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Effects of Kinesio Taping and Ankle Taping on a Drop Landing Into a Vertical Jump

Salvatore Ferranti Jr.

BARRY UNIVERSITY

COLLEGE OF NURSING AND HEALTH SCIENCES

EFFECTS OF KINESIO TAPING AND ANKLE TAPING ON A DROP LANDING INTO A VERTICAL JUMP

BY

SALVATORE FERRANTI JR. ATC, LAT

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Abstract

Taping applications are commonly used for athletes' ankles to prevent injuries from occurring. Various types such as prophylactic tape and kinesio tape claim to limit injury and benefit the athlete. The purpose of this study is to investigate the effects of lower leg closed basket weave ankle taping, Kinesio taping, and the two methods of taping combined on vertical ground reaction forces (vGRF) and neuromuscular activity in the gastrocnemius and anterior tibialis, following a single leg drop landing followed immediately by maximal vertical jump. Methods: forty-one collegiate athletes (24 Male and 17 Female) performed a single leg drop landing followed immediately by vertical jump using various tape conditions on the ankle and lower leg. Results: Significant differences were found in the vertical jump phase with Kinesio tape with Ankle tape (KAT) producing the least amount of forces during the jump phase, as well as the amount of muscle activation of the anterior tibialis in the KAT condition ($p<0.05$). No significant differences were found in drop landing vGRF and lateral gastrocnemius muscle activation between the four tape conditions. With significant findings in the results, regarding the KAT condition it can be concluded that the type of taping intervention may inhibit functional movement.

Key Words: Taping Application, Electromyography, Ground Reaction Force, Muscle Activation

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Introduction

The ankle is the foundation of the body and often gets treated in sports for the constant rigors required. The most common intervention used for the ankle joint is prophylactic ankle taping which entails a closed basket weave.[24] The closed basket weave is used for support and stability of the ankle joint.[15] Yet, in certain studies, it has been determined that after certain time has elapsed with the ankle tape on during exercise the tape job no longer has the stability and support it first had.[26] In recent years a new intervention such as Kinesio Tape with elastic properties to allow full range of motion has become a popular in sports medicine.[29] However, this tape does not have the same properties nor does it get applied the same as non-elastic tape. Research of Kinesio Tape has seen some benefits of neuromuscular adaptations as well as landing forces, but a definitive answer has yet to be determined.[4]

Many studies have investigated ankle taping or Kinesio taping and only a seldom amount of studies have looked into the comparative effects between the two.[7] In most recent studies ankle taping has been examined in terms of force production and ground reaction forces (GRF) [1,21,31,34]. Kinesio Tape has been investigated predominately for neuromuscular activation of the muscles that the tape is targeting[5,8,13,33]. Although some areas of research such as balance and proprioception have been examined and have found to show effect both types of ankle taping[23]. With addition to testing the effects of ankle and lower leg taping, most researchers have used healthy subjects rather than subjects with ankle instability or weakness. To simplify, this may be because of a possibly larger number of athletes who get their ankles taped, without having ankle issues or limitations in strength and range of motion, than those with ankle instability, weakness or injuries.

This would suggest a larger focus is need on athletes who do apply some sort of taping application to their ankle or lower leg on a consistent basis.

To reiterate, ankle taping applications are being used regardless of people having ankle sprains, weakness or are healthy individuals. Therefore, it can be assumed that taping can be used as a form of stabilization, yet the duration and limits of specific kinds of tape are limited. Thus, examining the effects of taping applications can determine if in fact they are beneficial or damaging to the people who are using tape for support. Both closed basket weave ankle taping and Kinesio taping are popular methods in today's sport medicine world. If there was sufficient information that showed taping limits muscle activation, increased ground reaction force and decreased force production, that could be used to show that the use of taping for injury prevent may not be beneficial and is potentially predisposing people to ankle sprains and other injuries within the lower leg. A new and innovative study should be conducted to test and analyze the two taping methods to determine how both ankle tape and Kinesio Tape effect the movements of the ankle and lower leg, thus giving practitioners a better understanding as to what intervention may be suited for use on the ankle joint.

Statement of Problem

There is an inadequate amount of data showing the effects of taping a closed basket weave for the ankle and Kinesio Tape on the lower leg in kinetic and neuromuscular activation. Few studies have looked at the both taping methods, as well as the kinetic and neuromuscular activation, yet there has been limited findings on the application of both tapes being applied in conjunction with each other.

Purpose of study

The purpose of this study is to investigate the effects of closed basket weave ankle taping, Kinesio taping the lower leg, and the two methods of taping combined on force production, ground reaction force and neuromuscular activity in the gastrocnemius and anterior tibialis, following a drop landing into a vertical jump.

Hypotheses

1. The ankle tape in conjunction with Kinesio taping will significantly decrease peak eccentric vertical ground reaction force production at the time of the landing, then compared to ankle taping, Kinesio taping, and no taping.
2. Ankle taping will have a significant increase in peak concentric vertical ground reaction force during the vertical jump when compared to the Kinesio Tape and ankle tape and no taping during application.
3. The amount of muscle activation for the anterior tibialis from touch down to time of take-off will significantly increase in Kinesio Tape with ankle taping when compared to ankle taping, Kinesio Tape, and no tape during the time the subject is in contact with the ground.
4. There will be no significant differences between the amount of muscle activation in the lateral gastrocnemius from touch down to time of take-off between all four conditions during the time the subject is in contact with the ground.

Variables

Independent variable

1. Four taping interventions

Dependent variables

1. The peak GRF by the participants during the landing phase of the drop box landing.
2. The amount of peak GRF by the participants during the jumping phase.
3. The amount of muscle activation for the anterior tibialis by the participants from touch down to time of take-off.
4. The amount of muscle activation for the lateral gastrocnemius by the participants from touch down to time of take-off.

Controlled variables

1. Participants will be student athletes who are currently enrolled from a southern Florida University.
2. All participants will be free from any ankle injury in the past six months. If any ankle injury was sustained within six months leading up to this study, participation is dependent on the primary researcher's evaluation of previous medial history.

Operational Definitions

1. **Anterior Tibialis**: that originates in the upper two-thirds of the lateral aspect of the tibia and inserts into the medial cuneiform and first metatarsal bones of the foot. It's muscle actions are to dorsiflex and invert the foot.[25]
2. **Athletic Tape**: (non-elastic tape) is light, adhesive and support to the area of application making it appropriate for use in sports.[25]
3. **Closed basket weave ankle taping**: a taping technique that offers rigid and stable support to the ankle joint for someone who may an ankle injury or ankle instability.[6]

4. **Electromyography**: assess the inhibition of motor neuron that transmit electrical signals.[8]
5. **Force**: a product of mass times acceleration.[9]
6. **Gastrocnemius**: the primary muscle in the calf as it originates at the medial and lateral condyles of the femur and inserts into the tendo calcaneus (Achilles tendon). It's muscle actions is to plantar flex the foot and flex the knee.[25]
7. **Kinesio Tape**: (elastic tape) light, adhesive, and stretchy for increased tension, that can be applied for days anywhere on the body, for muscles and joints due to its unique properties and effects to the skin/[16-17]
8. **Kinetics**: The forces acting upon a mechanism.[27]
9. **Muscle Coactivation**: A phenomenon where a muscle activates coordinately with another muscle.[30]
10. **Proprioception**: The unconscious movement of the body regarding spatial position responding to stimuli.[12]

Assumptions

1. The Force Plate, Delsys EMG, computer software, statistical analysis programs are valid and reliable.
2. Each tape intervention applied will contain the same pieces and applied for each subject.
3. The primary researcher will randomize the order of taping interventions between subjects.
4. Each subject will give maximal effort each time while conducting themselves during the research testing.

Limitations

Limitations of this study include:

1. Participants are not able to perform the given tasks
2. Participants do not complete the given tasks to their full capability
3. Participants will not be excluded if they are current users of ankle taping.
4. Participants will not be excluded if they sport does not require a large amount of jumping.

Delimitations

1. The study design will only use student athletes who are currently enrolled in Barry University.
2. This did not control any physical activity, diet, or sleep of the participant's days prior to testing.
3. Limited to athletes without an ankle injury for 6 months.

Significance of study

For years, clinicians in medical health care fields have use taping interventions as a preventive measure to reduce injuries at the ankle joint. As research has shown, interventions have altered, force production, ground reaction force, and muscle activation[5,21,31]. It can be stated that taping has led to biomechanical changes in muscle activation, strength, and proprioception when doing simple actions[1,18,30]. Many researchers would agree that constant use of taping techniques can put the athlete at risk of injury[8,13,23,31,34].

Allied health care professionals have begun to use research as a support reasoning to certain clinical applications and treatments in their respective fields. Looking primarily

at the athletic training and this study, many of the professionals in clinical field spend most time taping athletes. With tape being a common practice and application to the average athlete, health care professionals need to understand the benefits or risks, especially since there are new types of tape emerging such as Kinesio Tape, to make the necessary adjustments for the athletes who may use either type of tapes.

This study will investigate ankle taping and Kinesio Tape in combination to analyze the impact of the ankle in terms of force production, ground reaction force, and muscle activation and coactivation between the gastrocnemius and anterior tibialis. This area of research and information is important to the sports medicine field for many reasons. First, to examine the effects of both tapes applied in combination with each other during dynamic movement. Secondly, to see if there are any significant benefits or possible risks to the taping methods be applied. Third, to determine findings suggesting certain individuals need ankle tape, Kinesio Tape, both, or not all, when examining their force production, ground reaction forces, and muscle activation.

Literature Review

The purpose of this research study is to investigate the effects of closed basket weave ankle taping compared to Kinesio taping the lower leg in terms of force produced, ground reaction force absorbed and neuromuscular activity of the gastrocnemius and anterior tibialis, in a box drop landing countermovement jump.

The ankle is the foundation of the body and often warrants treatment in sports for the constant rigors required[24]. The ankle bears more weight per unit area than any other joint in the body[19]. Ankle sprains are the most common injuries in a variety of sports[32]. Superior proprioception is needed for to participate in sports or complete activities of daily life. Proprioception can be impactful regarding injuries in not just sports, but everyday life. Ankle proprioception may be one of the more important components contributing to balance control in sports, because during most sports activities, the ankle-foot complex is the only part of the body contacting the ground[25].

The most common mechanism of injury to the ankle ligaments is inversion of the foot[10]. Mechanisms of injury with the joint such as plantarflexion and dorsiflexion can determine what the injury may be, as well as be a predictor of which structures are damaged[10]. Despite inversion ankle sprains being the most common injury, other sports in the ankle and lower leg can occur as well. Ligament sprains such a deltoid ligament spring due to excessive eversion and dorsiflexion and spraining the anterior and posterior tibiofibular ligaments also known as a high ankle sprain[28]. Muscles strains and pain become present due factors such as overuse, excessive loading, and improper technique of movement[28]. Fractures in the foot and lower leg occur during traumatic repetitive stress due to forces being applied to the ankle joint[12]

Throughout the years, the closed basket weave is used for support of the ankle joint[15]. Closed basket weave ankle taping has become a customary application in athletics and sports medicine. Yet, in certain studies, it has been determined that after time has elapsed with the closed basket weave ankle tape on during exercise, the tape's properties diminish and loses the stability and support it first had when applied[26]. In recent years, a new taping application called, Kinesio Tape, with elastic properties to allow full range of motion has become a popular in sports medicine[29]. However, this tape does not have the same properties nor does it get applied the same as non-elastic tape. Nevertheless, research of Kinesio Tape has seen some benefits of neuromuscular adaptations as well as ground reaction force and force production, but a definitive answer has yet to be determined[7]. Many studies have examined either ankle taping or Kinesio taping and only a seldom amount of studies have considered the comparative effects between the two, yet no information on a combination of tapes must be concluded[4]. When analyzing previous literature and scientific finding of closed basket weave ankle taping and Kinesio Tape, the kinetics and neuromuscular activation can be classified to better understand this topic.

