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COMPARATIVE STUDY OF COMPETITIVE ANKLE SUPPORTS AND THEIR EFFECTS ON BALANCE AND FUNCTIONAL PERFORMANCE

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ABSTRACT

The purpose of this research study was to investigate the effects of two comparative ankle supports and their effect on dynamic and static postural control. Lower extremity dynamic balance was measured using the anterior, posterolateral and posteromedial directions of the Star Excursion Balance Test (SEBT). Static balance was measured using a quiet single-leg balance test on a force platform. Each participant was tested under three conditions: without ankle brace, wearing the ProTaco ankle brace manufactured by Topical Gear LLC (Lakeway, Texas) and wearing a semi-rigid lace-up DonJoy ankle brace, manufactured by DJO Global (St. Vista, California). Results from the dynamic balance measurements showed no statistically significant differences in reach for any of the three directions (anterior ($P = 0.560$), posterolateral ($P = 0.877$), or posteromedial ($P = 0.790$)) between ankle bracing conditions. Results from the static balance measurements also showed no statistically significant differences ($P = 0.728$) between ankle bracing conditions. Conclusion: The ankle braces utilized in this study did not impair or enhance performance in dynamic or static balance tests.

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Chapter 1

Introduction

The enhancement of joint stability by means of external supports, such as braces and taping has been a highly controversial topic in the sports medicine. [1] Researchers tested numerous makes and models of ankle and knee supports to assess their comparable ability to prevent injury or re-injury of these joints in a wide variety of sporting activities. Ankle injuries are the most common injuries associated with sports participation.[1] Athletes who suffer from ankle sprains are more likely to reinjure the same ankle which can result in disability and can lead to chronic pain and/or instability in 20% to 50% of these cases.[1] Volleyball is a noncontact sport with a high incidence of ankle sprains.[1] Taping and bracing also appear to be effective in preventing ankle sprains in athletes[4] when compared to un-braced or taped athletic participation. Ankle supports are commonly used in volleyball to prevent ankle injury and time loss from the sport. Mechanical stabilization of the ankle joint and facilitated proprioceptive activity of the peroneal tendons are hypothesized mechanisms by which ankle supports prevent injury. Previous research findings suggest that the prophylactic use of semi-rigid and lace-up style ankle braces does not disrupt the ability to maintain dynamic balance in healthy individuals and is most likely to improve dynamic and single-legged quiet stance balance. [3]

The purpose of this research study was to compare the effects of two different ankle supports and their effects on dynamic and static postural control. The two ankle supports that were studied are the ProTaco manufactured by Topical Gear LLC (Lakeway, Texas) and a semi-rigid lace-up, DonJoy ankle brace manufactured by DJO Global (St. Vista, California). The ProTaco is marketed as a lightweight functional ankle support with compressive structures focal to the peroneal tendons, which is proposed to facilitate proprioceptive activity of the ankle evertors

lending to enhanced joint stability. The DonJoy ankle brace is a bulkier, more traditional lace-up ankle brace that is designed to stabilize the joint through rigid external supports that restrain inversion.[2] Currently, there are no known research studies comparing the postural control profiles of each ankle support.

We hypothesize that braced conditions may demonstrate improved dynamic and static postural control responses compared to an un-braced condition. We are interested in revealing any differences in postural control responses between the ProTaco and the semirigid DonJoy ankle braces, but previous research does not provide the basis for a directional hypothesis regarding these potential differences.

Chapter 2

Materials and Methods

Experimental Design:

A comparative study design was used for this investigation. The independent variable was the braced-condition of the ankle (un-braced, ProTaco ankle brace and DonJoy ankle brace). The dependent variables included static balance measured by center of pressure path length using a force platform during a quiet single-legged balance task and dynamic balance measured by normalized reach distance (%LL) in the anterior, posterolateral and posteromedial directions of the Star Excursion Balance Test (SEBT).

Dependent variable measures were acquired for each participant under each of the independent variable conditions. Order of braced condition testing was randomly assigned based upon randomization permutations generated by statistical software (Minitab 16, State College, PA) to prevent order effects. For the case of this study, only the dominant legs were tested for static and dynamic postural control.

Participants:

The participants in this experiment were young, healthy and physically-active adults that participated in university competitive club volleyball. Eighteen participants (9 male, 9 female) from the ages of 18-22 were tested. To be included in the study, all participants were required to be in good physical health, an active member of the men's or woman's Penn State Club Volleyball team, and have had no injury to the lower extremities in the past 6 months. All participants were required to read and sign an informed consent form approved by the Institutional Review Board at Penn State.

