

SUPPLEMENT TO

JOURNAL OF ATHLETIC TRAINING

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Take this Supplement to Kansas City and use it as a guide to the Free Communications Sessions.

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 held at the NATA Annual Meeting.

The Free Communications Sessions allow certified 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.

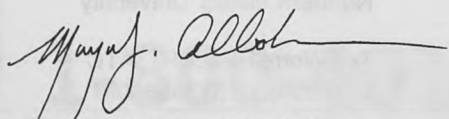
Free Communications presentations are divided into categories: basic science, clinical studies, educational research, sports injury epidemiology, and observational studies. In addition, the Clinical Case Reports sessions allow you to test your clinical assessment skills. We encourage you to attend these sessions, especially the popular thematic poster presentations that combine oral and poster formats.

We also urge you to attend the session featuring research funded by the Foundation. The Foundation not only funds research, but also a variety of educational programs. These include home study programs, the Athletic Training Educators' Conference, the District Lecture Series, and summits on issues critical to athletic training, as well as more than 50 scholarships annually to students of athletic training. It is important to note that responsibility for the development of program content and logistics of presentation of these programs has been assumed by the Continuing Education Committee of the NATA Education Council. The Foundation remains responsible for securing funding for financial support.

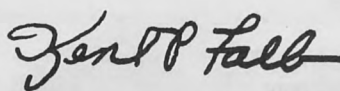
Support from NATA members, corporations, and other affiliated groups makes this supplement and all of the Foundation's programs possible. To make an investment in the future of the profession, please contact the Foundation today at 800-TRY-NATA, extension 142.

NATA and its Foundation are happy to offer this supplement as a service to NATA members. We hope that it provides you with theoretical and practical information you can use to improve your effectiveness as a certified athletic trainer. Thank you for your support!

Sincerely,



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



Kent P. Falb, ATC, PT
President, NATA

JOURNAL OF ATHLETIC TRAINING

Official publication of The National Athletic Trainers' Association, Inc

Volume 34, Number 2, Supplement, 1999

Abstracts of Research

Free Communications, Oral Presentations (Room 2218)

Education/Administration , Moderator: Malissa Martin, EdD, ATC	S-7
Shoulder , Moderator: Brent Arnold, PhD, ATC	S-9
Funded Research I , Moderator: Rod Harter, PhD, ATC	S-11
Ankle , Moderator: Dan Foster, PhD, ATC	S-13
Modalities , Moderator: David Draper, EdD, ATC	S-17
Injury Risk , Moderator: Michael Ferrara, PhD, ATC	S-19
Funded Research II , Moderator: Michael Sitler, EdD, ATC	S-23
General , Moderator: Mark Merrick, PhD, ATC	S-25
Spine , Moderator: Carl Mattacola, PhD, ATC	S-27
Thematic Poster Session: Trends in Balance/Posture , Moderator: Mitchell Cordova, PhD, ATC	S-29

Free Communications, Oral Presentations (Room 2219)

Thematic Poster Session: Current Trends in Ergogenic Aids/Pharmacology	S-33
Moderator: Richard Ray, EdD, ATC	
Clinical Case Reports: Lower Extremity	S-37
Moderator: Todd Evans, MA, ATC, CSCS; Discussants: Marjorie King, MS, ATC, PT; Rick Wright, MD	
Practice Meets Research: Mild Brain Injury	S-43
Moderator: Kevin Guskiewicz, PhD, ATC	
Thematic Poster Session: Current Trends in Anterior Cruciate Ligament Research	S-45
Moderator: Jay Hertel, MEd, ATC	
Clinical Case Report: Upper Extremity	S-49
Moderator: John McChesney, PhD, ATC; Discussants: Gary Ward, MS, ATC; TBA	
Student Clinical Case Reports	S-53
Moderator: Brent Mangus, EdD, ATC; Discussants: Dale Blair, MS, ATC, CSCS; Stewart Freed, MD	
Thematic Poster Session: Current Trends in Electromyography	S-57
Moderator: Ted Worrell, EdD, ATC, PT	

Free Communications, Poster Presentations (Convention Center, Lobby 200, Level 2)

Session A	S-61
Session B	S-67
Session C	S-71
Session D	S-75
Session E	S-81

Research Business

Letter from Marjorie J. Albohm, MS, ATC, and Kent P. Falb, ATC, PT	S-2
Call for Abstracts	S-89
Call for Reviewers	S-90
Thank You to Reviewers	S-4
Subject Index	S-91
Author Index	S-94

The abstracts on these pages were prepared by the authors and are printed here without correction. The accuracy, nomenclature, form, and style all remain the responsibility of the authors. Readers should note that the appearance of an abstract does not imply future publication of a regular scientific manuscript.

Thank You!

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S-6 Volume 34 • Number 2 • April-June 1999

Free Communications, Oral Presentations: Education and Administration

Wednesday, June 16, 8:30 AM-9:45 AM, Room 2218; Moderator: Malissa Martin, EdD, ATC

Methods Utilized By Athletic Trainers When Seeking Employment Opportunities

Meador R, Stilger V, Swanik C: West Virginia University, Morgantown, WV

PURPOSE: To determine the various means athletic trainers use to seek employment opportunities in the profession of athletic training. **METHODS:** A survey instrument was reviewed by Placement Committee members prior to the National Athletic Trainers' Association annual meeting in Baltimore, MD. After being approved by the Placement Committee, the survey was made available in the Placement Room to those athletic trainers (students, ATC's) seeking employment opportunities. The survey instrument consisted of ten questions seeking information on the techniques utilized in searching for employment opportunities. Techniques such as using the Internet, NATA fax-on-demand, NATA Placement Vacancy Notice (PVN), NATA Hotline, and networking were some of the options listed on the survey instrument. In addition, the survey instrument asked how long they have been active in their job search. **RESULTS:** A total of thirty-three surveys were returned. Frequency counts using SPSS (version 7.5, Chicago, IL) were used for analysis. There were strong positive responses in the use of the NATA PVN over the Internet (100%), NATA Placement Room (97%), networking (70%), and the NCAA NEWS (52%). Over 75% indicated using the Internet more than twice a month. Negative responses in which methods were not often utilized included the Chronicle of Higher Education (94%), NATA telephone hotline (94%), NATA fax-on-demand (79%), and the NATA PVN via mail (73%). The amount of time each applicant had been actively pursuing employment opportunities ranged from one month (21%) to constantly (6%). **CONCLUSIONS:** The Internet, NATA Placement Room, and networking are methods most commonly used by athletic trainers when seeking employment opportunities within the profession. The NATA hotline, NATA fax-on-demand, and NATA PVN via mail are services not commonly utilized when searching for employment. Athletic training educators should continually provide information within their curriculums on the different methods available when seeking employment opportunities. Additionally, the NATA may want to evaluate the employment opportunity services available to their membership.

A Comparison Of The Fitness Knowledge Acquired By Students In Athletic Training And Other Allied Health Professions

Nonnemacher MM, Loriz LM, Kleiner DM, Miller MG: University of North Florida, Jacksonville, FL

Each allied health profession has its own particular expertise, but may also share common knowledge with other disciplines. It has been previously reported that one such shared expertise 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 knowledge of fitness that was acquired by students during their professional preparation. Students from accredited allied health educational programs in: athletic training (AT), physical therapy (PT), and nursing (NU), from the same institution were used as subjects. The initial (pre-test) subject population consisted of 117 students (AT = 48, PT = 36, and NU = 33). The post-test was completed by 63% of the initial respondents. A 40-question, multiple choice test was administered to the students in the first and last semesters of their professional program of study. The test contained eight questions from each of the five domains of: body composition, flexibility, muscular strength, muscular endurance and cardiovascular conditioning. The data were analyzed by t-tests and are reported as mean scores (\pm S.D.), and percentages. The correct total scores for the pre-test were; 65% (\pm 11), 72% (\pm 7), and 59% (\pm 12) for AT, PT, and NU, respectively. The correct total scores for the post-test were; 80% (\pm 5), 74% (\pm 16), and 59% (\pm 15) for AT, PT, and NU, respectively. Thus, the pre-test to post-test total scores improved by 15%, 2%, and 0% for AT, PT, and NU, respectively. The change in total scores from pre-test to post-test was significant ($p < 0.05$) only for AT. AT improved significantly ($p < 0.05$) from pre-test to post-test in the domains of flexibility, muscular strength, muscular endurance, and cardiovascular conditioning, whereas PT improved only in muscular endurance, and NU improved in both flexibility and muscular endurance. The importance of this research is to identify the knowledge gained by 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, including their need to be knowledgeable in the area of fitness. The continued development of each discipline's individual and shared roles and responsibilities is advised.

Optimal Health Care Perceptions Of University Athletic Training/Sports Medicine Administrators

Chapski C, Wright K: The University of Alabama, Tuscaloosa, AL

The purpose of this study was to assess perceptions of sports medicine program administrators concerning optimal health care. This research study surveyed twenty-six administrators within the NCAA Division I program, in which a return rate of 88% was obtained. With a variety of responses, most administrators expressed a concern to these issues: ratio of National Athletic Trainers' Association Board of Certification (NATABOC) Certified Athletic Trainers (ATC's) to student athlete, facility operational hours, and employee work schedule as it is related to Optimal Health Care. Demographic information displayed that most administrators were male, had sixteen years of experience as an NATABOC certified athletic trainer and obtained a masters' degree. The full-time members of the sports medicine staff reported a mean of six, with additional support from local hospital/clinic. Concerning optimal health care, a significant number of respondents stated that the ideal ratio of ATC to student athlete should not exceed one to forty but most institutions stated that the actual ratio exceeded one to fifty. Employee work schedule for those institutions exceeding a 40 plus hour workweek, fifty two percent reported that their institution provided release time for time exceeding the 40 hours workweek. Based on the results obtained, this study concluded that a reduced ratio of ATC to student athlete and a decrease dependency on volunteer assistance with medical coverage of sports activities will enhance issues related to optimal health care in university settings.

The Incidence Of Sexual Harassment In An Undergraduate Athletic Training Education Program

Hauth JM, Vanic KA, Davis SE: East Stroudsburg University, East Stroudsburg, PA

Purpose: Research suggests that one in three college students will be subjected to some form of sexual harassment. Prior to this investigation, there has been no published information regarding the occurrence of sexual harassment among student athletic trainers enrolled in athletic training field experiences. The purpose of this study was to determine the incidence of sexual harassment among student athletic trainers enrolled in a Commission on Accreditation of Allied Health Education Programs (CAAHEP) accredited athletic training education program and to investigate the factors associated with the occurrence of different types of sexually harassing behaviors. **Methodology:** Thirty-nine undergraduate students (19 males, 20 females) enrolled in a CAAHEP accredited athletic training education program volunteered as subjects for the study by completing the Student Athletic Trainer - Sexual Experiences Questionnaire (SAT-SEQ). The SAT-SEQ is a 30-item Likert-type questionnaire designed by the researchers to assess a student athletic trainer's (SAT) perception of certain sexually harassing behaviors (SHB) that may occur during an athletic training field experience. The survey focused on experiences with student-athletes, coaches and supervising certified athletic trainers. The questionnaires were statistically analyzed using SPSS for Windows, Version 6.1. **Results:** Results indicated that (1) the percentage of SAT's who reported experiencing at least one behavior of a sexually harassing nature in their relationships with student-athletes, coaches and certified athletic trainers were 82%, 18% and 23% respectively; (2) the majority (85%) of the self-reported SHB's were of a non-physical nature; (3) the hypothesis that SAT's would be exposed to SHB's more frequently than other college students (30%) was supported (Dziech & Weiner, 1992); (4) SAT's are more likely (58%) to experience SHB's when the field experience is with a men's sport. Additionally, SAT's encounter these behaviors more frequently with male coaches (67%) compared with female coaches (33%). These behaviors occur most frequently in the primary athletic training facility (26%), at the athletic practice/game venue (20%) and in the van or bus (18%). (5) The Chi Square Test of Independence revealed that the occurrence of SHB's of a physical nature are dependent upon the gender of the SAT. **Recommendations:** The reported incidence of SHB's in the present study was alarming. By making program directors aware of the scope of this problem, we can design programs to address the issue of sexual harassment in athletic training field experiences.

Case Study: Hypersensitive/Allergic Reaction To Airborne Chemicals In The Athletic Training Learning Environment

Velasquez BJ, Drummond JL: University of Southern Mississippi, Hattiesburg, MS

PERSONAL DATA/MEDICAL HISTORY:

A 20-year-old Caucasian female Student Athletic Trainer enrolled at a CAAHEP accredited institution developed severe hypersensitive and allergic reactions to various airborne chemicals, vapors and fumes encountered in a cadaver laboratory and in the athletic training clinical setting. The student had previously been a student athletic trainer in high school and had spent one year in clinical observations at the university without any reported incidents. The student had a history of asthma and allergies to dairy products and certain foods.

PHYSICAL SIGNS AND SYMPTOMS: Breathing problems, light headedness, asthma attack and subsequent tunnel vision. Body hives and swelling of the face.

DIFFERENTIAL DIAGNOSIS: Acute allergic or hypersensitive reaction, acute sinusitis, dermatitis, and acute bronchial spasms from airborne chemical irritants.

DIAGNOSTIC IMAGING/LABORATORY TESTS: Physical examination by an allergist confirmed the initial evaluation.

CLINICAL COURSE: Benadril for the hives and Albuterol inhalation aerosol treatment on the nebulizer. In addition, the student was bedridden for one week after each incident. In the cadaver laboratory, activities were modified to allow the student to complete the course. The student subsequently changed her academic major, leaving the athletic training education program.

DEVIATION FROM THE EXPECTED: Although similar cases have been reported involving nursing students and others in cadaver laboratory situations, this is one of the first cases reported involving a student enrolled in an Athletic Training CAAHEP program.

Free Communications, Oral Presentations: Shoulder

Wednesday, June 16, 10:15 AM - 10:30 AM, 10:45 AM - 11:45 AM, Room 2218; Moderator: Brent Arnold, PhD, ATC

Effect Of Fatigue On Proprioception And Neuromuscular Control Of The Shoulder

Myers JB, Guskiewicz KM, Padua DA:
University of North Carolina at Chapel Hill,
Chapel Hill, NC

The purpose of this study was to determine the effect of fatigue on proprioception and neuromuscular control of the shoulder in both open and closed kinetic chain positions. The authors hypothesized a decrease in joint reproduction ability as well as decreased dynamic stability in the closed kinetic chain position. Thirty-two subjects (16 males, 16 females) age 18-27 with no history of glenohumeral instability or upper extremity injury volunteered for this study. Subjects were randomly assigned to either a control or experimental group. Each subject was pretested using either Active Angle Reproduction (AAR) on an isokinetic dynamometer or the Single Arm Dynamic Stability Test (SADS) using a long force plate. Immediately following the pretest, the experimental subjects were fatigued with the isokinetic dynamometer, performing continuous, concentric humeral rotation exercises. The control subjects remained inactive. Following fatigue, the subjects were posttested using the same pretest procedure. One week later, the subjects returned and were pretested, fatigued, and posttested using the procedure (AAR or SADS) not performed during the first session. Each subject performed three trials at three reference angles (30 ER, 30 IR, and 75 ER) for Active Angle Reproduction as well as three trials for SADS measuring sway velocity. A one within, two between repeated measures ANOVA ($\alpha = .05$) revealed a group by test interaction for Active Angle Reproduction ($p = .027$). Statistical analysis indicated a decrease in AAR following fatigue. A one within, one between repeated measures ANOVA analyzed the composite sway velocity analysis, while a Wilcoxon Signed Ranks Test analyzed the number of falls. Analysis of the composite sway velocity values revealed no significant group by test interaction ($F = 2.49$, $p = .125$). The Wilcoxon nonparametric data analysis revealed a significant increase in the number of falls following fatigue by the experimental group ($p = .016$) with no significant difference ($p = .317$) between pretest and posttest falls with the control group. Fatigue decreased proprioception as measured through Active Angle Reproduction, therefore suggesting that fatigue limits an individual's ability to detect changes in shoulder joint positioning. The analysis, however, revealed that fatigue had no significant effect on closed kinetic chain neuromuscular control as measured by sway velocity. Additional research may be needed to determine if and how fatigue affects dynamic stability as shown by the significant increase in falls following fatigue. If in fact fatigue of the humeral rotator muscles affects proprioception and neuromuscular control, an athlete may be at risk of injury as competition progresses.

The Effects Of Shoulder Plyometric Training On Proprioception And Muscle Performance Characteristics

Swanik KA, Lephart SM, Swanik CB, Lephart SP, Stone DA, Fu FH: Neuromuscular Research Laboratory, University of Pittsburgh, Pittsburgh, PA

PURPOSE: The purpose of this study was to determine the effects of plyometric training on shoulder proprioception, kinesthesia, and selected muscle performance characteristics of the internal rotators in female Division I varsity swimmers. **METHODS:** Twenty-four Division I female varsity swimmers (mean age = 20 ± 1.1) without shoulder pathologies were evaluated before and after a six week plyometric training program. Proprioception and kinesthesia were assessed during internal rotation (IR) and external rotation (ER) at 0° , 75° , and 90° of the subject's maximum ER. Proprioception was assessed by measuring the error in active reproduction of passive positioning (ARPP) on the Biodex II Dynamometer and kinesthesia was assessed by measuring threshold to detect passive motion (TTDPM) on the proprioception testing device. The Biodex II was also used to assess muscle performance at the speeds of 60, 240, and $450^\circ/\text{second}$ during reciprocal concentric contractions and included time to peak torque (ms), peak torque to body weight (%), torque decrement (%) and amortization time (ms). Agonist/antagonist peak torque ratios (Nm) were also established for IR and ER. Plyometric training sessions (2/week) involved 3 sets of 15 repetitions using a trampoline, weighted balls, and elastic tubing.

RESULTS: A two-way ANOVA was used to examine significant between group differences ($p < .05$). ARPP significantly improved at 0° of rotation moving into ER, as well as at 75° and 90° of maximum ER moving into both IR and ER. TTDPM also demonstrated significant improvements for all test conditions moving into both IR and ER following plyometric training. Significant improvements in muscle performance characteristics were revealed in the plyometric group for time to peak torque at both $60^\circ/\text{sec}$ and $240^\circ/\text{sec}$, amortization time at $450^\circ/\text{sec}$, and torque decrement at $240^\circ/\text{sec}$. Insignificant findings include ARPP at 0° moving into IR, time to peak torque at $450^\circ/\text{sec}$, peak torque to body weight at 60, 240, and $450^\circ/\text{sec}$, amortization time at $240^\circ/\text{sec}$, and agonist/antagonist torque ratio at $60^\circ/\text{sec}$.

CONCLUSIONS: The findings in this study support the theoretical concepts for utilizing plyometric types of activities for the upper extremity. This study also suggests that plyometric activities facilitate neural adaptations that enhance proprioception, kinesthesia, and muscle performance characteristics. Furthermore, due to the varying levels of intensity associated with plyometrics, significant neuromuscular benefits may also be attained if implemented earlier in shoulder rehabilitation.

Rotator Cuff Repair Tension As A Determinate Of Functional Outcome

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This study evaluates the effect of rotator cuff repair tension on surgical outcome. 72 consecutive rotator cuff repairs for full thickness tendon tears were prospectively evaluated with a minimum 18 month follow-up. One surgeon performed all repairs, using similar technique. Soft tissue releases were performed as needed to minimize tension. Rotator cuff repair tension was quantified, using an intraoperative calibrated tensiometer, following cyclic loading. The site of maximum repair tension was measured. Patients were evaluated before and after surgery, according to Constant scores, American Shoulder and Elbow Surgeons functional criterion, isokinetic strength testing and VAS pain and improvement scales. Rotator cuff repair tension ranged between 0 & 10 lbs., with a mean of 2.5 lbs. Preoperative Constant score ranged between 25 & 60 with a mean of 56.5. Postoperative constant scores ranged between 20 & 90 with a mean of 66.1. Increased repair tension correlated with decreased postoperative Constant scores ($P < .001$), a decrease in VAS perceived improvement ($P < .05$), and decreased isokinetic strength measurements ($P < .05$). Increased repair tension did not significantly correlate with postoperative VAS pain scores ($P > .05$). Rotator cuff repair tension is an important parameter in determining outcome of surgical repair. Tension of the rotator cuff tendon repair is demonstrated to significantly affect the results of rotator cuff tendon repair. Constant score, isokinetic strength gain and perceived improvement were all adversely affected by increased repair tension. Postoperative pain did not correlate with repair tension. Rotator cuff repair tension correlates directly with surgical outcome. Increased repair tension negatively affects Constant scores, perceived improvement and strength. Pain was not significantly affected by tension. Tension above 7 lbs. yields inferior results.

The Effect Of Humeral Head Taping On Humeral Head, Scapula, And Thoracic Spine Positions

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Forward shoulder posture may cause faulty dynamic humeral/scapular movement, predisposing an athlete to anterior shoulder impingement. Treatment should focus on establishing a more ideal structural posture to minimize stress on tissue. The purpose of this study was to determine the mechanical effect of humeral head taping on a forward humeral head. Fifteen asymptomatic subjects, 23-31 years old, participated in this study. Humeral head position, thoracic kyphosis, and scapular position were measured at three time intervals: before taping, immediately after tape application, and after a three hour duration of taping. Data were analyzed with a one-way repeated measures ANOVA for each dependent variable. Humeral head position and scapular position were significantly ($p < 0.05$) different before and after taping. However, thoracic kyphosis did not significantly change with the application of tape. The results of this study suggest that humeral head relocation taping creates a temporary postural change at the glenohumeral and scapulothoracic joint in subjects without shoulder pathology. Further study will investigate the use of humeral head taping on symptomatic subjects during dynamic activity.

Direct Three-Dimensional Measurement Of Scapular Kinematics During Dynamic Movements *In Vivo*

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Purpose: Abnormal scapular motion is thought to be associated with shoulder disorders such as impingement and instability. Previous studies describing scapular kinematics have been mostly two-dimensional focusing on upward rotation, and have been limited to static conditions. Additionally, several studies have used non-invasive methods to track scapular motion, which may be inaccurate due to skin motion artifact. The purpose of this study was to describe three-dimensional scapular motion patterns during dynamic shoulder movements using a direct technique. **Subjects:** There were 8 healthy volunteers (5 males, 3 females) who served as subjects. **Methods:** Direct measurement of scapular motion was accomplished by insertion of two 1.6mm bone pins into the spine of the left scapula (non-dominant) in 7 subjects and the right (dominant) of 1 subject. A small, three-dimensional motion sensor was rigidly fixed to the scapular pins. Additional sensors were also attached to the thoracic spine (T3) using tape, and to the humerus using a specially designed cuff. The motion sensors acted as receivers to detect motion via an electromagnetic signal emitted from a transmitter attached to a fixed base. All scapular motions were measured relative to the thorax and defined as upward rotation around an anterior-posterior axis, tilting around a medial-lateral axis and external rotation around a vertical axis. Subjects performed active, passive and resisted (vs 5lb wrist cuff weight) movements. **Results:** During active scapular plane elevation, the scapula upwardly rotated (mean = 51.9° , sd = 5.9), tilted posteriorly around a medial-lateral axis (mean = 35.8° , sd = 13.8), and externally rotated around a vertical axis (mean = 34.0° , sd = 11.6). Lowering of the arm using eccentric muscle action resulted in a reversal of these motions but in a different pattern. The overall mean (sd) ratio of glenohumeral / scapulothoracic motion was 1.7 (0.3) for active elevation, 1.9 (0.3) for passive elevation and 1.5 (0.2) for resisted elevation. **Discussion and Conclusion:** Normal scapular motion consists of substantial rotations around three axes, not simply upward rotation. Active motion results in relatively less glenohumeral motion compared to passive elevation and addition of resistance lessened the contribution of the glenohumeral joint to arm elevation suggesting that scapulohumeral rhythm varies with different amounts of loading and muscle activity. Understanding normal scapular motion may assist in identifying abnormal motion associated with various shoulder disorders.

Partially funded by a grant from the Orthopedic Section, APTA.

The Correlation Between Shoulder Joint Position Sense And Neuromuscular Control Of The Shoulder

Uhl TL, Gieck JH, Perrin DH, Arnold BL, Saliba EH, Ball DW: University of Virginia, Charlottesville, VA

This study examined the relationship between proprioception and neuromuscular control of the shoulder by determining the correlation between passive joint position sense and motor latencies of the shoulder. Forty division I athletes (age = 20.75 ± 1.52 , ht = $1.83 \pm .12$, wt = 89.63 ± 18.8) volunteered to participate. Twenty were classified as overhead throwers and 20 classified as non-throwers. All subjects were free from a history of shoulder pathology and demonstrated no systematic laxity. Passive joint position sense for all subjects was measured bilaterally at 2° sec^{-1} using an electrical goniometer of an isokinetic dynamometer at 2 angles (Mid & End-range), in 2 directions (IR & ER). The reliability [ICC (2,3)] of this method of joint position sense testing ranged from $R = .42 - .81$ and the SEM ranged from $.45 - 1.0^\circ$. Motor latency was used as a measure of neuromuscular control and was determined as the time to muscle activation in response to a shoulder perturbation. Bipolar surface electrodes were placed over the pectoralis major and infraspinatus to record surface EMG data. Both shoulders of all subjects were perturbed at $200^\circ \text{ sec}^{-1}$ in both internal and external rotation directions by an isokinetic dynamometer in the passive mode. The reliability [ICC (2,3)] of this method of motor latency testing for infraspinatus was $R = .72$ (SEM = 10.4 msec) and $R = .93$ (SEM = 9.0 msec) for the pectoralis major. A Pearson correlation performed between external rotation passive joint position sense and pectoralis major latency revealed no significant correlation for the throwing group ($r = -.006, -.183$) and for the non-throwing groups ($r = -.028, -.373$). A second correlation performed between internal rotation passive joint position sense and infraspinatus latency revealed no significant correlation for the throwing group ($r = -.087, .023$) or non-throwing groups ($r = .053, -.109$). The low correlation between joint position sense and motor latency may indicate the assessment of the sensorimotor system of a joint requires more than a single neuromuscular test. The precision of these testing methods must also be considered when interpreting the low correlations found between these measures. This study provides a reference point for future clinical research to assess shoulder proprioception and neuromuscular control.

Free Communications, Oral Presentations: Funded Research I

Wednesday, June 16, 1:00 PM - 2:00 PM, Room 2218; Moderator: Rod Harter, PhD, ATC

Muscle Accommodations To Anterior Cruciate Ligament Dysfunction

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Prior studies suggest that the hamstrings assist in joint stability and reduce the magnitude of net anterior tibial shear generated by quadriceps activity or external loads. However, there is controversy regarding the role of the hamstrings, and other muscle groups, in anterior cruciate ligament deficient (ACLD) subjects. The purpose of this study was to assess hip and knee extensor torques relative to anterior tibial shear in preoperative ACL deficient, postoperative and uninjured subjects. Simultaneous measurements of hip, knee, and ankle joint moments on the injured (INJ) and normal (NOR) contralateral limbs of 45 subjects were computed using an inverse dynamics method, during a lower extremity, variable resistance exercise performed on a closed-chain computer controlled dynamometer. Three groups of subjects were studied: 1) recently injured ACLD pre-operative subjects who were scheduled for imminent surgery (PRE; $n=15$); 2) post-operative subjects who had undergone ACL reconstructive surgery at least one year prior to testing (POST; $n=15$); and uninjured controls (CON; $n=15$). All PRE and POST subjects had a normal (NOR) contralateral limb. Tests were conducted under six conditions: 1 and 1.5 Hz cadence and maximum speed at 33% and 50% 1RM resistance. The results revealed that anterior tibial shear declined with speed ($P<0.01$) in the contralateral limbs of all groups. 71% of the PRE subjects generated significantly less anterior tibial shear ($P<0.05$) in the INJ compared to the contralateral NOR side at the maximum speed and resistance condition. Hip extensor/knee extensor torque ratios tended to increase with decreases in anterior tibial shear in all groups with correlations ranging from $r = -0.52$ to -0.92 ($P<0.01$) for the INJ limbs of PRE and POST groups, and $r = -0.39$ to -0.78 ; ($P<0.01$) for the CON group. These relationships tended to be strongest at the maximum speed condition. The results suggest that: 1) Pre- and post-ACL surgical subjects tend to reduce the magnitude of anterior tibial shear, and this effect is accentuated with increased speed; and 2) hamstring activity, relative to knee extensor activity, contributes significantly to reductions in anterior tibial shear.

This study was funded by a grant from the NATA Research and Education Foundation.

Neuromuscular Response Characteristics In Males And Females Following Knee Perturbation

Shultz SJ, Perrin DH, Granata KP, Gansneder BM, Arnold BL, Adams JM: University of Virginia, Charlottesville, VA

This study examined, through electromyographical analysis, the muscular response times and recruitment patterns of the quadriceps, hamstring and gastrocnemius muscles in healthy males and females following an unanticipated knee perturbation. Female soccer and lacrosse athletes ($N=32$, age= 19.4 ± 1 yrs, ht= 165.1 ± 5.4 cm, wt= 62.2 ± 5.7 kg) were compared to male lacrosse athletes ($N=32$, age= 20.5 ± 1.2 yrs, ht= 180.0 ± 5.2 cm, wt= 82.6 ± 9.9 kg). Neuromuscular responses were assessed with the knee in a functional, weight bearing stance under active muscular conditions. A lower extremity perturbation device was designed to produce a forward and either internal rotation (IR) or external rotation (ER) moment of the trunk and femur relative to the weight bearing tibia. Surface EMG recorded (in msec) long latency reflex times (LLRT) for the medial and lateral quadriceps (MQ, LQ), hamstring (MH, LH) and gastrocnemius (MG, LG) muscles. For each perturbation condition, five trials were processed with RMS (10 msec) and averaged for data analysis. Onset threshold was set at 2 SD above average baseline activity. Alpha was set at $p<0.05$. An ANOVA for muscle response times found a significant main effect for gender, with females responding faster than males during both ER (69.51 vs. 74.60) and IR (68.95 vs. 74.34) perturbation. There was no interaction between gender by muscle group (G, H, Q) or by muscle side (medial vs. lateral). An ANOVA for muscle recruitment order found a significant difference in muscle firing rates for both IR and ER. For ER, Tukey's revealed no difference in LLRT of the MG (55.8), LG (57.7), and MH (60.0) which responded first. After a significant delay, the LH (70.4) fired, followed by a second delay before activation of the MQ (93.0) and LQ (95.3). Activation order was similar for internal rotation [MG (53.2) = LG (56.1) = MH (58.4) < LH (76.9) < MQ (91.0) = LQ (94.3)] There was no difference in muscle recruitment order between males and females. These findings suggest that myoelectric timing and activation patterns do not differ between males and females. Further research should assess gender differences in intrinsic muscle characteristics that may influence rate of force production independent of myoelectric timing.

This study was funded by a grant from the NATA Research and Education Foundation.

Non-Operative Anterior Cruciate Ligament Rehabilitation For Individuals Participating In High Level Physical Activity

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Non-operative anterior cruciate ligament rehabilitation programs have not been successful in returning physically active individuals to pre-injury physical activity levels. Two reasons for poor success of these programs are: 1) inadequate criteria for selecting appropriate patients for non-operative management, and 2) lack of emphasis in rehabilitation programs on neuromuscular control of dynamic knee stability. The purpose of this project was to improve the success of non-operative anterior cruciate ligament management of physically active individuals by addressing the issues of patient selection and emphasis on neuromuscular control of dynamic knee stability in rehabilitation.

Two studies were conducted in an effort to meet the project objectives. The first study was done to develop and test a clinical screening examination that could distinguish patients who were good candidates for non-operative management, from those who were not, after anterior cruciate ligament rupture. The results of this study indicated that the incidence of episodes of giving way at the knee, the score on a self report knee function survey, a self report rating of global knee function, and the score on a single leg, timed hop test could distinguish patients who were good candidates for non-operative management, from those who were not, after anterior cruciate ligament rupture.

The second study was a randomized clinical trial to test the effectiveness of a treatment program designed to improve neuromuscular control of dynamic knee stability (perturbation training) in returning highly active individuals to pre-injury levels of function, after anterior cruciate ligament rupture. Only subjects who meet the criteria for participation in non-operative management, based on the screening examination developed in the first study, participated in the randomized clinical trial. The results of the randomized clinical trial indicated that subjects receiving the perturbed training were almost five times more likely to succeed in returning to pre-injury activity levels than those who did not receive the perturbed training.

Incorporating the screening examination and perturbed training procedures in non-operative anterior cruciate ligament rehabilitation programs significantly improved treatment success compared to previously reported non-operative treatment outcomes in physically active individuals with anterior cruciate ruptures. New treatment guidelines were established for non-operative management of anterior cruciate ligament ruptures in physically active individuals, based on the results of this project.

This study was supported by a grant from the NATA Research and Education Foundation.

The Effectiveness Of An Interactive Multimedia Program On Upper Extremity Injury Evaluation As A Supplement To Traditional Methods Of Instruction

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It has been shown that the use of multimedia instruction as a supplement to traditional methods of instruction is an effective means of educating students. Little research, however, had been conducted in the area of athletic training education. The purpose of this study was to examine the effectiveness of a multimedia instructional program on upper extremity injury evaluation as a supplement to traditional methods of instruction. The dependent measures included: (1) cognitive knowledge as measured by a written examination ($R = .82$); (2) practical skill assessment as measured by an oral-practical examination ($R = .23 - .89$); and (3) student attitudes toward instruction as measured by the Allen Attitude Toward Computer Assisted Instruction Survey ($R = .58 - .90$). A fall semester injury evaluation class ($n=22$) received traditional methods of instruction including slide and overhead presentations that reviewed pertinent anatomy, injury mechanisms, and injury evaluation techniques. In addition, hands-on demonstration of injury evaluation techniques were presented and laboratory experiences were provided for individual practice and one-on-one instruction. Students also had access to textbook references, a laboratory manual, and anatomical models. The spring semester injury evaluation class ($n=9$) received the same traditional methods of instruction outlined above with the addition of a multimedia instructional program on upper extremity special test techniques that was utilized as a reference source. Data were compared for the fall and spring semesters. The lecture/computer group significantly outscored the traditional instruction group on the written examination (mean = 25.67 and 19.64, respectively; $p = .002$). The lecture/computer group significantly outscored the traditional instruction group on the oral-practical examination (mean = 138.56 and 123.77, respectively; $p = .001$). Student attitudes toward computer assisted instruction were measured for both groups pre- and post-instruction on three subscales: creativity, comfort, and function; and overall. A 2 x 2 repeated measures ANOVA was used to determine changes in attitudes between the two groups. A significant interaction ($p = .03$) was reported for the function sub-scale. Student attitudes on function in the combined instruction group became more favorable post instruction, while student attitudes on

function in the traditional instruction group were less favorable post instruction. The results of this study indicate that the use of this particular multimedia computer program as a supplement to traditional instruction was more effective than traditional instruction alone. These results should be interpreted with caution, however, due to the unequal enrollment sizes in the fall versus spring semester classes.

This study was supported by a grant from the NATA Research and Education Foundation.

Free Communications, Oral Presentations: Ankle

Wednesday, June 16, 2:30 PM - 4:00 PM, Room 2218; Moderator: Dan Foster, PhD, ATC

Responsiveness In Self-Reported And Objective Measures Following Rehabilitation Of Acute Ankle Injuries Among Athletes

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The changing healthcare environment offers many challenges to health care practitioners which requires them to be accountable for their actions. We believe that classification schemes may help athletic trainers and physical therapists respond to these challenges. Classification schemes should include both self-reported and objective assessments which distinguish injury severity and accurately assess change. Therefore, the purposes of our study are as follows: 1) to determine the effects sizes for self-reported and objective evaluative measures during a course of rehabilitation and 2) to determine the association of self-reported and objective evaluative measures to the time to return to function. Eleven Division II college athletes with an acute ankle injury were assessed within 24 hours of the injury and upon full return to competition in an athletic training environment. Athletes were assessed by a self-reported global function questionnaire (GF), Health Status Questionnaire - Physical Function Scale (HSQ-SF36PF), visual analog pain scale (PAIN), active range of motion (AROM), dorsiflexion (DF) and plantar flexion (PF) muscle performance, and ambulatory status (AMB). Effect size (ES) and standardized response means (SRM) were used to analyze the data. Pearson correlation and Spearman's Rho were also used to determine the relationships between the evaluative measures and the time to return to function (DAYS). ES and SRMs revealed large changes in GF (2.07, 2.00), HSQ-SF36PF (2.78, 2.08), PAIN (2.76, 3.40), AROM (1.10, 1.44) and PF (.887, .652). Changes in DF (.79, .871) were moderate. A significant correlation existed between DAYS and GF (-.610), $p < .05$. These data reveal that improvement occurred in self-reported and objective data during a course of rehabilitation following acute ankle injuries in college athletes. The large effect sizes and the significant correlation between GF and DAYS supports the importance of self-reported measures to injury evaluation and classification.

Comparative Evaluation Of Ankle Prophylaxes On Joint Range Of Motion Before And After Exercise: A Meta-Analysis

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Objective: The purpose of this investigation was to evaluate the effects of different prophylactic ankle supports on ankle / foot range of motion before and after activity using meta-analysis procedures. **Data Sources:** A total of 253 cases from 19 studies were examined and included in this analysis. Studies published between 1966-1997 were obtained from MEDLINE and Sports Discus databases using the key words: ankle bracing, ankle taping, ankle brace and range of motion, and prophylactic ankle support. Additional studies were gathered from cross-referencing other published studies. **Study Selection:** All studies used met these criteria: 1) healthy subjects were used, 2) means and standard deviations for all data were reported, 3) studies were published in English, and 4) non-treatment control conditions were included. The investigators evaluated all studies. **Data Extraction:** The appropriate data from each study was coded in a summary sheet and used for subsequent analysis. The treatment variables of interest were ankle support with four levels (control, tape, lace-up and semi-rigid), and time with two levels (before exercise and after exercise). The dependent measures evaluated included: inversion range of motion (IROM), eversion range of motion (EROM), dorsiflexion range of motion (DROM), and plantar flexion range of motion (PROM). Standardized effect sizes were computed and analyzed using a mixed-model factorial ANOVA. **Data Synthesis:** For IROM, the semi-rigid condition demonstrated greater restriction compared to the tape ($P < .05$) and lace-up conditions ($P < .05$) before and after exercise. No differences were found between the tape and lace-up conditions ($P < .05$). Both the tape and lace-up conditions provided less restriction after exercise ($P < .05$), while the semi-rigid support was still able to maintain restriction after exercise ($P > .05$) compared to pre-exercise. For EROM, the semi-rigid support provided greater restraint compared to the tape and lace-up conditions ($P < .05$). The lace-up condition displayed greater support compared to tape alone ($P < .05$). When collapsed across all support conditions, EROM increased after exercise ($P < .05$). For DROM, greatest overall support was provided by the tape condition compared to the lace-up condition ($P < .05$). For PROM, a significant time effect existed where post

exercise range of motion values were greater than pre-exercise ($P < .05$). **Conclusions:** The semi-rigid support condition restricted frontal plane motion most effectively; whereas tape offered the most support for limiting DROM. The results of this study are critical in helping clinicians physicians make rationale decisions concerning ankle appliances whether preventing acute or chronic re-injury.

The Influence Of Foot Position, Knee Joint Angle, And Gender On Knee Muscle Joint Complex Stiffness

DeMont RG, Riemann BL, Ryu KH, Lephart SM: Neuromuscular Research Laboratory, University of Pittsburgh, Pittsburgh, PA

Passive movement within a joint is influenced through resistance from muscles crossing the joint and the compliance of other soft tissue joint structures, such as capsule and synovium. Stiffness within this complex of structures is termed the muscle joint complex stiffness (MJCS). With recent interest in the neurological component of injury, the stiffness in joints and muscles is being explored as a factor in the incidence of injury and is monitored during the rehabilitation process. The purpose of this investigation was to determine the effects of gender and joint position on the contribution of the gastrocnemius to knee JCS. **Methods:** The dominant leg of twenty subjects (10 male: 179.8±4.4 cm, 83.9±14.4 kg, 21.4±2.5; 10 female, 164.5±7.3 cm, 61.8±9.4, 19.4±1.5, yrs) free of pathological impairment were used in this study. EMG surface electrodes were placed on each subject, to measure muscle activity and ensure relaxation. The knee was aligned with the axis of an isokinetic dynamometer, and the foot was attached to the end of the lever arm and placed in one of two conditions (dorsiflexed 15° or neutral). The dynamometer range was set for 30° of knee motion and for passive movement at 5°. Passive torque, velocity, and position data were integrated with the EMG activity and stored on a computer. The stiffness of the joint complex was represented by the slope of the curve (torque x joint position) at 20°, 10° and 0° of knee flexion. A repeated measures ANOVA (*a priori* α = .05) was used to detect differences between the groups.

Results: A significant position x gender (F = 5.016, p = .012) interaction effect was found. Main effects were found for condition (F = 9.156, p = .007), position (F = 31.83, p = .000), and gender (F = 9.093, p = .007). Post hoc analysis revealed that the males had stiffer values at the knee extended range.

Conclusion: Positioning the ankle in further dorsiflexion increases resistance to the knee moving into extension. The interaction of gender with position and the gender main effect may provide insight into the gender difference of injury incidence. The influence of the MJCS on the gain of the muscle spindle in regulation of muscle tension could imply that the results of this study have implications on the role of stiffness in prevention and incidence of injury. However, heightened muscle spindle activity may reflexively influence the MJCS explaining differences in stiffness values attained.

The Effects Of Gender And Joint Angle On The Contribution Of The Gastrocnemius In Ankle Muscle-Joint-Complex Stiffness

Riemann BL, DeMont RG, Ryu KH, Lephart SM: Neuromuscular Research Laboratory, University of Pittsburgh, Pittsburgh, PA

Muscle-joint-complex stiffness (MJCS), the degree to which a joint resists angular motion, is a function of both the mechanical properties of the structures spanning a joint and muscle activation levels. While increased MJCS may be a desirable characteristic with respect to increasing joint stability, it may also increase the risk or exacerbate the signs and symptoms associated with antagonistic muscle syndromes. The purpose of this investigation was to determine the effects of gender and joint angle on the contribution of the gastrocnemius to ankle MJCS. Ankle MJCS was determined in twenty-five physically active subjects (12 males and 13 females, age = 21±2.8 yrs, height = 172.4±9.6 cm, weight = 71.6±16.3 kg) by measuring the resistance to passive movement (5°/s) into dorsiflexion. Three trials under two different conditions (knee straight and knee bent), designed to include or eliminate the contribution of the gastrocnemius, were completed. Separate fourth order polynomial equations for each trial were derived from the data collected in the angular ranges of 20° plantar flexion (PF) to 10° dorsiflexion (DF). Stiffness values were calculated at 10° PF, neutral, and 10° DF by using the slope of the line at each of the respective positions. The average stiffness values across the three trials of each condition were averaged and analyzed using a 3 factor (1 between, 2 within) repeated measures ANOVA. Results of the analyses revealed significant (p < .05) condition by position and gender by position interactions, as well as significant main effects for gender, position, and condition. Post hoc analyses of the condition by position interaction revealed significantly higher stiffness values under the knee straight condition compared to the knee bent condition at both ankle neutral and 10° DF. Within each condition stiffness values at each position were revealed to be significantly higher as the ankle moved into DF (10° PF < neutral < 10° DF). Post hoc of the gender by position interaction revealed significantly higher stiffness values at 10° DF in the males. These results demonstrate the gastrocnemius significantly increases ankle MJCS beginning at neutral ankle angle position. This finding provides a scientific basis for clinicians incorporating gastrocnemius stretching regimens into rehabilitative programs. The etiology and application of the significant gender by position interaction requires further investigation. Further research is also warranted investigating the effectiveness of various interventions in decreasing MJCS, as well as the influence of MJCS on ankle joint stability.

Intratester Reliability, Intertester Reliability, And Learning Effects Of The Star Excursion Balance Tests

Hertel J, Miller SJ, Denegar CR, Buckley WE: Pennsylvania State University, University Park, PA

The purpose of this study was to estimate the intratester and intertester reliability and learning effects of the star excursion balance tests. The star excursion tests assess dynamic balance in a single leg stance as subjects must maintain balance on their stance leg and slowly reach as far as possible with their contralateral foot along one of 8 lines extending from a common axis at 45° intervals on a 360° grid. Measurements are recorded in maximum distance reached from the axis of the star with a tape measure. Sixteen subjects (8 males, 8 females, age = 21.3 ± 1.3 yrs, height = 171.2 ± 6.7 cm, mass = 70.3 ± 10.0 kg) were assessed by each of two examiners on two separate days. On day 1, subjects performed 3 trials of the 8 balance tests on the right and left legs for each examiner. The stance leg and examiner order were assigned in a counterbalanced manner. On day 2, subjects repeated the protocol but in the opposite order of stance leg and examiner from day 1. Intratester and intertester reliability were assessed using intraclass correlation coefficients (ICC (2,1) and standard errors of measure (SEM). On day 1, intratester reliability measures were: examiner 1, right leg stance (ICCs = .84 to .96, SEMs = 1.84 to 3.18 cm); examiner 1, left leg stance (ICCs = .78 to .95, SEMs = 1.60 to 3.38 cm); examiner 2, right leg stance (ICCs = .89 to .93, SEMs = 1.88 to 2.92 cm); and examiner 2, left leg stance (ICCs = .83 to .94, SEMs = 2.06 to 2.25 cm). On day 2, intratester reliability measures were: examiner 1, right leg stance (ICCs = .90 to .95, SEMs = 1.78 to 3.22 cm); examiner 1, left leg stance (ICCs = .85 to .96, SEMs = 1.70 to 3.03 cm); examiner 2, right leg stance (ICCs = .82 to .96, SEMs = 1.93 to 3.28 cm); and examiner 2, left leg stance (ICCs = .87 to .96, SEMs = 1.93 to 2.76 cm). Intertester reliability measures were: day 1, right leg stance (ICCs = .35 to .84, SEMs = 3.52 to 4.96 cm); day 1, left leg stance (ICCs = .53 to .80, SEMs = 3.08 to 4.46 cm); day 2, right leg stance (ICCs = .81 to .93, SEMs = 2.27 to 3.76 cm); and day 2, left leg stance (ICCs = .86 to .93, SEMs = 2.33 to 2.96 cm). Subjects' measurements improved significantly from Day 1 to Day 2 on three of the 8 right leg stance tests and two of the 8 left leg stance tests (p < .05). Interestingly, these same 5 tests demonstrated significant learning effects on Day 1 (p < .05). No significant learning effects were found within Day 2 trials among any of the 8 tests on either leg (p > .05). The star excursion balance tests as measured manually appear to be a reliable measure of unilateral stance dynamic balance.

