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JOURNAL OF ATHLETIC TRAINING

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Dear NATA Members and Friends,

We are pleased once again to present the annual supplement to the *Journal of Athletic Training*. The supplement contains abstracts from the Free Communications Sessions sponsored by the NATA Research and Education Foundation and held at the NATA Annual Meeting.

The Free Communications Sessions allow athletic trainers and other healthcare providers the opportunity to present and learn about the latest in athletic training research. Research is presented in oral and poster formats and includes general research, Foundation-funded research, thematic posters, and clinical case reports. Abstracts of the research are presented in the order of presentation at the NATA Annual Meeting for your convenience.

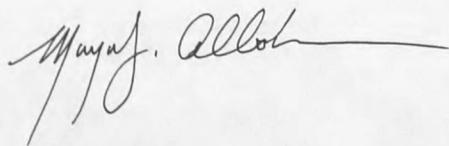
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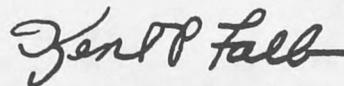
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Marjorie J. Albohm, MS, ATC
President, NATA Research & Education Foundation



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JOURNAL OF ATHLETIC TRAINING

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Thank You!

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The Effects of Cold Application on Nerve Conduction Velocity and Muscle Force

Knight KL, Okuda I, Ingersoll CD, Edwards JE: Indiana State University, Terre Haute, IN

Problem: There is much confusion concerning the effects of ice application on muscle force and how soon an iced athlete can return to physical activity. Previous research from our laboratory indicates that while force may be decreased by cold applications, functional activity is unaffected because of increased muscle activation. We wondered what the relationship was between muscle force and nerve conduction velocity following superficial cold applications. **Design:** A 2x2x5 repeated measures factorial design guided this study. Independent variable included treatment groups (ice and control), nerves (ulnar and median), and time (before treatment and 0, 20, 40, and 60 min following treatment). Two dependent variables were measured: motor nerve conduction velocity (NCV) and muscle force during a maximum voluntary isometric contraction (MVIC) on a hand held dynamometer. Ten healthy student volunteers were subjects. Each was tested on two separate days (ice & control). **Methods:** Ice was applied with two 1.2kg crushed ice packs applied on either side of the proximal 2/3rds of the forearm from just proximal of the elbow. They were held in place by a 6" elastic wrap with moderate tension. Nerve conduction velocity was measured with a double stimulation technique on a Biopac analyzer/amplifier using 8mm surface electrodes in the ulnar and median nerves. The difference of the location and magnitude was revealed by simple Paired T-tests and Newman-Keuls Post Hoc Tests. **Results:** Nerve conduction velocity was significantly less during following ice application at 0, 20, and 40 minutes in the ulnar and at 0 in the median nerve. There was no difference in muscle force. Superficial (ulnar) nerve conduction velocity was decreased more than that of the relatively deep median nerve (39% vs 20% at time 0). Nerve conduction velocity decreased most just after the ice application and gradually returned to normal. **Conclusion:** This study adds to the body of knowledge concerning the neuromuscular changes due to application of ice and compression, although it still doesn't answer the question about when to return an athlete to physical activity following icing.

The Effects Of Contrast Therapy On Intramuscular Temperature Of The Human Gastrocnemius Muscle

Higgins DL, Kaminski TW, Lacey DW, Spear PF: Marietta College, Marietta, OH

Contrast therapy has a long history of therapeutic use. Very little research is available examining the efficacy of this common treatment modality. The purpose of this study was to examine the effects of contrast therapy treatment on intramuscular tissue temperature of the gastrocnemius muscle. Twenty (7 females and 13 males) healthy, college students (age=20.9±1.2 yr, wt=79.2±21.7 kg, ht=178.5±11.1 cm) participated in this study. The subjects were randomly assigned to either the control (10) or treatment (10) groups. Intramuscular temperature was measured in the right gastrocnemius muscle at a depth of 4 cm, using a Series 522 Yellow Springs (YSI Incorporated, Yellow Springs, OH) temperature probe. A baseline intramuscular temperature was recorded two minutes after insertion. The experimental subjects were involved in a contrast therapy treatment for a total time of 31 minutes. The control subjects immersed their treatment leg in a warm whirlpool for 31 minutes. Intramuscular tissue temperature was recorded every 30 seconds during the treatment. In both groups, the effects of the treatment were analyzed by calculating the temperature change from baseline at ten points during the treatment time. A mixed model ANOVA was used to determine differences between the groups with respect to temperature change from baseline over those ten points. A t-test was used to analyze the differences in overall temperature change between the two groups. The results showed a significant difference between the two groups relative to overall temperature change [$t = -2.48, p = .02$]. The overall temperature change in the control group was 2.1 ± 1.5 degrees, while in the experimental (contrast) group the temperature change was $.85 \pm .6$ degrees. The ANOVA results demonstrated a significant interaction [$F(9,162) = 22.0, p < .001$] between group (control vs. experimental) and temperature change from baseline. The Tukey post hoc analysis showed differences in temperature change between both groups at all time periods, except from baseline to 11 minutes. Despite the statistical significance of the data in this study, the clinical significance remains questionable. In both groups the intramuscular tissue temperature never reached 40°C, indicating that the physiological effects of heating may not have occurred. Furthermore, tissue temperature did not significantly decrease in the experimental (contrast) group upon exposure to cold. These results appear to question the efficacy of contrast therapy.

A Comparison Of Subcutaneous And Intramuscular Temperature Change Between Ice Pack And Cold Whirlpool Cryotherapy

Myrer JW, Measom G, Fellingham GW: Brigham Young University, Provo, UT

Cryotherapy is a fundamental modality used in the treatment of athletic injuries. Two common methods of cold application are ice packs and cold whirlpools. The purpose of our study was to compare the cooling and rewarming effects of 20-minute treatments of ice pack and cold whirlpool cryotherapy on the subcutaneous and intramuscular temperatures of the human lower leg. Thirty-two subjects (17 men and 15 women) took part. Sixteen were randomly treated either with a 20-min 1.8 kg crushed-ice pack placed directly over the triceps surae muscle group, or 20-min in a cold (10°C) whirlpool. Subcutaneous and muscle tissue temperatures were measured by 26-gauge hypodermic needle microprobes inserted in the left calf just below the skin or 1 cm below the subcutaneous fat, respectively. There was a significant difference in temperature decrease subcutaneously ($p < .05$). This difference was apparent after the first five minutes and remained at the end of the 20-min treatment ($-16.97 \pm 3.81^\circ\text{C}$ ice pack and $-13.78 \pm 2.97^\circ\text{C}$ cold whirlpool). There was no significant difference in the decrease in intramuscular temperatures between treatments ($-7.09 \pm 4.07^\circ\text{C}$ ice pack and $-5.13 \pm 1.83^\circ\text{C}$ cold whirlpool). Although not significant, the ice pack produced a more rapid temperature decrease throughout each five minute interval of treatment. The subcutaneous temperature rewarmed significantly more in the ice pack group ($12.31 \pm 3.28^\circ\text{C}$ ice pack and $7.43 \pm 2.14^\circ\text{C}$ cold whirlpool). Most interesting was the significant difference between groups during intramuscular rewarming. The ice pack group's mean temperature increased over each 5-min interval of the 30-min rewarming period for an overall increase of $1.96 \pm 3.06^\circ\text{C}$. The cold whirlpool group, conversely, continued to get colder during the 30-min post treatment, for an overall decrease of $-1.76 \pm 1.36^\circ\text{C}$. We believe our results have significant clinical application. If rapid and significant temperature decrease is your goal, as in immediate management of athletic injuries, our results suggest crushed-ice packs are superior to cold whirlpools. However, if your goal is significant temperature reduction that is prolonged after treatment, such as during rehabilitation using cryokinetics, our results indicate cold whirlpools are superior to crushed-ice packs.

Changes In Dynamic Postural Stability Following Cryotherapy

Flynn WL, Horodyski MB, Meister K:
University of Florida, Gainesville, FL

The purpose of this study was to determine if cryotherapy had an effect on the neuromuscular input of the lower extremity during dynamic positions. A diminished dynamic stability may increase the risk for injury. The subjects were 23 (16 males, 9 females) university students who participated in recreational sport activities. Subjects were free from any injury to the lower extremities and back. The subjects had no head trauma or chronic ear infections within the past two years. The subjects attended three days of testing. One test day consisted of no cryotherapy treatment and served as the control. Cryotherapy treatments were administered on separate days at two temperatures: 15°C and 5°C. The dynamic postural stability indexes (stability, medial/lateral and anterior/posterior) were measured at one, two, three, four, five, ten, and fifteen minutes post-treatment. Data were analyzed using ANOVA with repeated measures, a 2x2x7 MANOVA, and paired t-tests. The level of significance was set at $p < .05$. No significant differences of the dynamic postural stability indexes were noted between dominant and nondominant limbs for the control trials, 15°C, and 5°C. Results of this study indicated that a significant difference was seen between time for stability and anterior/posterior indexes. A negative linear regression suggested that an increase in stability occurred over time. Analysis of the data revealed that the one minute interval measurements for stability indexes were greater than the control. This indicated that dynamic postural stability was initially decreased at one minute following ice immersion. No statistically significant difference was observed between the effects of immersion at 15°C and 5°C on dynamic postural stability, but the results indicated a possible trend toward a greater decrease in dynamic postural stability at 5°C. Thus, results of this study suggest that athletic trainers need to be cautious when using cryotherapy treatments prior to athletic activity.

Effects Of Cryotherapy Applied Through Various Barriers On Skin Temperature, Body Temperature, Heart Rate, And Blood Pressure

Tsang KKW, Buxton BP, Guion WK,
Hardy CJ, Fritz T: Georgia Southern
University, Statesboro, GA

The purpose of this study was to investigate the differences in skin temperature, body temperature, heart rate, and blood pressure during ice application applied through a towel and an elastic bandage. Nine subjects (5 males & 4 females) with a mean age of 22 (± 1.0) years participated in the study. Each subject read and signed an informed consent form and a pre-participation questionnaire prior to their participation in the investigation. A within subjects repeated measures design was used. The subjects completed three treatment sessions over a three day period, with a 24 hour rest between each treatment session. Each treatment consisted of a 10 minute pre-treatment measure for standardization of skin temperature (S temp), general body temperature (G temp), heart rate (HR), and blood pressure (BP). Then subjects completed a 30 minute treatment session which consisted of ice application (1.5 lb. Of crushed ice) applied through three conditions; (1) Towel, (2) Elastic Bandage, and (3) Control (directly on skin). Following the removal of the ice, all subjects were monitored for 20 minutes for S temp, G temp, HR, and BP. All measurements were recorded every two and a half minutes. A repeated measures ANOVA was performed to determine if differences existed between treatment groups. Significant differences between groups were determined using a Scheffe's post hoc F test. The alpha level was set at $p < 0.05$. The results of the investigation indicated that significant differences ($p = 0.0001$) existed in S temp between Control (14.03 ± 6.82) and Towel (24.41 ± 3.43), Control (14.03 ± 6.82) and Elastic Wrap (27.77 ± 2.54), and Towel (24.41 ± 3.43) and Elastic Wrap (27.77 ± 2.54). A significant difference in G temp was found between Control (96.15 ± 1.05) and Towel (95.35 ± 2.97). Furthermore, significant differences existed in Systolic BP between Control (120.24 ± 11.69) and Towel (112.74 ± 7.56), and Control (120.24 ± 11.69) and Elastic Wrap (114.11 ± 10.03). A significant difference in Diastolic BP was observed between Control (78.94 ± 8.22) and Towel (74.79 ± 6.73). The findings of this investigation indicate that using a barrier (towel or elastic bandage) limits the physiological effects of the ice application. Therefore, to enhance the physiological effectiveness of an ice treatment, barriers should not be used. These findings may help the athletic health care specialist become more efficient and productive in treating injured athletes, using cryotherapy.

The Effects Of Cryotherapy On Fine Motor Control In The Finger

Rublely MD, West TF, Newell KM: The
Pennsylvania State University, University
Park, PA

The effects of cryotherapy on motor control have yet to be completely investigated. Cryotherapy produces altered sensory input to the central nervous system but it is unclear what effect this has on motor control. Fine control of motor output relies on various sensory inputs. The purpose of this study was to investigate the effect of a fifteen min ice bath immersion of the distal phalanx of the first finger on the variability of force production in a finger pressing task. Twelve volunteer subjects (age = 23.7 ± 2.46 yr) participated. Subjects were tested on consecutive days. On day one subjects were randomly assigned to immersion in a 7.7° c ice bath or rest before testing and for thirty seconds between finger pressing trials. Prior to treatment, subjects' cutaneous sensory levels were measured to determine sensitivity to pressure and neuron density using Semmes-Weinstein monofilaments and a Disk Criminators two point discrimination device. In addition, a maximum force output was determined each day, using the mean of a three repetition maximum test. After ice immersion or rest sensory levels were reassessed and subjects performed a finger pressing task trial. Three finger task trials were performed with and without vision at 10% and 40% of maximum with thirty seconds of ice immersion or rest between each trial. Variability of force production was measured by having the subject press on a load cell for twenty seconds. At the end of testing sensation was again measured to ensure the altered sensation was maintained. On the second day of testing subjects received the opposite condition and were tested in reverse order of force outputs. Pressure sensitivity was not significantly ($p > .05$) affected by cold but two point discrimination was diminished ($p < .05$) following cold immersion and at the end of testing ($p < .05$). The variances of all the trials under each condition where averaged for each subject and a three-factor repeated measures ANOVA was performed. When vision was removed it significantly ($p < .05$) increased force variability. Following ice immersion variability in the finger pressing task was not significantly ($p > .05$) improved or diminished. There was no interaction between these two conditions. A fifteen min ice bath immersion did not effect maintenance of force in a finger pressing task suggesting that cold application may not influence fine motor control.

A Survey Of Lightning Policy In Selected Division I Colleges

Walsh, KM, Hanley, MJ, Graner, SJ, Beam, DJ, Bazluki, JM: East Carolina University, Greenville, NC

The purpose of this research was to investigate the hazards of lightning for participants of outdoor athletics, and to assess the existence and nature of lightning safety policy at the collegiate level. A review of the literature demonstrates the fatal potential of lightning, the risk being highest in the late spring through early autumn. The time of highest risk is from mid-afternoon until dark which affects many outdoor athletics. Data from the National Severe Storms Laboratory in Norman, Oklahoma, demonstrate that Florida, Michigan, Pennsylvania, North Carolina, and New York lead the country in lightning deaths and injuries from 1959 - 1994. A survey of the aforementioned states' National Collegiate Athletic Association Division I Universities shows that only 8% of these institutions have a written policy regarding safety in lightning situations. The results also indicate a clear lack of written safety instructions, failure to identify a person in charge of recognizing danger, and confusion as to when to postpone a practice. It is the intention of this report to demonstrate the need for a systemic plan of action to make fields safer for all who are involved in outdoor sport activities.

Sexual Harassment Issues In Athletic Training And Athletics

Velasquez BJ, MacBeth JL: The University of Southern Mississippi, Hattiesburg, MS and Middle Tennessee State University, Murfreesboro, TN

The purpose of this study was to examine the issues, perceptions and experiences of athletic trainers and athletic directors in the area of sexual harassment. **Subjects:** One hundred certified athletic trainers and one hundred athletic directors employed at universities and colleges were selected at random from thirteen states located in the southeastern region of the United States. The two groups combined, produced 119 usable surveys accounting for a total return response of 60%. Of the athletic trainers, (57% return), seventeen were female and forty were males. Of the athletic directors, (62% return), eighteen were female and forty-four were male. **Experimental Method:** This study was a causal-comparative design using a mailed-out survey questionnaire composed of (60) sixty questions broken down into the area of perceptions, experiences and problems encountered with handling sexual harassment. Questions specific to the area of athletics and athletic training were modified for use in this study. A two-way ANOVA was used to analyze nominal data and determine the statistically significant differences (at the .05 level of significance) among the frequencies of response. Additional research questions not addressed by the null hypotheses generated descriptive data. **Results:** This study found that there is a significant difference between the genders with females having higher perceptions and experiences of sexual harassment than males. The study also found that as a group, there was no significant difference in perceptions and experiences. Additional findings include that sexual harassment is not a problem only for females, both males and females are targets of sexual harassment. **Conclusions:** Athletic Directors are more cognizant of sexual harassment issues than athletic trainers. Athletic trainers are not fully aware that sexual harassment exists in this profession or poses a problem, although survey results (25% of the ATC respondents) indicate otherwise. The power of an superior is not instrumental in the initiation of sexual harassment. Of the cases reviewed, majority of sexual harassing behavior is from a colleague, student or other individual who was not in an administrative or supervisory role. Colleagues and associates who share equal positions of salary/employment display sexually harassing behavior more than supervisors. Individuals in supervisory positions may be subjected to (contra power) sexual harassment and gender discrimination from students more times than from supervisors.

The Impact Of Managed Health Care With Intercollegiate Football Athletic Trainers

Synowka DP, Gorse K, Bruce SL, Smith AD: Robert Morris College, Moon Township, PA

Historically, intercollegiate athletic health care has predominantly been paid for by family health care benefits through a variety of group insurance plans which permitted flexibility in the selection of physicians and ancillary health care services. Managed health care (MHC) is a system which attempts to control the cost, quality, and access of health care delivery. During the past two decades, in the United States there has been a phenomenal growth of MHC organizations. While the impact of the MHC system has been studied with various health care professions and consumer groups, little or no research has been done with the athletic training profession. A goal of this study was to explore the effect of MHC with health care services in intercollegiate athletics.

A survey consisting of 50 items was mailed to certified athletic trainers at 75 institutions participating in NCAA Division I, II, and III football programs during the 1995 season. With a response rate of 85%, summary data had 94% of the respondents reporting an increase in their student athletes being covered by MHC plans. Twenty eight percent reported a change in their athletic departmental secondary/primary insurance coverage due to MHC with 76% of this group reporting an increase in the athletic departmental medical services budget.

Additional data showed a 28% decrease in referrals to institutional team physicians with 70% reporting additional administrative responsibilities associated with interacting with MHC organizations. Seventy two percent indicated that MHC plans did not improve the quality of health care for their athletes and 84% agreed that MHC plans created greater role strain in their relationships with student athletes, coaches, parents, team physicians and athletic administrators in coordinating sports medicine health care. Finally, 84% disagreed that MHC organizations recognized the role of certified athletic trainers in intercollegiate athletics.

In conclusion, providing, coordinating and paying for quality health care in intercollegiate athletics is a vital support function. Managed health care has created issues for intercollegiate athletic trainers and departments of athletics and is an area which needs further research.

Comparison Of Concentric Versus Eccentric Hamstring Strength Training Using The Negator™ Training Device

Murphy RM, Kaminski TW, Wabbersen CV: University of Florida, Gainesville, FL

Hamstring injuries can be quite debilitating and often result in chronic problems. Eccentric muscular actions are often the last line of defense against muscular injury and ligamentous disruption. Traditionally, the focus of hamstring strength rehabilitation has been on concentric muscle actions. The purpose of this study was to compare hamstring muscle strength between concentric and eccentric hamstring strength training. Thirty-three healthy, male subjects (age = 22.9 ± 2.85 yr., wt = 82.0 ± 14.4 kg, ht = 177.9 ± 7.0 cm) participated in this study. Subjects were randomly assigned to one of three treatment groups: eccentric training, concentric training, and control. Hamstring curls were performed using the Negator™ (Myonics, Inc., Metairie, LA) isotonic weight training device. This specially designed isotonic resistance device is capable of producing both concentric and eccentric muscle actions within a single repetition. Pre-test 1RM weight values were determined for all subjects using a standardized 1RM protocol. Control group subjects refrained from weight training for 6 weeks. Subjects in the training groups trained two days per week for 6 weeks (12 sessions). Each training session was initiated by a stationary bicycle warm-up and lower extremity stretching. Subjects performed one warm-up set of 8 repetitions at 50% of their 1RM. Following a brief rest, subjects in the concentric group performed 2 training sets at 80% of their 1RM. Subjects in the eccentric group performed 2 training sets at 40% of their 1RM concentrically (up) and 100% of their 1RM eccentrically (down). 1RM values were obtained from all subjects at the conclusion of the study. A mixed model ANOVA with repeated measures was used to compare the 1RM weight values. The results showed a significant interaction between group and test [$F(2,30) = 28.05, p < .001$]. A Tukey post hoc analysis was performed to examine the differences of interest. The concentric group improved 17%, while the eccentric group improved 32%. The control group subjects did not show any significant change over the 6 weeks. These results demonstrate the effectiveness of isotonic strength training on the development of hamstring muscle strength. More importantly is the dramatic effect of eccentric strength training on overall hamstring muscle strength. Clinicians should consider using eccentric hamstring relationship between muscle injury and eccentric strength exercise requires further study. The strengthening as part of their rehabilitation protocols for hamstring and knee injuries.

Effects Of An Open Versus Closed Kinetic Chain Exercise Program On Shoulder Proprioception

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Open and closed chain exercises are commonly prescribed in the rehabilitative process. Some attention has been given to the effects of these exercises on lower extremity proprioception. However, very little research has compared the effects of open and closed chain exercise on upper extremity proprioception. This study compared the effects of open (supine dumbbell press) and closed (standard push-up) kinetic chain exercise on shoulder proprioception (joint reposition sense) in 39 healthy male military cadets (age = 16.31 ± 1.54 yrs, ht = 177.47 ± 10.67 cm, wt = 78.70 ± 17.42 kg). Subjects were randomly assigned to an open chain (n = 13), closed chain (n = 13) or control (n = 13) group. Pre and post-test training joint reposition sense was tested on a Cybex II (Division of Lumex, Inc., Ronkonkoma, NY) with a flexometer (Leighton, Spokane, WA) attached to the arm of the Cybex. Active and passive angular reproduction was assessed in 30 deg internal rotation, 30 deg external rotation, and 10 deg from full external rotation. A three within (test, angle, active/passive) and one between (group) analysis of variance with tukey post hoc analyses were computed. The finding of greatest relevance to this study was a group x test interaction ($F(2,36) = 29.29, p < .01$). The open and closed chain groups decreased in reposition error scores in comparison to the control group, but no difference was found between the two training groups ($p > .05$). This finding suggests that shoulder joint proprioception can be enhanced with training in healthy subjects. Also, open and closed kinetic chain exercise appear to be equally effective in improving shoulder joint proprioception.

Effect Of Closed Kinetic Chain Training On Neuromuscular Control Of The Upper Extremity Using The Functional Activity System For Testing And Exercise (Fastex)

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Injury to a joint can cause disruption of the proprioceptive mechanoreceptors within the joint and surrounding soft tissue, which are responsible for static and dynamic stabilization of the joint. The rehabilitation process focuses on restoring range of motion, strength, neuromuscular control and proprioception. While open chain exercises are necessary to properly strengthen the shoulder musculature for any upper extremity activity, it is imperative that proprioceptive mechanoreceptors within the joint be trained as well. The mechanoreceptors responsible for proprioception and neuromuscular control are maximally stimulated when the joint surfaces are compressed. This can be accomplished through closed kinetic chain exercise. The purpose of this study was to investigate the effect of a four week closed kinetic chain training program on the neuromuscular control of the upper extremity. Thirty-two normal, physically active subjects (14 male, 18 female) were randomly divided into two groups. The Training Group consisted of 7 males (age = 20.3 ± 1.1 yr; wt = 82.2 ± 6.4 kg; ht = 110.6 ± 2.8 cm), and 9 females (age = 19.3 ± 1.2 yr, wt = 60.5 ± 8.5 kg, ht = 99.7 ± 3.1 cm); and the Control Group consisted of 7 males (age = 20.1 ± 0.9 yr; wt = 76.9 ± 5.8 kg; ht = 109.8 ± 2.8 cm) and 9 females (20.4 ± 1.0 yr, wt = 62.5 ± 7.5 kg, ht = 101.3 ± 3.4 cm). All 32 subjects were tested twice on the FASTEX (pre-test/post-test) four weeks apart. A stability index was recorded as the dependent variable. A more stable position is indicated by a lower stability index score. The Training Group participated in a four week, three times per week closed kinetic chain training program using the non-dominant arm. The Control Group did not participate in the training program, with four weeks of relative inactivity for the upper extremity between the two FASTEX measurements. A mixed model (1 between, 2 within) repeated-measures ANOVA revealed a statistically significant group by test interaction ($p < .05$). Additionally, main effects were revealed for test ($p < .05$) and arm (skill-dominant vs. non-dominant) ($p < .05$). It was concluded that the closed kinetic chain training significantly improved the Training Group's ability to remain stable, as indicated by a decrease in the stability index for the post-test. The non-dominant limb tested significantly better for all Training Group subjects. The results suggest that increased accuracy of joint position sense due to increased stimulation of the mechanoreceptors can be attributed to the closed kinetic training. Further studies should investigate the effectiveness of a longer training session (6-8 weeks), and additional ways in which the FASTEX can be used to train and test the upper extremity in the closed kinetic chain position.

Body Composition Assessment Differences Between Skinfold And DEXA Measurements

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Analysis of body composition by dual energy x-ray absorptiometry (DEXA) is now recognized as the gold standard by most clinicians. However, skinfold measurements are still widely used because of low cost and ease with which the procedure is performed. Due to the high accuracy of DEXA in assessing body composition, other techniques are often compared to DEXA to establish reliability. The purpose of this study was to compare five (FSS) and six (SSS) site skinfold measurement techniques to DEXA measurements. Twenty-one Division I female collegiate swimmers (mean age 18.5 years) participated as subjects for the study. A DEXA scan was performed on each athlete followed by FSS and SSS analyses. The three testing procedures were completed on the same day. All skinfold measurements were taken by the same investigator. The FSS analyses included the abdomen, thigh, triceps, suprailium, and subscapular regions. The SSS analyses included the same regions listed for the FSS analyses with the addition of the chest. The formula used for calculating the FSS was $0.2973(\text{sum } 5) - 0.00053(\text{sum } 5)^2 + 0.03037(\text{age}) - 0.63054$. The formula used for calculating the SSS was $0.21661(\text{sum } 6) - 0.00029(\text{sum } 6)^2 + 0.13341(\text{age}) - 5.7288$. Data was analyzed using paired t-tests with the level of significance being set at $p < .05$. Total percent body fat was calculated for each athlete for all three techniques, as well as, means for the entire population. Mean percent body fat for DEXA, FSS, and SSS were 20.93, 22.99, and 16.78, respectively. Using paired t-tests, a significant difference was noted between the DEXA and FSS mean values and the DEXA and SSS mean values ($p < .05$). However, the difference noted between that of the latter was nearly twice that of the former. The results of this study indicated that for this population both skinfold techniques resulted in significantly different total percent body fat when compared the DEXA. However, the difference between the DEXA and the FSS mean percent body fat values was 2.06. This difference has been reported in the literature as not being clinically significant due to the fact that this value falls between the $\pm 3\%$ measurement error range. Thus, it is suggested that athletic trainers consider the utilization of the five site skinfold measurement technique when other methods are not readily available.

Clinical, Radiographical, And Functional Assessments Of Knee Meniscal Repair

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Advances in surgical techniques and procedures coupled with renewed interest in the healing properties of torn menisci led to acceptance of repair as a surgical option in the treatment of meniscal tears. The purpose of this study was to determine the clinical, radiographical, and functional outcomes of knee meniscal repair. Eight males (mean age 29.6 ± 7.76 years) who had undergone repair (inside-outside procedure) of either an isolated medial ($n = 6$) or lateral ($n = 2$) meniscal tear participated in the study. Average time from surgery to follow-up was 3.80 ± 1.64 years. Clinical and functional assessments were completed via the Knee Ligament Standard Evaluation Form (KLSEF) and Cincinnati Knee Rating System (CKRS), respectively. Radiographic assessment for Degenerative Joint Disease (DJD) was completed by comparing follow-up radiographical findings of the repaired meniscal knee to the contralateral normal knee. Fairbank's criteria were used to assess for DJD. Data analysis consisted of descriptive statistics. Results of the study revealed that 88% ($n = 7$) of the subjects were able to resume pre-morbid strenuous activities post surgery. Fifty percent ($n = 4$) of the subjects reported no complaints of knee pain, while 50% ($n = 4$) reported complaints of knee pain during activities of daily living. Eighty-eight percent ($n = 7$) of the subjects reported no incidence of swelling or partial giving way during activities of daily living. Knee range of motion was normal (0 - 130 deg) in 88% ($n = 4$) of the subjects. One subject exhibited limitations in knee flexion and extension of 7 and 3 deg, respectively. None of the subjects demonstrated anterior-posterior ridge formation or femoral condyle flattening at follow-up, however, one subject exhibited medial joint space narrowing ($< 25\%$ joint space narrowing). All of the subjects scored 93 or higher points (100 point total) on the CKRS at follow-up. Within the constraints of the present study it was concluded that medial and lateral meniscal repairs result in clinically intact knees which have positive functional outcomes. However, further investigation with larger samples and longer follow-up is needed before definitive conclusions about meniscal repair can be made.

