ACUTE EFFECTS OF POWER BALANCE BRACELETS ON STRENGTH, BALANCE, AND FLEXIBILITY

By

TYLER J FOX

Bachelor of Science in Education: Athletic Training

University of Kansas

Lawrence, KS

May 17, 2009

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
July 2011

ACUTE EFFECTS OF POWER BALANCE BRACELETS

ON STRENGTH, BALANCE, AND FLEXIBILITY

Thesis Approved:

Dr. Aric Warren

Thesis Adviser

Dr. Blaine C. Long

Dr. Doug Smith

Dr. Mark E. Payton

Dean of the Graduate College

.

ACKNOWLEDGMENTS

First, I would like to thank my parents, Kevin and Jane, for their unbelievable support throughout my life. Their belief in me has given me the confidence and motivation to attempt and complete things that wouldn't have been possible without them. I would also like to thank my sister, Katie, for setting an example of how to live life the right way and for always being there for me when I needed her. Finally, I would like to thank all of my grandparents for their unconditional support and interest in whatever I applied myself to. They have all been incredibly positive influences for me and their encouragement has always driven me to succeed.

I would also like to thank my committee members. Dr. Warren served as my chair and developed the idea for the content of this paper. Dr. Long served on my committee and provided guidance with countless suggestions and revisions. He was instrumental in my data collection and analysis as well. Without his leadership I never would have been able to complete my work. Dr. Smith was my third committee member and I benefited greatly from his knowledge and expertise in the graduate college. Without their guidance I would not have been able to complete my journey through Oklahoma State University Graduate School into the next step of my life.

Additionally, I would like to thank all of my friends for their support and understanding throughout the writing process. Kaz took time to help and answer all the questions I had for him and Andrew was always one step ahead of me and never hesitated to offer advice when I was stuck. All of my friends helped keep me on task while still reminding me to have a little fun at the appropriate times. Thanks guys, I couldn't have done it without you.

Finally, I want to thank the OSU athletic training program for providing the opportunity to serve my graduate assistantship under their supervision. I feel very fortunate to have had the opportunity to work with some of the best people and facilities in the athletic training field.

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER I

INTRODUCTION

Athletes at all levels have one thing in common, they want to be competitive. Remaining competitive at their respective sport often involves hard work, dedication, and practice. All of these things take extra time and energy, which is something that not everyone has in abundance. Several companies claim to provide products capable of improving performance in specific areas related to sports. Power Balance[1], Ampli5[2], Phiten[3], and iRenew[4] provide testimonial evidence that claim performance improvements through the application of their product.

Power Balance[1] suggests their product will maximize flexibility, balance, and power with the application of a wristband or pendant.[1] Many people, ranging from professional athletes to the average recreational athlete, are using these products and providing testimonials, suggesting that it may improve performance. The athletes range from professional basketball and football players to athletes in less mainstream sports such as surfers, beach volleyball players, and professional race car drivers[1]. If these claims are true, the Power Balance products would be beneficial to anyone, regardless of activity level.

Three tests are reported to show improvement. The balance test involves the tester pushing down on a subject's arm as they stand on the opposite foot, the flexibility test involves standing rotation of the subject's trunk in one direction, and the strength test involves the examiner pulling on the subject's arm as they stand with their feet together. The tests appear to demonstrate the claimed improvements, but have not been independently investigated.

Power Balance claims that it provides performance technology intended to work with your body's natural energy field. The bracelets contain a mylar hologram which is suggested to react with the body's natural energy flow in a concept similar to many Eastern philosophies.[1] The company claims that the mylar material at the core is treated with energy waves at specific frequencies. The resulting mylar is believed to resonate and work with the body's natural energy flow to help the user perform at peak ability.[1]

PURPOSE

The problem being studied here was that there is little scientific evidence showing the effects of any of the technologies mentioned previously to be valid, including the claims made by Power Balance. The tests used to examine their effectiveness are not reliable or valid scientific tests used to measure the variables they claimed. The purpose of this study was to determine the acute effects of the application of Power Balance wrist bracelet on flexibility, balance, and power.

HYPOTHESIS

We hypothesized that the null hypothesis would hold true. Power Balance bracelets will have no scientifically measureable effect on the performance of the subject's flexibility, balance, or power with either the immediate application of the bracelet or 24 hours post application. The only measureable effect hypothesized that may be seen is the placebo effect in which both groups receiving treatment show equal rates of improvement in all areas over the control group.

- H_0 – The application of the Power Balance bracelet will have no effect on the performance of the subjects in any of the testing.
- H_1 – The application of the Power Balance bracelet will increase flexibility immediately after application.
- H_2 – The application of the Power Balance bracelet will increase flexibility after 24 hours of continuous use.

- H_3 – The application of the Power Balance bracelet will increase balance immediately after application.
- H_4 – The application of the Power Balance bracelet will increase balance after 24 hours of continuous use.
- H_5 – The application of the Power Balance bracelet will increase power output of the lower extremity immediately after application.
- H_6 – The application of the Power Balance bracelet will increase power output of the lower extremity after 24 hours of continuous use.
- H_7 – The application of both the Power Balance bracelet and the placebo band will cause increased performance on immediate testing due to the placebo effect.
- H_8 – The application of both the Power Balance bracelet and the placebo band will cause increased performance on 24 hours post testing due to the placebo effect.

ASSUMPTIONS

1. Participants would not remove or tamper with the bracelets for the 24 hours that encompassed the testing period except to shower or bathe.
2. It was assumed that subjects wore the bracelet continuously as was instructed and only remove it to bathe.
3. It was assumed that participants who removed the bracelets for bathing did so with a maximum of 30 minutes of bracelet removal.
4. It was assumed that participants did not participate in strenuous activity during the study.
5. It was assumed subjects honestly answered all questions and self-reported any concussions or relevant injuries that may affect the testing.
6. It is assumed that subjects gave full effort during all testing procedures.
7. It was assumed subject's did not do anything in between sessions that would affect the 24-hour post testing session

DELIMITATIONS

The study was conducted with the following parameters:

1. Subjects were recruited through word of mouth, scripts read in HHP courses, and the College of Education SONA subject recruitment system. http://okstate-coeosu.sona-systems.com.
2. All familiarization and testing sessions were completed in the Applied Musculoskeletal & Human Physiology Research Laboratory in the Department of Health and Human Performance at Oklahoma State University.
3. Twenty-seven (27) healthy active individuals (18+ years) participated in the study.
4. Participants had less than 90º of hip flexion with complete knee extension with the opposite leg secured to the table.
5. Subjects were free from lower extremity and head injury over the past 6 months prior to data collection.
6. Subjects were free of medical conditions that could affect their performance on the balance testing, including concussions.

LIMITATIONS

1. Subjects in the control group were aware they were not receiving any treatment.
2. Subjects noted the flexibility testing during the first round of testing and attempted to improve on their score the second day by warming up before entering the lab.

DEFINITION OF TERMS

Balance Error Scoring System (BESS test) – test commonly used in a concussion battery to determine differences in a subjects balance control pre and post head injury.[5-9]

Mylar – polyester made in extremely thin sheets of great tensile strength and used for recording tapes, insulating film, fabrics, etc.

One Repetition Maximum (1RM) – maximum amount of weight one can lift in a single repetition for a given exercise.[10]

Opposing Muscle – (OM) – in PNF stretching, muscle group that opposing the muscle group being stretched.

Primary Investigator – (PI) – the researcher conducting all of the testing with the subjects throughout the study.

Proprioceptive Neuromuscular Facilitation – (PNF) – a specific type of stretching involving various combinations of passive and active stretching with muscular contractions in specific sequences.

Range of Motion – (ROM) – distance and direction a joint can move between the flexed position and the extended position.

Sit and Reach – (SR) – protocol commonly used to determine hamstring flexibility.

Target Muscle – (TM) – in PNF stretching, muscle group that is selected to be stretched.

CHAPTER II

REVIEW OF LITERATURE

INTRODUCTION

Athletes in all sports often look to gain an advantage over their competition. Improving performance with the application of a bracelet, necklace, pendant or any other similar product may provide a simple, legal, and cost effective method to easily maximize flexibility, balance, and strength. These three attributes are important in any athletic endeavor and their correlations with success and prevention of injury in sport have been seen many times. There are many products on the market that claim improvement in these areas and they are backed by testimonials from professional athletes as well as recreationally active people who claim to have experienced the benefit for themselves.

The products are designed to work through various methods ranging from controlling your body's natural frequency to aligning your body's energy waves with the earth's natural energy waves, which allows for maximized performance.[1-4] One particular company, Ampli5,[2] reports that "every object on the planet, whether it is alive or inanimate, has an electrical frequency than can be measured accurately." They also report that the average healthy human frequency ranges anywhere from 62-72 hertz and dropping below this range can cause anything from a compromised immune system to increased cancerous activity.[2] By utilizing the ideologies of ancient Eastern medicine and the benefits of advanced scientific research, Ampli5 also reports that they have been able to hone the ideas into a comfortable and convenient line of products[2] that

are supposed to help fight the compromise or drop in your body's electric frequency caused by electromagnetic pollution that we are all subjected to in today's society.[2]

Another example of technology designed to help you maximize your body's potential for performance is Aqua-Titanium produced by the Phiten company.[3] Titanium is a lightweight and insoluble metal used in medical devices due to its non-corrosive and hypo-allergenic properties.[3] In order to avoid placing a solid and potentially harmful piece of metal into their product Phiten consists of minute particles of titanium suspended in water. The water acts as a carrier of the titanium and is used in the process of dying the fabric, which embeds the particles into the fabric and spreads the effect of Phiten technology to the users. Phiten claims that the Aqua-Titanium is dissolved into the fabric and cannot be washed out or faded away. Fabric permeated with Aqua-Titanium emits energy that they claim will control your bio-electric current.[3] They also offer X30 technology, which is thirty times more concentrated than standard Aqua-Titanium and is designed to meet demands of higher performance athletes, and Aqua-Gold, which claims to "smooth the neural transmission."[3]

The iRenew bracelet is another product that makes similar claims to the previous products. They claim that the bracelet may promote wellbeing, enhance flexibility, renew balance, and increase overall wellness.[4] They use "biofield technology to attune your body's natural frequencies to make you better than you were, with enhanced mental and physical performance." iRenew admits on their website that there have been no scientific or medical studies done on the bracelet itself, but claims the technology behind its construction is sound.

Very similar to the iRenew bracelet is the Power Balance Bracelet. The Power Balance company claims that their product allows you to maximize your balance, strength, and flexibility.[1] The significance of gaining advantages in those categories is obvious in any sporting activity. Power Balance was chosen as the focus for this study because of its popularity and

claim of being the most widely used performance enhancing bracelet in the world.[1] Many athletes are turning to the Power Balance Company because of their results and it is our goal to use valid testing research to determine the effectiveness of the product.

FLEXIBILITY

Flexibility has been proven to increase performance and decrease incidence of injury in athletes as well as the general population.[11-14] Short muscles and tight joint connective tissue may predispose an athlete to either muscle strain or joint injuries, especially in the lower extremity.[14] Stretching muscles by pulling tension across the muscle belly and holding it for a given amount of time is often used to increase extensibility of the tissue. Decoster[15] reported all stretching positions tested resulted in considerable range of motion gains when compared to control groups who performed no stretching.

There are four different kinds of constraints to normal joint range of motion (ROM): neurogenic (voluntary and reflex control), myogenic (involving passive and active properties of the muscle), joint (involving the physical structures and articulation), and connective tissue.[16] Normal stretching exercises are used in an attempt to influence the neurogenic and myogenic properties of muscle. These exercises involve placing the muscle on tension for a short period of time, normally 30-60 seconds, and then releasing. After several sets of these are performed it is not uncommon to see slight gains in ROM.[16]

In addition to biomechanical and neurophysiological factors, it has been reported that proprioceptive neuromuscular facilitation (PNF) stretches are able to alter stretch perception and therefore yield even greater gains in ROM.[16] The same study reported that neither a 10-minute stretch nor a 4 week daily home stretching program made short hamstrings any longer or less stiff, but only increase stretch tolerance. Another study reported one (1) repetition of PNF stretching is sufficient to increase ROM with an expectant change of anywhere from 3º to 9º and

that changes in ROM will occur regardless of the stretching intervention chosen.[17] A study done by Boyce[18] concluded that the optimal number of PNF stretch repetitions needed to achieve significant gains in ROM was 5.

