EFFECTS OF EXTERNAL ANKLE SUPPORTS ON FUNCTIONAL PERFORMANCE IN DIVISION II FEMALE SOCCER ATHLETES

A THESIS

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THESIS APPROVAL

Graduate Athletic Training Education

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"Success is not final, failure is not fatal, it is the courage to continue that counts."

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INTRODUCTION

Ankle injuries are among the most common injury in sports today, comprising forty-five percent of all sports injuries.[1] Many choices are available to athletes when dealing with ankle injuries, such as taping and bracing. The literature clearly supports that external ankle supports mechanically limit range of motion (ROM). Most braces limit motion of the subtalar joint, limiting inversion and eversion but allowing for full talocrural joint motion. Whether these external ankle supports affect performance is still in question because of conflicting research.

Inconsistent data exists as to whether external ankle supports inhibit functional performance. From an injury standpoint, external ankle supports decrease ROM and therefore decrease the risk of injury. However, if external ankle supports decrease athletic performance, as some studies suggest[2-6], does this risk outweigh the benefits of injury prevention? A variety of ankle supports exist. This study will observe the use of tape versus a specific lace-up brace. While the literature regarding functional performance in athletes can be used across the board for

all different types of athletes, there is minimal literature that can be used for any specific sport.

A number of researchers have examined the effects of different types of tape when taping an ankle[3,7-9], taping techniques[2,7-14] and different braces[2,7,11,12,15-23] on various measures of performance. While most researchers have looked at explosive performance such as ground reaction forces,[16,17] vertical jump height,[24-28] sprint speed,[25-28] and agility,[23,25-27] kicking for distance or accuracy in soccer has yet to be studied. MacKean et al[5] looked at the effects of tape, Swede-O, Active Ankle, and Aircast Sport Stirrup on skills specific to basketball. The subjects were tested on vertical jump height, jump shot, sprint drill, and submaximal treadmill run. Vertical jump height, the sprint drill, and the submaximal run could potentially be comparable to soccer athletes. Wiley et al[29] looked at the effects of a Malleoloc ankle brace on a figure-eight course and concluded that this brace did not affect performance. However, the researcher did not specify the criteria for subject selection in this study, therefore decreasing the ability to compare results specifically to soccer athletes.

Researchers have also looked at the effects external ankle supports have on range of motion,[11-14,22,29,30-32] strength,[24,31,33] ankle stiffness,[19] and balance.[18] It is

apparent that bracing and taping the ankle decrease range of motion. Paris et al[22] looked at the effects of taping and bracing on ROM initially after application and after activity. The brace conditions showed a longer effect of decreasing ankle ROM than tape. Martin et al[11] also looked at the effectiveness of brace conditions versus tape conditions before and after exercise and supported the same conclusion. The difference between these two studies is Paris et al[22] used the Swede-O lace-up and Subtalar Support ankle braces and Martin et al[11] used the Swede-O lace-up and Aircast Sport Stirrup. The direct effect of ankle supports on soccer performance is still not understood.

Enough evidence exists to support a potential for taping and bracing to both positively and negatively affect performance. How support conditions affect specific skills in soccer is unknown. Being able to kick accurately and for distance are important to soccer athletes. The results of this study will help determine and clarify whether ankle supports affect kicking performance. This is useful information for clinicians and other health care professionals, specifically certified athletic trainers, and the evidence will determine if they should encourage the use of external ankle supports for athletes. Additionally the results will identify if one support type

should be preferred over another. It is important to have this information because previous research has shown much controversy about the potential effects of taping and bracing on performance. Also, the research has not examined soccer skills specifically, which may show differing results from other measures of performance. The purpose of this study is to examine the effects of external ankle supports on the distance and accuracy a soccer ball is kicked in Division II soccer athletes.

METHODS

The primary purpose of this study was to examine the effect of an Ankle Stabilizing Orthosis (ASO®) lace-up ankle brace versus taping on distance and accuracy a soccer ball is kicked in collegiate soccer athletes. This section includes the following subsections: Research Design, Subjects, Instruments, Procedures, Hypotheses, and Data Analysis.

Research Design

This research is a quasi-experimental, within subjects, repeated measures design (on condition). The independent variable in this study was support condition. This condition had three levels: taping, ASO® lace-up ankle brace, and control (no support). The dependent variables were (1) the distance a soccer ball is kicked as measured by a measuring wheel on a turf soccer field, and (2) the accuracy as measured by the distance from a bulls-eye a soccer ball is kicked from a distance of 18.29 meters (20 yards). A strength of this study is the use of a within-

subjects design so that the subjects act as their own control. To increase reliability, the researcher was the only one to fit the ankle braces and tape the subjects, and subjects wore the same cleats for each testing day. A sample of convenience of NCAA Division II female soccer athletes was used, limiting the generalization of this study.

Subjects

The subjects that were used for this study were sixteen volunteer female student-athletes from California University of Pennsylvania women's varsity soccer team who were actively participating with the team. Subjects filled out a Demographic Information Form (Appendix C1) concerning basic demographic information. Subjects were excluded if they were currently unable to participate on the team.

Each subject was required to meet with the researcher on two different days. The first day was used to fill out an Informed Consent Form (Appendix C2) and Demographic Information Form (Appendix C1) prior to participation in the study. The second day was used in order to collect data. The study was approved by the Institutional Review Board (Appendix C3) at California University of

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

Instruments

Support Conditions

White, Johnson and Johnson™ athletic tape was used to tape the subjects' ankles and an Ankle Stabilizing Orthosis® (ASO®) lace up ankle brace was also used.

Data Collection Sheet

The individual data collection sheet (Appendix C4) included each subject's number to maintain confidentiality. It also included the three support conditions for both accuracy and distance testing with five trials for each.

Testing Instruments

In measuring distance, a 300-foot tape measure was used. In measuring accuracy[34], a target was constructed using a plywood sheet measuring 243.5cm wide x 243.5cm (8ft x 8ft) high. It was held in an upright position by a posteriorly positioned frame of 5 x 10.2cm wood planks (Figure 2). A screw was placed in the middle of the target but was not fully inserted into the plywood, so that a hook

at the end of a tape measure could fit over the head of the screw. A tape measure attached to the screw was used to determine the distance from the center of the target to the center of the mark left where the ball struck the target. Sheets of white paper were placed over the board, which were covered by sheets of carbon paper with the carbon side in contact with the white paper (Figure 1, Appendix C5). The sheets were secured in place using a staple gun. When the soccer ball struck the carbon paper, it left a mark on the underlying white paper. To allow for subsequent measurements, a sheet of white paper containing a ball mark was replaced with a new sheet of white paper and covered by carbon paper. A data score sheet was used to record data for each subject (Appendix C3).

Procedures

The subjects performed a warm up. A specific warm up for this study was a dynamic warm up consisting of two laps around a soccer field, side shuffle, carioca, hip cradle, knee grabs, high knees, leg kicks, butt kicks, lateral lunges, forward lunges, backward lunges, inch worm, A-skip, and power skip.

Following the warm up, subjects were taped, fitted for a brace or had no support on both ankles depending on what support condition they were testing at that time. In between each support condition, five minutes were allotted for application, which also helped control for fatigue. The order of the support conditions was counterbalanced among the subjects. Support condition order was determined randomly to control for the possible effects of fatigue.

When taping an ankle, the same taping procedure, which was a standard taping procedure, was used for all subjects. First, the ankle was sprayed with Tuf-Skin, an adhesive to help the pre-wrap adhere better, and then heel and lace pads, which are made from a type of foam and used to prevent blisters, were placed on the skin over the Achilles tendon and talar window. Then pre-wrap was applied to help minimize irritation from the tape. Next, three anchors were placed just inferior to the distal end of the gastrocnemius muscle. After that three stirrups were placed medial to lateral alternating with three horseshoes. Subsequently, two figure eights were added. One began over the medial malleolus and the other began over the lateral malleolus. Then two heel locks on each side were added going behind the ankle. Anchors were placed to close up the tape once all that was applied.

