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Inhibitory Effect of the Kinesio Taping® Method on the Gastrocnemius Muscle

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Abstract The Kinesio Taping® method has been studied widely for its claims as a therapeutic taping technique designed to enhance performance and treat a variety of orthopedic, neuromuscular, neurological and other medical conditions. The applications of the Kinesio Taping® method are numerous and this intervention offers a broad range of research inquiry into its effectiveness. This study focuses on the performance benefits of the application of the Kinesio Taping® method. Specific attention was given to the inhibitory effects of the tape application on the gastrocnemius muscle group. Taping for muscle inhibition is indicated when a muscle is overactive as seen in muscular spasm. This study found that the Kinesio Taping® method was effective in inhibiting the muscle activity of the gastrocnemius muscle group without decreasing the performance output of the participants. This is clinically significant for clinicians who are progressing return to activity in patients who are recovering from a lower extremity injury, but still have some functional limitations from their injury. **Purpose:** This research study attempted to determine the effect of Kinesio® Tex Gold™ Tape on muscle inhibition when the tape is externally applied to a muscle group. **Method:** The participating athletes were measured by a Vertec© vertical jump device to determine height jumped as well as the BIOPAC Systems, Inc. (Goleta, CA) MP150 electromyography (EMG) machine to determine the amount of muscular activity. The participants were asked to complete nine single leg jumps on their dominant leg before being taped with Kinesio® Tex Gold™ Tape. The initial three jumps were performed as a warm-up, three more were performed while using the Vertec© to measure jump height, and the final three were performed while attached to the EMG machine to measure electrical activity in the gastrocnemius muscle group. After the initial jumps, each participant's dominant calf was then taped with Kinesio® Tex Gold™ Tape. The tape was applied from insertion to origin to test the inhibitory effects of the Kinesio® Tex Gold™ Tape. After the tape was applied, each participant completed six more maximal vertical jumps on their dominant leg. The first three jumps measured muscular activity, and the last three jumps measured vertical jump height. **Results:** EMG results demonstrated a significant decrease in electrical activity. Electrical activity decreased for 20 participants (74%) while it increased for 7 participants (26%). The decrease in electrical activity found was (t (26) = 2.551, p = .017). The results of the vertical jump test using the Vertec© showed that in the 27 participants, 52% showed an increase in vertical jump height after the Kinesio® Tex Gold™ Tape was applied, 37% showed a decrease in vertical jump height after the application of the tape, and 11% of the participants had no change in vertical jump height. No significant difference was found in the vertical jump height between the without tape and with tape trials (t (26) = -1.120, p = .273). **Conclusion:** Based on this research, it can be concluded there is statistical evidence to show a difference in muscle activity after application of Kinesio® Tex Gold™ Tape. The values obtained from the EMG showed a majority of the participants had a decrease in muscle activity during a single leg vertical jump after being taped. The data found during the study supports the inhibitory basic application technique [2].

Keywords: *Kinesio Taping®, vertical jump, muscle activation, muscle inhibition*

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1. Introduction

Created by Dr. Kenzo Kase in the 1970's in Japan, the Kinesio Taping® method eventually made it to the United States in the 1990's. It gained greater worldwide recognition after appearing in the 2008 Olympic Games held in Beijing, China [1]. According to Dr. Kenzo Kase, the Kinesio Taping® method provides multi-day benefits for approximately 3 to 4 days. It can treat orthopedic or neuromuscular conditions, dependent upon the application process [2].

There are many proposed effects which can be gained from using the Kinesio Taping® method. The Kinesio®

Tex Gold™ Tape can be used to normalize muscle function, improve lymphatic and blood flow, reduce pain, correct joint misalignment, and improve proprioception [3]. With the over 1200 recognized applications, there has been proven effects on the following body parts and systems after being applied with Kinesio® Tex Gold™ Tape: skin, fascia, muscles, ligaments, tendons, joints, lymphatic system, and circulatory system [4]. Numerous professional sports such as football, baseball, basketball, cycling, soccer, golf, and tennis use the Kinesio Taping® method [4]. It is designed to be used alongside other treatments such as manual therapy, modalities, and therapeutic exercises [4].