Assessment Of ACL Deficient And Normal Individuals Using The KT-1000 And Stryker Knee Arthrometers

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Ligamentous testing devices provide quantitative measures of clinical knee joint laxity, in normal and ligament deficient individuals. The purpose of this study was to determine intradevice reliability and intermachine differences of the Medmetric KT-1000 knee arthrometer and Stryker Knee Laxity Tester, among ACL deficient and non-injured individuals. Sixteen subjects with healthy knees (mean age = 24 ± 3.4 years) and 11 subjects (23 ± 4.2 years) with a unilateral disruption of the ACL were tested in a randomized sequence for anterior knee joint laxity. Each examination was performed according to the manufactures protocol with the knee at 30 degrees of flexion. Results were reported for the KT-1000 at 15, 20, and 30 pounds while Stryker results were reported at 20 and 30 pounds. Intramachine reliability was assessed by interclass correlation coefficients (2,1) and measurement error (SEM). Our results demonstrated high intramachine reliability estimates for the KT 1000 and Stryker under all conditions; within each limb, for injured and non-injured groups, ranging from: (ICC = 0.81 - 0.91, SEM = .45 - 1.9 mm.). Paired sample t-tests detected significant differences at 20 and 30 pounds of force for the non-dominant limb of the non-injured group between the Stryker (4.1 ± 1.5 ; 5.5 ± 1.5) and KT-1000 (5.9 ± 1.6 ; 7.4 ± 1.6) ($p < 0.05$). The dominant limb of the non injured subjects also displayed significant differences at 20 and 30 pounds of force between the Stryker (4.4 ± 1.8 ; 6.3 ± 1.6) and the KT-1000 (6.9 ± 1.4 ; 8.0 ± 1.1) ($p < 0.05$). Significant differences were also found at 20 and 30 pounds for the ACL deficient limb between the KT-1000 (9.41 ± 3.1 ; 12.0 ± 3.95) and the Stryker (7.42 ± 1.9 ; 8.9 ± 3.2). The results from the present study appear to be consistent with previous literature that found high test-retest reliability in both arthrometers. The intermachine differences between the KT-1000 and Stryker demonstrated that the KT-1000 produces measurements approximately 2 mm greater than the Stryker. Although the devices produce high intramachine reliability they should not be used interchangeably, nor can quantitative results from one device be directly compared to the other.

Isokinetic Assessment Of The Trunk Flexor And Extensor Muscles In High School Football Players

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This study obtained normative data on isokinetic trunk strength of high school football players, and compared muscle performance between players classified as linemen or non-linemen. Twenty-four subjects (age = 15.7 +/- 1.2 yrs, ht = 181.26 +/- 6.7 cm, wt = 89.8 +/- 19.7 kg) underwent isokinetic assessment of the trunk flexor and extensor muscle groups at 30 deg/sec on a Kin Com dynamometer (Chattanooga Group, Hixson, TN). The muscle performance parameters included concentric and eccentric average power, total work, peak torque, and average torque. All testing was performed while seated, and all measures were reported in a gravity uncorrected format. A one between (linemen/non-linemen), and two within (concentric/eccentric, flexion/extension) analysis of variance was performed for each of the muscle performance parameters, with Tukey post hoc analysis to examine for specific differences computed when indicated. For average power and total work, linemen produced more force than non-linemen ($p < .05$) and trunk extension was greater than flexion for all subjects ($p < .05$). No differences were found between concentric and eccentric values. For peak torque and average torque, no differences were found between linemen and non-linemen. For both groups, trunk extension was greater than flexion ($p < .05$). Eccentric trunk extension was greater than concentric extension ($p < .05$) for all subjects. In contrast, concentric trunk flexion was greater than eccentric flexion ($p < .05$). Concentric trunk flexion/extension reciprocal muscle group ratios calculated from the average torque data were 50% and 49% for linemen and non-linemen, respectively. Eccentric flexion/extension ratios were 34% and 39% for linemen and non-linemen, respectively. These findings indicate differences exist between linemen and non-linemen in some muscle performance parameters, but not in others. These normative values are also useful in detecting underlying strength deficits and for establishing rehabilitation goals for high school football players.

Water Displacement Measurement Of Ankle Volume: A Method Assessment

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Assessment of ankle volume is used to determine the amount of swelling following an injury and to monitor the healing process. While accepted as a gold standard, objective assessment technique, little data is available on the stability of the measure and the inter-observer variability of the method. The purpose of this study was to evaluate the inter and intra-observer variability on ankle volumetric assessment using water displacement. Ankle volume was measured using a commercially available immersion tank and 1000 cc graduated cylinder in two volunteers by six medical professionals with experience in volumetric assessment. Each investigator measured the ankle ten times in immediate succession. The total time required to complete all ten measurements was approximately 45 minutes. The investigator and a single study monitor read the water displacement volume and recorded the volume on separate data sheets. Water temperature was maintained at 35° and each assessment was done using standardized technique. Ankle volume was measured to the 1.0 cc. To measure inter-observer variability, a 1-within factor repeated measure ANOVA was calculated. There was no significant difference in the graduated cylinder readings between the investigator and study monitor [$F(1,59) = 1.53$; $p = 0.22$]. There was a significant difference between volume across the ten observations [$F(9,45) = 5.74$; $p < 0.01$]. Scheffe post hoc testing demonstrated that the last five measures were significantly greater than the first five measures. Mean displacement on the first measurement was 1378 +/- 133 cc and increased to 1405 +/- 140 cc by the tenth measurement. The data from this study demonstrate that the intra-observer variability of ankle volumetric assessment is generally good while the repeated measurement of ankle volume during a single session is highly variable. These findings suggest that studies evaluating treatment efficacy over a short duration need careful control over postural fluid shifts which may significantly effect swelling assessment.

Reliability And Effects Of Arm Dominance On Upper Extremity Isokinetic Force, Work, And Power Using The Closed Chain Rider System

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As new generation Closed Kinetic Chain (CKC) dynamometers are developed for upper extremity exercise and testing, the greater the importance of knowing the reliability of these machines. The Closed Chain Rider (Mettler Electronics) is a closed-chain system that provides accommodating resistance in a linear fashion with distal fixation to create the closed chain environment. Previous reliability and limb dominance studies of isokinetic devices do not apply to this system. The purpose was to assess the reliability of the Closed Chain Rider between exercise sessions and to determine the effects of arm dominance using muscle force, work, and power measures during closed-chain chest press exercise. Thirty-eight (M = 19, F = 19) college students (age = 22.2 ± 2.9 yrs; weight = 72.7 ± 17.7 kg; height = 168.5 ± 8.4 cm) underwent identical testing on two occasions. Prior to testing, subjects were familiarized with the system, and seat position and arm ROM were recorded. During the testing sessions subjects performed five reciprocal chest press movements while in the sitting position at speeds of 20 and 30 inches/second. Average force (kilograms), total work (joules), average power (watts), and linear range-of-motion (inches) were recorded. Reliability was evaluated by calculating intraclass correlation coefficients [ICC (2,1)]. Mean differences between the dominant and nondominant arms for the measured variables were analyzed by dependent t tests. For both the dominant and nondominant arms, respectively, at the 20 inches/second speed, the reliability values for average force (.89 vs. .91), total work (.92 vs. .92), and average power (.88 vs. .89) were clinically acceptable. For both the dominant and nondominant arms, respectively, at the 30 inches/second speed, the reliability values for average force (.88 vs. .85), total work (.90 vs. .88), and average power (.86 vs. .83) were also clinically acceptable. The t test analyses showed the dominant arm produced significantly greater ($p \leq 0.05$) average force, total work, and average power versus the nondominant arm. Average linear ROM was virtually equal ($p \geq 0.05$) between the dominant (41.7 ± 0.9 inches) and nondominant (41.4 ± 0.8 inches) arms. The results are clinically useful in providing information about the reliability of force, work, and power measures during multi-joint bilateral chest press movement using the Closed Chain Rider. Clinicians should be aware of measured differences between dominant and nondominant arms.

The Effects Of Long Term Ankle Bracing On Strength Of The Ankle Musculature

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It is a common belief that long term prophylactic taping or bracing may lead to a decrease in muscular strength. However, this perception appears to be based on testimonials and not on scientific investigation. Therefore, the purpose of this study was to determine any effects of long term ankle bracing on strength of the ankle musculature. Thirty-nine volunteers served as subjects in the experimental group by wearing bilateral ankle braces for the duration of the study. An additional ten subjects served in a control group and were not braced. All subjects were pre-tested for strength on a Biodex™ isokinetic dynamometer at speeds of 60°/s and 120°/s following a standard warm-up. The movements tested were; plantar flexion (PF), dorsiflexion (DF), inversion (IN), and eversion (EV). Following the pre-test, subjects in the experimental group were fitted with commercially available lace-up ankle braces and instructed to wear the braces daily for a period of eight hours. Following a period of seven weeks, all subjects were post-tested in an identical fashion to the pre-test. Strength of the ankle musculature was determined from peak torque data. Pre-test to post-test changes in strength were analyzed by t-tests and are presented as group means. Control subjects exhibited an increase in peak torque for all movements from pre-test to post-test which might indicate a learning effect. The changes in peak torque for the control group were; 0.1, 4.4, 0.9, and 1.3 ft./lbs. for DF, PF, IN, and EV, respectively. Within the experimental group, the only significant ($p < 0.05$) decrease in peak torque from pre-test to post-test was found in PF. The changes in peak torque for the experimental group were; 0.1, 5.5, 0.3, and 0.3 ft./lbs. for DF, PF, IN, and EV, respectively. These preliminary data suggest that long term ankle bracing may affect muscular strength, but that in our subjects it was limited to PF. Follow-up investigations will continue.

Comparison Of The Amount And Rate Of Inversion Between High Top And Low Top Shoes

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The purpose of this study was to determine the differences in the rate and amount of inversion between high-top and low-top shoes. Twenty male subjects were filmed at 60 Hz while standing on an inversion platform that suddenly inverts the right ankle 35°. Five trials of sudden inversion were measured for each subject in the high-top and low-top shoes. The amount and rate of inversion in the high-top and low-top shoes were digitized and analyzed with an Ariel video analysis system. Rearfoot angles from the raw x, y coordinates of the four landmarks (gastrocnemius, Achilles tendon, top and bottom of the shoe) were calculated and smoothed using a Butterworth second order, recursive digital filter with a cutoff frequency of 10 Hz. The inversion-eversion angles were calculated by subtracting the angle of the rear of the shoe to the right horizontal from the angle of the lower leg to the right horizontal. Inversion was represented by positive angles and eversion was represented by negative angles. When wearing the low top shoes subjects inverted $42.46 \pm 4.31^\circ$ with a peak rate of inversion of 506.63 ± 98.10 d/s. In the high top shoes subjects inverted 38.94 ± 3.90 d with a peak rate of inversion of 409.36 ± 66.11 d/s. The high-top shoes significantly reduced the amount of inversion by 3.51° and the rate of inversion by 97.27 d/s. The biomechanical factors which determine the relative potential of a load to cause an ankle sprain include: the magnitude of force, the rate of application, the point of application, the direction of force application, the critical state of the tissues [bone, ligament, tendon, muscle], and the pre-activation of the muscles. In our study the subjects stood in static weight bearing stance and a sudden inversion of the right ankle was introduced. The loading conditions for the ankle resulted in an average amount of inversion of $40.7 \pm 4.4^\circ$ in 0.31 ± 0.11 s. The average rate of inversion over the 310 ms time interval was 129 d/s. We concluded that the high-top shoes were more effective than low top shoes in reducing the amount and rate of inversion as compared to the low-top shoes.

The Effects Of Prophylactic Ankle Bracing On Ankle Biomechanics

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Prophylactic ankle braces have become a popular form of ankle injury prevention used by athletic trainers. The effect of these braces on ankle and foot biomechanics is still in question. Increased loading of the foot has been associated with a higher incidence of traumatic and overuse injuries of the foot and ankle. The purpose of this study was to compare impulse loading measurements and percentage of time spent in forefoot loading during gait, using two different prophylactic ankle braces. Eight subjects (age = 21.6 ± 1.2 yr., wt = 73.8 ± 7.9 kg, ht = 171.7 ± 6.2 cm) volunteered to participate in this study. Subjects were tested on one occasion under three different test conditions (two braced and one unbraced). The McDavid Lightweight Ankle Support (M-199; McDavid Sports Medical Products, Inc., Chicago, IL) and Aircast Sport-Stirrup (Aircast, Inc., Summit, NJ) prophylactic ankle braces were used in this study. Foot loading data was collected using the Parotec Insole Pressure Measurement System (Parotec Medizin Technik GmbH, Germany) measuring at 250 Hertz. Each subject was asked to perform a straight ahead sprint for a period 5 seconds. During that time the insole sensor system collected pressure data from the first ten steps of the sprint activity. Three trials were conducted during each of the three test conditions. A total of 30 steps per subject under each test condition, were then analyzed for statistical purposes. The dependent measurements were impulse (Ns) and percentage of time spent in forefoot loading (ms). An ANOVA with repeated measures was used to determine differences between the three test conditions. The values for the foot impulses were 87.7 ± 5.7 Ns for the McDavid brace, 93.8 ± 4.9 Ns for the Aircast brace, and 95.5 ± 6.2 Ns for the unbraced condition. The impulse loading test results indicated no difference between the test conditions [$F(2,239) = 0.81, p = .45$] at each of the 30 steps analyzed. In addition, no differences were detected between the three test conditions for the time spent during forefoot loading [$F(2,239) = 1.30, p = .28$]. The time values ranged from 187.5 to 206.1 ms across the three conditions. These results suggest that ankle braces do not adversely effect these two biomechanical variables of gait. Future study should focus on the effects of prophylactic ankle braces on other factors that may influence ankle and foot biomechanics.

The Effects Of Prophylactic Taping On Ankle Joint Motion And Performance

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The purpose of this study was to compare the effects of tape sparring and traditional ankle taping on range of motion, running speed, and agility among male college athletes. Ten, male college athletes with a mean age of 20.03 (± 1.2) years participated in the study. Each subject read and signed an informed consent form and a pre-participation questionnaire prior to their participation in the investigation. The subjects were tested using four treatment groups; (1) Control, (2) Traditional ankle taping (closed basketweave with 2 heellocks and 2 figure 8's), (3) Over shoe sparring, and (4) a combination of treatments 2 & 3. Each subject performed three trials of a 40 yard dash, and a 40 yard cone drill. Pre-exercise and post-exercise goniometric measurements of plantarflexion, dorsiflexion, inversion, and eversion were completed on all subjects. All subjects were assigned to a treatment order by using a counter balanced Latin Square design. Forty yard dash, and a 40 yard cone drill times were measured using a Solo Time[®] infrared photocell in conjunction with a digital timing clock. The mean scores of the speed and agility times and the goniometric measures were analyzed using a repeated measures ANOVA and a Scheffe F post hoc test. Significance was determined at an alpha level of $p < 0.05$. No significant differences were observed between groups for 40 yd dash times ($p = 0.89$) or 40 yd agility drill times ($p = .94$). A significant difference was observed between groups for the pre-exercise measure of inversion (and eversion ($p = 0.001$, $P = 0.003$) respectively. However, no significant difference existed in post-exercise range of motion. In evaluation of the delta change scores in range of motion, it was observed that significant changes in range of motion occurred between group for plantar flexion, inversion, and eversion ($p = 0.01$, $p = 0.0001$, and $p = 0.004$) respectively. The findings of this investigation indicate that prophylactic ankle taping and sparring did not restrict speed or agility. Moreover, the findings also indicate that the taping and sparring failed to restrict joint motion after approximately 15 minutes of activity. These findings do not support the use of taping and sparring for prophylactic joint motion control of the ankle joint.

The Effect Of Tape And Neoprene Ankle Supports On Ankle Joint Position Sense In Female Athletes

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Ankle joint injuries are among the most common in athletics. Proprioception deficits have been reported as a factor influencing these injuries. Tape and external supports have both been reported to influence the proprioception mechanism. The purpose of this study was to compare the effects of ankle taping and neoprene ankle supports on proprioceptive responses as measured by ankle joint position sense. Twenty healthy, female athletes (age=20.8 \pm 2.7 yr., wt=67.8 \pm 9.9 kg, ht=166.2 \pm 4.9 cm) from a small NCAA Division III institution participated in this study. The KinCom 125 AP (Chattanooga Group, Hixson, TN) isokinetic dynamometer was used to measure the angles for joint position sense. Subjects were blindfolded and repositioned four reference angles both passively and actively. The reference angles included 10° eversion, 0° neutral, 20° inversion and 30° inversion. Two trials were conducted at each reference angle. All tests were performed on both ankles under each of the three test conditions (no support, tape, neoprene support). The AliMed[™] (AliMed, Inc., Dedham, MA) neoprene ankle support was used in this study. The standard basketweave ankle taping technique was used for the tape condition. Absolute values of the four joint angle error scores were summed together and used for statistical analysis. A mixed model ANOVA with repeated measures was used to analyze the error scores. The results showed that joint position sense was not affected by the type of support (no support, tape, neoprene support) [$F(2,78) = .33$, $p = .721$]. There was a significant main effect for type of repositioning (active vs passive) [$F(1,39) = 9.50$, $p = .004$]. Active error scores (5.77 \pm 2.43 deg) were significantly higher than passive error scores (4.94 \pm 2.03 deg). These results suggest that both tape and neoprene ankle supports have little affect on ankle joint position sense in a group of healthy female athletes. Future research should examine the effect of these prophylactic measures on individuals with proprioception deficits, such as those who have functional ankle instability. In addition, the results of this study support previous studies that have shown active joint position sense error scores to be higher (less accurate) than passive error scores. It appears that the processing of additional neurological signals from the muscle afferent and efferent pathways result in higher error scores during active repositioning.

Resistive Torque Produced By Two Different Ankle Braces

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Prophylactic ankle braces are commonly used in the prevention of lateral ankle sprains. Previous authors have reported certain braces limited motion when the foot was passively inverted to a predetermined torque limit. However, the torque limits did not permit the ankle to rotate to its end range of motion, therefore the protective effects of bracing through normal range is uncertain. The purpose of this study was to determine the peak resistive torque produced by two different ankle braces when the ankle was passively inverted to the end range of motion. Seven athletic subjects (10 ankles, seven right and three left), age 20 to 28 years old, were tested on the Biodex isokinetic dynamometer. Each ankle was tested under 3 conditions: 1) unbraced, 2) wearing a Swed-O-Universal ankle brace (Brace 1), and 3) wearing a Sure Step Ankle Support System (Brace 2). Each condition consisted of three trials, passively inverting the ankle to a predetermined inversion end range. Peak torque values were recorded for each trial. Paired t-tests were used to determine if significant differences existed between conditions ($p < 0.0001$). The peak resistive torques at the end range of inversion at the ankle wearing Brace 1 (17.5 \pm 5.8 Nm) and Brace 2 (27.2 \pm 6.5 Nm) were both significantly greater than the unbraced ankle (12.0 \pm 5.0 Nm). The resistive torque for Brace 2 was significantly greater than Brace 1. Brace 1 increased the resistance to inversion by 46% compared to the unbraced condition, while Brace 2 increased the resistance by 127%. Our results suggest both braces had a protective effect in preventing inversion, with Brace 2 having a greater effect than Brace 1. However, it has yet to be determined how the braces would protect the ankle beyond normal inversion range and to what extent the braces limit performance.

Clinical Case Reports I

Thursday, June 19, 3:10 PM - 4:30 PM; Room 150 D; Moderator: Tamara L. Pascoe, ATC

Discussants: Ron Clark, MD; David O. Draper, EdD, ATC

Left Calf Pain And Swelling

Ireland ML, Barton B: Kentucky Sports Medicine, Lexington, KY

PERSONAL DATA/MEDICAL HISTORY: 21-year-old white male Division I-AA football athlete completed two day practices without difficulty. The following morning he awakened with pain in his left calf. He was unsure of any specific mechanism of injury, denied being hit or hurting his calf during or after practice. He did sustain a left ankle fracture at age 14 which was treated by casting. He also had some type of infection right second toe which required hospitalization at age 14. Otherwise he is healthy, without family history of arthritis or other significant medical illnesses. Patient was evaluated at student health and an appointment was suggested with infectious disease consultant. He was seen by team orthopaedist 12 hours after onset of his symptoms.

PHYSICAL SIGNS AND SYMPTOMS: Temperature 102.7. Ill-appearing tachypneic male, temperature 102.9, blood pressure 97/53, respiratory rate 24, heart rate 102. Heart exam revealed regular rate and rhythm. Left calf was erythematous posteromedially with marked soft tissue swelling about the ankle. Active and passive range of motion of the ankle produced pain with range of motion limited 0-40 degrees. There was significant calf tenderness at the musculotendinous junction medial gastroc. Increased warmth and erythema about the calf diffusely. There was red streaking into the left medial thigh with inguinal lymphadenopathy. Diffuse sunburn type rash was present.

DIFFERENTIAL DIAGNOSIS:

1. Infection
 - a. Cellulitis
 - b. Abscess
 - c. Bacteremia
 - d. Septic arthritis
 - e. Osteomyelitis
 - f. Toxic shock syndrome
 - g. Combination of above
2. Fracture
3. Medial gastrocnemius strain or rupture
4. Tumor
 - a. Ewing sarcoma
 - b. Hodgkin's lymphoma
 - c. Other

DIAGNOSTIC IMAGING/LABORATORY TESTS: Radiographs of the ankle revealed osteophytes of the distal tibia and talar neck consistent with footballer's ankle. No air in the soft tissues. Views of the tibia showed soft tissue swelling only without bony abnormalities.

Admission laboratory work included a white blood count of 21,560 with 80% neutrophils, 6% lymphocytes. 20% of the neutrophils were absolute neutrophils. Erythrocyte sedimentation rate was 0. Cultures of the calf aspirate which showed thin brownish fluid were Group B beta hemolytic streptococcus. Blood cultures were negative.

CLINICAL COURSE: The patient was hospitalized, started on IV antibiotics. He underwent an emergency debridement of his left calf following a left ankle arthroscopy which revealed no involvement of the joint by viewing and cultures. His calf was packed open and he was continued on IV antibiotics of Ceftriaxone. He was packed open at the time of his initial surgery. The wound was dressed twice daily. He was hospitalized for 8 days and sent home on IV antibiotics and twice a day dressing changes. Postoperatively he did well, underwent a split skin graft on October 31, 1996. Patient's IV antibiotics were continued for four weeks. He was placed on oral Amoxicillin for two more weeks. He had some ankle pain but with a vigorous rehabilitation program has improved. He expects to be able to return to football activities in the spring.

FINAL DIAGNOSIS: Toxic shock syndrome--Group B beta hemolytic streptococcus; calf abscess and septicemia.

DEVIATION FROM THE EXPECTED: A young healthy football athlete rapidly developed a life-threatening illness. During two-a-days and vigorous working out, healthy-appearing athletes can indeed have serious illnesses. The immune system may be less able to fight infection in times of stress or over-training. Early recognition of a serious condition such as toxic shock syndrome must be made or the risks of limb loss or life is great. Early institution of proper treatment, aggressive surgical intervention resulted in a very good result in this young man. Athletic trainers should be aware of potential for serious infections and act very quickly, seeking assessment by the physician immediately. If one thinks about this serious entity of streptococcus septicemia, toxic shock syndrome, quick referral is necessary.

A Scapular Fracture In A Junior Varsity Quarterback

Passerallo AJ, Calabrese GJ, Dimeff RJ: The Cleveland Clinic Foundation, Cleveland, OH

PERSONAL DATA/MEDICAL HISTORY: A 15 year old male, JV high school football quarterback, sustained a left shoulder injury after being tackled. The athlete was forcefully slammed into the natural turf, landing on the posterolateral aspect of his left shoulder. The athlete had significant and immediate pain, localized to the posterior left shoulder. He denies hearing a "pop" or "snap" at time of injury. The athlete was unable to continue play. He was evaluated the day of injury at a local emergency room. Treatment at that time consisted of a sling for comfort, ice and NSAID's. Six days after initial injury he presented for follow-up to our office. This athlete had no previous history of shoulder, neck or back injury.

PHYSICAL SIGNS AND SYMPTOMS: Examination, six days post-injury revealed nearly normal active shoulder range-of-motion, pain with overhead activity, and tenderness over the muscle belly of the infraspinatus and teres minor musculature. Pain was noted with manual muscle testing, with the arm at the side, of the left shoulder internal and external rotators.

DIFFERENTIAL DIAGNOSIS: Scapular fracture, posterior shoulder muscle contusion, rotator cuff injury, pneumothorax, rib fracture, brachial plexus injury, acromioclavicular sprain.

DIAGNOSTIC IMAGING/LABORATORY TESTS: Left Shoulder true A/P radiographic evaluation revealed a mid-body scapular fracture that was non-displaced.

CLINICAL COURSE: Initial treatment consisted of sling for comfort, discontinuation of football activity, ice and NSAID's. Passive and active range-of-motion exercises emphasizing elevation and external rotation were initiated. Rotator cuff and scapular stabilization exercise progression, advanced from neutral to overhead arm positions. Equipment evaluation revealed incorrect size of issued shoulder pads which did not extend inferior or laterally thus exposing the superior/lateral scapular boarder.

DEVIATION FROM THE EXPECTED: The scapula is one of the least common bones in the body to be fractured. These fractures are usually associated with high velocity trauma, such as motor vehicle accidents. To our present knowledge, there has been only 6 reported case of fractured scapular bodies relating to athletics in the last 10 years. Four of these were college or professional football players, one being a quarterback. Another, a fracture in a boxers scapula. Lastly, a fracture in a recreational athletes scapula while performing push-ups. These low reported cases along with the age of this athlete, make this unique athletic injury case report.

Life-Threatening Head Injury Following Concussion In A Collegiate Football Player

Kersey R: San Jose State University, San Jose, CA; case occurred at Hartnell College, Salinas, CA

PERSONAL DATA/MEDICAL HISTORY: The subject was a single 19 year-old male, Hispanic offensive lineman for a community college football team, with no previous central nervous system illness or injury. He was 178 cm tall and weighed 105 kg. After confessing continued headaches and nausea from a previously undisclosed head blow 12 days prior, the patient visited his physician. After one week of rest and continued headaches, he saw a neurologist. The diagnosis was "post-concussive syndrome". He started on Esgic, and following a normal electroencephalogram returned to his previous football schedule, (25 days after the trauma).

PHYSICAL SIGNS AND SYMPTOMS: Five weeks after the original trauma, the patient sustained a second head injury. Without any obvious incident, he started off the football field under his own power and then sat down. Symptoms included severe head pain, dizziness, and leg paresthesia. He became incoherent and then suffered a mild seizure. Respirations were about 20 bpm, and the heart rate was 90-100 bpm. Blood pressure was 210/110 mm/Hg and his reflexes diminished. During transport, the patient became unconscious and unresponsive. Signs and symptoms in the emergency room, included decerebrate posturing, a fixed, dilated left pupil, shallow breathing, right side paralysis, and bilateral Babinski signs.

DIFFERENTIAL DIAGNOSIS: Possible pathologies included: cerebrovascular accident, subdural hematoma, epidural hematoma, cerebral edema or "second impact syndrome," and intracerebral hemorrhage.

DIAGNOSTIC IMAGING/LABORATORY TESTS: Intubation occurred prior to a computerized tomography examination. Results indicated a large fluid collection overlying the left hemisphere and left temporal fossa with a massive shift to the right.

CLINICAL COURSE: After the placement of a left temporal bur hole, a large amount of clear watery fluid escaped under pressure followed by an acute subdural hematoma. A second craniotomy led to the evacuation of additional subdural blood. Post-operatively the patient's pupils equalized. After two days the patient began to awaken from the coma. Transfer from the intensive care unit occurred after six days. Discharge from the hospital took place 19 days following the trauma. The subject had no evidence of neurological deficit.

DEVIATION FROM THE EXPECTED: Traditional thinking holds that acute subdural hematomas normally result from single traumatic incidents. This subject suffered a mild concussion five weeks prior, and then without extreme trauma sustained an acute subdural hematoma. The present case may help document that individuals may be more susceptible to an acute subdural hematoma following recent head trauma, as some have suggested.

Mild Head Injury In A High School Football Player

Riemann BL, Guskiewicz KM, Onate JA: University of North Carolina at Chapel Hill, Chapel Hill, NC

PERSONAL DATA/MEDICAL HISTORY: A 15-year-old male high school football player experienced temporary loss of consciousness, after his head hit the ground during a game. The athlete had no previous history of head injury.

PHYSICAL SIGNS AND SYMPTOMS: The athlete experienced 20 seconds of unconsciousness following the impact. He was immediately removed from the game. Further assessment revealed both anterograde and retrograde amnesia, headache, confusion, photophobia, neck pain, fatigue, and blurry vision. He was sidelined and monitored for the remainder of the game.

