THE EFFECTS OF SPATTING ON VERTICAL GROUND REACTION FORCE PEAK VALUES DURING LANDING

A THESIS

Submitted to the Faculty of the School of Graduate Studies and Research
of
California University of Pennsylvania in partial fulfillment
of the requirements for the degree of

Master of Science

by
Benjamin A. Galley, ATC, PES

Research Advisor, Dr. Shelly DiCesaro

California, Pennsylvania
2009

CALIFORNIA UNIVERSITY of PENNSYLVANIA
CALIFORNIA, PA

THESIS APPROVAL

Graduate Athletic Training Education

We hereby approve the Thesis of

Benjamin A. Galley
Candidate for the degree of Master of Science

Date	Faculty
4-30-10	Dr. Shelly DiCesaro, PhD, ATC (Chairperson)
4-30-10	Dr. Jamie Weary, ATC, PT
4/30/2010	Dr. Robert Kane Jr., ATC, PT

AKNOWLEDGEMENTS

I would first like to thank my parents for supporting me throughout my entire life, especially this past year. Thank you Mom and Dad for never telling me that I couldn't and always letting me know how proud you are of me. Thank you for supporting me financially throughout my years at Liberty and now at Cal U. Thank you for a warm bed to sleep in, a car to drive, and warm meals.

Thank you, Katherine, for always encouraging me. Thank you for being so patient and never complaining about waiting for me to finish school before marrying me. Even though we were far a way for so long, thank you for your sacrifice and love that you truly showed me through this past year.

Thank you, siblings, for keeping my head up. Thank you for telling me that you are proud of me and encouraging me through the process. Thank you, Josh and Nicole, for supporting me through my years at Liberty and your continued support, it means so much to me. Thank you, Stacey and Tim, for your prayers and conversations

all the way from China. Thank you for always giving me encouraging words.

Thank you, God, for being my Rock and Firm Foundation that I could stand on. Thank you for being my Shelter in rough times that I could run to and count on. Thank you for always being faithful.

Thank you also, Ruth, Mr. Zigger, and Julie, for always being supportive of me and working with me through this tough process while at Southmoreland. Thank you, Julie, for always working with my schedule. Thank you to the athletes at Southmoreland who made my experience there enjoyable, I will never forget it.

Lastly, thank you to all the staff at Cal U who made this possible for me. Thank you, Shelly, for sticking it out with me and encouraging me to finish strong. Thank you, Bob and Jamie, for being a part of this journey with me and making this thesis project better. Thank you Tom, for all you taught me and for all of the unselfish support you show to all of us.

TABLE OF CONTENTS

LIST OF TABLES

Page

INTRODUCTION

Numerous braces and methods of taping have been created to limit the ROM of the ankle and to help decrease the rate of acute ankle injury. In conjunction with taping and bracing, many football players use the method of spatting in hopes to further limit the range of motion (ROM) and increase the stability of the ankle.

Spatting is a form of prophylactic ankle bracing that is commonly used among athletes of all levels of competition.[1] Many studies have been conducted examining the effects of popular prophylactic ankle bracing and taping conditions on athletic performance, however very little research has been conducted on the effects of spatting on athletic performance.

A review of the literature on the effects of prophylactic ankle braces on athletic performance focused mostly on speed, agility, and vertical jump height. [2-11] Most research suggests that speed is not affected by most prophylactic ankle braces, however research is inconsistent on the effects that prophylactic ankle bracing has on agility.[3,5,6,9,11] Research conducted by

Metcalf et. al.[2] and Rosenbaum et. al.[7] showed a decrease in performance in linen taped ankles, linen taped ankles with moleskin reinforcement, Sweed-O-Universal braces, and ridged ankle supports in agility testing, but no significant decrease in agility when braced with semi-ridged or soft ankle braces.

Research has mostly shown that vertical jump height is significantly decreased by most prophylactic ankle devices.[2,5-11] The research shows that prophylactic ankle braces that produced no difference in vertical jump height were mainly soft, semi-rigid, or lace up ankle braces. In the study conducted by Rosenbaum et. al.,[7] five semi-rigid and four soft braces showed no significant difference in vertical jump height. In contrast, the one rigid brace studied did have a significant negative difference as previously stated, while taped conditions also produced significant negative effects on vertical jump height.[6,7,12] Research seems to neglect the study of spatting on athletic performance.

Research has also been conducted on the effects of prophylactic ankle devices on ankle ROM. Research agrees that when an ankle is fitted with a prophylactic ankle brace, be it a braced, taped, or spatted condition, the ankle's ROM was significantly limited.

The minimal amount research that has been conducted on spatting has examined its effects on ROM and this was conducted by Pederson et. al.[1] This research found that a taped condition, taped and spatted condition, and only spatted condition all limit the ankles ROM significantly.[1]

Some researchers suggest that a decrease in ROM of the ankle provided by prophylactic ankle bracing leads to a decreased rate of injury due to added support of the ankle joint.[1,2,6] Others suggest that a decrease in ROM of the ankle provided by prophylactic ankle devices, including spatting, would increase the peak vertical ground reaction forces (PVGRF)values upon landing from a jump, and therefore may increase the rate of acute ankle injury.[12-14] Additional research suggests that a decrease in ROM at the ankle joint was compensated for through an increase in knee flexion to absorb force along the kinetic chain upon landing from a jump.[15]

Along with athletic performance and ROM, the effects of prophylactic ankle devices have been examined in PVGRF values during take-off and landing.[11-16] While some researchers have found that peak values were higher among braced conditions upon landing, others found no significant change in peak values.[15,16]

DiStefano et. al.[15] found significant changes in joint flexion throughout the kinetic chain, specifically in the knee, when subjects landed from a jump in a braced condition, even though the PGRF values were not significantly different among the braced group and the control group. This suggests that if an athlete wants to land with the same amount of force in a braced condition, compensations must be made somewhere along the kinetic chain when ROM of the ankle is limited.

Some researchers suggest that a decrease in ROM provided by a prophylactic ankle brace may cause an increase in PVGRF and therefore increase the rate of injury[12], while others suggest that a decrease in ROM may also decrease the rate of injury.[3] Finally researchers have also found that prophylactic ankle bracing does not impair PVGRF values, but that it may be due to compensation along the kinetic chain. However, no research has been conducted on the effects that spatting has on PVGRF values.[11]

The purpose of this study was to examine whether spatting has an effect on PVGRF values during landing. The following question was addressed: Will PVGRF be significantly different depending upon the braced condition? This study will provide information to the

sports medicine community as to the effects spatting may have on the kinetic chain when force is applied to the ground.

METHODS

The purpose of this study was to determine the effects of spatting on peak vertical ground reaction force (PVGRF) values during landing. This section includes the following subsections: Research Design, Subjects, Preliminary research, Instruments, Procedures, Hypotheses, and Data Analysis.

Research Design

A quasi-experimental within-subject research design was used for this study. The independent variables were the braced condition of the ankle, which will include the following: non-braced control; taped only; spatted only; taped and spatted. The dependent variables include vertical ground reaction force peak values upon landing. The study was conducted with each subject tested in all four braced conditions. The within-subjects research design allowed the subjects to serve as their own control, increasing the strength of the study.

Subjects

Fifteen (n=15) male division II soccer and football players from California University of Pennsylvania were included as subjects in this research study. Based upon previous research, the minimum number of subjects who were accepted to be sufficient for the study was 15.[11-16] Prior to testing each subject was screened for previous lower leg, foot, and ankle injury. Subjects who had had a previous ankle, foot, or lower leg (including the knee) injury within the past year, or have been diagnosed with any nerve or balance disorders have been excluded from participating in the study. The subjects were a sample of convenience.

Each subject completed an informed consent form (Appendix D)and demographics survey (Appendix C) before the study was conducted. The demographics survey included information on sport; years of participation; position; age; height; previous traumatic injury to the lower leg, foot, or ankle; and previous braced (taped, spatted, or tapped and spatted) experience.