The tape is made of 100% high grade cotton and is latex free. The hypoallergenic tape is heat activated [4]. The thickness of the tape is designed to replicate the thickness of the epidermis. Because of these properties, a single application of tape can remain in place for 3-4 days. It can be worn while bathing, or even swimming. The tape, while still on the paper wrapping, is approximately on a 25% stretch. It is capable of being stretched to 35-40% of its overall resting length. This design allows it to replicate the stretch of muscles and skin. Lastly, a certain amount of stretch/tension must be correctly applied to meet the desired needs. Basic applications require the tape to be applied on a muscle while it is in a stretched position. The stretch of the muscle along with the stretch in the tape may cause convulsions in the skin [2]. It is suggested that these convulsions cause microscopic lifting of the skin which aids in blood and lymphatic flow. These effects help to decrease pain by lifting pressure off the pain receptors [3].

The tape can be applied using various shapes, such as an "I", "Y", "X", "fan", "web", and "donut". The "Y" technique is the most common used when facilitation or inhibition of a muscle is desired. The base of the "Y" is applied approximately 2 inches beyond the origin or insertion of the muscle, depending on the desired effect. The tails of the "Y" are then applied in a fashion that surrounds the muscle. The treatment of muscles typically involves taping from either the origin to the insertion, or the insertion to the origin. When taping from the origin to the insertion, the tape facilitates the muscle. For muscle spasms or over used muscles, the muscle would be taped from insertion to origin to inhibit muscle function. In this approach, the tape is applied at 15-25% tension, or paper-off tension [2].

This study used the "Y" strip application to inhibit the gastrocnemius muscle. With this method, the validity of the inhibitory effect of Kinesio® Tex Gold™ Tape could be measured.

Measurements of single leg countermovement vertical jump height were gathered with the use of the Vertec© (Sports Imports, Hilliard, Ohio) stationary tool used to measure overall vertical height. This assisted in determining if an inhibitory effect would or would not have a direct impact on functional performance. The final component of the study was incorporating the use of the EMG machine, which measures the electrical activity of the muscle. This tool determined the extent to which the Kinesio Taping® method affected the decrease in activity of the target muscle.

2. Methods

2.1. Participants

This research study was conducted with 27 healthy varsity athletes on various athletic teams at an undergraduate institution. The participants' ages ranged from 18 to 23 years. The 21 female and 6 males who participated are approximately 10% of the student athlete population. The following sports were represented: men's and women's track & field, men's and women's basketball, men's and women's soccer, women's cheerleading and volleyball. No subjects had recently participated in high intensity workouts prior to their participation in the study. None of the participants involved in the study had a recent history of lower extremity injury or impairment.

2.2. Procedures

Before participating in the study, the athletes were informed on the process of the experiment and asked to sign an informed consent form approved by the Human Subjects Review Board of the above mentioned undergraduate institution.

All subjects were instructed to perform 3 maximum single leg countermovement jumps on their dominant leg. These jumps were used as a warm-up to familiarize the participants with the testing protocol. Participants then completed three more countermovement maximal vertical jumps on their dominant leg while using the Vertec© to measure the jump height in inches. The height of each jump was recorded individually and then were later averaged. The participants executed 3 additional single leg jumps while connected to the EMG machine to measure muscle activity of the gastrocnemius. Prior to electrode placement, each participant's skin was shaved, abraded and wiped with an alcohol pad to increase conductivity. Bipolar surface electrodes (Model #EL503, BioPac Systems, Inc., Goleta, Ca.) were placed on the skin superficially to the medial and lateral gastrocnemius muscle bellies and the ground lead was attached to the medial malleolus according to the Clinical SEMG Electrode Sites [6] (see Figure 1).

Figure 1. Electrode Placement

The EMG signal was collected on the BioPac MP150 and the gains were set for the TEL 100 transmitter at 2K with a filter of 0.5 Hz. The EMG signal was sampled at 1000 Hz, amplified (analogue differential amplifier, common mode rejection ration >110 dB, total gain 412, noise <0.1μV), analogue –to-digital converted (16-bit) using the AcqKnowledge 4.1 Software (BioPac Systems,

Inc., Goleta, Ca.) [6] and stored in a personal computer for later analysis. No EMG normalization procedures were included in this study's methodology. Participants were then instructed to complete 3 maximal jumps while attached to the EMG machine.