Effect Of Upper Limb Dominance On Performance Of The Star Excursion Balance Tests

Miller SJ, Hertel J, Buckley WE, Denegar CR: Pennsylvania State University, University Park, PA

Upper extremity dominance typically requires the contralateral lower limb to be the dominant stance and power leg in functional athletic activities such as throwing and jumping. The purpose of this study was to assess the effects of upper limb dominance on performance on dynamic unilateral stance balance tasks. The star excursion balance tests require subjects to maintain balance on their stance leg and slowly reach as far as possible with their contralateral foot along one of 8 lines extending from a common axis at 45° intervals on a 360° grid. Sixteen subjects (8 males, 8 females, age = 21.3 +/- 1.3 yrs, height = 171.2 +/- 6.7 cm, mass = 70.3 +/- 10.0 kg) were assessed by two examiners. Fourteen subjects were right hand dominant and two were left hand dominant as determined by questionnaire. Maximum distance reached along a line from the grid axis was recorded via tape measure. The subjects performed 3 trials of the 8 excursion balance tests on the right and left legs for each examiner. Data for the left hand dominant subjects was transposed to standardize lower limb relationships with upper extremity dominance. Paired t-tests were performed comparing the means of the 6 right leg trials to the means of the 6 left leg trials in each of the 8 directions. Two excursion tests requiring stance on the leg contralateral to the dominant upper extremity showed significantly greater excursion distances than the same tests for the ipsilateral leg. Differences were found in the anteromedial ($t = 4.45$, $df = 15$, $p < .0005$) and medial ($t = 2.96$, $df = 15$, $p = .01$) movements of the excursion leg in reference to the stance foot. Means for the anteromedial excursions were 79.71 +/- 7.96 cm for the stance leg contralateral to the dominant upper extremity limb and 75.68 +/- 8.57 cm for the ipsilateral leg. Means for the medial excursions were 89.74 +/- 9.29 cm for the contralateral stance leg and 85.89 +/- 8.89 cm for the ipsilateral leg. Two excursion tests requiring stance on the leg ipsilateral to the dominant upper extremity demonstrated significantly greater excursion distances than the same tests for the contralateral leg. Differences were found in the anterolateral ($t = 5.57$, $df = 15$, $p < .0005$) and lateral ($t = 2.31$, $df = 15$, $p = .036$) movements of the excursion leg in reference to the stance foot. Means for the anterolateral excursions were 73.99 +/- 7.67 cm for the stance leg ipsilateral to the dominant upper extremity limb and 69.82 +/- 7.76 cm for the contralateral leg. Means

for the lateral excursions were 80.78 +/- 7.38 cm for the ipsilateral stance leg and 77.79 +/- 6.36 cm for the contralateral leg. There may be associations between upper extremity dominance, lower extremity balance and neuromuscular control, and lower extremity injury patterns.

A Comparison Of Knee Extension Force Production With Dynamic Y-balance Tests
Karras
Karras, W.C., Gombard, S., Hill, S. University of North Carolina, Chapel Hill, NC
The purpose of this study was to compare the relationship between knee extension force production and dynamic Y-balance test performance. Twenty-four male and female subjects (mean age = 24.1 +/- 1.1 yrs, mean height = 178.1 +/- 6.1 cm, mean mass = 74.1 +/- 10.1 kg) were assessed by two examiners. Maximum knee extension force was measured using a force plate and a dynamometer. The subjects performed three trials of the Y-balance test on the right and left legs for each examiner. Data for the left hand dominant subjects was transposed to standardize lower limb relationships with upper extremity dominance. Paired t-tests were performed comparing the means of the 6 right leg trials to the means of the 6 left leg trials in each of the 8 directions. Two excursion tests requiring stance on the leg contralateral to the dominant upper extremity showed significantly greater excursion distances than the same tests for the ipsilateral leg. Differences were found in the anteromedial ($t = 4.45$, $df = 15$, $p < .0005$) and medial ($t = 2.96$, $df = 15$, $p = .01$) movements of the excursion leg in reference to the stance foot. Means for the anteromedial excursions were 79.71 +/- 7.96 cm for the stance leg contralateral to the dominant upper extremity limb and 75.68 +/- 8.57 cm for the ipsilateral leg. Means for the medial excursions were 89.74 +/- 9.29 cm for the contralateral stance leg and 85.89 +/- 8.89 cm for the ipsilateral leg. Two excursion tests requiring stance on the leg ipsilateral to the dominant upper extremity demonstrated significantly greater excursion distances than the same tests for the contralateral leg. Differences were found in the anterolateral ($t = 5.57$, $df = 15$, $p < .0005$) and lateral ($t = 2.31$, $df = 15$, $p = .036$) movements of the excursion leg in reference to the stance foot. Means for the anterolateral excursions were 73.99 +/- 7.67 cm for the stance leg ipsilateral to the dominant upper extremity limb and 69.82 +/- 7.76 cm for the contralateral leg. Means

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Free Communications, Oral Presentations: Modalities

Thursday, June 17, 1:00 PM - 2:00 PM, Room 2218; Moderator: David Draper, EdD, ATC

Effects Of Dependent Positioning And Cold Water Immersions On Non-Traumatized Ankle Volumes

Dolan MG, Mendel FM, Teprovich JM, Marvar PJ, Bibi KW: Canisius College Department of Sports Medicine and Exercise Sciences, Buffalo, NY, and The University of Buffalo, Department of Anatomy, Buffalo, NY

Edema induced by dependent positioning (DP) may serve as a model for testing putative therapies. The purpose of this study was to examine effects of varying temperatures of cold water immersion (CWI) on edema caused by DP on non-traumatized human ankles. Ten males and 10 females, age = 21.6 ± 1.7 yr. participated in the study. Each subject reported for 5 experiments, one each on 5 separate days. Prior to each experiment, each subject rested supine for 10 minutes before limb volumes were measured in a customized tank in which volumes were determined by weighing the water displaced (1ml = 1g). Reliability and validity of the volume measurement system were established prior to the experiment by repeatedly measuring the weight of water displaced by a volume-standardized Plexiglas cylinder. The procedure provided very high validity (measurement error = -0.7-0.1%) and reliability ($r=0.92-0.96$, coefficient of variation=0.5%) factors. Each subject was exposed to the 5 treatments in randomized order for 20 minutes after the first limb measurement of each experiment. Conditions were 1) Dependent position (DP), 2) DP and immersion in 36.1°C water, 3) DP and immersion in 1.7°C water, 4) DP and immersion in 7.3°C, and 5) DP and immersion in 12.9°C water. Immediately following each condition a second ankle measurement was taken. Paired t-tests were used to examine differences between pre and post treatment differences ($P<0.05$). DP and DP and 36.1°C water caused significant increases in ankle volumes over 20 minutes. CWI at 1.7, 7.3 and 12.9°C prohibited increases in ankle volumes caused by DP. We conclude that DP causes measurable increases in limb volumes and that exposing limbs to DP and 36.1°C water exacerbate that increase. CWI at 1.7°C, 7.3°C and 12.9°C prohibits such increases in limb volumes of non-traumatized ankles, and might similarly reduce volumes of traumatized ankles. Results from this and previous trials on rats suggest that CWI at 7.3°C and 12.9°C are at least as effective as CWI at 1.7°C in managing edema formation, and may reduce risk of cold injury and increase compliance.

Effects Of Hot, Cold, And Contrast Therapy Whirlpools On Non-Traumatized Ankle Volumes

Bibi KW, Dolan MG, Harrington K: Canisius College, Department of Sports Medicine and Exercise Sciences, Buffalo, NY

Use of hot, cold, and contrast therapy whirlpools is a common clinical practice in athletic training. In particular, contrast therapy is purported as an effective clinical treatment in the management of edema formation following ankle sprains. The purpose of this study was to examine the effect of these therapies on non-traumatized ankle volumes. Sixteen males and 14 females, age = 21.3 ± 1.8 yr. participated in the study. Each subject reported for 3 experiments, one each on 3 separate days. Prior to each experiment, each subject rested supine for 10 minutes before limb volumes were measured in a customized tank in which volumes were determined by weighing the water displaced (1ml = 1g). Repeated measurement of a Plexiglas cylinder using this system have produced high validity (measurement error = -0.7-0.1%) and reliability (coefficients of $r=0.92-0.96$, coefficient of variation=0.5%) factors. Each subject was exposed to the 3 treatments in randomized order for 20 minutes after the first limb measurement of each experiment. Conditions were 1) hot whirlpool in 40°C water, 2) cold whirlpool in 13°C water, and 3) contrast whirlpools. The contrast treatment consisted of a whirlpool in 40°C water for 3 minutes, followed by 1 minutes in a cold whirlpool at 13°C, this cycle was repeated 4 times for a treatment time of 20 minutes. A post treatment volumetric measurement was taken immediately after each 20 minute treatment. Subjects then were placed in a supine position for 20 minutes and then measured for a third time. The significance of the changes produced by the treatment was evaluated using two-factor mixed analysis of covariance, with the three pre-treatment ankle volumes as the covariates. A p value of ≤ 0.05 was used for all analyses. The analysis yielded a highly significant treatment effect, with no treatment by gender interaction. In the intragroup contrasts, using the Bonferroni procedure, immediate post-treatment and 20-minute post treatment values were significantly larger than baseline values in the warm and contrast groups only. Whereas the cold group was the only group that showed no change in ankle volumes after treatment. Clinicians using hot and contrast therapy whirlpools for pain management and/or edema management should be cognizant of the increases in ankle volumes that occur from these treatments.

A Comparison Of Knee Extension Force Production With Biphasic Versus Russian Current

Holcomb WR, Golestani S, Hill S: University of North Florida, Jacksonville, FL

Neuromuscular electrical stimulation (NMES) may be used to prevent atrophy and strength loss associated with immobilization. Two commonly used NMES currents are biphasic and a specialized current called "Russian". Russian current uses a high carrier frequency that encounters less impedance from superficial tissue, thus a greater current magnitude reaches underlying muscle. The purpose of this investigation was to compare the effect of biphasic and Russian current on force production during different contraction conditions. Ten healthy subjects (age=24.0 yr) received NMES, with test order randomly assigned, on separate days using a within subjects design. A Forte™ 400 Combo (Chattanooga Group, Inc, Hixson, TN) provided the electrical stimulating currents. Two channels were used simultaneously with current delivered via two pairs of surface electrodes. The right anterior thigh of each subject was shaven and cleaned. Four, 3" round carbon rubber electrodes were prepared with transmission gel. Electrodes from one channel were affixed over the femoral triangle and vastus medialis oblique motor point. Electrodes from the second channel were affixed over the rectus femoris and vastus lateralis motor points. Electrical stimulation intensity was either sensory level (minimum intensity subjects could feel), or motor level (maximum comfortable intensity), and frequency was 90 pps. After a standard warm-up, subjects were positioned on the Biodex™ Isokinetic Dynamometer with the knee in 105° of flexion. Isometric knee extension force was recorded with the Biodex™ under four conditions: 1) maximum voluntary contraction (control), 2) maximum voluntary contraction superimposed with sensory level stimulation (sham), 3) maximum voluntary contraction superimposed with motor level stimulation, and 4) motor level stimulation with subject passive. Data were analyzed with a 2 (Current Type) x 4 (Condition) ANOVA with repeated measures. The main effect for Current Type was not significant [$F(1,9) = 0.16$, $p=0.70$]. This result suggests no difference between current type under any condition. The main effect for Condition was significant [$F(3,27) = 45.5$, $p=0.0001$]. Tukey post-hoc analysis showed that the force produced during condition 4 was significantly less than the other conditions. The mean forces produced during biphasic current were 110.5 ± 13.5 , 111.7 ± 14.3 , 106.6 ± 14.4 and 22.6 ± 5.0 ft-lb, and during Russian current were 110.9 ± 11.4 , 106.7 ± 10.6 , 102.3 ± 11.6 , 26.2 ± 4.6 ft-lb under conditions 1, 2, 3 and 4, respectively. The results of this investigation suggest that there is no difference in the effectiveness of biphasic and Russian current when used to elicit forceful muscular contractions.

Klucinec B, Scheidler M, Denegar C, Domholdt E, Burgess S: University of Indianapolis, Krannert School of Physical Therapy, Indianapolis, IN

Free Communications, Oral Presentations: Injury Risk

Thursday, June 17, 2:30 PM - 4:15 PM, Room 2218; Moderator: Michael Ferrara, PhD, ATC

Relative Risk Of Injury Associated With Participation In Intramural Sports At The United States Military Academy

Cameron KL, Koesterer AL, Yunker CA, Bishop PA: United States Military Academy, West Point, NY

The purpose of this project was to study the relative risk of injury associated with participation in 9 intramural sports at the United States Military Academy (USMA). Over the 1994-95, 1995-96, and 1996-97 academic years, all injuries attributed to participation in 9 different intramural sports at USMA were tracked and entered into a customized injury tracking database (Microsoft Access 97). Although all injuries were entered into the database, only injuries that resulted in 7 or more days of restricted or altered participation were considered significant and appropriate for further analysis. All injuries were assessed or diagnosed by members of the medical staff at the United States Military Academy. Injury data was collected and entered into the computer via the cadet medical excusal USMA FORM 2-515 which every cadet that is placed on limited duty receives. The subjects for this study were the men and women cadets attending USMA during the 1994-95, 1995-96, and 1996-97 academic years. Injury rate data, per thousand exposures to injury, were calculated by dividing the total number of significant injuries by the total number of exposures to injury. Since participation in intramural athletics is mandatory at USMA and accountability is recorded daily, the total number of cadet exposures per athletic season could be calculated. Descriptive analysis of injuries by body part and sport were also computed. Finally, the percentage of cadets participating in each sport that sustained a significant injury is also presented. Over the three year reporting period 10,551 cadets participated in 9 different intramural sports. Of those participants, 9.71% sustained a significant injury. Overall there were 1,024 injuries sustained by participants who were exposed to injury 144,688 times. Contact sports such as rugby, football and soccer posed the greatest risk to significant injury. Injury rates for rugby, football, and soccer were 14.74, 9.96, and 7.71 per 1000 exposures to injury, respectively. Sports such as orienteering, cross country, and racquetball appear to pose the least risk to injury with 1.66, 1.25, and .24 injuries per 1000 exposures. Injury rates for rugby were approximately 50% greater than football and over 1000% greater than basketball. Injury rates were higher in soccer than in boxing and wrestling, an outcome that was not anticipated. Similarly it was not expected that the injury rate for soccer would be as similar to that of football. Further analysis is indicated to determine the actual cost to benefit ratio of medical care to sports participation, especially in sports such as rugby, football, and soccer.

Injuries To Athletes With Disabilities: 1990-1996

Ferrara MS, Snouse S, Peterson CL, Courson R: University of Georgia, Athens, GA, and United States Olympic Training Center, Lake Placid, NY

This study investigated the number and type of injuries that occurred to athletes with disabilities from 1990-1996. The subjects were U.S. athletes who participated in the 1990 World Games and Championships (WC), 1991 U.S. Paralympic Trials (PT), 1992 Paralympic Games (PGI), the 1994 World Athletics Championship (AC) and the 1996 Paralympic Games (PGII). A reportable injury was defined as an injury/illness that was evaluated by the U.S. Medical Staff during these competitions. A total of 1,037 injuries were reported for these five competitions. The WC had 52 (5.0%) reported injuries, the PT had 170 (16.4%), PGI had 387 (37.3%) injuries, AC had 22 (2.1%) and the PGII had 406 (39.2%) of the injuries reported. Of the 1,037 injuries, 67.9% were from acute episodes and 20.6% were chronic or reoccurring conditions. Injuries to athletes who use wheelchairs accounted for 27.7% and athletes with cerebral palsy had 24.3% of the reported injuries. Illnesses (29.8%) were the most commonly reported problem followed by muscular strains (22.1%). The most commonly injured body locations were the thorax/spine at 13.3%, the shoulder complex at 12.8%, the lower leg/ankle and toes at 12.0%. The majority of these injuries were musculoskeletal to include strains at 22.1%, sprains at 5.8% and abrasions at 5.1%. The results of this study were similar to those reported by the British and Canadian Paralympic experiences. They reported illnesses as the most commonly reported condition during major international events. Also, these injury trends are similar to those reported for athletes without disabilities.

The Presence Of Superficial Sensory Radial Nerve Damage In Division I Collegiate Football Players

Woodall WR, Wright B, Newlon H, Weber MD: Department of Physical Therapy, School of Health Related Professions, University of Mississippi Medical Center, Jackson, MS

PURPOSE: The purpose of this investigation was to determine the presence of superficial sensory radial nerve (SSRN) damage in offensive linemen of one Division I college football team, as compared to other players on the same team who were not offensive linemen, and a group of non-football playing college students.

SUBJECTS: Both arms of forty-four subjects were evaluated for a total of eighty-eight arms used in the study. The subjects were comprised of fourteen Division I college linemen, sixteen Division I college football players who were not offensive linemen, and fourteen male college students who had never played college football at any level. The fourteen college linemen constituted all of the offensive linemen for this particular team. The sixteen non-offensive linemen were volunteers from the same team, while the sixteen non-football players were volunteers from another college.

METHODS: All subjects had both arms evaluated for the presence of SSRN damage. This was done by checking for the presence of Tinel's sign at lateral-distal aspect of the forearm and by evaluating the subject's sense of light touch through performance of the Semmes Weirstein Monofilament test at three sites at the dorsal web space of the hand. Other conditions that could possibly mimic SSRN damage were evaluated, and if present, that subject was removed from the study. An arm was considered to have SSRN damage if there was a positive Tinel's sign and at least one of the three monofilament scores was abnormal.

ANALYSIS: The three groups (offensive lineman arms (N=28), non-offensive lineman football player arms (N=32), and control arms (N=28)) were compared using a 3x2 Chi Square test. Alpha levels of 0.05 were used to test for significance.

RESULTS: The Chi Square test revealed a significant association between the occurrence of SSRN damage and playing on the offensive line in college football.

CONCLUSION: An arm that is put through techniques employed by Division I collegiate linemen at this particular institution is more likely to develop SSRN damage than arms of non-offensive lineman or controls.

The Use Of Percentage Body Weight Loss As A Predictor For Heat Related Illness In Intercollegiate Football Players

Vardiman JP, Ransone JW, Jacobson BH:
Oklahoma State University, Stillwater, OK

The objective of this investigation was to determine the specific percentage of body weight loss that would cause heat related illness (HRI) in intercollegiate athletes. The study analyzed total body weight on 89 male intercollegiate football players (17-25 y/o) during a 6 week period of preseason practice and conditioning over a two year period approved by the University Institutional Review Board. The total body weight for each individual was determined prior to and after each practice session. A total of 39 episodes of HRI occurred between the HRI group (234.8 ± 39.86) and non-HRI group (228.5 ± 39.86) during the evaluation period. When a subject displayed any sign of heat related illness he was weighed prior to the administration of any fluids. If medical circumstances did not permit immediate weighing, a total body weight loss was taken immediately after and all fluid weight was subtracted to attain the athletes HRI weight loss. The total body weight loss for the HRI group was 3.58% and the total body weight loss for the non-HRI was 1.82% throughout the period of evaluation. A gain score analysis (total difference between the means) of total body weight loss in pounds yielded a difference of 4.05. A Gain score analysis of percentage body weight loss yielded a difference of 1.76%. This experimental design found significant differences ($p < 0.05$) between the total body weight loss in the HRI and non-HRI groups. Prior investigations have shown that a 3% loss in total body weight significantly decreases muscle strength and endurance. The results of this study suggests that a mean body weight loss of 3.58% or greater is a predictor for potential heat related illness.

The Occurrence Of Compartment Syndrome In Division I Athletics

Gentile G: California University of Pennsylvania, California, PA

The purpose of this study was to determine the occurrence of compartment syndrome in men's and women's athletics at NCAA Division I institutions during the 1995-1996 athletic year. The 200 randomly selected head athletic trainers from the 306 Division I institutions, were asked to complete the Compartment Syndrome Questionnaire. The data was analyzed using the Chi-square for goodness of fit method to determine a preference in both hypotheses. Hypothesis 1 stated compartment syndrome will have a significantly greater occurrence in contact sports than in non-contact sports. Contact sports include: baseball, basketball, field hockey, football, ice hockey, lacrosse, rugby, and soccer, while non-contact sports include: cross-country, diving, fencing, golf, gymnastics, skiing, swimming, tennis, track, and volleyball. Hypothesis 2 stated that there will be no significant difference in the occurrence of compartment syndrome between male and female athletes. Results demonstrate statistically significant differences between the occurrence of compartment syndrome in contact and non-contact sports and in male and female athletes. Additional findings report significant differences in the occurrence of compartment syndrome in the anterior compartment and in chronic compartment syndrome. Conclusions indicate that significantly more cases of compartment syndrome occurred in athletes participating in contact sports. Women's soccer accounted for 52% of the reported cases and football represented 45% of the cases in males. Track provided a higher incidence of compartment syndrome for the non-contact sports in both male and female athletes. Of the 109 cases reported, 65% were sustained by female athletes. In addition, the anterior compartment developed 74% of the reported cases and chronic compartment syndrome was developed in 75% of the reported cases. Compartment syndrome was diagnosed in 64% of the cases using one of the following pressure tests: The Slit-Catheter Technique, The Needle Manometer Techniques of Whitesides, and The Stryker Intra-Compartmental Pressure Test. In 57% of the cases of compartment syndrome, the physician chose to treat this injury conservatively. Following treatment, 97% of the athletes returned to competition. In conclusion, this study concluded that compartment syndrome

occurs more often in contact sports, as well as in female athletes. In addition, additional studies may be needed to investigate the occurrence of compartment syndrome between male and female athletes.

Biomechanical Efficacy of Chest Protectors Against Baseball Impacts

Burkhouse DR, Jayaraman G, Grimm TR, Whipple RL, Hegg T, Lehtola JA: Michigan Technological University, Houghton, MI

The purpose of this study is to evaluate the biomechanical efficacy of chest protectors in reducing the risk of chest injury due to baseball impacts in children. The criteria used to predict the efficacy of the chest protectors is the probability of severe chest injury due to blunt frontal impacts. This probability is determined by the time history of the chest compression and compression rate which is termed the viscous compression response. In the first phase, the biomechanical response of the chest in terms of maximum viscous compression is determined experimentally. This is accomplished with and without chest protectors using a fifth percentile female hybrid III crash dummy which approximates a 10 year old boy. It is shown from the experimental results that the probability of severe chest injury without protection is 25 % for an impacting ball speed of 56 mph, and 99+% for an impacting ball speed of 67 mph. The probability of severe injury with a chest protector is determined as 5 % at ball speeds of 56 mph, and 70% at ball speeds of 67 mph. These probabilities indicate the inadequacy of chest protectors to effectively reduce severe chest injury for ball speeds greater than 67 mph. The second phase was to develop a finite element model of the fifth percentile female Hybrid III chest model to evaluate the effectiveness of chest protectors. This would serve as a useful and meaningful tool in predicting the injury risk to the chest due to baseball impacts under varying conditions, and provide critical parameters for optimum design of the chest protector. Based on the criterion that a viscous compression response above 39.37 in/s implies a high risk of injury, the analysis of the finite element model predicts the viscous compression response as; 6 in/s for a ball speed of 27 mph, 40 in/s for a ball speed of 60 mph, 80 in/s for a ball speed of 90 mph. The study concludes that the protection of the chest protector is found to be inadequate for ball speeds above 60 mph as documented by the experimental results from Phase I, as well as the finite element modeling in Phase II. The finite element model will be employed in the future to advance an optimum design for baseball chest protectors. This research was sponsored by NOCSAE (National Operating Equipment for Safe Athletic Equipment).

Comparison Of Functional Training, Weight Training, And Traditional Physical Education Activities Among High School Students

Blair DF, Noble AD, Noble AC, Behler AS: Wenatchee High School, Wenatchee, WA

Functional training is comprised of a series of exercises that incorporate functional movements, i.e., multi-muscle group and multi-directional movements. The purpose of this research project was to observe the effects functional training has upon power, speed, and agility. Then, compare the effects of functional training with a traditional weight training program and a physical education curriculum. High school freshman (mean age=14.9) physical education students (n=41) were randomly divided into three groups. Twelve students (six males and six females) constituted group A and participated as the functional training group. Fifteen students (nine males and six females) comprised group B and participated in the weight training program. Group C was composed of fourteen students (seven males and seven females) who participated in the freshman physical education class. Groups A and B worked out three days a week, 30-45 minutes for eight weeks. Group A's workout consisted of various multi-planar functional exercises, utilizing medicine balls, dumbbells, and physio-balls. Group B trained used a traditional weight training plan of three sets of ten repetitions using free weight exercises. On the days they were not working in their respective groups, the subjects participated together in the physical education activities. Group C's physical education class consisted of various activities including: soccer, basketball, and baseball. The students were assessed prior to and after the eight week period using the following tests: 40 yard sprint, 20 yard shuttle run, and three kilogram overhead medicine ball throw. Timing of the 40-yard sprint and shuttle run was measured electronically.

Improvement During Eight Week Program

	40 yd. Dash	20 yd. Shuttle	3 kg. Overhead Throw
Group A : Functional Training	2.02%	3.91%	9.08%
Group B: Weight Training	2.25%	1.82%	.67%
Group C: Physical Education Activities	2.40%	1.67%	4.97%

Using an one-way ANOVA ($p < .05$), the results showed no significant differences between the groups in both the 40 yard dash and 20 yard shuttle run. There was a significant improvement in the functional training group A (9.08%) as compared to the weight training group B (.67%) the 3 kg. overhead medicine ball throw. The groups included a mix of athletic and non-athletic freshmen physical education students. Some students may have lacked the motivation to put forth a reasonable effort during the work-

outs and testing. A longer period of study, the use of an athletic population, and the assessment of other factors such a balance and proprioception would further enhance the study of functional exercise.

Notes:

Free Communications, Oral Presentations: Funded Research II

Friday, June 18, 9:45 AM -11:00 AM, Room 2218; Moderator: Michael Sitler, EdD, ATC

Pulsed Short-Wave Diathermy Treatments Heat A Considerably Larger Muscle Area Than 1 Mhz Ultrasound Treatments

Draper DO, Garrett C, Knight KL, Durrant E:
Brigham Young University, Provo, UT

Overview: Ultrasound effectively heats an area twice the size of the soundhead (a relatively small area). For years, it has been assumed that diathermy can heat a much larger area than ultrasound, and thus cause muscle to retain heat significantly longer. We wanted to be able to either support or dismiss this claim, via research. **Objective:** To determine which deep heating modality (pulsed short-wave diathermy or 1MHz ultrasound) causes the highest temperature increase, and retains heat longer over a large muscle mass. **Design and Setting:** Three 26 gauge thermistor microprobes were inserted into the medial aspect of the anesthetized gastroc-soleus complex, at a depth of 3 cm and spaced 5 cm apart so as to measure temperature in the middle and either edge of the diathermy drum. The diathermy unit we used was the Megapulse® (Accelerated Care Plus-LLC., Topeka, KS) with a frequency of 27.12 MHz. This device heats via an induction coil drum electrode that is 200 cm², with a 2 cm space plate. The ultrasound unit we used was the Omnisound 3000C™ (Accelerated Care Plus-LLC., Topeka, KS) with a 5 cm² transducer and an effective radiating area of 4 cm². Eight subjects received the diathermy treatment first followed by ultrasound treatment. This sequence was reversed for the other 8 subjects. The ultrasound was delivered at 1.5 watts/cm² in the continuous mode for 20 minutes. The diathermy was applied at a frequency of 27.12 MHz, at the following parameters: 800 bursts per second; 400 usec burst duration; 850 usec interburst interval; peak mean root square of 150 Watts per burst; average root mean square of 48 Watts. Data were collected in a ventilated research laboratory. **Subjects:** Eleven males and five females with a mean age of 23.56 ± years. **Measurements:** Baseline, peak and decay temperatures were recorded for each of the 3 probes. **Results:** The average temperature increases over baseline after PSWD were 3.02°C ± 1.02°C, 4.58°C ± 0.87°C, and 3.28°C ± 1.64°C, with probe 1 the most proximal, probe 2 in the middle, and probe 3 the most distal in the calf. The average temperature increase over baseline temperature after ultrasound was only 0.17°C ± 0.40°C, 0.09°C ± 0.56°C and -0.43°C ± 0.41°C. The temperature dropped 1°C in 8.8 minutes following PSWD. We conclude that PSWD is more effective than 1 MHz ultrasound in heating up large muscle mass, and in causing the muscles to retain heat.

This study was supported by a grant from the NATA Research and Education Foundation.

The Effects Of Electromagnetic Fields On Chemically-Induced Tendinitis In Rats

Sandrey MA, Fox MT, Balcavage WX,
Swez JA: Athletic Training Department,
Indiana State University, Terre Haute, IN,
and Indiana University School of Medicine,
Terre Haute Center, Terre Haute, IN, and
Department of Physics, Indiana State
University, Terre Haute, IN

Objective: The healing process of tendinitis is extremely slow due to the lack of oxygen and a tissue structure that shows damage from previous incomplete healing on the cellular level. Various modalities have been used to accelerate the healing process. One such device is the use of electromagnetic fields (EMFs). Which have been used empirically for a number of years to facilitate bone healing. Only recently has pulsed EMF (PEMF) therapy been considered for use in the treatment of tendinitis. The purpose of this research is to examine the effects of two different PEMFs on the healing rate of chemically-induced tendinitis. **Design and Setting:** This is a 3 x 4 factorial design. The independent variables will be time (14, 21, and 28 days) and treatment (60 Hz sinusoidal field, control sham field, commercial EBI field and a geo field). The dependent variable is the ratio of collagen typing (I or III). **Subjects:** Male and female Harlan Sprague-Dawley rats, n = 72, between the ages of 4 to 6 months were assigned to one of 4 experimental groups (a PEMF consisting of 1 G, 60 Hz; a control sham field, a commercial EBI field consisting of 18G bursts every 66.5msec, and a 0.4 Gauss static EMF (geofield control for the EBI field) after subcutaneous injections containing 150 IU/kg of collagenase along the achilles tendon in the ipsilateral paw and volume matched vehicle in the contralateral paw. **Measurements:** Four groups of rats were exposed to either the 60 Hz EMF, a sham control field, the EBI field, or the geofield as described above. Animals in each of the four groups were treated by EMF exposure for four hours at the same time each day during a variable 14, 21 or 28-day treatment period. Groups were block randomized. Six rats from each of the four groups were sacrificed at 14, 21, or 28 days and the achilles tendon harvested. Freshly harvested tendons were cut into 2mm squares, extracted in phosphate-buffered saline and analyzed using a quantitative enzyme immuno assay technique for Type I vs. Type III collagen content. **Results:** Using affinity-purified antibody for rat collagens, we were able to detect a difference in the Type I : Type III ratio in EBI-treated samples at day 14. By 21 days, the difference in the Type I : Type III

collagen ratio was more evident again in the EBI field. At 28 days the difference in the Type I : Type III collagen ratio was similar in the EBI field. This difference in the ratio was not evident with the other three treatment groups (Geo, 60 Hz sinusoidal and sham sinusoidal fields). **Conclusions:** A PEMF such as the proprietary EBI field used in this study may be a viable alternative therapy for the treatment of tendinitis as PEMFs promote the turnover of Type III to Type I collagen.

This funded research was supported by the National Athletic Trainers' Association Research and Education Foundation.

Effect Of Phonophoresis On The Absorption Of Dexamethasone In The Presence Of An Occlusive Dressing

Foreman SA, Gieck JH, Perrin DH, Ball D, Mistry D, McCue FC, Weltman A: University of Virginia, Charlottesville, VA

This study compared the effects of ultrasound to sham ultrasound on the absorption of topically applied dexamethasone. Two grams of 0.33% dexamethasone were applied to a 10 square cm area on the anterior aspect of the forearms of 10 healthy subjects (age = 29.2 ± 8.8 yrs, ht = 170.0 ± 3.9 cm, wt = 67.5 ± 18.4 kg). In order to maximize the phonophoretic effect, the medication was applied directly to the skin and covered with a Tegaderm® occlusive dressing for 30 min prior to the ultrasound or sham ultrasound treatments. Ultrasound treatments were delivered at an intensity of 1.0 W/cm^2 (50% pulsed) and a frequency of 3Mhz to produce a mild thermal effect which may be desirable when treating inflammatory conditions. The treatment was applied over the medication and occlusive dressing. All subjects received both treatments and the order in which subjects received the treatments was counter-balanced. Blood serum samples were drawn prior to the treatment, immediately after the treatment and at intervals of 2, 4, 6, 8, and 10 h post treatment. The serum was analyzed by High Performance Liquid Chromatography (HPLC) to determine dexamethasone concentrations. A two way repeated measures analysis of variance (condition and time) found a significant main effect for treatment [$F(1,9) = 5.277, p = .047$]. The rate of appearance as well as the total concentration of dexamethasone in the blood serum was greater in subjects following phonophoresis as compared to sham ultrasound. Furthermore, the sham ultrasound group had only trace amounts of dexamethasone in the serum, indicating that there was negligible drug absorption without the ultrasound energy. These findings suggest that a phonophoretic effect occurred with dexamethasone when applied in a manner to saturate the skin.

This research was funded by a grant from the National Athletic Trainers' Association Research and Education Foundation.

The Efficacy Of Therapeutic Continuous Ultrasound In The Diagnosis Of Tibial Stress Fractures

Romani WA, Perrin DH, Dussault RG, Kahler DM, Ball DW, Saliba EN, Gieck JG: University of Virginia, Charlottesville, VA

This study assessed the efficacy of therapeutic continuous ultrasound in diagnosing tibial stress fractures. Twenty-six subjects, (males $n=12$, age = 20.33 ± 1.37 yrs., ht. = 184.35 ± 9.53 cm, wt. = 96.84 ± 21.19 kg; females $n=14$, age = 20.78 ± 3.8 yrs., ht. = 170.17 ± 5.35 cm, wt. = 61.52 ± 5.58 kg) who complained of unilateral anterior or medial tibial pain that increased with activity and was present for less than two weeks were evaluated bilaterally with a protocol of continuous ultrasound and magnetic resonance imaging. Subjects participated in eight collegiate varsity and two recreational sports. Continuous ultrasound was applied to both legs at seven consecutive intensities from 0 to 2.9 w/cm^2 . Subjective responses following each ultrasound intensity were measured on a blank, 100 millimeter, visual analog scale. Visual analog scores from the involved and uninvolved legs were used to determine each subject's largest delta pain score. A one group discriminant analysis was conducted to determine if the largest delta pain score correctly predicted the subject's classification into one of three clinical classification groups. The largest delta pain scores classified subjects into the same clinical classification group as MRI in 42.31% of the cases. The largest delta pain score was determined between 1.5 and 2.9 w/cm^2 in 24 of 26 cases. These findings question the efficacy of using this protocol of continuous ultrasound to identify the presence of tibial stress fractures in an athletic population.

This research was funded by a grant from the National Athletic Trainers' Association Research and Education Foundation.

Effects Of Therapeutic Ultrasound On T Cell Proliferation And IL-2 Production

Johns LD, Colloton PA, Neuenfeldt J: University of Wisconsin-Parkside, Kenosha, WI

The purpose of this study was to determine whether therapeutic ultrasound altered the proliferation of ConA stimulated spleenocytes and the production of the T cell growth factor interleukin-2 (IL-2). In the normal course of inflammation, cells of the immune system migrate to the site of tissue injury and take an active role in the removal of injured tissue and remodeling. It has been shown that immune cell activity and the normal course of injury repair is tightly linked to the production and local concentration of lymphokines. Lymphokines are proteins which are produced by cells of the immune system in response to environmental stimuli and aid in determining the course of inflammation and tissue repair. Specifically, the production of the protein IL-2 is tightly linked to the proliferation of T cells and the overall activity of the immune system. Our data show, for the first time, that spleenocytes treated with 1.0 W/cm^2 3 Mhz ultrasound and stimulated with ConA results in a significant increase in IL-2 production and T cell proliferation. This data demonstrates that therapeutic levels of ultrasound enhance the immune response which may aid in the resolution of chronic inflammation and/or the healing response. Moreover, these data suggest that therapeutic levels of ultrasound may effect molecular mechanisms within the cell. Understanding ultrasound non-thermal molecular mechanism(s) could permit clinicians to redefine indications for ultrasound, by specifically and non-invasively manipulating the function(s) of the immune system. Ultrasound may find new applications in injury repair and/or autoimmune diseases.

This research was funded by a grant from the National Athletic Trainers' Association Research and Education Foundation.

Free Communications, Oral Presentations: General

Friday, June 18, 2:15 PM - 3:15 PM, Room 2218; Moderator: Mark Merrick, PhD, ATC

Influence Of A Pre-Exercise Glycerol Hydration Beverage On Performance And Physiological Function During Mountain Bike Races In The Heat

Casa DJ, Wingo JE, Knight JC, Dellis WO, Berger EM, McClung JM: Berry College, Mount Berry, GA

The purpose of this study was to assess if pre-exercise (PRE) hydration utilizing a commercially available glycerol drink would differentially affect physiological and performance responses during a mountain bike race in the heat when compared to PRE hydration without glycerol. Following PRE hydration (plain water or water/glycerol) equal to 2.8% of body weight, 12 heat-acclimated experienced male mountain bikers (age - 24.5 ± 1.1 years, % body fat - $14.3 \pm 1.0\%$, weight - 76.9 ± 1.9 kg, height - 179 ± 2 cm) completed a 30 mile mountain bike race in the heat (WBGT = 82°) on 3 separate (1 week apart) occasions. Testing (random, cross-over, double-blind design) included: 1) Water/No Water (NW), water PRE, no water during race, 2) Glycerol/Water (GW), glycerol (ProHydrator™) diluted (according to manufacturers guidelines) in water PRE, water via two water bottles during race, 3) Water/Water (WW), water PRE, water via two water bottles during race. The riders stopped for 8 min following each 10 miles to collect data, no rehydration occurred in this time. Prior to each 10 mile loop water supplies were full. Performance time was not ($p > .05$) different between NW (158.03 ± 5.41 min), WW (159.67 ± 6.22 min) and GW (155.04 ± 4.42 min). Total fluid consumed during exercise was not different ($p > .05$) between WW (2218 ± 200 ml) and GW (2403 ± 196 ml), but GW ($2.21 \pm .28\%$) was less ($p < .05$) dehydrated than NW ($5.02 \pm .19\%$) and WW ($2.99 \pm .35\%$) post-exercise (POE). PRE urine volume was less ($p < .05$) in GW (902 ± 108) compared to NW (1089 ± 98) and WW (1139 ± 101). Loop 1 ($p = .052$) and total urine volume ($p = .08$) tended also to be less in GW as compared to WW. POE thirst was less ($p < .05$) in GW than NW and WW. Thermal sensation was less ($p < .05$) following loop 1 in GW as compared to NW and WW. Scores on an Environmental Symptoms Questionnaire (ESQ) were less ($p < .05$) POE for GW as compared to WNW and WW. No significant ($p > .05$) differences were found for lactate, glucose, rectal temp., sweat rate, RPE, and heart rate between WW and GW. The data indicates an enhanced hydration status during a strenuous bout of exercise in the heat when glycerol was ingested PRE. Interestingly,

GW performed better (> 5 min, $p > .05$) during loop 3 as compared to NW and WW while performance times were within 1 min for loops 1 and 2. Lower ESQ scores, thermal strain, and % dehydration may indicate a decreased risk of heat illnesses in GW. Also, based on the NW trial performance, an ample PRE hydration plan (even without glycerol) may limit the detrimental effects of dehydration.

Supported by a Berry College Faculty Development Grant.

Effects Of The "Leg Harness" And Slide Board Exercise On VO₂ MAX And Lactate Concentration

Kimura IF, Nakasone KT, Hetzler RK: University of Hawai'i, Honolulu, HI

The goal of this project was to test the hypothesis that slide board exercise with the leg harness will increase maximal oxygen uptake (VO₂) and lactate concentrations (LAC) and decrease total time to exhaustion (TTE) of healthy untrained male and female subjects. The slide board was originally designed for dryland training of speed skaters. Currently, it is a widely used functional closed kinetic chain rehabilitation modality. The Leg Harness is a variable resistance exercise device designed to increase mechanical work, (via elastic tubing) consequently increasing energy cost during aerobic exercise and decreasing time dedication to exercise. Subjects were 8 males and 8 females 18 to 33 years of age. The experimental protocol included 1-2 practice session(s) and 2 data collection sessions. Data collection sessions were separated by 7 to 14 days and administered in a counter-balanced order with leg harness (EXP) or without leg harness (CON) conditions. The tests were continuous graded maximal protocols which consisted of two minute stages graded via increasing the slide cadence from 46 to 90 slides per minute. Respired air was collected to determine VO₂ and blood samples obtained from a free flowing digit puncture were used to determine LAC. Three, 2 x 2 analyses of variances (ANOVA) with repeated measures ($p < .05$) were used to examine the effects of two independent variables (gender) on three dependent variables (TTE, VO₂, LAC). Results revealed significant decreases in VO₂ (EXP = 37.7 ± 6.2 , CON = 39.3 ± 6.2 ml/kg/min), and LAC (EXP = 9.1 ± 2.4 , CON = 10.1 ± 2.5 mM) when subjects wore the Leg Harness during slide board exercise, regardless of gender. Results also revealed greater LAC in male subjects (11.5 mM) than in female subjects (7.8 mM) regardless of condition. No significant differences in TTE were revealed in either gender, in either condition (EXP = 10.5 ± 3.4 , CON = 11.4 ± 3.3 min). These results indicate that use of the Leg Harness did not significantly affect the time required to exercise to exhaustion and thus would not decrease exercise time requirement. The decrease in VO₂ and LAC indicates that the work performed when using the leg harness did not effectively challenge the aerobic system of subjects and may have negatively affected subjects' ability to exercise efficiently.

**Assessment Of The Endoscopic
Semitendinosis/Gracilis Autograft
Procedure With Interference Screw
Fixation For Reconstruction Of The
Anterior Cruciate Ligament**

Allen A, Sitler M, Marchetto P, Kelly J,
Mattacola C: Temple University, Philadel-
phia, PA

The purpose of this study was to evaluate the clinical and functional efficacy of the semitendinosis/gracilis autograft (SGA) procedure with interference screw fixation for reconstruction of the anterior cruciate ligament (ACL) deficient knee. Thirty unilateral SGA reconstructed patients (mean age 25.7 ± 8.2 years, mean height 67.5 ± 2.9 in., and mean weight 156.9 ± 33.4 lb.) served as subjects: 12 (40%) females and 18 (60%) males. Average time to post-surgery follow-up was 15.03 (± 2.3) months. Subjects were stratified as acute (Group A) ($n = 20$) (≤ 90 days between time of injury and surgery) or chronic (Group C) ($n = 10$) (≥ 91 days between time of injury and surgery). All subjects underwent a retrospective evaluation consisting of the Standard Knee Evaluation Form (SKEF), Lysholm Knee Rating Scale (LKRS), KT-2000 knee arthrometer (15, 20, and 30 lb; active quadriceps; and manual maximum), and functional [(one-legged hop for maximum distance and time (over distance of 6m)] tests. A functional symmetry index was calculated for each test: involved limb criterion measurement divided by the uninvolved limb criterion measurement, multiplied by 100. Twenty-two (73%) of the subjects had a SKEF score of normal or nearly normal post-surgery. Twenty-four (84%) subjects returned to strenuous or moderate activity levels post-surgery. Similar SKEF and return to activity outcomes existed between Group A and C. Average outcome score for the LKRS was $89 (\pm 4.9)$. No significant difference ($p = .52$) existed in LKRS outcome between Group A (88.65 ± 3.88) and Group C (89.90 ± 6.69). KT-2000 bilateral differences were less than 3 mm for all tests completed: differences between Group A and C were not statistically significant ($p \geq .61$). The functional symmetry index for the one-legged hop test for distance was 92.6% and for time was 98%. No significant difference ($p > .14$) existed for either functional symmetry indexes between Group A and C. Based on the findings of this study, the results demonstrate that the endoscopic SGA with interference screw fixation is a viable procedure for reconstruction of the ACL deficient knee. Furthermore, the procedure can be performed either acutely or chronically, resulting in similar clinical and functional outcomes.

**Effect Of Visual Feedback And Verbal
Encouragement On Concentric Quadri-
ceps And Hamstrings Peak Torque Of
Males And Females**

Campenella BJ, Mattacola CG, Kimura IF,
Cleary MA: Temple University, Philadel-
phia, PA

The purpose of this study was to determine the effect of visual feedback and verbal encouragement on concentric peak torque of the quadriceps and hamstrings muscles of males and females at an isokinetic velocity of 60 deg/s. All testing was performed on the Biodex B-2000 isokinetic dynamometer in three separate sessions, separated by 7 to 14 days. The first session was provided to familiarize the subjects with the isokinetic dynamometer. The second and third sessions were used for data collection. Fifteen males and 15 females (age = 25.4 ± 2.4 yrs, wt = 76.6 ± 16.5 kg, ht = 173.61 ± 9.5 cm) were tested under the following conditions: (a) visual feedback, (b) verbal encouragement, (c) combined visual feedback and verbal encouragement, and (d) no feedback (control). Testing order was counter-balanced to control for possible learning effects. Two separate 2×4 repeated measure analyses of variance (ANOVA) were used to examine the difference among test conditions. Tukey HSD post-hoc tests were performed to determine where significant differences occurred. Males produced greater quadriceps (males = 167.7 ± 6.7 ft/lb, females = 107.12 ± 6.7 ft/lb) and hamstrings peak torque (males = 100.5 ± 2.7 ft/lb, females = 60.2 ± 2.7 ft/lb) than females. Examination of quadriceps force production following treatment revealed that subjects generated greater peak torque when visual feedback (140.86 ft/lb) was provided versus verbal encouragement (131.31 ft/lb) and the control condition (131.44 ft/lb). Similarly, quadriceps force production was significantly greater when combined visual feedback and verbal encouragement (138.10 ft/lb) was compared to the verbal encouragement (131.31 ft/lb) and the control condition (131.44 ft/lb). Examination of hamstrings force production revealed that subjects generated greater peak torque when combined visual feedback and verbal encouragement (83.20 ft/lb) was provided versus verbal encouragement (78.68 ft/lb), and the control condition (78.05 ft/lb). Similarly, visual feedback was significantly more effective than the control condition (78.50 ft/lb). These results indicate that the use of visual and combined visual and verbal feedback significantly increased quadriceps and hamstring force production when compared to a control condition.

Free Communications, Oral Presentations: Spine

Friday, June 18, 3:45 PM - 4:45 PM, Room 2218; Moderator: Carl Mattacola, PhD, ATC

The Effects Of Aquatic Exercise On Low Back Pain

Arient J: University of Illinois at Chicago, Chicago, IL

Low back pain affects the physical, psychological, and social functioning of individuals. Treatment has been largely based on land exercises, which are somewhat successful, however, an increase in axial load on the spine due to the exercises might further increase the pain. Aquatic exercise has been shown, through buoyancy, to limit this axial load, thus possibly providing an environment for less chance of increased pain on the back. It was the purpose of this study to ascertain if aquatic exercise in a group setting will improve the physical, psychological, and social functioning of individuals with chronic low back pain. Seventeen males and thirteen females participated, aged from 19 to 55 years. All participants had low back pain for at least three months, caused by a low back strain, herniated lumbar disc, or sciatica as diagnosed by a physician. They had no prior orthopedic conditions and had not engaged in any previous exercise program. All participants were pre-tested and post-tested to measure their functioning. The first test, measuring endurance, recorded the distance walked in five minutes in chest deep water. The second test, measuring flexibility, was measurement of the trunk motions with a tape measure. The third test, measuring balance, consisted of the subjects walking a straight tape line on land for sixty feet, counting any time the subject stepped off the line or stumbled. Psychological and social testing were performed with pain scale measurements and the West-Haven Multidimensional Pain Inventory (Kerns, Turk, and Rudy). The experimental group consisted of fifteen randomly placed subjects that performed a set protocol of aquatic exercise three times a week for five weeks, while the control group of 15 randomly placed subjects did not perform any type of exercise. Data analysis was performed using two way analysis of variance with repeated measures. Results included statistically significant increases in trunk and lower extremity endurance (57.3%), balance (70%), flexion (36%), extension (13%), lateral flexion (13%), decreased pain measurements (16%), less interference in life due to pain (14%), less worried support from their spouse due to the pain (10%), and increased social activities (14%). It was concluded that aquatic exercise in a group setting is beneficial to individuals with chronic low back pain to improve the physical, psychological, and social aspects of their functioning.

