EFFECT OF BRACING VERSUS TAPING ON POST VERTICAL JUMP BALANCE

A THESIS

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by
Nicole Marie Jussaume

Research Advisor, Dr. Shelly DiCesaro

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CALIFORNIA, PA

THESIS APPROVAL

Graduate Athletic Training Education

We hereby approve the Thesis of

Nicole Marie Jussaume, ATC, PES
Candidate for the degree of Master of Science

Date	Faculty
4/30/10	Shelly DiCesaro, PhD, ATC Shelly DiCesaro, PhD, ATC (Chairperson)
4/29/10	Thomas F. West, PhD, ATC
4/29/10	Michael Meyer, MS, ATC

Dedicated to Paula Jussaume Quinn

"I don't need very much now," said the boy, "just a quiet place to sit and rest. I am very tired." "Well," said the tree, straightening herself up as much as she could, "well, an old stump is good for sitting and resting. Come, Boy, sit down. Sit down and rest." And the boy did. And the tree was happy.

Shel Silverstein “The Giving Tree”

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INTRODUCTION

Ankle injuries are one of the most common injuries in athletics.[1-4] Prevention and treatment of ankle injuries commonly includes the application of prophylactic devices with several types of braces and various ankle-taping methods available. These prophylactics are used to support, protect, and potentially prevent further injury to the affected area. There has been extensive research to determine the effects of prophylactics on performance and although there have been some mixed reviews, the majority of studies have discovered little to no negative effect on performance.[5-12]

Although potential impact on performance plays a large role in the use of prophylactic devices, balance is another factor associated with performance that warrants experimental evaluation since balance may be affected by an acute ankle sprain. Balance is stability produced by the even distribution of weight along an axis; without the ability to control this distribution, recurrent ankle sprains occur and chronic ankle instability is common.[13] Several tests measure balance including the Rhomberg Test,

Functional Reach Test and Star-Excursion Balance Test.[14-18] The drawback to these balance tests is that they are not functional measures, are performed with controlled movement, and do not combine balance testing with athletic performance.

Balance can also be measured digitally using force platforms. These devices are typically used for their accuracy, the output of an objective measure and the various balance measures they can calculate. Center of pressure (COP) is one measure of balance that can be calculated utilizing a force platform. The force platform measures anteroposterior, mediolateral, and vertical forces in the x, y and z axes. The information gathered from these three planes allows for a measurement of the displacement of center of foot pressure movements and postural sway.[16] The deficits that can be measured by a force plate can extend far past a single leg static test and has been used during a vertical jump test to determine time to stabilization after landing.[17]

The vertical jump is a functional movement required in most sports and may potentially provide accurate functional balance measurements when performed on the force platform. Few studies have used a force platform to measure the effects of prophylactics on COP during functional

testing.[14,18] The effects of prophylactics on COP after a vertical jump is important because it may be related to the number of injuries that occur in sports requiring vertical jumping as well as sprinting and agility. Determining the best prophylactic device to minimize instability will help decrease future injuries.

The purpose of this study was to examine the effect of bracing and taping on post-vertical jump balance. The following question will be addressed. Will there be a difference in anterior/posterior standard deviation of center of pressure (SDCOP), medial/lateral SDCOP, and overall length COP depending on support condition?

METHODS

The purpose of this study was to determine the effects of taping and bracing on post vertical jump balance. This section includes the following subsections: Research Design, Subjects, Preliminary Research, Instruments, Procedures, Hypothesis, and Data Analysis.

Research Design

A quasi-experimental within subject research design was used for this study. The independent variable was the type of support condition. The three levels of support included the Gibney ankle tape method (Appendix C6), ASO EVO ankle brace (Appendix C6), and an un-taped control condition. The other independent variable was a measurement of balance in the anterior/posterior, medial/lateral directions, and overall COP. The instrument used to determine center of pressure was an AMTI OR 6-7 force plate (Serial # 5386.1 Watertown, MA) with Net Force software version 2.2.

Each subject was tested under all three levels of prophylactic support during one testing session. To ensure

inter-tester reliability, the researcher was the only person to fit the ankle brace and tape the ankle. The subjects wore their personal athletic footwear for this study. A convenient sample of NCAA Division II California University of Pennsylvania athletes was used, limiting the generalization of results. The subjects served as their own control group through performance without the use of bracing or taping.

Subjects

Subjects (N=15) in this research study were male and female collegiate NCAA Division II athletes from California University of Pennsylvania. The subjects were a sample of convenience and included athletes with and without previous history of ankle injury.

Each subject completed a Demographic Information Sheet (Appendix C3) that included information about the subject's age, height, weight, previous and current injury to the ankle, use of prophylactic ankle braces or taping, and current visual, vestibular, and/or balance issues. Subjects were restricted from further participation in the study if they had any lower leg injury requiring medical attention within 30 days leading up to the study, if the subjects had

any current lower leg injury that impeded their athletic performance, or if they reported any visual, vestibular and/or balance issues.

Preliminary Research

Pilot testing was conducted to determine how long bracing, taping, and the vertical jump balance test would take and to familiarize the researcher with the instrumentation. Three college-aged students were used as subjects for the pilot study. Each subject was fitted with 1 of the 3 support conditions and asked to perform a warm up before the balance test was conducted. The warm up consisted of a treadmill warm up and dynamic stretching that is further discussed in the methods section.

Instrumentation

The following instruments were used in this study. A Demographic Information Sheet created by the researcher (Appendix C3), Individual Data Collection Sheet (Appendix C4), and an Order of Support Condition Spreadsheet (Appendix C5). The subjects' names were not recorded during

this study; instead, each subject was assigned a subject number based on the Order of Support Condition Spreadsheet.

Support

The support conditions were placed on the subjects' dominant ankle; this was determined by their response to Question 7, "what is your dominant leg (the leg you would use to kick a ball)?", on the Demographic Information Sheet. The prophylactic ankle brace used in this study was an ASO EVO ankle brace featuring; stirrup strap, stabilizing strap, dynamic cuff with lace up closure, bilateral capability and ballistic nylon base (Appendix C6). The Gibney Ankle Taping Method was used for the taped prophylactic support condition (Appendix C6).

AMTI Force Plate

An AMTI OR 6-7 force plate (Serial # 5386.1 Watertown, MA) with Net Force software version 2.2 was used to collect kinetic data (Appendix C7).

Procedures

Prior to testing, IRB approval was obtained from the California University of Pennsylvania Institutional Review Board for the Protection of Human Subjects (IRB) (Appendix C2). Subjects were recruited from various men and women's California University of Pennsylvania Division II intercollegiate teams. The researcher explained the purpose of the research to each subject when volunteers were asked to participate.

During their pre-determined testing date, each subject read and signed an Informed Consent Form (Appendix C1) approved by the IRB. The researcher answered any questions the subjects may have had. After signing the consent form the subjects filled out the Demographic Information Sheet (Appendix C3).

In order to determine the order of the support conditions, each condition was assigned a number: 1) No support 2) Braced 3) Taped. These 3 numbers were randomized on an excel spreadsheet that acted as a counterbalance to fatigue and learning over time. The first number on the spreadsheet was the first support condition used during the study, the second number was the second support condition and the last number was the third support condition.

A warm-up was completed before performing each vertical jump balance test, after the selected prophylactic support condition had been applied. Each subject began with a five minute light jog at a comfortable pace for the athlete on a treadmill followed by a dynamic warm-up within the testing facility. The dynamic warm-up consisted of high knees, butt kicks, straight leg kicks, and side shuffles. All components were completed twice in a 10 meter straight line on the testing facility's linoleum floor.

Subjects were individually introduced to the vertical jump test on the force platform. The researcher demonstrated to the subject how to perform the vertical jump test and allowed the subject a test trial. A maximum of 3 test trials were allowed for each subject to become comfortable with the procedure. The subject was asked to perform the vertical jump as if they were trying to grab a basketball rebound. The subject began each vertical jump on a level surface 30 centimeters away from the force platform and then used both legs to vertically jump onto the area of the force platform, landing only on the dominant leg (the ankle with the support condition applied) and held the landing for 5 seconds. The force platform measured the subject's anterior/posterior SDCOP, medial/lateral SDCOP, and overall length COP upon landing.

Each subject performed 3 trials with a 30 second rest between trials. The results were recorded on the Individual Data Collection Sheet (Appendix C4). Up to 5 trials were performed; a successful trial entailed remaining on the force platform for a full 5 seconds, not falling off of the force platform and not touching the non-dominant foot onto the force platform. If 3 successful jumps were not completed within those trials, the subject's data were not used. The mean overall length COP, anterior/posterior SDCOP, and medial/lateral SDCOP scores were used for data analysis and the protocol was the same for all three support conditions.