DIFFERENTIAL DIAGNOSIS: 1) Mild concussion 2) Moderate concussion; 3) Severe concussion; 4) Epidural hematoma; 5) Subdural hematoma.

DIAGNOSTIC IMAGING/LABORATORY TESTS: The athlete was referred to us 1 day postinjury for further assessment and was entered into our ongoing mild head injury study. All symptoms were reported by the athlete to be resolved by day one postinjury except for transient headaches which persisted through day 3 postinjury. Postural stability was assessed using the Sensory Organization Test (SOT) on the Smart Balance Master System (NeuroCom International, Clackamas, OR) and six variations of the Romberg balance test on days 1, 3, 5, 10 postinjury. The variations of the Romberg test included three different stances on two different surfaces with the eyes closed. During each of the Romberg trials an objective error assessment was counted. Results of the SOT composite score revealed abnormal postural sway on days 1 and 3 postinjury with scores of 44 and 67, respectively, compared to a normal score of 75. Further analysis of the SOT scores demonstrated deficiencies in the vestibular and visual sensory systems on day 1 postinjury, with a deficiency remaining within the vestibular system through day 5 postinjury. The Romberg variations completed on a normal surface in all three stances and the double leg stance on foam were within normal ranges for all testing sessions. The athlete could not complete the trial in a single leg foam surface trial on day 1 postinjury and the tandem foam trial on days 1 and 3 postinjury. The errors calculated for both of these stances on foam leveled off and were within normal ranges by day 5 postinjury. The difficulty the athlete had in performing the stances on foam with the eyes closed tends to support the premise of vestibular deficiency.

CLINICAL COURSE: The subjective and objective information attained from the athlete indicated a moderate (second degree) concussion. The increased postural sway and difficulty in maintaining equilibrium during the different stances is typical of acute head trauma. The athlete was withheld from full activity for seven days postinjury.

DEVIATION FROM THE EXPECTED: This case study is unique in that it compares several objective evaluation tools utilized in head injury assessment. The double leg and single leg Romberg tests are frequently used during on the field assessments of head injuries. The comparisons of these tests to the more sensitive method of postural assessment with the SOT in this case study suggest that these sideline tests may not accurately indicate head injury severity. Establishing individual baseline posture measurements prior to the start of a season may increase the accuracy of this method of objective head injury assessment. Additionally, this case study is particularly unique in that it illustrates one particular area within the postural control system, the vestibular system, being most affected by the head injury. The recovery of the vestibular system to normal levels at day 10 postinjury in this case study concurs with recommended guidelines based on subjective symptoms for return to activity. It is, however, important for clinicians to recognize this as only one perspective of head injury assessment.

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Clinical Case Reports II

Friday, June 20, 8:15 AM - 9:55 AM; Room 150 D; Moderator: Carol J. Zweifel, MS, ATC

Discussants: Dean N. Walker, MD; Gerald H. Geurts, PT, ATC

Acute Shoulder Pain In A Collegiate Football Player

Lesh SG, Carroll RJ: Arkansas State University, AR

PERSONAL DATA/MEDICAL HISTORY: The athlete is a 22 y/o 213-lb, 5-ft, 10-inch, male football player that participates at the running back position. Chief complaint was severe pain to left shoulder superiorly along the spine of the scapula and supraspinous fossa and into the acromial region as well as an inability to lift his left arm after suffering an acute trauma during competition. Mechanism of injury was as follows: the athlete was carrying football in his left arm on a long breakaway run and tackled from behind by a defensive back trying to dislodge the ball by reaching around the athlete from the left tying the ball and left arm of the athlete close to his shoulder pads. As the momentum of the two athletes progressed forward, the injured athlete contacted the ground in a downward angular fashion to the left striking the ground with his left shoulder first. Athlete reported that the onset of pain was immediate and intense.

PHYSICAL SIGNS AND SYMPTOMS: The athlete was markedly tender to palpation along the spine of the left scapula, the left supraspinatus muscle belly and over the acromial arch. No deformities, paresthesias or contusions were present in the left shoulder or upper extremity region. Active range of motion of the left shoulder was zero as he could not move upper extremity from the side of his body. He could grip with the left hand and partially move the left elbow despite pain at the shoulder.

DIFFERENTIAL DIAGNOSIS: supraspinatus contusion; acromioclavicular sprain; acute rotator cuff strain; traumatic scapular fracture

DIAGNOSTIC IMAGING/LABORATORY TESTS: X-rays taken on the day of the injury revealed a possible fracture of the superolateral aspect of the left scapula. CT scan performed 2 days post injury confirmed a 3.5 cm linear fracture extending into the superior scapular spine originating along the inferior medial acromion. Maximal separation of the scapular fragments was 8.0 mm. Acromioclavicular joint pathology was ruled out.

CLINICAL COURSE: The diagnosis of a mildly displaced left superolateral scapular fracture was treated immediately in the training room with ice for pain relief and the athlete was issued a standard over the neck arm sling. Conservative treatment regime of immobilization of left upper extremity for 10 days and use of oral pain killers (Vicodin) for severe left shoulder pain. Codman's pendular exercises, supine wand exercises and bone stimulator were introduced to left shoulder at day 11 as well as gentle left elbow and hand active range of motion exercises. Oral pain medication was switched to Darvocet at day 12 as intense pain began to lessen. Active range of motion skills to left shoulder began 4 weeks post injury as well as discontinued use of shoulder sling. Full range of motion, minimal discomfort and significant muscle atrophy was present about left shoulder girdle by week six. Excellent healing of the fracture site was demonstrated radiographically and the athlete was then introduced slowly to progressive resistive exercises for the upper extremities. By the third month post injury, the athlete had no significant discomfort, full range of motion and was participating in regular weight lifting sessions. The athlete did not return to competition as the competitive football season was nearing a conclusion as the full recovery of the traumatic injury was being realized.

DEVIATION FROM THE EXPECTED: Upon literature review of similar cases in athletic participation, very little supporting documentation to identify norms or expectations of return to play are found. Similar cases are identified in traumatic and emergency medicine journals and most often related to motor vehicle accidents where conservative care is the first avenue of intervention, however, there is very little concern for the rapid need for healing that is often expected in competitive athletics. This case is unique in such the documentation is generally absent in athletic journals and the presentation of this case begins the documentation effort to identify expectations and norms for identifying, rehabilitating and returning the athlete to competition.

Complication Of Blunt Chest Trauma In A Collegiate Basketball Player

Bazluki JM: East Carolina University, Greenville, NC

PERSONAL DATA/MEDICAL HISTORY: A 20 year old male basketball player received a blow to the chest by an opponents elbow while attempting to rebound the ball. The force of the blow knocked the player off his feet and to the court. The athlete returned to his feet and continued to play in the game. Shortly thereafter, the athlete removed himself from the game and reported a pain in his throat/neck region. The athlete had also developed a minor cough. A very small amount of blood was present in the athletes saliva. The athlete did not specifically recall being struck in the chest or throat. Symptoms subsided and the athlete was allowed to return to the game. The athlete removed himself from the game after several trips up and down the floor, reporting that he was not able to catch his breath. Also noted at that time was localized pain at the fifth chostalchondral margin on the right side.

PHYSICAL SIGNS AND SYMPTOMS: The team physician evaluated the athlete courtside at which time the diagnosis was a chostalchondral separation. Further evaluation was done a half-time by the team physician which included an in-depth history, observation, palpation, and auscultation. The injury was diagnosed as a chostalchondral separation and the athlete could continue participation as tolerated. The athlete played sparingly due to pain at the chostalchondral margin during deep inhalation. Following the game, a final evaluation was performed which resulted in the same diagnosis. Home care instructions were given to the athlete regarding the treatments and expected course of the injury.

DIFFERENTIAL DIAGNOSIS: A differential diagnosis of a chostalchondral separation was made due to the point tenderness at the rib margin and pain with deep inhalation. With out an absence or change in breath sounds, crepitus, or a clear mechanism other diagnoses of a pneumothorax or muscular strain were not warranted at the time.

DIAGNOSTIC IMAGING/LABORATORY TESTS: Several hours after the game, the athlete was developing additional chest discomfort and difficulty breathing not associated with the chostalchondral separation. The athlete reported the changes to the coach. The coach contacted the athletic trainer, who in-turn spoke to the team physician. It was determined that the athlete should transported to the local hospital for additional evaluation. Hospital evaluations found absence of breath sounds on the right side and x-rays revealed a large tension pneumothorax with mediastinal shift.

CLINICAL COURSE: The athlete was admitted to the hospital and underwent the insertion of a chest tube used to reinflate the collapsed lung. Four days later, a second chest tube was inserted due to the lack of expansion of the apical portion of the right lung. After 10 days, both tubes were removed and the athlete was discharged two days later. Following seven days of additional restriction from activity, the athlete was allowed to return to activity to tolerance and was cleared for full activity 20 days after the initial injury. The athlete competed for the remaining two weeks of the season including the conference tournament without difficulty.

DEVIATION FROM THE EXPECTED: The presentation of symptoms by the athlete in this case study reinforces that proper medical evaluation in a timely manner will identify most injuries that have occurred, but there is a small potential for an injury to be undetected at the time of initial evaluation. The potential risk of a pneumothorax occurring in a non-collision sport is low. The incidence of a pneumothorax remaining asymptomatic is also minimal. Yet, the case presented shows that the possibility does exist and as a result certain precautions should be taken to minimize the potential hazards of an unrecognized injury. These precautions should include home care instructions which empower the athlete to assist in the care that they are receiving. This will give the athlete instructions to follow if something unexpected occurs during the course of the injury.

Unusual Onset Of Swelling In The Knee Of A High School Softball Player

Paulson FD, Draper DO: Performance Physical Therapy, Orem, UT

PERSONAL DATA/MEDICAL HISTORY: A 16 year old white female high school softball player (ht. 5'8", wt. 130 lbs.) reported to our facility with pain and effusion of the right knee. During batting practice eight days previous, she heard a pop in her right knee while swinging at a pitch. By the next day there was diffuse swelling in her knee limiting her ROM. Four months earlier she had mild pain in her knee at the start of the basketball season, but continued to play.

PHYSICAL SIGNS AND SYMPTOMS: She reported her pain as moderate. Bending, lifting and repetitive movement exacerbated the pain. Her mid-patella girth was 34.5 cm (left) and 36.5 cm (right). Strength and ROM were limited, especially during knee extension.

DIFFERENTIAL DIAGNOSIS: Meniscal lesion; Mediotatellar synovial plica; Chondromalacia patella; Infrapatellar fat pad lesion; Larsen-Johansson disease; Osteochondral fracture/Osteochondritis dissecans.

DIAGNOSTIC TESTS/SURGERY: Due the amount of swelling and her history, arthroscopic examination was performed. Examination revealed three large loose bodies in the patellofemoral joint and a chondral fracture of the articular surface of the lateral compartment. The loose bodies were removed. The chondral fracture was debrided with arthroscopic baskets and curetting equipment so that the shoulders of the chondral fracture were stable articular cartilage. The area was thoroughly irrigated.

CLINICAL COURSE: The patient was placed on crutches with no weight bearing for four weeks and followed a home rehabilitation program of closed chain activities. She gradually increased in activity to the point of full weightbearing, yet running and jumping were still difficult. Also, there was recurrent swelling to the knee that would not resolve. At this point the physician recommended that she attend rehabilitation sessions in our clinic. We emphasized graded unloaded (chest harness) to loaded lower extremity exercise on a treadmill and total gym. The patient recovered fully. During an arthroscopic examination for mild chondromalacia two months later, the lateral compartment showed remarkable regeneration of the articular surface of the lateral femoral condyle.

DEVIATION FROM THE EXPECTED: Aggressive closed chain activities are often prescribed for lower extremity injury, yet in the case of osteochondral lesions they may impede regeneration and healing. This is the first case report documenting the effects of progressive unloaded (chest harness) to loaded lower extremity rehabilitation for osteochondral lesions. We believe our regimen put a halt to the recurrent swelling and led to what the physician recorded as "remarkable regeneration of the articular surface of the lateral femoral condyle."

Rehabilitation Of A Multiple Ligament Reconstruction In A Collegiate Football Player

Murphy TM, Koberna TR, Burnett QM: Kalamazoo, MI

PERSONAL DATA/MEDICAL HISTORY: The subject is a 22 year old, Caucasian, male, collegiate football player.

PHYSICAL SIGNS AND SYMPTOMS: The subject sustained a blow to the posterolateral aspect of his left knee while his foot was planted. The subject reported feeling a distinct "pop" and "giving way" of his knee. Upon immediate evaluation the subject had positive Lachman's and valgus stress tests with no end feels. He also had a questionable posterior sag. There was minimal swelling immediately, but forty-eight hours post injury he had significant swelling in the limb, that manifested itself primarily in the ankle and lower leg.

DIFFERENTIAL DIAGNOSIS:

- 1) Isolated ACL tear.
- 2) ACL disruption with partial MCL tear.
- 3) ACL disruption, partial MCL tear, partial PCL tear.
- 4) Complete ACL, MCL, and PCL tears.

DIAGNOSTIC IMAGING/LABORATORY TESTS: X-rays of the involved knee were negative for bony abnormalities. Magnetic Resonance Imaging test revealed complete tears of the ACL and MCL, and significant damage to the PCL.

CLINICAL COURSE: At the time of surgery the subject was diagnosed with a complete ACL, MCL, and PCL tears of the left knee. The surgical technique included using a semimembranosus tendon graft to repair the ACL. In addition, a bone-patellar tendon-bone graft was harvested and used to repair the PCL, and the medial capsule was approximated and sutured. The post-operative rehabilitation program had the following goals. 1) Decrease post-operative pain and inflammation. 2) Restore range of motion to full compared to the uninvolved extremity. 3) Strengthen surrounding musculature in such a way to provide dynamic stability to the joint, while not compromising the surgical grafts 4) Restore normal proprioceptive functioning. 5) Restore full function for ADL's and recreational activities.

DEVIATION FROM THE EXPECTED: The management and rehabilitation of this athlete presents a unique challenge due to the complex nature of the damage to the joint. Once the decision to reconstruct all of the ligaments during the same surgical procedure was reached, the need for integration when addressing rehabilitation was established.

Groin Pain In An Intercollegiate Volleyball Player

Winterstein AP, Best TM: University of Wisconsin-Madison, Madison, WI

PERSONAL DATA/MEDICAL HISTORY: A 19 year old intercollegiate volleyball athlete reported to the training room approximately 12 hours following a fall while rollerblading. The athlete reported falling on her left knee and buttocks with her legs in an abducted position. She did not immediately notify anyone of her fall, nor did she alter her activities for the evening.

PHYSICAL SIGNS AND SYMPTOMS: The athlete presented to the training room complaining of pain and swelling in the right groin region. She ambulated with a limp. On physical exam there was marked ecchymosis of the right groin and decreased hip range of motion (ROM). Palpation revealed tenderness in the gluteal, hamstring, and groin regions. The athlete was also tender over the right inferior ramus. There were no obvious sensory or motor deficits of either lower extremity. Due to increasing pain and the progression of swelling, she was referred to a team physician for further evaluation. There was particular concern because of early evidence of skin pallor and necrosis within the central area of the hematoma.

DIFFERENTIAL DIAGNOSIS:

- 1) Muscular Avulsion
- 2) Inguinal / Pelvic Hematoma
- 3) Pubic Ramus fracture

DIAGNOSTIC IMAGING/LABORATORY TESTS: Urinalysis revealed 3+ blood. She was stable hemodynamically with no orthostatic changes in blood pressure and pulse. X-rays revealed a normal A-P pelvis. CT scan revealed a 6mm rounded medial thigh hematoma extending from the level of the inferior right pubic ramus approximately 6mm inferior. The CT scan also revealed edema and infiltrating blood in the subcutaneous fat tracking into the labium majora and into the ischioirectal fossa. An avulsion of a small area of muscle from the inferior pubic ramus was later noted by the attending physician. However, this finding was not noted by the radiologist.

CLINICAL COURSE: The patient was admitted to hospital and, following a gynecology consult, conservative management was elected over surgical exploration and possible aspiration of the hematoma. Observation, bed rest, ice packs, and PCA (patient controlled assisted) device for pain were used. Over the three day hospital stay there was a marked decrease in swelling and pain with the patient remaining hemodynamically stable. She was discharged to home with crutches for ambulation. Rehabilitation consisted of regaining "pain free" range of motion and strength, along with normal functional gait patterns. Special attention was paid to managing any additional swelling. The patient returned to full activity approximately five weeks following her injury.

DEVIATION FROM THE EXPECTED: This case provides a vivid example of the athletic trainer's role as the primary evaluator in the health care system for the student athlete. Even though this injury took place outside of the athletes sport activity, the athletic trainer was required to triage and refer appropriately. The concern over the integrity of the skin tissue was very unique in this case. The need to monitor this tissue and be aware of possible breakdown or necrosis was unusual. Finally, this case illustrates how over time the rapidly changing signs and symptoms required greater levels of intervention and care. A simple fall that did not require immediate attention resulted in a hospital stay and lengthy recovery.

Foundation-Funded Research Presentations

Friday, June 20, 10:15 AM - 11:15 AM; Room 150 D; Moderator: Christopher D. Ingersoll, PhD, ATC

Evaluation Of A Screening Test For Female College Athletes With Disordered Eating

Black DR, Leverenz LJ, Nagel DL, Larkin LJ, Coster DC:
Purdue University, West Lafayette, IN

The purpose of this study was to develop a screening test to detect female athletes with disordered eating/eating disorders (EDs). Athletes with EDs are a special population that differ clinically from other ED populations. Athletes are confronted with unique weight management and performance achievement factors that may make them more vulnerable to EDs. These factors may reinforce maladaptive eating behaviors and attitudes, and discourage athletes from seeking professional assistance. Currently, there are *no validated ED* screening tests available for athletes that are quick and non-invasive. Additionally, many items in current validated instruments are not appropriate for athletes, are false markers, and jeopardize chances of detecting an athlete with an ED. This study focused on whether *psychosocial* and/or *physiological* factors would be effective in screening athletes. Subjects included ~150 female volunteer Division I and club athletes, ages 18-25. Teams assessed included basketball, cheerleading, dance, golf, gymnastics, softball, swimming, tennis, track, and volleyball. The *psychosocial* assessment included completion of 4 questionnaires: (a) the Athletic Milieu Direct Questionnaire, (125 items) assessed *DSM-III-R* criteria for EDs and effects of the athletic environment on eating behaviors; (b) The Athletic Milieu Indirect Questionnaire, (19 items) used indirect questions about EDs to reduce response bias; (c) the Eating Disorder Inventory-2, (91 items) a validated test that assessed behavioral and psychological traits of EDs; and (d) the Bulimia Test-Revised, (36 items) a validated test used to screen bulimia nervosa. The Eating Disorder Examination 12.OD was used to confirm the presence of an ED. The *physiological* appraisal included a 12-item questionnaire which assessed factors common to EDs (e.g., constipation and stress fractures). A verbal evaluation of physical behaviors and an assessment of physical parameters (i.e., height, weight, bodyfat, blood pressure, and parotid gland enlargement) was also completed. Analyses include descriptive statistics to assess parametric assumptions and correlation analyses to eliminate redundant test items. Group membership, ED or not, will be predicted by generalized logits regression analysis. Development of a quick, non-invasive screening test for "at-risk" athletes that can be easily administered and scored by athletic trainers is necessary to eradicate a serious medical problem undermining athletics. By integrating physiological and psychosocial assessments specific to the female athlete, those with chronic disordered eating may be more easily identified and deterred.

The Effects of Three Prophylactic Ankle Supports on the Athletic and Functional Abilities in Chronically Unstable Ankles

Eaves KG: University of Florida, Gainesville, FL

Use of external ankle supports as a prophylactic device has become commonplace in athletics. Research on the biomechanical and performance effects as well as clinical efficacy of these devices has, for the most part, involved stable ankles. To date there has been no published research on performance effects of prophylactic ankle supports in chronically unstable ankles. The purpose of this study was to determine the effects that both lace on and semirigid supports have on the performance capabilities in chronically unstable ankles. Fifteen subjects with functional and clinical laxity were recruited to serve as subjects. Functional laxity was determined via subjects' injury history. Clinical laxity was assessed by clinical exam and stress radiographs using a Telos GA - II/E stress testing device. Four events incorporating skills necessary for sports participation (40 yard dash, vertical leap, agility box run, and octagonal hop test) were used to test the athletic and functional abilities of subjects. All tests were performed in randomly assigned testing conditions, namely, an unbraced control, Mueller ATF, Aircast SportStirrup, and Swede-O Arch Loc, in order to control for learning and fatigue effects. Statistical analysis was calculated using a one way ANOVA with repeated measures, significance set at the 0.05 level. Data analysis indicated that there were no significant differences between braces for any of the performance tests. There were, however, significant differences within support conditions for the 40 yard dash and vertical leap. Forty yard dash times were significantly reduced by all three supports ($p < .05$). Vertical leap heights were significantly decreased when wearing the Mueller ATF ($p < .05$). Subjects jumped 3.9% lower when wearing the Aircast. Results for the box run indicated that times again improved when wearing the Swede-O (47.5%) and also the Mueller (62.5%). However, these improvements were not found to be statistically significant. Results of this study suggest that prophylactic ankle supports have no significant effect on the performance and functional ability of chronically unstable ankles. Results of agility testing reveal that times were improved when wearing the Mueller (lace on) and the Swede-O (semi-rigid) supports.

An Assessment of Learning Preferences Among Undergraduate Athletic Training Students

Harrelson G, Leaver-Dunn D: DCH SportsMedicine and The University of Alabama, Tuscaloosa, AL

Increased attention has been directed toward academic quality in athletic training education. The educational process has been assessed from a global level, but little is known about how athletic training students learn. Previous research suggests that undergraduate athletic training students are kinesthetic learners who learn best in a well-lit environment and have a strong preference for afternoon learning activities. The purpose of this study was to investigate the learning preferences of undergraduate athletic training students. One hundred nine students (52 male, 57 female; age = 18-31, $X = 21.4$), enrolled in four CAAHEP-accredited or NATA-approved undergraduate athletic training education programs, completed the Productivity Environmental Preference Survey (Price Systems, Inc., Lawrence KS). Data were analyzed using the mainframe version of the Statistical Package for the Social Sciences (Chicago IL). Separate one way ANOVAs for each learning subscale by school revealed no significant between school differences. Therefore, all subjects were pooled and the larger dataset was examined in further analyses. Analysis of covariance (ANCOVA) were performed for each subscale. Subjects were grouped by gender and year in program and covaried with age, grade point average, earned university hours, and clinical hours. Results of the ANCOVA indicate a significant main effect for gender on Temperature ($F(1,100) = 5.29, p = .024$) with females having stronger preferences for warmer learning environments. Analysis also revealed a significant main effect for year in program on Intake ($F(2,100) = 3.54, p = .033$) with significantly stronger preferences for eating or drinking while learning indicated by students in the final year of education over first and second year students. These results indicate that athletic training students are flexible and, as a whole, have similar learning preferences regardless of the type of institution at which their program is located.

Patellar Tendon-Tap Segmental Stretch Reflex and Persistent Quadriceps Strength Deficit Due to ACL Reconstruction

Tsuruike M, Koceja DM: Indiana University, Bloomington, IN

The patellar tendon-tap segmental stretch reflexes were examined in six neurologically healthy young subjects (mean age = 27.1 yrs) who had developed persistent quadriceps strength deficit in either leg due to ACL reconstruction. The purpose of the present study was to determine whether long-term strength deficit due to ACL reconstruction affected the corresponding muscle stretch reflex. All subjects underwent autograft ACL reconstruction 8 to 126 months before the investigation. Five out of the six subjects had regained full active range of motion; and all subjects had shown the absence of knee effusion with no pain during movement at the time of the investigation. All subjects were examined for maximum alternating quadriceps and hamstrings isokinetic contractions utilizing 3 different angular velocities prior to the stretch reflex examination. All subjects were also examined for the unilateral and conditioned patellar tendon-tap reflex response utilizing 3 different conditioning intervals: 25 ms, 75 ms, 150 ms, on two separate days. Peak isometric force and contraction time were measured by using a strain gauge. Also, peak-to-peak EMG was measured by using bipolar surface electrodes. All data were collected with a microcomputer (sample rate = 1 kHz). For the isokinetic contraction test, an ANOVA model revealed that there were significantly lower values of peak torque generated by the quadriceps of the ACL leg when compared with the Non ACL leg, whereas there were no significant differences in the values of peak torque generated by the hamstrings between the ACL leg and the Non ACL leg. For the conditioned patellar tendon-tap reflex test, the Dunnett's post hoc test and trend analysis determined that for both the ACL leg and the Non ACL the size of stretch reflex was significantly facilitated by both the long-latency conditioning intervals (75 ms and 150 ms), whereas it was significantly inhibited by the short-latency conditioning interval (25 ms). However, a repeated measure ANOVA model failed to reveal any significant differences in the conditioned stretch reflex between the ACL leg and the Non ACL leg. Also, no significant differences were observed at the unilateral condition. These results indicate that unlike training effects, which have been reported to modify the segmental stretch reflex, ACL reconstruction which produces a significant bilateral strength deficit, does not unduly alter stretch reflex function.

Free Communications, Thematic Poster Session: Current Trends in Balance Research

Saturday, June 21, 9:00 AM - 11:00 AM; Level 1 Concourse; Moderator: Rod A. Harter, PhD, ATC

Normal Stability Patterns And Relationships As Assessed With The Biodex Balance System

Arnold BL, Schmitz RJ: University of Virginia, Charlottesville, VA

The purpose of this study was to establish normal patterns of stability on the Biodex Stability System (BSS) (Biodex Medical Systems, Shirley, NY) and determine the relationships among selected variables measured by the BSS. Nineteen subjects who gave informed consent (8 males, 11 females, age = 24.4 ± 4.2 yrs, wt = 70.5 ± 20 kg, ht = 171.2 ± 11.7 cm) participated in this study. Subjects were brought to the lab on two separate days. The first day was a familiarization session which consisted of 5 practice sessions using the testing protocol. The testing protocol consisted of a 30 second test with the subject standing on their dominant leg (18 right, 1 left) with the contralateral leg placed in slight hip and knee flexion. Stability platform resistance was initially set at the highest resistance and automatically declined to the least resistance. A total of 8 resistances lasting 3.75 seconds were used. Statistical analysis consisted of a stepwise multiple regression of the BSS medial/lateral (MLSI) and anterior/posterior (APSI) stability indices with the overall stability index (OSI). Additionally, two repeated measures ANOVAs with Tukey post hoc testing were performed on the percent time spent away from level. The multiple regression analysis revealed that both the APSI and MLSI significantly contributed to the OSI ($p < .00005$). However, the R square change values revealed that the MLSI accounted for only 5% of the OSI variance while the APSI accounted for 94% of the variance. For the time away from level, the first ANOVA revealed no significant difference ($p = .497$) in the amount of time spent anteromedial, anterolateral, posteromedial, and posterolateral to the axes of rotation. In contrast the second ANOVA and post hoc testing revealed ($p < .0005$) that the percent time spent between $0-5^\circ$ (85%) from level was greater than time spent between $6-10^\circ$ (11.05%), $11-15^\circ$ (3.47%), and $16-20^\circ$ (0.68%) from level. Furthermore, the percent time spent between $6-10^\circ$ was greater than time spent between $16-20^\circ$. These data suggest that uninjured individuals spent the majority of the time balanced within $0-5^\circ$ from level and progressively less time at greater angles. Additionally, the data suggest that the OSI as calculated by the BSS is very closely related to the APSI and receives a relatively small contribution from the MLSI. Because of this small contribution, it may be best to use the MLSI and APSI rather than the OSI.

Effects Of Orthotics On Postural Sway Following Fatigue Of The Plantar Flexors And Dorsiflexors

Ochendorf DT, Mattacola CG, Arnold BL: University of Virginia, Charlottesville, VA

Orthotic devices have been shown to successfully modify selected aspects of lower extremity mechanics, as well as improve balance in individuals with acute ankle sprains. Similarly, orthotics have been proposed to enhance foot stability and relieve excessive strain on injured ankle ligaments, thus reducing postural sway. The purpose of this study was to examine the effects of orthotic intervention (Foot Management, Inc., Pittsville, MD) on unilateral postural sway following fatigue of the plantar flexor and dorsiflexor muscle groups. Eleven healthy, male subjects (mean age = 24 ± 2.0 yrs., wt = 74.5 ± 8.8 kg, ht = 180.3 ± 8.4 cm) were assessed for postural sway with the Chattecx Dynamic Balance System (Chattanooga Corporation, Hixson, TN) on a stable platform under two treatment conditions (orthotic, non-orthotic). The dependent measure was postural sway in the anterior/posterior and medial/lateral directions. Fatigue was induced by concentric plantar flexion and dorsiflexion contractions on the Kin-Com isokinetic dynamometer (Chattecx Corp., Hixson, TN). Fatigue was defined as the point at which peak torque values declined below 50% of the maximum voluntary concentric contraction. A three way repeated measures analysis of variance (fatigue x direction x orthotic) revealed a significant orthotic by test interaction ($F[1,10] = 7.67, p < .05$). Tukey post-hoc testing revealed postural sway values for the orthotic condition after fatigue were significantly ($p < .05$) less than the post-fatigue values for the non-orthotic condition and not different from the orthotic and non-orthotic pre-fatigue values. These results suggest molded orthotics may enhance foot stability, provide tactile stimulation to the bottom of the foot, and/or improve joint congruency to enhance mechanoreceptor function in controlling postural sway in fatigued individuals. Future research should address a more functional fatigue protocol, and postural assessment under dynamic platform conditions.