Cervical Spine Alignment In The Immobilized Ice Hockey Player – Radiographic Analysis Before And After Helmet Removal

Stephenson A, Horodyski MB, Meister K, Kaminski TW: University of Florida, Gainesville, FL

Appropriate immobilization of an athlete with a suspected cervical spine injury (CSI) is of critical importance. Ice hockey equipment may complicate and impede treatment efforts of emergency medical personnel of a player with a potential CSI. The purpose of this study was to radiographically assess the relative position of the cervical spine in healthy ice hockey players immobilized to an oversized backboard with and without equipment. Thirteen male ice hockey players (age range 18-27 years) with no prior CSI were positioned and immobilized to an oversized backboard. Lateral cervical spine radiographs were obtained on each subject for three different conditions: control, no hockey equipment (C), shoulder pads only (S), and helmet and shoulder pads (H/S). All radiographs were read and measured by a board certified orthopaedic surgeon using the Cobb technique. Three cervical spine measurements evaluating sagittal cervical alignment were made for each radiograph using three angles: occiput to C2 (O-C2), C2 to C7 (C2-C7), and occiput to C7 (O-C7). The ANOVAs revealed significant differences between the protocols for the measurements of O-C7 ($p = 0.007$) and C2-C7 ($p = 0.013$). The Fisher's LSD tests revealed significant differences between the conditions of S and H/S in both the O-C7 and C2-C7 measurements angles. No significant differences existed however, when these same two conditions were compared to the measurements of the control group. Similar to results previously reported by other researchers in the evaluation of cervical alignment with football and ice hockey equipment, the effect of ice hockey helmet removal in this study significantly alters cervical alignment when the shoulder pads are left in place. Therefore, based on the results of this study, in cases of extreme emergency, under most circumstances, if stabilization of the cervical spine can be maintained, then the helmet should not be removed.

The Effects Of Core Stabilization Training On Functional Performance In Swimming

Scibek JS, Guskiewicz KM, Prentice WE, Mays S, Davis JM: University of North Carolina at Chapel Hill, Chapel Hill, NC

The purpose of this study was to assess the effects of core stabilization training on functional performance tasks and on swimming as it relates to time. It was hypothesized that core stabilization training would improve functional performance and swimming time trials. Thirty-five male and female Division I collegiate swimmers ages 18-24 volunteered to participate in the study. Subjects were stratified by event specialty (sprint vs. distance) and were randomly assigned to either the control group or training group. Each subject performed the pretest involving: 2 swimming time trials (100 yards), 3 vertical jump tests, 3 forward and 3 backward medicine ball throws from a supine position, and a core stability test from a supine position with two unstable bases of support on the NeuroCom Smart Balance Master. The training group performed a six-week core stabilization training protocol consisting of six exercises, performed 3 times per week for six weeks, while the control group did not perform the exercises. The control and training groups were post-tested following the six week period. Repeated measures ANOVAs revealed significant group interactions ($p < .05$) for the following variables: Forward medicine ball throw (test \times group) and core stability test (test \times eyes \times group). Significant group interactions were not found for vertical jump, backwards medicine ball throw, and the 100 yard swim trials ($p > .05$). These results indicate that core stability training had a positive effect on upper trunk strength and postural control when performing the forward throw and supine stability test, but did not have an effect on swimming performance, vertical jump, or the backward throw. When considering the core stability test, the significant test \times eyes \times group interaction suggests that subjects from both groups have better core stability with their eyes open, however, subjects that underwent training demonstrated a greater decrease in sway velocity from pre-test to post-test for the eyes closed condition. Thus, core stability results indicate that eye condition (open vs closed) affects body awareness, proprioception and the body's ability to control sway velocity. It is speculated that the increases in trunk strength and postural control observed following training could lead to improvements in a functional performance such as swimming because of the need for controlling the body in a horizontal position with little or no support. Future research should investigate longer training periods to determine if this claim can be supported. However, at this time it can be concluded that a six week training protocol does not result in improvements across all variables.

Relief Of Pain During Stabilization Exercise For Mechanical Low Back Pain

Fukai M, Sandrey MA, Ingersoll CD,
Lawrence N: Athletic Training Depart-
ment, Indiana State University, Terre
Haute, IN

Objective: There is some evidence that stabilization exercise is effective for anatomical low back pain. However, there is not enough information about the effectiveness in decreasing in pain for the common cause of low back pain, mechanical low back pain. Therefore the purpose of this study was to determine if general stabilization exercise is effective in decreasing pain with mechanical low back pain patients. **Design and Setting:** A 5x2 factorial was used for this study. The independent variables were the test (pre, 1, 2, 3, and 4 weeks) and treatment. The dependent variable was pain. The exercise was performed at Indiana State University Athletic Training Clinic. **Subjects:** Thirty subjects who had low back pain for more than 2 month were used for this study. After the subjects were divided into two groups (exercise and control), the exercise group performed stabilization exercise for 3 times a week for 4 weeks. **Measurements:** The pain level was measured weekly using a 101-point numeric rating scale. **Results:** A difference was found within subjects ($F=3.730, p=.008$), but not between subjects ($F=.310, p=.583$). When comparing the pre-exercise pain and weeks in the experimental group, pain level was statistically significant after 2 weeks of stabilization exercise. In the control group, a significant difference was found only between 1st week and 2nd week, and 1st week and 3rd week. **Conclusion:** As the type of pain is different for each individual, it is important to know the individual's condition and level of treatment. To understand low back pain, other types of measurement may be needed, such as McGill Pain questionnaire, or disability questionnaire.

Free Communications, Thematic Poster Session: Current Trends in Balance/Posture

Saturday, June 19, 8:30 AM - 10:30 AM, Room 2218; Moderator: Mitchell Cordova, PhD, ATC

The Effects Of Ankle Taping And Balance Activities On Biodex Stability Measurements

Pinto KK, Kaminski TW, Horodyski MB:
University of Florida, Gainesville, FL

Prophylactic ankle taping is a common activity in traditional athletic training environments. The short-term proprioceptive benefits of ankle taping have been previously established. The question remains as to what happens to those benefits after a period of exercise or activity? The purpose of this study was to determine if measures of dynamic postural stability are affected by prophylactic ankle taping immediately after application and following a series of unilateral balance activities. Fifteen, healthy male subjects (age = 22.3 ± 2.7 yr., wt = 79.5 ± 10.3 kg, ht = 179.1 ± 6.7 cm) gave consent to participate in this study. The Biodex Stability System (BSS) (Biodex Medical Corporation, Shirley, NY) was used to measure postural stability. The overall stability index (OSI) measurement was utilized as the dependent measure in this study. The dominant leg (leg used to kick a ball) was used in all sessions as the test leg. Each subject was provided with a separate familiarization session on the BSS and given three practice trials. The platform level was set at 6. Baseline stability measurements were taken at the beginning of the test session. The dominant ankle was then taped and BSS measures redone. Subjects were then randomly assigned to the two balance exercise conditions: (1) foam base and (2) foam base + ball toss. Subjects balanced while standing unilaterally on a stationary foam base for 3'. Two exercise bouts were performed over 15' with three rest periods of 3' each interspersed between. In the foam base + ball toss exercise, subjects balanced on the foam surface while catching a tossed ball. The same sequence described above was used again during the 15' exercise bout. At the conclusion of each exercise bout subjects were tested on the BSS. Following the final BSS test, the tape was removed and post-test BSS measures taken. An ANOVA with repeated measures was conducted to see if differences existed between the five different conditions. The average time the tape was in place was 47.2 ± 1.4 '. The average OSI measurements for each condition included: baseline ($2.59 \pm 1.10^\circ$), baseline+tape ($2.27 \pm 1.04^\circ$), post foam exercise ($2.41 \pm 1.08^\circ$), post foam+toss exercise ($2.57 \pm 1.11^\circ$) and post-test ($2.38 \pm .87^\circ$). No significant differences were noted between the conditions. The results suggest prophylactic ankle taping followed by a sequence of short duration, balance exercises has little effect on the OSI as measured by the BSS. Further study using longer duration exercise activities is warranted.

Test-Retest Reliability Of The KAT-2000 For Balance Measurement

Hanssen TL, Patterson P, Wiksten D: San Diego State University, San Diego, CA

The purpose of this study was to determine the internal consistency and test-retest stability of the KAT-2000 as a balance measuring device. Eighty (40 males, 40 females) apparently healthy young adults between the ages of 18 and 25 participated in 8 trials of each of the four tests offered by the KAT-2000. These tests included right and left single leg static tests, double leg static test and double leg dynamic test. Testing was administered in a secluded office in order to limit environmental distractions and took place on 2 occasions within a 7 day period. These two testing days were separated by at least one day. A one-way repeated measures ANOVA was run to find significant differences between trials and a post hoc test, using Tukey HSD procedures, was run to identify these differences. Then an intraclass correlation was calculated using trials 2-8 to obtain a reliability coefficient. The confidence interval for these reliability coefficients were also calculated. Reliability on day 1 for men and women ranged from $R = .86$ to $R = .92$ with 95% confidence intervals ranging from $R = .75$ to $R = .96$. On day 2, reliability for men and women ranged from $R = .85$ to $R = .92$ with 95% confidence intervals ranging from $R = .73$ to $R = .96$. Test-retest reliability for men and women ranged from $R = .62$ to $R = .84$ with 95% confidence intervals ranging from $R = .40$ to $R = .91$. The KAT-2000 appears to be highly reliable for within day testing, and moderately reliable for test-retest stability when considering this particular sample of people.

Changes In Dynamic Postural Stability With The Use Of Neoprene Sleeves

Magill J, Horodyski MB, Kaminski TW, Bauer J, Meister K: University of Florida, Gainesville, FL

Many athletes wear neoprene knee sleeves as a brace believing that these devices improve athletic performance. Few documented studies exist on the efficacy of neoprene knee sleeves on knee function. The purpose of this study was to examine the effects of neoprene knee sleeves on dynamic postural stability on healthy human knees. Seventeen subjects completed an informed consent form and underwent a knee evaluation by an orthopaedic surgeon. The Biodex Stability System (Biodex Medical, Shirley, New York) was used to assess dynamic postural stability. Each subject performed two practice trials on the Biodex system prior to actual testing. On day one of testing, the subjects performed three trials with and three trials without the neoprene sleeve. This braced condition was randomized and only the last of the three trials was used for recording data. The subjects wore the neoprene sleeve for one week of physical activity and returned for day two of testing. Day two testing was performed in the same order and trial number as day one. Data was recorded for overall stability, and anterior/posterior and medial/lateral stability. T-tests for each condition and ANOVA for brace and time were performed to determine significance. The paired t-tests for overall stability yielded significant differences between day one and day two with the sleeve and between day one and day two without the sleeve. Paired t-tests for anterior/posterior stability yielded significant differences between the sleeve conditions on day one and day two, and on day two between the sleeve and no sleeve conditions. Significant main effects were noted for testing days with overall stability, and brace and testing days with anterior/posterior stability. The results of this study suggest that the subjects had improved stability primarily anterior/posterior during testing with the sleeve on day two of testing. Thus, supporting the idea that neoprene knee sleeves improve dynamic postural stability as measured by the Biodex Stability System.

Intersession Reliability Of Force Platform Measures Of Single Leg Postural Control

McCabe RE, Riemann BL, Caggiano NA, Lephart SM: Neuromuscular Research Laboratory, University of Pittsburgh, Pittsburgh, PA

A variety of measures describing postural control are available from force platform systems. Clinicians utilize these measurements with both healthy and injured patients in order to objectively assess postural stability. The primary purpose of this investigation was to determine the intersession reliability of three variables derived from force platform data. A secondary purpose was to examine the relationship between each of the variables. Single leg postural control of 15 healthy subjects ($M=8$, $F=7$, $Age=20.8 \pm 2.1$ yrs, $height=169.9 \pm 8.4$ cm, $weight=71.6 \pm 13.2$ kg) was tested during three sessions at two week intervals. Three 5 second single leg trials (dominant limb) under two different visual conditions (eyes open and eyes closed) were completed at each testing session. During each stance subjects assumed a standardized testing position and were encouraged, if it became necessary, to touch down on the force platform with the opposite leg. Force (F_x , F_y , and F_z) and center of pressure (COP_x and COP_y) variability and average sway velocity (ASV) were calculated from the data obtained by a Bertec forceplate (Bertec Inc. Worthington OH) sampled at 100 Hz. The variables calculated from the three trials performed under each visual condition within a session were averaged to form a session mean. Intraclass correlation coefficients (ICC) and standard error measurements were calculated for each variable across the three testing session means. Consistent with the secondary purpose, correlational coefficients were calculated between each of the session one variable means within each visual condition. The highest ICCs for the eyes open condition were found for the force measures ($F_y=.85$, $F_x=.84$, $F_z=.83$) and ASV (.78). For the eyes closed condition, a high ICC was only found for the ASV (.77). For the eyes open condition, significant correlations ($p<.05$) were revealed between all variables except COP_x with ASV and F_z . Significant correlations ($p<.05$) for the eyes closed condition were revealed between all variables except COP_x with ASV and F_y . The reliability results suggest utilization of force variability and ASV for assessing single leg stability with eyes open, while single leg stability with eyes closed is best assessed utilizing ASV. Results of the correlational analysis suggest that COP_x variability may reflect a different aspect of postural control in comparison with the other measures. Further research should consider the sensitivity of these measures to compensatory events other than touchdowns.

Balance And Joint Stability: The Relative Contributions Of Proprioception And Muscular Strength

Blackburn JT, Guskiewicz KM, Busby MA, Prentice WE: The University of North Carolina at Chapel Hill, Chapel Hill, NC

Acute ankle sprains often result in a variety of residual symptoms, including balance and strength deficits, as well as mechanical instability. These symptoms often manifest in functional instability evidenced by a sensation of the ankle "giving way". The purpose of this study was to determine if proprioception or strength is the dominant factor in controlling balance at the ankle joint while at the same time defining what type of rehabilitation protocol was most effective for enhancing the maintenance of balance. Thirty-two subjects age 18 to 25 (19 females, 13 males) were evenly divided into four groups: control (no training), strength training, proprioceptive training, and strength/proprioception combination training. Subjects were assessed for static, semi-dynamic, and dynamic balance abilities prior to initiation of and following completion of a six week training program. Static balance was assessed using the NeuroCom Smart Balance Master force plate system. Subjects performed a single-leg stance with the eyes closed. Semi-dynamic balance was assessed using the Biodex Stability System multi-axial platform with a single-leg stance and the eyes closed. Dynamic balance was assessed using a modified Bass Test for Dynamic Balance. Strength training involved the use of Theraband and ankle weights in the cardinal planes of motion about the ankle joint. Proprioceptive training included maintenance of balance on medium density foam padding and a BAPS board, as well as "T-band kicks" and four-square hops. Strength/proprioceptive training included a combination of these two protocols. Subjects participated in the training programs three times per week for six weeks (18 sessions). Statistical analyses were performed using the SPSS 6.1 statistical software package. A one within, one between analysis of variance (ANOVA) model was used, with a statistical significance level of $\alpha=.05$. The strength, proprioceptive, and combination training groups improved significantly ($p<.05$) in the ability to maintain semi-dynamic balance ($p=.038$) and dynamic balance ($p=.002$), but remained at pre-test levels for static balance. However, no statistically significant data were generated which would indicate that one training program was more effective than another, thus the dominance of proprioception or strength to the production of balance could not be determined. These results indicate that the maintenance of balance is equally dependent on proprioception and muscle strength.

The Effects Of Three Different Ankle Training Programs On Functional Stability And Single-Limb Stance

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Functional instability of the ankle has been found to increase the incidence of ankle injury, and identifying an effective and efficient means of ankle rehabilitation has become a priority of clinicians. The purpose of this study was to evaluate the effectiveness of three different ankle training programs on improving neuromuscular control of the ankle, thereby allowing subjects to stabilize themselves more efficiently during functional tasks. An additional purpose was to examine the effectiveness of the three ankle training programs on postural control in a single-limb stance. Twenty-seven healthy, active males and females between the ages of 18-25 with a subjective feeling of functional instability in one of their ankles participated in the study. All subjects were randomly assigned to one of three experimental ankle training groups: strength, proprioceptive, and functional activity. All three programs consisted of three weekly 15 minute training sessions over a six week period. Quantitative data for neuromuscular control, as measured by stabilization time, and stance stability, as measured by stability index, were collected on the Functional Activity System for Testing and Exercise (FASTEX) both prior to and following training. Measurements were recorded for three hopping tasks and one landing task. Repeated Measures ANOVA revealed no group interaction for any stabilization times ($p>.05$). However, significant test main effect for stabilization time was revealed in the hopping tasks ($p<.05$). Both the involved and uninvolved limbs improved following training. A significant test x limb interaction for stabilization time was revealed for the landing task ($p<.05$), indicating that although functionally unstable ankles improved with training, none of the training approaches were found to be significantly more beneficial than the others. The analysis also revealed a significant test x limb group interaction for stance stability, indicating that the proprioceptive group significantly improved on the involved limb ($p<.05$). Since functional instability has been described as a subjective problem, subjects were asked to rate the status of the ankle using a visual analogue scale prior to and following training. Mean subjective ratings significantly improved following training ($p<.05$), but no significant group interactions were found. Interestingly enough, the results indicate that strength, proprioceptive and functional activity training for functionally unstable ankles have benefits for the uninvolved limb as well as the involved limb. Further research is needed to examine a possible carryover effect. None of the groups appeared to benefit more from their specific training than the others for the dynamic hopping tasks. However, the proprioceptive training group showed greater improvement in performing static tasks. We recommend that all three approaches be considered when designing a rehabilitation program for the functionally unstable ankle.

The Relationship Between Ankle Kinesthesia And Peak Torque With Single Leg Multiaxial Platform Stability

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Objective: Proprioceptive, strength, and balance training are customary components of ankle rehabilitation programs. Theoretically, postural control on multiaxial platform surfaces requires increased ankle proprioception and strength in comparison to postural control on stable surfaces. The purpose of this investigation was to determine if significant relationships exist between ankle kinesthesia and peak torque with single leg multiaxial platform stability. Understanding these relationships would aid clinicians in determining the necessity of addressing each component in ankle rehabilitation programs.

Methods: Twenty (M=12, F=8) healthy subjects (age = 21.3 yrs \pm 2.74; height = 172.25 cm \pm 9.2; weight = 76.36 kg \pm 17.46) participated in this investigation. Assessments of dominant ankle kinesthesia, peak torque, and multiaxial stability were conducted during a single testing session. Kinesthetic testing was conducted at .5°/second using a modified continuous passive motion device (Smith and Nephew, Germantown, WI). During testing, subjects were blindfolded and wore headphones playing white noise to eliminate visual and auditory cues. Movement of the ankle into one of four directions (plantarflexion, dorsiflexion, inversion, or eversion) was randomly initiated within a ten second period of a prearranged signal. Subjects were instructed to push a handheld button upon detection of movement. The degrees of ankle displacement from motion commencement to subject perception were used for data analysis. Peak torque was assessed utilizing the Biodex II System (Biodex Medical Inc., Shirley, NY). Five repetitions at 30°/second and 10 repetitions at 120°/sec in both the inversion/eversion and plantarflexion/dorsiflexion directions were performed. Single leg multiaxial platform stability (eyes open) was assessed using the Biodex Stability System at stability level 6 (Biodex Medical Inc., Shirley, NY). Separate anterior/posterior and medial/lateral platform stability measures were obtained from a triaxial accelerometer secured to the platform. During each trial, subjects maintained a standardized testing position that included foot placement on a platform. Within each of the opposing directions, inversion/eversion (medial/lateral) and plantarflexion/dorsiflexion (anterior/posterior), Pearson correlation coefficients were calculated between the kinesthesia, peak torque, and platform stability

variables.

Results: The results failed to reveal significant correlations ($p < .05$) between any of the dependent variables.

Conclusions: The results of this investigation failed to demonstrate significant relationships between kinesthesia, peak torque, and single leg multiaxial platform stability. This finding suggests, therefore, that each component should be addressed as separate entities in order to optimize ankle rehabilitative outcomes.

Further research should consider the relationship between kinesthesia and peak torque with eyes closed multiaxial platform stability.

Knee Joint Reposition Sense With A Prophylactic Brace, A Functional Brace, And A Neoprene Sleeve

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It is believed that orthopedic bracing may work, in part, by enhancing proprioception. The purpose of this study was to determine the influence of three types of orthopaedic braces on proprioception as measured by joint position sense. Eleven male and fourteen female subjects (mean age 24.2 y, height 172.8 cm, weight 73.8 kg) with no previous injury participated in this study. The ability to reposition the knee joint was assessed using the electronic goniometer on the Biodex isokinetic testing apparatus. Each subject was tested under four conditions; (1) a control with no intervention [CTL], (2) a prophylactic knee guard [PKG], (3) a functional (ACL) brace [FTL], and (4) a closed patella neoprene sleeve [SLV]. Each subject performed all trials the same day, with the sequence of trials randomized for each subject. Once secured to the Biodex, the subject's right knee was flexed to 90° and verified by electronic goniometry. The subjects were then asked to close their eyes while the lower leg was passively extended to a predetermined point, held for 5 sec. and then returned to 90°. Subjects then were asked to actively reposition their lower leg to the point in the range of motion previously demonstrated and stop the lever arm of the Biodex with a hand held switch. The pre-determined position in the range of motion ranged between 25° and 45°, and was changed with each trial to negate any learning effect. The difference between the predetermined point in the range of motion and the subject's approximation is referred to as the error score and was used for analysis. Data were analyzed by ANOVA and are presented as means (\pm S.D.). There was no significant difference ($p > 0.05$) in error scores between the four conditions. The error scores were; 2.8° (\pm 2.0), 4.4° (\pm 3.5), 4.4° (\pm 3.9), and 4.1° (\pm 3.5) for CTL, PKG, FTL, and SLV, respectively. It was interesting to note that CTL produced the least amount of reposition error. These data indicate that knee bracing does not have a significant effect on the ability to actively reposition the knee in healthy, uninjured subjects. Additional research is indicated.

Notes:

The Effects Of Creatine Supplementation And Beta-Hydroxy-Beta-Methylbutyrate Supplementation On Delayed Onset Muscle Soreness

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This study examined the effects of oral creatine (Cr) supplementation and oral beta-hydroxy beta-methylbutyrate (HMB) supplementation on the signs and symptoms of delayed onset muscle soreness (DOMS). Twenty-eight untrained male and female subjects (age=26.71 \pm 6.63 yrs, ht=173.9 \pm 10.33 cm, wt=71.93 \pm 16.73 kg) were randomly assigned to one of four groups; Cr, HMB, placebo, or control and began a 10 day supplementation period. On the seventh day of supplementation each subject was assessed for passive elbow flexion and extension range of motion using a standard goniometer, upper extremity volume using a volumetric measuring tank, maximum voluntary isometric contraction (MVIC) on a Dynatrac isotonic dynamometer (Baltimore Therapeutic Co., Baltimore, MD), and perceived pain using a visual analogue scale. Following the initial assessment, each subject performed a bout of DOMS inducing eccentric exercise. The subjects continued with the supplementation and returned for reassessment 48 hours post-exercise and 72 hours post-exercise. Five mixed model ANOVAs with one between (group) and one within (time) factor found a significant time main effect for extension range of motion [$F(2, 48)=100.3, P<.05$], flexion range of motion [$F(2, 48)=39.71, P<.05$], upper extremity volume [$F(2, 48)=47.76, P<.05$], MVIC [$F(2, 48)=96.03, P<.05$], and pain scale rating [$F(2, 48)=33.58, P<.05$]. Tukey post hoc analysis showed that the 48 and 72 hour post-exercise measures differed significantly from the pre-exercise measure for all variables. A significant decrease in the pain scale rating was also observed when comparing the 72 hour measure to the 48 hour measure. A significant group \times time interaction [$F(6, 48)=2.57, P<.05$], was observed for flexion range of motion only, with a greater change for the Cr group from pre-exercise to 48 and 72 hours post-exercise. The results suggest that the exercise protocol was sufficient for inducing DOMS in untrained individuals. These results also suggest that supplementing a habitual diet with either Cr or HMB, using the manufacturer's recommended protocols, is not effective as a prophylactic intervention for DOMS. Results from the present study further suggest that the use of these supplements provide no benefit in the treatment of DOMS following exercise, although further investigation is necessary.

Creatine Monohydrate Supplementation Has No Effect On The Incidence Of Skeletal Muscle Cramping Induced Through Electrically Assisted Maximal Voluntary Contractions

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Objective: Creatine supplementation has gained tremendous popularity in athletics. Anecdotal reports of athletes who have supplemented with creatine suffering from increased incidence of muscle cramps has led to questions about its safety. No published studies exist investigating the effects of creatine supplementation on the incidence of skeletal muscle cramping. The purpose of this study was to investigate the effects of creatine supplementation on the incidence of muscle cramping induced through a maximal voluntary contraction coupled with electric stimulation of the gastrocnemius muscle. **Design and Setting:** A 1 X 3 factorial was used for this study. Its levels included supplementation with creatine monohydrate, a glucose powder and a control administered in a double-blind fashion. Research was performed in the Sports Injury Research Laboratory at Indiana State University. **Subjects:** Twenty-five subjects (fourteen males and eleven females), ages 18 to 29 years participated in this study. All subjects consumed a normal diet and were not supplementing with creatine at the time of the study. **Measurements:** The number of subjects experiencing a cramp following supplementation with creatine, placebo or control was measured. The cramp was induced using a maximal voluntary contraction augmented with electric muscle stimulation. **Results:** A Goodness-of-Fit Test indicated that subjects were more likely to cramp during the pretest than in the post-test ($\chi^2(2) = 11.19, p < 0.05$). **Conclusions:** Under the conditions involved in this study, creatine supplementation was not shown to cause an increase in the incidence of induced skeletal muscle cramping.

The Role Of Elk Velvet Antler Nutrient Supplementation On Strength Training Performance In Police Recruit

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Objective: The objective of this study was to investigate the potential anabolic effects of elk velvet antler (EVA) following a nine (9) week strength training program in police recruits.

Design: Double blind study supplementing police cadets with 6 EVA capsules vs placebo supplementation a day, during nine weeks of strength training.

Setting: Edmonton Police Headquarters.

Subjects: 18 male police recruits ages 21 - 34.

Interventions: The subjects were randomly assigned to two groups; strength training with placebo supplement, and strength training with supplementation with EVA. Strength training was performed for a nine week period using a combination of free weights and plate loading machines. The volume and intensity of the training program was varied between a strength training emphasis (< 8 reps/set) and an endurance emphasis (> 8 reps/set). The focus was on total body conditioning combining both upper and lower body exercises. The recruits trained two times per week, all sessions were monitored and members were encouraged to work to failure on all sets.

Main Outcome Measures: Strength was assessed via performance of three repetition maximum (3RM) lifts for bench press and squat exercises. Endurance was assessed via determining the maximum number of repetitions of the two aforementioned exercises that could be completed at 80% of the 3RM weight. Serum levels of plasma cortisol, insulin-like growth factor 1 and testosterone were measured before and after nine weeks of training.

Results: Significant differences were found in testosterone levels in the EVA supplemented group ($p < 0.01$) when compared to the placebo supplement. No significant difference between the two groups was found in improvements in muscular strength or endurance performance measures. No significant differences were found in cortisol and insulin-like growth factor 1.

Conclusions: Preliminary results have shown that EVA supplementation for a nine week period has been shown to increase plasma testosterone ($p < 0.01$) in exercising police recruits. Further studies are required to substantiate these findings.

Variables Which Influence The Frequency Of Use Of Over The Counter Medications By Athletes In Traditional And Non-Traditional Athletic Settings

McCabe KM, Shive ES, Hauth JM, Thatcher JR: East Stroudsburg University, East Stroudsburg, PA

Purpose: Research supports the use of over-the-counter medications in the sports medicine setting. The main purpose of this study was to determine the relationship between selected variables that influence the frequency of use of over-the-counter medications (OTC's) by athletes in traditional and non-traditional athletic settings. The selected variables included (1) gender, (2) outside pressure from coaches, parents or media, (3) sport classification: contact versus non-contact, (4) traditional versus non-traditional sport season and (5) situation: game versus practice.

Procedures: One hundred seventy four student athletes (94 males, 80 females) from twelve different intercollegiate athletic teams volunteered as subjects for this study. Designed by the researchers, the Likert-type survey consisted of eleven questions related to the use of OTC's in athletic settings. Student-athletes from football, men's and women's basketball, baseball, wrestling, men's and women's track and field, field hockey, women's swimming, softball, women's lacrosse and women's soccer completed this survey. The data were analyzed using Microsoft EXCEL 97. **Results:** Approximately 82% of the subjects reported using OTC's for the relief of pain and/or inflammation. Results also indicated that 42% of the athletes in this study increased the usage of OTC's on the day of games or competitions. Only 15% of the subjects reported that outside pressures influenced their decision to take OTC's. The Chi Square Test of Independence suggests that the usage of OTC's is dependent on: (1) whether the student-athlete is participating in the traditional or non-traditional season ($p < .01$); (2) whether the sport is categorized as contact or non-contact ($p < .02$); (3) whether the student-athlete is male or female when participating in the traditional season ($p < .02$); (4) whether a female student-athlete is participating in the traditional or non-traditional season ($p < .01$); (5) whether the student-athlete is playing contact sports in the traditional or non-traditional season ($p < .01$); and (6) whether a male student-athlete is participating in the traditional or non-traditional season ($p < .01$). The frequency of OTC usage during the non-traditional season was independent of gender for student-athletes in this study.

Recommendations: The data suggest that a large percentage of student-athletes take OTC's in an effort to reduce pain and control inflammation. Further study in this area should include athletes from different sports and different levels of competition. Additionally, these studies should investigate the use of OTC's between student-athletes of different educational classes. Most importantly, athletic trainers and team physicians should take steps to educate all student-athletes as to the appropriate usage of these medications.

A Comparison Of The Pharmaceutical Practices In The Treatment Of Athletic Injuries

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The purpose of this study was to identify the pharmaceutical practices of Division I head athletic trainers and to determine compliance with the Federal and State guidelines. A 34 item survey was specifically developed for this study investigating the pharmaceutical practices of athletic trainers for prescription and OTC medications. Questions were related to dispensing and administration practices, storage, labeling and record keeping of medications. The survey was mailed to 312 head athletic trainers and 188 (60%) responded to the survey. Prescription medications were provided in 59% of the athletic training rooms and 98% provided OTC medications. Seventy-nine percent of the team physicians administered prescription medications but 26% head athletic trainers and 19% assistant athletic trainers administered prescription medications. Student athletic trainers were also involved in the pharmacological distribution of medications to student athletes. Medications were usually dispensed in bottles or pre-packaged envelopes but 32% of the ATC's were packaging medications for the student athlete. Many athletic trainers dispensed and administered prescription medications to student-athletes which indicate that ATCs may not be following the Federal and State pharmaceutical guidelines. These practices could lead to compromised health care for the student-athletes and serious legal ramifications for ATCs, physicians, and their universities.

This study was funded by a grant from the Great Lakes Athletic Trainers Association.

Tinea Gladiatorum: Cream Or Pill?

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Background: Tinea gladiatorum is a ubiquitous entity in competitive wrestling. The presence of tinea infection has both competitive and infection control implications. Little has been published regarding treatment guidelines in this population where outbreaks are commonplace. This study compares the efficacy of a first line topical treatment regimen and an oral treatment regimen.

Methods: A randomized, prospective, open label pilot study was conducted during the 1997-98 interscholastic wrestling season at two high schools. Wrestlers with tinea corporis were randomized to receive either clotrimazole 1% cream applied twice daily, or fluconazole 200mg once weekly, for a total treatment duration of three weeks. Symptom scores, lesion measurements, and fungal cultures were followed to assess treatment efficacy. The symptom scores, lesion measurements, and culture results of the two groups were compared using the Mantel-Haentzel square analysis. Statistical significance was defined as a p -value < 0.05 . Because the goal of treatment in this population is a rapid return to competition while preventing transmission to other wrestlers, we analyzed time to a 50% resolution of symptoms, time to 50% reduction in lesion area, and time to eradication of the organism in each of the treatment groups.

Results: Eleven wrestlers received clotrimazole and six wrestlers finished the course of fluconazole. Age, weight, number of those with history of previous infection, and number of years experience were similar in both treatment groups. The extrapolated time to 50% improvement in symptom scores was 11.9 days in the clotrimazole group and 11.9 days in the fluconazole group ($P = 0.91$). The extrapolated time to 50% lesion reduction was 18.7 days in the clotrimazole group and 18.7 days in the fluconazole group ($P = 0.14$). The extrapolated time to 50% culture eradication was 22.7 days in the clotrimazole group and 11.1 days in the fluconazole group ($P = 0.05$).

Conclusions: Both clotrimazole and fluconazole produce similar improvement in clinical parameters which would allow return to competition in a similar time frame. Fluconazole showed arithmetically, but not statistically, superior culture eradication which may prove advantageous in preventing spread to other wrestlers. Fluconazole on a weekly dosing schedule should be considered in the first line treatment of tinea gladiatorum.

Substance Use Among Interscholastic And Recreational Adolescent Male Athletes

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The leading causes of morbidity and mortality that effect the nation can be traced to six categories of antecedent behaviors including the use of tobacco, alcohol, and other drugs. In addition, summaries of research on adolescent risk behavior have listed membership in a peer group that actively discourages substance use, and actively encourages academic, athletic, and artistic accomplishment as routes to popularity and status as a protective factor against the use and abuse of alcohol, cigarettes, and marijuana. As such, the purpose of this study was to assess the relationship between athletic participation and the use of alcohol, cigarettes and marijuana among adolescent males'. One thousand six hundred ninety males, enrolled in four public school systems across Alabama completed a 69-item self-report Adolescent Health Survey. Eighty one percent (n=1372) of the subjects were White and 14.8% (n=250) Black. Subjects ranged in age from 14 (8.4%) to 17+ (37.3%) years. Four hundred thirteen subjects (24.4%) were age 15 and the remaining 499 (29.5%) were 16 years old. Six hundred ninety (40.8%) of the subjects were 10th graders, 506 (29.9%) were in the 11th grade, and 456 (27.0%) were seniors. The subjects were classified as interscholastic or recreational athlete according to their response to variables about school and community-based sport participation. Of the interscholastic athletes 53.2% reported current alcohol use, 52.2% were binge drinkers, 51.6% had smoked marijuana in the past month, and 48.3% were classified as smokers. Similar results were seen for the recreational athletes where 53.8% were drinkers and 52.2% were binge drinkers. Current marijuana use was reported by 49.6% of the recreational athletes; 49.2% of this group reported smoking cigarettes in the past month. In this sample crosstabulation analyses revealed that participants in athletic activities had similar substance use and abuse profiles as their non-participant peers. These results have implications for Certified Athletic Trainers working with adolescent athletes as it is possible that they may be called upon to deal with an illness or injury that is related to the use or abuse of alcohol, cigarettes or marijuana. Additional research is needed to investigate the influence of coaches and parents in the substance use decisions of athletes and to identify variables which may protect these subjects from the adoption of alcohol, cigarettes, and marijuana.

Adolescent Perceptions Of Steroid Testing And Drug Use Differ By Grade

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PURPOSE: Improving our understanding of adolescent perceptions of drug use and drug testing will help efforts to deter this epidemic problem. This study assessed the opinions of teenagers on the topic of drug use and drug testing.

DESIGN AND SETTING: Subjects responded to a 21 question survey by shading in a 5 dot categorical continuum ranging from strongly disagree to strongly agree. The survey was completed during pre-participation physicals.

SUBJECTS: Junior and senior high school student athlete volunteers (n=430, 198 males, 232 females) from the same school district were study participants.

METHODS: The survey assessed drug use origin, when/where drugs are being used, related drug use reasons, who should receive mandatory drug testing, the kinds of drugs that should be tested for, how much the drug testing process was perceived as an invasion of privacy, and the need or benefit of high school drug testing. The survey was pilot tested prior to use. Data were encoded to ensure confidentiality. Chi-square tests (Chi-Sq) were performed following data collection to assess gender differences and differences by grade level in response to survey items (p<.05).

RESULTS: No overall gender differences were evident(p>.05). The subject population was further divided into four groups for comparison by grade (6th, 7th, and 8th grades formed Group 1, n=80), (9th grade formed Group 2, n=127), (10th grade formed Group 3, n=122), and (11th grade formed Group 4, n=101). Group 3 subjects agreed more strongly than the other groups that drug testing should be done to look for performance enhancing drugs like anabolic steroids (Chi-Sq=11.7, p=.019). Group 1 females agreed more strongly than males that drugs are being used during school (Chi-Sq=9.5, p=.05). Group 2 subjects agree that parents are not present when teenagers are using drugs (Chi-Sq=10.2, p=.037).

CONCLUSIONS: During 10th grade both males and females agreed that drug testing should include the detection of performance enhancing drugs such as steroids. For high schools that are currently testing, detecting steroids is too costly. According to the survey results, drug testing may be missing an important health risk by not testing for steroids. The survey also suggests that recreational drug use is occurring when parents are away, even possibly during school hours.

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Free Communications, Clinical Case Reports: Lower Extremity

Wednesday, June 16, 1:00 PM - 2:20 PM, 2:40 PM - 3:40 PM, Room 2219; Moderator: Todd Evans, MA, ATC, CSCS
Discussants: Marjorie King, MS, ATC, PT; Rick Wright, MD

Traumatic Acetabular Fracture In An Intercollegiate Football Player

Stilger V, Alt J, Hubbard D: West Virginia University, Morgantown, WV

Personal Data/Pertinent Medical History:

During a Division I football game in November, 1997 a 22-year-old inside linebacker, 187.96 cm (6'2") 106.82 kg (235lbs), sustained an injury to his right hip. While attempting to recover a fumble, the athlete's hip was flexed to 90° and internally rotated. The knee remained fully extended as the foot was firmly planted in the artificial surface. The forward momentum of the body, in effect, caused the opposite force with the upper body moving caudally resulting in the femur being pushed posteriorly. The force resulted in a subluxation of the femoral head posteriorly, with relocation, causing a fracture of the posterolateral dome and posterior wall of the right acetabulum. At the conclusion of the play, the athlete remained down on the field and was immediately examined by two certified athletic trainers (ATC). The injured athlete reported no prior history of injury to the hip.

Physical Signs and Symptoms: During the on-field examination, the athlete complained of general hip pain and denied any type of subluxing sensation. A quick assessment revealed adequate range-of-motion and no gross deformity. Since he had no obvious deformity, he walked off the field unassisted. On the sideline he began having increased complaints of general hip pain and stiffness. An antalgic gait became present during sport-specific functional testing but the athlete wanted to return to play. After the team physician determined the athlete to be nonfunctional, he was sent to the training room for treatment. After the game, the athlete was placed on crutches, non-weight bearing (NWB), and instructed to report to the training room the following morning.

Differential Diagnosis:

- 1) Anterior column fracture
- 2) T-shaped acetabular fracture
- 3) Segmental fracture of the femoral head
- 4) Femoral neck fracture
- 5) Capsular tear
- 6) Retro-peritoneal hematoma
- 7) Posterior column acetabular fracture

Results of Diagnostic Imaging: The following morning the athlete was again examined by the team physician who ordered x-rays of the pelvis and two oblique Judet views of the acetabulum. After reviewing the x-rays, the

team physician immediately ordered a CT scan secondary to the concern of transient weakness in the athlete's right ankle. The athlete was then referred to a trauma surgeon who diagnosed the injury as a posterior wall acetabular fracture with some displacement of the wall fragment. Radiography revealed the avulsed rim of the posterior acetabulum was displaced approximately 5 mm.

Clinical Course: The athlete and his mother met with the trauma surgeon four days post-injury to discuss treatment options. An evaluation under anesthesia (EUA) was recommended to determine levels of instability if a conservative treatment option was selected. The likelihood of an early onset of arthritic changes in an unstable hip, and an unlikely return to football were all concerns of conservative treatment. At the time of injury, the athlete had one year of eligibility remaining and wanted to return and compete during his final season. Conservative non-operative management would consist of 6-8 weeks of touch down weight bearing (TTWB) activity followed by a rehabilitation program. However, if the hip were unstable during EUA, surgical intervention using an open-reduction internal-fixation (ORIF) Kocher-Langenbeck procedure would be recommended. After further discussion, an EUA with a possible ORIF procedure was scheduled five days post-injury. Evaluation under anesthesia with fluoroscopic assistance revealed instability of the hip particularly with flexion and slight adduction; therefore, an ORIF Kocher-Langenbeck procedure using four screws and a plate was performed. The trauma surgeon suspected the instability was secondary to the posterior-wall fracture. The goal of the surgery was to restore the stability of the femoral head and to restore the normal anatomy of the acetabulum. During the surgery, an osteochondral fracture (1 cm x 0.5 cm) off the posterior femoral head was found and was surgically debrided. This was not detected on the x-rays or the CT scan. After surgery, the athlete was extubated and transported to the recovery room in good condition. Four days post-surgery the athlete was released from the hospital and reported to the training room for rehabilitation. An arduous rehabilitation program ensued and the athlete returned to full foot-

ball activity nine months post-injury and competed without complications during the 1998 season.

Deviation from the Expected: Most acetabular fractures occur from high-energy impact and the injury mechanism sustained by this athlete rarely occurs in athletics. Acetabular fractures are usually associated with automobile and motorcycle accidents and falls from great heights. Signs and symptoms associated with an acetabular fracture may include possible deformity, neurovascular compromise of the involved extremity, weakness, and general hip pain. However, this can be a difficult injury to assess for the Certified athletic trainer (ATC). Initial recognition, management, and treatment are essential to decrease the chance of developing posttraumatic arthritis and other long-term complications.

Acute Lateral Knee Pain In A Collegiate Soccer Player

Connolly TA, Zvijac JE, Keskula DR, Bolgla LA: HealthSouth/Doctor's Hospital Department of Sports Medicine, Coral Gables, FL

PERSONAL DATA. A 23 year old male collegiate soccer player presented with right knee pain one week following injury. The athlete stated that while tackling an opponent from behind, he wrapped his right leg around the opponent, who fell on it, producing a varus stress. He finished the game and had no immediate swelling or ecchymosis. The athlete complained of constant pain and a sense of instability with running activities. Past medical history included mild right knee patellar tendinitis.

PHYSICAL SIGNS AND SYMPTOMS. Upon examination, the athlete had pain-free active and passive range of motion (ROM) within normal limits. He had no joint effusion, ecchymosis or obvious deformity. Although the athlete had no medial or lateral joint line tenderness, palpation revealed pain over the insertion of the lateral collateral ligament (LCL). The LCL was not palpable in the figure four position. Steinman's and McMurray's tests were negative. Anterior drawer, posterior drawer and Lachman's tests were negative. Anterior drawer test performed with internal tibial rotation revealed slight posterior lateral rotary instability at both 30° and 90° of flexion. The knee was stable to valgus stress at 0° and 30° of flexion; however, varus testing revealed grade I laxity at 0° and grade II to III laxity at 30° of flexion.

DIFFERENTIAL DIAGNOSES.

1. Lateral collateral ligament sprain.
2. Posterolateral capsule tear.

RESULTS OF DIAGNOSTIC IMAGING. X-rays were normal. The results of the MRI demonstrated complete disruption of the mid-substance of the lateral collateral ligament. There was a partial tear of the distal biceps femoris tendon, close to its insertion on to the fibular head. No evidence suggested injury to the ACL, PCL, MCL or menisci.

CLINICAL COURSE. After his first visit, the athlete was placed in a double upright brace with no limits to ROM and ambulated without assistive devices. He was removed from soccer activities, placed on anti-inflammatory medication and instructed to ice for twenty minutes three times a day. One month after injury, the athlete underwent open primary repair of the LCL. Surgical procedure scheduled was arthroscopy right knee with open lateral collateral ligament repair vs. reconstruction with iliotibial band or allograft. Examination under anesthesia revealed full ROM. Grade I instability was present with varus testing at 0°, and grade II-III instability was present with varus testing at 30° of flexion. The knee was stable to all other ligamentous testing. Open primary repair of the lateral collateral ligament was performed. Post-surgically, a cast was placed on the

athlete in the operating room at 30° of flexion with valgus stress applied. One week post-operatively the athlete was placed in a ROM brace locked at 0° of extension to be worn at all times. He was instructed to continue to ambulate with crutches, weight bearing as tolerated. Three weeks following surgery, the athlete had no complaints of pain. There was no instability of the knee with gentle varus testing at 30° of flexion. The crutches and straight leg brace were discontinued, and the athlete was placed in a double upright knee brace with no restrictions to ROM. He was able to ambulate without assistive devices. The rehabilitation program included therapeutic exercises, modalities, home exercises and patient education. Nine weeks post-operatively, the athlete had pain free full ROM and no laxity to varus testing at 0° or 30° of flexion. The LCL was palpable in the figure 4 position. The rehabilitation program was continued with strengthening activities and progression to a straight ahead running program with no twisting or cutting activities. At 14 weeks following surgery, the athlete had no complaints with the knee and no difficulties with running activities. He was allowed to progress in a sports specific running program and allowed to return to play as tolerated with use of the double upright brace. At 24 weeks post-operatively, the athlete had returned to competitive soccer without complaints of pain or instability.

DEVIATION FROM THE EXPECTED. This case is unique due to the rare incidence of isolated LCL injuries. Most LCL tears occur in combination with multi-ligamentous knee injuries. The literature has reported isolated LCL injuries to people involved in motor vehicle and industrial accidents, but rarely to those participating in athletic activities. The most common mechanism of injury to the knee in sports is a valgus force. The varus forces that produce lateral knee injuries are less frequent, potentially due to the protective mechanism of the opposite leg. Close attention to patient history, mechanism of injury and clinical examination are vital for appropriate assessment and treatment. Few case studies exist as to proper treatment following this injury; however, the literature has suggested primary surgical repair as the treatment of choice in high level athletes with functional instability. Through appropriate injury recognition and treatment, this patient successfully returned to collegiate level soccer without limitations.

Acute Posterior Ankle Pain In A High School Football Player

Freed SD, Blair DF, Behler AS, Noble AD: Wenatchee High School, Wenatchee WA

PERSONAL DATA/MEDICAL HISTORY. A 16 year old white male reported to his physician with acute postero-medial pain in the right ankle. The athlete was cutting with a plantar flexed foot and felt a pop and immediate pain. The athlete was able to bear weight and continued to compete with discomfort. One month earlier he had injured his contralateral ankle with a jump from an eight-foot high rafter and had experienced pain in the same location with similar symptoms.

PHYSICAL SIGNS AND SYMPTOMS:

The athlete presented with exquisite tenderness at the posterior medial aspect of the talus and medial malleolus. He exhibited no tenderness over the lateral malleolus. He had full ROM but had pain in full plantar flexion. There was no instability as exhibited with the anterior drawer and tilt test. Manual muscle tests, particularly those in the sagittal plane, were limited by pain. A biomechanical evaluation revealed a forefoot varus.

DIFFERENTIAL DIAGNOSIS:

- 1) Achilles tendon strain
- 2) Flexor hallucis longus tendinitis/strain
- 3) Tibialis posterior tendinitis/strain
- 4) Deltoid ligament sprain
- 5) Osteochondral lesion of talus
- 6) Posterior tibio-talar impingement (bone block)

DIAGNOSTIC IMAGING/LABORATORY TEST:

X-rays revealed a complete fracture of the os trigonum.

CLINICAL COURSE:

A course of conservative management including walking boot immobilized the ankle at 90 degrees for a period of 3 weeks. Following the removal of the walking boot, he performed pool workouts progressing to running and cutting. He was also fitted with orthotics to correct his forefoot varus. The athlete was also given exercises to stretch and strengthen exercises with emphasis on the posterior ankle/calf musculature. Ironically, he had completed a similar rehabilitation protocol on the contralateral ankle for a non-sport related os trigonum fracture approximately one month earlier.