The study was approved by the California University of Pennsylvania Institutional Review Board. Each

participant's identity remained confidential and was not included in the study.

Preliminary Research

Preliminary research was conducted to determine the amount of time needed to complete the testing protocol and taping of each braced condition for each subject. The subject was instructed orally on testing procedure, taped, and tested in each braced condition (non-taped, spatted only, taped only, spatted and taped).

The preliminary research helped determine the length of time needed to test one subject in all braced conditions, as well as allowed the researcher to become familiar with the testing procedures.

Instruments

The following instruments to collect data were used in this study. A demographics survey (Appendix C)was used to document each subject's sport, years of participation, position, age, height, previous traumatic injury to the lower leg, foot, or ankle, and previous braced (taped, spatted, or tapped and spatted) experience. A force

platform (AMTI OR6-7, Watertown, MA) was used to collect data on vertical jump height and PVGRF upon landing. NetForce software was used for the PVGRF data collection. The data was analyzed statistically using SPSS 17.0.

Procedure

Prior to data collection, each subject will sign an informed consent form (Appendix D). After signing the informed consent form, the study was briefly explained to each subject and any questions were answered.

Next, each subject was randomly assigned the braced condition order, in which they were tested. Each subject would perform in all 3 braced conditions. Each condition was assigned a number to represent it and they are as follows: (1) non-braced control; (2) taped only; (3) spatted only; (4) taped and spatted. All possible combinations were placed into a hat and randomly selected by each subject until all possible combinations had been selected. Once all possible combinations had been exhausted, all combinations were placed back into the hat and the process was repeated as many times as necessary. The order selected was recorded.

The taping procedures were the same with each subject to maintain consistency throughout the study. All subjects wore tennis shoes in each condition. The researcher used pre-wrap and white inch and one half coach athletic speed tape for the taped only condition. The researcher used the closed basket-weave technique over pre-wrap utilizing two continuous heal locks and one figure eight.

The researcher used two inch power-flex to spat the subjects. The spatting procedure was a continues method in which the researcher used at least one whole roll of power-flex per ankle, covering the subjects shoe and two inches above the top of the shoe. The researcher used two continuous heal locks and one figure eight on each spatted condition. For the taped and spatted condition the researcher used the same procedures and methods used for the taped only and spatted only condition, while combining the two into a taped and spatted condition.

The subjects were then instructed on proper jumping technique for this study. Subjects were verbally instructed to place both hands on their hips at all times in order to maintain consistency among subjects in the method of jumping. Subjects were allowed a “loading phase” prior to take-off with a preparatory squat before

the jump. Subjects were instructed to jump as high as possible while keeping their hands on their hips and return to the force platform with both feet and looking directly ahead.

Subjects performed three jumps in each braced condition in the same day in the order that they randomly chose. The average of the three jumps in each braced condition was recorded. The subjects were allowed 15 attempts to land three vertical jumps with both feet simultaneously before requiring an additional rest period and re-taping.

Ten minutes of rest was given to each subject between braced conditions to limit fatigue as a possible variable, and to give the researcher time to prepare the subject in the next braced condition. All taping was performed by the researcher as to maintain consistency among subjects.

Hypothesis

The following hypothesis is based on previous research and the researcher's intuition based on a review of the literature.

1). There will be a difference in vertical ground reaction force peak values, upon landing from a jump, in the three braced conditions compared to the control condition with the taped and spatted condition having the greatest difference from the control condition.

Data Analysis

The data was analyzed using a repeated measures analysis of variance (ANOVA) comparing each independent variable to each other, and their effects on the dependent variable (PVGRF). The data was analyzed using SPSS 17.0. The level of significance was set at $\leq .05$.

Results

The purpose of this study was to determine whether spatting has an effect on PVGRF during landing from a vertical jump. The following section includes data collection through the study and is divided into the following three sections: Demographics Information, Hypothesis Testing, and Additional Findings.

Demographics Information

A demographics sheet was created to retrieve basic information about each subject and was completed along with the informed consent form during the oral instruction. The subjects age, height, current sport, years of participation, past ankle injury to the subjects knee, lower leg, ankle, or foot history within the past year, and previous bracing experience, were recorded on the demographics sheet.

Fifteen (n=15) subjects were included in this study and consisted of male division II soccer and football players from California University of Pennsylvania. Out of fifteen athletes, the study included five soccer

players (33.33%) and ten (66.67%) football players. The subjects ranged of age 19 to 24 years old (20.6 ± 1.24) and height ranged from 175.62 to 190.5 (72.6 ± 2.13 inches). The subject's years of participation at the collegiate level ranged from 1 to 4 years (2.73 ± 0.79). Nine subjects reported having previous ankle bracing experience and six reported having no previous ankle bracing experience. Out of the nine who reported previous ankle bracing experience six reported having experience in a braced only condition, eight reported having experience in a taped only condition, and three reported having experience in a spatted only condition.

Hypothesis Testing

The following hypothesis was tested for this study using an alpha level of ≤ .05.

Hypothesis: There will be a difference in peak vertical ground reaction force (PVGRF) values, upon landing from a jump, in the three braced conditions compared to the control condition with the taped and spatted condition having the greatest difference from the control condition.

Conclusion: The PVGRF values for each prophylactic ankle device were compared using a repeated measures ANOVA. Means and standard deviations are presented in Table 1. No significant difference was found between any prophylactic ankle brace condition compared to the control condition ($F_{3,42}$= 0.628, p>.05)(Table 1).

Table 1. Descriptive Statistics of PFGRF Values and Significance Level

Condition	Mean (N)	Standard Deviation	P Value
Control	7674.19	2118.780	.601
Spatted Only	7706.58	2056.767	
Taped Only	7507.17	1905.029	
Taped and Spatted	7985.93	2069.842	

Additional Findings

After testing the hypothesis, statistical tests were conducted on additional remaining data that was collected on the demographics sheet, including sport played and previous braced experience.

A repeated measures ANOVA was used to calculate the effects of each braced condition on the sport played. No significant data was found between soccer and football players ($F_{3,39}$= .215, p>.05) (Table 1).

A repeated measures ANOVA was used to calculate the effects of each braced condition on previous braced experience. No significant difference was found between previous braced experience and no previous braced experience ($F_{3,39}$= .744, p>.05) (Table 1).

DISCUSSION

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

Discussion of Results

The purpose of this study was to determine if spatting has an effect on PVGRF upon landing from a vertical jump. Spatting is a form of prophylactic ankle support that has been proven to significantly limit the ROM of the ankle in four directions.[1] The literature is mixed on the effects of prophylactic ankle bracing on PVGRF.[12-16] Two studies conducted by Cordova et. al. and DiStefano et. al. found no significant differences in PVGRF between braced and non-braced subjects.[15,16] However, three studies conducted by Abián-Vicén et. al., Reiman et. al., and Hodgson et. al., all found significant differences in PVGRF between subjects.[12-14] The researcher investigated this topic because no research has been conducted on the effects of spatting on PVGRF.

No significant difference was found when comparing the three braced conditions (spatted only, taped, only, and taped and spatted) to the control condition. It was originally hypothesized that there would be a difference in PVGRF between braced conditions with the taped and spatted condition having the greatest difference among conditions. These findings are similar to that of DiStefano et. al. and Cordova et al., in that they also found no significant difference in PVGRF values upon landing in prophylactic braced conditions.[15,16] However, both studies also measured other variables, such as knee flexion and muscle activity upon landing, in which they did find significant differences among braced conditions when compared to the control condition.

However, these findings disagree with Abián-Vicén et. al., Reiman et. al. and Hodgson et. al., who all found a significant differences in prophylactic ankle bracing conditions, specifically taped and Active Ankle Bracing, when compared to the control conditions. Reiman et al., however, also stated that stiff landings have a greater effect than soft landings in PVGRF when fitted with the ankle braced condition.[14] While the findings of this study are similar to some, and not others, it is the first to study the effects of spatting on PVGRF values.

