Journal of Science and Medicine in Sport 19 (2016) 109–112

Contents lists available at ScienceDirect

Journal of Science and Medicine in Sport

journal homepage: www.elsevier.com/locate/jsams

Original research

Facilitatory and inhibitory effects of Kinesio tape: Fact or fad?

C. Cai, I.P.H. Au, W. An, R.T.H. Cheung*

Department of Rehabilitation Sciences, Hong Kong Polytechnic University, Hong Kong

ARTICLE INFO

Article history:
Received 27 November 2014
Received in revised form 15 January 2015
Accepted 28 January 2015
Available online 7 February 2015

Keywords:
Taping
Performance
Strength

ABSTRACT

Objectives: Kinesio tape (KT) is a commonly used intervention in sports. It claims to be able to alter the muscle activity, in terms of both facilitation and inhibition, by certain application methods. This study compared the neuromuscular activity of the wrist extensor muscles and maximal grip strength with facilitatory, inhibitory KT, and tapeless condition in healthy adults who were ignorant about KT. Potential placebo effects were eliminated by deception.
Design: Randomized deceptive trial.
Methods: 33 participants performed maximal grip assessment in a randomly assigned order of three taping conditions: true facilitatory KT, inhibitory KT, and no tape. The participants were blindfolded during the evaluation. Under the pretense of applying a series of adhesive muscle sensors, KT was applied to their wrist extensor muscles of the dominant forearm in the first two conditions. Within-subject comparisons of normalized root mean square of the wrist extensors electromyographic activity and maximal grip strength were conducted across three taping conditions.
Results: 31 out of 33 enlisted participants were confirmed to be ignorant about KT. No significant differences were found in the maximum grip strength ($p = 0.394$), electromyographic activity ($p = 0.276$), and self-perceived performance ($p = 0.825$) between facilitatory KT, inhibitory KT, and tapeless conditions.
Conclusions: Neither facilitatory nor inhibitory effects were observed between different application techniques of KT in healthy participants. Clinically, alternative method should be used for muscle activity modulation.

1. Introduction

Kinesio tape (KT) is one of the most common adhesive therapeutic tapes for injury prevention, rehabilitation, and performance enhancement. It has been shown to be clinically effective in joint movement promotion,[1–3] increasing muscle activity,[4,5] inducing an earlier occurrence of muscle peak torque,[6,7] and functional performance enhancement.[8–10] However, the working mechanism of KT remains unknown.[11] It has been suggested that the therapeutic effects of KT may 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.[12] Reduction of motor neuron threshold may be induced by cutaneous stimulation, resulting in easier recruitment of the motor units,[13] and in turn, leading to an improved functional performance. Other than muscle facilitation, KT has been shown to be effective in pain control by inhibition of the muscle activity.[1,3,15] It is thought that inhibition of muscles can be achieved by stretching the Golgi tendon organ at the distal end of the muscle.[16] Interestingly, the muscle inhibitory effect of KT is mainly anecdotal and only clinically relevant. At our best knowledge, there is a paucity of evidence to examine the mechanism of the inhibitory KT. Vercelli et al.[17] reported similar isokinetic quadriceps strength and functional performance in 30 healthy adults with facilitatory and inhibitory KT. Conversely, Kuo et al.[18] found a delayed reduction of grip strength (24 h after the tape application) in 19 young adults with inhibitory KT.

The true effect of KT was questioned by a recent experiment which had eliminated the potential placebo effect by deceiving the participants.[19] In that particular study, a group of laypeople ($n = 30$) who were ignorant about KT were recruited and they were told that a series of adhesive muscle sensors might be applied in order to examine the muscle recruitment during the examination of isokinetic knee strength. Body mass normalized peak torque, total work, and time to peak torque were found similar between individuals with facilitatory KT, sham KT, and not taped. They concluded that placebo effects may attribute for the positive findings in previous studies of KT.

However, in that particular study, the inhibitory effect of KT was not examined. In addition, that deceptive study only measured the

* Corresponding author.
E-mail address: roy.cheung@polyu.edu.hk (R.T.H. Cheung).

http://dx.doi.org/10.1016/j.jsams.2015.01.010
1440-2440/

muscle strength but the neuromuscular response, in terms of the electromyographic (EMG) activity, remains unknown. Therefore, the aim of this study was using a deceptive design to examine the neuromuscular activity of the wrist extensor muscles and the maximal grip strength with facilitatory, inhibitory KT application, and without KT application in healthy adults who are ignorant about KT. We hypothesized that there would be no within-subject difference in the root mean square of the EMG activity and the maximal grip strength when the participants were applied with facilitatory KT, inhibitory KT, and not taped.

