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Original article

Acute effects of reverse kinesio taping on anaerobic performance in healthy subjects: a pilot study

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Abstract. *Study Objectives:* This study aimed to determine whether the Kinesio tape (KT) application through reverse taping on the quadriceps (Q) and hamstring (H) muscles have any effect on anaerobic power (AP). *Methods:* Sixteen healthy males were included in the study voluntarily. Muscle facilitation and muscle inhibition techniques were performed on the Q and H muscles of both the right and left sides by applying KT in the reverse direction, and AP parameters were measured using a Wingate ergometer. In trial 1 (Baseline), KT was not applied to the participants. In trial 2 (KT), the muscle facilitation technique was applied on the vastus medialis muscle in the Q of both legs, and the muscle inhibition technique was applied on the biceps femoris and semimembranosus muscles in the H, and AP performances of the participants were taken. The SPSS 22.0 software was used for statistical analysis. Paired sample *t*-test was used to analyze the differences between trials. *Results:* KT gave higher values than Baseline with regards to peak power, relative peak power, average power, and relative average power ($p < 0.05$). In addition, as a result of the KT application, there were minor improvements in minimum power, relative minimum peak power, power drop, and peak power %. However, these differences were not statistically significant ($p > 0.05$). *Conclusions:* It was observed that KT applied in the reverse direction on the Q and H muscle groups had a positive effect on AP. It was considered that this effect associated with the reverse KT application stemmed from the different tensions that decreased the neuronal threshold, which in turn ensured faster and easier stimulation of motor units and increased the muscle reflex, leading to a positive effect on AP.

Key words: Anaerobic Power, Kinesio Taping, Reverse Taping

Introduction

Improving the performances of athletes involves not only training methods relevant to their branch of sports but also a focus on diet and nutritional supplements (1,3) as well as other methods such as psychological interventions, clothing that externally support muscles, and cutaneous afferent applications that stimulate the peripheral nervous system (4,6). One of the methods used to increase the performance of athletes is the Kinesio tape (KT) application, a type of cutaneous afferent application. KT was developed by Dr. Kase in 1973, it is often applied with other methods and is one of the most commonly used taping methods currently (12,15) for increasing the blood flow toward the applied muscle group to provide increased nutrition to the muscle, for preventing athlete injuries (7), for the treatment of injured athletes and decreasing pain (8), for easy recovery, for increasing muscle power and performance (9), and for developing other components of athletic performance (10,11).

Various researchers have noted that KT provides a high degree of tension in the direction of contraction and movement of the muscle group to which it is

applied (up to 50%–75% of its original length); there are two types of application methods for KT in terms of the effect it has on muscle power (16,17). The first technique is called "muscle facilitation," and involves KT application from the point of origin of the muscle toward its point of insertion with a tension of 50%–75% to increase the contraction of the muscle. The second technique is called "muscle inhibition" and involves KT application from the point of insertion of the muscle toward its point of origin with a tension of 15%–25% to decrease the contraction of the muscle (6).

Anaerobic capacity is defined as the ability to provide the necessary energy for muscle contraction via the phosphagen and glycolytic systems (18). Consequently, it is expected that an improvement in the anaerobic energy system will cause direct improvement in muscle power and anaerobic threshold, along with an indirect improvement in the aerobic system, and thus will have a positive impact on athletic performance. Previous studies have demonstrated that the anaerobic system is directly related to the isokinetic muscle strength used in both phosphagen and glycolytic systems, which in turn are directly associated with anaerobic performance (19,20). Moreover, it is known that the increase in the athletic performance associated with the improvement in anaerobic power (AP) directly contributes not only to the protection from anaerobic activity at the beginning stage of the exercise but also to increase the time that passes before the beginning of the anaerobic threshold and to delay muscle fatigue (21). It is observed that while researchers have examined the effects of KT on muscle power, endurance, athletic performance, and AP with different taping methods, they have not reached a consensus regarding the negative or positive effects of KT on these components. However, several studies have demonstrated that KT applied through various taping methods leads to positive developments in these components (17,22,27).

Our study hypothesized that the muscle facilitation method applied on the vastusmedialis (VM) in the quadriceps(Q) muscle group and the muscle inhibition method applied on the biceps femoris (BF) and semimembranosus (SM) muscles in the H muscle group positively affect anaerobic performance. Based on all the aforementioned information, the primary objective of this study is to determine whether the muscle facilitation and muscle inhibition techniques applied with KT on the VM in the (Q) muscle group and the BF and SM muscles in the hamstring (H) muscle group have any effect on AP as a consequence of KT's impact on muscle strength. In addition, it is considered that the current study is important as it is the first to analyze the effects of reverse taping on AP.

