EFFECT OF THE KINESIO-TAPING ON FEMALE ATHLETES DURING THE STOP-JUMP TASK POST-FATIGUE

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The aim of this study was to investigate the effect of Kinesio taping (KT) by fatigue intervention, on stop-jump task. Eleven female athletes served as subject. Two force plates and ten cameras were synchronized to capture the stop-jump task. We found larger peak hip flexion angular velocity and lower jump height, at touch down after fatigue intervention. When without taping, peak vertical loading rate was increased. After taping, we found delayed time of peak hip flexion angle and peak anterior-posterior force, smaller peak vertical force and vertical impulse within 50 ms at landing phase, along with delayed time of peak vertical force after fatigue. It concluded that KT can decrease the load in landing on knee whether fatigue or not, but has no acute effect on enhancing performance. We recommend that KT be applied on intense exercises with repeated jumping.

KEY WORDS: Kinesiotape, no tape, vertical jump.

INTRODUCTION: In today's competitive sports, high intensity game generates a body's fatigue and an injury risk. Kinesio taping (KT) generally used by athletes may help to improve blood circulation, joint activity, muscle strength and proprioception and prevent injuries.
Kinesio taping is a specialized tape which is thin, elastic and can be stretched up to 120%~140% of its original length, making it quite elastic, compared with the conventional taping. It allows a partial to full range of motion for the applied muscles and joints with different pulling forces to the skin. It is proposed that the tapes can lift the skin to increase the space between the skin and muscle. Hence, it reduces the localized pressure and helps the promotion of circulation and lymphatic drainage. As a result, it reduces pain, swelling and muscle spasm.
Fatigue is an extrinsic factor affecting the musculoskeletal and neurologic systems. Fatigue is associated with decreased knee proprioception and increased joint laxity compared to baseline values(Rozzi, Lephart, & Fu, 1999) In sports competition, fatigue is unavoidable, especially after repeated high-frequency jumping action, not only to muscle strength decreased, but also make the body feel and reduce the sense of balance and increase the error rate of action (Rodacki, Fowler, & Bennett, 2002; Viitasalo, Hämäläinen, Mononen, Salo, & Lahtinen, 1993), which also increase injury rates in the game (Price, Hawkins, Hulse, & Hodson, 2004) (Chavez, 2011; Madigan & Pidcoe, 2003). Therefore, how to delay fatigue or effective support body joints in balance during fatigue are an important research topic to reduce sports injuries.
Studies have investigated the effects of fatigue lower extremity kinematics, kinetics and muscle activation in jumping, running, rapid stop tasks, and cross-cutting (Nyland et al., 1997; Nyland et al., 1994). In running and rapid stop tasks, late onset of quadriceps and hamstring muscle activation and early occurrence of maximal knee flexion occurred with fatigue. However, the use of Kinesio taping on fatigue in not clear and is important study topic.
The stop-jump tasks are often use in athletic sports, such as dribbling, jumping, or spiking. This action requires an immediate deceleration and rapid stabilization of the body to facilitate subsequent vertical jumps, thus causing a proximal tibial forward shear force that places a significant strain on the ACL. The stop-jump tasks can be perform under fatigue condition in order to study the effective of Kinesio taping. The purpose of this study was to investigate the effect of Kinesio taping by fatigue intervention, on stop-jump task. We hypothesized that lower extremity knee kinetics and kinematics during the landing phase of stop-jump tasks will be altering after muscle fatigue. The use of KT will reduce the lower extremity biomechanics after the muscle fatigue.