After testing the hypothesis, additional statistical tests were conducted on remaining data collected from the demographics sheet. The sport played by the athletes was one of the additional investigations of the study. No significant difference was found between soccer players and football players. While no significant difference was found, the significance value was much closer to the predetermined p value of .05, for the soccer players than the total significance value when the groups are combined. The subject size was small, and only five of the fifteen subjects that were tested were soccer players. If the trend were to continue, a researcher may potentially see a significant difference between groups in a larger sample size.

The other additional investigation was conducted between subjects who have previous braced experience compared to those who have no previous braced experience. No significant difference was found between groups. The researcher expected to see this result as no significant difference was found among PVGRF values in the combined groups.

Conclusion

Based on the results it may be concluded that spatting has no effect on PVGRF values upon landing from a vertical jump. The results support some of the literature.[15,16] This study supports some of the results from the DiStefano et. al. and Cordova et. al. studies which found PVGRF values had no significant difference between prophylactic ankle supported groups and the control condition. However DiStafano et. al. found a significant difference in knee flexion upon landing in the prophylactic ankle braced condition, suggesting that compensations must be made along the kinetic chain in order to absorb the force upon landing in a braced condition. The results did not support some literature such as that conducted by Abián-Vicén et. al. that showed a significant increase in PVGRF in a prophylactic braced condition when compared to the control group.[12-16]

The mixture of results may be due to the difference in subject selection. Abián-Vicén et. al. used 15 subjects all of whom have had no previous prophylactic ankle bracing experience of any kind. Additional findings of this study showed no significant difference between subjects who have had no previous prophylactic ankle

bracing experience and those who have had previous experience. However, Abián-Vicén et. al. suggests that if the subjects studied have had previous ankle taping experience, the results may have been different.[13]

Although the results from this study are not what the researcher predicted, this study contributes to the literature on ankle taping and spatting. This study does suggest that ankle spatting has no more significant difference in PVGRF than taping, taping and spatting, or a controlled condition, and therefore may not contribute to an increased chance in ankle injury.

Recommendations

It is important that Certified Athletic Trainers understand that spatting, spatting and taping, and taping the ankle were not found to change PVGRF values. This is of interest to those Athletic Trainers's that are concerned that spatting may increase the risk of ankle injury upon landing. Further testing should be conducted on spatting to examine the effects of spatting on knee flexion upon landing from a jump to determine if spatting may have an effect on the kinetic chain upon landing. While many studies have been conducted on prophylactic

ankle bracing on athletic performance, none have been conducted on the effects of spatting on athletic performance. It is recommended that further research be conducted on the effect of spatting on speed, agility, and vertical jump height. Another recommendation is to test the durability of spatting on limiting ROM during activity since other studies have researched this on other forms of prophylactic ankle bracing.

While the results of this study did not show a significant difference in PVGRF in spatting when compared to the control condition, spatting has been found to have significant differences from the control condition in ROM of the ankle in a study conducted by Pederson et. al.[1] As this study adds to the literature on spatting, hopefully it will also add to the legitimacy of spatting as a form of prophylactic ankle bracing among the athletic training profession, and not only as a cosmetic adornment.

REFERENCES

1. Pederson TS, Ricard MD, Merril G, Schulthies SS, Allsen PE. The Effects of Spatting and Ankle Taping on Inversion Before and After Exercise. *Journal of Athletic Training*. March 1997;32(1):29-33.

2. Metcalfe RC, Schlabach GA, Looney MA, Renehan EJ. A Comparison of MoleskinTape, Linen Tape, and Lace-Up Brace on Joint Restriction and Movement Performance. *Journal Of Athletic Training*. June 1997; 32(2): 136-140.

3. Paris DL, Vardaxis V, Kokkaliaria J. Ankle Ranges of Motion During Extended Activity Periods While Taped and Braced. *Journal Of Athletic Training*. September 1995; 30(3). 223-228.

4. Pederson TS, Ricard MD, Merril G, Schulthies SS, Allsen PE. The Effects of Spatting and Ankle Taping on Inversion Before and After Exercise. *Journal of Athletic Training*. March 1997;32(1):29-33.

5. Verbrugge JD. The effects of semirigid Air-Stirrup bracing vs. adhesive ankle taping on motor performance. *The Journal Of Orthopaedic And Sports Physical Therapy*. May 1996;23(5):320-325.

6. Paris DL. The Effects of the Swede-O, New Cross, and McDavid Ankle Braces, and Adhesive Ankle Taping on Speed, Balance, Agility, and Vertical Jump. *Journal of Athletic Training*. 1992;27(3)253-256.

7. Rosenbaum D, Kamps N, Bosch K, Thorwesten L, Völker K, Eils E. The influence of external ankle braces on subjective and objective parameters of performance in a sports-related agility course. *Knee Surgery, Sports Traumatology, Arthroscopy*. July 2005;13(5):419-425.

8. Yaggie J, Kinzey S. A Comparative Analysis of Selected Ankle Orthoses During Functional Tasks. *Journal of Sport Rehabilitation*. August 2001;10(3):174-183.

9. Bocchinfuso C, Sitler MR, Kimura IF. Effects of Two Semirigid Prophylactic Ankle Stabilizers on Speed, Agility, and Vertical Jump. *Journal of Sport Rehabilitation.* 1994;3:125-1 34.

10. MacKean LC, Bell G, Burnham RS. Prophylactic Ankle Bracing Vs. Taping: Effects on Functional Performance in Female Basketball Players. *The Journal Of Orthopaedic And Sports Physical Therapy*. August 1995; 22(2):77-81.

11. Pienkowski D, McMorrow M, Shapiro R, Caborn DNM, Stayton J. The Effects of Ankle Stabilizers on Antithetic Performance. *American Orthopaedic Society for Sports Medicine*. 1995;23(6):757-762.

12. Hodgson B, Tis L, Cobb S, Higbie E. The Effect of External Ankle Support on Vertical Ground-Reaction Force and Lower Body Kinematics. *Journal of Sport Rehabilitation*. 2005;14:301-312.

13. Abian-Vicen J, Alegre LM, Fernandez-Rodriguez JM, Lara AJ, Meana M, Aguado X. Ankle taping does not impair performance in jump or balance tests. *Journal of Sports Science and Medicine*. 2008; 7:350-356.

14. Reimann BL, Schmitz RJ, Gale M, McCaw ST. Effects of Ankle Taping on Vertical Ground Reaction Forces During Drop Landings Before and After Treadmill Jogging. *Journal of Orthopaedic & Sports Physical Therapy*. December 2002; 32(12):628-635.

15. DiStefano LJ, Padua DA, Brown CN, Guskiewicz KM. Lower Extremity Kinematics and Ground Reaction Forces After Prophylactic Lace-Up Ankle Bracing. *Journal of Athletic Training*. 2008;43(3):234-241.

16. Cordova ML, Armstrong CW, Rankin JM, Yeasting RA. Ground reaction forces and EMG activity with ankle bracing during inversion stress. *Medicine & Science in Sports & Exercise*. September 1998;30(9):1363-1370.

APPENDICES

APPENDIX A

Review of Literature

REVIEW OF LITERATURE

Athletes have been known to utilize spatting methods to limit ROM of the ankle in the hopes of increasing stability and decreasing rate of injury. Prophylactic ankle supports such as bracing, taping, and spatting may have a performance effect on the ankle's ROM and functional and athletic performance. Certain functional abilities such as speed, agility, vertical jump height, and vertical ground reaction force are commonly tested functional abilities on the effects of prophylactic ankle support. The following is a review of the literature on the effects of prophylactic ankle support on ROM of the ankle, and functional and athletic performance.

This literature review was divided into five major sections and subsections 1) A review of the functional anatomy and physiology of the ankle 2) The effects of prophylactic ankle support on ankle ROM 3) The effects of prophylactic ankle bracing on functional and athletic performance, including the following subheadings: a) Speed; b) Agility; c) Vertical jump height 4) The effects of prophylactic ankle bracing on vertical ground reaction

force with the following subheadings: a) Take off; b) Landing; c) Other factors that contribute to vertical ground reaction force values.

