

The Effect of External Ankle Support on Football Specific Performance

Tests and the Perception of the Athletes that Wear Them

A thesis

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by

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Keywords: performance, perception, comfort, football, ankle support

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ABSTRACT

Context: Researchers and manufacturers have been looking for the optimal method to safely and adequately support the ankle joint without hindering performance. A plethora of information on sport specific performance utilizing taping and/or bracing methods exists. However, no study has compared actual performance to the athletes' perception of their performance wearing various ankle support. *Objective:* The purpose of this study was to examine the effect of ankle braces and taping on football performance tests and the participants' perception of the affect the ankle support had on their performance. *Design:* Mixed methods crossover design with 3 conditions unsupported (U), a taped (T) using a modified basket weave, and two separate braced conditions; a traditional figure eight lace up with Velcro stirrups manufactured by McDavid (B₁) and a hinged ankle brace manufactured by UltraAnkle Zoom (B₂). *Setting:* Outdoor artificial turf surface *Participants:* Three collegiate football players (age = 21 +/- 2 yrs, with 3.5 +/- 1.5 yrs of college experience) voluntarily participated in this study. *Main Outcome Measures:* Vertical jump, broad jump, 5-10-5 agility test, 3-cone test, and the 40-yard dash. Because we were unable to achieve a large sample size, interviews were performed to gather descriptive data regarding the three conditions. *Results:* No trends were seen in data relative to the condition. Qualitative results indicated that participants felt most comfortable in condition they had used previously, but preferred the unsupported condition. Results: Vertical jump (U=24.01±4.31, T=22.91±4.87, B₁=23.88±4.17, B₂=23.73±4.11), broad jump

IV

($U=93.68\pm 10.91$, $T=96.42\pm 11.52$, $B_1=94.55\pm 12.96$, $B_2=95.84\pm 10.95$), the 5-10-5 agility test ($U=4.71\pm 0.23$, $T=4.69\pm 0.22$, $B_1=4.76\pm 0.29$, $B_2=4.79\pm 0.22$), the 3-cone test ($U=7.67\pm 0.40$, $T=7.74\pm 0.48$, $B_1=7.75\pm 0.54$, $B_2=7.83\pm 0.55$), and the 40-yard dash ($U=5.27\pm 0.24$, $T=5.35\pm 0.27$, $B_1=5.41\pm 0.28$, $B_2=5.46\pm 0.26$). *Conclusions:* Due to the small sample size, we were unable to draw objective conclusions regarding the effect of the conditions on performance, however participants in this investigation preferred the unsupported condition for the testing.

Key Words: performance, perception, comfort, football, ankle support

PREFACE

Ankle taping or utilizing ankle braces is something that all Athletic Trainers involved with football will encounter. I was interested in looking at the affect on performance of football players that were braced against tape against no external support. Additionally, I wanted to determine the athletes' perception of how the brace or tape affected their performance and the actual performance change. The study began with hopes of 60 participants and after quite a few roadblocks we ended with 3 individuals willing to participate. Although I was hoping to have more insight to share with you, I am happy to have had the experience.

ACKNOWLEDGMENTS

I would like to thank my thesis committee for helping me through this process. Without the insight, knowledge, and constant thinking on the fly this would have been a much steeper hill to climb. A special thank you to Dr. Lindsey Ebermen. Although she was not officially a part of my thesis committee, she was as much a part of this piece of work as any one of us listed. Her passion and dedication to the graduate program and the students that become a part of the ISU Athletic Training family cannot be quantified. I am lucky to have had her guidance among her help as well.

The process was an interesting one that I will not soon forget. I am happy to have completed the requirements of this thesis and the underlying coursework of my master's degree. Believe it or not, I am grateful to have completed these tasks while in Terre Haute, Indiana at Indiana State University.

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CHAPTER 1

INTRODUCTION

American style football is a popular sport in youth organizations, high schools, colleges and universities, recreationally amongst friends, as well as at the professional level.(1) Ankle injuries account for approximately 45% of all recreational sport related injuries.(2) In the NFL, ankle sprains are the 4th most prevalent injury,(3) while they account for the 2nd most reported injury within NCAA football athletes throughout a recent 16-year study.(4)

Due to the high prevalence of ankle injuries in football, most institutions provide external ankle support to help prevent or decrease the severity of ankle injuries.(5-7)

The effects of external support on range of motion, performance, comfort and cost must be considered when determining which method to use. In addition, an athlete may perceive that taping or bracing will decrease his or her performance.(2, 5-8) Researchers have reported that ankle braces negatively affect the results of vertical jump testing while differences in other performance style outcomes were insignificant.(5-10) Additionally, athletes choose to play without support due to comfort and a perception that their performance will decrease.(5)

Many athletic programs require their football players to wear ankle braces or tape their ankles. Due to the perception that athletic performance may be affected, we must attempt to look into measuring performance where external ankle support has been applied. One measure of football potential that is used by the NFL assesses athlete performance ability using quantifiable tests for power, speed, and agility.(11) Many teams use this data to determine the athlete's potential to translate performance test scores at the combine to on-field performance as a NFL

player.(11) The purpose of this study is to examine the effect of ankle braces and taping on performance in football specific testing. Furthermore, we will inspect the athletes' perception of the effect of bracing and taping on performance relative to no support.

Research Questions

1. Is there a difference in performance between a football player with taped, braced, and unsupported ankles?
2. What is the perception of the athletes while they perform these tests in each condition in regards to their performance.

Hypotheses

1. The taped and braced conditions will not have a significant effect on either of the two agility tests or 40-yard dash time, but will have a negative effect on the vertical and broad jump tests in comparison to the condition without external support. There will be no significant difference between the braced and taped conditions on any of the performance tests.
2. Participants will perceive that their performance will be positively affected by the braced and taped conditions during the 5-10-5 and 3-cone agility tests, but not on the other tests. Participants will also perceive that the support conditions will negatively affect their performance.
3. The participants will feel more comfortable and safer in the support conditions when compared to the non-braced. Of the two support conditions, participants will perceive the tape to be more comfortable.