Following those 3 jumps, Kinesio® Tex Gold™ Tape was applied. Kinesio® Tex Gold™ Tape was applied on the dominant leg using a "Y" strip to the gastrocnemius muscle according to the standards of the Kinesio Taping® Lower Extremity Work Book (2) [3]. Participants were instructed to lay prone in a relaxed position on an examination table with the foot hanging off the table. The tape was measured from base of the calcaneus to the middle of the popliteal fossa (Figure 2a). An additional 2 inches was added to the measurement as is standard when using a "Y" strip (Figure 2b).

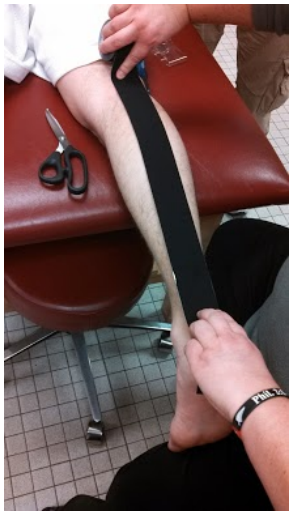


Figure 2a. Step 1: Measure tape length and apply base

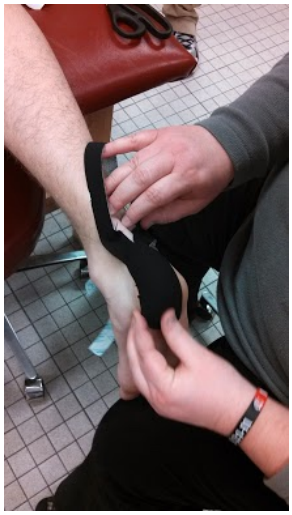


Figure 2b. Step 2: Cut Medial and Lateral Strips

A "Y" strip was cut. The base was applied on the plantar surface of the calcaneus and was rubbed to activate adhesion. The Certified Kinesio Taping Practitioner (CKTPs) then pushed the foot into end range passive dorsiflexion. The tails of the tape were applied with paper off tension to surround the medial and lateral bellies of the gastrocnemius (Figure 3a & Figure 3b). The medial and lateral tails ended approximately at the femoral condyles (Figure 4). The tails were then rubbed to activate the adhesive.

Figure 3a. Step 3: Apply Medial Strip

Figure 3b. Step 4: Apply Lateral Strip

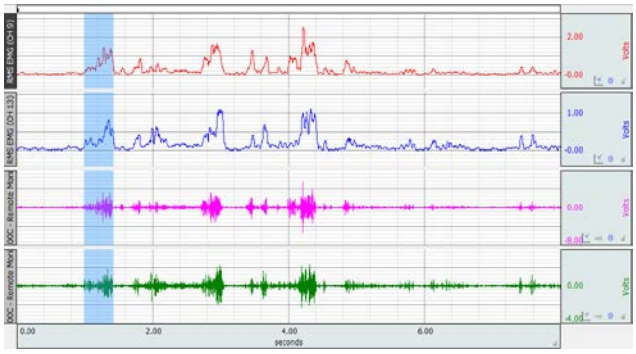
Figure 4. Step 5: Final product/Activate adhesive by rubbing down tape

After 10 minutes, the participants were then reattached to the EMG machine and instructed to perform 3 more jumps under the previous conditions. Participants completed both sets of jumps with electrodes attached consecutively to prevent electrodes from losing conductivity. Finally, the athletes were disconnected from the EMG and performed their final 3 maximal countermovement vertical jumps with the tape applied and using the Vertec© to measure each jump height

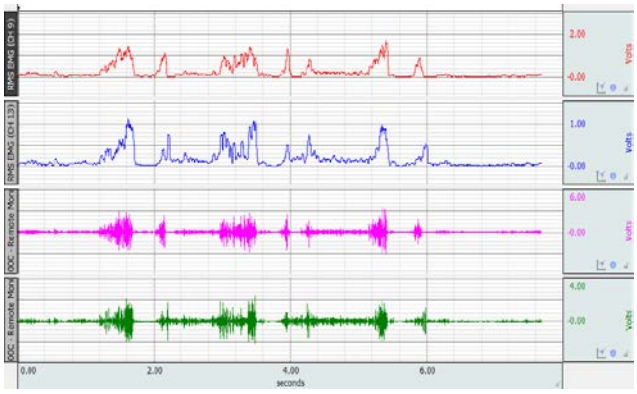
2.2. EMG Processing

The raw EMG data from the medial and lateral gastrocnemius were processed by AcqKnowledge