Functional Anatomy of the Ankle

Anatomically speaking, the ankle is a stable joint. The most anterior and proximal portion of the ankle is made up of the distal ends of the tibia and the fibula. The thickened distal portions of both the tibia and the fibula are referred to as the medial malleolus, formed by the distal end of the tibia, and the lateral malleolus, formed by the distal end of the fibula. The lateral malleolus forms greater bony stability than the medial malleolus as the fibula extends further distally.[1]

The ankle is a synovial hinge joint. The main movements of the ankle are dorsiflexion and planterflexion. Dorsiflexion is produced by the anterior compartment muscles of the leg.[2] The muscles of the anterior compartment of the lower leg include the following: tibialis anterior, extensor hallucis longus, extensor digitorum longus, and fibularis tertius.[3] Planterflexion is produced by the posterior compartment muscles of the lower leg.[2] The posterior compartment of

the leg includes a deep group and a superficial group. The deep group that has an influence on the motion of the foot includes the following muscles: flexor hallucis longus, flexor digitorum longus, tibialis posterior. The muscles superior compartment of the leg include the gastrocnemius, plantaris, and soleus.[3] Prophylactic ankle bracing is often used to limit these two motions, along with inversion and eversion.

Distal to the tibia and fibula is the talus bone. The superior portion of the talus (trochlea) articulates with the medial and lateral malleoli. As well as serving as a connection between the lower leg and the foot, the talus is the main weight bearing bone of the ankle, and is wider in the anterior portion than the posterior portion.[1]

When the foot is in dorsiflexion, it is in its most stable position. The widest part of the talus articulates with the narrow portion between tibia and fibula, forming a closed compact position. When the foot is moved into plantarflexion, the narrower portion of the talus articulates between the tibia and fibula causing a more unstable position for the ankle.[1]

The inferior surface of the talus known as the posterior calcaneal facet corresponds with the posterior

talar facet upon the superior surface of the calcaneus to form the sub talar joint. The two motions of the sub-talar joint are gliding and rotation. The gliding and rotation allows for inversion and eversion motion of the foot.[3]

Most lateral supporting ligaments of the ankle attach to the malleolus of the fibula. The anterior and posterior tibiofibular ligaments connect the distal portions of the tibia and fibula forming an oblique pattern. This oblique pattern is designed to diffuse the forces placed on the leg.[1] The anterior talofibular (ATF) ligament attaches from the anterior aspect of the lateral malleolus to the lateral aspect of the talar neck. The ATF ligament is often sprained because it is the first ligament to undergo stress upon ankle inversion. The calcaneofibular (CF) ligament attaches from the lateral malleolus and stretches downward to attach also to the medial aspect of the calcaneus. The CF ligament may also be torn or sprained, but only after damage has been done to the ATF. The posterior talofibular (PTF) ligament attaches from the posterior aspect of the fibular lateral malleolus to the posterior aspect of the talus. The main function of PTF if to prevent forward slipping of the

fibula into the talus, and is only injured in severe ankle trauma such as in dislocations.[4]

The lateral compartment of the lower leg contain two muscles of who's tendons travel behind the lateral malleolus on their way to their insertion; fibularis longus and fibularis brevis. The fibularis longus inserts to the medial cuneiform and base of the first metarsal on the medial aspect of the foot and is the prime mover in foot eversion. The fibularis brevis tendon attaches to the base of the fifth metarasal and assists in eversion of the foot.[3]

The ligaments that support the medial ankle are collectively known as the deltoid ligament. The deltoid ligament attaches from the medial malleolus, to the medial surface of the talus, and to the sustentaculum tali of the calcaneus. Although the medial malleolus is shorter distally than the lateral malleolus, the additional ligamentous support helps make up for the lack of bony structural support in preventing ankle eversion.[1]

The medial ankle also contains tendons of muscles that produce ankle inversion, adduction, and supination. These muscles include the tibialis posterior, flexor digitorum longus, and flexor hallicus longus which all pass posterior to the medial malleolus. Muscles passing

anterior to the medial malleolus include tibialis anterior and flexor hallicus longus. [1]

It is important to note also, that the muscles that cross anterior to the malleoli will collectively produce dorsiflexion of the ankle and toe extension. Muscles that pass posterior to the malleoli collectively produce plantar flexion and toe flexion. [1]

During jumping the ankle is first placed into dorsiflexion in the loading phase of the jump as the subject flexes the hips and knees as well as moving into ankle dorsiflexion in preparation for the jump. In this position, the ankle is in its most stable position.[1] When the subject begins the jump and the hips and knees move into extension, the force produced by the posterior muscle group of the lower leg moves the ankle into plantar flexion, a more unstable position of the ankle.[1] When the subject is in the air during the jump the ankles remain in plantarflexion, and are forced into dorsiflexion as the subject begins to absorb the force of their body weight upon landing.

It is reasonable to assume that the ankle is in its most vulnerable position just as load is beginning to be applied to the talus upon landing and continues to move

into a more stable position as the subject continues to absorb the force of their landing.

Prophylactic Ankle Support and ROM

Numerous studies have been conducted to determine the effects of prophylactic ankle devices on ROM (ROM) of the ankle. It is thought that when ROM is limited, athletic performance may also be limited.[5] Many studies have been conducted to determine the effects of prophylactic ankle braces in athletic performance.[4,7-13] Over the years, it has been a widely accepted practice to use prophylactic ankle bracing in athletic training to restrict ROM and in hopes to reduce the risk of injury to the ankle.[5]

In a study conducted my Metcalfe et. al.,[5] research was conducted on the restriction of three prophylactic ankle braces on ROM, as well as their effects on athletic performance in vertical jump height and agility. The three braced conditions were tape, tape with moleskin reinforcement, and Sweed-O ankle brace. The results confirmed what is commonly practiced in the athletic training profession, which is the tape with moleskin significantly restricted ankle ROM in planter flexion,

dorsiflexion, ankle inversion, and ankle eversion.[5] The taped condition restricted ROM in all directions except for planter flexion, while the brace restricted ROM in all directions but ankle eversion.[5]

Metcalf et. al.[5] also studied how this decrease in ROM would affect athletic performance. It was found that all three braced conditions produced significantly lower vertical jump heights in subjects, and slower times in the agility test. It may be argued that the decrease in ROM and decrease in athletic performance are positively correlated in this study.

It is reasonable to assume that an ideal condition is when a prophylactic ankle brace can reduce the rate of injury by limiting ROM without impeding on athletic performance.

Studies have also been conducted on the lasting durability of the limited ROM of different prophylactic ankle braced conditions. Paris et. al.[6] studied the lasting effects on ROM of three prophylactic ankle braces (Swede-O, SubTalar Support brace, and non-elastic athletic tape) before and after a period of exercise.[6] Significant ROM reductions were found between the unsupported control group and all three braced conditions pre-activity in inversion, eversion, plantarflexion, and

dorsiflexion. Pre-activity inversion ROM was limited as follows: both Swede-O and SubTalar Support conditions were limited by 12.3 degrees, and tape was limited by 12.8 degrees. Postactivity results showed a significant increase in inversion ROM in all three braced conditions from 0-15 minutes postactivity (Swede-O: 2.3 degrees, SubTalar Support: 4.2 degrees: tape: 3.8 degrees). A further significant increase in postactivity inversion ROM was seen in SubTalar Support braced condition between the 15 and 30 minute intervals by 1.6 degrees.[6]

Significant eversion ROM reductions were also reported between the control group and all three braced conditions preactivity (Swede-O by 11.9 degrees, SubTalar Support by 4.3 degrees, and tape by 11.4 degrees). A significant increase in eversion ROM of the taped group was found after only 15 minutes of activity by 3.8 degrees. Significant increases in eversion ROM of the Swede-O braced condition did not appear until after 60 minutes of exercise, and no significant increase in eversion ROM was seen in the SubTalar ankle supported condition.[6]