DEVIATION FROM THE EXPECTED:

It would be easy to suspect would suspect a medial ankle sprain or strain of postero-medial tendons with this type of injury. The os trigonum is located on the posterior aspect of the talus, lateral to the flexor hallucis longus. Thirty-nine percent of the population has an os trigonum process (an elongated bone on the posterior aspect of the talus), approximately 6.6 percent of the population have a distinct os trigonum. It is important for the evaluator to consider these unique deviations in his/her assessment to avoid overlooking a condition such as an os trigonum fracture.

Knee Dislocation From A Contact Injury In High School Football

Ullery LR, Johnson DJ: Section of Sports Medicine, Division of Orthopedic Surgery, University of Kentucky, Lexington, KY

Personal Data/Medical History: An 18 year old male football player (ht. 70 inches, wt. 178 lbs) with no previous history of knee injury. Primary complaint of right knee pain after being struck on the proximal medial tibia by an opposing player's helmet.

Physical Signs and Symptoms: On field evaluation was performed. No obvious deformities, or discoloration were noticed and patient had limited range of motion, secondary to pain. Patient complained of pain throughout the knee. A valgus stress test was performed in both 20 degrees of flexion and in full extension with unremarkable results, as compared bilaterally. A varus stress test was performed in 20 degrees of flexion with noticeable laxity, with no end point felt. The varus stress test was also performed in full extension, with no end point felt. He exhibited a positive lachman, a 3+ anterior drawer, 3+ posterior drawer, (+) posterolateral drawer, (+) external rotation recurvatum test. Pulses: 2+ dorsalis pedis, 2+ posterior tibialis equal and symmetric. Motor/sensory exam intact and bilaterally equal.

Differential Diagnosis:

- 1) ACL / PCL tear
- 2) PCL / posterolateral corner tear
- 3) ACL / posterolateral corner tear
- 4) ACL / PCL / posterolateral corner tear

Results of Diagnostic Imaging/Laboratory

Tests: A MRI was obtained which showed an ACL tear, arcuate ligament complex tear, biceps femoris avulsion, and a PCL femoral avulsion.

Clinical Course: Surgery was performed 12 days post-injury. The surgery involved reconstructing the ACL with a bone-patellar tendon-bone allograft, repairing of the PCL femoral avulsion, reconstructing the LCL with an anterior tibialis allograft, and reattachment of the biceps femoris to the head of the fibula. On arthroscopic evaluation a small radial tear of the lateral meniscus was noticed and removed. At 5 days post-up patient was instructed in quad sets and straight leg raises with his brace locked in full extension. At this time, the patient is continuing his rehabilitation and doing well.

Deviation From the Expected: This is a unique case that is rarely seen in athletics and needs to be evaluated immediately. 14 % of knee dislocations result in vascular problems that could result in loss of limb or possibly death. Constant communication between the athlete and the Certified Athletic Trainer was paramount in establishing normal neurovascular status.

Acute Knee Injury In A High School Football Player

Westrick K, Frey Law L, Ott G: University of Michigan MedSport, Ann Arbor, MI

Personal Data: A 17 year old, male, high school football player was hit on the lateral side of his right knee during a play-off game. Video evaluation of the injury later revealed a severe valgus blow. Minimal field evaluation was performed. He was evaluated by four physicians over a period of a month, with varying conclusions as to the extent of his injury.

Physical Signs and Symptoms: The athlete was initially unable to stand and complained of severe right knee pain, but was able to walk off the field with assistance. At the sideline, a brief knee evaluation by the team physician revealed only medial knee laxity. The athlete was encouraged to increase his activity level as tolerated. Four days later, after trying to jog, the athlete reported lower leg swelling and discoloration. Evaluation by his family physician revealed a positive (+) Lachman's exam. Referral to an orthopedic surgeon resulted in a magnetic resonance imaging study (MRI) and a recommendation for an isolated anterior cruciate ligament (ACL) reconstruction. The athlete obtained a second surgical opinion approximately four weeks after the original injury. However, clinical exam was difficult due to excessive swelling, limited range of motion (ROM), and muscle guarding. This exam revealed: (-) Lachman's test, (+) sag test (at 90° knee flexion), (+) valgus stress test, (-) varus stress test, and (-) patellar apprehension test.

Differential Diagnosis: The differential diagnosis includes: medial collateral ligament (MCL) injury, ACL injury, posterior cruciate ligament (PCL) injury, fracture(s), meniscal and/or other cartilage injury, bone bruise, patellar dislocation, and total knee dislocation (with possible concomitant neurovascular damage).

Results of Diagnostic Imaging/Laboratory

Tests: The MRI reported: MCL injury with avulsion of the distal attachment, torn PCL with possible avulsion, probable ACL tear (poor definition), lateral femoral condyle bone bruise, and possible intra-substance medial meniscus tear.

Clinical Course: The athlete did not tolerate an initial increase in activity and continued to have problems with ROM, pain, and swelling. Six weeks after the initial injury, a diagnostic scope was performed by the second surgeon due to the discrepancies between clinical exams and MRI findings. This surgery revealed: grade III tears of the ACL and PCL, a grade II MCL sprain, but no meniscal damage; the extent of injury was consistent with a total knee dislocation. The athlete was braced to protect the MCL and had autograft reconstruc-

tion of the PCL (13 weeks after injury with ipsilateral patellar tendon), followed by the ACL (22 weeks after injury with contralateral patellar tendon). Approximately eighteen months after his original injury, the athlete returned to competitive sports (baseball).

Deviation from the Expected: A total knee dislocation may not be an obvious diagnosis to the athletic trainer or physician on-site. This case provides an example of how a severe knee injury, such as a total knee dislocation with immediate reduction, can be unrecognized or misdiagnosed by several qualified health-care professionals. This athlete was very fortunate not to have any neurovascular involvement, however, any suspicious, severe knee injury should be treated conservatively until a full evaluation can be performed.

Medial Knee Pain In A High School Football Player

McNew S, Johnson D: Section of Sports Medicine, Division of Orthopedic Surgery, University of Kentucky, Lexington, KY

Personal Data/Medical History: A sixteen year old male football player (ht. 75 inches and wt. 195 lbs) received a posterior lateral blow to his left knee during practice. Did feel a "pop." No previous history of knee pain. Discontinued play, iced, an ace wrap was applied and the athlete was placed on crutches until further evaluation by an orthopedic.

Physical Signs and Symptoms: No appreciable effusion, 85 degrees of flexion at the time of injury but normal range of motion the following day, +2 medial laxity present with valgus stress at 30 degrees of flexion, no laxity present with valgus stress at 0 degrees of flexion. Point tender along the insertion of the medial collateral ligament onto the tibia, no significant medial lateral joint line tenderness. Negative Anterior Lachman's Test, Pivot Shift Test and Anterior Drawer Test.

Differential Diagnosis:

- 1) Medial Collateral Ligament Tear
- 2) Medial Meniscus Tear
- 3) Medial Collateral Ligament Tear and Medial Meniscus Tear

Diagnosis Imaging/Laboratory Tests: X-rays of the involved knee were negative for bony abnormalities. MRI results revealed a complete disruption of the medial collateral ligament off of the tibia and a possible tear of the posterior horn of the medial meniscus.

Clinical Course: Diagnostic arthroscopy was scheduled to fully evaluate the medial aspect of the knee. Arthroscopy confirmed the complete avulsion of the medial collateral ligament off of the tibia. It had scarred down slightly but was still very loose. An invasive screw and washer were used to anchor the medial collateral ligament back onto the tibia. There was also an area of increased separation of the posterior horn of the medial meniscus off the tibia consistent with meniscocapsular separation. A chondral abrasion was made to promote healing in this area. The athlete was placed in a brace locked at zero when weight bearing for four weeks. At this time he was allowed to do closed chain activities and strengthening and stretching exercises with no medial stress. After four weeks he was allowed to unlock the brace while weight bearing. He was instructed to wear the brace two more weeks. Half squats and bicycling were added to his rehabilitation. After the two week period, he was allowed to discontinue wearing the brace and was allowed to do straight

line jogging, gradually working in figure 8 runs and then into cutting drills.

Deviation From The Expected: This case was unique as it is rare to find the medial collateral ligament avulse from the tibial attachment. In almost all cases, the medial collateral ligament will detach from the femur leaving frayed ends of the ligament which are left to scar down on their own. It is rare to see a medial collateral ligament surgically reattached. With the conservative treatment and rehabilitation after surgery, this athlete was able to return to full activity within 16 weeks.

Hip Pain In A High School Football Player

Bolgia LA, Jones DL, Keskula DR, Duncan JB: Medical College of Georgia Center for Sports Medicine, Augusta, GA

PERSONAL DATA/MEDICAL HISTORY.

A 15 year old high school football player, with no history of hip or back pain, reported to the sports medicine clinic complaining of left buttock pain. He came to the clinic for a second opinion following an initial recommendation for surgical intervention. The player stated that he had hurt his hip on the previous day while doing squats in the high school weight room. The athlete routinely had squatted 445 pounds safely; however, he had changed his technique on this particular day such that his right leg was 2 inches in front of the left, placing more weight on the left lower extremity. As he was coming out of the parallel position, the athlete felt a tearing and sharp pain to his left buttock. Following this lift, he could neither fully extend his left knee or hip nor could he bear weight through the left lower extremity. The athlete's goal was to return to football and weight lifting without surgical intervention.

PHYSICAL SIGNS AND SYMPTOMS. The player walked to the clinic using crutches because he was unable to bear weight through the left lower extremity secondary to pain. Palpation revealed extreme tenderness at the origin of the left hamstring muscles. The athlete was neurovascularly intact; yet he had decreased tone to the left hamstring muscles. Goniometric measurements showed hip extension to neutral. In a sitting position, he had 45 degrees of hip flexion. In a prone position, he had 90 degrees of active knee flexion. The athlete had normal quadriceps strength. Sitting hip flexion was a 3+/5; he could not extend his left hip from a prone position although he did have a visible contraction of the hamstrings in this position.

DIFFERENTIAL DIAGNOSIS.

Hamstring muscle strain/ tear

Avulsion of ischial tuberosity/ apophysis

Sciatic nerve palsy

DIAGNOSTIC IMAGING. CT scan revealed a left ischial apophyseal avulsion displaced approximately 7 mm.

CLINICAL COURSE/FINAL DISPOSITION.

During the first week, the athlete took a non-steroidal anti-inflammatory drug and continued with ice and rest. One week after the injury, he began rehabilitation. Rehabilitation initially focused on pain control, gait training and isometric hamstring strengthening. Two weeks after the injury, the athlete walked with a normal gait pattern and reported a significant decrease in pain. He then progressed to gentle hamstring stretching and more aggressive

strengthening to include open and closed kinetic chain exercises as well as balance activities. Four weeks after the injury, the athlete began a light jogging program. Once his range of motion and strength returned to a functional level, he began sports specific drills. Fourteen weeks after the initial injury, he returned to his previous sporting level and played throughout the entire football season without limitations.

UNIQUENESS/DEVIATION FROM THE EXPECTED. Bony avulsions from the ischial tuberosity are rare. Generally, the mechanism of injury is a sudden forceful flexion of the hip with the knee extended and the hamstring muscles powerfully contracted, which can occur with sprinting, long jumping or hurdling. This case differed in that the athlete avulsed the ischial tuberosity after having a forceful hamstring contraction with the knee and hip flexed. Another unique feature was that most published case studies have reported safe return to sport following surgical intervention. This case differed as it demonstrated how an athlete successfully completed conservative treatment and safely returned to unrestricted sporting activities when following rehabilitation that focused on appropriate strengthening, stretching and functional activities.

Free Communications - Practice Meets Research: Mild Brain Injury

Wednesday, June 16, 4:00 PM - 4:50 PM, Room 2219; Moderator: Kevin Guskiewicz, PhD, ATC

Loss Of Consciousness In A Collegiate Rugby Player

Deacon JL, Cameron KL: United States Military Academy, West Point, NY

Personal Data/ Pertinent Medical History:

A 22 year-old male collapsed and lost consciousness for approximately thirty seconds while participating in a collegiate rugby match. On field primary survey noted that the athlete was unconscious but breathing with a normal circulatory pattern. The athlete was stabilized and the paramedics were called.

Physical Signs and Symptoms: Secondary survey revealed normal pupillary response; strong pulse; hot, red skin; and no visible signs of trauma. The athlete regained consciousness while awaiting the arrival of medial transport. Upon regaining consciousness the subject was disoriented and lethargic, reported blurred vision, and complained of a moderate headache and thirst. The athlete also reported sustaining a blow to the back of the head within the few minutes prior to the episode of unconsciousness. The athlete's vital signs were within normal limits: pulse of 90 bpm, 32 respirations per minute, and normal pupillary response. A thorough neurological exam ruled out the suspicion of a cervical spine injury. The athlete was monitored until EMS arrived and was transported to the emergency room where he received treatment from the attending physician.

Differential Diagnosis: 1) Cardiac Malfunctions; 2) Metabolic Disturbances; 3) Heat Stroke; 4) Shock; 5) Respiratory Distress; 6) Traumatic Brain Injury; 7) Epileptic Seizure; 8) Intracranial hemorrhage.

Results of Tests: Computed Tomography Scans were not initially obtained but were taken at 3 and 14 days post injury and both were normal. Magnetic Resonance Imaging, CT Scans and EEG taken at 7 weeks post injury were also reported as normal.

Clinical Course: The initial diagnosis from the physician indicated dehydration as the cause of the loss of consciousness and few tests were completed to rule out mild traumatic brain injury. Despite the reported loss of consciousness the athlete did not receive a CT Scan the day of the injury. The athlete was given three liters of IV solution and his condition was monitored. The athlete was discharged from the hospital approximately two hours following the incident. Upon being discharged, the athlete was cleared for all activities but was instructed to follow up with the doctor the following day. The athlete returned to the playing field the day of the injury with the intent of returning to participation. After returning to the playing field the athlete was instructed, by the certified athletic trainer on site, to rest and report for a follow-up evaluation in the athletic training room the following day, prior to participating in any physical activity. During the 24-hour follow-up visit to the athletic training room, the athlete exhib-

ited signs and symptoms of post-concussive syndrome. The patient was then referred to the general surgeon for further evaluation and was formally diagnosed with a grade III concussion, according to the American Academy of Neurology Guidelines, and associated post concussion syndrome. The athlete returned to the training room 72 hours post injury complaining of intensifying symptoms such as vertigo, nausea, fatigue, aversion to light, and short term memory loss. His left pupil was sluggish and appeared to be larger than the right when compared bilaterally. The athlete's blood pressure was 160/100. Shortly after reporting to the training room, the athlete's condition rapidly deteriorated and he lost the ability to speak and within minutes lost consciousness. The athlete was administered oxygen and was evacuated to the emergency room where he was sent for an emergency CT scan. Although the CT revealed no abnormalities, the patient was hospitalized for two days before being released to bed rest for a period of two weeks. Additionally, the athlete was instructed to follow-up with the certified athletic trainer at 48-hour intervals, in order to continually assess the progress of post concussive symptoms. At 14 days post injury, the patient was still complaining of persistent headaches, dizziness, nausea, inability to read for periods longer than 20 minutes, and sensitivity to light and noise. Subsequently, a follow-up CT scan was ordered. The results of the scan were normal, however, physical examination revealed irregular functioning of cranial nerves II, III, IV, and VI. The visual disturbances had diminished by the end of the third week post injury, but intense intermittent headaches, dizziness, and memory deficits persisted. At four weeks post injury the athlete's neurologic exam had returned to normal, although the athlete continued to complain of persistent headaches and short term memory problems. Six weeks post injury, the athlete was referred to the Defense and Veterans Head Injury Program at Walter Reed Army Medical Center to undergo a thorough neurologic and neuropsychological exam in order to evaluate cognitive deficits associated with the injury.

Deviation From the Expected: This case is unique for several reasons. First, although this athlete reported a blow to the head and was observed to have lost consciousness for approximately thirty seconds the focus of the treatment administered by the emergency room staff was on heat illness rather than mild traumatic brain injury. The certified athletic trainer served as a safety net in this case and prevented the athlete from returning to contact sports despite the clearance from the emergency room staff. Secondly, while post concussion syndrome is not uncommon following an episode of mild brain injury, the severity and duration

of symptoms in this case are noteworthy. Finally, the athlete in this case had the benefit of going through a week of exhaustive neurological and neuropsychological testing within the Defense and Veterans Head Injury Program at Walter Reed Army Medical Center. The Defense and Veterans Head Injury Program was established in 1992 with the mission to ensure that military and veteran personnel with brain injury receive the best evaluation, treatment, and follow-up care available. Each episode of traumatic brain injury with associated post concussion syndrome is unique and possesses a unique recovery curve. However, if persistent symptoms of post concussion syndrome are left unaddressed, the injury may significantly impair the social, academic or professional career of the athlete similarly to the present case.

Effect Of Mild Head Injury On An Instrumented Agility Task In Collegiate Rugby And Ice Hockey Players

Johnson PD, Hertel J, Denegar CR, Olmsted LC, Putukian M, Echemendia R, Salvaterra G, Buckley WE: Pennsylvania State University, University Park, PA

The purpose of this study was to examine effects of mild head injury (MHI) on an instrumented agility task over the course of 10 days following MHI. Baseline data on the "Getback 2-1" agility task on the Cybex Reactor was collected for 25 male collegiate club rugby players (age = 21.12 \pm 2.07 yrs, mass = 86.27 \pm 10.65 kg, height = 179.32 \pm 7.51 cm), 34 female collegiate club rugby players (age = 19.79 \pm 1.12 yrs, mass = 64.79 \pm 9.22 kg, height = 167.12 \pm 6.76 cm), and 25 male collegiate club ice hockey players (age = 20.32 \pm 1.41 yrs, mass = 83.82 \pm 9.58 kg, height = 180.64 \pm 7.31 cm). All subjects performed 4 practice trials of the agility task on a day during preseason conditioning, and baseline data of three trials were recorded either two or three days following. Trials consisted of 25 preprogrammed moves requiring subjects to react to visual cues as quickly as possible. Subjects also completed a baseline post-concussion symptom scale which asked subjects to report physical and emotional abnormalities associated with MHI. Nine athletes (2 male rugby, 5 female rugby, and 2 male ice hockey) who suffered MHI within four months of baseline testing were cleared for reassessment 1 day post-injury by the same team physician. Injured athletes were then subsequently tested on the agility task on days 1, 3, 5, and 10 post-injury. Subjects performed 3 trials of the agility task on each day. The symptom scale was given at these same intervals. Nine healthy, gender and sport-matched subjects were randomly selected from the subject pool to serve as controls and were tested at the same intervals as MHI subjects. Two separate 1-factor (MHI versus control) ANOVA's with repeated measures were computed with: 1) mean time to complete the agility task, and 2) post concussion symptom score serving as the dependent variables. Both groups of subjects performed the task faster on each consecutive day with the exception of day 10 ($F_{1,16}=22.89$, $p<.0005$), but significant differences were not found for mean time to complete the agility task between injured and uninjured subjects ($F_{1,16}=1.31$, $p=.27$). Two MHI subjects, however, demonstrated substantial decrements 1 day post-injury. Injured subjects reported significantly more post concussion symptoms than controls ($F_{1,16}=7.05$, $p=.017$). Use of the Reactor with the methods employed in this study did not reveal significant differ-

ences between subjects with and without MHI in performance of an instrumented agility task, however it was useful in identifying subjects with psychomotor deficits. Future research should focus on using revised methodology to further investigate the Reactor as a valid assessment tool of functional performance following MHI.

Comparison Of Three Different Orientation Strategies On The Performance Of A Balance Test

Peterson CL, Ferrara MS, Courson R: University of Georgia, Athens, GA

Computerized dynamic posturography tests, such as a Sensory Organization Test (SOT) conducted on a NeuroCom Smart Balance System (Clackamas, OR), have gained in popularity as an objective measure to aid clinical decision making in the evaluation of mild traumatic brain injuries. This test utilizes a movable dual forceplate and a movable visual surround to measure sway during six different sensory conditions. While the information from this type of test can be extremely valuable, it is important to determine the test methodology which will provide clinicians with the most accurate information. The purpose of this study was to compare three different orientation techniques; verbal instructions (VI), video previewing with verbal instructions (VP), and single practice trial with verbal instructions (PT), to an individual's performance on the NeuroCom Smart Balance SOT. Forty-five healthy, male and female college students (mean age = 20.62 yrs.) were randomly assigned to one of the three orientation groups. Participants in the VI group received instructions about what to expect prior to the start of each testing condition. Participants in the VP group watched a brief instructional video and received verbal instructions consistent with the VI group. The PT group received verbal instructions consistent with the VI group, but performed a practice trial prior to test trial where they were encouraged to stand steady during the first 10sec. of the trial and then sway as much as desired during the second 10sec. of the practice trial. Paired sample t-tests were used to compare mean performance across trials in each of the three orientation groups. The VP group demonstrated statistically significant ($p<.05$) improvement in balance from trial 1 to trial 3 in 3 of 6 sensory conditions. The VI group demonstrated similar changes in 2 of 6 sensory conditions, and the PT group in 1 of 6 conditions. This would suggest that participants were able to use the information learned in previewing the video and performing the practice trial to decrease variability across consecutive trials. While time constraints may limit the performance of a complete SOT prior to baseline measurements allowing test subjects to preview the test or a video or perform a practice trial prior to scoring will decrease variability across trials. This will result in more accurate data during evaluation and return to play decision making.

The Effectiveness Of Knee Taping In Reducing Anterior Tibial Translation During Exercise

Pero S, Mangus B: University of Nevada-Las Vegas, Las Vegas, NV

The purpose of the study is to determine whether the standard method of taping for an anterior cruciate deficient knee is effective in preventing unwanted anterior translation of the tibia. The vast majority of athletic trainers utilize standardized taping techniques to help stabilize an anterior cruciate deficient knee during athletic activity. To this point there is little or no empirical evidence that these taping techniques are effective at reducing knee instability. In addition, there is little to no data that demonstrates how effective these techniques are both during and post exercise. All 12 subjects were diagnosed by an orthopedic surgeon as having an anterior cruciate deficient knee and were at least two weeks post injury occurrence to reduce the initial swelling that accompanies injury and a maximum of eight weeks post injury to prevent any muscular accommodation to the increased instability of the knee. Knee ligament laxity was measured by the KT-1000 upon arrival in the laboratory for a baseline reading. All measurements on the KT-1000 were performed as the 89N test so that the testing force was standardized within and across subjects. Subjects then had their knee taped by a certified athletic trainer proficient in the ACL taping technique. They were then retested with the KT-1000 to determine the reduction in laxity due to the tape. Subjects then walked for twenty minutes on a treadmill at 3.0 miles per hour. They were then tested a final time with the KT-1000 to determine how effective the taping was in continuing to reduce knee laxity or instability during exercise. Results indicate that ACL taping is effective in significantly reducing anterior tibial translation, as measured by the KT-1000, immediately post taping and prior to exercise ($p < .05$). However, it is not significantly effective in reducing unwanted movement after 15 minutes of exercise ($p < .05$). Subjects reported an increased sense of stability in their knee once it is taped both before, during, and after exercise. Although the results suggest that the subjects feel as if their knee is more stable, the increase in stability whether it is real or perceived, is not being provided by the tape. This suggests that there is another mechanism at work which is providing the perception of increased stability in ACL deficient individuals while their knee is taped.

The Effect Of The C.Ti 2 Brace On ACL Deficient Knees

Cooper ER, Ferrara MS: NovaCare Outpatient Rehabilitation, Athens, GA, and University of Georgia, Athens, GA

It has been previously reported that individuals suffering from anterior cruciate ligament (ACL) ruptures are predisposed to secondary ligament and meniscal injuries when this situation is present. Further more, studies have indicated a decrease in these secondary injuries when anterior translation is prevented or reduced. The purpose of this study was to examine the specific effects a knee brace on documented ACL insufficiencies. The Knee Signature System (Acufex Microsurgical, Inc.), a computerized knee motion analyzer, was used to measure anterior plane translation of the knee while performing the Lachman test. Anterior translation of the tibia in relation to the femur was measured at 20 and 40 Newton meters (NM) of force applied by a force bar. There were twelve subjects between eighteen and fifty-six years of age that had suffered a complete ACL rupture within the past twenty-four months as confirmed by MRI. All subjects were fitted with a C.Ti 2 (Innovation Sports) derotation brace according to the instructions provided by the manufacturer. Individuals were seated at fifty-five degrees hip flexion with the femur fixed via Velcro strapping and the feet placed on a footplate, which was also strapped securely. The knee was positioned at thirty degrees flexion during the administration of the Lachman test. Each subject was measured under three different conditions: 1.unbraced, normal knee; 2.unbraced, injured knee; 3.braced, injured knee. All trials were measured in millimeters by the electrogoniometer. An ANOVA was used to analyze the three conditions. At 20 NM and at 40 NM of force, the brace condition was statistically significant in providing restricted anterior translation when compared to the non-braced condition. We found that the C.Ti 2 brace reduced anterior translation by 60% ($p = .002$) at 20 NM and by 35% ($p = .023$) at 40 NM when compared to the unbraced condition. We have concluded that the use of the C.Ti 2 brace can significantly effect the anterior translation of the injured knee. With the bracing of ACL deficient knees to reduce anterior translation in addition to an aggressive rehabilitation program, prevention or reduction of secondary knee damage can be achieved.

Differences In Calcaneal Eversion And Navicular Drop Between Genders Between Noncontact ACL Injured And Noninjured Knees

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The occurrence of anterior cruciate ligament (ACL) injuries has led to investigations related to athlete susceptibility to non-contact ACL injuries. Factors associated with ACL injuries include gender, shoe-surface interface, intercondylar notch width. Although, excessive foot pronation has been reported to be associated with ACL injuries, the results of these investigations have been contradictory. Thus, the purpose of this study was to determine differences in calcaneal eversion (CE) and navicular drop (ND) between males (M) and females (F), and between injured ACL (IACL) and non-injured ACL (NACL) knees. **METHODS:** Eighty-four volunteer subjects (168 knees) (M = 96; F = 72) were divided into 2 groups: IACL (n = 74) and NACL (n = 94) knees. CE and ND were measured as determinants of pronation. CE was determined by bisecting the lower one third of the leg and the calcaneus. With the subtalar joint in neutral, the non-weight bearing angle was measured. The weight bearing angle was then measured with the difference in angles recorded as the amount of CE. After marking the navicular tuberosity with the subtalar joint in a neutral position, the height of the navicular tuberosity was measured in the non-weight bearing position, and then remeasured in the weight bearing position. The difference between the two heights was recorded as the amount of ND. The data were analyzed with two, 2X2 ANOVAs to determine differences between CE and ND for gender and between IACL and NACL knees. **RESULTS:** The NACL group had significantly greater ($p < .05$) CE when compared to the IACL group ($NACL = 10.680 \pm 0.914$; $IACL = 6.987 \pm 1.028$). However, the mean CE of both groups fell within documented ($0-15^\circ$) normal limits. No significant difference ($p > .05$) for CE occurred between genders. Males had significantly greater ND ($p < .05$) when compared to females ($M = 10.441 \pm 0.661$, $F = 8.364 \pm 0.762$). There was no significant difference ($p > .05$) for ND between NACL and IACL knees. These data indicate that with greater CE, within documented normal limits, there may be a reduced risk of a noncontact ACL injury. ND may not be a risk factor for non-contact ACL injuries. Therefore, these findings indicate that the normal limits for CE may need to be re-evaluated.

Metrecom Measurement Of Navicular Drop In Subjects With A Torn ACL

Glase WM, Allen MK, Yack HJ: Physiotherapy Associates, Cedar Rapids, IA

Purpose: Subtalar joint pronation and tibial internal rotation occur simultaneously during gait. Research suggests excessive pronation of the foot contributes to the incidence of ACL tears by increasing tibial rotation, which may strain the ACL. Navicular drop measures pronation and is defined as the change in height of the navicular when the foot moves from subtalar neutral to a relaxed stance. Studies have documented greater navicular drop in individuals with a history of an ACL tear by measuring the change in the vertical position of a pen mark on the skin overlaying the navicular tubercle. Navicular drop occurs in three-dimensions. A skin mark may not reflect true motion of underlying bone. The Metrecom accurately measures the three-dimensional motion of navicular drop. The purpose of this investigation was to compare the navicular drop of subjects with a history of ACL tears to healthy controls when measured by a Metrecom. **Subjects:** Thirty-six subjects (18 to 49 yrs) volunteered for this study. Eighteen subjects with a history of a torn ACL (surgical or conservative treatment) were matched with controls by age, gender, and limb. Controls had no history of ACL injury and no foot or ankle trauma within the 6 months preceding testing. **Methods:** All navicular drop measures were performed by a single investigator and repeated to test reliability. The probe of the Metrecom was positioned directly under the navicular tubercle. The position of the navicular was digitized while the subject stood barefoot on a flat surface in subtalar joint neutral. The foot was then relaxed to normal stance and the navicular location re-digitized. Both feet were tested, but only the injured limb and the matched control limb were used for data analysis. Intratester reliability was determined using intraclass correlation coefficient (ICC 3,1). An independent t-test was used to assess the difference between the amount of navicular drop in the ACL group and that of the controls. **Results:** Analysis of repeated measures, ICC (3,1), demonstrated intratester reliability of the navicular drop measure to be 0.89. The independent t-test showed greater navicular drop in the ACL group ($p < 0.05$). **Conclusion:** The Metrecom reliably measured the three dimensional motion of the navicular. Subjects with a history of ACL tears had significantly greater measures of navicular drop than the control group, suggesting excessive pronation as one factor that may contribute to ACL injury.

Isokinetic Strength Status Post Anterior Cruciate Ligament Reconstruction: The First Year

Frey Law L, Dargur L: University of Michigan MedSport, Ann Arbor, MI

The purpose of this study was to assess the isokinetic knee flexion and extension strength of individuals status post anterior cruciate ligament (ACL) reconstruction with no meniscal or other ligamentous repairs. Numerous studies have reported isokinetic strength returns following ACL reconstruction at six months, one year, and later, however, few have evaluated the time course over the first year. Sixty-nine patients were included in this study (39 males, 30 females) with age range from 15 - 40 years (mean = 24.9). Subjects were recreationally active, with few varsity level athletes. Peak torque/body weight (PT/BW) was evaluated for knee flexion and extension at 60°/sec (Biodex). Each subject performed five reps following a practice trial, starting with the uninvolved leg. Not all patients performed the isokinetic tests at the same times, as they were done at physician follow-up appointments, but results were placed into five groups according to time status post surgery, as follows: 12 - 19.9 weeks (mean 16.6), 20 - 26.9 weeks (mean 23.3), 27 - 32.9 weeks (mean 29.8), 33 - 40.9 weeks (mean 36.2), and 41 - 55 weeks (mean 46.6). Overall, the average uninvolved, PT/BW for males and females combined was 98.9% for knee extension and 47.8% for knee flexion, and neither altered significantly ($p < 0.05$) over the five time periods. Male knee extension PT/BW values for the uninvolved leg were significantly higher than female values for the first two time periods following surgery, but not for the remaining three. Involved knee extension PT/BW values were not significantly different between male and females at any time period in the year following surgery. However, the knee flexion PT/BW values were significantly higher for males for all five time periods for the uninvolved leg and for all but the last period for the involved leg. Significant differences existed between the involved and uninvolved legs for knee extension at each of the time periods. The average knee extension PT/BW was 61.7% at a mean of 16.6 weeks and increased to 77.7% at a mean of 46.6 weeks; whereas, knee flexion PT/BW was 40.9% at 16.6 weeks and 46.4% at 46.6 weeks. Overall, knee flexion strength was less affected after ACL reconstruction and returned to full, but extension strength remained significantly less even at one year following surgery.

Neuromuscular Characteristics of ACL-Deficient Females

Swanik CB, Lephart SM, Swanik KA, Stone DA, Fu FH: Neuromuscular Research Laboratory, University of Pittsburgh, Pittsburgh, PA

The dynamic restraint mechanism is influenced by several neuromuscular characteristics that may be related to the incidence of non-contact anterior cruciate ligament (ACL) injuries in females and the restoration of functional joint stability through compensatory mechanisms.

PURPOSE: The purpose of this study was to compare the neuromuscular characteristics of ACL-deficient (ACLD) and healthy females.

METHODS: Twelve ACLD (mean age = 25.2 ± 7.3 years) and 12 control (mean age = 22.7 ± 4.0 years) females participated in this study to assess the following measures: 1) area of preparatory and reactive electromyographic (EMG) activity in the lower extremity during landing, 2) onset time of muscle activity after knee joint perturbation, 3) hamstring muscle stiffness by modeling the lower extremity after single degree of freedom mass spring system, 4) isometric and isokinetic (60 and 240°/second) peak torque, time to peak torque, and torque at .2 seconds, 5) hamstring flexibility, 6) and joint function was assessed with a single leg hop test and Lysholm rating scale.

RESULTS: Multiple t-tests revealed that ACLD females exhibited significantly ($p < .05$) increased area of preparatory muscle activity in the lateral hamstring prior to landing, lower hamstring muscle stiffness, greater peak torque and torque at .2 seconds for isometric and isokinetic knee flexion. ACLD females reached their peak torque in less time during knee flexion and had less hamstring flexibility. The ACLD females also had lower Lysholm scores, but no difference was found in performance of the single leg hop test. The area of reactive muscle activity and the onset time of reflexive muscle activity after joint perturbation was not significantly different.

CONCLUSIONS: ACLD females compensate for mechanical instability with dynamic restraint mechanism by: anticipating joint loads and pretensioning the lateral hamstrings, and by producing greater knee flexion torque in a shorter period of time. Hamstring inflexibility may enhance dynamic restraint through protective reflexes mediating hamstring length and tension. Decreased muscle stiffness in the ACLD females could be a predisposing factor to injury or a mechanism to absorb excessive joint loads in the tenomuscular unit. ACL deafferentation does not appear to affect the area or onset time of reactive muscle activity. This research provides a foundation for research on the predisposing factors to ACL injury and direction for investigating conditioning and rehabilitation techniques that may enhance the dynamic restraint mechanism.

Journal of Athletic Training S-47

Free Communications - Clinical Case Reports: Upper Extremity

Friday, June 18, 9:50 AM - 11:50 AM, Room 2219; Moderator: John McChesney, PhD, ATC

Discussants: Gary Ward, MS, ATC; TBA

Myositis Ossificans In The Upper Arm Of A High School Football Lineman: A Case Report

Jacobs D, Freidhoff G, Laise K, Johnson D:
University of Kentucky Sports Medicine,
University of Kentucky, Lexington, KY

Personal Data/Medical History: A 17 year old male high school football lineman reports with severe inflammation, pain, tightness and tenderness in the right upper arm, with limited ROM at the elbow. He denies any trauma other than direct blows to the upper arm for 4 consecutive days since the first recognition of the injury. He tried padding the area along with the treatment of ice and over the counter pain reliever. The pain and limited ROM has made him unable to participate.

Physical signs and symptoms: Inflammation and ecchymosis from the wrist to the axilla are present. A tightness and tenderness of approximately 4 inches long and 2 inches wide is present at the biceps. No laxity of the ligaments of the elbow joint. No shoulder or wrist involvement. Vascular and neurological function in the extremity normal. Range of motion measurement of 130 flexion and 0 extension at the elbow were found on the non involved left extremity. Measurements of 95° flexion and -65° extension were found on the involved right extremity on the initial examination. Girth measurements were also taken every 2 inches distal and proximal to the olecranon.

Girth measurements on initial examination

9 inches distal to the olecranon	(L) 21 cm	(R) 27cm
7 inches distal to the olecranon	(L) 24 cm	(R) 25 cm
5 inches distal to the olecranon	(L) 26 cm	(R) 30 cm
3 inches distal to the olecranon	(L) 28 cm	(R) 31 cm
1 inches distal to the olecranon	(L) 28.5 cm	(R) 33.5 cm
olecranon	(L) 28 cm	(R) 34 cm
1 inches proximal to the olecranon	(L) 27 cm	(R) 35 cm
3 inches proximal to the olecranon	(L) 31 cm	(R) 35.5 cm
5 inches proximal to the olecranon	(L) 31.5 cm	(R) 38 cm
7 inches proximal to the olecranon	(L) 32.5 cm	(R) 40 cm
9 inches proximal to the olecranon	(L) 33.5 cm	(R) 38.5 cm
Range of motion and Girth measurements were take again four days later		

Active extension of -45° of extension to 130° of extension

Passive -40° of extension to 130° of extension

Girth measurements

9 inches distal to the olecranon	(L) 21 cm	(R) 21 cm
7 inches distal to the olecranon	(L) 24 cm	(R) 23.5 cm
5 inches distal to the olecranon	(L) 26 cm	(R) 27cm
3 inches distal to the olecranon	(L) 28 cm	(R) 29.5 cm
1 inches distal to the olecranon	(L) 28.5 cm	(R) 31.5 cm
olecranon	(L) 28 cm	(R) 32 cm
1 inches proximal to the olecranon	(L) 27 cm	(R) 31.5cm
3 inches proximal to the olecranon	(L) 31 cm	(R) 34 cm
7 inches proximal to the olecranon	(L) 32 cm	(R) 36 cm
9 inches proximal to the olecranon	(L) 33 cm	(R) 37.5 cm

Differential Diagnosis:

- 1) Humerus fracture
- 2) Contusion/hematoma
- 3) Anterior compartment syndrome of upper arm
- 4) Myositis ossificans
- 5) Thromboembolic Disease

Diagnostic Imaging: Initial x-rays revealed no abnormalities to the bone structure. X-rays

obtained approximately 3 weeks after injury reveal an early ossification formation in the biceps consistent with the signs and symptoms of myositis ossificans.

Treatment Initial treatment of Jobst cryotemp at 30 mm of Mercury for 20 minutes followed by soft tissue mobilization to the biceps and passive range of motion. Equipment of a elastic bandage from the wrist to the axilla and placed in a sling. Home program instruction of active and passive range of motion emphasizing extension. With treatment daily for a week. Ultrasound at 1.5 W/cm² for 10 minutes was administered to the contused area followed by soft-tissue mobilization and deep friction massage to entire upper arm. Joint mobilizations were also used to increase elbow extension. Followed by 20 minutes in the Jobst cryotemp at 40 mm of mercury. Patient was instructed strengthening of the wrist extensors and active on the UBE for 10 minutes. Upon improve of inflammation and ROM the patient was placed in a dynamic elbow brace protected by an orthoplast splint and donut pad to off-load pressure. The patient was warned of possible reinjury by returning to participation. Allowed to return to activity with the protection devices.

Uniqueness: This case is unique because ossification in the biceps is a rare occurrence, or is not frequently reported.

Re-Entry Program For Swimmer's Shoulder: A Case Report

Page P: Tulane University, New Orleans, LA

Personal Data: This was a 16-year-old female national elite junior swimmer in middle and long-distance events. She had a 6-month history of left shoulder pain as a result of resuming training too quickly and too intensely after a bout of mononucleosis. **Signs & Symptoms:** She exhibited generalized laxity of both shoulders, a positive impingement sign, and a positive apprehension sign for pain which was relieved with relocation. She complained of pain at the middle of her down stroke that was relieved with slight scapular retraction. She exhibited a 30% deficit of external rotator concentric strength on the involved side. **Differential Diagnosis:** Possible diagnoses included: Subluxation, impingement, rotator cuff tendonitis, glenoid labrum tear. Results of diagnostic imaging: radiographs and MRI were both normal. **Clinical Course:** She had a dynamic weakness of the scapular retractors at the middle of her downstroke, which caused excessive shoulder protraction, thus causing impingement at the point of greatest torque in the swimmer's shoulder. She responded well to therapeutic exercise in the training room and at home to strengthen her rotator cuff and scapular stabilizers. She also performed neuromuscular re-education activities to restore normal glenohumeral function. After one month, she no longer exhibited signs of impingement, and her external rotator strength had improved to a 10% deficit. She was then placed on a swimming re-entry program that emphasized functional exercise and appropriate volumes and intensities both on land and in the water. She returned to competition three months from the onset of her treatment. **Deviation from the expected:** This patient did not respond to traditional modality and exercise routines for impingement before this treatment routine. Her impingement was secondary to a dynamic scapular stabilizer weakness, rather than mechanical impingement. A re-entry program was designed specifically for her event that consisted on land-based and water-based exercise.

Shoulder Pain In A High School Football Player

Beck J, Johnson D, Mair S: Section of Sports Medicine, Division of Orthopedic Surgery, University of Kentucky, Lexington, KY

Personal Data/Medical History: A 17 year-old male football player suffered a posteriorly directed force and felt a pop while blocking at practice. Previous history of AC joint laxity 5 months previous. Discontinued play, iced, ACE wrap applied and athlete was held from contact until further evaluation by an orthopedic.

Physical Signs and Symptoms: No atrophy about his shoulder. No AC joint tenderness. No pain with crossed arm adduction. Diffuse tenderness about his shoulder. Normal range of motion but pain at the extremities. Positive O'Brien test. Translation testing reveals posterior translation over the rim. Increased translation is 2 cm and anterior to the rim. Posterior and inferior translation increased from the opposite side. He also has a significant klunk with anterior translation.

Differential Diagnosis:

- 1) Left shoulder multidirectional instability
- 2) Anterior labral tear
- 3) Posterior labral tear

Diagnostic Imaging/Laboratory Tests: X-rays of the involved shoulder were negative for bony abnormalities. MRI results showed a Bankart lesion anteriorly and a labral tear posteriorly.

Clinical Course: Diagnostic arthroscopy was scheduled to fully evaluate the shoulder joint. Arthroscopy confirmed an anterior Bankart tear as well as a posterior labral tear. The patient was also noted to have global laxity and redundant capsule throughout including anteriorly, posteriorly, and inferiorly. The redundant anterior labrum was reduced against the glenoid using a Sure tack. The procedure was repeated on the posterior labrum. The cautery was then placed into the glenohumeral joint and thermal capsular shrinkage was performed anteriorly, posteriorly, and inferiorly. He was placed in a gun sling brace at 30 degrees of abduction and limits with flexion, extension, and rotation. He was in this brace for six weeks. After six weeks he was able to begin passive range of motion. When full range of motion was achieved he was able to begin strengthening.

Deviation from the Expected: This case was unique in that the amount of damage and laxity was so extreme. Usually healthy, active athletes do not have this amount of injury on one episode.

Acute Shoulder Pain And Numbness Following Injury In A High School Football Player

Welsh WE, Brooks PV: Section of Sports Medicine, Division of Orthopaedic Surgery, University of Kentucky, Lexington, KY

Personal Data/ Pertinent Medical History:

A 16 year-old black male fullback and defensive back (170 pounds, 70 inches) injured his left shoulder during a football game in November of 1996 when he was struck from behind. After being struck, he continued to try to catch the pass by diving to catch the ball with an outstretched hand and impacted the ground with his left elbow. He describes that his arm went into an externally rotated position, causing him immediate and intense pain. Examination revealed dislocation of the left glenohumeral joint, which underwent spontaneous reduction upon standing. Past medical history is otherwise unremarkable.

Physical Signs and Symptoms: On evaluation, he complains of pain with active motion in all planes. Passive Abduction was to 75 degrees in the neutral scapular plane, external rotation was to 20 degrees, forward flexion to 90 degrees, and extension was 0 degrees to the point of extreme pain. Anterior Apprehension (Crank) test was positive, Anterior Drawer and fulcrum tests of the shoulder were positive, as was the Relocation test. Hawkins-Kennedy Supraspinatus Impingement test was positive as well. He had numbness on his left lateral upper arm with no noted numbness in his hand. Initially, rotator cuff muscle testing was limited due to pain. Three days after injury, deltoid strength and supraspinatus strength were measured at 2/5 and all other rotator cuff muscles including the teres minor, infraspinatus and subscapularis were tested to be of minimal 5-/5 strength although limited by pain. Neurologic examination revealed decreased sensation to light touch and pin prick along the anterior and lateral aspect of his deltoid and along the anterior-superior bicep. He had normal biceps, triceps, pronator and brachioradialis deep tendon reflexes.

Differential Diagnosis:

- 1) Anterior Shoulder Dislocation with spontaneous reduction
- 2) Labral tear of the left glenoid
- 3) Traumatic Brachial Plexus injury of the posterior cord
- 4) Peripheral nerve injury of the Axillary nerve
- 5) Humeral head fracture
- 6) Anterior Shoulder Dislocation with associated Axillary nerve injury

Results of Diagnostic Imaging/Laboratory Testing: On examination of X-rays of the left shoulder, there appeared to be a small sliver of bone off the anterior-inferior glenoid lip. Other than this, x-rays appeared unremarkable for acute change.

Clinical Course: Based on clinical examination, the patient was diagnosed with anterior shoulder dislocation with axillary nerve palsy and started on range of motion exercises immediately. A home electrical stimulation unit was used to make the deltoid fire while concurrently performing forward flexion and abduction exercises. A global shoulder program was instituted to gradually increase range

of motion and rotator cuff strength. He was able to compete in the Kentucky State Football Championship five weeks later because of strength and active motion gains. He was protected in a Sawa shoulder harness. For college recruitment purposes, EMG/NCS were performed five months post injury to document that an isolated injury had occurred and assure viability of the remaining rotator cuff muscles. Results demonstrated that the patient was able to fire motor units in both the deltoid and teres minor, with axillary nerve injury without electrodiagnostic evidence of upper/posterior trunk injury. Cybex testing was also performed to demonstrate strength improvements and ability to self protect in internal and external rotation, abduction and adduction prior to further college football recruitment. Additional clinical testing showed improvement in joint awareness and proprioception for protective purposes.

Deviation from the expected: Axillary nerve injuries are some of the most common peripheral nerve injuries in athletes who participate in contact sports. Deltoid muscle paralysis is secondary to nerve trauma, which occurs following shoulder dislocation or a direct blow to the deltoid muscle. A clinically suspected axillary nerve injury is confirmed by electrophysiological testing, including electromyography and nerve conduction studies. For this patient, the possibility of arthroscopic intervention arose because of the bony sliver off the glenoid lip which could have caused a mechanical impingement or because of the possible association of labral tears with shoulder dislocations. The possibility of surgical intervention should be considered only after a course of primary rehabilitation for recurrent dislocation or continued gross instability of the shoulder joint. There was some worry of impending rotator cuff tear in this patient due to the initial findings of rotator cuff impingement, however, these resolved with his rigorous and well monitored rehabilitation course. If no axillary nerve recovery is observed in 3 to 4 months following injury, surgical exploration is generally indicated. This course of action was not undertaken for this athlete because of concerns for future college recruitment and his excellent strength gains. It is recommended that athletes who sustain axillary nerve injury may return to contact sport participation when they achieve full active range of motion of the shoulder and when shoulder strength is documented to be good to excellent by isometric (cybex) and manual muscle testing. This patient was allowed to return to play when these criteria were met.

Paget-Schroetter Syndrome in a College Football Quarterback

Courson R, Dillon M, Ferrara MS, Tanner J:
University of Georgia, Athens, GA

Personal Data: A nineteen year old right hand dominant football quarterback presented after football practice with complaints of significant swelling in his right chest, arm and hand. There was no known mechanism of injury or prior history of injury to the right upper extremity. In regards to possible precipitating factors, the athlete had significantly increased his throwing with the transition from high school to collegiate football practice, as well as increased his in-season weight-lifting activities from two to four times weekly approximately two weeks prior to this episode.

Physical Signs and Symptoms: Swelling, venous distention, slight cyanotic discoloration were noted in the right chest, arm and hand, as well as a delayed capillary refill test. Adson's maneuver and hyperabduction test were positive. There were no neurological signs or symptoms. Upper extremity manual muscle testing and DTRs were normal.

