Portuguese Journal of Sport Sciences
11 (Suppl. 2), 2011

INFLUENCE OF ANKLE TAPING ON DYNAMIC BALANCE PERFORMANCE

Ian C. Kenny, Can Wu and Johnson McEvoy

Biomechanics Research Unit, University of Limerick, Ireland

This research aimed to investigate the effect of ankle taping on dynamic balance performance. Eighteen recreational athletes without any previous ankle sprain history performed six star excursion balance tests on each leg; randomly three trials with taped ankles and three trials without. A three-layer modified closed-basket inelastic taping technique was used. Normalised (by leg length) reaching distance was measured. It was found 1. Movement direction significantly influenced normalised reaching distance (p<0.01); 2.No significant difference in performance between taped and un-taped conditions (p>0.05). Ankle taping did not affect dynamic balance performance therefore taping could be used without risk of negative impact on balance, and protect from ankle sprain for sportspersons.

KEY WORDS: limb dominance, sprain, star excursion balance test.

INTRODUCTION: Ankle ligament sprain is among the highest rate of sports injuries (Dick *et al.,* 2007) and is a major cause of athletes' disability and time off sport. External support to the ankle joint by taping is considered to be at least a partial aid (Dick *et al.*, 2007) and one of the most widely used ankle sprain preventative methods. Although the mechanics of effectiveness of ankle taping is uncertain, sports people use taping not only to support an injured joint but also as a means to improve posture and balance (Ozer *et al.*, 2009). Indeed, Kenny & Jeyram (2009) reported modest but non-significant increases in jumping performance with ankle taping applied. Taping is not only used for those with previous ankle sprain but also recommended to athletes by some trainers for athletes without previous ankle sprain as a way of preventing sports injury (Rarick *et al.*, 1962). The information available from current literature indicates that ankle taping restricts ankle range of motion (ROM) and controls postural sway related to ankle instability (Rose *et al.*, 2002), which help to improve balance ability. However, this does not necessarily imply that taping has a superior preventive effect in real sports situations, because measurement of ankle ROM cannnot completely reflect ankle function in a weight-bearing situation (Arnold *et al.*, 2009), and postural sway only represents static balance (Abian-Vicen *et al.*, 2008) which fails to estimate ankle function in a dynamic situation. The potential benefits of ankle taping for prevention of ankle injury must be weighed against the possible detrimental effect on actual performance of the athlete. To replicate a competitive situation, jumping tests and static balance tests are commonly employed to assess the effect of ankle taping on performance. However, dynamic balance tasks, which cause the centre of gravity to move in response to muscular activity (Kinzey & Armstrong, 1998), are seldom applied. The aim of the current research was to ascertain whether ankle taping would influence dynamic balance control in healthy individuals without previous ankle sprain.

METHODS: Eighteen participants, ten male and eight female were recruited following institutional research board's ethical consideration. Table 1 shows the subject characteristics.

Table 1
Subject characteristics

Gender	Number	Age ± s.d. (yrs)	Height ± s.d. (m)	Body Mass ± s.d. (kg)	BMI ± s.d. (kg/m^2)
Female	8	24 ± 1.8	1.68 ± 0.06	60.25 ± 6.78	21.28 ± 1.50
Male	10	22 ± 2.1	1.80 ± 0.07	76.64 ± 9.58	23.58 ± 3.02
Total	18	24.3 ± 1.8	1.75 ± 0.10	69.36 ± 11.74	22.56 ± 2.67

The dominant leg of each individual was determined by the results of three tests (Hardy *et al.*, 2008): kicking a ball, stepping on a bench, and restoring balance from a posterior push. A three-layer modified closed-basket inelastic taping technique was used on both ankles as shown in Figure one (Abian-Vicen *et al.,* 2008). Taping was applied by a trained therapist and technique was checked every third subject by a chartered physiotherapist.

Figure 1: Three-stage modified closed-basket ankle taping technique.

A modified Star Excursion Balance Test (SEBT) was utilised. While SEBT requires maximum reach in all 8 directions, measuring three of the directions, which incorporated anterior, posteriolateral and posteriomedial (Figure 2) helps to increase repeatability in measuring components of the SEBT and to cut off the unnecessary redundancy (Plisky *et al.*, 2009).

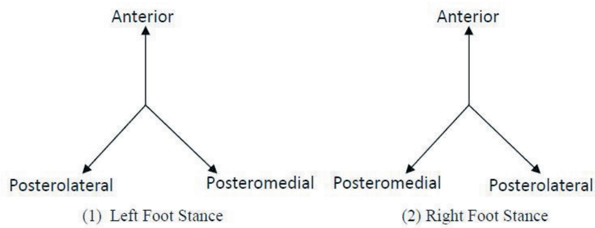

Figure 2: Reaching directions for the modified SEBT.