Ankle Anatomy

The ankle has been described as the formation of the tibia, fibula, and talus, commonly called the ankle mortise, while the subtalar joint is formed by the talus and calcaneus[25]. The ligaments around the ankle can be divided, depending on their anatomic position, into three groups. One, is the stabilizing ligaments in the ankle are the anterior tibiofibular and posterior tibiofibular, also referred to as syndesmotic ligaments[10,25]. Second, is the lateral ligaments, which include the anterior talofibular ligament,

calcaneofibular ligament, and posterior talofibular ligament, known as the talocrural joint. Third is the deltoid ligament, which contains four ligaments within itself is known as the medial group[28]. Lateral muscles of the ankle include peroneus muscle bundle called peroneus longus, brevis, and tertius, which are responsible for eversion[25]. The Gastroc-Soleus complex is a part of the posterior ankle via the Achilles tendon and is responsible for ankle plantarflexion[25]. The anterior tibialis, responsible for dorsiflexion works opposite to the gastrocnemius and soleus as all three muscles can generate a substantial amount force requiring dynamic stability by the tendons and ligaments in the ankle. Understanding the anatomy of the ankle ligaments is important for correct diagnosis and treatment[19].

Testing Proprioception

Proprioception is an essential ability for static and dynamic movement that can greatly benefit people with proper training. Proprioception has three major components that allows individuals to move quickly, effectively while being precise[12.] Agility, balance, and coordination are controlled by the proprioceptors within the body[12.] Proprioception in the ankle joint is especially important due to much of the body weight being loaded and absorbed during any dynamic action. Its relationship with generated forces and neuromuscular activation is also impacted by any application applied to the body, specifically at the ankle. One study has looked at the incorporation of proprioceptive exercises to 116 volleyball players[32]. With the use of 14 balance exercises to improve proprioception, the results of ankle sprain incidences significantly decreased. The ankle sprain incidence rate was 0.5 times per 1000 playing hours in the intervention group and 0.9 times in the control group. Showing that the ankle injury incidence in the

intervention group risk difference was 0.4 less times per 1000 playing hours. Simple interventions such as balance exercises can benefit athletes. Another study has drawn similar conclusions following a study of balance trials on a force plate[18]. Kiers[18] et al used 100 participants to be put through a sequence of 9 balance tests, stable and unstable, with some vision impairment to test the proprioceptive levels of these subjects. It was found that after testing multiple environmental conditions proprioceptive levels increased on unstable surfaces[18]. Thus, gathering that by challenging the participant and targeting the ankle through exercises, the participant will benefit from training programs. Though this may not always be the case according to Smith et al[30], who investigated 40 subjects with functional ankle instability out of the University of Indiana, found strength exercises to develop the muscles around the ankle joint but no difference in force sense errors. Abian-Vicen et al[1], researched static and dynamic testing of ankle taping during balance tests and drop box countermovement jump using a 40-cm plyometric box. It was concluded to have no effect on balance in the static aspect of research, but a 12% increase in second peak vertical force in the dynamic movement. It was also noted that the possible limited effects of exercises on proprioception may occur prior to study noting healthy participants may limit findings. Static movements in research are valuable, yet limited when being applied clinically due to the dynamic movements that are responsible for most injuries.

Tapes in Sport Medicine

Many past studies have investigated the different types of sport tapings. For the ankle, interventions such as power tape, prophylactic, Kinesio Tape, power flex all have been used for clinical treatment[1,20,22,31]. The main theory behind these tapes is to help

prevent injuries to the ankle region. The most popular intervention for closed basket weave ankle taping ankle taping known as prophylactic "athletic tape"[22]. Prophylactic tape has been used for countless people, and sport teams around the world[34]. Conversely, a trending taping technique in sports medicine is Kinesio Tape created by Dr. Kenzo Kase[33]. Previous studies have investigated use of prophylactic ankle taping and strips of Kinesio Tape to test balance and proprioceptive levels in the ankle and lower leg[1,20,30,32].

Research studies exploring taping interventions for athletes and recreationally active people has not stopped there. Although the focus of prophylactic taping for the ankle has been to determine the level of stability provided in the joint[31]; ankle tape has shown to increase vertical force when landing[1]. This could be due to decreased muscle activation seen when tape is applied[34]. Whereas, Kinesio Tape is often examined for the neuromuscular benefits that are claimed to occur when being on placed directly on the skin. Kinesio Tape has recently been studied for similar effects on the lower leg and ankle[4,5,11,14]. Majority of modern researchers have examined muscle activation through EMG[4,5]. Multiple studies have shown significant differences between the taping techniques of ankle taping and Kinesio Tape[1,11,14,20,22,31]. Although many authors have found conclusive results regarding ankle tape and Kinesio Tape, there is still a lacking comparative. With taping being an integral and popular part of the sport medicine world further research needs to be conducted.

Purpose of ankle taping

Ankle taping is a clinical intervention technique used in sports medicine. Ankle taping is a common practice that has been used for many years for health care professionals to prevent ankle sprains[20]. The most common mechanism for an ankle

sprain is excessive inversion usually accompanied by slight plantarflexion and some internal rotation[6.] In a study by Callahan, it was noted that ankle taping is often governed by personal preference of the athlete or patient, the experience of the person applying the tape, and a general "feel" as to the correct technique for everyone. This may be due, in part, to the lack of comparative studies between the different taping techniques for clinicians and people who frequently get their ankle taped[6.] Although ankle taping does improve the mechanical stability of the joint, evidence has displayed a decrease in effectiveness on restriction of range of motion during workouts[6]. This article helped provided in depth detail of how ankle taping over time may become ineffective.

The correspondence of tape durability of ankle taping must also be considered when being applied, as it has been shown in other studies tape may lose its effectiveness as the length of time of the activity increases[2]. Specifically, Ashton Miller et al[2], reported a decrement in effectiveness may occur in as little as 10 minutes of exercise. Whereas other results from this study suggest taping can provide enough mechanical support to limit ankle motion even 30 minutes after walking on the treadmill[2]. Thus, it can be assumed that ankle tape can last to a certain point in physical exercise depending on the intensity. Benefits of using nonelastic ankle taping is the ability to decrease range of motion in excessive forces and stability to the joint. Some pitfalls of nonelastic tape for ankle taping is the durability of the tape, limited to joints and inability to be placed on muscles, and inflexibility. Ultimately, the purpose of ankle taping is to decrease the range of motions in the talocrural and subtalar joints, as well as reduce any excessive movements that could potentially lead to ankle injury leaving the joint susceptible to trauma.

Purpose of Kinesio Tape

Kinesio Tape began back in the 1970s by Dr. Kenzo Kase. It was a global sensation when it was used during the 2008 Olympics[33]. The application of Kinesio Tape on Olympic athletes sparked a massive intrigue and psychological belief of the benefits that Kinesio Tape may have. There has been two of the proposed potential benefits of Kinesio Tape which include the following: (1) correcting misaligned joints by relieving muscle spasm such as inhibiting the recruitment of muscle's motor units, and (2) improving range of motion through increasing blood circulation or through stimulation of cutaneous mechanoreceptors[22]. Researchers have begun to investigate the possible benefits of Dr. Kase's Kinesio Tape that claim to be made for its application use.

Although there has been a recent surge of Kinesio Tape popularity, research has been limited. One of the predicaments currently being faced by researchers are the lack of findings in testing the use of neuromuscular function. Williams et al examined various studies on Kinesio Tape and reported little to no benefits of Kinesio taping. Therefore, two arguments can be made, (1) the purpose of Kinesio Tape may not be considered a valid taping application due to previous findings, (2) is used for psychological benefits to the people who frequently place it on their bodies[33]. However, these hypotheses have not been validated[33]. Kinesio tape's ability to be versatile, used for multiple days with one application, and elasticity that can be used for many different areas of the body. However, Kinesio Tape is not as stable as nonelastic athletic tape and does not have the same rigid properties intended to reduce excessive range of motion. Indeed, there is limited scientific evidence evaluating the effectiveness of Kinesio Tape and the results are inconsistent and mixed as a deeper focus is warranted[22].

Ankle tape and Kinesio Tape application

As previously mentioned ankle tape has been traditionally used in sports medicine. The ankle tape technique has remained the same over dozens of years[20]. Knight et al[20] used 1.5-inch prophylactic tape for a closed basket weave ankle taping, covering the tendon of gastrocnemius to the midfoot. With the closed basket weave's specificity and consistency of application it can be considered a reliable application for treatment and injury prevention[20]. Kinesio Tape has some unparalleled properties when being applied to the body that makes it so versatile. Kinesio Tape can be placed on almost any part of the body. Frequently placed over muscle, bones and joints the application can vary for it purpose of edema, swelling control, and more[16,17]. Some studies have investigated the use multiple strips of Kinesio Tape to the lower leg in attempt to find decrease risks of ankle injury [8,11]. Both studies concluded the results to be lacking in certainty as they neither prove the Kinesio Tape to be beneficial or potentially risky. Another study of Kinesio Tape found the application improved balance after 48 hours of application[14.] Jackson et al[14], used subjects with chronic ankle instability to determine the effects of Kinesio Tape over a long period of time as the study went a full 72 hours following application. This is a worthy study as it shows the peak benefits of Kinesio Tape to occur at 48 hours. Limited significant findings between prophylactic and Kinesio Tape warrants more research regarding functional and dynamic movements.

Taping application and balance

Exercises are not the only intervention tested to develop proprioception. Another recent study out of Bloomington, Indiana by Simon et al[29], investigated the use of Kinesio Tape in subjects with functional ankle instability. Using 14 participants with

functional ankle compared to healthy individuals. At first functional ankle instability showed increased force sense errors during testing, however after 72 hours of the Kinesio Tape application, it was found that proprioceptive levels became congruent to the control group who have never been injured. Ankle taping has shown to be effective in proprioception and stability[23,31]. By limiting the movement of the ankle joint proprioception was increased to limit the excessive forces generated[23]. This implies that taping interventions can benefit athletes limited by their proprioception. As previously discussed, Abian-Vicen[1] et al did not have similar success regarding ankle taping generating superior balance. Rather improved balance may be attributed using training exercises and ankle strengthening[1.] Developing a strong proprioceptive body is beneficial to people such as athletes due to the constant position changes they face. Further studies with ankle taping and Kinesio taping needs to be reviewed to determine a definitive conclusion.

Kinetic forces with tape applications

Testing the effects of forces on taping applications at the ankle joint have been examined. Abian-Vicen et al[1], examined 15 healthy subjects around the age of twenty-one to partake in a static and dynamic collection. During this study, the use of prophylactic taping on the ankle during a countermovement jump from a 40cm box was performed to compare kinetic forces[1]. It was found there could report some notable but not significant findings. The second peak vertical force had a 12% increase in prophylactic taping compared to no tape, which may lead the participant susceptible to ankle injury. A similar study was conducted by Yi et al[34] was done with participants being tested before being taped, while taped, exercised with tape, and post taping. Yi et

al[34], had participants drop from a 40cm box using a single leg landing technique. It was found that there was an increase in ground reaction force and decrease of time to peak ground reaction force during the taped application testing. Therefore, it can be concluded in equivalence to Abian-Vicen et al[1], injury risk would increase in the ankle joint.

As for other kinetic research, balance, running and jumping have been analyzed in recent years. Koyama et al[21] investigated the time rate of force development and ground reaction force comparison of 12 healthy men countermovement jumping and squat jumping with and without ankle taping. It was found that at 35, 40, 45, 50, 55, 60, and 65% of total time of the contact phase in jumping performance were significantly smaller for ankle tape than no tape in the countermovement jump, but not in squat jump. Conversely, peak ground reaction force was not significantly different between the groups in either jump condition. Hence, countermovement jump was shorter due to the decrease in velocity. Stoffel et al[31] examined knee kinetics and kinematics, in subjects running and cutting with and without ankle tape. Stoffel et al[31] concluded that there were no differences in ankle tape for running angles or forces cutting with or without tape. However, it was noted that there was a peak internal rotation moment was reduced by 18% for both planned and unplanned tasks, which may cause more loading at the ACL.