Results of Diagnostic Imaging/Laboratory Tests: A venous doppler of the right upper extremity was performed, which showed normal flow with the right upper extremity at rest and decreased flow in subclavian vessels with arm in abduction. MRI demonstrated a narrowed thoracic inlet on the right. The athlete was diagnosed with thoracic outlet syndrome, removed from all athletic activity at this time and placed on a regime of rest, medication, and structured rehabilitation.

Clinical Course: One month post episode, the athlete's symptoms had fully resolved and he was cleared by physicians to begin a gradual return to functional activity. After completing an interval throwing program, he developed repeat symptoms. A venous doppler and subsequent venogram demonstrated a clot completely obstructing the right subclavian vein. He was hospitalized and treated with thrombolytic/anti-coagulant therapy and referred to a thoracic surgeon who diagnosed his condition as Paget-Schroetter Syndrome or effort thrombosis of the subclavian vein. Surgery was performed to resect the 1st rib, decompressing the thoracic inlet and the entrapped neurovascular structures.

Differential Diagnosis: Primary axillosubclavian thrombosis, also known as effort thrombosis or Paget-Schroetter syndrome, consists of primary thrombosis of the axillary and/or subclavian vein. It is important to differentiate between venous and arterial occlusion. Patients with venous thrombosis usually have symptoms (venous distension, swelling, diffuse aching in limb) aggravated by activity. Classical arterial occlusion is accompanied by a more dramatic presentation of a cold, pale, pulseless extremity.

Deviation From the Expected: At eight weeks post-op, the athlete experienced repeat symptoms of swelling in his right chest, and arm, cyanosis, and venous distension. Venogram showed the axillary vein had rethrombosed. Thrombolytic and anti-coagulation therapy was unsuccessful in opening the axillary vein; however, some tributaries of

the axillary vein were opened. It was suspected that after the decompression surgery there remained a fibrotic and stenotic area of the subclavian vein in the costoclavicular region, leading to inadequate flow and rethrombosis when physical activity was resumed. A six month period of anticoagulation therapy and light exercise was initiated to aid in the progression of collateralization. The athlete is currently one year status post the initial effort thrombosis and nine months status post rethrombosis. He is currently asymptomatic, throwing with his normal distance and velocity without any swelling. He continues aspirin therapy and refrains from traditional upper body resistance training. It is anticipated that the athlete will have a normal upper extremity with little chance of recurrent thrombosis.

Shoulder And Arm Pain/Numbness In A Collegiate Volleyball Player

Passerallo AJ, Calabrese GJ: Cleveland Clinic Foundation, Section of Sports Medicine, Cleveland, OH

Personal Data: Athlete is a 19 year old Division I collegiate front line volleyball player. Athlete is right hand dominant but has the ability to spike with both upper extremities equally. Injury occurred in off season while weight lifting and conditioning for the upcoming season. Patient does not recall any instance of trauma associated with her condition. **Physical signs and symptoms:** Athlete had a sudden onset of shoulder pain associated with numbness and tingling sensation into her right arm, hand and fingers, as well as decreased blood flow to her hand and fingers, characterized by her hand turning white and pale. Pain in shoulder and arm was more pronounced while running. The athlete was unable to raise her arm above shoulder height without noticeable numbness and weakness occurring. Initial assessment at her college included the possibility of a cervical nerve root impingement. The recommendation of abstaining from all training activities was followed. The athlete was returning to her home town to follow up with her vascular surgeon who had treated her for thoracic outlet syndrome on her left side three years previously. **Differential Diagnosis:** Suprascapular neuropathy, Cervical nerve root irritation, Brachial plexus injury, Cervical disc herniation, Thoracic outlet syndrome, Rotator cuff injury, Cardiothoracic condition. **Results of Diagnostic Test:** Echocardiogram and Electrocardiogram negative for heart abnormality. Aortic arch angiogram revealed single splinter hemorrhages to her second and third digits. A decrease in blood pressure at various arm positions above the head was noted at the brachial radialis as well as in all digits. **Clinical Course:** Athlete was placed on coumadin and followed up with evaluating physician in one week. Athlete's symptoms did not decrease. A repeat of the aortic arch angiogram was performed and revealed multiple splinter hemorrhages in the second and third digits. Athlete was admitted to the hospital where a first rib resection and anterior scalenectomy was performed. Athlete was instructed to do nothing for six to eight weeks and gradually return to sport. At eight weeks a noticeable weakness was detected in the athlete's rotator cuff muscle groups. Specifically with external rotation and scapular stabilizers. Athlete was placed on a glenohumeral and scapular thoracic strengthening program utilizing theraband, free weights and upper extremity functional exercises. **Deviation from the expected:** It is important to recognize the team approach to treating an athlete's injury. In this case, communication was performed without the usual involvement of the orthopaedist. Proper communication with the physician was needed to assure a comprehensive treatment plan was developed to address this athlete's needs. Rehabilitation is a key component to the recovery of an athlete from this type of surgery. Working with physicians who may not be familiar with rehabilitation principles provides a challenge to the clinical athletic trainer.

Notes:

Free Communications - Student Clinical Case Reports

Friday, June 18, 2:20 PM - 3:40 PM, 4:00 PM - 4:40 PM, Room 2219, Moderator: Brent Mangus, EdD, ATC
Discussants: Dale Blair, MS, ATC, CSCS; Stewart Freed, MD

Rehabilitation Of Multiple Surgical Procedures In The Knee Of A Recreational Athlete

Clark AL, Rieger M, Bell G: Carle Sports Medicine, Urbana, IL, and Athletic Training Education/Sports Injuries Research, University of Illinois at Urbana-Champaign, Urbana, IL

Personal Data: The patient is a 36-year-old male hog researcher who participates in recreational sports. He is a former baseball player and bull rider. The patient has a previous history of right biceps tendon repair, but otherwise no significant medical history. Initial evaluation occurred 6 months prior to surgery. At that time, the patient presented with a 10-12 year old injury that occurred when he slid into third base during a high school baseball game and immediately developed an effusion in the left knee. The patient has experienced intermittent pain and instability since the original injury. He was unable to completely straighten or flex the knee as compared to the right. He stated he has an instability in the knee as it gives out approximately one time per week. He is unable to play sports with his children due to the pain and instability.

Physical Signs and Symptoms: The patient exhibited 4-140° range of motion on the left knee as compared to 0-150° on the right. A trace effusion is observed, as is increased genu varum on the left. Anterior Drawer test performed on the left does not reveal a good end point as compared to the right. McMurray's Maneuver reveals no palpable click, but pain over the medial joint space. Varus and Valgus testing is negative. Pivot Shift maneuver was inconclusive due to guarding.

Differential Diagnosis: Meniscal Injury; Degenerative Joint Disease; Tibial Plateau Fracture; Osteochondritis Dissecans; Posterior Cruciate Ligament Injury.

Results of Diagnostic Imaging: X-rays performed on original evaluation revealed decreased medial joint space, an old, healed tibial plateau fracture, and osteophytic spurring.

Clinical Course: The patient was diagnosed with left knee ACL deficiency and severe arthritic medial compartment changes. He began with a rotational ACL brace with medial spacers, which was unacceptable. Patient then underwent a simultaneous left knee Arthroscopic Medial Meniscectomy, ACL Reconstruction, and High Tibial Osteotomy. The patient was seen 5 weeks post-surgery for therapy. The patient presented in a non-weight bearing state. At this evaluation, the patient exhibited significant edema in the left knee, as well as significant left quadriceps atrophy. The areas around the surgical incisions were red and febrile to the touch. There was palpable tenderness to the medial aspect of the anterior tibial plateau as well as the medial border of the patella. Knee range of motion was measured at

5-80° on the left, and 0-150° on the right. Manual muscle testing revealed lower extremity weakness on the left side as compared to the right as follows: hip flexion 2/5, knee flexion 2/5, hip abduction 3/5, and hip adduction 3/5. The rehabilitation program included a home exercise program designed to increase range of motion while remaining in the non-weight bearing status. Per the surgeon's orders the patient was not fully weight bearing until approximately ten weeks post-surgery. Structured therapy included Russian Stimulation for muscle re-education, quadriceps strengthening and aggressive range of motion exercise. At six weeks post surgery, isokinetic exercise was initiated with passive-resistive force control. The patient was progressed through the strengthening program as tolerated. He was discharged from therapy at 18 weeks post surgery with full weight bearing, 35% concentric quadriceps strength deficit as compared to the unaffected side, and 25% eccentric quadriceps strength deficit as compared to the unaffected side. At the time of discharge, the patient was able to jog, however, the surgeon has discouraged this activity. The doctor, patient, and therapists felt comfortable with releasing him to an independent program at this time, with the understanding that he continues to strengthen and maintain range of motion.

Deviation from the Expected: Range of motion was a struggle throughout the course of treatment. At approximately eight weeks post surgery, a manipulation was performed under general anesthesia. Range of motion began to improve immediately after. The patient did not weight bear until after the manipulation was performed. Once weight bearing began, ACL rehabilitative measures were able to begin. At the time of discharge at 18 weeks post surgery, the patient was performing activities typically seen with patients that had recently had isolated ACL reconstruction. The patient returned at 36 weeks post surgery with passive range of motion of 0°-140°, and muscle strength equal to the unaffected side. He is able to perform all activities of daily living and play with his children without significant pain. He still does, however, have intermittent knee pain, but no sensation of instability. Due to time constraints, he has not been performing his home exercise program. Overall, the patient feels significant improvement, however, he is experiencing more knee pain than he initially expected.

Unusual Complications Following Injury To Lower Leg In A Collegiate Swimmer: A Case Report

Clarke RA, Hancock J, Smith D, Evans TA: Slippery Rock University, Slippery Rock, PA, and Orthopedic and Sports Medicine Associates, Franklin, PA

Personal Data: An otherwise healthy, 19 year old, female swimmer received trauma to the right lower leg while executing a flip turn off of the swimming pool wall. Initially, she presented severe pain, limited motion in all ankle movements, as well as an antalgic gait. At this time, she was diagnosed with a strain of the medial head of the gastrocnemius. Within a few days, the athlete began experiencing neurological symptoms.

Physical Signs and Symptoms: Sixteen days after the initial injury, the athlete began to experience dysesthesia and significant swelling within the right lower leg. Approximately, twenty-five days after the initial injury, the athlete began experiencing low back pain (6.5/10). This pain persisted and increased to 8/10 regardless of activity level. The pain radiated from her toes, through her leg, into her back, and up to her neck. She also complained of severe headaches and loss of sensation.

Differential Diagnosis: Possible pathologies include reflex sympathetic dystrophy, severed nerve, nerve inflammation, herniated nucleus pulposus, posterior compartment syndrome

Results of Diagnostic Imaging/ Laboratory

Tests: The athlete underwent an MRI of the lumbar spine. The results were examined by an orthopedic surgeon, as well as a neurologist. The results suggested a possible lumbosacral radiculopathy between the 5th lumbar vertebrae 1st sacral vertebrae. However, these results were not considered conclusive.

Clinical Course: The athlete was removed from swimming and all other activities. She was placed in an immobilization boot and was instructed to ambulate weight bearing as tolerated. Initially, the rehabilitation protocol consisted of multidirectional flexibility exercises for the ankle. In addition, she was prescribed a muscle relaxant and an anti-inflammatory medication to relieve pain and reduce inflammation. Upon reevaluation, the orthopedic surgeon felt she may also be suffering from Reflex Sympathetic Dystrophy (RSD), as well as posterior compartment syndrome, caused by the gastrocnemius strain. Although her strength improved, three months after the injury, she had not returned to activity, nor regained a pain free gait.

Deviation from the expected: Traditionally, a strain of the gastrocnemius is not accompanied or complicated by neurological impairments. However, in this case, the initial diagnosis of a gastrocnemius strain was associated with three possible pathologies: lumbosacral radiculopathy; RSD; posterior compartment syndrome.

Acute Back Pain In A Collegiate Football Player

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and Orthopedic and Sports Medicine Associates,
Franklin, PA

Personal Data: An 18-year old collegiate football player suffered from upper back pain immediately after being tackled during a full-contact scrimmage. While carrying the ball at full speed, the athlete was struck directly in the chest by a defender. The defender used his shoulder and executed an appropriate tackling technique. The athlete stated his pain began at the time of contact. He was evaluated on the field and was able to leave the playing field without assistance.

Physical Signs and Symptoms: The immediate signs and symptoms included: difficulty breathing, pain beneath the left scapula, general pain over the thoracic spine, and bilateral pain over the related musculature. One hour following the injury, the athlete continued to complain of pain with active trunk flexion. In addition, deep inhalations were painful. Twenty-four hours following the initial injury, the pain centralized over the cervical and thoracic spine, from C7-T3. Forty-eight hours following the injury, upon evaluation by the team orthopedic surgeon, the athlete presented point tenderness over the T6-L1 region. Although the athlete was able to walk without pain, functional movements and passive terminal trunk flexion from a seated position caused immediate pain and obvious discomfort.

Differential Diagnosis: Possible pathologies included: ligament sprain, musculature strain, spondylolysis, costal fracture, costo-vertebral sprain, intervertebral disc herniation, or another spinal disorder exasperated by direct trauma.

Results of Diagnostic Imaging/ Laboratory Tests: Cervical and thoracic x-rays revealed increased spaces between the area of the fifth and seventh thoracic vertebra, indicating a possible compression fracture. A bone scan then confirmed the suspicions, revealing a compression fracture of the fifth thoracic vertebra.

Clinical Course: The athlete was restricted from all activity for 17 days. Upon reevaluation by our orthopedic surgeon, the athlete was permitted to begin limited conditioning, eliminating overhead weight training and plyometric activities. Two months post-injury, the orthopedic surgeon determined that normal healing of the compression fracture had occurred. The athlete was permitted to return to full participation, gradually increasing duration and intensity.

Deviation from the expected: Compression fractures of the thoracic vertebrae are uncommon in athletics. Furthermore, the mechanism of this injury, direct anterior chest trauma, is inconsistent with the typical mechanism for compression fractures that do occur during athletics. In addition, the progression of symptoms from diffuse to specific pain, is not common with other fracture sites.

Chronic Hip Pain in High School Baseball Player

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of Sports Medicine, Division of Orthopaedic
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KY

Personal History/Medical History: A 16-year-old male baseball player. The subject reported pain in his right hip when running and cutting. He does not report any pain when walking or jogging. The pain is described as being sharp and does not linger for any extended period of time; it was originally evaluated as a groin strain. The subject was diagnosed with Perth's' disease at the age of two. He has had unrestricted movement for 16 years.

Physical Signs and Symptoms: The subject demonstrates 130 degrees of hip flexion and 35 degrees of external rotation on both sides. He is limited to 25 degrees of internal rotation on the left and right with some pain noted during this activity. The patient was 5/5 during muscle testing for all hip motions. Some pain was noted during testing of hip flexion on the right. Patient has decreased flexibility for quadriceps, hamstrings, and hip rotators.

Differential Diagnosis:

- 1) Groin strain
- 2) Hip flexor strain
- 3) Legg-Calve-Perthes disease

Diagnostic Imaging/Laboratory Tests: X-rays of the pelvis and right hip were positive for avascular necrosis of the femoral head. Both femoral heads did show flattening in deformity with malformed acetabuli bilaterally. The changes were more pronounced in the right hip than the left.

Clinical Course: Treatment consisted of non-surgical stretching that consisted of a comprehensive program for the right hip with emphasis on quadriceps, hamstrings, and hip internal/external rotation along with an emphasis on global hip strengthening and trunk exercises, including abdominal and back strengthening. The patient was to return in a week for further evaluation and functional testing. Upon return the patient was grossly tested for muscle strength, showing 5/5 in right hip. He was given a felt heel lift in his right shoe for treatment of symptoms of avascular necrosis of the femoral head (AVN) and was to continue the comprehensive stretching program. As of this date the patient has graduated high school and is playing college baseball with no ill effects.

Deviation from the expected: This case is unique because Legg-Calve-Perthes disease has no medical treatment for the bony changes that can and will occur as the bones mature. The patient was diagnosed with LCP disease at the age of two. This disease effects one out of every 1200 between the ages of two and

twelve. The disease causes bone deformity and can result in osteoarthritis. The patient's bony development was affected during childhood causing deformation of each femoral head and acetabuli. The changes were compensated for by the muscle strength in the pelvic region which allowed the patient a pain free childhood. The disease did not require treatment until the injury to the musculature of the hip and should not return with proper maintenance of the hip musculature.

Low Back Pain in a Collegiate Runner

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Personal Data/ Pertinent Medical History:

A twenty-two year old female cross country runner complained of low back and buttock pain after completing an indoor distance race. She believed her pain was related to a back extension workout the previous week. She had no previous history of low back or buttock pain. Two weeks prior she was diagnosed as osteopenic, after a long history of amenorrhea (less than 10 cycles in 6 years).

Physical Signs and Symptoms: Upon examination the athlete presented with low back pain radiating down her right side from approx. L4-5 to S2 and laterally to the iliac crest. She had discomfort with walking, and demonstrated an antalgic gait. Pain did not radiate into her leg. Active motions of hip flexion, extension, abduction and adduction, internal and external rotation, lumbar flexion, extension, side bending and rotation caused discomfort. Passive motions were within normal limit. Resistive motions were not tested due to discomfort. Muscle guarding and spasm were also noted along the right side lumbar area. Two days after the initial evaluation she reported that the most comfortable position was lying prone with a pillow propped under her hips. She also had discomfort in the lumbar area with prolonged sitting. Evaluation now demonstrated active and resistive motions of lumbar extension and hip extension caused the greatest amount of discomfort, with all other motions within normal limits. She also had pain in the right SI joint with single leg stance. Neurovascular status was within normal limits. No pain could be elicited with the Faber test. SI compression, straight leg raise and slump sit tests were also negative.

Differential Diagnosis: Possible pathologies included SI ligament sprain, spondylolysis, femoral head or neck stress fracture, discogenic injury, SI joint injury.

Results of Diagnostic Imaging/ Laboratory

Tests: Plain radiographs of the lumbar region were not remarkable, and did not show any abnormalities. A bone scan revealed a focal solitary intense uptake in the right side of the sacrum. Additional tests concerning amenorrheic status were taken, and appropriate estrogen therapy treatments were implemented.

Clinical Course: After the athlete was diagnosed with a sacral stress fracture, she was restricted to non weight-bearing cardiovascular exercise for six weeks. After this six week period she progressed to full, pain-free activity. Workouts consisted of a combination of pool, stationary bike and the Precor EFX cross-trainer that lasted for approximately 60 minutes per session, two times per day. This

program was designed to maintain her current fitness level to allow her to compete in middle distance events upon her return. At twelve weeks she was running pain free and able to compete at pre-injury competition level.

Deviation from the Expected: The cause of this runner's low back pain was found to be a sacral stress fracture. In distance runners it is not uncommon to see lower leg, femoral, or even lumbar vertebrae stress fractures due to repetitive weight bearing stresses. Research on sacral stress fractures produced limited studies, indicating primarily older, post-menopausal populations. Sacral stress fracture in the young athletic population is not commonly noted. Informal discussions with other athletic trainers suggest that the incidence of this injury seems higher, but has gone unreported. There is the possibility that prior history of amenorrhea and osteopenia predisposed this athlete to this injury. It is important that warning signs are recognized early, such as amenorrhea, osteopenia, and diet irregularities. There is a need for continued research in etiology and diagnosis of sacral stress fractures in the athletic population.

Ruptured Flexor Digitorum Profundus Tendon In A Football Athlete: A Case Report

Miller D, Vanic K: East Stroudsburg
University, East Stroudsburg, PA

Objective: To present the case of a college football player who was struck on the right distal interphalangeal (DIP) joint, which resulted in a ruptured flexor digitorum profundus tendon.

Background: A ruptured flexor digitorum profundus (FDP) tendon, commonly referred to as "Jersey Finger" may occur as a result of an athlete attempting to grasp an opposing player's jersey while moving in opposing directions. In addition, forced hyperextension of a flexed DIP joint or a blow sustained to the distal phalanx causing abrupt hyperextension are potential injury mechanisms.

Differential Diagnosis: Fractured distal phalanx, sprained DIP joint, strained phalangeal intrinsics, volar plate disruption,

Treatment: Within nine days, a Zone I surgical repair was conducted to repair the FDP rupture. Post-operative management included a dorsal blocking splint to obstruct the metacarpal phalangeal (MCP) joints and allow free extension of IP joints. Kleinert Protocol was initiated for early passive range of motion.

Uniqueness: Jersey finger is an unusual injury, yet common to most throwing sports where an object or implement can strike an exposed DIP joint.

Conclusions: Early diagnosis and treatment are essential for ensuring a quality tendon repair and establishing full restoration of intrinsic hand function. Such urgency for surgical intervention allows the tendon to receive nutrition through motion. Therefore, misdiagnosis may cause serious complication for a functional repair.

Free Communications - Thematic Poster Session: Current Trends in Electromyography

Saturday, June 19, 8:30 AM - 11:30 AM, Room 2219; Moderator: Ted Worrell, EdD, ATC, PT

VMO And VL Activation During A Mini-Squat Exercise With And Without Hip Adduction

Earl JE, Schmitz RJ, Arnold BL, Gansneder BM: University of Virginia, Charlottesville, VA

The purpose of this study was to compare vastus medialis (VMO) and vastus lateralis (VL) activity while performing a mini-squat with and without isometric hip adduction. Twenty recreationally active subjects (10 men, 10 women; age = 28.10 ± 5.91 yrs, ht = 170.94 ± 11.03 cm, mass = 72.32 ± 16.66 kg) with no history of patellofemoral pain, quadriceps injury, or other knee injury participated in the study. Subjects performed two sets of three repetitions of a traditional mini-squat (TMS) and a mini-squat with isometric hip adduction (AMS) while maintaining their back against a wall. Hip adduction was maintained and monitored by having subjects squeeze a hand held dynamometer between their knees. The pace of the mini-squats was controlled with a metronome set at 1Hz, and each flexion and extension phase was performed during 2 beats of the metronome with a 2 beat rest between repetitions. Subjects were allowed to practice this procedure until they were comfortable with the pace. The EMG signals of the VMO and VL were recorded bilaterally with bipolar electrodes during the TMS and AMS. These signals were normalized to the EMG of the quadriceps maximal voluntary isometric contraction. For VMO and VL EMGs separate repeated measures ANOVAs with one between (gender) and two within (leg and squat) variables were used to analyze the data. Tukey's HSD was used for post hoc comparisons. These analyses revealed greater VL activity ($P < .05$) during the AMS (0.28 ± 0.1 mV) than TMS (0.39 ± 0.2 mV) and greater VMO activity ($P < .05$) in the right leg during the AMS ($R = 0.33 \pm .17$ mV, $L = 0.36 \pm 0.12$ mV). Additionally, using the EMG data from the two sets of TMS and AMS exercises, one-way repeated measures ANOVAs and intraclass correlation coefficient (3,2) were used to assess intrasession EMG reliability. All ICC values were greater than 0.9. In summary, combining isometric hip adduction with a mini-squat exercise significantly increased the activity of the VL. The failure to demonstrate VMO differences may be due to large variability in the data.

The Effects Of Selected Ankle Braces On Postural Control And Electromyographic Activity Of The Leg Muscles

Mead JJ, Daigneault BM, Ingersoll CD, Cordova ML, Sandrey MA: Athletic Training Department, Indiana State University, Terre Haute, IN

Objective: A few studies have analyzed the frequency characteristics associated with postural control in subjects wearing an ankle brace. EMG activity of the leg muscles have also been measured in the braced and unbraced conditions. There have been no known studies which incorporated both. Thus, the purpose of this study was to investigate the effects of ankle bracing on somatosensory control of posture and tibialis anterior, medial gastrocnemius, and peroneus longus muscle activity during a single-leg stance. **Design and Setting:** A 1 X 3 factorial was used for this study. The single independent variable, brace, had three levels (control, Active Ankle, McDavid). The five dependent variables measured were: antero-posterior (AP) mean frequency, medio-lateral (ML) mean frequency, and integrated electromyogram (I-EMG) of the and tibialis anterior (TA), medial gastrocnemius (MG), and peroneus longus (PL). This study took place at the Sports Injury Research Laboratory at Indiana State University. **Subjects:** Thirty college-aged volunteers between the ages of 18-29 who had not sustained a significant ankle injury in the last two years served as subjects. **Measurements:** AP and ML center of pressure values were measured during five, 15 second one-legged modified Romberg tests performed under three conditions. The center of pressure data were converted to the frequency domain using a Fast Fourier Transformation. I-EMG values for each of the three conditions were measured and the average of five trials were normalized to a percent of a maximum voluntary contraction. The AP and ML mean amplitude of the of the frequency within the somatosensory band (.7 to 1.2 Hz) were analyzed. The effect of bracing on these dependent measures was assessed using a one-way repeated measures MANOVA, with univariate F-tests, and the appropriate post-hoc procedures. **Results:** An overall brace effect existed for ML somatosensory mean frequency ($F(2,58)=3.7, P=.031$). When compared to the control, the Active Ankle brace produced a greater mean frequency ($P < .05$). No differences were found between braces on AP somatosensory mean frequency ($P < .05$). Bracing had no overall effect on I-EMG activity of the TA ($F(2, 58)=.03, P=.973$), MG

($F(2,58)=1.59, P=.854$), and PL ($F(2, 58)=2.52, P=.089$) muscle activity. **Conclusions:** It appears that ankle bracing does not affect normal muscle function activity when maintaining balance during a one-legged stance. The Active Ankle brace was the only condition that increased the mean somatosensory frequency in the ML direction possibly suggesting increased somatosensory input. It is not certain whether this increased amplitude is beneficial when wearing an ankle brace to prevent or protect the ankle from injury.

Comparison Of Weight Bearing And Non-Weight Bearing Gluteus Medius EMG During An Isometric Hip Abduction

Bauer AM, Webright WG, Arnold BL, Schmitz RJ, Gansneder BM: University of Virginia, Charlottesville, VA

The purpose of this study was to determine differences in electromyographic (EMG) activity of the gluteus medius during standing isometric hip adduction with subjects weight bearing (WB) and non-weight bearing (NWB) on the tested (ipsilateral) limb. Twenty females (age = 20.2 ± 1.3 years, ht = 170.1 ± 6.8 cm, wt = 65.4 ± 8.7 kg) with no history of lower extremity injury for the previous six months volunteered to participate. Surface EMG was collected with two electrodes placed over the ipsilateral gluteus medius half the distance between the mid-iliac crest and the greater trochanter. For testing, subjects were positioned standing and facing the axis of the Kin-Com II (Chattecx Corp., Hixson, TN) dynamometer with the ASIS aligned with the axis. The dynamometer force pad was placed approximately 2.5 cm superior to the lateral femoral condyle. All testing was completed with the respective hip in 0° of flexion and abduction. Prior to testing, maximal voluntary ipsilateral and contralateral isometric hip abductions (MVIC) were measured using the test position. During the weight bearing condition, subjects stood on their ipsilateral limb and performed 3 isometric abductions at 50 and 80% of MVIC with the contralateral hip. During the non-weight bearing condition, subjects stood on the contralateral limb and performed 3 isometric abductions at 50 and 80% of MVIC with the ipsilateral hip. During the test contractions, raw EMG signals were collected at 1000 Hz. For data analysis a 1s window of consistent EMG activity was identified for each contraction. From these windows the root mean square (RMS) was calculated, and the RMS was averaged for each set of 3 contractions. To analyze the data a two-factor (isometric contraction level by weight bearing condition) repeated measures analysis of variance was performed using the average RMS as the dependent measure. The results demonstrated significant main effects for contraction level [$F(1,19)=34.0$, $P<0.001$] and limb condition [$F(1,19)=21.7$, $P<0.001$]. As expected gluteus medius EMG activity was greater at 80% MVIC (870.2 ± 356.1 $mV \times 10^{-5}$) than 50% MVIC (533.1 ± 195.6 $mV \times 10^{-5}$). Furthermore, EMG activity was greater during WB (817.7 ± 354.6 $mV \times 10^{-5}$) than NWB (589.6 ± 197.1 $mV \times 10^{-5}$). Thus, the combination of weight bearing and contralateral hip abduction produced more muscle activity than the non-weight bearing hip abduction.

Muscle Activation Levels During Exercise On The Flipflex Exercise Device

Swartz EE, Armstrong CW, Hodgson C, Norkus S, Sterner R: Applied Biomechanics Laboratory, University of Toledo, Toledo, OH

The purpose of this evaluation was to determine if selected muscles would have levels of activity consistent with strength gains while performing specific exercises on the FlipFlex exercise device developed by Fitness Quest Inc. Twelve subjects were recruited having mean age, weight, and height of 26.08 years, 168.9 lbs., and 68.66 in., respectively. Sixteen specific FlipFlex exercises were selected: squat, calf raise, back lunge, lat raise, low row, high row, biceps curl, overhead press, chest press, triceps press, back flye, reverse curl, side bend, oblique curl, ab curl, and back extension. The first phase of the study was used for acclimatization and determining the subjects' 1 repetition maximum for 11 selected Paramount exercises which approximate to the 11 FlipFlex exercises. Five exceptions were sub-maximal exercises performed without the use of an external device: back lunge, calf raise, ab curl, oblique curl, and back extension. During the second phase, surface electrodes were placed over 13 of the subjects' muscles which associated with specific exercises. Subjects completed 8-10 repetitions of the 11 Paramount, 5 sub-maximal, and 16 FlipFlex exercises. Standard cadences were established for the exercises using a metronome. Subjects were given rest between exercises and testing order of exercises was randomized. A Noraxon EMG telemetry system was used to record muscle activity. Five repetitions, digitized at 1000 Hz, were analyzed. Data was rectified and filtered using a low-pass filter (100 Hz cut-off rate). A representative contraction was analyzed to determine the integrated EMG (IEMG) value. The IEMG values for the 16 exercises were normalized by dividing them by IEMG values from Paramount exercises. The results were converted to percentages. The results indicate that for the squat (hamstring-111%, gastroc-22%, gluteus max.-125%, rectus femoris-91%), lateral raise (deltoid-101%, trapezius-103%, biceps-13%), high row (deltoid-75%, trapezius-100%, biceps-17%, latissimus dorsi-94%), and triceps press (trapezius-56%, pectoralis major-41%, triceps-110%), the levels of muscle activity that occurred were sufficient to induce a strength training effect. Additionally, for the calf raise and back lunge, the levels of muscle activity were comparable to that of exercises that are typically assumed to be useful in strengthening these muscles. All other exercises did not produce a level of activity sufficient to induce strength training. Thus, the FlipFlex device may be effective for individuals seeking a method of improving muscle strength for specific exercises.

Electromechanical Delay In The Superficial Muscles Of The Quadriceps Femoris

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Mechanomyography (MMG) records and quantifies the lateral oscillations of contracting skeletal muscle fibers and reflects the mechanical counterpart of motor unit electrical activity as measured by electromyography (EMG). The purpose of this study was to examine the effect of joint angle on electromechanical delay in the superficial muscles of the quadriceps femoris (rectus femoris, vastus lateralis, and vastus medialis). Fifteen adults (10 male and 5 female; mean age \pm SD = 23.3 ± 2.0) performed maximal isometric muscle actions of the leg extensors on a Cybex II isokinetic dynamometer at joint angles in which the Cybex II lever arm was positioned at 30° , 60° , and 90° below the horizontal plane. Bipolar (7.62cm center to center) surface electrode arrangements, with piezoelectric MMG recording devices positioned between the proximal and distal EMG electrodes, were placed on the rectus femoris, vastus lateralis, and vastus medialis muscles of the dominant leg. The time delays between the onset of the EMG signal and torque (TQ) production (EMG-TQ), the onset of the MMG signal and TQ production (MMG-TQ), and the EMG and MMG signals (EMG-MMG) were measured at each joint angle. The time delay data were analyzed using a three-way repeated measures ANOVA (muscle by joint angle by delay) and Tukey post-hoc comparisons. The three-way interaction was not significant ($p>0.05$), but there was a significant ($p<0.05$) two-way interaction for joint angle by delay (collapsed across muscle). Follow-up analyses indicated significant ($p<0.05$) decreases in the EMG-MMG delays between 30° and 90° and 60° and 90° . There were, however, no differences ($p>0.05$) in the EMG-TQ and MMG-TQ time delays between joint angles. Thus, the length of the quadriceps femoris may affect the time delay separating the onset of the electrical (EMG) and mechanical (MMG) events which occur prior to torque production, but not the time delay separating the onset of the electrical and mechanical events from torque production.

Effect Of Isotonic And Isometric Knee Extension Exercises On Mechanical And Electromyographical Specificity Of Fatigue

Schmitz RJ, Arnold BL, Perrin DH, Granata KP, Gaesser GA, Gansneder BM: University of Virginia, Charlottesville VA, and University of North Carolina, Greensboro, Greensboro, NC

This study investigated the effects of isotonic and isometric knee extension exercises on strength, power, and surface EMG in male and female populations. Using the knee extensors, ten males (age = 22.1 ± 3.3 yr, ht = 180.3 ± 5.5 cm, mass 78.7 ± 5.1 kg) and ten females (age = 23.9 ± 4.6 yr, ht = 163.7 ± 11.1 cm, mass 63.2 ± 7.4 kg) performed a 120 second maximal voluntary isometric contraction (MVIC) and 120 maximal isotonic contractions (at a resistance of 25% of MVIC peak torque). The two exercise protocols were counterbalanced and separated by at least 48 hours. Prior to each exercise ($t=pre$) knee extensor isometric peak torque (strength) and average peak power (power) were tested utilizing three, 3 second MVIC's and three maximal isotonic contractions (at 25% of MVIC), respectively. Following each exercise, strength and power were assessed immediately after ($t=00$) and at 2.5 ($t=02.5$), 5 ($t=05$), 10 ($t=10$), and 15 ($t=15$) minutes. At each time point, strength and power were normalized to the respective $t=pre$ value. Additionally, vastus lateralis surface EMG signals were collected during all muscle testing and normalized to the respective $t=pre$ value. A 1-between (gender), 2-within (time and type of muscle performance) repeated measures ANOVA was performed on the muscle performance and EMG data for each exercise session. Following isometric exercise, both strength and power at $t=00$ (68.7 ± 8.7 & 88.0 ± 8.7) and $t=02.5$ (82.2 ± 17.8 & 95.2 ± 5.0) significantly decreased from $t=pre$ (100 ± 0.0) ($p < .05$) with greater decreases in strength at each time point ($p < .05$). EMG analysis revealed a significant EMG amplitude decrease ($p < .05$) at $t=00$ and $t=02.5$ during strength testing with respect to $t=pre$. Following isotonic exercise, both strength and power at $t=00$ (68.0 ± 13.2 & 38.8 ± 10.7) and $t=02.5$ (84.5 ± 14.9 & 81.6 ± 14.5) significantly decreased from $t=pre$ (100 ± 0.0) with a greater power decrease at $t=00$ ($p < .05$). The EMG amplitude of males was significantly less at $t=00$ than the respective EMG amplitude for females ($p < .05$) (irrespective of testing condition). These results suggest that muscle performance in a fatigued state is directly dependent upon the type of exercise performed and that gender may play a role when determining accurate indices of fatigue. This may have implications upon muscle performance assessment in the clinical as well as the laboratory setting. If a true measure of fatigue is necessary, the test should be similar in nature to the exercise that induced the intrinsic changes associated with alterations of muscle performance.

EMG Activity During Selected Upper Extremity Tubing Exercises

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Through the process of muscle activation, the neuromuscular system may experience positive changes considered to reflect improvements in muscle strength. Various exercise devices, including those that use tubing as a form of resistance, have been used for this purpose. The goal of this study was to examine muscle activation during selected tubing exercises on a recently developed exercise device. Twelve healthy adults volunteered to serve as subjects for this investigation. Surface electromyography (EMG) was utilized to assess muscular activity of six muscles [latissimus dorsi (LD), anterior deltoid (AD), posterior deltoid (PD), pectoralis major (PM), biceps brachii (BB), triceps brachii (TB)] during performance of the selected tubing exercises and on an isotonic exercise device. Subjects performed one set of ten repetitions with the tubing, and one set of ten at 70% of their one repetition maximum for each of the selected exercises [chest fly (CF), low row (LR), overhead press (OP), triceps press (TP)]. EMG data were collected and analyzed for five repetitions of each set. The levels of activation for tubing exercises are expressed as a percentage of the corresponding isotonic exercise. Results indicated that the levels of muscular activation associated with tubing exercises were well below those to which they were compared. For the CF, levels of muscle activation for the six muscles were 42% (AD), 51% (PD), 40% (PM), 39% (LD), 28% (BB), and 38% (TB). The values for the LR exercise were 32% (AD), 26% (PD), 28% (PM), 29% (LD), 30% (BB), 38% (TB). The OP revealed activation of 48% (AD), 41% (PD), 52% (PM), 41% (LD), 42% (BB), and 37% (TP); while the TP presented with 46% (AD, PD), 38% (PM), 59% (LD), 36% (BB), and 25% (TB) of muscle activity compared to the isotonic exercise. The exercises performed on this new exercise device resulted in levels of activation consistent with low to moderate intensities. It may be that in a low fit or clinical population (i.e., those with upper extremity injuries/conditions), the level of activation would be sufficient to produce muscle strengthening.

An EMG Comparison Of Selected Ankle Rehabilitation Exercises

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Ankle injuries are one of the most common injuries in sport and physical activity. Many types of rehabilitation exercises are used to re-establish lower extremity neuromuscular function and strength, specifically following ankle injuries. Furthermore, it has not been established as to which exercise induces the greatest leg muscle activity. Exercise that stimulates the greatest activity may allow patients to recover more quickly from their injury. The purpose of this investigation was to establish which exercises induce the most muscle activity in the medial head of the gastrocnemius (MG), peroneus longus (PL), and tibialis anterior (TA) as measured by integrated electromyography (I-EMG). Twenty-four healthy subjects (age = $22 \pm .59$; mass = 63.5 ± 2.1 kg; ht = 165.7 ± 1.2 cm) under went each of the four exercise conditions (stork stance, stork stance on a trampoline, t-band kicks, and sports-cord) in a counterbalanced order. Each subject completed 5 repetitions of each exercise for 30 seconds. The middle 20 seconds of I-EMG activity were studied. Individuals were given a 1 minute rest between each trial. A one-way repeated measures MANOVA was used to determine if differences existed across exercise condition on I-EMG activity of the PL, TA, and MG. Univariate F-tests and Tukey multiple comparison procedures were used post-hoc to locate specific group differences. For the PL, the T-band kicks produced greater I-EMG activity than the stork stance ($P < 0.05$) or the sports-cord exercises ($P < 0.05$), but no differences were found when compared to the trampoline condition ($P > 0.05$). Furthermore, the trampoline, T-band kicks and sports-cord exercises were not different from each other ($P > 0.05$). The stork stance exercise was not different from the trampoline or sports-cord exercises for the PL either ($P > 0.05$). Greater I-EMG activity was present in the MG for both the trampoline and T-band kicks exercises when compared to the stork stance ($P < 0.05$). No differences were found between the sports-cord and all other exercises ($P > 0.05$) and the trampoline and T-band kicks exercise ($P > 0.05$). All exercises produced greater I-EMG activity in the TA when compared to the stork stance ($P < 0.05$). In addition, the T-band kicks exercise induced more muscle activity than the trampoline in the TA ($P < 0.05$). The sports-cord did not differ from the T-band kicks or the trampoline condition with respect to the TA. In summary, the T-band kicks exercise induces greater I-EMG in all three muscles, while the trampoline exercise causes more I-EMG activity in the MG and TA. Lastly, the sports-cord exercise induces greater I-EMG activity in the TA.

Notes:

Free Communications, Poster Presentations: Session A

Wednesday, June 16, 1:00 PM - 4:30 PM, Convention Center, Lobby 200, Level 2. Authors present from 3:30 PM to 4:30 PM to answer questions.

An Interactional Analysis Of Experienced And Inexperienced Athletic Trainers' Behavior In Clinical Instruction Settings

Stemmans CL, Gangstead SK: Indiana State University, Terre Haute, IN, and The University of Southern Mississippi, Hattiesburg, MS

The purpose of this study was to observe behaviors between the clinical instructor, student athletic trainer, and athlete and compare the frequency of identified behaviors on the experience level of the clinical instructor. Subjects were thirty clinical instructors at five CAAHEP accredited or NATA approved undergraduate education programs. Ten subjects in each of the Novice (N; ± 1 year), Intermediate (I; 2-4 years) and Advanced (A; ± 5 years) experience groups participated. The Clinical Instructor Analysis Tool - Athletic Training II was developed to identify verbal and nonverbal behaviors initiated in athletic training clinical instruction. Three allied health education program experts confirmed face validity. Reliability was determined through inter-observer agreement and calculated at 95.4%. This surpassed the accepted standard of eighty-five percent. Thirty minutes of clinical instruction was recorded using a video camera and wireless microphone. Conversion of video records into raw data was accomplished in three-second intervals. Behaviors initiated by the clinical instructor, student athletic trainer and athlete were recorded. Raw data were summarized into total clinical instructor contribution, total student athletic trainer contribution, total athlete contribution, silent observation, clinical instructor use of skill and evaluation techniques, student athletic trainer use of skill and evaluation techniques, clinical instructor use of questions, clinical instructor use of skill feedback categories. Direct/indirect ratio was computed to determine the teaching style of the clinical instructor. Frequency and proportional data of the nine categories were analyzed across experiential level of the clinical instructor. Results showed that Total Student Athletic Trainer Contribution (N=5.21%, I=15.99%, A=15.01%) was three times more frequent in intermediate and advanced clinical instruction than in novice clinical instruction. Frequency of Student Athletic Trainer Use of Skill and Evaluation Techniques (N=6.34%, I=10.27%, A=36.05%) were associated with an increase in clinical instructor experience. Clinical Instructor Use of Skill Feedback (N=1.71%, I=3.84%, A=1.71%) was substantially low in all experience levels. By comparing frequency distributions of categorical be-

havior, we concluded that the frequency of student athletic trainer initiated behaviors, specifically skill and evaluation techniques are influenced by experience level of clinical instructor. Additionally, skill feedback initiated by clinical instructors warrants further investigation. Certified athletic trainers' in their early professional years may lack the experience to teach students in a clinical setting. Education program directors need to appropriately assign clinical instructor responsibilities to certified athletic trainers who demonstrate the ability to provide appropriate health care and enable students through teachable moments.

Perceived Importance Of Effective Clinical Instructor Characteristics In Athletic Training Education

Vanic KA, Drummond JL: East Stroudsburg University, East Stroudsburg, PA

Objective: The purpose of this study was to investigate effective clinical instructor techniques as exhibited by the certified athletic trainer during a clinical field experience. **Design:** The Clinical Instructor Survey Tool (CIST) was designed to assess difference in the perceived importance of effective clinical instructor techniques between certified athletic trainers and student athletic trainers. This 20-item survey was based on a 5-point Likert-type scale and categorized into four critical areas: (1) professional competence, (2) involvement/receptivity, (3) instructional practices, and (4) evaluation practices. A five-member expert panel of certified athletic trainers assessed face validity of the CIST and necessary modifications were made. Internal consistency was determined by administering the CIST to thirteen student athletic trainers. Cronbach alpha was .82. **Subjects:** The CIST was mailed to a random selection of twenty-eight NATA-approved or CAAHEP-accredited undergraduate athletic training education programs. **Results:** A total of 1062 (301 clinical instructor and 761 student) surveys were randomly distributed throughout NATA Districts 1, 2, 3, and 9. After a 30-day follow-up, 25 (89.3%) programs had returned the mailing. A total of 697 (64.5%) surveys were returned from the selected districts. There were 181 (60.1%) clinical instructor and 499 (65.6%) student athletic trainer forms returned. Statistical analyses were performed on each CIST item to determine if there were differences between certified athletic trainers and student athletic trainers regarding their perceived importance of the clinical instructor items. **Conclusions:** It was concluded that (1) there were differences among the CAAHEP-accredited athletic training programs in NATA districts 1, 2, 3, and 9 with respect to all perceived areas of effective clinical instruction, (2) a negative relationship was reported between the age and number of years CAAHEP-approved athletic training faculty were clinical instructors and their perceived importance for effective clinical instruction with respect to instructional and evaluation practices, (3) female athletic trainers, both certified and student, reported higher mean differences than their male counterparts with respect to all perceived areas of effective clinical instruction, and (4) second-year student athletic trainers reported higher mean differences than their first-year counterparts on the perceived importance of effective clinical instruction characteristics with respect to involvement/receptivity.

Key Words: athletic training, clinical instruction, field experience, survey

A Survey Of The Perceived Competencies By Certified Athletic Trainers In The Outpatient Clinical Setting

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Historically, the relationship between certified athletic trainers and physical therapists has been antagonistic in that there is a lack of understanding regarding the characteristics that define each profession's clinical role. It has been cited that the ATC is trained to deal with sports-related injuries, whereas the physical therapist has a broader knowledge in injury rehabilitation across numerous, and more diverse patient populations. The purpose of this study is to examine the perceived competencies of certified athletic trainers regarding their roles to practice in the non-traditional (outpatient clinical) setting. Telephone calls made to each of the 77 facilities within the Phoenix, Ariz. metropolitan area to determine the types of services provided (ie: physical therapy and/or rehabilitation), and the presence of ATCs. Out of the 77 clinics telephoned, 22 clinics were found to employ ATCs on staff. A total of 29 ATCs were found to be employed out of the 22 outpatient clinics surveyed. A written survey was used to collect the data. The questions were written in a closed-format to limit variability of responses, and multiple-choice items were provided to measure factual information such as amount of experience, academic degree earned, and educational program type. A ranking-number system was used for questions regarding types of diagnoses treated, frequency of treatment involvement, and perceived competence with clinical performance tasks. The results obtained from the questionnaire were calculated using descriptive statistics in order to quantify the responses. A chi-square analysis was also used to determine the existence of the relationship between program type and perceived competence. The study found that a majority of the ATCs surveyed throughout Phoenix are employed in non-physician owned, outpatient clinics. They spent most of their time treating individuals with sports-related orthopedic diagnoses. Less than 80% of the 29 respondents felt competent with joint mobilization (77%), gait training (77%), joint manipulation (62%), and evaluation (54%). The results of the chi-square showed that there were no differences between program type and the reported overall perceived competence by the ATCs ($p < .05$). It may be assumed that a relationship between the variables of program type and perceived competence does not exist. Although the results presented from this study are not statistically significant, the responses to each survey question helped to set a foundation for further research on this topic.

A Demographic Description Of Students Enrolled In CAAHEP-Accredited Athletic Training Education Programs

Chally PS, Kleiner DM: University of North Florida, Jacksonville, FL

Previous reports have suggested that athletic training students will become increasingly more diverse in the 21st century, and that these changes in the student demographic complexion may impact educational strategies. Furthermore, many state-sponsored institutions of higher learning strive to recruit more minority students, often without any data for comparison. The purpose of this study was to describe the current demographic composition of students pursuing entry-level athletic training education in programs accredited by the Commission for the Accreditation of Allied Health Education Programs (CAAHEP). A survey was sent to the 82 program directors who were identified from the 1998 list of CAAHEP-accredited programs provided by the National Athletic Trainers Association (NATA). Sixty-five percent of the instruments ($n = 53$) were returned to the investigators and analyzed. Standard descriptive analyses were used, as well as t-tests. Data are presented as means (\pm S.D.) and percentages. Data were combined for national demographics, and grouped according to NATA district. Nationally, the mean number of students enrolled in these programs was 36.7 (± 19.9), and ranged between 11 and 106 students. There were significantly ($p < 0.05$) more female students enrolled 57.3% (± 9.6) than male students 42.8% (± 9.6). When analyzed by district, the percent of female students was greater in every district, except 6 and 8. The difference in percent of males and females was statistically significant in 3 of 10 districts. The national breakdown of racial and ethnic statistics was; 90.2% (± 11.7) White, 3.7% (± 4.3) Black, 2.7% (± 8.6) Hispanic, 0.5% (± 1.3) American Indian/Alaskan Native, 2.4% (± 3.4) Asian/Pacific Islander, and 0.5% (± 1.2) for "Other". At the district level, it was observed that districts 7 and 8 had the smallest percentage of white students, as well as the greatest percentage of Hispanic students. District 5 had the greatest percentage of white students, and district 9 had the greatest percentage of black students. It was also interesting to note the uneven distribution of the number of CAAHEP accredited programs across the 10 NATA districts. These data may be useful in encouraging academic institutions to develop accredited curricula in under served geographic regions, identify under served student populations, and encourage minority recruitment.