Hypothesis

The following hypothesis was tested during this study:

The anterior/posterior SDCOP, medial/lateral SDCOP, and overall length COP (ability to keep force evenly distributed) will decrease under the braced condition compared to tape and no support conditions, indicating an increase in balance.

Data Analysis

A 3 x 3 factorial repeated measures analysis of variance (ANOVA) was used to analyze the hypothesis involving the support condition (brace, tape, control) and balance measures in the anterior/posterior, medial/lateral, and overall COP directions. The mean standard deviations of length traveled (cm) in the X axis and Y axis were used for the anterior/posterior and medial/lateral COP measurements and the total length traveled (cm) was used for the overall COP measurement. The level of significance for this study was set at $p \leq 0.05$ for the hypothesis. SPSS version 17.0 for Windows was used for the statistical analysis.

RESULTS

The purpose of this study was to examine if there would be a significant difference between prophylactic bracing and taping on post vertical jump balance. The independent variables were support condition with three levels of support (brace, tape, control) and balance measure with three levels, the anterior/posterior SDCOP, medial/lateral SDCOP, and overall length COP. The following section contains the data divided into three subsections: Demographic Information, Hypothesis Testing, and Additional Findings.

Demographic Information

Fifteen (n=15) California University of Pennsylvania NCAA Division II athletes from basketball (n=4), volleyball (n=3) and track and field (n=8) participated in the study. Subject demographics are displayed in the following table.

Table 1. Subject Demographic Information

Sport	N	Age(yrs)	Height(cm)	Weight(kg)	Number of Ankle Sprains
Basketball	4	21.00 ± 0.82	194.31 ± 8.43	93.29 ± 4.43	1.25 ± 1.50
Volleyball	3	19.67 ± 0.58	173.56 ± 3.89	68.94 ± 4.41	0.00 ± 0.00
Track and Field	8	19.38 ± 0.92	169.88 ± 8.94	61.14 ± 6.34	1.00 ± 1.20
Total	15	19.87 ± 1.06	177.11 ± 13.21	71.27 ± 15.02	0.87 ± 1.19

Six subjects had sustained an ankle sprain to their dominant leg and of those 6, 5 had sustained multiple ankle sprains. Subjects were recruited by a sample of convenience.

Hypothesis Testing

Hypothesis testing was performed utilizing the data collected from the 15 subjects who met the specified criteria described in the methods section. The hypothesis was tested with a level of significance set at $p \leq 0.05$.

Hypothesis 1: The anterior/posterior SDCOP, medial/lateral SDCOP, and overall length COP (ability to keep force evenly distributed) will decrease under the braced condition compared to tape and no support conditions, indicating an increase in balance.

A 3 x 3 factorial repeated measure ANOVA was calculated comparing the anterior/posterior, medial/lateral, and overall COP measures under three different support conditions: control, brace, and tape. Mean standard deviation scores of anterior/posterior and medial/lateral COP are found in Table 2. Mean overall length by support condition is found in Table 3.

Table 2. Mean Standard Deviation of Anterior/Posterior, Medial/Lateral Center of Pressure and Mean Overall Length Scores by Support Condition

	Support Condition		
Direction of Measurement(cm)	**Control**	**Brace**	**Tape**
Anterior/Posterior	2.57 ± 1.02	2.26 ± 0.62	2.91 ± 1.62
Medial/Lateral	1.35 ± 0.49	1.34 ± 0.40	1.76 ± 1.39

Table 3. Mean Overall Length Scores by Support Condition

	Support Condition		
Direction of Measurement(cm)	**Control**	**Brace**	**Tape**
Overall Length	124.83 ± 61.46	121.39 ± 58.54	177.89 ± 156.63

No significant main effect was found for support condition ($F(2,28) = 1.454$, $p > 0.05$). This indicates there is no difference in performance based upon support conditions. The support x measure ($F(4,56) = 1.441$, $p > 0.05$) was also not significant. This indicates bracing and

taping did not affect measure differently. A significant main effect on COP measure was found ($F(2,28) = 81.388$, $p < 0.001$). This indicates that varying scores were found for the anterior/posterior, medial/lateral, and overall COP measures.

Due to the significant difference found in the main effect of COP measure, Post Hoc testing was performed. Since the overall COP calculated total length traveled while the medial/lateral and anterior/posterior calculations were standard deviations of length traveled, only the medial/lateral and anterior/posterior measures were compared. Differences between anterior/posterior and medial/lateral length traveled were examined utilizing a paired samples t-test. The mean score for the anterior/posterior measure was 2.57 cm ± 1.166 and the mean score for the medial/lateral measure was 1.486 cm ± .884. Subjects had significantly greater variability of COP in the anterior/posterior direction than the medial/lateral direction ($t(44) = 12.628$, $p < 0.001$).

DISCUSSION

The following section is divided into three subsections: Discussion of Results, Conclusions, and Recommendations.

Discussion of Results

Ankle injuries are widespread throughout athletics and researchers have sought to decrease the incidence of ankle injury without affecting athletic performance. While several studies have been conducted to examine the effect of prophylactic bracing and taping on performance, there is limited research about the effect prophylactic bracing and taping has on balance. Most studies have examined balance via the Functional Reach Test, Star-Excursion Balance Test, time to stabilization measures, and postural sway.[18-21] Although this knowledge is useful, in order to fully understand the effects of prophylactic bracing and taping on balance, subjects should be instructed to perform functional sport specific activities that are relative to the athletes sport.

The purpose of this study was to examine the effect of prophylactic bracing and taping on post vertical jump balance in healthy male and female NCAA Division II California University of Pennsylvania athletes. It was hypothesized that the anterior/posterior, medial/lateral, and overall center of pressure (ability to keep force evenly distributed) would decrease under the braced condition compared to tape and no support conditions, indicating an increase in balance. Measurements in this study were collected on a force platform and the data were analyzed using the associated Net Force software. Statistical analysis revealed no significant difference in main effect support condition and main interaction support x measure.

Although a significant difference was noted for main effect on measure, this was to be expected due to the variability of measures between the mean standard deviation lengths of anterior/posterior and medial/lateral COP while mean overall length was calculated using total length traveled. A Post Hoc analysis noted subjects had significantly greater variability of COP in the anterior/posterior direction than the medial/lateral direction. This anterior/posterior length increase is most

likely due to the forward motion in the X axis experienced jumping on to the force platform.

The goal of using a prophylactic device such as an ankle brace or taping is to prevent lateral ankle sprains by restricting inversion. By applying external support to the ankle, ligamentous structures are reinforced and ankle stability is increased. Ankle bracing and taping have also been demonstrated to enhance proprioception.[22,23]

Baier and Hopf[24] conducted a single-limb standing balance test in athletes with functional ankle instability and found rigid and flexible ankle prophylaxis's reduced sway velocity, most likely due to increased ankle proprioception. Prophylactic ankle taping was also discovered to not impair performance of physically active young individuals during counter movement jump tests, static balance tests, and dynamic posturography tests.[18] Prophylactic bracing conditions were determined to have no effect on the Star Excursion Balance Test measures when physically active volunteers were tested.[25]

One study that did functionally test prophylactic ankle taping and bracing found no significant differences between devices. Dynamic stability was measured with time to stabilization on a force plate. The study consisted of each subject performing a single leg jump-landing with

ankle tape, brace, both tape and braces application, and a control condition without either tape or brace.[26] The methods and results are very similar to this current study. In both cases, no difference between the control condition and bracing, control condition and taping, and bracing and taping conditions were found.

Results may not have been statistically significant because 60% of the subjects had never sustained a dominant leg ankle injury. Bracing has been shown to provide greater benefit to subjects with a prior history of ankle sprains compared to those who have no prior history.[27] Future studies should test for differences between healthy and previously injured ankles.

Conclusions

This study revealed that there is no significant effect on anterior/posterior SDCOP, medial/lateral SDCOP, and overall length COP when tested under various prophylactic support conditions; brace, tape, control. The subjects in this study performed three jumps onto the force platform each time a new support condition was applied and the mean of each set of jumps was averaged for data analysis. With this knowledge, athletic trainers can

continue to brace or tape athletes with confidence that balance will not be affected by either support condition.

Recommendations

It is important for athletic trainers to understand the biomechanical effects of ankle braces and taping. While there are several studies examining the effects of prophylactic bracing and taping on performance, and several more that examine effects of prophylactic bracing and taping on static balance, more research needs to be conducted examining the effects of bracing and taping on functional balance.