Operational Definitions

Ankle brace condition- lace-up, figure-8, elastic stirrup lateral ankle braces. Used in accordance to the manufacturer. Sizing is determined by shoe size and will be worn over the top of the athlete's sock and under their football cleats.

Ankle tape condition- Closed basket weave ankle tape job using 1.5" cloth Johnson and Johnson tape, pre-wrap, tuf-skin spray, and heel and lace pads. There will be 3 certified Athletic Trainers applying the ankle tape in the same manner. There will be a familiarization session for the practitioners to ensure this.

College-aged- Individuals aged between 18 and 25.

Football performance activities- 40-yard dash, vertical jump, broad jump, 3-cone agility test, and 5-10-5 agility tests.

Functional ankle instability- Having withstood a significant ankle injury that caused significant time to be missed within the lifetime of the athlete.

Healthy football athlete- Any football athlete not incurring a lower extremity injury within the past 6 months prior to data collection.

NFL Combine- An NFL sponsored event that showcases power, speed, agility, and specific skill by post-collegiate football athletes that plan to enter the NFL draft.

Perception questionnaire- Questionnaire completed by the athlete on perceived effect of ankle tape/brace on performance and comfort

Assumptions

1. Participants will accurately represent college level football players in the football championship subdivision.

2. Participants will follow directions.
3. The type of cleat worn will not affect testing scores.
4. The braces will maintain integrity throughout the three days of data collection.
5. Participants will not practice the skill tasks in between data collections.
6. Participants will perform each test to their fullest ability.
7. Participants will be truthful in answering their questionnaire.
8. Participants will be able to remember the first day of testing when comparing that of the braced conditions for the questionnaire.

Delimitations

1. DI-AA Football athletes at a mid-west institution
2. College-aged individuals
3. Individuals that haven't sustained a lower extremity injury within the previous six months.
4. Testing is conducted on field turf.
5. Taping procedures; excluding this study, not all practitioners tape the same way.
6. Ankle bracing limited to McDavid lateral ankle brace.

Limitations

1. Sample size
2. Variability among participants
3. Use of particular taping, bracing techniques

Significance of the Study

By determining the possible effects of ankle support on football specific performance tests, Athletic Trainers and coaches may choose the method of which they will brace their athletes. Decisions will be made with knowledge of effect on performance, athlete perception, and institution cost instead of only the latter. We already know that ankle braces are the most cost efficient method of support. If we find that there is no significant effect on performance between either of the supported conditions, a better argument can be made for the use of the more cost and time efficient method.

CHAPTER 2

LITERATURE REVIEW

The purpose of this literature review is to discuss previous research on ankle stability as well as perceptions of taping and bracing through functionality and performance testing. The review will examine the prevalence of ankle injuries in athletics and football, preventative measures of ankle sprains, effects of ankle taping and bracing on performance, football specific testing that best measures performance, and athlete perceptions of ankle taping and bracing. The search strategy used for the review will also be discussed.

Search Strategies

The MEDLINE, CINAHL, SportsDiscus, Google Scholar, and Cochrane library databases were searched to obtain information using the keywords found in Table 1, singularly or combined. Additional information was obtained from references cited in the literature that was found.

Table 1. Terms Used for Database Search.

Ankle &	Football &	NCAA &	NFL &
bracing effects on	agility testing	ankle injuries	ankle injuries
performance	ankle injuries	injury prevalence	injury prevalence
injuries	combine testing	lower extremity	lower extremity

Table 1. Terms Used for Database Search.

Ankle &	Football &	NCAA &	NFL &
injury prevalence	injury prevalence	injuries	injuries
performance testing	Performance testing		
sprain management			
sprain prevention			
support methods			
taping methods			

Prevalence of Ankle Injuries in Football and Athletics

Due to the popularity and intense nature of many sports in today's athletic population, there are an increasing number of injuries being reported to sports medicine staffs.(1) Ankle sprains are the most commonly reported injury across collegiate sports, accounting for 15% of all injuries.(4) Approximately one sixth of all time loss injuries are ankle sprains, (5) which demonstrates the need for prevention. Over 27,000 ankle sprains were reported in all of collegiate athletics over a 16-year research period.(4)

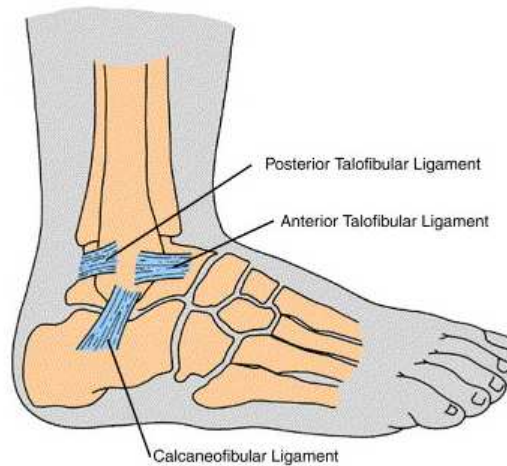
Sprains of the ankle joint complex occur at the talocrural and subtalar joints. Lateral ankle sprains account for 85% of ankle sprain injuries and occur when the ankle is forced into plantarflexion and supination or inversion.(5, 9, 12, 13) These movements cause stress to the lateral aspect of the ankle and inflict damage to the static connective tissue stabilizing the joint. The most common structures injured in these sprains are the static stabilizers seen in Figure 2 that comprise the lateral ankle complex (anterior talofibular ligament, calcanofibular ligament, and posterior tibiofibular ligament.)(4, 6, 14) Sprains to the ankle joint are the most common

musculoskeletal injury found among all athletes regardless of age or participation level.(10, 15)

Ankle injuries represent 45% of all athletic injuries in recreational activity.(2) Of these injuries,

85% are of the ankle sprain classification.(2, 6)

