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Original research

Acute effects of Kinesio taping on muscle strength and fatigue in the forearm of tennis players

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ABSTRACT

Objectives: To explore the immediate effects of Kinesio taping applied over the wrist extensors and flexors on muscle strength and endurance during isometric and isokinetic muscle actions.
Design: The study had a single-blinded, placebo control, and randomized design.
Methods: Fourteen trained male volunteers were required to complete 5 s isometric maximal voluntary contractions and 50 consecutive maximal concentric wrist extension and flexion repetitions at each of two angular speeds (60°/s and 210°/s) in three taping conditions: Kinesio taping (KT), placebo taping (PT), and no taping (NT).
Results: KT did not improve peak moment, peak power, average power, and total work for wrist extensors and flexors in the isometric and isokinetic contractions. However, KT showed a 13% decrease in work fatigue of the wrist flexors compare to NT ($p = 0.014$) at 60°/s. Furthermore, a 20% decrease was also observed in the rate of decline of moment (k) of the wrist flexors in KT compared to NT ($p = 0.007$), and the k in PT was also significantly lower in magnitude compared to NT ($p = 0.035$). Moreover, there was also a trend in terms of magnitudes for $k_{KT} < k_{PT} < k_{NT}$ in the wrist flexors at 210°/s.
Conclusions: Kinesio taping may not be able to modulate strength production in healthy athletes immediately, but does have a significant positive effect on reducing muscle fatigue during repeated concentric muscle actions. Additionally, the potential beneficial effects of placebo taping on muscle endurance should not be ignored either.

1. Introduction

In recent years, Kinesio taping (KT) has been widely applied in the treatment of various musculoskeletal conditions, especially in the fields of sports medicine and rehabilitation.[1] Due to its practical applications on maintenance of muscle function and treatment of sports injury, KT has attracted much attention from athletes, physical therapists and researchers.[2] To date, the proposed mechanisms for the treatment of sports injuries and enhancement of performance with KT include[2,3] (1) reducing inflammation and promoting range of motion by improving circulation of blood and lymph, (2) relieving pain by decreasing the pressure on subcutaneous nociceptors, (3) facilitating joint and muscle function by improving sensory feedback and muscle alignment/activation. It is, however, noteworthy that the practical effects of KT and its alleged clinical usefulness still remain controversial.[4] 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.

Recently, Kim et al.[5] reported a significant increase in peak moment, average power, and total work of the knee joint during isokinetic contractions immediately after application of KT. Slupik and colleagues[6] further revealed an increase in the electromyographic activity of vastus medialis muscle after KT application compared with no taping, which may partially be attributed to the potential effect of KT on correcting muscle function by strengthening weakened muscles and/or promoting sensory input. However, it should be noted that results from a number of studies still do not support some of the effectiveness claimed anecdotally by KT manufacturers. The work by Fu[2] and Poon et al.[7] 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[7]. Notably, the tonic muscles, e.g., anti-gravity lower limb muscles,