2. Methods

A total of 33 healthy adults were recruited by convenient sampling. In order to ensure all the participants were ignorant about taping, prior to experiment, they were asked to list all the prophylactic and rehabilitation equipment in sportsmen they could think of. Two of them were excluded as they were able to name "tape", "adhesive plaster", "adhesive ribbon", or equivalent. All enlisted participants were also free from any known cardiopulmonary conditions and previous surgery in the tested upper extremity. In addition, they were free of any active joint pain or other related symptoms in the recent 12 months. The concerning ethical review committee reviewed and approved the experiment procedures and written consents were obtained from the participants.

Before testing, each participant performed 15 repetitions of wrist stretching exercise of the dominant hand as warm-up followed by a one-minute rest. Immediately following application of KT, all participants were then asked to perform a maximal power grip for thrice, with each attempt lasted for approximately 3 s. One-minute rest was given between trials. Grip strength was quantified by a Jamar dynamometer (Model J00105, Lafayette Instrument, IN, USA) while the handle position and testing position were standardized.[20] Surface EMG activity of the wrist extensors was simultaneously measured using Ag/AgCl electrode (SX230, Biometrics Limited, Newport, UK). In order to reduce skin impedance, the skin of the tested forearm was shaved, cleaned with alcohol, and lightly abraded with sandpaper. A circular hole of the same size of the EMG electrode was produced by a puncher so that the contact surface area was identical between different taping conditions. Conductive gel was applied to the electrode, which was positioned longitudinally along the muscle belly of the wrist extensor group (Fig. 1). The EMG signal was pre-amplified (×330), band-pass filtered (10–3000 Hz), and sampled at 1000 Hz. The root mean square (RMS) of EMG was computed from the middle 1-s time window during the maximum grip strength test. There was a seven-day washout period between testing sessions.

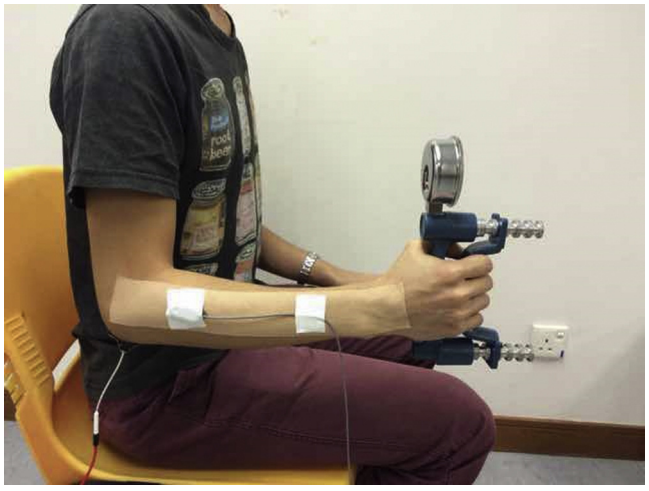

Fig. 1. EMG measurement of the wrist extensor muscles with Kinesio tape application.

The participants were blindfolded during the entire experiment so that they were unable to realize the actual purpose of the experiment. They were told that we might apply a series of adhesive muscle sensors in order to examine the muscle recruitment but we applied different KT conditions in a randomized order indeed. The KT conditions were "facilitatory KT condition" (FKT), "inhibitory KT condition" (IKT), and "tapeless condition" (NKT). In FKT condition, we applied KT onto the skin overlying the wrist extensors of the dominant forearm. KT was applied from the direction of origin to insertion with 75% of its maximal length tension, which is proposed to provide muscle facilitation effect.[6] The tension of KT was confirmed by the anthropometric measurement of the tape i.e. measure the change in length of tape before and after stretched. In IKT condition, the procedure and the tape contact area were identical with FKT condition except the application direction was reverse i.e. from insertion to origin, which is proposed to provide muscle inhibitory effect.[21] In NKT condition, no tape was applied on the participants.

After testing in each condition, we also collected subjective feedback about their performance (VAS: 0—worst performance; 10—best performance). All of them were explained with the true purpose of the experiment after the end of the third testing session. They were immediately given a debriefing session about the deception upon the completion of the experiment.

All data was analyzed using SPSS version 17 (SPSS Software, Chicago, IL, USA). Repeated measures ANOVA was used to test the within-subject effects of KT i.e. RMS–EMG activity, maximal grip strength, and the self-perception on the performance at different taping conditions. The global alpha level was set at 0.05.