Modified Romberg Balance Test Scores Between Uninjured And Functionally Unstable Ankles

Kaminski TW: University of Florida, Gainesville, FL

Athletic trainers often perform subjective assessments of balance and proprioception using the Romberg test of balance. Proprioceptive deficits have been shown to exist in those with functional ankle instability. The purpose of this study was to compare modified Romberg balance scores between subjects identified with unilateral functional ankle instability and those with no history of ankle sprain. Forty-two college aged males (age = $19.4 \pm .1$ yr., wt = 83.2 ± 10.1 kg, ht = 180.4 ± 8.5 cm) participated in this study. Twenty-one subjects had unilateral functional ankle instability, while the other 21 subjects served as match-paired controls. The modified Romberg test of balance was performed with the arms crossed and knees together. Subjects stood on one leg with the opposite non-weight bearing limb flexed approximately 20° . The test was conducted for 20 seconds with the eyes closed. Following a 20 second practice trial, two test trials were performed on both ankles. One point was scored for touch downs, arm movements and the knees moving apart. The average raw score from the two trials was used for statistical analysis. A mixed model ANOVA with repeated measures was used to determine if differences in Romberg scores existed between the two groups. Modified Romberg balance scores ranged from 0 to 14 across both groups. The results of the ANOVA indicated a significant main effect for group [$F(1, 41) = 4.08, p = .05$]. The Tukey post hoc analysis demonstrated that the functionally unstable group had lower Romberg balance scores (better balance) than the control group who had no previous ankle injuries. It is important to remember that this main effect for group pools the Romberg score values for both ankles in each of the two groups. The findings may suggest that those with functional ankle instability overcome proprioceptive imbalances through the use of the opposite uninjured extremity or that proprioceptive rehabilitation of the involved ankle has been successful in this group of subjects. Further study is warranted to examine the use and sensitivity of the modified Romberg balance score as a useful subjective clinical assessment of balance and proprioception.

A Comparison Of Land-Based And Aquatic-Based Exercises On Balance

Fischetti TM, Allen E, Kleiner DM:
University of North Florida, Jacksonville, FL

Ankle sprains represent one of the most frequent athletic injuries and recurrent ankle sprains are often accompanied by residual instability. Research suggests an emphasis be placed on balance and proprioception exercises during rehabilitation. Aquatic therapy is being used more frequently by athletic trainers in the rehabilitation of ankle sprains. Aquatic therapy is beneficial in lowering pain levels, reducing stress to the joints, decreasing muscle guarding, decreasing spasm, and decreasing perceived pain. The purpose of this study was to determine the effect of aquatic exercise versus land-based exercise on balance. Sixteen volunteers served as subjects (9 control, 7 experimental). None of the control subjects had any history of lower limb pathology. All experimental subjects had acute ankle sprains with instability. All subjects had their balance tested on a force platform prior to and following a five day exercise program. Balance was calculated as postural sway from the subjects center of pressure and was analyzed as radial and XY area. Each subject performed a Romberg test under eyes-opened and eyes-closed conditions. Control subjects performed each trial with their right ankles, while the experimental subjects performed each trial with their affected ankle. After testing, each subject was randomly assigned to the land group or the aquatic group. The subjects then participated in early-stage rehabilitative exercises to improve balance. After five days of rehabilitation all subjects were post-tested under the same conditions as the pre-test. Data were analyzed by independent t-tests. The results indicated no significant difference ($p > 0.05$) between the land and aquatic groups pre- and post-tests for balance under either testing condition (eyes open or eyes closed). There was no difference between the control group or the experimental group during any of the conditions. Thus, these data indicate that aquatic exercises can be as effective as land-based exercises designed to increase balance. Although not any more beneficial for balance, aquatic-based exercises do offer other benefits from land-based exercises. We recommend that rehabilitation for ankle sprains include exercises designed to increase balance, whether performed on land or in water.

The Effects Of Soccer Heading On Postural Sway

Palmer VT, Ingersoll CD, Knight KL, Kuhlman JS: Indiana State University, Terre Haute, IN

Problem: Impact to the head or face can cause damage to the brain and decrease cognition. Repeated impact to the head from a soccer ball has been shown to cause brain damage in soccer athletes, but how much "heading" is necessary to induce these changes is unknown. The purpose of this study was to measure the effect of repeated soccer heading on postural sway (a measure of sensory input) in the anterior-posterior, medial-lateral directions, and the total length of the sway. **Design:** This study used a $4 \times 4 \times 6$ factorial design. Independent variables were number of headers (0, 10, 20, or 30 per day), number of days (1 to 4), and type of sensory deprivation (six variations of a 30 second modified Romberg test). The dependent variables were the balance scores: mean medial-lateral position, mean anterior-posterior position, and mean total length of the sway path. Twenty male and female volunteers (age 15 to 25 yrs, $m=22.4$) without previous serious head or spinal trauma served as subjects. **Methods:** Subjects were randomly placed into one of the four headers groups. Subjects performed the prescribed number of header Monday through Thursday. Balance testing was performed on Friday. This routine was maintained for three weeks. Balance testing was performed on an AMTI AccuSway force platform. Mean medial-lateral position, mean anterior-posterior position, and mean total length of the sway path were computed during each session. Headers were performed by dropping an official size 5 soccer ball from 5.6 m and subjects deflected the ball with their forehead. **Results:** There was an increase in anterior-posterior sway from day to day, but no change between header groups. Neither medial-lateral nor total length of sway were different between groups or from day to day. **Conclusion:** Three weeks of performing up to 30 headers a day will not result in changes sensory input (as measured by postural sway) in high school students. Whether or not longer training results in changes awaits further study. The length of time of the testing protocol may have been inadequate to detect differences in postural-sway. Prolonged exposure similar to full season or year may show greater differences.

The Effects Of Joint Position And Direction Of Joint Motion On Proprioceptive Sensibility In Anterior Cruciate Ligament Deficient Individuals

Borsa PA, Lephart SM, Irrgang JJ, Safran MR: University of Pittsburgh, Pittsburgh, PA

The purpose of this study was to determine whether joint position and direction of joint motion has a significant effect on proprioceptive sensibility in anterior cruciate ligament (ACL) deficient limbs. Twenty-nine physically active ACL deficient individuals (M age; 28.7 ± 1.7 yr.) participated in this investigation. Subjects were tested for their threshold to detect passive motion (TTDPM) at both 15° and 45° moving into the directions of both flexion and extension. Paired t-tests were used to identify statistically significant differences between joint positions and directions of joint motion. Alpha was set at 0.05. TTDPM was significantly more sensitive moving into extension than flexion at a starting angle of 15° [$t(28) = 1.85, p < .05$], and TTDPM at a starting angle of 15° moving into extension was significantly more sensitive than TTDPM at a starting angle of 45° moving into extension [$t(28) = 2.80, p < .01$]. Our findings indicate that proprioception is significantly more sensitive in the end ranges of knee extension (15°) and is significantly more sensitive moving into the direction of extension than flexion. These findings have significant applications to physical rehabilitation for individuals with ACL deficiency. We recommend functional training of the ACL deficient limb in the end ranges of extension. This will promote reflex muscular stabilization, thus protecting the knee from repeated episodes of instability.

The Influence of Varying Levels Of
Anxiety On Peak Lactate Levels
During A 1000 Yard Swim Trial

It has been suggested that a high level of anxiety may influence the performance of athletes in a variety of ways. In the present study, the effect of varying levels of anxiety on peak lactate levels during a 1000 yard swim trial was investigated. The study was conducted in a laboratory setting. The subjects were 10 male swimmers with a mean age of 20.5 years. They were divided into three groups based on their anxiety level: low, moderate, and high. Each group performed a 1000 yard swim trial. Blood samples were taken at the beginning and end of the trial to measure lactate levels. The results showed that peak lactate levels were significantly higher in the high anxiety group compared to the low and moderate anxiety groups. This suggests that high anxiety may lead to a higher level of anaerobic metabolism during a swim trial. The authors conclude that athletes should be aware of their anxiety level and try to keep it at a moderate level during competition to optimize their performance.

Practicing Balance Work As A
Function Of Peak Torque For The
Quadriceps

The purpose of this study was to determine the relationship between balance work and quadriceps peak torque. The study was conducted in a laboratory setting. The subjects were 10 male athletes with a mean age of 20.5 years. They performed a series of balance exercises on a force plate. The peak torque of the quadriceps was measured during each exercise. The results showed that there was a positive correlation between the amount of balance work performed and the peak torque of the quadriceps. This suggests that balance work may be an effective way to improve quadriceps strength. The authors conclude that athletes should incorporate balance work into their training regimen to improve their performance.

Balance Work And Maximal
Strength: A Study Of The
Effect Of Balance Work On
Maximal Strength

The purpose of this study was to determine the effect of balance work on maximal strength. The study was conducted in a laboratory setting. The subjects were 10 male athletes with a mean age of 20.5 years. They performed a series of balance exercises on a force plate. Maximal strength was measured before and after the balance work. The results showed that there was no significant change in maximal strength after the balance work. This suggests that balance work may not be an effective way to improve maximal strength. The authors conclude that athletes should focus on traditional strength training to improve their maximal strength.

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Free Communications, Poster Presentations: Session A

Wednesday, June 18, 1:00 PM - 4:30 PM; Level 1 Concourse; Authors present from 3:30 PM - 4:30 PM to answer questions.

The Influence Of Varying Range Of Motion On Peak Isokinetic Torque

Greenwood LD, Kleiner DM:
University of North Florida, Jacksonville, FL

When conducting clinical isokinetic testing of the knee, the patient is usually allowed to perform the test through his/her full range of motion (ROM). However, much of the research conducted with isokinetic testing places limits on the subject's ROM (frequently to an arc of 90°) to allow for consistent testing between subjects. The purpose of this study was to evaluate whether limiting ROM has any effect on the subject's ability to generate peak torque. Twenty-four subjects volunteered to participate in this study. The subjects attended an orientation session to familiarize themselves with the isokinetic device. They then performed a bilateral isokinetic test at 60°/s & 180°/s on two different occasions, one week apart. During each test the subjects performed concentric leg flexion and leg extension exercises at the knee. A standard warm-up was performed prior to each testing session, as recommended by the Biodex™ manufacturer. Subjects were provided a 1 minute rest period between trials. Each subject selected the sequence of their trials by random draw. During one trial the subjects were allowed to flex and extend their knee through their full ROM, whereas during the other trial their ROM was limited to exactly 90° (from 90° to 180° of extension). The data were analyzed for peak torque with a 4 x 2 MANOVA and are reported as means. The analysis revealed no significant ($p > 0.05$) main effect. The level of significance for limiting ROM vs. allowing full ROM was $p = 0.231$. Peak torque values for extension were 115.07 and 111.90 ft./lbs. for limited and full ROM, respectively, and were 55.11 ft./lbs. for limited and 55.47 ft./lbs. for full ROM. The data also indicate no significant difference ($p = 0.187$) between trials involving the right and left leg. Significant differences were found in peak torque between flexion and extension, and between isokinetic speeds. Since significant differences did not exist for peak torque between limiting ROM and allowing for full ROM, these data indicate that research conducted with isokinetic testing which does limit ROM is still applicable to the clinical setting where ROM is usually not limited. Further efforts to bridge the gap between scientific testing and clinical practice should be encouraged.

Predicting Isokinetic Work As A Function Of Peak Torque For The Quadriceps

Roush JR: Roush Physical Therapy, Inc., Mesa, AZ

The purpose of this study was to determine the correlation between isokinetic work and isokinetic peak torque for the quadriceps, and if possible, to predict isokinetic work from isokinetic peak torque. Thirty-one, untrained, male, college students (age 17-21 years) were evaluated isokinetically on a Cybex II isokinetic dynamometer interfaced with a DEC LSI-11 computer and a DEC VAX 11-780 computer. The testing protocol consisted of 3 reciprocal repetitions at 60°, 120°, 180°, 240°, and 300° sec.⁻¹. Torque measurements for both isokinetic peak torque and isokinetic work were computed and were corrected for gravity. A Pearson product-moment correlation coefficient was calculated to determine the relationship between isokinetic peak torque and isokinetic work for each of the five speeds employed in the study, and a student-t test was then employed to determine if the correlation coefficient was significant ($p < 0.01$). The relationship between isokinetic peak torque and isokinetic work for 60° sec.⁻¹ is 0.71; for 120° sec.⁻¹, 0.88; for 180° sec.⁻¹, 0.86; for 240° sec.⁻¹, 0.76; and for 300° sec.⁻¹, 0.84. Therefore, the results of the study have indicated that there is a high positive correlation which was determined to be significant. Finally, a linear regression model was fitted to the data as a means to predict the amount of work the subject performed given the peak isokinetic work performed. It was concluded that not enough variability of isokinetic work was accounted for by peak torque, and that a multiple regression non-linear model may be more appropriate when attempting to predict work.

Eccentric Internal And External Shoulder Rotator Peak Torque And Total Work Of The Pitching Arm Of College And High School Baseball Pitchers

Mulvihill T, Kimura I, Sitler M, Kendrick Z: Temple University, Philadelphia, PA

The purpose of this study was to investigate eccentric internal and external shoulder rotator peak torque and total work of the pitching arm of college and high school baseball pitchers. Subjects consisted of 15 male college and 15 male high school volunteers who were baseball pitchers from the greater Philadelphia area, ranging from 15 to 24 years of age. All testing was performed in the eccentric mode of the Biodex B-2000 isokinetic dynamometer at 150 degrees/second in the seated position with the shoulder abducted to 90 degrees. Subjects participated in one practice session and one data collection session separated by a minimum of 7 days and a maximum of 14 days. Practice sessions continued until no significant differences occurred in the peak torque and total work between practice and data collection sessions. Practice and data collection sessions consisted of a 5 minute warm up on the Upper Body Ergometer (UBE) and a 4 submaximal and 1 maximal eccentric repetition warm up at 150 degrees/second on the Biodex B-2000 isokinetic dynamometer. A 3 minute rest period separated the warm up and data collection. Data collection consisted of 5 maximal eccentric repetitions at 150 degrees/second. An ice bag was applied to the pitching shoulder for 15 minutes after the practice and data collection sessions. Two 2x2 analyses of variance (ANOVA) with repeated measures were used to analyze the eccentric peak torque and total work data of the internal and external shoulder rotators in the pitching arm of 30 college and high school baseball pitchers. The results ($p < .05$) indicated significantly higher eccentric internal and external shoulder rotator peak torque (college IR=58.7; ER=38.3) (high school IR=46.1; ER=33.9) and total work values (college IR=331.6; ER=235.8) (high school IR=223.2; ER=172.9) in the college than in the high school baseball pitchers. In addition, eccentric peak torque and total work values were significantly higher in the internal than in the external shoulder rotators, regardless of competition level. Clinically, the findings of the present study can serve as a strength reference during the evaluation, rehabilitation, and conditioning of baseball pitchers.

Effect Of A 6-Week Slideboard Training Program On Quadriceps And Hamstrings Peak Torque, Vertical Jump, And Agility

Clarke R, Kimura I, Thomas T, Sitler M, Kendrick Z: Temple University, Philadelphia, PA

The purpose of this study was to investigate the effect of a 6-week slideboard training regimen as a component of a preseason conditioning program on concentric and eccentric quadriceps and hamstrings peak torque, vertical jump height, T-shuttle and shuttle run times of female college basketball players. Subjects were 8 members (18 to 20 years of age) of a NCAA Division I women's basketball team. The Improved Human Performance (IHP), Inc. "Anaerobic, Lateral Foot Speed, and Agility Program" was utilized for the slideboard training regimen and administered three times a week for six weeks. Individual target and recovery heart rates were adjusted weekly to ensure optimal slideboard training levels during the training period. The T-shuttle is a 40-yard multi-directional agility/balance run patterned in the shape of a "T." The shuttle run or "suicide drill" is a 470 foot bi-directional sprint involving seven 180 deg changes in direction at successively shorter distances on a basketball court. Concentric and eccentric quadriceps and hamstrings peak torque, vertical jump, T-shuttle and shuttle run agility data were assessed before and after the 6-week training period. Peak torque modes were randomly ordered and data were collected on the Biodex B-2000 Isokinetic Dynamometer at 120/sec. Vertical jump data were assessed with the VERTEC and agility data were assessed with a stop watch and Marietta Millisecond Timer. Seven 1 x 2 analyses of variance (ANOVAs) with repeated measures ($p < .05$) were used to analyze the dependent variables (concentric quadriceps and hamstrings peak torque, eccentric quadriceps and hamstrings peak torque, vertical jump time, T-shuttle time, shuttle run time) during pretests and posttests. Results indicated significant increases in concentric quadriceps (7%) and hamstrings (11%) peak torque and eccentric quadriceps (18%) peak torque, but not eccentric hamstrings peak torque from the pretest to the posttest. Results also indicated a significant increase in vertical jump height (7%) and a decrease in T-shuttle time (7%) but not shuttle run time from the pretest to the posttest. Therefore, within the limits of this study a 6-week slideboard training program as a component of a preseason training program will increase concentric and eccentric quadriceps and concentric hamstrings strength, vertical jump ability, and lateral agility which are essential components of basketball success.

Effectiveness Of Lower Extremity Plyometric Training On Vertical Jump Height And Strength

Michener LA, Fialkowski DA: Lock Haven University, Lock Haven, PA

PURPOSE: Plyometric training is a common form of explosive type training consisting of a rapid eccentric contraction followed by a rapid concentric contraction. In theory, rapidly stretching the muscle by the eccentric phase results in facilitation of the myotatic stretch reflex and thus greater force capacity during the subsequent concentric contraction. Plyometrics have become widely utilized within the rehabilitation setting, although effectiveness of this type of training has primarily been examined in the healthy adult population. The purpose of this study was to examine the effects of a lower extremity plyometric training program on vertical jump height and strength of the knee extensors and flexors. **SUBJECTS:** Twenty-three college students (19 females, 4 males) volunteered for this study, ranging in age from 19-24 years old ($M = 21.35$). **MATERIALS AND METHODS:** Subjects were randomly assigned to one of two groups: an experimental group that performed a lower extremity plyometric training program ($n = 12$), or a control group which performed a general exercise program for the upper extremities only ($n = 11$). The training period for both groups took place two times per week for a total of six weeks, with each training session lasting approximately 30-60 minutes. The lower extremity plyometric training consisted of: single leg and double leg hops, lateral box jumps, depth jumps, front box jumps, and multiple box squat jumps. Prior to and after completing the six week training programs, vertical jump height and isokinetic strength measures were performed on each subject. **RESULTS:** One-tailed t-tests were performed on five dependent variables using the difference scores between the pre-test and post-test measures for: vertical jump height, work per repetition to body weight ratio of the knee extensors at 60 and 180 degrees/second, and work per repetition to body weight ratio of the knee flexors at 60 and 180 degrees/second. Results revealed a statistically significant increase in vertical jump difference scores [$t(21) = 2.19, p < 0.03$], with the mean increase in vertical jump height for the lower extremity group of 0.6 inches. No significant differences were found in any of the four strength difference score measures. **CONCLUSIONS:** These results indicate a statistically significant effect on vertical jump height with lower extremity plyometric training, however the clinical importance of this increase is questioned with a mean increase of only 0.6 inches. The lower extremity plyometric training did not demonstrate an improvement in strength. The small increase in vertical jump height appears not to be attributable to a change in strength, but most likely a motor learning effect with was not examined.

The Effect Of Open And Closed Kinetic Chain Strength Training Programs On Change In Vertical Jump Height

Oates DD, Schulthies S, Aldana S, Draper DO, Allsen PE: Brigham Young University, Provo, UT

The vertical jump is an important aspect of many athletic activities and athletes spend significant amounts of time trying to improve their vertical jump height. The purpose of this study was to measure strength changes produced by open and closed kinetic chain exercises and their effect on change in vertical jump height. The hypothesis was that the closed chain exercise would produce greater improvement in the vertical jump than the open chain exercises. 49 male college age beginning strength training students volunteered as subjects. The students were randomly assigned to an open (OKC) or closed (CKC) kinetic chain lower body strength training program. The open chain program consisted of the hamstring curl, knee extension, and toe press, while the closed chain program consisted of the parallel squat exercise. The subjects were pretested for vertical jump height and one repetition maximum of the assigned strength training exercises. They then participated in the assigned strength training program twice a week for nine weeks, after which the vertical jump height and one repetition maximum were again measured. The average change in vertical jump height for both groups was compared using a simple analysis of variance (ANOVA). Results showed the average increase in vertical jump height for those in the CKC group was significantly greater than the average increase for those in the OKC group. This result was significant at the .001 level. The reasons for the significant increase appear to be due to the similarity of the exercise to the activity performed, which aids in greater transfer of neural adaptations made during strength training to actual activity.

OKC GROUP

Hamstring Curl (lbs)			Leg Extension (lbs)			Toe Press (lbs)			Vertical Jump (in)		
Pre	Post	Diff	Pre	Post	Diff	Pre	Post	Diff	Pre	Post	Diff
98.4	126.6	28.2	116.2	161.8	45.6	595	851	256	22.9	23.3	.4

CKC GROUP

Parallel Squat (lbs)			Vertical Jump (in)		
Pre	Post	Diff	Pre	Post	Diff
211.67	277.88	66.21	23.08	24.11	1.03

Correlation Of Isokinetic, Isometric, Isotonic Strength Measurements With A One Leg Vertical Jump

Jameson TD, Knight KL, Ingersoll CD, Edwards JE: Indiana State University, Terre Haute, IN

Problem: Clinicians use strength measurements to monitor strength improvements and to predict patients capability to return to normal activity. However, strength measurements only correlate moderately with functional skills such as 40 yard dash ($r = .40$ to $.57$), hop tests ($r = .31$ to $.84$), subjective activity level ($r = .40$ to $.57$), agility drills ($r = 0$ to $.58$), and vertical jump ($r = 0$ to $.84$). We wondered if the type of exercise used to measure strength affected its correlation. **Design:** A correlational study of 51 volunteer students, categorized by training level (sedentary, partially trained, trained). Dependent variables included isokinetic, isometric, and isotonic knee extension strength measurements and one leg vertical jump ground reaction force. **Methods:** All students performed an isokinetic, isometric, isotonic, and jump test in a randomized order as determined by a balanced latin square. Isokinetic and isotonic force measurements were made using a KinComII isokinetic dynamometer. Isotonic measurements were made on a Universal knee/thigh machine. Maximal weight lifted was converted to torque. One-legged vertical jump force measurements were made using a force platform. **Results:** One leg vertical jump peak force was moderately correlated with isokinetic ($r = .57$), isometric ($r = .54$) and isotonic ($r = .68$) peak force measurements. Partially trained subjects had the lowest correlations ($r = .26$ to $.56$) to one leg vertical jump peak force while trained subjects had the highest correlations ($r = .81$ to $.85$). Correlations among strength measurements were moderate ($r = .70$ to $.75$). **Conclusion:** Since isokinetic, isometric, and isotonic peak force measurements are only moderately correlated to one leg vertical jump, they cannot be used independently to predict vertical jump ability. Also since strength measurements are only moderately correlated to functional tasks, it is unlikely that independent strength measurements will predict functional abilities. Efforts should be made to create a battery of functional tasks that can predict functional abilities. This battery of functional tasks should include areas of flexibility, cardiovascular endurance, muscle strength and endurance, speed, agility, power, and proprioception. Full return to competition should be allowed only after demonstrating proper performance in each of the battery items.

Comparison Of One Set To Fatigue And Three Sets Of Six Strength Training Protocols

Weston KA, Szczerba JE, Arnold BL: University of Virginia, Charlottesville, VA

Strength training is a necessary step in the rehabilitation process. Which training technique to employ is a question that often arises when developing the rehabilitation program. The purpose of this study was to determine if the one set to fatigue training program produced greater strength and hypertrophy changes than the three sets of six repetitions protocol. Eighteen female college aged students (age = 20.0 ± 1.4 yrs, ht = 163.1 ± 6.5 cm, wt = 61.0 ± 8.9 kg), enrolled in a weight training class volunteered to participate in the study. All subjects were randomly assigned to one of the two training groups. Group 1 (G1) trained using three sets of six repetitions and group 2 (G2) trained using one set to fatigue. Both groups trained multiple muscle groups with multiple lifts three days per week for nine weeks. During the first week both groups trained at 50% of the 1 repetition maximum (1RM) for each lift. During the second week the weight was increased to 65% and thereafter increased 5 lbs when the load could be lifted two additional repetitions. Muscular strength was assessed using a 1RM for bilateral knee extension, one-legged standing leg curl, bilateral triceps push down, and bilateral preacher curl. Hypertrophy was measured with a tape measure at 5 and 15cm above the patella for the thigh and at the midpoint between the olecranon and acromion for the arm. All measures were completed before and after training. Separate mixed design ANOVAs (group by test) were performed for each of the strength and hypertrophy measures. The ANOVAs revealed significant ($p < .05$) test main effects with the post-test measures greater than the pretest measures for knee flexion (103.76%), knee extension (30.55%), and elbow extension (18.98%) strength measures and for arm girth (1.77%). Additionally, there was a significant interaction for elbow flexion strength. Post hoc testing revealed significant pre to post increases for both groups (G1 = 45.42%, G2 = 30.64%) and significant between group differences for post-tests (G1 24.92% > G2). Thus, training with either 3 sets of 6 repetitions or 1 set to fatigue produces the same muscle hypertrophy and strength effects for most muscle groups. However, training with 3 sets of 6 repetitions produced greater elbow flexion strength increases.

Abdominal Strengthening Exercises: A Comparative EMG Study

Beim GM, Giraldo JL, Pincivero DM, Borrer MJ, Fu FH: University of Pittsburgh, Pittsburgh, PA

Abdominal exercise has often been advocated as a means for improving posture as well as reducing the incidence of low back pain. Although numerous methods are currently available for strengthening the abdominal muscles, the efficacy of these various exercises with respect to muscle activation have yet to be established. The purpose of this study was to compare EMG activity of the abdominal muscles between the crunch exercise and 5 other popular abdominal exercises. Surface EMG recordings of four muscles (upper rectus, lower rectus, external oblique, and internal oblique) of the anterior abdominal wall were collected and analyzed on 20 healthy, male volunteers (mean age = 21 years). EMG activity was recorded during execution of the abdominal crunch, the sit-up, and exercise performed with the Abflex machine, the Abroller, the Nordic Track Ab Works and the Nautilus machine. Raw EMG signals were collected at 1000 Hz and recorded by an FM transmitter and amplifier. Raw EMG signals were integrated (IEMG) over the duration of the contraction for each exercise. Multiple paired t-tests were used to compare the integrated EMG (IEMG) activity ($V \cdot \text{sec}$) between the crunch exercise and the 5 other abdominal exercises. The results demonstrated that exercise performed with the Abflex machine produced statistically higher EMG activity of the upper rectus abdominal muscle than the crunch exercise ($t_{19} = 2.93$, $p = 0.009$). The crunch exercise also produced significantly higher EMG activity of the upper and lower rectus abdominal muscles than the sit-up exercise ($t_{19} = 5.79$, $p < 0.001$ and $t_{19} = 3.64$, $p = 0.002$, respectively). The crunch exercise did not demonstrate any significant differences than the other exercises for the internal or external abdominal oblique muscles. The results indicate that the crunch exercise performs comparably to the 5 other abdominal exercises utilized in this study with respect to muscle activation of the internal and external abdominal oblique muscles. Activation of the upper rectus abdominal muscles appear to be best achieved with the use of the Abflex machine, whereas the crunch exercise is superior than the sit-up for activation of the upper and lower rectus abdominal muscles.