The Power Balance website claims that they are able to maximize flexibility and they attempt to prove their claim with a simple test.[1] In the test the subject stands with their heels and toes together. They are then instructed to flex the glenohumeral joint to 90 degrees with their palm pronated, wrist neutral, and fingers and thumb adducted together in extension (Figure 1.). The subject keeps their feet planted and rotates their torso as far as they can to the same side as the outstretched arm while following the outstretched arm with their eyes. The glenohumeral joint remains flexed to 90 degrees and horizontally abducts as the torso rotates (Figure 2.). The subject is instructed to twist as far as they are able and mentally note how far they made it. After they return to normal the product is applied and they are instructed to repeat the exact same test. The video on the website does not show the repeated test with the product applied but the

Figure 1. Power Balance Field Flexibility Test Starting Point

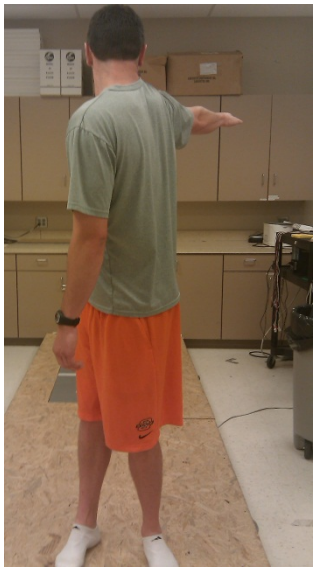

Figure 2. Power Balance Field Flexibility Test Ending Point

insinuation is that the bracelet will improve the total range of motion.[1] The results of this specific test are almost always in favor of the bracelet.

A common method for quantifying flexibility gains is the sit and reach protocol (SR).[14] Many studies on the validity and reliability of SR protocols have been reported and a number have been proposed.[11,13] Previous studies indicate that the standard SR test protocol provides moderate validity for hamstring flexibility (r = .64)[11-13] and extremely high reliability estimates (0.96 < 0.99).[11] Since the aim of this particular study is not to test the hamstrings specifically, but flexibility increases in general, then the reliability of the test is the most important variable and the standard SR test has been proven to score very high in that area. Davis et. al. reported on the standard SR test's high validity as a general flexibility test because of the forced ankle dorsiflexion that occurs.[19] The fascial attachments between the lower extremity's posterior kinetic chain increase its validity as a general flexibility test as opposed to a test targeting one specific muscle or muscle group.[19]

Additionally, Lemmink et. al. reported the SR test produces reliable scores in middle-aged to older men and women from trial to trial at one session (intraclass correlation coefficient [ICC] = .99 for both men and women), from test session to test session (ICC = .98 for men; ICC = .96 for women), and from rater to rater (ICC = .98 for men and women).[12] Davis et. al. reported an intra-tester reliability score of 0.94.[19]

The goal of this study is to determine if the bracelets facilitate an overall increase in flexibility. There is no specific application of the bracelet that claims to target specific areas of the body, so the somewhat low validity for hamstring flexibility (r=.64)[11-13] is not a pressing concern in this case. The sit and reach test is valid for showing increases in flexibility through the posterior chain as a whole, which will be demonstrated if the bracelet maximizes overall flexibility as it claims.[1] Overall reliability is the most important factor in the procedure being

used. The high reliability of the SR test will ensure that the measures taken with each round of testing in the study will be useful for the data analysis purposes.

BALANCE

Body control is an essential attribute for athletes ranging the entire spectrum of sporting events. Balance improvements of even the smallest degree can have effects on an athlete's performance. It is important to have full control for mainstream athletes in basketball, football and baseball and even more so in X-game athletes who participate in events such as surfing, skateboarding, snowboarding, and mountain biking. The Power Balance testimonials contain athletes across this entire spectrum of sporting events and more who provide testimonials about their experience with the products.[1] This is evidence that athletes across all genres of athletics will gladly seek out improvement in their balance to increase overall performance in their respective domains.

The Power Balance company tests each subject's balance by having them stand with their heels and toes together and abduct their glenohumeral joint to 90 degrees with elbows extended, wrists neutral, fingers extended and palms pronated. Then, using the elbow as a visual reference, the tester pushes straight downward on one arm while the subject resists the motion (Figure 3.). The test is repeated with the subject standing on the opposite leg of the side the force is applied (Figure 4.). Finally, the video instructs the subject to apply the bracelet and repeat both tests[1]. The insinuation is that the product will improve the subject's balance. Generally, using this test as a guideline, a performance increase is seen. However, the same question arises; will the same increase in performance be seen in a scientific test proven to be reliable and valid?

One simple and effective method for determining postural stability and balance commonly used in athletics is the Balance Error Scoring System (BESS). It was initially developed as an easily administered objective assessment tool to be used by clinicians for the

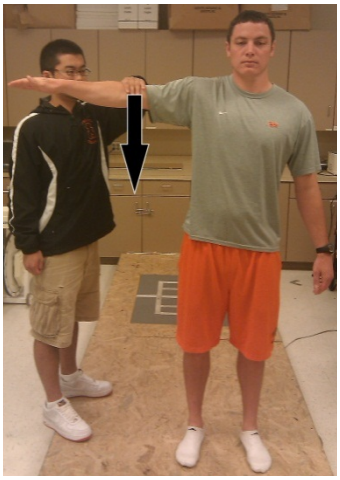

Figure 3. Power Balance Double Leg Field Balance Test

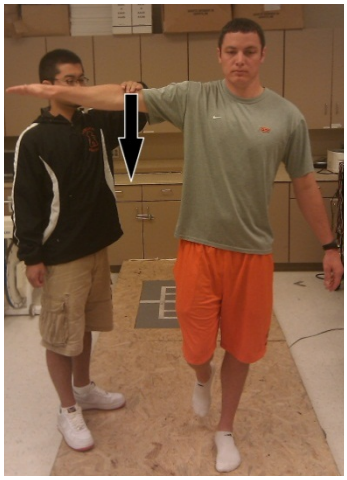

Figure 4. Power Balance Single Leg Field Balance Test

evaluation of stability after an athlete had sustained a concussion[7]. The test is commonly administered in healthy individuals to determine their baseline balance score and then re-administered after a suspected head injury in attempt to evaluate deficiencies that may be present.

The BESS test consists of 6 separate 20 second tests of balance in 3 different stances (double leg, single leg, tandem) on two different surfaces (flat ground, foam pad). The numbers of errors on each of the six tests for each individual trial are added to achieve the BESS score. The subjects begin each test with their feet in the designated alignment, their eyes closed, and their hands placed on their hips. Predefined errors are then counted as the subject attempts to maintain their balance in the given stance for entire 20 second time period. When all 6 tests are completed the total number of errors is added together to form the final score.[8,9]

With an intrarater reliability score ranging anywhere from .87 – .98 when administered by an experienced professional, the BESS test will serve as an excellent assessment of balance improvements for the purposes of this study.[5,7,9] The commonly accepted minimum score for clinical reliability is 0.80.[5] There appears to be a learning effect associated with the BESS test in which scores improve slightly from day to day with a single administration of the test each day.[8,9]

However, these effects are significantly reduced if the test is administered a minimum of 3 to 4 times in one setting. This has been proven to be sufficient to increase the intrarater reliability to clinically significant levels ranging from .83 – .91.[5,7] The minimum recommendation for obtaining reliable scores is 4 trials. The first trial should be thrown out as a practice round and the average of the next 3 trials should be taken as the score.[5,7] Additionally, a change of 7.3 points between trials of BESS testing may be needed to ensure that the increase in errors can be attributed to the subject and not simply error associated with the administrator.[6]

A scientifically valid and reliable score should be attainable by allowing each subject a practice test and then using the average of the 3 tests following the practice round. Comparing these scores across the control, placebo, and treatment groups as well as across initial, immediate, and 24 hours post application for each subject will give a good indication of any performance changes associated with the application of the bracelet.

Another balance test commonly administered is the Berg Balance Scale (BBS). The BBS was developed to measure balance among older people with impairment in balance function by assessing the performance of functional tasks. It is a valid instrument used for evaluation of the effectiveness of interventions and for quantitative descriptions of function in clinical practice and research.[20] The reliability of the test is also strong with one study reporting and inter-tester reliability value of .88 (Spearman rho).[20] The test is a 14-item scale designed to measure balance of the older adult in a clinical setting. Most frequently the items require the subject to maintain a given position for a certain amount of time. Points are deducted for failure to meet time, require aid of the examiner or external support, or inability to complete the task.

The BESS test was chosen over the BBS because of its design for all ages and its use in athletics. The subjects tested here will all be college age most likely be recreational athletes. The BBS was designed primarily for older individuals and is not commonly used in athletics.

STRENGTH AND POWER

For many athletes the quality of their performance is largely affected by the application of force through strength and power movements that are integrated throughout their activity. These movements can be directed toward the ground, a ball, other athletes, or anything else they encounter during competition. There are various ways to measure the application of force ranging from a simple 1 repetition maximum (1RM)[21] test to the more advanced methods of using a force plate.[22,23]

The most simple and cost effective way to measure muscular strength that is commonly used is the 1RM test. This involves the subject estimating what the maximum amount of weight they can lift in a given exercise and attempting to do it one time. If they are successful then they add a small amount of weight and make the attempt again. This process continues until the subject is unable to complete the exercise.[21] Ideally this will give the subject as estimate of the maximum they are able to lift in that particular exercise. However, this is not a very efficient method of determining force, especially in inexperienced lifters. Fatigue quickly becomes a factor and can affect the results. It is also a dangerous technique requiring the use of at least one spotter and is some cases two or more.[24]

One of the most common and reliable methods of force testing in a laboratory setting is vertical jump testing on a force plate.[22,23,25] For ground-based tasks in which leg extensors are predominant, like ball games, track and field, and even mixed martial arts, the application of an explosive movement of short duration such as a vertical jump is an excellent way to assess power.[1,22] Vertical jumps have also been used to monitor response to various training protocols.[23]

Traditional methods of increasing force production such as resistance training[10,26] and plyometric training[27] require a commitment of work over time. Chtara[26] used a 12 week study in order to monitor 1RM strength improvements using resistance training and found significant ($p <$

0.01) increases of 17% for resistance training only and 12.2% for resistance training combined with endurance training in untrained individuals. Additionally, Dorgo[10] found significant improvements ($p < 0.001$) in pre and post scores for both bench press and squat after performing a 14 week weight training or manual resistance training exercise program. A meta-analysis[27] on the effects plyometric training on strength and force development concluded that plyometric training significantly improved strength performance. They recommended a 10 week training program to be the ideal time necessary to see the greatest improvements.

Although the Power Balance product cannot be classified as a specific training protocol, it can easily be classified as an ergogenic aid that is designed to maximize performance. Any improvements in power caused by the application of the product should be measurable through the same vertical jump testing that is commonly used to measure gains after traditional strength and conditioning programs.

The Power Balance website tests for strength improvements by having the subjects assume a standing position with the heels and toes together and the glenohumeral joint adducted to 0º (arms hanging relaxed at side), elbows extended, palms neutrally facing sides, wrists locked in neutral position, and the fingers of one hand flexed in position around examiner's fist forming a comfortable grip (Figure 5). The subject is instructed to grip the tester's fist in their palm as tester applies a force straight downward along the subject's leg, being careful not to pull away from the subject's body. The subject is to attempt to resist the force, but inevitably the subject leans toward the direction of force and eventually loses their balance (Figure 6). The subject is then instructed to wear the product and repeat the test. Again the results of this test, almost without fail, seem to improve with the bracelet application. Is the improvement seen really caused by the bracelet, or are there other variables at play again?

