



Original Article

Neuromuscular control of the lower extremities can be better enhanced by applying ankle taping and kinesiological taping rather than elastic bandaging: a randomized control study in amateur soccer players

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Abstract. [Purpose] This study evaluated the effects of ankle elastic bandaging, taping, and kinesiology taping on the neuromuscular control of the lower extremities before and after their application and after exercise in soccer athletes. [Participants and Methods] Fifty-five amateur soccer players were randomly divided into four research sub-groups either receiving bandaging (n=15), taping (n=15), and kinesiology taping (n=15) on their ankle or serving as controls (n=10). The dynamic stability of the non-dominant limb was assessed through the star excursion balance test (SEBT) in three research conditions: a) before sports taping application, b) after the application, and c) after a 15 min laboratory simulation of soccer activities. [Results] Taping and kinesiology taping improved the dynamic stabilization of the lower limb more statistically significantly than bandaging. The addition of exercise significantly improved the SEBT results in the taping and kinesiology taping more than the bandaging and control groups. [Conclusion] Exercise activates the proprioceptive mechanisms of the lower limb and improves its neuromuscular control. This functional improvement of the lower limb appears to be enhanced after ankle taping and kinesiology taping compared with elastic bandaging and controls.

Key words: Ankle, Taping, Star excursion balance test (SEBT)

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INTRODUCTION

The large number of people involved in sports activities has led to a corresponding increase in research interest in sports. In addition, this increase in popular participation in sports has led to a corresponding increase in sports injuries. Especially in soccer, which is an activity with many participants and direct contact between athletes, a high epidemiological incidence of sports injuries has been recorded. The main injuries involve the lower extremities, mainly ligaments, muscle strains, and tendinopathies^{1, 2)}.

The etiology of sports injuries is based on a set of factors that relate either to the athlete's characteristics or the environment in which he plays, and the external stimuli present in it. The leading causes of sports injuries are increased age and

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previous injuries^{3, 4}). However, the results of other studies have shown that poor physical conditions, incomplete recovery, and joint instability are also important causes of injuries^{5, 6}).

Different taping techniques have been used to stabilize the lower extremities' joints and, thereby, prevent possible injuries. These techniques include different taping materials ranging from elastic non-adhesive taping (Bandaging), non-elastic adhesive taping (tapping) and elastic adhesive taping (kinesiology taping). Non-elastic applications are used for joint range of motion control and joint neuromuscular reinforcement. Elastic bandages enhance neuromuscular control of joints without aiming to limit movement. The classic method of taping using an elastic bandage (bandaging) seems to have little effect on the proprioception of the ankle joint⁷); however, it is used as the first choice of joint protection⁸). On the other hand, taping with hard inelastic material seems to increase the stabilization of the ankle joint in healthy and injured people^{9, 10}). However, other sources¹¹) have also reported that taping negatively affects static control or has no observable effect on balance¹²). The application of kinesiology taping has been reported to have no negative effect on functional tests but only a positive effect on some of them¹³). It is also claimed that kinesiology taping does not affect proprioception¹⁴).

The above studies show that findings differ regarding the contribution of different taping techniques to improving neuromuscular control of the lower extremities. In this context, the present study aims to evaluate the effects of ankle bandaging, taping, and kinesiology taping on the neuromuscular stability of the lower limb under different conditions (before and after exercise) in amateur soccer athletes.

PARTICIPANTS AND METHODS

The sample consisted of 55 amateur soccer players (22.4 ± 3.2 years of age, weight 73.2 ± 2.6 kg, height 177.3 ± 4.8 cm) voluntarily recruited from six amateur teams. The soccer players had approximately the same training regime (1–2 training sessions per week), no injury at least five (5) months before the evaluation, and at least three (3) years of playing at the amateur level. All athletes were informed about the research objectives and signed a written consent to participate voluntarily in the measurements. The ethical committee of the Department of Physical Therapy, Technological Educational Institute of Patras (23/4-10-2013) approved the study.

