ACUTE EFFECTS OF FOREARM KINESIO TAPING ON MUSCLE STRENGTH AND FATIGUE IN HEALTHY TENNIS PLAYERS

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The aim of this study was to explore the acute effects of Kinesio taping (KT) applied over the wrist extensors and flexors on muscle strength and endurance. Fourteen participants completed 50 consecutive maximal concentric wrist extension and flexion repetitions at 60 °/s and 210 °/s in KT, placebo taping, and no taping conditions. There was no significant KT effect on the strength output (peak moment and peak / average power). KT reduced work fatigue and induced an increased regression of torque compared to no taping at 60 °/s. These findings provide preliminary evidences suggesting that KT may not be able to modulate strength production in healthy athletes immediately, but would have a significant positive effect on muscle fatigue resistance during repeated concentric muscle actions.

KEY WORDS: Kinesio taping, muscle strength, work fatigue, regression of torque

INTRODUCTION: In recent years, Kinesio taping (KT) has been widely applied in the prevention of various musculoskeletal conditions, especially in the fields of sports medicine and rehabilitation (Castro-Sanchez *et al.*, 2012; Griebert *et al.*, 2014). To date, the proposed mechanisms for the treatment of sports injuries and enhancement of performance with KT include 1) reducing inflammation and increasing range of motion by improving circulation of blood and lymph (Kase *et al.*, 1996; Yoshida & Kahanov, 2007), 2) relieving pain by decreasing the pressure on subcutaneous nociceptors (Adamczyk *et al.*, 2009; Álvarez-Álvarez *et al.*, 2014), 3) facilitating joint and muscle function by improving sensory feedback and muscle alignment / activation (Bassett *et al.*, 2010; Briem *et al.*, 2011). However, owing to the lack of clinical and experimental evidence, no clear scientific consensus has been reached yet with regard to the positive effect of KT on the improvement of athletic-based performance, especially on muscular strength and endurance.

The work by Fu et al. (2008) and Poon et al. (2014) suggested that KT does not enhance nor inhibit muscle strength during isokinetic knee extensions in healthy non-injured young athletes. These authors further suggested that previously reported muscle facilitatory effects using KT might be attributed to placebo effects. Moreover, a more recent meta-analysis showed that on average the application of KT to facilitate muscular contraction has no or only negligible effects on muscle strength (Williams *et al.*, 2012). There is, obviously, uncertainty concerning the beneficial effects of KT application for the improvement of muscular strength, and very few data are available in the literature regarding the effect of KT on continuous power outputs and endurance during repetitive exercise bouts, which further hinders our understanding of the potential mechanisms underlying KT effects (Beedie & Foad, 2009; Nakajima & Baldridge, 2013).

Based on the above observations, the purpose of this study was to examine the immediate effects of KT applied over the wrist extensors and flexors on muscle strength and endurance during isometric and isokinetic muscle actions at both low (60 °/s) and high (210 °/s) angular velocity. We hypothesized that a KT intervention would lead to an increase in wrist muscle strength as well as endurance performance.

METHODS: Fourteen trained male volunteers (age: 23.8 ± 1.4 years, height: 177.3 ± 4.0 cm, mass: 71.3 ± 6.5 kg) with a minimum of 3 years of experience in tennis events were recruited for this experiment. Three taping conditions were applied to each participant: 1) Kinesio taping (KT); 2) placebo taping (PT); 3) no taping (NT). The Kinesio Tex Tape (Kinesio Holding Company, Albuquerque, NM) was comprised of pure cotton fabric and waterborne acrylic pressure-sensitive adhesives. The placebo tape was a common CaduMedi non-woven adhesive tape (T&G Healthcare Co. Ltd., China). The tapes were applied on the wrist flexors and extensors of the dominant arm.

Participants were asked to be in the laboratory on three separate days and complete strength testing in one of the three taping conditions, i.e., KT, PT, and NT, in each visit. During each visit, the participant was asked to complete two strength testing tasks using an isokinetic dynamometer (Contrex, PM1/MJ, CMV AG Corp., Switzerland). First, two sets of five seconds isometric MVCs of both the wrist extensors and flexors were measured at 0 ° angles of wrist extension. Subsequently, during the isokinetic testing session, participants performed one set of 50 consecutive maximal concentric wrist extensions and flexions at each of the two angular velocities (60 °/s and 210 °/s).