Figure 1. Lateral Ankle Complex



Considering the violent nature of football, it should come as no surprise that football is attributed with the highest injury rate among all sports, doubling that of the second leading injury prone sport.(1, 14) During two 16-year epidemiological studies of football injuries in the National Collegiate Athletic Association (NCAA), ankle sprains were the second most prevalent injury following knee sprains.(4, 14) The findings of injury rates through all levels of football resonate the same statistics, stating that 88% of ankle injuries are of the sprain variety.(1) As athletes progress through levels of competition, there is no decrease in ankle sprain occurrence. On the professional level, ankle sprains are the 4th most common injury.(3)

Preventative Measures of Ankle Sprains

Measures to decrease the rate and severity of ankle sprains have been practiced for many years. One method of supporting the ankle joint is from athletic tape, which uses a combination of adhesive spray, heel and lace pads to prevent friction blisters, pre-wrap, and the athletic tape itself. The main focus of this method or any external supportive measure is to reinforce the

lateral ankle complex.(4-7, 12, 16) The second method of external support is a pre-fabricated multi-material ankle brace. The brace laces up to ensure a tight fit around the foot with elastic straps that encompass the ankle in a way to add stability, especially to the lateral ankle complex.(4, 5, 8, 10, 12, 16-18) Other braces that have been included in past research include hard plastic stirrup style braces that use Velcro straps to stay in place.

Researchers have shown a proprioceptive benefit with the use of tape that has not been noticed with bracing.(2, 5, 7, 8, 16, 18) This proprioceptive benefit is attributed to heightening the sensitivity of a preventative feed-forward mechanism of the central nervous system in attempts to avoid ankle sprains by increasing muscle activation of the peroneal muscle group.(5, 7, 16, 18) It appears that the method of tape application, as styles tend to vary, shows little to no difference in effectiveness of sprain prevention.(15) Tape must rely on the presence of the secondary preventative measure as it loses its mechanical restrictiveness after twenty minutes of activity.(5, 7, 16) The structural integrity of an ankle brace has been shown to outlast that of ankle tape. Most rigid ankle braces lose approximately 4.5% of ankle support within a similar time frame, while the tape loses approximately 21%.(8) One advantage of ankle taping is the ability to individualize the tape application to fit the specific need rather than rely on the uniformity of an ankle brace. Active range of motion has shown limitations from style to style, but overall performance of the tape through activity has remained consistent.(15)

Although ankle tape has been found to lose some of its mechanical strength, the pre and post activity measurements still show that there is a level of increased restriction seen when compared to baseline range of motion measurements.(5, 7) Regardless of the method of support, both have been proven to decrease instance and severity of ankle sprains. External ankle support

has been shown to be more advantageous for individuals with a history of ankle injury.(4, 5) This can be attributed to the disruption of the static ankle stabilizers among other neurological and muscularly related damage.

Effects of Ankle Taping and Bracing on Performance

Ideally, providing external support to the ankle joint would not hinder the performance of the athlete.(6, 12, 15) There is conflicting evidence in regard to how ankle support alters performance. Some researchers have reported decreases in vertical jump height and increase in sprint and shuttle times braced, taped, and non-supported conditions while other researchers have reported no changes in performance for similar tests.(2, 5-8, 12) The vertical jump test exhibited the most common decreases in performance.(5-10) The style of ankle brace has an effect on variation in performance. McDavid braces (seen in Figure 3) have been shown to affect vertical jump height to a lesser degree than other braces in comparison.(8)

Figure 2. Lace-Up, Figure-8, Elastic Stir-Up Ankle Brace



While these results are inarguably varied, one result that remains consistent is that no condition has ever increased performance abilities.(5, 12) The limitations that external support put on dorsiflexion and plantarflexion appear to be the factor for the differences in performance that has been seen, but it appears to vary among the support style used.(5, 6)

Football Specific Testing that Best Measures Performance

The National Football League (NFL) holds a scouting combine every year to showcase the raw talent of athletes entering the upcoming NFL draft. There are a wide variety of tests that address areas of skill, speed, power, strength, and the knowledge required of an NFL athlete. There are 9 performance tests that include an intelligence quiz to gauge mental acuity, 40-yard dash (with split times taken at 10 and 20 yards), vertical jump, broad jump, 5-10-5 shuttle drill, 3 cone drill, and bench press.(11) These drills, coupled with collegiate performance, have been proven to effectively assess a particular player and to validate their positional rank in the NFL draft. Some results are more heavily weighted than others in terms of position specific tasks, but all are regarded as the best way to evaluate the potential talent of each player.

Grouping performance scores of these tests in the correct combination, dependent on the position played by the athlete, allows for success in the NFL to be estimated.(11) Relationships and equations have been determined to do just that. For example, the vertical jump scores have been more closely correlated with success at the running back position as compared to the bench press test which had little to no bearing on success at the position.(11) These tests are designed to show the physical ability to perform at a high intensity. They have not been shown to effectively measure success in the NFL.(11) There are intangibles that simply cannot be measured that are an absolute necessity for success. These skills do, however, accurately demonstrate required abilities that football players of any age or level need to possess to be effective on the field.

Perceptions from the Athlete

There has been a documented effect from perception by the athlete from the act of simply wearing the ankle brace or tape. Many athletes believe that wearing ankle braces restricts their

athletic performance,(5) while others believe that it increases perceptions of stability and confidence which in turn will increase their ability to perform.(2) These perceptions could influence the choice in support, choosing the most comfortable option versus the most supportive. In comparing comfort levels between the two conditions, it appears that more athletes prefer the feel of an ankle brace to that of athletic tape.(9, 12) In contrast, clinicians believe that the manner of which tape is applied allows for an increased comfort level felt by the athlete.(15)

Summary

Considering the injury rates and patterns within the NFL and NCAA, the need for studies of this nature is overdue. By creating a NFL-like testing environment in which participants test under 3 conditions for between condition comparisons in performance, the question of potential performance effects of various external support methods will be answered. With current results of effects remaining conflicted throughout research, the hope is that further insight will be found. With respect to an athlete's preference on support method, the perception questionnaire will further inspect if preference is indeed as divided as research shows. Beyond this, participants are encouraged to provide information as to why their preference may be swayed. This additional information could influence brace design or possibly taping strategies for future research targets as well as sway external support practices in the clinical setting.