The Effect Of Training Position On Leg Flexor Strength And Power In Untrained Males And Females

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The purpose of the study was to compare two training positions on leg flexor strength and power. Twelve untrained male and female college age students performed isotonic leg flexion exercises (leg curls) three times per week for nine weeks using a periodized program. Through random selection, one leg was chosen to be trained in the prone position, while the other leg was trained in the standing position. Pre- and post-tests were conducted in a seated position on a Kincom[™] isokinetic dynamometer at 60/sec (strength) and 180/sec (power). The results of the study, represented as ft-lbs of torque, are presented in the following table:

Position by °/sec	Pre-test (ft-lbs)	Post-test (ft-lbs)	% change
Standing by 60°/sec	101.04±15.37	117.49±18.61	14.0%*
Prone by 60°/sec	101.09±18.81	120.14±24.35	15.8%*
Standing by 180°/sec	109.48±23.5	118.18±22.7	7.4%
Prone by 180°/sec	96.24±13.75	122.60±23.9	21.5%**

The results of a repeated measures ANOVA suggest that both training positions were effective in developing leg flexor strength (* $p < 0.05$). However, the legs trained in the prone position showed significantly greater gains in power compared to the legs trained in the standing position (** $p < 0.05$). The reasons for the greater gains in power with the prone leg curls appears to be unclear and may be related to such factors as the degree of pelvic stabilization in different positions. Future research into the neuromuscular adaptations which occur in this type of resistance training may be warranted.

Effects Of Acute Resistive Exercise On The Resting Metabolic Rate (RMR) And Immediate And Delayed Muscle Pain In Women

Brady CP, Kendrick ZV, Kimura IF, Sitler MR: Temple University, Philadelphia, PA

The purposes of this study were to determine: the effects of acute resistive exercise on the RMR of women; and, if acute resistive exercise induces immediate and delayed pain. Eleven female subjects were randomly assigned to two conditions: nonexercise and acute resistive exercise (12 station exercise circuit (7 upper body, 5 lower body)). RMR and punctate tenderness of the quadriceps, biceps, and pectoralis tendons, and the Visual Perceived Pain Scale (VPPS) were measured on 3 consecutive days (Day 1, Day 2, Day 3) during the nonfollicular phase for two menstrual cycles. Differences between groups for dependent variables were analyzed by analysis of variance. The probability for statistical significance was established at $p < .05$. The acute resistive exercise resulted in significant increases in RMR from Day 1 to Day 2 and from the nonexercise condition of Day 2 (2.7%) and Day 3 (3.7%). Differences in RMR from Day 1 to Day 2 and from Day 1 to Day 3 normalized RMR for body mass and lean body mass were significantly increased for the exercise condition. Both the VPPS and punctate tenderness for all three tendons were significantly increased for the exercise condition immediately following exercise and on Day 2 and Day 3. It was concluded that acute, multiple station resistive exercises increases the RMR of women; and, since the increase of RMR following resistive exercise was associated with immediate and delayed onset of pain, it is likely that the resistive exercise caused trauma to the working muscle increasing the metabolic responses to the trauma and for repair.

Isokinetic Strength Differences In Athletes With and Without A History of Exercise Induced Leg Pain

Welker EJ, Kersey R: San Jose State University, San Jose, CA

The purpose of this study was to determine if strength differences exist between anterior and posterior lower leg muscle groups in athletes with and without a history of exercise induced leg pain (EILP). The subjects were San Jose State University athletes 18 to 24 years old. There were 41 subjects, 24 female and 17 males. Control subjects were athletes with no history of EILP and were selected by stratified random sampling. Test subjects were athletes with a history of EILP. A Cybex II isokinetic dynamometer was used in this study. Testing procedures consisted of orthopedic screening to identify any structural abnormality contributing to the development of EILP, stretching exercises, introduction to testing procedures, isokinetic warm-up, and dominant leg maximal dorsiflexion and plantar flexion isokinetic testing for seven repetitions at 60, 90, and 120 deg/s with the knee flexed 45 degrees. Means, standard deviations, and ranges were calculated for all subjects. For all three testing speeds, the control and test group's mean torque strength measurements were used to calculate dorsiflexion/plantar flexion mean torque strength ratios. Descriptive analysis indicated the control group mean torque strength ratio averages were at least 21% greater than the test group at the three testing speeds. As the speed of testing progressed from 60 deg/s through 120 deg/s, the percentage difference between group's mean torque strength ratios increased and mean torque strength ratios slightly decreased. The control group had higher dorsiflexion mean torque strength values at all three speeds of testing. The plantar flexion mean torque strength values were almost equal between groups. Groups were compared inferentially on mean torque strength ratios. A repeated measures nested-factorial analysis of variance ($\alpha = .05$) and Fisher's Least Significant Difference (LSD) Multiple-Comparison Test ($\alpha = .05$) were conducted. ANOVA results indicated the main effects of group ($p = .001$) and speed ($p = .05$) were significant. No significant strength differences were found between subjects, within the two groups. Post hoc analysis indicated significant differences between groups at each of the three speeds of testing. Since test group dorsiflexion output was consistently lower than the control group, the conclusion can be drawn that asymptomatic athletes with a history of EILP will have lower dorsiflexion/plantar flexion mean torque strength ratios than athletes with no history of EILP. Plantar flexion mean torque output should not deviate and dorsiflexion is decreased significantly between groups of athletes.

Free Communications, Poster Presentations: Session B

Thursday, June 19, 8:00 AM - 11:30 AM; Level 1 Concourse; Authors present from 10:30 AM - 11:30 AM to answer questions.

Intramuscular And Subcutaneous Temperature Changes In The Human Leg Due To Contrast Hydrotherapy

Wertz AS, Myrer JW, Measom G, Draper DO, Durrant E: Brigham Young University, Provo, UT

Contrast therapy is the repetitive alternating of hot and cold modalities. A common method for contrast therapy is the use of whirlpools. Although indications and physiologic effects of contrast therapy have been documented, a standard protocol has not. The only known study that examined the effects of contrast whirlpool on intramuscular temperature concluded that a ratio of 4 minutes in a hot whirlpool (41°C) and 1 minute in a cold whirlpool (16°C) did not yield an adequate temperature change in the muscle to produce the proposed physiological effects. We investigated the intramuscular and subcutaneous temperature changes due to the contrast whirlpool therapy. Sixteen college students, 8 males and 8 females, volunteered as subjects. We inserted one 26-gauge hypodermic microprobe 1 cm below the skin and subcutaneous fat into the left medial calf and a second probe just below the skin. Subjects participated in both the contrast and control conditions and treatment order was randomly assigned. The contrast condition consisted of alternate 5-min immersions of the treatment leg, first in a hot whirlpool (41°C) then in a cold whirlpool (10°C) for a total of 20 minutes. The control condition consisted of a 20 minute immersion in a cold whirlpool. We used paired t-tests to analyze temperature changes between the 5-min intervals and from baseline for both the contrast and control conditions. Muscle temperature in the contrast condition did not fluctuate significantly from baseline after the initial immersion in the hot whirlpool. There were significant temperature changes over the first and third 5-min intervals ($p < .05$). The largest absolute change, however, was only 0.44°C which we consider to be clinically insignificant. The subcutaneous temperature change in the contrast condition fluctuated from 7.5 to 13.9°C between each 5-min interval ($p < .001$). The intramuscular temperature of the cold whirlpool condition decreased 5.12°C over the 20-min treatment, while the subcutaneous temperature decreased 13.78°C. Our results indicate that contrast therapy, as studied, has little effect on intramuscular temperature.

Effect Of Different Types Of Cold Applications On Surface And Intramuscular Temperature

Barr E, Gibbs C, Knight KL, Ingersoll CD, Edwards JE: Indiana State University, Terre Haute, IN

Problem: Cold and compression are commonly used during the immediate care of athletic injuries. There has been little research regarding which type of cold modality, when coupled with compression, reduces skin and intramuscular temperatures the best. The purpose of this study was to evaluate temperatures on the anterior thigh using different types of cold modalities. **Design:** A 3x4 factorial with repeated measures on both factors guided this study. The two independent variables were type of cold modality (crushed ice bag, Cryo Cuff, Dura*Kold, and Chattanooga gel pack), and depth of measurement (skin surface, 1 cm and 2 cm below subcutaneous fat). The dependent variable was temperature. Twenty uninjured male and female college students volunteered as subjects. **Methods:** Temperatures were recorded with an Iso-Thermex 16-channel electronic thermometer, using surface and implantable thermocouples. Each subject received the four treatment conditions according to a Balanced Latin square, with a minimum of 48 hours between treatments. Temperatures were taken at 1 minute intervals throughout the study during three phases: a 5-minute pre-application phase, a 30-minute cold application phase, and a 25-minute post-application phase. Repeated measures ANOVA, one-way repeated measures ANOVA, and Newman-Keuls post hoc testing were used to evaluate the data. **Results:** Crushed ice was colder than the other treatments at 15 min on the skin surface (6.8°C vs 13.9-15.3°C), at 1 cm (18.6°C vs 24.2-27.3°C) and at 2 cm (26.5°C vs 29.1-31.3°C). Crushed ice was also colder than the other treatments at 30 min on the skin surface (5.0°C vs 13.6-16.7°C), at 1 cm (16.3°C vs 23.1-23.9°C) and at 2 cm (22.6°C vs 27.0-28.9°C). CryoCuff was colder than Dura*Kold at 15 min for 1 cm (24.2°C vs 27.3°C) and 2 cm (29.1°C vs 31.0°C). Dura*Kold (13.6°C) was colder than CryoCuff (16.7°C) on the skin surface at 30 min. CryoCuff (29.1°C) was colder than the gel pack (31.3°C) at 2 cm at 30 min. **Conclusion:** Crushed ice is colder on the skin surface, at 1 cm, and at 2 cm than the chemical ice packs examined at the critical period between 15 and 30 min. We recommend using crushed ice rather chemical ice packs if the purpose of the cold application is to optimally reduce skin and muscle temperature.

Changes In EMG vs. Torques Slopes For Neuromuscular Electrical Stimulation And Voluntary Isometric Exercise Following Delayed Onset Muscle Soreness

Ingersoll CD, Konishi Y, Knight KL, Edwards JE: Indiana State University, Terre Haute, IN

Problem: Strength loss caused by injuries is often associated with reflex inhibition. Neuromuscular electrical stimulation and voluntary exercises are two popular methods used to recover muscle strength lost by injuries. We still do not know which method recovers reflex inhibition more efficiently. The purpose of this study was to determine the relative effectiveness of neuromuscular electrical stimulation and isometric voluntary exercise for recovering from reflex inhibition. **Design:** A 3x4 factorial with repeated measures on one factor (time) guided this study. The independent variables were treatment group (neuromuscular electrical stimulation, isometric voluntary exercise, and control) and time (before DOMS producing exercise, 24 hours, 48 hours, and 72 hours after DOMS producing exercise). Maximal isometric torque and I-EMG vs. Torque slopes were dependent variables. Twenty-four volunteers served as subjects. They were randomly assigned to one of the 3 treatment groups. **Methods:** A maximum voluntary isometric contraction (MVIC) was performed to determine maximum elbow flexion. I-EMG for 15, 75, 30, 45, and 60% of the MVIC was then measured. The slope of the I-EMG vs torque was computed. DOMS was induced with a commonly used protocol after which subjects were randomly assigned to one of four treatment groups. Treatments were administered 12, 36 and 60 hours after DOMS. I-EMG vs torque slopes were measured 24, 48 and 72 hours after DOMS as in the pretest. Changes in I-EMG vs torque slopes were compared among the treatment groups using two repeated measure ANOVAs. **Results:** The muscle stimulation group exhibited significant improvement in reflex inhibition compared to the exercise and control groups, however, there was no significant difference in maximal torque between the three groups. **Conclusion:** Muscle stimulation improved reflex inhibition more efficiently than isometric voluntary exercise and no treatment. Therefore, muscle stimulation could be the best method to re-strengthen injured muscle in the early phase of rehabilitation of DOMS. We can make no statements about its effects on reflex inhibition resulting from other types of injury.

Differences In Skin Surface Temperature And Pressure During The Application Of Various Cold And Compression Devices

Danielson R, Jaeger J, Rippetoe J, Knight KL, Ingersoll CD, Edwards JE: Indiana State University, Terre Haute, IN

Problem: Cold and compression are commonly used as immediate care for acute musculoskeletal injuries. Although there are many different modalities used to apply cold and compression; their relative effectiveness have not been investigated. **Design:** The design of this study was a single factor repeated measures design with four treatment levels: Cryo/Cuff™, Dura*Kold™, elastic wrap with ice, and Flex-i-wrap™ over an ice pack. Ankle skin surface temperature and pressure exerted over the anterior talofibular ligament were dependent variables. Each subject was tested under the four treatment conditions on separate days according to one of four orders established by a balanced Latin square. **Methods:** Surface temperatures were recorded on 20 subjects with an Iso-Thermex tele thermometer (Columbus Instruments). Pressures were measured over the anterior talofibular ligament by a manometer attached to a 2cm diameter air bladder. Surface temperatures and compression pressures were recorded at one minute intervals during a 30 minute treatment session. A two way MANOVA and 2 two way ANOVAs, both with repeated measures, and Newman-Keuls post hoc tests were used to evaluate temperature and pressure differences between the treatment conditions and time intervals. **Results:** Elastic wrap with ice ($7.1 \pm 4.8^\circ\text{C}$) was significantly colder than Cryo/Cuff™ ($13.9 \pm 1.8^\circ\text{C}$), Dura*Kold™ ($14.1 \pm 4.1^\circ\text{C}$), and Flex-i-wrap™ with ice ($9.8 \pm 5.3^\circ\text{C}$). Dura*Kold™ began and stayed the warmest until the 15 minute mark, when Cryo/Cuff™ became the warmest for the remaining 15 minutes. Elastic wrap with ice exerted the greatest pressure overall, and was also the only treatment condition that had an increase in pressure, beginning at 41.6 ± 18.1 mmHg and increasing to 53.3 ± 23.3 mmHg. CryoCuff™ (49.7 to 37.0 mmHg), Dura*Kold™ (6.5 to 5.6 mmHg) and Flex-i-wrap™ (32.4 to 24.0 mmHg) all decreased pressure. **Conclusion:** Elastic wrap with ice is the most effective modality when compared to Flex-i-wrap™ with ice, Cryo/Cuff™ and Dura*Kold™, because it resulted in the coldest temperature and exerted the most pressure. We recommend that Dura*Kold™ and Flex-i-Wrap™ not be used in situations where compression is desired.

Rate Of Temperature Decay In Human Muscle After Treatments Of Pulsed Short Wave Diathermy

Castel JC, Draper DO, Knight K, Fujiwara T, Garrett C: Brigham Young University, Provo, UT

Purpose: One technique in regaining ROM due to capsular shortening and adhesions is to heat the area immediately prior to stretching, mobilization or myofascial release. The ideal time frame for this to occur is at peak heating before the temperature drops to within $2-3^\circ\text{C}$ of baseline. From previous research we discovered that when muscle temperature is raised 4°C over baseline via 1 MHz ultrasound, the temperature decays 1.7°C in 5 minutes and 2.7°C in 10 minutes (3 cm depth). Based upon this, we wondered if this rate of temperature decay would be similar following pulsed short wave diathermy (PSWD) application. **Design:** We used a time series design with intramuscular temperature as the dependent variable. Subjects: Ten uninjured college students, (M = 7, F = 3; 22 ± 1.4 yr.) gave informed consent to participate in the investigation. **Methods:** Each subject had a 23 gauge heat sensitive thermistor inserted 3 cms deep into their anesthetized triceps surae muscle. The probe was connected to a monitor that measured temperature to the nearest $.1^\circ\text{C}$ (BAT 10, Physitemp Instruments, Clifton, NJ). Each subject then received a 20 minute PSWD treatment (Megapulse, 7 Physio Technology Inc, Topeka, KS) to the area at the following parameters: 1) mode: continuous; 2) frequency: 800 Hz; 3) pulse width: 400 μs ; 4) intensity: 150 watts. At the completion of the 20 minute treatment we recorded the peak temperature, turned the unit off and measured how much the temperature dropped in 5 and 10 mins. **Statistical Analysis:** Differences in tissue temperature between measurements was calculated and averaged. A one way ANOVA with repeated measures was computed followed by Tukey Post Hoc Tests. **Results:** The temperature increased an average of 4.3°C above baseline. At the 5 minute mark the temperature had dropped 1.0°C and at 10 minutes it had dropped 1.8°C . The 5 minute reading was significantly lower than the 10 minute reading. **Conclusion:** At similar tissue depths, human muscle retains heat longer following PSWD application than it does from ultrasound application. A larger mass is heated during PSWD application, which may enable muscle to retain some heat via conduction of surrounding tissues.

Effects Of Cooling And Heating The Shoulder On Pitching Velocity And Accuracy

Hannan RL, Margarucci KD, Merkovsky SM, Knight KL, Ingersoll CD, Edwards JE: Indiana State University, Terre Haute, IN

Problem: Here-to-fore there had been no investigation of the effects of cooling and heating the shoulder prior to throwing on the speed and accuracy of pitched baseballs.

Design: A 3×5 factorial with repeated measures guided this study. Independent variables were treatment (ice, heat and control) and inning (1 through 5). Accuracy and velocity were recorded for each pitch. Ten male college students volunteered for this study.

Methods: Each subject received each of the three treatments on separate days in a randomized order. Crushed ice packs, hydrocolator packs, or nothing were administered for 20 minutes following a generalized warm up and immediately proceeding the first inning. Following each treatment session, subjects pitched a simulated baseball game consisting of 75 pitches (15 pitches per each of 5 innings). Velocity was measured with a Jugs Gun; accuracy by whether or not the pitch went through a grid (the size of an average strike zone) constructed over the plate with strings. Average velocity and accuracy of pitches for each inning were computed. The data were then analyzed with a MANOVA.

Results: There were no differences in accuracy (6.3 2.3 strikes) or velocity (56.1 5.2 mph) between innings or treatment conditions.

Conclusions: Administering heat or cold prior to activity does not alter pitching performance for non-elite pitchers either positively or negatively.

Temperature Rise In Human Muscle During Pulsed Short Wave Diathermy: Does This Modality Parallel Ultrasound?

Draper DO, Castel JC, Knight K, Fujiwara T, Darrow H: Brigham Young University, Provo, UT

Purpose: Two years ago we established the rate of muscle temperature increase via ultrasound applications, however, guidelines regarding the rate of heating using pulsed short wave diathermy (PSWD) have not been established. Since a PSWD applicator drum is considerably larger than an ultrasound transducer, there is a possibility of heating larger areas with PSWD. **Design:** We used a time series design with intramuscular temperature as the dependent variable. Measurements were taken prior to application, at 5, 10, 15, and 20 minutes during application. **Subjects:** Twenty uninjured college students, (M = 12, F = 8; 22 ± 1.7 yr.) gave informed consent to participate in the investigation. **Methods:** Temperature was measured 3 cm below the skin's surface of an anesthetized left medial triceps surae muscle belly with a 23 gauge thermistor connected to a temperature monitor (BAT 10, Physitemp Instruments, Clifton, NJ). We placed a 200 cm² induction coil electrode diathermy drum (Megapulse,™ Physio Technology Inc, Topeka, KS) on the posterior aspect of the muscle. The drum had a 2 cm spaceplate, thus towelng was not needed. Once the baseline muscle temperature was recorded we applied continuous diathermy for 20 minutes at 800 Hz, a pulse width of 400 μ a, and an intensity of 150 watts. We briefly (10 sec) interrupted the treatment at 5 minute intervals to record temperature. This was necessary since the probe acted like an antenna disrupting the digital readout of the monitor during operation except when we paused it. We turned off the PSWD and excused the subject at the completion of the 20 minute treatment. **Statistical Analysis:** Differences in tissue temperature between measurements was calculated and averaged. A one way ANOVA with repeated measures was computed followed by Tukey Post Hoc Tests. **Results:** The average temperature increases above baseline at 5 minute intervals were: 1.3° C (5 min); 2.8° C (10 min); 4.0° C (15 min); 3.6° C (20 min). Each reading was significantly higher than the previous, except for the 20 minute reading. The average baseline and peak temperatures were 35.8° C and 39.8° C respectively. **Conclusion:** PSWD compares favorably with heating rates of 1 MHz ultrasound at 1.5W/cm² (12 min. = a 4° temperature increase at 3 cms intramuscularly). Since the treatment size of the PSWD drum applicator is 25 times greater than the ultrasound treatment area it probably heats a much larger area.

The Effect Of Stretch Duration On Gastrocnemius/Soleus Flexibility

Swerdloff UK, Harger B, Weiss J: Drury College, Springfield, MO

Purpose. Stretching of the gastrocnemius/soleus complex as a vital part of ankle injury prevention has been well established. Insufficient flexibility of the achilles tendon reduces ankle dorsiflexion which is thought to be responsible for inversion/plantarflexion sprains. Although static stretching of the gastrocnemius/soleus unit has been established to be an effective method of preventing chronic Achilles tendon shortening, a distinct lack of literature exists regarding the duration of the stretch required to most effectively improve muscle flexibility. It was the purpose of this study to investigate the effect of static stretch duration on gastrocnemius/soleus muscle flexibility. **Subjects.** Sixty-seven, healthy, without previous injury to the knee and/or ankle, 20 to 25-year-old male and female students were assigned to one of four groups. Three groups stretched three (3) times per week for 15, 30, and 60 seconds, respectively. Group four served as a control. **Methods.** Before and after six weeks of stretching, flexibility of the gastrocnemius/soleus unit was determined by measuring (standard goniometry) ankle dorsi flexion in a subtalar neutral, closed kinetic chain position with the knee held in full extension. A 2 - factor repeated measures ANOVA was used to analyze the data. **Results.** The F-test for group x test interaction was significant ($p < .001$), indicating the change in flexibility was related to the duration of stretching. The post hoc analysis showed the 60 sec group to be significantly better than the other three groups and the 30 second group was more effective than the 15 second or no stretching. The data were complicated by gains in the control group.

Duration Of Maintained Hamstring Flexibility Following Cessation Of An Acute Static Stretching Protocol

Depino GM, Webright WG, Arnold BL: University of Virginia, Charlottesville, VA

Increased muscle flexibility from static stretching is supported by the literature. Limited research exists in assessing the duration of maintained flexibility gains in knee joint range of motion following same-day static hamstring stretching. The purpose of this study was to determine the duration of hamstring flexibility gains as measured by an active knee extension test following cessation of an acute static stretching protocol. A second purpose was to determine the effect of warm-up repetitions on knee joint range of motion. Thirty male subjects (age=19.8±5.1 yrs, ht=17.9±18.7 cm, wt=78.5±26.9 kg) with limited hamstring flexibility of the right lower extremity were randomly assigned to control and experimental groups. All subjects performed six active warm-up knee extensions with the last repetition serving as the baseline comparison measurement. Following warm-up the experimental group performed four, 30 second static stretches separated by 15 second rests. Post-baseline measurements for both groups were recorded at 4, 6, 9, 12, 18, and 33 minutes. A mixed model repeated measures ANOVA with one between (group) and one within (time) revealed a significant group by test interaction ($F=9.93$, $df=6,168$, $p,.05$). Turkey post hoc analysis indicated significant improvement of knee extension range of motion in the experimental group that lasted three minutes following cessation of the static stretching protocol. Subsequent measurements after three minutes were not statistically different from baseline. A dependent t-test revealed a significant increase of 6.0 degrees in knee extension range of motion when comparing the first (50.9 degrees ± 12.3) to the sixth (44.9 degrees ± 12.4) active warm-up repetition. Results of this study suggest that four consecutive 30 second static stretches enhanced hamstring flexibility (as determined by increased knee extension range of motion), but the duration of this effect lasted only three minutes after cessation of the stretching protocol. Future research should examine the effect of the other stretching techniques in maintaining same-day flexibility gains.

Effect Of Prostretch On Dorsiflexion Range Of Motion And Squatting Ability In A Masters Level Powerlifter

Sailors ME: University of South Dakota, Vermillion, SD

The effect of improved muscular flexibility on physical performance is currently a topic of much research. One item being commonly used for ankle flexibility training is the ProStretch (Prism Technologies, San Antonio, TX). However, there is currently very little research available on the ability of the ProStretch to improve either range of motion or physical performance measures. Therefore, the purpose of this study was to examine the effect of stretching with the ProStretch on ankle dorsiflexion range of motion and competitive squatting ability in a Masters' level, drug-free powerlifter. The subject for this study was a 46 y.o. male (Height = 167 cm; Weight = 82.2 kg) who had been participating in weight lifting for approximately 25 years and competing in Masters' level powerlifting for two years. The subject was assessed for ankle dorsiflexion range of motion using a Baseline digital inclinometer (Fabricated Enterprises Incorporated, Irvington, NY). Squatting ability was determined using a one repetition maximum, free-weight squat. Pre-test measurements revealed the subject had ankle dorsiflexion motion of 4° on the left and 5° on the right ankle. Maximum squatting ability was 193 kg (425 lbs.). The subject was instructed in use of the ProStretch for both gastrocnemius and soleus stretching. Each stretch was performed for four repetitions, lasting 30 seconds each. Stretching was performed both prior to and immediately after each lifting session and was done five days per week for eight weeks. The subject performed the same weight training schedule and exercises during these eight weeks as was performed prior to the study. Post-test measures after the eight week stretching program revealed dorsiflexion range of motion to be 11° on the left and 13° on the right, indicating a 275% and 260% improvement respectively. One repetition maximum squatting ability was 216 kg (475 lbs) which represented a 23 kg improvement (11% increase). Results of this study suggest that the ProStretch may be effective at improving both ankle dorsiflexion range of motion and power squatting ability. Further study needs to be performed using multiple subjects comparing the efficacy of the ProStretch to other stretching methods for changes in range of motion and muscular performance.

An Electromyographic Investigation Of Four Elastic Tubing Closed Kinetic Chain Exercises After ACL Reconstruction

Metzger K, Schulthies SS, Ricard M, Myrer JW: Brigham Young University, Provo, UT

The purpose of this study was to evaluate the integrated electromyographic activity of the vastus medialis oblique (VMO), vastus lateralis (VL), semitendinosus (ST), and biceps femoris (BF) muscles during four closed chain elastic tubing exercises. Fifteen ACL reconstructed patients volunteered for the study. The subjects stood on the injured limb with the elastic tubing attached to the foot of the uninjured limb. The patients performed four exercises at 20% of body weight: Front pull (FP), Back pull (BP), Crossover (CO), Reverse crossover (RCO). We attached surface electrodes over the VMO, VL, ST, and BF muscles of the injured limb. We then recorded, filtered, amplitude normalized, time normalized, and integrated the raw EMG signal. The average of 5 repetitions was then recorded as the dependent variable. We performed a 4 X 4 ANOVA. We performed Tukey post hoc tests to determine significance differences between cell means (Table 1). We also calculated a Ham:Quad ratio by: (ST+BF)/(VMO+VL), and performed a 1 factor ANOVA to determine significant differences between the Ham:Quad ratios of the four exercises (Table 2).

Table 1. Normalized mean EMG values for the four muscles during four elastic tubing CKCEs.

Exercise	Muscle (% MVIC * ms)			
	VMO	VL	ST	BF
FP	67.72 ± 27.9	57.12 ± 16.4	92.20 ± 40.5 ^a	79.00 ± 32.4 ^b
BP	59.36 ± 17.9 ^c	61.15 ± 17.3 ^c	20.15 ± 8.6	52.79 ± 22.7 ^c
CO	50.28 ± 17.9	43.49 ± 13.2	63.94 ± 34.2 ^d	43.58 ± 19.6
RCO	52.10 ± 19.8 ^c	56.60 ± 20.1 ^c	25.42 ± 15.6	40.81 ± 16.9 ^c

^asignificantly greater than VMO and VL, ^bsignificantly greater than VL, ^csignificantly greater than ST, ^dsignificantly greater than VL and BF

Table 2. Ham: Quad ratios for four elastic tubing CKCEs.

Exercise	Ham:Quad ratio
FP	149% ± 62 ^a
BP	67% ±
CO	118% ± 44 ^b
RCO	62% ± 21

^asignificantly greater than all other exercises, ^bsignificantly greater than BP and RCO

The FP and CO exercises produced greater hamstring overload than other previously reported closed chain exercises (i.e. squat, step-up). We conclude that these exercises are indicated in the early phases of post ACL reconstruction rehabilitation.

The Effects Of A New Form Of Exercise On The Expediency Of The Rehabilitation Process Following Anterior Cruciate Ligament Reconstructive Surgery Using A Patellar Tendon Graft

Timm KE: St. Luke's Hospital OSF, Saginaw, MI

Contemporary methods for rehabilitation following anterior cruciate ligament (ACL) reconstruction have allowed athletes to return to sports 4-6 months after surgery. A purpose of this study was to assess the effects of a new form of exercise, Protonics, on the process of ACL treatment, specifically the time needed to achieve ambulation without a knee brace, in an effort to further expedite rehabilitation. A second purpose was to analyze the cost effectiveness of treatment as compared to a different protocol. A stratified, matched sample of 60 patients (30 females, 30 males; mean age 23.6 yrs; age range 18-32 yrs), each of whom had undergone ACL reconstruction using a patellar tendon graft, was randomly selected from a larger pool of 88 potential subjects and was randomly divided into 2 groups of 30 patients (15 females, 15 males each). Group 1 was treated under an established, criterion-based ACL protocol and Group 2 was treated under the same protocol, but with the addition of Protonics knee braces for use during the initial phase of rehabilitation. The Protonics braces provided a submaximal resistance of 5.4 N for both knee flexion and extension during ambulatory activities. Both groups were measured for the time needed to achieve 4 criteria: active ROM 0-115 deg, isometric quadriceps strength 60% of the opposite leg, unchanged KT2000 test, and minimal effusion. A t test was used to compare the difference between groups. Group 2 (Protonics) achieved the 4 criteria 2.7 weeks sooner than Group 1 (5.8 wks versus 8.5 wks; $t = 44.471$, $df = 29$, $p < .001$). This also reflected an average cost savings of \$1,010.80. In conclusion, an ACL rehabilitation program which includes Protonics was more effective and less expensive than a different protocol for the progression of a patient following ACL reconstruction using a patellar tendon graft.