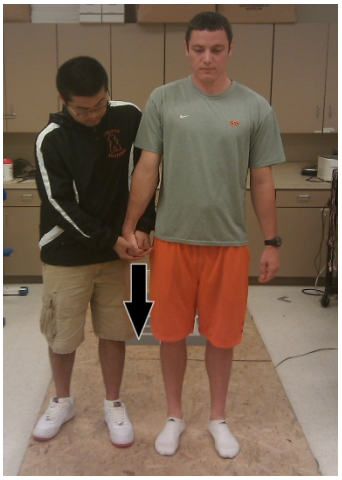

Figure 5. Power Balance Field Strength Test Starting Point

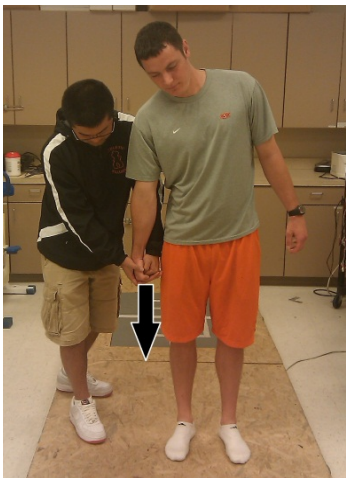

Figure 6. Power Balance Field Strength Test Ending Point

As with the previous testing, the goal of this section is to find a scientifically reliable and valid test that subjectively measures the intended variable. Moir et. al. demonstrated high test-retest reliability in unloaded jumps for peak force, average power, and peak power (ICC .96, .94. and .97 respectively) along with low individual variation (CV range: 2.4%, 4.6%, and 3.3% respectively). Additionally, they determined through the results of their study that a familiarization session was not necessary in order to obtain reliable data.[23] Hori et. al. confirmed that the vertical jump test is a reliable measure of peak power and peak force by showing ICC of .98 and .92 and CV of 2.3% and 4.1% respectively at 500 Hz sampling frequency. They also determined that 200 Hz was the minimum sampling frequency for most measures of vertical jump on a force plate to produce reliable and accurate results.[22] Cordova et. al. also found a high reliability (ICC = .94) for peak force.[25]

For the purposes of this study we will look at peak force produced with a maximal vertical jump. The subjects will stand on a force plate and be instructed to perform a maximal vertical jump. They will be allowed a practice jump and then be required to perform 3 live jumps of which the average score will be taken. The results will be interpreted through the compatible software and recorded appropriately. It is not necessary to allow familiarization with the testing

procedure as determined by previous studies[23], but in order to match the methods used for the other testing performed, the subjects will still be required one practice attempt before live recording begins.

SUMMARY

This study will use three tests that have been validated through other scientific publications to attempt to determine if the claimed improvements are actually seen in the subjects after acute application of the bracelet and 24 hours post application of the bracelet. A standard sit-and-reach test will be used to test differences in flexibility. The Balance Error Scoring System, or BESS test, will be used to test balance changes. A force plate measuring force generated by a maximal vertical jump will be used to test differences in power, which is a derivative of strength.

CHAPTER III

METHODS

INTRODUCTION

The claims cited earlier about the instantaneous improvement of balance, flexibility and strength are very significant in the sporting world. The companies make compelling cases on their websites[1-4] and during their street testing.[1,2,4] However, their methods raise issues concerning the validity of the claims and are the reliability of the tests being used. Finding scientifically reliable and valid tests that measure the variables these companies claim to help improve is a vital step in determining if they are able to produce the results they lead us to believe they can. Therefore, the purpose of this study was to determine the immediate effects of the application of Power Balance wrist bracelet on strength, balance, and flexibility.

SUBJECTS

Twenty-seven college students volunteered and were eligible to participate. Participants were randomly assigned to receive a placebo bracelet, a Power Balance bracelet, or nothing (control group). The average participant was 22.9 ± 2.62 years of age. Eighteen women and 9 men completed the study. The average female was 22.71 ± 2.07 years old, measured 166.93 ± 7.78 cm tall and weighed 70.08 ± 10.49 kg. The average male was 24.44 ± 3.05 years old, measured 180.34 ± 4.58 cm tall and weighed 82.58 ± 9.53 kg.

The control group had 9 subjects aged 23.3 ± 3.46 years old, measuring 174.7 ± 8.11 cm tall and weighing 77.1 ± 11.63 kilograms. The placebo group had 9 subjects aged 23.7 ± 1.66

years old, measuring 173.0 ± 10.81 cm tall and weighing 78.4 ± 11.33 kilograms. The treatment group had 9 subjects aged 21.8 ± 2.28 years old, measuring 166.5 ± 7.74 cm and weighing 67.2 ± 9.63 kilograms (Table 1).

All subjects consented to participation through signing of a university approved informed consent waiver. They all participated voluntarily and were not penalized in any way for failure to complete the study. Subjects filled out a health history questionnaire that informed the examiners of any exclusionary criteria such as injury or surgery in the past 6 months, previous history of balance deficits or concussion, or previous use of Power Balance products or any product claiming similar effects. Included in the waiver were clauses that affirmed they were 18 years of age or older, informed them of the procedures and asked that they would give maximum effort during all testing. Their age, height, weight, and gender were collected for demographic purposes.

INSTRUMENTS

All testing was conducted in the Applied Musculoskeletal & Human Physiology Research Laboratory in the Department of Health and Human Performance at Oklahoma State University. All equipment necessary for the study was located in the laboratory. The force plate measurements were taken using an AccuPower System, (AMTI, Watertown, MA) and the compatible software AccuPower Functional Power Assessment System, v1.3.5, March 2007, (Watertown, MA). A Flex-tester ® Sit and Reach, (Novel Products, Rockton, IL) box was used to measure sit and reach scores. The box used measured 12 inches tall, 20 inches deep and 12 inches wide. There was an overhang of 7 inches measured from the bottom of the feet to the front of the box. The top of the box contained a slide ruler that moved along a groove and was used to measure the distance the subject was able to stretch. (Figure 7) A foam mat measuring 19 x 16 x 2.5 inches, (Airex, Longmont, CO) was used for the balance testing.

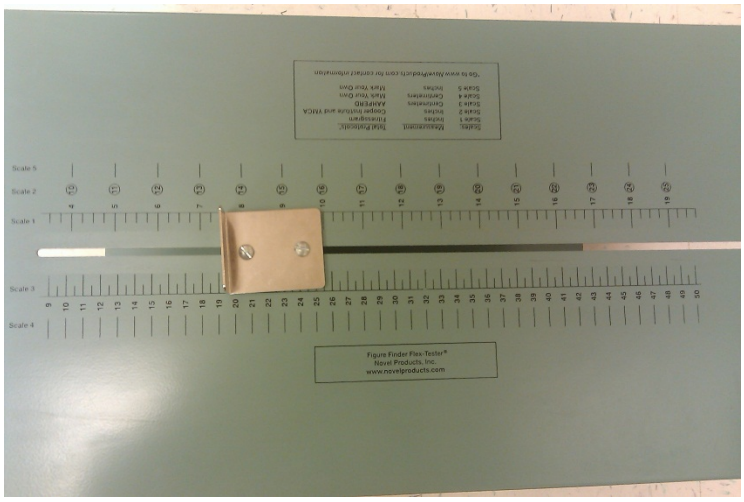

Figure 7. Top View of Sit and Reach Box

We used Power Balance bracelets purchased directly from the company. The company reports that bracelets are manufactured in China while the hologram is programmed in the United States.[1] The bracelets used were placed inside standard Nike sweat bands (Figure 8). The sweat bands were used to conceal the bracelet so subjects would not know if they were receiving the treatment or placebo bands. The sweat bands were cut open to allow for the Power Balance bracelet to be slipped inside and were sewn back to prevent tampering. One of the bands contained the Power Balance product (treatment group); the other band contained the Power Balance product with the mylar cores removed and replaced with rubber filler so that no one would be able to feel the difference (placebo group).

Figure 8. Power Balance Bracelet Inside of Sweat Band

PROCEDURES

Subjects reported to the lab dressed in athletic shorts and a t-shirt where they read and signed the approved consent form. Subjects were then screened to ensure they met the inclusion criteria for hamstring flexibility. They were instructed to lie supine on a padded table with their dominant leg secured to the table using a belt to prevent accessory movement of the lower extremity. An additional belt was placed across subject's hips at the level of the anterior superior iliac spine (ASIS) to provide increased stabilization (Figure 9). A bubble inclinometer (Baseline, White Plains, New York) was used to accurately record pre-treatment range of motion in the non-dominant hip. The inclinometer was zeroed on the table and then placed at the midpoint of the quadriceps muscle while the subject was lying supine. Hip dominance was determined by asking the subjects which leg they would use to kick a soccer ball. The leg striking the ball was classified as dominant. If the subject had greater than 90º hip flexion in this position then they were excluded from the study to ensure there was an appropriate available range for flexibility increases to occur.[19,28]

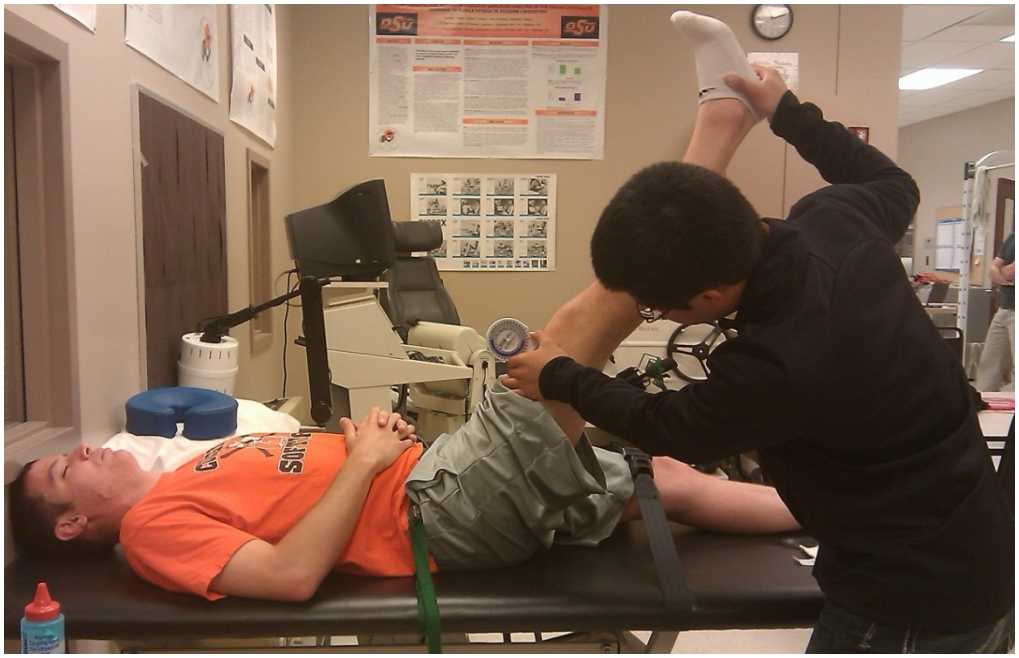

Figure 9. Prescreening Testing Method for Subject Inclusion

Tests were performed without shoes, but socks were allowed. If the subject chose to remain in their socks they were required to complete all tests on all days wearing socks. The same rule applied if they chose bare feet. Once each test was performed, the groups were required to repeat all tests a second time in the same order. The treatment and placebo groups placed the sweatbands and bracelets on their right wrist before completing the tests for the second time. The initial testing session took approximately 1 hour to perform and the follow-up session was performed approximately 24 hours later.