3. Results

In the debriefing session, we confirmed that 31 participants (14 females; age = 23.7 ± 2.7 years; mass = 62.5 ± 12.3 kg; height = 1.70 ± 0.09 m) were successfully deceived and they were ignorant about KT. No significant difference was found in the maximum grip strength between FKT (22.4 ± 16.2 kg), IKT (22.9 ± 15.6 kg), and NKT (23.5 ± 16.7 kg) ($p = 0.327$). Likewise, there was no significant difference in the RMS–EMG between the three taping conditions (FKT = 0.287 ± 0.117 mV; IKT = 0.273 ± 0.148 mV; NKT = 0.249 ± 0.104 mV; $p = 0.076$). Besides, the self-perceived performance in different conditions were similar ($p = 0.041$) (Fig. 2).

4. Discussion

This study examined the true effects of facilitatory and inhibitory KT on the muscle activity and functional performance in deceived participants. Our findings were consistent with our original hypotheses that, with the elimination of placebo effect, KT did not facilitate or inhibit muscle activity and change the functional performance in healthy adults.

Previous experiments reported inconsistent findings about the effects of KT on the EMG activity. For instance, Briem and colleagues reported that application of KT did not alter the muscle activity in male athletes during a sudden perturbation.[22] Conversely, Yeung et al. found a significant shorter time required for taped muscle to generate peak torque.[7] Such inconsistent can be explained by the different psychological belief about KT in the tested participants in the experiments,[23,24] as most of them did not provide effective measures to eliminate the placebo effects. Regarding the grip strength, our findings were in accord with the study by Kuo et al.,[18] which also reported no immediate change in the grip strength by

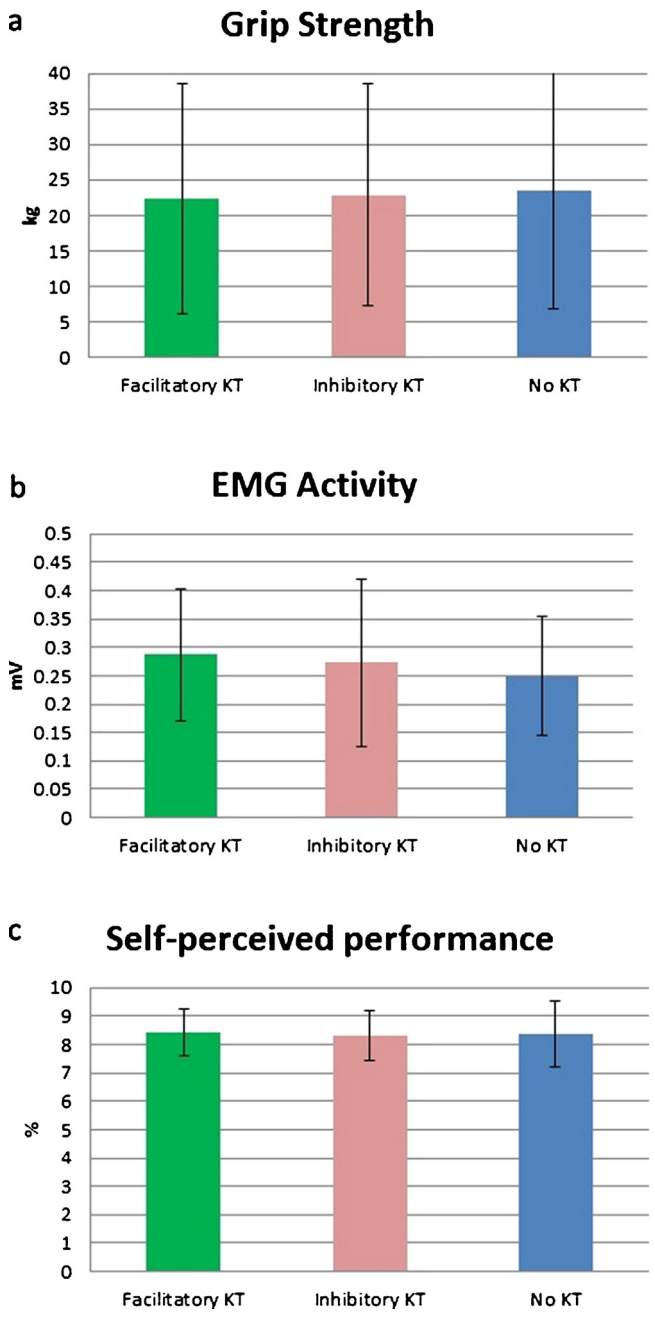

Fig. 2. Grip strength (a), root-mean-square electromyographic activity (b), and self-perceived performance (c) with facilitatory KT, inhibitory KT and no KT.

either facilitatory or inhibitory KT. Interestingly, Kuo et al.[18] found significant facilitatory and inhibitory effects after 24 h of KT application, although they did not provide additional evidence to explain such phenomenon.