Bovonsunthonchai et al[3] looked at 10 subjects who had functional ankle instability. Using Kinesio Tape and prophylactic tape had subjects perform a single leg drop landing from a 40cm, as well as doing a third set of trials with no tape. It was found that there were minimal reductions in the ground reaction forces in the taping conditions, yet no statistical differences occurred. Time to peak vertical ground reaction forces were significant among the three conditions, revealing Kinesio Tape to take the longest to peak

71.10 milliseconds (ms) ± 8.52 ms, but similar to no tape condition, 70.37 ms ± 10.13 ms, and non-elastic tape peaking significantly quicker, 62.63 ms ± 11.63 ms. To add to these findings, Fayson et al[8], focused more on the application of Kinesio Tape. Using 22 healthy subjects, ran three separate trials, one without tape, one just after Kinesio Tape application, and one following 24 hours of Kinesio Tape application. All three test conditions were within statistical norms of each, accordingly presenting no significant differences. Although many studies had significant findings, consistency within the research has not yet been achieved and additional exploration of time to peak, vertical forces, and contact phase with the ground.

Muscle activation with tape applications

Many previous studies, including ones that were previously discussed in this chapter, focuses on the neuromuscular effects of taping using electromyography (EMG). The use of EMG is to probe the neuromuscular activity within a specific muscle or muscles for analysis of inhibitory effects[5]. As previously suggested by Williams et al[33], the working mechanism of Kinesio Tape is unknown. However, Cai et al[5] believed the therapeutic effects of Kinesio Tape may due to the interplay between cutaneous afferent stimulation and motor unit firing in both central and peripheral nervous systems. Looking to investigate the inhibitory and facilitation effects of Kinesio Tape as well as no tape. Testing maximum grip strength and EMG, it was found that there were no significant differences from the 33 subjects, reporting Facilitatory Kinesio Tape = 0.287 ± 0.117 maximal voluntary contraction (mV); Inhibitory Kinesio Tape = 0.273 ± 0.148 mV; No Kinesio Tape = 0.249 ± 0.104 mV. This Testing was conducted immediately following application and can infer that Kinesio Tape does not have effects on neuromuscular as

soon as it is placed on the skin[5].

In a recent study the investigation of elastic tape was used for vertical jump to test GRF and EMG[13]. Using elastic tape, Kinesio Tape, and a placebo tape. Despite a significance in vertical ground reaction force in the Kinesio Tape group, the medial gastrocnemius had an increase in activation as well. This could be due to the gastrocnemius attempting to compensate for the vertical ground reaction force. As previously noted earlier in this chapter, Fayson et al[8], also researched the effects of Kinesio Tape. Compared to Huang et al[13] the muscle activity decreased in the anterior tibialis, specifically between the no tape to the immediate application of the Kinesio Tape. This shows that there is an effect of Kinesio Tape when it is first applied coinciding with other studies. Despite the consistency of research findings one study did change the trend. As discussed in the purpose of Kinesio Tape section, Martínez-Gramage et al[22] found significant changes regarding the Kinesio Tape group and EMG. Although the duration time of the lateral gastrocnemius activity was significantly shorter at the 72 hours post application mark through a Bonferroni test, however this was not accompanied by a significant reduction in amplitude of the muscle. Accordingly, these findings can be recognized as a possible outcome for future studies that investigate Kinesio Tape over multiple days.

Another study did not look at drop landing or running, rather the basic motion or function of the joint[4]. One study looked at the sudden inversion perturbation with Kinesio Tape, non-elastic tape and no tape, using a 10kg weight for the perturbation[4]. This simple test revealed significant increase in muscle activity of the non-elastic tape group[4]. This is a good example of how non-elastic tape can beneficial and increase muscle activation,

whereas Kinesio Tape did not. It should be noted that there was a lack of studies present involving ankle taping on muscular activation compared to Kinesio taping. This may be due to the amount of skin covered during a traditional ankle tape and may not produce the desired outcomes in the gastrocnemius, soleus and peroneus muscle group, specifically the peroneus longus. Nonetheless, this is a valid reason for further investigation in this topic.

Recent understanding and negatives of taping

With an increase of new studies being collected with better technology, equipment, testing protocols, researchers are finding the negatives of taping applications to the ankle and lower leg [6,8,20,21,33,34]. The use of taping interventions is constantly seen every day due to the use of tape in sports. From the Olympics to basketball or football prophylactic taping and Kinesio Tape is being used[33]. Indirectly people everywhere are creating a bad stigma that taping athletes miraculously works wonders and helps players return after an injury within minutes or play a tournament in dominating fashion due to the use of tape. Apart from the injury preventions and healing the two tapes do, improper use can lead to serious injury.

Summary

The ankle is the most commonly injured joint and bears the most weight. Health care professionals and clinicians, such as orthopedics, podiatrists, athletic trainers, physical therapist and more use countless methods and interventions to prevent damage to the ankle joint. The consistent intervention has been taping the lower leg in some manner. Closed basket weave ankle taping has been the traditional method of taping over the last few decades[30]. Meanwhile Kinesio Tape has vastly grown over recent years use due its television and market popularity. Despite their differences, prophylactic and Kinesio Tape have been examined together but results have been inconclusive and lacking depth. Often finding significance in one of the taping applications, only for another study to counteract their respective findings. Both interventions have shown to impact proprioception, force production as well as ground reaction force. While some authors have found decreased maximal voluntary contraction within the Kinesio and prophylactic taping. However, incorporation of exercise and use of the taping its effects following have been limited. One thing that is certain is the different properties of two types of tape, prophylactic being nonelastic and rigid and Kinesio Tape being elastic and flexible. So, attempting to perform a closed basket weave ankle taping versus Kinesio Tape would not be reasonably comparable.

There is a lack of scientific information regarding ankle tape and Kinesio tape in dynamic movements when in comparison with each other. Also, it should be noted the lack of consistency in biomechanical areas such as kinetic forces and neuromuscular activation in ankle tape and Kinesio tape when comparing the two. Therefore, a research study using ankle tape in conjunction with Kinesio Tape during a dynamic movement

needs to be examined. A proposed study of collegiate athletes completing a drop box landing followed immediately by a vertical jump measuring the aspects of the dynamic movement to determine if there are any factors in relation to injuries of the ankle joint. This study will examine the peak eccentric GRF in during the vertical jump, peak concentric GRF in the x-axis of the drop landing and ratio between the gastrocnemius and anterior tibialis from touchdown to takeoff during the dynamic movement.

Methods

Participants

Participants of this study will consist of male and females who are student athletes, from a Division II Institution in Southern Florida. Potential participants will be between the ages of 18-25 years old. 60 participants will be the anticipated number for this research study. Participants for this study will be recruited by flyers and word of mouth. This study will be completely voluntarily and no one will be coerced into participating and completing this research study. Declining to participate in this study or withdrawal from this study prior to completion will not impact their status as an athlete. Prospective participants must be free from having an ankle injury in the last six months prior to testing. Prospective participants must also be able to perform the following actions with no sign of pain or discomfort: (1) perform a drop box landing followed by a vertical jump, (2) repeat this process for all four conditions. Participants will be asked to report to the Motion Analysis Center at Barry University at their respective assigned time given by the primary investigator. Participants will also receive documentation approved by Barry University's Institutional Review Board and contact information with any questions or concerns.

Procedures

Participants will be given an informed consent form to read and sign prior to participation. This form provided, in detail, explains all procedures the participants will be asked to perform during the research study, as well as any contact information needed regarding the procedures of testing. Once consent is given and documented, participants will report to the Barry University Motion Analysis Center at their assigned times.

Participants will be asked to wear athletic clothing with access to the lower leg for taping. Participants will be given an identification number for the study. Participants will be asked through a questionnaire to report their age in years, gender, height in inches, weight in pounds and dominant leg. Their dominant leg will be determined by which leg they would use to jump forward. A warmup using a stationary bike for 10 minutes at consistent pace of the 60 revolutions per minute using a metronome app on the primary researcher's phone, followed by a dynamic warmup. The dynamic warmup will include two sets of high knees for 15 yards, two sets of butt kicks for 15 yards, and ten jump squats.

Participants will randomly be assigned to one of the 4 conditions: control group with no tape (CT), closed basket weave ankle taping (AT), Kinesio Tape (KT), and both ankle tape and Kinesio Tape (KAT). A certified athletic trainer will be onsite to apply each taping conditions. The certified athletic trainer also holds a certification for practical use of KT tape. The taping interventions will then be applied to their dominant ankle and lower leg of the participants. The participants will be setup by the primary researcher to be connected to the Delsys EMG electrodes. The skin will be prepped with alcohol electrodes over the target area of the EMG electrodes. Participants will be asked to shave if there is body hair covering the lower leg that may impede EMG electrode placement. The electrodes will be placed on the following muscles: anterior tibialis and lateral gastrocnemius muscle bellies. The placement will of the anterior tibialis will be placed on the proximal portion of the muscle belly just below the origin.

Figure 1. of EMG placement on anterior tibialis[4].

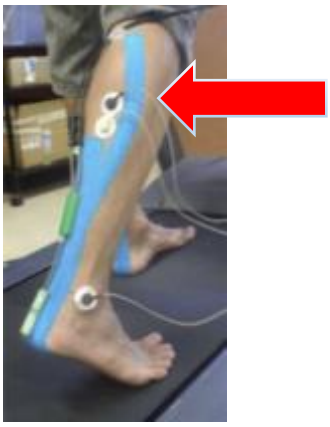

Figure 2. EMG pad placement of the lateral gastrocnemius[22].

The EMG electrodes will be secured with a strip of tape around the lower leg to keep them connected to the skin. The Bagnoli 8-system Delsys channel box will be placed on the backside of the participant's waistband. After the EMG is placed and secured on the muscle bellies, a static trial will be collected to measure body weight of each participant on the force plate. Then the primary researcher will demonstrate how to perform the drop box landing followed immediately by a maximum vertical jump. Participants will perform several practice jumps until feeling comfortable with the task. Participants will step up onto the box then follow the commands of the primary researcher. The plyometric box will be placed 20cm (7.8 in) behind the force plate. The

researcher will instruct them to perform a single leg drop landing on the force plate with both feet followed by a maximum vertical jump as high as they can, landing on the force plate again. A Tandem Sport Vertex will be used as a visual target. Participants will be allowed at least three practice jumps before doing the three trials that will be collected and analyzed for data. The primary researcher will collect data before and after the drop jump. Participants will be instructed to start with the phrase "Go." If the participant misses the force plate the trial will be repeated. Rest intervals between each condition will be at least three minutes, during that time the primary researcher will remove the previous tape condition and apply the next for data collection. Time of data collection for one participant will be needed from one hour and 30 minutes. Data collection of all four applications will be performed on the same day.

For any injuries that may occur during testing participants will be withdrawn. For care of potential injuries, participants will be referred to the Barry Student Health Center located in the Landon Student Union, room 104, phone number 305-899-3750.

Taping Procedures

Applying the closed basket weave ankle taping for this study will be performed as listed: the foot will be placed on a table in front of the clinician in 90º at the talocrural joint. Adherent spray will be applied, followed by heel and lace pads. Then after the ankle is dry pre-wrap will be applied from the base of the fifth metatarsal to the musculotendinous junction of the gastrocnemius known as the Achilles. Two anchor strips will be placed at the musculotendinous junction. Followed by three strips of stirrups going medial to lateral, covering both malleoli in the process. Next two-three horseshoe strips will be applied until the tape is covering the ankle superior to the

malleoli. Then a heel lock was applied starting medially around the Achilles and up over the arch of the foot, then repeated laterally. This will be repeated twice each side. Finally, the closing strips of the tape will be applied from the base of the fifth metatarsal up towards the original anchors of the tape. The area for EMG placement will then be cleaned with an alcohol pad and then place directly on the participant's skin.