Academic Preparation For Counseling In Athletic Training Programs: Two Views

Misasi SP: Southern Connecticut State University, New Haven, CT

Athletic trainers have assumed several roles and responsibilities over the years, but perhaps there is none more important than that of a counselor. Athletic trainers have traditionally enjoyed a unique relationship with student-athletes and interactions can range from physical to mental issues. They are able to view the athlete at his/her highs and lows. As athletic trainer/athlete relationships are primarily based on trust, the athletic trainer's opinion is often sought by athletes regarding topics other than injury prevention and management. This study examined the educational views of 83 Undergraduate Accredited/Approved Athletic Training Program Curriculum Directors and their student athletic trainers on issues related to counseling. The Modified Revised Wylie Inventory was utilized to obtain the data. Three research questions were investigated. Of the 83 packets, 52 (62.6%) were returned. Fifty-one Curriculum Directors and 826 student athletic trainers responded. The instrument was found to be both valid and reliable. The inventory yielded six factors, therefore a MANOVA was conducted. Addressing research question one statistically significant results were found with Factor three (Participation) and Factor five (Emphasis B). Statistically significant results were found concerning the issue of suicide for the second research question with respect to where the education emphasis should be placed. With respect to research question three, there was a significant difference in the ranking of the counseling issues between the Curriculum Directors and the student athletic trainers with regard to nutrition and suicide. In reference to which counseling courses the two groups had taken, there were statistically significant differences between Curriculum Directors and student athletic trainers concerning the following: Sport Psychology, Introduction to Counseling, Group Dynamics, Group Facilitation, Developmental Psychology, Adolescent Psychology, Abnormal Psychology, and Multicultural Counseling. Examining where the Curriculum Directors refer athletes, the response was most 'often' to counselors on campus. Based on the results of the study one must examine the educational process of the athletic trainers. The athletic trainer must be educated to address both, mind and body, issues that athletes present. It is necessary to better prepare the future athletic trainer for their role as a counselor.

Qualitative Assessment Of The Effectiveness Of An Interactive Multimedia Program On Upper Extremity Injury Evaluation

Voigt G, LaMaster K, Wiksten DL, Patterson P: San Diego State University, San Diego, CA

While the literature indicates the effectiveness of interactive computer programs in educating students and saving instructor's time, it is not fully understood how this type of instruction can be best integrated into athletic training educational curricula. Preliminary research indicates that instructional technology is an effective tool for instruction, but may not be able to stand alone as an independent means of instruction. The purpose of this study was to qualitatively assess the effectiveness of a multimedia instruction program on upper extremity injury evaluation as a supplement to traditional instruction. A fall semester injury evaluation class (n=22) received traditional methods of instruction including slide and overhead presentations reviewing pertinent anatomy, injury mechanisms, and injury evaluation techniques. In addition, hands-on demonstrations and laboratory experiences were provided for individual practice and one-on-one instruction. Students also had access to textbook references, a laboratory manual, and anatomical models. The spring semester injury evaluation class (n=9) received the same traditional methods of instruction with the addition of a multimedia instructional program on upper extremity special test techniques that was utilized as a reference source. Data sources were compared for the fall and spring semesters and included weekly student journals and focus group discussions. Both of these data sources sought to determine students' perspectives concerning method of instruction and examination preparation techniques. Weekly journals were read and reread to identify recurring themes. Several themes evolved and were categorized as effective instruction, ineffective instruction, use of instructional materials, and professor access. Transcriptions from the audio taped focus group discussions were read and reread to identify themes. Results from weekly journals indicated that all students in the traditional lecture and the combined computer/lecture groups felt the method of instruction was effective, and the available resources were deemed to be of use. The computer/lecture group made specific notations concerning the CD-ROM program that identified access, feedback, and compatibility issues. In addition to the above stated themes, the focus group discussions revealed that the professor could have been more efficient if there was more than one in-

structor or extra laboratory time. It does appear there is a need for enhancing professor efficiency in the classroom. It is possible the use of multimedia instruction as a resource during laboratory class time may assist students' quest for clarification of knowledge. However, the use of multimedia instruction does have its limitations and should not be intended as a substitute for human contact or hands-on practice.

Developing An Interactive Application Using Authorware Professional

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

This presentation is designed to demonstrate the use of multimedia technology in creating computerized interactive applications, using an authoring package that does not require extensive programming knowledge, but allows flexibility. Authoring packages provide an alternative for individuals not proficient in programming skills or who may not have the time to learn a programming language. Authorware Professional was used to create The Basic Athletic Training Interactive Quiz for use with individuals who will be taking the Athletic Trainers Certification Exam. The quiz tests entry level knowledge on the domains of prevention of athletic injuries, evaluation and management of athletic injuries, reconditioning and rehabilitation of athletic injuries, health care administration, and professional development. The authoring package used to develop the computerized interactive quiz was Authorware Professional, which employs an object-oriented interface and does not require extensive programming knowledge or skills. Authorware Professional enables the developer to use most conventional types of testing formats and also allows use of simulations. Applications can include graphics, digitized video, and sound; and responses to items can be given in a variety of ways.

Male School Teacher/Athletic Trainers' Earn More Than Females

Carr JL, Wimer JW: Wilmington College, Wilmington, OH

Many observational studies have examined salary differences based on years of experience, educational level and employment setting. There is little empirical evidence, however, to suggest that salary differences exist in the K-12 school setting among men and women. Therefore, the purpose of this study was to investigate whether male school teacher/athletic trainers earn more than female school teacher/athletic trainers. Based on a review of the literature, we hypothesized that men would earn more than women. In order to test our hypothesis, we designed a survey that consisted of 16 items organized into two parts: demographic information and attitudes. The surveys were mailed to 100 certified athletic trainers who listed high school as their primary employment in our state Athletic Trainers' Association membership directory. Fifty-nine surveys were returned. The sample was comprised of 40 males (68%) and 19 females (32%). Results of the surveys showed that males earn more than females. Specifically, we found a significant difference between men and women's self-reported earnings using an independent samples t-test ($p=.019$). In our sample, males earned, on average, \$6,933 more than women for their teaching and athletic training duties (mean = \$44,234 \pm \$9,737). Although pay discrepancies continue to be a common occurrence in our society, the wage gap appears to be closing in some allied health professions (e.g., nursing). In part, federal laws like Title IX prohibit sex discrimination. However, we believe that subtle sexist behaviors (i.e., gender bias) will continue to make fairness issues like equal salary for equal work difficult to rectify, even in light of federal legislation. In other words, we believe that subtle sexist behaviors, practiced over time, create an unequal climate for women. For example, when men ignore women's contributions, interrupt women in conversations, or attribute a woman's idea to a male, (behaviors typically found in the athletic setting), they tend to create an unequal and potential hostile climate for women. This climate causes people to regard issues such as pay differences for men and women as normal and acceptable.

Comparison Of Preferred Characteristics In Hiring Practices Of Athletic Trainers In Different Intercollegiate Divisions

McWilliams BJP, Ransone JW, Jacobson B, Edwards SW: Oklahoma State University, Stillwater, OK

The objective of the study was to investigate the preferred employment characteristics in hiring a certified athletic trainer as determined by head athletic trainers in four different intercollegiate divisions. The sample group, divided into four groups, represented National Collegiate Athletic Association (NCAA) Division I, II, and III as well as smaller schools such as junior colleges. A 43 item questionnaire designed to investigate the differences among intercollegiate divisions when hiring an athletic trainer was distributed to head athletic trainers working at collegiate levels randomly selected by the NATA computer database. Of the 300 surveys distributed, 206 were returned for a return rate of 68.7%. The questionnaire addressed areas of expertise of athletic trainers, along with work and personality traits associated with athletic trainers. In addition, the domains of athletic training and tasks associated with each domain as established by the National Athletic Trainers Association Board of Certification (NATABOC) in 1995 assessed. Using a five point Likert scale, the respondents ranked the domains, individual tasks, work and personality traits appropriate to hiring an athletic trainer. Further, analysis was performed using analysis of variance measurements. There were striking similarities in how domains were answered by the four groups. The five domains of athletic training: prevention of athletic injuries ($2.11 \pm .88$), recognition, evaluation and immediate care of athletic injuries ($1.17 \pm .41$), rehabilitation and reconditioning of athletic injuries ($1.87 \pm .80$), health care administration (3.00 ± 1.17), and professional development and responsibility (2.68 ± 1.27) revealed no significant differences ($p>0.05$) within and between the various divisions in the importance levels of each domain. The total scores of all respondents were not significantly different ($p>0.05$) from the individual scores. A significant relationship ($p > .05$) existed among the five domains and the sub-sets of the domain's task. Positive attitude, professionalism, willingness to learn and adaptability were the top four work and personality characteristics desired in new employees with possessing a master's degree and the years of experience ranked eighth and ninth respectfully. The results of this study suggest that employers among the different collegiate divisions are looking for the same job skills, work and personality characteristics when hiring an athletic trainer. Recognition of athletic injuries was the most important domain in selecting an employee. Positive attitude and professionalism were the top work and personality characteristics chosen by the respondents.

Consistency And Quality Of Athletic Training Services In Ohio's High Schools

Smith Goodwin E: Wright State University, Dayton, OH

The purpose of this study was to investigate and determine the consistency and quality of athletic training services in Ohio's high schools. Instrumentation included a twenty-six part questionnaire that was sent to all (N = 1196) certified and licensed athletic trainers in the State of Ohio. A total of 405 questionnaires were returned for a 34% return rate. The frequencies of responses were analyzed using percentages and one-way analysis of variances. There was a significant difference between the number of full time staff across Ohio High School Athletic Association divisions such that division I schools had significantly more full time staff (75% had at least one full time trainer) than the other divisions (50% of division V schools reported no full time trainer). Full time trainers worked a variety of hours with the most common response being that of 41 - 50 hours a week. When comparing the number of weekly visits made by the part time ATC across the divisions, division II schools ($M = 4.65$) were significantly greater than division IV ($M = 3.08$) and division V ($M = 2.41$) schools. The larger the school the more likely the ATC will visit. The most common response for part time ATC's hours were 11 - 20 hours a week. Part time athletic trainers ranged anywhere from one to as many as six visits per week to their school. In regards to athletic trainers covering games where admission was charged, 48% of those surveyed responded to being at those games 100% of the time. In contrast, only 16% responded to being at 100% of the games without an admission charge. Results showed that athletic trainers covered 94% of home varsity football games, 82% of home boy's varsity basketball games, and 70% of home wrestling matches. Athletic trainers covered 89% of away football games. It was also found that the majority of the time a doctor was present at less than 25% of the games. Further studies are needed to add more concrete evidence and strength to the foundation of this problem. In an attempt to find solutions to these problems, we can actually educate coaches and school administration about the profession of athletic training and rectify their understanding of proper medical personnel and the consequences of that deficiency.

Williams RB, Hadfield OD: New Mexico State University, Las Cruces, NM

Notes:

Free Communications, Poster Presentations: Session B

Thursday, June 17, 8:30 AM - 12:00 PM, Convention Center, Lobby 200, Level 2. Authors present from 11:00 AM to 12:00 PM to answer questions.

The Assessment Of Pain In Original Research Articles Published In The Journal Of Athletic Training: Implications For Improving Research And Practice

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The purpose of this investigation was to examine the methods by which pain was assessed in original research articles published in the *Journal of Athletic Training* during the 7-year period from 1992 to 1998. A "by hand" search of the title, abstract, methods and results sections of every original research article was conducted in order to determine those papers in which pain measurements were reported. A total of 21 of the 173 (12 %) research articles that were published over the 7-year period included some type of pain assessment. Most of the research articles that included a measure of pain addressed either the topic of delayed onset muscle pain (43%) or pain resulting from cryotherapeutic procedures (19%). The large majority of pain-related research published in the *Journal of Athletic Training* (81%) assessed only pain intensity and ignored other potentially important aspects of pain such as the extent to which pain changed behavior or how the pain made the patient/research subject feel (i.e., no measure of the affective component of pain was obtained). Several investigations employed pain measures that lacked supportive validity evidence, and frequently the instructional set employed was inadequately described. An appreciable portion (14%) of the articles published in the *Journal of Athletic Training* were on topics with direct or indirect relevance to pain; for example, articles dealing with patellofemoral syndrome or those examining temperature changes associated with the use of modalities such as ultrasound or cryotherapy. Unfortunately, these pain-related papers did not include any measures of pain. A primary conclusion of this investigation is that pain is frequently not assessed/reported by individuals conducting athletic training research, and those investigators who do include measures of pain typically assess pain in a narrow fashion. That is, the pain measures used typically focus solely on the intensity of the pain sensation. These results suggest that opportunities for learning more about whether or how pain is influenced by athletic training procedures are being missed. Based on the findings of this investigation, athletic trainers who are involved in research as well as those who are clinical practitioners are urged to consider employing valid, multidimensional measures of pain in order to better understand relationships between pain and both athletic training procedures and clinical outcomes.

A Comparison Of Acupuncture, TENS, And Acupuncture With TENS For Pain Relief Following Delayed Onset Muscle Soreness

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Objective: One of the main goals during early rehabilitation of musculoskeletal injury is to decrease pain. Recently, acupuncture and TENS have widely used for relief pain. However, limited evidence to compare the effects of these modalities for treating musculoskeletal pain in athletic training field. The purpose of this study is to compare the effects of acupuncture, acupuncture with TENS, or TENS alone on pain associated with delayed onset muscle soreness (DOMS). **Design and Setting:** A 4 X 8 factorial design was used. The dependent variable was perceived pain of the biceps brachii as measured by the Visual Analog Scale. The two independent variables were treatment (acupuncture, TENS, acupuncture with TENS, and control) and test (24, 48, 72, and 96 hours after exercise with both before and after treatment). **Subjects:** Forty volunteers (20 male, 20 female) between the age of 19 and 33 were recruited for this study. All subjects would not have trained the upper body within three months prior to beginning the study and had no history of pain or injury to the non-dominant arm. Also they were not taking any medicine at the time. **Measurements:** Perceived pain was measured with the Visual Analog Scale both before and after treatment every 24 hours for 4 days after inducing DOMS, and treatment groups were compared. A repeated measure two-way multivariate analysis of variance used to determine if any differences in pain existed between groups. **Results:** There were no significant differences in pain between treatment groups at any of the individual time intervals ($p > .05$). **Conclusions:** We conclude that none of the treatments were superior in treating the pain associated with DOMS.

Microcurrent Electrical Stimulation May Reduce Clinically Induced Mild Delayed Onset Muscle Soreness

Ansoleaga E, Wirth VJ: University of Charleston, Charleston WV

The effectiveness of the Microcurrent Electrical Neuromuscular Stimulation (MENS) units has been debated for a long time, and their effectiveness is still argued. The purpose of this study was to determine the effect of MENS on delayed onset muscle soreness (DOMS). The subjects were 21 Caucasian males, (age = 16.38 ± 0.49 years; ht = 175.02 ± 4.08 cm, wt = 67.71 ± 6.35 kg), randomly assigned to one of three groups; A, B, or C. Subjects with any elbow or triceps brachii muscle pathology within the last 6 months, or those involved in any training program that includes the triceps brachii muscle group, were disqualified for this research. Laying supine on the floor, and using a dumbbell on the non-dominant arm, the subjects performed a series of 5 repetitions of elbow flexion and extension, (90° - 180°), with the shoulder at 90° with 30 seconds of rest in between each series, until exhaustion, using 75 % of their 1 RM. The day before this task, and for 3 consecutive days afterwards (24, 48 and 72 hours), the pain level (visual analogue scale VAS, and a verbal rating scale VRS) and the AROM (universal goniometer) were documented. Group A (experimental group) received a 20 minutes microcurrent treatment for 3 days, while group B (sham group) received a sham treatment, and group C (control group) no treatment at all. A Repeated-measures ANOVA and Tukey Post-hoc test revealed a decrease in VRS pain for the experimental group at 48 and 72 hours post-workout ($P < .05$). Pain increased in the sham and control groups at 48 and 72 hours post workout. No significant differences in AROM or VAS. The results are contradictory, with a significant difference appearing in the VRS, but no differences in the VAS or AROM. One explanation is that MENS may actually reduce pain sensation; the second possibility is that the VRS (seven categories), is less accurate to measure mild soreness than the VAS (graded 1 to 10).

The Influences Of Various Layers Of Insulation On Heat Transfer

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FL

Hydrocollator packs are maintained in 77°C water for use as a thermal modality. Specifically designed teri-cloth covers are commonly used with these hydrocollator packs. These covers are often inadequate and require additional insulation, which is frequently provided by cotton towels. The purpose of this study was to determine if various insulators affect the amount of heat that is transferred from the hydrocollator pack to the subjects skin during a standard 20 min. treatment. Manufacturer-provided teri-cloth hydrocollator-pack covers and cotton towels were used as the insulators in this study. Seventeen subjects (10 females, 7 males) participated in this study. Each subject had a hydrocollator pack applied to the same anterior portion of their thigh on four days spaced one week apart. Skin temperature was obtained with a surface thermistor. Each subject participated in four trials; (1) one standard teri-cloth hydrocollator pack cover [1C], (2) two standard teri-cloth hydrocollator pack covers [2C], (3) one standard teri-cloth hydrocollator pack cover and one towel [1C1T], and (4) one standard teri-cloth hydrocollator pack cover and two towels [1C2T]. Data were analyzed by ANOVA and are presented as means (\pm S.D.). Each subject was asked to allow the hydrocollator pack to remain in place for 20 minutes. However, 65% of the subjects ($n = 11$) were unable to complete the treatment under the 1C condition. The mean duration for the 1C condition was 8.9 (\pm 8.5) minutes. One subject was also unable to complete the 2C condition (5 min.), while every subject was able to complete the entire 20 min. treatment for the 1C1T and 1C2T conditions. Baseline (pre-treatment) skin temperature was 30.6°C (\pm 2.0). Final (post-treatment) temperatures were not significantly different ($p > 0.05$) across conditions. Final (post-treatment) temperatures were 39.0°C (\pm 7.0), 37.0°C (\pm 1.0), 37.0°C (\pm 1.0), and 37.0°C (\pm 1.0) for 1C, 2C, 1C1T, and 1C2T, respectively. These data show that adding layers of insulation to hydrocollator pack covers does not affect the amount of heat that is transferred to the skin after a 20 min. treatment. However, additional layers of insulation may be necessary to allow adequate patient/athlete comfort and achieve the full duration of treatment.

Joint Position Sense In The Knee Following 30 Minutes Of Cryotherapy

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Cryotherapy is one of the most commonly used modalities in athletic training and physical therapy. Previous research has supported the conclusion that cryotherapy does slow local blood flow and nerve conduction velocity (NCV). One could draw the conclusion that due to decreased NCV, proprioception would also be affected. Therefore, the purpose of this study was to investigate any change in proprioception brought on by the application of cold to the knee. This study would use the subject's ability to actively reproduce passive motion as a measure of proprioception. Nineteen subjects volunteered and were accepted for this study (11 male, 8 female, median age=26). The study design consisted of 2 separate trials: one experimental (30 minutes of cold) and one control (30 minutes of sitting with no cold). Subjects participated in both trials. Prior to each trial, subjects were blindfolded and the knee of the dominant leg was passively moved through three predetermined ranges: 90-45-90, 75-30-75 and 60-15-60 three times each in a Lido isokinetic dynamometer. Following passive movement through each angle, subjects were asked to actively reproduce the movement. They then participated in one of two sessions; an experimental session or a control session, after which subjects were again measured in the manner previously described. Cold treatment was delivered using two 11X18 reusable chemical cold packs that were circumferentially wrapped lengthwise around the knee. A 2 (trial)X2 (pre/post measures)X3 (angle) ANOVA was used to compare the average deviation in degrees from total movement for each angle. For 90-45-90, pre-treatment average deviation was 7.8, SD=4.0, post-treatment deviation was 15.9, SD=8.6, $F=14.0$, $P=.006$. Pre-Control deviation was 7.4, SD=3.1, post-control deviation 6.9, SD=3.4, $F=0.2$, $P=0.7$. For 75-30-75, pre-treatment was 7.3, SD=3.4, post-treatment 15.4, SD=4.6, $F=38.5$, $P=3.65e-07$. Pre-control deviation was 7.3, SD=5.6, post-control deviation was 6.4, SD=2.7, $F=0.4$, $P=0.5$. For 60-15-60, pre-treatment deviation was 7.1, SD=3.5, post-treatment deviation was 16.8, SD=6.1, $F=36.3$, $P=6.5e-07$. Pre-control deviation was 6.9, SD=1.2, post-control deviation 8.4, SD=3.7, $F=2.4$, $P=0.1$. These results suggest that the proprioceptive ability of our subjects, as measured by ability to accurately reproduce passive knee motion, was affected by a 30-minute application of cold. Further research into this area should be conducted and should include a measurement for subcutaneous temperature changes.

Changes In Dynamic Postural Stability Following Cryotherapy To The Ankle And Knee

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Cryotherapy is a widely used modality for treatment of acute and chronic injuries. Some of its positive effects include pain relief, muscle spasm reduction, decrease in cell metabolism, modification of the inflammatory response, and decrease in blood flow and swelling. However, cryotherapy is reported to have detrimental effects on isometric peak force development rate and nerve conduction velocity. The effects of cryotherapy on proprioception are somewhat conflicting in the literature. The purpose of this study was to investigate the effects of ice on dynamic postural stability when icing joints at the knee, and the knee and ankle simultaneously. Twenty male and female subjects, ages 18-30 years, volunteered for participation. Each subject was tested for dynamic postural stability using a single-leg stance on a Biodex Stability System (BSS). Testing occurred on three separate days. Subjects were tested following treatment. The three treatments consisted of a control, an Ice-Pak (Readlyn, Iowa) surrounding the knee joint for twenty minutes, and an Ice-Pak surrounding both the knee and ankle joints for twenty minutes. The results given from the BSS included an overall stability index (OSI), a medial/lateral index (M/L), and an anterior/posterior index (A/P). Results of three trials were averaged together to obtain means for OSI, M/L, and A/P. Three ANOVAs with repeated measures were run to determine significant difference between the means for each variable of stability. The level of significance was set at $p < 0.05$. If a significant difference was noted, a Tukey post hoc test was used to determine where the differences occurred. From the results of the investigation, it was determined that no significant difference was noted between the treatments of control, ice at the knee, and ice at the knee and ankle. However, a significant difference was determined to be present between genders for OSI and A/P indices, regardless of treatment, with the males demonstrating a deficit in dynamic postural stability. Dynamic postural stability was not affected immediately following treatments of ice for twenty minutes surrounding the joints of the lower extremity. From the conclusion of this investigation it was determined that activity can be performed following treatments of cryotherapy without increasing the chance for occurrence of injury related to balance deficits. Further investigations should be conducted to determine if the treatment of ice in the same manner would affect functional activities or agility.

Effect Of Beam Nonuniformity Ratio Of Three Ultrasound Machines On Tissue Phantom Temperature

Gatto J, Kimura IF, Gulick D, Mattacola C, Sittler MR, Kendrick Z: Temple University, Philadelphia, PA

The purpose of this study was to determine the effect of beam nonuniformity ratio (BNR) of three ultrasound machines on tissue phantom temperature. Tissue phantom temperature data across three (left, center, and right) thermocouple probe positions were collected for three ultrasound machines during five, 12-min data collection trials of continuous mode, 1 MHz frequency at 1.5 W/cm² with 5 cm² transducers. A 3 x 3 analysis of variance (ANOVA) at $p < .05$ alpha level was used to compare ultrasound machines and temperature increases at three thermocouple probe positions. The F values indicated a significant difference between ultrasound machines regardless of thermocouple probe position. Tukey post-hoc test results indicated that the tissue phantom temperature increase for the Dynatron 150+ ultrasound machine from baseline to 12 min was 2.61 and 2.51 degrees C greater than the Intellect 225P and Rich-Mar V ultrasound machine tissue phantom temperature increases, respectively. Three, 3 x 13 ANOVAs with repeated measures at $p < .05$ alpha level were used to compare three thermocouple probe positions and 12 min treatments of each ultrasound machine. The Dynatron 150+ F values indicated a significant interaction between thermocouple probe positions and treatment time. Subsequent tests for simple effects (Hotelling's t-squared statistic) indicated significant differences ($p < .05$) between treatment minutes 3 through 12 across the thermocouple probe positions. Results of two pairwise t-tests adjusted via the Bonferroni technique revealed significant differences in left and right, and center and right thermocouple probe positions. Dynatron 150+ results also revealed increases in tissue phantom temperature for the three thermocouple probe positions during the 12-min treatments. These results revealed uneven heating across thermocouple probe positions, suggesting uneven heating capabilities of the Dynatron 150+ transducer. The F values for the Intellect 225P and Rich-Mar V ultrasound machines indicated significant differences in time, regardless of thermocouple probe position. Tukey post-hoc tests performed for the Intellect 225P and Rich-Mar V ultrasound machines indicated significant increases in tissue phantom temperatures during the 12-min ultrasound treatments. In conclusion ultrasound treatment efficacy should not be based solely on the reported BNR of the ultrasound machine. Regular calibration, reliable treatment techniques, and consistent use of the same ultrasound machine throughout a patient's treatment prescription should provide consistent ultrasound treatment results.

Accuracy Of Intensity Output, Beam Nonuniformity Ratio, And Effective Radiating Area Of Four Therapeutic Ultrasound Machines

Young DR, Kimura IF, Gulick D, Mattacola C, Kendrick Z: Temple University, Philadelphia, PA

The purpose of this study was to investigate the accuracy of intensity output, beam nonuniformity ratio (BNR), and effective radiating area (ERA) of four ultrasound machines. Methods included an ultrasonic hydrophone probe and a Tektronix 455 A2/B2 oscilloscope used to assess the output of four ultrasound machines. Three data collection trials were completed for each machine at a continuous mode, 1MH frequency at 1.5 W/cm². Measurements were taken in 1mm increments in the vertical and horizontal directions from the center of the transducer. The accuracy between the measured intensity and preset intensity output of the four ultrasound machines was analyzed by performing pairwise t-test (Microsoft Excel, Redmond, WA) at $p < .01$ alpha level. The BNR of the four ultrasound machines was calculated by dividing the highest intensity (W/cm²) within the ultrasound beam to the average intensity (W/cm²) of the ultrasound beam. The ERAs of the four ultrasound machines were evaluated by comparing the percent difference of the measured ERA to the reported ERA. ERA was calculated by measuring the effective total surface area of each ultrasound transducer. Pairwise t-tests results indicated no significant difference between the preset and the measured intensity output ($p < .01$) of the Omnisound 3000C machine. The Intellect 225P and Mettler Sonicator 706 measured intensities were higher than the preset outputs and the Rich-Mar V measured intensity was lower than the preset output. Calculations of the BNRs were 2.0:1, 1.4:1, 3.1:1, and 2.2:1 for the Intellect, Mettler, Omnisound, and Rich-Mar units, respectively. The ERAs were 99%, 61.5%, 170.4%, and 118.4% of the transducer head for each unit mentioned above, respectively. In conclusion the consistency of the output of the ultrasound machine is far more important than the traditional calculation of BNR. A "modified BNR" was suggested with the calculation based on the actual intensity output, not the preset intensity. The mapping of the ultrasound crystal revealed variable ERAs and output patterns. Clinically this information suggests that our ultrasound application method should be a circular technique to compensate for the lack of homogeneity of the crystal.

Overlying Adipose Significantly Effects Intramuscular Temperature Change During Crushed Ice Pack Therapy

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When applying ice a temperature gradient is obvious, with the skin cooling immediately, cooling in the subcutaneous tissue next and a delayed response in the muscle. Adipose serves as an insulator. While researchers have documented that a > 2 cm skinfold leads to slower cooling at 1 cm into a muscle, no research has been done to examine the relationship between the amount of adipose tissue and intramuscular temperature change over a wide range of skinfolds. **PURPOSE:** To investigate the relationship between the amount of adipose tissue and intramuscular temperature change during a 20-minute crushed ice pack treatment and for 30 minutes post-treatment. **SUBJECTS:** Thirty healthy college students volunteered and signed an Institutional Review Board approved consent form to become subjects. They were divided in three equal groups according to the depth of subcutaneous fat over each subjects gastrocnemius: ≤ 8 mm, 10-18 mm, ≥ 20 mm. **METHODS:** We placed two microprobes at 1 cm and 3 cm, respectively, below the subcutaneous fat in the left medial calf. Each subject had a 1.8 kg crushed ice pack placed directly over the triceps surae muscle group. Intramuscular temperature was recorded, every 10 seconds over the entire treatment and for 30 minutes post-treatment. **ANALYSIS:** Two separate 2 X 3 repeated measure ANOVA's were used to access temperature change during the treatment and post-treatment for each depth. Duncan's Multiple Range Tests were used post-hoc to look for differences between skinfold thickness groups. **RESULTS:** There were significant differences in intramuscular temperature decreases between skinfold thickness groups at the end of treatment at both 1 cm and 3 cm below the subcutaneous fat ($p = 0.0001$ and $p = 0.0006$) respectively. At 1 cm the temperature decreases were 14.43°C, 9.06°C, and 5.00°C respectively, for ≤ 8 mm, 10 - 18 mm, and ≥ 20 mm skinfold. At 3 cm they were 6.22°C, 3.86°C and 2.42°C. During the post-treatment at 1 cm the ≤ 8 mm group rewarmed 5.39°C, the 10-18 mm group rewarmed 2.22°C, but the ≥ 20 mm group remained .49°C below the temperature they were at the end of the treatment. At 3 cm all three groups were colder at 30 minutes post-treatment than they were at the end of the treatment. **CONCLUSION:** Overlying adipose is a significant factor in the amount of intramuscular cooling that occurs during cryotherapy and therefore should be taken into account in determining appropriate treatment protocols.

Passive Hip Flexion Does Not Increase During Or Following Ultrasound Treatment Of The Hamstrings Musculature

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Objective: The stretching window refers to the period of maximum tissue temperature increase during and immediately following ultrasound treatment. This study was conducted to determine if an optimal time period exists for combining ultrasonic heat and stretching to obtain maximum joint range of motion. **Design and Setting:** A 1 x 5 factorial design was used. The independent variable was time with 5 levels (5 minutes into treatment or 1½, 3½, 6, or 10 minutes following treatment). The dependent variable was maximum passive hip flexion range of motion (PHROM). **Subjects:** Fifty healthy graduate and undergraduate students (27 males, 23 females) at Indiana State University (age = 24.1 ± 3.4 yrs, ht = 174.1 ± 10.2 cm, wt = 74.0 ± 16.6 kg) participated in this study. All subjects were free from significant lower extremity injury and had less than 90° PHROM. **Measurements:** A range of motion pre-test was taken for each subject and compared with a range of motion post-test taken either 5 minutes into or 1½, 3½, 6, or 10 minutes following a 3 MHz ultrasound treatment of the hamstrings musculature. A one-way ANCOVA (with pre-test ROM as the covariate) was used to determine if a difference in ROM existed between groups. **Results:** No difference in PHROM existed between any of the 5 treatment groups ($F(4,44) = .28, p = .889$). **Conclusions:** A theoretical stretching window exists; or in other words, a maximum tissue temperature increase has been measured during and immediately following ultrasound treatment. However, this study did not find an optimal time period for stretching either during or following ultrasound treatment of the hamstrings musculature. The theoretical stretching window does not translate into increased range of motion in the hamstrings.

Clinical Efficacy Of Dexamethasone Iontophoresis In The Treatment Of Patellar Tendinitis In Collegiate Athletes: A Double Blind Study

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The purpose of this study was to determine the clinical efficacy of dexamethasone sodium phosphate (DmNaP) iontophoresis on patellar tendinitis in Division I collegiate athletes. Twenty eight subjects were randomly assigned to either a DmNaP (RX) or placebo (Control) iontophoresis group. A visual perceived pain scale (VPPS) and a pain threshold gauge (PTG), were used on days 1, 2, 3, 4, 5, and 7. A functional index questionnaire (FIQ), active range of motion (AROM) via goniometer, MicroFET hand-held dynamometer (HHD), and a functional test (FXN) were used on days 1, 2, 5, and 7. Two analyzes of variance (ANOVAs) with repeated measures ($p < .05$) used to analyze VPPS and PTG data indicated differences among sessions regardless of treatment group and Session x Group interactions. Tukey HSD tests (HSD) indicated decreases in pain between sessions 1 and 4, 5, 6 and decreases in tenderness between Sessions 1 and 5; 2 and 5, 6 for both groups, respectively. HSD Session x Group interaction indicated improvements in VPPS and PTG values of the RX group between Sessions 1 to 3, 4, 5, 6; 2 to 5, 6, and Sessions 1 to 5, 6; 2 to 5, 6 respectively. VPPS values of the RX group in Sessions 3; 4; 5; and 6 were less than those of the control group in Session 6; 5; 1, 3, 4, 5; and 6, respectively. Four 2 x 4 ANOVAs with repeated measures ($p < .05$) were used to analyze FIQ, AROM, HHD, and FXN data. No differences were found for FIQ and AROM data between treatment groups and among sessions. HSD for Session x Group interaction indicated HHD values of the RX group in Sessions 3 and 4 were greater than those in Session 1. HHD values of the Control group in Session 1; 3 and 4 were greater than those of the RX group in Sessions 1 and 2; and session 1, respectively. FXN F values indicated differences among sessions regardless of treatment group and a Session x Group interaction. HSD indicated increases in FXN values for both groups between Sessions 1 and 4. HSD for FXN session by group interaction indicated increases in FXN values of the RX group in Sessions 1 and 3, 4; and 2 and 4. FXN values of the Control group in Session 1 were greater than those of the RX group in Session 1. FXN values of the RX group in Session 3; and 4 were greater than those of the Control group in Session 2; and

Sessions 1, 2, 3, and 4, respectively. It was conclude that perceived pain, tenderness, isometric force production, and functional ability of Division I college athletes with patellar tendinitis improved within a 3- to 7-day period when treated with DmNaP iontophoresis and ice massage.

Free Communications, Poster Presentations: Session C

Thursday, June 17, 1:00 PM - 4:30 PM, Convention Center, Lobby 200, Level 2. Authors present from 3:30 PM to 4:30 PM to answer questions.

Differences Among Navicular Drop Measures

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There have been different methods of calculating navicular drop reported in the literature. The reliability of these measures has been reported independently, making direct comparison impossible. Thus, the purpose of this study was to assess the reliability of those measures and investigate the differences among different navicular drop measures. Twenty four subjects consisting of 12 males and 12 females (age = 22.3 ± 4.2 yr; ht = 174.5 ± 11.5 cm; wt = 72.3 ± 16.8 kg) with no history of reconstructive surgery to the lower extremity participated in this study. Two examiners took two sets of 4 navicular height measures on both feet of subjects. The 4 measures were: seated subtalar joint relaxed position (SR), seated subtalar joint neutral position (SN), standing subtalar joint relaxed position (STR), and standing subtalar joint neutral position (STN). We calculated navicular drop by subtracting the SR, SN, and STN positions from the STR position. We calculated reliability coefficients for the two navicular drop methods previously described in the literature using intraclass correlation coefficient formula (2,1). Intratester and intertester reliability for SN navicular drop and STN navicular drop ranged from .46-.87, and .25-.72, respectively. Separate 1 between (gender) x 2 within (foot position, body position) mixed model ANOVA's for each foot revealed significant differences among navicular drop calculations for left [$F(2,44) = 14.06, p < .0001$] and right [$F(2,44) = 23.8, p < .0001$] feet. Post hoc testing revealed left foot differences for SN (8.94 ± 6.26 mm) and STN (5.63 ± 3.33 mm) navicular drop and SN and SR (4.87 ± 4.76 mm) navicular drop. Significant right foot differences were found for SN (8.94 ± 3.74 mm) and STN (5.00 ± 2.25 mm) navicular drop and SN and SR (5.06 ± 3.19 mm) navicular drop. Our results showed SN navicular drop was more reliable than STN navicular drop, and that SN navicular drop produced higher values than STN navicular drop (3.31-3.86 mm) or SR navicular drop (3.07-3.31 mm). Future research should examine standardizing methods of calculating navicular drop to insure the most accurate and clinical relevant assessment.

The Effect Of Chronic Ankle Bracing On Evertor Isometric Torque

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Objective: Ankle braces are commonly used to prevent and protect the ankle and foot complex from injury. The effects of prolonged ankle brace use on foot and ankle muscle strength is not well understood. The purpose of this study was to evaluate the effects of chronic ankle bracing on evertor isometric torque. **Design & Setting:** A 2 x 3 factorial design was used with two levels: time (pretest and posttest) and brace (Active Ankle trainer, McDavid 199, and control). The dependent variable was eversion isometric torque. Subjects: Twenty-eight active college-aged volunteers (age = 23.7 ± 2.9 yrs, ht = 170.3 ± 11.0 cm, wt = 75.1 ± 18.4 kg) free from lower extremity injury within the past 12 months participated in the study. **Measurements:** An isotonic dynamometer (BTE Dynatrac Extremity System) measured evertor isometric torque before and after 8 weeks of brace wearing (totaling 8 hours per day). **Results:** There was a significant two-way interaction between time and brace for evertor isometric torque ($F(2,25) = 7.045, p = .004$). Simple main effects revealed that evertor isometric torque increased over time when collapsed across brace. Thus, there were no differences among the brace conditions. **Conclusion:** Eight weeks of wearing an ankle brace does not appear to have a deleterious effect on evertor isometric torque. Although ankle brace wearing does not appear to affect evertor strength, it may result in negative neurological consequences.

Somatosensory Control Of Posture While Performing Proprioceptive Ankle Exercises

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Objective: The purpose of this study was to compare three proprioception exercises (BAPS Board™, T-Band Kicks, one-legged stance) to determine the magnitude of change that each exercise may place on the somatosensory system as measured by the spectral qualities of postural sway. **Design and Setting:** A 1 x 3 general linear model with repeated measures was used to determine if differences existed between proprioceptive exercises on mean somatosensory frequency for the mediolateral (ML) and anteroposterior (AP) center of pressure trajectories. Univariate F-tests and Tukey multiple comparison techniques were used post-hoc to locate group differences. The study took place in the Indiana State University Sports Injury Research Laboratory. **Subjects:** Thirty healthy college students volunteered for this study. All subjects were free from lower leg and ankle pathologies within the past twelve months. **Measurements:** A BAPS Board™ exercise, a Thera-Band™ exercise and a one-legged stance were each performed on the force platform. An AMTI Accusway strain gauge force platform was used to measure ML and AP center of pressure trajectories (COP). Mean frequency amplitudes in the .7 - 1.2 Hz range were computed from the COP values using a Fast Fourier Transformation, representing somatosensory activity. **Results:** In the AP direction, the T-Band kicks exercise condition had a greater somatosensory frequency compared to the one-legged stance exercise ($P < 0.05$) and BAPS Board™ exercise exercise ($P < 0.05$). The BAPS Board™ produced greater somatosensory frequency compared to the one-legged stance exercise ($P < 0.05$). In the ML direction, the BAPS Board™ exercise had greater somatosensory frequency compared to the T-Band kicks exercise exercise ($P < 0.05$). The one-legged stance exercise condition resulted in greater mean somatosensory frequency compared to the T-Band kicks exercise exercise ($P < 0.05$). No differences were found between the BAPS Board™ and one-legged stance conditions. **Conclusions:** We recommend using multiple exercises that emphasize and challenge the AP and ML components of maintaining postural control.

An Examination Of Eversion/Inversion Isokinetic Strength Ratios Between Uninjured And Functionally Unstable Ankles

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Functional ankle instability (FAI) troubles many athletes and leads to countless hours of treatment and rehabilitation. The exact cause of FAI is not clearly understood. Recent research has focused attention to the examination of strength ratios between reciprocal muscle groups such as the evertors and invertors. The purpose of this study was to determine if differences in eversion/inversion (E:I) isokinetic strength ratios existed between subjects with FAI and subjects with uninjured ankles. Thirty subjects volunteered for this study: 15 subjects suffered unilateral FAI (age=21.6±2.3 yr., wt=72.7±18.4 kg, ht=170.8±8.3 cm) while 15 subjects served as matched-paired controls (age=20.8±1.3 yr., wt=73.2±19.4 kg, ht=170.1±8.0 cm). FAI was determined through the use of a subjective questionnaire and subsequent orthopedic evaluation to rule-out mechanical instability. The Kin Com 125 AP (Chattanooga Corporation - Hixson, TN) isokinetic dynamometer was used to assess peak torque. Subjects were tested while seated in the dynamometer chair with the ankle in 5° of plantar flexion. Concentric isokinetic eversion and inversion strength of the involved ankles was assessed at 30°/sec and 120°/sec. Strength was measured throughout a complete eversion to inversion range of motion. Subjects provided maximal effort until a consistent maximal torque curve was produced 3 times. A 1 minute rest was provided between different velocities and ankle motions. Maximal peak torque (PT) values normalized for body mass (kg) were extracted and used to calculate the E:I ratios. A mixed model ANOVA was used to determine if differences in E:I ratios existed between the two groups. Mean concentric E:I ratios at 30°/sec were .98±.34 Nm/kg in the FAI group and .96±.29 Nm/kg in the control group. Mean concentric E:I ratios at 120°/sec were 1.08±.27 Nm/kg in the FAI group and 1.00±.24 Nm/kg in the control group. The concentric E:I ratios were consistently higher in the FAI group, however no significant differences existed between the two groups. The high E:I ratios in both groups suggests that the evertor and invertor muscle groups are close to each other in terms of concentric isokinetic strength at the two velocities studied. This study adds support to the growing body of evidence that suggests that muscle weakness may not be a major contributing factor in those who suffer from FAI. The development of a database of normative E:I ratios for the subtalar joint motions of eversion and inversion is needed for future comparisons.

The Effect Of Donning A Swede-O Ankle Brace On Peak Plantar Pressures During Gait

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The purpose of this study was to determine if the usage of a Swede-O ankle brace has an effect on the peak plantar pressure of the foot during normal gait. The hypothesis is that usage of a Swede-O ankle brace will change the peak plantar pressure forces experienced by the subject's foot during gait. Ten subjects having a common shoe size were randomly selected to participate in this study. The subjects ambulated for 10 gait cycles of which the plantar pressures for steps five and six were recorded. The subjects ambulated with the F-Scan insoles without wearing a brace. Then the subjects ambulated donning both the F-Scan insoles and a Swede-O ankle brace. The F-Scan insoles were attached to an IBM computer and analyzed by the F-Scan software. The data gathered was examined by the F-Scan software to determine the peak plantar pressures in three different areas of the foot based on the coordinate system that exists in the sensor insole. The three regions of the foot were used for data analysis; region 1 (anteromedial), region 2 (anteriolateral), and region 3 (posterior). The peak plantar pressure means for each region were compared to the braced and nonbraced groups for each step. Only the data gathered on the right foot was used for data analysis. The independent variables for this study were bracing versus nonbracing and the plantar region studied. The dependent variable was plantar pressures measured in pounds per square inch. A repeated-measures ANOVA was used to determine the effects of the independent variables on the dependent variable. No significant differences were found between the peak plantar pressures of the braced and nonbraced groups for any of the three regions ($p < .05$). Studies should be developed to investigate different forms of ankle immobilization such as prophylactic ankle taping on plantar pressures. Studies of ambulation on different surfaces with bracing and without bracing are also recommended. It is recommended that this study be duplicated allowing the research subjects to wear an ankle brace over an extended period of time, such as one or more weeks, to investigate changes in plantar pressures over time and to more closely simulate the patient undergoing an ankle rehabilitation program.

The Effects Of Underwrap Barriers On Ankle Tape Migration

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It has been suggested that ankle taping becomes loose, and loses its effectiveness with both time and exercise. It has also been suggested that underwrap is detrimental in securing tape to the body, and that the application of tape directly to the skin is more effective than when barriers are used to protect the skin. It has been further suggested that PowerFlex™ may be a more effective barrier than traditional underwrap. The purpose of this study was to determine the amount of migration that occurs with these barriers. Twenty female subjects (mean age 21.1 y) participated in this study. Each subject's right ankle was taped with a closed basket weave using standard 1 1/2 inch athletic tape, in combination with; (1) underwrap [UW], (2) PowerFlex™ [PF], and (3) no barrier [NB]. The same athletic trainer taped each subject for every condition. Each subject performed one trial per day for three consecutive days, with the sequence of trials randomized. The position of the tape was marked on the anterior and posterior surfaces of the skin before and after each subject completed a standard exercise bout which included a 3/4 mile run, and a shuttle run. The difference in tape position is referred to as migration. Subjects also reported comfort and perceived stability of each condition with a 10-point scale. Data were analyzed by ANOVA and are presented as means (± S.D.). Migration was significantly different ($p < 0.05$) for anterior and posterior measures. Anterior migration was; 2.5 mm (± 3.4), 12.8 mm (± 5.6), and 15.5 mm (± 5.3), and posterior migration was; 0.1 mm (± 0.3), 5.2 mm (± 4.7), and 6.2 mm (± 5.5) for NB, UW, and PF, respectively. Both comfort and stability were significantly different ($p < 0.05$) between conditions. Ratings of comfort were; 4.1 (± 2.0), 6.7 (± 2.3), and 4.8 (± 2.5), and ratings of stability were; 8.4 (± 1.2), 7.5 (± 1.1), and 5.3 (± 2.6) for NB, UW, and PF, respectively. These data indicate that significantly more migration occurs when underwrap barriers are used, however the notion that tape needs to be tightly affixed to the body in order to be effective continues to be questioned.

Changes In Range Of Motion From The Time Of Ankle Tape Application To Time Of Participation

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Ankle tape loosens with time, and it is thought that this loosening permits greater range of motion (ROM). Many athletes attend meetings or other activities after they have been taped, and prior to the start of practice. The purpose of the investigation was to determine if any changes occur in ROM of the ankle from the time the tape is applied until the time of participation. Ten male and ten female subjects (mean age 22.4 y, height 172.8 cm, weight 73.4 kg) participated in this study. Each subject's right ankle was taped with a closed basket weave, utilizing anchors, stirrups, horseshoes and heel locks using standard 1 1/2 inch athletic tape and underwrap. The same athletic trainer taped every subject throughout the study. Plantar flexion/dorsiflexion (P/D), and inversion/eversion (I/E) ROM were obtained with the electronic goniometer on the Biodex isokinetic testing apparatus. Each subject was tested under four conditions; 0, 15, 30 and 60 minutes of waiting between pre- and post-tests. Each subject performed one trial per day for four consecutive days, with the sequence of trials randomized. During each trial, the subjects walked a predetermined course every fifteen minutes, and spent the remaining time seated. Data were analyzed by ANOVA and are presented as means (\pm S.D.). Baseline ROM values were 58.7° (\pm 12.7), and 72.8° (\pm 9.0), for I/E and P/D, respectively. Post-test ROM for P/D was significantly different ($p < 0.05$) between trials with values of 61.3° (\pm 8.1), 64.9° (\pm 8.0), 63.7° (\pm 6.4), and 66.9° (\pm 8.5) for 0, 15, 30 and 60 min., respectively. However, post-test ROM for I/E was not significantly different ($p > 0.05$) between trials with values of 47.8° (\pm 12.0), 48.8° (\pm 9.7), 47.1° (\pm 10.6), and 50.6° (\pm 10.1) for 0, 15, 30 and 60 min., respectively. These data indicate that ROM of the ankle does increase as time to participation increases, however, these changes were only significant for P/D, and not for I/E. Caution should be used when interpreting these data, and when making any inferences between ROM and ankle injury.

