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Original article

Kinesiology tape does not facilitate muscle performance: A deceptive controlled trial

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ABSTRACT

Kinesiology tape (KinTape) is a therapeutic tape without much understanding of its mechanism. KinTape claims to increase cutaneous stimulation, which facilitates motor unit firing, and consequently improves functional performance; however these, benefits could be due to placebo effects. This study investigated the true effects of KinTape by a deceptive, randomized, and controlled trial. Thirty healthy participants performed isokinetic testing of three taping conditions: true facilitative KinTape, sham KinTape, and no KinTape. The participants were blindfolded during the evaluation. Under the pretense of applying adhesive muscle sensors, KinTape was applied to their quadriceps in the first two conditions. Normalized peak torque, normalized total work, and time to peak torque were measured at two angular speeds (60°/s and 180°/s) and analyzed with one-way repeated measures ANOVA. Participants were successfully deceived and they were ignorant about KinTape. No significant differences were found between normalized peak torque, normalized total work, and time to peak torque at 60°/s or 180°/s ($p = 0.31$–0.99) between three taping conditions. The results showed that KinTape did not facilitate muscle performance in generating higher peak torque, yielding a greater total work, or inducing an earlier onset of peak torque. These findings suggest that previously reported muscle facilitatory effects using KinTape may be attributed to placebo effects.

1. Introduction

Kinesiology tape (KinTape) is a well-recognized adhesive therapeutic tape which has been widely used for injury prevention, rehabilitation, and even performance enhancement. It appears to be clinically effective in controlling pain (Thelen et al., 2008; González-Iglesias et al., 2009; García-Muro et al., 2010; Kalichman et al., 2010; Saavedra-Hernández et al., 2012), promoting range of movement (Jaraczewska and Long, 2006; Yoshida and Kahanov, 2007; Kalichman et al., 2010; Williams et al., 2012), increasing muscle activity (Thelen et al., 2008; Briem et al., 2011; Wong et al., 2012), inducing an earlier occurrence of muscle peak torque (Wong et al., 2012; Fratocchi et al., 2013), and functional performance enhancement (Jaraczewska and Long, 2006; Yasukawa et al., 2006; Chang et al., 2010). However, the positive results can be due to the absence of adequate blinding and placebo controls. More importantly, the working mechanism of KinTape remains unclear. It has been speculated that the muscle facilitatory effects of KinTape may be due to the interplay between cutaneous afferent stimulation and motor unit firing in both central and peripheral nervous systems. An increase of peripheral nerve stimulation was shown to promote excitability of the motor cortex (Ridding et al., 2000). Reduction of motor neuron threshold may be induced by cutaneous stimulation, resulting in easier recruitment of the motor units (Maratou and Theophilidis, 2000), and in turn, leading to an improved functional performance.

Such speculation can only be proved or refuted by an experiment with a true placebo group. Previous clinical controlled trials and randomized controlled trials used KinTape without any additional tension, or KinTape application on irrelevant position as their sham condition (Thelen et al., 2008; González-Iglesias et al., 2009; Hsu et al., 2009; Saavedra-Hernández et al., 2012; Fratocchi et al., 2013; de Almeida Lins et al., 2013). However, it is arguable that sham KinTape may still provide therapeutic effect as additional cutaneous sensory input may still be present in both sham conditions. It is also noteworthy that the participants in other studies were aware of the KinTape application, meaning the observed effects could be attributed to placebo effects (Beedie and Foad, 2009).

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Hence, it is necessary to interpret the results of previous studies with caution.

Since it is not feasible to effectively induce a temporary block to tactile sensation that the tape stimulates, a possible method to eliminate placebo effects is deception. A deception experimental design previously has been considered impractical by healthcare professionals. However, a recent large scale study which recruited more than 6000 laypeople suggests that deceptive placebo use appears to be more pragmatic than what was previously thought (Köteles and Ferentzi, 2012). Deception in healthcare research is considered acceptable if the study fulfills the following criteria (Wendler, 1996): 1) any other effective non-deceptive alternatives are not feasible; 2) participants are not deceived about research risk, discomfort, or unpleasant emotional experience; 3) the deception must be explained to participants as early as is feasible; and 4) debriefing is offered immediately after the study. Thus, deception can be used to evaluate the true effects of KinTape by deceiving a group of laypeople who are ignorant about KinTape.

Isokinetic test of muscle strength is a reliable and safe method to quantify muscle performance at selected contraction speeds (Osternig, 1986; Montgomery et al., 1989). It is also a common test in previous randomized controlled trials which examined effects of KinTape. Therefore, this study examined the muscle performance of the quadriceps with and without KinTape application in participants who did not realize the potential treatment effects of the adhesive therapeutic tape using isokinetic muscle strength measurement. We hypothesized that there would be no difference in the muscle performance when the participants were taped with true facilitative KinTape, sham KinTape, and received no KinTape.