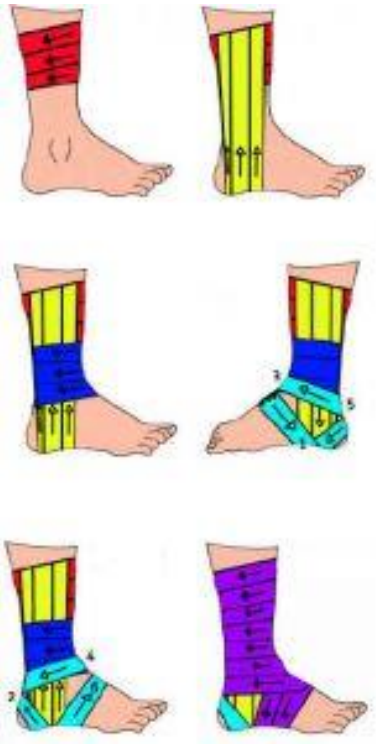

Figure 3. Application of the closed basket weave ankle taping

For applying the Kinesio Tape intervention, the following steps will be completed as follows: the foot will be in the same position as the closed basket weave ankle taping. Adherent spray will be use prior to taping. The first strip of Kinesio Tape will be placed on the dorsum side of the midfoot and ran proximally, inferior to the tibial tuberosity along the anterior shin. The second strip will start superior to the medial malleolus and run underneath the calcaneus pulling laterally and up as the strip is placed and anchored inferior to the fibular head. The third and final strip is going to be placed transversely

starting at the medial malleolus to the lateral malleolus. Strips 1 and will be measured and placed on the skin at full stretch 100%. The third strip will be placed on light 15-25% stretch. EMG procedure will also follow the methods of the closed basket weave.

Figure 4. Medial and lateral view of the Kinesio Tape technique[8].

For application of both the ankle tape and Kinesio Tape, the same steps of application previously mentioned. The Kinesio Tape will be applied under the ankle tape to provide the skin to skin neuromuscular activation that is claimed[16,17]. The removal and reapplication of the tape for each participant will be done by the primary researcher.

Materials Used

Materials used for this study included Cramer Tuf-Skin spray, Mueller pre-wrap. The tape to be used will be non-elastic 1.5 inch Johnson & Johnson Tape and KT Tape Pro Synthetic Uncut. Alcohol wipes will also be used for cleaning of the skin for preparation of the EMG pad placement. Scissors will be used to cut the KT Tape for creating strip length. A Cramer Shark Tape cutter will be used to assist in tape removal in between condition trials.

Instrumentation

To measure ground reaction force and force production, an AMTI force plate (ATMI, Watertown, MA) installed in the floor of the Motion Analysis Center will be used. A Bagnoli-8 system Delsys (Delsys Inc., Boston, MA) will collect muscle electromyography data. Data will be processed in Vicon Nexus 2.4 software (Vicon, UK) and then be transferred to Microsoft Excel 2016 (Microsoft, Albuquerque NM) for further analysis. The sampling rate of the force plate will be used at a sampling rate of 1000 hertz (Hz) per second. It will be simultaneously with the Delsys EMG collecting at 1000 Hz per second. Force plate data will be filtered by a Butterworth Filter at 20 Hz. For the EMG, a band-pass filtered from 8-1000 Hz. Microsoft excel will be used to compute data, rectify and graph results of the study. Data from Excel will be placed into IBM SPSS 21 (IBM, Armonk NY) software for statistical analysis. A 45 cm (17.7 in) plyometric box will be used for the drop box landing into countermovement jump. A Schwinn IC indoor Cycling Bike will be used for the participants to warm up prior to data testing.

Data Collection & Analysis

The design for this study involves the use of four one-way ANOVAs with repeated measures through IBM 24 SPSS software. Significance level defined as $p < 0.05$ for each test. Participants will only be required to participate once on one single day. Data will be entered prior to collection within the Nexus Software. Collected data will be processed and analyzed using one-ways MANOVAs for significant differences in the force production, ground reaction force, or activation and coactivation through EMG.

Participant information will be noted by a two-digit identification number starting with 01. A master roster of the participants' names and information will be kept secure by being locked in a drawer in the researchers' office. For all purposes, this study will refer to the participants' identification number when referring to the data that will be collected and used in written text. Reports of results will be produced in means and standard deviations. No collected data will be made available to any third parties such as coaching staff, athletic department or any outsiders looking for information of the participants within this study. No data from this study will be erased or destroyed for at least 5 years after the study has been completed.

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Manuscript

Introduction

Ankle sprains are the most common injuries in a variety of sports.[1] The ankle bears more weight per unit area than any other joint in the body.[2] Superior proprioception is needed to participate in sports or complete activities of daily life. Ankle proprioception may be one of the more important components contributing to balance control in sports, considering the ankle-foot complex has contact with the ground at all times during exercise.[3] The most common mechanism of injury to the ankle ligaments is inversion of the foot.[4] Other pathologies such as fractures, muscle strains, and dislocations can occur at the ankle joint and lower leg region.[5-6] The standard intervention for the ankle joint is prophylactic ankle taping which entails a closed basket weave technique.[7.8] In recent years Kinesio Tape has become popular in sports medicine.[10] The purpose of prophylactic or athletic tape is to provide stiffness to the joint and limit excessive ROM, whereas, Kinesio Tape has elastic properties and its purpose is to increase ROM and potentially create more neuromuscular activtity.[10]

In recent studies, ankle taping has been examined in terms of force production and ground reaction forces (GRF). [11-14] Abian-Vicen et al,[11] investigate the influence of prophylactic ankle taping in 15 healthy subjects during two balance tests and one jump test, at push off the jump and at the landing phase. [11] Ankle taping had no influence on balance performance or in the push off phase of the jump. However, it was found that the peak vertical force value in the landing phase of the jump was 12% greater with ankle taping. A similar study was conducted by Yi et al[14] examined participants before being taped, while taped, exercised with tape, and post taping. the participants performed a

single leg jump from 40 cm height onto a force plate. Significant higher peak forces, at heel contact, were observed in the taped condition, 549.51 ± 45.04 (% body weight), versus the pre-taped condition, 503.42 ± 34.23 (% body weight). Bovonsunthonchai et al[15] looked at 10 subjects who had functional ankle instability and the use of Kinesio Tape to determine peak forces as well as time to peak. Kinesio Tape and prophylactic tape were used on subjects performing a single leg drop landing from a 40 cm, as well as doing a third set of trials with no tape. The results of the study showed that there were minimal reductions in the ground reaction forces with the taping conditions, however it was not statistically significant. It should be noted that time to peak vertical ground reaction forces were significant among the three conditions, notably, Kinesio Tape producing the longest time to peak 71.10 milliseconds (ms) ± 8.52 ms, but similar to no tape, 70.37 ms ± 10.13 ms, and non-elastic tape peaking significantly quicker, 62.63 ms ± 11.63 ms. Thus, Kinesio Tape potentially inhibiting the subject's ability to perform maximal effort, yet non-elastic tape improving the rate of force development. Kinesio Tape has also been investigated predominately for neuromuscular activation of the muscles that the tape is targeting.[16-19] In a recent study by Huang et al[18] they looked at application of Kinesio Tape for intervention, and Kinesio Tape as a placebo intervention by not applying the recommended tension and location of tape application. With the two tape conditions, the participants performed a vertical jump to examine GRF and EMG. Significance difference was found in vertical ground reaction force and EMG activity, specifically in the medial gastrocnemius reporting larger muscle activation in the Kinesio Tape group during the jump task. This could mean that Kinesio Tape can help achieve higher performance in maximal effort. Martínez-Gramage et al[20] did not find significant

changes regarding the Kinesio Tape when using EMG. Martínez-Gramage et al[20] compared the effects of tape after initial application as well as having the kinesio tape on for 72 hours. The duration of muscle activation of kinesio tape after 72 hours compared to no tape, kinesio tape did not shorten the time to peak muscle activation of the lateral gastrocnemius. Another study by Briem et al[21] examined ankle inversion movement with Kinesio Tape, non-elastic tape and no tape, using a 10-kg weight for withstanding stress at the ankle joint. A significant main effect was found of the non-elastic tape condition producing 14% MVIC of mean muscle activation when compared to no tape displaying 12% MVIC. Therefore, non-elastic tape may enhance dynamic muscle support of the ankle and enhance performance output. However, benefits of Kinesio Tape remains to be seen and the efficacy of Kinesio Tape in preventing ankle sprains in the same mechanism is unlikely.[21]

To the best of our knowledge, there are not many studies comparing kinetics and muscle activation of the lower leg in both taping methods. Few studies have looked at the effects of the closed basket weave technique for the ankle and the effects of Kinesio Tape on the lower leg in kinetic and neuromuscular activation, yet the effects on performance vary. These studies examined only drop landing, jumping, or jumping followed by landing but not drop jump followed by immediate maximal vertical jump. The purpose of this study is to investigate the effects of closed basket weave ankle taping, Kinesio taping the lower leg, no tape, and the two methods of taping combined on vertical ground reaction force and neuromuscular activity in the gastrocnemius and anterior tibialis during a single leg drop landing followed immediately by a maximal vertical single leg jump.

Methodology

Participants

Collegiate athletes from a Division II Institution in South Florida were recruited for this study. Forty-one participants, were included in the study (Table 1). Inclusion criteria for this study included being free from an ankle injury in the past six months prior to testing, must be active division II colligate athlete, and between the ages 18-25. Participants had to able to perform the following actions with no signs of pain or discomfort: (1) perform a single leg drop box landing followed by a single leg vertical jump, (2) repeat this process for all four conditions. Participants signed an informed consent form prior to participation, approved by the university IRB committee, and participant's history questionnaire.

Table 1. Participants Demographics (n=41)

Characteristics	Baseline Information (n=41)
Gender	24 Male/ 17 Female
Age (years)	20.17 ± 1.60
Weight (kg)	73.5.5 ± 11.06
Height (cm)	170.34 ± 10.16

Instrumentation

To measure vertical ground reaction force (vGRF), an AMTI force plate (ATMI, Watertown, MA) was used with sampling rate of 1000 Hz. A Bagnoli-8 system Delsys (Delsys Inc., Boston, MA) collected muscle electromyography data with sampling rate of 1000 Hz. Data were processed in Vicon Nexus 2.4 software (Vicon, UK) and then transferred to Microsoft Excel 2016 (Microsoft, Albuquerque NM) for further analysis. Force plate data were filtered by a fourth order zero lag Butterworth filter with a cutoff frequency of 20 Hz. For the EMG, a fourth order zero lag Butterworth filter with a

bandwidth of 20-500Hz was used. Statistical analysis was performed using SPSS 24 (IBM, Armonk NY) software.

Procedures

All data were collected in a single testing session. A Schwinn IC elite indoor Cycling Bike was used for the participants to warm up prior to data collection. Each participant cycled for 10 minutes at a pace set at a comfortable resistance, followed by a dynamic warmup including two sets of high knees for 15 yards, two sets of butt kicks for 15 yards, and ten jump squats prior to collection. Participants were also informed of shaving their dominant leg prior to participation. Participants were randomly assigned an order of the 4 conditions: control group with no tape (CT), closed basket weave ankle taping (AT), Kinesio Tape (KT), and both ankle tape and Kinesio Tape (KAT). A certified athletic trainer who was also certified in KT taping applied each taping condition. The taping interventions were then applied to their dominant ankle and lower leg of the participants. The EMG sensors were placed on the following muscles: anterior tibialis and lateral gastrocnemius muscle bellies. Electrode placement was just proximal to the palpated muscle belly of each muscle in line with a previous study by Fayson et al.[17] The EMG electrodes were secured with a strip of tape around the lower leg to keep them connected to the skin. The Delsys channel box input module (Delsys Inc., Boston, MA) was placed on the backside of the participant's waistband. Following the EMG setup, a static trial was collected to measure body weight of each participant on an AMTI force plate (ATMI, Watertown, MA). A 45-cm plyometric box was used for the single leg drop box landing followed immediately by maximal single leg vertical jump. The plyometric box was placed 20 cm behind the force plate. A demonstration was given on

how to perform the single leg drop box landing followed immediately by a maximum single leg vertical jump. Participants performed practice drop jumps until feeling comfortable with the task. participants were instructed to perform a single leg drop landing on the force plate with one foot followed by a maximum single leg vertical jump as high as they could, landing on the force plate again. A Tandem Sport Vertex (Louisville, KY) was used as a visual target Each of the four conditions required three single leg drop landings followed by maximal single leg jumps, a total of twelve jumps for each participant. If a trial was not completed correctly, such as missing the force plate or stepping with both feet, the trial was deleted and that specific trial was repeated. Rest intervals between each trial were 30 seconds. Rest intervals between each condition were at least three minutes, during that time the primary researcher removed the previous tape condition and apply the next tape condition for the next data collection.