CHAPTER 3

METHODS

Design

A mixed-methods, randomized crossover experimental and interview design will be used to guide this study. The independent variable is ankle support, with three levels (no support, ankle tape, and ankle brace). The dependent variables include the outcomes of the following performance test: 40-yard dash, vertical jump, broad jump, 5-10-5 shuttle, cone drill, and performance perception questionnaire. We will use interview to supplement the quantitative data acquired during the athletic testing.

Participants

Sixty eligible, uninjured, college-aged football athletes will be recruited for this study. These participants will be members of Indiana State University's varsity football program and will be present during the normal voluntary summer conditioning program. Each participant will provide informed consent prior to data collection. Participant will be excluded if they report any injury within the previous six months leading up to data collection, if they are unable to perform any of the football performance tests, or if they become injured during the period of testing. This study will meet the Indiana State University's Institutional Review Board approval criteria.

Instruments

Brower Speed Trap II

The Brower Speed Trap II timing system will be used to measure the total times with the use of stop watches to account for split times at 10 and 20 yards. This same wireless system will be used for the 5-10-5 and 3-cone agility tests. There will be no split time measurements with the agility tests. There will be stopwatches used as a backup to the wireless timing system as well as for the split times recorded. Both the stopwatches and timing system have specificity to the hundredth of seconds.

Standard Tape Measure

Standard tape measure will be used for measurement of the broad jump test. Distance on the broad jump will be measured from the starting point of the jump to the landing heel strike nearest to the starting position. The same tape measure will be used to set up the cones in the 3-cone agility test. Measurements will be taken to the nearest ½ inch.

Vertec

Vertec measuring system will be used to measure vertical jump height. The parameters will be set to the tallest participant and adjusted if necessary for participants unable to register a score at that height. The Vertec measures in inches and has increments of one half inch.

Perception Questionnaire

The perception questionnaire (Table 2) will be used after the final two days of performance testing. Participants will compare their supported performances to their unsupported condition. A 3-point Likert scale will be used to dictate whether the athlete felt there was a decrease in performance, no effect on performance, or an increase in performance.

Table 2. Perception Questionnaire

Please fill out as accurately as possible with an “X” in the appropriate box.

ID#

Circle which condition you were placed in today: TAPED or BRACED

Compared to **NO TAPING/BRACING** how do feel your condition affected your performance of each listed test

	Decreased	No effect	Increased
40 yard dash			
Vertical Jump			
Broad Jump			
5-10-5			
3-cone			

Comfort Questionnaire

The comfort questionnaire is a brief two part question asking the participant to decide which condition was most comfortable to them and why. This questionnaire will be filled out after the final day of testing only.

Interview

Interview will be used to supplement the perception and comfort questionnaires. Notes will be taken at interviews. These notes will be transcribed and integrated into the results aligned with the specific combine tests. The interview questions are detailed in Appendix A.

Procedures

There will be one screening session and three testing sessions at least one week apart. The screening session will take place in the athletics weight room at least one week prior to the first test date. This will include informed consent, demographic survey (including age, height, weight, football position, health history questionnaire, and injury history of the past six months), and familiarization session (conducted by the Indiana State University Head Strength and Conditioning coach). The participants will be given an ID number and organized into groups to allow for assignments to be made regarding condition and testing order. This is to account for randomization.

For data collection days two and three, each participant will report to Memorial Stadium approximately ninety minutes prior to testing. Ninety minutes will allow for sufficient preparation, warm-up, and application of external ankle support. Each athlete shall be dressed in athletic shorts, t-shirt, and football cleats. The Head Strength and Conditioning coach will lead the warm-up. Water and Gatorade will be available for all participants throughout testing to ensure proper hydration is maintained.

The first day of data collection for all participants will be completed without external ankle support. Participants will be equally divided into 5 groups and instructed on the order of testing for this day. The group they are placed in will be the group they remain with for all three days of data collection. The testing order will be random for each group of participants. Each group will complete all five of the football specific performance tests (40-yard dash, vertical jump, broad jump, 5-10-5 agility test, and 3-cone test) on each of the 3 testing days.

On the second day of testing, the participants will be divided in half. One half will

complete this day of testing in the braced condition while the other half completes the testing in the taped condition. The tape will be applied upon arrival to the facility by one of the three ATC's conducting this study. The half that will be completing the testing in the braced condition will be given braces and instructions on application at this time as well. The participants will be instructed of the order that their group will complete testing on this day. Upon completion of each of the testing days, the participants will have their tape removed and the ankle braces will be collected. At the completion of on the field data collection, the participants will complete the perception questionnaire.

On the third and final day of testing, the groups will participate in the opposite form of external ankle support from which they were placed in during the previous testing day. Those that were braced will be taped and vice versa for the collection of data. The tape will be applied upon arrival to the facility by one of the three ATC's conducting this study. The participants will be instructed of the order that their group will complete testing on this day. Upon completion of the testing day, the participants will complete the perception questionnaire. On this final day, an additional questionnaire will be given out to address the question of which condition is most comfortable to the participant.

Participants will be given instruction as to how the testing will take place. Once at a testing station, each participant will complete three valid trials of the test. If in the first three attempts there is an invalid repetition, the participant will perform up to two additional repetitions until three valid scores are recorded. The participants will be given two full minutes of recovery time in between repetitions and also between tests to account for fatigue. Adequate hydration supplies including water and Gatorade will be present at each station and therefore

available to the participants.

Following the data collection sessions, each participant will be interviewed regarding participation.

Performance Tests

40-Yard Dash

The 40-yard dash will use a track style starting position and time will begin upon their hand picking up from the turf. There will be timers positioned at the ten and twenty-yard markers to measure split times with stop watches. The total time will be measure with a wireless timing device. These measures will be recorded in seconds. Additionally, we will also have stop watches to back up the timing system if it were to fail during testing. The fastest recorded time for each condition will be used in the data analysis.

