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Single-blinded crossover study

Type effect of inhibitory KT tape on measured vs. perceived maximal grip strength

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ABSTRACT

This study examined the effects of KT tape (KT) applied in an inhibitory manner on muscle activity, measured maximal grip strength, and perceived maximal grip strength in regular KT-users and non-users. This study was a single-blinded crossover study with sixty participants including 27 kT-users and 33 non-users. Participants underwent maximal grip strength tests with and without inhibitory KT applied across the wrist extensors. Muscle activity and maximal grip strength were measured, while perceived maximal grip strength was rated using a visual analogue scale. No significant interaction effect was found between taping conditions and participant KT-experience for muscle activity ($F = 0.825$, $p = 0.367$), measured grip strength ($F = 1.018$, $p = 0.317$) or perceived grip strength ($F = 0.122$, $p = 0.728$). No significant differences were observed in the EMG activity between taping conditions for either KT-users ($p = 0.367$) or non-users ($p = 0.215$). A similar trend was found in the measured grip strength (KT-users: $p = 0.317$; non-users: $p = 0.294$) and perceived grip strength (KT-users: $p = 0.728$; non-users: $p = 0.063$). KT applied in an inhibitory manner does not impede EMG activity, measured maximal grip strength, or perceived maximal grip strength in adults, regardless of their preconceived notions of KT.

1. Introduction

The creators of the controversial sports intervention Kinesio Tape claim that, with specialized application techniques, the tape can elicit short and long-term effects on muscle strength, tissue edema, pain, and lymphatic drainage (Kase et al., 2003). However, previous research on the effects of elastic therapeutic tape in a clinical setting has provided mixed results. Some studies have found the tape to be effective in increasing muscle activity (Hsu et al., 2009; Słupik et al., 2006) reducing pain (Kalron and Bar-Sela, 2013; Montalvo et al., 2014) and increasing lymphatic flow (Białoszewski et al., 2008). However, the mechanisms behind the tape are still poorly understood, particularly in regards to the inhibitory application of KT, which few previous studies have examined. Furthermore, multiple meta-analyses have concluded that insufficient evidence currently exists for the use of KT over other clinical practices (Morris et al., 2013; Williams et al., 2012). Additionally, recent research in to the effects of KT, which controlled for any potential placebo effect, has failed to see any clinically significant results (Cai et al., 2016; Poon et al., 2015; Vercelli et al., 2012). This suggests that previously witnessed clinically significant effects with KT may be partially or fully due to an active placebo effect and this idea must be explored.

Despite years of research, the placebo effect is still a minimally understood phenomenon. Considerable study of the effect in sport and exercise has been carried out to explore the potential of enhancing athlete performance, as well as reducing their fatigue perception (Köteles et al., 2011; Wallman et al., 2015). A recent meta-analysis concludes that, from the majority of athletes believe in the power of placebo to improve their performance in sport (Bérdi et al., 2015). Furthermore, the results of a number of studies

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have shown evidence of an active placebo effect and that said phenomenon has the potential to work positively and negatively i.e. both enhance and reduce performance (Beedie and Foad, 2009; Zhang et al., 2016).

The purpose of this study was to investigate the potential role of placebo when utilizing KT, specifically the inhibitory application of KT. This study sought to determine how KT applied in a supposedly inhibitory manner would affect muscle activity, measured maximal grip strength and perceived maximal grip strength in regular KT-users and non-users. We hypothesized that muscle activity, measured and/or perceived grip strength in KT-users would be more affected by KT applied in an inhibitory manner than in non-users, due to their preconceived notions of KT.

2. Methods

A total of 60 adults were recruited for this study through convenient sampling. Subjects were split into two groups with 27 kT-users (12 females, 15 males) and 33 non-users (16 females, 17 males), according to their previous experience with KT (Table 1.). To be considered a KT-user, participants should have utilized KT at least once per week for the preceding 3 months. Non-users are participants who have never utilized KT, but may be aware of its existence. The elastic therapeutic tape utilized in this study is titled KT Tape (KT Health, LLC, UT, USA). All participants in the study were free from any known cardiopulmonary conditions as well as previous surgical procedures on the tested extremity (Table 2). The concerning ethical review committee reviewed and approved the experimental procedures and written consent was collected from each participant.

Participants underwent testing in a randomly assigned order of “tapeless condition” (NKT) and “inhibitory KT condition” (IKT). In the IKT condition, KT was applied along the surface of the wrist extensor muscles (Extensor carpi radialis brevis, Extensor digitorum) of the dominant arm (Fig. 1a). Arm dominance was defined as that which was preferred for writing (Powers et al., 2005). The tape was applied from insertion to origin, which is proposed to have an inhibitory muscle effect (Kase et al., 2003). The tension of the tape during application was 25% for both conditions, as recommended for origin to insertion application (Kase et al., 2003). The tension was maintained through anthropometric measurement of the tape i.e. measuring the change in length of tape before and after stretching (Poon et al., 2015). A certified physical therapist was present to apply the KT on each participant. In the NKT condition, no tape was applied on the participants. To allow for any placebo effect to occur, participants were made aware of each condition and the supposed effects.