Taping Procedures

For closed basket weave ankle taping and Kinesio taping, participants were applied by the same certified Kinesio taping practitioner who was also a certified athletic trainer. These basic techniques were applied for stimulating the anterior tibialis and lateral gastrocnemius to dorsiflex and evert the ankle. Prior to taping, skin cleaner with 3% alcohol was applied over the area of taping. For the ankle tape, anchor strips were placed at the Achilles musculotendinous junction. Then three horseshoe and three stirrups were placed going medially to lateral. Followed by a closed basket weave and heel lock technique with closing strips starting at the base of the fifth and going superiorly up the body.

For the kinesio tape application, the technique protocol was duplicated from a previous study by Fayson et al.[17] One strip starting at the dorsum of the foot up the shin inferior to the tibial tuberosity. The second strip started above the medial malleoli under the foot, covering the lateral malleoli, and ended inferior to the fibular head. The last strip was placed anteriorly covering the both malleoli and talar dome. The first two strips of Kinesio Tape were placed on full stretch 100% and the third strip was placed on a light 15-25% stretch. For the KAT tape condition, the Kinesio Tape was applied prior to the ankle tape being applied. This was to provide the skin to skin neuromuscular activation that has been claimed to benefit the person who is using Kinesio Tape.[22]

Data Analysis

The design for this study involved the use of one-way ANOVAs with repeated measures and processed through IBM 24 SPSS software (Armonk, NY). Significance level was defined as $p < 0.05$ for each test. If a main effect was identified a post hoc t-test was used to find significant differences between the groups. Collected data were analyzed using One-Way ANOVAs with repeated measures for significant differences in the peak vGRF during landing, peak vGRF during jumping, and muscle activation of gastrocnemius and tibialis anterior during the whole movement. Peak forces were measured relative to % body weight. The peak forces of each trial were divided by the body weight of each subject then multiplied by 100 to determine the % body weight. The mean and standard deviation of the three trials of each tape conditions were calculated. For EMG calculations, the frames of muscle activity from touch down of landing to jump take off were identified. The magnitude of the instantaneous EMG data were squared, then the mean of the squared EMG data were calculated for each trial and condition. This

was done the same way for anterior tibialis and lateral gastrocnemius muscle activation. The mean and standard deviation of each of the three trials in each condition were calculated.

Results

The purpose of this study is to investigate the effects of closed basket weave ankle taping, Kinesio taping the lower leg, no tape, and the two methods of taping combined on vertical ground reaction force and neuromuscular activity in the gastrocnemius and anterior tibialis during a single leg drop landing followed immediately by a maximal vertical single leg jump. Subject Demographics are displayed in Table 1. It was suggested that the KAT condition will significantly decrease peak eccentric vGRF production at the time of the landing, then compared to ankle taping, Kinesio taping, and no taping. A one-way ANOVA with repeated measure was used to compare the peak vGRF at time of the landing between tape conditions. There were no significant differences found, ($F(1,12) = .000$, $p > .05$. It was also proposed that the AT condition will have a significant increase in peak concentric vertical ground reaction force during the vertical jump when compared between tape conditions. A one-way ANOVA with repeated measure was run and significance was found ($F(1,12) = .000$, $p < .024$. Follow up t-tests showed that AT condition 233.18 ± 32.9 % body weight, produced significantly lower forces than the CT 242.73 ± 32.8 % body weight and KT condition 240.79 ± 34.79 % body weight. The KAT condition also produced the least amount of forces 232.7 ± 38.41 % body weight and was significantly less than the CT condition.

For muscle activation of the anterior tibialis it was believed that KAT will significantly increase when compared to AT, KT, and CT during the time the subject is in

contact with the ground. One-way ANOVA with repeated measure was run and significance was found (F (1,12) = .000, $p < .000$. Follow up t-tests indicated that anterior tibialis activation in the KAT condition was significantly lower than 0.099 ± 0.029 (V) than all three conditions, with AT having 0.119 ± 0.052 (V), CT = 0.134 ± 0.059 (V), and KT 0.135 ± 0.070 (V). It was also noted that AT had significantly less muscle activation than the CT and KT condition. Lastly it was thought that there will be no significant differences found in muscle activation at the lateral gastrocnemius. There were no significant differences found (F (1,12) = .000, $p > .05$. Mean and standard deviations of peak landing and muscle activation of the lateral gastrocnemius are shown in Table 2. Mean and standard deviations of peak jumping and muscle activation of the anterior tibialis are displayed in Figure 1 & 2.

Table 2. Mean Peak Landing vGRF and Muscle Activation of Lateral Gastrocnemius per Tape Conditions (n=41)

	AT	CT	KT	KAT
Peak Landing vGRF % Body Weight	367.08 ± 82.03	376.68 ± 90.51	382.76 ± 103.26	376 ± 0.94
Lateral Gastrocnemius Activation (V)	0.0856 ± 0.0070	0.0924 ± 0.024	0.085 ± 0.022	0.089 ± 0.019

Tape Conditions are stated as such: AT = Ankle Tape; CT= Control Tape; KT= Kinesio Tape; KAT= Kinesio and Ankle Tape. Variables are stated vGRF % Body Weight= Percent of body weight produced in vertical ground reaction force and (V)= Voltage.
$p < 0.05$

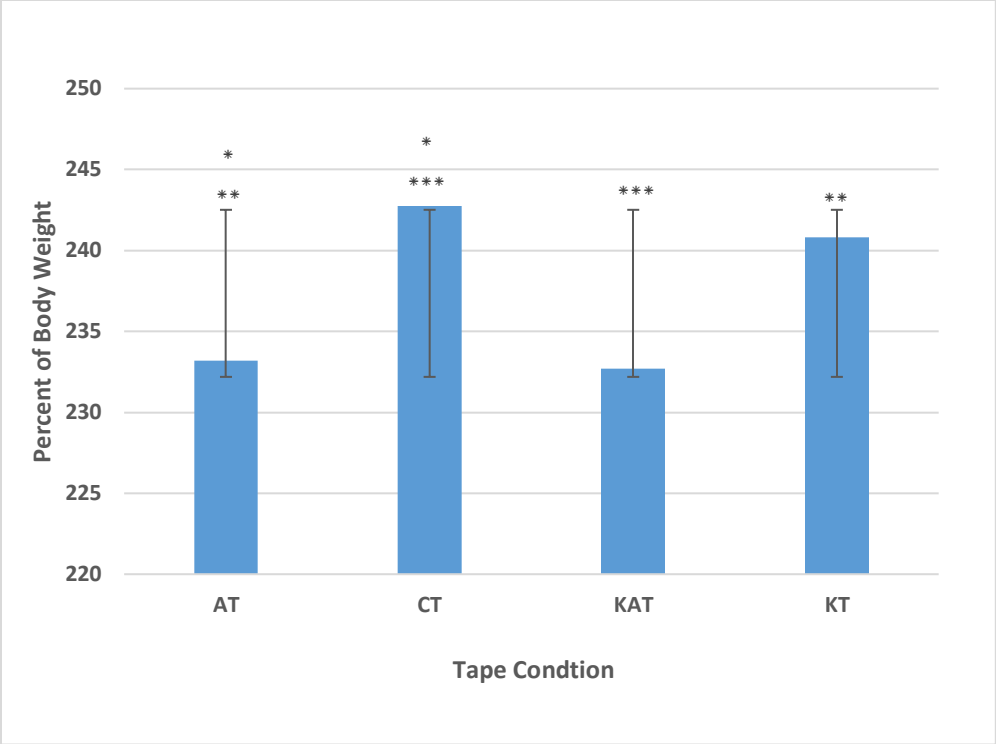

Figure 5. Mean and Standard Deviations of Peak Jump Forces of each Tape Condition. For significant differences between conditions should be noted by an asterisk (*). * = Significance between AT & CT, ** = Significance between AT & KT, *** = Significance between CT & KAT. $p < 0.05$.

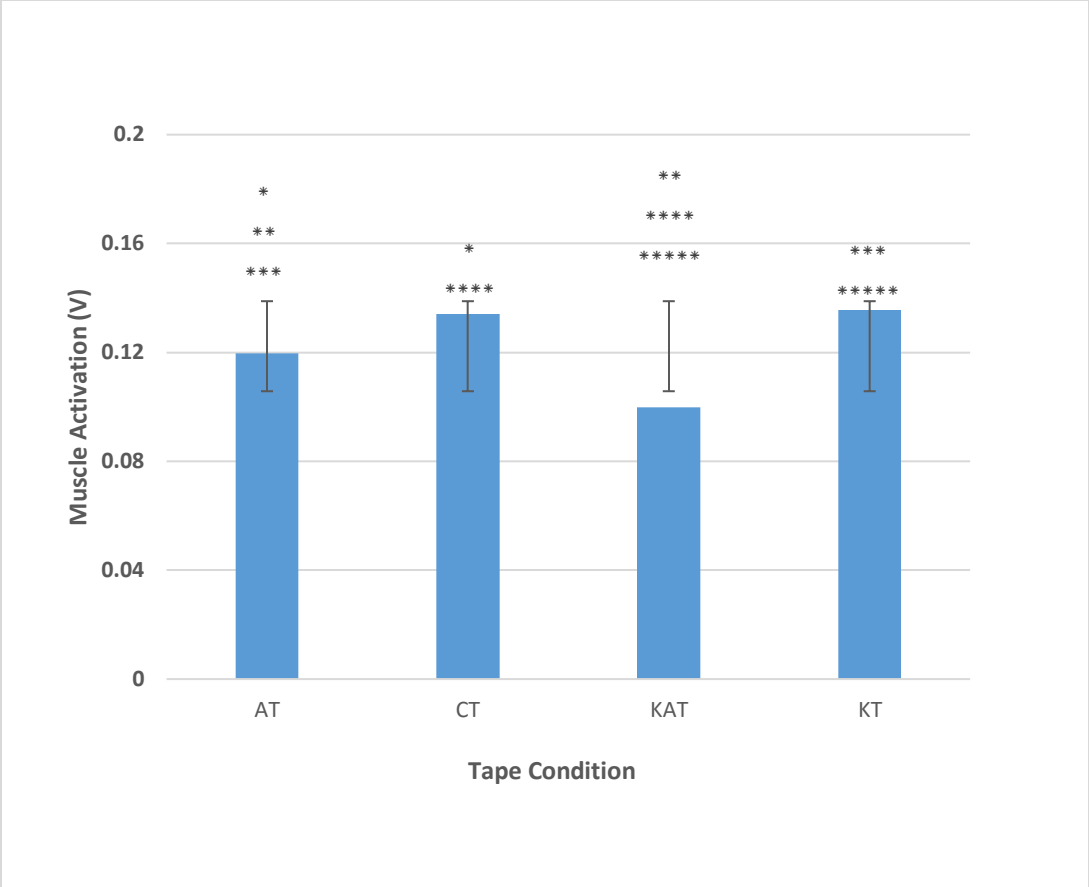

Figure 6. Mean and Standard Deviations of Muscle Activations in the Anterior Tibialis of each Tape Condition. For significant differences between conditions should be noted by an asterisk (*). * = Significance between AT & CT, ** = Significance between AT & KT, *** = Significance between AT & KAT, **** = Significance between CT & KAT, ***** = Significance between KAT & KT. $p < 0.05$.