Software[7]. The raw EMG signal was filtered using a band-pass between 10 and 500 Hz, and then the signal was full-wave rectified with a Root Mean Square (RMS) with the time interval set to 30 milliseconds. For this study the time began as the EMG signal exceeded the baseline. The pre-flight phase of jumps 1, 2, and 3 were evaluated separately in order to determine the values of total time length (< 1 sec.) of the pre-flight phase and the total amount of muscle activity or area under the curve (Graph 1). The same process was used to analyze the time of contraction and pre-flight muscle activity of the 3 jumps before and after the Kinesio® Tex Gold™ Tape was applied to the athletes' gastrocnemius (Graph 2) [7]. The EMG activity of the medial and lateral gastrocnemius was only analyzed during the pre-flight phase. The muscle activity for the 3 without tape jumps were averaged, and the same was done for the with tape jumps. The results were recorded in a separate Excel spreadsheet. All data are presented as mean and standard deviations for vertical jump (Graphs 3 and 4) and muscle activity (Graphs 6 and 7). Differences between the means in the vertical jump height and muscle activity for the without tape and with tape jumps were analyzed with a paired samples t-test. The Statistical Package for Social Sciences (SPSS) was used for statistical analysis, with the level for significance being set at 0.05.



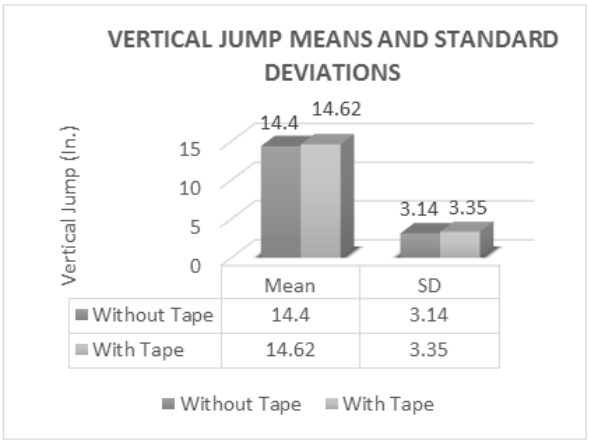
Graph 1. An example of BIOPAC Systems, Inc. MP150 EMG results for athlete without the application of Kinesio® Tex Tape (Jump 1 pre-flight)



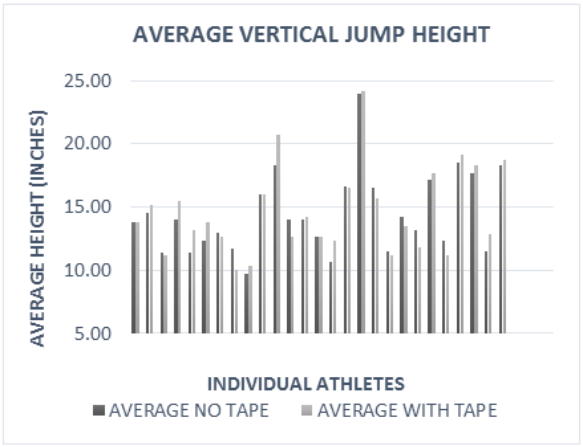
Graph 2. An example of BIOPAC Systems, Inc. MP150 EMG results for athlete with the application of Kinesio® Tex Tape

3. Results

The three vertical jumps with and without tape measured by the Vertec© were averaged. A paired-samples *t* test was calculated to compare the mean vertical jump height without tape to the mean with tape score. The mean vertical jump score without tape was 14.40 in. (*sd* = 3.14) and the mean on the with tape was 14.62 in. (*sd* = 3.35) (Graph 3). No significant difference from without tape to with tape was found (t (26) = -1.120, p = .273). The vertical jump test revealed no significant change of height jumped with or without the athlete being taped (Graph 4).

