medline](#)]
- 5) Di Fabio RP: Sensitivity and specificity of platform posturography for identifying patients with vestibular dysfunction. *Phys Ther*, 1995, 75: 290–305. [[Medline](#)]
- 6) Berg KO, Maki BE, Williams JI, et al.: Clinical and laboratory measures of postural balance in an elderly population. *Arch Phys Med Rehabil*, 1992, 73: 1073–1080. [[Medline](#)]
- 7) Galley PM, Forater AL: *Human movement*. Churchill Livingstone, 1985, pp 174–176.
- 8) Jeong BY: Respiration effect on standing balance. *Arch Phys Med Rehabil*, 1991, 72: 642–645. [[Medline](#)]
- 9) Judge JO, King MB, Whipple R, et al.: Dynamic balance in older person: effects of reduced visual and proprioceptive input. *J Gerontol*, 1993, 50: M263–M270.
- 10) Kilburn KH, Thornton JC: Prediction equations for balance measured as sway speed by head tracking with eyes open and closed. *Occup Environ Med*, 1995, 52: 544–546. [[Medline](#)] [[CrossRef](#)]
- 11) Lim C, Park Y, Bae Y: The effect of the kinesio taping and spiral taping on menstrual pain and premenstrual syndrome. *J Phys Ther Sci*, 2013, 25: 761–764. [[Medline](#)] [[CrossRef](#)]
- 12) Kowall MG, Kolk G, Nuber GW, et al.: Patellar taping in the treatment of patellofemoral pain. A prospective randomized study. *Am J Sports Med*, 1996, 24: 61–66. [[Medline](#)] [[CrossRef](#)]
- 13) Leanderson J, Ekstam S, Salomonsson C: Taping of the ankle—the effect on postural sway during perturbation, before and after a training session. *Knee Surg Sports Traumatol Arthrosc*, 1996, 4: 53–56. [[Medline](#)] [[CrossRef](#)]
- 14) Simoneau GG, Degner RM, Kramper CA, et al.: Changes in ankle joint proprioception resulting from strips of athletic tape applied over the skin. *J Athl Train*, 1997, 32: 141–147. [[Medline](#)]
- 15) Danaka N: *Spiral balance taping therapy*. Gangju: Pyungwha ME CO, 1997, pp 14–25.
- 16) Ibrahim AI, Muaidi QI, Abdelsalam MS, et al.: Association of postural balance and isometric muscle strength in early- and middle-school-age boys. *J Manipulative Physiol Ther*, 2013, 36: 633–643. [[Medline](#)] [[CrossRef](#)]
- 17) Licht S: *Therapeutic Exercise*. Elizabeth Licht Publisher, 1965, pp 486–506.
- 18) Schenkman M: Interrelationships of neurological and mechanical factors in balance control. In: Duncan P, ed., *Balance: proceedings of the APTA Forum*. Alexandria: APTA, 1990 pp 29–41.
- 19) Njikiktjen C, de Rijke W: The recording of Romberg' test and its application in neurology. *Agressologie*, 1972, 13: C, 1–7. [[Medline](#)]
- 20) Shelton GL: Conservative management of patellofemoral dysfunction. *Prim Care*, 1992, 19: 331–350. [[Medline](#)]
- 21) Lutz GE, Barnes R, Wickiewicz TL: Prophylac is athletic taping In: Renström PAFH, ed. *Sports Injuries: Basic principles of prevention and care*. Blackwell Scientific Pub, 1993, pp 388–397.
- 22) Delahunt E, McGrath A, Doran N, et al.: Effect of taping on actual and perceived dynamic postural stability in persons with chronic ankle instability. *Arch Phys Med Rehabil*, 2010, 91: 1383–1389. [[Medline](#)] [[CrossRef](#)]
- 23) Fitzpatrick R, McCloskey DI: Proprioceptive, visual and vestibular thresholds for the perception of sway during standing in humans. *J Physiol*, 1994, 478: 173–186. [[Medline](#)]
- 24) Burl MM, Williams JG, Nayak US: Effects of cervical collars on standing balance. *Arch Phys Med Rehabil*, 1992, 73: 1181–1185. [[Medline](#)]
- 25) Yoo WG: Effect of the Neck Retraction taping on forward head posture and the upper trapezius muscle during computer work. *J Phys Ther Sci*, 2013, 25: 581–582. [[Medline](#)] [[CrossRef](#)]