Discussion

The purpose of this study is to investigate the effects of closed basket weave ankle taping, Kinesio taping the lower leg, no tape, and the two methods of taping combined on vertical ground reaction force and neuromuscular activity in the gastrocnemius and anterior tibialis during a single leg drop landing followed immediately by a maximal vertical single leg jump. The results suggest that Kinesio Tape in conjunction with ankle tape (KAT) produce the least amount of force and muscle activation with respect to the other taping conditions. Significantly less muscle activation was found in the KAT

condition with 0.136 ± 0.071 V, then the CT condition 0.134 ± 0.060 V, also displaying the least amount of muscle activation of the four tape conditions. Based on the results of this study, it is evident that certain tape applications are inhibiting maximum effort and performance. With significant findings, there is still uncertainty within the consistency of the results of this study and findings from previous study with similar methods. In this study, the CT condition presented a larger amount of force created during the jumping phase 242.73 ± 32.82 % body weight then when compared to AT condition during the jumping phase 233.17 ± 32.91 % body weight. The results of this study do replicate similar findings in a study by Koyama et al, where it was determined that ankle tape decreases the amount of vGRF.[12] Koyama et al used a countermovement jump and found that ankle tape participants had a GRFmax of 21.6 ± 2.2 ($N \bullet Kg^{-1}$), whereas without tape. 22.1 ± 2.9 ($N \bullet Kg^{-1}$). Also, the results did not concur with the previous findings of Yi et al. as their study found that peak jump reported higher forces in non-elastic ankle tape when compared to no tape. Yi et al[14] found the increases in heel contact peak force occurred in participants taped 549.51 ± 45.04 (% body weight) whereas pre-taped heel contact peak force 503.42 ± 34.23 (% body weight). Along with shorter time to peak, it could be assumed that this may enhance. This could be different due to the dynamic movement being performed in the previous study, walking for 30 minutes, whereas the present study did a drop landing vertical jump, this could be since there is a decrease amount of velocity in the jump and longer time to peak. Thus, inhibiting performance and not allowing the athlete to provide maximal effort.

When compared to previous research, muscle activation has shown to be restricted due to the tape applications that were applied in those respective studies.

However, Fayson et al[17] reported similar findings that KT had an initiatory effect on muscle activation when compared to no tape looking at the anterior tibialis, peroneal, and lateral gastrocnemius, specifically in the anterior tibialis. It was reported that the no tape group had a higher peak activation with 0.622 ± 0.17 % versus the Kinesio Tape condition displaying a peak activation of 0.481± 0.25 %.[17] It should be noted that areas taped were measured before tape application, and strips were cut at 80% of resting tape length to standardize tape tension. This could suggest that the nervous system may identify the KT intervention as a reason to initiate a decreased amount of dynamic restraint to support the ankle joint. It should also be noted that the tape application of the KT tape placement and tension of application was replicated from Fayson et al.[17] The findings in the present study also showed to be consistent with previous studies on muscle activation in the anterior tibialis, however this is not the circumstance for the lateral gastrocnemius. Such as in the study by Huang et al[18] where the study examined the muscle activation of medial gastrocnemius and anterior tibialis and soleus in a vertical jump. It was found that during a max effort vertical jump in a pre-and post-test ratio, there was an increase in medial gastrocnemius activation 1.08 ± 0.11, yet decrease in muscle activation for the anterior tibialis 0.97 ± 0.09. The present findings do support these previous findings from Huang et al. Despite the current study, not analyzing correlations or some muscles previously examined by other researchers, there appears to be some question still regarding whether tape applications, inhibit or enhance performance.

The main outcome of this study was to demonstrate the impact of taping applications of the lower leg and ankle. While examining the kinetic effects in the tape

applications, it was found that the participants during a vertical jump reported significant differences, whereas during the landing phase of the drop movement there was no significance. As for the muscle activation during touch down to take off during, the time the foot was in contact with the ground, the anterior tibialis had significantly higher differences between the AT, CT, and KT conditions when looking at the KAT condition. However, there were no differences for muscle activation of lateral gastrocnemius between tape conditions. Furthermore, these results demonstrated the variability of ankle control, strength, and overall functional performance in a maximum effort movement.

Limitations

One of the limitations of this study was that some participants from basketball, baseball, and softball were in the middle of their sport season during the time of data collection. In-season practice and training sessions can have an impact on individual's ability to perform each jump of a better quality than out of season athletes. Therefore, criteria to be in-season should have been used for this study. A second limitation is the consistency of the amount of effort given within each trial. Although the participants were given 2-3 minutes of rest time between tape conditions, it is difficult to predict and assume that each participant gave the same effort for each jump required for this study. Rather than using the Vertec as an only a target, including it in the study to measure vertical jump could have enhance the reliability of each subject. Another limitation within this study was the inclusion of athletes whose' sports do not include a substantial amount of jumping. Some participants who volunteered for this study did not participate in a sport with high frequency of jumping, (i.e. soccer, basketball, and volleyball). A participant who plays basketball, may have been able to complete this study with ease

and larger forces and muscle activation because of their respective sports' movement. This may not have been the case for athletes of baseball, softball, or rowing. Therefore, the results regarding participants from baseball softball and rowing may have be skewed due to the broad inclusion of certain sports from the university Accordingly, potential pre- and post-test intervention may be needed in future studies. Since this current study was a one-time data collection, there may more significant differences between the tape conditions. Therefore, application of Kinesio Tape prior to research study could be a modification for further research. The final limitation was not assessing the kinematics of the vertical drop land into a jump. A further look at joint angles and moments of the lower extremity benefit analysis and determined where forces may be distributed with in the body. For each study limitation, you need to offer a solution that you had done in your study to limit the errors.

Clinical Implications

In this study ankle tape and Kinesio Tape has shown to inhibit performance when looking at muscle activation and generation of forces, specifically when they are used in conjunction with each other. This could limit the athlete's ability to perform at competitive levels. Despite previous studies suggesting larger force generations could lead to injury, larger forces may be required for certain sports such as basketball, soccer, volleyball during competition. The immediate effects of tape applications could inhibit performance and should be carefully considered by athletic trainers, physical therapists, coaches, and parents. Long term effects tape applications have not yet been examined now.

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Appendix A: IRB Forms

Barry University
Informed Consent Form

Your participation in a research project is requested. The title of the study is "Effects of kinesio taping and ankle taping on a drop landing into a vertical jump." The research is being conducted by Salvatore Ferranti ATC, LAT, a student in the Human Performance and Leisure Sciences department at Barry University, and is seeking information that will be useful in the field of Athletic Training, biomechanics, and sports medicine. The aims of the research are to better understand the effects of Kinesio Tape and ankle tape on athletes' lower leg that may be linked to alter biomechanics, which may lead to injury. In accordance with these aims, the following procedures will be used: Participants will be asked to arrive at the research study wearing athletic clothing that they can train and perform in; must currently be on a collegiate sports team; athletes must be free of any ankle injury for the past 6 months prior to the study. We anticipate the number of participants to be 60.

If you decide to participate in this research, you will be asked to do the following: Participants will arrive at Barry University's Motion Analysis Center wearing athletic clothes, which allow for unobstructed access for EMG placement directly on the skin and taping of the lower leg. Examples of clothing that is appropriate is shorts that do not go below the knee. To fill out the Subject Information Questionnaire, which should take 5 minutes of your time. Participants will complete a 10-minute warm-up on a stationary bike, followed by a dynamic warm-up. The dynamic warmup will include two sets of high knees for 15 yards, two sets of butt kicks for 15 yards, and ten jump squats. The dynamic warmup will take a total of minutes to be completed. The total time of warmup is 15 minutes. Participants will complete the following movements: Drop box landing followed immediately by a vertical jump in four different conditions. The following conditions will be randomized: no tape (CT), ankle tape (AT), Kinesio Tape (KT), Kinesio and Ankle Tape). The data collect session will take no more than 1 hour and 30 minutes of your time.

Your consent to be a participant in this research study is strictly voluntary and should you decline to participate or choose to drop out at any time during the study, there will be no adverse effects on your status as a collegiate athlete. There is minimal risk for involvement in this study, such as muscle fatigue and muscle soreness. The risk of involvement in this study are minimized through warm-up and dynamic warm-up. All testing will be conducted by a Certified Athletic Trainer. The risk will be no greater than what you encounter in your daily trainings. If the unlikelihood of injury the athlete will be referred to Barry Student Health Services located in the Landon Student Union room 104. Although there are no direct benefits to you or anyone as a participant, however this study may help our understanding of possible effects of training with ankle tape, Kinesio tape, or both tapes biomechanically. As well as help reduce the chance of injuries in sports.

As a research participant, information you provide will be held in confidence to the extent permitted by law. Documents will be kept in a locked file in the researcher's office.

IRB consent forms with participant's names will be kept in a separate locked drawer. Your signed consent form will be kept separate from the other documents. All data will be kept secured on the primary researchers' password-protected computers. Any published results of the research will refer to group averages only and no names will be used in the study. No photos or videos will be strictly prohibited from use any time of this study. All data will be destroyed after 5 years of data collection.

If you have any questions or concerns regarding the study or your participation in the study, you may contact me, Salvatore Ferranti at (914)-589-7517 or email at salvatore.ferranti@mymail.barry.edu, my supervisor, Dr. Kuo at (305)-505-8928 or email at ykuo@barry.edu, or the Institutional Review Board point of contact, Barbara Cook, at (305)899-3020 or email at bcook@mail.barry.edu. If you are satisfied with the information provided and are willing to participate in this research, please signify your consent by signing this consent form.

Voluntary Consent

I acknowledge that I have been informed of the nature and purposes of this experiment by Salvatore Ferranti ATC, LAT and that I have read and understand the information presented above, and that I have received a copy of this form for my records. I give my voluntary consent to participate in this experiment.

_____ _____

Signature of Participant *Date*

_____ _____ _____ _____

Researcher *Date* *Witness* *Date*

(Witness signature is required only if research involves pregnant women, children, other vulnerable populations, or if more than minimal risk is present.)

Barry University

Research with Human Participants Protocol Form

PROJECT INFORMATION

1. **Effects of kinesio taping and ankle taping on a drop landing into a vertical jump**

2. **Primary Researcher**

Student Number or Faculty Number: 3070081
Name: Salvatore Ferranti ATC, LAT
School – Department: Human Performance and Leisure Sciences
Mailing Address: 11905 NE 2nd Ave Apt C-303, North Miami, FL 33161
Telephone Number: (914)-589-7517
E-Mail Address: salvatore.ferranti@mymail.barry.edu

3. **Faculty Sponsor**

Name: Dr. Yi-Tzu Kuo PhD, LAT, ATC
School – Department: Human Performance and Leisure Sciences
Mailing Address: 11300 NE 2nd Ave, Miami Shores, FL 33161
Telephone Number: 305-899-4818
E-Mail Address: ykuo@barry.edu

Faculty Sponsor Signature:_____ Date: _____

4. **Is an IRB Member on your Dissertation Committee? Yes _____ No: __X_____**

5. **Funding Agency or Research Sponsor**
   N/A

6. **Proposed Project Dates**
   Start __12/5/16_____
   End __12/5/17_____

Please Provide the Information Requested Below

A. Project activity STATUS is: (Check one of the following three as appropriate.)

__X_NEW PROJECT
___ PERIODIC REVIEW ON CONTINUING PROJECT
___ PROCEDURAL REVISION TO PREVIOUSLY APPROVED PROJECT
(Please indicate in the **PROTOCOL** section the way in which the project has been revised.

