Comparison of Kinesiology Taping Techniques to Promote Ankle Stability in Male Football Athletes with Chronic ankle instability

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Abstract

The key to success in football games are from fully performing athletes and the injuries during the match are undeniably the most problematic to the sport performance, especially ankle instability from the recurrent ankle sprain. *Objectives:* The aims of this study are to compare the two techniques of kinesiology taping to promote ankle stability in a male football player with chronic ankle instability. *Methodology:* forty participants selected from professional football players with chronic ankle instability were treated by three different KT techniques; Kenzo Kase's technique, new technique and placebo technique. They were randomly treated by 1 technique per day. The measurement of modified star excursion balance test (mSEBT) in the anterior, posterolateral and posteromedial directions was tested before and after every taping application. Normalized reach distances of mSEBT was used to determine the ankle stability. *Results and Discussion:* Normalized reach distances in new technique showed a statistically significant increased ($p < 0.05$) in Posterolateral and Posteromedial directions. Two other techniques were found to improve normalized reach distance but not found a significant difference ($p > 0.05$). *Conclusion:* The new technique had a tendency to promote ankle stability more than the other techniques.

Keywords*: *Kinesiology tape, Chronic ankle instability, Recurrent ankle sprain, Ankle stability, Dynamic balance, Athletes

1. Introduction

Nowadays football is one of the most popular sports in Thailand and worldwide. Resulting in high competition to be successful athletes and we cannot deny that the injuries during the sports game; such as contusion, muscle strain, joint sprain and other accident occurs often (Wong & Hong, 2005). The most common type of injury in football games is lateral ankle sprain which is the key control structure in playing football (Akkaya, Serinken, Akkaya, Turkcuer, & Uyanik, 2011; Trojian & McKeag, 2006). After the injury, > 40% of the athletes continue to feel ankle instability or sway without limitation of structure in the ankle (Sekir, Yildiz, Hazneci, Ors, & Aydin, 2007) and eventually lead to a reoccurrence of ankle sprain via the loss of joint position sense (Andersen, Floerenes, Arnason, & Bahr, 2004; Trojian & McKeag, 2006). In the event of repeated injuries, it will affect daily living activities, sports practice and sports performance in the area of speed, agility, coordination and balance. If ignored, it would lead to more problem that affects to long-term impair of joint stability called chronic ankle instability (CAI) (Akkaya et al., 2011; Hertel, 2002).

Chronic ankle instability approach in many methods emphasizes in improving stability by using braces, orthosis device and traditional balance training (Lee, Lim, Jung, Kim, & Park, 2013). Ankle taping using rigid adhesive tape was used to protect the unstable ankle or at risk of injury (Reid, 1992) through mechanical restriction of ankle movement (Bunch, Bednarski, Holland, & Macinanti, 1985; Fumich, Ellison, Guerin, & Grace, 1981). However, the ankle joint limitations caused by ankle taping using adhesive rigid tape leads to impaired postural control (Bennell & Goldie, 1994). Kinesiology taping was the innovation of taping that was used in clinical and on-field. It was developed by Dr.Kenzo Kase in 1998 and was popular in the Olympics in 2008. Where most athletes were applied with the kinesiology tape during the game match, causing the whole world to more interested in the effect of this tape (Beutel & Cardone, 2014). Woodward, Unnithan, and Hopkins (2015) presented that the kinesiology tape had effects on increased blood circulation, decreased pain, prevent injury and reduced rehabilitation time. Farquharson and Greig (2015) supported the result and explained the effects of increased flexibility and range of motion. Moreover, in the study of Reneker, Latham, McGlawn, and Reneker (2018) was mention to the effect of kinesiology tape for improved strength, joint stability and especially in sports performance (Farquharson & Greig, 2015; Reneker, Latham, McGlawn, & Reneker, 2018; Woodward, Unnithan, & Hopkins, 2015). The mechanism of kinesiology tape to improve the joint stability was demonstrated by Murray and Husk (2001), Chang, Chou, Lin, Lin, & Wang (2010) and Kumbrink (2012) the tape stimulated the proprioception and joint position sense via the cutaneous

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mechanoreceptor under the area that the tape was applied. In the same way, the force while taping to the joint prevents the over movement of the joint and gives the athlete more confidence while playing. According to this mechanism, the application of kinesiology tape at the ankle may improve stability. Oftentimes, kinesiology taping uses elastic tape to stabilize and support the ankle muscles and joints without limiting the range of motion (Ohman, 2013).