Paris et. al.[6] also found that all three braced conditions provided significant restrictions in ROM in plantarflexion preactivity, when compared to the control

group (Swede-O by 17.3 degrees, SubTalar Support by 12.2 degrees, and tape by 19.4 degrees). In regards to plantarflexion ROM, the SubTalar Support braced condition and taped ankle condition both showed significant increases in ROM after 15 minutes of activity (Subtalar Support by 2.2 degrees and tape by 2.4 degrees). Additionally, initial significant increase in ROM was seen in the Swede-O ankle braced condition at 30 minutes by 2.2 degrees. It is important to note that tape also showed significant increases in plantarflexion ROM in 15 minute intervals at 30,45, and 60 minutes of activity.[6]

In regards to dorsiflexion, Paris et. al.[6] found that all three braced conditions provided significant restriction in ROM preactivity when compared to the control group (Swede-O by 5.6 degrees, SubTalar Support by 0.7 degrees. The researchers found that the taped ankle condition showed a significant increase in dorsiflexion ROM after 45 minutes of activity, while neither Swede-O nor SubTalar braced condition showed any significant increase in dorsiflexion ROM.[6]

Few studies have been conducted on the effects of ankle spatting, despite spatting being a common practice especially in sports where cleats are worn.[7] Pederson et. al.[7] studied the effects of spatting and ankle taping on

ankle inversion and rate of inversion before and after exercise. The independent variables studied by Pederson et. al.[7] were non-taped control, taped ankle only, spatted ankle only, and taped and spatted ankle. The researchers found that all braced conditions significantly limited ankle inversion before a 30 minute exercise bout when compared to the control group (taped: 11.4 degrees, spatted and taped: 17.3 degrees, and spatted: 12.8 degrees). After the 30 minute bout of exercise, the researchers found that inversion ROM significantly increased in all three braced conditions (taped: 5.5 degrees, spatted and taped: 2.4 degrees, and spatted: 2.2 degrees).[7]

Pederson's study also found that all three braced conditions significantly reduced the rate of ankle inversion before and after exercise with the combination of spatting and taping being the most effective, then spatting only, followed by tape only being the least effective. Although tape was the least effective of the three braced conditions, the Pederson study found that the rate of inversion of all three braced conditions was significantly less that the non-taped control group.[7]

The Effects of Prophylactic Ankle Support on Athletic Performance

Speed, agility, and vertical jump tests are often used to subjectively measure an individual's athletic and functional ability. Therefore, when researchers want to measure the effects of a variable on functional or athletic ability, they often utilize some form of speed, agility, and vertical jump tests individually, or in combination with each other.

Speed

Speed is an important functional ability in practically every sport. Several studies have been conducted that investigate the effects of various prophylactic ankle braces on speed. Many different functional tests were employed in these studies to determine the effect of a prophylactic ankle brace on speed. These tests included the shuttle run, 80 foot sprint, 40 yard sprint, 50 yard sprint, a combination of straight ahead and slalom sprinting, and a predetermined "sprint drill." [8-13]

Many studies compared multiple types of prophylactic ankle braces to another, such as tape, soft brace, lace-

up brace, air cast, rigid, and semi-rigid braces, and to a non-braced control group.[8-13] Most researchers found no significant difference in sprint speed between the non-braced control group when compared to any braced group.[7-12] Furthermore, in studies that examined more than one braced condition to another, researchers also found that no significant differences occurred between braced groups.[8-16]

Although it may be difficult to compare the results of these studies to one another, the overall effect that prophylactic ankle braces have on speed may still be seen. The majority of studies showed that prophylactic ankle bracing (regardless of the type) had no significant effect on speed performance.

For example, research conducted by MacKean et. al.[13] studies *Prophylactic Ankle Bracing Vs. Taping: Effects on Functional Performance in Female Basketball Players*, and examined the effects of Aircast Air-Stirrup Ankle Training Brace (Aircast, Inc.), Swede-O-Universal Ankle Brace (Swede-0-Universal), Active Ankle Training Brace (Active Ankle Systems. Inc.), and tape (Dr. Scholl's double seal 1 VG adhesive) on speed in young female subjects with a sprint test across a basketball court with a set of four lines that progressively moved further

apart. MacKean et. al.[13] found that there was no significant difference in speed in any braced condition when compared to the non-braced control group. Since most of the studies used different speed tests, and results varied, it is hard to make a conclusion of the effects of prophylactic ankle devices on speed.

Agility

Agility is another characteristic commonly used to assess an athlete's ability. The effect of prophylactic ankle bracing on agility has also been researched. The same issue arises when comparing studies of agility that arose when comparing studies of speed, namely many researchers use different tests to determine an athletes level of agility. Tests commonly used are the Southeast Missouri (SEMO) agility test, four-point agility run, "cone running" drill, Barrow and McGee's agility run, and a "side-cut" drill.[5,8,9,12,14]

Multiple studies compared more than one type of prophylactic ankle brace to other prophylactic braces and to a non-braced control group such as moleskin tape, linen tape, adhesive tape, soft brace, lace-up brace, air cast, rigid, and semi-rigid.[5,8,9,12,14] Research results are mixed among studies that examine the effects that

prophylactic ankle bracing has on agility. While some researchers found no significant differences between agility times, others did find significant differences in agility times between the non-braced control and certain braced conditions. When a significant difference between the non-braced control and the braced conditions was found, the braced condition always produced slower agility times.[5,10]

Two studies that found significant negative differences in agility were conducted by Matcalf et. al.[5] and Rosenbaum et. al.[10] In Matcalf's study the results showed that braced conditions that produced a significant negative difference in agility times in the SEMO agility test from the non-braced control, were moleskin reinforced ankle tape, normal basket weave linen ankle tape, and Swede-O-Universal Ankle Brace (Swede-0-Universal).[5] Furthermore, it was found by Rosenbaum et. al.[10] that the rigid ankle support (Caligamed) that was tested had a significant negative effect on agility times when compared to the non-braced control. Metcalf et. al.[5] also found that the semi-rigid and soft ankle braces had no significant effect on agility.[10]

Moleskin, linen tape, and the Swede-O-Universal ankle braces were tested in the same study and therefore

the results that they produced can be compared with no significant differences found between them. No comparison can be made however between the moleskin, linen tape, and Swede-O-Universal to the rigid braced condition that also negatively affected agility because different testing procedures were used.

Some results have shown that certain prophylactic ankle devices have a significant negative effect on agility.[5,10] But again, since most of the studies used different agility tests, it is hard to make a definite conclusion of the effects of prophylactic ankle devices on agility.

Vertical Jump

Jumping is a skill that is required for most sports. Sports such as football, basketball, softball, volleyball, baseball, various track events, soccer, even tennis and swimming require the athlete to jump. For this reason it is important to study the effects of prophylactic ankle support on vertical jump height. In the studies reviewed, only two vertical jump height tests were used; Vertec test, and chalk test.[5,8-14] Since only two tests were used it is easier to make a conclusion on

the effects of prophylactic ankle support on vertical jump height when comparing study to study.

Similar to speed and agility, many studies compared more than one type of prophylactic ankle brace to other prophylactic braces and to a non-braced control group such as moleskin tape, linen tape, adhesive tape, soft brace, lace-up brace, air cast, rigid, and semi-rigid.[5,8-14] Research results are mixed among studies that examine the effects that prophylactic ankle bracing has on vertical jump height. While some researchers found no significant differences between the non-braced control group and the braced group in vertical jump heights. Others did find significant differences in vertical jump heights between the non-braced control and certain braced conditions.