STUDY DESIGN

We used a 3 x 3 double blind repeated measures procedure on both factors to guide data collection. The independent variables were group, (placebo, treatment, and control) and time (pretest, immediate post test, and 24 hours post test). The dependent variables were number of balance errors (BESS test), flexibility (sit and reach test), and power out-put (vertical jump test). The eligible subjects were randomly assigned into the three groups using a balanced Latin square with 3 conditions. The subjects chose their groups by drawing a number out of a bowl. "1" indicated Bracelet 1, "2" indicated bracelet 2, and "3" indicated control. The control group received no treatment at all.

FLEXIBILITY

Flexibility was tested using the sit and reach test. Subjects removed their shoes and sat with their heels flat against the box. They were instructed to sit with their ankles and toes touching, overlap their hands equally, and lean forward in a smooth motion to slide the measuring device forward (Figure 10). They also were instructed not to bend their knees. To ensure reliability the PI held their knees in the proper position throughout the test. Special care was taken not to place extra force down on the knee joints, but to simply prevent them from flexing.

Subjects were allowed 1 practice trial and 3 live trials.[11] The average score across the 3 live trials was used in calculations for flexibility.

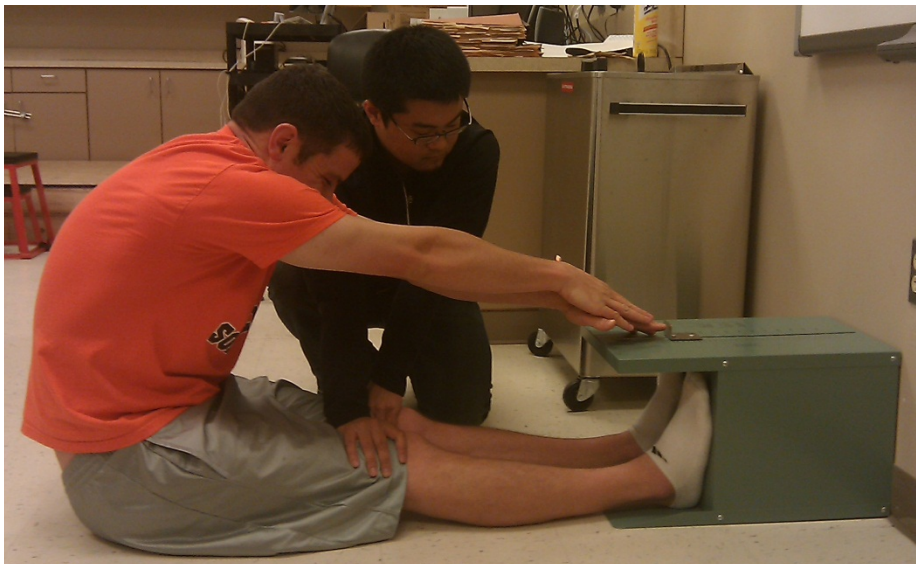

Figure 10. Sit and Reach Testing Position

BALANCE

Balance was assessed using the BESS test. Testing consisted of 6 separate 20 second tests of balance in 3 different stances (double leg, single leg, and tandem) on 2 different surfaces (flat ground and foam pad). During the double stance subjects stood with their feet together in the center of a square marked on the ground in tape that matched the length and width (19 x 16 inches) of the foam pad (Figure 11. A). During the single leg stance subjects stood on their non dominant leg in the center of the required area (Figure 11. B). During the tandem leg stance the subjects stood with their non dominant leg lined up directly behind their dominant leg as if they were on a tightrope (Figure 11. C). Next subjects were asked to repeat each stance position while standing on the designated foam surface (Figure 11. D, 11. E, and 11. F).

The numbers of errors on each of the 6 tests for each individual trial were added to achieve the BESS score. Each subject was allowed 1 practice trial going through the tests and 3

live trials. Each trial was completed in its entirety before starting over. (i.e. the subjects were not allowed to perform all single leg tests in a row; they were required to follow the order described exactly.) The subject's average score of the 3 trials was used in the calculations.

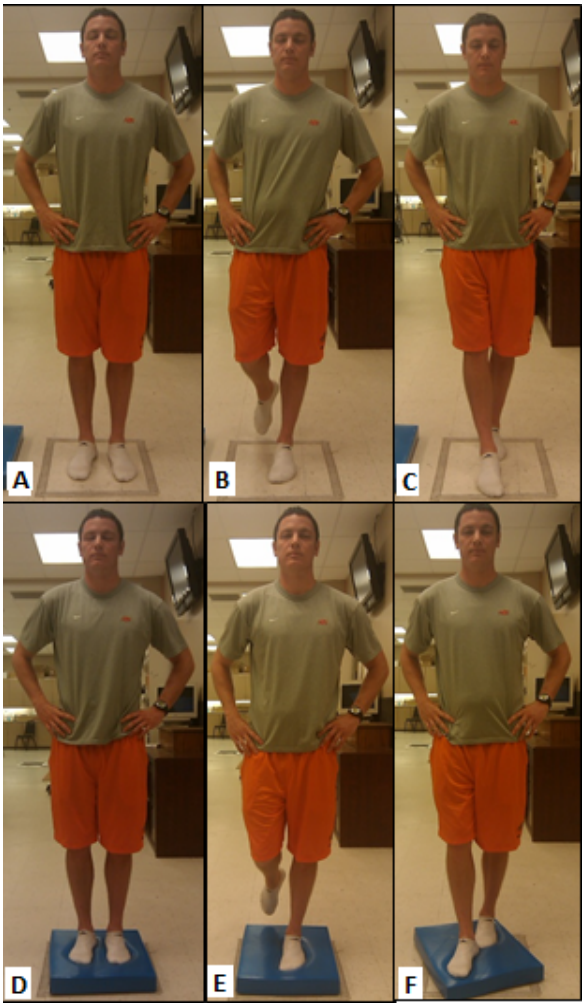

Figure 11. Bess Testing Positions

The subjects began each test with their feet in the designated alignment, their eyes closed, and their hands placed on their iliac crests. Prior to assuming this position they were read a list of predefined balance errors to ensure they understood how to avoid unnecessary penalties. Errors were operationally defined on the scoring sheet as: opening the eyes; hand coming off of the hip; taking a step; moving hips into 30° of abduction, flexion or extension; lifting the forefoot or heel; or remaining out of testing position for more than 5 seconds. Each individual error counted as

one point and it was possible to incur multiple errors at once. The order of trials followed a standard BESS format, which progressively increased the demands placed on the subject. The testing progressed as follows: double-leg, single-leg, tandem on firm, and then a repeat of the same order on the foam. Subjects were instructed to stand comfortably and allowed to hold their contralateral limb in the most comfortable position for them that ensured it would not touch the ground or anything around them, including the pad.

POWER

Power was tested using the force plate to measure the amount of ground force generated when the subject performed a maximum vertical jump. Each subject stood on the force plate on a spot marked with a tape "X". The subjects were allowed to use their arms to aid in the jump if they felt comfortable with it. They were allowed to bend their knees to a comfortable depth before jumping and were instructed to jump as high as possible while attempting to land in the exact same place they jumped from (Figure 12). They were allowed 1 practice jump that was not recorded followed by 3 live jumps that were measured and recorded. The average power produced across the 3 live jumps was used for calculations.

Subjects in the placebo and treatment groups then applied the bracelet to their right wrist and immediately repeated testing in the same sequence. Control subjects were also required to immediately perform the second round of testing, but did not apply anything to their wrists. After completion of the immediate post-measure testing the subjects in the treatment and placebo groups were instructed not to remove their bracelet other than for bathing or showering. Subjects returned 24 hours following the initial measures to repeat the test measurements for flexibility, balance, and power.

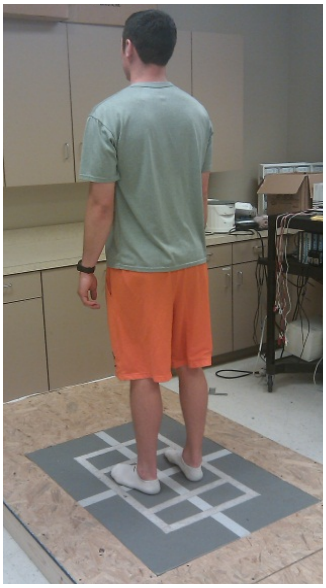

Figure 12. Power Output Testing Position

STATISTICAL ANALYSIS

Means and standard deviations were calculated for BESS error scores, sit and reach scores, and power output scores after each testing session. A 2-way repeated measures ANOVA was used to compare the data and the Tukey-Kramer post-hoc test was used to identify statistical differences at an alpha level of ($p < .05$).

CHAPTER IV

RESULTS

RESULTS

The average scores for each BESS test are summarized in Table 2. There was no difference in scores between groups ($F_{2,24} = .33$; $P = .72$) across time indicating that the bracelet had no effect on balance. There was, however, a difference across all groups with respect to time ($F_{2,48} = 3.66$; $P = .03$) indicating that the subjects improved from the pretest to the 24-hour post test (Table 3 and Table 4).

The average scores from sit-and-reach test are summarized in Table 5. There was no difference in flexibility scores across groups between Immediate-Post test scores and 24-hour post test scores ($F_{2,24} = .12$; $P = .88$) indicating there was no improvement seen during that time period in any group. Immediate post and 24-hour post test flexibility scores were greater than pretest flexibility for all groups against time ($F_{2,48} = 7.55$; $P = .001$) indicating each subject improved their flexibility score, regardless of treatment (Table 6 and Table 7).

The average scores for each Vertical Jump test are summarized in Table 8. There was no difference in power output scores between groups ($F_{2,24} = 2.47$; $P = .11$) across time indicating that the bracelet had no effect on power. There was also no difference across groups with respect to time ($F_{2,48} = .37$; $P = .69$) indicating that there was no improvement seen in power throughout the study in either immediate post testing or 24-hour post testing (Table 9).

CHAPTER V

CONCLUSION

The objective of this study was to examine performance changes using of the Power Balance bracelet.[1] The company claims that its product will maximize a person's balance, flexibility and strength.[1] Normally such increases are seen over weeks or months,[10,15-18,21,24,26,27] not immediately[1-4] as the company information from some ergogenic aids claim. At the time of this study, the investigators were not able to find any scientific evidence to support the validity or reliability of the flexibility test used by Power Balance. However, evidence exists in other studies that may contribute to improvements seen.[6,8,9,16,18,29]

Athletes of all varieties already use Power Balance or similar technologies, and more would likely utilize them if scientifically backed evidence existed to support it. We were able to examine the effects of Power Balance in a controlled environment using proven testing measures to determine the results of its application over a 24-hour period. We hypothesized that the bracelet would have no effect on performance in any of categories of balance, flexibility, or power immediately after application or after 24-hours of continuous use.

The results of our study indicate that there was no difference between groups for the balance testing measures in each testing interval. There was no improvement with application of the wrist band containing the Power Balance product when compared to the placebo or control groups. However there was a significant difference when comparing the pretest scores to the

24-hour post test scores across all groups. Since this difference was seen across all groups, it does not indicate a performance increase as a result of the bracelet application. The improvements in all groups over time are likely due to a learning effect.[8,9] This is described in previous research as the propensity of a subject to improve their scores with repeated testing of balance. Initially the subject seems to be learning the movements neuromuscularly and with successive trials they appear to improve.[8,9] We attempted to minimize the learning effect by requiring a total of 4 trials for each session, throwing out the 1st trial as a practice, and then averaging the 3 remaining trails.[5,7] By only performing the minimum amount of recommended trials we appear to have not closed the gap for error caused by the learning effect. It should be noted though that most of the subjects complained of fatigue during the 3rd and 4th administration of the BESS test during each trial. Requiring more testing during each session, as would have been necessary in this study, likely would have added fatigue errors.