In previous studies, Lee and Lee (2015) applied the kinesiology tape in ankle instability athletes to find the immediate effect of taping compared to non-taping and placebo taping. The result shows the improvement of dynamic stability in the taping group. In another study of the long-term effects, they applied kinesiology tape in CAI athletes for 48 hours and the result also shows significant improvement in ankle stability (Jackson, Simon, & Docherty, 2016). And the effect of taping was direct change to the time that taping was attached (Simon, Garcia, & Docherty, 2014). However, some studies reported that the ankle taping method according to the Kinesio perfect taping manual (Kase, Hashimoto, & Okane, 1998) did not show the improvement of ankle stability in a healthy athlete (Halseth, McChesney, DeBeliso, Vaughn, & Lien, 2004; Nunes, de Noronha, Cunha, Ruschel, & Borges, 2013), individual with CAI group (de-la-Torre-Domingo, Alguacil-Diego, Molina-Rueda, Lopez-Roman, & Fernandez-Carnero, 2015). Moreover, some study shows kinesiology taping does not affect the ankle stability in both immediate and long-term effect (Wilson, Douris, Fukuroku, Kuzniewski, Dias, & Figueiredo, 2016). This argument indicates that the kinesiology taping technique for ankle stability did not significantly improve the ankle stability. Conversely, kinesiology taping shows benefit during sports performance in clinical usage after an ankle injury. Therefore, a more effective ankle taping method using kinesiology tape is needed. Anyhow after we analyzed the weakness of the ankle taping for stability technique, we found that the main point is the force applied by the tape did not match with the recommended force for improving stability and the taping area did not hold all possible laxity joints. The specific ankle taping method requires greater ankle joint stability by controlling all directions of ankle joint movements especially in inversion, the easier direction of injury, as well as adjustment of the posterior gliding of the talus without ankle joint limitations.

2. Objectives

The objective of this study is to compare the effect of kinesiology taping technique to promoting the ankle stability in football athletes with chronic ankle instability.

3. Materials and Methods

3.1 Participants

The crossover experimental design was used in this study. All participants were allocated to applied 3 methods of kinesiology taping techniques by randomized technique sequence in 3 days continuously. G-power program (version 3.1) was used for the sample size calculation, effect size of 0.64 (Lee & Lee, 2015), significance level (α) of 0.05, desired power ($1-\beta$) of 0.90 and 10% dropout rate was applied. A sample size of 40 was calculated. The 40 athletes signed a consent form from the university's institutional review board before participating. The inclusion criteria were as follows: (1) male athlete, (2) age range 18-28 years old, (3) full time practicing and competition athlete, (4) history of ankle injury within 5 years and (5) score $\leq$ 27 of 30 in Cumberland Ankle Stability Tool (CAIT) questionnaire, sensitivity and specificity 0.56 and 0.86 consequently (Hiller, Refshauge, Bundy, Herbert, & Kilbreath, 2006). The exclusion criteria were as follows: (1) history of ankle surgery within 1 year, (2) history of lower limb injury within 1 week, (3) problem of postural stability from vestibular impairment and (4) skin allergy from kinesiology tape. The recruitment was done by the professional football club in the Bangkok metropolitan region. The study was approved by the local ethics committee of Rangsit University.