In order to test for kicking distance, the ball was placed at the end line of a regulation, turf soccer field and the subject kicked the ball as far as she could. Subjects were allowed to approach the ball however they felt comfortable in order to make the most natural kick possible. Where the ball first hit, a marker was placed by the researcher at the spot it landed. From that mark, a measurement using a 300-foot tape measure was taken back to where the ball was initially placed. This was repeated five times and an average distance was calculated.

In order to test for accuracy, a target was constructed using two plywood sheets measuring 243.5cm wide x 243.5cm high (Figure 1). It was held in an upright position by a posteriorly positioned frame of 5 x 10.2cm wood planks (Figures 2 and 3). A screw was placed in the middle of the board but was not fully inserted into the plywood, so that a hook at the end of a tape measure could fit over the head of the screw. A tape measure attached to the screw was used to determine the distance from the center of the target to the center of the mark left where the ball struck the target. Sheets of white paper were placed over the board, which were covered by sheets of carbon paper with the carbon side in contact with the white paper. The sheets were secured in place using a staple gun.

When the soccer ball struck the carbon paper, it left a mark on the underlying white paper. To allow for subsequent measurements, a sheet of white paper containing a ball mark was replaced with a new sheet of white paper and covered by carbon paper.[34] The ball was placed 18.28 meters (20 yards) from the center of the target on the soccer field. The subjects were instructed to aim for the center of the target that was placed in the middle of the goal. They were allowed two practice kicks at the beginning of the entire testing session and then instructed to kick five times making a total of 15 kicks for accuracy testing. The approach and the type of kick were left to the discretion of the athlete in order to make the kick the most natural.

The cool down was done on the subjects own; they were allowed to take as long as they needed.

Hypotheses

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

1. Taping will have no effect on the distance and accuracy a soccer ball is kicked.

2. Bracing will have no effect on the distance or accuracy a soccer ball is kicked.

Data Analysis

All data was analyzed by a repeated measures ANOVA computed with SPSS version 18.0 for Windows at an alpha level $\leq$ 0.05 where support conditions (brace and tape) will be compared for kicking distance and accuracy.

RESULTS

The purpose of this study was to examine the effects of external ankle supports on the distance and accuracy a soccer ball is kicked in NCAA Division II female soccer athletes. The following section contains the data collected through the study and is divided into three subsections: Demographic Information, Hypotheses Testing, and Additional Findings.

Demographic Information

The subjects that participated in this study were sixteen NCAA Division II female soccer athletes from California University of Pennsylvania. First the researcher approached the head soccer coach to ask permission to use his athletes. Then the researcher approached the team separate from the coach to ask for volunteers to participate in the study. The demographic information sheet (Appendix C5) was collected to give the researcher a background of the subjects participating in the study. They ranged from freshman to seniors in college and 18 to 22 years of age with the average age being 19.7 $\pm$ 1.35 years old. The years of soccer played ranged from 12 years to 17

years with an average of years played being 13.9 ± 1.73 years (Table 1).

Table 1: Demographic Information

	Minimum	Maximum	Average	Standard Deviation
Age	18	22	19.7	1.35
Years played	12	17	13.9	1.73

Subjects' reported positions were goalie, defense, midfield and forward with the most common position being midfield. The researcher looked at if they had worn ankle braces or any kind of lower extremity braces before and if so what kind. Of the sixteen subjects, one wears a knee brace on a consistent basis, two wear ankle braces on a consistent basis, thirteen have had their ankles taped before, four use prophylactic taping on a consistent basis, and three have never had their ankles taped before.

Hypothesis Testing

The following hypotheses were tested in this study. All hypotheses were tested with a level of significance set at ≤ 0.05. A repeated measures ANOVA was calculated for the effect of external ankle supports on functional performance.

Hypothesis 1: Support conditions will have no effect on distance a soccer ball is kicked.

Conclusion: A within subjects repeated measures ANOVA on condition was calculated comparing the three levels of support conditions (tape, brace and no support). A significant effect was found ($F(2,30) = 11.382$ $p < 0.001$). Mean scores for distance can be found in Table 2.

Table 2: Mean scores for distance and accuracy

	No Support	**Tape**	**Brace**
Distance(m)	32.26 ± 4.045	32.49 ± 4.289	29.77 ± 4.935
Accuracy(m)	0.88 ± 0.207	0.98 ± 0.218	0.96 ± 0.205

Hypothesis 2: Support conditions will have no effect on accuracy a soccer ball is kicked.

Conclusion: A within subjects repeated measures ANOVA on condition was calculated comparing the three levels of support conditions (tape, brace and no support). No significant effect was found ($F(2,30) = 1.302$ $p > 0.05$). Mean scores for accuracy can be found in Table 2. Post hoc analysis determined there to be a significant difference between no support/taping and bracing ($t(15) = 3.536$ $p < 0.05$).

Additional Findings

Following the testing of the hypotheses, further testing was conducted to determine if there was any relationship between position and support condition on functional performance and then grade level and support condition on functional performance. A within subjects factorial ANOVA was calculated comparing position and support condition as independent variables and accuracy as the dependent variable. The main effect of support on accuracy was not significant ($F(2,26) = 1.199$ $p > 0.05$). The main effect of position was not significant ($F(2,26) = 1.641$ $p > 0.05$). The interaction was also not significant ($F(4,26) = 1.090$ $p > 0.05$).

A within subjects factorial ANOVA was calculated comparing grade level and support condition as independent variables and accuracy as the dependent variable. The main effect of support was not significant ($F(2,24) = 0.834$ $p > 0.05$). The main effect of year was not significant ($F(2,24) = 1.288$ $p > 0.05$). The interaction was also not significant ($F(6,24) = 0.913$ $p > 0.05$).

A within subjects factorial ANOVA was calculated comparing grade level and support condition as independent variables and distance as the dependent variable. The main

effect of support was significant ($F(2,24) = 7.536$ $p = 0.003$). The main effect of grade level was not significant ($F(2,24) = 0.370$ $p > 0.05$). The interaction was also not significant ($F(6,24) = 0.307$ $p > 0.05$).

A within subjects factorial ANOVA was calculated comparing position and support condition as independent variables and distance as the dependent variable. The main effect of support was significant ($F(2,26) = 12.864$ $p < 0.001$). The main effect of position was not significant ($F(4,26) = 1.427$ $p > 0.05$). The interaction was also not significant ($F(6,24) = 1.397$ $p > 0.05$).

DISCUSSION

The purpose of this study was to examine the effects of external ankle supports on the distance and accuracy a soccer ball is kicked in NCAA Division II female soccer athletes. The following section is divided into three subsections: Discussion of Results, Conclusions, and Recommendations.

Discussion of Results

The researcher wanted to investigate this topic for multiple reasons. One reason being there is a lot of controversy about whether external ankle supports affect functional performance. The second reason is because there is little to no research on how external ankle supports affect functional performance specific to soccer athletes. Through the researcher's professional and personal experience, ankle injuries in soccer are common injuries. The researcher hypothesized that neither tape nor brace would have a negative effect on functional performance. This study determined tape had no effect on kicking distance or accuracy; brace had no effect on kicking accuracy but did have an effect on kicking distance.

Minimal to no research exists discussing the effects of external ankle supports on functional performance specific to soccer. However, much research does exist about other measures of functional performance such as vertical jump height, sprint speed, and agility being the most common. While these variables can be related to soccer athletes, another part of soccer has yet to be evaluated and that is looking at how external ankle supports effect kicking a soccer ball.