The practice effect may play a role in the illusion that Power Balance is able to immediately improve balance during field testing. Participants in an uncontrolled setting likely react slowly to the pressure applied and may easily be knocked off balance. When the examiner hands them the bracelet and then repeats the exact same test there is a good chance that the subject's resistance to being pulled off balance will increase. They have previously experienced the test and are better prepared to counteract its force. This result would likely be seen after any initial testing session regardless of what, if anything, is handed to the subject between trials. This leads us to believe that the order of trials for each balance testing may have a larger effect on the result than the Power Balance product itself does.

There were no differences observed in flexibility scores between groups over time indicating the bracelet had no effect on balance. However, at the immediate post and at 24 hour post time measurements each showed greater flexibility than the pretest measurements across all groups. This was likely due to the fact that the subject's did not warm up before testing. The

immediate post test scores were likely greater because subjects had been through an entire round of pretesting before attempting the 24 hour post test. This subjected them to a minimum of 4 vertical jumps, 4 brief hamstring stretches, and 8 total minutes of balance activity before attempting their flexibility testing in the immediate post testing round.

The increase in flexibility after 24-hours of use could be explained by the admission by some participants that they had warmed up before entering the lab the second day. Subjects were advised not to do anything different before the final testing day as compared to the initial testing day, but some admitted to performing a warm up anyway. This outside variable was beyond the control of the examiners and seemed to occur with most of the subjects.

The ROM increases that appear to be evident in the field tests are likely attributed to the concept of reciprocal inhibition of the muscles involved. Reciprocal inhibition is achieved through voluntary contraction of the opposing muscle group (OM) which leads to reduced activation levels in the target muscle group (TM).[17,29] This will ideally allow for a greater stretch to the TM.

The type of stretch related to the flexibility test described on the Power Balance website is commonly known as 'contract relax agonist contract.'[17] This is performed when the TM is contracted, then relaxed, and then the OM is contracted. This places the original TM on a stretch.[17] Studies have demonstrated that PNF stretches which incorporate this shortening contraction of the OM to lengthen the TM achieve greater gains in ROM than static stretching alone.[17]

The OM group for rotating to the right are the right internal oblique and the left external oblique. They pull the TM group, the left internal oblique and right external oblique, into a stretch while the subject is rotating, then it relaxes when the subject rotates back to neutral. The Power Balance product is applied and the trial is repeated. This is essentially a second repetition

in the PNF stretching protocol described previously. Sharman et. al. cite research claiming that one repetition of PNF is sufficient to increase ROM with an expectant change anywhere from 3° to 9°, regardless of the stretching intervention.[17] This is supported by Boyce et. al., Ford and McChesney, and Osternig et. al. in their studies which show that the greatest gains in ROM are seen between the first and second trial of most stretching protocols.[18,28,29] Osternig et. al. reported up to 94% of total ROM gains occurred after the first trial in agonist-contract-relax conditions.[29] Boyce et.al. used a slightly longer stretching hold of 15 seconds, but they found that 53% of the total ROM gained was achieved by the second repetition.[18] Similarly, Ford and McChesney found that all stretching techniques they studied, including PNF stretching, produced an increase in ROM after only one trial.[28] All of the articles cited previously list PNF stretching as the most effective way of increasing immediate ROM.[17,18,28] This is evidence to the idea that the order of trials may contribute to the increase of ROM claimed in the video and not solely the effects of the bracelet itself.

The bracelet alone does not provide a stretch mechanism as seen with general stretching and PNF. Therefore, the bracelet alone is not sufficient to provide an increase in muscle length and range of motion because the muscle is not undergoing the physical changes seen with stretching. This explains why the gains were not seen with sit and reach testing. In our protocol we required 4 stretches. We discounted the first one, and averaged the next 3 together. This helped to eliminate the effects seen with stretching and concentrate on the effects produced by the bracelet. The lack of increased flexibility of the treatment group when compared to all other groups indicated the bracelet did not have an effect.

There were no significant differences in power across time or treatment groups. The bracelet appeared to have no effect on force output during maximal vertical jump. Power was used in this study as a more functional and sport specific derivative of strength. Strength

improvements seen in the field testing described by Power Balance likely are attributed to the learning effect again.

The neuromuscular improvements commonly attributed to acute increases in strength and power[10,21,24,26] do not appear to be achieved by the application of the bracelet. The physiological[10,21,26] changes associated with long term increase in strength and power do not appear to be present either. We attempted to remove the learning effect from the vertical jump test[23] by requiring 4 total jumps, discounting the 1st one, and averaging the last three. Our attempt appears to be effective because there are no differences seen either across groups or across time periods for any of the measurements taken concerning vertical jump. The power balance product appears to be ineffective at improving force output.

FUTURE RESEARCH

Future research should include a longitudinal study on the bracelet's effects on balance. The longer study would help to minimize the error due to learning effect while also minimizing possible error due to fatigue of repeated testing on the same day. Another method for reducing error would be to include a warm up period into the procedures. This would minimize the changes in muscle extensibility due to testing procedures or outside activity by the subject.

Additional research could be done by choosing a testing method more directly related to strength, rather than power output. Investigation of other forms of ergonenic aids, such as the ones listed in this study, and their effects on the same variables could prove beneficial in determining if one product is superior to another. Testing of the power balance product in conjunction with more traditional methods of performance improvement could also prove beneficial for finding useful applications of the product.

CLINICAL APPLICATIONS

The Power Balance product may provide an emotional effect that may improve performance as noted through the many testimonials.[1] However, according to the results of this study this product provides no significant increase in performance in any of the categories measured in this study. Balance, flexibility and strength were all unaffected from a physiological standpoint by the application of the bracelet. The results seen in field testing are likely attributable to the learning effect in testing methods as well as the reciprocal inhibition phase of PNF stretching in the case of flexibility. Clinically, the results of this study cannot be used to support the use of Power Balance technology to enhance performance in the areas of balance, flexibility or strength.

REFERENCES

1. POWERBALANCE L. Power Balance - Performance Technology. 2010; http://www.powerbalance.com. Accessed 11-05-2010, 2010.

2. Ampli(5). Ampli(5): Strength Balance Flexibility. 2011; http://www.amplifive.com/. Accessed 4/25/2011, 2011.

3. Phiten USA I. Phiten. 2011; http://www.phitenusa.com/. Accessed 4/25/2011, 2011.

4. Site ASOTO. IRenew Bracelet - As Seen On TV. 2011; http://www.asseenontvofficialsite.com/IRenew-Bracelet-p/irenew.htm. Accessed 4/24/2011, 2011.

5. Broglio SP, Zhu W, Sopiarz K, Park Y. Generalizability theory analysis of balance error scoring system reliability in healthy young adults. *J Athl Train.* 2009;44(5):497-502.

6. Finnoff JT, Peterson VJ, Hollman JH, Smith J. Intrarater and interrater reliability of the balance error scoring system (BESS). *PM R.* 2009;1:50-54.

7. Hunt TN, Ferrara MS, Bornstein RA, Braumgartner TA. The reliability of the modified balance error scoring system. *Clin J Sport Med.* 2009;19(6):471-475.

8. Valovich TC, Perrin DH, Gansneder BM. Repeat administration elicits a practice effect with the balance error scoring system but not with the standardized assessment of concussion in high school athletes. *J Athl Train.* 2003;38(1):51-56.

9. Valovich McLeod TC, Perrin DH, Guskiewicz KM, Shultz SJ, Diamond R, Gansneder BM. Serial administration of clinical concussion assessments and learning effects in healthy young athletes. *Clin J Sport Med.* 2004;14(5):287-295.

10. Dorgo S, King GA, Rice CA. The effects of manual resistance training on improving muscular strength and endurance. *J Strength Cond Res.* 2009;23(1):293-303.

11. Baltaci G, Un N, Tunay V, Besler A, Gerceker S. Comparison of three different sit and reach tests for measurement of hamstring flexibility in female university students. *British Journal of Sports Medicine.* 2003;37(1):59-61.

12. Lemmink KAPM, Kemper HCG, de Greef MHG, Rispens P, Stevens M. The validity of the sit-and-reach test and the modified sit-and-reach test in middle-aged to older men and women. *Res Q Exerc Sport.* 2003;74(3):331-336.

13. Chung P-K, Yuen C-K. Criterion-related validity of sit-and-reach tests in university men in Hong Kong. *Percep Mot Skills.* 1999;88:304-316.

14. Bozic PR, Pazin NR, Berjan BB, Planic NM, Cuk ID. Evaluation of the field tests of flexibility of the lower extremity: reliability and the concurrent and factorial validity. *J Strength Cond Res.* 2010;24(9):2523-2531.

15. Decoster LC, Cleland J, Altieri C, Russell P. The effects of hamstring stretching on range of motion: a systematic Literature Review. *J Orthop Sports Phys Ther.* 2005;35(6):377-387.

16. Mitchell UH, Myrer JW, Hopkins JT, Hunter I, Feland JB, Hilton SC. Acute stretch perception alteration contributes to the success of PNF "contract-relax" stretch. *J Sport Rehabil.* 2007;16:85-92.

17. Sharman MJ, Cresswell AG, Riek S. Proprioceptive Neuromuscular Facilitation stretching: mechanisms and clinical implications. *Sports Med.* 2006;36(11):929-939.

18. Boyce D, Brosky JA, Jr. Determining the minimal number of cyclic passive stretch repetitions recommended for an acute increase in an indirect measure of hamstring length. *Physiother Theory Pract.* 2008;24(2):113-120.

19. Davis DS, Quinn RO, Whiteman CT, Williams JD, Young CR. Concurrent validity of four clinical tests used to measure hamstring flexibility. *J Strength Cond Res.* 2008;22(2):583-588.

20. Riddle DL, Stratford PW. Interpreting validity indexes for diagnostic tests: an illustration using the berg balance test. *Phys Ther.* 1999;79(10):939-948.

21. Holm L, Reitelseder S, Pederson TG, et al. Changes in muscle size and MHC composition in response to resistance exercise with heavy and light load intensity. *J Appl Physiol.* 2008;105:1454-1461.

22. Hori N, Newton RU, Kawamori N, McGuigan MR, Kraemer WJ, Nosaka K. Reliability of performance measurements derived from ground reaction force data during countermovement jump and the influence of sampling frequency. *J Strength Cond Res.* 2009;23(3):874-882.

23. Moir G, Sanders R, Button C, Glaister M. The Influence of familiarization on the reliability of force variables measured during unloaded and loaded vertical jumps. *J Strength Cond Res.* 2005;19(1):140-145.

24. Saeterbakken AH, Tillaar RVD, Fimland MS. A comparison of muscle activity and 1-RM strength of three chest-press exercises with different stability requirements. *J Sport Sci.* 2011;29(5):533-538.

25. Cordova ML, Armstrong CW. Reliability of ground reaction forces during a vertical: implications for functional strength assessment. *J Athl Train.* 1996;31(4):342-345.

26. Chtara M, Chaouachi A, Levin GT, et al. Effect of concurrent endurance and circuit resistance training sequence of muscular strength and power development. *J Strength Cond Res.* 2008;22(4):1037-1045.

27. Saez-Saez de Villarreal E, Requena B, Newton RU. Does plyometric training improve strength performance? A meta-analysis. *J Sci Med Sport.* 2010;13:513-522.

28. Ford P, McChesney J. Duration of maintained hamstring ROM following termination of three stretching protocols. *J Sport Rehabil.* 2007(16):18-27.

29. Osternig LR, Roberston R, Troxel R, Hansen P. Muscle activation during Proprioceptive Neuromuscular Facilitation (PNF) stretching techniques. *Am J Phys Med.* 1987;66(5):298-307.

