

Supplement to

# JOURNAL OF ATHLETIC TRAINING

VOLUME 30



NUMBER 2



JUNE 1995



N A T A

*Official Publication of The National Athletic Trainers' Association*

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# JOURNAL OF ATHLETIC TRAINING

Official Publication of  
The National Athletic Trainers' Association

Volume 30, Supplement, 1995

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Dear NATA Members and Friends,

The Free Communications of the NATA Annual Meeting celebrate their 10th anniversary in 1995. These events offer the NATA membership an opportunity to present research findings as well as learn about the latest developments in athletic training science. Until this year, the abstracts of these presentations were published in the Summer (June) issue of the *Journal of Athletic Training*.

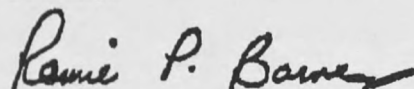
To commemorate the 10th anniversary, the NATA and the NATA Research & Education Foundation are happy to assist the *Journal of Athletic Training* in providing this supplemental issue which includes the Free Communications, REF Funded, and Clinical Case Report abstracts, listed in order of presentation at the NATA Annual Meeting for your convenience.

Presentations (oral and poster) are divided into categories: basic science, clinical studies, educational research, sports injury epidemiology, and observational studies. In addition, two clinical case report sessions enable you to challenge your clinical assessment skills. The case report author presents the medical history and physical findings of a case involving a rare or unusual problem. He/she is then questioned by a panel and the audience in an effort to determine the nature of the problem. Yet another format, the Foundation Funded Research Presentations, feature presentations from individuals who have received a grant from the NATA Research and Education Foundation. The Foundation's Research Committee has been responsible for the complete planning and implementation of the Free Communications sessions since 1991 including the solicitation of abstracts, evaluation and selection of abstracts, scheduling, selection of moderators and event logistics. Abstracts are due on January 5 of each year. The Call for Abstracts is printed in this supplement and will be printed in future 1995 issues of the *Journal of Athletic Training* and the *NATA News*.

The NATA Research & Education Foundation is dedicated to enhancing the health care of the physically active through support and funding of research and education. The Free Communications (Oral and Poster), Clinical Case Reports, Funded Research, and this research supplement are examples of the excellent programs that your donations make possible.

We hope that this supplement provides you with theoretical and practical information you can use to improve your effectiveness as an athletic trainer. Thank you for your support!

Sincerely,

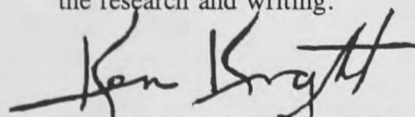


Ronnie P. Barnes, MS, ATC  
Chair, NATA Research & Education Foundation



Denny Miller, ATC, PT  
President, NATA

The Journal Committee is grateful to the NATA Board of Directors and the NATA Research and Education Foundation for their support of this project. As I pointed out in my Editorial in the June issue of the journal, the increased number of Free Communications and of quality manuscripts made it impossible to continue publishing the Free Communications in the journal. This supplement allows us to give you more printed information. Thanks to those who made it financially possible, my staff in Terre Haute who took on the added workload, and to the many authors who created a need for all this by doing the research and writing.



Kenneth L. Knight, PhD, ATC  
Editor-in-Chief



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The abstracts on these pages were prepared by the authors and are printed here without correction, except for condensing some to fit in the allotted space. 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.

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## **NATA Research & Education Foundation CALL FOR REVIEWERS**

The NATA Research & Education Foundation sponsors the Free Communications and Poster Presentations at the NATA Annual Meeting. 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 case reports (unique injury cases).

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

Those interested in volunteering to become an abstract reviewer should send a curriculum vitae or resume, your preferred review category and a short description of why you would make a good abstract evaluator to Reviewer, NATA Research & Education Foundation, 2952 Stemmons Freeway, Dallas, TX 75247. Responses preferred by November 1, 1995.



## Free Communications, Oral—Basic Science

Wednesday, June 14, 8:00 — 9:30

### Determination of Skeletal Motion at the Ankle Using the MRI

Martin DE, Kaplan PA. University of Virginia, Charlottesville, VA 22903

Ankle range of motion is frequently assessed during clinical evaluation of injury and instability. Selection of bony landmarks, motions of interest, and displacement of vectors are often examiner specific. Instrumented and radiologic assessments have been suggested as direct ways to quantify ankle motion; however, as with manual exams, little consistency exists in examination protocols. The purpose of this study was to quantify ankle joint motion using magnetic resonance imaging (MRI). Axial T1 images (600/20, TR/TE, 3 mm slice) were obtained on two subjects with no history of ankle trauma using a 1.5T scanner with a flexible surface RF coil. Ankles were positioned using a Tibial Fixator Device which stabilized the leg and foot in fixed orientations. Images were obtained in neutral (N) position (plantar aspect of the foot perpendicular to the tibia), 10° dorsiflexion (D), and 20° plantarflexion (P). Twelve images were obtained in each position. Angular motion of selected bones was measured relative to a horizontal line and relative to talar angulation. The following table presents the ratio of MRI determined motion to external position in the first two columns and angular motion difference relative to the talus in the second two columns.

Bone	P Ratio	D Ratio	P °Δ from Talus	D °Δ from Talus
Talus	0.7	0.5	na	na
Calcaneus	0.8	0.4	0.8	0.0
Navicular	0.8	0.1	1.5	3.0
Med Cuneiform	0.7	0.4	1.0	0.8
1 <sup>st</sup> Metatarsal	1.2	1.2	10.0	6.3
5 <sup>th</sup> Metatarsal	0.5	0.8	4.0	2.0

These data show that angular motion referenced by the plantar surface of the foot is comprised of contributions from several joints. In plantarflexion and dorsiflexion, the talocalcaneal joint was stable. These data suggest that the 1st and 5th metatarsals do not move in concert with the talus and therefore may have limited utility for use as anatomical landmarks when estimating talar motion. This project was supported by the University of Virginia Department of Radiology.

### Relationship Between Postural Sway Measures and Ankle Joint Position Sense in Subjects With Functional Ankle Instability

Bernier JN, Perrin DH. University of Virginia, Charlottesville, VA 22903

Articular mechanoreceptors provide proprioceptive sensations, and are an important neurological component contributing to muscular reflex stabilization. As such, the ankle joint is thought to be a major contributor to the automatic reflexes which act to control posture. Afferent nerves in ligament and joint capsule may become damaged when injury occurs, causing a partial deafferentation. Postural sway and reproduction of joint positioning (joint position sense) are two measures often used to assess proprioceptive deficits that follow ligament and joint capsular damage. The purpose of this study was to determine if a relationship exists between postural sway measures and joint position sense (JPS) error in subjects with functional ankle instability. Forty-eight subjects, 24 men and 24 women (age=22.5 ± 3.8 yr, ht= 172 ± 11 cm, wt=72.4 ± 15.8 kg) participated in this study. All subjects had at least one ankle injury in which they were unable to bear weight, followed by repeated episodes and a feeling of instability within the past year. Subjects were tested for active and passive joint position sense at 5°/sec in four positions: 20° inversion, 10° eversion, 0° neutral, and a maximum inversion position (-5° of the individuals maximum active inversion). Postural sway was measured under eyes-open and eyes-closed conditions both on a stable platform as well as an inversion/ eversion tilting platform. Sway index, sway equilibrium (A/P and M/L), and a ratio of eyes-open to eyes-closed were the dependent measures used to assess postural stability. A total of eight JPS measures and 14 postural stability measures were placed in a correlation matrix. Only 4 of 112 showed very low relationships ( $r=.29$  to  $.32$ ) that were significant ( $p<.05$ ) between JPS and postural stability measures. Both postural sway and joint position sense serve as means for evaluating afferent input. However the very low relationship between JPS and postural stability may be due to variations in the contribution of muscular and cutaneous mechanoreceptors. Accordingly, thorough evaluation may necessitate assessment of both JPS and postural stability.

### The Effects of Ankle Hair and Ankle Taping on Postural Stability

Ryan MA, Kleiner DM, McCaw ST, Knox KE, Ricard MD. Illinois State University, Normal, IL 61761

Previous studies have suggested that ankle taping may increase proprioceptive responses, in addition to the mechanical support that it may offer. In addition, body hair is known to have a sensory role which may contribute to proprioception and balance. Therefore, the purpose of this study was to evaluate the effects of ankle taping and ankle shaving on postural stability as an evaluation of proprioception at the ankle. Twenty male volunteers ( $\bar{x}$  age=23.8 yr) without ankle injury served as subjects. Each subject performed a 10-second modified Romberg test (single-leg stance, eyes closed and arms at side) on the stable platform of the Chattecx™ Balance System, under 4 conditions; shaved-untaped, unshaved-untaped, shaved-taped, and unshaved-taped. The unshaved conditions always preceded the shaved conditions, but the sequence of the tape conditions was randomized. An independent control group of five subjects demonstrated no learning effect with repeated trials. A closed basketweave was applied to the ankle with tape extending to 40% of the length of the fibula, by the same certified athletic trainer. Postural sway was calculated from the subject's center of balance and is reported as the sway index. Data were analyzed with an ANOVA with repeated measures and are presented as means ( $\pm$  SD). Results indicated no interaction between taping and shaving, and there was no main effect for shaving. However, the main effect for taping was significant ( $p<.05$ ), with the taped conditions allowing the most postural sway. The sway index for the conditions; shaved-untaped, unshaved-untaped, shaved-taped and unshaved-taped were 1.44(.43), 1.45(.30), 1.71(.41), and 1.81 cm(.42), respectively. These data suggest that the presence or absence of ankle hair does not affect postural sway. Additionally, the effect of ankle taping on postural stability appears to be inhibitory and not facilitatory as previously hypothesized. Further research is recommended on the effects of both ankle hair and ankle taping on proprioception. The Balance System provided by The Chattanooga Group, Inc.

## The Effects of Ankle Taping and Visual Input on Balance

McCaw ST, Ryan MA, Kleiner DM, Knox KE, Ricard MD. Illinois State University, Normal IL 61761

Although it has been suggested that ankle taping may play a role in providing increased proprioceptive feedback, our other study indicates that when the eyes are closed, postural stability is better in the untaped condition versus the taped condition. Since visual input is the dominant sense used to maintain balance, any beneficial effects of taping might interact with visual input. Therefore, the purpose of this study was to evaluate the effects of ankle taping on postural stability in the presence and absence of visual input. Twenty male volunteers ( $\bar{x}$  age = 23.8 yr) without ankle injury served as subjects. Each subject performed a 10-second modified Romberg test (single-leg stance, arms at side) on the stable platform of the Chattecx™ Balance System, under four conditions; untaped—eyes open, taped—eyes open, untaped—eyes closed, and taped—eyes closed. The eyes open and eyes closed trials were randomized within the randomized taped and untaped conditions. An independent control group of 5 subjects demonstrated no learning effect with repeated trials. A closed basketweave was applied to the ankle with tape extending to 40% of the length of the fibula, by the same certified athletic trainer. Postural sway was calculated from the subject's center of balance, and is reported as the sway index. Data were analyzed with an ANOVA with repeated measures, and are presented as means ( $\pm$ SD). Results indicated no interaction between taping and vision, and there was no main effect for the taping conditions. However, the main effect for vision was significant ( $p < .05$ ), with the eyes—closed conditions allowing the most postural sway. The sway index for the conditions; untaped—eyes open, taped—eyes open, untaped—eyes closed, and taped—eyes closed were 0.81(.26), 0.83(.24), 1.95(.45), and 2.11 cm(.42), respectively. These data suggest that when vision is eliminated a decrease in balance is discernible, and that balance appears to be further inhibited with tape. We conclude that when all proprioceptive feedback is functioning properly (visual, vestibular, joint receptors, etc) ankle tape provides inadequate additional feedback to affect postural stability. Further research is recommended regarding ankle taping and proprioception. (The Balance System provided by The Chattanooga Group, Inc.)

## Effect of Lateral Ankle Joint Anaesthesia on Joint Position Sense, Postural Sway, and Center of Balance

Hertel JN, Guskiewicz KM, Kahler DM, Perrin DH. University of Virginia, Charlottesville, VA 22903

Damage to ankle joint afferent receptors has been theorized to cause functional instability with recurrent ankle sprains. This study investigated induced anaesthesia of the lateral ankle joint on proprioception in open and closed kinetic chains. Passive joint position sense was assessed on a Kin-Com dynamometer (Chattanooga Group, Chattanooga, TN). Postural sway and center of balance were tested for unilateral stance on a Chattecx Dynamic Balance System (Chattanooga Group, Chattanooga, TN). Sixteen subjects (age =  $22.6 \pm 1.9$  yr, ht =  $172.0 \pm 10.0$  cm, wt =  $69.7 \pm 11.0$  kg) were assigned to balance their test ankle, order of treatments, and order of tests. Subjects were given an 8-cc injection of lidocaine into the anterior talofibular ligament of the test ankle. Passive joint position was measured as degrees from reference angles; 10° eversion, and 20° and 30° inversion. Sway and center of balance were taken on the platform in 3 conditions: stable, plantarflexion/dorsiflexion, and inversion/eversion. A two-factor repeated measures ANOVA on joint position scores revealed no main effect for condition (anaesthesia vs no anaesthesia). A main effect was found at the different reference angles. Tukey post hoc analysis revealed scores for 10° eversion significantly less than scores for either of the inversion angles ( $p < .05$ ). No condition by angle interaction was found. A two-factor repeated measures ANOVA on postural sway scores revealed no main effect for condition. A main effect was found for platform movement. Tukey post hoc test revealed that postural sway significantly increased during the dynamic conditions as compared to stable condition ( $p < .05$ ). No condition by movement interaction. A three-factor repeated measures ANOVA on center of balance revealed no main effect for platform movement or axis ( $x$  vs  $y$ ). However, a main effect for condition was found. Tukey post hoc test revealed significant lateral adjustment of center of balance with stable tests compared to medial adjustment during dynamic tests under anaesthetized condition ( $p < .05$ ). Movement by axis interaction was found. These findings suggest that inhibition of the joint receptor afferent fibers adversely affects joint proprioception as assessed in the closed kinetic chain.

## Swede-O, SubTalar Support, and Airstirrup Ankle Braces Effect on Vertical Jump Ability Over Extended Activity Periods

Paris DL, Jones D. Concordia University, Montreal, Quebec, Canada HB4 1R6

Several studies have been published on the effects of nonelastic adhesive tape and commercial ankle braces on various motor tasks, but the results have not produced a consensus of opinion. Studies have shown that tape significantly decreases vertical and broad jump performance, while others show no difference in similar activities between ankle braces and tape. This study compared vertical jump performance of subjects under Swede-O (SO), SubTalar Support (STS), and Airstirrup (AS) ankle braced conditions over extended periods of activity. The 22 subjects were tested under each support condition with the same ankles tested unbraced as the control. Vertical jump performance was recorded by the Sargent Chalk Jump Test preactivity, and after 20, 40, and 60 minutes activity. Activity sessions included speed walking on an inclined motorized treadmill in forward, left and right carioca directions, and a series of passive inversion and eversion range of motion repetitions performed on a BIODEX dynamometer. After three trial jumps, the maximum jump score from three attempts was recorded as the data. Three one-way ANOVAs with repeated measures were used to identify the effects of the three types of braces on vertical jump. Results showed that all support conditions significantly reduced preactivity vertical jump performance compared to unsupported ankles. Significant increases in jump performance were recorded for the SO (10.87%) and STS (6.33%) braces after 20 minutes of activity compared to preactivity braced ankles. An initial increase in vertical jump performance was recorded for the AS (5.35%) brace after 40 minutes of activity. At 60 minutes postactivity, significant increases in jump scores compared to preactivity braced ankles were recorded for the STS (7.81%), AS (9.01%), and SO (10.34%) braces. The literature shows many of the studies which had reported either no or significantly reduced jump performance, had data collected soon after support conditions were administered. Our study shows that after activity periods between 20 and 60 minutes, vertical jump performances were significantly improved with ankle braces. Where SO, STS, and AS ankle braces are worn as alternatives to tape, we conclude that support may not be compromised for vertical jump performance as is suggested in the literature.



## Free Communications, Oral—Clinical Studies

Wednesday, June 14, 9:45 - 11:30

### The Effects of Qualifications on the Efficiency of Football Helmet Face Mask Removal With Various Tools

Knox KE, Kleiner DM, McCaw ST, Ryan MA. Illinois State University, Normal, IL 61761

The purpose of this study was to evaluate the efficiency of tools commonly used to remove the face mask from a football helmet. A secondary purpose was to evaluate which group of subjects were most efficient with which tool. Subjects were 5 entry-level student athletic trainers (SAT), 5 certified athletic trainers (ATC), and 5 emergency medical technicians (EMT). After receiving videotaped instructions, each subject was asked to remove the face mask from the helmet of a live model, using each tool. The tools were: a Phillips screwdriver (SD), the Trainer's Angel™ (TA), an anvil pruner (PR), and a utility knife (KN). However, the KN had to be removed from the study after the first 2 subjects injured themselves. Subjects were asked to remove the two lower straps securing the face mask to the helmet, and to lift the face mask as if to gain access to the model's airway. The model, who represented an unconscious athlete, was equipped with a football helmet and shoulder pads, and was lying supine with his helmet positioned on a force platform. The dependent variables were: time to remove straps, time to lift face mask, and amount of head movement of the model. Electromyographic activity of the model's neck muscles was monitored to ensure that he did not assist nor resist the subjects. Data were analyzed using a mixed factor (group  $\times$  tool) ANOVA and are presented as group means ( $\pm$  SD). There were no interactions between the variables. The data revealed no difference in the amount of time that it took to remove the face mask with the tools ( $p > .05$ ). However, the data from the force platform revealed that movement (radial area of the center of pressure) was significantly ( $p < .05$ ) higher with the TA, than with PR, or SD [2.51 cm<sup>2</sup> (1.27), 2.04 cm<sup>2</sup> (1.00), and 1.69 cm<sup>2</sup> (0.87), respectively]. In addition, the mean radial area for the ATC [2.91 cm<sup>2</sup> (0.57)] was significantly higher than for the SAT [1.18 cm<sup>2</sup> (1.05)]. Subjects were also asked to rate their satisfaction with each tool, and they rated the PR significantly higher than the TA or the SD. The data from this preliminary study suggest that ATCs need to practice the skill of face-mask removal. Further research and the development of alternative methods for face mask removal are also warranted.

### An Evaluation of the Techniques Used by Athletic Trainers When Removing a Face Mask With the Trainers Angel™

Kleiner DM, Knox KE. Illinois State University, Normal, IL 61761

The purpose of this study was to survey how athletic trainers manage possible cervical-spine injuries on the field, including their technique for using the Trainers Angel™ (TA). Fifty certified athletic trainers (mean time certified = 6.81 yr) were asked to complete a short written survey, and then were observed using the TA. Their technique was noted, along with any difficulties they had in cutting the plastic straps that secured the face mask to the football helmet. When asked if they would personally attempt to remove the helmet from an athlete with a suspected spinal injury, 92% of the subjects responded no. When asked if they would attempt to place that same athlete on a spine board, 14% said they would, while 86% said they would wait and let Emergency Medical Services do it. When asked what tool is in their trainers kit that they would use to remove the straps that secure the face mask to the helmet, 54% reported the TA, 12% reported a scalpel or knife, 12% scissors, 12% a screwdriver, and 10% other or none. The subjects were then observed for the technique they used with the TA, which was classified into four basic categories. Only 12% used the technique recommended by the manufacturer, while 52% used a technique where the cuts in the plastic straps were made only on top of the face mask bar. Sixty percent of the subjects had difficulty or had to use two hands when using the TA, and 58% were unable to make a satisfactory cut during their first attempt. Sixty-eight percent of the subjects responded that they had never practiced using the TA. Four of the subjects reported having to use the TA during "real" on-the-field situations a total of six times. These data suggest that while the TA may be a satisfactory tool, it should have better instructions for use. It is further recommended that athletic trainers practice the skill of face mask removal. It is suggested that consideration be given to including the skill of face mask removal as a competency for athletic trainers. Further research and the development of alternative methods for face mask removal are also warranted. ArmorGuard™ face mask straps were provided by Schutt Manufacturing Co.

### Airway Preparation Techniques for the Cervical-Spine-Injured Football Player

Ray RR, Luchies C, Farrell R, Bazuin D. Hope College, Holland, MI 49423

Athletic health care professionals have been concerned about how to optimize the emergency care the cervical-spine-injured football player receives on the field. Much of the discussion has centered around the issue of how to best expose and prepare the airway for rescue breathing or CPR in the quickest and safest manner possible. Although testimonial evidence abounds, no experimental data previously existed to support any particular technique. This study compared the time required and the extraneous motion induced at the cervical spine during three traditional and one new airway exposure and preparation technique. Twelve subjects wearing football helmets and shoulder pads were exposed to multiple trials of airway exposure via face mask repositioning using a manual screwdriver (MSD), power screwdriver (PSD), and the Trainer's Angel cutting device (TA). Subjects also underwent airway preparation using the pocket mask insertion technique (PM). Cervical spine motion was measured in two dimensions using an optoelectronic motion analysis system. Time and qualitative assessment were obtained through videotape analysis. Significant differences were found between the techniques with respect to time and cervical spine motion. The PM allowed quicker activation of rescue breathing or CPR than the other three traditional techniques ( $p < .0003$ ). There was no significant difference in the amount of extraneous motion induced at the cervical spine between the PM, MSD, and PSD techniques. The TA induced significantly more motion than the other three techniques in each of the four motions measured ( $p < .00001$  to  $.0005$ ). Changes in traditional protocols used to treat cervical-spine-injured football players on the field are recommended based on these data.

### **The Relationship of Intervertebral Foramina Canal Stenosis and Traumatic Upper Extremity Paresthesias**

Aliquo D, Sittler M, Kelly J, Moyer R, Kimura I, Ryan J. Temple University, Philadelphia, PA 19122

Traumatic upper extremity paresthesias (burners) are poorly understood but frequently occur in contact sports. The purpose of this study was to determine the relationship between intervertebral foramina canal stenosis (IFCS) and traumatic upper extremity paresthesias. The research design consisted of prospective burner group (PBG), retrospective burner group (RBG), and retrospective control (non-burner) group (RCG). IFCS measurements were based on radiographic assessment of C3 through C6 and calculated by dividing the height of the intervertebral foraminal canal by the height of the corresponding vertebral body. All measurements were completed by one investigator. Investigator measurement and radiographic angle reliability was determined a priori and resulted in ICCs (2,1)  $\geq .93$ . Mean and mean minimum IFCS measurements for PBG, RBG, and RCG were .80 and .66, .73 and .65, and .79 and .72, respectively. A significant difference ( $p < .05$ ) existed in the mean and mean minimum IFCS measurement between the RBG and RCG. With PBG and RBG collapsed, 27 subjects had IFCS measurements  $< .80$  and 4 subjects had IFCS measurements  $> .80$ . Five of the RCG subjects had IFCS measurements  $< .80$  and 3 subjects had IFCS measurements  $> .80$ . The Fisher Exact Probability test statistic revealed these differences were not significant ( $p = .14$ ). A similar frequency cross tabulation existed for the mean minimum IFCS measurements, which also was not statistically significant ( $p = .33$ ). In conclusion, intervertebral foramina canal stenosis is associated with upper extremity paresthesias. Further study is needed, however, to establish clinically relevant IFCS standards.