Underwrap Does Not Contribute To The Loosening Of Ankle Tape

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UT

Objective: The objective of this study was to determine if prewrap contributes to the loosening of ankle tape after exercise.

Design and Setting: Doubly multivariate analyses of variance (MANOVAs) with repeated measures were employed to compare the taping and exercise conditions. Subjects were randomly assigned to a fixed treatment order as determined by a Balanced Latin Square. The independent variables were tape application (no tape, tape with prewrap, tape to skin) and exercise (before and after). The dependent variables were average inversion velocity, total inversion, maximum inversion velocity, and time to maximum inversion.

Subjects: Thirty college-age male and female students (17 males, 13 females; mean age, 24.9 \pm 4.3 years; range 19-39 years) were tested. Subjects had no acute symptoms of lower leg, ankle, or foot trauma.

Measurements: Data were collected using electronic goniometers while subjects stood on an inversion platform that suddenly moved their right ankle from a neutral position into 37° inversion and 15° plantar flexion. Ten satisfactory trials were recorded on the inversion platform before and after a prescribed exercise bout. Total inversion, time to maximum inversion, average inversion velocity and maximum inversion velocity following sudden inversion were calculated.

Results: There were no significant differences between taping to the skin and taping over prewrap for any of the variables measured. There were significant differences between both taping conditions and no tape postexercise for average inversion velocity, maximum inversion, maximum inversion velocity, and time to maximum inversion. The total inversion mean for no tape postexercise was 38.8 \pm 6.3° while the mean for tape/skin was 28.3 \pm 4.6° and for tape/prewrap was 29.1 \pm 4.7°. The no tape condition loosened approximately 1.0 \pm 2.8° after exercise while the tape to skin and tape over prewrap loosened about 2.1 \pm 3.2° and 1.7 \pm 2.2° respectively.

Conclusions: There is no difference in the amount of inversion restriction when taping with prewrap compared to taping to the skin. Taping significantly reduced the total inversion, time to maximum inversion, average inversion velocity, and maximum inversion velocity. There was a significant loosening of tape during exercise, however, we feel these differences are not meaningful. Tape provides residual inversion restriction that we feel is sufficient to help prevent ankle sprains or reduce their severity. About 50% of the reported loosening of tape following exercise may be due to the "anatomical warming" of the ankle connective tissue.

Eversion To Inversion Strength Ratios: Normative Values

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Antagonist muscle group comparisons are routinely made between muscles in the thigh and shoulder regions. These comparisons are often used to help the clinician determine if muscle imbalances exist. A few recent studies have examined the strength ratios between the subtalar joint evtor and invertor muscle groups in functionally unstable ankles, however there lacks a database of normative values for comparison. The purpose of this study was to develop a normative database of both concentric (CON) and eccentric (ECC) eversion to inversion (E:I) peak torque (PT) ratios normalized for body mass (BM). A total of thirty subjects (age=21.2 \pm 1.9 yr., wt=73.0 \pm 18.6 kg, ht=170.4 \pm 8.0 cm) volunteered for this study. Isokinetic strength data was derived from assessments on both ankles from all subjects. The Kin Com 125 AP (Chattanooga Corporation - Hixson, TN) isokinetic dynamometer was used to assess both concentric and eccentric strength of the ankle evertors and invertors. The subjects foot was strapped to the footplate attachment with the ankle in 5° of plantar flexion. Eversion and inversion motions were tested separately at velocities of 30°/sec and 120°/sec. The order of presentation was randomly assigned using a coin flip. Each eccentric contraction was preceded by a concentric contraction, with a brief pause separating each repetition. Subjects performed maximal test repetitions until a consistent torque curve was replicated 3 times. PT values were extracted from the maximal torque curves and normalized for BM. E:I ratios were calculated using the PT/BM values. A total of 60 values (30 subjects times 2 ankles each) were used to calculate the mean E:I ratios at both 30°/sec and 120°/sec for the eccentric and concentric muscle actions. Concentric E:I ratios ranged from .51 to 1.64 (1.01 \pm .31) at 30°/sec and from .49 to 1.55 (1.04 \pm .26) at 120°/sec. Eccentric E:I ratios ranged from .48 to 3.21 (1.16 \pm .52) at 30°/sec and from .48 to 3.00 (1.17 \pm .45) at 120°/sec. Previous work had suggested that the optimal concentric E:I ratios at 30°/sec ranged from .70 to .90 and while those at 120°/sec ranged from .65 to .85. The mean values in our study were slightly higher than those previously suggested. There are no previous studies with which to compare our eccentric E:I ratios. The establishment of a normative database of both concentric and eccentric E:I ratios will prove useful in the future for both researchers and clinicians alike.

Effect Of Coupling Medium Temperature On Intra-Muscular Temperature Rate Of Rise Using Continuous Ultrasound

Oshikoya CA, Shultz SJ, Perrin DH, Arnold BL, Mistry D, Gansneder BM:
University of Virginia, Charlottesville, VA

Research has demonstrated that the application of superficial heat or cold prior to an ultrasound treatment may influence the rate of intra-muscular temperature rise. This study determined the effects of coupling medium temperature on the rate of intra-muscular temperature rise (RTR) during continuous ultrasound. Eighteen healthy, male subjects (age=23.6 \pm 3.5 yrs, ht=177.8 \pm 6.9 cm, wt=76.6 \pm 8.2 kg, calf size=37.6 \pm 2.4 cm) participated in this study. To record intra-muscular temperature, a thermistor was inserted into the left medial triceps surae at a depth of 5 cm and baseline tissue temperatures were recorded prior to treatment. Ultrasound (Omnisound 3000, Physio Technology Inc, Topeka, KS) was applied in a continuous mode at a frequency of 1 MHz and intensity of 1.5 w/cm². Intra-muscular temperature was recorded every 30 seconds until the temperature rose 4°C above baseline or until discomfort was felt. Each subject received three treatments, using water-based coupling gel (Aquasonic 100, Parker Laboratories, Inc, Newark, NJ) at temperatures of 18°C, 25°C, and 39°C. All gel temperatures were monitored and a new sample was added approximately every 2 minutes to maintain gel temperature during treatments. All treatments were given during the same session and counterbalanced to control for order effect. RTR was calculated by dividing the absolute temperature change by treatment time. A one-way repeated measures ANOVA revealed a significant difference in RTR between gel temperatures {F (2,34) = 6.487, p < .05}. RTR was significantly faster using the 25°C (.39°C/min) gel compared to the 18°C (.31°C/min) and 39°C (.33°C/min) gel treatments (Tukey's p < .05). There was no difference between the 18°C and 39°C treatments. These results suggest that the use of a cooled or heated gel may be counterproductive when maximal thermal effects are desired within a given time frame. However, a gel warmer can be used to provide patient comfort if treatment time is adjusted for the slower rate of rise. Our results indicate that the time required to reach a 4°C increase in tissue temperature at a 5 cm depth was 13.0, 10.6, and 11.1 minutes for the 18°C, 25°C, and 39°C, treatments respectively. Further research should investigate other methods or modalities that may enhance the thermal effects of ultrasound.

Free Communications, Poster Presentations: Session D

Friday, June 18, 8:30 AM - 12:00 PM, Convention Center, Lobby 200, Level 2. Authors present from 11:00 AM to 12:00 PM to answer questions.

Reliability Of The Soleus Hoffmann Reflex In The Supine And Standing Positions

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Objective: The Hoffmann reflex (H-reflex) is a measure of motoneuron pool excitability, which is a valuable tool to determine muscle inhibition caused by joint damage (arthrogenic muscle inhibition). In order to detect changes in H-reflex due to injury, the reliability of such a measurement must be established. The purpose of this study was to establish the reliability of the soleus H-reflex in a supine and standing position. **Design and Setting:** Intrasection reliability was computed using 12 trials (12), 12 trials dropping the high and low (12x), the first 7 trials dropping the high and low (7x), and the first 5 trials (5). Intrasection and intersection reliability were estimated using intraclass correlation coefficients (ICC (3,1)). **Subjects:** Thirteen healthy subjects (6 males, 7 females), age 24.10 ± 2.63 years, with no lower extremity pathology participated in this study. **Measurements:** To determine the intrasection and intersection reliability of this measure in a supine resting position and a one-leg standing position, EMG data were collected from the soleus while the tibial nerve was stimulated in the popliteal space. A high voltage (120-200 V), short duration (1.0 msec) stimulus was automatically triggered, eliciting a reflex twitch measurable by EMG. Several of these measurements were performed with 20 second rest intervals to find the maximum H-reflex. The maximum H-reflex was located by adjusting the intensity of the stimulus. Once a maximum H-reflex was found 12 measurements were taken in that position with 20 second rest intervals. These steps were repeated for each position (supine and standing) at the same time for 5 consecutive days. **Results:** The supine intrasection reliability was estimated to be 0.93 (12), 0.93 (12x), 0.94 (7x), and 0.93 (5). The standing intrasection reliability was 0.85 (12), 0.85 (12x), 0.87 (7x), and 0.86 (5). The intersection reliability was 0.94 in the supine position and 0.80 in the standing position. **Conclusions:** These results indicate that the H-reflex measured by the BIOPAC system in our laboratory in a supine and standing position is a reliable assessment between trials and between days. The data show that 5 measurements are sufficient to observe reliable measurements within a single session. Most importantly, this data shows that the H-reflex is a reliable assessment that may be used to measure motoneuron excitability.

Effect Of Body Position On Tibial Displacement As Measured By The Don Joy Knee Laxity Tester

Dorshaw AD, Webright WG, Perrin DH, Arnold BA, Gansneder BM: University of Virginia, Charlottesville, VA

Modifications to the traditional Lachman Test (e.g., Drop Leg Lachman, Prone Lachman) have been used which attempt to increase accuracy of results and examiner ease. This study compared tibial translation in supine, semi-reclined, and prone positions using the Don Joy (Smith & Nephew, Inc., Vista, CA) Knee Laxity Tester (KLT), and determined the test-retest reliability of the device in measuring displacement in the three positions. Twenty males (age=20.2 +/- 1.4 yrs, ht=181.4 +/- 6.2 cm, wt=79.7 +/- 9.3 kg) free from history of surgery or present pathology in the right knee participated in the study. Tibial displacements in the three body positions (supine, semi-reclined, and prone) were obtained in counterbalanced order. The subjects were positioned on a seat support allowing between 25 and 30 deg of knee flexion. Anterior and posterior forces of 133.5 N (30 lbs) were applied to the right knee using the KLT. Three anterior and three posterior tibial displacement (mm) measures were obtained at each body position and used for analysis of total displacement. A second set of measurements were obtained and used to determine test-retest reliability. A one-way analysis of variance found a significant difference between the prone position (4.1 ± 1.4 mm) and the semi-reclined (4.8 ± 1.8 mm) and supine (4.8 ± 1.7 mm) positions { $F(2,38)=10.6$, $p<.05$ }. The intraclass correlation coefficient (2,k) was $R=.94$ for the three positions and the standard error of measurements were .42 mm for the supine and semi-reclined positions and .37 mm for the prone position. Although statistically significant, the difference in displacement measures between the prone position and semi-reclined and supine positions was not considered to be clinically relevant. As such, this study suggests alterations in body position during assessment of tibial displacement in an uninjured population is not problematic. Also, the Don Joy Knee Laxity Tester appears to be a reliable instrument for the assessment of tibial displacement.

The Influence Of Foot Position, Knee Joint Angle, And Gender On Knee Muscle Joint Complex Stiffness

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Passive movement within a joint is influenced through resistance from muscles crossing the joint and the compliance of other soft tissue joint structures, such as capsule and synovium. Stiffness within this complex of structures is termed the muscle joint complex stiffness (MJCS). With recent interest in the neurological component of injury, the stiffness in joints and muscles is being explored as a factor in the incidence of injury and is monitored during the rehabilitation process. The purpose of this investigation was to determine the effects of gender and joint position on the contribution of the gastrocnemius to knee JCS. **Methods:** The dominant leg of twenty subjects (10 male: 179.8 ± 4.4 cm, 83.9 ± 14.4 kg, 21.4 ± 2.5 ; 10 female, 164.5 ± 7.3 cm, 61.8 ± 9.4 , 19.4 ± 1.5 yrs) free of pathological impairment were used in this study. EMG surface electrodes were placed on each subject, to measure muscle activity and ensure relaxation. The knee was aligned with the axis of an isokinetic dynamometer, and the foot was attached to the end of the lever arm and placed in one of two conditions (dorsiflexed 15° or neutral). The dynamometer range was set for 30 (of knee motion and for passive movement at 5°). Passive torque, velocity, and position data were integrated with the EMG activity and stored on a computer. The stiffness of the joint complex was represented by the slope of the curve (torque x joint position) at 20° , 10° and 0° of knee flexion. A repeated measures ANOVA (*a priori* $\alpha = .05$) was used to detect differences between the groups.

Results: A significant position x gender ($F=5.016$, $p = .012$) interaction effect was found. Main effects were found for condition ($F=9.156$, $p = .007$), position ($F=31.83$, $p = .000$), and gender ($F=9.093$, $p = .007$). Post hoc analysis revealed that the males had stiffer values at the knee extended range.

Conclusion: Positioning the ankle in further dorsiflexion increases resistance to the knee moving into extension. The interaction of gender with position and the gender main effect may provide insight into the gender difference of injury incidence. The influence of the MJCS on the gain of the muscle spindle in regulation of muscle tension could imply that the results of this study have implications on the role of stiffness in prevention and incidence of injury. However, heightened muscle spindle activity may reflexively influence the MJCS explaining differences in stiffness values attained.

Effects Of Static And Hold-Relax Stretching On Hamstring Range Of Motion Using The FlexAbility LE1000

Gribble PA, Guskiewicz KM, Prentice WE, Shields EW: The University of North Carolina at Chapel Hill, Chapel Hill, NC

There has been extensive research conducted on the assessment of flexibility as well as the methods of improving flexibility. Several measurement methods have been used including goniometric and instrumental straight leg raise (ISLR) measurements. No substantial research has been performed using the FlexAbility LE 1000 manual stretching machine. This study attempted to compare established stretching techniques to examine if there were significant differences among them. The purpose of this study was to determine the effects of Static and Hold-Relax hamstring stretching on hamstring range of motion. A second focus of this study was to examine the reliability of the FlexAbility LE1000 compared with the goniometrically measured Active Knee Extension Test. Forty-two subjects (18-25 yrs. old) were assigned to either the Control, Static or Hold-Relax training group. Subjects were stretched four times a week over a six-week period with four thirty-second stretches per session using a Straight Leg Raise method on the FlexAbility LE1000. Subjects in the Static group were stretched to a stopping point where they held a passive stretch for thirty seconds before being lowered back to the resting position. Those in the Hold-Relax group were stretched to a stopping point, but then completed four phases consisting of passive stretching and isometric contraction before being lowered to the stopping point. It was determined that both Static and Hold-Relax techniques significantly improved hamstring flexibility (ISLR: $+33.08^{\circ} \pm 9.08^{\circ}$ and $+35.17^{\circ} \pm 10.39^{\circ}$, respectively). Subjects of both techniques reached a plateau effect in flexibility improvement between the fourth and fifth weeks of training. Thus, both Static and Hold-Relax stretching methods are equally effective in improving hamstring ROM. Reliability of the FlexAbility LE1000 and the goniometer were both found to be high. Therefore, it appears that either measurement technique could be used successfully to measure hip flexion ROM.

Duration Of Maintained Hamstring Flexibility Following A One-Time Modified Proprioceptive Neuromuscular Facilitation Stretching Protocol

Spernoga SG, Uhl TL, Arnold BL, Gansseder BM: University of Virginia, Charlottesville, VA

The purpose of this study was to measure the duration of maintained hamstring flexibility following a one-time modified PNF (hold-relax) stretching protocol. Thirty healthy male subjects (age = $18.8 \pm .63$ yrs, ht = 185.2 ± 14.2 cm, mass = 106.8 ± 15.7 kg) with limited hamstring flexibility in the right lower extremity were randomly assigned to stretch (n=15) and no-stretch (n=15) groups. Hamstring flexibility was measured in degrees of active knee extension. The active knee extension baseline was established with 5 active knee extensions as warm up, and a 6th knee extension serving as the pre-stretch measurement. After the active knee extension, the stretch group received five modified (no rotation) hold-relax PNF stretches. The no-stretch group laid quietly supine on a table for five minutes. Post-test measurements were recorded for both groups at 0, 2, 4, 6, 8, 16, and 32 minutes. The 0 measurement immediately followed the stretching protocol for the stretch group and at the end of the 5 minutes of no activity for the no-stretch group. A repeated measure ANOVA of 1 within (time) and 1 between (group) revealed a significant group by time interaction ($F_{7,239} = 14.97, p < .0005$). For the stretch group, Dunnett post hoc testing revealed significant flexibility increases from baseline ($38.8 \pm 11.2^{\circ}$) at 0 ($31.0 \pm 9.2^{\circ}$), 2 ($32.33 \pm 8.53^{\circ}$), 4 ($34.47 \pm 8.66^{\circ}$), and 6 ($36.27 \pm 9.45^{\circ}$) minutes. In contrast, the non-stretch group's flexibility significantly decreased from baseline ($40.5 \pm 11^{\circ}$) after the 5 minutes of no activity 0 ($42.87 \pm 11.28^{\circ}$) and was further decreased at 2 ($43.33 \pm 11.42^{\circ}$), 4 ($44.67 \pm 11.48^{\circ}$), and 6 ($45.4 \pm 11.48^{\circ}$), and 32 (49.47 ± 13.12) minutes. These findings suggest a sequence of 5 modified PNF (hold-relax) stretches increased hamstring flexibility but was insufficient to maintain flexibility beyond six minutes post-stretch. Additionally, inactivity longer than 5 minutes produced progressive decreases in flexibility. However, it is unclear whether physical activity might maintain or limit flexibility increases and decreases, respectively.

The Reliability Of Knee Joint Reposition Sense Testing With And Without Orthopedic Bracing

Delmonte SA, Plomaritis MJ, Barelare NL, Kleiner DM: University of North Florida, Jacksonville, FL

It is a current belief that orthopedic bracing may work, in part, by enhancing proprioception. Proprioception has many components, including joint position sense. The purpose of this study was to determine the reliability of joint position sense testing and any influence that external support such as orthopedic taping or bracing may have on proprioception. Eleven male and fourteen female subjects (mean age 24.2 y, height 172.8 cm, weight 73.8 kg) with no previous injury participated in this study. The subjects' ability to reposition the knee joint was assessed using the electronic goniometer on the Biodex isokinetic testing apparatus. Each subject was tested on two separate occasions spaced one week apart under the following five conditions; (1) a control with no intervention [CTL], (2) a prophylactic knee guard [PKG], (3) a functional (ACL) brace [FTL], (4) a closed patella neoprene sleeve [SLV], and (5) with one 12.7 cm (5 inch) strip of athletic tape applied in a distal-proximal direction over the patella [TAP]. Once secured to the Biodex, the subject's right knee was flexed to 90° and verified by electronic goniometry. The subjects were then asked to close their eyes while the lower leg was passively extended to a predetermined point, held for 5 sec. and then returned to 90° . Subjects then were asked to actively reposition their lower leg to the point in the range of motion previously demonstrated and stop the lever arm of the Biodex with a hand held switch. The pre-determined position in the range of motion ranged between 25° and 45° , and was changed with each trial to negate any learning effect. The same positions were used in the same sequence during the post-test one week later. The difference between the predetermined point in the ROM and the subject's approximation is referred to as the error score and was used for analysis. Correlation coefficients were .005, .222, -.142, -.067, and .160 for CTL, PKG, FTL, SLV, and TAP, respectively. These data indicate that reliability of joint position sense testing at the knee is poor, and that external support such as orthopedic bracing or strips of athletic tape do not improve the reliability of proprioception testing in healthy, uninjured subjects.

Effect Of Prophylactic Knee Braces On Functional Performance Of Brace-Experienced Football Players

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Increased interest in the use of prophylactic knee braces has prompted debate over the effect of these braces on functional performance. Previous research has shown that prophylactic knee braces limit the functional performance of novice brace wearers. However, there is limited data examining the effects on brace-experienced wearers. Therefore, the purpose of this study was to examine the effects of prophylactic knee braces on the functional performance of brace-experienced football players. Seventeen healthy, Division I football players (ages 18–25), offensive and defensive linemen (ht 182.88 cm–200.66 cm and wt 109.1 kg–136.4 kg) with at least one season's experience using a prophylactic knee brace, were evaluated in braced and unbraced conditions. Functional performance was assessed with a timed 40 yard sprint, a timed 40 yard agility course, and a vertical jump test. Analysis of the results using a paired t-Test with a Bonferroni's adjustment revealed no statistical difference in functional performance between braced and unbraced conditions ($p>0.01$). These findings suggest that the players had acclimated to performing with the brace prior to the study. Further research is warranted to determine the acclimation period using a prophylactic knee brace.

The Effect of Prophylactic Knee Braces on Agility, Speed, and Power in Collegiate Football Players

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Prophylactic knee bracing has been shown to be effective in reducing the frequency and severity of acute knee injuries in football, yet athletes are reluctant to wear them due to the belief that the braces detrimentally affect their performance. The effect of prophylactic bracing on functional activity has been investigated with mixed results. Most tests have been done on subjects not experienced in wearing the prophylactic knee brace while also performing skills that the subject may not be familiar with. The purpose of this study was to investigate if prophylactic knee bracing had an effect on the speed, agility, and power of non-injured athletes accustomed to wearing prophylactic knee braces. Forty Division IA collegiate football players were recruited to participate in this study. All subjects had no history of significant knee injury and had worn prophylactic knee braces during the previous football season on a daily basis. Each subject completed four functional tests (forty-yard sprint, 6.1 meter shuttle run, agility ladder, and vertical jump) on two consecutive days. The tests were designed to evaluate speed, power, and quickness and the tests were familiar to the subjects, as they were common test/conditioning tools in the sport of football. On day one, twenty of the subjects were randomly assigned to the treatment (brace-wearing) group and performed all the tests wearing bilateral (DonJoy) prophylactic knee braces. The twenty remaining subjects performed the tests without wearing the braces. On day two, the groups were switched and the testing protocol was repeated. An ANOVA ($p<.05$) was used to determine any significant differences in time required to complete the tests while wearing the braces versus non-braced. There was a significant difference in the forty-yard dash time ($p<.0001$) and the agility ladder ($p<.003$). There was no significant difference in vertical jump height ($p<.124$) and in shuttle run time ($p<.750$). These results indicate that the wearing of prophylactic knee braces bilaterally may affect an athlete's ability to perform skills that require strictly speed. However, wearing prophylactic knee braces do not seem to affect an athlete's jumping, stop/start activity, or power-related skills.

The Assessment Of McConnell's Patellar Taping On Patellofemoral Pain And Quadriceps Strength

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Objective: A decrease in pain and the enhancement of quadriceps strength are important considerations in the facilitation of increased function during patellofemoral pain (PFP) rehabilitation. Studies have shown that McConnell's patellar taping effectively enhances quadriceps strength. Although these strength increases presumably result from optimizing the patellar position and maximizing surface contact area, some researchers believe that the cutaneous stimulation alone is responsible for the gains. The purpose of this study was to investigate the efficacy of McConnell's patellar taping compared to placebo taping, offering cutaneous stimulation alone, on the facilitation of quadriceps strength and pain reduction in individuals with PFP. **Subjects:** Twenty-six symptomatic subjects (15 males, 11 females) with an age range of 19-31 years participated in this study. Each subject was assessed by a certified athletic trainer, physical therapist, or physician as having patellar malalignment that contributed to PFP, chondromalacia, or patellar tendinitis and was a candidate for McConnell's taping. **Design and Setting:** All subjects were randomly assigned to either a McConnell or placebo group with an equal representation of gender within each group. Subjects in the placebo group were assessed in the same manner and taped using the same supplies as the McConnell group but without patellar manipulation. Subjects performed five maximal concentric knee extension contractions at 60 deg/sec on the Biodex System II dynamometer in two conditions (1) without the patellofemoral joint taped and (2) with patellar taping. The maximum peak torque was assessed for each of the conditions. Pain was assessed both before and after taping using the visual pain analog scale. **Analysis:** A 2x2 mixed ANOVA was used to assess the differences in peak torque production between each of the two taping groups. The Wilcoxon Signed Ranks test compared the change in pain separately for both groups. The Mann Whitney-U test was conducted between the conditions to analyze whether there was a decrease in pain after tape application. A level of statistical significance was set a priori at 0.05. **Results:** Statistical analysis did not reveal a significant difference between the placebo and McConnell groups regarding peak torque production. There was a significant difference in pain be-

fore and after tape for each group (Pain means: McConnell_{pre} = 3.38 McConnell_{post} = 2.46 placebo_{pre} = 2.96 and placebo_{post} = 0.92). A significant decrease in pain was seen between the two groups (Pain mean_{pre} = 3.17 and mean_{post} = 1.69). **Conclusion:** These results suggest that patella manipulation using McConnell's patellar taping does not play a significant role in increasing knee extension strength, but does cause a significant decrease in pain. Furthermore, a decrease in pain in both groups suggests that a placebo effect does exist and that cutaneous stimulation alone does play a significant role in taping effectiveness. **Key words:** anterior knee pain, PFP syndrome, quadriceps femoris muscle, McConnell's patellar taping.

Changes In Knee Joint Proprioception Resulting From A Strip Of Athletic Tape Applied Over The Skin

Plomaritis MJ, Barelare NL, Delmonte SA, Kleiner DM: University of North Florida, Jacksonville, FL

Previous research has demonstrated that increased cutaneous sensory feedback provided by strips of athletic tape applied across the ankle joint in healthy individuals can help improve ankle joint position perception in nonweightbearing conditions. The purpose of this study was to determine whether a strip of athletic tape applied across the anterior portion of the knee joint would influence the subject's ability to reposition the knee joint in a nonweightbearing condition. Eleven male and fourteen female subjects (mean age 24.2 y, height 172.8 cm, weight 73.8 kg) with no previous injury participated in this study. The subjects' ability to reposition the knee joint was assessed using the electronic goniometer on the Biodex isokinetic testing apparatus. Each subject was tested; (1) with one 12.7 cm (5 inch) strip of athletic tape applied in a distal-proximal direction directly to the skin over the patella [TAP], and (2) without any intervention (control) [CTL]. Each subject performed both trials the same day. Once secured to the Biodex, the subject's right knee was flexed to 90° and verified by electronic goniometry. The subjects were then asked to close their eyes while the lower leg was passively extended to a predetermined point, held for 5 sec. and then returned to 90°. Subjects then were asked to actively reposition their lower leg to the demonstrated point in the range of motion and stop the lever arm of the Biodex with a hand held switch. The pre-determined position in the range of motion ranged between 25° and 45°, and was changed with each trial to negate any learning effect. The difference between the predetermined point in the range of motion and the subject's approximation is referred to as the error score and was used for analysis. Data were analyzed by *t*-test and are presented as means (\pm S.D.). There was no significant difference ($p > 0.05$) in error scores between the taping and control conditions. Error scores were; 3.4° (\pm 2.8) for TAP, and 2.8° (\pm 2.0) for CTL. These data indicate that a strip of tape does not have a significant effect on the ability to actively reposition the knee in healthy, uninjured subjects.

Estradiol Levels And Knee Joint Stiffness: A Pilot Study

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sity of Virginia, Charlottesville, VA

The purpose of this study was to determine the effect of estradiol on knee joint compliance. Five active, healthy females (age=21.2±1.2 yrs, wt=67±3.3 kg, ht=165.8 ± 4.6 cm with no history of pregnancy, knee joint injury, birth control pill usage, or menstrual irregularities) had blood estradiol levels and knee stiffness assessed at the beginning of menstruation and near the estradiol peak (ovulation). With the examiner blinded to the phase of menstruation, the examiner displaced the tibia with a 137N load using the KT-2000, and the displacement (in millimeters) was determined at 67N, 113N, and 137N. To calculate stiffness, the difference in loads at 67N and 113N was divided by the difference between the tibial displacements at these loads. Additionally, joint laxity was assessed at 137N. To estimate the time of estradiol peak, subjects used a commercial ovulation test kit each day beginning 12 days after the start of menstruation. For data analysis, a correlated t-test was calculated for differences in stiffness, laxity, and estradiol levels at menstruation and ovulation. No significant difference for joint laxity was found (menstruation = 2.9mm±0.89, ovulation = 3.6±1.2, P=.17). However, a significant decrease for stiffness was found (menstruation = 92±43N/mm, ovulation = 58±24N/mm, P=.03) indicating a change in the joint deformation rate and a possible decrease in energy absorption. This occurred in association with a significant increase in estradiol levels (menstruation = 32±11 pg/ml, ovulation = 173±25 pg/ml, P=.0009). These findings suggest that joint stiffness differs at menstruation and ovulation and that these differences may be related to estradiol levels. Future studies with a larger number of subjects will examine the association between estradiol levels and joint stiffness at more time points during the menstrual cycle.

Presentations Session 2

Effectiveness Of Therapeutic Ultrasound In Strengthening The Shoulder External Rotators
Murray MJ, Miano NJ, Ward CA, West JC, Schmitz MJ: Physical Therapy Department, University of Michigan-Flint, Flint, MI

PURPOSE: The purpose of this study was to determine if a home exercise program using Therapeutic Ultrasound (TUS) over the external rotator muscles was more effective at increasing strength than a home exercise program without TUS. **DESIGN:** This was a randomized controlled trial. **SETTING:** The study was conducted in a home setting. **SUBJECTS:** The subjects were 15 healthy females, aged 18-30, who were active and had no history of shoulder injury. **INTERVENTIONS:** The subjects were randomized into two groups: TUS and no TUS. The TUS group received TUS over the external rotator muscles for 10 minutes, 3 times per week, for 6 weeks. The no TUS group received no TUS. **MEASUREMENTS AND MAIN RESULTS:** The subjects performed a home exercise program for 6 weeks. The TUS group showed a significant increase in strength compared to the no TUS group. **CONCLUSIONS:** The results of this study suggest that a home exercise program using TUS over the external rotator muscles is more effective at increasing strength than a home exercise program without TUS.

have been off of control studies. Statistical analysis revealed that there was no significant effect as well as no significant effect on the dependent variable. There was no significant difference between the two groups and no significant difference between the two groups. **CONCLUSIONS:** These results suggest that a home exercise program using Therapeutic Ultrasound (TUS) over the external rotator muscles is more effective at increasing strength than a home exercise program without TUS.

Notes:

The purpose of this study was to determine the effect of a 12-week training program on the physical fitness and body composition of sedentary, middle-aged men. The study was conducted in a laboratory setting and involved 20 participants who were randomly selected from a local community. The participants were divided into two groups: a control group and an experimental group. The control group remained sedentary throughout the study, while the experimental group participated in a 12-week training program. The training program consisted of three sessions per week, each lasting 45 minutes. The sessions included cardiovascular exercise, strength training, and flexibility exercises. The physical fitness of the participants was assessed using a variety of tests, including a 1.5-mile run, a 10-minute step test, and a 1-minute sit-up test. Body composition was assessed using a skinfold thickness measurement and a bioelectrical impedance analysis (BIA). The results of the study showed that the experimental group significantly improved their physical fitness and body composition compared to the control group. Specifically, the experimental group showed a significant decrease in body fat percentage and an increase in lean body mass. Additionally, the experimental group showed significant improvements in all three physical fitness tests. These findings suggest that a 12-week training program can effectively improve the physical fitness and body composition of sedentary, middle-aged men.

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Free Communications, Poster Presentations: Session E

Friday, June 18, 1:00 PM - 4:30 PM, Convention Center, Lobby 200, Level 2. Authors present from 3:30 PM to 4:30 PM to answer questions.

The Effects Of Wrist Taping Techniques On Range Of Motion and Joint Position Sense

Weiss VS, Haimowitz MA, Chmielewski C, Kleiner DM: University of North Florida, Jacksonville, FL

Previous research on wrist taping has evaluated grip strength and ground reaction forces. The purpose of this study was to determine the effects of two taping techniques on range of motion (ROM) and joint position sense (JPS) of the wrist. Twenty-three male and female subjects underwent ROM (flexion, extension, radial deviation, ulnar deviation) and JPS measurements of the right wrist using the electronic goniometer on the Biodex isokinetic testing apparatus. The conditions examined were; (1) no tape [NT], (2) taping the wrist only [WT], and (3) taping the wrist and hand [HT]. The NT condition served as a control and required no taping. All subjects were taped with standard methods by the same athletic trainer. The sequence of trials was randomized. Active ROM measurements were taken before, and after a standardized exercise bout. The difference in ROM between the pre-test and post-test is referred to as change data and was used for analysis. To determine JPS, subjects were asked to actively reposition their wrist to a previously demonstrated point in their ROM. The difference between the predetermined point in the ROM and the subject's approximation is referred to as the JPS error score. An ANOVA with repeated measures and t-tests were employed to detect significant differences between taping conditions. The data are presented as means (\pm S.D.). There was no significant difference ($p > 0.05$) in ROM change data for radial/ulnar deviation, but there was a significant difference ($p < 0.05$) in the flexion/extension data. The mean changes in ROM for radial/ulnar deviation were; $12^\circ (\pm 8)$, $12^\circ (\pm 11)$, and $11^\circ (\pm 10)$ for NT, WT, and HT, respectively, and $10^\circ (\pm 7)$, $10^\circ (\pm 8)$, and $21^\circ (\pm 17)$ for NT, WT, and HT, respectively for flexion/extension. There was no significant difference ($p > 0.05$) in JPS between the taping conditions. The JPS error scores were; $7.3^\circ (\pm 4.9)$, $5.1^\circ (\pm 5.2)$, and $5.9^\circ (\pm 5.2)$ for NT, WT, and HT, respectively. These data indicate that wrist taping does not have a significant effect on the ability to actively reposition the wrist in healthy, uninjured subjects, and that only HT significantly restricts ROM.

Effectiveness Of Theraband® On Strengthening The Shoulder External Rotators

Manley ML, Macko SD, Maul CA, Roth BE, Sakalas MA: Physical Therapy Department, University of Michigan-Flint, Flint, MI

PURPOSE: The purpose of this study was to demonstrate that a home exercise program using Theraband® strengthens the external rotators isometrically and isokinetically of the non-dominant shoulder in normal adult females age 18-30. **SUBJECTS:** Fifty-six female subjects volunteered. Four were excluded from participating due to medical reasons. Of the 52 who began the study, one dropped out due to illness and another did not show up for the post-test. Fifty subjects completed the study. Subjects were randomly divided into one of four groups using the Randomized Solomon-Four-Group design. The groups were divided as follows: 1) completed a pre-test, four weeks upper extremity home exercise strengthening program and post-test ($n=11$), 2) completed a pre-test and post-test ($n=14$), 3) completed four weeks of a home exercise strengthening program and post-test ($n=13$), 4) completed a post-test only ($n=12$). Ages ranged from 18-30. **METHODS AND MATERIALS:** Subjects completed a medical/activity questionnaire from which age and weight were obtained. Subjects completed an exercise log after each training session from which the following data were collected: color of Theraband® used per set and the maximum number of repetitions achieved per set. Test data were gathered in the non-dominant shoulders (48 left, 2 right) in 90° abduction, in the frontal plane, using the Cybex® 340 dynamometer (Cybex, Division of Lumex, Inc., Ronkonkoma, NY). Isokinetic strength was tested at $75^\circ/\text{sec}$. Isometric strength was tested in 60° , 30° , and 0° of internal rotation, and 30° and 60° of external rotation. Systat 7.0 was used to analyze data. Subjects were given different colors of Theraband® along with a Theraband door anchor®. **ANALYSES:** A repeated measures one-way ANOVA, using the normalized strength to body weight data, was used to determine if isokinetic and isometric mean pre-test and mean post-test scores differed. A Post-Hoc Tukey's HSD was used to determine if there was any pre-test effect or any pre-test and Theraband® interaction. Descriptive statistics such as mean, range, variance and standard deviations were calculated to perform secondary analyses. **RESULTS:** The results indicate that there is a significant difference between mean pre-test and mean post-test peak torque strength results for all

tests except 60° of external rotation. Statistical analysis determined that there was no significant pre-test effect as well as no significant pre-test and Theraband® interaction. There was no significant percentage increase in the shortened end of range as measured isometrically. **CONCLUSION:** These results suggest that a home exercise program using Theraband® for three sets of four to six repetitions will show a significant increase in isometric and isokinetic strength of shoulder external rotators in adult females age 18-30.

Shoulder Internal And External Rotator Reciprocal Muscle Group Ratios In Overhead Athletes And Non-Athletes

McKenzie MA, Powers ME, Perrin DH, Arnold BL: University of Virginia, Charlottesville, VA

This study compared two methods of determining shoulder rotator reciprocal muscle group ratios in 12 overhead athletes (age=20.3 +/- 1.0 yrs, ht=178.1 +/- 6.2 cm, wt=91.7 +/- 9.1 kg) and 12 non-athletes (age=21.7 +/- 1.7 yrs, ht=176.5 +/- 4.1 cm, wt=79.1 +/- 1.6 kg). Shoulder concentric and eccentric internal and external rotation peak torque were assessed on a Biodex System 3 isokinetic dynamometer (Biodex Medical Systems, Shirley, NY). Subjects performed 4 maximal contractions from a seated position with the glenohumeral joint at 60 deg abduction in the plane of the scapula. Testing of the dominant and non-dominant side rotators occurred through a 105 deg arc of motion (90 deg external rotation to 15 deg internal rotation) in a counterbalanced fashion. The test protocol included continuous concentric internal and external followed by eccentric internal and external rotation repetitions at 180 deg/sec and 300 deg/sec. Peak torque was normalized to body weight (PT/BW) and all values were gravity corrected. Shoulder reciprocal muscle group ratios were first calculated in a traditional manner (concentric external divided by concentric internal rotator PT/BW), and then with a more functional technique (eccentric external divided by concentric internal rotator PT/BW). To determine reliability of the assessments, five subjects from each group were randomly selected to return for an identical retest session and intraclass correlation coefficients (ICC, 2,1) were calculated. The reliability coefficients ranged from R=.72 to .91. A mixed model ANOVA with one between (group) and three within (side, velocity, ratio) factors found a higher functional (1.0) than traditional (.84) reciprocal muscle group ratio for both groups [F(1,22)=28.32, p<.05], independent of side and test velocity. The difference between ratios was attributed to a greater value of eccentric PT/BW in comparison to concentric PT/BW of the external rotators. We believe shoulder reciprocal muscle group ratios derived from concentric internal and eccentric external rotator PT/BW may have greater functional application than those derived from only concentric values. These findings confirm differences between these two techniques of determining shoulder reciprocal muscle group ratios, and begin to establish normative ratios for pre-season screening and rehabilitation of athletes and non-athletes.

Instrumented Arthrometry Reveals Increased Sagittal Plane Glenohumeral Joint Laxity In Females

Sauers ES, Borsa PB, Herling DE: Oregon State University, Corvallis, OR

Clinical assessment of glenohumeral (GHJL) laxity is based on subjective manual laxity stress tests. Quantitative in vivo assessment of GHJL is scarce in the orthopedic / sports medicine literature. Joint laxity comparisons between males and females are prevalent at the knee, however very little quantitative research regarding gender-based laxity is available at the shoulder. The purpose of this study was to evaluate gender differences in sagittal plane GHJL at quantified loads in forty healthy shoulders using an instrumented arthrometer. Our first objective was to compare the total anterior/posterior (A/P) GHJL range between genders. Secondly, we sought to evaluate the relative contribution of anterior and posterior translation in males and females to the total A/P laxity range. Forty healthy shoulders (N= 20, 10 males, 10 females, *M* age = 25.1 ± 5.5 yr.) were assessed for sagittal plane GHJL at 15 and 20 lb. loads. Tests were conducted using an instrumented shoulder arthrometer that provides quantification of GHJL (mm) relative to an applied load (lb.). Subjects were positioned with the shoulder in the scapular plane and the arm in 20° of elevation. Linear displacement transducers were affixed externally to the acromion and proximal humerus. A slow progression load was then applied to the proximal humerus to simulate the A/P drawer stress test. Anterior and posterior laxity values were combined for each subject to produce a total A/P laxity range. Alpha was set at 0.05. A 2(load) x 2(gender) ANOVA revealed statistically significant differences in the mean A/P laxity range between genders at 15 lb. [F(1, 18) = 6.4, p=.02; males = 6.7 ± 2.3 mm; females = 9.8 ± 2.6 mm] and 20 lb. [F(1,18) = 5.8, p=.03; male = 8.6 ± 2.6 mm; females = 11.8 ± 2.8 mm]. Anterior and posterior laxity values were then compared between genders using four separate univariate 2(load) x 2(gender)x 2(direction) ANOVAs. No statistically significant differences were present between genders for anterior laxity at either load. Statistically significant differences in posterior laxity between genders was present at both 15 lb. [F(1, 18) = 6.0, p=.03] and 20 lb. [F(1,18) = 5.9, p=.03]. Our data indicate that females have a greater total A/P laxity range than males and that the majority of this difference is accounted for by an increase in posterior laxity. Conclusive evidence regarding the contribution of physiologic laxity to

injury at the shoulder has not been established. Increased GHJL, specifically posterior laxity, in females should be further evaluated with respect to instability, impingement, and rotator cuff pathology.

Intra-Tester Reliability Of Multi-Point Isometric Strength Measurements Of The Shoulder External Rotators

L'Hommedieu S, Kaminski TW, Horodyski MB, Bauer JA: University of Florida, Gainesville, FL

The reliability of measurements is vital in the interpretation of research results examining the efficacy of rehabilitation strength training programs. The majority of the reliability studies involving strength measurements of the shoulder muscles have focused on isokinetic measurements. An alternative to isokinetics is the use of multi-point isometric measurements for strength analysis. The purpose of this study was to determine the intra-tester reliability of multi-point isometric measurements recorded during shoulder external rotation. Thirteen (7 females and 6 males) healthy subjects (age = 22.0 ± 1.5 yr., wt = 76.0 ± 13.0 kg, ht = 172.8 ± 6.8 cm) participated in this study. Subjects were tested by the same examiner on two different occasions. The multi-point isometric values were obtained from a Kin Com 125 AP (Chattanooga Group, Hixson, TN) isokinetic dynamometer, set at $0^\circ/\text{sec}$. The subjects were seated in the dynamometer chair with their shoulder abducted ($\approx 80^\circ$) and horizontally flexed ($\approx 15^\circ$). Isometric testing was conducted at five angles (15° , 30° , 45° , 60° and 75°) of shoulder external rotation. Both the dominant and non-dominant arms were tested. A Latin Square was used to randomize the test angle order. Peak torque (PT) values from 3 maximal test repetitions were averaged and used for statistical analysis. A ten second rest period was provided between each repetition. Subjects received visual feedback and verbal encouragement throughout the testing session. An ANOVA with repeated measures was executed to determine differences between the pre and post test mean PT values. Reliability was assessed by calculating separate intraclass correlation coefficients (ICC) for each arm (dominant vs. non-dominant) at each angle (15° , 30° , 45° , 60° , and 75°). In addition, standard error of measurement (SEM) values were calculated to determine the precision of measurement. PT values ranged from 5.89 Nm to 58.49 Nm. ICC (1,1) values ranged from .78 (very good) to .97 (excellent). The ICC and SEM values are summarized in the following table:

	(ICC/SEM)	
	Dominant Arm	Non-Dominant Arm
15°	.93/3.71 Nm	.95/3.20 Nm
30°	.83/4.82 Nm	.97/2.01 Nm
45°	.82/3.75 Nm	.78/4.85 Nm
60°	.92/2.86 Nm	.82/3.98 Nm
75°	.89/2.79 Nm	.84/3.08 Nm

The results of this study establish the reliability of the Kin Com 125 AP isokinetic dynamometer in assessing multi-point isometric strength of the shoulder external rotators. Our findings support the findings of several other researchers who used similar test protocols, but different isometric strength measuring devices.

Effects Of Closed Kinetic Chain, Open Kinetic Chain, And Proprioceptive Neuromuscular Facilitation Training On The Shoulder

Padua DA, Guskiewicz KM, Myers JB: University of North Carolina at Chapel Hill, Chapel Hill, NC

Currently, therapeutic exercise of the shoulder is addressed through a multifaceted approach. The use of closed kinetic chain (CKC), open kinetic chain (OKC), and proprioceptive neuromuscular facilitation (PNF) techniques are often described as methods to address shoulder rehabilitation and maintenance. However, the effectiveness of these exercise techniques is often based on theoretical knowledge or knowledge based on lower extremity studies. Therefore, the purpose of this study was to determine the outcomes of CKC, OKC, and PNF exercises in terms of strength, proprioception, neuromuscular control, and functional performance of the shoulder. Fifty-four healthy subjects were randomly assigned to one of four groups: control, CKC, OKC, and PNF. The exercise groups trained 3-days per week, 25 minutes each day over a 5-week period. Strength was assessed through concentric and eccentric peak torque production measurements of internal and external rotation of the shoulder using the LIDO Multi-Joint II Isokinetic Dynamometer (Loredan Biomedical, Inc., Sacramento, CA). Joint position sense measured through active angle reproduction (AAR) served as the measurement of proprioception. AAR reference angles included 30° internal rotation, 30° external rotation, and 75° external rotation. The Smart Balance Master force plate system (NeuroCom International, Inc., Clackamas, OR) provided an objective assessment of neuromuscular control as subjects performed the Single Arm Dynamic Stability (SADS) test. The SADS test determined the subject's ability to maintain dynamic stability through the shoulder in response to an unstable support surface. The Functional Throwing Performance Index (FTPI) served as an indicator of the individual's functional performance levels (Davies and Dickoff-Hoffman, 1993; Rankin and Roe, 1996). FTPI results were determined, by dividing the number of accurate throws by the total number of throws, producing a percentage score. Repeated measures ANOVAs ($\alpha=.05$) were performed on all variables to determine if the training methods had an effect. Results revealed no significant differences among the groups on measures of strength, proprioception, and neuromuscular control ($p>.05$). Analysis of functional performance produced a significant group by test interaction and post hoc

analyses revealed that the PNF group performed significantly better than the control, CKC, and OKC groups at posttest. These results suggest that healthy individuals were unable to significantly improve strength, proprioception, neuromuscular control, and functional performance. However, subjects in the PNF training group performed significantly better on the FTPI at posttest when compared to the other groups. While no significant improvements were revealed the use of these techniques should not be discouraged.