Materials and Methods

Experimental Design

The study was designed according to a cross-sectional and experimental design in which aerobic performance parameters before and after reverse kinesio banding were compared in healthy individuals. Based on this design, the effect of KT on AP was analyzed by performing reverse taping through the muscle facilitation and muscle inhibition techniques on the VM muscles in the Q muscle group and the BF and SM muscles in the H muscle group of both legs. The participants visited the laboratory three times at 24-h intervals. At the first visit, the participants were informed regarding the test protocols to be implemented; their height, weight, and body mass index measurements were obtained; and a pilot application was performed for the anaerobic test protocol that would be performed in the following visits with the Wingate ergometer. At the second visit, AP measurements were taken without any KT in the participants (Baseline). At the third visit, muscle facilitation was applied on the VM muscle and muscle inhibition was applied on the BF and SM muscles of the participants with KT, and their AP measurements were taken (KT). During the application period of KT, the participants were instructed not to perform any other exercise or physical activities. The applications were performed at the same time of the day (14:00–16:00). Informed consent forms were obtained from all participants in our study, and the study was designed and performed in compliance with the Helsinki Declaration. Ethics committee approval of the study was obtained from Gümüşhane University Scientific Research and Publication Ethics Committee (2021/1).

Participants

Sixteen healthy males (mean age: 20.61±1.26 years; height: 1.76±0.06 m; weight: 75.31±7.67 kg) with at least 3 years of regular physical activity were included in the study voluntarily (Table 1). GPower 3.1. program was used to determine the number of subjects. The inclusion criteria were having regular physical activity at least for the past 3 years and not having had any injuries. People with <3 years of regular physical activity and participants with any history of injury were excluded from the study. Participants were excluded if they had musculoskeletal injuries or surgery that may affect performance in the last 6 weeks before the study.

Collection of Data

Determination of descriptive information

A Gaia 359 Plus Body Pass analyzer was used to find out the height, weight, and BMI parameters of the subjects. Before the measurements, the device was introduced to all the subjects and they were asked to stay as quiet and as immobile as possible during the test. An individual demonstrated the test with the analyzer to help the subjects understand it. The subjects stood on the analyzer with bare feet, wearing a t-shirt and shorts, and their height (m), weight (kg), and BMI values were recorded.

Determination of anaerobic power

The Wingate ergometer was used to assess AP. The subjects were asked to sit on the ergometer and place their feet on the pedals, to which their feet were fixed. The initial posture for measurement required all participants to maintain their body angle at a 75-degree inclination, with a 10-degree angle between the handle of the bicycle ergometer and the elbow. Each participant was set as 0.8* body weight (in Nm), the figure for adult male athletes. The participants sat on the ergometer and warmed for 3 minutes at 60 rpm to establish a heart rate of 120-125. A 5-second countdown was used to signal to the participants to pedal with all their strength for 30 seconds immediately after the command "Start". After 30 seconds, the participants were allowed to have active rest for 10 seconds at 60 rpm and 100W. Verbal encouragement was given to the participants to exert maximum effort (28).

Table 1. Descriptive data (n: 16)

	Mean	SD
Age (year)	20.61	1.26
Height(m)	1.76	0.06
Weight (kg)	75.31	7.67
BMI (kg/m²)	24.09	2.10

SD: Standard Deviation; BMI: Body Mass Index

Mechanical power indices

The mechanical power outcomes were automatically measured during the test by the computer software. Wingate indices were then calculated including; [1] peak power (PP) defined as the greatest mechanical power production in any 5-s interval, [2] average power (AP) defined as the mean power production sustained throughout the 30-s test period, [3] minimum power (MP) defined as the lowest power production in any 5-s interval, [4] power drop (PD) defined as the degree of power drop-off during the test duration, and [5] the time to peak power (TTPP) defined as the time (sec) until peak power value is reached. PP, AP, MP, and PD were calculated and recorded in watts (W) and watts per kilogram body weight (W/kg) and TTPP was recorded in sec (s).

KT application

To examine the effects of the muscle facilitation and muscle inhibition techniques performed with KT on the Wingate AP test, muscle facilitation at high tension (50%–75%) was reciprocally applied from the point of origin of the VM to its point of insertion, whereas muscle inhibition at low tension (25%) was applied from the point of insertion of the BF and SM to their point of origin, and Wingate AP test measurements were taken. Before the KT application, the Q and H regions of the participants were epilated and cleaned, and it was ensured that the applications would be performed in the most suitable manner (6,29,30).