Hume et al[12] looked at multiple studies that all discussed the effects of external ankle supports on ground reaction forces, proprioception, balance, range of motion, sprint speed, vertical jump height, agility and strength using a wide variety of external ankle supports. Ten studies say there is no significant effect on performance and eight say there is a significant effect on performance. Another conclusion made in this article is nine studies claimed bracing has a significant effect on limiting ankle range of motion. Strength was also affected from bracing use, which may be an indication as to why distance kicked decreased in this study.

It is possible distance was affected in the bracing condition because the foot angle plays a role in kicking. The brace constricts the ankle-foot complex from going into

eversion and plantarflexion, which is typically the range of motion the ankle needs to be in to hit the ball properly. By not being able to put the foot in this specific position, kicking form changes and a negative effect on the distance occurs. A possible reason why accuracy was not affected during the brace condition is because the margin of error was smaller.

The researcher believes the distance of 18.29 meters (20 yards) for testing accuracy might be too far. With the target being a third the size of the goal, the area to hit was too small compared to what soccer athletes are used to aiming for during soccer.

The tape possibly did not have an effect on kicking distance or accuracy because it is known that tape loosens up after 20 minutes of activity whereas a brace is used to have restrictions on range of motion throughout activity.

The researcher investigated two additional findings 1) if grade level in college and 2) if position had any significant effect on kicking. A possible explanation for why there was no significance found when looking at grade level and position on accuracy kicking is because of the years of experience for each athlete as well as the small margin of error as previously discussed. A freshman and senior could potentially have played the same number of

years even though they are three grades apart. A possible explanation for why there was a significant difference when looking at grade level and position on distance is most likely due to the ankle-foot complex range of motion restrictions from the brace. In the demographic information form, one question was how many years have the subjects played soccer.

When testing for accuracy, the researcher did not anticipate the number of misses that would occur. Some subjects ranged from missing once for a particular support condition to as many as 17 times for another support condition. The reason this happened could be due to the wind on some days, which was a variable that was out of the researcher's control. Another reason is the distance from the target the subjects were kicking. Twenty yards may not seem far, but usually soccer players have a target that is three times the size of the constructed target when shooting from 20 yards away. Due to the number of misses that did occur, fatigue might have been a factor after a certain amount of misses, which could have also affected the proceeding trials.

The researcher used Finnoff et al[33] recommendations to construct the target. Plywood was supported by posteriorly positioned frame made of wood planks. A textured paint was

painted onto the plywood. White paper was placed over the paint and in contact with carbon paper in order to make a mark on the white paper when the soccer ball made contact with the board. No explanation was given in the literature as to the purpose of the textured paint. By having the textured paint, an imprint potentially could have been seen better and cause less variation in measurements.

Conclusions

This study revealed taping did not have any significant effect on kicking distance or kicking accuracy in soccer athletes. This study also revealed bracing did not have a significant effect on kicking accuracy but did on distance a soccer ball is kicked. In this case, the certified athletic trainers can inform the athletes that taping will not have any effect on kicking accuracy or distance and that bracing will not have any effect on kicking accuracy but might have a significant effect on kicking distance. However, it should be stressed that the minimal distance reported lost when wearing an ankle brace may outweigh the risks of potentially sustaining an ankle injury and missing part of a season. Kicking for distance is a small part of soccer that may or may not have an

effect in the game whereas accuracy is much more important. A soccer player needs to be able to be accurate when shooting on goal and passing the ball to a teammate. When looking at the two dependent variables, accuracy seems to be the more important variable in relation to the game.

Recommendations

The first recommendation would be to have the data collection sessions at an indoor turf soccer facility. It would reduce any climate variables that may have caused issues. There were many days the wind might have been a factor to the number of misses that occurred. The second recommendation would be to expand the subject population to males because they might be affected differently than females but also make the findings more useful as well. The third recommendation would be to test athletes that wear external ankle supports, mainly braces, on a consistent basis because of the potential effects that it had on the dependent variables. Many of the subjects who did not wear a brace on a consistent basis complained about the size of the brace. Masse et al[25] stated, "a majority of the subjects in this study stated that they felt they were working harder when wearing a prophylactic device than when they

were not wearing one.” The fourth recommendation is to shorten the distance for accuracy. As previously mentioned, since the target was a third the size of a regulation soccer goal, it made hitting the target more difficult. A recommendation would be to have a protocol concerning the number of misses. If future studies keep the same distance, allowing only a certain number of total kicks and recording the misses regardless might help the possible effects of fatigue. The fifth recommendation would be to paint the board with a textured paint. The textured paint would allow for the ball marks to be seen more clearly and have more accurate measurements.

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APPENDICES

APPENDIX A

Review of Literature

REVIEW OF LITERATURE

It is a widely accepted practice in the athletic training profession to provide prophylactic ankle support to individuals.[1] External ankle supports such as tape and various ankle braces are common in athletic use today to support, stabilize, and prevent injury. The main goal of prophylactic ankle support is to restrict excessive inversion of the ankle-foot complex while allowing normal ankle dorsiflexion and plantar flexion.[2] The most important reason for prophylactic device use is to prevent injury without inhibiting functional performance.[3] They are also used by athletes who have a past medical history of ankle injuries to prevent future injuries. Taping and bracing have been shown to decrease ankle range of motion and provide subtalar (inversion and eversion) joint support without suffering a loss of talocrural (dorsiflexion and plantar flexion) joint ROM.[1,4-10] The talocrural, or ankle joint, is a uniaxial, modified-hinge joint formed by the talus, the medial malleolus of the tibia, and the lateral malleolus of the fibula.[11] Dorsiflexion and plantarflexion movements occur at this joint. The subtalar joint is a

gliding joint that lies beneath the talus, where the posterior calcaneal facet on the talus articulates with the posterior facet on the superior aspect of the calcaneus. Inversion and eversion movements occur at this joint. Since these prophylactic devices can potentially limit motion in the talocrural joint, there is the potential for external supports to alter or decrease physical performance.

Numerous studies examining the difference between taping and different types of braces on performance measures such as vertical jump height, agility, and sprint speed have been conducted. However, the results as to whether external ankle supports negatively affect performance are still in question due to inconsistent findings. For example, in a review article by Hume et al,[12] the author cites nine articles all claiming external ankle supports do not have a significant effect on performance while eight claim to have a significant effect on performance.

The purpose of this Review of Literature is to enlighten the reader on previous work examining the effects of various external ankle supports on different measures of performance. This literature review will examine different types of ankle braces, ankle injury rates and mechanics, prevention of ankle injuries, effects of external ankle

supports on performance, and will end with a summary of the research performed to date.

Prophylactic Devices

The general purpose of various ankle braces and taping techniques is to limit excessive range of motion and provide support in the ankle joint in order to prevent ankle injuries. Since the majority of ankle injuries result from excessive inversion and eversion, prophylaxis has focused on limiting motion in the frontal plane. Athletic trainers have choices when it comes to taping or bracing with a variety of taping techniques available and many different types of ankle braces on the market. Some of the major ankle braces used in athletics today are: DonJoy Ankle Ligament Protector, Aircast Sports Stirrup, Active Ankle, Swede-O, Malleoloc, McDavid lace-up and Ankle Stabilizing Orthosis (ASO). Taping techniques will also be discussed in this section.

Taping

Most ankle tape techniques consist of the same basic components; however, many variations exist in the application of these components between health care

professionals. A typical ankle taping begins just inferior to the gastrocnemius and soleus. It begins with a heel and lace pad over the talar window and over the Achilles tendon. Pre-wrap is used to minimize irritation from the adhesive tape. Ankle taping should be composed of three stirrups starting medially and moving laterally. Horseshoes are another component to ankle taping in order to keep the stirrups in place. Heel locks, generally two on each side, are used to keep the ankle in a neutral position. Usually two figure eights are used in taping an ankle. Once all these components are completed, the health care professional will "close off" the tape with anchors. What is important to remember is, each health care professional will have all of these components but each may have a different order or added components to the ankle tape.