METHODS: Eleven college female athletes were recruited as participants. Their mean age, body mass, and height were 22.1±1.5 years, 60.8±6.9 kg, and 164.6±7.5 cm respectively.
After the dressing, the subjects were measured the length of the limbs of the body and attached the reflective balls to the joints of the subjects. The adhesive position was: left and right sides of the skull temples and both sides of the skull at the same level, shoulder acromioclavicular joint, medial and lateral condyle of the elbow, upper arm and forearm center, the wrist joint inside and outside, the second palm of the hand, the seventh section of the spine, thoracic seventh section, clavicle, xiphoid and right back, the proximal and distal bones, the anterior iliac spine and the posterior superior iliac spine, the greater trochanter, the lateral thigh and lateral calf, the medial and lateral condyle of the knee joint and the medial and lateral condyle of the ankle, medial metatarsal head, proximal second metatarsal head, lateral metatarsal head and heel. One certificate athletic trainer applies the Kinesio tape to each subject by taping from the anterior inferior iliac spine to the tibal tuberosity with a total length of 120% tension with two I-sharped stickers to cover the rectus femoris.
The stop-jump task were collected by a 10-camera Vicon motion capture system (250 Hz) and two Kistler force plate (1,500 Hz) respectively. The Visual3D software (C-Motion, Rockville, MD, USA) was applied to analyze the data. Kinematic data were low-pass filtered at 10 Hz (Yu B, Gabriel D, Boble L, & An KN, 1999) using 4th order zero-lag Butterworth filters. Force plate data were low-pass filtered at 50 Hz. Anatomical reference frames for the body segments were defined as the positive x-axis (medial/lateral) to the right, the positive y-axis (anterior/posterior) to the forward, and the positive z-axis (superior/inferior) to the upward.
Each subject came to the lab twice in two separate days, one for no-taping and one for Kinesio-taping exercise. A 5-minute self-directed warm-up was allowed for each subject. The stop-jump tasks were described and demonstrated to the subject. Each of the 3 stop-jump tasks consisted of a 3-step approach run followed by a 1-footed take-off, a 2-footed landing with each foot on a separate force plate, and a 2-footed take-off for maximum height. Each subject was allowed to practice each task until she felt comfortable performing the task in a pre-fatigue exercise test and immediately after completion of the fatigue protocol for the post-fatigue exercise test. The order of the 3 tasks was randomized for each subject.
The fatigue exercise consisted of unlimited repetitions of consecutive vertical jumps for 90 seconds (one jump for one second) and reached a state of volitional exhaustion. To maintain the fatigued state, the subject was instructed to perform 5 consecutive vertical jumps as done previously after every 5 stop-jump trials during the post fatigue exercise test. The joint angle, joint angular velocity, 50ms vertical impulse, vertical loading rate were defined and calculated by the Visual3D.

Statistics was performed with repeated-measure two-way ANOVA using SPSS 20.

RESULTS AND DISCUSSION: There are longer take-off and total time and lower jumping height at fatigue for both taping condition. The results support the hypothesis that biomechanical differences were observed before and after muscle fatigue. No difference was observed in jump performance on non-taping and taping during fatigue (Table1) which indicate KT has no effect on jumping performance after Fatigue. The results indicated during the landing phase differences was found at time to peak hip flexion velocity on taping (table 2). The hip has an important role during the landing which is related to the time to the peak forces. This may support hip to keep body more stable during the landing. The time to peak A-P forces also delay from 0.042 s to 0.045 s before fatigue and from 0.035 s to 0.044 s after fatigue when apply taping (Table 3). The peak vertical force also reduces from 2.45 BW to 2.15 BW before fatigue and from 2.72 BW to 2.16 BW during fatigue when taping.

The results indicated 50ms vertical impulse and vertical impulse after landing is significant smaller at post-fatigue after taping. A smaller vertical loading rate was observed at post-fatigue after taping. These results may suggest that apply Kinesio tape may delay the time to peak forces and reduce the loading in fatigue condition. The results may support the hypothesis of using of KT may reduce the lower extremity biomechanics loading after the muscle fatigue.

The mean vertical GRF of 11 subjects during landing and take-off phase for four conditions were shown in Figure 1. The peak vertical GRF of taping was significant smaller than non-taping after fatigue.

Table 1: Landing, takeoff, total time and jumping height

	Non-taping		Taping	
	B-fatigue	A-fatigue	B-fatigue	A-fatigue
Landing (s)	.171±.044	.177±.041	.178±.041	.177±.028
Takeoff (s)[b]	.179±.049	.194±.054	.183±.041	.196±.053
Total (s)[b]	.350±.088	.371±.088	.361±.073	.373±.072
Height (m) [b]	.346±.049	.295±.042	.345±.040	.302±.040

[b]Main effect of fatigue (B-before, A-after)

Table 2: Peak angular velocity and time to peak angular velocity of hip and knee at landing.