In a study conducted by Metcalf et. al.[5] on the effects of moleskin tape, linen tape, and Swede-0 Universal brace on athletic performance, all three braced conditions had a significant negative effect on vertical jump height, similar to agility.[5] It was also found by MacKean et. al.[13] that a taped ankle had significantly lower values in vertical jump height than the other braced conditions which included: Aircast Air-Stirrup Ankle Training Brace (Aircast, Inc.); Swede-0-Universal

Ankle Brace (Swede-0-Universal); Active Ankle Training Brace (Active Ankle Systems Inc.). Another braced condition that had a significant negative effect on vertical jump height was a rigid (Caligamed) ankle support found by Rosenbaum et al.[13]

The research shows that prophylactic ankle braces that produced no difference in vertical jump height were mainly soft, semi-rigid, or lace up ankle braces. In the study conducted by Rosenbaum et. al.[11] Five semi-rigid and 4 soft braces showed no significant difference in vertical jump height, while the 1 rigid brace studied did have a significant negative difference as previously stated, while taped conditions also produced significant negative effects on vertical jump height.[5,10,13]

The Effects of Prophylactic Ankle Support on Vertical Ground Reaction Force

Take Off

Abián-Vicén et. al.[15] studied the effects of ankle taping on peak vertical ground reaction forces and peak power values during the take off phase of a jump test utilizing a force platform. They reported that ankle

taping does not impair performance in the push-off phase of the vertical jump test.[15]

Landing

In the same study that Abián-Vicén et. al.[15] studied the effects of taping on take-off, the researchers also investigated the effects that taping had on the landing phase of a jump. They found that there was a significant increase in the second peak force value by 12% upon landing in the taped group when compared to the non-taped control group.[15] This increase in peak vertical ground reaction force agrees with similar studies conducted on the effects of prophylactic ankle braces on vertical ground reaction force.[15-17]

An increase in force may imply that the subjects absorb less of the force of their own body weight upon landing. This may also lead to an increased risk of injury in the landing phase of a jump in taped athletes.[15] Conversely, the literature suggests that most prophylactic ankle braces restrict ROM, at least for a certain period of time. With this decrease in ROM, it is also suggested that the prophylactic ankle brace would decrease risk of injury to an athlete.[5]

DiStefano et. al.[18] conducted a study that examined knee flexion, ROM (dorsiflexion), and peak values in the landing phase of a jump. The researchers found that ankle dorsiflexion in the sagittal plane were significantly limited when compared to the non-braced condition. Although ROM was significantly different, no significant difference was found in peak values upon landing, or in time to reach maximum dorsiflexion of the ankle. Researchers suggest that this is due to the increase in knee flexion angle upon initial contact of the landing phase.[18] Research conducted by Cordova et. al.[19] studied the peak vertical ground reaction forces of braced and non-braced ankles during dynamic inversion stress, while also looking at EMG activity of muscles of the lower leg. The independent variables of this study were the braced condition of the ankle (no brace-control, Aircast Sport-Stirrup, Active Ankle). No significant differences in peak values in any braced conditions were found when compared to the control. However it was found that, during peak impact force, EMG activity of the peroneus longus was reduced in the Aircast and Active Ankle braces when compared to the control, but no difference was found between braces.[19] This evidence also

supports the idea the restricting the ROM of the ankle can have an effect along the kinetic chain.

Other factors that contribute to vertical ground reaction force values

Many other studies have been conducted in order to determine the effects of a variable on vertical ground reaction force. The following variables have been found to have significant effects on vertical ground reaction force values: heal-toe landings when compared to fore-footed landings; surface in which the force platform is fixed; absorption properties of the surface in which the subjects land; tibial axial acceleration; development of life stages; augmented feedback given to subjects. This is important information to know when studying the effects of a variable on vertical ground reaction force in order that the researcher can know what other variables have been found to have a significant effect on vertical ground reaction force values, as to not replicate such variables unless intended to.[20-25]

Summary

Most research agrees that ROM is significantly limited by most prophylactic ankle braces, at least during pre-activity.[5-7] What researchers may still not agree upon is the effectiveness of reducing the rate of injury among the braced population. While research shows that most prophylactic ankle bracing significantly limits ROM, it is hard to research the correlation between limited ROM and rate of ankle injury, although it is commonly assumed that limited inversion ROM also decreases rate of inversion ankle injuries.[5]

The effect that prophylactic ankle bracing has on athletic performance is also unclear. Although much research has been conducted on speed, agility, and vertical jump height, in a variety of braced conditions studies have been inconclusive.[5,8-14] Furthermore, limitations apply to the study of prophylactic ankle braces on athletic performance when reviewing the literature such as the variety of different tests used to assess speed, agility, and vertical jump height. With all of these factors at play, most literature seems to suggest that prophylactic ankle devices had no effect on

an athlete's speed.[8-13] While some studies showed a significant difference in an athlete's agility, others did not.[5,8-10,12,14] Research also shows that the braced conditions that had the most effect on vertical jump height were taped conditions and rigid braced conditions.[5,13]

Some researchers have suggested that a decrease in ROM provided by a prophylactic ankle brace may cause an increase in vertical ground reaction force and therefore increase the rate of injury[19], while others suggest that a decrease in ROM may also decrease the rate of injury.[5] Other researchers have found that prophylactic ankle bracing does not impair vertical ground reaction force values, but may have an effect on the kinetic chain up the leg.[18]

By understanding how the lower extremity reacts to prophylactic ankle bracing on peak vertical ground reaction forces, we may be able to predict how the body may react to spatting when landing from a jump. With the information on the effects of spatting on peak vertical ground reaction force, athletic trainer may be able to determine if spatting is a safe and practical form of prophylactic ankle bracing.

APPENDIX B

The Problem

The Problem

Spatting is a form of prophylactic ankle bracing that is commonly used among athletes of all levels of competition. Many studies have been conducted examining the effects of popular prophylactic ankle bracing, such as braced and taped conditions on athletic performance, however very little research has been conducted on the effects of spatting on athletic performance. The purpose of this study was to examine the effects of spatting on peak vertical ground reaction force values.

Definition of Terms

The following Terms were operationally identified for this study:

1) Vertical ground reaction force- The force that is produced by the ground upon the body upon landing.
2) Peak Vertical Ground Reaction Force- The point in time at which the ground reaction force is maximally applied.
3) Prophylactic ankle device- a device applied to the ankle to potentially prevent injury and improve support and stability.

4) Spatting- A type of prophylactic ankle device that consists of taping over the athletes shoe and distal aspect of the lower leg.
5) Kinetic chain- the sequence of anatomical structures within the body

Basic Assumptions

The following are basic assumptions of this study:

1) The subjects used in this study was honest when reporting the absence of ankle or lower leg injury or neurological or balance disorders in the past year.
2) All subjects will participate voluntarily and without coercion.
3) All subjects will give their best effort in each performance test.
4) All braces used was fitted sufficiently in accordance to each subject.
5) All ankle taping was sufficient and done with the same technique.
6) The AMTI force platform and Netforce software was a valid and reliable tool to measure vertical ground reaction peak force values.

Limitations of the Study

The following are possible limitations to the study:

1) ROM limitations of the tape and spat may not simulate real training and game situations because of the limit of activity required by each subject and braced condition.
2) Testing was conducted in a laboratory in a controlled setting; therefore results may not apply to a real training or game time setting.
3) A sample of convenience was used for this study.
4) External validity may be of concern because the study was limited to Division II football and soccer athletes of California University of Pennsylvania.
5) Only one method of taping and one method of spatting was used in this study.
6) The study will not include any prophylactic conditions that tested the effects of any ankle brace devices.