### **Closed Chain Performance Following Lower Extremity Ice Immersion**

Cross KM, Wilson RW, Perrin DH. University of Virginia, Charlottesville, VA 22903

This study examined the effects of ice immersion on motor performance during 3 closed kinetic chain activities: single-leg vertical jump (VJ), shuttle run (SR), and 6-meter hop for time (HT). Twenty male volunteers (age =  $19.3 \pm 1.2$  yr, ht =  $177.0 \pm 6.9$  cm, wt =  $76.5 \pm 9.6$  kg) from an NCAA Division III soccer team and football team who had not sustained a lower extremity injury during the prior 6 months were randomly assigned to either a control (C) or experimental (E) group. A pretest-posttest design was employed as a data-gathering strategy. Subjects in the experimental group performed 3 trials of each closed chain activity before (Pre) and after (Post) application of a 20-minute ice immersion ( $13^{\circ}\text{C}$ ) to the lower leg. Subjects in the control group followed the same procedure except that a 20-minute resting period replaced the cold treatment. Separate analyses of variance were used to analyze performance data gathered during each motor activity. VJ scores (PreE = 41.4 cm, PreC = 45.2 cm; PostE = 39.3 cm, PostC = 45.7 cm) were significantly reduced following ice immersion [ $F(1,18) = 7.35, p = .014$ ]. SR times (PreE = 6.5 sec, PreC = 6.8 sec; PostE = 6.7 sec, PostC = 6.8 sec) were significantly increased compared to the controls [ $F(1,18) = 8.17, p = .01$ ]. Differences in HT scores between groups were inconclusive [ $F(1,18) = 3.36, p = .083$ ] ( $\phi = 0.411$ ). These findings suggest that clinicians should carefully consider the potential adverse effects of ice immersion on closed chain motor performance during the period immediately following treatment. Future research should examine the effects of ice immersion on lower extremity motor performance in a population of injured athletes.

### **Effect of Seated Versus Standing Test Positions on Shoulder Internal and External Rotation Strength in the Frontal and Scapular Planes**

Heydt WM, Guskiewicz KM, Perrin DH, Gansneder BM. University of Virginia, Charlottesville, VA 22903

Research concerning peak torque of the shoulder internal (IR) and external (ER) rotators in the scapular plane is limited. Two studies have conflicting results. This study determined if the seated or standing test position had an effect on the production of concentric (CON) and eccentric (ECC) IR and ER peak torque values. Sixteen male athletes (ht =  $179.2 \pm 3.8$  cm, wt =  $85.2 \pm 7.6$  kg, age =  $20.2 \pm 1.7$  yr) with collegiate baseball or football experience served as volunteers. All but one subject was currently participating in Division I athletics. Subjects were assessed using a Kin-Com (Chattecx Inc, Chattanooga, TN) dynamometer at  $60^{\circ}/\text{sec}$  for concentric and eccentric peak torque of the internal and external rotators of their dominant arms. Subjects were tested during two sessions ( $7.7 \pm 1.7$  days apart), each counterbalanced according to frontal vs scapular plane and seated vs standing position. In the seated position, the frontal plane test position was  $90^{\circ}$  of shoulder abduction and  $90^{\circ}$  of elbow flexion. In the frontal plane while standing, the test position was  $45^{\circ}$  of shoulder abduction and  $90^{\circ}$  of elbow flexion. Previous data revealed no differences in the force production between  $45^{\circ}$  and  $90^{\circ}$  of abduction. The scapular plane for each position was defined as  $35^{\circ}$  anterior (horiz add) to the frontal plane. The axis of rotation of the dynamometer was aligned with the glenohumeral joint in both positions and planes. Subjects were assessed within their comfortable ROM (seated =  $155.8^{\circ} \pm 13.8^{\circ}$ , standing =  $162.9^{\circ} \pm 16.6^{\circ}$ ). Data analyses consisted of four, 2-factor ANOVAs with repeated measures on plane (frontal vs scapular) and position (seated vs standing) for both CON and ECC IR and ER. Results revealed a main effect for plane when tested for CON IR. Peak torque was significantly higher in the frontal plane [ $F(1,15) = 4.64, p < .05$ ]. No other significant main effects or interactions were found for plane or position for IR or ER. These findings suggest that no significant difference exists between testing in the seated or standing position. Shoulder concentric IR strength was significantly higher in the frontal plane. This may be due to the anatomical position of the joint and/or the length tension relationship of the musculature. Shoulder rehabilitation in a seated or standing position in the frontal or scapular plane may be a decision based on patient progress and comfort.



# **Intratester and Intertester Reliability of the Lateral Scapular Slide Test and Its Ability to Predict Shoulder Pathology**

Odom CJ, Hurd CE, Denegar CR,  
Taylor AB. Slippery Rock University,  
Slippery Rock, PA 16057

The purpose of this study was to estimate the reliability of the lateral scapular slide test (LSST) described by Kibler and to determine its ability to predict shoulder pathology in the presence of scapular instability. Forty-six subjects, 18 to 65 years of age participated in this study. Subjects were patients in a sports medicine center; 20 were being treated for shoulder pathology, the remaining subjects for other conditions. Each subject was measured by two physical therapists during one test session. Scapular distance was measured from the inferior angle of the scapula and to the spinous process of the thoracic vertebra in the same horizontal plane. Three measures in each of three test positions (0°, 45°, 90° of glenohumeral abduction) were taken bilaterally. All measures were taken with an unmarked section of string in an effort to eliminate examiner bias. Intraclass correlation coefficients (ICC) and standard errors of measurement (SEM) were calculated for intratester (n=46) and intertester (n=43) reliability for scapular distance measures for each arm in each test position. Intratester ICC (1,1)=.84 to .88; SEM=.52 to .85 cm. Intertester ICC (1,1)=.65 to .85; SEM=.60 to 1.27 cm. The reliability estimates were considered acceptable. SEM values indicate that bilateral differences <1 cm may be due to measurement error. Although the LSST did not accurately predict the presence of shoulder pathology, Chi Square (.05)=3.60; we believe results of the LSST may be correlated with other clinical findings when assessing functional scapular instability.

## Notes



## Clinical Case Reports

Wednesday, June 14, 1:30 - 3:10

### Foot Pain in a Female Collegiate Volleyball Player

Ireland ML, McKirgan CM, Moser K. Kentucky Sports Medicine, Lexington, KY 40517

**PERSONAL DATA/MEDICAL HISTORY.** A 20-year-old Division I volleyball athlete complained of pain in her left second metatarsophalangeal joint in the spring following vigorous practice. She had no previous problems.

**PHYSICAL SIGNS AND SYMPTOMS.** On physical exam, she had pain and swelling localized to the second metatarsophalangeal joint. There was limited active dorsiflexion and pain on both plantar flexion and dorsiflexion.

#### **DIFFERENTIAL DIAGNOSIS.**

1. Second metatarsophalangeal joint synovitis.
2. Osteochondral fracture second metatarsal.
3. Freiberg's infraction.
4. Metatarsal neck or head fracture.
5. Proximal phalanx fracture.
6. Second metatarsophalangeal joint turf toe.

**DIAGNOSTIC IMAGING/LABORATORY TESTS.** Patient underwent plain radiographs of her foot which were negative. She did have a long second metatarsal, however, there were no abnormalities of the metatarsal head. There were no radiograph findings consistent with Freiberg's infraction.

**CLINICAL COURSE/FINAL DISPOSITION.** The patient did improve, but when she began volleyball next season she had increasing pain. She underwent injection of her second metatarsophalangeal joint with some improvement. A bone scan was performed which showed increased activity in the blood pool and delayed images confined it to the periarticular region consistent with inflammation or synovitis. It was not felt there was a significant bone problem based on this increased activity. The patient had an increase in her swelling and pain over the course of the next year and two years from the time of initial onset underwent arthrotomy and exploration of the second metatarsophalangeal joint. She was found radiographically to have been developing an osteophyte of her second metatarsal. Her findings at the time of surgery were a chondral lesion, a punch-type lesion in the central portion of the second metatarsal head with exposed bone. This was consistent with the patient's volleyball activities of repetitive loading and going up on her toes. She did have a large osteophyte on the distal metatarsal and a smaller one on the proximal phalanx. She underwent arthrotomy, synovectomy, debridement of her second metatarsophalangeal joint, dorsal cheilectomy, and drilling of her second metatarsal head over her left foot. She is now one year postop and continues to wear an orthotic but has had improvement in her pain.

**UNIQUENESS/DEVIATION FROM EXPECTED.** The chondral lesions of the smaller toes are not well appreciated. Attention to sport biomechanics such as this case of volleyball will lead the health care professional to earlier surgical intervention as the chondral lesion is most likely present early on. If injection is only short-lived and there is persistent of pain, surgical exploration is suggested.

### Bilateral Foot Pain in a Collegiate Distance Runner

Siple B, Denegar CR. Slippery Rock University, Slippery Rock, PA 16057

**PERSONAL DATA/MEDICAL HISTORY.** A 19-year-old female cross country runner complained of bilateral plantar foot pain 1 week into the season. She had been running cross country and indoor/outdoor track since age 13. She stated that she had suffered from bilateral foot pain during a running camp 3 years previously, which was diagnosed as bilateral plantar fasciitis. She was referred to a podiatrist. Her x-ray exam was negative. Orthotics were prescribed, and foot pain resolved in 1 month. She experienced similar bilateral foot pain 1 year previously in preparation for the cross country season. She was again treated by a podiatrist with orthotics, an oral anti-inflammatory, and ultrasound 2 to 3 times/wk. She missed the entire cross country season, but was able to compete in indoor/outdoor track. Prior to the most recent onset of pain, she trained 40 mile/wk.

**PHYSICAL SIGNS AND SYMPTOMS.** The athlete's chief complaint was bilateral plantar pain during and after running and walking. The pain extended from the calcaneus to the head of the first metatarsal. No swelling, discoloration, or deformity was present. She was point tender near the insertion of the Achilles tendon and along medial plantar arch including the area of the talonavicular joint. She was observed to hyperpronate bilaterally.

**DIFFERENTIAL DIAGNOSIS.** Initially the patient was diagnosed as suffering from plantar fasciitis. Treatment consisted of oral medication, phonophoresis, transverse friction massage, and conventional stretching and strengthening exercises. Night splinting was added to the treatment regimen. Due to a failure to respond to treatment, an x-ray was ordered. X-rays were negative and the athlete was referred for a second opinion. Three possible diagnoses emerged: bilateral tarsal tunnel syndrome, navicular stress fractures, and insertional posterior tibial tendinitis.

**DIAGNOSTIC IMAGING/LABORATORY TESTS.** Nerve conduction velocity studies of the tibial nerve distributions were normal. Subsequent radionuclide bone scans revealed an increased uptake over the navicular bilaterally. Computerized tomography (CT) of the right navicular reinforced suspicion of a stress fracture. There was no transcortical defect present on CT; however, mild cortical sclerosis was evident. Because the patient was more symptomatic on the right, the patient was treated touch down weight bearing in a walking cast while using axillary crutches. CT of the left foot was deferred.

**CLINICAL COURSE/FINAL DISPOSITION.** Following 6 weeks of limited activity and crutch-assisted ambulation, the point tenderness over both navicula completely resolved. Gradual weight bearing with accompanying foot/ankle rehabilitation is in progress at this time. A return to running program will be initiated once reconditioning of the lower extremity has progressed sufficiently.

**UNIQUENESS/DEVIATION FROM THE EXPECTED.** Stress fractures of the navicular have been reported in running athletes, especially those who hyperpronate, but bilateral fractures are rare. The clinician should suspect stress fracture with tenderness over the bone and the pattern of pain deviates from the typical complaint of morning pain associated with plantar fasciitis. Due to the medial plantar nerve distribution, medial arch pain is common, usually after running and walking. Plain x-ray films identify navicular stress fractures in less than 20% of cases. Because of the pain distribution and false negative plain films, diagnosis of navicular stress fracture is often elusive; additional diagnostic imaging is often needed. Nonunion is a common complication of missed fractures. Immobilization and nonweight bearing for 6 weeks is recommended, except for a transcortical defect when ORIF is indicated.

## Knee Pain in a Collegiate Basketball Player

Hutchinson MR, Humble C. University of Illinois at Chicago, Chicago, IL 60612

**PERSONAL DATA/MEDICAL HISTORY.** A 23-year-old senior male basketball player for a Division I university landed after an attempted blocked shot and felt intense pain over the posterolateral aspect of his knee. He did not feel a pop or have complaints of instability. He had no previous history of knee pain or injury. The fifth year senior wanted to complete his final season if possible.

**PHYSICAL SIGNS AND SYMPTOMS.** The athlete was evaluated at courtside by the athletic trainer and in the training room by the team physician. His primary complaint was of pain and inability to fully extend his knee. Range of motion was 15° to 60° limited by pain. No gross effusion was present. He was focally tender over the posterior lateral joint line. Ligamentous stability appeared to be intact with a negative Lachman's, negative posterior sag, negative external rotation recurvatum, and negative laxity to varus and valgus stress at 0° and 30°. McMurray's examination instituted pain laterally but was not complete secondary to limited range of motion.

### DIFFERENTIAL DIAGNOSIS.

1. Lateral meniscus tear
2. Posterolateral complex injury
3. Popliteal tendon rupture
4. Lateral collateral ligament strain
5. Fracture or bone bruise

**DIAGNOSTIC IMAGING/LABORATORY TESTS.** Plain radiographs were negative for fracture or bony pathology. Magnetic resonance imaging revealed a peripheral tear of the entire posterior horn of the lateral meniscus and Grade 1 changes in the lateral collateral ligament and posterolateral complex.

**CLINICAL COURSE/FINAL DISPOSITION.** After review of the test results with the athlete, his family, and his athletic trainer, he was taken to surgery for arthroscopy of his knee. A large bucket handle tear of his posterior meniscus was identified locked in the intercondylar notch. The unstable fragment comprised 60% to 70% of his entire meniscus and 100% of his posterior horn. Meniscal repair was selected over meniscectomy due to the peripheral nature and overwhelming size of the tear. An accelerated aggressive rehabilitation allowing full weight-bearing and full range of motion immediately was instituted. However, he was restricted from twisting and cutting activities for 2 months.

**UNIQUENESS/DEVIATION FROM THE EXPECTED.** While meniscus tears are not an uncommon injury in elite athletes, they do present a difficult dilemma in recommendation and treatment options for coaches, athletic trainers, team physicians, and orthopaedic surgeons. This case notes an athlete playing in his final collegiate season who is an important cog in his team's success. The player, coach, athletic trainer, and physician would like to have the athlete back as soon as possible which would imply partial meniscectomy. Nonetheless, due to the likelihood of early degenerative arthritis with a nearly complete meniscectomy, a Meniscal repair with its associated longer rehabilitation would best serve this patient in the long term.

## Anterior Knee Pain and Poor Range of Motion in the Avid Skier

Galway WC, Wickiewicz T. The Hospital for Special Surgery, New York, NY

**PERSONAL DATA/MEDICAL HISTORY.** A 43-year-old white female injured her right knee while skiing in the winter of 1991. The patient's primary complaint was of bilateral knee instability and right knee pain. She was diagnosed at another institution as being bilaterally ACL insufficient, with bilateral knee instability. She subsequently underwent a right ACL reconstruction with patellar tendon autograft in June of 1991. The patient was referred to our institution in January of 1993 with complaints of right knee pain, poor active range of motion, and inability to perform pain-free activities of daily living and recreational skiing. Her passive range of motion at the time of initial evaluation was -8° to 125°. In March 1994 the patient underwent an open patella/patellar tendon allograft to reconstruct the calcified patella tendon, correct patella infera, and debride the arthrofibrotic joint.

**PHYSICAL SIGNS AND SYMPTOMS.** The patient presented with a quadriceps inhibition gait, quadriceps atrophy, passive range of motion -8° to 125° and pain during normal activities of daily living.

**DIFFERENTIAL DIAGNOSIS.** Anterior knee pain, hypersensitivity, knee joint arthrofibrosis, patella infera, calcified patellar tendon, reflex sympathetic dystrophy.

### DIAGNOSTIC IMAGING/LABORATORY TESTS.

Preoperative radiographs on her right knee revealed disuse osteoporosis, calcified patellar tendon, patella infera, S/P ACL reconstruction. Left knee radiographic reports were unavailable.

**CLINICAL COURSE/FINAL DISPOSITION.** The patient underwent rehabilitation of her right knee with a functional, goal-related progression. Effusion control, patellofemoral joint mobilization, knee joint range of motion, reestablishment of quadriceps control and gait, were the primary focus immediately postoperatively. Muscular strengthening without creating further patellofemoral symptomatology, knee joint proprioception, muscular endurance and muscular flexibility exercises were emphasized in the secondary phase of the therapy. Quadriceps strengthening on the right knee was achieved using closed kinetic chain exercises which emphasized minimal patellofemoral joint compression. Current active range of motion is 0° to 125° with a normal gait and the ability to perform activities of daily living without subjective complaints of pain. As of this date the patient's left knee instability has not been surgically addressed. Conservative treatment of the left ACL insufficient knee has consisted of open and closed chain hamstring strengthening, closed chain quadriceps strengthening, lower extremity proprioception exercises as well as muscular endurance and flexibility exercises. As of December 23, 1994 the patient continues therapy.

### UNIQUENESS/DEVIATION FROM THE EXPECTED.

Calcification of the patellar tendon following ACL reconstruction, open reconstruction of the extensor mechanism with patella/patella tendon allograft. Postsurgical rehabilitation of the extensor mechanism on the right knee during rehabilitation of a conservatively managed ACL insufficient left knee.



# NATA—REF Funded Research Symposium

Wednesday, June 14, 3:30 - 5:00

## Ankle Joint Proprioception on Normal and Sprained Ankles

Simoneau GG, Dramper CA, Degner RM. Marquette University, Milwaukee, WI 53233

This study investigated the effects of acute ankle sprains and the use of athletic tape on ankle joint proprioception. It was hypothesized that an ankle injury would decrease ankle joint proprioception while the use of tape would improve proprioception. The effects of taping on ankle proprioception was investigated on 20 healthy males between the ages of 19 and 25 ( $\bar{x}$  age=20.3 yr). The effects of ankle sprain and taping on sprained ankles were investigated on nine subjects who had an acute sprain ( $\bar{x}$  age=20.8 yr, range 18 to 26). Ankle joint movement and position perception for plantar and dorsiflexion were tested using two independently moveable foot platforms. Joint position was monitored using an inclinometer, precise to 0.01°. Effectiveness of tape to increase proprioception in the healthy subjects was tested by applying two 5-inch strips of tape directly to the skin in front and behind the talocrural joint. In the ankle sprain group, the effects of the acute injury and tape on joint movement and position perception were measured by comparing proprioception with and without the tape application on both the injured and uninjured ankle. All data were analyzed using ANOVA with repeated measures. For the subjects without injuries, taping resulted in a significant ( $p < .01$ ) improvement on ability to perceive joint position in plantarflexion. Without tape, the average error in reproducing a 10° plantarflexed position was 1.98° as compared to 1.45° with the use of tape. On normal ankles, taping did not have a significant effect ( $p > .05$ ) on joint position perception in dorsiflexion and joint movement perception. For the group of subjects with acute ankle sprains, taping did not have a significant effect on either joint movement or position perception ( $p > .05$ ). The injury had a significant effect ( $p < .05$ ) on joint position perception but not on joint movement perception. Unexpectedly, a better ability to perceive joint position was found on the sprained ankles. We conclude that, on normal ankles, athletic tape applied across the ankle joint may help improve ankle joint position perception in plantarflexion. Taping does not seem to either help or hinder the proprioception of ankles with a recent sprain. Finally, individuals with an acute ankle sprain had an increased sense of joint position perception and the injured side as compared to the contralateral uninjured ankle.

## 1994 Entry-Level Athletic Training Salaries

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The purpose of this study was to examine the salaries for entry-level positions in athletic training during the year 1994. An entry-level position was defined as an athletic trainer, certified by the National Athletic Trainers' Association, with no full-time paid employment experience. According to the "Placement Vacancy Notice" (National Athletic Trainers' Association, Dallas, TX) and "BYLINE" (Athletic Trainer Registry, Mt. Pleasant, MI), there were 432 entry-level vacancies in the hospital/clinics, college/universities, and high school settings. A survey was designed and mailed to these entry-level positions. A total of 271 surveys (635) were returned. Overall, beginning salaries for entry-level athletic training positions were \$23,228( $\pm$ \$3,177) for a bachelors' degree and \$25,362( $\pm$ \$3,883) for a master's degree. A stipend (\$4,216 $\pm$ \$2,039) was included in most of the high school positions. Term of contract for high school was usually a 10-month position (10.0 $\pm$ 0.9 months), hospital/clinic a 12-month (11.7 $\pm$ 0.7 months), while the college/university varied from 9 to 12 months (10.5 $\pm$ 1.2 months). Also included in the study was fringe benefit information: Pension (other than SS), Life, Medical, Dental, and Vision Insurance. Continued studies are recommended to establish salary norms and trends for entry-level positions so that athletic trainers will understand what monetary compensation is expected for their services.

## 1994 Entry-Level Salaries According to Job Site and Position

Position	(n)	Bachelor's $\bar{x} \pm SD$	Master's $\bar{x} \pm SD$
<b>Hosp/Clin</b>			
AT	(17)	23,847 $\pm$ 2608	28,117 $\pm$ 2382
AT/Athl	(114)	23,967 $\pm$ 2965	25,782 $\pm$ 2963
Total	(131)	23,949 $\pm$ 2904	26,032 $\pm$ 2893
<b>Coll/Univ</b>			
Head AT	(16)	23,101 $\pm$ 4585	25,706 $\pm$ 6820
AT/Teach	(43)	22,136 $\pm$ 3522	25,822 $\pm$ 5139
Asst AT	(35)	21,966 $\pm$ 3664	23,676 $\pm$ 3991
Total	(94)	22,262 $\pm$ 3752	25,035 $\pm$ 5113
<b>High School</b>			
AT	(11)	21,584 $\pm$ 3992	23,000 $\pm$ 2943
AT/Teach	(35)	25,963 $\pm$ 2474	28,017 $\pm$ 3073
Total	(46)	24,892 $\pm$ 2887	27,444 $\pm$ 3036

## Effects of Various Treatment Techniques on the Signs and Symptoms of Delayed Onset Muscle Soreness

Gulick DT, Kimura I, Sitler M, Paolone A, Kelly J. Temple University, Philadelphia, PA 19122

The purpose of this study was to examine the effects of various treatment techniques on the symptoms of delayed onset muscle soreness (DOMS). Subjects were 70 untrained volunteers, age=21 to 40 yr. DOMS was induced via 15 sets of 15 eccentric contractions of the forearm extensor muscles on the Lido isokinetic dynamometer. A pilot exercise bout was performed a minimum of 9 weeks prior to data collection to assure the production of DOMS. Baseline data included the following 15 dependent variables: active wrist flexion and extension, passive wrist flexion and extension, forearm girth, limb volume, Visual Analogue Scale, Muscle Soreness Index, isometric strength, concentric and eccentric wrist total work, concentric and eccentric average peak torque, and concentric and eccentric angle of peak torque. Subjects then repeated the exercise bout and dependent variables were reassessed. Subjects were randomly assigned to 1 of 7 groups (6 treatment and 1 control). Treatment included an anti-inflammatory drug (NSAID), high velocity concentric muscle contractions on an upper extremity ergometer, ice massage, 10-minute static stretching, topical Arnica montana ointment, and sublingual Arnica montana pellets. Baseline assessments were repeated immediately after treatment and 24, 48, and 72 hours posttreatment. A 7  $\times$  6 analysis of variance with repeated measures on time was performed on each of the 15 dependent variables. Significant ( $p < .05$ ) main effects were found for all of the dependent variables on time only. Newman-Keuls post hoc test revealed no significant differences between the various treatments for any of the dependent variables. Although not significant, the NSAID and Arnica montana treatments appeared to impede recovery of muscle function. The upper extremity ergometer treatment failed to significantly reduce edema or decrease muscle soreness. The ice massage treatment appeared to influence acute muscle soreness but was not effective in abating DOMS. The static stretching treatment initially influenced range of motion but did not significantly influence muscle soreness or function. Therefore, none of the modalities employed in this study significantly abated all of the symptoms of DOMS.