3.2 Kinesiology taping techniques

The taping technique in this study consists of 3 techniques, New ankle Balance Technique (NBT), Kenzo Kase's Technique (KKT) and placebo technique. First, subjects were comfortably seated with the neutral position of the ankle. Then a physical therapist has applied the kinesiology tape (STRONG TAPE, PROTIQ ENTERPRISE CO., LTD, BANGKOK, THAILAND). The NBT was performed as described: 1) begins the anchor from medial malleolus at 0% stretched then stretched 50% passed below the calcaneus end at 5 cm above lateral malleolus with 0% stretched (Figure 1A). 2) begins the anchor at the half of the medial

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side of foot with 0% stretched then stretched 50% passed the lateral side of calcaneus over the subtalar joint and turned around the calcaneus to pass the starting point and end at the top of midfoot (Figure 1B). 3) opposite from the second process, begins the anchor at the half of lateral side of foot with 0% stretched for the anchor, then stretched 50% passed the medial side of calcaneus over the subtalar joint turned around the calcaneus and pass the starting point and end at the top of midfoot (Figure 1C).

Figure 1 New ankle Balance Technique (NBT) taping

Second, subjects were seated with slightly ankle plantar flexion. The KKT was performed as described: 1) begins the anchor at anterior midfoot with 0% stretched then stretched 20% along with tibia bone to tibia tuberosity (Figure 2A). 2) begins the anchor from medial malleolus at 0% stretched then stretched 20% passed below the calcaneus end beside the first tape (Figure 2B). 3) begins the anchor from medial malleolus at 0% stretched then stretched 20% across the anterior side of the ankle joint end at lateral malleolus (Figure 2C). 4) begins the anchor from medial malleolus at 0% stretched then stretched 20% passed the arch of foot and end at the top of the foot (Figure 2D).

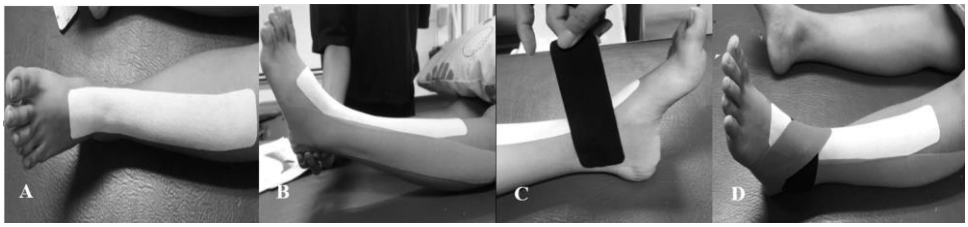

Figure 2 Kenzo Kase's Technique (KKT) taping

Third, subjects were seated with the neutral position of the ankle. The placebo technique was performed as described: 1) begins the anchor at medial half of midfoot with 0% stretched then attaches the tape to the half of shank along to the tibia without stretch (Figure 3A). 2) begins the anchor from lateral malleolus at 0% stretched and 0% stretched across the anterior side of the ankle joint end at medial malleolus (Figure 3B).

