Acute Effects of Dynamic Tape® Application on Vertical Jump Performance: A Case Report

Efectos Agudos de la Aplicación del Dynamic Tape® sobre el Rendimiento de Salto Vertical: un Estudio de Caso

Mateo Baena Marín[1]
Alejandro Gómez Rodas[2]
Diego A. Bonilla[3]
Luis Enrique Isaza Velásquez[4]
Anthony Baculima López[5]
Hernán Mauricio García Cardona[6]

1 Fundación Universitaria del Área Andina, Universidad Tecnológica de Pereira, Pereira, Colombia
2 Fundación Universitaria del Área Andina, Universidad Tecnológica de Pereira, Pereira, Colombia, alegomez@utp.edu.co
3 Research Division, DBSS International, Bogotá, Colombia, dabonilla@gse.com
4 Centro de Innovación y Desarrollo Tecnológico, CIDT. Universidad Tecnológica de Pereira, Pereira, Colombia, kalios@utp.edu.co
5 Physical Therapy student at Fundación Universitaria del Área Andina, Pereira, Colombia. abaculima@estudiantes.areandina.edu.co
6 Universidad Tecnológica de Pereira, Pereira, Colombia. maogarcia@utp.edu.co

Abstract

Introduction: Different types of neuromuscular tapes have led to no consensus about its benefits on muscle performance. Unlike kinesiology and rigid tapes, Dynamic Tape® has different composition and properties with unknown effects on performance. The aim of this exploratory-type case study was to report the acute effects of dynamic tape® application on vertical jump performance. *Material and methods:* Using a test-retest methodology, a case study was carried out in two 21-year-old, healthy and physically active women. Flight time, jump height and muscle power were evaluated by squat jump and countermovement jump tests using a contact mat, before and after the application of dynamic tape® on quadriceps and gastrocnemius muscles. Single and double taping were also used in different combinations. *Results:* Improvements of up to 10.8% on flight time, 22.6% on jump height and 8.9% on muscle power were observed for squat jump after the application of dynamic tape®. *Conclusions:* This preliminary and exploratory case study showed that using dynamic tape® might improve vertical jump performance; however, further research is necessary in this relatively novel type of tape.

Keywords: Athletic tape, functional performance, elastic bandages, sports performance

Resumen

Introducción: Actualmente, no existe un consenso sobre los beneficios de los diferentes tipos de cintas neuromusculares sobre el rendimiento muscular. A diferencia del vendaje neuromuscular y las cintas rígidas, el Dynamic Tape® tiene una composición y propiedades diferentes con efectos desconocidos sobre el rendimiento. El objetivo de este estudio fue reportar los efectos agudos del tape dinámico® sobre el rendimiento del salto vertical. *Materiales y métodos*: Utilizando una metodología test-retest, se realizó un estudio de caso con dos mujeres de 21 años, saludables y

físicamente activas. Se evaluó el tiempo de vuelo, la altura del salto y la potencia muscular a través de salto desde sentadilla y salto con contra movimiento en plataforma de contacto, antes y después de la aplicación del tape dinámico® en cuádriceps y en gastrocnemios. *Resultados:* Se encontraron mejoras en el salto desde sentadilla de hasta 10.8% en el tiempo de vuelo, 22.6% en la altura del salto y 8.9% en la potencia muscular después de la aplicación del tape dinámico®. *Conclusiones:* Este estudio preliminar y exploratorio mostró que la utilización del tape dinámico® podría mejorar el rendimiento del salto vertical; sin embargo, se necesitan más investigaciones sobre este tipo de vendaje.

Palabras Clave: Vendaje atlético, rendimiento funcional, vendajes elásticos, rendimiento deportivo

1. Introduction

In recent years, the implementation of neuromuscular tape has increased considerably. The term neuromuscular taping refers to bandages of different composition with longitudinal stretch characteristics that reach between 120 to 140% of elongation, with regards to its initial state, and that shorten when the tape is attached to the skin (Reneker et al., 2018) (McNeill & Pedersen, 2016). This taping is used with the aim of supporting muscle function during the rehabilitation/readaptation of injuries or in cases where muscle function is restricted by processes of overuse or muscle damage (Vinken, 2015). The possible mechanisms of neuromuscular tape application for rehabilitation and prevention of sports injuries are the improvement of muscle function, blood flow, lymphatic flow, sensory perception and fascia function (Drouin et al., 2013). Furthermore, neuromuscular taping can also be used to prevent, correct exercise technique or even improve athletic performance (Wilson et al., 2016), but this last is still controversial. In fact, Reneker et al., (2018) concluded, in a recent systematic review of 15 studies, that there is no definitive evidence

about the effectiveness of the neuromuscular tape Kinesio Tape® on sports performance. Notwithstanding, the lack of consensus regarding the effectiveness of the neuromuscular tape application might be associated with differences of tape materials and variation of methodologies and procedures used among the studies (Huang et al., 2011).