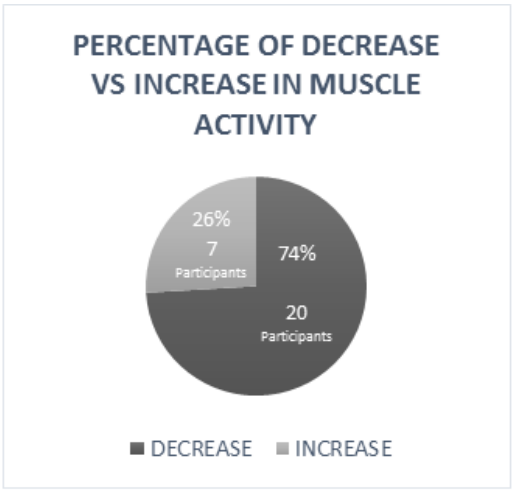


Graph 3. Results of the Vertical Jump Height



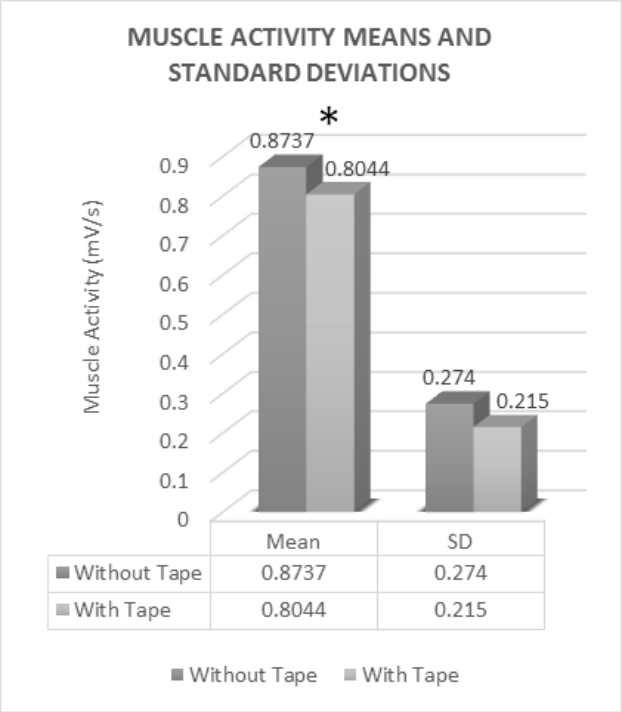
Graph 4. Individual Results of the Vertical Jump Height with/without tape

Individually, 74% (20 participants) showed a decrease in muscle activity with the Kinesio® Tex Gold™ Tape applied; while 26% (7 participants) showed an increase in muscle activity (Graph 5).

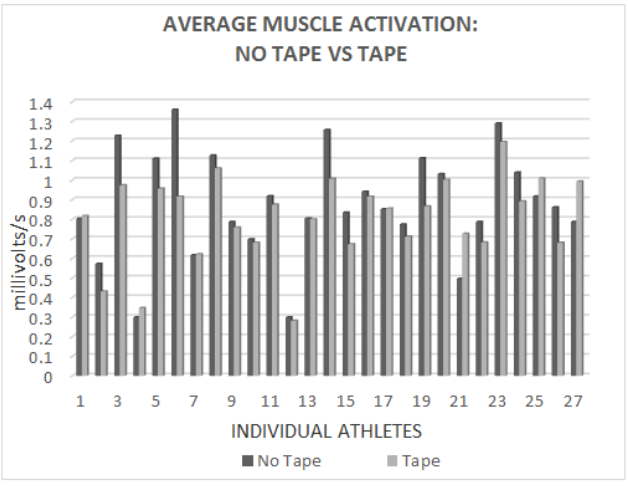


Graph 5. Percentage of Participants who Increased vs. Decreased in Amount of Muscle Activity

The without tape and with tape EMG results were analyzed and compared. The values of the medial and lateral gastrocnemius were combined for each athlete to better understand total gastrocnemius activity. A paired-samples *t* test was calculated to compare the mean muscle activity without tape to the mean with tape score. The mean muscle activity without tape was 0.8737 mv/s (*sd* = 0.274) and the mean on the with tape was 0.8044 mv/s (*sd* = 0.215) (Graphs 6 and 7). A significant decrease from without tape to with tape was found (t (26) = 3.263, p = .017).



Graph 6. Results of the Muscle Activity; * p< 0.05



Graph 7. Individual Results of the Muscle Activity with and without tape

4. Discussion

Based on this study, differences were observed between jumps when participants were taped and when they were not taped. The results of the jump height measured by the Vertec© showed half of the participants' jump height increased, but the data collected by the EMG showed muscle activity decreased. When taped, the increased vertical jump heights could have been a result of learned gains and familiarity [8].