Statistical Analysis: SPSS version 22.0 (SPSS Inc., Chicago, Illinois, USA) program was used for statistical analysis, and all figures were visualized using the GraphPad Prism 8.4.3 program (GraphPad Software Inc., San Diego, CA, USA, free trial). The data were presented as mean, minimum, maximum and standard deviation (SD). Assumptions of normality were analyzed by the Shapiro–Wilk test. Paired samples t-test was used for the analysis of the differences between the applications (pre and post KT application). The statistical p values <0.05 were considered to indicate significance.

Results

When the anaerobic power parameters between trials were examined statistically, study results showed that kinesio tape application's PP (763.86±137.83; -4,033), RPP (10.26±1.65; -3.543), AP (535.43±76.21; -3.654) and RAP (7.17±0.66; -2.885) values were higher than the baseline PP (739.49±123.69), RPP (9.98±1.54), AP (520.95±73.96) and RAP (6.98±0.65) values, respectively, mean±SD with t ($p<0.05$) (Figure 1, 2). On the other hand, when the baseline PD (434.75±106.19), MP (304.73±65.19), relative minimum peak power (RMPP) (4.06±0.64) and TTPP (2.69±1.42) values were compared with the KT (451.91±138.52; 319.04±52.86; 4.19±0.47; 2.86±1.57) respectively, no significance was found in PD, MP, RMPP, and TTPP($p>0.05$). However, the results showed that there was a minor improvement in trials KT(Figure 1, 2, 3).

Discussion

The main objective of this study was to analyze the effect of muscle facilitation and muscle inhibition techniques performed through the reverse taping on KT on AP in the Q and H muscles. The anaerobic performance was primarily evaluated by measuring peak power and average power. Peak power is an indicator of the phosphagen energy system capacity (short <10-s supra-maximal exercise), whereas average power evaluates the capacity of phosphagen and

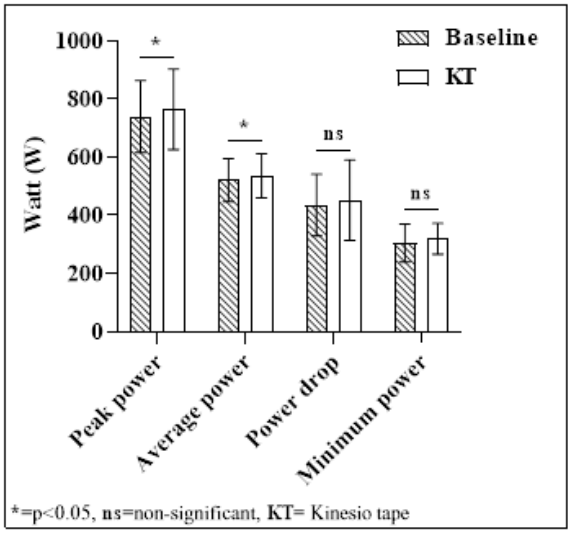

Figure1. Analysis of anaerobic power parameters of subjects between trials (n: 16)

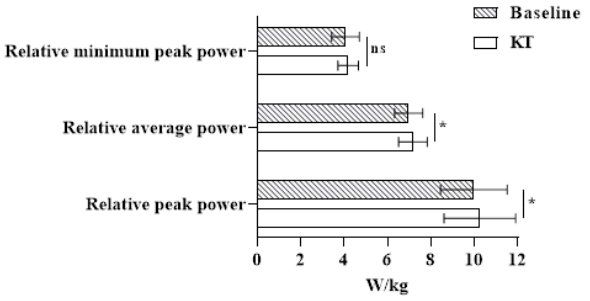

Figure 2. Anaerobic power parameter results per kilogram of subjects (n: 16)

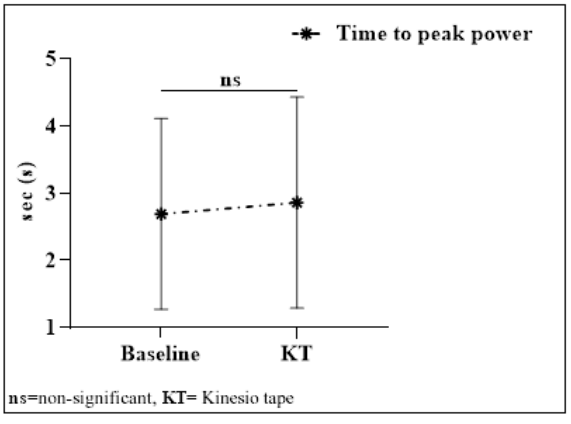

Figure 3. Time to peak power parameter difference between trials

glycolytic energy systems (exercises of 20–60 s long) (31). The major finding of this study was that after KT application, there was a significant positive increase in the peak and average power parameters, which are the most fundamental indicators of AP ($p < 0.05$).