One recommendation for future research would be to examine the effects of bracing and taping after a full practice or game so that both the support condition and the athlete's are fatigued. While each subject was required to complete a treadmill and dynamic warm-up with the support condition applied, this was a brief bout of exercise compared to a 2 hour practice or game. Balance could be affected due to loosening of the support condition over time as well as neuromuscular deficits due to muscle fatigue.

Future studies can also analyze data using different measures. While this study examined mean standard deviation and overall length traveled on a force platform, the computer software can examine several different measurements like area of ellipse, minimum and maximum COP in several directions, etc.

Another recommendation would be to perform the same experiment with a cross section of gym flooring, turf, or track composite material mounted on top of the force platform to mimic actual playing surfaces. The force platform is a stationary instrument with a metal landing surface; most jumping activities occur on wood flooring, turf, or grass fields. Applying a similar surface to the force platform would also allow the athlete the chance to wear sport specific footwear such as cleats or running spikes. If the results were found to be the same as this study, it would support the usage of taping and bracing across several different types of sports.

One last recommendation would be to perform the experiment with a larger number of support conditions and subjects. There are several kinds of prophylactic braces on the market today and studying their effects on balance could provide a better option for increasing an athlete’s balance. The results of this study can be generalized to

collegiate athletes, however future research should include larger samples of varying types of athletes for further generalization. Also, there will most likely be a greater distribution of athletes with and without previous ankle injury; data can be analyzed to examine the effects of bracing and taping on these two groups. A larger subject number can also decrease the amount of variability within the study.

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APPENDICES

APPENDIX A

Review of Literature

REVIEW OF LITERATURE

Ankle injuries are one of the most predominant injuries in athletics today.[1-4] Prophylactic taping and bracing devices allow athletes to return to play with support to the injured ankle. While there are several different ways to tape and brace the injured ankle, there is inconclusive evidence in the current research to support the use of one of the methods as the most beneficial or preferred. Most evidence supports the use of prophylactic devices in athletics because there are minimal negative effects on an athlete's performance.[5-13]

The purpose of this review of literature is to present the reader with previous work examining the differences between taping and bracing. This will be accomplished through an examination of: Ankle Anatomy and Physiology, Prophylactic Ankle Devices, and end with a Summary of the research provided.

Ankle Anatomy & Physiology

The ankle is composed of 3 main joints; the talocrural joint, the subtalar joint, and the tibiofibular syndesmosis which allow the rear foot to move in all planar directions. In order for the ankle to maintain stability, the joint surfaces must articulate properly and the muscles and ligaments surrounding the joint must provide stabilization and limit range of motion.

The talocrural joint is formed from 3 separate bones that form a hinge joint primarily responsible for plantarflexion and dorsiflexion as well as the transfer of torque forces between the lower leg and the foot. The dome of the talus articulates with the medial and lateral malleoli of the tibia and fibula respectively and during full weight bearing, the articulating surfaces against the talus aid in stabilization. There is a joint capsule and several ligaments that support this joint including the anterior and posterior talofibular ligaments and calcaneofibular ligament laterally while the deltoid ligament supports this joint medially.

The talus and calcaneus form the subtalar joint where pronation and supination occur; this joint also aids in the transfer of torque forces between the lower leg and foot.

The talus articulates posterior with the calcaneus and anterior with the navicular tarsal bone. There are two separate capsules within the cavity along with 3 intrinsic subtalar ligaments and peripheral ligaments that include the calcaneofibular, lateral talocalcaneal and fibulotalocalcaneal ligaments. Although the calcaneofibular ligament does not directly connect to the talus, its relation to the talus helps prevent excessive inversion. The distal tibiofibular joint is a syndesmosis between the tibia and fibula. It is unlike the other 2 joints since there is very little movement between these two bones; however, the joint is vital to normal ankle biomechanics and forms the superior border of the talocrural joint.

The muscles and tendons that cross the ankle complex also contribute to function and stability at the ankle. There are several muscles that cross the ankle at varying locations to aid in the four main directions of movement. These muscles include the anterior tibialis, extensor digitorum longus and brevis, as well as the peroneous longus, brevis and tertius. When these muscles concentrically contract the force generates movement; however, during eccentric contraction, the muscles act as dynamic stabilizers.[14]

Ankle joint stabilization is derived from the somatosensory system, also known as proprioception. The function of this system is to detect sensory stimuli such as touch, pain, pressure, and joint movements from peripheral articular and musculotendinous receptors concerning muscle length and tension changes as well as joint position and motion. While there are cutaneous nerves that aid in joint proprioception, mechanoreceptors found in the joint capsule, bone and ligaments serve as range limit detectors, joint compression sensors and signal the presence of noxious stimuli.[15] Ankle proprioception is an important factor that affects susceptibility to ankle sprains and in order to protect the mechanoreceptors located within the skin, musculotendinous unit and within the bone, joint ligaments and joint capsule, external ankle prophylactic devices may be applied. The application of a prophylactic device may actually increase proprioceptive ability, therefore, decreasing the potential for injury.[16]

Mechanisms of Injury

Due to a stronger medial joint capsule and ligaments, inversion sprains involving the lateral structures are more common and are found to be the most common ankle injury in recreational and competitive athletes.[17] More than 50% of

the major injuries sustained in basketball are due to ankle sprains while ankle sprains constitute 25% of all soccer and volleyball injuries. Lateral ankle sprains occur during activities like running, jumping, rapid change in directions, or participating on an uneven surface when excessive inversion and plantarflexion occurs.[18]

Following a lateral ankle sprain, functional instability is hypothesized to predispose individuals to re-injury because structural damage occurs to the ligamentous tissue as well as nervous and musculotendinous tissue around the ankle. These deficits may impair balance, reduce range of motion, and impair proprioception.[19]

The Injured Ankle

The ankle is an intricate compilation of articulations and musculotendinous connections that can be easily disturbed. If excessive force is applied to the ankle, damage to these structures can occur and predispose an athlete to future injuries including a chronic functionally and/or mechanically unstable ankle.[19] Bracing and taping are two prophylactic measures often used to protect ankles from a sprain during athletic participation.[17] The application of an external ankle support can reduce ankle inversion in turn reducing the risk of a lateral ankle sprain therefore

external ankle support should be encouraged when there is a clear history of recurrent ankle sprains.[16]

Mechanically and Functionally Unstable Ankles

Two factors have been targeted as precursors to chronic ankle impairments, mechanical and functional instability. Mechanical instability occurs due to anatomic changes that may occur due to an initial ankle sprain. Changes occur in the synovial lining, as well as degenerative changes, chronic laxity, and impaired arthrokinematics. Functional instability is caused by neuromuscular impairments related to proprioception, strength, neuromuscular control, and postural control. The combination of any of these mechanical and functional impairments is believed to lead to recurrent ankle sprains.[14]

If an athlete is predisposed to ankle injuries due to mechanical and functional instability, preventive measures should be taken to reduce the recurrence of injury. These measures include proprioceptive exercises, muscle strengthening, and the use of prophylactic devices.[20]

Prophylactic Ankle Devices

Prophylactic ankle devices are used to provide external support to the ankle. There are different methods of application with traditional athletic tape and several types of braces on the market. A multitude of studies examined the effectiveness of bracing and taping against stability and performance.[5-8,10-13,21]

Purpose of Prophylactics

The goal of using a prophylactic device is to prevent lateral ankle sprains by restricting inversion; athletes with a previous history of inversion ankle sprains are the most susceptible to reinjury.[22] By applying external support to the ankle, ligamentous structures are reinforced and ankle stability is increased. Additionally, taping and bracing have been shown to enhance proprioception.[9,16] Several studies have demonstrated that both taping and bracing protect against injury to the ankle thus reducing the incidence of a secondary ankle sprain.[23]

Ankle Taping

Athletic tape is commonly used to support the ankle joint to prevent ankle sprains and recover from previous injuries.[24,25] Although few studies have been conducted to determine the best method for taping the ankle, the research available has determined taping can prevent lateral ankle injuries, especially among previously injured ankles.[26]

While there are several styles of ankle taping, Gibney ankle taping procedure is one of the most common taping techniques used today. The Louisiana heel lock and figure-of-eight wrapping patterns are also used in combination with the basket weave in contemporary tape techniques.[27] Literature has shown a basket weave with stirrups and heel locks provides the best mechanical resistance against inversion; excessive inversion is the most common mechanism of lateral ankle sprains.[28] Tape application can be advantageous to braces because it can conform to the athlete's anatomy more precisely and address more individualized biomechanical problems.

According to Garrick and Requa's[29] study there was a significant decrease in ankle sprain rates among intramural basketball players when their ankles were taped. Taping has been shown to also prevent ankle sprains in soccer players

due to the increase mechanical and functional stability.[24] Wilkerson[27] noted that taping may facilitate the use of dynamic neuromuscular protective mechanisms and provides a means to address biomechanical factors responsible for instability of the talocural joint. Although ankle taping is a standard practice for athletic trainers, more research is needed to determine the effectiveness of ankle taping.