A variety of tape is available to tape an ankle. Some common tapes other than standard white tape that is used are Moleskin and Elastikon. Moleskin[13] is a non-stretch, zinc oxide adhesive, which helps prevent irritation. It is typically used for stirrups when taping an ankle or used for areas where white tape is not strong enough. It can also be used for treatment and prevention of blisters, corns, calluses and chafing. It has a napped cotton backing that wicks away moisture. Elastikon[14] is a thick, porous

cotton elastic material with rubber-based adhesive. It is typically used for areas that need more support because of its strength and it is also used for hard-to-tape areas because of its flexibility. These two types of tape are more expensive per roll than white tape therefore choosing to use only white tape is more practical. Some schools do not have the funds to use the more expensive tape and white tape is the only option. This study can reach a larger audience by only using white tape as well.

Bracing

DonJoy Ankle Ligament Protector®

This brace has a unique design that allows for full plantar flexion and dorsiflexion but limits inversion and eversion. It has an opening over the Achilles tendon to prevent friction.[15]

Aircast Sport Stirrup®

An Aircast Sport Stirrup is designed to fit both feet and only comes in one size. It has a solid, plastic outer layer to limit inversion and eversion. It has a pre-inflated inside making it easy to apply because there is little to do once the brace is on.[16]

Active Ankle™

There are three types of rigid Active Ankle braces: T1, T2, and Volt. Both T1 and T2 are a solid U-shape design, which is intended to relieve pressure from the ankle joint and provides superior protection. They have bilateral hinges to allow for full talocrural joint range of motion. There is vinyl padding on the inside to allow for custom molding to take place for better comfort and fit. The Volt is made of a carbon fiber shell for support, has bilateral hinges for full sagittal range of motion, and a soft padding on the inside for comfort. The purpose of Active Ankle braces is to limit subtalar range of motion in order to prevent ankle injuries but allow for sagittal range so it does not prevent athletic performance.[17]

Swede-O®

Multiple types of Swede-O ankle braces exist and there is little clarification as to which one was used in previous research. The types that will be discussed are Ankle Lok®, Inner Lok 8®, Strap Lok®, Multi-sport®, and Tarsal Lok®. The Ankle Lok® is made of three layers of vinyl laminate to ensure durability. It is a lace-up design with sidebar stabilizer inserts to allow for a greater restriction of transverse motion. The back is elastic so it

does not interfere with the Achilles tendon. It has an internal U-shaped spiral that provides added support. The Inner Lok 8® is similar to an ASO® brace in that there is a lace-up and figure eight portion. The Strap-Lok® is made of ballistic nylon for a lightweight and thin feel but still durable. It is comprised of a lace-up and figure eight portion with an elastic back over the Achilles tendon. The Multi-sport is similar to the Strap-Lok® in the sense it is made of the same material and is comprised of the same parts. The Tarsal Lok® combines a lace up brace with a rigid brace. It uses body heat to mold to the contours of the ankle.[18]

Malleoloc®

The Malleoloc® is made of a thermoplastic material that can be heated and molded. It has figure eight Velcro straps to hold the brace in place as well as provide added support to the ankle complex. The goal of the Malleoloc® brace is to increase ankle stability without restricting mobility. It fits anterior of the lateral malleolus and posterior to the medial malleolus in order to prevent eversion ankle sprains. It allows for full talocrural range of motion.[19]

Ankle Stabilizing Orthosis® (ASO)

This brace consists of a lace-up portion as well as two figure eight straps for customized fit. It also has a strap across the top to ensure the straps remain in place. It is made of nylon, which allows for the ankle to breathe while in the brace as well as provide durability throughout activity. It is intended to keep the ankle in a neutral position preventing inversion ankle sprains. It comes in different sizes, sized by shoe, in order to create the most comfortable and appropriate fit possible.

Choosing to use the ASO® lace-up brace is a personal decision due to the researcher's individual experience with this brace as well as using this brace for teams. Almost all the braces discussed have lace-up and figure eight components, which makes up the ASO® lace-up brace. Based on the researcher's personal experience, Active Ankle braces are characteristically used in volleyball athletes and are not seen much outside that specific sport. The DonJoy Ankle Ligament Protector is an uncommon ankle brace and has minimal research associated with its use. The Aircast Sport Stirrup is typically used for treatment of acute ankle injuries rather than as a prophylactic device. The Swede-O brace could have been used but due to the lack of familiarity with this brace, the researcher decided against

it. The Malleoloc® brace seems to be out dated and has had minimal advancements over the years.[20]

Ankle Injury Rates and Mechanisms

Ankle injuries are among the most common injury in athletics. Many types of ankle injuries can occur with a variety of mechanisms and levels of severity. Ankle sprains tend to occur at foot strike during running or landing from a jump when the ankle joint complex is plantarflexed and supinated.[12] Seventy-three percent of the athletic population has sprained at least one of their ankles one or more times.[21] Eighty-five percent of ankle injuries are acute sprains, and an equally high proportion of these injuries involve the lateral ligamentous structures of the ankle.[10] Hume et al[12] claims that rugby union had the largest number (22.2%) of ankle injury claims. There is a mechanical and anatomical explanation for this. The lateral ankle static stabilizers are made up of three small ligaments: anterior talofibular ligament (ATF), posterior talofibular ligament (PTF), and calcaneofibular ligament (CFL). The lateral ligaments are much weaker than their counterparts, the medial ligaments, which combine to form the deltoid ligament. The deltoid ligament is comprised of

four separate ligaments named: tibionavicular ligament, calcaneotibial ligament, anterior talotibial ligament, and the posterior talotibial ligament. The spring ligament also provides structural support to the medial ankle therefore making the medial ankle more stable. Another anatomical structure that predisposes ankles to injury is the medial malleolus, which is anatomically superior to the lateral malleolus allowing for an increase in inversion. It is these anatomical structures that create an increase in inversion range of motion (ROM) in comparison to eversion.

Prevention of Ankle Injuries

The lateral ligament complex of the ankle is the most common site of injury in sports participants.[22] Preventing ankle injuries is a difficult task to accomplish but one that is necessary due to the frequency of ankle injuries that occurs in athletics. The athletic trainer has many tools at his/her disposal in regards to preventing injury including strength and conditioning workouts but the focus of this research is on external ankle supports. It is common to see a line of athletes waiting to get his or her ankle taped before practices or games. Many certified athletic trainers are switching over to ankle braces not only to reduce cost but also to help prevent ankle injuries

over longer periods of activity than tape would. Research has shown that tape weakens after exercise, whereas braces limit motion much longer. Paris et al[23] states, "although several studies have shown that tape offered significant support 10 to 30 minutes into activity, others have reported significant taped support reduction of 40% to 50% within 5 to 20 minutes of activity." Effectiveness of tape seems to depend on how the tape is applied and factors other than the mechanical support of taping may explain the effectiveness of ankle taping preventing ankle sprains.[12]

Effects of External Ankle Supports on Performance

Much research has been performed examining the effects of external ankle supports on ROM, vertical jump height, sprint speed, and agility. However, the data is inconclusive with some research stating that ankle supports have no effect on these measures of functional performance while others suggest the ankle supports provide rigidity to the ankle, which in turn affects performance in these categories.

Agility

When determining an agility protocol, some requirements must be considered. Quick change in direction, moments of acceleration and deceleration, and sprinting are all recommended.[24] Many variations of agility tests were considered when doing various studies. Some of the most common agility tests are T-test, Southeast Missouri (SEMO), shuttle run, figure eight, and four-point run. Agility times were statistically significant but clinically, they were not.[25] Metcalfe et al[1] stated moleskin, linen tape, and lace-up brace all significantly limited performance in the SEMO agility test. Cordova et al[24] states external ankle support has virtually no effect on agility. Once again, even with quality research, the debate is still open.