Figure 3: Right foot posteriolateral reach without left ankle taping.

Figure 3 shows pilot testing performed for the modified SEBT, without left foot ankle taping. The reach was discarded and repeated if the subject subjectively reported any of the following (1) participant placed supporting body weight on the reach leg to stop the body from falling in the direction rather than a light touch, (2) reach leg came to rest on the ground, (3) the foot of the stance leg moved away from the centre of the grid, (4) the reach leg could not be returned to the centre of the grid under control (Hardy *et al.*, 2008). A maximum of two mis-trials during data collection were permitted. Reaching distances were normalised by leg length, measured from the greater trochanter to the ground (Gribble & Hertel, 2003). Differences between taped and un-taped conditions were assessed with a repeated measures ANOVA in SPSS. An Intervention (two levels: stance foot with and without ankle taping) × Direction (Anterior, Posteriomedial, Posteriolateral) × Reaching leg (dominant leg, non-dominant leg) repeated measurement was used. A Mauchly's Test for sphericity was performed and significance level was 0.05 for all analyses. Protocols: All subjects wore t-shirt, shorts and were barefoot. Subject anthropometric characteristics were collected and subjects were then permitted 5 minutes light jogging as a warm-up. Subjects were randomly assigned into two groups: group A performed the SEBT un-taped then taped, group B vice versa. Each subject performed 18 acceptable trials for the taped condition and 18 acceptable trials for the un-taped condition (3 trials for each of the three directions for dominant leg and non-dominant leg).

RESULTS AND DISCUSSION: The possibility that using the dominant side as a stance leg might score better was taken into consideration, because it is commonly stronger and for some populations also have better mechanism in neuromuscular coordination. However, results showed (Table 2) that the side used for reaching did not contribute to variance in reaching distance. This is similar to conclusions by Gribble *et al.* (2009), confirming that leg dominance does not significantly affect performance in SEBT.

Table 2
Normalised SEBT reach performance (% of mean leg length L.L.)

Reaching Leg	Intervention	Direction*	Reach Performance % L.L. (Mean ± s.d.)
Non-Dominant Leg	Un-taped	Anterior	87.84 ± 6.86
		Posteriomedial	102.22 ± 8.40
		Posteriolateral	99.22 ± 9.74
	Taped	Anterior	88.77 ± 7.06
		Posteriomedial	104.01 ± 8.16
		Posteriolateral	100.62 ± 9.22
Dominant Leg	Un-taped	Anterior	86.37 ± 6.60
		Posteriomedial	99.40 ± 9.63
		Posteriolateral	94.40 ± 8.60
	Taped	Anterior	86.75 ± 6.84
		Posteriomedial	101.36 ± 9.34
		Posteriolateral	96.76 ± 9.20

**p*<0.001

In contrast, there was a significant difference (p<0.001) in performance among the three directions (Figure 4) comparing well with previous findings that movement directions are intrinsically different (Olmsted *et al.*, 2002). Hardy *et al.* (2008) also found that SEBT reach distances were greater in the posterior and medial directions and less in the anterior and lateral directions. The combination effect of intrinsic stability of the ankle joint and the property of muscles around the joint and stiffening effect of the taped lower leg might account for such significant differences of performance in different directions. Kenny & Jeyaram (2009) reported that taping did significantly (p<0.01) reduce ankle plantar flexion (5.75º) and inversion (7.25º) ROM; restriction potentially linked to post-activation potential (McCann & Flanagan, 2010). Gehlsen *et al.* (1991) pointed out that after ankle taping, the ankle normal ROM such as plantar flexion and dorsiflexion was restricted, causing a deficit in performance afterwards. However, in their research, an open-chain movement test was used to measure the effect of ankle taping, which is not the common pattern of movement in most sports. A weight-bearing closed-chain movement is more closely related to real sports movement (Arnold *et al.*, 2009).

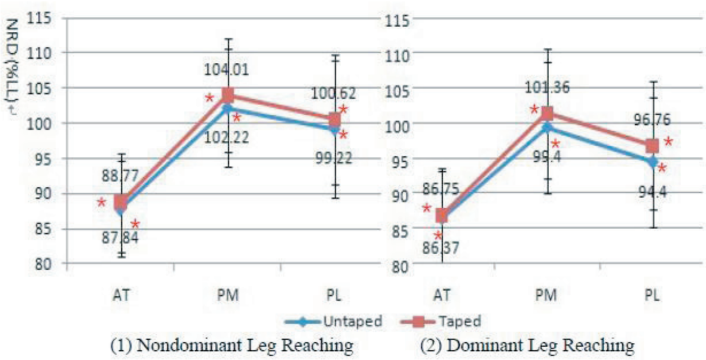

Figure 4: SEBT direction X taped and un-taped intervention interaction

Results for the current study show that taping does not impair performance in the SEBT inferring no negative influence in balance control. Figure 4 shows the trend for varied performance due to movement direction, but no significant change due to taped or un-taped conditions. Gribble *et al.* (2004) reported that in dynamic postural-control task performance variation is related to larger degrees of knee and hip flexion: altered neural activity and compensatory muscle recruitment at one joint disrupts movement patterns along the kinetic chain.