Soccer players were randomly divided into four research groups receiving a) ankle elastic bandaging (bandaging group, $n=15$), ankle taping (taping group, $n=15$), ankle kinesiology taping (kinesiology taping, $n=15$), or served as controls (controls, $n=10$). The evaluation of the dynamic stabilization of the non-dominant lower extremities was performed with the star excursion balance test (SEBT) in three different conditions: a) before the application of the three different types of taping, b) after the application of the three different types of taping, and c) after the implementation of a 14 min specific program of exercise that simulates soccer activities.

The exercise protocol included aerobic running on a treadmill and anaerobic exercises (sprints and jumps) that simulated soccer activities. Specifically, each athlete performed three four-minute sets of aerobic running on a treadmill. The aerobic exercise intensity was set at 80% of the maximum heart rate calculated by the formula $220 - \text{age}$ of the athlete. Two one-minute sets of anaerobic exercises were inserted, with sprints in different directions and jumps between sets of aerobic running. Sprints were performed with abrupt changes of direction on a specific route of 20 meters designed on the floor of the laboratory. The athletes also performed 30 jumps in front, back, and sideways on a pre-planned route.

The three taping techniques were applied according to the manufacturers' instructions set out by the specialized staff of the Therapeutic Exercise and Sports Laboratory of the University of Patras, who are experienced in taping techniques. SEBT evaluations were also carried out in the same laboratory by other researchers who were blind in terms of the purposes of the research.

RESULTS

Detailed data on the performance of athletes in SEBT in the various sub-groups by the condition are presented in [Table 1](#).

The analysis of the results of the comparisons within the groups showed a linear increase in performance in SEBT after applying all three types of taping and exercise. SEBT performance in the controls also showed a linear increase from condition 1 (before application) to condition 3 (after exercise).

In most measurements, the application of taping and kinesiology taping on the ankle joint improved the dynamic stabilization of the lower limb better than bandaging. However, bandaging and exercise showed better results in the lower limbs' dynamic stabilization than in the control group.

Taping ($p=0.064$) and kinesiology taping ($p=0.052$) improved the dynamic stabilization of the ankle at the non-dominant extremity to the degree that approached statistical significance compared with elastic bandaging. A similar trend, with a statistically significant variation, appeared in the evaluation of improvement with addition and exercise. In this condition, taping ($p=0.00$) and kinesiology taping ($p=0.007$) significantly improved the SEBT results compared with the elastic band and those of the control group at the non-dominant end. The elastic bandage did not lead to particularly positive adjustments in the dynamic stabilization of the ankle, and its results are compared with those of the control group in which no ligation was performed.

Table 1. Star excursion balance test (SEBT) results in research sub-groups (with bandaging, taping, kinesiology taping, and control) by condition

| Therapeutic interventions | N | Non-dominant extremity | | |
|---|--------------------|------------------------|--------------------|-------|
| | | Mean | Standard deviation | |
| Condition 1 (Before taping) | Elastic bandaging | 15 | 84.12 | 8.67 |
| | Taping | 15 | 88.57 | 7.12 |
| | Kinesiology taping | 15 | 97.05 | 5.90 |
| | Control | 10 | 86.51 | 8.08 |
| Condition 2 (After taping) | Elastic bandaging | 15 | 87.08 | 9.01 |
| | Taping | 15 | 93.30 | 8.41 |
| | Kinesiology taping | 15 | 100.62 | 6.67 |
| | Control | 0 | . | . |
| Condition 3 (After taping and exercise) | Elastic bandaging | 15 | 86.71 | 10.43 |
| | Taping | 15 | 96.36 | 7.89 |
| | Kinesiology taping | 15 | 103.57 | 6.00 |
| | Control | 10 | 89.28 | 10.15 |

DISCUSSION

The results of the SEBT test showed that all forms of ankle taping procedures improved the dynamic stabilization of the lower limbs in amateur soccer athletes, especially after exercise. The study findings also showed that the effect of the exercise was significant for the activation of proprioceptive mechanisms, especially when combined with taping and kinesiology taping. In most of the measurements performed, taping had the best results, followed by kinesiology taping, while bandaging with an elastic bandage had a negligible effect and was not significant for dynamic stability.