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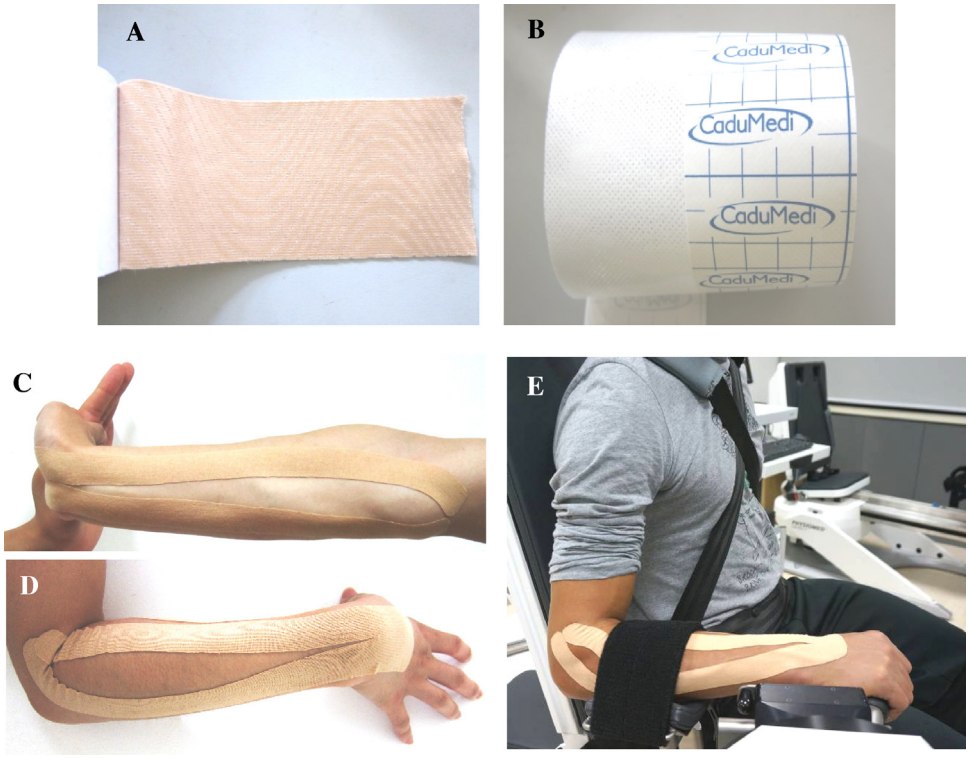

Fig. 1. Kinesio tape (A); placebo tape (B); application procedure of KT for the wrist flexors (C) and extensors (D); positions of forearm and wrist joint for measurement using an isokinetic dynamometer (E).

were involved in the aforementioned studies. Meanwhile, a recent meta-analysis showed that on average the application of KT to facilitate muscular contraction has no or only negligible effects on muscle strength.[8] Hence 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.

Isokinetic strength testing has been widely used to investigate muscle strength and power production. Most previous studies on KT by means of isokinetic strength evaluation, however, have mainly focused on the performance of tonic muscle groups, e.g., knee extensor and flexor[5] and ankle plantarflexor.[9] Little is known about the isokinetic muscle strength of phasic muscles, e.g., wrist extensors and flexors, after applying the KT.[10] In highly skilled adult tennis players, significantly greater isokinetic strength was observed for the flexion and extension of dominant arm wrist.[11] More importantly, a recent electromyographic study has indicated that the wrist extensor and flexor muscles play an important role in gripping during the procedure of holding the racket in an extended tennis or badminton match.[12] Therefore, questions still remain regarding how KT affects phasic extensors and flexors strength and fatigue performance of wrist joint during prolonged dynamic movements.

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 speeds. We hypothesized that a KT intervention would lead to an increase in wrist muscle strength as well as endurance performance.

2. Methods

Fourteen trained male volunteers (age: 23.8 ± 1.4 years, height: 177.3 ± 4.0 cm, mass: 71.3 ± 6.5 kg) were recruited to participate in this study. All subjects had 3–4 years of experience in tennis events and were free of musculoskeletal injuries of the upper extremity at least six months prior to the testing. A post-hoc power analysis was conducted using G*Power software (version 3.1.9) as previously described.[13] A two-tailed *t*-test was used to determine whether a sample size of 14 was sufficient to avoid type II error for our variables of interest ($p = 80\%$ at $\alpha = 0.05$). Each of them signed the consent form approved by the Human Ethics Committee of Shanghai University of Sport.

Three taping conditions were applied to each subject: (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 (Fig. 1A). The placebo tape was a common CaduMedi non-woven adhesive tape (T&G Healthcare Co. Ltd., China) (Fig. 1B).

The tapes were applied on the wrist flexors and extensors of the dominant arm. Specifically, before applying the tape, the skin of the participants was shaved and cleaned with alcohol. For wrist flexors/extensors, the subject was required to keep the wrist in a hyperextended/hyperflexed position with the elbow in full extension and supination/flexion and pronation. The length of the forearm of the participants was measured by the experimenter (Fig. 1C and D). A roll of tape was cut into a strip and then cut down the middle of the strip to produce a "Y-strip". The proximal head of the Y-strip was applied to the distal of wrist palmar and dorsal side, the tails were along the ulnar and radial wrist flexors and wrist extensors to medial and lateral epicondyle, respectively, with natural stretch tension.