Vertical Jump

The vertical jump will use a two-legged stance. Participants will be instructed to stand with their feet at shoulder width and will be allowed an arm swing counter movement with jump attempts. Once a jump is completed, the height is scored and the Vertec is reset. These measures will be recorded in inches. The highest jump height will be used for data analysis for each condition.

Broad Jump

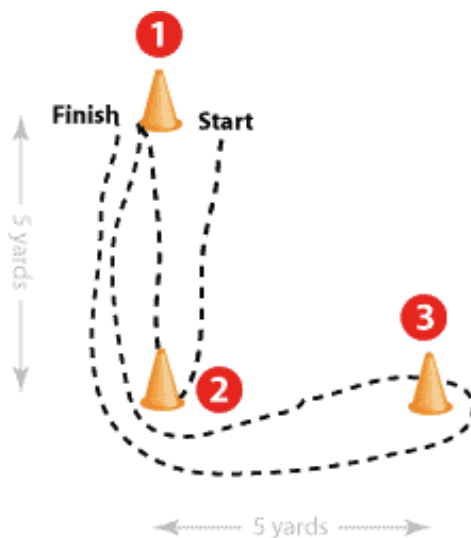
The broad jump will use a two-legged stance. Participants will be instructed to stand with their feet at shoulder width and will be allowed an arm swing counter movement with jump attempts. There will be a spotter to ensure the participant does not cross the starting line as well as a spotter to mark the heel strike closest to the starting point. A measuring tape will be used to

measure the distance from starting line to closest heel strike. These measures will be recorded in inches. The longest jump distance will be used for data analysis for each condition.

3-Cone Agility Test

The 3-Cone Agility Test (Figure 3) will use a track style starting position and time will begin upon their hand picking up from the turf. There will be a spotter present to ensure that the proper course was taken through this test. The total time will be measured with a wireless timing device with stopwatches being used as a back up. These measures will be recorded in seconds. The fastest recorded time for each condition will be used in the data analysis.

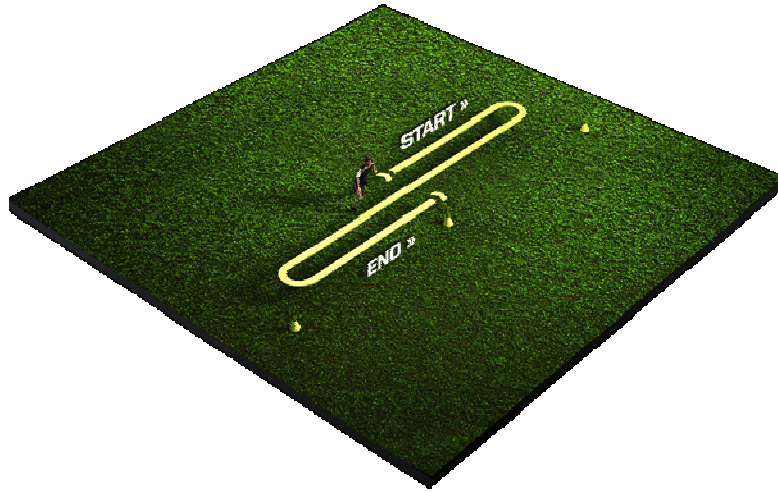
Figure 3. 3-Cone Test



5-10-5 Agility Test

The 5-10-5 Agility Test (Figure 4) will use a track style starting position and time will begin upon their hand picking up from the turf. There will be a spotter present to ensure that the proper course was taken through this test. The total time will be measured with a wireless timing device with stopwatches being used as a back up. These measures will be recorded in seconds. The fastest recorded time for each condition will be used in the data analysis.

Figure 4. 5-10-5 Shuttle Test



Perception Questionnaire

The perception questionnaire will be used to determine participant's perception of how tape or bracing affected their performance when compared to the unsupported condition. Participants will not be told of their test results until the study has concluded in an attempt to not skew the perception questionnaire. This questionnaire will be filled out following the latter two days of testing only.

Data and Statistical Analyses

Data will be analyzed using descriptive statistics (mean, SD) using SPSS. Interview data will be transcribed and integrated into the results to supplement the quantitative data.

CHAPTER 4
MANUSCRIPT
Introduction

American style football is a popular sport in youth, high schools, colleges, recreationally, as well as professionally.(1) Ankle injuries account for approximately 45% of all recreational sport related injuries.(2) In the NFL, ankle sprains are the 4th most prevalent injury,(3) while they account for the 2nd most reported injury within NCAA football athletes.(4)

Many athletic programs require their football players to wear ankle braces or tape their ankles to help prevent or decrease the severity of ankle injuries.(5-7) The effects of external support on range of motion, performance, comfort and cost must be considered when determining which method to use. In addition, an athlete may perceive that taping or bracing will decrease his or her performance.(2, 5-8) Researchers have reported that ankle braces negatively affect the results of vertical jump height while differences in other performance style outcomes were insignificant.(5-10) Additionally, athletes choose to play without support due to comfort and a perception that their performance will decrease if they have external support.(5)

An athlete is less likely to wear protective equipment if they perceive it is going to affect their performance. Due to the athletes' perception that athletic performance may be affected, we must measure performance with external ankle support applied and the athletes' perception of the support on their performance. The NFL assesses athletic performance using

quantifiable tests for power, speed, and agility. (11) Many NFL teams use this data to determine the athlete's potential to on-field performance as a NFL player.(11) The purpose of this study was to examine the effect of ankle braces and taping on performance in football specific testing and compare their perception to their performance relative to no support using questionnaires and interviews.

Methods

Design

A mixed-methods, randomized crossover experimental and interview design was used to guide this study. The independent variable was ankle support, with levels (no support, ankle tape, and ankle brace). The dependent variables were the outcomes of the following performance test: 40-yard dash, vertical jump, broad jump, 5-10-5 shuttle, cone drill, and performance perception questionnaire. Additionally, we used interview answers to supplement the perception questionnaire data acquired during the performance testing.