## Notes

## Free Communications, Poster—All 5 Categories

Wednesday, June 14, 8:00 - 5:00; Thursday, June 15, 8:00 - 11:00

### 1. The Acute Effects of Stretch Duration on Range of Motion and Eccentric Torque

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61761

Previous studies have found changes in concentric and eccentric torque, and range of motion (ROM) after chronic stretching programs. However, little is known about the acute effects of varying the duration of static stretching on ROM or peak eccentric torque (PET). The purpose of this study was to examine the length of time the hamstring muscles should be placed in a sustained stretch position to maximally increase acute ROM at the knee and acute PET of the hamstring muscles. Twenty-five subjects ( $\bar{x}$  age=20.5 yr) completed prestretch and poststretch ROM measurements by a manual goniometer, and pre-stretch and poststretch isokinetic testing under four conditions. The treatment conditions were a manually assisted static stretch for 15, 30, and 60 seconds, and a control (no stretching). The subjects completed one condition each day, with at least 48 hr rest between testing days. The sequence of the conditions was randomized. Stretching was accomplished via a standing toe reach, with the extremity maintained at 180° of extension and the foot maintained in a neutral position. Stretching was performed after a standard 3-minute warm-up on a cycle ergometer and was always assisted by the principle investigator. ROM was determined with the subject in the supine position by measuring knee extension with the femur maintained in 90° of hip flexion. Subjects were tested for eccentric hamstring strength at an isokinetic speed of 120°/sec. Three testing trials used for analysis followed three practice trials. The same ATC collected all data. Data were analyzed with a repeated measures ANOVA. The results indicated no significant ( $p > .05$ ) difference in ROM or PET between any of the prestretch conditions. There were also no significant differences in any of the poststretch PET conditions. However, a significant ( $p < .05$ ) treatment effect for poststretching ROM was present. Mean extension increased 2.7°, 6.6°, 5.7°, and 8.2° for control, 15-, 30-, and 60-second stretch duration, respectively. These data indicate that although there was no treatment effect on torque production, the duration of stretching did have a significant effect on ROM. These acute findings are similar to data reported after chronic stretch training and may be useful when determining the duration for static stretching.

### 2. The Effects of Application Procedures of Prophylactic Knee Braces on Performance, Comfort, and Migration

Longenecker EI, Newton W, Kleiner DM. Illinois State University, Normal, IL 61761

Despite the continuing controversy regarding their efficacy of use, prophylactic knee guards (PKG) continue to be used, and are being applied by different methods. The purpose of this study was to rate the method of application for selected brands of PKGs. The DonJoy™ (DJ), McDavid™ (MD), and Stromgren™ (ST) knee guards were rated for comfort, displacement (migration), and inhibiting the performance of the subject, when secured with the straps provided by the manufacturer, and with elastic tape. Fourteen subjects completed performance tests for agility, speed, vertical jump, and an isokinetic test for strength, on 10 separate occasions. Following each trial, the PKG was measured for migration. Comfort and perceived inhibition were assessed by 0 to 10 scales with key words. Each brace was applied once with the strap provided by the manufacturer, and once with 2-inch elastic tape (Conform™). Hence, the ten conditions were: DJ with the neoprene straps provided (DJS), DJ applied with tape (DJT), MD with the neoprene straps provided (MDS), MD with tape (MDT), ST with the cloth straps provided (STS), ST with tape (STT), wearing only the ST cloth straps (CST), wearing only the DJ neoprene straps (NST), wearing only tape (TAP), and wearing nothing (CTL). Data were analyzed by ANOVA, and post hoc analyses by Scheffé. Results indicated no significant difference ( $p > .05$ ) between any of the conditions, including CTL, for any of the performance measures. Nevertheless, subjects did report significant differences ( $p < .05$ ) for inhibition, perceiving that MDT and STT inhibited their performance most. Significant differences were also found for comfort, with MDT and STT reported to be the least comfortable, while NST, TAP, and DJS were rated the most comfortable. ANOVA also revealed significant differences for migration, with NST, TAP, and DJS having the least migration while STT and STS moved the most. There was no significant difference ( $p > .05$ ) for migration, between the tape conditions and the strap conditions (.92 cm and .80 cm, respectively) as was hypothesized. These data indicate that PKGs do not inhibit performance, but that differences occur with regard to perceived inhibition, comfort, and migration.

### 3. The Influence of Cryotherapy and Aircast® Bracing on Total Body Balance and Proprioception

Rivers D, Kimura I, Sitler M, Kendrick Z. Temple University, Philadelphia, PA 19122

A Bongo Board was used to investigate the influence cryotherapy, Aircast® Sport-Stirrup bracing, and a control had on total body balance and proprioception. Subjects were 25 males and females with no history of lower extremity pathology within 1 year and no vasospastic disorders or hypersensitivity to cold. Bongo Board proficiency was established prior to the testing sessions in order to minimize the learning effect. Proficiency was defined as the ability to stay in balance for at least 40 seconds in a 1-minute trial. Treatment conditions consisted of cryotherapy, Aircast® Sport-Stirrup ankle braces, or control, with neither cryotherapy or Aircast® Sport-Stirrup ankle braces. Treatment conditions were randomly ordered on 3 separate testing days. Testing consisted of a running time, 1-minute warm-up, and a 1-minute pretest. Each test session included a 20-minute treatment period between the pretest and the first posttest. During this time, one of the aforementioned treatment conditions was administered. Treatment was followed by five 1-minute data collection posttests with 1-minute rest intervals between tests. Data analysis consisted of a  $3 \times 6$  analysis of variance (ANOVA) with repeated measures at the  $p < .05$  alpha level. The F value indicated a significant interaction effect between condition and test. Three subsequent  $2 \times 6$  ANOVAs were performed to compare brace condition to cryotherapy and control conditions, and cryotherapy and control conditions individually. Results revealed a significant decrease in total body balance only during the first 3 minutes postcryotherapy. However, no significant effect on total body balance was indicated 4 to 10 minutes postcryotherapy. Results revealed no significant effect on total body balance during any of the brace posttests. However, a significant increase in total body balance was revealed when the first brace posttest was compared to brace posttests 2, 3, and 4. Finally, results revealed no significant effect on total body balance in the control posttests.

#### 4. Effect of the Achilles Tendon Adhesive Taping and Pro M-P Achilles Strap on Eccentric Plantar Flexion Peak Torque

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The purpose of this study was to investigate the effect the Achilles tendon adhesive taping technique, the Pro M-P Achilles Strap, and control, where nothing was applied to the Achilles tendon, conditions had on eccentric plantar flexion peak torque output at 30° and 120°/sec on the Biodex B-2000 Isokinetic Dynamometer. Subjects were 31 asymptomatic males (15) and females (16) between the ages of 18 and 32 years. Subjects participated in at least two practice and three data collection sessions separated by no less than 7 days and no more than 14 days. Condition and angular velocity were randomly ordered. The practice and data collection sessions consisted of a warm-up and test at both velocities. The warm-up consisted of 4 submaximal eccentric contractions and 1 maximal eccentric contraction through 40° of plantar flexion and 10° of dorsiflexion at the talocrural joint. A 1-minute rest period was administered followed by the test consisting of 5 maximal eccentric contractions. A 5-minute rest period was given in order to change the velocity, re-stabilize the subject, and minimize muscle fatigue. The subject repeated the warm-up and test procedure at the nontested velocity. A 2 × 3 ANOVA with repeated measures on all factors (gender, condition, and velocity) was used to examine the eccentric plantar flexor peak torque data. A significant interaction was revealed between gender, condition, and velocity at the  $p < .05$  alpha level. Additional 2 × 3 ANOVAs with repeated measures on condition and velocity were performed on the male and female eccentric plantar flexor peak torque data. Significantly higher peak torque values were revealed at 120°/sec than at 30°/sec, regardless of condition in the male and female subjects. No significant differences in peak torque values of the male subjects were revealed among the conditions. However, a significant difference in peak torque values of the female subjects was revealed among the conditions. A Scheffé post hoc test ( $p < .05$ ) indicated that the female subjects produced significantly lower peak torque values in the Pro M-P Achilles Strap condition than in the control condition at 120°/sec.

#### 5. Intratester and Intertester Reliability When Using the Chatillon Hand-Held Dynamometer to Measure Force Production in the Upper and Lower Extremities

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The purpose of this study was to investigate intratester and intertester reliability when using the Chatillon hand-held dynamometer (HHD) to measure isometric force production of the wrist extensors, elbow flexors, ankle dorsiflexors, and knee extensors. Prior to participation in this study, all examiners and subjects read and signed an informed consent form in accordance with the Temple University Institutional Review Board. Examiners were 4 females and 8 males between the ages of 21 and 42 years. All examiners are NATA-certified athletic trainers. Examiners were instructed in the proper use of the Chatillon HHD as directed by a Chatillon Service Representative. Examiner proficiency was established prior to the data collection. Subjects were 3 females and 9 males between the ages of 21 and 39 years who denied history of injury to the tested upper extremity or lower extremity in the past twelve months. Subjects were positioned, stabilized, and tested with the Chatillon HHD interposed between the examiner's hand and the test limb. Testing was performed at the midpoint in the joint range of motion. Goniometrically obtained joint test positions were: 35° of wrist extension, 75° of elbow flexion, 10° of ankle dorsiflexion, and 67.5° of knee extension. Manual Muscle Testing (MMT) consisted of isometric contraction break tests. Four tests, two test-retest sequences, were performed at each joint test site by the examiners. The averages of the first test-retest and the second test-retest sequence were used to determine intratester reliabilities. Those scores were averaged and used to determine intertester reliabilities. Intratester reliabilities were generally high, ranging from  $r = .71$  to  $r = .87$ , for the upper and lower extremities. Intertester reliabilities were low, ranging from  $r = .03$  to  $r = .87$  for the wrist extensors,  $r = .28$  to  $r = .96$  for the elbow flexors,  $r = .17$  to  $r = .90$  for the ankle dorsiflexors, and  $r = .36$  to  $r = .88$  for the knee extensors. The results of this study indicated that the Chatillon HHD was reliable when used by a single examiner who had been properly trained in its use.

#### 6. The Effects of Wrist Taping Techniques on Ground Reaction Forces During a Free-Fall Landing

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Taping of the wrist continues to grow in popularity; however, its effectiveness has not been adequately documented. The purpose of this study was to evaluate the effects of wrist taping on the ground reaction forces produced during landing from a free fall on a outstretched hand. Twenty-five male subjects ( $\bar{x}$  age =  $20.0 \pm 1.6$  yr) with no prior wrist pathology, performed six trials under each of the three conditions: control with no tape applied (CT), taping the wrist only (WR), and taping the wrist and hand to prevent hyperextension (HD). WR involved overlapping circular tape strips for 8 cm from the wrist proximally along the distal forearm. HD taping involved the hand as well, and included applying stirrups on the palmar surface of the hand, which was maintained in a neutral position. The same taping techniques were applied to all subjects by the same certified athletic trainer, and the sequence of the conditions was randomized. Each trial consisted of the subject falling forward onto a force platform from a fixed positions at a height of 40 cm. The subject was instructed to flex at the elbow during the time of impact in order to produce a soft landing. Only the subject's right hand was permitted to have contact with the force platform. Vertical ground reaction forces were sampled at 1000 Hz. An ANOVA with repeated measures was used to analyze ground reaction force peak values across conditions. Data are reported as mean ( $\pm$ SD). The time(s) to maximum force values were also determined; however, those data were not significantly different ( $p > .05$ ). A significant ( $p < .05$ ) main effect for taping was evident for the second peak value, but not for the first peak force value. Ground reaction force data for CT, WR, and HD at the second peak were  $9.92 (\pm 3.4)$ ,  $9.89 (\pm 3.5)$ , and  $6.24 (\pm 2.5)$  N/kg, respectively. Post hoc analysis indicated no significant difference between CT and WR conditions. Because ground reaction force values reflect force required to stop the body during landing, these results indicate that some wrist taping techniques alter shock absorption patterns on the arm, while others do not. Additional research regarding the energy absorption by the wrist, elbow, and shoulder joints during taped and untaped conditions is suggested.



## 7. Reliability of Ankle Volumeter

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The purpose of this study was to determine the standard error of measure (SEM) of an ankle volumeter and to measure variations of noninjured ankle volumes during a day and a week. Other studies have reported SEM of 1.5% and .6% for ankle volumeters. Sixty participants aged 18 to 30 volunteered for the study and were equally divided into 6 groups. None of the volunteers had sustained an ankle injury at least 1 month prior to this study. An ankle volumeter from Volumeters Unlimited (Idyllwild, CA) was used to measure ankle volume. Groups 1 (males) and 2 (females) were used to calculate the SEM by measuring the right ankle 5 times in rapid succession. Groups 3 (males) and 4 (females) tested variation in right ankle volume during a day by obtaining measurements in the morning. A *t*-test was used to determine statistical significance between morning and afternoon measures. Groups 5 (males) and 6 (females) tested right ankle volume over 5 days by obtaining measurements at the same times each morning and afternoon. A single-factor ANOVA was used to observe the equality of the means ( $\bar{x}$ ) over 5 days. The SEM for groups 1 and 2 were 6.65 ml and 7.96 ml, respectively. The *t*-test on group 3 ( $\alpha = .05$ ,  $p = .90$ ) and 4 ( $\alpha = .05$ ,  $p = .61$ ) show no significant difference. The single factor ANOVA on groups 5 ( $\alpha = .05$ ,  $p = 1.0$ ) and 6 ( $\alpha = .05$ ,  $p = 1.0$ ) show no significant difference. Based on these results we conclude the SEM for the ankle volumeter to be 6.65 ml for males and 7.96 ml for females. Ankle volume can be measured in the morning or afternoon with no statistical significant difference, and ankle volume shows no statistical significant difference during a week.

## 8. The Effect of Elevation and Submaximal Isometrics on Edema Following Lateral Ankle Sprains

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Edema management is a primary goal in the treatment of acute athletic injuries. The purpose of this study was to examine the effects of elevation and submaximal isometric contractions on edema following lateral ankle sprains. Eighteen high school and college-aged students (14 males and 4 females) volunteered as subjects for this study. All subjects had sustained a grade I or II lateral ankle sprain and were treated 24 to 72 hours postinjury. Each subject was randomly assigned to one of two treatment groups. Subjects in group 1 ( $n=9$ ) were placed in a supine position with leg elevated to 45° of hip flexion for 30 minutes. Subjects in group 2 ( $n=9$ ) were placed in the same position and performed a 5-second submaximal isometric dorsiflexion every minute for a duration of 30 minutes. A 3-kg weight was suspended via a pulley and cable system to provide uniform force during the isometric contraction. Pre and postvolumetric measurements were performed prior to and immediately after the treatment. Subjects placed the injured ankle in a standard volumetric tank with the hip and knee at 90° of flexion. Subsequent water that overflowed into a collection chamber was then weighted on an analytical balance to determine limb volume. Reliability of this measurement technique has yielded an intrasubject correlation of 0.994. Volume changes were expressed relative to pretreatment ankle volumes to control for the initial amount of edema and size of the ankle ( $[(\text{Pre} - \text{Post}) \div \text{Pre}] \times 100$ ). The results were as follows:

GROUP 1 (Elevation)	GROUP 2 (Elevation and Isometrics)
0.0640%	-0.1526%

An independent *t*-test yielded a significant difference between the two groups ( $p \leq .05$ ). These data suggest that the inclusion of submaximal dorsiflexion isometrics are a valuable adjunct in the treatment of edema in postacute ankle sprains.

## 9. Role of Hyperpronation as a Potential Risk Factor for ACL Injury

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Injuries frequently occur to the anterior cruciate ligament (ACL) without contact. This suggests that people may have anatomical features that could predispose them to injuring their ACL. Therefore, the purpose of this study was to examine the relationship between hyperpronation and occurrence of injury to the ACL. Hyperpronation was assessed via two measurements, the navicular drop test and the calcaneal stance test. Fourteen anterior cruciate ligament injured (ACLI) subjects (age =  $21.1 \pm .83$  yr, ht =  $174.8 \pm 8.3$  cm, wt =  $72.3 \pm 13.5$  kg) and 14 ACL uninjured (ACLU) subjects (age =  $21.1 \pm 2.0$  yrs, ht =  $177.4 \pm 11.3$  cm, wt =  $73.0 \pm 14.8$  kg) participated. To justify using the ACLI subjects' uninjured legs as their preinjury state, a *t*-test was used to compare the differences between the left and right feet for the ACLU group on both measurements. Although there was no significant difference ( $p > .05$ ) between feet for the navicular drop test, there was a significant difference ( $p < .05$ ) between feet for the calcaneal stance test. A regression analysis was performed on the data comparing the ACLI subjects' uninjured legs with the ACLU group for the navicular drop test only. The regression analysis showed no significant difference between the ACLI and ACLU subjects. In conclusion, hyperpronation, measured by the navicular drop test, may not be a predisposing factor to ACL injuries.

# 10. Assessment of the Knowledge and Attitudes of Certified Athletic Trainers in Pennsylvania in Treating Athletic Injuries of HIV+/AIDS Athletes

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Results of several studies reveal that despite education, some allied health professionals have misconceptions about HIV+/AIDS and concerns about treating HIV+ individuals. To date, no research has been conducted to determine the level of knowledge and attitudes of NATA-certified athletic trainers in treating the athletic injuries of HIV+/AIDS athletes. In Spring 1994, a researcher-generated questionnaire was mailed to 816 certified athletic trainers with a Pennsylvania mailing address. A total of 420 (52%) of the questionnaires were returned. Privacy was ensured by keeping the responses anonymous. The majority of respondents were white (97%) males (65%) who were certified via an undergraduate curriculum (60%) and had an earned master's degree (54%). Results of the study indicated that athletic trainers in the state of Pennsylvania are moderately knowledgeable about HIV+/AIDS; 61  $\pm$  2.35% correct on a HIV+/AIDS knowledge assessment instrument. Primary mode of HIV+/AIDS education was as follows: 202 (49%) seminar, 76 (19%) undergraduate education, and 15 (4%) undergraduate education/seminar. A total of 113 (28%) ATCs had no formal HIV+/AIDS education. The majority of respondents had an overall positive attitude in treating the athletic injuries of HIV+ athletes although fear of crosscontamination was a concern (56%). A total of 352 (84%) respondents felt "a need to know" if an athlete was HIV+; 236 (56%) felt that HIV+ athletes should not be allowed to compete in contact sports. No relationship ( $p > .05$ ) existed between knowledge and attitude (positive vs negative) towards treating the athletic injuries of HIV+ athletes.

# 11. Clinical and Functional Assessment of Abrasion Chondroplasty of the Knee

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The purpose of this investigation was to retrospectively evaluate the long-term clinical and functional results of abrasion chondroplasty of the knee. Eighteen (40.9%) of 44 subjects who underwent abrasion chondroplasty of the knee joint consented to participate in the study. Six (33.3%) subjects were female, and 12 (66.7%) subjects were male. The mean age of the subjects was  $42.9 \pm 12.2$  yr. Average time of postsurgical follow-up was  $45.9 \pm 26.7$  months. All subjects underwent clinical evaluation including completion of the Standard Knee Evaluation Form (SKEF), Cincinnati Knee Rating Scale (CKRS), and the Articular Cartilage Rating System (SCRS). Standing anteroposterior 45° knee flexion x-rays were included in the evaluation. Clinical assessment consisted of subjective evaluation of symptoms, objective measurement of compartment findings and range of motion (ROM), and assessment of compartment crepitation and ligamentous stability. SKEF scores revealed 10 (55.6%) subjects scored nearly normal, 5 (27.8%) subjects scored abnormal, and 3 (16.7%) subjects scored severely abnormal. Preinjury activity level was as follows: 16 (88.9%) subjects were able to perform strenuous or moderately strenuous activities and 2 (11.1%) subjects were able to perform light activities. Postsurgical activity level was as follows: 5 (22.7%) subjects were able to perform strenuous activities, 8 (44.5%) subjects were able to perform moderate activities, 2 (11.1%) subjects were able to perform light activities, and 3 (16.7%) subjects were able to perform sedentary activities. Fourteen (77.7%) subjects had meniscal pathology and 4 (22.2%) did not. The composite SKEF score was independent of time of follow-up ( $p = .26$ ). The mean CKRS was  $70.39 \pm 18.25$ . Twelve (66.6%) subjects reported a score of 70 or higher. Subjects who scored nearly normal on the SKEF also scored significantly higher on the CKRS ( $p < .05$ ). The CKRS score was independent of the time of follow-up ( $p = .80$ ). The mean ACES score was  $86.5 \pm 7.74$ . Subjects who scored nearly normal on the SKEF had higher ACES scores. The results of the study indicate that abrasion chondroplasty of the knee has a favorable prognosis. Overall, subjects who underwent this procedure were able to return to preinjury activity levels and had preservation of the medial, lateral, and patellofemoral joint spaces.

# 12. Assessment of the Conventional and Modified Boyd-Anderson Surgical Procedures for Repair of Distal Biceps Tendon Ruptures

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The purpose of this study was to retrospectively evaluate the clinical, functional, and radiographic outcome of the Conventional Boyd-Anderson Procedure (CBAP) and Modified Boyd-Anderson Procedure (MBAP) for surgical repair of acute distal biceps tendon ruptures. Thirteen (72%) of 18 patients who underwent the surgery agreed to participate in the study: 5 CBAP and 8 MBAP patients. Subjective assessment included determination of activity and vocational status at the time of injury and patient satisfaction of surgical outcome. Objective assessment included measurement of elbow flexion and forearm pronation ROM and upper arm girth circumference, upper extremity neurological testing, concentric isokinetic testing at 90° and 180°/sec, and upper extremity functional testing (mechanized screwdriver). X-rays were taken to screen for proximal radioulnar synostosis. Time from surgery to follow-up ranged from 1 to 3 years. Six (46%) and 5 (38%) of the thirteen patients reported work-related and recreation-related injuries, respectively. Six (46%) injured their dominant arm and 7 (54%) injured their nondominant arm. Activity level was crossstabulated as follows: 8 (62%) reported strenuous activity levels preinjury and postsurgery, 3 (23%) reported strenuous activity levels preinjury and moderate activity levels postsurgery, and 2 (15%) reported moderate activity levels preinjury and postsurgery. Six (46%) patients were very satisfied, 6 (46%) were satisfied, and 1 (8%) patient was neither satisfied nor dissatisfied with the surgical outcome. All patients returned to their original vocations postsurgery. Two (15%) patients had decreased neurological function postsurgery (decreased peripheral sensation or reduced biceps tendon reflex). No significant difference ( $p > .05$ ) existed in contralateral ROM, girth circumference, or peak torque for either CBAP or MBAP patients. No patient had proximal radioulnar synostosis. In conclusion, the CBAP and MBAP result in similar, favorable clinical and functional outcomes in the management of acute distal biceps tendon ruptures.