Star Excursion Balance Test

The Star Excursion Balance Test is a functional screening tool that measures lower extremity reach while challenging the associated limitations of joint stability and postural control. The goal of the modified SEBT used in this investigation is to reach as far as possible with the non-stance leg in each of the three directions (anterior, posteromedial, posterolateral) while maintaining balance upon the opposite stance-leg. The stance leg requires ample ankle, knee, and hip ranges of motion as well as adequate strength and neuromuscular control to perform such tasks.[5] The SEBT is a reliable test that has been shown to be a valid method of identifying individuals with chronic ankle instability.[5, 6, 7,8]

The Star Excursion Balance Test is performed with the participant standing at the center of an outlined floor grid with eight lines extending at 45^{o} angles from the center of the grid. The lines positioned on the grid are labeled according to the direction of excursion relative to the stance leg. The grid is constructed in an area using a protractor and 3 in (7.62 cm)-wide adhesive tape enclosed in a 182.9 cm by 182.9 cm square on a hard bare floor. A verbal and visual demonstration of the testing procedure was given to each participant by the investigators. Each participant performed three practice trials in a prescribed direction with 15 seconds between each trial. After a one minute rest period, three measured trials were performed with 15 second rest periods between each trial. To perform the reach task, the participant maintained a single-legged stance on the dominant leg while reaching with the non-stance leg as far as possible along the appropriate direction (Fig. 2-1). While keeping their hands on their hips to control for countermovement, the participant contacted the furthest point possible on the line with a toe-touch using minimal pressure in order to ensure that stability was achieved through balance. The participant was asked to place their toes on the center line of the grid for the anterior reach or

heel on the center line for the posterior reach tasks. The participant was instructed to assume the "ready position" with hands on hips and the reach-leg lifted off the ground. On a "go" command from the investigator, the participant reached as far as they could with the reach-leg and lightly taped the grid. At no time were verbal cues or communication of encouragement directed to participants performing while performing the test. Trials were discarded and repeated if a participant did not touch the line with the non-stance leg while maintaining weight bearing on the stance leg, lifted the stance foot from the center grid, lost balance at any point in the trial did not maintain initial and return positions for one full second, hands came off hips or touched down with the reach leg in a way that caused the reach leg to considerably support the body. The point of furthest reach of the great toe was manually marked on the floor grid by a researcher. For the anterior reach direction, an investigator manually measured the distance from the toes of the stance foot to the touch point with a tape measure in centimeters. For the posterior reach directions, the investigator manually measured the distance from the heel of the stance foot to the touch point of the reach foot with a tape measure in centimeters. The same investigator took all reach measurements. Reach distance was measured within 1 millimeter of precision. Reach distances were normalized to non-stance leg length (cm) and expressed as percentages to permit a standardized comparison among participants. The average of the three reaches in each of the three directions was calculated. The order of reach excursions performed were randomized using statistical software (Minitab 16, State College, PA) to control for learning as well as order effects.

Figure 2-1: Posterolateral Reach of SEBT.

Quiet Single-leg Balance Task

Center of pressure data collected during a quiet stance single-legged balance task has been commonly used as a reliable and valid measure of postural control in prior studies of chronic ankle instability.[10, 11]

The goal of the quiet stance single-legged balance task was to stand barefoot on the dominant leg while maintaining balance for a ten second period. Trials were conducted with eyes open. The stance foot was placed in the same position for each trial and was precisely positioned on the force platform (AccuSway force platform (AMTI Corp., Watertown, MA).[9] The participant was instructed to stand as still as possible with their hands stabilized on their hips while keeping the non-stance hip flexed to 30 degrees and knee flexed to 45 degrees without touching the stance leg (Fig. 2-2). During the trial the participant was asked to focus on a reference point placed 10 feet in front of the force platform at eye level. If the participant touched the ground or the other leg with the non-stance foot during the trial, the trial was discarded and repeated. Three practice trials were performed prior to data collection trials. Thirty-second rest periods were given between trials and one minute of rest was provided between the practice and data collection trial sets. Center of pressure data was collected using an AccuSway force platform (AMTI Corp., Watertown, MA) which is controlled through a computer using Balance Clinic software (AMTI Corp., Watertown, MA). Center of pressure path length data was averaged for the three trials.