Recently, a relatively novel tape called Dynamic Tape (DT) has being introduced to the market with alleged better outcomes due to the simulated viscoelastic behavior of the connective tissue of its components (Nylon/Lycra or Recyled PET/Lycra), that allow moving in four directions and a longitudinal stretching capacity greater than 200% with respect to its initial state (McNeill & Pedersen, 2016). These features would suppose a mechanical help when the subject is performing vertical jumps, offering accumulation of additional elastic energy to the musculature and providing an improvement in the jump performance, especially starting from positions where elastic energy cannot be taken advantage. Based on the above information, the objective of this exploratory-type case study was to report the acute effects of DT on jump performance in two young adult women that used this kind of neuromuscular tape.

2. Materials and methods

Using a test-retest methodology a case study was carried out in an university laboratory

2.1. Patient

Two 21-year-old, healthy and physically active women, who practice regularly resistance training and basketball, participated in a research project at the Human Movement Laboratory at the Universidad Tecnológica de Pereira (Pereira, Colombia) and called the attention of the researchers due to their morpho-functional

characteristics. In their medical questionnaire, the women reported no history indicating cardiac pathology, any ongoing pathologies or pain at upper limbs, lower limbs and trunk during the last six months.

In Case 1, a 21-year-old woman (height = 172.2 cm; body mass = 62.1 kg; BMI = 20.94kg·m-2). University student of sports sciences, physically active, occasional weightlifting practitioner, without skeletal muscle pathologies during the last six months.

Case 2 involved another 21-year-old woman (height = 162.3 cm; body mass = 56.2 kg; BMI = 21.33 kg·m-2). University student of sports sciences, physically active, occasional basketball practitioner, without skeletal muscle pathologies during the last six months. After volunteering and signing the informed consent in accordance to the ethical guidelines of the World Medical Association Declaration of Helsinki (2013), the women participated in a case study with test-retest methodology.

2.2. Intervention

Each subject performed three squat jumps (SJ) and three countermovement jumps (CMJ) after instructions on proper jump execution based on previous recommendations (Bosco & Riu, 1994) on a contact mat (Globus Ergo Tester, Codognè, Italy) with no tape (NT) application. Briefly, to perform the SJ the subject positioned himself with hands fixed to the hips, in a squat with knees flexed at 120°, remaining in this static position for five seconds in order to produce loss of elastic jump performance, and then the subject executed the maximum jump. Any countermovement was avoided. For the CMJ, the subject stood with knees in 180°, hands on the hips. Then, every subject performed the countermovement technique, which consists of a rapid stretching-shortening cycle, where there was a simultaneous knee, hip and ankle flexion followed by an extension of the knees seeking to push the body in a vertical position in order to

reach the maximum height. For both jumps, it was required that knees remained in extension during the jump, and the interval between one trial and another was 10 seconds. Absolute power was calculated for every jump test according to Sayers equation (Sayers, Harackiewicz, Harman, Frykman & Rosenstein, 1999).

Table 1. Equations used for calculating interest variables

Variable	Equation	Reference
Jump height (cm)	$ft^2 * (g/8)$	(Bosco & Riu, 1994)
Absolute power for SJ (W)	(60.7 * height SJ (cm)) + (45.3 * BM) - 2055	(Sayers et al., 1999)
Absolute power for CMJ (W)	(51.9 * height CMJ (cm)) + (48.9 * BM) - 2007	(Sayers et al., 1999)

ft = flight time; g = gravity (9.8 $m \cdot s^{-2}$); BM = body mass (kg)

Same jump protocols were performed under different conditions of DT (Official manufacture under the direction of Ryan Kendrick). Tape was placed in a layer from the upper and anterior region of the thigh to the anterior half of the tibia with the knee in extension, applying a tension such that a deceleration was generated towards flexion (quadriceps; 1Q). The same procedure was performed but with the application of a double layer of DT or power band, to enhance the described effect (2Q). The application on gastrocnemius (1G) corresponded to a single layer of DT applied from the plantar region to the superior and posterior aspect of the tibia with the ankle in plantar flexion, until reaching with the tape a tension such that it produced a deceleration towards the dorsiflexion. The application called (2G) consisted of the same procedure described as before but with a double administration of DT or power band, to enhance the described effect. Four series of three SJ and three CMJ with five minutes rest between series and ten seconds rest between jumps were performed in the following

conditions 1Q, 2Q, 2Q+1G and 2Q+2G. The tape was placed by a certified and expert physical therapist. Three data sets were registered from each condition and the best record was chosen for each subject in each condition. Afterwards, the mean of the best records of both subjects was determined at each condition. Jump height, flight time and absolute power were analyzed contrasting by percentage differences the performance in each of the jumps.

3. Results

Table 2 presents the comparison of the means obtained before and after the application of DT. Improvements on jump height were seen for SJ after dynamic taping on 1Q, 2Q, 2Q+1G and 2Q+2G (9.6%, 9.9%, 16.9% and 22.6%, respectively). Regarding CMJ, improvements on jump height were observed after DT application on 1Q, 2Q+1G and 2Q+2G (1.8%, 4.9% and 8.8%, respectively); however, a negative behavior of 4.2% was shown for the 2Q condition.