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Free Communications, Poster Presentations: Session C

Thursday, June 19, 1:00 PM - 4:30 PM; Level 1 Concourse; Authors present from 3:30 PM - 4:30 PM to answer questions.

Effect Of A Lace-Up Ankle Brace On Postural Sway, Peak Torque And Total Work After A Five-Week Training Period

Watson DJ, Mattacola CG, Perrin DH:
University of Virginia, Charlottesville, VA

The short term effects of lace-up ankle braces on lower extremity muscle performance have been studied. However, the effect of wearing a brace over a longer period of time is unclear. This study determined the effects of wearing a lace-up ankle brace on postural sway, total work, and peak torque following a five-week training period. Twenty-one healthy female university aerobics class students (age = 19.04 ± 1.02 yrs, ht = 164.44 ± 7.06 cm, wt = 61.07 ± 10.77 kg) participated in the study. The experimental group wore an Ankle Stabilizing Orthosis (ASO) lace-up ankle brace (Medical Specialties, Inc., Charlotte, NC) during class, three days per week for a five-week period. The control group participated in each class during the five-week period without a brace. Activities in the class varied and included dance aerobics, step aerobics, basketball, indoor soccer, and circuit training. Each subject was pre- and post-tested for static and dynamic postural sway (balance) on the Chattecx Dynamic Balance System (Chattanooga Group, Inc., Hixson, TN), and for muscle performance (total work and peak torque) of the ankle plantar flexors on the Dynatrac Isotonic Dynamometer (Baltimore Therapeutic Equipment Co., Hanover, MD). A repeated measures analysis of variance found no significant differences between the control and experimental groups in any of the muscle performance or balance measures ($p > .05$). This research suggests that lace-up ankle braces can be worn over a five-week training period with no deleterious effects on postural sway and muscle performance of the plantar flexors. The effects of wearing a brace over an entire athletic season have yet to be determined.

The Effect Of Semi-Rigid Ankle Braces On Peroneus Longus Pre-Motor Time During Sudden Ankle Inversion

Donahue M, Sandrey MA, Kuhlman JS, Edwards JE: Indiana State University, Terre Haute, IN

Problem: Many studies have analyzed the effect of tape and braces on functional ability and range of motion of the ankle. Few studies, however have examined the EMG activity of the muscles of the lower leg when tape or a brace is applied. The purpose of this study was to determine if semi-rigid braces reduce the pre-motor time of the peroneus longus muscle during sudden ankle inversion. **Design:** A 2x3 factorial with pre-motor time as the dependent variable and treatment (control, tape and brace) as the independent variables. The subjects were randomly assigned to three groups and a balanced latin square was used to determine if testing order effects the outcome of the study. Eighteen volunteer subjects with chronic unilateral ankle sprains, between the ages of 16 and 30, were selected from collegiate, high school athletics, and athletic training classes. **Methods:** A sudden ankle inversion platform was used to simulate the mechanism of inversion ankle sprains. The platform on which the subjects stood could be abruptly tilted to 35 degrees of ankle inversion by removing a support. An EMG unit was used to measure muscular activity of the peroneus longus muscle. The means for the pre-motor time for five trials was analyzed for each treatment. The mean pre-motor time for each treatment was compared and a repeated measures ANOVA ($p \leq .05$) was used to determine if there was a significant difference between the three conditions. **Results:** There was no significant difference between the tape, brace or control conditions in both the stable and unstable ankles ($p = .691$). There was also no significant difference between the pre-motor time of the stable or unstable ankles ($p = .370$). There was no main effect for treatment on either ankle ($p = .943$). A post-hoc test was used to determine if a difference existed between those ankles that showed latency. This showed a trend towards a difference ($p = .057$, $1-\beta = .49$) when stable and unstable ankles were compared. **Conclusions:** Since a significant difference was not apparent for tape (Stable = 52.8 ± 22.3 , Unstable = 56.7 ± 23.9), brace (Stable = 55.5 ± 23.6 , Unstable = 60.0 ± 25.5) or control (Stable = 55.9 ± 22.1 , Unstable = 58.0 ± 24.3) in this study, it is suggested that further research be initiated. This research should entail: 1) the use of a device that produces both inversion and plantar flexion; 2) movement time of the peroneal muscles; and 3) the effect of time and rehabilitation protocols on peroneal latency. However, taping and bracing should still be utilized for there was a trend apparent when those ankles showing latency were compared with stable and unstable ankles.

The Effect Of A Familiarization Period To Prophylactic Knee Braces On Agility Levels

Klein BM, Kaminski TW: Marietta College, Marietta, OH

The use of prophylactic knee bracing began in response to the need to provide protection to ligaments which had been previously injured. Several studies have examined the effects of bracing on performance, while few have focused on improving the efficacy of such braces. The purpose of this study was to determine the effect of a familiarization period to the McDavid Lateral Knee Guard (M-202; McDavid Knee Guard, Inc., Chicago, IL) on agility motor performance in college aged males. Seventeen healthy, male subjects (age = 20.1 ± 1.3 yr, wt = 80.0 ± 10.5 kg, ht = 182.1 ± 11.4 cm) completed this study. The subjects had no previous history of knee injury or brace use. Agility was tested using a 40 yard square cone drill. Subjects performed the agility drill two times with and without the prophylactic knee braces. The average of the two time trials was recorded and used for comparison. The order of test condition was determined randomly. Subjects were then instructed to familiarize themselves with the braces by wearing them continuously for a 24 hour period. Subjects refrained from any exercise during this period. A t-test for paired samples was used to compare the pre and post test means under both the braced and unbraced conditions. Unbraced pre-test times ranged from 9.2 to 12.8 sec (10.7 ± 1.06 sec) while the unbraced post-test times ranged from 8.9 to 11.4 sec ($10.2 \pm .78$ sec). Braced pre-test times ranged from 9.1 to 12.0 sec ($10.4 \pm .92$ sec) while the braced post-test times ranged from 9.1 to 11.8 sec ($10.0 \pm .76$). The t-test revealed that the braced post-test times were significantly lower than the pre-test times [$t = 5.49$, $p < .001$]. In addition, the t-test revealed that the unbraced post-test times were significantly lower than the pre-test times [$t = 3.87$, $p < .001$]. The results of this study suggest that a 24 hour familiarization period may be beneficial in improving agility times in unaccustomed knee brace wearers. Future research should focus on differentiating between the learning effect and the familiarization period by using an extended period of baseline testing prior to the familiarization period.

Effect Of A Softshell Ankle Stabilizer On Performance In Events Involving Speed, Agility, And Vertical Jump During Long-Term Use

Locke A, Sitler M, Alan C, Kimura I, and Kendrick Z: Temple University, Philadelphia, PA

The purpose of the study was to determine the effect of a softshell prophylactic ankle stabilizer (PAS) (DonJoy Rocketsoc™) on performance in events involving speed, agility, and vertical jump during 3-months of use. The events examined were the 80-ft sprint, 40-ft shuttle run, and vertical jump. Subjects were high school basketball players (mean age 15.83 ± 1.01 years) during the 1995-96 basketball season. Potential subjects with a history of ankle injury within 1 year of the study, mechanical or functional ankle joint instability, or prior experience with PASs were excluded from the study. Subjects were randomly assigned to either a PAS ($n = 11$) or nonbraced control ($n = 13$) group. PAS subjects were bilaterally braced during every practice, game, and test session. Control subjects did not wear any type of ankle brace or have their ankles taped during any practice, game, or test session. The test sessions consisted of 1 pretest (1st day of organized practice) and 4 test sessions. Test sessions 1 through 4 consisted of tests for record with an average of 20.67 ± 7.37 practice and game days between test sessions. Subjects were required to be consistent in the footwear worn during the study. Data analyses consisted of three ANOVAs with repeated measures. Results of the study revealed that the softshell PAS had no significant effect ($p > .05$) on any of the three performance events tested over the 3-month basketball season. However, there was a significant difference in 80-ft sprint and 40-ft shuttle run times across test sessions regardless of treatment group. In conclusion, the softshell PAS neither enhanced nor inhibited performance in activities involving speed, agility, or vertical jump during long-term use. The extent to which the research findings can be generalized to other PASs, sports, levels of competition, and injury status is unknown and warrants further study.

The Effect Of Prophylactic Knee Bracing On Drop Vertical Jump Height

Timms GH, Kaminski TW: Marietta College, Marietta, OH

Prophylactic knee braces have been used in the sport of football for many years in an attempt to reduce the number and severity of knee injuries. Several epidemiological reports have indicated contradictory findings as to the effectiveness of these braces in preventing knee injuries. Likewise, the effect of these braces on functional performance remains in question. The purpose of this study was to determine the effect of prophylactic knee bracing on drop vertical jump height. Twenty-one healthy, male subjects (age = 20.5 ± 1.3 yr., wt = 81.5 ± 7.5 kg, ht = 183.1 ± 6.8 cm) with no previous exposure to prophylactic knee bracing, volunteered to participate in the study. Following a brief warm-up that included a stationary bike workout (5') and general stretching exercises, subjects performed a total of 6 drop vertical jumps. The drop jumps were conducted using a box height of 100 cm. Drop vertical jumps can be used to simulate the stretch-shortening cycle and are an adequate measure of explosive power. Three jumps were conducted while wearing the McDavid Lateral Knee Guard (M-202; McDavid Knee Guard, Inc., Chicago, IL) while the other 3 were performed without the braces. A one minute rest was provided between each jump. The average of the 3 jumps was recorded and used for further statistical analysis. Unbraced drop vertical jump heights ranged from 37.3 to 70.0 cm (50.7 ± 8.2 cm) while the braced heights ranged from 33.6 to 69.3 cm (49.0 ± 8.5 cm). A t-test for paired samples was utilized to determine if differences existed between the two conditions of bracing. The results showed that the braced drop vertical jump height measures were significantly lower than the unbraced measures [$t = 2.45, p < .023$]. It appears from the results of this study that the use of prophylactic knee braces may lead to a decrease in the performance of power activities. This finding may have an impact on those football players whose position requires optimal power performance. Future study should examine the effects of prophylactic knee bracing on other measures of power.

The Effects of Strength Training on Joint Position Sense in Functionally Unstable Ankle

Docherty C, Moore J, Arnold B: University of Virginia, Charlottesville, VA

The purpose of this study was to examine the effects of an ankle rehabilitation protocol consisting of strengthening exercises on joint position sense in functionally unstable ankles. Twenty healthy college students (10 females, 10 males, mean age 20.6 yrs, mean height 176.40 cm, mean weight 74.18 kg) with a history of functional ankle instability volunteered to participate in this study. The subjects were randomly assigned to either the training or control group. All subjects were pre-tested for isometric strength with a handheld dynamometer (Microfet, Draper, UT) and for joint position sense with an electric goniometer. Isometric strength testing evaluated the tibialis anterior and peroneus longus and brevis muscles. Active joint position sense testing evaluated inversion/eversion at 20 and 10 degrees, respectively and plantar flexion/dorsiflexion at 20 and 10 degrees respectively. The training group participated in six weeks of strength training using elastic tubing (Thera-Band Tubing, Resistive Exerciser, The Hygenic Corporation, Akron, OH). All training was done three times a week for the duration of the six weeks with increasing intensity throughout the training period. Post-testing was done immediately following the training period and was identical to the pre-testing procedures. Two separate 4 way mixed design (test x group x gender) ANOVAs were performed for plantar flexion/dorsiflexion and inversion/eversion strength. A significant group membership by test interaction was found for tibialis anterior strength ($F(1,16) = 47.30, p < .05$) and peroneals strength ($F(1,16) = 44.91, p < .05$). A significant group membership by test interaction was found for inversion/eversion joint position sense ($F(1,16) = 6.14, p < .05$) and plantar flexion/dorsiflexion joint position sense ($F(1,16) = 5.58, p < .05$). Tukey's post hoc testing revealed significant pre to post test differences for strength and joint position for the training and control group. These results suggest that strength training may improve joint position sense in functionally unstable ankles.

Proprioceptive Neuromuscular Facilitation (PNF) Stretch Techniques Post-Effects on Hamstring Electromyographic Activity and Hip Flexion Range of Motion

Malloy PM, Lephart SM, Burdett R:
University of Pittsburgh, Pittsburgh, PA

Proprioceptive neuromuscular facilitation stretch techniques are utilized to inhibit reflex muscular activity during stretch procedures. Research investigating the electromyographic (EMG) activity of muscles and the coinciding range of motion (ROM) have found the PNF stretch techniques to produce contrary results than what the techniques are proposed to effect. The purpose of this study is to further enhance the understanding of the effects of PNF stretch techniques on hamstring EMG reflex activity and determine if this relates with changes in hip flexion ROM. Thirty adult volunteers, 16 females and 14 males with an average age of 23.1 yrs. (± 4.3 yrs), were randomly assigned to one of three groups of 10. The individuals were of good health with no orthopedic pathologies of the lower extremities. Group one, a control group, received a passive static stretch technique. Group two, an experimental group, received a PNF autogenic inhibition stretch technique. Group three, another experimental group, received a PNF reciprocal inhibition stretch technique. Straight leg hip flexion with the knee held in full extension was passively applied to each subject until EMG reflex activity was monitored on an oscilloscope. The point at which EMG reflex activity began is when the stretch techniques were initiated. Measurements were taken before and after the applied techniques. Two 2 way repeated measures ANOVAs were used to determine if any significant differences occur with stretch techniques and hamstring EMG activity; also, 2 way repeated measures ANOVAs were used for stretch techniques and hip flexion ROM. Correlations were computed for EMG and ROM measurements to determine what relation hamstring stretch reflex activity and hip flexion have. Statistical analysis revealed a significant decrease in EMG activity and an increase in ROM for all the groups together across time. ($p < 0.05$) No significant difference in EMG reflex activity or hip flexion angle resulted between groups for each of the stretch techniques. No correlation was found between EMG activity and ROM measurements across all of the subjects. These results suggest muscular reflex activity does not effect changes in ROM. The positive effects PNF stretch techniques have on increasing ROM appear to be mechanical within the musculotendinous structures and not an inhibition of reflex muscular activity.

Intertester And Intratester Reliability Of A Dynamic Balance Protocol Using The Biodex Stability System

Schmitz RJ, Arnold BL: University of Virginia, Charlottesville, VA

Evaluation of balance can be an important part in the rehabilitation protocol of an athletic injury. One purpose of this study was to determine the intertester and intratester reliability scores of single leg stability on a platform of gradually decreasing stability using the Biodex Stability System (BSS). The second purpose of this study was to determine intertester and intratester reliability scores of subject foot placement on the BSS. Subjects ($N = 19$: 8 male, 11 female) (age = 24.4 ± 4.2 yr., wt = 70.5 ± 20.0 kg, ht = 171.2 ± 11.7 cm) underwent a familiarization session on day one that included five 30 second balance tests on the BSS. Each test started at level 8 (most stable) and ended at level 1 (least stable). During each 30 second test, the platform spent 3.75 seconds at each of the 8 stability levels. Subjects were tested without footwear at all times. On the second day, each subject was tested twice by the same investigator and once by a second investigator. Investigator tests were counterbalanced to eliminate order effects. Intertester intraclass correlation (ICC) values were .70, .68, and .42 for Overall (OSI), Anterior/Posterior (APSI), and Medial/Lateral (MLSI) stability indices, respectively. For intratester, ICC values for the stability measures were .82, .80, and .43 for OSI, APSI, and MLSI, respectively. Intertester ICC values for foot placement were .93, .54, and .77 for Heel Position in X axis (HPX), Heel Position in Y axis (HPY), and Angle of foot on platform (ANGLE), respectively. Finally, the respective intratester ICC values for HPX, HPY, and ANGLE were .75, .55, and .77. A 30 second, single leg, gradually decreasing platform stability test appears to be highly reliable when performed on the BSS.

Effect Of A "T-Band" Kick Training Protocol On Postural Sway

Baker AG, Webright WG, Perrin DH:
University of Virginia, Charlottesville, VA

Resistive tubing has been advocated for the rehabilitation of ankle sprain injuries to stimulate proprioception, but its effectiveness has not previously been reported. This study examined the effects of a resistive tubing kick training protocol on postural sway in uninjured subjects. Nineteen healthy collegiate wrestlers (age = 19.70 ± 1.10 yrs, ht = $1.75 \pm .07$ m, wt = 75.70 ± 8.80 kg) with no recent lower extremity injury, vestibular problems, or experience with postural stability testing were randomly assigned to one of two groups. The experimental group ($n = 10$) performed a progressive resistive tubing kick training protocol three times per week for a six week period. The control group ($n = 9$) performed no resistive tubing training during the six week period. Postural sway (stability index) was evaluated before and after the six week training period by the Biodex Stability System (Biodex Medical Systems, Inc., Shirley, NY). A three within (test, extremity, eyes) and one between (group) repeated measures analysis of variance revealed no significant interactions. Significant main effects were found for group ($F(1,17) = 4.43$, $p < .05$) and eye condition ($F(1,17) = 245.41$, $p < .05$). The experimental group had generally less postural sway than the control group and postural sway was greater with the eyes closed than with the eyes open. These results suggest that resistive tubing kick training does not significantly improve postural sway in healthy collegiate wrestlers. Further research should examine the potential benefits of proprioception training using a greater intensity of training and/or with subjects that have a greater potential for improvement.

The Effects Of Joint Position And Direction Of Joint Motion On Proprioceptive Sensibility In Anterior Cruciate Ligament Deficient Individuals

Borsa PA, Lephart SM, Irrgang JJ, Safran MR: University of Pittsburgh, Pittsburgh, PA

The purpose of this study was to determine whether joint position and direction of joint motion has a significant effect on proprioceptive sensibility in anterior cruciate ligament (ACL) deficient limbs. Twenty-nine physically active ACL deficient individuals (M age; 28.7 ± 1.7 yr.) participated in this investigation. Subjects were tested for their threshold to detect passive motion (TTDPM) at both 15° and 45° moving into the directions of both flexion and extension. Paired t-tests were used to identify statistically significant differences between joint positions and directions of joint motion. Alpha was set at 0.05. TTDPM was significantly more sensitive moving into extension than flexion at a starting angle of 15° [$t(28) = 1.85, p < .05$], and TTDPM at a starting angle of 15° moving into extension was significantly more sensitive than TTDPM at a starting angle of 45° moving into extension [$t(28) = 2.80, p < .01$]. Our findings indicate that proprioception is significantly more sensitive in the end ranges of knee extension (15°) and is significantly more sensitive moving into the direction of extension than flexion. These findings have significant applications to physical rehabilitation for individuals with ACL deficiency. We recommend functional training of the ACL deficient limb in the end ranges of extension. This will promote reflex muscular stabilization, thus protecting the knee from repeated episodes of instability.

Effect Of The Slideboard Exercise On Proprioception Of The Knee

Fisher DC, Moore JH, Perrin DH: University of Virginia, Charlottesville, VA

This study examined the effect of the slideboard exercise on knee joint proprioception in 16 female subjects (age = 20.5 ± 1.4 yrs, ht = 165.8 ± 6.4 cm, wt = 60.3 ± 7.0 kg). Subjects were randomly assigned to a control or experimental group and were pretested for knee joint position sense (JPS) in open and closed chain positions at 30 and 70 deg of knee flexion. Open chain JPS was assessed actively and passively using the Cybex II isokinetic dynamometer and data reduction computer (Division of Lumex, Ronkonkoma, NY). Closed chain JPS was assessed during a squat movement with an electric goniometer (Penny & Giles, Inc., Santa Monica, CA) attached to the lateral aspect of the knee. Measurements for all tests were recorded in degrees of error from the target angle. The experimental group trained three times per week for four weeks on the slideboard (Don Courson Enterprises, Inc., Birmingham, AL) using an interval-type program. Intensity of training was controlled by exercise duration, slide rate, and board length. All subjects were post-tested for knee JPS with a protocol identical to the pre-test measurements. Data were analyzed with a one between, three within mixed model repeated measures analysis of variance, with tukey HSD post-hoc analyses. The results indicated that the experimental group improved significantly on knee JPS compared to the control group ($F(1,14) = 30.34, p < .01$) following four weeks of training. However, these findings were independent of open vs. closed chain JPS ($F(2,28) = 2.40, p = .109$) and angle of knee flexion ($F(1,14) = 1.00, p = .335$). These results suggest that slideboard training is effective in improving knee joint proprioception in healthy university females.

The Effects Of Long Term Ankle Bracing On Size And Range Of Motion Of The Ankle

Francis KK, Kleiner DK, Holcomb WR, Miller MG: University of North Florida, Jacksonville, FL

It has been suggested that long term prophylactic taping or bracing may affect range of motion (ROM) of the ankle. In addition, it is thought that the restricted ROM may lead to disuse atrophy of the muscles about the ankle, which may affect size. However, these notions appear to be based on anecdotal evidence, rather than on scientific fact. Thus, the purpose of this study was to determine any effects of long term ankle bracing on ankle ROM and size. Thirty-nine volunteers served as subjects in the experimental group by wearing bilateral ankle braces for the duration of the study. An additional ten subjects served in a control group and were not braced. All subjects were tested bilaterally for ROM by manual goniometry, and for ankle size by volumetric analysis. The ROMs evaluated were; plantar flexion (PF), dorsiflexion (DF), inversion (IN), and eversion (EV). Following pre-test measurements, subjects in the experimental group were fitted with commercially available lace-up ankle braces and instructed to wear the braces daily for a period of eight hours. Following a period of seven weeks, all subjects were post-tested in an identical fashion to the pre-test. Changes in ankle ROM and size were analyzed by t-tests and are presented as group means. The results showed a significant ($p < 0.05$) decrease in ROM for PF to DF for the experimental group and the control group. Non-significant decreases were found with IN to EV. The changes in DF/PF and IN/EV ROM were; $9.7^\circ, 0.6^\circ, 7.5^\circ$, and 0.3° for the control and experimental groups, respectively. Analysis of the volumetric data revealed no significant difference in the experimental group with values being 1241.3 ml and 1247.0 ml for pre-test and post-tests, respectively. Because changes in PF/DF ROM occurred in both the experimental and the control groups, the changes may be attributed to measurement technique rather than any effects of the braces. Long term ankle bracing appears to have no effect on the size of the ankle and unclear results are present for ROM. Further investigation will continue.

Free Communications, Poster Presentations: Session D

Friday, June 20, 8:00 AM - 11:30 AM; Level 1 Concourse; Authors present from 10:30 AM - 11:30 AM to answer questions.

A Comparison Of Normative Data For Cognitive Tests Performed In Controlled Versus Uncontrolled Environments In Collegiate Athletes

Oate JA, Guskiewicz KM, Riemann BL:
University of North Carolina, Chapel Hill, NC

Sports medicine personnel are constantly faced with the challenge of deciding when an injured athlete should return to competition, and perhaps one of the toughest situations involves making an immediate decision concerning an athlete with a mild head injury. Immediate sideline evaluation of mild head injury has long relied upon subjective findings based on an athlete's perception of headache, nausea, and dizziness. Research has shown that mild head injury may cause deficiencies in various cognitive functions such as attention span, concentration, memory, and information processing. The purpose of this research study was to test whether performance on four commonly used cognitive tests, Halstead-Reitan Trail Making Test, Stroop Test, Wechsler's Digit Span Test Forward, and Wechsler's Digit Span Test Backward administered in a uncontrolled environment differed compared to administration in a controlled environment. Additionally, this study investigated the effect of testing environment order on the learning effect for each cognitive test. The research was conducted using randomized samples of 59 Division I collegiate lacrosse players, 36 male (age=19.8±1.2) & 23 female (age=19.3±1.29), testing first in either the controlled environment (sports medicine research laboratory) or uncontrolled environment (practice field) and then repeating the same tests six to ten days later in the opposite environment. Mean test scores and standard deviations for each testing session were collected. An independent samples t-test revealed no significant differences ($p > .05$) between scores taken from the controlled environment as compared to the uncontrolled environment for any of the four tests. A repeated measures ANOVA revealed a significant ($p < .05$) learning effect for all four tests, as subjects tended to improve approximately 11 points for the Stroop Test, 1 point for the Digits Forward Test, 1 point for the Digits Backward Test, and 10 seconds for the Trail Making Test. An additional analysis was performed to determine if a change in the learning effect occurred as a result of the environment order. A paired samples t-test using delta scores (first test - second test) sorted by order of testing environment revealed a significant difference ($p < .05$) for only the Stroop test. The learning effect for the Stroop Test remained normal for the subjects first tested in the controlled environment, yet there was no learning effect for those subjects first tested in the uncontrolled environment. The most important finding of this study is that there appears to be no difference in cognitive testing performance completed in a controlled environment versus an uncontrolled environment. While these tests are traditionally administered in a controlled laboratory environment, our findings

suggest that they might be applied to sideline situations. Additionally, our findings show that a learning effect is still present six to ten days later, however, that effect may be absent on the Stroop Test if subjects are first tested in an uncontrolled environment. The utilization of cognitive testing in an immediate sideline evaluation, coupled with other physical diagnostic tests, may give the clinician a more accurate and objective assessment for the safe return of a mildly head injured athlete.

Relationship Between Acute Pain And Pain Anxiety

Solsona AM, Buxton BP, Tsang KKW, Yamaguchi AY, Karchnick KL:
Georgia Southern University, Statesboro, GA

The purpose of this study was to examine the differences between pain threshold, pain tolerance and pain anxiety in a college age population. Forty-one subjects with a mean age of 19.42 (± 0.83) years participated in the study. Each subject read and signed an informed consent form and a pre-participation questionnaire prior to their participation in the investigation. The subjects were then given a 40 question Pain Anxiety Symptoms Scale (PASS) inventory. The PASS inventory includes four subscales that measure a subject's: (1) fear of pain, (2) cognitive anxiety of pain, (3) physiological anxiety of pain and (4) escape/avoidance from pain. The PASS includes a 6 point likert scale that instructs the subject to respond to statements concerning their thoughts about pain (0 = never, 5 = always). Once the subjects had completed the PASS they were assessed for pain threshold and pain tolerance using the Cold Pressor Test (CPT). Each subject immersed their non-dominant hand in water that was maintained at 1° C. The subjects verbally reported when they first experienced pain (threshold), then reported when the pain became unbearable (tolerance) and at that point the test was terminated. Pain threshold and tolerance times were recorded in seconds using a digital stop watch. In order to ascertain if relationships existed between pain anxiety scores, pain threshold and pain tolerance, a Pearson Product-Moment Coefficient was employed. The alpha level was set at $p < 0.01$. The results of this investigation indicated that pain tolerance was negatively correlated with total pain anxiety ($r = -0.41$). However, there were no significant correlations between any of the subscales and pain tolerance. Furthermore, pain threshold was not correlated with any measure of pain anxiety. The findings of this investigation indicate that there may be a relationship between total pain anxiety and pain tolerance. These findings may be helpful to the clinical health care specialist that treats patients suffering from pain.

The Effects Of Relaxation Therapy On Cold-Pressor Pain Tolerance

Waske AB, Kaminski TW: Marietta College, Marietta, OH

Pain is a factor often associated with athletic injuries. Pain can delay healing, inhibit rehabilitation progress and stress the athlete psychologically. Unmanaged, persistent pain can be detrimental in the treatment of athletic injuries. The purpose of this study was to investigate the effects of relaxation therapy on pain tolerance to cold. Sixteen female subjects (age = 19.9 ± 1.5 yr., wt = 65.9 ± 10.7 kg, ht = 163.7 ± 7.8 cm) free from cold allergies, agreed to participate in this study. Subjects were tested individually on two separate occasions. All subjects participated in a pre-test cold-pressor session to determine baseline tolerance to cold. This session involved the subjects submersing their hand and forearm into a cold tank filled with ice and water at a temperature of 1° C. The amount of time the subject spent in the cold tank was recorded and used as a baseline. Any subject who tolerated the cold-pressor test for a period of 240 seconds reached the maximum time allowed for the test. Subjects were randomly assigned to either the treatment or control groups and returned 24 hours later for treatment and post-testing. Subjects in the experimental group listened to a relaxation audiotape recording for 10' prior to the post-test cold-pressor session, while subjects in the control group listened to a 10' audiotape of soothing music prior to post-testing. Time spent in the cold tank was again recorded and used for statistical analysis. A repeated measures ANOVA was used to analyze the pain tolerance data. The results demonstrated significant main effects for both group [$F(1,14) = 6.73, p = .021$] and test [$F(1,14) = 12.52, p = .003$]. There was no significant interaction. However, the Tukey post hoc test was only able to detect significant differences between the pre and post test sessions. Post-test pain tolerance measures (110.6 ± 86.6 sec) were significantly higher than the pre-test measures (63.3 ± 64.0 sec), indicating a greater tolerance to the cold-pressor treatment. Despite the fact that relaxation therapy did not significantly effect pain tolerance to cold, these results suggest that auditory distraction of any form may effectively increase pain tolerance to cold. Further study is indicated to examine the effects of other forms of distraction on pain tolerance.