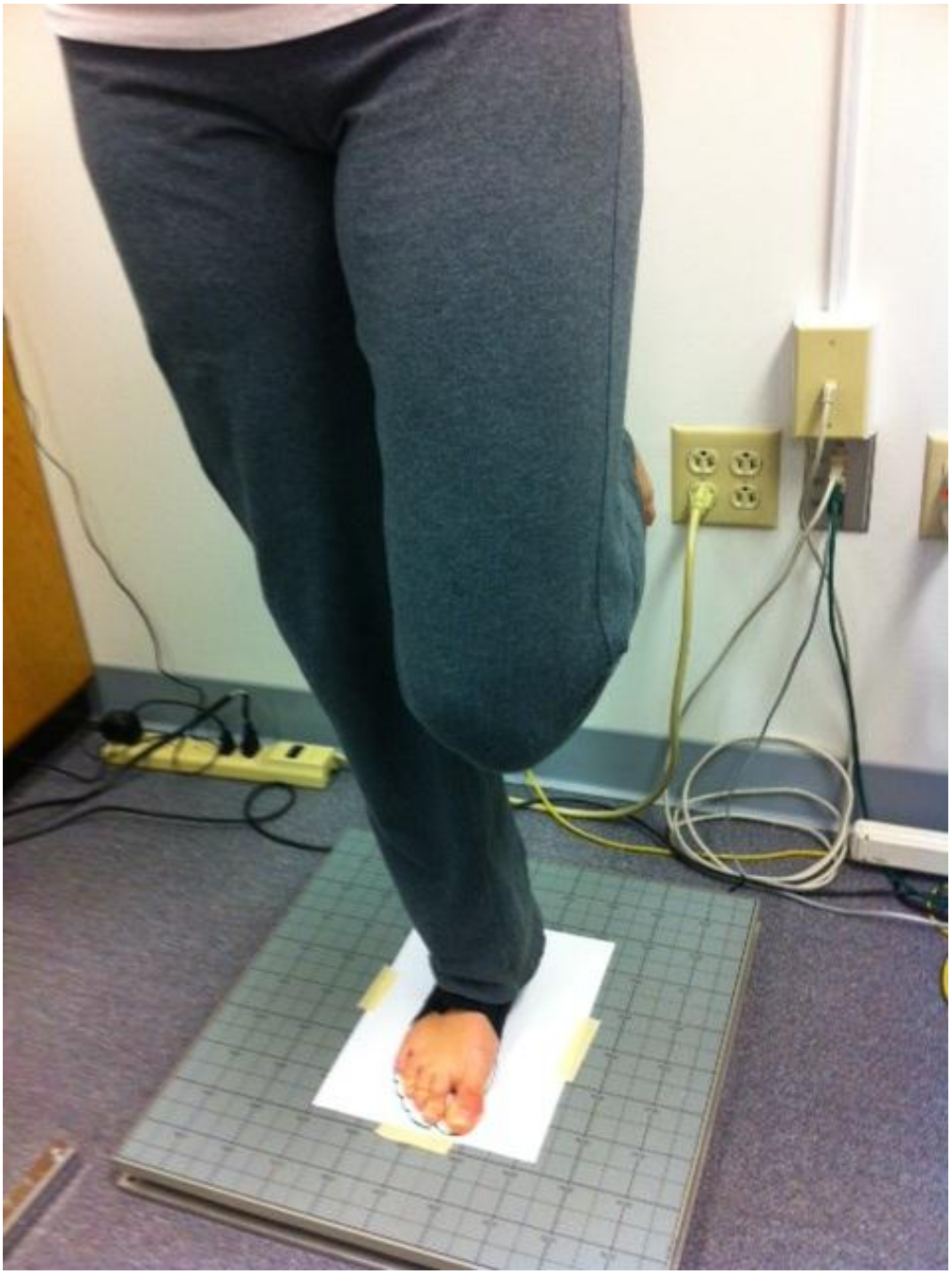

Figure 2-2: Quiet Stance Single-legged Balance on Force Plate (AMTI, Watertown Corp., NY).

Experimental Protocol:

Each participant visited the lab for data collection three times. On the first visit, all paperwork was filled out and signed. Paperwork included an informed consent agreement and a screening questionnaire that was approved by the Penn State Institutional Review Board. Prior to the initiation of data collection, anthropometric data of height, weight, and leg length was collected for each participant. A randomization calculator in Minitab software allowed for each test condition, SEBT or force plate, to be randomized. Depending on that randomization, the participant would then begin the experiment, starting with either the SEBT or the force plate. On the second and third visits, the participants would simply start their trials on either the SEBT or the force plate since all paperwork and anthropometric data had been acquired on their first visit.