Sprint Speed

As previously stated, the purpose of an ankle support is to limit range of motion in the subtalar joint, not the talocrural joint; therefore, running should not be affected. In a review article by Cordova et al[24], he found seven articles claiming sprint speed was not affected but one article claiming sprint speed was affected. The protocols and procedures were not clearly outlined, therefore leaving this debate unsolved once again. Coffman

et al[21] concluded that for both ankle taping and Aircast Sport Stirrup, speed was significantly different than the no support condition.

Vertical Jump Height

Metcalfe et al[1] stated moleskin tape, linen tape, and lace-up brace all significantly limited performance in vertical jump height. Metcalfe quoted Mayhew and Paris both stating vertical jump height was significantly affected by prophylactic taping and bracing applications. Coffman et al[21] concluded ankle taping significantly affects vertical jump height but not for the Aircast Sport Stirrup. Hume et al[12] cites multiple authors who all claim vertical jump height was negatively affected due to external ankle supports. Some of these external ankle supports included Swede-O, DonJoy Ankle Ligament Protector, McDavid, Active Ankle, Aircast Sports Stirrup, New Cross, Mikros, and various taping techniques.

Vertical Ground Reaction Force

Landing from a jump is a common task in many sports that serves as the primary mechanism of many lower extremity injuries.[2] Hodgson et al[26] looked at the relationship between jump height with vertical ground-

reaction forces. Volleyball players were used in this study due to the repetitive jumping involved but this could pertain to soccer as well because there are times when a player needs to jump to head the ball or the goalie needs to jump to catch a ball. Hodgson states, "When landing and recovering from a jump, the vertical component of the ground-reaction force ranges from 2.3 to 7.1 times body weight. Studies that have examined the effect of landing type on vertical ground-reaction force have reported that an increase in landing stiffness will result in an increase in peak vertical ground-reaction force." Cordova et al[2] stated, "ankle taping and bracing may influence impact absorption during drop landings, which may lead to an increase in energy absorption at the knee and hip joints. With this being said, the constant increase in physical demand could lead to injury. With active ankle braces being so popular in volleyball today, this is a legitimate concern as to whether the immediate benefit of decreased ankle injuries is worth the possibility of chronic injuries in the future.

Range of Motion

Omori et al[4] looked at the effects of the Air-Stirrup on severed ATF ligaments on cadavers and determined that

Air-Stirrup decreased excessive inversion. Hume et al[12] cites twenty-six articles, which all claim that external ankle supports restrict range of motion. Specifically, Gehlsen[27] found that plantar flexion total work is affected by some support devices indicating a decrease in ROM. Cordova et al[2] states, "For ankle-joint displacement, both the tape and semirigid-ankle-brace conditions showed significantly less ankle-joint ROM than no support condition, whereas no differences were observed between the tape and semirigid-brace conditions." Rarick et al[28] concluded that the basket weave, stirrups, and heel-lock conditions provided the most restriction in ROM. Metcalfe et al[1] concluded that a specific taping technique consisting of tape with moleskin application significantly restricted range of motion in plantar flexion, dorsiflexion, inversion, and eversion. Tape alone restricted dorsiflexion, inversion, and eversion and the braced condition restricted plantar flexion, dorsiflexion, and inversion. Gross et al[28] looked at the effects of the DonJoy Ankle Ligament Protector and Aircast Sport Stirrup on ROM and concluded that both supports significantly reduce inversion and eversion after application and maintained their ability to reduce inversion and eversion after exercise.

Kicking Biomechanics

Kicking is a natural fluid motion and a fundamental skill in soccer.[31] Kicking biomechanics is something that is widely studied by physicists and biomechanics. Mechanics change between each person depending on what is comfortable and what type of kick. A different approach is warranted for distance versus accuracy when kicking a ball. Players prefer to use an approach angle between 43° and 45° to generate maximum ball speed.[32] It has also been supported that the last step before kicking is the determining factor in distance the ball is kicked. When kicking for distance, it has been shown the longer the last stride length is, the further the ball will travel. The longer stride length allows for greater pelvic retraction, which in turn allows for greater pelvic protraction.[32] Clagg et al[31] also concluded that when participants kicked with their dominant kicking limb they produced a larger pulling force, indicated by an increase in hip, knee, and ankle flexion, internal rotation, and adduction torque of the dominant plant leg. Having the ankle in a plantarflexed, internally rotated, and adducted position can be greatly limited by many support conditions. Most of the literature looking at kicking biomechanics deals with the plant leg, hip on the

kicking leg, knee range of motion of the kicking leg, but not specifically the ankle-foot complex. The upper body has also been studied for kicking mechanics.

Summary

In summary, the literature provides sufficient research on support conditions including taping and various types of braces and how they affect functional performance such as sprint speed, agility, vertical jump height, vertical ground reaction force, range of motion, and kicking. However, no current research reports on how external ankle supports affect skills necessary to play and succeed in soccer. It is clear that all external ankle supports provide some type of stability to the ankle-foot complex that mainly decreases range of motion. The ideal support would limit only inversion movement and not plantar flexion or dorsiflexion. Most claim this is the case, which is where the controversy remains. The purpose of this current study is to determine the effects of the ASO lace-up brace and a specific taping technique on distance and accuracy a soccer ball is kicked.

APPENDIX B

The Problem

STATEMENT OF THE PROBLEM

Conflicting data exists as to whether external ankle supports inhibit functional performance. From an injury standpoint, external ankle supports decrease ROM and therefore decrease the risk of injury. However, if external ankle supports decrease athletic performance, as some studies suggest, does this risk outweigh the benefits of injury prevention? A variety of ankle supports exist. The purpose of this study was to examine the effect of external ankle supports (taping versus a lace-up brace) on the accuracy and distance with which a soccer ball was kicked.

Definition of Terms

The following terms are defined for this study:

1) External Ankle Supports – tape or brace support that is designed to decrease excessive range of motion of the subtalar joint.
2) Functional Performance - accuracy and distance a soccer ball is kicked.
3) Agility – incorporating sprinting, acceleration, deceleration, forward and backwards running, and directional changes.
4) Vertical Jump Height – Difference between standing

reach and the height reached at the end of the vertical jump.

5) Ground reaction force – measured using a force plate while walking.
6) Sprint speed – 40-yard dash and 50-yard dash.
7) Range of Motion – using a specific measuring device called a goniometer to measure ankle range of motion including inversion and eversion.

Basic Assumptions

The following were basic assumptions of this study:

1) The ankle taping will be applied equally during each application.
2) The subjects will be consistent and perform to the best of their ability during testing sessions.
3) The ankle braces will be fitted correctly, high quality and consistently applied.
4) Built in rest periods will adequately control for fatigue.
5) Instruments and testing procedures are reliable and valid.

Limitations of the Study

The following are possible limitations of the study:

1) Support conditions may feel uncomfortable due to lack of previous use.
2) Only NCAA Division II female soccer players were used in this study decreasing the ability to extrapolate the results to the general population.
3) Only one particular brace was used in this study.
4) Only white tape was used in this study.

Significance of the Study

The results of this study will help determine and clarify whether ankle supports affect kicking performance. This is useful information for clinicians and other health care professionals, specifically certified athletic trainers, and the evidence will determine if they should encourage the use of external ankle supports for athletes. Additionally the results will identify if one support type should be preferred over another. It is important to have this information because previous research has shown much controversy about the potential effects of taping and bracing on performance. Also, the research has not examined soccer skills specifically, which may show differing results from other measures of performance.