Participants were then asked to carry out a maximal power grip three times in each condition with a 30-second rest in between each attempt. A three-minute rest was given between each taping condition. Grip strength was quantified using a digital dynamometer (Model J00105, Lafayette Instrument, IN, USA). Positioning of the instrumentation and participants was standardized according to a past study (Trampisch et al., 2012). Surface EMG of the wrist extensor muscles was measured using an Ag/AgCl electrode (SX230, Biometrics Limited, Newport, UK). To reduce skin-electrode interference, the testing area was cleaned with alcohol and gently abraded with sandpaper so that the skin impedance was lower than 5 kΩ. To maintain a constant contact surface area between participants and conditions, a hole-puncher was used to cut two circular holes in each piece of KT. After the application of conductive gel, the electrode was positioned longitudinally along the muscle belly of the wrist extensor muscles (Fig. 1b). The EMG signal was pre-amplified (×330), band-pass filtered (50–300 Hz), and sampled at 1000 Hz. The middle 1-second time window of the maximum grip strength test was utilized to calculate the root mean square (RMS) of the EMG data. Maximal grip strength and RMS EMG data from each of the three trials was averaged for further analysis. After each test condition, participants were asked for feedback about their performance. This subjective feedback was collected using a visual analogue scale (VAS: 0 – Worst performance; 10 – best performance).

All data was analysed using SPSS version 22 (SPSS Software, Chicago, IL, USA). Due to the significant difference in age between regular KT-users and non-users, a repeated measures ANCOVA was used to test the effects (RMS-EMG activity, measured grip strength, and perceived grip strength) of each taping condition (NKT vs. IKT) in KT-users and non-users with age as a covariate. Paired t-tests were also conducted for pairwise comparisons, when necessary. The global alpha level was set at 0.05.

Table 1
Subject Demographics Demographic data of participants (mean ± standard deviation) split by previous Kinesio tape (KT) experience.

	KT-users	Non-users	P-value
Age (Years)	22.3 ± 1.2	26.0 ± 6.5	0.006
Weight (Kg)	59.6 ± 10.2	62.6 ± 9.5	0.255
Height (m)	1.69 ± 0.09	1.69 ± 0.08	0.793
BMI	20.8 ± 2.3	21.7 ± 2.1	0.115

3. Results

RMS-EMG activity, measured grip strength, and perceived grip strength of KT-users and non-users are presented in Fig. 2. A repeated measures ANCOVA demonstrated that age was not a significant confounding factor in the comparisons of muscle activity ($p = 0.701$) measured grip strength ($p = 0.474$), or perceived grip strength ($p = 0.534$). There was no significant interaction effect between taping conditions and subject KT-experience for muscle activity ($F = 0.825$, $p = 0.367$), measured grip strength ($F = 1.018$, $p = 0.317$), or perceived grip strength ($F = 0.122$, $p = 0.728$). Furthermore, there was no significant taping effect on muscle activity in both KT-users ($p = 0.367$, Cohen's d = 0.04) and non-users ($p = 0.215$, Cohen's d = 0.28). A similar trend was observed in the measured grip strength (KT-users: $p = 0.317$, Cohen's d = 0.00; non-users: $p = 0.294$, Cohen's d = 0.15) and perceived grip strength (KT-users: $p = 0.728$, Cohen's d = 0.07; non-users: $p = 0.063$, Cohen's d = 0.29).

4. Discussion

The study examined the effects of the inhibitory application of KT on the muscle activity of the wrist extensor muscle, measured grip strength, and perceived grip strength in two groups of health adults; regular KT-users and non-users. The results of this study showed no significant interaction between taping condition and experience for any of the measured parameters. This suggests that muscle activity, measured grip strength, and perceived grip strength in KT-users and non-users did not differ based on taping conditions. Although a few studies have recorded significant changes in muscle activity when utilizing KT (Hsu et al., 2009), others have failed to do so. For example, Cai et al. found that muscle activity and grip strength were not significantly different between the inhibitory tape condition, facilitatory tape condition, and tapeless condition, when subjects were ignorant of KT and its supposed effects. Additionally, recent meta-analytical reviews conclude that, despite previous studies, there is not enough evidence to support the claims surrounding KT– including its effects - and that further research is needed (Morris et al., 2013; Williams et al., 2012).

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