APPENDICES

APPENDIX A

Table 1. Individual Group Demographics (n=9/group; mean ± St. Dev)

Variable	Placebo	Treatment	Control
Age (yr.)	23.7 ± 1.66	21.8 ± 2.28	23.3 ± 3.46
Height (cm)	173.0 ± 10.81	166.5 ± 7.74	174.7 ± 8.11
Weight (kg)	78.4 ± 11.33	67.2 ± 9.63	77.1 ± 11.63

Table 2. Mean Number of Errors During BESS Testing (n=9 Sub/group; Mean ± SD)

Time	Placebo	Treatment	Control
Pretest*	26.93 ± 3.75	29.52 ± 9.40	25.97 ± 7.52
Immediate Post	24.54 ± 5.05	28.61 ± 6.76	22.76 ± 8.07
24-Hour Post*	24.74 ± 5.10	28.00 ± 6.62	21.36 ± 6.49

*Pretest > 24-Hour post

Table 3. Tukey-Kramer Multiple-Comparison Test for Ave Number of BESS Errors Over Time

Time	Count	Mean	Different From Groups
Pretest*	27	27.23	24-Hour post
Immediate Post	27	25.28	
24 hours Post*	27	24.91	Pretest

*Pretest > 24-Hour post

Table 4. Repeated Measures ANOVA for Each Group Over Time in BESS Testing

Source	DF	SS	MS	F-Ratio	Prob Level	Power (Alpha=0.05)
A: Group	2	122.31	61.15	0.33	0.719	0.097
B(A): Sub	24	4391.01	182.96			
C: Time	2	83.96	41.98	3.66	0.033*	0.647
AC	4	19.37	4.84	0.42	0.791	0.140
BC(A)	48	550.44	11.47			
S	0					
Total (Adjusted)	80	5167.10				
Total	81					

Table 5. Average Sit and Reach Score (cm)* (n=9 Sub/group; Mean ± SD)

Time	Placebo	Treatment	Control
Pretest	31.50 ± 12.15	29.19 ± 7.51	29.67 ± 5.56
Immediate Post*	32.09 ± 11.35	31.66 ± 6.39	31.37 ± 6.70
24-Hour Post*	30.72 ± 11.25	31.33 ± 6.50	32.46 ± 7.62

*Immediate Post and 24-Hour post > Pretest

Table 6. Tukey-Kramer Multiple-Comparison Test for Sit and Reach Test distance (cm)

Time	Count	Mean	Different From Groups
Pretest*	27	30.84	Immediate Post, 24-Hr Post
Immediate Post	27	32.21	Pretest
24 Hour Post	27	32.13	Pretest

*Immediate Post and 24-Hour post > Pretest

Table 7. Repeated Measures ANOVA for Each Sit and Reach Group Over Time

Term	DF	SS	MS	F-Ratio	Prob Level	Power (Alpha=0.05)
A: Group	2	47.62	23.81	0.12	0.88	0.07
B(A): Sub	24	4631.65	192.99			
C: Time	2	31.99	15.99	7.55	0.001*	0.93
AC	4	12.23	3.06	1.44	0.23	0.41
BC(A)	48	101.66	2.12			
S	0					
Total (Adjusted)	80	4825.16				
Total	81					

Table 8. Mean Force Output (Newtons) in Vertical Jump Testing (n=9 Sub/group; Mean ± SD)

Time	Placebo	Treatment	Control
Pretest	1653.16 ± 370.34	1399.49 ± 282.77	1736.88 ± 267.17
Immediate Post	1658.64 ± 347.50	1424.04 ± 294.02	1718.23 ± 273.49
24-Hour Post	1650.18 ± 351.71	1417.09 ± 304.26	1746.28 ± 284.88

Table 9. Repeated Measures ANOVA for Each Vertical Jump Group Over Time

Term	DF	SS	MS	F-Ratio	Prob Level	Power (Alpha=0.05)
A: Group	2	1,346,965	673,482.4	2.47	0.11	0.45
B(A): Sub	24	6,549,709	272,904.5			
C: Time	2	3799.13	1899.57	0.37	0.69	0.11
AC	4	7029.31	1757.33	0.34	0.85	0.12
BC(A)	48	247,554.5	5157.39			
S	0					
Total (Adjusted)	80	8,155,056				
Total	81					

APPENDIX B

Oklahoma State University Institutional Review Board

Date:	Tuesday, January 18, 2011
IRB Application No	ED10156
Proposal Title:	Acute Effects of Power Balance Bracelets on Strength, Balance and Flexibility
Reviewed and Processed as:	Expedited

Status Recommended by Reviewer(s): Approved Protocol Expires: 1/17/2012

Principal Investigator(s):

Tyler J. Fox
4599 N. Washington St.Apt. 19A
Stillwater, OK 74075

Aric Warren
194 Colvin Center
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Shelia Kennison, Chair
Institutional Review Board

APPENDIX C

CONSENT TO PARTICIPATE IN A RESEARCH STUDY
OKLAHOMA STATE UNIVERSITY (Non-SONA recruitment)

Project Title: Acute effects of Power Balance Bracelets on strength, balance, and flexibility

Investigators: Tyler J. Fox ATC, LAT; Softball Graduate Assistant; Health and Human Performance; Oklahoma State University, Stillwater, OK 74075; 785.766.5330

Aric Warren, EdD, ATC, LAT, CSCS; Associate Professor; Health and Human Performance; Oklahoma State University; Stillwater, OK; Phone: 405-744-4060; aric.warren@okstate.edu

Purpose: This study is being conducted as research at Oklahoma State University. The purpose of this study is to determine the acute effects of the application of Power Balance wrist bracelet on strength, balance, and flexibility.

Procedures: Following your commitment to participate in this study, you will report to the Applied Musculoskeletal and Human Physiology Laboratory (Colvin Recreation Center; room 192) dressed in athletic shorts and a t-shirt. You will complete a health history questionnaire form in order to determine if you qualify for this study. If you qualify to participate, you will sign this informed consent form and have your non-dominant hip range of motion tested to ensure it is less than 90 degrees. If you still qualify for the study you will be randomly assigned to 1 of 3 groups (treatment 1, treatment 2, or the control (no braceletet)).

In order to determine which group you will be assigned to, you will blindly take a piece of paper from a bowl with the numbers 1, 2, or 3. Testing will begin as soon as it is determined what group you will be in. You will be required to remove your shoes for the duration of the testing. Testing will commence as follows.

All subjects will perform all tests. Once all the tests have been performed all groups will perform the tests again. It is at this time when the subjects who have been assigned a number corresponding with a bracelet will apply the specific bracelet to their right wrist. The subjects who are assigned the option that does not include a bracelet will perform the tests again as well. Each initial testing session will take approximately 1 hour to perform. The follow-up session approximately 24 hours later will take approximately 30 minutes to complete.

The control group will have 20 subjects and they will know they are the control group because they will be given nothing to wear. However, it is important to the study they give their full and best effort for all tests. The treatment groups will be given bracelets to wear beginning at the second round on the 1st day of testing. They will be required to wear the bracelets continuously until they complete the last test on the 2nd day of testing. At no time will they be allowed to remove the bracelet for any reason.

To determine effects on balance you will be taken through the B.E.S.S. test consisting of 20 seconds of balancing in 3 different stances (single leg, double leg, tandem) on two different surfaces (flat ground and foam pad). The total number of errors in each stance for each surface will be counted and added together to achieve your B.E.S.S. score. You will be allowed 1 practice run going through the tests and 3 live trials. Your best score of the 3 trials for each surface will be used in the calculations. You will then move on to the other baseline testing before returning to complete the balancing test for the second round.

Power will be tested using a force plate to measure the amount of ground force generated when you perform a maximum vertical jump. You will stand on the force plate on the spot marked with tape. You will jump as high as you are able and attempt to land in the exact same place you jumped from. You will be allowed 1 practice jump and 3 live jumps that will be measured. The jump in which you produce the most power will be used for calculations.

Flexibility will be tested using a simple, but effective sit and reach test. You will be instructed to overlap your hands equally and lean forward in a smooth motion to slide the measuring device forward. You will be allowed 1 practice trial and 3 live trials. The trial in which you score the highest amount of flexibility will be used in calculations.

Risks of Participation: There are no known risks associated with this project which are greater than those ordinarily encountered in daily life.

Benefits: You may gain an appreciation and understanding as to how research is conducted. In addition, you may see the benefits of Power Balance products and wish to purchase the products for your personal use, or you may not feel the benefits and gain the knowledge that you do not want to purchase them. No other benefits are foreseen.

Confidentiality: All information about you will be kept confidential and will not be released. Questionnaires and record forms will have identification numbers, rather than names, on them. Research records will be stored securely and only researchers and individuals responsible for research oversight will have access to the records. This information will be saved as long as it is scientifically useful; typically, such information is kept for five years after publication of the results. Results from this study may be presented at professional meetings or in publications. You will not be identified individually; we will be looking at the group as a whole. It is possible that the consent process and data collection will be observed by research oversight staff responsible for safeguarding the rights and wellbeing of people who participate in research.

Compensation: Subjects recruited by means other than the College of Education SONA subject recruitment system (http://okstate-coeosu.sona-systems.com) will not be offered credit in their courses. There will be no other form of compensation available to the subjects recruited by non-SONA means.

Contacts: You may contact any of the researchers at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study: Tyler J. Fox, ATC, Colvin Recreation Center, Health and Human Performance, Oklahoma State University, Stillwater, OK 74078, (785) 766.5330; Tyler.Fox@okstate.edu or Dr. Aric Warren, ATC, 180 Colvin Recreation Center, Stillwater, OK 74078, (405) 744.4060; Aric.Warren@okstate.edu. If you have questions about your rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, (405) 744.3377 or irb@okstate.edu

Rights: Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time, without penalty. Participation in this research is voluntary and there is no compensation available for participation other than that listed above. In case of injury or illness resulting from this study, basic emergency first aid treatment will be available immediately by a licensed certified athletic trainer conducting the research and any time thereafter you must report to the Oklahoma State University Student Health Center on your own time and cost. No funds have been set aside by Oklahoma State University to compensate you in the event of illness or injury. In the event of illness or injury the subject will be referred to the Oklahoma State University Student Health Center.

Signatures:

CONSENT DOCUMENTATION:

I am aware that no matter what treatment group I am chosen for that it is vital to the study that I give my best effort in all areas.

I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and the benefits of my participation. I also understand the following statements:

I affirm that I am 18 years of age or older.

I promise to give my best effort at all times during the testing.

I understand that I am NOT to perform any strenuous physical activity outside of the testing during the 24 hours that I am participating in the study.

I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me. I hereby give permission for my participation in the study.

_____ _____

Signature of Participant Date

I certify that I have personally explained this document before requesting that the participant sign it.

_____ _____

Signature of Researcher Date

COMPLIANCE DOCUMENTATION

I attest that I have not removed the bracelet at any time since the time it was placed on my wrist approximately 24 hours ago except to shower or bathe (no more than 30 minutes), nor have I done anything in the last 24 hours that would change my answers on the Health History Questionnaire.

_____ _____

Signature of Participant Date

I certify that I have personally explained this document before requesting that the participant sign it.

_____ _____

Signature of Researcher Date

CONSENT TO PARTICIPATE IN A RESEARCH STUDY
OKLAHOMA STATE UNIVERSITY (SONA Recruitment)

Project Title: Acute effects of Power Balance Bracelets on strength, balance, and flexibility

Investigators: Tyler J. Fox ATC, LAT; Softball Graduate Assistant; Health and Human Performance; Oklahoma State University, Stillwater, OK 74075; 785.766.5330

Aric Warren, EdD, ATC, LAT, CSCS; Associate Professor; Health and Human Performance; Oklahoma State University; Stillwater, OK; Phone: 405-744-4060; aric.warren@okstate.edu

Purpose: This study is being conducted as research at Oklahoma State University. The purpose of this study is to determine the acute effects of the application of Power Balance wrist bracelet on strength, balance, and flexibility.

Procedures: Following your commitment to participate in this study, you will report to the Applied Musculoskeletal and Human Physiology Laboratory (Colvin Recreation Center; room 192) dressed in athletic shorts and a t-shirt. You will complete a health history questionnaire form in order to determine if you qualify for this study. If you qualify to participate, you will sign this informed consent form and have your non-dominant hip range of motion tested to ensure it is less than 90 degrees. If you still qualify for the study you will be randomly assigned to 1 of 3 groups (treatment 1, treatment 2, or the control (no bracelet)).