B. This project involves the use of an **INVESTIGATIONAL NEW DRUG (IND) OR AN APPROVED DRUG FOR AN UNAPPROVED USE** in or on human participants.
___ YES **_X__**NO
Drug name, IND number and company:
_____

C. This project involves the use of an **INVESTIGATIONAL MEDICAL DEVICE (IMD)** or an **APPROVED MEDICAL DEVICE FOR AN UNAPPROVED USE.**
___ YES **__ X_** NO

D. This project involves the use of **RADIATION** or **RADIOISOTOPES** in or on human participants.
___ YES **_X__**NO

E. This project involves the use of Barry University students as participants. (If any students are minors, please indicate this as well.)
_X__YES Barry Students will be participants (Will minors be included? ___ YES **_X__** NO)
___ NO Barry Students will participate

F. **HUMAN PARTICIPANTS** from the following population(s) would be involved in this study:

___ Minors (under age 18)
___ Abortuses
___ Prisoners
___ Mentally Disabled
___ Other institutionalized persons (specify)
___ Fetuses
___ Pregnant Women
___ Mentally Retarded
_X__Other (specify) __Student athletes between ages 18-25_____

G. Total Number of Participants to be Studied: ____60_____

Description of Project

1. **Abstract** (200 words or less)

Taping interventions has been used by many clinicians in sports medicine. Tape has been a valuable application for injury prevention of athletes for many athletic trainers, physical therapists, and physicians. Although healthcare professionals have used various taping applications and types of tape for injury prevention, obtaining a better understanding of the potential benefits or risks of these tape applications is needed. By understanding the role of tape applications clinicians can determine appropriate treatment for athletes for injury prevention and protection of the ankle joint. The purpose of this study is to examine the kinetic and electromyography differences between no tape, ankle tape, Kinesio Tape, and Kinesio Tape with ankle tape. This study will compare peak vertical eccentric and concentric ground reaction force, and ratio of muscle activation between gastrocnemius and anterior tibialis.

2. **Recruitment Procedures**

Participants for this study will be recruited by flyers and word of mouth. The flyers will be posted throughout the Landon Student Union in areas, such as the Gymnasium, athlete locker rooms, and near the coach's office in Landon as well. This study will be completely voluntarily and no one will be coerced into participating and completing this research study. Declining to participate in this study or withdrawal from this study prior to completion will not affect their status as an athlete in any way at Barry University. When a potential participant contacts the primary investigator, a detailed discussion of this study and explanation will be conducted to make sure the potential participants asked what is required of them if they choose to participate. Prospective participants must be free from having an ankle injury in the last six months prior to testing. Prospective participants must also be able to perform the following actions with no sign of pain or discomfort: (1) perform a drop box landing followed by a vertical jump, (2) repeat this process for all four conditions.

3. **Methods**

Participants

Participants of this study will consist of male and female student athletes, from Barry University. Potential participants will be between the ages of 18-25 years old. 60 potential student athletes will be asked to participate for this research study. Participants will be asked to report to the Motion Analysis Center at Barry University in the Landon Student Union at their respective assigned time given by the primary investigator prior to data collection. The student athlete will also be asked prior to the assigned data collection time to show up wearing athletic clothing. Upon the arrival of the student athlete at the assigned time for collection, participants will be given the consent forms to be signed prior to any warmup or data collection. Participants will also receive documentation approved by Barry University's Institutional Review Board and contact information with

any questions or concerns.

Procedures

Participants will be given an informed consent form to read and sign prior to participation by the primary researcher. The primary researcher is also the athletic trainer who will be applying each tape condition throughout the study to all participants. This form explains all procedures the participants will be asked to perform during the research study, as well as any contact information needed regarding the procedures of testing. Once consent is given and documented, participants will report to the Barry University Motion Analysis Center at their assigned times. Participants will be asked to wear athletic clothing with access to the lower leg for taping. Participants will be given an identification number for the study. Participants will be asked through a questionnaire to report their age in years, gender, height in inches, weight in pounds and dominant leg. Their dominant leg will be determined by which leg they would use to jump forward. A warmup using a stationary bike for 10 minutes at consistent pace of the 60 revolutions per minute using a metronome app on the primary researcher's phone, followed by a dynamic warmup. The dynamic warmup will include two sets of high knees for 15 yards, two sets of butt kicks for 15 yards, and ten jump squats. The dynamic warmup will take a total of minutes to be completed. The total time of warmup is 15 minutes.

Participants will be randomly assigned to one of the 4 conditions: control group with no tape (CT), closed basket weave ankle taping (AT), Kinesio Tape (KT), and both ankle tape and Kinesio Tape (KAT). A certified athletic trainer will be onsite to apply each taping conditions. The certified athletic trainer also holds a certification for practical use of KT tape. The taping interventions will then be applied to their dominant ankle and lower leg of the participants. The subjects will be connected to a Delsys EMG electrodes. The skin will be prepped with alcohol electrodes over the target area of the EMG electrodes. No shaving of body hair will be done for pad placement on participants. The electrodes will be placed on the following muscles: anterior tibialis and lateral gastrocnemius muscle bellies. The placement of the anterior tibialis will be placed on the proximal portion of the muscle belly just below the origin.

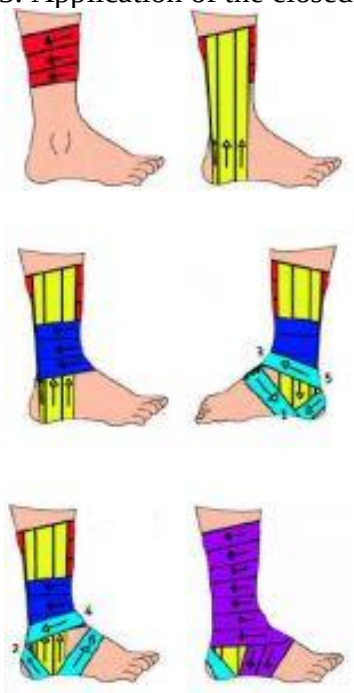
The EMG electrodes will be secured with a strip of tape around the lower leg to keep them connected to the skin. The Bagnoli 8-system Delsys channel box will be placed on the backside of the participant's waistband. After the EMG is placed and secured on the muscle bellies, a static trial will be collected to measure body weight of each participant. Then the primary researcher will demonstrate how the drop box landing to a vertical jump will be completed. Participants will then practice the jumps until comfortable. Participants will step up onto the box then follow the commands of the primary researcher. The plyometric box will be placed 20cm (7.8 in) behind the force plate. The researcher will instruct them to perform a single leg drop landing on the force plate with both feet followed by a vertical jump as high as they can, landing on the force plate again. A Tandem Sport Vertex will be used as a visual target. Participants will be allowed three practice jumps before doing the three trials that will be collected and analyzed for data. The primary researcher will start the data collection prior to the drop landing and following the vertical jump. Participants will be instructed to start with the phrase "Go." If the participant misses the force plate, the trial will be repeated. Rest intervals between each condition will be at least three minutes, during that time the primary researcher will remove the previous tape condition and apply the next for data

collection. The duration of the data collection will be a total of one hour and 30 minutes. Data collection of all four conditions will be performed on the same day. If any injuries occur during testing participants will be withdrawn. For care of potential injuries, participants will be referred to the Barry Student Health Center located in the Landon Student Union, room 104, phone number 305-899-3750.

Taping Procedures

Applying the closed basket weave ankle taping for this study will be performed as listed: the foot will be placed on a table in front of the clinician in 90º at the talocrural joint. Adherent spray will be applied, followed by heel and lace pads. Then after the ankle is dry pre-wrap will be applied from the base of the fifth metatarsal to the musculotendinous junction of the gastrocnemius known as the Achilles. Two anchor strips will be placed at the musculotendinous junction. Followed by three strips of stirrups going medial to lateral, covering both malleoli in the process. Next two-three horseshoe strips will be applied until the tape is covering the ankle superior to the malleoli. Then a heel lock was applied starting medially around the Achilles and up over the arch of the foot, then repeated laterally. This will be repeated twice each side. Finally, the closing strips of the tape will be applied from the base of the fifth metatarsal up towards the original anchors of the tape. The area for EMG placement will then be cleaned with an alcohol pad and then place directly on the subject's skin.

Figure 3. Application of the closed basket weave ankle taping



For applying the Kinesio Tape intervention, the following steps will be completed as follows: the foot will be in the same position as the closed basket weave ankle taping. Adherent spray will be use prior to taping. The first strip of Kinesio Tape will be placed on the dorsum side of the midfoot and ran proximally, inferior to the tibial tuberosity along the anterior shin. The second strip will start superior to the medial malleolus and run underneath the calcaneus pulling laterally and up as the strip is placed and anchored inferior to the fibular head. The third and final strip is going to be placed transversely

starting at the medial malleolus to the lateral malleolus. Strips 1 and will be measured and placed on the skin at full stretch 100%. The third strip will be placed on light 15-25% stretch. EMG procedure will also follow the methods of the closed basket weave.

Figure 4. Medial and lateral view of the Kinesio Tape technique[8].

For application of both the ankle tape and Kinesio Tape, the same steps of application previously mentioned. The Kinesio Tape will be applied under the ankle tape to provide the skin to skin neuromuscular activation that is claimed[16,17]. The removal and reapplication of the tape for each subject will be done by the primary researcher.

Instrumentation

To measure ground force reaction and force production, an AMTI force plate (ATMI, Watertown, MA) installed in the floor of the Motion Analysis Center will be used. A Bagnoli-8 system Delsys (Delsys Inc., Boston, MA) The Vicon Nexus 2.4 software (Vicon, UK) will process the data and then be transferred to Microsoft Excel for analysis. Nexus software will transfer data into Microsoft Excel 2016 (Microsoft, Albuquerque NM) where chart formations and data will be calculated. Data from Excel will be placed into IBM SPSS 21 (IBM, Armonk NY) software for statistical analysis. A 45 cm (17.7 in) plyometric box will be used for the drop box landing into countermovement jump. A Schwinn IC indoor Cycling Bike will be used for the participants to warm up prior to data testing.

4. **Alternative Procedures**

Participation will be strictly voluntary and subjects may decline to participate at any stage of the protocol. Participants are free to stop and/or withdraw from the testing at any time. Should they choose to not participate or withdraw completely from the study, there will be no adverse effects on their status as a collegiate athlete. Their data will not be processed or analyzed for the study.

5. **Benefits**

Although there are no direct benefits to you or anyone as a participant, however this study may help our understanding of possible effects of training with ankle tape, Kinesio tape, or both tapes biomechanically. As well as help reduce the chance of injuries in sports.

6. **Risks**

There is minimal risk for involvement in this study, such as muscle fatigue and muscle soreness. If the unlikelihood of injury the athlete will be referred to Barry Student Health Services located in the Landon Student Union room 104.

7. **Anonymity/Confidentiality**

The will not be any anonymity in this study, However, confidentiality will be kept before, during, and after the study is conducted. As a research participant, information you provide will be held in confidence to the extent permitted by law. Documents will be kept in a locked file in the researcher's office in the Athletic Training Facility in the Landon Student Union. IRB consent forms with participant's names will be kept in a separate locked drawer in the Athletic Training Facility in the Landon Student Union. Your signed consent form will be kept separate from the other documents. All data will be kept secured on the primary researchers' password-protected computers. Any published results of the research will refer to group averages only and no names will be used in the study. No photos or videos will be strictly prohibited from use any time of this study. All data will be destroyed upon 5 years of study completion.

8. **Consent**

Attach a copy of the consent form(s) to be signed by the participant and/or any statements to be read to the participant or informational letter to be directed to the participant. **(A copy of the consent form should be offered to each participant.)** If this is an anonymous study, attach a cover letter in place of a consent form.