Ankle Bracing

Ankle braces are also frequently used after acute ankle sprains as well as for chronic ankle instability and offer an alternative to ankle taping.[30] This type of support structure is usually composed of a thermoplastic material and molded to conform to the user's foot and ankle in a stirrup fashion as well as lace up canvas construction.[31]

Ankle bracing can offer advantages during the acute management phase of ankle sprains due to its ease of application and removal, adjustability of tension and in some cases, edema reduction.[27] A cost-benefit analysis revealed that in a given athletic season, bracing is three times more cost effective than taping.[22]

Cordova et al.'s[32] analysis regarding the influence of ankle prophylactics on joint range of motion demonstrated that a semi-rigid support condition offered restriction of

motion in the medial/lateral plane. Semi-rigid ankle stabilizers have been established to reduce injury to the ankle ligaments in basketball players.[33] When female subjects used a semi-rigid orthotic during a 3 hour volleyball practice, the orthotic was effective in providing initial ankle protection and in guarding against ligamentous injury.[34] Pedowitz et al.[35] also found prophylactic bracing significantly reduced the ankle injury rate associated with loss of play among Division I female college volleyball players.

Effects of Ankle Prophylactics on Performance

While the purpose of prophylactic ankle devices is prevention of primary injury and reduce recurrence of re-injury, competitive athletes are concerned with the devices effect on performance. If athletes feel they are at risk of affecting optimal performance they tend to opt out of using prophylactic devices. The needs of athletic performance must be weighed against the need for the prevention of injury to the athlete's ankle. The athlete's ankle should have adequate proprioceptive support and stability without a significant compromise in performance. Three common measures of performance are vertical jump, speed and agility testing.[5-8,10-13,21,29]

Vertical Jump Testing

Jumping is commonplace in several athletic arenas including basketball, volleyball, and track events. A multitude of sports also incorporates jumping maneuvers during competition such as football, volleyball, and soccer. Since vertical jump testing is a good measure of power, testing various ankle prophylactic devices during a vertical jump determines if there is positive, negative, or neutral effect on power.

Several methods of vertical jump testing have been used throughout the studies reviewed. Procedures ranged from putting chalk on the subject's fingers and performing a vertical jump next to a wall to using electronic systems like the Vertex™ or Just Jump System™. [6-8,10,12,13,21,36]

Vertical jump performance has been tested using taping methods as well as a variety of bracing methods. Semi-rigid and soft-shell prophylactic ankle braces were used to determine their effect on vertical jump height among high school football players. Both braced conditions had no significant effect on vertical jump performance.[6] A similar vertical jump study used high school basketball players and noted no significant differences among the two semi-rigid prophylactic bracing devices.[7] MacKean et al.[21] compared the effectiveness of ankle taping and semi-rigid orthotic

discovered that vertical jump height decreased with the use of the semi-rigid orthotic and was even less with ankle tape as compared with no tape while Verbrugge's[13] study noted no impediment on vertical jump height with both a semi-rigid brace and conventional tape.

Most studies used in this review that compared ankle bracing to taping concluded that there was very little to no detrimental effect on vertical jump performance.[37] Athletes and athletic trainers should consider the minimal negative effects on performance is warranted.[21]

Speed and Agility Testing

Speed and agility is a component of nearly every athletic competition. As explained above, athletes will most often refuse to wear any type of prophylactic device if they feel their speed and agility may be compromised. There are several tests that can be performed to measure speed and agility, including sprinting speed, timed shuttle runs, four point run performance tests, and T-tests. Several studies have been conducted to determine if certain ankle braces and tape applications affect these two factors.[5-8,10-13,37,21]

Verbrugge's[13] study comparing the effects of bracing versus taping on motor performance concluded that while the

male athletes tested found using a brace to be more comfortable, both taping and bracing have no substantial effect on agility and sprinting speed. Several studies utilized similar performance testing among high school football and basketball players and noted bracing had no significant effect on speed and agility.[6,7]

Among 30 college athletes tested under braced and taped conditions, there was a significant decrease in sprinting and agility performance while taped and a minor decrease while braced.[11] Paris[37] conducted a study using 18 elite soccer players and found no significant differences in speed and agility under braced and taped support conditions. Although some studies have indicated a decrease in speed and agility performance, literature supporting the use of external ankle prophylactics for the prevention of injury outweighs the possibility of performance impairment.

Balance Testing

Although balance is not perceived as a measure of performance, athletes may notice performance deficits if their balance is compromised. After an acute lateral ankle sprain occurs, balance problems may develop because of damage to musculotendinous and ligamentous tissues that proprioceptive feedback.[38] Balance deficits can been tested

through varying functional tests including the Functional Reach Test, Star-Excursion Balance Test, time to stabilization measures, and postural sway.[38-41] During a study examining stabilization times with functionally unstable ankles, Ross et al.[42] discovered time to stabilization was longer for participants with functional ankle instability than those with stable ankles. Fu and Hui-Chan[39] found basketball players with multiple ankle sprains had increased errors in repositioning and postural sway. In a similar study, McGuine et al.[41] assessed susceptibility to ankle injury in high school basketball players and found athletes who demonstrated high postural sway scores had nearly 7 times as many ankle sprains as compared to athletes with low postural sway scores.

Similar balance tests have been conducted using different prophylactic devices. Baier and Hopf[43] conducted a single-limb standing balance test in athletes with functional ankle instability and found rigid and flexible ankle prophylaxis's reduced sway velocity, most likely due to increased ankle proprioception. Ankle taping was also discovered to not impair performance of physically active young individuals during counter movement jump tests, static balance tests, and dynamic posturography tests.[40] Prophylactic bracing conditions were determined to have no

effect on the Star Excursion Balance Test measures when physically active volunteers were tested.[44]

One study that did functionally test prophylactic ankle taping and bracing found no significant differences between devices. Dynamic stability was measured with time to stabilization on a force plate. The study consisted of each subject performing a single leg jump-landing with ankle tape, brace, both tape and braces application, and a control condition without either tape or brace.[45]

Most of the tests found in this literature review were static or did not require functional athletic movements. In order to fully understand the effects of prophylactic bracing and taping on balance, subjects should be instructed to perform functional sport specific activities that are relative to the athletes sport. Also, some tests relied on the investigator to keep balance scores instead of using a measurement device to accurately collect data.

Summary

Prophylactic ankle devices and their effects on performance have been thoroughly studied. In most cases ankle bracing and taping have not shown to negatively affect performance.[5-13] Balance has also been studied in

conjunction with prophylactic ankle devices; however, there is minimal research about the functional effects of prophylactic ankle devices and balance. Athletes typically do not stand still during athletic events; therefore, a stationary test does not offer enough data to support or negate the effects of prophylactics on balance.

Performing a vertical jump with varying ankle support conditions to examine balance may be more of a functional movement rather than statically standing on a force platform. If the athletic trainer is aware of the difference in balance when applying varying support conditions he can more accurately assess the best prophylactic device needed to increase their athlete's balance.

APPENDIX B

The Problem

THE PROBLEM

The purpose of this study was to determine if bracing and taping have an effect on post-vertical jump balance. Subjects performed a vertical jump onto a force platform and land on the dominant leg with the applied prophylactic condition.

Studying the effects of prophylactic ankle devices on balance is important due to the effect an ankle injury has on balance. Understanding the effects of prophylactic devices on balance may help sports medicine professionals determine the type of device that would benefit their athletes the most.

Definition of Terms

The following terms were operationally defined for this study:

1) Balance- the ability to maintain a position of equilibrium; may be measured by postural sway.
2) Postural Sway- the deviation from the mean center of pressure of the foot for a given trial.[14]

3) Center of Pressure- the central point of pressure that is applied to the foot during standing on the ground.
4) Prophylactic Ankle Device- a device applied to the ankle to provide stability, support, and help prevent injuries to the ankle.
5) Proprioception- the afferent information derived from muscles, tendons, joint capsules, and ligaments.[46]
6) Chronic Ankle Instability- a combination of mechanical and functional instability that leads to recurrent ankle sprains.[19]

Basic Assumptions

The basic assumptions for this study are as follows:

1) All subjects will be honest in reporting no previous lower extremity injury within the past six months.
2) All subjects will be honest in reporting no current visual, vestibular or balance issues.
3) The equipment will be calibrated and work properly during the study.
4) All subjects will give their best effort during the vertical jump balance testing.
5) All subjects will participate in this study without any form of coercion.