APPENDIX C

Additional Methods

APPENDIX C1

Demographic Information Form

Demographic Information

Age: _____

Year in school: _____

Years of soccer played: _____

Kicking foot: L R No Preference

Do you wear a brace on a consistent basis?

No Yes: Ankle Knee

Have you had your ankle taped before?

No Yes

Do you get your ankle taped on a consistent basis?

No Yes: every day games only practices only

APPENDIX C2

Informed Consent Form

California University of Pennsylvania

Informed Consent Form

1. Lysha Draskovic, who is a Graduate Athletic Training Student at California University of Pennsylvania, has requested my participation in a research study at California University of Pennsylvania. The title of the research is *The Effect of External Ankle Supports on Functional Performance in Division II Female Soccer Athletes*.

2. I have been informed that the purpose of this study is to determine if external ankle supports, specifically ankle taping and braces, affect distance and accuracy when kicking a soccer ball. 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 approximately 19 other individuals because I am a soccer athlete at California University of Pennsylvania with no current injury or injury that affects my participation in this study.

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 consist of two separate days. The first day is solely for filling out a demographic questionnaire, reviewing and signing this informed consent form. The second day will involve going through a dynamic warm-up, kicking a soccer ball at a target to measure for accuracy and kicking a soccer ball for distance. All this will be done while wearing an ankle brace, getting my ankle taped and not having any support condition. Five kicks will be done for accuracy and five kicks for distance for each support condition making a total of thirty kicks that will be scored. This testing will last for about sixty minutes in total.

When being tested for accuracy, I will be kicking from one spot on the field 20 yards away from the goal at a target that is placed in the center of the goal. I am aiming for the center of the target. I will be allowed two practice kicks and the next five kicks will be scored and averaged.

When being tested for kicking distance, I will be kicking from the end line of the soccer field. I will kick the ball as far as I can. I will have two practice kicks and the next five kicks will be scored and averaged.

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.

I will be asked to perform soccer kicks, something I do on a frequent basis. I understand that I could potentially strain a muscle or tendon in my leg when kicking for distance. I will be allowed to discontinue participation if I am in pain or feel I can no longer continue. I could slip or fall during testing but this also occurs during normal participation in soccer. I will be excluded from participating in the study if I currently have an injury that prevents my participation from kicking a soccer ball, if I am currently pregnant or may believe I am pregnant. I also understand I may be asked to discontinue my participation if I cannot comply with the testing protocol established by the researcher. No tests are physically invasive. If an injury was to occur, the researcher is a Certified Athletic Trainer and will be able to provide immediate care and treatment in the athletic training room. The Athletic Training Room in Hamer Hall at California University of Pennsylvania is also available to me. The campus health center is also available on the bottom floor in Carter Hall. The health center staff can also be reached by calling 724-938-4232.

5. I understand that, in case of injury, I can expect to receive treatment or care in Hamer Hall's Athletic Training Facility. This treatment will be provided by the researcher, Lysha Draskovic, under the supervision of the CalU athletic training faculty, all of which can administer emergency care. Additional services needed for prolonged care will be 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 are to help determine the

effects of ankle taping and bracing on kicking. This study can help athletic trainers and other health care professionals decide whether to encourage the use of external ankle supports such as taping and this specific ankle brace in order to prevent ankle injuries without decreasing functional performance.

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

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

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

Lysha Draskovic ATC
STUDENT/PRIMARY RESEARCHER
Dra9026@calu.edu
(203) 556-9244

Dr. Edwin Zuchelkowski PhD
RESEARCH ADVISOR
Zuchelkowski@calu.edu
(724) 938-4202

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

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

claims, rights, or remedies. A copy of this consent form will be given to me upon request.

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

14. The IRB approval dates for this project are from: 02/13/12 to 02/12/13.

Subject's signature:_____

Date:_____

Witness signature:_____

Date:_____

APPENDIX C3

Institutional Review Board –

California University of Pennsylvania

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

(Reference IRB Policies and Procedures for clarification)

Project Title ***The Effects of External Ankle Supports on Functional Performance in Division II Female Soccer Athletes***

Researcher/Project Director ***Lysha Draskovic***

Phone # ***(203) 556-9244*** ***E-mail Address*** ***dra9026@calu.edu***

Faculty Sponsor (if required) ***Dr. Edwin Zuchelkowski***

Department ***Health Science***

Project Dates ***January 1, 2012*** ***to*** ***December 31, 2012***

Sponsoring Agent (if applicable) ***NA***

Project to be Conducted at *California University of Pennsylvania*

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

Keep a copy of this form for your records.

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

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

   The purpose of this study is to examine the relationship between prophylactic ankle supports and two measures of soccer skills, the abilities to kick the ball for distance and accuracy. Following IRB approval, subjects will be recruited from California University of Pennsylvania women's soccer team and complete informed consent forms. They will complete a standard warmup for the women's soccer team they use before each practice and game. This warm up will consist of jogging two laps around a soccer field, side shuffle, carioca, hip cradle, knee grabs, high knees, leg kicks, butt kickers, lateral squat, forward lunges, backward lunges, inch worm, A-skip, and power skip.

   After the warmup, the subjects will have one of the three support conditions (tape, brace or no support) applied to both ankles. Five minutes will be allotted for application, which will also help control for fatigue. Following completion of the testing for a particular subject, the same protocol will be applied with the remaining support conditions. The order of the support condition will be counterbalanced among the subjects. Support condition order will be determined randomly to control for the possible effects of fatigue.

   When taping an ankle, a standard taping procedure will be used. First, the ankle will be sprayed with Tuf-Skin and then heel and lace pads will be placed on the skin over the talar window and Achilles tendon. Then pre-wrap will be applied to help minimize irritation from the tape. Next, three anchors will be placed just inferior to the distal end of the gastrocnemius muscle. Then three stirrups will be placed medial to lateral alternating with three horseshoes. Then two figure eights will be added one beginning over the medial malleolus and the other beginning over the lateral malleolus. Then two heel locks on each side will be added going behind the ankle. Anchors will be placed to close up the tape once all that is applied. Braces utilized will be standard ankle braces fitted to manufacturer's instructions.

   In order to test for kicking distance, the ball will be placed at the end line of a regulation, turf soccer field and the subject will kick the ball as far as they can. They will be allowed to approach the ball however they feel comfortable in order to make the most natural kick. A marker will be placed where the ball first hits allowing for a distance measurement. From that mark, a measurement will be taken back to where the ball was initially placed using a tape measure. This will be repeated five times and an average distance will be calculated.

   In order to test for accuracy, a target will constructed according to Finnoff et al (2002), using a plywood sheet measuring 243.84cm wide x 243.84cm high. It will be held in an upright position by a posteriorly positioned frame of 5 x 10.2cm wood planks. A black mark measuring 5 x 5cm will be placed at the center of the board. This will be referred to as the bull's-eye. A screw will be placed in the middle of the bull's-eye but will not be fully inserted into the plywood, so that a hook at the end of a tape measure could fit over the head of the screw. A tape measure attached to the screw will be used to determine the distance from the bull's-eye to the center of the mark left where the ball will strike the target. Sheets of white paper will be placed over the board; these will be covered by sheets of carbon paper with the carbon side in contact with the white paper. The sheets will be held in place using a staple

gun. When the soccer ball strikes the carbon paper, it will leave a mark on the white paper underneath. To allow for additional measurements, a sheet of white paper containing a ball mark will be replaced with a new sheet of white paper and covered by carbon paper. The target will be placed in the middle of a regulation soccer goal that measures 243.84x 731.52cm. The ball will be placed at one spot on the soccer field and the subjects will be instructed to aim for the center of the target. The spot on the field will be at a distance of 20 yards from the center of the target. They will be allowed two practice kicks before any support condition will be applied and then instructed to kick five times making a total of fifteen kicks. They will be scored based on the distance measured from the bull's-eye to the center of the mark.