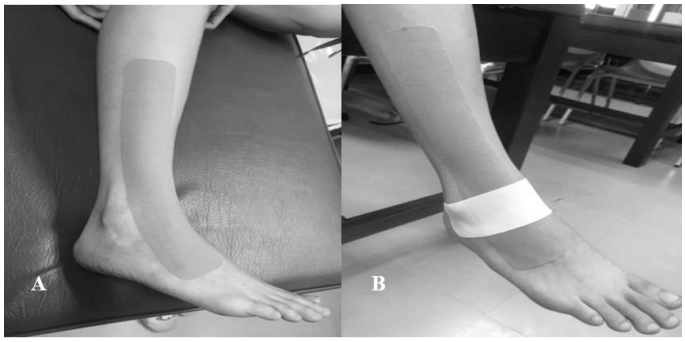

Figure 3 placebo technique taping

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3.3 Outcome measurement

In this study, we measured the reach distance value by a modified star excursion balance test (mSEBT). mSEBT was developed from the star excursion balance test (SEBT) to assess the reach distance in 8 directions, which takes a long time. But from the study of Plisky et al. (2006) concluded that only 3 directions of reach distance can represent the change of dynamic balance and the risk for injury that depended on the decreased of balance. Moreover, mSEBT is a reliable and fast field test for the dynamic balance of ankle. The instruction was to do a single-leg stand on the CAI leg at the middle of Y-balance kit platform (FMS Y-BALANCE), both hands placed on the hips then use another leg to push the box as far as possible with the big toe and return to the original two-foot standing 3 times in each direction (Figure 4), 3 directions; anterior, posteromedial and posterolateral (Gribble, Hertel, & Plisky, 2012). During reaching of the leg, flexion of knee and hip of the fixed leg was permitted to reach as far as possible, but the task will fail and be repeated if the subject: 1) could not stand on one leg, 2) fixed leg was moved from the marked point, 3) could not hold both hands on the hips, 4) could not return to the two-foot standing position, 5) obvious swaying during the test, 6) the big toe of reached leg touches the ground before returning to the center or 7) the reached leg shows the pushing force onto the box. After completing the motions, each direction was measured by the distance that shows on the bars of the research equipment. Normalized reach distance by the percentage of leg length was calculated by the greatest distance of each direction divided by the leg length of each individual subject then multiplying by 100 (Plisky, Rauh, Kaminski, & Underwood, 2006; van Lieshout et al., 2016). The measurement was assessed two times. First, before the taping application (no tape). Second, 30 minutes after the taping application. During waiting time, subject was not allowed to run or practice any football skill. After the assessment, all taping application was removed immediately.

3.4 Data analysis

For the data analysis, IBM SPSS statistics were used in this study. The normality of the data was tested by the Shapiro-Wilk test. The One-Way AVOVA was used to compare the differences of reached distances in each of three directions under three conditions and the Bonferroni post hoc test was used to analyze the differences among those conditions. Define p-value < 0.05 as statistical significance difference.

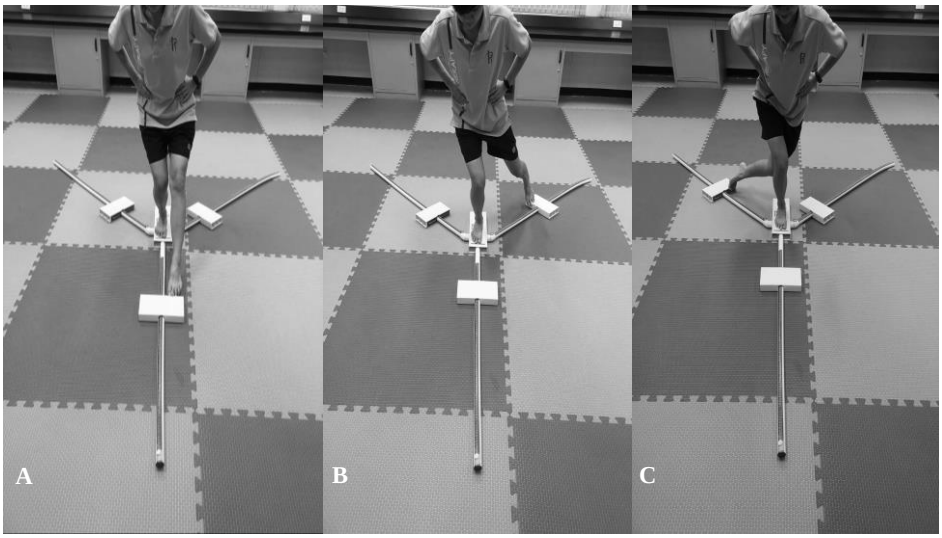

Figure 4 performance in the (A) anterior, (B) posterolateral and (C) posteromedial of the modified star excursion balance test

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4. Results and Discussion

During this study, participants did not report any adverse side effects, and all subjects fully completed the study. The characteristic of the 40 subjects is shown in Table 1.

Table 1 Demographic and clinical characteristics

Variables	Mean ± SD (n = 40)
Ages (years)	20.28 ± 2.45
BMI (kg/m^2)	22.20 ± 1.73
Football experience (years)	9.53 ± 3.51
History of ankle sprain (times)	2.90 ± 1.61
Cumberland Ankle Instability Tool (CAIT) (point)	17.15 ± 3.53

The change of the normalized reach distance was significantly different in the ANOVA test in posterolateral and posteromedial between three conditions (Table 2). According to the results from the post hoc test, there was significantly increased in NBT group (*p*-value < 0.05) compared with the pretest, *p*-value = 0.036 and 0.014 subsequently. But no significant difference in the anterior direction of NBT group and all directions of KKT group and placebo group (Figure 6).