Effectiveness Of Shoulder Bracing In Limiting Active Range Of Motion

McLeod IA, Uhl TL, Arnold BL, Gansneder BM: University of Virginia, Charlottesville, VA

The purpose of this study was to determine the effectiveness of the Sawa (Brace International, Scottsdale, AZ), Sully (Saunders Group, Chaska, MN), and Douglas Shoulder Sling (Douglas Protective Equipment, Houston, TX) shoulder braces and a homemade elastic restraint (Shoulder Strap) in limiting active range of motion before and after football related activities. Twenty Division I and former high school football players (age = 19.9 ± 1.8 yrs, wt = 92.9 ± 11.9 kg, ht = 183.7 ± 7 cm) voluntarily participated in the study. Subjects had no history of shoulder subluxation/dislocation six months prior to testing and were classified as having normal shoulder range of motion. Using a pretest/post-test design the four shoulder braces were individually tested with the subject wearing shoulder pads. Active shoulder goniometric measurements were collected for shoulder abduction (SA), flexion (FX), and external rotation (ER). ROM measurements were quantified with an electric inclinometer (J Tech Medical, Inc., Heber City, UT) while subjects maintained an end ROM that could be comfortably held for 3 seconds. The football related activities included jogging, wide receiver patterns, defensive routes, pass receptions, up/downs, and simulated blocking drills. For each movement a repeated measures ANOVA (brace by time) with Bonferroni corrections ($\alpha = .006$) was used to determine differences between pretest/post-test measurements and braces. For each ANOVA performed there were no brace by time interactions, but there were significant main effects across time for SA ($F(1,20) = 45.6$), FX ($F(1,20) = 25.9$), and ER ($F(1,20) = 76.7$); and among braces for SA ($F(3,60) = 6.9$), FX ($F(3,60) = 15.2$), and ER ($F(3,60) = 5.5$). The results of the study indicated that all braces loosened to the same degree between pretest and post-test measurements (SA pre = 81.8° , post = 90.0° ; FX pre = 109.1° , post = 115.9° ; and ER pre = 73.4° , post = 78.5°). However, post-hoc testing for the brace main effect revealed: 1) the Shoulder Strap allowed greater mean ROM than the Sawa during SA (Shoulder strap = $94.15 \pm 17.6^\circ$, Sawa = $81.25 \pm 16.2^\circ$), FX (Shoulder strap = $125.8 \pm 21.9^\circ$, Sawa = $109.4 \pm 18.8^\circ$), and ER (Shoulder strap = $80.45 \pm 13.7^\circ$, Sawa = $73.1 \pm 9.8^\circ$) and 2) the Shoulder Strap allowed greater mean ROM than the Sully ($101.3 \pm 20.6^\circ$) during FX. Thus, these braces can be expected to loosen following physical activity with the Shoulder Strap and Sawa differing the most across all motions, and the Shoulder Strap and Sully differing during flexion.

The Influence Of Temperature On The Ability To Cut The Football Helmet Face Mask Loop-Strap Attachment

Kleiner DM, Sonnenberg RJ: University of North Florida, Jacksonville, FL

Several recent investigations have reported the time that it takes to remove the face mask from a football helmet. However, many of these studies have been conducted in climate-controlled laboratories at room temperature. The purpose of this study was to evaluate any influence that temperature has on the time that it takes to cut the face mask loop-strap. Thirty student athletic trainers served as subjects. After receiving standard instructions, each subject cut through the two lateral face mask loop-straps and retracted the face mask using the two anterior loop-straps as a hinge. Each subject repeated this task with two tools; the Trainers Angel™ (TA) and an anvil pruner (AP), and under three temperature conditions; hot (helmet placed in a 175°F water bath for 24 h), cold (helmet placed in a 0°F freezer for 24 h), and at room-temperature. The sequence of trials was random and varied for each subject. The subjects also reported a rating of satisfaction with a 10-point scale. The data were analyzed by ANOVA and are presented as means \pm S.D. Time to cut the face mask strap was significantly ($p < 0.05$) better with the AP than with the TA for the cold, and room temperature conditions, but not for the hot condition. Significant differences ($p < 0.05$) were also found between temperature conditions for each tool. Removing the loop-strap with the TA took the longest during the room-temperature condition (138.9 ± 132.2 s), followed by the cold (129.7 ± 100.7 s) and then the hot (53.2 ± 25.9 s), whereas with the AP the cold condition was the slowest (104.3 ± 67.7 s) followed by the room-temperature (81.1 ± 48.9 s), and then the hot condition (45.4 ± 25.7 s). The ratings of satisfaction were also significantly different ($p < 0.05$) between the TA and the AP for each temperature condition, with the hot condition being rated significantly ($p < 0.05$) easier for each tool. The present study did find differences between the TA and AP, as well as differences between temperature conditions. Athletic trainers working in cold environments should be aware of the potential increased difficulty in face mask removal.

The Bactericidal And Cytotoxic Effects Of Antimicrobial Wound Cleansers

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Objective: Wound care is a part of daily activity for many athletic trainers. Knowing which cleansers are effective against bacteria that most commonly cause infection and whether they are toxic to healthy cells enables athletic trainers to make educated decisions on which cleanser to use. This study compared the bactericidal effectiveness and cytotoxicity to human fibroblast cells of 4 cleansers at various dilutions. **Design and Setting:** A 4×4 factorial design was used for the cytotoxicity testing. The independent variables were type of cleanser and dilution of cleansers. The dependent variable was cell viability of the human fibroblast cells. A $2 \times 3 \times 4 \times 4$ factorial design was used for the bacterial testing. The independent variables were type of bacteria used, dilution of bacteria, type of cleanser, and dilution of cleansers. The dependent variable was the bactericidal action of the cleanser on the bacteria. **Subjects:** Human foreskin samples were used to obtain a line of fibroblast cells. Bacterial samples were obtained from an athletic training clinic, isolated from swabs of a whirlpool water supply valve. **Measurements:** Bactericidal measurements were obtained by testing isolated gram positive (*Staphylococcus aureus*) and gram negative (*Pseudomonas aeruginosa*) bacteria. Minimum and maximum concentrations were identified according to bactericidal effectiveness. Cytotoxicity measurements were obtained from spectrophotometric readings of a neutral red assay for fibroblast cell viability. Final dilutions tested were determined by pilot testing. **Results:** At the 1:5 dilution both NitroTan & Cinder Suds and hydrogen peroxide were different from the control with *Pseudomonas aeruginosa*. At the 1:10 dilution both Betadine and hydrogen peroxide were different from the control with *Pseudomonas aeruginosa*. These two cleansers were also different from each other. At the 1:10 dilution only Betadine was not different from the control for the cytotoxicity testing. **Conclusions:** Betadine was both effective against bacteria and not harmful to human fibroblast cells at a 1:10 dilution of a commercially purchased solution.

Impact Of A Dynamic And Static Flexibility Program On Range Of Motion, Number Of Days Injured, And Muscle Soreness

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The investigation was designed to determine the effect of a dynamic (DYN) and static (ST) warm-up program on range of motion (ROM), number of days injured and muscle soreness. Participants ($N = 52$) were on one of four Division III women's lacrosse or softball teams selected to participate in either the ST or DYN programs. Muscle imbalance measurements were measured for the upper and lower extremity utilizing the Cybex Norm isokinetic dynamometer (Lumex, INC). Muscle imbalance measurements were taken to determine if muscular imbalances were a confounding variable in the number of days of injury analysis. No significant ($p > .05$) differences were found in the proportion of athletes with muscular imbalances in the lower and upper extremity at the speed of 60 deg/s between the four groups in number of days injured. Therefore, muscle imbalances were not considered a confounding variable among the four groups. A $2 \times 2 \times 2$ repeated Measures ANOVA was used to determine if baseline and post-program ROM measurements were higher for participants in the DYN or ST program. No significant ($p > .05$) differences were found in ankle, knee, hip and shoulder ROM over the course of a 12-week season for either flexibility program. A 2×2 independent groups ANOVA was used to determine if participants in the DYN program sustained less injuries than participants in the static flexibility program. The DYN program appears to be significantly more ($p = .03$) effective in reducing the number of days missed from competition and practice due to muscular injury when compared to the ST program. A $2 \times 2 \times 12$ repeated measures ANOVA was used to determine the differences in weekly muscle soreness ratings over the 12 week investigation. Muscle soreness levels were higher in the beginning of the season for participants in the DYN program; however, as the season continued the soreness levels of the participants in the ST program increased. In conclusion, both the DYN and ST program appear equally effective at improving range of motion over the course of a 12-week period, however, dynamic flexibility may be better able to reduce muscular soreness later in the season as well as the number of days missed due to athletic-related injury. Future researchers need to further investigate the role of DYN as a warm-up technique to improve of range of motion and decrease of muscle soreness and athletic injury.

Measurements of Dynamic Postural Stability, Visual Scanning, And Mental Flexibility In Collegiate Football Players

Horodyski MB, Walser M, Kaminski TW, Indelicato PA: University of Florida, Gainesville, FL

One hundred three athletes on a collegiate football team (age range 18 to 23) volunteered to participate as subjects in this study. The purpose of this study was to determine relationships between the following variables: postural stability indices (overall stability index, OSI; anterior/posterior index, A/P; medial/lateral index, M/L), the Trail Making Test (versions A and B; TMA and TMB), height, weight, and scholarship. Postural stability was tested in three standing positions (bilateral, skill leg, and stance leg). The Trail Making Test (Reitan Neuropsychology, Tucson Arizona) and the Biodex Stability System (Biodex Medical Systems, Inc., Shirley, New York) were used for all investigations. A total of three trials were completed for bilateral stance, skill leg stance, and stance leg stance. The first two trials were for familiarization and the third was recorded for the actual data point. A sample test was given before the administration of the TMA and TMB. Data was analyzed using correlation matrices and Welch's Modified t-Tests. Low correlation values were noted between variables bilateral OSI and TMA/B ($r=0.1099$, $r=0.1027$, respectively). A moderate correlation value ($r=0.5274$) was noted between the variables of height and bilateral OSI. A low correlation value was noted ($r=0.2753$, $r=0.3349$) between the variables height and skill leg OSI and stance leg OSI, respectively. A moderate correlation value ($r=0.6071$) was noted between weight and bilateral OSI. Again, low correlation values ($r=0.2903$, $r=0.3793$) were noted between the variables weight and skill leg OSI and stance leg OSI, respectively. A significant difference ($p<0.0001$) was noted between scholarship and non-scholarship athletes for all bilateral dynamic postural stability (DPS) indices (OSI, A/P, M/L). Based on the analysis of the recorded data, the following conclusions were made. Although similar tasks were shared between the BSS and the Trail Making Test, no clinically significant relationships were established. When examining the relationship between the variables of height and bilateral OSI, a moderate correlation was noted. A moderate correlation value was noted between the variables of weight and bilateral OSI. When analyzing OSI, A/P, M/L bilateral DPS scores between scholarship and non-scholarship players, the non-scholarship players scored significantly better than the scholarship players on bilateral DPS.

Certified Athletic Trainers Ranked Fourth As The Appropriate Health Care Providers For Equestrian (Horse Riding) Events

Alborn CH, Wimer, JW: Wilmington College, Wilmington, OH

The term equestrian sports can be defined many ways. Horse back riding, for example, has two categories: English and western styles. English riding involves jumping, hunting, dressage, and polo. Western is classified as barrel racing, trail riding, roping cattle, reining, and rodeo. As with other sports, injuries to participants are common. Christopher Reeves, the actor, brought notoriety to equestrian sports injuries after his unfortunate accident left him a quadriplegic. And recently, a group of physicians came together to form the American Medical Equestrian Association. In light of these events, the medical care provided at organized equestrian events is sparse at best. Therefore, the purpose of this study was to determine the knowledge and attitudes of people involved with equestrian events. We hypothesized that students studying equine science, (an academic major), at a small liberal arts college in the Midwest would rank order the Certified Athletic Trainer as the least preferred allied health care provider when compared with Chiropractor, Emergency Medical Technician, Firefighter, Massage Therapist, Nurse, Physical Therapist, and Physician. A survey was administered to 57 equine students in order to test our hypothesis. It consisted of 10 items categorized into three parts: demographic information, attitudes, and ranking. The mean ratings revealed that EMTs are considered the most important allied care professional. This was followed by, (in order of importance), Physician, Nurse, Certified Athletic Trainer, Physical Therapist, Chiropractor, Massage Therapist and Firefighter. There was no significant difference in the ranking of students who played sports in high school and/or college compared with those who did not play sports ($t=0.1234$, $p=.350$). Interestingly, EMTs were ranked higher than physicians, and nurses were ranked higher than ATC's as the appropriate medical provider for 2-3 day equestrian events. These findings suggest that equine science majors may be unaware of each profession's qualifications. Additionally, equestrian events may provide the ATC with another employment opportunity.



1999 REQUEST FOR PROPOSALS

The NATA Research & Education Foundation is pleased to announce that \$120,000 is available in 1999 for Grant Awards. Priority consideration will be given to proposals which include a certified athletic trainer as an integral member of the research or project team.

Research Grants

No. of Awards Available:	Multiple awards are available \$115,000 total, no minimum or maximum dollar amounts for individual grants
Deadlines:	March 1 and September 1
Notification:	July and February

I. General Grants

The Foundation will fund a number of studies which address important issues in five categories: basic science, clinical studies, sports injury epidemiology, observational studies and educational studies.

II. Pediatric Sports Health Care

The Foundation encourages research studies that will have clinical relevance to the development of the pediatric athlete, and the prevention, treatment and rehabilitation of injuries sustained by the physically active pediatric participant. A great need exists for epidemiologic studies to determine pediatric injury patterns and specific populations at risk.

Background

Very little experimental evidence concerns the impact of physical activity upon the general development of the child. The recent, tremendous growth of children's participation in organized sport has outpaced efforts to clearly understand the consequences of intense physical activity on the developing young adult. The incidence of organized sports participation by preadolescents and adolescents has increased dramatically in the past two decades. Children represent the largest group of individuals engaging in organized sport in this country. However, little is known about the incidence and severity of

injuries associated with child or adolescent participation in these activities.

Furthermore, the number of children and adolescents participating in sport increases regularly from year to year. Despite this increase, the President's Council on Physical Fitness has determined that the fitness levels of young adults in this country are on the decline and urges regular participation in sport and exercise by a much higher percentage of the childhood population.

It is assumed that exercise and sports participation have positive effects on children, and there is increasing evidence that regular exercise is important to their physical and psychological well-being. The United States Department of Health and Human Services in its compendium on National Health Promotion and Disease Prevention Objectives recommends significant increases in daily physical activity for children to combat problematic sedentary lifestyles and obesity among young adults. Many experts believe that lifestyles leading to adult heart disease often begin in childhood and that habitual physical activity during development may play an important role in slowing the progression of cardiovascular disease, particularly in high-risk children. Moreover, the increasing awareness and interest in exercise as a treatment medium by the medical community has undoubtedly influenced parents' perceptions of the importance of regular physical activity in the lives of their children.

Yet, participation in sport does pose risks. Exercise is a human stressor which results in bodily adaptations that can have beneficial or adverse effects on health. Childhood and adolescence as developmental periods, introduce variables that are not found in the adult athlete. Asynchronous rates of development among similarly-aged children present difficult challenges to those who teach and supervise the physical

activity of young athletes. Attempts to develop training programs for the young athlete pose a dilemma that the exercise science and medical professions have yet to resolve satisfactorily. A developing child differs significantly in anatomical and physiological parameters from the mature adult. These differences must be taken into account when prescribing exercise programs for young athletes. Children in the 8-15 year age group are in a complicated and critical growing period. Muscular development also varies considerably and the actual strength of muscle relates to the stresses that can be placed on the skeletal framework without injury. If children and adolescents are involved in organized sports, it is obvious that a considerable amount of skeletal growth is occurring simultaneously with periods of intense physical activity.

The repetitive microtrauma and overuse syndromes associated with sports, and their development in children's growth plates have been widely debated. Traumatic sports injuries to the growth plate do occur and the potential for a growth disturbance is always a concern of parents and physicians. While the growth plate seems relatively immune to damage from overuse, it remains to be seen if this sensitive area of children's anatomy remains protected from the increasingly rigorous training to which young athletes are subjected.

Objectives

The Research and Education Foundation, therefore, encourages high quality research proposals that will help establish a firm scientific foundation for basic and applied programs in pediatric sports health care. Areas of interest may include but are not limited to: epidemiology of athletic injuries in children and adolescents; the role of pre-participation physical examination in the identification of injury risk factors among children and adolescents; the efficacy of specific safety equipment in preventing or reducing the incidence and severity of injury; injury mechanisms and exercise pathophysiology in children; prevention, treatment and rehabilitation of pediatric athletic injuries; conditioning of the child athlete; and musculoskeletal healing processes in children. Given the present funding available, it is expected that grant proposals emphasizing local and regional epidemiological approaches will initially be submitted with the intent to develop data bases and model approaches to injury surveillance which can lead to future large scale epidemiologic or intervention studies on a national level.

III. Doctoral Research Grants

No. of Awards:	Two
Available:	\$2,500 for each grant
Application Deadline:	March 1
Notification:	April 15
Sponsor:	Active Ankle Systems

Applicants must be current certified member of the NATA. You must be a doctoral student at the institution where the

research is to be performed and have doctoral student status during the term of the grant to be considered for funding.

Larger-Scale Projects

Those seeking funding for projects which exceed the dollar figures indicated in the RFP, may do so by submitting a letter of inquiry – no longer than 3 pages – outlining a statement of the problem, a description of methods, expected outcomes and estimated budget. If interested, the Foundation will request a full application. There are no deadlines for letters of inquiry.

Application Procedure

To receive a copy of the Grant Application or the Doctoral Research Grant Application, please write to NATA Research & Education Foundation, 2952 Stemmons, Dallas, TX 75247, e-mail the request to BarbaraN@nata.org or call 800-TRY-NATA ext. 121. ■



REQUEST FOR PROPOSALS

Introduction

The NATA Research and Education Foundation announces that \$250,000 is available to support research on pediatric sports health care. The primary goal is to encourage epidemiological study that will have clinical relevance to the development of the pediatric athlete and the prevention, treatment and rehabilitation of injuries sustained by the physically active pediatric participant.

Background

The incidence of sports participation by preadolescents and adolescents has increased dramatically in the past two decades. It is estimated that more than 30 million children and adolescents are participating in organized sports in the United States. Consequently, they represent the largest group of individuals engaging in such activities in this country. However, this recent growth of children's participation in sport has outpaced efforts to clearly understand the consequences of intense physical activity on the development of young adults.

It is assumed that exercise and sports participation have positive effects on children, and increasing evidence shows regular exercise is important to their physical and psychological well-being. Yet, participation in sport does pose risks. Increasing sports specialization at younger and younger ages has placed a high premium for

athletic success. However, little is known about the incidence and severity of injuries associated with child or adolescent participation in these activities. Therefore, a great need exists for epidemiological studies to determine pediatric injury patterns and specific populations at risk. Furthermore, types of intervention strategies to reduce the incidence and severity of pediatric injuries in sport need to be developed as well as the measures of their effectiveness.

Objectives

The Research and Education Foundation, therefore, encourages high quality research proposals emphasizing the epidemiology of athletic injuries in children and adolescents, which will help establish a firm scientific foundation for basic and applied programs in pediatric sports health care.

Procedure

To receive a copy of the Research Grant Application, contact:

NATA Research and Education Foundation
2952 Stemmons
Dallas, TX 75247
phone (800) TRY-NATA, ext.121
fax (214) 637-2206
e-mail <barbaran@nata.org> ■

NATA Research & Education Foundation CALL FOR ABSTRACTS

2000 National Athletic Trainers' Association — Annual Meeting & Clinical Symposia

Nashville, Tennessee • June 29 - July 2, 2000

DEADLINE FOR ABSTRACT SUBMISSION: JANUARY 5, 2000

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 and credentials 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.

5. The title of the clinical case report should not contain information that may reveal the identity of the individual nor the specific nature of the medical problem to the reader. An example of a proper title for a clinical case report is "Chronic Shoulder Pain in a Collegiate Wrestler."
6. Complete the six different categories of information as required for a clinical case report abstract. These categories are:
 - a. Personal Data/Pertinent Medical history (age, sex, sport/occupation of individual, primary complaint, and pertinent aspects of his/her medical history)
 - b. Physical Signs and Symptoms (a brief summary of the physical findings)
 - c. Differential Diagnosis (array of possible injuries/conditions)
 - d. Results of Diagnostic Imaging/Laboratory Tests
 - e. Clinical Course (eg, diagnosis, treatment, surgical technique, rehabilitation program, final outcome)
 - f. Deviation From the Expected (a brief description of what makes this case unique)

NATA Research & Education Foundation Call for Reviewers

The NATA Research & Education Foundation sponsors the Free Communication Sessions at the NATA Annual Meeting & Clinical Symposia. The Joe W. King Orthopedic Institute sponsors the Student Poster Awards Program. These events offer NATA members the opportunity to present and learn about the latest developments in athletic training.

The Foundation is currently recruiting individuals interested in reviewing the abstracts submitted for inclusion in these oral and poster research presentations. The abstracts fall under the following categories: basic science, clinical studies, educational research, observational studies, sports injury epidemiology, and clinical case reports (unique injury cases).

Abstracts are due January 5 of each year. During the month of February, reviewers are asked to submit written evaluations of blind abstracts within their interest or expertise area.

Those interested in volunteering to become an abstract reviewer should send a curriculum vitae or resume, a preferred review category, and a letter of application to:

Christopher D. Ingersoll, PhD, ATC
Athletic Training Department
Indiana State University
Terre Haute, IN 47809

Responses preferred by December 1, 1999

Instructions for Submitting Abstracts (either Free Communications or Clinical Case Reports)

Complete the form and mail it, the original abstract, two photocopies of the original abstract, six (6) blind copies (showing no information about the authors or institution) of the abstract and a labeled 3.5" DISKETTE copy (preferably in WordPerfect or ASCII format; if you must send it in Macintosh format, please use a high-density diskette) of your abstract to:

NATA Research & Education Foundation
Free Communications
2952 Stemmons Freeway
Dallas, TX 75247

**ABSTRACTS POSTMARKED AFTER
JANUARY 5, 2000, WILL NOT BE ACCEPTED.**

Abstract Author Information Form

Mailing Address of Presenting Author:
(Please type; provide full name rather than initials)

☐ I was a student at the time of this study.

Name _____

Institution _____

Address _____

City _____

State _____ Zip _____

Work Telephone _____

Fax # _____

NATA Membership Number _____

e-mail _____

Key Words: (two to six words that identify your abstract)

Indicate the most appropriate TYPE for the presentation: (check one only)

☐ Clinical Case Report ☐ Free Communication

If FREE COMMUNICATION, indicate the most appropriate CATEGORY for your presentation:
(check one only)

<input type="checkbox"/> Basic Science	<input type="checkbox"/> Clinical Studies
<input type="checkbox"/> Educational Research	<input type="checkbox"/> Sports Injury
<input type="checkbox"/> Observation/Informational Studies	<input type="checkbox"/> Epidemiology

Indicate your presentation preference:

(check one only; choice does not influence acceptance)

☐ Poster ☐ Oral ☐ Indifferent

Subject Index

A

Abduction, S-58
Absorption Of Dexamethasone, S-24
Accredited Athletic Training Curriculum Programs, S-65
Acetabular Fracture, S-37
Acoustic Energy, S-18
Acupuncture, S-67
Adipose, S-69
Adolescent Male Athletes, S-35
Agility, S-77
Airborne Chemicals, S-8
Ankle, S-17, S-30, S-31, S-38, S-59, S-68, S-71, S-72, S-73
Brace, S-57, S-71, S-72
Kinesthesia, S-31
Muscle Joint Stiffness, S-14
Rehabilitation, S-59
Tape, S-72, S-73
Taping, S-29
Training Programs, S-30
Anterior Cruciate Ligament, S-11, S-46
ACL Deficient Knees, S-45
ACL Reconstruction, S-26
ACL-Deficient Females, S-46
Dysfunction, S-11
Reconstruction, S-46
Anterior Tibial Translation, S-45
Antimicrobial Wound Cleansers, S-84
Aquatic Exercise, Effects on Low Back Pain, S-27
Arm, S-49, S-51
Assessment Of Pain, S-67
Athletes, S-70
Athletic Injuries, S-34
Athletic Trainers, S-61, S-64
Athletic Training, S-7, S-62, S-64
Curriculum, S-65
Education, S-61
Learning Environment, S-8
Services, S-64
Authorware Professional, S-63
Autograft Procedure, S-46

B

Back, S-54, S-55
Bactericidal
Effects of Antimicrobial Wound Cleansers, S-84
Balance
Activities, S-29

Measurement, S-29
Test, S-44
Baseball, S-21, S-54
Impacts, S-21
Beam Nonuniformity Ratio, S-69
Beta-Hydroxy-Beta-Methylbutyrate Supplementation, S-33
Biodex Stability Measurements, S-29
Biomechanical Efficacy, S-21
Biphasic Versus Russian Current, S-17
Body
Position, S-75
Weight Loss, S-20
Brace, S-71, S-72, S-76, S-84
Brace-Experienced Football Players, S-77
C.Ti 2 Brace, S-45

C

C.Ti 2 Brace, S-45
CAAHEP-Accredited Programs, S-62
Calcaneal Eversion, S-45
Certified Athletic Trainers, S-85
Chemically-Induced Tendinitis, S-23
Chest Protectors, S-21
Clinical Instruction, S-61
Clinically Induced DOMS, S-67
Closed Kinetic Chain Training, S-83
Cold Water Immersions, S-17
College Football, S-51
Collegiate
Athletes, S-70
Football, S-54, S-77, S-85
Rugby, S-43, S-44
Runner, S-55
Swimmer, S-53
Volleyball, S-51
Compartment Syndrome, S-20
Competencies, Athletic Trainers', S-62
Complications Following Injury To Lower Leg, S-53
Concentric Quadriceps And Hamstrings Peak Torque, S-26
Consciousness, S-43
Contact Injury, S-39
Contractions, S-33
Core Stabilization Training, S-27
Counseling In Athletic Training Programs, S-62
Coupling Agents, S-18
Coupling Medium, S-74
Cramping, S-33
Creatine
Supplementation and DOMS, S-33
Supplementation and Muscle Cramping, S-33
Crushed Ice Pack Therapy, S-69
Cryotherapy, S-68
Cutting Football Helmet Face Mask Strap,

S-84

Cytotoxic Effects
Of Antimicrobial Wound Cleansers, S-84

D

Delayed Onset Muscle Soreness, S-33, S-67
Dependent Positioning, S-17
Dexamethasone Iontophoresis, S-70
Diagnosis Of Tibial Stress Fractures, S-24
Disabilities, S-19
Division I Athletics, S-20
Division I Collegiate Football Players, S-19
Don Joy Knee Laxity Tester, S-75
Drug Use, S-35
Dynamic And Static Flexibility Program, S-85
Dynamic Movements In Vivo, S-10
Dynamic Postural Stability, S-29, S-68, S-85

E

Earnings, Male vs. Female, S-64
Effective Clinical Instructor Characteristics, S-61
Effective Radiating Area, S-69
Electromagnetic Fields, S-23
Electromyographic Activity, S-57
Elk Velvet Antler Nutrient Supplementation, S-33
EMG, S-58, S-59
Employment Opportunities, S-7
Endoscopic Semitendinosis/Gracilis Autograft Procedure, S-26
Equestrian Events, S-85
Estradiol Levels, S-79
Eversion, S-72, S-73
Evertor Isometric Torque, S-71
Exercise, S-45, S-58, S-59, S-71
Experienced Athletic Trainers, S-61

F

Fatigue, S-9, S-59
Females, S-11, S-26, S-47, S-64, S-82
Fitness Knowledge, S-7
Flexibility, S-76
Flexibility Program, S-85
Flexor Digitorum Profundus, S-55
Flipflex Exercise Device, S-58
Foot Position, S-14, S-75
Football, S-19, S-20, S-37, S-38, S-39, S-40, S-41, S-49, S-50, S-51, S-54, S-55, S-77, S-85
Helmet Face Mask, S-84
Force Platform Measures, S-30
Fracture, S-37
Frequency of Use of Over The Counter Medications B, S-34

Functional
 Brace, S-31
 Outcome, S-9
 Performance in Swimming, S-27
 Stability, S-30
 Training, S-21
Functionally Unstable Ankles, S-72

G

Gait, S-72
Gastrocnemius, S-14
Gender, S-14, S-45, S-75
Gluteus Medius, S-58
Glycerol Hydration Beverage, S-25

H

Hamstring, S-26, S-70, S-76
Head, S-44
Health Care Providers, S-85
Heat, S-25
 Heat Transfer, S-68
 Heat-Related Illness, S-20
Helmet Removal, S-27
High Level Physical Activity, S-11
High School
 Baseball, S-54
 Football, S-38, S-39, S-40, S-41, S-49, S-50
 Students, S-21
Hip, S-54, S-58
Hip Adduction, S-57
Hiring Practices, Athletic Training, S-64
Humeral Head Taping, S-10
Hypersensitive/Allergic Reaction, S-8

I

Ice Hockey, S-27, S-44
IL-2 Production, S-24
Improving Research And Practice, S-67
Inexperienced Athletic Trainers, S-61
Influences of Insulation on Heat Transfer, S-68
Injury, S-19
 Evaluation, S-63
 To Athletes With Disabilities, S-19
 To Lower Leg, S-53
Instrumented
 Agility Task, S-44
 Arthrometry, S-82
Insulation, S-68
Intensity Output, S-69
Interactive Application
 Application, S-63
Interactive Multimedia, S-63
Intercollegiate Football, S-37
Interference Screw Fixation, S-26
Intertester Reliability, S-14

Intra-Muscular Temperature, S-74
Intramural Sports, S-19
Intramuscular Temperature Change, S-69
Intratester Reliability, S-83
Inversion, S-72, S-73
Isokinetic Strength Ratios, S-72
Isometric
 Hip Abduction, S-58
 Knee Extension Exercises, S-59
 Strength Measurements, S-83
Isotonic Exercises, S-59

J

Joint
 Angle, S-14
 Complex Stiffness, S-75
 Laxity in Females, S-82
 Position Sense, S-68, S-81
 Range of Motion, S-13
 Stability, S-30

K

KAT-2000, S-29
Knee, S-38, S-39, S-40, S-45, S-53, S-68, S-75, S-76, S-77, S-78
 Extension Exercises, S-59
 Extension Force Production, S-17
 Joint Angle, S-14, S-75
 Joint Proprioception, S-78
 Joint Reposition Sense, S-76
 Muscle Joint Complex Stiffness, S-14, S-75
 Perturbation, S-11
 Taping, S-45
Knee Joint Stiffness, S-79

L

Lactate Concentration, S-25
Laxity, S-75
Layers Of Insulation, S-68
Leg, S-30, S-31, S-53, S-57
 Harness, S-25
 Muscles, S-57
Low Back Pain, S-27, S-28

M

Maintained Hamstring Flexibility, S-76
Males, S-11, S-26
Maximal Voluntary Contractions, S-33
McConnell's Patellar Taping, S-78
Mechanical and Electromyographical Specificity, S-59
Mechanical Low Back Pain, S-28
Medications, S-34
Mental Flexibility, S-85
Metrecom Measurement, S-46

Mild Head Injury, S-44
Mountain Bike Races, S-25
Multimedia Program, S-63
Muscle, S-58, S-75, S-82
 Performance Characteristics, S-9
 Soreness, S-85
 Strength, S-30
Myositis Ossificans, S-49

N

National Certification, S-65
Navicular Drop, S-45, S-46, S-71
Neoprene Sleeve, S-29, S-31
Nerve Damage, S-19
Neuromuscular Control, S-9, S-10
Non-Traumatized Ankle Volumes, S-17
Noncontact ACL Injured And Noninjured Knees, S-45
Numbness, S-50, S-51

O

Occlusive Dressing, S-24
Open Kinetic Chain, S-83
Orientation Strategies, S-44
Orthopedic Bracing, S-76
Outpatient Clinical Setting, S-62
Over the Counter Medications, S-34

P

Paget-Schroetter Syndrome, S-51
Pain, S-27, S-38, S-40, S-41, S-50, S-51, S-54, S-55, S-67, S-78
Pain Relief, S-67
Participation In Intramural Sports, S-19
Passive Hip Flexion, S-70
Patellar
 Taping, S-78
 Tendinitis, S-70
Patellofemoral Pain, S-78
Peak Plantar Pressures, S-72
Peak Torque, S-31
Pharmaceutical Practices, S-34
Phonophoresis, S-24
Physiological Function, S-25
Positions, Supine and Standing, S-75
Postural Control, S-57
Posture, S-71
Power, S-77
Preferred Characteristics In Hiring, S-64
Prophylactic Braces, S-31, S-77
Proprioception, S-9, S-30, S-76
Proprioceptive
 Ankle Exercises, S-71
 Neuromuscular Facilitation Stretching, S-76
 Neuromuscular Facilitation Training, S-83
Pulsed Short-Wave Diathermy, S-23

Q

Quadriceps, S-26
Femoris, S-58
Strength, S-78

R

Radiographic Analysis, S-27
Range Of Motion, S-73, S-76, S-81, S-84,
S-85
Reciprocal Muscle Group Ratios, S-82
Reconstruction Of The Anterior Cruciate
Ligament, S-46
Recreational Athlete, S-53
Reducing Anterior Tibial Translation, S-45
Rehabilitation, S-13, S-53, S-59
Rugby, S-43, S-44
Runner, S-55
Rupture, S-55

S

Sagittal Plane Glenohumeral Joint Laxity,
S-82
Scapula, S-10
Scapular Kinematics, S-10
School Teacher, S-64
Self-Reported And Objective Measures,
S-13
Sexual Harassment, S-8
Shoulder, S-9, S-10, S-50, S-81, S-82, S-83,
S-84
Bracing, S-84
External Rotators, S-81, S-83
Joint Position Sense, S-10
Plyometric Training, S-9
Single Leg
Multiaxial Platform Stability, S-31
Postural Control, S-30
Single-Limb Stance, S-30
Skeletal Muscle Cramping, S-33
Slide Board Exercise, S-25
Soccer, S-38
Soleus Hoffmann Reflex, S-75
Somatosensory Control, S-71
Speed, S-77
Sports Medicine Administrators, S-7
Stability, S-30, S-31, S-68, S-85
Stabilization Exercise, S-28
Star Excursion Balance Tests, S-14, S-15
Static And Hold-Relax Stretching, S-76
Status Post ACL Reconstruction, S-46
Steroid Testing, S-35
Stiffness, S-75
Strength, S-46, S-83
Ratios, S-73
Training Performance, S-33
Strengthening, S-81
Stress Fractures, S-24

Stretching Protocol, S-76
Substance Use, S-35
Superficial
Muscles of the Quadriceps Femoris,
S-58
Sensory Radial Nerve Damage, S-19
Supplementation, S-33
Swede-O Ankle Brace, S-72
Swimmer, S-49, S-53
Swimming, S-27

T

T Cell Proliferation, S-24
Taping, S-45, S-78, S-81
Temperature Change, S-69
Temperature, Helmet Strap, S-84
Tendinitis, S-23
Tendon, S-55
TENS, S-67
Theraband®, S-81
Therapeutic
Continuous Ultrasound, S-24
Ultrasound, S-69
Thoracic Spine Positions, S-10
Three-Dimensional Measurement, S-10
Tibial Displacement, S-75
Tinea Gladiatorium, S-34
Tissue Phantom Temperature, S-69
Traditional Physical Education Activities,
S-21
Tubing Exercises, S-59

U

Ultrasound, S-24, S-69, S-74
Treatments, S-23, S-70
Undergraduate Athletic Training Education
Program, S-8
Underwrap, S-72, S-73
United States Military Academy, S-19
University Athletic Training, S-7
Upper Arm, S-49
Upper Extremity
Injury Evaluation, S-63
Tubing Exercises, S-59
Upper Limb Dominance, S-15
Use Of Over The Counter Medications,
S-34

V

Verbal Encouragement, S-26
Visual Feedback, S-26
Visual Scanning, S-85
VL and VMO, S-57
VO2 MAX, S-25
Volleyball, S-51

W

Weight Loss, S-20
Weight Training, S-21
Whirlpools, S-17
Wound Cleansers, S-84
Wrist Taping Techniques, S-81

Author Index

A

Adams JM, S-11
 Akel JW, S-68, S-72
 Alborn CH, S-85
 Alcorn S, S-35
 Allen A, S-26
 Allen MK, S-46
 Alt J, S-37
 Anderson MJ, S-33
 Ansoleaga E, S-67
 Arient J, S-27
 Armstrong CW, S-58, S-59
 Arnold B, S-10, S-11, S-33, S-57, S-58,
 S-59, S-71, S-74, S-75, S-76, S-79,
 S-82, S-84
 Axe MJ, S-11

B

Balcavage WX, S-23
 Ball DW, S-10, S-24
 Barelare NL, S-31, S-76, S-78
 Bauer AM, S-58
 Bauer J, S-29, S-83
 Beck J, S-50
 Behler AS, S-21, S-38
 Bell G, S-53
 Bell SL, S-10
 Berger EM, S-25
 Bernard A, S-77
 Bibi KW, S-17
 Bishop P, S-45
 Bishop PA, S-19
 Blackburn JT, S-30
 Blackman L, S-77
 Blair DF, S-21, S-38
 Blank CB, S-68, S-72
 Bolgla LA, S-38, S-41
 Boone L, S-70
 Borsa PB, S-82
 Brand J, S-54
 Brody M, S-77
 Brooks PV, S-50
 Brown S, S-62
 Bruce SL, S-54
 Buckley WE, S-14, S-15, S-44
 Burgess S, S-18
 Burkhouse DR, S-21
 Busby MA, S-30

C

Caggiano NA, S-30, S-31
 Calabrese GJ, S-51
 Cameron KL, S-19, S-43
 Campenella BJ, S-26
 Carr JL, S-64
 Casa DJ, S-25
 Chally PS, S-62
 Chapski C, S-7
 Chmielewski C, S-81
 Clark AL, S-53
 Clarke RA, S-53
 Cleary MA, S-26
 Colloton PA, S-24
 Connolly TA, S-38
 Cooper ER, S-45
 Cordova ML, S-13, S-57, S-59, S-70, S-71,
 S-75
 Courson R, S-19, S-44, S-51, S-77
 Cross KM, S-13

D

Daigneault BM, S-57
 Dargur L, S-46
 Davidson PA, S-9
 Davis H, S-11
 Davis JM, S-27
 Davis SE, S-8
 Deacon JL, S-43
 Dellis WO, S-25
 Delmonte SA, S-31, S-76, S-78
 DeMont RG, S-14, S-75
 Denegar C, S-14, S-15, S-18, S-44
 Dillon M, S-51
 Dolan MG, S-17
 Domholdt E, S-18
 Dorshaw AD, S-75
 Draper DO, S-23
 Drummond JL, S-8, S-61
 Duncan JB, S-41
 Durrant E, S-23
 Dussault RG, S-24

E

Earl JE, S-57
 Ebersole KT, S-58
 Echemendia R, S-44
 Edwards JE, S-33, S-67, S-75
 Edwards SW, S-64
 Elliott R, S-77
 Evans TA, S-53, S-54
 Evetovich TK, S-58

F

Fellingham GW, S-69
 Ferber R, S-11

Ferrara MS, S-19, S-34, S-44, S-45, S-51,
 S-67

Fisher BD, S-33
 Fitzgerald GK, S-11
 Foreman SA, S-24
 Fox M, S-23, S-84
 Franklin PJ, S-72, S-73
 Freed SD, S-38
 Freidhoff G, S-49
 Frey Law L, S-39, S-46
 Fu FH, S-9, S-46
 Fukai M, S-28

G

Gaesser GA, S-59
 Gangstead SK, S-61
 Gansneder BM, S-11, S-57, S-58, S-59,
 S-71, S-74, S-75, S-76, S-79, S-84
 Garrett C, S-23
 Gatto J, S-69
 Gentile G, S-20
 German TL, S-78
 Gieck JH, S-10, S-24
 Giesen D, S-34
 Gillespie JM, S-78
 Gilpin M, S-33
 Glasoe WM, S-46
 Glover TA, S-33
 Golestani S, S-17, S-68
 Granata KP, S-11, S-59
 Green BL, S-35
 Gribble PA, S-76
 Grimm TR, S-21
 Grossman J, S-77
 Gulick D, S-69, S-70
 Guskiewicz KM, S-9, S-27, S-30, S-76, S-83

H

Haddock KM, S-73
 Hadfield OD, S-65
 Haimowitz MA, S-81
 Hancock J, S-53
 Hanssen TL, S-29
 Haring KN, S-45
 Harrington K, S-17
 Hauth JM, S-8, S-34
 Hegg T, S-21
 Herling DE, S-82
 Hertel J, S-14, S-15, S-44
 Hetzler RK, S-25
 Hicks T, S-77
 Hill JB, S-71
 Hill S, S-17
 Hirth CJ, S-30
 Hodges JR, S-71
 Hodgson C, S-58
 Holcomb WR, S-17

Hopkins JT, S-59, S-75

Horodyski MB, S-27, S-29, S-68, S-72,
S-73, S-83, S-85

Housh TJ, S-58

Hubbard D, S-37

Huggard C, S-70

I

Indelicato PA, S-85

Ingersoll CD, S-13, S-28, S-33, S-57, S-67,
S-70, S-71, S-75, S-84

J

Jacobs D, S-49

Jacobson B, S-20, S-64

Jayaraman G, S-21

Johns LD, S-24

Johnson D, S-39, S-40, S-49, S-50

Johnson GO, S-58

Johnson PD, S-44

Jones DL, S-41

Jones MT, S-85

Joyce CJ, S-71

Jutte LJ, S-59

K

Kahler DM, S-24

Kaminski TW, S-27, S-29, S-68, S-72, S-73,
S-83, S-85

Karduna AR, S-10

Kelly J, S-26

Kelly R, S-71

Kemper J, S-62

Kendrick Z, S-69, S-70

Keskula DR, S-38, S-41

Khalid RV, S-13

Kimura IF, S-25, S-26, S-69, S-70

Kirk SE, S-79

Kleiner DM, S-7, S-31, S-62, S-68, S-72,
S-73, S-76, S-78, S-81, S-84

Klucinec B, S-18

Knight JC, S-25

Knight KL, S-23, S-73

Koesterer AL, S-19

Kohl T, S-34

Kono T, S-67

L

Laird S, S-10

Laise K, S-49

LaMaster K, S-12, S-63

Lawrence N, S-28

Leaver-Dunn D, S-35

LeBlanc MJ, S-13

Leeper JD, S-35

Lehtola JA, S-21

Leonard K, S-68

Lephart SM, S-9, S-14, S-30, S-31, S-46,
S-75

Lephart SP, S-9

Leslie JE, S-13

L'Hommedieu S, S-83

Livings D, S-72

Loriz LM, S-7

Loudon JK, S-10

M

MacDonald LM, S-55

Mackey TR, S-34

Macko SD, S-81

Magill J, S-29

Mair S, S-50

Malley C, S-30

Mangus B, S-45

Manley ML, S-81

Mann DP, S-85

Manos T, S-85

Marchetto P, S-26

Martin D, S-34

Marvar PJ, S-17

Mattacola C, S-26, S-69, S-70

Maul CA, S-81

Mays S, S-27

McCabe KM, S-34

McCabe RE, S-30

McClung JM, S-25

McClure PW, S-10

McCue FC, S-24

McKenzie MA, S-82

McLeod IA, S-84

McNew S, S-40

McWilliams BJP, S-64

Mead JJ, S-57

Meador R, S-7

Measom GJ, S-69

Meister K, S-27, S-29

Mendel FM, S-17

Mercer J, S-11

Merrick MA, S-33

Michener LA, S-10

Miller D, S-55

Miller JJ, S-79

Miller KA, S-54

Miller MG, S-7

Miller SJ, S-14, S-15

Misasi SP, S-62

Mistry D, S-24, S-74, S-79

Mollosky J, S-71

Moyer J, S-34

Murphy RM, S-67

Myers JB, S-9, S-83

Myrer JW, S-69

Myrer KA, S-69

N

Nagy S, S-35

Nakasone KT, S-25

Neuenfeldt J, S-24

Newlon H, S-19

Noble AC, S-21, S-38

Noble AD, S-21, S-38

Nonnemacher MM, S-7

Norkus S, S-58, S-59

Nyland J, S-35

O

O'Connor PJ, S-67

Olmsted LC, S-44

Orr ED, S-55

Oshikoya CA, S-74

Osternig L, S-11

Ott G, S-39

Ozee JP, S-71

P

Pack CB, S-71

Padua DA, S-9, S-83

Page P, S-49

Passerallo AJ, S-51

Patel H, S-77

Patterson P, S-12, S-29, S-63

Pero S, S-45

Perrin DH, S-10, S-11, S-24, S-59, S-74,
S-75, S-82

Perry J, S-77

Perry SR, S-58

Peterson CL, S-19, S-44

Pinto KK, S-29

Plomaritis MJ, S-31, S-76, S-78

Porter D, S-55

Powers ME, S-33, S-82

Prenger J, S-77

Prentice WE, S-27, S-30, S-76

Putukian M, S-44

Pyle M, S-68

R

Rabenberg VS, S-84

Ransone JW, S-20, S-64

Ricard MD, S-73

Rice M, S-63

Rieger M, S-53

Riemann BL, S-14, S-30, S-31, S-75

Rippe M, S-10

Rivenburgh DW, S-9

Rizzo CS, S-33

Romani WA, S-24, S-79

Rosene JR, S-45
Roth BE, S-81

Roush J, S-62, S-72
Ryu KH, S-14, S-75

S

Sakalas MA, S-81
Saliba EN, S-10, S-24
Salvaterra G, S-44
Sandrey MA, S-23, S-28, S-57, S-67, S-71, S-84
Sauers ES, S-82
Scheidler M, S-18
Schmitz RJ, S-57, S-58, S-59
Schulthies SS, S-73
Scibek JS, S-27
Sennett BJ, S-10
Sherwood SM, S-73
Shields EW, S-76
Shive ES, S-34
Shultz SJ, S-11, S-74
Sitler M, S-26, S-69
Slawski DP, S-45
Slone KR, S-73
Smith D, S-53, S-54
Smith DB, S-58
Smith Goodwin E, S-64
Snouse S, S-19
Sonnenberg RJ, S-84
Spernoga SG, S-76
Stemmans CL, S-61
Stephenson A, S-27
Sterner R, S-58, S-59
Stilger V, S-7, S-37
Stone DA, S-9, S-46
Stopka C, S-68, S-72
Straub S, S-70
Sumida K, S-35
Swanik C, S-7, S-9, S-46
Swanik KA, S-9, S-46
Swartz EE, S-58
Swez JA, S-23
Synder-Mackler L, S-11

T

Tanner J, S-51
Taylor JE, S-35
Teprovich JM, S-17
Terhune WG, S-54
Thatcher JR, S-34
Threlkeld AJ, S-68

U

Uhl TL, S-10, S-76, S-84
Ullery LR, S-39

V

Vanic K, S-8, S-55, S-61

Vardiman JP, S-20
Velasquez BJ, S-8
Voigt G, S-12, S-63

W

Walser M, S-85
Weber MD, S-19
Webright WG, S-58, S-75
Weiss VS, S-81
Welsh WE, S-35, S-50, S-54
Weltman A, S-24
Westrick K, S-39
Whipple RL, S-21
Wiksten D, S-12, S-29, S-63
Wiles D, S-33
Williams RB, S-65
Wilson B, S-77
Wimer JW, S-64, S-85
Wingo JE, S-25
Wirth VJ, S-67
Woodall WR, S-19
Worrell TW, S-13
Wright B, S-19
Wright K, S-7, S-35, S-63
Wright V, S-63

Y

Yack HJ, S-46
Young DR, S-69
Yunker CA, S-19

Z

Zacherl TM, S-78
Zvijac JE, S-38

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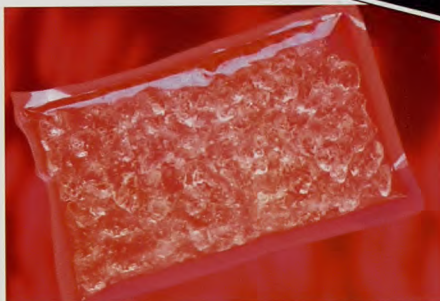
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