This study was designed to investigate the validity of Kinesio® Tex Gold™ Tape to inhibit muscular activity in the gastrocnemius. The data appears to support claims of the Clinical

Therapeutic Applications of the Kinesio Taping® Method (2nd edition), which states the desired outcome for the insertion to origin tape technique is inhibition of a muscle. According to the manual, "For acutely over-used or stretched muscles, the tape is applied from insertion to origin to inhibit muscle function [2]." Many believe that applying an external aid (taping, bracing, etc.) cannot affect an internal pathology. The findings of this study did not wholly agree with existing research on this topic and research methodology. Janwantanakul and Gaogasigam's study showed there were no significant differences in EMG activity of the vastus lateralis and vastus medialus during the application of inhibition and facilitation tapes when compared with no tape condition [9].

The EMG data comparing without tape and with tape jumps contradict other studies which have come to the conclusion of tape not having a significant effect on muscle activity. According to the study by Cools, Witvrouw, Danneels, and Cambier, tape had no major impact on EMG activity in muscles of the shoulder girdle in subjects with good overall health [10]. A study by Lumbroso, Ziv, Vered, and Kalichman looked at the force production in the gastrocnemius and hamstring groups while being taped with the Kinesio Taping® method to inhibit muscle activity. They measured force production 15 minutes after application and again 48 hours after application. They found a significant increase in force production of the muscles 48 hours after the initial tape application [11].

A separate study looked at the effects of facilitating muscle function for vertical jump by using the lateral ankle sprain taping technique by Dr. Kenzo Kase. They had experimental and control groups of participants, the experimental group's tape was applied with 140% of its maximal length and the controls group's tape was applied with paper off tension. Participant's maximal vertical jump was measured for a pre-test, post-test, and 24 hours after tape application. This study found no significant difference in the heights jumped over the three trial periods [12].

The data collected in this study shows that the application of the Kinesio® Tex Gold™ Tape did have a significant effect on electrical activity of the gastrocnemius muscle. As a result, it appears that the insertion to origin taping technique does inhibit the ability for the taped muscle to function fully. It toned down the muscle activity but not enough to have a functional related difference. The vertical height showed no significant different between the without and with tape measurements. Other muscles may have helped to compensate for the "turning down" of the gastrocnemius, resulting in no significant change in the height jumped.

It is important to note the study tested healthy, uninjured college-aged athletes. The Kinesio Taping® manual states that it is designed to inhibit the activity in either an over-used or over stretched muscle, which

already have decreased stimulus [2]. It appears the Kinesio® Tex Gold™ Tape may also have the ability to inhibit the activity in a healthy, uninjured muscle.

5. Conclusion

Based on this research, it can be concluded there is statistical evidence to show a difference in muscle activity after application of Kinesio® Tex Gold™ Tape. The values obtained from the EMG show a majority of the participants did have a decrease in muscle activity during a single leg vertical jump after being taped. The data found during the study supports the inhibitory basic application technique [2].

Future studies could focus on the effects facilitation techniques can have on muscle activity for possible performance enhancement. Also, other research can take a more in depth approach of studying the inhibitory taping technique. This can be done by looking at more participants, using a force plate to measure vertical ground reaction force, using intramuscular EMG electrodes, and wearing the tape for a longer period of time before testing. Having a control and a placebo group may help to find a greater change in statistical evidence. A study could divide participants in half, testing the inhibitory effect on half the participants and the effects of facilitating muscle function on the other half.

This study could have been limited by the small percentage of student athletes tested. Athletes from a variety of sports may have distorted data collection in the study. Different performance demands and training methods for each sport could affect the ratio or use of slow twitch and fast twitch muscle fibers. Athletes may have been worn out from doing several maximal vertical jumps within a limited period of time. An alternate warm-up such as biking could have been used to limit the number of jumps being performed. In order to make sure learned effect had no influence on the jump height or muscle activity, the group could have been split in half. Half of the group could have performed the tests with tape first, and then performed the tests without tape and vice versa for the second group.

Additionally, many studies relating to the Kinesio Taping® method are published in other languages. While not insurmountable, this does create a barrier in the investigative process. Many studies are case studies which lack a control group and are performed on healthy patients, similar to this study. Lastly, many studies perform evaluation and collect data immediately after application of the Kinesio Taping® method.

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