Limitations of the Study

The limitations for this study are as follows:

1) Testing will be done with a force platform, which means the athletes will not be landing on a surface used in their sport.
2) Athletes will be required to wear their own athletic footwear during testing. This footwear may not be the same footwear used in their sport and some athletes may wear more supportive shoes than others.
3) Only the ASO EVO ankle brace will be used so the results will only be generalized for post vertical jumps with this brace.

Significance of the Study

The significance of this study is to expand the understanding of ankle bracing and taping and their effects on post vertical jump balance. During exercise of athletic performance, a person's balance is constantly changing due to forces on the body. The ability to maintain one's balance can be measured through the use of center of pressure measurements. When a force is applied to the body and a person is unable to maintain a reasonable center of pressure, injury may occur.

Many authors have examined the mechanisms of ankle injury and prophylactic devices used for prevention and support.[9,16,20,24,26,27,29,31,33,34,35,47,48] Several others have examined the relationship between prophylactic devices and performance.[5-13] However, there are a limited number of studies examining these devices effect on balance during functional activities.

The vertical jump is a functional movement that is used in a variety of sports and contains two specific motions (ankle plantarflexion and inversion) that most commonly result in ankle injury. The findings of this study may demonstrate that post vertical jump center of pressure is significantly different between ankle bracing and ankle taping. If this difference is demonstrated, athletic trainers may reconsider the use of ankle bracing and taping for the support and prevention of ankle injuries.

APPENDIX C

Additional Methods

APPENDIX C1

Informed Consent Form

Informed Consent Form

1. Nicole Jussaume, who is a Graduate Athletic Training Student at California University of Pennsylvania, has requested my participation in a research study at California University of Pennsylvania. The title of the research is the Effect of Bracing versus Taping on Post Vertical Jump Balance.

2. I have been informed that the purpose of this study is to examine the effects of bracing and taping on post vertical jump balance. I understand that I must be 18 years of age or older to participate. I understand that I have been asked to participate along with 30 other individuals because I have no current lower extremity injury impeding my athletic performance nor have I suffered a lower extremity injury requiring medical attention within the last 30 days, I am not suffering from any visual, vestibular or balance issues, and I am a NCAA Division II California University of Pennsylvania collegiate athlete.

3. I have been invited to participate in this research project. My participation is voluntary and I can choose to discontinue my participation at any time without penalty or loss of benefits. My participation will involve two different external ankle support conditions, athletic tape and bracing, and then partaking in an 8-10 minute dynamic warm-up that includes a 5 minute light jog on a treadmill as well as dynamic stretching exercises. The test I will be performing immediately after the dynamic warm-up is a vertical jump test using a force platform. My participation in this study will consist of a brief orientation session that is included in three testing days.

4. I understand there are foreseeable risks or discomforts to me if I agree to participate in the study. With participation in a research program such as this there is always the potential for unforeseeable risks as well. The possible risks and/or discomforts include possible lower extremity injury due to falling from loss of balance and minor fatigue due to the dynamic warm-up. To minimize these risks the researcher will be asking me questions about prior injury to my lower extremity. The researcher will also stand by closely during the vertical jump testing in case I need help or begin to fall.

5. I understand that, in case of injury, I can expect to receive treatment or care in Hamer Hall's Athletic Training Facility. This treatment will be provided by the researcher, Nicole Jussaume, under the supervision of the Cal U athletic training faculty, all of which can administer emergency care. Additional services needed for prolonged care will be referred to the attending staff at Health Services located on campus.

6. There are no feasible alternative procedures available for this study.

7. I understand that the possible benefits of my participation in the research are to help determine the effects of bracing and taping on post vertical jump balance. This study can help athletic trainers decide a preferred method of providing external ankle support to their athletes.

8. I understand that the results of the research study may be published but my name or identity will not be revealed. Only aggregate data will be reported. In order to maintain confidentially of my records, Nicole Jussaume will maintain all documents in a secure location on campus and password protect all electronic files so that only the student researcher and research advisor can access the data. Each subject will be given a specific subject number to represent his or her name so as to protect the anonymity of each subject.

9. I have been informed that I will not be compensated for my participation.

10. I have been informed that any questions I have concerning the research study or my participation in it, before or after my consent, will be answered by:

Nicole Jussaume, ATC
STUDENT/PRIMARY RESEARCHER
jus0205@calu.edu
603-508-1542

Shelly Fetchen DiCesaro, PhD, ATC, CSCS
RESEARCH ADVISOR
dicesaro@calu.edu
724-938-4562

11. I understand that written responses may be used in quotations for publication but my identity will remain anonymous.

12. I have read the above information and am electing to participate in this study. The nature, demands, risks, and benefits of the project have been explained to me. I knowingly assume the risks involved, and understand that I may withdraw my consent and discontinue participation at any time without penalty or loss of benefit to myself. In signing this consent form, I am not waiving any legal claims, rights, or remedies. A copy of this consent form will be given to me upon request.

13. This study has been approved by the California University of Pennsylvania Institutional Review Board.

14. The IRB approval dates for this project are from: 3/18/10 to 3/18/11.

Subject's Signature:_____Date:_____

Witness Signature:_____Date:_____

Approved by the California University of Pennsylvania IRB.

APPENDIX C2

Institutional Review Board –

California University of Pennsylvania

Institutional Review Board
California University of Pennsylvania
Psychology Department LRC, Room 310
250 University Avenue
California, PA 15419
instreviewboard@cup.edu
instreviewboard@calu.edu
Robert Skwarecki, Ph.D., CCC-SLP,Chair

Nicole Jussaume,

Please consider this email as official notification that your proposal titled "Effect of Bracing Versus Taping on Post Vertical Jump Balance" (Proposal #09-057) has been approved by the California University of Pennsylvania Institutional Review Board as amended.

The effective date of the approval is 3-18-2010 and the expiration date is 3-18-2011. These dates must appear on the consent form .

Please note that Federal Policy requires that you notify the IRB promptly regarding any of the following:

(1) Any additions or changes in procedures you might wish for your study (additions or changes must be approved by the IRB before they are implemented)

(2) Any events that affect the safety or well-being of subjects

(3) Any modifications of your study or other responses that are necessitated by any events reported in (2).

(4) To continue your research beyond the approval expiration date of 3-18-2011 you must file additional information to be considered for continuing review. Please contact instreviewboard@calu.edu

Please notify the Board when data collection is complete.

Regards,
Robert Skwarecki, Ph.D., CCC-SLP
Chair, Institutional Review Board

California University of Pennsylvania

Proposal Number

Date Received

PROTOCOL for Research Involving Human Subjects

Institutional Review Board (IRB) approval is required before beginning any research and/or data collection involving human subjects

(Reference IRB Policies and Procedures for clarification)

Project Title ***EFFECT OF BRACING VERSUS TAPING ON POST VERTICAL JUMP BALANCE***

Researcher/Project Director ***Nicole Jussaume***

Phone # ***603-508-1542*** ***E-mail Address*** ***jus0205@cup.edu***

Faculty Sponsor (if required) ***Shelly Fetchen DiCesaro, PhD, ATC,CSCS***

Department ***Health Science***

Project Dates ***March 18, 2010*** ***to*** ***March 18, 2011***

Sponsoring Agent (if applicable)

Project to be Conducted at ***California University of Pennsylvania***

Project Purpose: ☒ ***Thesis*** ☐ ***Research*** ☐ ***Class Project*** ☐ ***Other***

Keep a copy of this form for your records.

Please attach a typed, detailed summary of your project AND complete items 2 through 6.

1. *Provide an overview of your project-proposal describing what you plan to do and how you will go about doing it. Include any hypothesis(ses)or research questions that might be involved and explain how the information you gather will be analyzed. For a complete list of what should be included in your summary, please refer to Appendix B of the IRB Policies and Procedures Manual.*

The purpose of this study will be to examine the relationship between ankle bracing and taping on post vertical jump balance. Healthy National Collegiate Athletic Association (NCAA) Division II collegiate athletes from the California University of Pennsylvania age 18 or older are expected to participate in this study (N=20). All subjects have undergone a pre-season physical prior to their sport season. Subjects who suffer from any visual, vestibular, balance disorder, serious lower extremity injury within 30 days prior to the test and/or currently suffering from lower extremity injury will be excluded from this study.

Each subject who signed the informed consent (attached) and is not suffering from any of the aforementioned conditions will have one measure of balance performed under three support conditions (no support, ASO ankle brace, Gibney ankle tape method) during one testing session. A warm-up will be completed before performing each vertical jump balance test and after the application of the support condition. Each subject will begin with a five minute light jog at a comfortable pace on a treadmill followed by a dynamic warm-up within the testing facility. The warm-up will consist of high knees, butt kicks, straight leg kicks and side shuffles. All components will be completed twice in a 10 meter straight line. This dynamic warm-up will be completed after each support condition is applied. The total time for warm-up will take 10 minutes.