The cool down will be done on the subjects own and will be allowed to take as long as they need.

My hypothesis is support conditions will have no effect on distance and accuracy a soccer ball is kicked.

Finoff JT, Newcomer K, Laskowski ER. A valid and reliable method for measuring the kicking accuracy of soccer players. J Sci and Med Sports. 2002;5(4):348-353.

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

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

    The possible risks and/or discomforts are minimal to the subjects. Female division II soccer athletes will be used for this study. What is being asked of the subjects is specific to soccer, therefore it is something that is done on a daily basis and is not a difficult task for the subjects to complete. A subject could potentially strain a muscle or tendon in her leg when kicking for distance. Subjects will be allowed to discontinue participation if they are in pain or feel they can no longer continue. The subjects could slip or fall during testing but this also occurs during normal participation in soccer. Subjects will be excluded from participating in the study if they currently have an injury that prevents their participation in soccer practices or games. No tests are physically invasive. If an injury was to occur, the researcher is a Certified Athletic Trainer and will be able to provide immediate care and treatment in the soccer stadium athletic training room. The Athletic Training Room in Hamer Hall at California University of Pennsylvania is also available to the subjects. The campus health center is also available on the bottom floor in Carter Hall. The health center staff can also be reached by calling 724-938-4232.

    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 and are NCAA division II collegiate athletes at California University of Pennyslvania. Prior to this study, an informational meeting will be held with the potential subjects to explain the concept of the study in the absence of the coaches. Any athlete will be excluded from this study if they are currently not participating in practice or competitions due to an injury.

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.*

Subjects will complete an informed consent form (attached) at the initial meeting prior to any participation in this study or any data collection. All subjects will be 18 years of age or older therefore they are able to legally provide their own consent. Each signed form will be kept by the researcher.

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 collected will be documented on an individual data collection sheet (attached). Data will be collected during the spring semester. All subjects are supposed to come in two different days, one for paperwork and the other for data collection. The second day will consist of testing under three ankle support conditions (no support, tape, brace). All collected data, which will be identified by subject number only, will be maintained by the researcher in a secure location in the Graduate Program Director's office on campus. Only the researcher and the research advisor will have access to these records.

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

Dear Lysha Draskovic:

Please consider this email as official notification that your proposal titled "The Effects of External Ankle Supports on Functional Performance in Division II Female Soccer Athletes" (Proposal #11-044) has been approved by the California University of Pennsylvania Institutional Review Board as submitted.

The effective date of the approval is 2-13-2012 and the expiration date is 2-12-2013. 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 2-12-2013 you must file additional information to be considered for continuing review. Please contact instreviewboard@calu.edu

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

Appendix C4

Individual Data Collection Sheet

Data Collection Sheet			
Subject #			
Accuracy (m)			
Condition	No Support	Tape	Brace
Trial			
1			
2			
3			
4			
5			
Average			
Distance (m)			
Condition	No Support	Tape	Brace
Trial			
1			
2			
3			
4			
5			
Average			