Establishment Of Normative Data On Cognitive Tests For Comparison With Athletes Sustaining Mild Head Injury

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Athletic trainers and team physicians are often faced with the difficult decision of whether or not an athlete is ready to return to competition following mild head injury. This decision is often difficult due to the lack of understanding of mild head injury as well as the lack of objective data available for the evaluation of such injuries. Research has revealed deficiencies in cognitive functions such as attention span, memory, concentration, and information processing as a result of mild head injury, however normative data for studying recovery is not available. The purpose of this study was to determine if repeated testing on normal subjects resulted in improved scores (ie: learning effect) for 4 commonly used cognitive tests. Additionally, this study sought to determine if certain cognitive tests correlated highly with others. Normative data was collected on the Hopkins Verbal Learning Test, Trail Making Tests A & B, Wechsler Digit Span Test, and Stroop Test using 72 Division I collegiate athletes. Mean test scores and standard deviations on each of three test sessions (taken two days apart) were calculated. Mean scores for the initial assessment were as follows: Hopkins Verbal Learning, 39.56 ± 3.18 ; Trail Making A and B (summed), 64.75 ± 12.52 ; Wechsler Digit Span, 17.47 ± 2.80 ; and Stroop (total), 243.50 ± 22.48 . A repeated measures ANOVA revealed significant ($p < .05$) learning effects on all tests except the Hopkins Verbal Learning. The results indicate that clinicians should expect to see the following improvements, which can be attributed exclusively to learning over subsequent testing sessions: 8 sec for each Trail Making Test; 1 point for each Wechsler Digit Span Test; and 20 points (2nd day) and 10 points (3rd day) for the Stroop Test. This normative data can be used as a comparison to provide an objective measure of an athlete's cognitive ability following a mild head injury. Additional analyses utilizing Pearson Correlations revealed a significant correlation ($r = .40, p < .01$) between the Stroop and the Trail Making tests. Clinically this may indicate that both tests may not need to be administered as part of a testing battery if both tests are unavailable or if time is a factor in administering the tests. The Digit Span Test correlated the least to other cognitive tests (Trail Making, $r = .04$; Stroop, $r = .09$; and Hopkins Verbal Learning, $r = .16$) on each of the three days. This may indicate that the Digit Span Test is sensitive to cognitive abilities that are not correlated with the other three tests. Thus, the Digit Span test would be very valuable in a cognitive test battery for possibly identifying deficits in cognitive ability not discovered by other tests. Through the addition of this test battery to other physical and neurological tests, the decision to return an athlete to competition following mild head injury can be made with improved confidence and with less likelihood for reinjury.

Gender Differences In Pain Threshold, Tolerance And Anxiety

Karchnick KL, Buxton BP, Tsang KKW, Solsona AM, Yamaguchi AY: Georgia Southern University, Statesboro, GA

The purpose of this study was to investigate the differences between pain threshold, pain tolerance and pain anxiety between males and female college students. Forty-one subjects (18 males & 23 females) with a mean age of $19.42 (\pm 0.83)$ years participated in the study. Each subject read and signed an informed consent form and a pre-participation questionnaire prior to their participation in the investigation. The subjects were then given a 40 question Pain Anxiety Symptoms Scale (PASS) inventory. The PASS inventory includes four subscales that measure a subjects; (1) fear of pain, (2) cognitive anxiety of pain, (3) physiological anxiety of pain and (4) escape/avoidance from pain. The PASS includes a 6 point likert scale that instructs the subject to respond to statements concerning their thoughts about pain (0 = never, 5 = always). Once the subjects had completed the PASS they were assessed for pain threshold and pain tolerance using Cold Pressor Test (CPT). Each subject emersed their non-dominant hand in water that was maintained at 1° C. The subjects verbally reported when they first experienced pain (threshold), then reported when the pain became unbearable (tolerance) and at that point the test was terminated. Pain threshold and tolerance times were recorded in seconds using a digital stop watch. In order to ascertain if differences in pain scores existed between males and females, a one-way ANOVA was performed. Significant differences between groups were determined using a Scheffe' post hoc F test. The alpha level was set at $p < 0.05$. The results of the investigation indicated that significant differences ($p = 0.04$) existed for pain tolerance between males (134.01 ± 177.57) and females (52.00 ± 58.14). Furthermore, significant differences existed for fearful thoughts related to the experience of pain ($p = 0.02$) between males (12.39 ± 5.74) and females (17.91 ± 8.3). The findings of this investigation indicate that there appear to be differences in pain tolerance and fear of pain between males and females. These findings may help the athletic health care specialist become more sensitive to the individual needs of injured athletes that suffer from pain.

Long Term Retention Of Concepts Presented In A Sport Psychology Program For Athletic Trainers

Pero SF, Sachs ML: University of Nevada-Las Vegas, Las Vegas, NV

A five hour workshop was specifically designed for athletic trainers as an overview of sport psychology as related to athletic training, how sport psychology techniques could be used to prevent injury, and how to facilitate the rehabilitation process once an injury had occurred through utilizing the psychological skills training techniques (e.g., goal setting, imagery, self talk, relaxation) in conjunction with the injury rehabilitation program. Not only was it important for the athletic trainers who participated in the workshop to increase their overall knowledge base of sport psychology and athletic training, but it was crucial for them to retain and utilize this information in their practices as athletic trainers for the long term. The athletic trainers were given a short Sport Psychology Knowledge Test (SPKT) developed specifically to correspond with the theoretical and applied concepts covered in the workshop prior to and at the completion of the workshop. All participants were given the SPKT again at both six months and one year post workshop completion to determine how well they retained the information covered in the workshop. Through a repeated measures ANOVA it was found that the SPKT scores significantly increased from the pretest to the posttest ($p < .001$), demonstrating a 43% increase in average score. Although the mean scores did decrease slightly on the six month and one year SPKT administrations, the decrease was not statistically significant. As the information presented in the workshop was applied in nature, it was essential to determine whether the athletic trainers were actually utilizing these techniques in conjunction with their practices as athletic trainers. A questionnaire administered at one month, six months, and one year post workshop completion, indicated that the athletic trainers who participated in the workshop were still routinely using a variety of the techniques presented in the workshop during injury rehabilitation. In addition, the athletic trainers reported that their perceptions of the importance of sport psychology in athletic training, especially their sensitivity to the psychological and emotional response to injury, increased after participating in the workshop. Based on these results, it appears that the athletic trainers retained a significant level of sport psychology knowledge and were incorporating this knowledge into their athletic training practices as long as one year after the completion of the workshop.

Rehabilitation/Treatment Adherence In High School Athletes

Honard M, Baack R, Ingersoll CD, Kuhlman JS, Lacy A: Indiana State University, Terre Haute, IN

Rehabilitation and treatment adherence are influenced by many factors. Six of these factors are pain tolerance, perceived exertion, support from others, scheduling, environment, and self-motivation. Factors affecting adherence in college-aged athletes has been previously described, but there are no studies examining factors that influence adherence in high school athletes. The purpose of this study was to examine six factors that are thought to influence adherence and how they describe rehabilitation/treatment adherence of high school athletes. A questionnaire was distributed to 30 (18 adherers, 12 non-adherers) high school athletes who had experienced a musculoskeletal injury. The questionnaire provided scores for pain tolerance, perceived exertion, support from others, scheduling, environment, and self-motivation. We found no significant differences between adherers and non-adherers in the six categories but the probability approached significance levels ($p = .07$). Suboptimal power ($1 - \beta = .68$) and a low probability of a type I error ($p = .07$) encouraged us to speculate that focusing on the issues of environment (athletic training facility) and self-motivation may lead to increased adherence of high school athletes to rehabilitation/treatment programs. Athletic trainers need to be aware of the factors related to rehabilitation to rehabilitation/treatment adherence to facilitate adherence in high school athletes. We also recommend further refinement of a tool to measure adherence behaviors in high school athletes.

Differences In Response And Anxiety Between Athletes And Non-Athletes

Yamaguchi AY, Buxton BP, Tsang KKW, Karchnick KL, Solsona AM: Georgia Southern University, Statesboro, GA

The purpose of this study was to investigate the differences between pain threshold, pain tolerance and pain anxiety between collegiate athletes and non athletes. Forty-one subjects (32 athletes & 9 non-athletes) with a mean age of 19.42 (± 0.83) years participated in the study. Each subject read and signed an informed consent form and a pre-participation questionnaire prior to their participation in the investigation. The subjects were then given a 40 question Pain Anxiety Symptoms Scale (PASS) inventory. The PASS inventory includes four subscales that measure a subject's; (1) fear of pain, (2) cognitive anxiety of pain, (3) physiological anxiety of pain and (4) escape/avoidance from pain. The PASS includes a 6 point likert scale that instructs the subject to respond to statements concerning their thoughts about pain (0 = never, 5 = always). Once the subjects had completed the PASS they were assessed for pain threshold and pain tolerance using the Cold Pressor Test (CPT). Each subject emerged their non-dominate hand in water that was maintained at 1° C. The subjects verbally reported when they first experienced pain (threshold), then reported when the pain became unbearable (tolerance) and at that point the test was terminated. Pain threshold and tolerance times were recorded in seconds using a digital stop watch. In order to ascertain if differences in pain scores existed between athletes and non-athletes, a one-way ANOVA was performed. Significant differences between groups were determined using a Scheffé post hoc F test. The alpha level was set at $p < 0.05$. The results of the investigation indicated that there were no differences in pain threshold or pain tolerance scores between athletes and non-athletes. However, significant differences did exist between athletes and non-athletes for fear of pain ($p = 0.02$), cognitive anxiety of pain ($p = 0.01$), escape/avoidance from pain ($p = 0.001$) and total pain anxiety scores ($p = 0.01$). In all instances the athletes had significantly lower scores than did the non-athletes. The findings of this investigation indicate that there appear to be differences in pain anxiety scores between athletes and non-athletes. These findings may be helpful to the clinical health care specialist that treats both athletic and non-athletic populations for pain.

New Technologies That Help Prepare Allied Health Students For NATABOC Certification Examination

Newman M, Wright V, Wright K: The University of Alabama, Tuscaloosa, AL

This presentation presents components of educational technology, specifically related to Internet usage, which assist student athletic trainers in studying and preparing for the National Athletic Trainer's Association's Board of Certification (NATABOC) certification examination. This presentation summarizes how The University of Alabama's Athletic Training Education program, in cooperation with the university's Instructional Technology department, implemented WebWhacker to develop an educational curriculum. This curriculum focuses on several skills the student athletic trainer must master before taking the NATABOC certification exam, specifically, the domains of health care administration and professional development/responsibility. A WWW search for viable pages related to the skills was accomplished and using WebWhacker software, the selected files were downloaded and organized into a study bank for students to utilize offline. For students and classroom instructors with or without network access, this is a fast, reliable and efficient way to deliver important lessons and related information. The primary advantages of this technological tool are learner flexibility, maximization of content, timeliness and availability, and content retention.

Database of Multimedia Learning Resources for Allied Health Professionals

Wright K, Hughey S, Wright V, Newman M: The University of Alabama, Tuscaloosa, AL

This project developed a visually appealing database reference source of multimedia products available to athletic trainers. The database includes references to video tapes and technology based software (educational and clinical). Using software, MicroSoft Windows Access, the database was developed to include reference information such as product description, abstract of product, author, vendor, and year product developed. Utilizing the NATABOC's domains of athletic training and anatomical structures as key words, the allied health professional can input three key words and access educational resources (videos and software) related to these content areas. The primary advantages of this database tool are content specific educational resources, availability, and the focus on NATABOC role delineation areas as related to anatomical structures. By developing this technological tool, the allied health professional can access specific content related to individualized interests.

Third Party Reimbursement for ATCs: An Investigation Of Attitudes From Certified Athletic Trainers, Physical Therapists, And Physicians

Kokesh MH, Wimer JW: University of Charleston, Charleston, WV

Third party reimbursement has become an important issue within the profession of athletic training. The NATA has established a reimbursement advisory group to determine outcomes, and a three year study is underway. The purpose of our study was to investigate the attitudes of athletic trainers, physical therapists, and physicians toward third party reimbursement. We mailed surveys to 30 athletic trainers, 30 physical therapists, and 30 physicians in West Virginia (n = 90). We hypothesized that athletic trainers would have the most positive attitudes towards reimbursement, whereas physical therapists would have the least positive attitudes, and physicians would fall somewhere in the middle. Each participant received a questionnaire and one self-addressed, stamped envelope. Briefly, the questionnaire asked whether ATCs should be able to charge for services rendered in a variety of settings (e.g., high school, clinic, etc.). Responses to each question were based on a modified Likert scale, (1 = strongly disagree to 7 = strongly agree). Using one-way analysis of variance (ANOVA, $p < .05$), the results showed a significant difference between the groups. Contrary to our hypothesis, these data suggest that athletic trainers have similar attitudes as the physicians in that they were neither pro-reimbursement or anti-reimbursement. Physical therapists, however, have negative attitudes regarding reimbursement for athletic trainers. Age and practice location were non-significant factors. Third party reimbursement is an important issue for the profession and will become more significant as ATCs move from the traditional training room settings and into managed care and other varied settings.

A Comparison Of The Fitness Knowledge Between Students Of Athletic Training And Other Allied Health Professions

Miller MG, Kleiner DM, Holcomb WR:
University of North Florida, Jacksonville,
FL

In 1990 athletic training was recognized as an allied health profession. Each allied health profession has its particular expertise, but may also share commonalities with other disciplines. We believe that one such commonality should be the knowledge of fitness as it relates to the prevention and management of disease or injury. The purpose of this study was to identify the incoming fitness knowledge of students from three different allied healthcare professions; athletic training (AT), physical therapy (PT), and nursing (NU). A 40-question, multiple choice test covering the five domains of; body composition, flexibility, muscular strength, muscular endurance and cardiovascular conditioning, was administered to 106 undergraduate students. Eight questions were provided for each of the five domains, the sum of which represents the total score. The subject population consisted of 47 AT, 36 PT, and 23 NU students enrolled in the introductory classes of these various healthcare specialties. The data were analyzed by ANOVA and are reported as mean score (\pm S.D.). A significant main effect ($p < 0.05$) was found for total scores, as was the pair-wise comparison between PT & NU. Total scores were 26.13 (3.68), 27.17 (3.68), and 24.57 (3.63) for AT, PT, and NU, respectively. Significant differences were also found between the groups for the domains of body composition, flexibility, and muscular strength, but not for muscular endurance, or cardiovascular conditioning. PT had the highest score for every domain except flexibility, where AT was higher, and NU had the lowest score for every domain except body composition, where AT was lower. The importance of this preliminary research is to identify strengths or weaknesses in entry-level allied health students. This information may help educators develop appropriate curricula to better prepare students for their role as future health care providers. The further development of each discipline's roles and responsibilities, as well as an increased knowledge of fitness for athletic trainers is indicated.

Free Communications, Poster Presentations: Session E

Friday, June 20, 1:00 PM - 4:30 PM; Level 1 Concourse; Authors present from 3:30 PM - 4:30 PM to answer questions.

Validity Of The Sling Psychrometer Under Various Environmental Conditions

Bergeron MF, Holcomb WR, Kleiner DM: University of North Florida, Jacksonville, FL

Heat illness is a serious concern in regions of the country that experience a combination of high temperature and high relative humidity (RH). Athletic trainers measure temperature and calculate RH to identify dangerous playing conditions so that prevention efforts can be appropriately increased. The most popular tool used by athletic trainers for estimating RH is the sling psychrometer (SP). The purpose of this research was to determine the validity of the SP for determining RH under a variety of environmental conditions. To do so, the SP was compared to a thermohygrometer (TH) which is a more sensitive instrument that directly measures RH. RH was determined simultaneously with two independent SPs and measured directly by a TH under four environmental conditions; indoor air conditioned at 24°C (IAC), indoor refrigerated at 16°C (IR), outdoors in the sun at 27°C (OS), and outdoors in the shade at 23°C (OSH). Measurements were obtained according to manufacturer's guidelines by certified athletic trainers skilled in the use of the instrumentation. Measurements were repeated four times under each condition. Initial t-tests showed no statistical difference between the two SP measurements. Therefore, an average of the two SP values was compared to the TH values. Data were further analyzed with an ANOVA and are presented as means (S.D.). Results showed a significant ($p < 0.05$) main effect. However, pairwise comparisons revealed differences only between environmental conditions and not between instruments. RH values obtained with the SP were 40.5 (1.0), 60.5 (16.4), 29.3 (1.9), and 33.3 (3.9) %RH for IAC, IR, OS, and OSH, respectively. Whereas RH values obtained with the TH were 38.3 (0.5), 51.8 (1.9), 19.0 (0.8), and 25.3 (0.5) %RH for IAC, IR, OS, and OSH, respectively. Assuming that the TH is the more accurate instrument, the statistical analysis of our data suggests that the SP provides valid measurements. However, in the more extreme environmental conditions mean differences of 8.7 and 10.3 %RH were found. A possible explanation for this is that the SP took longer to acclimate to the temperature changes than did the TH. These differences between instruments should be noted and warrant further investigation.

The Posterior Occlusal Thickness Of A Custom Made Mouth Guard And How It Can Aid In The Prevention Of Burners

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Despite the many recent technological advances in sports medicine treatments, injuries to neurological tissues remain very difficult to manage. Although nervous tissue has been shown to repair itself given time, the process is usually very lengthy and uncertain. For this reason, neurological conditions may often rule an athlete out of collision sport participation. One of the most commonly incurred and often under reported neurological injuries in collision sports is brachial plexopathy, more commonly known as a burner or stinger. Burners are a common occurrence on the football field and may be often overlooked by the coaches, trainers and athletes themselves. Although the transient paresthesias and sometimes significant loss in strength and upper-extremity function may severely limit the athlete's ability, they often fail to report such incidences fearing removal from competition. Much of the frustration with this particular condition stems from the lack of an affective means of treatment. Many of the neck devices designed to prevent excessive neck motion, specifically hyperextension and lateral flexion, have proven themselves successful in preventing recurrence in less severe cases. However, many of the athletes who chronically suffer from this condition can recreate the symptoms simply by moving their neck or applying a compression force to the top of their head. These athletes are the ones who run an increased risk of causing permanent damage to the brachial plexus or cervical nerve roots. This study examined five athletes suffering from burners in which the mechanism of injury was hyperextension and ipsilateral, lateral flexion. These five NCAA Division I, college football players filled out preliminary questionnaires detailing the way the injury was incurred, any unusual sensations (loss of strength, numbness, tingling), how long the episodes lasted and how often they occurred. For the course of one season, these athletes wore custom fit mouthguards of varying posterior, occlusal thicknesses, during which time they reported on the number of incidences and the severity of each. Our goal was to demonstrate that increased posterior occlusal thickness would inversely affect the number of burners incurred. Using an Analysis of Variance with repeated measures, we were unable to demonstrate statistical significance. However, closer evaluation does show that the pattern is proceeding in the anticipated direction. This suggests to us that this type of treatment may be useful on a case by case basis for the treatment of ipsilateral, hyperextension brachial plexopathies.

Cervical Spine Motion In Football Players During Three Airway Exposure Techniques

Ray RR, Luchies C, Abfall MK, Hughes WL, Sturmfels R: Hope College, Holland, MI

Most health care professionals responsible for the immediate care of the cervical spine-injured football player agree that the helmet should be left in place until cervical fracture or dislocation can be ruled out by x-ray in the hospital. Less is known and little agreement exists as to the best method to expose the airway of these patients, especially in cases where rescue breathing or CPR are needed. A previous study has demonstrated the efficacy of the pocket mask insertion technique and called into question the practice of cutting face mask straps so the face mask can be rotated out of the way of the athlete's airway. The purpose of this study was to compare two pocket mask insertion techniques with face mask removal using a manual screw driver to determine which method allowed the quickest initiation of rescue breathing and which induced the least amount of extraneous cervical spine motion. Cervical spine displacements and rotation were measured using an opto-electronic motion analysis system. Time to completion of each task was measured using video analysis. Dependent measures were compared using analysis of variance. Both pocket mask insertion techniques allowed quicker initiation of rescue breathing. Anterior-posterior displacement of the cervical spine was greater for the pocket mask insertion technique using the chin as an entry portal than the screw driver technique or the pocket mask insertion technique which used the eye hole of the face mask as an entry portal. Lateral translation was greater for the screw driver technique than for either pocket mask method. Peak displacement from initial cervical spine position was greater for the chin insertion method than for the eye hole insertion method. We conclude that either pocket mask insertion technique is of significant benefit in allowing quicker initiation of rescue breathing. The cervical spine displacements and rotation caused by one technique were not systematically different than those associated with the other two methods, but all were significantly lower than those caused by cutting face mask clips as reported in the literature. A protocol for field management of cervical spine injuries in football players is suggested based on these data.

The Influence Of Hand Size And Grip Strength On The Ability To Remove A Football Helmet Face Mask

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FL

Several recent investigations have reported the time that it takes to remove the face mask from a football helmet. Many of these studies have cited difficulties in cutting the straps that secure the face mask to the helmet when using the Trainers Angel™ (TA). Further analysis revealed that the majority of subjects experiencing difficulty with the TA were female. Therefore, the purpose of this study was to evaluate any influences that hand size or grip strength may have on the time that it takes to cut the face mask strap. Twenty-eight student athletic trainers (13 males, 15 females) with no experience in face mask removal served as subjects. However, 3 female subjects withdrew from the study after they were unable to cut the strap with the TA. After receiving standard instructions, each subject cut through a single Surlyn AmorGuard™ face mask strap with both the TA and an anvil pruner (AP). The sequence of the trials was random. Grip strength was assessed by hand grip dynamometry from the best of three trials. Hand size was measured for both length and width. The subjects also reported a rating of satisfaction with a 10-point scale. Data were analyzed by t-test and correlation coefficients and are presented as means (\pm S.D.). Time to cut the strap was significantly ($p < 0.05$) better with the AP 44.89 (32.41) sec. than with the TA 118.06 (88.33) sec. The ratings of satisfaction were also significantly different between the TA (2.64 [2.4]) & the AP (6.00 [1.87]). Time did not have a strong relationship with hand width, hand length or grip strength ($r = -.40, -.54,$ & $-.38$, respectively). When analyzed by gender, time was significantly different between males and females for the TA, but not for the AP. Despite significant differences in the data between the TA and AP, the present study was unable to attribute the differences between males and females to hand size or grip strength. Further research designed to identify the factors which have influenced these results is warranted.

Face mask straps were provided by Schutt Manufacturing Co.

Differences Between Gymnasts And Recreational Athletes In Vertical Ground Reaction Force During Drop Landings

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The purpose of this study was to compare vertical ground reaction force (GRF) between female gymnasts ($n = 10$) and recreational athletes ($n = 10$) during drop landings from different heights. Gymnasts were members of an intercollegiate gymnastics team with at least 8 years of experience (Mean 12.6 ± 2.8 yrs). Recreational athletes, intentionally selected for height and weight characteristics similar to the gymnasts, had previous involvement in sport or training programs which included jumping but did not include competitive gymnastics. Subjects performed 10 drop landings from each of a 30, 60, and 90 cm high platform, landing with the right foot on a forceplate installed flush with the top surface of the floor. GRF sampling rate was 960 Hz. To account for differences in body mass between subjects, GRF data were scaled to force in newtons per kilogram of body mass (N/kg). The magnitude, time to occurrence and impulse to the forefoot and rearfoot peak forces (Gross & Nelson, 1988) were measured from the vertical GRF-time curve of each trial. For each of the six dependent variables, each subject's ten trial mean in each condition was calculated. These values were entered into a 2×3 (group \times height) repeated measures ANOVA ($p = 0.05$). Results of the ANOVA indicated a significant group by height interaction for toe force magnitude, heel force magnitude, and heel force impulse. A significant main effect of height was present for time to toe force magnitude and time to heel force magnitude. Tukey post hoc analyses revealed non-significant differences in toe and heel force magnitude between groups at the 30 cm height. However, significant differences at the 60 and 90 cm heights indicated that the gymnasts had higher GRF values than the recreational athletes. There were also significant differences in all variables as height increased. Additionally, it was observed that gymnasts tended to land stiffer than the recreational athletes. These results suggest that gymnasts typically land with higher vertical ground reaction forces than recreational athletes. High forces attenuated regularly, as experienced by competitive gymnasts, may be a predisposing factor to injury. Further research, studying the kinetics and kinematics of landings in a more realistic gymnastics setting seems warranted.

Difference In Landing Styles Contributes To Patellar Tendinitis

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Prolonged pain and disability from patellar tendinitis may affect approximately 28% of all athletes. The purpose of this study was to quantify the lower extremity kinematics and kinetics in two groups of athletes, one with physician diagnosed patellar tendinitis and one without patellar tendinitis. A secondary purpose of this study was to determine the effects of a four week patellar tendinitis rehabilitation program on lower extremity kinetics. Twenty-six (17 males, 9 females) age 11-43 athletes with physician diagnosed patellar tendinitis (PT) and 26 (17 males, 9 females) ages 19-32 athletes without (norm) patellar tendinitis participated in this study. The patellar tendinitis (PT) subjects participated in a four week rehabilitation program. Rehabilitation consisted of soft tissue mobilization, selected strengthening exercises and the regular use of ice for pain control. Subjects were tested three times, at zero, six, and twelve weeks. At twelve weeks, 7 PT subjects had completed the entire testing and rehabilitation program. A Kistler force platform was used to record the ground reaction forces from a drop landing. Video data was recorded on an RCA camera (60 fps). The subjects were suspended 40 cm above the force plate and then performed three trials of a one footed drop landing onto the plate. Ground reaction forces were analyzed for time to peak force, maximum vertical force, loading rate, and power. Video data was analyzed using the Peak 5 motion analysis system for deepest angle of knee flexion. After each drop landing trial subjects were asked to subjectively rate their pain using the Borg scale. Analysis of maximum vertical force, slope, and power with a one way ANOVA shows significant difference ($p < 0.0001$) between norm and PT subjects at 0 weeks, 6 weeks and 12 weeks. Analysis of pain scale data shows statistical significance ($p = 0.022$) between testing sessions for the PT subjects. Over twelve weeks of testing, pain scale scores decreased dramatically but differences in loading rates did not. This suggests that differences in landing styles between persons with tendinitis and those without tendinitis still exist after resolution of pain. This supports the idea that a harder landing style with less force absorption contributes to the development of patellar tendinitis.

Anthropometric And Performance Gender Differences In High School Basketball Players

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While professional, international and collegiate basketball players have been studied, there is little published information on high school basketball players. The purpose of this study was to gather anthropometric and performance data on a cohort of high school basketball players. Fifty four female and sixty one males volunteered to participate. Data were collected during the first week of basketball practice. Anthropometric measurements included: height, weight, caliper skinfolds to determine body composition, hamstring flexibility, foot type as well as ankle plantar and flexion. Performance measures included: single limb balance, vertical jump, 25 yard shuttle run and 20 yard sprint. A one way analysis of variance was carried out for all measures between male and female subjects with a p-value of 0.05 used to indicate significant differences. Male subjects were significantly taller and heavier than the female subjects. Females had a significantly higher percent body fat, increased hamstring flexibility and increased ankle dorsiflexion as compared to the male subjects. There was no significant difference between the two groups for ankle plantar flexion. Female subjects had a greater percentage of pronated feet while males had a higher percentage of supinated feet. Performance testing revealed that male subjects were able to jump significantly higher and ran the 25 yard agility and 20 yard sprint significantly faster than the female subjects. There was no significant difference in single limb balance time. This study documented various anthropometric and performance differences in high school basketball players. Further study is necessary to determine if these differences predict susceptibility to athletic injuries and facilitate gender specific performance enhancement programs.