Subjects will be individually introduced to the vertical jump test on the force platform. The researcher will demonstrate to the subject how to perform the vertical jump test and allow the subject a test trial. One to 3 test trials will be allowed for each subject to become comfortable with the procedure. The subject will perform the vertical jump as if the subject were trying to grab a basketball rebound. The subject will begin each vertical jump on a level surface 30 centimeters away from the force platform and then vertically jump onto the force platform landing only on the dominant ankle (the ankle with the support condition applied). The force platform will measure the subject's anterior/posterior, medial/lateral, and overall COP post vertical jump.

Each subject will perform 3 trials with a 30 second rest between trials. The results will be recorded on an Individual Data Collection Sheet. Up to 5 trials may be performed; a successful trial entails remaining on the force platform for a full 5 seconds, not falling off of the force platform and not touching the non-dominant foot onto the force platform. If 3 successful jumps are not completed within those trials, the subject's data will not be used. The mean overall, anterior/posterior, and medial/lateral COP scores will be used for data analysis and the protocol will be the same for all three support conditions. Subjects may withdraw from the research at any time without penalty. Subjects who do not successfully complete the study will be eliminated from the study without penalty.

The following are the hypotheses for this study: 1) The overall COP (ability to keep force evenly distributed) will decrease under the braced condition compared to taped and no support conditions, indicating an increase in balance. 2) The anterior/posterior COP (ability to keep force evenly distributed) will decrease under the braced condition compared to taped and no support conditions, indicating an increase in balance. 3) The medial/lateral COP (ability to keep force evenly distributed) will decrease under the braced condition compared to taped and no support conditions, indicating an increase in balance.

A multivariate analysis of variance (MANOVA) will be used to analyze the hypotheses involving the support condition (braced, taped, no support) and the dependent variable (COP). The level of significance for this study will be set at ≤ 0.05 for the hypotheses. SPSS version 17.0 for Windows will be used for the statistical analysis.

2. *Section 46.11 of the Federal Regulations state that research proposals involving human subjects must satisfy certain requirements before the IRB can grant approval. You should describe in detail how the following requirements will be satisfied. Be sure to address each area separately.*

   a. *How will you insure that any risks to subjects are minimized? If there are potential risks, describe what will be done to minimize these risks. If there are risks, describe why the risks to participants are reasonable in relation to the anticipated benefits.*

      The possible risks and/or discomforts are very minimal and include falling down during vertical jump balance testing and minor fatigue due to warm-up protocol. The researcher will minimize the risk of falling by acting as a spotter. If an injury occurs, the researcher, who is a certified athletic trainer and is certified in CPR, will provide care to the subject in the Hamer Hall Athletic Training Room.

   b. *How will you insure that the selection of subjects is equitable? Take into account your purpose(s). Be sure you address research problems involving vulnerable populations such as children, prisoners, pregnant women, mentally disabled persons, and economically or educationally disadvantaged persons. If this is an in-class project describe how you will minimize the possibility that students will feel coerced.*

      All subjects will be volunteers who are eighteen years or older and are NCAA Division II collegiate athletes at the California University of Pennsylvania. Prior to the study, an informational e-mail will be sent out to the potential subjects to explain the concept of the study with exclusion criteria. Subjects who suffer from any visual, vestibular, balance disorder, serious lower extremity injury within 30 days prior to the test and/or currently suffering from lower extremity injury will be excluded from this study.

   c. *How will you obtain informed consent from each participant or the subject's legally authorized representative and ensure that all consent forms are appropriately documented? Be sure to attach a copy of your consent form to the project summary.*

      An informed consent form (attached) will be completed and signed by all subjects before participating in this study on the first day of testing. Each signed form will be kept by the researcher in a secure location in which only the researcher and research advisor can access to ensure subject confidentiality.

   d. *Show that the research plan makes provisions to monitor the data collected to insure the safety of all subjects. This includes the privacy of subjects' responses and provisions for maintaining the security and confidentiality of the data.*

      Data will be collected during the spring semester. All subjects will come once to measure post vertical jump balance based on three different support conditions (no support, ASO ankle brace, Gibney ankle tape method). All collected data which will be identified by subject number will be maintained by the researcher in a secure location in which only the researcher and research advisor can access to ensure subject confidentiality.

3. *Check the appropriate box(es) that describe the subjects you plan to use.*

☐ *Adult volunteers*	☐ *Mentally Disabled People*
☒ *CAL University Students*	☐ *Economically Disadvantaged People*
☐ *Other Students*	☐ *Educationally Disadvantaged People*
☐ *Prisoners*	☐ *Fetuses or fetal material*
☐ *Pregnant Women*	☐ *Children Under 18*
☐ *Physically Handicapped People*	☐ *Neonates*

4. *Is remuneration involved in your project?* ☐ *Yes or* ☒ *No. If yes, Explain here.*

5. *Is this project part of a grant?* ☐ *Yes or* ☒ *No If yes, provide the following information:*

   Title of the Grant Proposal

   Name of the Funding Agency

   Dates of the Project Period

6. *Does your project involve the debriefing of those who participated?* ☐ *Yes or* ☒ *No*

   If Yes, explain the debriefing process here.

7. *If your project involves a questionnaire interview, ensure that it meets the requirements of Appendix___in the Policies and Procedures Manual.*

California University of Pennsylvania Institutional Review Board
Survey/Interview/Questionnaire Consent Checklist (v021209)

This form MUST accompany all IRB review requests

Does your research involve ONLY a survey, interview or questionnaire?

☐ **YES**—Complete this form
☒ **NO**—You MUST complete the "Informed Consent Checklist"—skip the remainder of this form

Does your survey/interview/questionnaire cover letter or explanatory statement include:

☐ (1) Statement about the general nature of the survey and how the data will be used?

☐ (2) Statement as to who the primary researcher is, including name, phone, and email address?

☐ (3) FOR ALL STUDENTS: Is the faculty advisor's name and contact information provided?

☐ (4) Statement that participation is voluntary?

☐ (5) Statement that participation may be discontinued at any time without penalty and all data discarded?

☐ (6) Statement that the results are confidential?

☐ (7) Statement that results are anonymous?

☐ (8) Statement as to level of risk anticipated or that minimal risk is anticipated? (NOTE: If more than minimal risk is anticipated, a full consent form is required—and the Informed Consent Checklist must be completed)

☐ (9) Statement that returning the survey is an indication of consent to use the data?

☐ (10) Who to contact regarding the project and how to contact this person?

☐ (11) Statement as to where the results will be housed and how maintained? (unless otherwise approved by the IRB, must be a secure location on University premises)

☐ (12) Is there text equivalent to: "Approved by the California University of Pennsylvania Institutional Review Board. This approval is effective nn/nn/nn and expires mm/mm/mm"? (the actual dates will be specified in the approval notice from the IRB)?

☐ (13) FOR ELECTRONIC/WEBSITE SURVEYS: Does the text of the cover letter or explanatory statement appear before any data is requested from the participant?

☐ (14) FOR ELECTONIC/WEBSITE SURVEYS: Can the participant discontinue participation at any point in the process and all data is immediately discarded?

California University of Pennsylvania Institutional Review Board
Informed Consent Checklist (v021209)

This form MUST accompany all IRB review requests

Does your research involve ONLY a survey, interview, or questionnaire?
☐ **YES**—DO NOT complete this form. You MUST complete the "Survey/Interview/Questionnaire Consent Checklist" instead.
☒ **NO**—Complete the remainder of this form.

1. Introduction (check each)
☒ (1.1) Is there a statement that the study involves research?
☒ (1.2) Is there an explanation of the purpose of the research?

2. Is the participant. (check each)
☒ (2.1) Given an invitation to participate?
☒ (2.2) Told why he/she was selected.
☒ (2.3) Told the expected duration of the participation.
☒ (2.4) Informed that participation is voluntary?
☒ (2.5) Informed that all records are confidential?
☒ (2.6) Told that he/she may withdraw from the research at any time without penalty or loss of benefits?
☒ (2.7) 18 years of age or older? (if not, see Section #9, Special Considerations below)

3. Procedures (check each).
☒ (3.1) Are the procedures identified and explained?
☒ (3.2) Are the procedures that are being investigated clearly identified?
☒ (3.3) Are treatment conditions identified?