We adopted the study design of the previous deceptive study[19] which examined the true effects of KT as it successfully eliminated participants' individual belief on KT. The success rate to deceive the participant was very comparable between Poon et al.'s (30 out of 34) and our study (31 out of 33). Such high success rate reinforced the practicality of the protocol and this model can be referenced for future studies. However, we also expect a lower success rate if the experiment is conducted in athletic population or sample with extensive understanding of sports gear.

Placebo effect is a psychological phenomenon which can be attributed to alter the condition and performance because the expectations of the individual changes their beliefs and behavior leading to a more positive outcome.[23,24] Previous studies have suggested that placebo may provide analgesic effects[25] and promote motor function.[26] Similar findings have been reported among athletes for sport performance enhancement. Most of the athletes believed that placebo effects could influence sport performance and admitted to having experienced placebo effects themselves.[23,24] Although there is limited knowledge about placebo mechanisms, our findings suggest that there is a strong relationship between belief and performance which could affect the accuracy of experimental research.[24]

There were several limitations in this study. First of all, this study only examined an immediate effect after taping. Prolonged effects of KT have been reported in a previous study.[18] An investigation of the carryover effect is, therefore, warranted, though a longer follow-up deceptive study may not be very feasible. Second, the current study only recruited healthy adults. Our findings may not be generalized to other populations such as athletes and patients under rehabilitation. Future research might investigate the effects of KT in participants with a history of injury. Third, we did not examine the effects of sham tape in this experiment. An experiment with a sham group may further enhance the understanding of its working mechanism.

5. Conclusions

Our findings do not support the claimed functions of KT on the modulation of muscle activity and force generation by facilitatory or inhibitory techniques. Clinical application of KT for muscle activity promotion or inhibition may be overstating.

Practical implications:

- Facilitatory KT did not promote muscle activity or increase force generation.
- Inhibitory KT did not reduce muscle activity or reduce force generation.
- Clinically, alternative method should be used for muscle activity modulation.

Acknowledgements

None.

References

1. González-Iglesias Javier, Fernández-de-Las-Peñas César, Cleland Joshua A et al. Short-term effects of cervical kinesio taping on pain and cervical range of motion in patients with acute whiplash injury: a randomized clinical trial. *J Orthop Sports Phys Ther* 2009; 39(7):515–521. http://dx.doi.org/10.2519/jospt.2009.3072.
2. Yoshida Ayako, Kahano Leamor. The effect of kinesio taping on lower trunk range of motions. *Res Sports Med Print* 2007; 15(2):103–112. http://dx.doi.org/10.1080/15438620701405206.
3. Thelen Mark D, Dauber James A, Stoneman Paul D. The clinical efficacy of Kinesio tape for shoulder pain: a randomized, double-blinded, clinical trial. *J Orthop Sports Phys Ther* 2008; 38(7):389–395. http://dx.doi.org/10.2519/jospt.2008.2791.
4. Hsu Yin-Hsin, Chen Wen-Yin, Lin Hsiu-Chen et al. The effects of taping on scapular kinematics and muscle performance in baseball players with shoulder impingement syndrome. *J Electromyogr Kinesiol* 2009; 19(6):1092–1099. http://dx.doi.org/10.1016/j.jelekin.2008.11.003.
5. Słupik Anna, Dwornik Michał, Białoszewski Dariusz et al. Effect of Kinesio taping on bioelectrical activity of vastus medialis muscle. *Ortop Traumatol Rehabil* 2007; 9(6):644–651 (Preliminary report).
6. Wong Oscar MH, Cheung Roy TH, Li Raymond CT. Isokinetic knee function in healthy subjects with and without Kinesio taping. *Phys Ther Sport* 2012; 13(4):255–258. http://dx.doi.org/10.1016/j.ptsp.2012.01.004.
7. Yeung Simon S, Yeung Ella W, Sakunkaruna Yosawin et al. Acute effects of Kinesio taping on knee extensor peak torque and electromyographic activity after exhaustive isometric knee extension in healthy young adults. *Clin J Sport Med* 2014 (in-press).