Participants

Five male collegiate football players volunteered for the study, but only three players (age=21+/-2 years; height=75.5+/-1.5 inches; weight=252.5+/-27.5 pounds) completed all three conditions. One participant was removed from data collection due to an illness and one was removed due to an injury, which was evaluated and treated. The participants were members in good standing with the Indiana State University varsity football team. Each participant provided informed consent prior to data collection. Participants were excluded if they reported any injury within the previous six months leading up to data collection, if they were unable to perform any

of the football performance tests, or if they became injured/ill during the period of testing. This study was approved by the Indiana State University's Institutional Review Board.

Instruments

Brower Speed Trap II

The Brower Speed Trap II timing system was used to measure the total time for the 40-yard dash with the use of stop watches to account for split times at 10 and 20 yards. Stopwatches were used to time the agility tests in similar fashion to the method used by the NFL. Both the stopwatches and timing system have specificity to the hundredth of seconds.

Standard Tape Measure

Standard tape measure was used for measurement of the broad jump test. Distance on the broad jump was measured from the starting point of the jump to the landing heel strike nearest to the starting position.. Measurements were taken to the nearest ½ inch.

Vertec

A Vertec measuring system was used to measure vertical jump height. The parameters were set to the tallest participant and adjusted if necessary for participants unable to register a score at that height. The Vertec measures in inches and has increments of one half inch. The participants reach height was subtracted from the recorded Vertec jump height

Perception Questionnaire

The perception questionnaire (Table 2) was used after the end of each of the last two days of performance testing. Participants compared their supported performances to their unsupported condition. A 3-point Likert scale was used to dictate whether the athlete felt there was a decrease in performance, no effect on performance, or an increase in performance for each performance

test.

Comfort Questionnaire

The comfort questionnaire is a brief two part question and asked the participant to decide which condition was most comfortable to them and why. This questionnaire was filled out after the final day of testing only (Table 3).

Table 3. Comfort Questionnaire

Please fill out as accurately as possible with an “X” in the appropriate box.

ID#

Circle which condition you were placed in today: NAKED TAPED BRACED

Perception Questionnaire:

How do you feel the condition affected your performance in each of the tests. Please check only one box per performance test with an **X**.

	Significantly Decreased	Decreased	No Effect	Increased	Significantly Increased
40 Yard Dash					
Vertical Jump					
Broad Jump					
3-Cone Test					
5-10-5 Test					

Comfort Questionnaire:

How **comfortable** were you during the testing today. Please check the appropriate box with an **X**

Very Uncomfortable	Not Comfortable	Neutral	Comfortable	Very Comfortable
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In one sentence or less, please provide a brief explanation as to why.

Which of the following was your MOST preferred method? (Circle one.)*

No Support

Ankle Tape

Ankle Brace

Interview

Interview was used to supplement the perception and comfort questionnaires. Notes were taken at interviews. These notes were transcribed and integrated into the results aligned with the specific combine tests. The interview questions are detailed in Appendix A.

Procedures

There was one recruitment/screening session and three testing sessions at least one day apart. The recruitment/screening session took place in the Neurological Laboratory on the first floor of the Student Services building prior to the first test date. The study was presented to the football team (n=65) and they were asked to complete the informed consent and questionnaire, which included a demographic survey (including age, height, weight, football position, pertinent health history, and injury history of the past six months). The participants were given an ID number and organized into just one group due to the small number of willing participants (n=5).

Each participant reported to Memorial Stadium approximately thirty minutes prior to testing for each data collection day. This time allowed for sufficient preparation, warm-up, and application of external ankle support. Each athlete dressed in athletic shorts, t-shirt, and team issued football cleats. The Head Strength and Conditioning coach led the same warm-up each session. Water and Gatorade were available for all participants throughout testing to ensure that proper hydration was maintained.

For the first day all data collection was completed without external ankle support. Each group completed all five of the football specific performance tests in the following order vertical

jump, broad jump, 5-10-5 agility test, 3-cone test, and 40-yard dash on each of the 3 testing days.

On the second day of testing, all of the participants were supported with ankle tape. The tape was applied upon arrival to the facility by only the primary investigator conducting this study using a modified basket weave to ensure identical application. Upon completion of each of the testing the participants had their tape removed and asked to complete the perception questionnaire.

On the third and final day of testing, the groups completed participation of the events in 2 separate braced conditions. One brace used was a circumferential lace up ankle brace (McDavid, Woodridge IL) and the other was a hinged brace (UltraAnkle; Zionsville IN). The participants completed the tests in the lace up brace initially with the hinged brace being applied following completion of the first test set in the braced condition. Keeping up with the manufacturers recommendation, the UltraAnkle braces were tightened after each test. Upon completion of the testing day, the participants completed the perception questionnaire as previously mentioned. In addition to the perception questionnaire, an additional questionnaire was given out to address the question of which condition is most comfortable to the participant when considering each of the conditions.

Participants were given instruction as to how the tests were administered by the strength and conditioning coach. Each participant completed three valid trials of each test. If there was an invalid repetition, the participant performed up to two additional repetitions. The test was not continued beyond these five maximal attempts and only valid repetition scores would have been kept. In this case, only one extra trial was needed across all three testing days. The participants were given two full minutes of recovery time between repetitions and also between tests to

account for fatigue. Adequate hydration supplies including water and Gatorade were present at each station and therefore available to the participants at all times during recovery periods.

Following the data collection sessions, each participant was interviewed further regarding participation.

Performance Tests

40-Yard Dash

The 40-yard dash uses a track style starting position and time began upon the action of their hand picking up from the turf. There were timers positioned at the ten and twenty-yard markers to measure split times with stop watches. The total time was measured with a wireless timing device. These timing measures were recorded in seconds. The average of the recorded times for each condition was used in the data analysis.

Vertical Jump

The vertical jump uses a two-legged stance. Participants were instructed to stand with their feet at shoulder width and were allowed an arm swing counter movement with jump attempts. Once a jump was completed, the height was recorded and the Vertec was reset. These measures were recorded in inches. The average jump height was used for data analysis for each condition.