4. Risks and discomforts. (check each)
☒ (4.1) Are foreseeable risks or discomforts identified?
☒ (4.2) Is the likelihood of any risks or discomforts identified?
☒ (4.3) Is there a description of the steps that will be taken to minimize any risks or discomforts?
☒ (4.4) Is there an acknowledgement of potentially unforeseeable risks?
☒ (4.5) Is the participant informed about what treatment or follow up courses of action are available should there be some physical, emotional, or psychological harm?
☒ (4.6) Is there a description of the benefits, if any, to the participant or to others that may be reasonably expected from the research and an estimate of the likelihood of these benefits?
☒ (4.7) Is there a disclosure of any appropriate alternative procedures or courses of treatment that might be advantageous to the participant?

5. Records and documentation. (check each)
☒ (5.1) Is there a statement describing how records will be kept confidential?
☒ (5.2) Is there a statement as to where the records will be kept and that this is a secure location?
☒ (5.3) Is there a statement as to who will have access to the records?

6. For research involving more than minimal risk (check each),
☐ (6.1) Is there an explanation and description of any compensation and other medical or counseling treatments that are available if the participants are injured through participation?

☐ (6.2) Is there a statement where further information can be obtained regarding the treatments?
☐ (6.3) Is there information regarding who to contact in the event of research-related injury?

7. Contacts.(check each)
☒ (7.1) Is the participant given a list of contacts for answers to questions about the research and the participant's rights?
☒ (7.2) Is the principal researcher identified with name and phone number and email address?
☒ (7.3) FOR ALL STUDENTS: Is the faculty advisor's name and contact information provided?

8. General Considerations (check each)
☒ (8.1) Is there a statement indicating that the participant is making a decision whether or not to participate, and that his/her signature indicates that he/she has decided to participate having read and discussed the information in the informed consent?
☒ (8.2) Are all technical terms fully explained to the participant?
☒ (8.3) Is the informed consent written at a level that the participant can understand?
☒ (8.4) Is there text equivalent to: "Approved by the California University of Pennsylvania Institutional Review Board. This approval is effective nn/nn/nn and expires mm/mm/mm"? (the actual dates will be specified in the approval notice from the IRB)

9. Specific Considerations (check as appropriate)
☐ (9.1) If the participant is or may become pregnant is there a statement that the particular treatment or procedure may involve risks, foreseeable or currently unforeseeable, to the participant or to the embryo or fetus?
☐ (9.2) Is there a statement specifying the circumstances in which the participation may be terminated by the investigator without the participant's consent?
☐ (9.3) Are any costs to the participant clearly spelled out?
☐ (9.4) If the participant desires to withdraw from the research, are procedures for orderly termination spelled out?
☐ (9.5) Is there a statement that the Principal Investigator will inform the participant or any significant new findings developed during the research that may affect them and influence their willingness to continue participation?
☐ (9.6) Is the participant is less than 18 years of age? If so, a parent or guardian must sign the consent form and assent must be obtained from the child
- ☐Is the consent form written in such a manner that it is clear that the parent/guardian is giving permission for their child to participate?
- ☐Is a child assent form being used?
- ☐ Does the assent form (if used) clearly indicate that the child can freely refuse to participate or discontinue participation at any time without penalty or coercion?

☒ (9.7) Are all consent and assent forms written at a level that the intended participant can understand? (generally, 8th grade level for adults, age-appropriate for children)

California University of Pennsylvania Institutional Review Board
Review Request Checklist (v021209)

This form MUST accompany all IRB review requests.
Unless otherwise specified, ALL items must be present in your review request.

Have you:

☒ (1.0) FOR ALL STUDIES: Completed ALL items on the Review Request Form?
Pay particular attention to:

- ☒ (1.1) Names and email addresses of all investigators
  - ☒ (1.1.1) FOR ALL STUDENTS: use only your CalU email address)
  - ☒ (1.1.2) FOR ALL STUDENTS: Name and email address of your faculty research advisor
- ☒ (1.2) Project dates (must be in the future—no studies will be approved which have already begun or scheduled to begin before final IRB approval—NO EXCEPTIONS)
- ☒ (1.3) Answered completely and in detail, the questions in items 2a through 2d?
  - ☒2a: NOTE: No studies can have zero risk, the lowest risk is "minimal risk". If more than minimal risk is involved you MUST:
    - ☐ i. Delineate all anticipated risks in detail;
    - ☐ ii. Explain in detail how these risks will be minimized;
    - ☐ iii. Detail the procedures for dealing with adverse outcomes due to these risks.
    - ☐ iv. Cite peer reviewed references in support of your explanation.
  - ☒ 2b. Complete all items.
  - ☒ 2c. Describe informed consent procedures in detail.
  - ☒ 2d. NOTE: to maintain security and confidentiality of data, all study records must be housed in a secure (locked) location ON UNIVERSITY PREMISES. The actual location (department, office, etc.) must be specified in your explanation and be listed on any consent forms or cover letters.
- ☒ (1.4) Checked all appropriate boxes in Section 3? If participants under the age of 18 years are to be included (regardless of what the study involves) you MUST:
  - ☐ (1.4.1) Obtain informed consent from the parent or guardian—consent forms must be written so that it is clear that the parent/guardian is giving permission for their child to participate.
  - ☐ (1.4.2) Document how you will obtain assent from the child—This must be done in an age-appropriate manner. Regardless of whether the parent/guardian has given permission, a child is completely free to refuse to participate, so the investigator must document how the child indicated agreement to participate ("assent").
- ☐ (1.5) Included all grant information in section 5?
- ☒ (1.6) Included ALL signatures?

☒ (2.0) FOR STUDIES INVOLVING MORE THAN JUST SURVEYS, INTERVIEWS, OR QUESTIONNAIRES:

- ☒ (2.1) Attached a copy of all consent form(s)?
- ☐ (2.2) FOR STUDIES INVOLVING INDIVIDUALS LESS THAN 18 YEARS OF AGE: attached a copy of all assent forms (if such a form is used)?
- ☒ (2.3) Completed and attached a copy of the Consent Form Checklist? (as appropriate—see that checklist for instructions)

☐ (3.0) FOR STUDIES INVOLVING ONLY SURVEYS, INTERVIEWS, OR QUESTIONNAIRES:

- ☐ (3.1) Attached a copy of the cover letter/information sheet?

☐ (3.2) Completed and attached a copy of the Survey/Interview/Questionnaire Consent Checklist? (see that checklist for instructions)
☐ (3.3) Attached a copy of the actual survey, interview, or questionnaire questions in their final form?

☒ (4.0) FOR ALL STUDENTS: Has your faculty research advisor:
☒ (4.1) Thoroughly reviewed and approved your study?
☒ (4.2) Thoroughly reviewed and approved your IRB paperwork? including:
☒ (4.2.1) Review request form,
☒ (4.2.2) All consent forms, (if used)
☒ (4.2.3) All assent forms (if used)
☒ (4.2.4) All Survey/Interview/Questionnaire cover letters (if used)
☒ (4.2.5) All checklists
☒ (4.3) IMPORTANT NOTE: Your advisor's signature on the review request form indicates that they have thoroughly reviewed your proposal and verified that it meets all IRB and University requirements.
☐ (5.0) Have you retained a copy of all submitted documentation for your records?

Project Director's Certification

Program Involving HUMAN SUBJECTS

The proposed investigation involves the use of human subjects and I am submitting the complete application form and project description to the Institutional Review Board for Research Involving Human Subjects.

I understand that Institutional Review Board (IRB) approval is required before beginning any research and/or data collection involving human subjects. If the Board grants approval of this application, I agree to:

1. Abide by any conditions or changes in the project required by the Board.
2. Report to the Board any change in the research plan that affects the method of using human subjects before such change is instituted.
3. Report to the Board any problems that arise in connection with the use of human subjects.
4. Seek advice of the Board whenever I believe such advice is necessary or would be helpful.
5. Secure the informed, written consent of all human subjects participating in the project.
6. Cooperate with the Board in its effort to provide a continuing review after investigations have been initiated.

I have reviewed the Federal and State regulations concerning the use of human subjects in research and training programs and the guidelines. I agree to abide by the regulations and guidelines aforementioned and will adhere to policies and procedures described in my application. I understand that changes to the research must be approved by the IRB before they are implemented.

Professional Research

Project Director's Signature	Department Chairperson's Signature

Student or Class Research

Student Researcher's Signature	
Supervising Faculty Member's Signature if required	Department Chairperson's Signature

ACTION OF REVIEW BOARD (IRB use only)

The Institutional Review Board for Research Involving Human Subjects has reviewed this application to ascertain whether or not the proposed project:

1. provides adequate safeguards of the rights and welfare of human subjects involved in the investigations;
2. uses appropriate methods to obtain informed, written consent;
3. indicates that the potential benefits of the investigation substantially outweigh the risk involved.
4. provides adequate debriefing of human participants.
5. provides adequate follow-up services to participants who may have incurred physical, mental, or emotional harm.