Table 2 Comparison of normalized reach distances in anterior, posterolateral, and posteromedial among the three conditions

Directions	Mean ± SD (cm)				p-value
	Pretest	NBT	KKT	Placebo	
Anterior	59.28 ± 5.33	60.24 ± 5.15	59.57 ± 5.87	59.44 ± 5.67	0.874
Posterolateral	97.62 ± 7.73	103.14 ± 8.61	100.97 ± 9.33	99.16 ± 9.57	0.037*
Posteromedial	96.93 ± 9.62	103.53 ± 8.60	100.77 ± 9.38	99.55 ± 10.38	0.022*

NBT, New ankle Balance Technique KKT, Kenzo Kase's Technique
**significant difference p-value < 0.05*

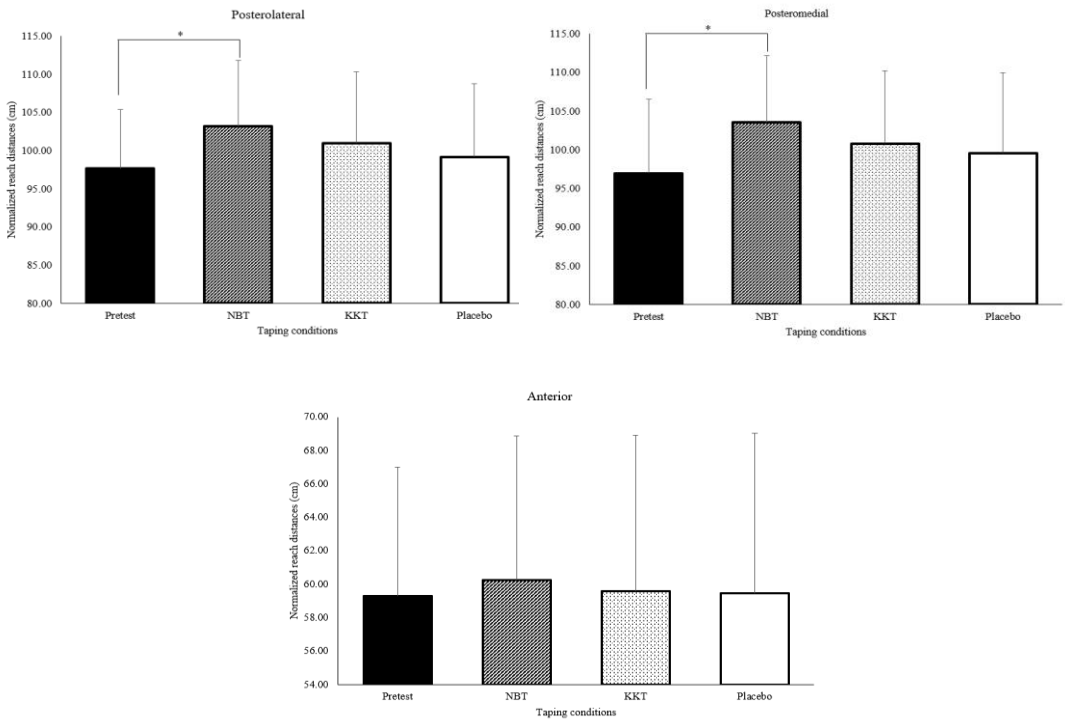

Figure 6 Comparison of the normalized reach distances among three conditions (**p*-value <0.05)

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However, the KKT group shows improvement trend of normalized reach distances but insufficient to be categorized as a significant difference (*p*-value > 0.05).

In this study only NBT shown a significant increase in normalized reach distances at a posterolateral and posteromedial direction. Especially in a posteromedial direction because this direction is more accurate and quickly sensed the changed of dynamic ankle stability in the CAI group (Hertel, Braham, Hale, & Olmsted-Kramer, 2006).