### 13. Inter- and Intra-Tester Reliability of Lower Extremity Circumference Measurements

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The purpose of this study was to examine the intertester and intratester reliability of lower extremity circumference obtained by examiners when using both the same tape measure and two different types of tape measures. Twenty-one males between the ages of 18 and 19 volunteered. A standard flexible tape measure (1 cm  $\times$  150 cm) and a Lufkin tape with a Gulick spring-loaded handle were used to obtain all measurements. Measurements were performed independently by two examiners: an NATA-certified athletic trainer (Examiner 1) and a graduate athletic training student (Examiner 2). The following sites were used for this study: medial joint line (MJL), 20 cm above the medial joint line (ABVMJL), and 15 cm below the medial joint line (BELMJL). Landmarks were identified and marked by Examiner 1 using the flexible tape measure. Half of the subjects were randomly selected to have their right leg measured while the other half had their left leg measured. Measurements were obtained with subjects in a supine position. Each examiner performed 6 measurements (to the nearest 0.1 cm) per subject: ABVMJL, MJL, and BELMJL using the standard tape; ABVMJL, MJL, and BELMJL using the Gulick tape. All measurements were repeated the following day using the same protocols. Intraclass correlation coefficients (ICCs) were computed for each intertester and intratester comparisons for each site. Results demonstrated intertester measurements to be reliable at all sites with both tape measures (Gulick: ABVMJL:  $R=.9956$ ; MJL:  $R=.9981$ ; BELMJL:  $R=.9579$ ; Standard: ABVMJL:  $R=.9978$ ; MJL:  $R=.9937$ ; BELMJL:  $R=.9579$ ). Intratester measurements, both with the same tape and different tape measures, were also very reliable as shown below.

#### Intratester ICCs

Tester	Tape	above	below	
		MJL	MJL	MJL
Same Tape Measure				
1	Gulick	.9953	.9925	.9643
	Standard	.9915	.9875	.9967
2	Gulick	.9852	.9953	.9942
	Standard	.9951	.9943	.9902
Different Tape Measure				
1		.9970	.9936	.9911
2		.9978	.9985	.9762

### 14. The Effects of Prophylactic Lateral Knee Braces on Functional Performance

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Previous authors have reported diminished running speed and inconsistent effects on agility when wearing prophylactic lateral knee braces, but effects of extended use of knee braces on performance is unknown. The purposes of this study were to determine if agility times and forward running speed would be diminished with initial brace use and if 22 hours of brace wearing would reestablish diminished measures of agility and forward running speed. Thirty-two physically active males were randomly assigned to one of three brace groups (Anderson Knee Stabler, McDavid Knee Guard or Knee Saver) or a control group. Each subject participated in 5 separate testing sessions which involved performing 3 agility tests (co-contraction, carioca and shuttle run) and a 40-yard dash. The first session was performed without braces. The other 4 sessions involved wearing the same pair of assigned knee braces. Testing sessions 3, 4, and 5 were preceded by a training period which consisted of playing basketball and additional brace wearing. Differences between brace groups and test sessions over time were analyzed with a repeated measures MANOVA. Univariate  $F$  tests and Duncan post hoc tests were used for post hoc comparisons. Subjects who wore the Anderson Knee Stabler and McDavid Knee Guard braces had slower times (average of 5 sessions) for the agility and forward running tests. The subjects who wore the Anderson Knee Stabler ran slower for the initial brace exposure and at 14.75 hours of brace wearing. The subjects returned to their pretest (no brace) times at 22 hours of brace wearing. We recommend that 22 hours of brace wearing should be provided to novice knee brace wearers to allow familiarization to lateral prophylactic knee braces.

### 15. Motion Complications After Arthroscopic Repair of Anterior Cruciate Ligament Avulsion Fractures in the Adult

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Avulsion of the anterior cruciate ligament (ACL) is a rare injury in the adult, accounting for only 1% to 5% of ACL disruptions. We retrospectively reviewed the outcome of 17 adults treated arthroscopically for displaced anterior cruciate ligament avulsion fractures. Patients were evaluated an average of 5.1 years (range 2 to 9 years) after surgery. Twelve patients with acute avulsions were treated with primary repair of the avulsion fragment. Four patients (three acute, one chronic) were treated with resection of the ACL and its avulsion fragment, followed by immediate ACL reconstruction with autograft (two patella tendon, two semitendinosus-gracilis grafts). One patient, with a chronic fibrous nonunion, was treated with resection alone without reconstruction. Patient allocation to each group was dictated by individual surgeon preference. Follow-up consisted of a chart review and detailed questionnaire which included a 100-point visual analog scale. Physical examination included assessment of stability, goniometric measurement of knee range of motion, and KT-1000 (Medmetric, San Diego, CA) arthrometer. Lower extremity strength was assessed using isokinetic and functional testing. Of the 12 patients with primary repair of the avulsion fragment, 5/12 (42%) had severe difficulty regaining motion postoperatively. Two patients (17%) required manipulation under anesthesia to help regain motion. Three patients (25%) required multiple arthroscopic debridement for lysis of arthrofibrotic scar tissue. An additional 3 patients (25%) required a second arthroscopy for reasons including loose bodies, suspected meniscal tear, and removal of hardware. Only 4/12 (33%) progressed through physical therapy uneventfully. All four (100%) of the patients treated with resection and immediate ACL reconstruction progressed through rehabilitation without loss of motion. The one patient with resection alone did well with full motion postoperatively. The functional outcome of patients treated with primary repair versus resection with reconstruction was similar regarding stability, quadriceps strength, and final level of function. Patients treated with resection and reconstruction showed better self-rating of knee function, decreased anterior knee pain, decreased requirement for secondary procedures, and shorter overall rehabilitation time.



## 16. Laser-Assisted Shoulder Capsular Shift

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Laser-assisted arthroscopic surgery is relatively new technology. Using the Holmium: YAG laser, it has been observed that collagen containing capsular material contracts becoming a shorter, thicker structure. Basic science research suggests a collagen cross-linking alteration as the source of this phenomenon. Thus, a clinical trial was undertaken to evaluate the arthroscopic stabilization of shoulders in patients with multidirectional (MDI) and unidirectional (UDI) glenohumeral instability using a Holmium: YAG laser-assisted capsular shift (LACS) procedure. Patients with MDI or UDI with or without labral tears, partial thickness rotator cuff tears, and subacromial impingement not requiring acromioplasty were studied. Those with full thickness rotator cuff tears, frank capsular labral detachment associated with instability or impingement requiring acromioplasty were excluded. Laser energy was applied at 10 W (1 joule, 10 Hz) in a tendential defocused manner to shrink the capsule about the glenohumeral joint. In cases of UDI, starting at the 6 o'clock position, capsular modification was accomplished by applying laser energy; an inferior to superior fashion on the anterior portion of the joint's capsule. In cases of MDI, capsular modification was obtained by applying laser energy in an inferior to superior fashion on the anterior and posterior portions of the joint's capsule. The laser was applied through standard arthroscopic portals using standard arthroscopic equipment and applied radially through the capsule in paintbrush-like fashion. A total of 41 shoulders in 40 patients ( $M=31$ ;  $F=9$ )  $\bar{x}$  age 28 yr (range 15 to 50 yr) were treated. There were 9 nondominant and 32 dominant shoulders; 9 were dislocated, 32 were subluxed. MDI was maintained in 28 shoulders while 13 had UDI. Patients were scored using the 100-point Carter Rowe system (80 points=subjective; 20 points=objective) and were followed for an average of 6 months (range 2 to 12). For all patients, postsurgical subjective scores ( $68 \pm 2.2$ ) were significantly higher ( $p < .0001$ ) than presurgical scores ( $17 \pm 1.9$ ). At follow-up, patients had an average total score (objective + subjective) of  $88 \pm 2.2$ . These results indicate that in short-term follow-up, regardless of arm dominance, age, gender, or direction of instability, patients with UDI and MDI without capsular labral detachment or full thickness rotator cuff tears improve significantly after nonablative reduction of redundant glenohumeral joint capsule using the Holmium YAG laser.

## 17. A Comparison of Moleskin Tape, Linen Tape, and Lace-Up Brace on Joint Restriction and Movement Performance

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It is a widely accepted in athletic training to provide prophylactic ankle support to individuals exhibiting vulnerability. Studies have examined the effectiveness of tape, semirigid support, and ankle braces on motor performance tasks and joint restriction, as measured by range of motion. Also, there are studies that examined the effects of these ankle prophylactics on motor skill performance. Few studies in the athletic training literature, however, have examined the effectiveness of moleskin taping application. The purpose of the study is: 1) to compare four conditions (control/no support, closed basketweave tape application, closed basketweave with moleskin stirrup reinforcement tape application, and a lace-up ankle brace) on selected motor performance tasks, and 2) to compare the four conditions on ankle and subtalar joint restriction, as measured by ROM before, during, and after a 20-minute run. Ten females, with no recent history of ankle injury, participated (vertical jump and SEMO agility test) and a 20-minute run/agility test under the four conditions. The influence of the four conditions on vertical jump was recorded in inches and in seconds for the SEMO agility test. The restriction, as measured by passive plantarflexion, dorsiflexion, inversion, and eversion, that all four conditions provided, was reported before, during, and after a 20-minute run/agility test. The results of the study revealed that all three ankle prophylactics (brace, moleskin, tape) significantly reduced motor performance in the vertical jump and SEMO agility test. The extent of the reduction was equal among the ankle prophylactics. After the 20-minute run/agility test, it was found that: 1) plantarflexion ROM was significantly restricted by the brace and moleskin, 2) dorsiflexion ROM was significantly restricted by all three applications, 3) inversion was significantly restricted by all three applications, and 4) eversion was significantly restricted by tape and moleskin. Based on the findings, in comparison to tape and the ankle brace, moleskin tape application significantly reduces ROM after a 20-minute exercise program, but does not reduce motor performance to any great extent.

## 18. Interactive Athletic Training Enhancement Curriculum (IATEC) Design and Development

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Computer-assisted athletic training software can aid in the instruction of athletic training students. The development of an IATEC fills a need to augment traditional classes that use books, lectures, and practical instruction. The IATEC multimedia software combines seven educational components: self-paced learning environment; auditory, visual, and kinesthetic interaction; positive feedback; demonstration; practice; student and teacher reports; and, modular presentation. The projected modules are Prevention, Management, Rehabilitation and Evaluation. The first prototype lesson created to test the IATEC model teaches measurement of the Quadriceps angle within the module of Evaluation. The prototype combines the seven essential components using digital movies demonstrating concepts, interactive explorations including hot text and interactive pictures of anatomical and human models, measurement tools for the student, and interactive examination with positive feedback and accomplishment reporting. Hi-8 video of human models in gymnasium, training room, and studio environments are digitized and incorporated into a multimedia computer authoring environment. Some graphics were touched up in Adobe Photoshop to highlight key features, remove unwanted features, and label other features. Digitized speech was added to aid in pronunciation of anatomical and other scientific terms. Scripting language was used to meld text, graphics, sound, and user input. A consistent user interface was maintained with a progressive introduction of new analysis and testing tools. Each lesson requires approximately 60 MB of storage on CD ROM. The onset of computer technology and computer-based learning can facilitate the growing needs of educational curriculums for correct, consistent material that students can access outside the classroom, laboratory, and training room. IATEC can be developed and designed to fit the specialized needs of all allied health based curricula.

### 19. The Effect of an Interactive Computer Enhancement Program on Cognitive Athletic Training Knowledge

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The purpose of this investigation was to examine the effect of an interactive athletic training computer (IATEC) program and textbook material in teaching university students about the basis for assessment of the quadriceps angle in the knee and related pathologies. Thirty-two university students participated as subjects ( $\bar{x}$  age  $22.6 \pm 3.2$  yr) and were randomly assigned to one of four treatment groups. The treatments consisted of: 1) one hour interaction with the IATEC program ( $n=8$ ), 2) one hour to read and study selected Q-angle material from two athletic training textbooks (Books)( $n=8$ ), 3) one hour combination of IATEC and Books ( $n=8$ ), and 4) no treatment/control ( $n=8$ ). All subjects were blinded to the purpose of the study. All subjects completed a pre and post written test consisting of 10 multiple choice questions pertaining to the measurement of Q-angles, and patellofemoral pathologies related to abnormal Q-angles. An ANOVA on pretest scores did not show any difference among groups ( $p=.83$ ) for preexisting knowledge. The difference (delta) in pretest and posttest scores were also analyzed using a one-way ANOVA with Scheffé post hoc testing. The mean ( $\pm$ SD) pretest scores for the IATEC, Books, IATEC/Books combination and control treatment groups were  $3.62 \pm 1.92$ ,  $3.25 \pm 2.12$ ,  $3.88 \pm 2.42$ , and  $4.25 \pm 2.25$ , respectively. Following treatment, the mean delta score for the IATEC, Books, IATEC/Books combination and control treatment groups were  $4.12 \pm 1.73$ ,  $4.38 \pm 1.60$ ,  $2.38 \pm 2.33$  and  $0.88 \pm 1.36$ , respectively. The ANOVA revealed a significant treatment effect among groups ( $p=.002$ ) for mean delta scores. The Scheffé post hoc test indicated that the differences in mean delta scores for the written tests existed between the IATEC and control group, and the Books and control group. No other differences were observed among the treatment groups.

### 20. The Methods of Internet Information Acquisition and Its Application for Athletic Training in the Clinical and Educational Settings

Tsuchiya M. University of North  
Dakota, Grand Forks, ND 58102

The purpose of this review was to introduce the phenomenal amount of information available over Internet as well as its potential for clinical and educational applications. The development of computer technologies and the ease of accessibility to Internet have broadened the possibility for allied health professionals to explore the wealth of information available all over the world. However, not many computer users explore the Internet features beyond electronic mail. Internet users can access electronic information dissemination methods such as e-mail, listserv, Usenet, File Transfer Protocol, Gopher, Mosaic, and other applications that can assist clinicians, educators, and students. As the National Information Infrastructure plan is being instituted, Internet and its peripheral technologies will have a significant impact on practicing athletic trainers as well as students. In the coming years, an emphasis will be placed not only on the exploration and acquisition of desired information but also on the smooth exchange and sharing of information to improve the efficiency and effectiveness of athletic training functions.

### 21. Factors That Affect the Selection and Attrition Rates of Students in NATA-Approved Athletic Training Curricula

Perkins SA, Schmitt BA. Southern  
Illinois University at Carbondale, IL  
62901

The purpose of this study was to determine what factors affect college choice and dropout of the athletic training (AT) student. The subjects were 41 program directors and 343 AT students. The subjects were given a questionnaire regarding college choice and dropout. An SAS program was used to find the means and standard deviation for the program directors' responses to college choice and the AT students' responses for college choice and dropout. Students who have felt like dropping out said the causes were time commitment, lack of rewards or reinforcement from others, and stress. Program directors felt the reasons for dropout were as follows: time commitments, inability to handle the course work or academics, financial problems, change of majors, and athletic training was not what the student had expected. Both program directors and AT students believe college choice is highly affected by geographic location (state), location of the university (distance from home), cost of attending, specific academic programs offered, reputation of faculty and academic program, NATA approval of the AT program, AT course selection/requirements, and AT facilities available. This research has provided a means to evaluate recruitment and attrition of AT students.



## **22. Variation of Injury Patterns in Professional Hockey: Ice Versus In-Line Skates**

Hutchinson MR. University of Illinois at Chicago, Chicago, IL

The goal of this study was to assess injury patterns in professional hockey; ice vs in-line skates. Prospective injury surveillance was undertaken on two professional roller hockey teams and two professional ice hockey teams. Data was recorded as to injury type, mechanism of injury, anatomical region of injury, time loss from sport, and the number of athletic exposures. For comparison purposes, only game-related injuries were recorded. While the proportion of specific anatomic sites of injuries was comparable between professional ice and roller hockey, there were differences in the types of injuries secondary to the skate being a blade and not wheels. The overall number and severity of injuries was also less in roller hockey. Roller hockey may be slightly safer than ice hockey for several reasons. First, a reduction in both player and puck speed reduces the overall energy available to cause serious injury. Second, by removing blades and trading them for wheels, blade-related lacerations disappear. Third, since roller hockey players generally roll through the curves rather than the stop and go of ice hockey, they are less susceptible to blind checks into the boards. Finally, since the number of players on the playing surface at one time is less in roller hockey (five to six men), the total number of players at risk is reduced.

## **23. The Relationship Between Strength and Flexibility to Chronic Low Back Pain**

Ashmen KJ, Lephart SM, Kuligowski L. University of Pittsburgh, Pittsburgh, PA 15260

The mechanisms associating muscle insufficiency to chronic low back pain (CLBP) is not clearly understood. Present studies have identified pelvic stabilization as being a major contributor. The purpose of this study was to identify strength and flexibility deficits in those subjects with chronic low back pain (CLBP). A pool of 16 female Division I athletes with a  $\bar{x}$  age 19.5 yr and average weight of 146.5 lb were used in this study. The experimental group consisted of 8 athletes who experienced chronic low back pain for at least 6 months prior to testing. Athletes were excluded if there was any evidence of scoliosis, spondylolisthesis, spondylosis, neurologic symptoms, previous back operations, or leg-length discrepancy. The variables assessed in this study included: abdominal strength, erector spinae endurance, hip flexion and extension, lateral flexibility of the torso, and low back flexibility. Strength and endurance were calculated as a function of time in seconds. Goniometric measurements were used to determine the degree of flexibility. Matched subjects were used as the control group. Significant mean differences were found in abdominal strength, erector spinae endurance, right and left hip extension, and right lateral flexion of the torso by using a dependent *t*-test. The results of this study validate the necessity to focus on pelvic stabilization. Although significance was specifically found in particular areas, it should be noted that the deficits could change when treating a different population.

## **24. Motivational Congruency and Discrepancy Between Physical Therapists and Certified Athletic Trainers in the State of Hawaii**

Okasaki EM, Buxton BP, Lankford SV, Noda LS. University of Hawaii at Manoa, Honolulu, HI 96822

A survey to assess motivational preference was sent to 80 physical therapists and 25 certified athletic trainers in the State of Hawaii. To assess motivational congruency and discrepancy, the Neal-Priest Inventory for Motivational Congruency or Discrepancy® 1992 was used. The respondent is asked to rank order the 16 motive stems (in terms of individual importance as motivators), as well as rate each of the motive stems using a five point Likert-type rating scale. The return rate was 64% for both the physical therapists and 80% for the certified athletic trainers. To determine the differences in motivation between the two groups represented in the study, a Mann Whitney U test provided a statistical measure of dissimilarity between the two groups for motivational ranking of the 16 items. Mann Whitney U, a nonparametric statistic, was used due to its ability to deal with rank ordered scores and categories. An unpaired, two-tailed *t*-test was used to determine differences between the ratings of the motivational statements. The findings of the study indicated that a motivational discrepancy existed between the physical therapists and the athletic trainers for the ranking the importance of opportunities for advancement in their occupational settings ( $p < .05$ ). Further, the findings indicated differences in rating the importance of motivators between the physical therapists and the athletic trainers for the following motivational stems: designation as a leader, opportunity for advancement, benefits and wages, job security, feedback on performance, and role in decision making ( $p < .05$ ). The differences in motivational factors between these two groups indicate that the athletic trainers were more concerned with extrinsic rewards than were the physical therapists. This information could be useful to supervisors of athletic trainers and physical therapists in a clinical setting.



## 25. A Survey of the Organization and Direction of NATA-Approved Programs

Kauth WO, Kleiner DM. Illinois State University, Normal, IL 61790

The purpose of this study was to survey the current NATA-approved athletic training education programs (ATEP) regarding their organization and plans for CAAHEP accreditation. A survey was sent to the 96 program directors identified from the 1993-1994 list of NATA-approved ATEP. Eighty-two percent of the program directors responded. Of the 13 graduate ATEP responded, 10 reported that they have advanced programs, 2 have entry-level programs, and one has both. Nine of the 10 advanced-graduate ATEP said they will renew their NATA approval, while one program is being discontinued. Of the 2 entry-level graduate programs, one will seek CAAHEP accreditation, while the other will let their accreditation expire and become an internship program. Of the 66 undergraduate (UG) respondents, 55 said they would seek CAAHEP accreditation, 9 said they have already received CAAHEP accreditation, one said they would allow their accreditation to lapse, and one said they would see NATA reapproval for their UG program (which is no longer possible). Of the respondents, 75% said their institutions are public, and most of the respondents (21.5%) said their institution's enrollment was between 10,000 and 15,000 students. The next highest enrollment was for schools of less than 5,000 students (19.0%). Enrollment of less than 20,000 students were 72.1%. When asked to identify where their ATEP was located, 49.3% said they were their own major, 25.3% said they were a concentration within the PE major, 8.9% were their own department, and 16.5% were located elsewhere. Most of the latter were in majors such as movement science, but also included schools of medicine, nursing, and physical therapy. Only 16% of the respondents said their athletic department athletic trainers and their curriculum athletic trainers were completely separate. Eighty-four percent of the respondents said there was some crossover between the two departments, and 42% said their athletic department athletic trainers and their curriculum athletic trainers were one and the same. The mean number of athletic training credits offered was  $25.9 \pm 11.2$  semester hours. Other information reported includes the number of full-time educators and adjunct faculty members employed, along with their credentials. This information may be useful to institutions seeking CAAHEP accreditation.

## 26. Athletic Training and the News: Strategies for Orchestrating Press Coverage

Frasca RL, McKnight CM. University of Toledo, Toledo, OH 43606

Historically, athletic training has suffered from insufficient recognition from the general public. Most people outside the realm of athletics do not understand the value or role of athletic trainers. Such misperceptions and dearth of understanding could be remedied by greater public awareness of the field through the mass media. In addition to aesthetic benefits, greater public awareness of athletic training could lead to: more jobs available for athletic trainers; improved public perception of the diversity of the field, which could in turn lead to augmented funding; more parental cooperation with trainers; augmented sense of professionalism, which could lead to improved salaries, greater morale, higher vocational self-esteem, and less burnout. Thus, professional aspirations of the field's practitioners could be greatly bolstered by increased—and favorable—coverage in the print and broadcast news media. One option is to engage in advertising campaigns. However, these are accompanied by considerable risk and cost, and seldom produce the desired results. A better alternative is to construct positive relations with the press and invite more media coverage of the field. This paper offers athletic trainers numerous practical strategies for orchestrating press coverage. By incorporating some or all of these strategies into their occupational routine, athletic trainers will exert considerable influence over the shaping of public perceptions about the field and their specific institution.

## 27. Job Satisfaction Among Certified Athletic Trainers

Halterman AR, Perkins SA. Southern Illinois University at Carbondale, Carbondale, IL 62901

The purpose of this study was to determine if certified athletic trainers were more satisfied in one facility compared to another, and to determine some of the differences between each facility. A questionnaire was distributed at the 1992 GLATA District Meeting of athletic trainers (AT); 111 responses were received. Athletic training facilities represented in the sample were: high schools, colleges, clinics, industry, hospital, and professional sports. The questionnaire measured job satisfaction in the areas of supervision, colleagues, working conditions, pay, responsibility, the work itself, advancement, security, recognition, and specific questions pertaining to the job of an AT. Overall, results suggest ATs were satisfied with their jobs. It appears that ATs in the clinical settings were more satisfied than in other settings. Hospital and high school trainers were the least satisfied. Industrial ATs rated security high in job satisfaction. Clinical ATs with high school responsibilities were the third highest in job satisfaction. College ATs were the second most satisfied ATs in the study. Professional ATs job satisfaction rating was the third lowest. In conclusion, it appears from the results that key factors to achieve job satisfaction are to have a secure job with adequate salary, opportunity for advancement, good working environment, and to enjoy the work.

## Notes

1. The authors are grateful to the following individuals for their assistance in the preparation of this manuscript: Dr. J. H. ...

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## Clinical Case Reports

Thursday, June 15, 1:30 - 3:10

### Mild Head Injury in a High School Football Player

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**PERSONAL DATA/MEDICAL HISTORY:** A 17-year-old white male football player experienced a severe headache, confusion, disequilibrium, and dizziness after being struck by an opposing player during a game.