Assessment Of Athletic Injury Occurrence During A Season Of Professional Ice Hockey

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KE: University of Southwestern
Louisiana, Lafayette, LA

The purpose of this descriptive study was to assess and describe injury type, anatomical region of injury, period of occurrence of game injuries, and whether the injury occurred during a fight or actual game play of the Ice Gators, an East Coast Hockey League team in Lafayette, Louisiana. Data was obtained during the recent inaugural season of the Ice Gators. Subjects were all active members of the team totaling twenty players, ages 20-32. New injuries were evaluated by the Athletic Trainers and documented in a database. Injuries were documented as but not limited to the following categories: contusions, lacerations, fractures, sprains, strains, and other. "Other" injuries included such things as tendinitis, bursitis, subluxations and dislocations and were described more specifically as they occurred. One hundred ninety new injuries were documented through the season (including games and practices). Of the forty contusions documented, thirty-three occurred in game play. Eight contusions occurred in the first period, fourteen in the second, and eight in the third. Ten lacerations occurred, all in game play. Three lacerations occurred in the first period, five in the second, and one in the third period of game play. During game play four fractures were documented, two of which occurred in the second period. Thirty-four sprains occurred through the season, seven of which happened in practice. Twenty-seven sprains were recorded on game day, of which eight were in the first period, nine in the second and four in the third. Twenty-two strains occurred during practice and thirty-three strains occurred during game play. Of game day strains, nine occurred in the first period, five in the second, and seven during the third period of play. Twenty-two hockey injuries were documented as occurring during a fight. Game day injuries not recorded by period were not reported until after the game. Overall, there was quite a large number of injuries which occurred in this first season of the Ice Gators. Approximately twelve percent of injuries were the result of a fight, while twenty-seven percent of all injuries occurred during a practice. There were no fights in practice that resulted in an injury.

Epidemiological Study of Football Injuries Sustained by Participants in Interscholastic Tackle Football in Five Treasure Valley High Schools

Sandberg TD, Pfeiffer R: Boise State
University, Boise, ID

The Treasure Valley of Idaho represents the fastest growing region within the state. Five of the public high schools within the valley, e.g., Boise, Borah, Capital, Meridian and Centennial are classified as A-1, which is the largest category within the state. This study of tackle football injuries at these five Treasure Valley high schools was facilitated by the fact that each of these schools presently employs a NATA-BOC Certified Athletic Trainer. As such, there was the assurance that the initial evaluations and related information regarding each injury was accurate and current. Injury data were collected on the different positions that are associated with tackle football (e.g., tackles, guards, running backs). Specifically, type of injury, severity of injury and duration of time loss due to an injury were examined. The National Athletic Injury/Illness Reporting System (NAIRS) provided the definition of an injury and was used to classify injury severity. The goal of this study was to determine that no statistically significant differences in injuries between six different categories of playing positions when compared to those participants not in a category in high school varsity football in the Treasure Valley. The sample consisted of all varsity players at the above five high schools (N=342). Due to the low incidence of injuries, 6 positional categories were generated. They were defensive and offensive line, defensive and offensive backfield, linebackers and receivers. Analysis determined the relative risk and odds ratio of grouped position data in conjunction with descriptive statistics. Injury ratios were calculated to examine the odds of receiving an injury in a specific position category compared to the odds of receiving an injury among all the varsity players. Confidence limits were calculated based on a 95% level and calculated by Woolf's method. No statistically significant findings were generated thus none of the odds ratios were significant. However, the offensive backfield was associated with a greatest percentage of injuries (14%) followed by the defensive line (12.5%) and linebackers (9.5%). In terms of severity, only 3.5% of the injuries qualified as "significant" whereas 92% did not meet the injury definition standards to fall into one of the five NAIRS injury classifications. Significant injuries are equal to the sum of the moderate, major and severe categories.

Incidence Of Injury Of Male And Female High School Basketball Players

Napolitano TJ, Horodyski MB, Dorman S, Siders R, Delude NA: University of Florida, Gainesville, FL

Basketball was reported as the most popular sport in high school athletics in a survey conducted by the National Federation of State High School Associations during the 1993-94 academic year. With increasing participation in the sport, the purpose of this study was to determine and compare the incidence of injury of male (n=256) and female (n=210) varsity and junior varsity high school basketball players. Variables investigated during the study included injury nature, anatomical site of injury, player position, mechanism of injury, injury severity, time of injury and re-injury rates. Data analysis was completed through the use of descriptive and inferential statistics. Theoretical expected frequencies were generated by an iterative proportional fitting procedure (to adjust for differences in athlete-exposures) prior to the use of Pearson's chi-square test (to compare differences between incidence of injury between male and female basketball players). The level of significance was set at $p < .05$. Male basketball players sustained 48 injuries during 15,129 athlete-exposures and female players experienced 43 injuries during 10,452 athlete-exposures. No significant difference was noted for injury rates between the two populations (male, 3.16 and female, 4.08 injuries per 1,000 athlete-exposures). A significantly greater injury rate was noted during games (6.43 per 1,000 athlete-exposures) as compared to practices (1.94 per 1,000 athlete-exposures) when the two populations were combined. A significantly greater incidence of lower extremity injuries occurred in both populations (male, 64.6%; female, 65.1%). Both populations sustained significantly greater number of ankle injuries when compared to any other anatomical site. A significantly greater number of injuries were incurred while players were on offense with the guards sustaining significantly greater number of injuries when compared to centers and forwards. No significant differences were noted for mechanism of injury (contact versus noncontact) or re-injury rates. The data of this study suggest that few significant differences with respect to the variables investigated occur between male and female high school basketball players. Also important was that time loss due to injuries was not significantly different between the two populations. This study can be used by high school athletic trainers to monitor injury trends for basketball players.

Free Communications, Poster Presentations: Session F

Saturday, June 21, 8:00 AM - 11:30 AM; Level 1 Concourse; Authors present from 10:30 AM - 11:30 AM to answer questions.

The Effect Of Arc Of Motion, Angular Velocity And Contraction Type On EMG Activity Of The VMO During Knee Extension

Munoz S, Holcomb WR, Tandy R:
University of Nevada-Las Vegas, Las Vegas, NV and University of North Florida, Jacksonville, FL

Rehabilitation is often required after injury to the knee. An important part of this rehabilitation is strengthening the musculature surrounding the knee. One concern during knee rehabilitation is maintaining a strength balance between the often deficient vastus medialis oblique (VMO) and the vastus lateralis (VL). Identifying the parameters that provide activation of the VMO could help athletic trainers facilitate the balance of muscular strength. Therefore, the purpose of this study was to determine the arc of motion, angular velocity and contraction type where the VMO is most active. Nineteen healthy subjects performed three maximal concentric and eccentric contractions at 30, 60, and 90°/sec on the Kin-Com 125E+ isokinetic dynamometer. The range of motion available on the dynamometer was divided into three arcs of motion (10-35°, 35-60°, and 60-85°). Electromyographic data were collected, via surface electrodes placed over the VMO, and analyzed to determine which parameters had an effect on VMO activity. A 3 x 3 x 2 (arc of motion x angular velocity x contraction type) ANOVA was used for statistical analysis. The VMO activity was greatest during the 60-85° arc of motion with both concentric and eccentric contractions. But, activity was only significantly greater during the 60-85° arc of motion when compared to the 35-60° arc of motion while contracting eccentrically ($p < 0.05$). The greatest VMO activity was observed at 90°/sec but these values did not reach a level of statistical significance. These results support recent studies that suggest the activity of the VMO is affected by isokinetic exercise parameters. However, due to a lack of statistical significance in this study, no clear picture exists. Therefore, further research in this area is warranted.

The Effects Of Patellar Taping On Knee Joint Proprioception

Galloway WD, Ernst G, Arnold BL:
University of Virginia, Charlottesville, VA

Patellofemoral Pain Syndrome (PFPS) is a prevalent and troublesome condition that affects approximately 25-34% of the general population. Several studies have assessed the efficacy of various forms of external support to the patellofemoral joint on improving knee joint function and alleviating pain. The purpose of this study was to examine the effects of a specific patellar taping technique on joint position sense and postural sway measures in 14 athletic female subjects (age = 22.21 ± 5.19 yr; ht. = 169.27 ± 0.62 cm; Wt. = 61.91 ± 10.63 kg; length of symptoms = 1.97 ± 2.41 yr) with a history of PFPS. Active, closed chain joint reposition sense was assessed using the Penny & Giles M-180 Electronic Goniometer and Display Unit (Penny & Giles Biometrics Limited, United Kingdom). Sway index was assessed using the Chattecx Dynamic Balance System (Chattanooga Group, INC, Hixson, TN). Fourteen female volunteers were measured under each of the following treatment conditions: control (no tape), placebo, and in the McConnell taping technique. Joint reposition sense was measured in degrees of error from two preselected target angles (30 and 45 degrees). Sway index measures were recorded in centimeters under the following platform conditions: stable and plantar flexion/dorsiflexion. An analysis of variance (ANOVA) for joint reposition sense revealed a main effect ($F=22.98$, $df=2,26$, $p<.001$) for condition. A Tukey post-hoc analysis further revealed that there were significant differences between each of the three conditions with the McConnell taping technique yielding the best scores. No significant differences were found for postural sway. The results suggest that while patellar taping has no significant effect on postural sway or balance, both the placebo taping and the McConnell taping techniques may improve joint reposition sense.

Patellar Taping Does Not Increase Mean VMO:VL EMG Ratios

Papanicolaou C, Ingersoll CD, Knight KL, Sandrey MA: Indiana State University, Terre Haute, IN

Problem: Patellofemoral pain syndrome (PFPS) is a condition suffered by many. McConnell's patellar taping technique, a common treatment for patellofemoral pain, attempts to increase the activity and motor control of the vastus medialis oblique muscle (VMO). Although initially believed to alter patellar tracking, recent evidence indicates no changes in patellar position as a result of taping. However, many studies have shown that pain reduction occurs with patellar taping. In order to better understand quadriceps' muscle function with patellar taping, electromyographic (EMG) activity of the knee was examined during an isometric contraction. **Design:** A 4 x 4 factorial design was used for this study. The dependent variable was I-EMG activity expressed as a ratio of VMO:VL averaged from three pain-free isometric contractions at 60° of knee flexion and with a force equal to 60% of maximum. The 2 independent variables were taping condition (McConnell's taping technique, McConnell's taping technique using duct tape, McConnell's taping technique applied nonfunctionally, and control) and testing order. **Methods:** Vastus medialis oblique to vastus lateralis (VMO:VL) EMG ratios were recorded. Twenty subjects performed an isometric knee extension while undergoing each of four taping conditions. **Results:** The control condition and the McConnell's non-functional taping condition produced a significantly greater VMO:VL EMG ratio than the duct tape condition. No other differences were significant. **Conclusion:** Traditional McConnell's patellar taping does not enhance VMO:VL ratio. Thus, patellar taping may not be beneficial in the management of patellofemoral pain syndrome if the purpose of the treatment is to enhance VMO activity.

EMG Biofeedback Improves The VMO:VL Ratio In Asymptomatic And Anterior Knee Pain Subjects

Glazer DD, Ingersoll CD, Knight KL, Worrell TW: Indiana State University, Terre Haute, IN

Problem: Selective recruitment of the vastus medialis oblique (VMO) is a controversial topic. Although clinicians use EMG biofeedback in the belief that it increases the vastus medialis oblique/vastus lateralis (VMO/VL) ratio, there has heretofore been no quantitative evidence that such changes occur. **Design:** This study was designed as a 2x2x4 factorial with repeated measures on sessions. Independent variables included treatment (exercise, exercise & EMG biofeedback), knee pain (asymptomatic, symptomatic), and sessions (1 through 4). The dependent variable was the ratio of integrated EMG of the VMO to the VL during an isotonic short arc (90° - 60°) quadriceps extension. Thirty-six male and female subjects volunteered for this study, half of whom had anterior knee pain, and half who were asymptomatic. **Methods:** During each of the four sessions, all subjects performed 7 isotonic short arc (90° - 60°) quadriceps extensions on a KinComII isokinetic dynamometer. Half of the symptomatic and half of the asymptomatic groups also received EMG biofeedback in the form of visual and auditory feedback in conjunction with performing the exercises. All subjects were pre and post-tested during each of the 4 sessions, which occurred twice a week for 2 weeks. Integrated EMG was recorded for the VL and VMO for each repetition. The average was used to compute the VMO to VL ratio. Changes in the VMO/VL ratios were compared among the groups. **Results:** EMG biofeedback training resulted in significant changes in the VMO/VL ratio during sessions 1 and 4. There were no differences between asymptomatic subjects and subjects with anterior knee pain as a result of either of the treatments. **Conclusion:** It appears that the VMO can be selectively recruited with EMG biofeedback training, both within sessions and from session to session whether or not the subject anterior knee pain. EMG biofeedback increases the VMO:VL in asymptomatic and symptomatic subjects. Exercise without biofeedback does not selectively recruit the VMO. We recommend incorporating EMG biofeedback in exercise protocols for anterior knee pain, particularly if the patient has documented lateral tracking of the patella.

Exercise And Orthotics Do Not Reduce Patellofemoral Pain

Berg T, Camp A, Palmer J, Ingersoll CD, Knight KL, Sandrey MA: Indiana State University, Terre Haute, IN

Problem: Traditionally, treatment of patellofemoral pain consists of quadriceps strengthening exercises and semirigid foot orthotics. However, there is little research to support the effectiveness of these methods. **Design:** This study was designed as a repeated measures single factorial with four treatments: orthotics, exercise, orthotics and exercise, and control. Changes in two dependent variables as a result of three weeks of training were measured: patellofemoral knee pain and quadriceps muscle output. Subjects (20 females 18-25 years of age with patellofemoral pain) were randomly assigned to one of the four groups. **Methods:** The exercise program was a typical home exercise program; it consisted of 3 sets of 10 repetitions of quad-set/straight leg raises and 3 sets of 30 quadriceps and hamstring stretches. A visual analogue scale was used to measure pain and the Kin-Com was used to measure work and power. All groups were tested after 10 days and 21 days for strength and pain. Between days 10 and 21 subjects came to the research laboratory to perform the exercises 3 times per week. **Results:** Power (56.6-81.3 W), work (883-1601 J), and pain (19.2-56.2mm) were not different between groups. **Conclusion:** Three weeks of quadriceps exercise, with or without foot orthotics, does not appear to be sufficient to change power, work, or pain in subjects with mild patellofemoral pain using a typical home exercise program of quad setting/straight leg raising and quadriceps and hamstrings stretching. A more vigorous exercise program may have produced different results. Also, other types of orthotics should be examined.

The Relationship Between Q-Angle And Isokinetic Torque In Females

Felts AM, Tis LL: Georgia State University, Atlanta, GA

Isokinetic dynamometry can provide quantitative assessment of knee extensor strength. Although consideration is given to positioning and other technical variants that effect torque production, minimal research has examined anatomical variants and their effect on torque production. Therefore, the purpose of this study was to examine the relationship between Q-angle and isokinetic torque produced by the knee extensor musculature. Twelve college-aged females (age=24.8 ± 4.4 yrs; ht=162.2 ± 7.8 cm; wt=63.0 ± 7.7 kg) were bilaterally assessed for Q-angle at 0° of extension in the fully-weight bearing (FWB) and non-weight bearing (NWB) positions. Q-angles were measured videographically utilizing the N.E.A.T. System. Subjects were then assessed for concentric and eccentric isokinetic (KinCom 500H, Chattecx Corp., Hixson, TN) peak and average torque of the knee extensor musculature at 60°/sec and 120°/sec. For the purpose of statistical analysis, bilateral data were combined. Correlational analyses revealed relationships between NWB Q-angle and peak and average torque values ranging from r=-.48 to -.28 and r=-.54 to -.21, respectively. Correlational analyses revealed relationships between FWB Q-angle and peak and average torque values ranging from r=-.20 to -.15 and r=-.26 to -.18, respectively. These findings suggest a moderate relationship exists between NWB Q-angle and isokinetic torque production. Clinically, it may be important to consider excessive Q-angles when assessing isokinetic knee extensor strength. These findings also suggest the need for further research to determine the relationship between Q-angle and functional performance measures.

Intradvice Reproducibility And Interdevice Comparison Of The CA-4000 Knee Motion Analyzer And KT-2000 Knee Ligament Arthrometer In Healthy Individuals

Bowen KM, Borsa PB, Harter RA:
Oregon State University, Corvallis, OR

Instrumented arthrometry studies have reported high reproducibility for absolute anterior tibial displacement (ATD) in asymptomatic knees. However, bilateral comparison values of ATD are more relevant to clinician diagnosis of ligamentous laxity. The purpose of this study was to determine the intradvice reproducibility and perform interdevice comparisons of two commercial instrumented knee arthrometers in a group of healthy individuals. We hypothesized that there would be no statistically significant differences between the relative ATD measurements between trials, days and devices. Twelve healthy subjects (M age = 24.3 ± 4 yrs.) were randomly tested for anterior laxity using two commercial instrumented knee arthrometers: the KT-2000 Knee Ligament Arthrometer (KT), and the CA-4000 Knee Motion Analyzer (CA). The order of limb and arthrometer tested was counterbalanced among subjects. Relative ATD measures were reported as the absolute difference between the right and left knee. Intraclass correlation coefficients (ICC) (2,1) were used to identify test/retest reliability and mean differences both between days and trials. A Pearson Correlation Coefficient (PCC) was used to reveal the between device relationship. Alpha was set at a 0.05 significance level. Mean relative ATD values for the CA (0.84 ± 0.64 mm) and KT (1.01 ± 0.76 mm) were not significantly different, however ICC (2,1) values for reproducibility were very low between trials [CA, $r = 0.071$; KT, $r = 0.131$] and days [CA, $r = 0.187$; KT, $r = 0.312$]. Correlational analysis revealed a very low relationship ($r = 0.17$) between arthrometers. Reproducibility and accuracy of relative ATD measurements is highly dependent on the proficiency of the test administrator. Our findings demonstrate low reproducibility between trials and days for relative measurements of both arthrometers. The degree to which test administrator error contributed to the low reliability is not known. Other sources of measurement error can occur from application inconsistencies between days and design differences. Scrutiny should be exercised when using instrumented arthrometry to report bilateral differences in ligamentous laxity of the knee. Additionally, between arthrometer relationships were very low indicating that laxity values for one arthrometer cannot be generalized to another. Further reliability and validity research must be done in both asymptomatic and symptomatic populations.

Concentric And Eccentric Glenohumeral Joint Peak Torque Reliability Of The Biodex 2000 Isokinetic Dynamometer

Toy BJ, Rankin JM: University of Southern Maine, Portland, ME and The University of Toledo, Toledo, OH

The purpose of this study was to determine the reliability of the concentric (CON) and eccentric (ECC) peak torque (PT) values produced by the Biodex[®] 2000 isokinetic dynamometer for the glenohumeral joint (GH). Strength values of the dominant (DOM) extremity of 10 college-aged students (5 male; 5 female) were tested at 1.047 rad/s for the flexor (FLEX), extensor (EXT), abductor (AB), adductor (AD), horizontal adductor (HAD), horizontal abductor (HAB), external rotator (ER) and internal rotator (IR) muscle groups. Subjects were re-tested 7-10 days post the initial test date. For each test situation, 3 submaximal and 3 maximal contractions were produced prior to a 3 maximal contraction test. The testing orders for the muscle groups and for the modes of contraction were randomly selected. To determine reliability, the windowed (WIN) and non-windowed (NW) data produced by the Biodex[®] Advantage Software Package were interpreted via an ICC (2,1). **Results:**

GROUP	CONCENTRIC		ECCENTRIC	
	WIN ICC	NW ICC	WIN ICC	NW ICC
FLEX	.97	.87	.78	.78
EXT	.97	.97	.79	.77
ABD	.94	.73	.87	.73
ADD	.94	.94	.78	.76
HAD	.95	.91	.95	.91
HAB	.78	.71	.88	.83
ER	.97	.97	.88	.94
IR	.97	.97	.91	.91

These results indicate that the Biodex[®] 2000 produces moderate to highly reliable WIN and NW CON and ECC GH PT data at 1.047 rad/s. For CON PT, WIN reliability equals or exceeds NW reliability in all instances. With the exception of ER, WIN ECC PT reliability equals or exceeds NW ECC PT reliability. Thus, when using the Biodex 2000[®] to interpret GH CON and ECC PT production, clinicians should use the unit's WIN data.

Reliability Of Lower Extremity Functional Performance Tests

Bolgia LA, Keskula DR: Medical College of Georgia, Augusta, GA

The purpose of this investigation was to determine the reliability of lower extremity functional performance tests. Five males and 15 females (age = 24.5 ± 4.2 yr) with no history of lower extremity dysfunction were evaluated using the single hop for distance, triple hop for distance, 6 meter timed hop and cross-over hop for distance tests as described by Noyes. One clinician measured each subject's performance using a standardized protocol. Subjects participated in a general warm-up and a task specific warm-up prior to actual testing. Subjects rode a stationary bike and did gentle stretching for the general warm-up and then practiced each test 3 times during the task specific warm-up. For actual testing subjects performed 3 repetitions of each functional performance test in a randomly determined order. Each person rested 30 seconds between trials and 45 seconds between individual tests. Subjects repeated gentle stretching exercises after actual testing. The same clinician retested subjects in an identical manner approximately 48 hours later. Intraclass correlation coefficients (ICCs) and standard error of measurement (SEM) values based on average day 1 and day 2 scores were used to estimate the reliability of each functional performance test. ICCs were .96, .95, .96 and .66 and SEMs were 4.56 cm, 15.44 cm, 15.95 cm and .13 seconds respectively for the single hop, triple hop, cross-over hop and 6 meter timed hop. The timed hop's lower ICC value resulted from limited variability between measurements. A repeated measures Analysis of Variance (ANOVA) revealed no significant difference ($p < .05$) between individual trial scores except for the single hop for distance. We concluded that this difference represented a learning effect not found with the other tests. The results of this investigation demonstrate that clinicians can use functional performance testing to obtain reliable measures of lower extremity performance when using a standardized protocol.

Cardiorespiratory Responses During Graded Exercise Treadmill Tests With And Without The Leg Harness

Holman D, Kimura I, Kendrick Z, Sitler M: Temple University, Philadelphia, PA

The purpose of this study was to determine cardiorespiratory responses (heart rate and oxygen uptake), in the following two randomly ordered graded exercise treadmill test conditions: with (experimental) and without (control) the Leg Harness (Improve Human Performance, Englewood, CO). The Leg Harness is a variable resistance device which loads the lower extremity musculature via elastic tubing. Subjects were 17 males and females 22 to 27 years of age, who were tested in a post-absorptive state. Stage one of the treadmill test was initiated for one minute at 3 mph and 0% grade. Treadmill grade was increased to 2.5% and speed was increased to 3.0, 3.5, 4.0, 5.0, 5.5, 6.0, 7.0, and 7.5 mph for stages 2 through 9, with each stage lasting three minutes in length. The electrocardiogram was monitored during the last 15 seconds of each stage of the treadmill test to obtain the exercise heart rate. A metabolic cart was used to measure oxygen uptake. Two 2x4 analyses of variance with repeated measures at the $p < .05$ alpha level were used to analyze the heart rate and oxygen uptake data from the first, third, fifth, and final stages. No significant differences were found for heart rate and oxygen uptake between experimental and control conditions. A Tukey post hoc tests indicated significant increases in oxygen uptake with each progressive treadmill stage, regardless of test condition. A significant interaction for heart rate data was found between stage and condition. Tests for simple effects revealed significant increases in heart rate with each progressive stage, regardless of test condition. It was concluded that Leg Harness use during graded treadmill exercise will not significantly increase heart rate or oxygen uptake.

Effect Of Trunk Position On Anterior Tibial Displacement As Measured By The KT-1000 Knee Arthrometer

Webright WG, Perrin DH, Gansnedder BM: University of Virginia, Charlottesville, VA

Clinicians may be obtaining false-negative Lachman tests for tibial displacement when they vary trunk position of the athlete as the assessment of acute anterior cruciate ligament injury moves from on the field, to the sideline, and to the clinic. This study examined the influence of supine, semireclined, and sitting trunk positions on arthrometric laxity measurements of the knee. Subjects included ten men and 5 women without present knee injury or history of knee ligament repair to the right lower extremity. The trunk was passively supported in the three trunk positions in a counterbalanced order. The right knee was maintained at 29.0 ± 3.1 degrees flexion. A 133 Newton (30 lb) anterior force was applied to the right knee using a modified KT-1000 knee arthrometer equipped with an LCCB-50 strain gauge that allowed for digital display of the displacement force. Three tibial displacement (mm) trials at each trunk position were averaged and used for analysis. A one-way analysis of variance with repeated measures performed on trunk position was used to examine trunk position differences in anterior displacement. Results indicated that trunk position had no effect on tibial displacement ($p > .05$). Group means for displacement were 7.9 ± 2.3 mm (supine), 8.1 ± 2.5 mm (semireclined), and 8.3 ± 2.5 mm (sitting). These findings suggest alterations in trunk position are not problematic in the instrumented assessment of anterior tibial displacement in an uninjured population. Further research should determine the relevance of these findings in subjects with injury to the anterior cruciate ligament. Further research should also determine if these findings can be applied when comparing passive versus active (e.g., propped on elbows or hands) trunk support in anterior cruciate ligament injured knees.

NATA Research & Education Foundation CALL FOR ABSTRACTS

1998 National Athletic Trainers' Association — Annual Meeting & Clinical Symposia
Baltimore, Maryland • June 17-20, 1998

DEADLINE FOR ABSTRACT SUBMISSION: JANUARY 5, 1998

Instructions for Submission of Abstracts and Process for Review of All Submissions

Please read all instructions before preparing the abstract. Individuals may submit only one abstract or clinical case report as primary (presenting) author, but may submit unlimited abstracts or clinical case reports as a coauthor. All abstracts will undergo blind review.

FREE COMMUNICATIONS ABSTRACTS

Specific Content Requirements

Abstracts in this category must include the purpose of the study or hypothesis, a description of the subjects, the experimental methods and materials, the type(s) of data analysis, the results of the study, and the conclusion(s). Authors are asked to indicate a preference for oral or poster presentation of their abstracts. Authors of free communications are required to categorize their abstracts in one of the five specific areas of research funded by the NATA Research and Education Foundation:

- **Basic Science** — includes controlled laboratory studies in the subdisciplines of exercise physiology, biomechanics, and motor behavior, among others, which relate to athletic training and sports medicine.
- **Clinical Studies** — includes assessment of the validity, reliability, and efficacy of clinical procedures, rehabilitation protocols, injury prevention programs, surgical techniques, and so on.
- **Educational Research** — a broad category ranging from basic surveys to detailed athletic training/sports medicine curricular development. An abstract in this category will generally include assessment of student learning, teaching effectiveness (didactic or clinical), educational materials and curricular development.
- **Sports Injury Epidemiology** — includes studies of injury patterns among athletes. These studies will generally encompass large-scale data collection and analysis. Surveys and questionnaires may be classified in this category but are more likely to come under the Observation/Informational Studies category.
- **Observation/Informational Studies** — includes studies involving surveys, questionnaires, and descriptive programs, among others, which relate to athletic training and sports medicine.

Instructions for Preparing the Abstract

1. Provide all information requested on the Abstract Author Information Form. Abstracts should be typed or word processed using a letter-quality printer with no smaller than elite (12 cpi) or 10-point typeface. Do not use a dot matrix printer.

2. Top, bottom, right, and left margins should be set at 1.5" using a standard 8.5" x 11" sheet of paper. Type the title of the paper or project starting at the left margin.
3. On the next line, indent 3 spaces and type the names of all authors, with the author who will make the presentation listed first. Type the last name, then initials (without periods), followed by a comma; continue with the other authors (if any), ending with a colon.
4. Indicate the institution (including the city and state) where the research or case report was conducted on the same line following the name(s) of the author(s).
5. Double space and begin typing the text of the abstract flush left in a single paragraph with no indentions. Do not justify the right margin. Do not include tables.
6. The abstract must **not** exceed 400 words.

CLINICAL CASE REPORTS

Specific Content Requirements

This category of abstracts involves the presentation of unique individual athletic injury cases of general interest to our membership. This year, no form is provided so that authors may use their own word-processing software to format and submit the following information using a two-page format. Abstracts in this category must include the following information. A maximum of one paragraph should be presented for each of the following required content area headings:

- 1) Personal data
- 2) Physical signs and symptoms
- 3) Differential diagnosis
- 4) Results of diagnostic imaging/laboratory tests
- 5) Clinical course
- 6) Deviation from the expected

Instructions for Preparing the Abstract

1. An individual may submit only one clinical case report abstract as primary (presenting) author; however, there is no limit to the number of abstracts (free communications or case reports) listing an individual as coauthor.
2. Clinical case report abstracts are to be word processed or typed using a **letter-quality** printer with no smaller than elite (12 cpi) or 10-point typeface. Do not use a dot matrix printer.
3. Top, bottom, right, and left margins should be set at 1.5" using a standard 8.5" x 11" sheet of paper. Type the title of the paper or project starting at the left margin.
4. Provide all information requested on the information form on the next page. Please note that the institution (including the city and state) where the clinical case occurred should be cited, not the current address of the author(s), if different.

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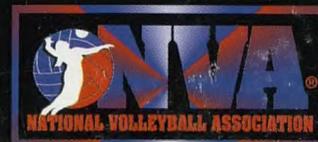
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