Appendix C5

Figures for Target

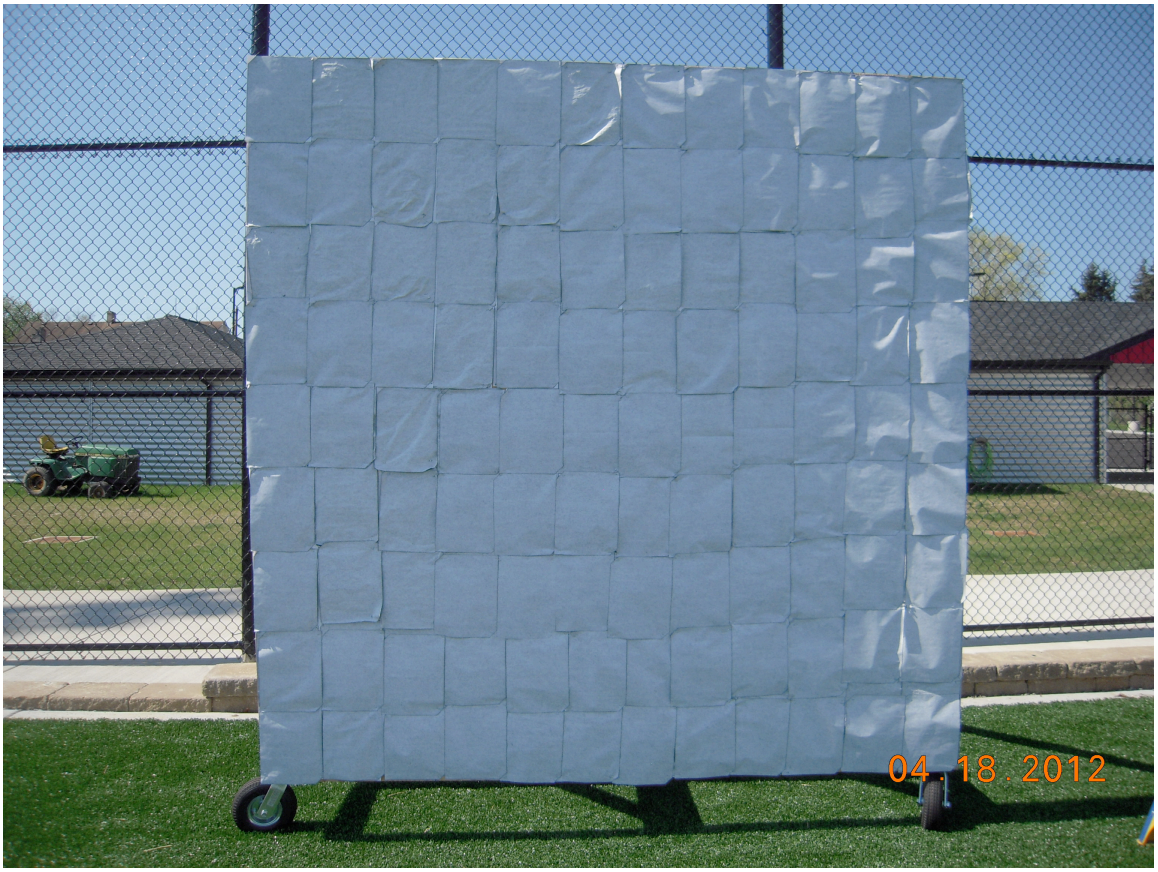

Figure 1: Front view of target

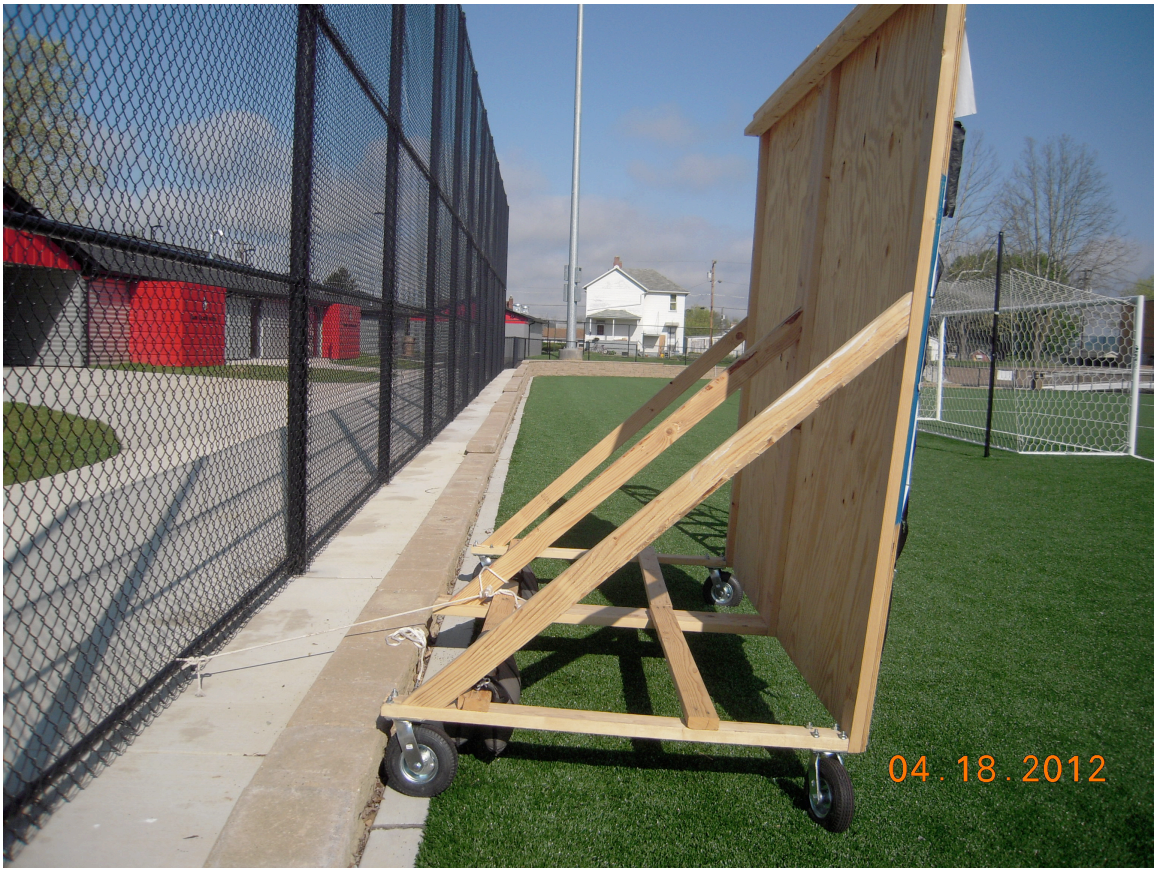

Figure 2: Side view of target

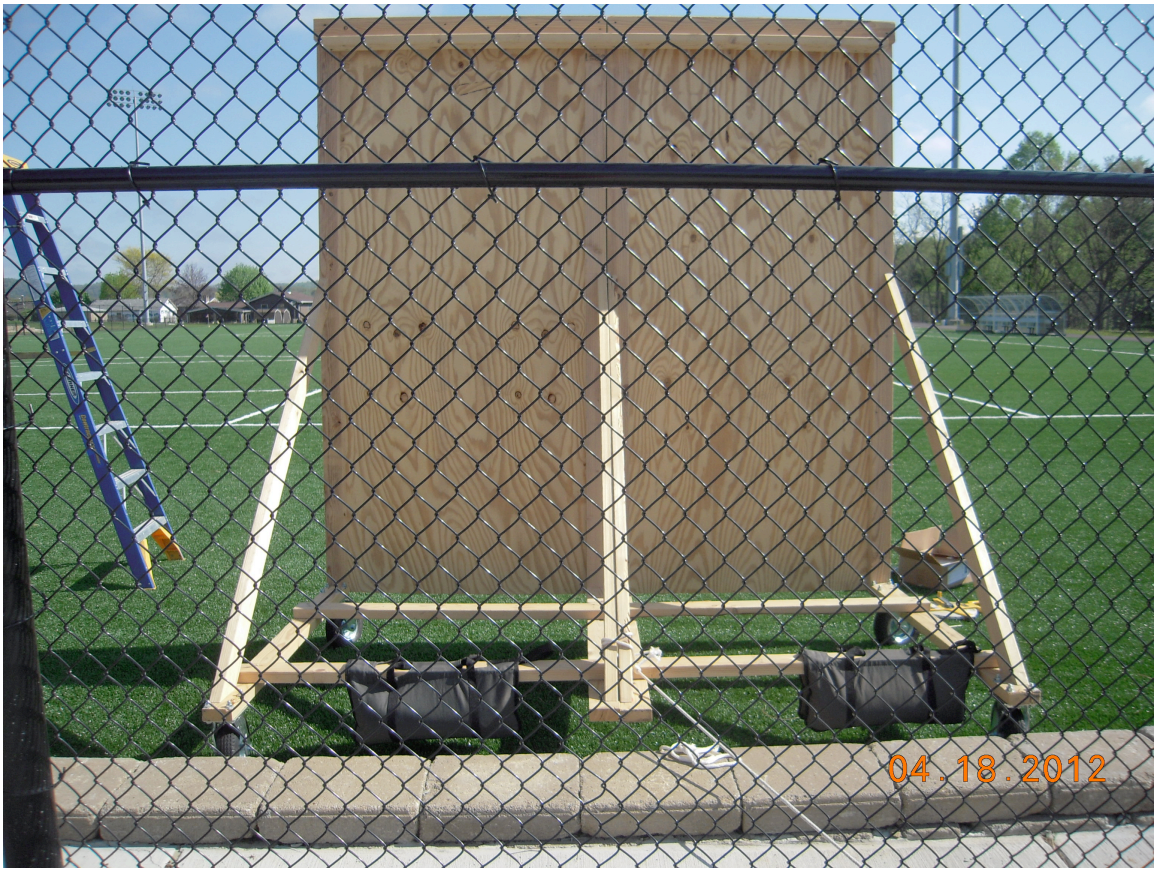

Figure 3: Posterior view of target

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ABSTRACT

Title: The Effects of External Ankle Supports on Functional Performance in Division II Female Soccer Athletes

Researcher: Lysha R. Draskovic, ATC

Advisor: Edwin Zuchelkowski, PhD

Research Type: Master's Thesis

Context: Ankle injuries are among the most common injury in athletics. It is a widely accepted practice in the athletic training profession to provide prophylactic ankle support to individuals. There it little to no information about the effects of external ankle supports on functional performance specific to soccer.

Objective: The purpose of this study was to determine the effects of external ankle supports (tape and brace) on kicking accuracy and distance.

Design: Quasi-experimental, within subjects, repeated measure ANOVA design (on condition).

Setting: Data was collected outdoors, on an artificial turf surface.

Participants: 16 female, 19.6 + 1.35 years of age with 12 to 17 years of experience, Division II soccer athletes were used as subjects in this study. This was a convenience sample.

Interventions: The independent variable, support condition had three levels ASO® EVO® Ankle Stabilizer, closed basket weave taping, and no support.

Main Outcome Measures: The dependent variables were distance (how far a subject could kick a soccer ball with maximal effort) and accuracy (how close to the center of the target they could kick the ball). Distance measurements were made using

a 300-foot tape measure. An 8’x8’ board was used as a target. Subjects were provided 5 trials for each measure for each support condition.

Results: A repeated measures ANOVA was calculated comparing the effect of support condition on kicking distance and accuracy. A significant effect was found for support conditions having an effect on kicking distance ($F(2,30) = 11.382$ $p < 0.001$). Post hoc analysis determined there to be a significant difference between no support/taping and bracing ($t(15) = 3.536$ $p < 0.05$). The average distance kicked was 29.77 + 4.936 meters. No significant effect was found for support conditions having an effect on accuracy ($F(2,30) = 1.302$ $p > 0.05$). The average distance kicked was 0.96 + 0.207 meters. No significant effect was found for tape having an effect of kicking distance. The average kicking distance is 32.49 + 4.045 meters. No significant effect was found for tape having an effect on kicking accuracy. The average distance kicked was 0.98 + 0.218 meters.

Conclusions: Bracing decreased kicking distance. Taping did not affect either accuracy or distance. Athletes that wear a brace or get taped on a consistent basis may have different results than those that never had his or her ankles taped or braced before. Taping has been shown to decrease ankle injuries so if an athlete has never been taped or braced, tape is easier to adjust to than braces.