Significance of the Study

Many prophylactic ankle devices have been constructed over the years to reduce the ROM of the ankle joint in hopes to reduce the rate of ankle injury, even when landing from a jump. When landing, the primary goal

of a prophylactic ankle device is to restrict inversion and eversion of the ankle in order to keep the ankle in a neutral position.[4] However, most prophylactic ankle devices also restrict dorsiflexion and plantarflexion ROM as well.[4]

The force reproduced by the ground (vertical ground reaction force) is absorbed through the kinetic chain, starting distally and dissipating proximally throughout the joints of the lower extremity.[17] Studies have shown an increase in peak values of vertical ground reaction forces when prophylactic ankle devices were used, [14-16] while others have shown an increase in knee flexion upon landing while wearing a prophylactic ankle device. [17] This evidence suggests that when the ROM of the ankle is limited in the sagittal plane by a prophylactic device, it will have an effect on force absorption upon landing from a jump, which may lead to an increased risk of injury to the lower extremity.[17]

While spatting is a common prophylactic ankle device used in athletics today, specifically in football, no study has been found examining the effects of spatting on athletic performance on vertical ground reaction forces. By investigating the effects that spatting has on vertical ground reaction forces upon landing, athletic

trainers are better able to determine if spatting is a safe and beneficial form of ankle stabilization, in absorbing force, when landing from a jump.

APPENDIX C

Demographic Information

Demographic Information

-Subject Number: _____

-Age: _____

-Height: _____

-Current Sport: _____

-Position: _____

-Years of Participation at this level: _____

-Have you incurred any injury to your knee, lower leg, ankle, or foot within the past year that has prevented you from playing:

Yes: If Yes, what was the injury _____

No

-Do you have any experience with any type of ankle bracing or taping:

Yes

No

-If the answer to the previous question was “Yes,” circle all that apply

Braced

Taped only

Spatted only

Taped and Spatted together

APPENDIX D
Informed Consent Form

California University of Pennsylvania

Informed Consent Form

1. Benjamin Galley, ATC, 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 Effects of Spatting on Vertical Ground Reaction Force Peak Values During Landing.*

2. I have been informed that the purpose of this study is to The Purpose of this study is to examine whether spatting has an effect on vertical ground reaction force peak values during landing. 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 subjects who have not suffered any lower leg (including knee), ankle, or foot injury within the past year and/or have not been diagnosed with neurological or balance disorders prior to the test that have caused the athlete to cease participation from their sport.

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 randomly choosing the order in which I was braced. I will perform three jumps on the AMTI OR 6-7 force platform in three braced ankle conditions (taped only, spatted only, taped and spatted) with sufficient rest between each tested condition as to limit fatigue. I was instructed as to how to jump. The testing procedure will take approximately one hour.

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 possibly falling during the landing phase of the jump. To minimize this risk, the researcher will place a wooden adaptor around the force plate to increase the landing surface area.

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 was provided by the researcher, Benjamin Galley, under the supervision of the CalU athletic training faculty, all of which can administer emergency care. Additional services needed for prolonged care was referred to the attending staff at the Downey Garofola 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 is to help determine the risk effects that spatting may have on an athlete's performance and body upon landing from a jump in the aforementioned ankle braced conditions. This study can help athletic trainers determine if spatting is a safe, effective, or efficient form of ankle bracing.

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 was reported. In order to maintain confidentially of my records, Benjamin Galley 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 was 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, was answered by:

Benjamin A. Galley, ATC
STUDENT/PRIMARY RESEARCHER
GAL4846@calu.edu
724-972-3124

Dr. Shelly DiCesaro, PhD, ATC
RESEARCH ADVISOR
dicesaro@calu.edu

724-938-4342

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 was 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: 03/25/10 to 03/25/11.

Subject's signature:_____
Date:_____

Witness signature:_____
Date:_____

APPENDIX E

Institutional Review Board Approval

Proposal Number

Date Received

California University of Pennsylvania

PROTOCOL for Research Involving Human Subjects

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

Project Title ***The Effects of Spatting on Vertical Ground Reaction Force Peak Values During Landing***

Researcher/Project Director ***Benjamin A. Galley***

Phone # ***724-972-3124*** ***E-mail Address*** ***GAL4846@calu.edu***

Faculty Sponsor (if required) ***Dr. Shelly DiCesaro***

Department ***Health Science***

Project Dates _____ ***to*** ***December 1, 2010***

Sponsoring Agent (if applicable) ***-***

Project to be Conducted at *California University of Pennsylvania*

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

(Reference IRB Policies and Procedures for clarification)

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 whether spatting has an effect on vertical ground reaction force peak values during landing. Healthy National Collegiate Athletic Association (NCAA) Division II male football and soccer players will be asked to participate in this study (N~20). Only athletes from the football and men's soccer teams will be asked to participate because spatting is only utilized in sports where cleats are worn. Males will only be asked to participate to limit the variable of gender. Subjects who have suffered any lower leg (including knee), ankle, or foot injury within the past year, or who have been diagnosed with neurological or balance disorders prior to the test, and/or currently suffering from any of the aforementioned injuries, that have caused the athlete to cease participation from their sport, will be excluded from participating in the study. Each subject who signed the informed consent (attached) will have their vertical ground reaction force peak values measured upon landing from a jump in three prophylactic ankle braced conditions and a control condition. Subjects will act as their own control in this quasi-experimental within-subjects research design. The prophylactic braced conditions include a taped only condition, spatted only condition, and a taped and spatted condition, where the control condition will be natural (non-braced). Each subject will report only one day for testing in all braced conditions. The testing procedure will last no longer than three hours per subject.

The subjects will randomly choose the order in which they will be braced. Each subject will perform three vertical jumps on the AMTI OR 6-7 force platform in each braced condition, with ten minutes of rest between each tested condition as to limit fatigue. Each subject will be instructed to place their hands on their hips and jump as high as possible, landing on the force platform with both feet. A wooden platform will be placed around the force plate to extend the landing area to limit the possibility of injury.

The research question seeking to be answered is, "Will spatting have an effect on vertical ground reaction force peak values." The hypothesis is stated as the following: "There will be a difference in vertical ground reaction force peak values in the three braced conditions when compared to the control condition, where the tapped and spatted condition will have the most significant difference."

The vertical ground reaction force peak values will be compared to each condition including the controlled condition using a multivariate analysis of variance (MANOVA) with a significance value set at .05
($P \leq 0.05$). The data will be analyzed by the latest version of SPSS software.

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.

There is a small possibility that when the subjects land from their jump, they may miss the platform with both feet. A wooden platform the same height will be placed on the ground to completely surround the force platform in increase the landing area. The wooden adaptor will increase the landing surface in order to minimize the risk for potential injury. Another potential risk that may be present is the potential risk for general muscle soreness.

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 of age or older, male, NCAA division II collegiate football or soccer athletes from California University of Pennsylvania. Prior to the research, each potential subject will be review and sign an informed consent form, absent of their coaches, the will describe the concept of the study. Any athlete who currently suffers from, or has suffered from a lower leg (including knee), ankle, or foot injury within the past year, or who have been diagnosed with neurological or balance disorders prior to the test, and/or currently suffering from any of the aforementioned injuries, that have caused the athlete to cease participation from their sport, will be excluded from participating in the study as these conditions may interfere with the subjects ability to absorb force. This exclusion due to these medical conditions will be performed by the supervising Certified Athletic Trainer in order to maintain patient confidentiality.
Only athletes from the football and men's soccer teams will be asked to participate because spatting is only utilized in sports where cleats are worn. Males will only be asked to participate to limit the variable of gender.

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 reviewed, completed, and signed by all subjects prior to participating in the study on the day of testing. Each signed form will be kept by the researcher in a locked filing cabinet located in the program directors office in Hammer Hall on the campus of California University of Pennsylvania. Only the program director, researcher, and research advisor will have access to the data.

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.

All data will be recorded during the spring semester. All subjects will report to the testing site once for testing and the secession will take no longer than 3 hours. All electronic files will be password protected and only be accessible by the researcher and research advisor. All hard copy files will be stored in a locked filing cabinet on campus in the program directors office in Hammer Hall that will only be able to be accessed by the program director, researcher, and

research advisor. Also, all collected data will be identified by subject number, not name, to ensure patient data 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

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

Benjamin Galley,

Please consider this email as official notification that your proposal titled " The Effects of Spatting on Vertical Ground reaction Force Peak Values During Landing" (Proposal #09-073) has been approved by the California University of Pennsylvania Institutional Review Board as amended, with the following stipulation:

The "laymen's terms" definition of spatting submitted to the board must be added to the consent form.