CONCLUSION: Ankle taping did not significantly affect dynamic balance performance measured by the Star Excursion Balance Test. Thus, taping of recreational athletes does not interfere or enhance balance performance, and may be used in normal populations without risk of negative impact on balance.

REFERENCES:

Abian-Vicen, J., Alegre, L. M., Fernandez-Rodriguez, J. M., Lara, A. J., Meana, M., & Aguado, X. (2008). Ankle taping does not impair performance in jump or balance tests. *Journal of Sports Science and Medicine*, 7, 350-356.

Arnold, B.L., De La Motte, S., Linens, S. & Ross, S.E. (2009). Ankle instability is associated with balance impairments : a meta-analysis. *Medicine & Science in Sports & Exercise*, 41, 1048-1062.

Dick, R., Hertel, J., Agel, J., Grossman, J. and Marshall, S. W. (2007). Descriptive epidemiology of collegiate men's basketball injuries: National Collegiate Athletic Association Injury Surveillance System 1988-1989 through 2003-2004. *Journal of Athletic Training,* 42, 194-201.

Gehlsen, G. M., Pearson, D. and Bahamonde, R. (1991). Ankle joint strength, total work, and ROM: comparison between prophylactic devices. *Athletic Training*, 1, 62-65.

Gribble, P. A. (2003). The Star Excursion Balance Test as a Measurement Tool, *Athletic Therapy Today*, 8(2), 46-47

Gribble, P. A. & Hertel, J. (2003). Considerations for Normalizing Measures of the Star Excursion Balance Test. *Measurement in Physical Education and Exercise Science*, 7, 89–100.

Gribble, P. A., Hertel, J., Denegar, C. R. & Buckley, W. E. (2004). The Effects of Fatigue and Chronic Ankle Instability on Dynamic Postural Control. *Journal of Athletic Training*, 39, 321-329.

Gribble, P. A., Robinson, R. H., Hertel, J. & Denegar, C. R. (2009). The effects of gender and fatigue on dynamic postural control. *Journal of Sport Rehabilitation*, 18, 240-257.

Hardy, L., Huxel, K., Brucker, J. & Nesser, T. (2008). Prophylactic ankle braces and star excursion balance measures in healthy volunteers. *Journal of Athletic Training*, 43, 347-351.

Kenny, I.C. & Jeyaram, S.P. (2009) Influence of ankle taping on jump performance, Presented at the 2009 International Society of Biomechanics in Sports Conference, 17th - 21st August 2009, Limerick, Ireland.

Kinzey, S. J. & Armstrong, C. W. (1998). The reliability of the star-excursion test in assessing dynamic balance. *Journal of Orthopaedic and Sports Physical Therapy*, 27, 356-360.

McCann, M.R. & Flanagan, S.P. (2010), The effects of exercise selection and rest interval on postactivation potentiation of vertical jump performance. *Journal of Strength & Conditioning Research,* 24, 1285-1291.

Olmsted, L. C., Carcia, C. R., Hertel, J. & Shultz, S. J. (2002). Efficacy of the Star Excursion Balance Tests in Detecting Reach Deficits in Subjects with Chronic Ankle Instability. *Journal of Athletic Training*, 37, 501–506.

Ozer, D., Senbursa, G., Baltaci, G. & Hayran, M. (2009). The effect on neuromuscular stability, performance, multi-joint coordination and proprioception of barefoot, taping or preventative bracing. *Foot*, 19, 205-210.

Plisky, P. J., Gorman, P. P., Butler, R. J., Kiesel, K. B., Underwood, F. B. & Elkins, B. (2009). The reliability of an instrumented device for measuring components of the Star Excursion Balance Test. *North American Journal of Sports Physical Therapy,* 4, 92-99.

Rarick, G. L., Bigley, G., Karst, R. & Malina, R. M. (1962). The measurable support of the ankle joint by conventional methods of taping. *Journal of Bone and Joint Surgery*, 44-A, 1183-1190.

Rose, J., Wolff, D. R., Jones, V. K., Bloch, D. A., Oehlert, J. W. & Gamble, J. G. (2002). Postural balance in children with cerebral palsy. *Developmental Medicine & Child Neurology*, 44, 58-63.