8. Jaraczewska Ewa, Long Carol. Kinesio taping in stroke: improving functional use of the upper extremity in hemiplegia. *Top Stroke Rehabil* 2006; 13(3):31–42.
9. Yasukawa Audrey, Patel Payal, Sisung Charles. Pilot study: investigating the effects of Kinesio taping in an acute pediatric rehabilitation setting. *Am J Occup Ther* 2006; 60(1):104–110.
10. Chang Hsiao-Yun, Chou Kun-Yu, Lin Jau-Jia et al. Immediate effect of forearm Kinesio taping on maximal grip strength and force sense in healthy collegiate athletes. *Phys Ther Sport* 2010; 11(4):122–127. http://dx.doi.org/10.1016/j.ptsp.2010.06.007.
11. Williams Sean, Whatman Chris, Hume Patria A et al. Kinesio taping in treatment and prevention of sports injuries: a meta-analysis of the evidence for its effectiveness. *Sports Med* 2012; 42(2):153–164.
12. Ridding MC, Brouwer B, Miles TS et al. Changes in muscle responses to stimulation of the motor cortex induced by peripheral nerve stimulation in human subjects. *Exp Brain Res* 2000; 131(1):135–143.
13. Maratou E, Theophilidis G. An axon pacemaker: diversity in the mechanism of generation and conduction of action potentials in snail neurons. *Neuroscience* 2000; 96(1):1–2.
15. Kalichman Leonid, Vered Elisha, Volchek Lio. Relieving symptoms of meralgia paresthetica using Kinesio taping: a pilot study. *Arch Phys Med Rehabil* 2010; 91(7):1137–1139. http://dx.doi.org/10.1016/j.apmr.2010.03.013.
16. Terri M, Skirven A, Lee Osterman et al. *Rehabilitation of the hand and upper extremity, 2-volume set: expert consult*, Philadelphia, Elsevier Health Sciences, 2011.
17. Vercelli Stefano, Sartorio Francesco, Foti Calogero et al. Immediate effects of kinesiotaping on quadriceps muscle strength: a single-blind, placebo-controlled crossover trial. *Clin J Sport Med* 2012; 22(4):319–326. http://dx.doi.org/10.1097/JSM.0b013e31824c835d.
18. Kuo Yi-Liang, Huang Yueh-Chu. Effects of the application direction of Kinesio taping on isometric muscle strength of the wrist and fingers of healthy adults—a pilot study. *J Phys Ther Sci* 2013; 25(3):287–291. http://dx.doi.org/10.1589/jpts.25.287.
19. Poon KY, Li SM, Roper MG et al. Kinesiology tape does not facilitate muscle performance: a deceptive controlled trial. *Man Ther* 2015; 20(1):130–133. http://dx.doi.org/10.1016/j.math.2014.07.013.
20. Trampisch Ulrike Sonja, Franke Julia, Jedamzik Nina et al. Optimal Jamar dynamometer handle position to assess maximal isometric hand grip strength in epidemiological studies. *J Hand Surg* 2012; 37(11):2368–2373. http://dx.doi.org/10.1016/j.jhsa.2012.08.014.
21. Kase K, Wallis J, Kase T. *Clinical therapeutic applications of the Kinesio taping method*, Tokyo, Ken Ikai Co. Ltd., 2003.
22. Briem Kristin, Eythörsdöttir Hrefna, Magnúsdóttir Ragnheidur G et al. Effects of Kinesio tape compared with nonelastic sports tape and the untaped ankle during a sudden inversion perturbation in male athletes. *J Orthop Sports Phys Ther* 2011; 41(5):328–335. http://dx.doi.org/10.2519/jospt.2011.3501.
23. Beedie Christopher J, Foad Abigail J. The placebo effect in sports performance: a brief review. *Sports Med* 2009; 39(4):313–329.
24. Beedie Christopher J. Placebo effects in competitive sport: qualitative data. *J Sports Sci Med* 2007; 6(1):21–28.
25. Qiu Yun-Hai, Wu Xin-Yin, Xu Hao et al. Neuroimaging study of placebo analgesia in humans. *Neurosci Bull* 2009; 25(5):277–282. http://dx.doi.org/10.1007/s12264-009-0907-2.
26. Benedetti Fabrizio, Mayberg Helen S, Wager Tor D et al. Neurobiological mechanisms of the placebo effect. *J Neurosci* 2005; 25(45):10390–10402. http://dx.doi.org/10.1523/JNEUROSCI.3458-05.2005.