The variables for the wrist strength of the extensors and flexors normalized by body mass included 1) peak moment (PM, Nm/kg) during the isometric task; 2) peak moment (PM, Nm/kg), peak power (PP, W/kg), average power for the first five repetitions (AP, W/kg), and total work (TW, J/kg) during the isokinetic tasks. A work fatigue index (WF) and regression of torque (k) was chosen to reveal the decreasing trend of peak moment across the 50 repetitions and to evaluate the anti-fatigue ability of muscle during long duration tasks.

A 2 × 3 (velocity × condition) repeated measures analysis of variance (ANOVA) was used to examine the effects of the contraction velocities and taping conditions on muscle strength and fatigue performance. LSD post hoc tests were used to determine individual significant differences. The significant level was set at $\alpha = 0.05$.

RESULTS AND DISCUSSION:

Muscle strength: No significant differences were observed in peak moment of the wrist extensors and flexors among the KT, PT and NT during MVC trials. For the isokinetic strength testing, there were no significant differences in PM, AP, PP, and TW for both wrist extensors and flexors between the KT and NT conditions at both velocities (Table 1)

Table 1
The effect of Kinesio taping (KT), placebo taping (PT), and no taping (NT) on strength variables of wrist extensors and flexors during isokinetic muscle actions at 60 °/s and 210 °/s angular velocity.

Wrist muscles	Variables	60°/s			210°/s		
		KT	PT	NT	KT	PT	NT
EXT	PM (Nm/kg)	0.22±*0.08*	0.21±*0.06*	0.23±*0.07*	0.18±*0.03*	0.20±*0.03*	0.20±*0.04*
	AP (W/kg)	0.11±*0.05*	0.14±*0.02*	0.12±*0.03*	0.15±*0.04*	0.16±*0.03*	0.16±*0.03*
	PP (W/kg)	0.23±*0.08*	0.22±*0.06*	0.23±*0.08*	0.50±*0.08*	0.60±*0.12*	0.59±*0.16*
	TW (J/kg)	4.31±*2.01*	4.90±*1.35*	4.35±*2.32*	4.45±*0.79*	4.39±*0.85*	4.27±*1.18*
FLEX	PM (Nm/kg)	0.34±*0.06*	0.38±*0.08*	0.32±*0.07*	0.26±*0.04*	0.29±*0.06*	0.28±*0.05*
	AP (W/kg)	0.19±*0.04*	0.23±*0.05*	0.21±*0.05*	0.23±*0.07*	0.25±*0.08*	0.23±*0.07*
	PP (W/kg)	0.36±*0.06*	0.39±*0.09*	0.42±*0.22*	0.89±*0.15*	1.00±*0.20*	0.93±*0.16*
	TW (J/kg)	9.19±*1.89*	9.58±*1.97*	9.16±*2.15*	6.00±*1.02*	6.44±*1.72*	5.82±*1.37*

Note: EXT, wrist extensors; FLEX, wrist flexors; PM, peak moment normalized by body mass; AP, average power normalized by body mass; PP, peak power normalized by body mass; TW, total work normalized by body mass.

Work fatigue: At 60 °/s, KT showed a significant decrease in work fatigue (WF) of the wrist flexors compared to NT (Figure 1). No significant differences, however, were observed in the wrist extensor WF among the three taping conditions. In addition, the WF of wrist muscles was not significantly different between the taping conditions at 210 °/s.

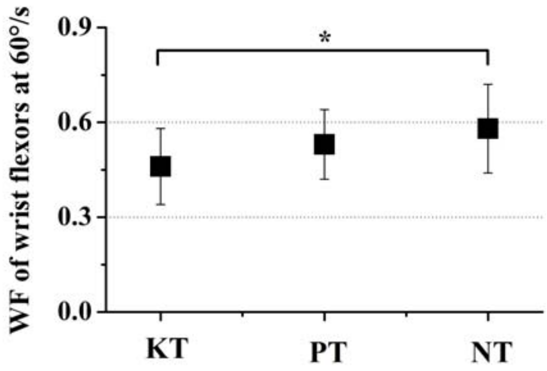

Figure 1: Effects of three taping conditions on work fatigue (WF) of the wrist flexors at 60 °/s.

