



Original Article

Effects of spiral taping on proprioception in subjects with unilateral functional ankle instability

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Abstract. [Purpose] The Purpose of this study was to investigate the effects of spiral taping on proprioception in functional ankle instability. [Subjects and Methods] Thirty-five participants in this study had discomfort in only one ankle and Cumberland ankle instability score of ≤ 23 . ST was applied to the unstable ankle, and proprioception was measured baseline and 30 min later. Proprioception was measured using the active joint angle reproduction test. [Results] Plantar flexions of 10° (ES, 0.303) and 20° (ES, 1.369) and inversion 20° (ES, 0.998) showed a significant improvement. [Conclusion] Spiral taping improved on proprioception. Therefore, spiral taping may be an effective method for functional ankle instability.

Key words: Functional ankle instability, Proprioception, Spiral taping

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INTRODUCTION

Functional ankle instability (FAI) indicated that symptom pain, instability and feeling of “giving way” after repeated ankle sprain¹⁾. Functional insufficiencies of ankle include impaired proprioception, impaired neuromuscular control, and impaired postural control²⁾. FAI diminished functional impairment such as proprioception³⁾. Furthermore, diminished proprioception caused postural stability deficits in FAI⁴⁾. Therefore, it is important for proprioception deficits to be emphasized during rehabilitation.

Previous studies suggest that proprioceptive exercise improve postural stability⁵⁾, and prevent recurrent ankle injury³⁾. Also, tape has been use for rehabilitation after ankle injury and ankle taping can reduce the prevention and re-injury of ankle injury⁶⁾. Type of tape is elastic tape and nonelastic tape. Elastic tape called kinesio taping was developed by Kenzo Kase. It has improved joint function by enhancing sensory mechanism⁷⁾, and improved the balance with chronic ankle instability⁸⁾. Nonelastic tape was introduced by jenny McConell and it has been reported to enhance muscle activity, restore functional movements⁹⁾. Particularly, nonelastic tape called athletic taping such as spiral taping (ST) is known to be effective for improving ankle proprioception¹⁰⁾. The ST was increased balance when applied on the ankle¹¹⁾, and decreased low back pain¹²⁾. ST are frequently used in the clinical setting¹³⁾, but efficacy for ankle injury is unclear. In the present study, author aimed to identify the change of the proprioception following application of the ST in subjects with FAI.

SUBJECTS AND METHODS

The 39 subjects were 21–30 years old and student and sport club recruited. The inclusion criteria for study participation were discomfort in only one ankle in daily activities, such as walking, jogging; Cumberland ankle instability score of ≤ 23 ¹⁴⁾, provision of written informed consent. The exclusion criteria were any surgery and fractured bones in the ankle within the

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past 6 months, previous neurological or vestibular impairment or any contraindications to the measurement procedures. This study was approved by the Institutional Review Board Ethic Committee of the Gachon University (1044396-201602-HR-011-01). This study compared baseline and post-intervention changes in a single group of subjects. ST was applied to the unstable ankle, and proprioception tests were conducted baseline and 30 min later.

Spiral tape (SPX-50H, Nichiban Inc., Japan) applied to the unstable ankle. A 3 × 4 shape was attached on the medial malleolus. The tape was attached under the medial malleolus and then above and below it. The tape's direction was diagonal toward the right at a 30–35° angle with an 8-mm interval. Next, the top of the next tape attached was divided and its direction was diagonal toward the left at a 30–35° angle with an 8-mm interval. Then, lateral malleolus and anterior talocalcaneal joint, similar to the medial malleolus (Fig. 1).

Proprioception measured using the active joint angle reproduction (AJAR) test. The interrater reliability of the AJAR test is very high (ICC range: 0.91–0.99)¹⁵. According to the previous study¹⁶, the subjects were seated on a height-adjustable table and the unstable foot was placed at a 90° angle from the hip, knee, and ankle, and then plantar flexion and inversion of 10° and 20° measured that the footplate was moved using the passive for 3 times, the subjects were requested to move the angle detected using the active.

Statistical analyses were performed using the statistical program SPSS 21.0. Changes between pre- and post-intervention values were compared using Student's paired t-test. All values are expressed as mean ± standard deviation (SD). Statistical significance was determined at $p < 0.05$.

RESULTS

Descriptive baseline characteristics, unstable ankle scores, and CAIT scores are presented in Table 1. Plantar flexions of 10° (ES, 0.303) and 20° (ES, 1.369) and inversion 20° (ES, 0.998) showed a significant improvement ($p < 0.05$), but not in the inversion 10° (Table 2).

DISCUSSION

In the present study showed AJPS at plantar flexions of 10°, 20° and inversion 20° significantly improved after ST application. FAI significantly decreases the accuracy of the active position sense in a position close to the maximum inversion³. When a non-elastic tape is applied at the front of the ankle, cutaneous sensory feedback as well as midrange plantar flexion may increase¹⁰. In this finding are consistent with those of other studies showing that ST increases cutaneous sensory feedback while also increasing the accuracy of the active position sense.

Joint ROM can be restricted by providing external support by applying the ST such as non-elastic tape¹⁷. Proper ankle taping is generally understood to reduce plantarflexion and inversion of the ankle⁶. Interestingly, by restricting movement, it



Fig. 1. Spiral taping method

A: lateral aspect, B: anterior talocalcaneal joint, C: medial aspect

Table 1. General characteristics of the subjects

Gender (male/female)	35 (14/21)
Age (years)	21.3 ± 1.4
Height (cm)	166.4 ± 7.6
Weight (kg)	60.2 ± 9.5
Affected side (left/right)	14/21
CAIT score	19.5 ± 3.1

CAIT: Cumberland ankle instability tool

Table 2. Active joint position sense pre- and post- intervention

	Pre-intervention	Post- intervention	Change (95% CI)	ES
Plantar flexion 10°	6.73 ± 1.25	7.09 ± 1.12*	0.36 ± 0.58 (0.19–0.54)	0.303
Plantar flexion 20°	16.58 ± 2.25	19.09 ± 1.27*	2.51 ± 2.19 (1.76–3.27)	1.369
Inversion 10°	7.45 ± 2.13	8.05 ± 2.05	0.56 ± 1.63 (0.99–2.12)	0.287
Inversion 20°	16.25 ± 2.11	18.14 ± 1.63*	1.89 ± 1.13 (1.43–2.35)	0.998

*Compared with pre-intervention ($p < 0.01$), CI: confidence interval, ES: effect size

is possible that the accuracy of joint position sense may be increased. ST could be thought of being able to be used to manage proprioception in FAI based the large ESs in plantar flexion 20° and inversion 20°. Therefore, the author suggested that ST is an effective method for FAI.

There are limitations to this study that experiment was conducted with single group pre-test post-test design. Therefore further study should be conducted to compare with the other taping methods. Also, proprioception feedback from the ankle is an important factor in maintaining and controlling balance for postural stability. The author recommends that the mechanism of ST-related proprioception increase be identified and will investigate the relationship between the changes in proprioception and postural stability after ST application in FAI in a future study.

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