2. Methods

2.1. Participants

A total of 46 healthy participants were recruited. The institutional review board reviewed and approved the research protocol and all of the participants provided their written informed consent before being tested. All participants were issued a screening survey prior to participation in order to ensure that they were: 1) free of known musculoskeletal, cardiopulmonary, and any other chronic medical conditions requiring pharmaceutical management; 2) free of any active joint pain or other related symptoms in the recent 12 months; and 3) ignorant about KinTape, meaning participants had no exposure to KinTape and failed to name “kinesiology tape”, “KT”, “tape, “adhesive plaster”, “adhesive ribbon”, or anything equivalent as prophylactic equipment for sports. Participants' ignorance towards KinTape was re-assessed after the experiment with a second brief survey. Ten participants were screened out before the experiment and six of them dropped out due to scheduling conflicts (Fig. 1). Remaining 30 participants (18 females) had a mean ± SD age of 21.8 ± 3.05 and a body mass of 59.72 ± 15.5 kg.

2.2. Testing procedures

All participants attended three isokinetic knee testing sessions (Fig. 1), each of which was separated by around seven days to avoid any carryover effect (Fu et al., 2008). An isokinetic dynamometer (Cybex Norm, Humac, CA, USA) was calibrated before each data collection session. The measurements for each testing session were taken at two angular speeds (60°/s and 180°/s) for five repetitions (Carregaro et al., 2011). The order of the testing speed was randomly assigned using an online program (http://www.random.org).

Participants' dominant knee, defined by the leg preferred to kick a ball (Ghena et al., 1991), were tested in a seated position at 100° hip flexion. The pad of the lower leg attachment was positioned 5 cm above the lateral malleolus. The trunk was stabilized with a torso seat belt and the thigh with a Velcro strap. The range of motion was set at maximal concentric knee extension to 100° knee flexion (Wong et al., 2012).

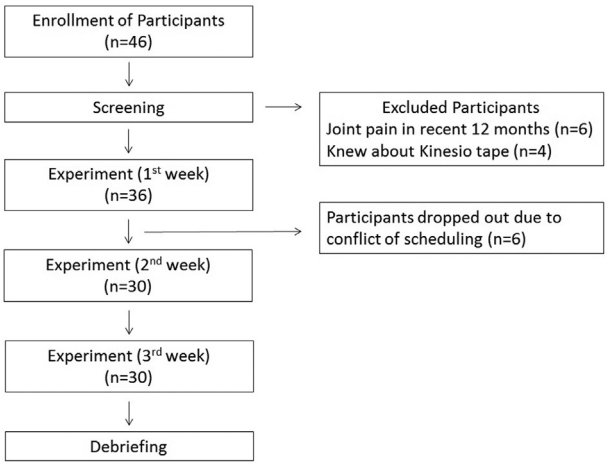

Fig. 1. Flow diagram of the study and dropout of participants.

Participants were blindfolded once they were seated on the apparatus. They were informed that we were testing different adhesive sensors to examine muscle activity and they may or may not feel the sensor application. Under the pretense of applying a series of adhesive sensors, participants underwent one of three conditions pre-assigned in a randomized order: the true KinTape condition, the sham KinTape condition, and the tapeless condition. In true KinTape condition, KT was applied onto the skin overlying the rectus femoris and vastus medialis muscle of the dominant leg from origin to insertion with 35% of its maximal length tension, which has been proposed to provide muscle facilitatory effect (Fig. 2) (Kase et al., 2003). The tension of KinTape was confirmed by the anthropometric measurement of the tape i.e. measuring the change in length of tape before and after being stretched. In sham KinTape condition, the procedure was identical with true KinTape condition except that there was no additional tension put onto the tape. In tapeless condition, no tape was applied but we still touched on participants' thigh to mimic the tape application.

The participants were allowed to have 90-s rest periods between each set (Blazquez et al., 2013). Five trials of sub-maximal effort were performed before each set of measurement to ensure familiarity of the evaluation. Standardized and consistent verbal encouragement was provided for all participants.

Peak torque (NPT) was functionally defined as the mean of maximum force output in the five repetitions and total work (NTW) was the amount of energy generated by the muscle for the entire set of testing. Time to peak torque (TPT) was defined as the mean time from the onset of movement to the point of the peak torque in all trials. NPT and NTW were normalized with participants' body mass. These three parameters were used to determine the muscle performance. All of the participants were explained with the true purpose of the experiment during debriefing after the end of the third isokinetic knee testing session.

2.3. Statistical analysis

One-way repeated measures ANOVA was used to test the effects of KinTape on the muscle performance at the selected angular speeds. Least Significant Difference test was used for pair-wise