The reason for the significant increase in NBT consists of the taping direction, the characteristic of kinesiology tape and applied force. First for the tape direction, the first tape was used for reducing the ankle inversion and supported the talocrural joint that corrected the movement of ankle in dorsiflexion and plantar flexion. The second tape supported the subtalar joint and controlled ankle inversion. And the third tape supported the subtalar joint and controlled the ankle eversion because ankle sprains can occur in both lateral ankle sprain and medial ankle sprain (Puffer, 2001), which was the main cause of decreased of ankle stability by pain and tear of stability ligament of the joint. In addition, NBT covered both the talocrural joint and the subtalar joint which was the risk of joint laxity (Hertel, 2002). Second for the characteristic of kinesiology tape, the sine wave pattern under kinesiology tape had a function to recoil to the origin after stretched. The sine wave cause to pulling back force in parallel with the tape, which combined with the horizontal force and resolution force. From this mechanism, it made the athlete able to move freely with supporting force and did not get injured by the effect of taping (Kumbrink, 2012). And last for the applied force, the NBT applied force in 50% stretched in all tape because the force at 50-75% stretched was the recommended force that can be supported by the joint function at the 3 majors; muscle, ligament and capsule (Blackburn, Guskiewicz, Petschauer, & Prentice, 2000). The kinesiology tape stimulated the 3 majors of joint stability through the mechanoreceptor in the skin, muscle and joint capsule (Kumbrink, 2012). This approach was directed to adjust the impairment of the CAI group, which was the loss of proprioceptive sense and decreased feedback by the injury of functional structure and joint sense receptors (Hubbard & Kaminski, 2002; H. J. Lee et al., 2013).

Proprioceptive sense is the sense to detect the joint position after movement and helps with returning to normal positions. Which receives the information from the changed muscle length, skin tension and joint position then sends the signal to the brain (feedback) and accepts the top-down order to react to the situation with the most stable and safe choice (Sudsuang, 1996). Then, the stimulated proprioceptive sense and with improved feedback is the key to increased ankle stability in the CAI group (Kumbrink, 2012; Simon et al., 2014).

Supported by the previous study, kinesiology taping has been shown to improve proprioceptive sense (Chang, Chou, Lin, Lin, & Wang, 2010; Murray, 2001) due to the stimulated of cutaneous mechanoreceptor to activate the proprioceptive sense (Grigg, 1994; Ohman, 2013) to assist and maintain the stability of ankle joint during the movement of the center of mass and resulted in an increased distance reached by the opposite leg. Moreover, Lee & Lee (2015) obviously supported the adjustment of the posterior gliding of talus for dorsiflexion and the fine inversion and eversion movement of the calcaneus was the main cause to prevent ankle injury, that same mechanism as a technique in this study. However, the KKT shows improvement trend of normalized reach distance because of 20% stretched tape can stimulate the cutaneous mechanoreceptor of the skin and muscle around the joint (Kumbrink, 2012) to feedback for the adapted muscle tension around the joint (Lee & Lee, 2015; Simon et al., 2014) but not enough for the joint control, that why the subject can reach farther but did not have a significant change. As for the little increase of the placebo group was described as a psychological effect to have more confidence in movement after applying the tape (de-la-Torre-Domingo et al., 2015).

This study had several limitations. First, the mSEBT was the assessment for the stability of ankle joint in the main joint but if an athlete had a problem of core stability muscle, it can affect the ability to maintain balance during movement center of mass (dynamic balance). Second, somehow the effort to reach farther from the past was shown, some subjects sway at the trunk but did not fail for the test criteria, then the correlation of reach distance and the postural sway during the test must be investigated. Third, the long-term effect of NBT was not evaluated in this study.

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5. Conclusion

In conclusion, kinesiology taping by NBT improved the dynamic balance in professional football players with CAI.

6. Acknowledgments

This study was funded by Rangsit University. The authors would like to express our sincere appreciation to all participants who excellently participated in this study and to the Faculty of Physical therapy and Sport medicine for supporting in the data collection

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