In order to determine which group you will be assigned to, you will blindly take a piece of paper from a bowl with the numbers 1, 2, or 3. Testing will begin as soon as it is determined what group you will be in. You will be required to remove your shoes for the duration of the testing. Testing will commence as follows.

All subjects will perform all tests. Once all the tests have been performed all groups will perform the tests again. It is at this time when the subjects who have been assigned a number corresponding with a bracelet will apply the specific bracelet to their right wrist. The subjects who are assigned the option that does not include a bracelet will perform the tests again as well. Each initial testing session will take approximately 1 hour to perform. The follow-up session approximately 24 hours later will take approximately 30 minutes to complete.

The control group will have 20 subjects and they will know they are the control group because they will be given nothing to wear. However, it is important to the study they give their full and best effort for all tests. The treatment groups will be given bracelets to wear beginning at the second round on the 1st day of testing. They will be required to wear the bracelets continuously until they complete the last test on the 2nd day of testing. At no time will they be allowed to remove the bracelet for any reason.

To determine effects on balance you will be taken through the B.E.S.S. test consisting of 20 seconds of balancing in 3 different stances (single leg, double leg, tandem) on two different surfaces (flat ground and foam pad). The total number of errors in each stance for each surface will be counted and added together to achieve your B.E.S.S. score. You will be allowed 1 practice run going through the tests and 3 live trials. Your best score of the 3 trials for each surface will be used in the calculations. You will then move on to the other baseline testing before returning to complete the balancing test for the second round.

Power will be tested using a force plate to measure the amount of ground force generated when you perform a maximum vertical jump. You will stand on the force plate on the spot marked with tape. You will jump as high as you are able and attempt to land in the exact same place you jumped from. You will be allowed 1 practice jump and 3 live jumps that will be measured. The jump in which you produce the most power will be used for calculations.

Flexibility will be tested using a simple, but effective sit and reach test. You will be instructed to overlap your hands equally and lean forward in a smooth motion to slide the measuring device forward. You will be allowed 1 practice trial and 3 live trials. The trial in which you score the highest amount of flexibility will be used in calculations.

Risks of Participation: There are no known risks associated with this project which are greater than those ordinarily encountered in daily life.

Benefits: You may gain an appreciation and understanding as to how research is conducted. In addition, you may see the benefits of Power Balance products and wish to purchase the products for your personal use, or you may not feel the benefits and gain the knowledge that you do not want to purchase them. No other benefits are foreseen.

Confidentiality: All information about you will be kept confidential and will not be released. Questionnaires and record forms will have identification numbers, rather than names, on them. Research records will be stored securely and only researchers and individuals responsible for research oversight will have access to the records. This information will be saved as long as it is scientifically useful; typically, such information is kept for five years after publication of the results. Results from this study may be presented at professional meetings or in publications. You will not be identified individually; we will be looking at the group as a whole. It is possible that the consent process and data collection will be observed by research oversight staff responsible for safeguarding the rights and wellbeing of people who participate in research.

Compensation: Participants will earn course credit for their participation. Many introductory and lower-level College of Education and other courses offer students a small amount of course credit (usually less than 5% of their grade) for participation in the research process. Whether for required credit or extra credit, each course must offer alternatives to research participation for earning credit. For example, in HHP courses students have the opportunity to earn up to five "units" of research experience. This requirement may be fulfilled in one of four ways: 1) serving as a human participant in current research project(s), 2) attending special research events, 3) researching and writing 4 page papers on designated research topics, or 4) co-created relevant educational experience. Each hour of participation in a research project as a participant is generally regarded as satisfying one "unit" of the requirement, students completing a half hour will receive 0.5 units.

Students participating in this study will earn 1.5 "unit" of credit. Those subjects who were recruited by mouth, or not enrolled in a COE SONA course will not receive any inducements for their participation.

Contacts: You may contact any of the researchers at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study: Tyler J. Fox, ATC, Colvin Recreation Center, Health and Human Performance, Oklahoma State University, Stillwater, OK 74078, (785) 766.5330; Tyler.Fox@okstate.edu or Dr. Aric Warren, ATC, 180 Colvin Recreation Center, Stillwater, OK 74078, (405) 744.4060; Aric.Warren@okstate.edu. If you have questions about your rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, (405) 744.3377 or irb@okstate.edu

Rights: Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time, without penalty. Participation in this research is voluntary and there is no compensation available for participation other than that listed above. In case of injury or illness resulting from this study, basic emergency first aid treatment will be available immediately by a licensed certified athletic trainer conducting the research and any time thereafter you must report to the Oklahoma State University Student Health Center on your own time and cost. No funds have been set aside by Oklahoma State University to compensate you in the event of illness or injury. In the event of illness or injury the subject will be referred to the Oklahoma State University Student Health Center.

Signatures:

CONSENT DOCUMENTATION:

I am aware that no matter what treatment group I am chosen for that it is vital to the study that I give my best effort in all areas.

I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and the benefits of my participation. I also understand the following statements:

I affirm that I am 18 years of age or older.

I promise to give my best effort at all times during the testing.

I understand that I am NOT to perform any strenuous physical activity outside of the testing during the 24 hours that I am participating in the study.

I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me. I hereby give permission for my participation in the study.

_____ _____

Signature of Participant Date

I certify that I have personally explained this document before requesting that the participant sign it.

_____ _____

Signature of Researcher Date

COMPLIANCE DOCUMENTATION

I attest that I have not removed the bracelet at any time since the time it was placed on my wrist approximately 24 hours ago except to shower or bathe (no more than 30 minutes), nor have I done anything in the last 24 hours that would change my answers on the Health History Questionnaire.

_____ _____

Signature of Participant Date

I certify that I have personally explained this document before requesting that the participant sign it.

_____ _____

Signature of Researcher

APPENDIX E

Subject Information & Health History Questionnaire

Please answer the following questions to the best of your knowledge. Please place a check in the appropriate box. All information from this questionnaire will be kept confidential.

Subject ID number: _____

Please indicate the most appropriate answer to the following questions	Yes	No
1. Have you been injured or had surgery in the past 6 months?		
2. Are you currently active in a sporting event?		
3. Are you currently taking any sport supplements?		
2. Have you ever in your lifetime had any abnormal problems with balance?		
3. Are you currently experiencing any symptoms, injuries, or anything else that my effect your balance during the testing?		
4. Do you know of or have any medical conditions that might aggravate you during the study?		
5. Have you ever worn the Power Balance product or any products that make similar claims?		
6. Have you ever been diagnosed by a Physician with a concussion? (If so please notify the investigator and list your symptoms below)		

If "yes" to any of the above questions, please explain: _____
_____
_____
_____
_____
_____
_____

Should you become ill and/or incapable of finishing the study, alert the investigator (s) immediately.

APPENDIX F

Raw B.E.S.S. Data

Sub #: _____ Gr #: _____

Height(in):_____ Age (yrs): _____ Treatment Order: _____

Weight(lbs): _____ Gender(M/F): _____ Initial Date and Time: _____

Follow up Date and Time: _____

Instructions:

1. Subject first stands with both feet narrowly together, both hands on hips, and eyes closed
2. Subject holds this stance for 20 seconds while the examiner records the number of balance errors
    a. A balance error is operationally defined as:
        i. Opening the eyes, hands coming off of hips, taking a step, moving hips into 30° of abduction, lifting the forefoot or heel, remaining out of testing position for more than 5 seconds
3. Repeat the test with single leg stance using the non-dominant foot and again using a heel-to-toe stance with the non-dominant foot in the rear.

Premeasure						
	Trial 1		Trial 2		Trial 3	
Position	Ground	Foam	Ground	Foam	Ground	Foam
Double-Leg						
Single-Leg						
Tandem						
Total Errors						

Total Score			

Immediate Post-Measure						
	Trial 1		Trial 2		Trial 3	
Position	Ground	Foam	Ground	Foam	Ground	Foam
Double-Leg						
Single-Leg						
Tandem						
Total Errors						

Total Score			

24 Hours Post-Measure						
	Trial 1		Trial 2		Trial 3	
Position	Ground	Foam	Ground	Foam	Ground	Foam
Double-Leg						
Single-Leg						
Tandem						
Total Errors						

Total Score			

APPENDIX G
Power Balance Bracelet Study
B.E.S.S. Scores

		Pre-Measure				Immediate Post-Measure				24 Hours Post-Measure			
Sub #	**Gr #**	**1.1**	**1.2**	**1.3**	**Ave (1)**	**2.1**	**2.2**	**2.3**	**Ave (2)**	**3.1**	**3.2**	**3.3**	**Ave (3)**
1.	3	45.0	31.0	31.0	35.7	38.0	32.0	30.0	33.3	42.0	33.0	27.0	34.0
2.	2	10.0	11.0	16.0	12.3	25.0	14.0	12.0	17.0	17.0	14.0	15.0	15.3
3.	2	32.0	26.0	25.0	27.7	25.0	29.0	25.0	26.3	29.0	33.0	18.0	26.7
4.	3	7.0	8.0	14.0	9.7	12.0	11.0	8.0	10.3	17.0	13.0	8.0	12.7
5.	1	40.0	36.0	36.0	37.3	26.0	28.0	28.0	27.3	38.0	33.0	30.0	33.7
6.	2	17.0	14.0	17.0	16.0	20.0	19.0	29.0	22.7	14.0	13.0	17.0	14.7
7.	1	27.0	36.0	29.0	30.7	30.0	31.0	28.0	29.7	26.0	25.0	26.0	25.7
8.	1	18.0	22.0	27.0	22.3	16.0	22.0	22.0	20.0	15.0	16.0	17.0	16.0
9.	3	47.0	45.0	50.0	47.3	33.0	41.0	51.0	41.7	37.0	37.0	30.0	34.7
10.	3	14.0	18.0	20.0	17.3	17.0	13.0	20.0	16.7	26.0	34.0	15.0	25.0
11.	2	41.0	39.0	35.0	38.3	28.0	34.0	28.0	30.0	29.0	29.0	31.0	29.7
12.	2	43.0	37.0	28.0	36.0	33.0	42.0	31.0	35.3	40.0	33.0	48.0	40.3
13.	1	27.0	31.0	18.0	25.3	27.0	22.0	27.0	25.3	42.0	21.0	28.0	30.3
14.	2	24.0	24.0	19.0	22.3	21.0	19.0	19.0	19.7	24.0	23.0	32.0	26.3
15.	1	39.0	33.0	24.0	32.0	35.0	30.0	33.0	32.7	28.0	27.0	30.0	28.3
16.	3	17.0	13.0	27.0	19.0	28.0	12.0	14.0	18.0	15.0	16.0	18.0	16.3
17.	3	20.0	30.0	27.0	25.7	24.0	21.0	27.0	24.0	19.0	24.0	33.0	25.3
18.	2	48.0	42.0	36.0	42.0	42.0	40.0	34.0	38.7	35.0	29.0	39.0	34.3
19.	1	34.0	26.0	30.0	30.0	30.0	28.0	36.0	31.3	26.0	33.0	36.0	31.7
20.	1	30.0	28.0	22.0	26.7	23.0	21.0	14.0	19.3	23.0	18.0	17.0	19.3
21.	3	28.0	23.0	26.0	25.7	22.0	14.0	7.0	14.3	12.0	14.0	7.0	11.0
22.	2	29.0	36.0	38.0	34.3	34.0	31.0	31.0	32.0	31.0	28.0	27.0	28.7
23.	1	23.0	20.0	26.0	23.0	19.0	22.0	19.0	20.0	23.0	21.0	19.0	21.0
24.	3	32.0	25.0	32.0	29.7	27.0	35.0	33.0	31.7	21.0	24.0	24.0	23.0
25.	3	29.0	25.0	22.0	25.3	22.0	17.0	23.0	20.7	21.0	27.0	23.0	23.7
26.	1	29.0	23.0	22.0	24.7	14.0	28.0	24.0	22.0	17.0	29.0	23.0	23.0
27.	2	14.0	22.0	21.0	19.0	26.0	26.0	16.0	22.7	19.0	23.0	24.0	22.0