Statistical Analysis:

Statistical analyses of the data were conducted using Minitab software (Minitab, Inc., State College, PA). Descriptive statistics, including group means and standard deviations were calculated per condition for each dependent variable. Separate one-way analysis of variance (ANOVA) assessments were calculated to determine statistically significant differences among group means for the conditions. Concurrent inspection of the standardized residuals was conducted to verify the data meet the necessary assumptions for ANOVA. An a priori alpha level of $P < 0.05$ indicated statistical significance. Tukey's Honestly Significant Difference post hoc test was conducted for pairwise comparisons using a 95% simultaneous confidence interval (SCI) to determine statistical significance between conditions.

Percent difference and effect size between each bracing condition was also calculated. Effect sizes were interpreted in a manner such that values ≤ 0.40 signified weak, values ranging

from 0.41 to 0.70 signified moderate and values ≥ 0.71 signified strong effects.[12] Descriptive statistics, including group means and standard deviations were computed for the dependent variables of interest. A one-way analysis of variance (ANOVA) was calculated to examine differences among the dependent variable means for the three conditions. Residual analyses were implemented in order to confirm the data met the necessary assumptions for ANOVA. An *a priori* alpha level of $P < 0.05$ denoted statistical significance. When directed, Tukey's Honestly Significant Difference post hoc test was calculated to examine pairwise comparisons among the three conditions. A 95% simultaneous confidence interval was used to denote statistically significant pairwise comparisons.

Chapter 3

Results

No significant differences in normalized reach distance were found among any of the bracing conditions in any reach direction of the modified SEBT (Table 1.1-1.3). Effect sizes for differences in normalized reach distance between bracing conditions were classified as weak for every reach direction of the modified SEBT (Table 1.1-1.3). Ankle bracing did not enhance or impair dynamic postural control compared to the non-braced condition. The DonJoy and ProTaco ankle braces did not differ in their influence on SEBT reach distance.

Static postural control measures (center of pressure path length) revealed similar results to the measures of dynamic postural control. No significant differences were found between bracing conditions or in comparison to the no brace condition (Table 2.1). As with dynamic postural control measures, ankle bracing did not enhance or impair static postural control compared to the non-braced condition. The DonJoy and ProTaco ankle braces did not differ in their influence on center of pressure path length during quiet stance.

Table 1.1: Lower Extremity Dynamic Balance Measure: Anterior Reach Distance Measures (%LL)

Pairwise comparisons	M ± SD	95% SCI	d	%diff
Baseline vs:	69.818 ±5.851			
DonJoy	71.427± 5.172	(6.049, -2.832)	0.292	14.42306
ProTaco	71.643± 5.531	(6.266, -2.616)	0.33	14.7234
DonJoy vs:	71.427± 5.172			
ProTaco	71.643± 5.531	(4.657, -4.224)	0.039	0.30195

P Value: 0.560

Values are mean ± standard deviation;

SCI = simultaneous confidence interval; v = versus;

Baseline denotes No Brace condition; DonJoy and ProTaco denote the two brace conditions.

Table 1.2: Lower Extremity Dynamic Balance Measure: Posterolateral Reach Distance Measures (%LL)

Pairwise comparisons	M ± SD	95% SCI	d	%diff
Baseline vs:	82.75± 9.97			
DonJoy	83.73± 9.75	(9.09, -7.13)	0.097	1.177319
ProTaco	82.01± 10.54	(7.37, -8.85)	0.073	0.898276
DonJoy vs:	83.73± 9.75			
ProTaco	82.01± 10.54	(6.39, -9.83)	0.17	2.07554

P- Value: 0.877

Values are mean ± standard deviation;

SCI = simultaneous confidence interval; v = versus;

Baseline denotes No Brace condition; DonJoy and ProTaco denote the two brace conditions.