Based on the study results, elastic bandaging had a negligible effect on lower limb neuromuscular control, which appeared to be similar to the effect of the exercise on the control group. These findings confirm the results of Bennell and Goldie¹¹⁾, who claimed that elastic bandaging had no significant effect on the orthostatic control of healthy individuals. However, the present study's results showed that the combination of exercise with an elastic bandage seemed to have better results in the dynamic stabilization of the lower extremities than the control group.

Taping and kinesiology taping have been shown to significantly improve the dynamic stabilization of the lower extremities when compared with bandaging and controls. Based on the findings of the study, neuromuscular control of the lower extremities was shown to improve with taping, in accordance with the research findings of Robbins et al.⁹⁾, Spanos et al.¹⁵⁾, and Miralles et al.¹⁶⁾ reached the same conclusions, proposing the taping method as a means of preventing and rehabilitating ankle sprains. Larsen et al.¹⁷⁾ argued that ankle neuromuscular control increases only before exercise and then loses its protective role, which disagrees with the results of the present study, as exercise significantly helped to improve the dynamic stability of the lower extremities.

In contrast, the results of the present study on neuromuscular control adaptations do not agree with those of Refshauge et al.¹⁸⁾ and Sawkins,¹⁹⁾ as well as those of Delahunt et al.¹²⁾, who used the SEBT test but for people suffering from chronic instability. These studies showed that sports taping does not improve ankle proprioception.

The effect of kinesiology taping on improving lower extremity stability was also significant, based on the analysis of the results. These findings conflict with those of Halseth et al.¹⁴⁾ and Hettle et al.²⁰⁾, where both studies argued that kinesiology taping had no significant effect on increasing ankle proprioception. Fayson et al.²¹⁾ and Shields²²⁾, studying the effect of this therapeutic intervention on static balance, concluded that they improved static control. However, Shields²²⁾ stated that kinesiology taping does not improve ankle instability.

Based on the statistical data obtained from the measurements, taping and kinesiology taping improved neuromuscular control of the lower extremities more than bandaging. Furthermore, kinesiology taping showed better results than bandaging, and the elastic bandage showed better results in the dynamic stabilization of the ankle than the non-application of the bandage. However, Bennel and Goldie's findings¹¹⁾, which compared the effects of elastic bandage and tape, argued that the bandage did not have a significant effect, which is consistent with the present study's results but contradicts their conclusion that taping has adverse effects. Briem et al.²³⁾, studying the effects of kinesiology taping and sports taping on sudden supination of the ankle, argued that tape causes more significant muscle activity in the underlying joint muscles while kinesiology taping has no effect. This was not examined in this study. However, Bicici et al.¹³⁾ showed that ankle muscles are supported by taping, which was confirmed in the results of this study, but argued that kinesiology taping had no effect, disagreeing with the findings of the present study.

Final results regarding the effects of these three types of sports taping on the lower extremities' neuromuscular control cannot be deduced from this research under the weight of its limitations. The most important limitation of the present study was that it evaluated the effects of sports taping applications on amateur soccer players. This participant selection limits the application of these findings to amateur athletes. In addition, the fact that the participants in this study were young athletes makes it challenging to apply these conclusions to older athletes whose neuromuscular control will have been significantly affected by the passage of time. An additional methodological limitation of the study is that the assessment was based on a functional examination test (SEBT) and not a laboratory assessment. Despite its limitations, the clinical value of the findings of this research is significant. In particular, it shows some evidence that both taping and kinesiology taping can improve neuromuscular control of the lower extremities, especially when combined with exercise, and can thus be used for injury prevention strategies.

In conclusion, the present study's results show that the application of all three forms of binding improved lower extremity dynamic stabilization. The application of sports taping helps to improve the dynamic stability of the ankle to a greater extent than the other forms of bandaging, followed by kinesiology taping and elastic bandaging but without significant results.

Funding and Conflicts of interest

The authors declare no conflicts of interest.

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