☐ Approved[_____] ☐ Disapproved

Chairperson, Institutional Review Board	Date

APPENDIX C3

Demographic Information Sheet

DEMOGRAPHIC INFORMATION SHEET

Subject #: _____

1. Sport: _____ 4. Age:_____

2. Position: _____ 5. Height: _____

3. Gender:_____ 6. Weight: _____

Please Circle the Appropriate Answer

7. What is your dominant leg (the leg you would use to kick a ball)? RIGHT LEFT

8. Have you ever sustained an ankle sprain to your dominant ankle? YES NO

If YES, how many? 1 2 3 4 or >4

9. Do you have any current lower extremity injuries or any lower extremity injuries that have required medical attention in the last 30 days? YES NO

10. Are you experiencing any lower extremity issues that currently affect your athletic performance? YES NO

11. Have you ever worn any type of ankle brace or tape application in high school or college? YES NO

12. Are you currently suffering from any visual, vestibular or balance disorders? YES NO

APPENDIX C4

Individual Data Collection Sheet

INDIVIDUAL DATA COLLECTION SHEET

Subject #: _____

Weight (Newtons): _____

CONTROL
Peak Impulse (Newtons): _____
Average COP (cm): 1_____2_____3_____Mean_____
Average COP along X (cm): 1_____2_____3_____Mean_____
Average COP along Y (cm): 1_____2_____3_____Mean_____

ASO ANKLE BRACE
Peak Impulse (Newtons): _____
Average COP (cm): 1_____2_____3_____Mean_____
Average COP along X (cm): 1_____2_____3_____Mean_____
Average COP along Y (cm): 1_____2_____3_____Mean_____

GIBNEY ANKLE TAPE METHOD
Peak Impulse (Newtons): _____
Average COP (cm): 1_____2_____3_____Mean_____
Average COP along X (cm): 1_____2_____3_____Mean_____
Average COP along Y (cm): 1_____2_____3_____Mean_____

APPENDIX C5

Subject Order of Support Condition Spreadsheet

SUBJECT #		Order of Support Condition		
1		1	2	3
2		2	1	3
3		3	1	2
4		1	3	2
5		2	3	1
6		3	2	1
7		1	2	3
8		2	1	3
9		3	1	2
10		1	3	2
11		2	3	1
12		3	2	1
13		1	2	3
14		2	1	3
15		3	1	2
16		1	3	2
17		2	3	1
18		3	2	1
19		1	2	3
20		2	1	3
21		3	1	2
22		1	3	2
23		2	3	1
24		3	2	1
25		1	2	3
26		2	1	3
27		3	1	2
28		1	3	2
29		2	3	1
30		3	2	1

APPENDIX C6

Ankle Support Conditions

The ASO EVO Ankle Stabilizing Orthosis® Ankle Brace
http://www.asoankle.com

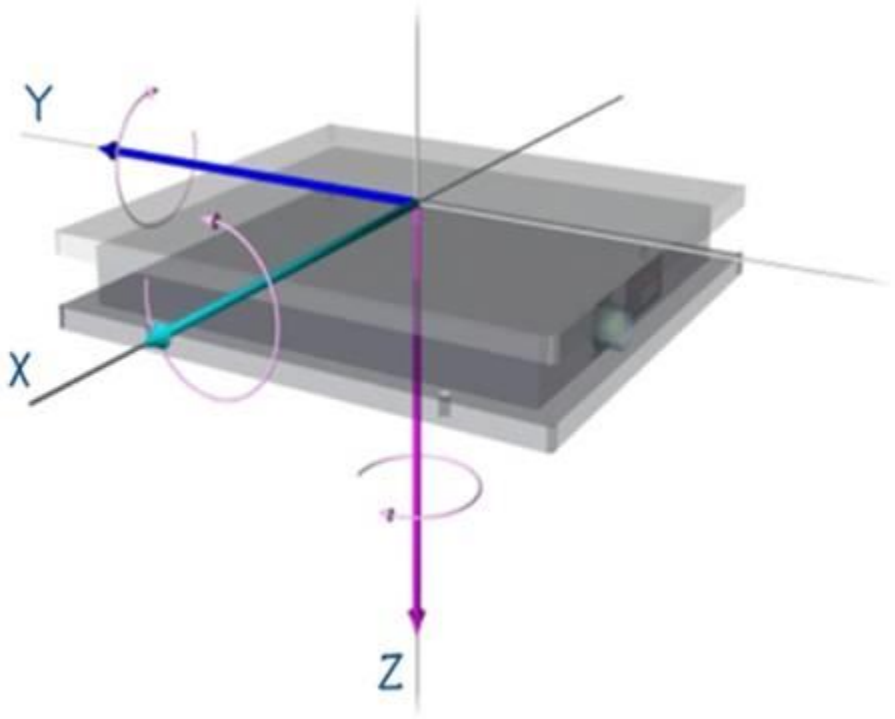
Gibney Ankle Tape Method[49]

1. The athlete's foot should be maintained in full dorsiflexion. Spray the front and back of the ankle with tuff-skin. Place a lubricated heel and lace pad on the anterior and posterior surface of the ankle. Apply under wrap to the skin around the mid-forefoot spiraling upward to just below the belly of the gastrocnemius muscle.
2. Using 1½" white adhesive tape, apply one anchor to the mid-arch. Apply three overlapping anchors to the lower leg directly below the gastrocnemius muscle.
3. Apply one stirrup starting on the medial upper anchor and finishing on the lateral upper anchor. Apply one "U" strip starting on the medial mid-arch anchor and finishing on the lateral mid-arch anchor. Repeat this step two more times. Alternate the stirrups (moving forward) with the "U" strips (moving upward), in each case overlapping by half the width of the tape.
4. Start the figure-of-8 support strip on the medial side of the ankle, just above the malleolus. Travel posterior around the ankle, across the anterior ankle and continue down the medial side of the ankle, underneath the foot. Continue by pulling up on the lateral side, across the anterior and pulling around to the posterior ankle to finish this figure-of-8 on the anterior of the ankle.

5. The first heel lock starts on the medial side of the ankle just above the malleolus. Continue around the posterior ankle, across the anterior, down the medial side, under the foot and pulls up on the lateral side of the heel. The second heel lock continues from the posterior, travels across the anterior, down the lateral side, under the foot and pulls up on the medial side of the heel.
6. Repeat steps 4 and 5.
7. Begin closure of the lower leg starting just above the malleolus and working upwards. Overlap each strip be half the width of the tape and follow the leg contours. Apply a finishing forefoot closure to seal the ends of all the "U" strips.

APPENDIX C7

AMTI OR 6-7 Force Plate



AMTI OR6-7 Force Plate

http://amti.biz/

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ABSTRACT

Title: THE EFFECT OF BRACING VERSUS TAPING ON POST VERTICAL JUMP BALANCE

Researcher: Nicole M. Jussaume

Advisor: Dr. Shelly DiCesaro

Date: 4/29/2010

Research Type: Master's Thesis

Context: There is little research studying the effects of ankle prophylactics on balance during functional movement. Understanding the effects of prophylactic devices on balance may help sports medicine professionals determine the type of device that would most benefit their athletes.

Objective: The purpose of this study was to determine the effect of prophylactic bracing versus taping on single leg post vertical jump balance.

Design: Quasi-experimental, within subjects, repeated measure design.

Setting: Controlled laboratory setting.

Participants: 15 California University of Pennsylvania NCAA Division II collegiate athletes with no lower extremity injury within 30 days of the study and no visual, vestibular or balance issues.

Interventions: Subjects were tested during a single session. All subjects performed a 5 minute treadmill jog at a comfortable pace set by the subject followed by a dynamic warm-up. Subjects performed 3 jumps after each randomly selected support condition was

applied and their data were averaged for the three jump trials.

Main Outcome Measures: Anterior/posterior mean standard deviation of center of pressure (SDCOP), medial/lateral SDCOP, and overall length traveled.

Results: No significant main effect was found for support condition ($F(2,28) = 1.454$, $p > 0.05$) or for the support x instructor interaction ($F(4,56) = 1.441$, $p > 0.05$). A significant main effect on COP measure was found ($F(2,28) = 81.388$, $p < 0.001$).

Conclusion: This study revealed that there is no significant effect on anterior/posterior SDCOP, medial/lateral SDCOP, and overall length traveled when tested under various support conditions; brace, tape, control. With this knowledge, athletic trainers can continue to brace or tape athletes with confidence that balance will not be affected by either support condition.

Word Count: 294