Table 1.3: Lower Extremity Dynamic Balance Measure: Posteromedial Reach Distance Measures (%LL)

Pairwise comparisons	M ± SD	95% SCI	d	%diff
Baseline vs:	74.906± 7.400			
DonJoy	74.533± 10.256	(6.475, -7.222)	0.044	0.4992
ProTaco	76.380± 7.607	(8.322, -5.375)	0.0173	1.948627
DonJoy vs:	74.533± 10.256			
ProTaco	76.380± 7.607	(8.695, -5.001)	0.217	2.447768

P-Value: 0.790

Values are mean ± standard deviation;

SCI = simultaneous confidence interval; v = versus;

Baseline denotes No Brace condition; DonJoy and ProTaco denote the two brace conditions.

Table 2.1: Quiet Single-Leg Center of Pressure Path Length Measures (cm): Eyes Open Condition

Pairwise comparisons	M ± SD	95% SCI	d	%diff
Baseline vs:	41.80±11.10			
DonJoy	39.03±9.47	(5.65, -11.19) 6.853891	0.26	
ProTaco	40.71±10.79	(7.33, -9.51) 2.642104	0.104	
DonJoy vs:	39.03±9.47			
ProTaco	40.71±10.79	(10.10, -6.74) 4.213695	0.16	

P-Value = 0.728
Values are mean ± standard deviation;
SCI = simultaneous confidence interval; v = versus; ; % diff = percent difference;
d = Cohen's effect size;
Baseline denotes No Brace condition; DonJoy and ProTaco denote the two brace conditions.

Chapter 4

Discussion

The objective of this study was to compare the effects of two ankle supports on static and dynamic postural control. The results of previous research suggest taping and bracing are effective in preventing ankle sprains in athletes,[4] leading to their common usage with athletes. There is a debate as to the mechanism of this benefit. Some ankle braces are marketed as mechanical restraints to ankle motion while others have been marketed as facilitators of muscle activation. We chose two braces with two different hypothetical mechanisms of benefit for our study: the ProTaco brace which is purported to promote facilitation of the peroneal tendons and the semi-rigid DonJoy brace which is designed to provide mechanical stability to the ankle joint. A concern with bracing is that wearing them during physical activity may impair balance and performance.[4,13,14,15] To the contrary, previous research findings suggest that ankle bracing does not impair a healthy individual's ability to balance under dynamic conditions,[3] and may improve dynamic and static single-leg balance.[16,17]

Our primary hypothesis was that participants under both braced conditions in our study would demonstrate improved postural control responses compared to the un-braced condition. Our other goal was to identify differences in postural control responses in participants wearing the ProTaco versus the semi-rigid DonJoy braces. Our findings did not support the primary hypothesis nor did they suggest differences in responses between braced conditions.

We used a modified SEBT as our measure of dynamic postural control. Our results demonstrated no statistically significant ($P>0.05$) difference between either braced condition and the un-braced condition or between the braced conditions in the normalized reach distance in any of the three directions tested. Similarly, effect sizes for differences in normalized reach distance

between bracing conditions were classified as weak (≤ 0.40) for every reach direction of the modified SEBT (Table 1.1-1.3) The 95% confidence intervals for each reach direction (anterior, posterolateral and posteromedial) were more divergent in all three of the tested conditions. This wide divergence in confidence intervals could be attributed to the small number of participants (18) in the study. . Our findings support the findings of other investigators who found that ankle braces do not disrupt or enhance lower extremity dynamic balance during a reaching task in healthy participants.[13,14,15] Our findings do not support the hypothesized enhancement of dynamic stability suggested for taping and bracing via the prevention of excessive movement.[16,17]

We used center of pressure path length during a quiet single-legged stance task as our measure of static postural control. Our results showed no statistically significant (P>0.05) difference in COP path length between either braced condition and the un-braced condition (Table 2.1). There was also no statistically significant (P=0,728) difference between the braced conditions. Similarly, effect sizes for differences in quiet single-legged stance center of pressure path length measures between bracing conditions were classified as weak (≤ 0.40). It should be noted that the only condition tested under static postural control was the eyes-opened condition. Removing input from the visual system by testing participants in an eyes-closed condition would force the central nervous system to rely on other somatosensory afferent input to maintain postural equilibrium. The potential enhancement of proprioceptive input provided by bracing may become evident under this condition. Our findings were consistent with those of studies showing that of the wearing of an ankle brace has no effect on overall single- legged balance, [18,19] but in contrast with the findings of another study which suggest that bracing the ankle may actually be detrimental in its effect of proprioception.[20] Our findings do not support the findings

of (Kinzey, Ingersoll and Knight) who found an increase in static proprioception while wearing an ankle brace.[21]

Limitations:

Several limitations may have contributed to the lack of significant findings in our investigation. First, we only looked at the acute changes in postural control with bracing. We did not acquire data on prolonged use of ankle braces. Long-term ankle brace usage possibly would have more measurable effects on postural control.[19] Second, the inclusion criteria drew upon a healthy cohort of student-athletes. Had the study been conducted on a population of recreational, or volunteer participants, findings could have been different. [13,14] Individuals with postural control deficits and/or chronic ankle instability may respond differently. A final factor could be that participants were only tested in eyes open condition. Results may have been different if the eyes closed condition were also used for the study.