Studies examining the effects of KT on muscle power with different taping methods have reported that KT plays an effective role in increasing muscle power (25,32,33). However, other studies have reported that KT does not have any acute effects on different contraction types and different angular speeds (12,23,25,26,34). Similarly, it has been reported by researchers that KT applied to muscle groups and various joints do not have an acute effect on isokinetic power (27,30,35). Another study showed that KT does not affect muscle power (35). In their review, Williams et al. (36) stated that only 38% of participants showed an improvement in power after the KT application. Although researchers have not reached a consensus regarding whether KT has a positive or negative effect on muscle power and AP, it is known that KT application decreases the duration of maximum working power (as measured by isokinetic dynamometers) and increases muscle activation in anaerobic systems (12,21,34). When analyzed from this perspective, it is unclear whether KT has a positive or negative effect on the power measurements performed about AP. While there are certain studies in literature conducted on the direct effect of KT on anaerobic performance through various taping methods (20,37,39), there are no studies that directly analyze the effect of KT on AP through reverse taping via the muscle facilitation and muscle inhibition methods.

In previous studies that have been directly conducted about AP, participants were asked to perform the 30 s Wingate anaerobic test, which was also used in our study. Most of these studies performed KT before the tests, as was also the case in our study, and their acute effects on AP were examined. Harmanciet al. (39) found that there was a small improvement (2%) in the power performance after KT application but stated that the results were not statistically significant. Trecroci et al. (38) found in their study that there was a significant increase in peak power results and total work state in the group with the tape application compared with the group without tape application. However, there were no statistically significant differences between the two application methods. It was shown that tactile stimulation of KT applied longitudinally provides positive effects on sprint cycle performance in healthy and active participants. However, Szymuraet al. (37) determined that KT performed after eccentric exercise has a positive effect on anaerobic performance and recovery. In a study by Kim and Seo (20), KT was applied on the rectus femoris muscle of the Q muscle, and a clear increase was observed in the AP (peak power and mean power) in the trial where taping was performed. In the same study, it was stated that although KT positively affects athletic performance capacity, it does not affect the anaerobic threshold. In parallel with the results of our study, previous studies have stated that KT application has a positive effect on anaerobic performance indicators. Based on the physiologic examination, Jones et al. (40) stated that owing to its positive effect on neural activations, muscle power, and muscle fibers, KT application will also have positive effects on muscle power when applied for certain periods alongside various training programs. The positive effects that KT application has on muscle power when applied at certain intervals through special training methods were demonstrated in certain studies (41), which confirms the hypothesis of Jones et al. (21). Conversely, Ridding et al. (42) described that increasing motor unit stimulation in both the central and peripheral nervous system through cutaneous afferent applications leads to greater stimulation of the motor cortex, which in turn increases muscle activation. Moreover, there are also studies demonstrating that cutaneous applications decrease the neuron threshold, resulting in faster and easier stimulation of motor units (43). According to Hsu et al. (32), the increase in muscle activations can increase the tension in the taped muscle, thereby increasing the muscle reflex and by extension, the muscle activation. However, according to certain researchers, even if the cutaneous application of KT can increase muscle activations by changing motor neuron stimulations, this increase is not strong enough to affect power (12).

In conclusion, it was determined that the muscle facilitation and muscle inhibition techniques of KT applied on the VM muscle in the Q muscle group and the BF and SM muscles in the H muscle group with

the reverse taping approach has a positive effect on AP. It is believed that this increase was due to the faster and easier stimulation of the motor units as a result of a decrease in the neuron threshold because of the different tensions formed in the Q and H muscle groups owing to the reverse KT application and the positive effect of the facilitation technique on AP by increasing the tension and reflex of the muscle. In parallel with this, reverse taping had a positive effect on athletic performance and other performance parameters concerning AP. It is considered that the small differences observed in the results of the present study and other studies could have been caused by the differences in the study protocols, including differences related to various study features (the tension of the tape and contraction of the muscles), the different exercise methods, and the performance assessments.

Limitations

A controlled group is essential to prove the effectiveness of KT application for eliminating evaluation limitations. In addition, only VM muscle was facilitated, and BF muscle was inhibited and on the contrary, VM muscle was inhibited and CF muscle was not facilitated. This is one of the limitations of our study in terms of predicting reverse banding completely.

Conflict of interest: Authors declare no conflict of interest

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