Regression of torque: Compared to NT, a 19.98% increase was observed for KT in the slope of the curve *k* of the wrist flexors ($p < 0.01$) at 60 °/s (Figure 2). It is, however, noteworthy that the *k* in PT was also significantly higher compared to NT ($p < 0.05$). In addition, there was a trend for $k_{KT} > k_{PT} > k_{NT}$ in the wrist flexors at 210 °/s ($p < 0.1$). Meanwhile, for the wrist extensors, no significant taping effect was observed for the slope of the curve *k* at both velocities.

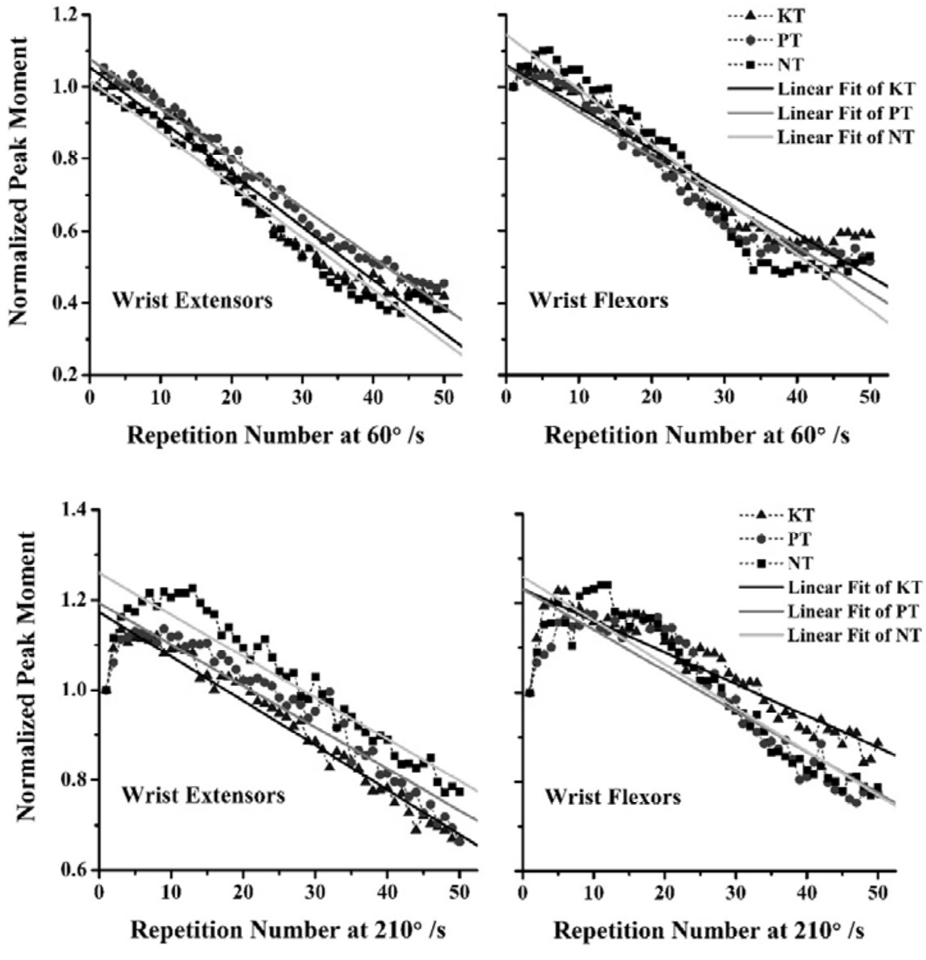

Figure 2: Effects of three taping conditions on the slope of the curve *k* of the wrist extensors and flexors at 60 °/s (upper) and 210 °/s (lower).

CONCLUSION: KT applied over the wrist extensors and flexors did not improve isometric and isokinetic strength, yielding no changes in normalized peak moment, peak power, average power, and total work. However, KT exerted on the wrist flexors reduced work fatigue and induced an increased regression of torque compared to no taping at 60 °/s. These findings provide preliminary evidences suggesting that KT may not be able to modulate strength production in healthy athletes immediately, but would have a significant positive effect on muscle fatigue resistance during repeated concentric muscle actions. Additionally, potential beneficial effects of PT on muscle endurance should not be ignored either.

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