**PHYSICAL SIGNS AND SYMPTOMS:** The athlete suffered no apparent loss of consciousness. He was immediately removed from the game, where we administered a series of field tests to determine the severity of injury. He appeared to have mild retrograde amnesia (GOAT score of 90), and difficulty performing Romberg's balance test. His pupillary size and reaction were normal. He demonstrated no extraocular movements, and his mental processing appeared normal. He experienced moderate neck pain in addition to the headache, but tests were negative for motor and sensory deficiencies. He did not resist our decision to keep him sidelined for the remainder of the game.

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

**DIAGNOSTIC IMAGING/LABORATORY TESTS:** One month prior to the injury, the athlete had entered our study investigating the effect of mild head injury on postural stability and cognitive functioning. A preseason assessment therefore allowed us to compare preinjury scores to postinjury scores. His postural stability was assessed using the Chattecx Balance System (Chattanooga Group, Inc, Chattanooga, TN), and cognitive testing involved the use of the Paced Auditory Serial Addition Task (PASAT). He was assessed on days 1, 3, 5, and 10 following his injury with various sensory modalities being altered throughout testing trials. Results revealed a significant increase in postural sway on day 1 following the injury, especially when multiple sensory modalities were altered. On day 3 following the injury, postural sway values had returned to near preseason measures. This held true for assessments at day 5 and 10. The athlete was again assessed 1 month postseason to determine if residual effects were present, and tests revealed no significant changes from preseason to postseason. The PASAT test for mental processing revealed increases from day 1 through day 5, and then a leveling off of scores.

**CLINICAL COURSE:** Through the use of both subjective assessment and objective assessment, the athlete was diagnosed with a mild (1st degree) concussion. Increased postural sway is indicative of acute intracranial involvement. The athlete was therefore not permitted to return to practice or competition until his postural stability had returned to normal levels and all subjective signs and symptoms had resolved. After the athlete tested normal on day 5 postinjury, he returned on a limited basis (no contact) so we could observe signs and symptoms both during and following activity. On day 6 postinjury, he returned to full practice, and participated on a limited basis in a game on day 7.

**UNIQUENESS/DEVIATION FROM THE EXPECTED:** From a management standpoint, this case presents an alternative solution to a dilemma many athletic trainers and team physicians face. With increasing reports of recurring concussions and Second Impact Syndrome in sports, clinicians need a more effective method of quantitatively assessing mild head injury. This will provide clinicians with a tool for determining when an athlete can safely return to competition following a mild head injury.

### Anterior Shoulder Instability in a Female Collegiate Basketball Player

Ireland ML, Satterwhite YE, Healy J. Kentucky Sports Medicine Clinic, Lexington, KY 40517

**PERSONAL DATA/MEDICAL HISTORY:** An 18-year-old white female, Division I collegiate basketball athlete sustained an anterior glenohumeral dislocation, which she was able to reduce herself, in the middle of the season. Past history reveals that she has had several episodes of anterior pain and feeling that her shoulder was slipping with her arm in an abducted external rotated position in high school. She was placed on a rehabilitation program and continued to have pain anteriorly and weakness.

**PHYSICAL SIGNS AND SYMPTOMS:** On physical exam she had a positive apprehension test on the left, labral pop, and anterior glenohumeral subluxation maneuvers. There was moderate weakness on manual muscle testing of the supraspinatus, negative sulcus sign. No posterior instability.

#### DIFFERENTIAL DIAGNOSIS:

- 1) Anterior glenohumeral instability, recurrent.
- 2) Possible anterior glenoid labrum tear.
- 3) Rotator cuff imbalance, possible partial tear.
- 4) Physiologic habitual multi-directional instability.

**DIAGNOSTIC IMAGING/LABORATORY TESTS:** Plain radiographs were normal and showed no evidence of instability including no Bankart lesion, and no Hill-Sachs' lesion.

**CLINICAL COURSE:** The patient was felt to have recurrent anterior glenohumeral dislocation episodes and moderate to severe anterior glenohumeral instability of her left nondominant shoulder. She was able to continue basketball during the season, work on a rehabilitation program of internal greater external rotation. She underwent diagnostic arthroscopy of her left shoulder and Suretac anterior labral reattachment for an anterior glenoid labrum injury. Removal of cartilaginous loose body was done. She had a normal rotator cuff and no evidence of a Hill-Sachs' lesion arthroscopically. Postoperatively she was immobilized for 4 weeks and placed on a vigorous rehabilitation program. Five months later, she sustained a recurrent anterior glenohumeral dislocation when she was rebounding a ball with her arm overhead in abducted external rotated position. Due to recurrent instability, she underwent an anterior glenohumeral capsulorrhaphy capsular shift of the humerus after repeat arthroscopy. She is doing well postoperatively and has a stable shoulder. She is now 5 months postop.

**UNIQUENESS/DEVIATION FROM EXPECTED:** This represents an interesting case of shoulder instability in a women's basketball athlete. The patient had physiologic laxity underlying. Failed Suretac and underlying laxity without a traumatic dislocation may result in need for repeat surgery. Anterior glenohumeral reconstructions which are best for specific sports should be stimulated in the discussion. Failure of the Suretac and repeat anterior dislocations in the sport of basketball which demands more abducted external rotated position than one would expect was seen. Increasing frequency of instability necessitate now open procedures as there are failures with the Suretac in laxity and shoulders without a traumatic unidirectional Bankart lesion.

## Trauma-Associated Pneumothorax in a College Football Player

Johnson MB. San Diego State University, San Diego, CA 92182

**PERSONAL DATA/MEDICAL HISTORY:** While participating in an intercollegiate football game, a 19-year-old male running back sustained a direct blow to the left lateral rib cage in the region of the 8th and 9th ribs. The athlete's major complaint at the time of injury was pain over the ribs and difficulty with breathing. The athlete was otherwise healthy, with no previous history of injury to the region. The athlete immediately reported persistent sharp pain in his left chest, as well as difficulty in inhalation and exhalation, both forced and relaxed.

**PHYSICAL SIGNS AND SYMPTOMS:** Other physical signs while on the field included point tenderness in the left chest and crepitus over the left 8th and 9th ribs. Compression over the suspected fracture sites caused increased pain. The athlete was transported to the field medical examination room for further evaluation.

**DIFFERENTIAL DIAGNOSIS:** Assessment led the medical team to suspect rib fracture in the region of the 8th and 9th ribs. Pneumothorax was also suspected, as well as the possibility of splenic or hepatic involvement.

**DIAGNOSTIC IMAGING/LABORATORY TESTS:** The team general surgeon and orthopaedic surgeon ordered emergency retroenterograms, which were performed on site. Limited posterior/anterior (AP) retroenterograms revealed a small left-sided pneumothorax without evidence of a tension component or the presence of pleural fluid. The athlete was transported by ambulance to the hospital for further treatment. At the hospital, a CT scan with intravenous and oral contrast was performed. Axial sections were obtained from the level of the diaphragm to the aortic bifurcation. The scans confirmed the field x-ray findings of left pneumothorax without evidence of pleural effusion. The PA chest and left rib cage x-ray series taken at the hospital revealed fractures of both the 8th and 9th ribs on the anterior lateral thorax. There was no evidence on any testing indicative of splenic or hepatic injury, nor any other organ involvement.

**CLINICAL COURSE:** Athlete was admitted to the hospital for follow-up treatment. A pleural drainage tube was inserted in the area of the pneumothorax, the tip overlying the left medial posterior 7th rib. Complete lung re-expansion occurred within 8 hours of the tube insertion. The lungs remained clear. The tube was removed at 48 hours to preserve lung integrity. After removal, a moderate pneumothorax reaccumulated, confirmed by x-ray. A tube was reinserted, allowing immediate re-expansion. This chest tube remained in place for 72 hours, at which time a small apical pneumothorax remained. At 6 days postinjury, the chest tube was removed. The athlete was released from the hospital 1 week postinjury. X-rays taken 3 weeks postinjury showed healing fractures of the 8th & 9th left ribs. The soft tissues appeared normal at this time. The athlete was cleared for full activity 4 weeks postinjury. Thereafter, he employed protective padding to safeguard against further injury to his ribs.

**UNIQUENESS/DEVIATION FROM EXPECTED:** Pneumothorax injuries, even those from blunt trauma, are uncommon in athletics. Therefore, literature regarding its occurrence is scarce. Complications arising from this injury can be life-threatening. Trauma-induced pneumothorax may be overlooked if the evaluation centers on immediate injury, such as rib fracture, rather than potential complications. Treatment should include close monitoring of symptoms and a gradual return to activity. With careful monitoring, adequate recuperation and proper equipment modification, an athlete can return to contact following trauma-associated pneumothorax.

## In-Season Shoulder Pain in a Collision-Sport Athlete

William RI, Ireland ML. Kentucky Sports Medicine Clinic, Lexington, KY 40517

**PERSONAL DATA/MEDICAL HISTORY:** A 21-year-old right-hand dominant football athlete developed left shoulder pain during summer weight lifting. He denied any specific injury during the previous season and spring football session. He felt as if the shoulder may have "slipped" during weight lifting. Presents for preseason physical.

**PHYSICAL SIGNS AND SYMPTOMS:** Essentially full passive range of motion, including 100° sitting external rotation. Internal rotation lacks four spinous processes actively. Tenderness over bicipital groove; positive Speed's test, positive Hawkins' sign for impingement. Pain with supine apprehension test not relieved by posteriorly applied pressure. Discomfort with supine posterior instability testing. Mild to moderate rotator cuff weakness due to break away from pain.

**DIFFERENTIAL DIAGNOSIS:** Shoulder instability (anterior/posterior vs multidirectional) vs rotator cuff tendinitis/secondary impingement.

**DIAGNOSTIC IMAGING/LABORATORY TESTS:** Radiographs show a large intra-articular body.

**CLINICAL COURSE:** Exam under anesthesia, arthroscopy left shoulder with removal of loose bodies and debridement of posterior glenoid surface. Aggressive rehabilitation resulted in return to full-contact competition 15 days postop, with actual game play 1 month postop. He played the remainder of season as starting safety without further left shoulder complaints. Suffered a minor right AC separation and minor right ankle sprains.

**UNIQUENESS/DEVIATION FROM EXPECTED:** Case illustrates ability to rapidly return to competition upon removal of mechanical problem (loose body) once proper muscle rehabilitation is completed.



## Free Communications, Oral—Educational Research

Thursday, June 15, 3:30 - 5:00

### Computer-Based Instruction in Athletic Training Education Programs

Wright K, Fincher AL. The University of Alabama, Tuscaloosa, AL 35487

The purpose of this study was to determine what percentage of undergraduate and graduate NATA-approved athletic training programs currently use computer-based instruction (CBI). In keeping with the literature, we defined CBI to include both computer-assisted instruction (CAI) and interactive video (IAV). Additionally, we had the following research questions: 1) what athletic training educational software is currently being used by athletic training students and educators, 2) what factors currently impede the use of CBI in athletic training education, 3) what instructional methods are commonly used to incorporate CBI into the athletic training curricula, and 4) what are the attitudes of athletic training program directors toward the use of CBI in athletic training education. A survey was designed and mailed to the program directors ( $n=98$ ) of all graduate and undergraduate NATA-approved athletic training education programs. Eighty-six (87.7%) usable surveys were returned. Respondents included 76 undergraduate program directors and 10 graduate program directors. Forty-eight (55.8%) of the respondents reported using some form of CBI. When broken down by academic level, 46 (60.5%) of the responding undergraduate program directors used some form of CBI, while only 1 (10%) of the responding graduate program directors used this technology. When broken down by type of CBI, 47 (54.7%) of the total respondents reported using CAI while 9 (10.6%) reported using IAV. The educational software currently used by athletic training educators was also identified. Respondents reported using CBI software most frequently to supplement traditional instructional methods (91.3%). Other instructional methods reported included using CBI as a primary method of instruction (15.2%), using CBI in the lecture process via an LCD panel (15.2%), and using CBI for testing purposes (34.8%). A lack of funds (63.2%) was reported to be the primary impeding factor for those programs not using CBI. Respondents reported an overall positive attitude toward CBI use in athletic training education and indicated the need for increased development of athletic training/sports medicine software. This research study was funded through a College of Education research grant from The University of Alabama in Tuscaloosa, Alabama.

### The Effects of an Interactive Computer Program on Knowledge Structures in Athletic Training

Chen A, Buxton BP, Holgen KA, Speitel TW. University of Hawaii at Manoa, Honolulu, HI 96822

Learning occurs when external knowledge is internalized by the learner in a knowledge structure (KS). This research compared the effects of an interactive athletic training computer (IATEC) program with a traditional reading method on university students' KSs. Concepts ( $n=17$ ) related to the assessment of Quadriceps angle (Q-angle) were selected based on the review of two popular textbooks. An expert KS model was established as a referent KS for the evaluation of the students' KSs. University students ( $n=34$ ) were randomly assigned to four treatment groups: IATEC, Reading, IATEC/Reading (Combo), and Control. All except the control group received 1-hour training on Q-angle, using the assigned treatment method. Pre and posttraining KSs were elicited using Pathfinder™, a computerized knowledge mapping algorithm. Subjects rated relatedness of the paired 17 concepts on a 9-point scale (1=unrelated, 9=highly related). Correlations between subjects' ratings and the expert model, structural similarities between the subjects' KSs and the expert model, and KS coherence (expertise index) were calculated and analyzed. An ANOVA on pretraining KSs showed no significant differences among groups. An ANOVA on posttraining data revealed that posttraining correlation coefficients differed significantly among groups ( $p=.02$ ). Post hoc analysis showed that the means of the coefficients for both the IATEC and the Combo were significantly higher than the Control, while the Combo was significantly higher than the Reading group. An ANOVA on KS structural similarity demonstrated significant differences among groups ( $p=.01$ ). Post hoc analysis indicated that the computer training groups (IATEC and COMBO) similarity coefficients were significantly higher than those of Reading or Control. No treatment effects on expertise index were found. Qualitative analysis of KS networks from the four groups supported the above results and revealed quality differences among the groups in terms of anchor concepts distribution in KSs. The findings suggest that an IATEC program can have positive impact on the students' learning by influencing their knowledge internalization process when the concepts were structured.

### Comparison of Effectiveness of an Interactive Computer Enhancement Program Versus Textbooks for Practical Application of Athletic Training Assessment Skills

Buxton BP, Speitel TW, Holgen KA. University of Hawaii at Manoa, Honolulu, HI 96822

The purpose of this investigation was to compare the effectiveness of an interactive athletic training computer (IATEC) program and textbook material in teaching university students to explain and demonstrate the assessment of the quadriceps angles on a human model. Thirty-two university students participated as subjects ( $\bar{x}$  age  $22.6 \pm 3.2$  yr) and were randomly assigned to one of four treatment groups. The treatments consisted of: 1) 1 hour interaction with the IATEC program ( $n=8$ ), 2) 1 hour to read and study selected Q-angle material from two athletic training text books (Books)( $n=8$ ), 3) 1 hour combination of IATEC and Books ( $n=8$ ), and 4) no treatment/control ( $n=8$ ). All subjects were blinded to the purpose of the study. All subjects completed a pre and post oral practical test consisting of objective evaluation of their ability to explain and demonstrate the measurement of Q-angle on a live human model. Prior to pretesting, all subjects viewed a 2-minute video on goniometer measurement to familiarize themselves with the use of a goniometer. An ANOVA on pretest scores did not show any difference among groups ( $p=.43$ ) for preexisting knowledge. The differences (delta) in pretest and posttest scores were also analyzed using a one-way ANOVA with Scheffé post hoc testing. The mean ( $\pm$ SD) pretest scores for the IATEC, Books, IATEC/Books combination, and control treatment groups were  $2.00 \pm 1.31$ ,  $1.12 \pm 0.35$ ,  $2.25 \pm 2.19$ , and  $1.56 \pm 1.33$ , respectively. Following treatment, the mean delta score for the IATEC, Books, IATEC/Books combination and control treatment groups were  $6.88 \pm 2.70$ ,  $6.75 \pm 2.55$ ,  $7.38 \pm 2.62$ , and  $0.67 \pm 1.32$ , respectively. The ANOVA revealed a significant treatment effect among groups ( $p=.0001$ ) for mean delta scores. The Scheffé post hoc test indicated that the differences in mean delta scores for the oral practical evaluation existed between the IATEC and control group, Books and control group, and the IATEC/Books combination and control group. No other differences were observed among the treatment groups.

## Multimedia Computer-Assisted Learning Program

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The traditional athletic training educational system employed today is limited in its ability to effectively meet the educational needs of the student athletic trainer. The computer has the capability to fulfill the inadequacies of the student athletic trainer's education. The purpose of this project is to create a multimedia computer-assisted learning program (MCALP) which offers a new approach to learning in athletic training. Computer-assisted learning in athletic training offers several advantages when used in conjunction with traditional teaching methods; 1) the design of MCALP allows users to systematically learn at their own pace, 2) any aspect of MCALP (video, animation, text or test) can be accessed quickly by the user as a reference, 3) the multiple variables present in MCALP allows the user to partake in the ideal learning situation. The user is capable of becoming involved in a learning experience with the ability to detach from the situation to reflect upon the presented information. The advantage of MCALP is the user ability to become reinvolved with the situation where they left off to experience the learning again. The use of the MCALP program requires a Macintosh computer with 7.0 system software, CD Rom drive, and 8 MB Ram. The development of the MCALP program was accomplished through three primary phases: 1) model construction and animation on the Silicon Graphics computer, 2) video capturing and video conversion into quick time movies (movies playable on the computer), and 3) MCALP program development on the Macintosh computer. Phase 1 created 3-dimensional still images and animations of the knee within the Alias program on the Silicon Graphics computer. Phase 2 was the process of acquiring surgery footage of injuries to the knee and converting the video to quick time movies so they can be viewed within the MCALP program. Phase 3 was the construction of the MCALP program through Macromind director allowing the user to create interactive programs for the computer. The MCALP is a program allowing the user to learn the following; 1) anatomy of the knee, 2) injuries which can occur to the knee, 3) special tests to examine the knee, and 4) exams testing user recall. Future development of this project would involve other joints of the human body and eventually develop an entire body learning tool for the student athletic trainer.

## The Current Status of Employment-Preparation Education in the Approved Undergraduate Athletic Training Curricula

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The purpose of the study was to investigate the current trends and the extent of employment-related education among the NATA/JRC-AT undergraduate curricula. We supplied surveys to all directors of approved undergraduate athletic training curricula. Seventy-four curriculum directors (88%) responded to the survey, and the data were computed with descriptive statistical methods. Eighty-six percent of the directors who responded allocate some class time to instruct the students on employment issues ( $\bar{x}=120$  min). Career services centers are available to the students (96%), but only 53% of the programs seek instructional assistance from the campus career services center personnel. There was no significant correlation between the time spent on employment issues and the directors' perceived importance of job search skills. We conclude that the majority of the curriculum directors provide the basic employment preparation skills to the athletic training students. However, there is a wide variance among the programs in the depth of instruction. The students may benefit from an increased time and complexity of the instruction to be prepared for the competitive job market.

## A Comparison of Student Knowledge Retention Following Instruction Using Computer-Assisted Instruction Versus Lecture Method for an Undergraduate Athletic Training Program

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The purpose of this study was to compare acquired knowledge and retention of knowledge using two different instructional strategies. This study compared computer-assisted instruction (CAI) and traditional lecture method (TLM) as means of primary instruction for 36 undergraduate athletic training majors. Using a posttest control group design with a 5-month retention measure, 36 subjects were randomly assigned to one of two groups ( $n=20$  CAI or  $n=16$  TLM). Each group received a lesson on the anatomy of the knee joint. The control group received the (TLM) lesson while the experimental group received the lesson through CAI. Each instructional lesson was limited to one 50-minute session. A 20-item multiple choice test was given to each group 2 days after the instruction. A *t*-test was conducted to determine if significant differences existed between groups. There was no significant differences between scores of the experimental group (CAI) ( $M=16.55$ ,  $SD=1.84$ ) and the control group (TLM) ( $M=16.81$ ,  $SD=1.10$ ),  $t=-.5274$ ,  $p>.05$ . The 20-item multiple choice test was administered after 5 months postinstruction to determine if significant differences existed between scores of the two groups. There were no significant differences between scores of the experimental group (CAI) ( $\bar{x}=15.05$ ,  $SD=1.98$ ) and the control group (TLM) ( $\bar{x}=15.25$ ,  $SD=1.47$ )  $t=-0.3378$   $p>.05$ . A paired *t*-test (correlated *t*) was also performed to test for within subject change. The results of this analysis indicated that significant decreases in scores existed between the posttest measurement and the retention measurement. The experimental group scores were (CAI) ( $\bar{x}=-1.500$ ,  $t=-4.265$ ) and the control group scores (TLM) ( $\bar{x}=-1.562$   $t=-4.037$ )  $p<.05$ . Based on these data, the authors concluded that 1) no significant differences were found between groups on the posttest measurement, 2) no significant differences were found between groups on the retention measurement, and 3) both groups had significant decreases in knowledge scores across the 5-month retention period.



## Free Communications, Poster—All 5 Categories

Thursday, June 15, 1:30 - 5:00; Friday, June 16, 8:00 - 5:00; Saturday, June 17, 8:00 - 11:00

### 28. A Comparison of Temporal Data During the Loading Phase of Vertical and Depth Jumps

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The purpose of this investigation was to compare temporal data during the phase of a vertical jump where elastic loading of the bones, muscles, tendons, and ligament occur. Four jumps were studied: three depth jumps from heights of 1.5 ft, 1.0 ft, and 0.5 ft, and a standing vertical jump. Specifically, the investigation compared the following electromyographic (EMG) and kinematic parameters: 1) the effect of depth jump height on the amortization time; 2) the relationship between amortization time and the criterion task, height jumped; 3) the effect of depth jump height on time to peak recruitment; and 4) the relationship between time to peak recruitment and the criterion task, height jumped. The EMG response in the following six muscles in the dominant limb was measured: 1) rectus femoris, 2) vastus medialis, 3) medial head of the gastrocnemius, 4) peroneal group, 5) biceps femoris, 6) semimembranosus/semitendinosus. Eight NCAA Division I, football players who play specialty positions characterized by the ability to create stored elastic energy and to transfer energy served as subjects. Surface EMG synchronized with high-speed video was used to analyze the EMG and kinematic response of the six muscles during three trials for each of the four jumps. Joint angles of the lower extremity were used to identify temporal data associated with the phases of the motion. Preliminary findings included: a) the amortization time decreased as the depth jump starting height increases; b) the amortization time for the vertical jump was greater than the amortization time of the depth jumps; c) as amortization time decreases, jump height increased for all jumps; d) the time to peak recruitment after foot contact decreased as jump starting height increased; e) the time to peak recruitment after foot contact for the vertical was greater than the time to peak recruitment for the depth jumps; and f) as the time to peak recruitment after foot contact decreased, the jump height increased for the depth jumps.