Broad Jump

The broad jump uses a two-legged stance. Participants were instructed to stand with their feet at shoulder width and were allowed an arm swing counter movement with jump attempts. There was a spotter to ensure the participant did not cross the starting line as well as a spotter to mark the heel strike closest to the starting point. A measuring tape was used to measure the distance from starting line to closest heel strike. These measures were recorded in inches. The

average of the jump distances were used for data analysis for each condition.

3-Cone Agility Test

The 3-Cone Agility Test (Figure 3) uses a track style starting position and time began upon their hand picking up from the turf. There was a spotter present to ensure that the proper course was taken through this test. The total time was measured with a wireless timing device. These measures were recorded in seconds. The average of the recorded times for each condition were used in the data analysis.

5-10-5 Agility Test

The 5-10-5 Agility Test (Figure 4) uses a track style starting position with the time beginning upon their hand picking up from the turf. There was a spotter present to ensure that the proper course was taken through this test. The total time was measured with a wireless timing device with stopwatches used as a back up. These measures were recorded in seconds. The average of the recorded times for each condition were used in the data analysis.

Perception Questionnaire

The perception questionnaire was used to determine participant's perception of how tape or bracing affected their performance when compared to the unsupported condition. Participants were not told of their test results until the study had concluded in an attempt to not skew the information obtained in the perception questionnaire. This questionnaire was filled out following the latter two days of testing only.

Data and Statistical Analyses

Data was analyzed using descriptive statistics (mean, SD) using SPSS. Interview data was transcribed and integrated into the results to supplement the quantitative data.

Results

Each participant completed each test and reported their perceptions and comfort (Tables 3-5). Data suggests that no differences exist between conditions (Table 6). However, we were able to ascertain that the participants reported being more comfortable in the taped condition (Table 7). Participants also claimed that no support was preferred if given the option to participate without external ankle support.

Table 4. Participant One. Mean \pm SD of the trials for each condition.

Test	Unsupported	Taped	McDavid	UltraAnkle
40 yard dash (seconds)	5.47 \pm 0.13	5.52 \pm 0.05	5.58 \pm 0.10	5.61 \pm 0.06
Vertical Jump (inches)	21.12 \pm 1.76	19.79 \pm 1.53	20.83 \pm 0.29	21.15 \pm 1.04
Broad Jump (inches)	84.99 \pm 1.73	90.14 \pm 2.57	85.98 \pm 2.83	88.46 \pm 3.54
5-10-5 (seconds)	4.67 \pm 0.22	4.71 \pm 0.01	4.71 \pm 0.02	4.87 \pm 0.16
3-cone (seconds)	7.99 \pm 0.08	8.02 \pm 0.12	8.05 \pm 0.11	8.19 \pm 0.04

Note: 3 trials were recorded for the unsupported and taped conditions, 2 trials were recorded for the braced conditions.

Table 5. Participant Two. Mean \pm SD of the 3 trials for each condition.

Test	Unsupported	Taped	McDavid	UltraAnkle
40 yard dash (seconds)	5.36 \pm 0.09	5.53 \pm 0.08	5.60 \pm 0.05	5.64 \pm 0.01
Vertical Jump (inches)	22.0 \pm 0.00	20.5 \pm 0.00	21.66 \pm 0.76	20.49 \pm 0.87
Broad Jump (inches)	89.16 \pm 0.76	88.99 \pm 1.32	87.98 \pm 2.83	90.49 \pm 2.12
5-10-5 (seconds)	4.95 \pm 0.03	4.94 \pm 0.03	5.11 \pm 0.08	5.04 \pm 0.04
3-cone (seconds)	7.89 \pm 0.10	8.12 \pm 0.05	8.17 \pm 0.04	8.21 \pm 0.08

Note: 3 trials were recorded for the unsupported and taped conditions, 2 trials were recorded for the braced conditions.

Table 6. Participant Three. Mean \pm SD of the 3 trials for each condition.

Test	Unsupported	Taped	McDavid	UltraAnkle
40 yard dash (seconds)	4.99 \pm 0.12	5.01 \pm 0.03	5.05 \pm 0.02	5.13 \pm 0.08
Vertical Jump (inches)	29.80 \pm 1.61	29.64 \pm 1.44	29.16 \pm 0.58	28.47 \pm 1.05
Broad Jump (inches)	108.50 \pm 1.00	111.75 \pm 5.11	111.74 \pm 1.77	109.96 \pm 4.24
5-10-5 (seconds)	4.52 \pm 0.18	4.45 \pm 0.08	4.47 \pm 0.05	4.46 \pm 0.01

Test	Unsupported	Taped	McDavid	UltraAnkle
3-cone (seconds)	7.16±0.07	7.14±0.16	7.08±0.16	7.14±0.10

Table 7. Combined data for all 3 participants (Mean).

Test	Unsupported	Taped	McDavid	UltraAnkle
40 yard dash (seconds)	5.27	5.35	5.41	5.46
Vertical Jump (inches)	24.01	22.91	23.88	23.73
Broad Jump (inches)	93.68	96.42	94.55	95.84
5-10-5 (seconds)	4.71	4.69	4.76	4.79
3-cone (seconds)	7.67	7.44	7.75	7.83

Note: 3 trials were recorded for the unsupported and taped conditions, 2 trials were recorded for the braced conditions.

Discussion

Injuries in football are an accepted reality by all participants (1, 3, 4, 14, 16). One of the roles of Athletic Trainers is to limit the prevalence and severity of these injuries by utilizing the best-proven methods(2, 5-10, 12, 15-18). We studied the effect of external support on

performance and the perceived effect of the external support on performance, while other researchers have focused on the material or strength of the external support. Previous studies on performance and external ankle support show minimal effects that findings are deemed insignificant(5, 7-10, 12, 13, 15, 17, 18). The researchers involved in this study understand that a statistical difference may be drastically different than a true on the field football difference. One extra inch on a vertical jump, one tenth of a second fewer on a 40-yard dash, and other seemingly miniscule performance score differences that we saw may be the difference of a touchdown or turnover. This remains one of the differences between controlled research and real life athletics. Limited by the small number of participants, it is once again difficult to make a broad statement regarding our conditions. Other studies that focused on athletes' perception found that while athletes often choose whichever support method they're most familiar with or is comfortable for their specific sport, the most frequent choice was ankle tape(6, 9, 10, 17). Our findings regarding comfort echo this message from previous researchers.