Power Balance Bracelet Study
Vertical Jump Scores

		Pre-Measure				Immediate Post-Measure				24 Hours Post-Measure			
Sub #	**Gr #**	**1.1**	**1.2**	**1.3**	**Ave (1)**	**2.1**	**2.2**	**2.3**	**Ave (2)**	**3.1**	**3.2**	**3.3**	**Ave (3)**
1.	3	26.5	27.0	29.0	27.5	27.6	28.0	29.5	28.4	28.5	30.0	31.0	29.8
2.	2	31.0	31.0	31.8	31.3	31.0	32.5	32.5	32.0	31.5	30.5	32.0	31.3
3.	2	31.0	35.0	36.5	34.2	37.0	37.5	36.5	37.0	36.5	36.0	38.5	37.0
4.	3	30.0	30.5	30.0	30.2	31.0	31.0	31.0	31.0	31.5	31.0	32.0	31.5
5.	1	35.0	37.0	37.0	36.3	39.0	40.0	29.5	36.2	38.5	41.0	40.5	40.0
6.	2	28.5	29.5	29.5	29.2	29.5	29.5	29.5	29.5	27.0	27.5	28.5	27.7
7.	1	30.0	30.0	31.0	30.3	33.0	33.0	32.5	32.8	32.0	33.0	32.0	32.3
8.	1	35.0	36.5	38.5	36.7	37.0	38.5	40.0	38.5	37.0	36.5	39.5	37.7
9.	3	30.5	29.0	33.0	30.8	32.0	31.5	33.0	32.2	32.5	31.0	30.5	31.3
10.	3	34.0	35.0	35.5	34.8	34.5	34.0	35.0	34.5	34.0	36.0	34.5	34.8
11.	2	34.5	35.0	34.0	34.5	34.0	35.5	35.0	34.8	35.5	35.5	33.5	34.8
12.	2	24.5	25.0	25.5	25.0	26.0	27.0	26.0	26.3	26.5	27.5	28.0	27.3
13.	1	13.0	14.5	15.0	14.2	17.0	18.5	19.0	18.2	14.5	16.0	18.0	16.2
14.	2	34.0	37.0	41.0	37.3	42.0	40.5	42.0	41.5	39.5	42.0	42.0	41.2
15.	1	39.5	38.0	38.0	38.5	38.5	38.5	37.0	38.0	39.5	41.5	39.5	40.2
16.	3	15.0	17.5	17.5	16.7	15.0	14.5	15.5	15.0	13.5	14.0	14.0	13.8
17.	3	34.5	34.5	34.5	34.5	37.5	37.5	38.5	37.8	39.5	40.0	39.0	39.5
18.	2	33.0	33.5	33.5	33.3	31.5	32.5	35.0	33.0	33.0	33.0	33.0	33.0
19.	1	44.0	43.0	44.0	43.7	44.5	45.0	46.0	45.2	42.5	41.5	44.0	42.7
20.	1	40.5	41.5	39.0	40.3	40.0	39.0	38.0	39.0	38.0	37.0	37.0	37.3
21.	3	29.0	32.5	31.5	31.0	34.0	35.0	35.5	34.8	35.5	36.0	38.0	36.5
22.	2	32.5	35.5	35.0	34.3	35.5	36.0	38.0	36.5	35.5	35.5	37.0	36.0
23.	1	37.5	38.0	39.0	38.2	37.0	37.0	37.5	37.2	30.5	33.5	34.0	32.7
24.	3	25.5	28.5	28.0	27.3	29.0	32.0	29.0	30.0	32.0	30.0	32.5	31.5
25.	3	33.0	32.0	35.0	33.3	34.0	33.5	36.0	34.5	36.5	36.5	37.5	36.8
26.	1	12.5	11.5	13.0	12.3	13.5	13.0	13.5	13.3	13.0	12.0	13.0	12.7
27.	2	20.0	18.5	12.5	17.0	20.5	24.0	23.5	22.7	20.0	23.0	22.5	21.8

Power Balance Bracelet Study
Sit and Reach Scores

		Pre-Measure				Immediate Post-Measure				24 Hours Post-Measure			
Sub #	Gr #	1.1	1.2	1.3	Ave (1)	2.1	2.2	2.3	Ave (2)	3.1	3.2	3.3	Ave (3)
1.	3	2054	2021	1823	1966.00	1759	1806	1621	1728.67	1486	1483	1452	1473.67
2.	2	1512	1421	1308	1413.67	1373	1307	1303	1327.67	1328	1230	1178	1245.33
3.	2	1523	1500	1518	1513.67	1673	1588	1534	1598.33	1648	1621	1541	1603.33
4.	3	1424	1386	1430	1413.33	1479	1439	1407	1441.67	1440	1533	1508	1493.67
5.	1	1459	1425	1537	1473.67	1426	1510	1506	1480.67	1379	1500	1389	1422.67
6.	2	1441	1396	1549	1462.00	1571	1475	1450	1498.67	1370	1392	1412	1391.33
7.	1	1346	1327	1308	1327.00	1354	1543	1614	1503.67	1372	1524	1386	1427.33
8.	1	1428	1398	1369	1398.33	1482	1439	1411	1444.00	1427	1491	1451	1456.33
9.	3	1590	1562	1524	1558.67	1614	1445	1546	1535.00	1616	1476	1450	1514.00
10.	3	2130	2141	2094	2121.67	2215	2192	2113	2173.33	2276	2205	2141	2207.33
11.	2	1199	1329	1296	1274.67	1177	1220	1215	1204.00	1322	1315	1263	1300.00
12.	2	1609	1614	1685	1636.00	1673	1622	1625	1640.00	1650	1637	1687	1658.00
13.	1	1906	1886	1886	1892.67	1747	1729	1729	1735.00	1801	1823	1814	1812.67
14.	2	1691	1766	1567	1674.67	1775	1760	1737	1757.33	1715	1632	1673	1673.33
15.	1	2149	2020	2123	2097.33	2034	2003	1927	1988.00	1850	1803	1846	1833.00
16.	3	2216	2157	2248	2207.00	2141	2223	2278	2214.00	2175	2336	2312	2274.33
17.	3	1886	1901	1847	1878.00	1694	1854	1845	1797.67	1663	1869	1821	1784.33
18.	2	1138	1090	1169	1132.33	1142	1114	1147	1134.33	1106	1143	1177	1142.00
19.	1	924	967	1020	970.33	1010	972	1014	998.67	988	915	1036	979.67
20.	1	2044	2104	2053	2067.00	2061	2110	2120	2097.00	2235	2171	2110	2172.00
21.	3	1506	1457	1471	1478.00	1445	1478	1402	1441.67	1514	1493	1457	1488.00
22.	2	982	958	1035	991.67	1049	1050	1030	1043.00	1016	1000	938	984.67
23.	1	1483	1497	1510	1496.67	1479	1465	1525	1489.67	1564	1532	1526	1540.67
24.	3	1500	1498	1470	1489.33	1475	1457	1581	1504.33	1499	1522	1501	1507.33
25.	3	1728	1821	1695	1748.00	1769	1647	1721	1712.33	1799	1777	1762	1779.33
26.	1	1737	1858	1796	1797.00	1817	1827	1957	1867.00	1762	1790	1885	1812.33
27.	2	1861	1601	1594	1685.33	1621	1820	1718	1719.67	1734	1795	1746	1758.33

Can You Improve Strength, Balance, & Flexibility Immediately with only a Bracelet??

Volunteers are needed in this athletic training investigation. You qualify for this investigation if you:

- have NOT been seriously injured in the past 6 months
- have NOT consumed sports supplements, over-the-counter or prescription pain or anti-inflammatory medications within 24 hrs. of testing
- do NOT have any previous history or current problems with normal balance
- are NOT pregnant (if applicable)
- have NOT worn a similar product designed to improve your functional ability in these areas
- have NOT been diagnosed by a Physician with a concussion of greater than Grade 1 in the last year. (if you have questions please ask)
- Meet the flexibility requirements of less than 90° hip flexion in non-dominant hip (determined by investigators during pretesting, please contact investigator for more information)

You will be required to visit the OSU Applied Musculoskeletal and Human Physiology Research Lab (CRC room 192) 1 time for approximately 1 hour with 1 follow up 24 hours later lasting approximately 30 minutes. You will need to **dress in a T-shirt and shorts**.

You will complete a health history questionnaire form. Following your acceptance to the study you will take a piece of paper from a bowl with the number 1, 2, or 3. Depending on the number written on the piece of paper you will either be given a band to wear throughout portions of the study or you will not. Following selections you will perform the following tests in a randomly selected order

- A simple balance testing protocol used in sports concussion testing
- A test for your force production during a vertical jump using a force plate
- A V-sit and reach test for hamstring flexibility.

If you are interested in participating or have any questions, call Tyler Fox 785-766-5330 or e-mail him at tyler.fox@okstate.edu (email preferred)

VITA

Tyler John Fox

Candidate for the Degree of

Master of Science

Thesis: ACUTE EFFECTS OF POWER BALANCE BRACELETS ON STRENGTH, BALANCE, AND FLEXIBILITY

Major Field: Health and Human Performance

Biographical:

Education:

Completed the requirements for the Master of Science in Health and Human Performance at Oklahoma State University, Stillwater, Oklahoma in July, 2011.

Completed the requirements for the Bachelor of Science in Education: Emphasis Athletic Training at The University of Kansas, Lawrence, KS in 2009.

Experience:

Oklahoma State University: Graduate Assistant Athletic Trainer: Softball

University of Kansas: Athletic Training Student

Professional Memberships:

BOC Certified Athletic Trainer (#2000001720)	July 2009 – Present
Licensed Athletic Trainer (Oklahoma #587)	Aug 2009 – Present
National Athletic Trainer's Association (#1011656)	Aug 2007 – Present
American Red Cross: Professional Rescuer	May 2007 – Present
American Red Cross: First Aid	May 2005 – Present

Name: Tyler John Fox Date of Degree: July, 2011

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: ACUTE EFFECTS OF POWER BALANCE BRACELETS ON STRENGTH, BALANCE, AND FLEXIBILITY

Pages in Study: 51 Candidate for the Degree of Master of Science

Major Field: Health and Human Performance

Scope and Method of Study: The purpose of this study was to examine the acute effects of Power Balance bracelets on strength, balance, and flexibility. For this human subjects approved study, 27 healthy subjects were recruited with no history of lower extremity injury, concussion, or use of similar products in the 6 months prior to study participation. Twenty-seven subjects (male: n = 9, age = 24.44 ± 3.05 yrs, ht = 180.34 ± 4.58 cm, mass = 70.08 ± 10.49 kg; female: n = 18, age = 22.17 ± 2.07 yrs, ht = 166.93 ± 7.78 cm, mass = 82.58 ± 9.53 kg) completed all requirements of the study. Subjects were randomly assigned to 1 of 3 groups receiving either a; power balance bracelet, placebo bracelet, or nothing (control). Subjects completed baseline testing in a randomized order for balance, flexibility and power before receiving their treatment. Immediately after completion of pretesting and all tests were immediately administered again exactly as they were in the pretest. Subjects were instructed not to remove or tamper with their bracelet until after they visited the lab again 24 hours later and were taken through all tests again.

Findings and Conclusions: The Power Balance product provides no significant increase in performance in any of the categories measured in this study. The results seen in field testing are likely attributable to the learning effect in testing methods as well as the reciprocal inhibition phase of PNF stretching in the case of flexibility. Clinically, the results of this study cannot be used to support the use of Power Balance technology to enhance performance in the areas of balance, flexibility or strength.

ADVISER'S APPROVAL: Aric Warren Ed.D., ATC, LAT