### 29. Interrater and Intrarater Reliability of the Vestige 5000, Midsagittal Contour Gauge for Standing Posture

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Although the assessment of human posture has been a concern of clinicians for centuries, it remains an area of investigation fraught with difficulty. There still is a lack of agreement as to what is "good," "correct," "ideal," or "normal" posture. Much of this discordance comes from the lack of a reliable, simple, noninvasive, time and cost-effective device to objectively quantify the curvature of the spine in the sagittal plane. We designed this study to determine the reliability of a new postural assessment device, the Vestige 5000. Fourteen male college students with no history of chronic back pain nor overt scoliosis or other spinal abnormality served as subjects. Two raters tested each subject on 4 different days over the 12-week duration of the study. Subjects signed up for 20-minute testing times, at the same time of day, for 4 days. Subjects were tested on weeks 1, 2, 10, and 12. Each time the subject came, we took their height, weight, and age. Each rater then tested the subject twice in their "natural" posture and then twice in their "posed" stance. We analyzed the proportional relationship between the height of the cervical, thoracic, and lumbar curves with their depth, as derived by the Vestige software program. We used intraclass correlation coefficients to estimate relative reliability. Our between-rater reliabilities ICC(2,1) were .974, .982, and .958 for the cervical, thoracic, and lumbar curves, respectively, for the normal relaxed stance. For the posed erect stance, they were .960, .981, and .988, respectively. The within-rater correlations were even higher. Our absolute reliability estimators (95% confidence intervals) were small, indicating little variability. For the normal stance, they were  $\pm 2.01$  for the cervical,  $\pm 1.76$  for the thoracic, and  $\pm 1.58$  for the lumbar. For the posed stance, they were  $\pm 1.75$ ,  $\pm 1.52$ , and  $\pm 1.59$ . Our results indicate that the Vestige 5000 is a reliable device for assessing standing posture using the proportional method.

### 30. Fatiguing Isotonic Contractions Recruit More Motor Units Than Similar Isokinetic Contractions

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Two years ago we presented data indicating that peak and average torque were greater during the last three repetitions of a set of isotonic contractions to fatigue than during matched isokinetic repetitions. We speculated this was due to increased motor unit recruitment. In the present study we measured both torque and integrated EMG to directly test this hypothesis. Subjects performed 25 maximal effort isokinetic repetitions of knee extension at 60°/sec on a Kin-Com II. Following 25 to 72 hours rest, they performed maximal repetitions isotonic (force mode) on the Kin-Com II using 60% or 70% of the isokinetic peak torque and with speed set at 300°/sec. We also measured EMG output from the vastus lateralis and vastus medialis muscles with a Kin-Com EMG unit. We computed peak and average torque of the first and last three isotonic repetitions and the corresponding isokinetic repetitions, and percent change in integrated EMG from the first to last repetitions for each muscle and type of exercise. We compared isotonic and isokinetic results with a MANOVA followed by post hoc ANOVAs. Both peak and average torque decreased more during isokinetic repetitions (42% & 44%) than during isotonic repetitions (20% & 8%). IEMG changed slightly during isokinetic testing (VL = 31% dec, VMO = 10% inc), but increased tremendously during isotonic testing (VL = 5501% inc, VMO = 4574% inc). We conclude that for developing strength, isotonic contractions are more effective than isokinetic contractions because as the muscle fatigues, it must recruit additional motor units to continue lifting a constant isotonic load, whereas an isokinetic device accommodates with a decreased load.

### 31. Effects of Cutaneous and Joint Receptors on the In Vivo Quadriceps Femoris Torque-Velocity Relationship

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The influence of cutaneous and joint receptors on the quadriceps femoris force-velocity relationship was assessed with the Kin-Com (Chattecx, Inc, Hixson, TN) isokinetic dynamometer. Twenty-four females (age =  $21.0 \pm 1.4$  yr, ht =  $163.5 \pm 6.0$  cm, wt =  $60.9 \pm 7.6$  kg) were divided into two groups and tested with the force pad placed either proximally or distally on the leg. Three concentric and eccentric contractions were performed at 0.44, 0.87, 1.31, 1.74, 2.18, 2.62, 3.05, and 3.49 rads/sec on two separate days with an anesthetic applied to the skin under the force pad on one of the two days. An ANOVA was performed on peak torque with trend analyses performed on velocity factors. The results indicate the cutaneous and knee joint receptors do not affect the quadriceps femoris concentric or eccentric force-velocity relationships [ $F(7,154) = 1.61$ ]. Furthermore, the results revealed significant linear [ $F(1,154) = 161.14$ ] and quadratic trends [ $F(1,154) = 25.85$ ] for concentric and eccentric peak torque, respectively. Thus, the concentric force-velocity relationship is best described by a linear relationship rather than the classic curvilinear relationship. Conversely, the eccentric relationship is best described by the classic curvilinear relationship. These results suggest that adequate assessment of muscular torque production requires testing at multiple velocities.

### 32. A Comparison of Oxygen Uptake, Heart Rate, and Tidal Volume Between Upright and Recumbent Cycle Ergometry

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Exercise that supports the weight of the body can be particularly helpful for athletes with acute and/or chronic degenerative changes in the knee joints or lower back. The purpose of this study was to compare physiological responses between standard upright cycle ergometry (UR) versus a recumbent cycle ergometry (R) position and to determine if recumbent cycling is a viable alternative to upright cycling. Maximum oxygen uptake ( $\text{VO}_2$  max), maximum heart rate, maximum tidal volume, and heart rate/ $\text{VO}_2$  slope were determined on 20 (male = 9, female = 11) healthy subjects 17 to 33 years. Subjects performed graded maximal exercise tests in a standard upright cycling position on a Monarch ergometer and in a recumbent position on a PTS Turbo 1000 recumbent ergometer. The protocol consisted of 2-minute stages and 50-watt increments. Paired sample *t*-test revealed no significant difference between  $\text{VO}_2$  max (UR =  $2.74 \pm .84$  l/min, R =  $2.60 \pm .78$  l/min); maximum heart rate (UR =  $179.8 \pm 7.9$  bpm, R =  $179.8 \pm 10.5$  bpm); and heart rate/ $\text{VO}_2$  slope (UR =  $.045 \pm .01$ , R =  $.047 \pm .01$ ). There was a significant difference ( $p < .05$ ) between maximum tidal volumes (UR =  $2290.0 \pm 760$  ml, R =  $2162.0 \pm 712.0$  ml). These findings suggest that although there is a difference in pulmonary mechanics resulting in a reduction in maximum tidal volume, exercising in a recumbent position should not have a negative effect on oxygen uptake and/or heart rate. Similar heart rate/ $\text{VO}_2$  slope characteristics would indicate that exercising on a recumbent cycle ergometer at an appropriate intensity, duration, and frequency will elicit the same aerobic training benefits as cycling in an upright position. Athletes suffering from pathologies aggravated by an upright cycling posture may find the recumbent position a viable alternative for maintaining cardiovascular condition.

### 33. The Effects of Serial Stretch Loading on Strength Gains When Performing the Dead Lift

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The purpose of this research was to determine if there was a difference in strength gains between a traditional lift (TL) method and a new lift method, serial stretch loading (SSL), when performing the dead lift. SSL is a technique whereby the subject has small eccentric loads superimposed into the movement in question, in this case the dead lift. The eccentric loads were created and controlled by a computer interfaced with a pullied weight stack and were applied every 0.15 sec throughout the entirety of the lift. The TL method was simply performing a dead lift using a pullied stack of weights. In this study, 20 male volunteers (age =  $23.4 \pm 1.8$  yr) were randomly assigned to one of two groups: the SSL group or the TL group. A 7-repetition maximum (RM) using the TL method served as pretest and 8 weeks posttest scores. Results show that the subjects performing the SSL lift increased their strength by an average of  $103.7 \pm 30.1$  lb and those performing the TL increased by an average of  $63.1 \pm 25.4$  lb. The difference in strength gains between the two groups was significant at the .05 level ( $F = 7.85$ ,  $p = .0143$ ). The researchers conclude that strength is enhanced by the superimposed eccentric loads. This is deemed important as most occupational and athletic injury is caused by some type of eccentric load, whether it be one maximal load or multiple minimal loads. And, if one can train or rehabilitate in a similar fashion, then the individual can gradually condition his/her body to respond appropriately, in an injury-free fashion, to pathologic eccentric loads. Follow-up research will continue with EMG and biomechanical analyses.



### 34. Effect of 25%, 50%, and 75% Maximal Voluntary Isometric Contraction Determined Preloads on Quadriceps Average Torque

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Studies examining the effect of preload on isokinetic torque have shown an increase in average torque values. Preload values may be set arbitrarily or as a percentage of a maximal voluntary isometric contraction. This study examined the effects of 25%, 50%, and 75% of the maximal voluntary isometric contraction on average torque values. Fifteen females (age=19.8±1.7 yr, ht=160.5±7.6 cm, wt=60.5±10.2 kg) with no previous history of knee injury participated in this study. Concentric and eccentric contractions of the quadriceps at 90°/sec with the three specific preload settings were evaluated. The range of motion included 100° to 10° of knee flexion. For concentric contractions, average torque values under three preload settings were 73.1 Nm, 77.5 Nm, and 79.5 Nm for the 25%, 50%, and 75% preloads, respectively. For eccentric contractions, average torque values were 85.1 Nm, 87.9 Nm, and 87.0 Nm for the 25%, 50%, and 75% preload settings. A repeated measures ANOVA found a significant difference between the 25% and 75% preload settings for concentric contractions ( $p < .05$ ). However there were no significant differences between the 25% and 50% and between the 50% and 75% preload settings for the concentric contractions. No significant differences were found for the eccentric contractions. These findings support previous studies that showed an increase in average torque with an increase in preload for concentric contractions. However, the failure to see an increase in eccentric average torque is in contrast to other studies. This suggests additional research is necessary to explain the different effects of these preload settings on concentric and eccentric average torque.

### 35. Effect of Cold Treatment on the Concentric and Eccentric Force Velocity Relationship of the Quadriceps

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This study examined the effect of cold treatment on the force-velocity relationship of the quadriceps muscle of 8 male and 8 female athletes (age=20.4±1.2 yr, ht=175.5±12.0 cm, wt=84.4±23.4 kg, bf%=15.6±4.7). Each subject performed 3 maximal concentric and eccentric quadriceps contractions on the Kin-Com at 25°, 50°, 75°, 100°, 125°, 150°, 175°, and 200°/sec in a rotated order, on two occasions separated by at least 72 hours. Prior to one of the testing sessions, all subjects received a 20-minute ice application (ice condition), and, for the second test session, no ice was applied (no ice condition). The results revealed that there was no significant change in the force-velocity relationship. A trend analysis revealed linear relationships for the concentric ice [ $F(1,15) = 82.2$ ] and no ice [ $F(1,15) = 44.9$ ] conditions as well as for the eccentric ice ( $F=38.6$ ) and no ice ( $F=26.4$ ) conditions. A Tukey post hoc test revealed no significant difference between the concentric ice and no ice conditions at any velocity, but did reveal that peak torque (PT) at 200°/sec was significantly different from PT at 25° to 100°/sec for the ice condition. For eccentric contractions, there was a difference between ice and no ice conditions, with an increase of 20% and 16% for the ice condition at 175° and 200°/sec, respectively. For the eccentric ice conditions across velocities, the PT at 200°/sec was significantly different from the PT at 125° to 200°/sec. This suggests that the application of ice will not decrease strength but may in fact result in an increase in eccentric strength.

### 36. Effect of Clinical Application of Heat and Cold on Knee Joint Laxity

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Although knee joint laxity has been well documented, the effects of temperature on laxity have not been previously studied. This study examined how clinical applications of heat and cold influence arthrometric laxity measurements of the knee. Fifteen subjects (8 males, 7 females; age=22.8±2.5 yr; ht=173.1±14.2 cm; wt=75.6±22.4 kg) were tested following 20 minutes of 40°C whirlpool (WP), 15°C WP, and no WP conditions in a counter-balanced order on separate days. Following each WP condition, subjects were positioned in a Tibial Fixator Device (Manufacture data) in tibial external rotation, internal rotation, and neutral. Subjects were tested in all three positions on each day. Displacement force to maximum manual displacement was measured using a modified KT-1000 knee arthrometer equipped with a strain gauge. Displacement forces were recorded at 1 mm increments until an end point was reached. Millimeters of displacement at 89N and maximal displacement forces were analyzed and are presented as mean±SD (see table below). Two mixed model analyses of variance tests (one for each of the two force conditions) were performed. No significant thermal effect was present ( $p > .05$ ). Tibial rotation significantly affected the amount of displacement ( $p < .01$ ). Scheffé post hoc analysis revealed that external rotation was greater than neutral and internal rotation respectively at the 89N displacement force and external rotation was equal to neutral and greater than internal rotation ( $p < .01$ ) at the maximum displacement force. This study found no evidence to suggest that clinical applications of heat or cold significantly alter knee laxity as assessed with the KT-1000 knee arthrometer. Rotation of the tibia does significantly affect the magnitude of displacement of the knee.

Displacement Force in 1mm Increment

Cond	ER89	ERMAX	N89	NMAX	IR89	IRMAX
No WP	4.1(2.0)	6.8(2.8)	3.5(2.1)	6.1(2.7)	3.1(2.1)	5.7(2.9)
15°C WP	4.2(2.1)	6.7(3.0)	3.8(2.0)	6.9(3.4)	3.3(1.4)	6.0(2.2)
40°C WP	3.8(1.9)	6.3(2.9)	3.4(1.7)	5.9(2.7)	2.7(1.5)	5.4(2.2)

### 37. Effect of Closed Chain Induced Fatigue of the Hip and Knee Extensors on Postural Sway

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This study examined the effect of lower extremity fatigue on postural sway using the Chattecx Balance System (Chattecx Corp, Hixson, TN). Sixteen male athletes from a military academy (age =  $18.6 \pm .36$  yr, ht =  $183.4 \pm 5.9$  cm, wt =  $89.9 \pm 14.4$  kg) volunteered and gave informed consent to participate in this study. All subjects were tested on the Chattecx Balance System for unilateral postural sway assessment measured in cm. Each subject was randomly assigned to one of two groups. Group 1 then performed closed chain fatiguing contractions on the Kin-Com isokinetic dynamometer (Chattecx Corp, Chattanooga, TN) while group 2 received no treatment. All subjects were then retested on the Chattecx for post-treatment balance assessment. All balance tests consisted of 5 separate 10-second measures: static, medial/lateral, inversion/eversion, anterior/posterior, and plantar/dorsiflexion. A repeated measures ANOVA was used to assess sway index (SI) for pre and post tests. No significant main effects for group [ $F(1,14)=1.3$ ,  $p=.27$ ], test [ $F(1,14)=.73$ ,  $p=.41$ ], and no test  $\times$  group interaction [ $F(1,14)=3.32$ ,  $p=.09$ ] were found. There were significant differences between movements [ $F(4,56)=21.26$ ,  $p<.01$ ], and group  $\times$  movement [ $F(4,56)=3.05$ ,  $p<.05$ ], and test  $\times$  movement [ $F(4,56)=3.48$ ,  $p<.01$ ] interactions were found. The test  $\times$  group  $\times$  movement interaction revealed no significant difference [ $F(4,56)=.31$ ,  $p=.87$ ]. The lack of a test  $\times$  group interaction suggests that closed-chain fatiguing contractions have no effect on balance measures. This suggests that the ankle musculature may play a more significant role in postural sway. Since the ankle musculature were minimally fatigued using this protocol, further research needs to be done to examine postural sway following induced fatigue to these muscles.

### 38. Effects of Forward and Backward Stair Stepping on Electromyographic (EMG) Quadriceps and Hamstring Characteristics

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An important aspect in anterior cruciate ligament (ACL) knee rehabilitation is incorporating a form of closed kinetic chain exercise that emphasizes strengthening of the vastus medius oblique (VMO) and hamstring muscles. The purpose of this study was to determine the EMG activity (root mean square and area under the wave values) for the quadriceps and hamstrings muscles during forward and backward stair stepping. Fifteen female subjects, with a mean age of 20.9, volunteered. EMG electrodes were applied to the vastus medius oblique (VMO), vastus lateralis (VL), and the biceps femoris (BF) of the subject's dominant leg. The subjects performed two trials of each exercise on a Stairmaster 4000PT set at manual resistance of level 5 with a rate of one step per second. The exercise was videotaped with a stationary shuttered camera to obtain knee range of motion. A repeated measures ANOVA revealed a significant difference ( $p<.03$ ) between forward and backward VMO and VL muscular EMG activity. Percent of contraction time statistical analysis indicated that there was a significant difference ( $p<.03$ ) between forward and backward stair stepping for the VL muscle. Forward and backward stepping Range-of-motion values were also significantly different ( $p<.05$ ). The results of this study suggest that forward and backward stair stepping involves different intensities of VMO, VL, and BF activity.

### 39. The Effects of Hip Rotation on Electromyographic Activity of the Lower Extremity Muscles During Stair Step Exercises

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The purpose of this study was to determine the difference in muscular involvement of the vastus medialis oblique, vastus lateralis, and biceps femoris muscles during the stair stepping exercise with three different hip positions. The positions were  $45^\circ$  of internal and external rotation and  $0^\circ$  of rotation. EMG analysis was used to determine the muscular involvement. Fifteen females participated in this study. Subjects were recruited on the basis of availability, lack of pathological knee conditions, and ability to perform the exercises without undue stress. Surface electrodes were placed on the subjects' quadriceps and hamstrings muscles, and electromyographic (EMG) data was collected as the subjects stepped on the Stairmaster under each of the experimental conditions. The speed of movement was controlled with a metronome set at 2 seconds per one complete movement. ROM motion was continually monitored (via video recording) to insure proper ROM during the entire exercise. The internal and external RMS values were calculated in terms of percent of no rotation. The RMS values indicated that the external rotation for the vastus medialis oblique, vastus lateralis, and the biceps femoris was 17.12%, 20.00%, and 18.75%, respectively, greater than no hip rotation, and the internal rotation was 14.86%, 6.25%, and 6.25%, respectively, greater than no hip rotation. Results of this study suggested that internal and external hip rotation would allow optimal muscular involvement of the vastus medialis oblique and vastus lateralis and biceps femoris muscles.



#### 40. Effects of a Five-Week Balance Training Protocol on Postural Sway and Lower Extremity Strength

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This study examined the efficacy of 5 weeks of balance training on knee and ankle strength and postural sway. Twenty-seven healthy university graduate and undergraduate students participated in this study (mean age =  $20.5 \pm 2.6$  yr, wt =  $69.3 \pm 8.5$  kg, ht =  $169.2 \pm 9.3$  cm). All subjects were free from injury to the tested extremity for a minimum of 1 year prior to the study. Subjects were randomly assigned to a training or control group. A 5-week training program was performed on the Stability Testing and Rehabilitation [STAR] Station (Spectrum Therapy Prod, Jasper, MI). This device is an ellipsoidal board mounted on a shaft that permits a combination of plantar flexion, dorsiflexion, inversion, and eversion movement patterns. Pressure around the periphery of the board was recorded by 120 switches. Visual feedback was provided regarding the load and position of the board on the platform. The training protocol progressed in difficulty by increasing the number of repetitions and the height of the board in 1.5 cm increments. Pre and post testing included assessment of concentric and eccentric average torque on a Kin-Com II dynamometer (Chattecx Corp, Hixson, TN) at 60°/sec for knee flexion/extension and 30°/sec for ankle plantar/dorsiflexion. Balance was measured as postural sway (SI) in centimeters by the Chattecx Balance System (Chattecx Corp, Hixson, TN). Postural sway was assessed under static and dynamic conditions for the right and left extremity. Repeated measures analysis of variance found no training effect for any of the strength and postural sway ( $p > .05$ ) measures. These findings suggest that 5 weeks of training on a balance board have no effect on postural sway and lower extremity strength in noninjured subjects. Future research is needed to access the effects of a similar training protocol in an injured population.

#### 41. Reliability and Validity of Kin-Com Ankle Inversion and Eversion Torque Measurements

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This study examined the test-retest reliability of a prototype device used to measure ankle inversion and eversion isokinetic average torque (AT). Concentric (CON) and eccentric (ECC) average torque were assessed at 90°/sec on the Kin Com II dynamometer using 14 healthy subjects (3 men and 11 women, age =  $21 \pm 3.3$  yr, ht =  $170 \pm 11.5$  cm, wt =  $69.5 \pm 8.9$  kg) in two sessions. Retesting occurred with no more than 10 days between sessions. The ankle was placed in 10° of plantar flexion, while the hip and knee joints were slightly flexed. A specially built plinth was used to position the subjects for testing. A manufactured prototype ankle inversion/eversion attachment device was used on the Kin-Com II dynamometer for testing these two ankle motions. It contained a completely redesigned adapter surface that was rounded to match the Kin-Com II load cell surface. The original design consisted of a square female adapter surface, which, when attached to the round load cell, created areas of nonuniform pressure. This subsequently produced errors in measurement. Following a brief warm-up, subjects performed three maximal test repetitions. The results showed average torque values ranging from 98.2 Nm to 172.5 Nm for inversion motions, and 85.5 Nm to 162.3 Nm for eversion motions. Reliability was assessed by performing separate intraclass correlations (ICC 2,1) on the results. Inversion ICC values ranged from .71 to .91, while the eversion ICC values ranged from .69 to .89. The results on average torque measurements ranged from fair to excellent. However, the validity of this prototype device to accurately measure average torque for these two ankle motions is questionable. These data indicate that the average torque calculated from the clockwise direction was consistently higher than those values from the counterclockwise direction, regardless of ankle movement or side measured. This finding demonstrates a situation where the measures appear to be reliable, while the validity of the device used to obtain the measures is suspect. Further study is needed to explore the issue of validity with this type of isokinetic testing apparatus.

#### 42. The Effect of Silicate Gel Hot Packs on Human Muscle Temperature

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Hot packs are among the most commonly used therapeutic modalities in sports medicine, yet there is little information pertaining to muscle temperatures obtained during treatment. The purpose of this study was to investigate the effects of a 15-minute hydrocollator heat pack treatment on the temperature of the human gastrocnemius muscle. The hot packs consisted of a canvas bag filled with a hydrophilic silicate, placed in a standard 6-ply terry cloth envelope. The hot packs were kept in a thermostatically controlled cabinet filled with water at a temperature of 75°C. Twenty-two subjects had two 23-gauge needle microprobes (Phystek MT-23/5, Physitemp Instruments, Clifton, NJ) inserted into the medial aspect of the anesthetized muscle at 1 and 3 cm below the subcutaneous/muscle interface. Data were collected on each subject for one of two randomly assigned treatments: a) 15-minute hot pack treatment; or b) 15-minute sham hot pack treatment (control). Temperature readings were recorded at 30-second intervals. At 1 cm depth, the sham pack increased temperature  $.2^\circ \pm .4^\circ\text{C}$ , while the hot pack increased it  $3.6^\circ \pm .1^\circ\text{C}$ . At 3 cm depth, the sham pack caused a reduction in temperature ( $-.3^\circ \pm .2^\circ\text{C}$ ) and the hot pack increased the temperature of the muscle  $.8^\circ \pm .6^\circ\text{C}$ . The change in peak temperature at 1 and 3 cm was analyzed using a 2-way ANOVA with repeated measures, and significance was set at the .05 level. At 1 cm, we found a significant difference between the hot pack and the sham pack treatment. At 3 cm, no significant difference was found between the two treatments. Based upon our findings, we consider hot packs to be a viable form of therapeutic heat for both superficial and shallow intramuscular depths. When vigorous heating (an increase of  $>3^\circ\text{C}$ ) is warranted at depths  $\geq 3$  cm, silicate gel hot packs are ineffective.