	Non-taping		Taping	
	B-fatigue	A-fatigue	B-fatigue	A-fatigue
Hip flexion(deg/s)[b]	366±151	369±101	362±143	432±111
Knee flexion(deg/s)	903±140	893±124	914±109	935±105
Time to hip flexion[a] (s)	.03±.01	.027±.01	.031±.01	.032±.01
Time to knee flexion (s)	.036±.01	.035±.01	.035±.01	.036±.01

[a]Main effect of taping
[b]Main effect of fatigue

Table 3. Kinetic variables during landing phase

	Non-taping		Taping	
	B-fatigue	A-fatigue	B-fatigue	A-fatigue
A-P (BW)	1.19±.31	1.08±.36	1.09±.30	1.08±.25
Peak V (BW)[a]	2.45±.40	2.72±.61	2.15±.39	2.16±.28
Time to A-P (s)[a]	.042±.010	.035±.011	.045±.012	.044±.011
Time to V (s)[*]	.027±.015	.019±.010	.025±.013	.026±.012
50ms A-P I (BW* s)	.030±.006	.030±.010	.027±.006	.026±.004
50ms VI (BW*s) [a]	.074±.015	.078±.018	.065±.014	.065±.013
Landing A-P I (BW*s)	.101±.016	.099±.025	.100±.020	.097±.015
Landing V I (BW*s) [a]	.240±.042	.242±.037	.234±.042	.236±.028
A-P loading rate (BW/s)	30.02±11.77	33.84±15.22	26.37±12.00	27.30±12.14
V loading rate(BW/s) [*]	120.61±60.33	171.44±72.65	104.17±49.07	97.96±36.43

[a]Main effect of taping
[*]Interaction

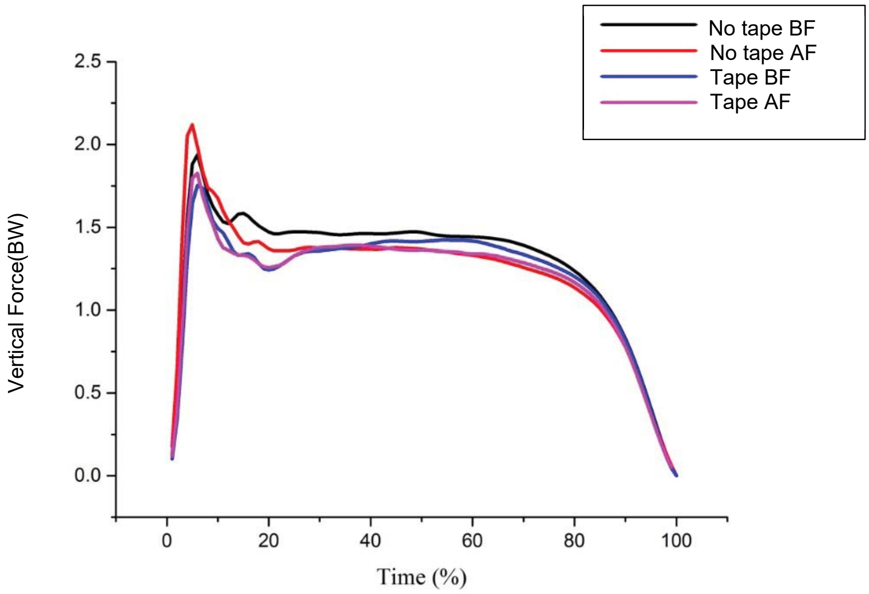

Figure 1: Vertical GRF before take-off

CONCLUSION: The purpose of this study was to investigate the effect of Kinesio taping, followed by fatigue intervention, on stop-jump task on the female athletes. It concluded that the low performance was observed after fatigue and peak anterior-posterior force and peak vertical force were reduced after taping. However, the Kinesio taping has no acute effect on enhancing performance. We recommend that preventive Kinesio taping be applied on intense exercises with repeated jumping

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