Clinical Implications:

Prophylactic ankle bracing is an intervention recommended to reduce the risk of ankle sprains.[24] Previous literature has shown that ankle bracing/taping does lead to a reduction in the rate of ankle sprains in both recreational, and varsity athletes.[2,26] Our findings suggest that neither the ProTaco or the semi-rigid DonJoy ankle brace had a detrimental or enhancement effect on static or dynamic postural control. Since our study did not investigate injury rates while wearing the ProTaco or semi-rigid DonJoy ankle braces we cannot provide support for or against the use of these braces to prevent ankle injuries during athletic participation.

Conclusion:

The ProTaco and semi-rigid DonJoy ankle supports had no effect on postural control under either static or dynamic conditions. Future research should explore weather wearing these ankle braces over a prolonged period of time would have an effect on the occurrence of ankle injuries and postural control.

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Chapter 5

Literature Review

Ankle sprains are the most common musculoskeletal injuries that occur in athletes, and they have a profound impact on health care costs and resources.[24] The enhancement of joint stability by means of external supports, such as braces and taping has been a highly provocative topic in the sports medicine. [2] Numerous brands of ankle supports in a wide variety of sporting activities have been tested to see how they compare to other competitive brands in helping the participant avoid injury or prevent further injury of a specific joint or bone. The premise of this research is to look at those ankle injuries, and two of those ankle braces, DonJoy and ProTaco, which have both been only minimally studied in research up to this point, and to see their effects on single leg balance.

Many ankle injuries are the result of impaired balance in the joints. Functional ankle instability (FAI), which is very common in many recreational and collegiate athletes, is characterized by the ankle giving out and the person losing balance.[25] FAI is associated with impaired balance.[25] Poor balance and FAI may predispose athletes to ankle sprains or ankle injuries.[26] Sustaining an ankle injury may require the athlete to wear a particular ankle brace. In a multifaceted intervention study, balance training has been shown to significantly reduce the recurrence of ankle ligament injury in volleyball players and recreational athletes.[26] In accordance with balance training as an intervention strategy, additional research suggests balance training can also be used prophylactically to reduce further ankle sprains in recreational athletes.[23]

Studies up to this point suggest prophylactic use of semirigid and lace-up style ankle braces does not disrupt the ability to maintain dynamic balance in healthy individuals. [3] Ankle bracing has been shown to alter a healthy individual's ability to balance under dynamic conditions,[3] and is most likely to improve dynamic and single-leg balance. Taping and bracing also appear to be more effective in preventing ankle sprains in athletes,[4] further suggesting their reliability compared to no brace at all.

The purpose of this literature review is to investigate the efficacy of static and dynamic single leg balance testing under bracing and non-bracing conditions to explore their effect on postural control. This review examined static balance by means of the quiet single leg balance test and dynamic balance by means of the star excursion balance test. Future research to enhance our study and all comparative studies on ankle bracing and taping will also be explored.

Dynamic Balance:

Dynamic Stability is the characterized by the body's ability to restore its movements and return back to its original state. In this review, dynamic balance was examined by means of the Star Excursion Balance Test (SEBT). The SEBT is best described as a functional screening tool that measures lower extremity reach while challenging the associated limitations of joint stability. This review will look at the modified SEBT in three directions, anterior, posterolateral, and posteromedial, as opposed to all eight directions of the non-modified test. The goal of the modified SEBT is to reach as far as possible with one leg in each of the three directions while maintaining balance upon the opposite leg. The stance leg requires ample ankle, knee, and hip ranges of motion as well as adequate strength, proprioception and neuromuscular control to perform such tasks. The SEBT appears to be an effective means for determining reach deficits

both between and within participants with unilateral chronic ankle instability.[6] Although the SEBT is an adequate test of dynamic stability, this review will also look at a few more functional tests of dynamic stability as means of measuring postural control