As suspected, even with our low participant number (n=3), we saw very small differences between in scores throughout the 5 performance tests across conditions. We were unable to discern a pattern between conditions suggesting that the support conditions had little to do with the change in result. The change could be due to the mental component or perception that an external support would affect performance. As athletes feel more restricted in certain motions and movements, it can be theorized that self-doubt may limit true maximal effort. Previous studies mention that lack in range of motion could restrict the ability to maximally contract musculature through the full range required for maximal performance(5-10, 12, 15-18). The questionnaires and interview sessions we implemented were aimed at discovering these possible-

underlying factors. One factor we must keep in mind when comparing the braced conditions is that these two different braces were tested on the same day. Even when considering that an adequate resting period was mandated, there could have been a fatigue factor associated with the UltraAnkle brace as it was tested second on the third day of collection. This could have been reflected in scores as well as perception as the common theme of heavy feeling legs could have been exacerbated. Ideally we would have balanced the treatments by taping two participants on Day 2 and having 1 in a brace and then 2 in braces day 3 and 1 taped. This would have helped prevent a possible order affect. Additionally, when we had 2 participants braced on the same day we could have had each participant start with a different brace and then switch.

As indicated by the responses we received, all 3 of the participants stated that they all feel most comfortable in the condition they most commonly participated throughout their football career. Two participants felt more comfortable supported because they were introduced to bracing or taping early in their athletic career for prevention or due to injuries they sustained while playing. One of our participants felt more comfortable without support simply because he had not been taped or braced prior to this study.

What if we had 65 participants?

If we had the intended number of participants ($n=65$), the study design would have changed slightly. The first day of data collection would have taken place in an unsupported condition for the entirety of the group to allow for comparison to this unsupported condition throughout the questionnaires. In an attempt to avoid taping all of the participants on the same day, the external support conditions would have been split between testing days two and three. Half of the participant on day two would have been taped while the other half would have been

given McDavid ankle braces to wear. Day three would have placed the braced group from day two in ankle tape while the braced group from day two would have been given the UltraAnkle braces to wear for day three. A second slight change would have occurred with the statistical component of analysis. Rather than looking at descriptive statistics alone, we would have used a 4x5 repeated measures ANOVA to allow for comparisons between the four conditions throughout each of the five football specific performance tests. Additionally, we would have made a random selection of 10 participants to interview about the conditions rather than interviewing each individual as we did with the 3 participants we had.

Clinical Relevance

If we let football players make medical choices based on what they perceived was best for their performance versus what will best prevent injuries, injury rates would consequently increase. In reality, participating in football without ankle support is simply not an option for football players at higher levels of competition. Given the benefits of such support on preventing or decreasing the severity ankle injuries, using mechanical (braced) or proprioceptive (ankle tape) methods are far safer than wearing no support at all. Literature suggests that the taping and bracing provided roughly the same level of protection against ankle injury. This statement certainly has its flaws, as there are a large variety of ankle braces and taping methods that will have different effects on performance. The specific braces and type style used in this study have been shown to have the best preventative results(6, 8-10, 16, 17).

Finding a way to support the ankle in the most cost effective way is the goal for every sports medicine team while at the same time trying to affect the psyche of the athlete the least. Athlete education is vital to a positively received change from the “norm”, although any change

is guaranteed to cause issues. More studies like this aimed at addressing the comfort while maintaining the braces protective nature and limited affect on performance are essential to developing a universally accepted brace. It will be near impossible to find a method, whether it be taped or braced, that all football players will embrace. As the cost of athletic tape continues to rise and it becomes more cost effective to purchase ankle braces, research in this area may become more desired. One suggestion that developed during the interview portion of our study was perhaps there isn't one true ankle brace for all football players. Instead of trying to create one universal brace for all football athletes, maybe we should consider the possibility of a position-specific brace. It is easy to understand that certain football positions demand very specific movements and range of motion freedoms while others need to be as limiting and supportive as possible. It would be interesting to see different braces offered that were tailored towards specific target users whether that be within or between sports.

Table 8. Perception and Comfort Data.

Test	Conditions											
	Unsupported *			Taped **			McDavid Brace			UltraAnkle Brace		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
40 yard dash	N/A	N/A	N/A	Dec	Dec	Sig Dec	None	None	Dec	None	Dec	Dec
Vertical Jump	N/A	N/A	N/A	Dec	Dec	None	None	Dec	Dec	None	Dec	Dec
Broad Jump	N/A	N/A	N/A	Dec	None	Inc	Dec	None	None	Inc	Dec	Dec
5-10-5	N/A	N/A	N/A	Dec	None	None	Dec	Dec	None	Inc	Dec	None
3-cone	N/A	N/A	N/A	Dec	None	Inc	None	Dec	None	Inc	Dec	None

Note: Participants #1, #2, and #3 were all asked to indicate perceived effect on performance that each condition may have produced based on the unsupported condition. The response options for response were: Significantly increased (sig inc), increase (inc), no effect (none), decrease (dec), and significantly decrease (sig dec). “*” indicates which condition the participants deemed as most comfortable through the testing.

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APPENDIX A: Interview Questions

1. Can you describe any previous lower extremity injury that may have affected your participation in football?
 - a. Were these injuries long lasting? How did they affect your play? Were you more apprehensive/nervous about playing after the injury?
 - b. Did you wear a brace or tape your injury after it happened? How did that affect your play?
2. Which condition did you prefer during our combine testing? Why? Were any of the conditions uncomfortable? Please elaborate/describe.
3. If you had to choose one off the conditions, what would it be? Why?
4. Can you describe the brace condition to me? Did you feel stable? Why do you think?
5. Were there any other factors/conditions that may have impacted your performance during the testing conditions?