There was an improvement on flight time in SJ after application of DT on 1Q, 2Q, 2Q1G and 2Q2G (4.2%, 4.8%, 8.0% and 10.8%, respectively). In contrast, an increase on flight time was observed in CMJ for 1Q, 2Q+1G and 2Q+2G (0.8%, 2.2% and 4.3%, respectively), but a diminishment was seen after DT application on 2Q (2.1%). Absolute power showed also increased values in SJ (2.1%, 0.3%, 2.1% and 8.9%) and CMJ (9.4%, 5.0%, 6.6% and 12.5%) for 1Q, 2Q, 2Q+1G and 2Q+2G, respectively.

Table 2. Comparison of the jump height between CMJ and SJ in each of the moments evaluated.

	SJ			CMJ		
	Flight time (s)	**Jump height (cm)**	**Power (W)**	**Flight time (s)**	**Jump height (cm)**	**Power (W)**
NT	0.500	30.8	2484	0.523	33.6	2622
1Q	0.521	33.7	2663	0.527	34.2	2653
2Q	0.524	33.8	2669	0.512	32.2	2549
2Q+1G	0.540	36.0	2800	0.535	35.3	2708
2Q+2G	0.554	37.7	2906	0.546	36.6	2775

squat jump; CMJ = countermovement jump; NT = no tape; Q = quadriceps; G = gastrocnemius.

Finally, comparing the jump height performance between SJ versus CMJ, an improvement of 9.27% and 1.48% in favor of the CMJ in NT and 1Q condition, while an improvement of 4.73%, 1.95% and 3.05% was observed in favor of the SJ in condition 2Q, 2Q1G and 2Q2G respectively, indicating that the dynamic tape attenuates the characteristic loss of elastic performance of the SJ condition.

4. Discussion

One of the main exploratory findings of this study was that the use of DT produces positive changes on jump height, flight time and absolute power, possibly due to optimization of quadriceps and triceps surae function during the execution of vertical jumps. To our knowledge, no previous research has evaluated DT as an element that can modify vertical jump performance. Thus, this is the first scientific approach to evaluate the effects on muscle performance. Conversely, Kinesio Tape®, a kind of neuromuscular tape, has not shown significant improvements on vertical jump performance

when applying on both quadriceps and gastrocnemius (Drouin et al., 2013; Reneker et al., 2018). Our findings do not agree with these reports, possibly due to the mechanical differences attributed to the DT, which seems to offer possibilities of elastic energy recovery and might favor the mechanical properties of muscle tissue. Both women of this case study experienced an improvement on jump performance after application of DT on the facilitated muscles. These data demonstrate in a preliminary and exploratory fashion the potential improvement of jump performance based on the mechanical advantages of DT composition.

The possible positive effects of this tape could be related to support structures directly involved in the transmission of muscle tension, as the elastic component in series and parallel, which would allow an immediate increase in effective force during explosive gestures, such as vertical jumps (Vinken, 2015; Wilson et al., 2016). Among the most representative results of this exploratory study were the improvements obtained in the SJ, position in which the elastic energy accumulated by the muscle tissue cannot be effectively transferred to the mechanical gesture (Cavagna, Dusman, & Margaria, 1968; Hortobagyi, Hill, Houmard, Fraser, Lambert & Israel, 1985). Initially, the improvement of jump performance may be attributed to the mechanical and viscoelastic properties of DT, which simulates the viscoelastic behavior of the connective tissue (McNeill & Pedersen, 2016). These properties could compensate the energy eliminated as heat (Bolstad & Ersland, 1978; Edwards et al., 1975) during the five isometric seconds prior to SJ execution. The jump height performance reached by the SJ supports the previous hypothesis, showing an increasing behavior of the elastic capacity of the facilitated muscles, getting the point where the SJ surpasses the CMJ. Possibly, the high recruitment of motor units during the isometric action of the SJ plus the mechanical facilitation offered by the DT would favor the gain of the elastic component after the isometric action. It is to emphasize that the performance on jump height would favor CMJ, considering the expression of the

elastic capacity of the muscle tissue; however, when applying the DT bandages, the SJ exceeds the elastic capabilities of the CMJ. This compensation of elastic energy propitiated by DT would have important implications on the mechanical behavior of muscles subjected to fatigue states, which would prevent the possible appearance of injuries during intense exercise situations, such as those experienced by athletes in various sport disciplines.

The compensation offered by DT would be useful during sports rehabilitation processes, in which mechanical facilitation of injured muscles is required. This would shorten the time of rehabilitation/readaptation and would provide safety and support during the processes.

5. Didactic contributions

Although the effects of Kinesio Tape® on vertical jump performance are still inconsistent in the short or medium term (Nakajima & Baldridge, 2013; Nunes et al., 2013; Schiffer et al., 2014; Vinken, 2015), the results of this exploratory study suggest that other types of tape with better viscoelastic properties, such as DT, might improve jump performance. Particularly, the application of DT on quadriceps and gastrocnemius might improve vertical jump performance, especially in SJ, possibly because of the mechanical support provided by the tape in positions where the elastic energy cannot be used efficiently.

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