#### 43. The Stretching Window Revealed: Rate of Heat Loss in Human Muscle Following 3 Megahertz Ultrasound

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When therapeutic ultrasound vigorously heats tissues, it can increase extensibility of collagen affected by scar tissue. These findings give credence to the use of continuous thermal ultrasound to heat tissue prior to stretching, exercise, or friction massage in an effort to decrease joint contractures and increase range of motion. Prior to our investigation, it was not known how long following an ultrasound treatment, the tissue will remain at a vigorous heating level ( $>3^{\circ}\text{C}$  above baseline). We conducted this study to determine the rate of temperature decay following ultrasound in order to determine the time period of optimal stretching. Twenty subjects had a 23-gauge hypodermic needle microprobe inserted 1.2 cm deep into the medial aspect of their anesthetized triceps surae muscle. Subjects then received a 3MHz ultrasound treatment (Omnisound 3000, Physio Technology Inc, Topeka, KS) at  $1.5\text{ W/cm}^2$  until the tissue temperature was increased at least  $5^{\circ}\text{C}$ . The mean baseline temperature prior to each treatment was  $33.8^{\circ}\pm 1.3^{\circ}\text{C}$ , and it peaked at  $39.1^{\circ}\pm 1.2^{\circ}\text{C}$  from the ultrasound. Immediately following the treatment, we recorded the rate at which the temperature dropped at 30-second intervals. We ran a stepwise nonlinear regression analysis to predict temperature decay as a function of time following ultrasound. We found a significant nonlinear relationship between time and temperature decay ( $r=.99$ ,  $r^2=.99$ , SE of estimate=.06). The time that it took for the temperature to drop each degree as expressed in minutes and seconds was:  $1^{\circ}\text{C}=1:20$ ;  $2^{\circ}\text{C}=3:22$ ;  $3^{\circ}\text{C}=5:50$ ;  $4^{\circ}\text{C}=9:13$ ;  $5^{\circ}\text{C}=14:55$ ;  $5.3^{\circ}\text{C}=18:00$  (baseline). We measured the temperature change at 1.2 cm depth, since this is about how far below the surface many tendons and ligaments lie, and this is an appropriate target depth for 3 MHz ultrasound. We conclude that under similar circumstances where the tissue temperature is raised  $5^{\circ}\text{C}$ , stretching will be effective, on average, for 3.3 minutes following an ultrasound treatment. To increase this stretching window, we suggest that stretching be applied during and immediately after ultrasound application. Our research has uncovered the critical time period regarding when stretching can occur as a part of ultrasound therapy. This will enable clinicians to effectively increase joint ROM due to adhesive capsulitis, tendinitis, and joint contractures.

#### 44. Biotran (Fastex) Reliability in Measuring Balance and Dynamic Movement, and Validity in Measuring Vertical Jump

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The Biotran (Impulse Technology, Inc), known as the Fastex (Cybex, Inc), is used clinically to test and rehabilitate lower extremity functional deficits. There is little documented research examining its reliability and validity. Two studies assessed its reliability and/or validity in measuring balance and dynamic movement. Data for both studies were collected on the Biotran interfaced with a 386 computer. All testing followed established protocols recommended by Impulse Technology, Inc. **Study 1** used a test-retest design to assess the reliability of specific functional tests: 1) the single-leg stance stability test measured by the average stabilization index [ASI] and 2) the single-leg, forward movement linear plyometric hop test measured by average ground time [AGT] and average transit time [ATT]. Fourteen university students (11 females, 3 males) volunteered and gave informed consent. Subjects were considered healthy and had reported no lower extremity injury within the past year. They performed four trials per leg (dominant first; then nondominant) for each of the two functional tests. Subjects were retested 1 week later. Intraclass correlation coefficients (ICC) were computed for the right (R) and left (L) leg measures for each test-retest variable. Results revealed single-leg stance stability tests moderately reliable for the right and left legs (RASI: $r=.77$ ; LASI: $r=.77$ ). Forward movement, linear plyometric hop test was moderately reliable (RATT: $r=.78$ ; LATT: $r=.50$ ; RAGT: $r=.84$ ; LAGT: $r=.55$ ), with right leg measures slightly more reliable than left leg. **Study 2** used a crossover research design to examine the relationship between vertical jump height with the Biotran and the Vertec (Senoh). Subjects were 23 high school athletes (3 females, 20 males) aged 16 to 18 years. They performed 4 jumps on each device. Results indicate highly correlated vertical jump measures with Biotran and Vertec ( $r=.8209$ ) with Biotran measures consistently lower than Vertec (Biotran  $\bar{x}=18.09\pm 3.73$ ; Vertec  $\bar{x}=22.13\pm 4.38$ ). However, a paired *t*-test showed vertical jump measures obtained with Biotran and Vertec significantly different. Therefore, Biotran may not provide accurate measure for vertical jump height. These two preliminary studies examined either the reliability or the validity of only four of the Biotran measurement variables as they were used in three specific Biotran functional tests. Further research is needed to examine the reliability and validity of the other Biotran measurement variables and functional tests.

#### 45. Reliability of the BTE Dynatrac Isotonic Dynamometer

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The BTE Dynatrac is a new generation dynamometer where the preset resistance determines the effort, and where the limb must overcome the resistance to accelerate through the ROM. Previous reliability studies of isokinetic devices do not apply to this type of dynamometer. Therefore, the purpose of this study was to assess the reliability of the BTE Dynatrac Isotonic Dynamometer using average work and power to determine whether the Dynatrac is capable of producing consistent results under different preset loads and between exercise sessions. Twenty-nine ( $M=19$ ;  $F=10$ ) recreational active college students ( $\text{age}=23.0\pm 3.8\text{ yr}$ ;  $\text{wt}=79.5\pm 18.9\text{ kg}$ ;  $\text{ht}=175.7\pm 9.5\text{ cm}$ ) underwent identical testing on 3 occasions. On a day prior to testing, peak torque was measured during a 6-second maximal voluntary isometric contraction (MVIC) at  $70^{\circ}$  of knee flexion. This value determined the preset loads used for the 3 isotonic testing sessions. During the isotonic sessions, each subject performed 6 repetitions of maximal knee extensions at preset loads (20%, 40%, and 60% of MVIC) through a  $90^{\circ}$  ROM. The order of testing on each of the 3 days was determined by using a balanced Latin Square. Average work (joules) and power (watts) were recorded and analyzed with Intraclass Correlation Coefficients (ICC (2,1)). The reliability of average power measurement was excellent regardless of the preset load (20% MVIC=0.82; 40% MVIC=0.83; and 60% MVIC=0.90). The reliability of average work measurement was excellent at 60% MVIC(0.86) and 40% MVIC(0.80), but only fair at 20% MVIC (0.57). We conclude that clinicians can be confident in comparing average power measurements between sessions regardless of the preset load, and for average work at the moderate to higher preset loads. Be cautious when comparing average work between sessions at lower preset loads. This study was supported by Baltimore Therapeutic Equipment Company.



#### 46. Force Perception at the Ankle Following Heat and Cold Applications

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The ability to perceive forces (barognosis) presented to a joint is essential during sport participation. Barognosis may be altered by thermal modalities due to changes in nerve conduction characteristics. The purpose of this study was to determine if cryotherapy or thermotherapy would affect the ability to perceive forces applied to the ankle. Thirty volunteer students (ages 18 to 30) served as subjects. Initial 20-minute treatment consisted of either 1°C ice immersion, 40°C warm bath, or a rest period. Subjects' right ankles were then positioned on an ankle exerciser in an everted position. After a specific weight was placed on the machine (weight 1), the subject eccentrically lowered the weight for a count of three. The weight was then removed, the ankle was placed in its original position, and the task was repeated. The weight (weight 2) was then changed and two repetitions were performed as with the first weight. The subject was asked to identify which weight, 1 or 2, was the heavier one. Subjects made 5 weight comparisons during each of the 3 days of testing. The number of correct responses made following each therapeutic intervention were compared using a one-way, repeated measures ANOVA. Barognosis was the same following cooling, heating, and control. We concluded that the ability to perceive differences in small forces presented to the ankle is unaffected by cold and heat. Therefore, cryotherapy and thermotherapy can be used prior to active exercise without loss of barognosis at the ankle.

#### 47. A Comparison of Isokinetic and Isotonic Predictions of a Functional Task

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Controversy still exists regarding the use of isokinetic and isotonic exercise in rehabilitation. Many studies have compared these two types of training methods on various strength measures and functional activity, but have focused on open kinetic chain training. The purposes of this investigation were to determine: 1) which form of closed kinetic chain training, isokinetic or isotonic, would produce the greatest increase in one-legged jump reaction force; and 2) which training method most accurately predicts peak force produced during a one-legged jump. Forty-two legs from 21 female volunteer subjects were used. Each subject had her dominant and nondominant extremities identified, and each extremity was randomly assigned to either isokinetic training, isotonic training, or control. Both training groups trained using a leg press exercise 3 days a week for 5 weeks, while the control extremities did not train. The isokinetic extremities were trained using a velocity spectrum (2 sets of 10 repetitions at each speed: 60°, 180°, and 240°/sec) and the isotonic extremities trained using the DAPRE technique. One-legged jump force change was not different for the three groups ( $F(2,36)=.274$ ,  $p=.737$ ). Both isokinetic ( $t(24)=5.8$ ,  $p<.0005$ ) and isotonic ( $t(26)=9.5$ ,  $p<.0005$ ) groups increased strength after training, but these changes did not correlate with changes in one-legged jump reaction force ( $r=.134$ ,  $p=.66$  and  $r=-.470$ ,  $p=.09$ , respectively). These results suggest that changes in neither isokinetic force nor isotonic weight lifted, developed in a nonweight bearing closed kinetic chain, directly translate into increased force production during a functional activity.

#### 48. Learning Effects and Reliability of the Biodex Stability System

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Balance training can be a valuable tool in the rehabilitation of athletic injuries providing that a reliable method is used to carry out this task. The purpose of this study was to establish the reliability of testing over multiple trials, subsequent to negating the effects of learning, on the Biodex Stability System. Subjects included 20 college-aged students. Stability indices were obtained under 3 conditions: bilateral stance, dominant single-leg stance and nondominant single-leg stance at two stability levels: level 2 and level 8. Subjects were tested without footwear and stood on the Biodex Stability System platform in a comfortable position. Foot position coordinates were recorded for consistency between trial tests. Subjects' arms were folded across their chests and knees were flexed approximately 10 to 15°. All tests were performed with the subjects' eyes open. Subjects were instructed to maintain a level platform for a duration of 20 seconds for each test. The order of the tests were randomized. Prior to the three test trials, one familiarization trial was performed at each condition and stability level. Two familiarization trials were performed for bilateral stance level 2. The familiarization trials were selected to negate any learning effects. A one-way analysis of variance with repeated measures was employed to establish statistical mean differences between the three test trials. Intraclass correlation coefficients were then calculated to determine reliability between the three test trials under each condition at both stability levels. There were no significant mean differences revealed between any of the test trials under the 6 conditions. Intraclass correlations (ICC 1,1) for each of the 6 conditions were: dominant single level 8 (ICC=0.95), nondominant single level 8 (ICC=0.78), bilateral stance level 8 (ICC=0.71), dominant limb level 2 (ICC=0.60), nondominant limb level 2 (ICC=0.60), and bilateral stance level 2 (ICC=0.85). The Biodex Stability System appears to be a highly reliable assessment device across multiple test trials in healthy individuals. It is recommended that subjects perform two trial tests for the purposes of instrument familiarity prior to data collection to ensure learning effects are negated, regardless of the test condition.

#### 49. Relationship Between Muscle and Balance Performance as a Function of Age

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Aging is associated with decreases in strength and muscle mass. Also, the ability to maintain balance decreases with age. Few studies have examined the relationship between isokinetic muscle performance and static and dynamic balance performance. The purpose of this study to determine if there is a relationship between muscle and balance performance, and to discover how this relationship is affected by age. Fifty-five healthy females were recruited from two different age groups, 28 females, 18 to 30 years of age (mean age=22.9 yr, ht=163.5 cm, wt=64.8 kg) and 26 females >60 years of age (mean age=68.1 yr, ht=159.7 cm, wt=68.0 kg). Concentric and eccentric isokinetic muscle performance for the hip, knee, and ankle were measured using the Kin-Com isokinetic dynamometer. Balance performance was measured subjectively using the sharpened Romberg and one-legged stance tests. Static and dynamic objective balance performance were measured using the Chattecx Balance System. Younger subjects performed significantly better than older subjects on all muscle and balance performance variables ( $p=.05$  to  $p=.0001$ ), except the sharpened Romberg test with the eyes open and the double-leg static test. The older group exhibited significant relationships between subjective balance and muscle performance measures ( $r=-.10$  to  $r=.57$ ). The younger group exhibited significant relationships between objective balance and muscle performance measures ( $r=-.01$  to  $r=-.49$ ). In the older group, hip muscle performance correlated significantly better with subjective balance performance than knee or ankle muscle performance. Ankle muscle performance correlated significantly better with objective balance performance measures than knee muscle performance. Similarly, in the younger group, hip muscle performance correlated significantly better with objective balance performance than knee or ankle muscle performance. Also noted was a significantly greater relationship between muscle performance and subjective balance performance with the eyes closed in the older group, as compared to the younger group. This is the first study known to thoroughly examine the relationship between muscle and balance performance. The presence of significant relationships warrants further examination. It is recommended that this relationship be examined in a broad spectrum of young, old, healthy, and disabled populations.

#### 50. The Effect of the Pro-Stim™ Edema Management System on Cutaneous Cooling

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A common technique used to control the magnitude and duration of edema associated with acute athletic injury is the simultaneous administration of ice, compression, and cathodal direct current electrical stimulation. To make this simultaneous treatment both simple and more effective, the Pro-Stim Edema Management System (Mfg Info) was developed. The system is predicted to be more effective because the electrodes are incorporated into the fabric of the ice pack, and therefore provide little insulation from the cold. The purpose of this study was to test the effectiveness of the Pro-Stim System on cutaneous cooling by comparing it to conventional methods of ice and electrical stimulation application. Twelve subjects (age=21.8±1.2 yr, ht=170.9±9.4 cm, wt=64.4±11.9 kg) received the ice portion of the two experimental conditions for 5 minutes before and after treatment, and during 30 minutes of treatment. Cutaneous temperatures were monitored at two sites during the ice treatment; one under the electrode and one away from the electrode. Physitemp skin surface probes (Model SST-1, Mfg Info) interfaced to Physitemp digital monitoring thermometers (Model TH-8, Mfg Info) were used for measurements. Temperature data were analyzed using a 2 × 2 (method × location) ANOVA with repeated measures on both factors. The administration of ice resulted in a rapid decrease in temperature for all conditions. However, the temperature under the electrode with the Pro-Stim System was significantly lower throughout the treatment period than the temperature under the electrode with the conventional system ( $p<.05$ ). Thus, the Pro-Stim System provides a more thorough cooling of the tissue being treated during the application of electrical stimulation. Further research should be done to test the Pro-Stim Edema Management System on the treatment of injuries resulting in the formation of edema.

#### 51. Intratester Reliability of the Star Station Excursion to Assess Dynamic Balance

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The purpose of this study was to determine the intratester reliability of the Star Station Excursion Test to assess dynamic balance. This test requires the subjects to stand on one leg and reach with the other leg along preexisting lines without touching the ground. Two lines perpendicular to each other and at 45° with respect to the subject allow the subjects to reach in the following four directions: right anterior (RA), left anterior (LA), right posterior (RP), and left posterior (LP). After reaching out, the subject must then return to the starting position without touching. A small horizontal box represented the starting position. The distance from the starting position to the excursion point was then recorded as a percentage of leg length. Twenty subjects participated in this study after giving informed consent. An athletic trainer experienced in the administration of the test collected the data. Each subject performed five trials for each direction. They repeated this process 7 days later. Pre and post directional scores were then averaged: preRA ( $\bar{x}=.82$ ), postRA ( $\bar{x}=.83$ ), preLA ( $\bar{x}=.80$ ), postLA ( $\bar{x}=.85$ ), preRP ( $\bar{x}=.90$ ), postRP ( $\bar{x}=.95$ ), preLP ( $\bar{x}=.89$ ), and postLP ( $\bar{x}=.91$ ). Intraclass correlation coefficients (ICC) (2,1) were poor to moderate ( $R=.63$  to  $.85$ ). The ICC and the standard error measurement for the four directions were RA=.63 (.01), LA=.83 (.01), RP=.79 (.02), and LP=.85 (.02). These results suggest that variability within subjects exists during this test. We conclude that this test should not be used as a tool to evaluate dynamic balance. Clinicians should not disregard this protocol because it may serve as an activity to aid in the rehabilitation of lower extremity injuries.



## 52. Managing Exercise-Induced Asthma

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In December 1994, the United States Olympic Committee sponsored an Exercise-Induced Asthma (EIA) Summit to develop guidelines for managing EIA. Participants included physicians, athletic trainers, elite athletes with asthma, and pharmacologists. This report summarizes our findings. EIA affects 10% to 15% of the population and probably the same proportion of athletes; 11% of the 1992 US summer Olympic team and 13% of the medal winners suffered from EIA. There is a stigma attached to EIA, and many young people may be discouraged from participating in sport because of parents', teachers', and coaches' ignorance concerning the disease. The exact mechanisms by which EIA occurs are unknown, but the consequences are airway narrowing. Athletic trainers can assist in screening for EIA by ensuring that PEFR is measured during physical exams so that baseline measures are available for future comparison. Such measures can be made with an inexpensive (<\$25) spirometer. Athletic trainers should carry a spirometer in their trainers' kit for use during an exercise-induced attack (labored breathing/shortness of breath, feeling out of shape, tired, fatigued, chest tightness, wheezing, pain). Although many of these signs are identical to lack of conditioning, a 15% decrease in PEFR indicates airway narrowing and EIA. The primary goal of therapy is to prevent airway narrowing. There are various drug-free approaches for controlled situations, but pharmacologic intervention is necessary for more effective control in most athletes. All drugs shift the exercise dose response curve to the right. The key is to find the right drug (or combination of drugs) and dosage for the particular athlete and exertion level (dose) required for his/her sport. Inhaled Beta agonist are the first choice drugs. Cromolyn & Nedocromil are good adjuncts, but are not too effective if used alone. Through physician-monitored trial and error, athletes can learn to control their EIA and thus fully participate at their otherwise normal level.

## 53. Concentric and Eccentric Shoulder Strength Evaluation of College-Aged Females

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The purpose of this study was to compare shoulder concentric and eccentric peak torque (PT) values of college-aged females. Foot-pound (ft-lb) strength of the dominant (DOM) and nondominant (ND) extremities of 23 subjects (age =  $19.0 \pm 1.6$  yr; wt =  $64.7 \pm 15.6$  kg; ht =  $163.8 \pm 7.6$  cm) were tested concentrically (CON) and eccentrically (ECC) at  $60^\circ/\text{sec}$  on a Biodex® 2000 isokinetic dynamometer for the flexor (FLEX), extensor (EXT), abductor (AB), adductor (AD), horizontal abductor (HAB), horizontal adductor (HAD), external rotator (ER), and internal rotator (IR) muscle groups. For each test situation, 3 submaximal and 3 maximal contractions were performed prior to a 3 maximal contraction test. The windowed data produced by Biodex's® Advantage Software Package were used for interpretation. After separately averaging CON and ECC PT values produced by each muscle group, a paired student *t*-test was used to compare CON vs CON and ECC vs ECC PT production of identical muscle groups of the DOM and ND extremities.

### ECC PT PRODUCTION (ft lbs)

GROUP	DOM	ND	<i>p</i>
FLEX	24.9 ( $\pm 4.8$ )	22.3 ( $\pm 4.9$ )	.001
EXT	37.0 ( $\pm 8.3$ )	34.0 ( $\pm 7.7$ )	.001
AB	21.3 ( $\pm 4.7$ )	17.8 ( $\pm 4.5$ )	.001
AD	27.1 ( $\pm 6.6$ )	25.5 ( $\pm 6.5$ )	.25
IR	20.7 ( $\pm 4.3$ )	19.5 ( $\pm 5.0$ )	.16
ER	12.8 ( $\pm 3.2$ )	12.4 ( $\pm 4.3$ )	----
HAB	24.6 ( $\pm 7.5$ )	24.8 ( $\pm 6.8$ )	----
HAD	22.8 ( $\pm 5.6$ )	19.4 ( $\pm 5.4$ )	.001

### CON PT PRODUCTION (ft lbs)

GROUP	DOM	ND	<i>p</i>
FLEX	19.9 ( $\pm 4.0$ )	20.6 ( $\pm 4.1$ )	.28
EXT	28.9 ( $\pm 5.8$ )	27.6 ( $\pm 6.4$ )	.2
AB	16.3 ( $\pm 4.1$ )	16.4 ( $\pm 3.7$ )	----
AD	23.2 ( $\pm 6.4$ )	20.2 ( $\pm 5.8$ )	.001
IR	16.0 ( $\pm 3.9$ )	15.4 ( $\pm 4.0$ )	.16
ER	10.4 ( $\pm 2.9$ )	10.4 ( $\pm 2.8$ )	----
HAB	21.5 ( $\pm 6.1$ )	18.9 ( $\pm 7.0$ )	.001
HAD	17.0 ( $\pm 3.5$ )	16.6 ( $\pm 3.4$ )	.3

## Notes



## Free Communications, Oral—Observational Studies

Friday, June 16, 8:00 - 9:30

### Assessment of the Need for Certified Athletic Trainers in New York State High Schools

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The purpose of this study was to assess the need for NATA-certified athletic trainers in New York State high schools. Questionnaires were mailed to all 1054 public, private, and parochial high schools in New York State. A total of 603 questionnaires were returned for a response rate of 57%. Five hundred forty-one respondents (90%) reported a need for certified athletic trainers at the high school level. Four hundred sixty-seven respondents (77%) reported that the NATA-certified athletic trainer was the person most qualified to prevent and treat athletic injuries. In high schools where a certified athletic trainer was not employed, the individual coach was responsible for health care at 454 (75%) and 456 (75%) schools for boys and girls varsity practices, respectively. Two hundred forty-six of the non-NATA personnel (51%) had a basic first aid course as their only training for treating athletic injuries. Eighty-four athletic trainers (14%) were employed in high schools by using the contract services of local physical therapy/sports medicine centers. Only six high schools (1%) in New York State employed an NATA-certified athletic trainer on a full-time basis and 132 (22%) high schools employed NATA-certified athletic trainers on a part-time basis. Four hundred thirty-eight respondents (75%) expressed concern relative to litigation involving athletic injuries. Two hundred seventy-six schools (46%) had been involved in litigation due to serious athletic injuries. Three hundred twenty-four of the respondents (54%) noted their school districts would not be hiring certified athletic trainers in the near future. Budgetary constraints were the most commonly cited reasons that NATA-certified athletic trainers would not be hired. There are over 170,000 male and female high school students who participate in interscholastic sports in New York State. Based on the findings of this study, there are approximately 155 NATA-certified athletic trainers employed in New York State high schools in some capacity. The ratio of 1 NATA-certified athletic trainer for every 2,000 high school athletes is too low. High school athletes in New York State are not being provided adequate health care according to these figures.

### In Search of Comparable Statewide High School Sports Injury Data: Pennsylvania Athletic Trainers' Society, Inc Injury Reporting System (PIRS)

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As the number of competitive sports in senior high schools has increased, injury occurrence has become accepted as a natural risk of sports participation. Yet, injuries constitute major expenses in interscholastic athletics. As injury costs (ie, personal injury insurance, school coverage policies, etc) continue to escalate, the cost-benefit ratio assumed by school districts for athletic programs has been questioned. What cannot be disputed is that injury reduction, particularly severe injuries, will eventually stabilize or reduce these costs. Sports injury surveillance can help preserve the diversity of organized high school athletics by monitoring injury-associated factors and costs. Various sports injury surveillance programs have been tried but maintenance costs and declining compliance have resulted in waning use. Also, because surveillance systems have varied operational definitions, target populations, data collection methods, and length of coverage there is little comparable local, regional, or national data. The National Institutes of Health and the Centers for Disease Control acknowledge a need to gather comparable injury data at the national and regional levels. Thus, there is a need for a standardized method of high school sports injury surveillance to monitor temporal trends in injury and identify associated risk factors. Data collection is essential to any surveillance system and the ATC is the ideal source for ongoing high school sports injury data collection in a cost-effective manner. PIRS was initiated in the 1994-95 school year to develop a uniform statewide surveillance for the consistent ongoing acquisition of high school sports-injury data. ATCs providing coverage of 10 sports at 134 Pennsylvania high schools (20% of the school districts and 33 of 67 counties) volunteered to participate. Data collection instruments were adapted from previous experiences in Iowa (NATA) and Syracuse, NY (SSIRS). A 1-page scannable injury incident form streamlined to minimize data entry costs and enhance compliance is used. Exposure is quantified by documenting the participation days for each athlete in each sport. Evaluation of the system's success will center on compliance and cost-effectiveness of obtaining statewide data using minimal resources and manpower. This system has important implications for the ATC in national sports injury monitoring.