See Attached

9. Certification

I certify that the protocol and method of obtaining informed consent as approved by the Institutional Review Board (IRB) will be followed during the period covered by this research project. Any future changes will be submitted to IRB review and approval prior to implementation. I will prepare a summary of the project results annually, to include identification of adverse effects occurring to human participants in this study. I have consulted with faculty/administrators of any department or program which is to be the subject of research.

_____ _____

Principal Investigator *Date*

Subject History Questionnaire

Participant Number: _____
(Researcher Only)

Please answer the following questions:

Athlete Demographics

Age	_____years
Height	____ft ___ inches or ____cm
Weight	_____lbs or _____kg

Leg Dominance

Leg you would use for jumping (layups or to jump vertically)

Left or Right

Past Medical & Athletic History

Have you been free of any ankle injury for at least 6 months prior to collection of data?

___YES ___NO

Do you frequently get any tape application on your ankle prior to training or competition?

___YES ___NO

Recruitment Flyer

Are you a student-athlete? Can you jump?

If you are a collegiate student athlete and want to volunteer for a research study looking at the biomechanical forces and muscle activity through a drop box landing to vertical jump, you're in luck!!!

Who: Male and female collegiate athletes
What: Performing a drop box landing into a vertical jump
Why: To examine the biomechanical forces and muscle activities

Inclusion Criteria:

1. Are currently a student athlete for Barry University
2. Between the ages of 18-25
3. Have not had any ankle injury in the last six months

This is completely voluntary. If interested, please contact one of the following for more information:

Primary Researcher, Salvatore Ferranti, at (914)-589-7517 or email at salvatore.ferranti@mymail.barry.edu. Faculty Supervisor, Dr. Yi-Tzu Kuo, at (305)-505-8928 or email at ykuo@barry.edu or Institutional Review Board point of contact, Barbara Cook, at (305)899-3020 or email at bcook@mail.barry.edu.

Thank you, Salvatore Ferranti ATC, LAT

BARRY UNIVERSITY

KT TAPE

Certificate Of Course Completion

Salvatore Ferranti

Has successfully completed the course requirements defined by KT Tape, as stated below

Sports Specialist Taping Certification

Course Title

Spring 2015

Course Date

15

Signature

Dr. Holly Moriarty, DC, Dacbs

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Salvatore Ferranti** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 09/09/2016.

Certification Number: 2161311.

Appendix B

THESIS DATA COLLECTION SIGNUP SHEET

Name	Phone	Email	Free/Time Days
1.			
2.			
3.			
4.			
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20.			

THESIS DATA COLLECTION SIGNUP SHEET

Name	Phone	Email	Free/Time Days
21.			
22.			
23.			
24.			
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THESIS DATA COLLECTION SIGNUP SHEET

Name	Phone	Email	Free/Time Days
41.			
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Appendix C

THESIS DATA COLLECTION SIGNUP TIME

	2/6/17	2/7/17	2/8/17	2/9/17	2/10/17		2/11/17	2/12/17
8:00am						10:00am		
9:30am						12:00pm		
11:00am						2:00pm		
7:00pm						4:00pm		
8:30pm						6:00pm		
10:00pm								
	2/13/17	2/14/17	2/15/17	2/16/17	2/17/17		2/18/17	2/19/17
8:00am						10:00am		
9:30am						12:00pm		
11:00am						2:00pm		
7:00pm						4:00pm		
8:30pm						6:00pm		
10:00pm								
	2/20/17	2/21/17	2/22/17	2/23/17	2/24/17		2/25/17	2/26/17
8:00am						10:00am		
9:30am						12:00pm		
11:00am						2:00pm		
7:00pm						4:00pm		
8:30pm						6:00pm		
10:00pm								
	2/27/17	2/28/17	3/1/17	3/2/17	3/3/17		3/4/17	3/5/17
8:00am						10:00am		
9:30am						12:00pm		
11:00am						2:00pm		
7:00pm						4:00pm		
8:30pm						6:00pm		
	3/6/17	3/7/17	3/8/17	3/9/17	3/10/17		3/11/17	3/12/17
8:00am						10:00am		
9:30am						12:00pm		
11:00am						2:00pm		
7:00pm						4:00pm		
8:30pm						6:00pm		

Appendix D: List of Tables

Table 1. Participants Demographics (n=41)

Characteristics	Baseline Information (n=41)
Gender	24 Male/ 17 Female
Age (years)	20.17 ± 1.60
Weight (kg)	73.5.5 ± 11.06
Height (cm)	170.34 ± 10.16

Table 2. Mean Peak Landing vGRF and Muscle Activation of Lateral Gastrocnemius per Tape Conditions (n=41)

	AT	CT	KT	KAT
Peak Landing vGRF % Body Weight	367.08 ± 82.03	376.68 ± 90.51	382.76 ± 103.26	376 ± 0.94
Lateral Gastrocnemius Activation (V)	0.0856 ± 0.0070	0.0924 ± 0.024	0.085 ± 0.022	0.089 ± 0.019

Tape Conditions are stated as such: AT = Ankle Tape; CT= Control Tape; KT= Kinesio Tape; KAT= Kinesio and Ankle Tape. Variables are stated vGRF % Body Weight= Percent of body weight produced in vertical ground reaction force and (V)= Voltage. $p < 0.05$

Appendix E: List of Figures

Figure 1. of EMG placement on anterior tibialis[4].

Figure 2. EMG pad placement of the lateral gastrocnemius[22].

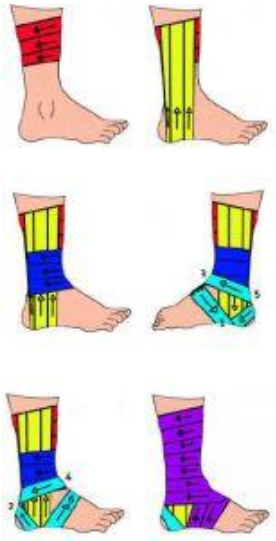

Figure 3. Application of the closed basket weave ankle taping

Figure 4. Medial and lateral view of the Kinesio Tape technique[8].

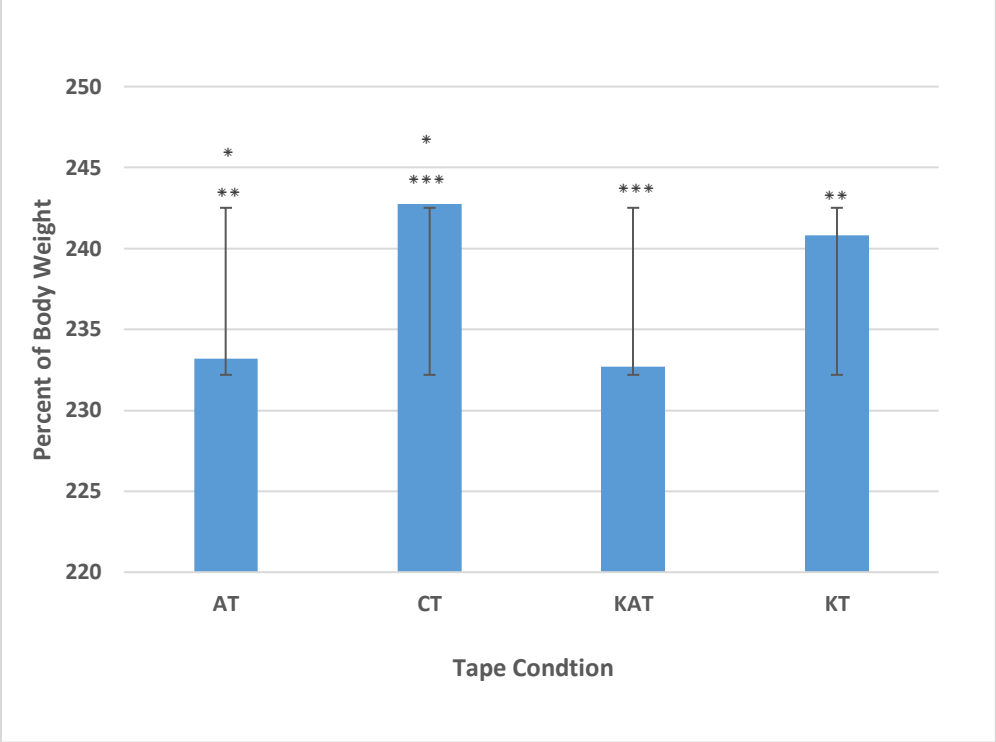

Figure 5. Mean and Standard Deviations of Peak Jump Forces of each Tape Condition. For significant differences between conditions should be noted by an asterisk (*). * Significance between AT & CT, ** = Significance between AT & KT, *** = Significance between CT & KAT. $p < 0.05$.

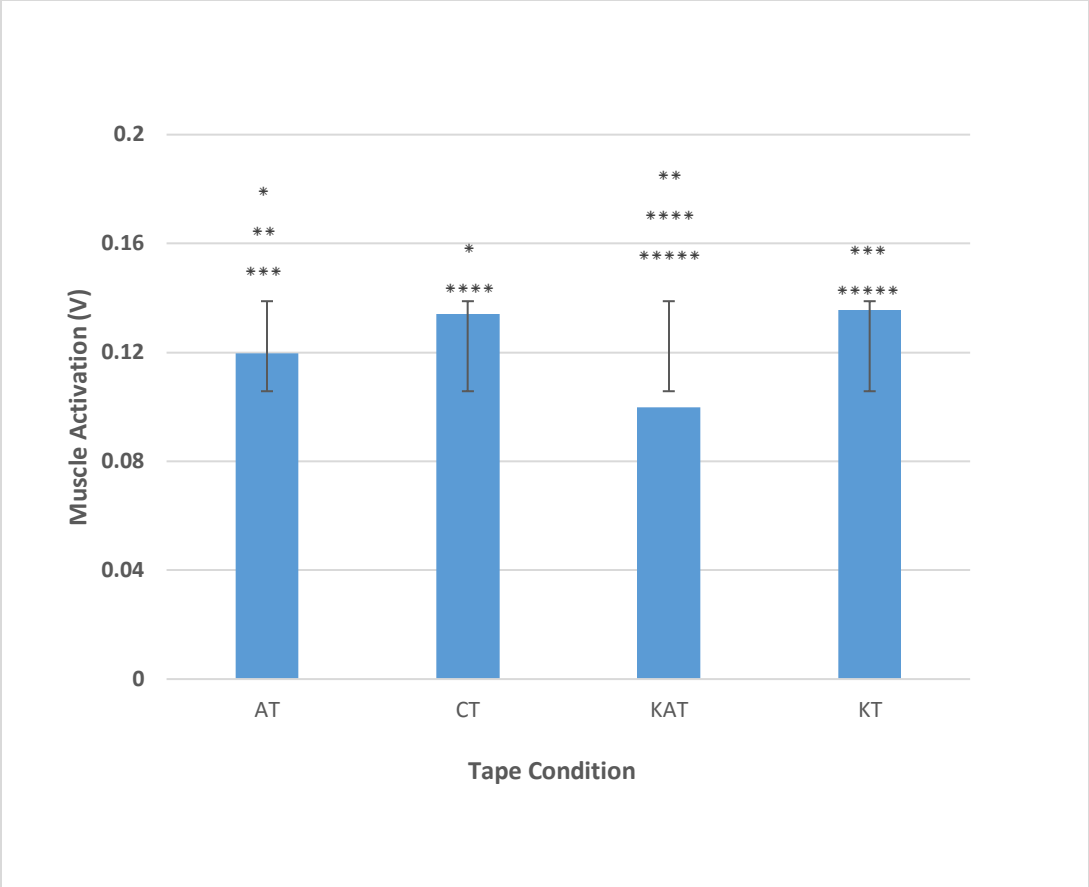

Figure 6. Mean and Standard Deviations of Muscle Activations in the Anterior Tibialis of each Tape Condition. For significant differences between conditions should be noted by an asterisk (*). * = Significance between AT & CT, ** = Significance between AT & KT, *** = Significance between AT & KAT, **** = Significance between CT & KAT, ***** = Significance between KAT