Once you have made this revision, you may immediately begin data collection. You do not need to wait for further IRB approval. [At your earliest convenience, you must forward a copy of the revised consent form for the Board's records].

The effective date of the approval is 3-25-2010 and the expiration date is 3-25-2011. 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 3-25-2011 you must file additional information to be considered for continuing review. Please contact instreviewboard@cup.edu

Please notify the Board when data collection is complete.
Regards,
Robert Skwarecki, Ph.D., CCC-SLP
Chair, Institutional Review Board

REFERENCES

1. Prentice W. Arnheim's Principles of Athletic Training A Competency-Based Approach. 11th ed. New York, NY: McGraw –Hill Companies, Inc.; 2003.

2. Moore KL, Dalley AF. Clinically Oriented Anatomy Forth Edition. Baltimore, MD: Lippincott Williams & Wilkins; 1999.

3. Drake RL, Vogl AW, Mitchell AWM. Gray's Anatomy for Students. 2nd ed. Philadelphia, PA: Churchill Livingstone, Elsevier Inc.; 2010.

4. Hoppenfeld S. Physical Examination of the Spine and Extremities. Upper Saddle River, NJ: Prentice Hall, INC.; 1976.

5. Metcalfe RC, Schlabach GA, Looney MA, Renehan EJ. A Comparison of MoleskinTape, Linen Tape, and Lace-Up Brace on Joint Restriction and Movement Performance. *Journal Of Athletic Training*. June 1997; 32(2): 136-140.

6. Paris DL, Vardaxis V, Kokkaliaria J. Ankle Ranges of Motion During Extended Activity Periods While Taped and Braced. *Journal Of Athletic Training*. September 1995; 30(3). 223-228.

7. Pederson TS, Ricard MD, Merril G, Schulthies SS, Allsen PE. The Effects of Spatting and Ankle Taping on Inversion Before and After Exercise. *Journal of Athletic Training*. March 1997;32(1):29-33.

8. Verbrugge JD. The effects of semirigid Air-Stirrup bracing vs. adhesive ankle taping on motor performance. *The Journal Of Orthopaedic And Sports Physical Therapy*. May 1996;23(5):320-325.

9. Paris DL. The Effects of the Swede-O, New Cross, and McDavid Ankle Braces, and Adhesive Ankle Taping on Speed, Balance, Agility, and Vertical Jump. *Journal of Athletic Training*. 1992;27(3)253-256.

10. Rosenbaum D, Kamps N, Bosch K, Thorwesten L, Völker K, Eils E. The influence of external ankle braces on subjective and objective parameters of performance in a sports-related agility course. *Knee Surgery, Sports Traumatology, Arthroscopy*. July 2005;13(5):419-425.

11. Yaggie J, Kinzey S. A Comparative Analysis of Selected Ankle Orthoses During Functional Tasks. *Journal of Sport Rehabilitation*. August 2001;10(3):174-183.

12. Bocchinfuso C, Sitler MR, Kimura IF. Effects of Two Semirigid Prophylactic Ankle Stabilizers on Speed, Agility, and Vertical Jump. *Journal of Sport Rehabilitation.* 1994;3:125-1 34.

13. MacKean LC, Bell G, Burnham RS. Prophylactic Ankle Bracing Vs. Taping: Effects on Functional Performance in Female Basketball Players. *The Journal Of Orthopaedic And Sports Physical Therapy*. August 1995; 22(2):77-81.

14. Pienkowski D, McMorrow M, Shapiro R, Caborn DNM, Stayton J. The Effects of Ankle Stabilizers on Antithetic Performance. *American Orthopaedic Society for Sports Medicine*. 1995;23(6):757-762.

15. Abian-Vicen J, Alegre LM, Fernandez-Rodriguez JM, Lara AJ, Meana M, Aguado X. Ankle taping does not impair performance in jump or balance tests. *Journal of Sports Science and Medicine*. 2008; 7:350-356.

16. Reimann BL, Schmitz RJ, Gale M, McCaw ST. Effects of Ankle Taping on Vertical Ground Reaction Forces During Drop Landings Before and After Treadmill Jogging. *Journal of Orthopaedic & Sports Physical Therapy*. December 2002; 32(12):628-635.

17. Hodgson B, Tis L, Cobb S, Higbie E. The Effect of External Ankle Support on Vertical Ground-Reaction Force and Lower Body Kinematics. *Journal of Sport Rehabilitation*. 2005;14:301-312.

18. DiStefano LJ, Padua DA, Brown CN, Guskiewicz KM. Lower Extremity Kinematics and Ground Reaction

Forces After Prophylactic Lace-Up Ankle Bracing. *Journal of Athletic Training*. 2008;43(3):234-241.

19. Cordova ML, Armstrong CW, Rankin JM, Yeasting RA. Ground reaction forces and EMG activity with ankle bracing during inversion stress. *Medicine & Science in Sports & Exercise*. September 1998;30(9):1363-1370.

20. Kovacs I, Tihanyi J, Devita P, Racz L, Barrier J, Hortobagyi T. Foot placement modifies kinematics and kinetics during drop jumping. *Medicine & Science in Sports & Exerc*ise. May1999;31(5):708-716.

21. Fritz M, Peikenkamp K. Simulation of the influence of sport surfaces on vertical ground reaction forces during landing. *Medical and Biological Engineering & Computing*. 2003;41:11-17.

22. Peikenkamp K, Fritz M, Nicol K, Wilhelm W. Simulation of the Vertical Ground Reaction Force in Sport Surfaces During Landing. *Journal of Applied Biomechanics*. 2002; 18:122-134.

23. Elvin NG, Elvin AA, Arnoczky SP. Correlation Between Ground Reaction Force and Tibial Acceleration in Vertical Jumping. *Journal of Applied Biomechanics*. 2007;23:180-189.

24. Swartz EE, Decoster LC, Russell PJ, Croce RV. Effects of Developmental Stage and Sex on Lower Extremity Kinematics and Vertical Ground Reaction Forces During Landing. *Journal of Athletic Training*. 2005;40(1):9-14.

25. Cronin JB, Bressel E, Finn L. Augmented Feedback Reduces Ground Reaction Forces in the Landing Phase of the Volleyball Spike Jump. *Journal of Sport Rehabilitation*. 2008;17:148-159.

ABSTRACT

Title: THE EFFECTS OF SPATTING ON VERTICAL GROUND REACTION FORCE PEAK VALUES DURING LANDING

Researcher: Benjamin A. Galley, ATC, PES

Advisor: Dr. Shelly DiCesaro, ATC

Date: May 2010

Research Type: Master's Thesis

Purpose: The purpose of this study was to determine the effects of prophylactic ankle taping, spatting, and taping and spatting on peak vertical ground reaction force (PVGRF) values during landing.

Problem: Spatting is a common form of prophylactic ankle bracing, however very little research has been conducted on its effect on athletic performance.

Methods: Fifteen California University NCAA Division II football and male soccer players participated in this study (10 football; 5 male soccer). Subjects preformed three vertical jumps on a force plate in each prophylactic ankle braced condition. The braced conditions included control, taped only, spatted only, and taped and spatted conditions. The highest PVGRF value of each condition was recorded. The results were analyzed using a repeated measures analysis of variance test using a significance level of $\leq .05$.

Findings: No significant difference was found between any prophylactic ankle brace condition compared to the control condition ($F_{3,42}= 0.628$, $p>.05$.)

Conclusion: Based on the results it may be concluded that spatting has no effect on PVGRF values upon landing from a vertical jump.

This study suggests that ankle spatting has no more significant difference in PVGRF than taping, taping and spatting, or a controlled condition, and therefore may not contribute to an increased chance of ankle injury, especially when landing from a jump.

Word Count: 214