### Football-Helmet Fitting in Wisconsin Schools

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Experience of the authors suggests that high school coaches use varied methods for fitting football helmets. The purpose of this study was to evaluate if there was a difference in the quality of football helmet fit based on who fit the helmet. Sixteen hundred seventy-one high school football players from 33 randomly selected public high schools in Wisconsin were chosen for this study. Helmets were evaluated for correct fit by 13 certified athletic trainers during the first week of practice with consent from the head coach. Helmet fit was assessed by examining 7 specific criteria selected from standardized helmet-fitting guidelines. The criteria selected were: 1) 1" clearance above the eyebrows, 2) 2" clearance from nose to face mask, 3) chin strap aligned and tight, 4) jaw pads snug to face, 5) ear holes aligned, 6) coverage of the posterior cranium, and 7) minimal anterior/posterior movement with pressure. Each criteria was visually and manually inspected while the helmet was being worn. The player was then questioned as to who fit the helmet for him. Helmet fitting personnel were grouped as Coaches (n=1053), Self (players who fit their own helmet; n=419) and Other (n=199). Results of this inspection found 3403 total fitting errors for an average error per helmet of  $2.04 \pm 1.4$ . No significant difference ( $p < .05$ ) was found in the average error per helmet between Coaches ( $2.11 \pm 1.37$ ) and Self ( $2.18 \pm 1.42$ ). Personnel grouped as Other (mostly staff or outreach ATCs) had an average error per helmet of  $1.31 \pm 1.21$ , which was significantly less ( $p < .05$ ) than Coaches or Self. The most common error in helmets fit by Coaches (44.6%) and Other (41.2%) was 1" clearance above the eyebrows. The most common error in self-fit helmets (48.4%) was having the chin strap centered and tight. Helmets fit by Others had much lower error frequencies than coaches and players for the following criteria: chin strap centered and tight, jaw pads snug to face, and minimal anterior/posterior movement with pressure, which suggests that these personnel more closely followed the fitting guidelines of helmet manufacturers. The least common error for all fitting personnel was adequate coverage of the posterior cranium which was 2.9% overall. Further study in football helmet fitting is warranted.

### Anabolic-Androgenic Steroid Use Among California Community College Student-Athletes

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This original research was completed to determine the incidence of anabolic-androgenic steroids (AAS) use among a random, stratified, cluster, sample of California Community College student-athletes, to compare AAS users and AAS nonusers demographically, psychographically, and sociographically, as well as to describe the AAS usage patterns among the identified AAS users. Using an anonymous, 27-item, valid, and reliable instrument, student-athletes ( $n=1185$ ) from ten institutions statewide were surveyed during the 1992-93 academic year. Data were collected and descriptively analyzed. Results indicated that 3.27% of all student-athletes sampled were AAS users. Gender-specific incidence rates were 4.19% for males and 1.17% for females. AAS users tended to be older males, usually in their second (academic and athletic) year of college. They were committed to strength training, both in hours per week and in previous years in this type of exercise. The AAS users were more often minorities, and often trained at bodybuilding type gyms. They believed that they were knowledgeable about AAS, and that the rates of AAS usage was higher than reported. Sources of AAS information were often lifting partners and fellow athletes. Usage of these drugs was frequently done using multiple AAS at a time. The average number of cycles completed was 2.9, while the average cycle lasted 6.7 weeks. A wide variety of AAS was used by the student-athletes, of which most were obtained from black market sources. Results indicated that use of AAS among California Community Colleges student-athletes were similar to other previous research studies involving high school, college, and university student-athletes.

### The Effect of an Upper Respiratory Infection on Physiological Responses During Graded Exercise Testing

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Upper respiratory infection (URI) may cause more frequent acute disability among athletes than all other diseases combined. The purpose of this study was to determine to what extent an URI would influence maximal and submaximal physiological exercise responses. Twenty-four men and 21 women (18 to 29 years) of varying fitness levels were assigned to the experimental group (URI) while 10 additional individuals served as a control group (CRL). An initial serological screening was performed on all experimental group subjects to exclude those with the rhinovirus 16 (RV16) antibody. Exercise testing to volitional fatigue was performed before and after subjects were infected on two consecutive days with the RV16 virus. The second graded exercise test for the URI subjects was completed at the peak of illness (day following inoculations). The control subjects performed graded exercise tests 1 week apart. ANOVA IDENTIFIED no significant differences ( $p < .05$ ) at minutes 2, 5, and 8 for the physiological responses measured between the pre- and post-exercise tests for both the URI and CRL groups. Furthermore, there were no significant differences between maximal exercise performance between running trials for either group. In conclusion, physiological responses to submaximal and maximal exercise do not appear to be altered by an URI. (Supported by NIH HL 50123.)

### A Survey of Athletic Trainers as Health Care Advocates for Testicular and Breast Self-examination in Athletic Populations

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The purpose of the study was to survey athletic trainers about their educational practices regarding: 1) breast/testicular cancer, 2) breast/testicular self-examination (BSE and TSE), 3) breast/testicular concerns of athletes, and 4) the incidence of breast/testicular cancer among athletes in their care. The present study is particularly significant because there have been no previous studies with athletic trainers in these areas. Subjects ( $n=100$ ) for the study were athletic trainers attending the 1994 National Athletic Trainers' Convention. Responses were received from 76 athletic trainers (42 male, 34 female). The majority of respondents ( $n=69$ ) were certified athletic trainers. A researcher developed questionnaire was randomly distributed to athletic trainers in attendance at the convention. Basic statistics (frequency, mean, median, mode, and percentages) were used to analyze the data. Most athletic trainers ( $n=63$ ) **do not educate** female athletes regarding breast cancer. Most ( $n=62$ ) **do not educate** male athletes regarding testicular cancer. BSE ( $n=69$ ) and TSE ( $n=68$ ) were also found **not to be taught** to athletes. The incidence of male athletes with reported testicular concerns ( $n=37$ ) was higher than the incidence of female athletes ( $n=17$ ) with reported breast concerns. A glaring find was that more than one third ( $n=20$ ) of the athletic trainers reported having worked with athletes who had cancer; this alone should emphasize the need for education. Athletic trainers did not know at what age males are most susceptible to testicular cancer, nor did they know at what age females are most susceptible to breast cancer. The athletic trainers surveyed did not know (nor could they accurately describe) the breast or testicular self-examination techniques. The athletic trainers also did not know the risk factors for breast or testicular cancer. The conclusions of this study are that athletic trainers need to become more involved in (BSE) education of female athletes and (TSE) education of male athletes. Recommendations are for advocacy among athletic trainers and other health educators in educating athletes regarding breast and testicular self-examination.



### The Relationship Between Knee Hyperextension and Articular Pathology in the ACL-Deficient Knee

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The term "cruciate dominant knee" has been used to describe patients who are unable to compensate for ACL deficiency. Knee hyperextension has been used as a marker of cruciate dominance. The purpose of this study was to determine whether there was a relationship between knee hyperextension (supine heel height in centimeters) and intra-articular pathology in patients whose sole ligament injury was an arthroscopically confirmed ACL rupture. One hundred consecutive patients (32 women/68 men) were classified as: Acute (those reconstructed within 1 month of injury), Subacute (those reconstructed 1 to 6 months after injury), and Chronic (those reconstructed more than 6 months after injury). Supine heel height in centimeters was used to determine hyperextension of both knees. Reliability of the prone heel height measurement was 0.94 using an ICC formula 2,1. The data were examined and a critical value of 3 cm of hyperextension was identified using nonlinear approximation. Patients were then also classified as: Hyperextension (hyperextension  $\geq 3$  cm), and No Hyperextension ( $< 3$  cm of hyperextension). Articular pathology was graded from pictorial operative records by a single examiner who was blind to group assignment. Medial and lateral menisci, medial and lateral tibial condyles, and medial and lateral femoral condyles were graded separately. Pathology in hyperextension differences were evaluated using ANOVA. Effect of chronicity was analyzed with ANCOVA, with time from injury to surgery as the covariate. There was more articular damage to the total joint, lateral joint, and lateral meniscus in patients in the hyperextension group than those in the no hyperextension group ( $p < .05$ ). There was more articular damage to the total joint and medial joint in patients in the chronic group than those in the acute or subacute groups ( $p < .05$ ). There was no significant interaction between chronicity and hyperextension. Individuals with ACL injuries whose knees hyperextend 3 cm or more sustain significantly more joint damage at the time of injury than those whose knees hyperextend less than 3 cm. This study offers a reliable means of measuring knee hyperextension and further defines the role of hyperextension in ACL injuries.

### Comparison of Open Kinetic Chain Knee and Hip Extension to Closed Kinetic Chain Leg Press Performance

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Rehabilitation following knee injury often incorporates closed kinetic chain exercises followed by isokinetic testing to determine when the patient may return to work or sports activities. Knee extension peak torque values are often used as indicators of lower extremity strength. Limited research exists describing the relationship between isokinetic leg press and knee extension peak torque. Therefore, the purposes of this study were to determine the relationship of isokinetic quadriceps and hip extensor peak torque to isokinetic leg press peak torque and to determine the influence of hip position (seated vs supine) on leg press peak torque. Forty subjects (20 males and 20 females) were tested bilaterally on the isokinetic dynamometer. Subjects were tested during knee extension, hip extension, seated leg press, and supine leg press. Intraclass correlation coefficient and standard error of measurement values revealed acceptable reliability for all tests (.76 to .92 and 6.65 to 11.51 Nm, respectively). An analysis of variance revealed significant dominant vs non-dominant difference in all tests except hip extension. A repeated measures analysis of variance revealed no significant difference between seated and supine leg press peak torque. Finally, stepwise regression revealed a significant relationship between knee extension and leg press peak torques, with hip extension adding only minimally to the explained variance. These findings suggest that the generation of leg press peak torque did not vary significantly with hip position, and the contribution of hip extensors to leg press performance was minimal. We recommend further research involving EMG analysis to determine the influence of gluteus maximus on leg press force.

### The Relationship Between Kinesthetic Awareness and Performance of Two Functional Tests in the Anterior Cruciate Ligament Deficient Knee

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The loss of proprioception associated with an anterior cruciate ligament (ACL) tear is thought to have a significant impact on ability to return to normal function. We investigated kinesthetic awareness and functional tests in the ACL-deficient knee comparing the uninvolved "normal" knee and matched individuals without ACL deficiency. The experimental group included nine participants with confirmed ACL tears who met the following criteria: diagnosis as ACL-deficient by Magnetic Resonance Imaging, manual knee examination by a physician, and a KT-1000 knee arthrometer measurement of  $> 5$  mm injured-normal side to side difference at 20 lb anteroposterior load at 30° of knee flexion. The control group included nine participants with no known knee pathologies. Both groups were randomly and blindly assigned for testing. An apparatus built by the researcher to measure kinesthetic awareness was used to measure a participant's ability to detect slow passive motion of the knee joint. Functional testing was assessed using two hop tests, the single-legged hop for distance and the single-legged timed hop. The Spearman Rank-Order Correlation following a rank order analysis of score difference for kinesthetic awareness and percentages for each of the functional tests were used. A two-sided test level of significance at 0.05. Participants in the ACL-deficient group demonstrated decreased kinesthetic awareness scores and equivalent functional test scores versus the uninvolved knee. The control revealed equivalent kinesthetic awareness scores and functional test scores between knees. Statistical analysis showed that no observed significant correlation between kinesthetic awareness and functional tests in ACL-deficient knees. The importance of proprioception has been demonstrated to play an important role for proper joint and muscle function in initiating reflex stabilization in sports activities. However, functional tests we used were linear in direction making it difficult to conclude that proprioceptors were being tested in all planes of movement. This suggests a need for more sports-specific functional tests to better assess ACL-deficient knees.

### Assessment of Lower Extremity Dominance Via Strength and Balance Measurements

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It is common practice to ask subjects to identify their kicking leg to determine lower extremity dominance for purposes of strength assessment. However, the validity of this practice has yet to be determined. This study examined the issue of lower extremity dominance through self-perception, two common field tests, and a comparison of strength and balance between right and left sides. Twenty-seven healthy subjects (age =  $20.5 \pm 2.6$  yr; ht =  $169.2 \pm 9.3$  cm; wt =  $69.3 \pm 8.5$  kg) volunteered and gave their informed consent to participate in the study. All subjects were asked to state their perceived dominant leg, and given the option to kick a bean bag, and to perform the Stork Stand balance test on the right or left foot. Concentric (CON) and eccentric (ECC) average torque (AT) values were recorded via a Kin-Com II dynamometer (Chattecx Corporation, Hixson, TN) for both knee flexion/extension and ankle plantarflexion/dorsiflexion movements at  $60^\circ/\text{sec}$  and  $30^\circ/\text{sec}$ , respectively. Single-leg balance measures, recorded as postural sway in centimeters by the Chattecx Balance System (Chattecx Corporation, Hixson, TN), were assessed under both static and dynamic conditions. Results indicated that 23 (85.2%) perceived themselves to be right-leg dominant compared to 4 (14.8%) who perceived themselves as left-leg dominant. All subjects (27, 100%) chose to strike the bag with their right leg. However, 15 (55.6%) selected their right leg to balance themselves during the Stork Stand balance test compared to 12 (44.4%) who balanced on their left foot. Paired *t*-tests were used to compare the differences between the right and left extremities for all strength and balance measures. The only significant differences for strength were for concentric and eccentric dorsiflexion (right CON AT =  $110.3 \pm 31.8$  Nm, left CON AT =  $94.3 \pm 23.9$  Nm; right ECC AT =  $172.8 \pm 44.3$  Nm, left ECC AT =  $153.3 \pm 40.5$  Nm;  $p < .05$ ). All other bilateral strength values were within 8.8% of each other. The only significant difference in postural sway values was under the dynamic anterior/posterior tilt condition with the right leg eliciting significantly less sway ( $.81 \pm .26$  cm) than the left leg ( $.89 \pm .29$  cm). These findings suggest that there are minimal bilateral differences determined by self-perception and common field tests.

### The Effect of Ultrasound on Temperature Rise in Preheated Human Muscle

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Therapeutic ultrasound is commonly applied via a conducting medium directly to the treatment area. However, some clinicians preheat the tissues while others precool tissues prior to ultrasound application. Within the past 2 years, we have shown that precooling tissue prior to ultrasound diminishes its heating effects. We performed this study to see if preheating tissues prior to ultrasound has any merit. Twenty-one subjects were randomly assigned to one of two treatment groups: 1) 1 MHz ultrasound preceded by a 15-minute moist heat application (silicate gel hydroculator pack); or 2) 1 MHz ultrasound preceded by an identical sham pack. The ultrasound (Omnisound 3000, PTI, Topeka, KS) was administered for 10 minutes at  $1.5 \text{ W}/\text{cm}^2$  in an area two times the size of the applicator face. Muscle temperature was measured every 30 seconds using a 23-gauge hypodermic needle microprobe inserted intramuscularly at 3 cm below the subcutaneous/muscle interface in the anesthetized triceps surae muscle group. We used a 1-factor analysis of variance to examine the effects of the two treatments. There was no significant difference between the two treatments in the heating caused by the ultrasound alone ( $p = .47$ ). However, there was significantly greater overall heating with the hot pack/ultrasound treatment ( $F(1,19) = 7.80$ ,  $p = .01$ ). On average, the ultrasound treatments raised the muscle temperature  $3.4 \pm .8^\circ\text{C}$ ; yet the hot pack caused an increase in temperature of  $1 \pm .6^\circ\text{C}$  greater than the sham pack. Therefore, the hot pack/ultrasound treatment raised the muscle temperature  $4.4 \pm .8^\circ\text{C}$ , while the sham pack/ultrasound treatment raised it only  $3.4 \pm .8^\circ\text{C}$ . We have shown that ultrasound heats at the same rate whether the tissue has been preheated or not. However, when peak temperature increases of  $>4^\circ\text{C}$  are desired, preheating the tissue can reduce the amount of time needed for an ultrasound treatment by about 3 minutes. We conclude that the only advantage to preheating tissue prior to ultrasound is that the length of the ultrasound treatment can be reduced. We suggest that this study be repeated at 3 MHz, since it heats three times faster than the 1 MHz frequency.

### Balance and Proprioception Differences in Female Intercollegiate Basketball Players and Gymnasts

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Injury to the anterior cruciate ligament (ACL) in female basketball players is occurring at a disproportionate rate compared to male basketball players. It has previously been established that proprioception and balance deficits are related to impaired knee function and are demonstrated following ACL injury. Lower extremity proprioceptive and balance deficits reflecting poor joint position sense and joint instability are postulated as factors that may predispose female players to ACL injury. The purpose of this study was to determine if female collegiate basketball players possess lower extremity proprioceptive and balance deficits than other female collegiate athletes. Nine female collegiate basketball players (ht =  $170.3 \pm 14.8$  cm, wt =  $68.4 \pm 11.0$  kg) and nine female collegiate gymnasts (ht =  $162.6 \pm 4.7$  cm, wt =  $58.0 \pm 5.4$  kg) were measured for knee joint proprioception and lower extremity balance ability. Proprioception was measured using a proprioception testing device (PTD) designed to assess proprioceptive sensibility. Using the dominant limb, threshold to detection of passive motion (TTDPM) was measured from a starting position of  $15^\circ$  of knee flexion. A total of 6 trials, 3 trials moving into flexion and 3 trials moving into extension were performed and values averaged. Lower extremity balance was assessed with a commercially available testing device (Biodex Stability System, Shirley, NY). Each subject stood on an unstable platform and maintained center for 20 seconds. Using random order testing, dominant and nondominant single-leg stance and bilateral stance positions were tested. The stability index, medial/lateral sway, and anterior/posterior sway values were recorded for three trials at each test position. One-way analysis of variance was used to determine significant mean differences between gymnasts and basketball players across all test variables (nine balance and two proprioception). The results revealed significant differences ( $p < .05$ ) between the gymnasts' and the basketball players' test values. The basketball players demonstrated test scores inferior to the gymnasts for all test variables. In conclusion, the results of this study suggest that female collegiate basketball players possess balance and proprioception characteristics inferior to gymnasts and these characteristics may predispose these athletes to ACL injury. Future research to identify additional risk factors associated with ACL injury in female athletes is recommended.



## Prevalence and Features of Joint Hypermobility in a Sample of Adolescent Athletes

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The purpose of this study was to determine the prevalence of hypermobility in a group of adolescent interscholastic athletes, in an effort to determine the necessity of conducting further research to address the concern that athletes with hypermobile joints are predisposed to injury. Studies of nonathletes have shown hypermobility prevalence rates of 5% to 38.5%, varying depending on the gender, age, and racial make-up of the sample. We used the widely-accepted Carter-Wilkinson-Beighton method to screen 264 athletes during preseason physical examinations. This method examines range of motion at the knees, trunk, fingers, thumbs, and elbows bilaterally, and employs a 0 to 9 scoring scheme. Athletes who scored 5 or higher were considered hypermobile. We also used an "injury allowance," whereby, if an athlete screened positive for only one side of a bilateral test, but had a history of injury to the corresponding side, they were given an injury allowance point. The 264 subjects studied were predominantly Caucasian (99.2%); 150 males, 114 females (age =  $15.5 \pm 2.5$  yr). Thirty-two scored five or higher, with another 2 positive by means of the injury allowance, for a total of 34 (12.9%) hypermobiles. There was a highly significant ( $p = < .001$ ) difference between the sexes, with 25 females (22%) and 9 males (6%) testing positive. There was no significant difference related to age or sport. The overall prevalence of hypermobility in this group of adolescent athletes was 12.9%. Adolescent female athletes have a significantly higher rate of hypermobility than their male peers, but there were no apparent differences based on other factors. This data indicates that prevalence and gender distribution are similar to nonathlete populations of comparable age. Given that a significant segment of athletes may be hypermobile, prospective studies of the incidence of injury in these athletes are necessary to investigate its influence on injury risk.

**NATA RESEARCH AND EDUCATION FOUNDATION  
CALL FOR ABSTRACTS**

1996 National Athletic Trainers' Association Annual Meeting: Orlando, Florida; June 12-15, 1996  
(Deadline for abstract submission: January 5, 1996)

**INSTRUCTIONS FOR SUBMISSION OF ABSTRACTS AND  
PROCESS FOR REVIEW OF ALL SUBMISSIONS**

Please read all instructions before preparing the abstract. Individuals may submit more than one abstract, but no individual may be the primary (presenting) author on more than one paper. All abstracts will undergo blind review.

**I. SPECIFIC CONTENT REQUIREMENTS: FREE COMMUNICATIONS ABSTRACTS**

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, results of the study, and conclusion(s). Authors are asked to indicate a preference for oral or poster presentation of their abstract. Authors of free communications are required to categorize their abstract in 1 of the 5 specific areas of research funded by the NATA Research and Education Foundation, specifically:

**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 patterns of injury 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 Observational/Informational Studies category.

**OBSERVATIONAL/INFORMATIONAL STUDIES**—includes studies involving surveys, questionnaires, and descriptive programs, among others, which relate to athletic training and sports medicine.

**II. INSTRUCTIONS FOR PREPARING A FREE COMMUNICATIONS ABSTRACT:**

1. Provide all information requested on the Abstract Author Information Form. Abstracts are to 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 in all CAPITAL letters on the left margin.
3. On the next line, indent 3 spaces and type the names of all authors with the author who will make the presentation listed first. Type the last name, then initials (without periods), followed by a comma; continue with the other authors (if any), ending with a colon.
4. Indicate the institution where the research or case report was conducted on the same line following the author(s) names.
5. Double space and begin typing the text of the abstract flush left in a single paragraph with no indentations. Do not justify the right margin.
6. The abstract should not exceed 500 words.

**III. SPECIFIC CONTENT REQUIREMENTS: CLINICAL CASE REPORTS**

This category of abstracts involves the presentation of unique individual athletic injury cases of general interest to our membership. Abstracts in this category must include the following information. 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 2-page format. 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, and 6) Deviation from the expected.

**IV. INSTRUCTIONS FOR PREPARING A CLINICAL CASE REPORT 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 co-author.
2. Clinical case report abstracts are to be word-processed or typed using a letter-quality printer with no smaller than elite (12 characters per inch) or 10-point font. 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 in all CAPITAL letters on the left margin.
4. Provide all information requested on the information form below. Please note that the institution where the clinical case occurred should be cited, not the author(s)' current address, 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 (provide the age, gender, sport/occupation of individual, their primary complaint, and pertinent aspects of their 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)

#### V. INSTRUCTIONS FOR SUBMITTING ABSTRACTS (EITHER FREE COMMUNICATIONS OR CASE REPORTS)

1. Complete the form below 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 ACSII format; if you must send it in MacIntosh format, please use a high-density diskette) of your abstract and the following author information to:

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2. Abstracts **POSTMARKED AFTER JANUARY 5, 1996 WILL NOT BE ACCEPTED.**

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## Notes





## The game has changed. Thirst hasn't.

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