Recent research, specifically that of a 2008 study testing the effects of prophylactic ankle braces on lower extremity functional performance, observed a general trend when studying the effects of ankle bracing/taping on dynamic balance. That trend is that bracing/taping neither enhances or hinders dynamic balance in athletes. In the 2008 study, thirty-six active volunteers were studied to see the effects of prophylactic ankle braces, a semi-rigid and a lace-up brace in particular, on lower extremity functional performance to determine if prophylactic ankle braces affected multidirectional reach distances during a test of dynamic balance.[3] Using the Star Excursion Balance Test, researchers found that the bracing condition had no effect ($P > .05$) on any of the Star Excursion Balance Test directional measures. This indicated that the actual reach differences due to bracing were less than 5.08 cm (2 inches) in length.[13] The major conclusion drawn from this particular study was that the use of ankle braces does not disrupt or enhance lower extremity dynamic balance during a reaching task in healthy participants.

In a similar study to the one previously alluded to, a crossover design study was used to determine the effects of both soft and semi-rigid prophylactic ankle stabilizers (PAS) on dynamic postural stability and vertical ground reaction forces.[13] The Dynamic Postural Stability Index (DPSI) is a relatively new measure of dynamic postural stability that determines how well balance is maintained as the participant transitions from a dynamic to a static state. The DPSI was used during this particular study to determine the effects of PAS's on dynamic balance. Using the McDavid Ultra Ankle 188 semi rigid brace and the Mueller Lace-Up ankle brace as

the means of testing, results suggested that soft and semi rigid PASs did not improve dynamic postural stability in twenty-eight participants with functional ankle instability.[13] Further research in basketball players observed that bracing, by means of Aircast-type orthosis, and taping generated alterations in vertical and medial-lateral ground reaction forces when compared to control conditions. This may lead to increased compressive and inversion/eversion forces on the skeletal system by restricting joint mobility,[14] which suggests that ankle bracing and taping may be detrimental to postural control in recreational basketball players. The findings of these two studies suggest that taping and bracing had no effect on dynamic stability in recreational and volunteer participants. Further research with in patients with chronic ankle instability (CAI) also provide similar findings with the studies previously mentioned.[3]

Contrasting research from the studies previously mentioned has also been extrapolated upon for the purpose of this review. In particular, evidence suggesting that taping and bracing do have an effect on dynamic stability.[13,14] In a study conducted at The University of Western Ontario, researchers discovered that taping played a role in enhancing joint stability. Varsity male and female volleyball players were the participants. Using a 3M underwrap taping on the ankle, it was concluded that taping played a role in the reduction of torque on the ankle joint following exercise.[16] These findings suggests that taping of the ankle joint is an effective method for preventing excessive movement of the ankle, fostering support for taping/bracing as a means of enhancing dynamic stability.

In a similar study specific to the desired population of collegiate volleyball players, 10 healthy female collegiate volleyball athletes participated in three separate testing sessions, applying a different bracing condition at each session: no brace (NB), Swede-O Universal lace-

up ankle brace (AB), and Active Ankle brace (AA).[17] Three trials of a jump-landing task were performed under each condition before and after induced functional fatigue. The jump-landing task consisted of a single-leg landing onto a force plate.[17] Results suggested that during post-testing, the AB condition was more effective than the other two conditions in providing dynamic stability in the anterior-posterior direction during a landing task .[17]

Further evidence suggesting that taping and bracing do have an effect on dynamic stability was examined in athletes with a previously reported ankle injury. Varsity soccer players' who had suffered a previous sprain to either one or both ankles (38 players) were identified as subjects and received one of four interventions: a canvas, laced ankle brace, taping, a combination of taping and ankle bracing or no treatment.[27] Ankle sprain recurrence frequency was 0%, 25%, 25%, and 35% for the braced, taped, combination, and untreated groups. The recurrence incidence for the braced group was significantly lower than that of the other three groups, suggesting that prophylactic ankle bracing is effective in reducing the incidence of ankle sprains.[27] Similar findings in male and female basketball players were found. A total of 1460 male and female basketball players from 46 high schools were randomly assigned to a braced or control group. The braced group players wore lace-up ankle braces.[28] For players who did not report a previous ankle injury, the incidence of acute ankle injury was 0.40 in the braced group and 1.35 in the control group showing the use of lace-up ankle braces reduced the incidence.[28]

Static Balance:

Stationary balance, or static balance, is the body's ability to maintain a balance stance and does not require any means of active performance. A common way of testing static balance,

is known as the quiet single-leg balance task. The goal of the quiet single-leg balance task is to stand barefoot on one leg while maintaining balance for a ten second period. The force platform obtains the data by detecting changes in the participant's weight distribution across the foot. This review will look at results from quiet single-leg tests, as well as results from other static balance measurements on the lower extremities. Center of pressure data has been commonly used in prior studies of chronic ankle instability.[18, 21]

Thirty three male physical education student volunteers were measured under three ankle brace conditions: i) without brace, ii) with brace and 30 kPa application pressure and iii) with brace and 60 kPa application pressure, with the goal of the study being to investigate the effect of different skin-ankle brace interface pressures on quiet single limb balance.[18] No specific brace was used for the study, instead the different pressures applied to the ankle were meant to simulate what it would be like to wear an air-stirrup ankle brace. Single limb balance (anteroposterior and mediolateral parameter) was assessed on the dominant lower limb, on a force platform.[18] The results of this study showed that the application of an ankle brace with two different skin-brace interface pressures had no effect on overall single limb balance and the sequence of lower limb muscle activation.[18] From these findings, it seems that static balance is not effected by bracing procedures. In a similar study, twenty-eight Indiana State University students, who had not suffered from any ankle injuries, were tested using the strain-gauge force-platform system to measure postural control.[20] Findings suggest that application of an ankle brace may not require modifications in the postural-control strategies during a 1-legged stance in participants with healthy ankles, and that bracing the ankle may actual be detrimental in its effect of proprioception.[20]

Contrasting evidence on the other hand, supporting the notion that ankle bracing enhances static proprioception was also examined for the purpose of this review. A study measuring center of pressure was conducted in 24 males with no previous ankle injuries, comparing the changes in the center of pressure resulting from wearing ankle braces and wearing no brace.[21] Although perplexed by the results, researchers found that when wearing an ankle brace, the participants relocated their center of pressure. Concluding evidence suggested that this relocation of the center of pressure of the ankle may be due to an increase in static proprioception while wearing an ankle brace due to the ankle moving from a dorsiflexed to an everted position.[21]

Literature Review References

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Education

The Pennsylvania State University — **University Park, PA**
Schreyer Honors College — *Anticipated Graduation: May 2013*
B.S., Kinesiology

Employment Experience

BetterBall Basketball Camp *(Counselor)* — **Bryn Mawr, PA**
Summer 2005-Spring 2009

- Supervised basketball activities for over 100 youth basketball players ranging from ages 6-16.
- Led group and individual sessions for the players.

Neebo Bookstore *(20 hours per week during the school year)* — **State College, PA**
Summer 2009-Present

- Work as an associate sales clerk and manage seven other employees.
- Assist in ordering, stocking and packaging of book orders and inventory.

Volunteer at Mount Nittany Medical Center *(Volunteer)* — **State College, PA**
Summer 2011-Present

- Volunteer 5 hours a week in the Physical Therapy Wing, where I assisted the therapists in rehabbing patients, setting up therapy stations, taking blood pressures and transporting patients.
- Accumulated over 90 hours of experience over the past two semesters.

University of Pittsburgh Health Career Scholars Academy *(RLC)* — **Pittsburgh, PA**
Summer 2012

- Assigned to a "dorm group" comprised of eleven students of the same gender, and lived with them in the dormitory.
- Responsible for supervising students in the dormitory, on site visits, and during school-wide social events.
- Facilitated some parts of the curriculum; organized informal, small group social activities; lead small group discussions and individual meetings to provide feedback to the students on specific projects; and served as a role model and mentor to the students.

Activities

- Order of the Omega, Pennsylvania State University *2011-Present*
- Health and Human Development Honors Society *2011-Present*
- Member, Delta Tau Delta Fraternity *2010-Present*
- Academic Chair for Delta Tau Delta Fraternity *2010-2011*
- Pennsylvania Governor's School for Health Care *Summer 2009*
- Catholic Youth Leadership Mentor *2005-Present*
- Four Year Varsity Basketball and Baseball Letterman (*2 years captain*) *2005-2009*

Research Interests

I have broad interests in sport and human performance, particularly the diagnosis, treatment, and prevention of injury. Specifically, I am interested in medical devices and rehabilitation programs that are designed to prevent the reoccurrence of injury and enhance physical performance.